



## **GTL-2891**

**28-Port Stackable Layer 3 Managed Gigabit Switch,  
2 x SFP+, 2 x SFP+ (Optional Modules)**

# **CLI Reference Guide**

**V1.0**

Digital Data Communications Asia Co., Ltd.

<http://www.level1.com>

# CLI Reference Guide

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## **GTL-2891**

Layer 3 Stackable Gigabit Ethernet Switch  
with 24 10/100/1000BASE-T (RJ-45) Ports,  
2 10-Gigabit SFP+ Ports, and  
Optional Module with 2 10-Gigabit SFP+ Ports

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# How to Use This Guide

This guide includes detailed information on the switch software, including how to operate and use the management functions of the switch. To deploy this switch effectively and ensure trouble-free operation, you should first read the relevant sections in this guide so that you are familiar with all of its software features.

**Who Should Read This Guide?** This guide is for network administrators who are responsible for operating and maintaining network equipment. The guide assumes a basic working knowledge of LANs (Local Area Networks), the Internet Protocol (IP), and Simple Network Management Protocol (SNMP).

**How This Guide is Organized** This guide describes the switch's command line interface (CLI). For more detailed information on the switch's key features or information about the web browser management interface refer to the *User Manual*.

The guide includes these sections:

- ◆ Section I ["Getting Started"](#) — Includes information on initial configuration.
- ◆ Section II ["Command Line Interface"](#) — Includes all management options available through the CLI.
- ◆ Section III ["Appendices"](#) — Includes information on troubleshooting switch management access.

**Related Documentation** This guide focuses on switch software configuration through the CLI. For information on how to manage the switch through the Web management interface, see the following guide:

*User Manual*

For information on how to install the switch, see the following guide:

*Installation Guide*

For all safety information and regulatory statements, see the following documents:

*Quick Start Guide*  
*Safety and Regulatory Information*

**Conventions** The following conventions are used throughout this guide to show information:



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**Note:** Emphasizes important information or calls your attention to related features or instructions.

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**Caution:** Alerts you to a potential hazard that could cause loss of data, or damage the system or equipment.

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This section summarizes the changes in each revision of this guide.

### October 2016 Revision

This is the first version of this guide. This guide is valid for software release v1.2.2.19a.

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# Section I

## Getting Started

This section describes how to configure the switch for management access through the web interface or SNMP.

This section includes these chapters:

- ◆ ["Initial Switch Configuration" on page 59](#)



# 1

## Initial Switch Configuration

This chapter includes information on connecting to the switch and basic configuration procedures.

---

### Connecting to the Switch

The switch includes a built-in network management agent. The agent offers a variety of management options, including SNMP, RMON and a web-based interface. A PC may also be connected directly to the switch for configuration and monitoring via a command line interface (CLI).



**Note:** An IPv4 address for this switch is obtained via DHCP by default. To change this address, see [“Setting an IP Address” on page 66](#).

---

### Configuration Options

The switch’s HTTP web agent allows you to configure switch parameters, monitor port connections, and display statistics using a standard web browser such as Internet Explorer 6, Mozilla Firefox 4, or Google Chrome 29, or more recent versions. The switch’s web management interface can be accessed from any computer attached to the network.

The CLI program can be accessed by a direct connection to the RS-232 serial console port on the switch, or remotely by a Telnet connection over the network.

The switch’s management agent also supports SNMP (Simple Network Management Protocol). This SNMP agent permits the switch to be managed from any system in the network using network management software.

The switch’s web interface, console interface, and SNMP agent allow you to perform the following management functions:

- ◆ Set user names and passwords
- ◆ Set an IP interface for any VLAN
- ◆ Configure SNMP parameters
- ◆ Enable/disable any port
- ◆ Set the speed/duplex mode for any port
- ◆ Configure the bandwidth of any port by limiting input or output rates
- ◆ Control port access through IEEE 802.1X security or static address filtering

- ◆ Filter packets using Access Control Lists (ACLs)
- ◆ Configure up to 4094 IEEE 802.1Q VLANs
- ◆ Enable GVRP automatic VLAN registration
- ◆ Configure IP routing for unicast or multicast traffic
- ◆ Configure router redundancy
- ◆ Configure IGMP multicast filtering
- ◆ Upload and download system firmware or configuration files via HTTP (using the web interface) or FTP/TFTP (using the command line or web interface)
- ◆ Configure Spanning Tree parameters
- ◆ Configure Class of Service (CoS) priority queuing
- ◆ Configure static or LACP trunks (up to 16)
- ◆ Enable port mirroring
- ◆ Set storm control on any port for excessive broadcast, multicast, or unknown unicast traffic
- ◆ Display system information and statistics
- ◆ Configure any stack unit through the same IP address

### Connecting to the Console Port

The switch provides an RS-232 serial port that enables a connection to a PC or terminal for monitoring and configuring the switch. A null-modem console cable is provided with the switch.



---

**Note:** When configuring a stack, connect to the console port on the Master unit.

---

Attach a VT100-compatible terminal, or a PC running a terminal emulation program to the switch. You can use the console cable provided with this package, or use a null-modem cable that complies with the wiring assignments shown in the Installation Guide.

To connect a terminal to the console port, complete the following steps:

1. Connect the console cable to the serial port on a terminal, or a PC running terminal emulation software, and tighten the captive retaining screws on the DB-9 connector.
2. Connect the other end of the cable to the RS-45 serial port on the switch.
3. Make sure the terminal emulation software is set as follows:
  - Select the appropriate serial port (COM port 1 or COM port 2).
  - Set the baud rate to 115200 bps.
  - Set the data format to 8 data bits, 1 stop bit, and no parity.

- Set flow control to none.
- Set the emulation mode to VT100.
- When using HyperTerminal, select Terminal keys, not Windows keys.

**4.** Power on the switch.

After the system completes the boot cycle, the logon screen appears.

**Logging Onto the  
Command Line  
Interface**

The CLI program provides two different command levels — normal access level (Normal Exec) and privileged access level (Privileged Exec). The commands available at the Normal Exec level are a limited subset of those available at the Privileged Exec level and allow you to only display information and use basic utilities. To fully configure the switch parameters, you must access the CLI at the Privileged Exec level.

Access to both CLI levels are controlled by user names and passwords. The switch has a default user name and password for each level. To log into the CLI at the Privileged Exec level using the default user name and password, perform these steps:

- 1.** To initiate your console connection, press <Enter>. The “User Access Verification” procedure starts.
- 2.** At the User Name prompt, enter “admin.”
- 3.** At the Password prompt, also enter “admin.” (The password characters are not displayed on the console screen.)
- 4.** The session is opened and the CLI displays the “Console#” prompt indicating you have access at the Privileged Exec level.

**Setting Passwords**

If this is your first time to log into the CLI program, you should define new passwords for both default user names using the “username” command, record them and put them in a safe place.

Passwords can consist of up to 32 alphanumeric characters and are case sensitive. To prevent unauthorized access to the switch, set the passwords as follows:

- 1.** Open the console interface with the default user name and password “admin” to access the Privileged Exec level.
- 2.** Type “configure” and press <Enter>.
- 3.** Type “username guest password 0 *password*,” for the Normal Exec level, where *password* is your new password. Press <Enter>.

4. Type “username admin password 0 *password*,” for the Privileged Exec level, where *password* is your new password. Press <Enter>.

```
Username: admin
Password:

CLI session with the GTL-2891* is opened.
To end the CLI session, enter [Exit].

Console#configure
Console(config)#username guest password 0 [password]
Console(config)#username admin password 0 [password]
Console(config)#
```

\* This manual covers the GTL-2891 Gigabit Ethernet switch.

**Remote Connections** Prior to accessing the switch’s onboard agent via a network connection, you must first configure it with a valid IPv4 or IPv6 address, subnet mask, and default gateway using a console connection, or DHCP protocol.

An IPv4 address for the switch is obtained via DHCP by default. To manually configure this address or enable dynamic address assignment via DHCP, see [“Setting an IP Address” on page 66](#).

After configuring the switch’s IP parameters, you can access the onboard configuration program from anywhere within the attached network. The onboard configuration program can be accessed using Telnet or SSH from any computer attached to the network. The switch can also be managed by any computer using a web browser (Internet Explorer 6, Mozilla Firefox 4, or Google Chrome 29, or more recent versions), or from a network computer using SNMP network management software.



**Note:** This switch supports eight Telnet sessions or SSH sessions.

**Note:** Any VLAN group can be assigned an IP interface address ([page 66](#)) for managing the switch. Also, note that the Master unit does not have to include an active port member in the VLAN interface used for management access.

The onboard program only provides access to basic configuration functions. To access the full range of SNMP management functions, you must use SNMP-based network management software.

## Stack Operations

Up to eight switches can be stacked together as described in the Installation Guide. One unit in the stack acts as the Master for configuration tasks and firmware upgrade. All of the other units function in Slave mode, but can automatically take over management of the stack if the Master unit fails.

To configure any unit in the stack, first verify the unit number from the front panel indicator on the switch, and then select the appropriate unit number from the web or console management interface.

### Selecting the Stack Master

Note the following points about unit numbering:

- ◆ When the stack is initially powered on, the Master unit is selected based on the following rules:
  - If the stack master button has been enabled with the [switch master button](#) command on only one unit in the stack, that unit will serve as the stack Master.
  - If the stack master button has been enabled on more than one unit, the system will select the unit with the lowest MAC address as the stack Master from those with the stack master button enabled.
  - If the stack master button is not enabled on any unit, the system will select the unit with the lowest MAC address as the stack Master.
- ◆ When the stack is initially powered on, the Master unit is designated as unit 1 for a ring topology. For a line topology, the stack is simply numbered from top to bottom, with the first unit in the stack designated at unit 1. This unit identification number appears on the Stack Unit ID LED on the front panel of the switch. Any unit in the stack can be selected on the front panel graphic of the web interface (from the Unit scroll-down list), or from the CLI (as specified by the "unit" parameter for applicable commands).
- ◆ If the Master unit fails and another unit takes over control of the stack, the unit numbering will not change.
- ◆ If a unit in the stack fails or is removed from the stack, the unit numbers will not change. This means that when you replace a unit in the stack, the original configuration for the failed unit will be restored to the replacement unit.
- ◆ If a unit is removed from the stack and later reattached to the stack, it will retain the original unit number obtained during stacking.
- ◆ If a unit is removed from the stack, and powered up as a stand-alone unit, it will also retain the original unit number obtained during stacking.

**Selecting the Backup Unit** Once the Master unit finishes booting up, it continues to synchronize configuration information to all of the Slave units in the stack. If the Master unit fails or is powered off, a new master unit will be selected based on the election rules described in the preceding section. The backup unit elected to serve as the new stack Master will take control of the stack without any loss of configuration settings. To ensure a logical fail over to the next unit down in the stack, place the Slave unit with the lowest MAC address directly beneath the Master unit in the stack.

**Recovering from Stack Failure or Topology Change** When a link or unit in the stack fails, a trap message is sent and a failure event is logged. The stack will be rebooted after any system failure or topology change. It takes two to three minutes for the stack to reboot. If the Master unit fails, the backup unit will take over operations as the new Master unit, reboot the stack, and then select another backup unit after the stack finishes rebooting. Also note that powering down a unit or inserting a new unit in the stack will cause the stack to reboot. If a unit is removed from the stack (due to a power down or failure) or a new unit added to the stack, the original unit IDs are not affected after rebooting, and a new unit is assigned the lowest available unit ID.

### Broken Link for Line and Wrap-around Topologies

All units in the stack must be connected via stacking cable. You can connect the units in a simple cascade configuration from the top to the bottom unit. Using this kind of line topology, if any link or unit in the stack fails, the stack will be broken in two.

When the stack fails, a Master unit is selected from the two stack segments, either the unit with the Master button enabled, or the unit with the lowest MAC address if the Master button is not enabled on any unit. The stack reboots and resumes operations. However, note that the IP address will be the same for any common VLANs (with active port connections) that appear in both of the new stack segments. To resolve the conflicting IP addresses, you should manually replace the failed link or unit as soon as possible. If you are using a wrap-around stack topology, a single point of failure in the stack will not cause the stack to fail. It would take two or more points of failure to break the stack apart.



---

**Note:** If a stack breaks apart, the IP address will be the same for any common VLANs (with active port connections) that appear in both stack segments.

---

### Resilient IP Interface for Management Access

The stack functions as one integral system for management and configuration purposes. You can therefore manage the stack through any IP interface configured on the stack. The Master unit does not even have to include an active port member in the VLAN interface used for management access. However, if the unit to which you normally connect for management access fails, and there are no active port members on the other units within this VLAN interface, then this IP address will no longer be available. To retain a constant IP address for management access across



failover events, you should include port members on several units within the primary VLAN used for stack management.

### Resilient Configuration

If a unit in the stack fails, the unit numbers will not change. This means that when you replace a unit in the stack, the original configuration for the failed unit will be restored to the replacement unit. This applies to both the Master and Slave units.

### Renumbering the Stack

The startup configuration file maps configuration settings to each switch in the stack based on the unit identification number. If the units are no longer numbered sequentially after several topology changes or failures, you can reset the unit numbers using the System > Stacking (Renumber) menu in the web interface or the `switch all renumber` command in the CLI. Just remember to save the new configuration settings to a startup configuration file prior to powering off the stack Master.

### Ensuring Consistent Code is Used Across the Stack

Consistent Runtime Code in Each Switch – The main board runtime firmware version for each unit in the stack must be the same as the Master unit's runtime firmware. After Auto-ID assignment is completed, the Master unit checks the image versions for consistency. If the firmware versions (i.e., runtime code) configured for bootup on any slave units are not the same as those on the Master unit, the stack will operate in Special Stacking Mode in which all backup units are disabled as described below:

- ◆ The master unit starts normal operation mode in standalone mode.
- ◆ The master unit can see all units in the stack and maintain stack topology.
- ◆ None of the other units can function (all ports will be disabled).
- ◆ All user-initiated commands to configure the non-functioning units are dropped. The master unit, however, will be able to communicate the following information to the non-functioning units:
  - Image downloads
  - Stack topology information
  - System configuration information already stored on the master.

In Special Stacking mode, the master unit displays warning messages whenever you log into the system through the CLI that inform you that an image download is required.

You can use the CLI, web or SNMP to download the runtime image from an FTP or TFTP server to the master unit. The master unit stores the image as its "Next boot

image” and downloads the image to those backup units that are running a different image version.

---

## Configuring the Switch for Remote Management

### Using the Network Interface

The switch can be managed through the operational network, known as in-band management. Because in-band management traffic is mixed in with operational network traffic, it is subject to all of the filtering rules usually applied to a standard network ports such as ACLs and VLAN tagging. In-band network management can be accessed via a connection to any network port (1-28).

### Setting an IP Address

You must establish IP address information for a stand-alone switch or a stack to obtain management access through the network. This can be done in either of the following ways:

- ◆ **Manual** — You have to input the information, including IP address and subnet mask. If your management station is not in the same IP subnet as the switch, you will also need to specify the default gateway router.
- ◆ **Dynamic** — The switch can send IPv4 configuration requests to BOOTP or DHCP address allocation servers on the network, or automatically generate a unique IPv6 host address based on the local subnet address prefix received in router advertisement messages. An IPv6 link local address for use in a local network can also be dynamically generated as described in [“Obtaining an IPv6 Address” on page 71](#).

This switch is designed as a router, and therefore does not support DHCP for IPv6, so an IPv6 global unicast address for use in a network containing more than one subnet can only be manually configured as described in [“Assigning an IPv6 Address” on page 67](#).

### Manual Configuration

You can manually assign an IP address to the switch. You may also need to specify a default gateway that resides between this device and management stations that exist on another network segment. Valid IPv4 addresses consist of four decimal numbers, 0 to 255, separated by periods. Anything outside this format will not be accepted by the CLI program.



**Note:** The IPv4 address for VLAN 1 is obtained via DHCP by default.

---

### Assigning an IPv4 Address

Before you can assign an IP address to the switch, you must obtain the following information from your network administrator:

- ◆ IP address for the switch
- ◆ Network mask for this network
- ◆ Default gateway for the network

To assign an IPv4 address to the switch, complete the following steps

1. From the Global Configuration mode prompt, type “interface vlan 1” to access the interface-configuration mode. Press <Enter>.
2. Type “ip address *ip-address netmask*,” where “ip-address” is the switch IP address and “netmask” is the network mask for the network. Press <Enter>.
3. Type “exit” to return to the global configuration mode prompt. Press <Enter>.
4. To set the IP address of the default gateway for the network to which the switch belongs, type “ip default-gateway *gateway*,” where “gateway” is the IP address of the default gateway. Press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#exit
Console(config)#ip default-gateway 192.168.1.254
```

### Assigning an IPv6 Address

This section describes how to configure a “link local” address for connectivity within the local subnet only, and also how to configure a “global unicast” address, including a network prefix for use on a multi-segment network and the host portion of the address.

An IPv6 prefix or address must be formatted according to RFC 2373 “IPv6 Addressing Architecture,” using 8 colon-separated 16-bit hexadecimal values. One double colon may be used to indicate the appropriate number of zeros required to fill the undefined fields. For detailed information on the other ways to assign IPv6 addresses, see [“IPv6 Interface” on page 900](#).

**Link Local Address** — All link-local addresses must be configured with a prefix in the range of FE80~FEBF. Remember that this address type makes the switch accessible over IPv6 for all devices attached to the same local subnet only. Also, if the switch detects that the address you configured conflicts with that in use by another device on the subnet, it will stop using the address in question, and automatically generate a link local address that does not conflict with any other devices on the local subnet.

To configure an IPv6 link local address for the switch, complete the following steps:

1. From the Global Configuration mode prompt, type "interface vlan 1" to access the interface-configuration mode. Press <Enter>.
2. Type "ipv6 address" followed by up to 8 colon-separated 16-bit hexadecimal values for the *ipv6-address* similar to that shown in the example, followed by the "link-local" command parameter. Then press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address FE80::260:3EFF:FE11:6700 link-local
Console(config-if)#ipv6 enable
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled.
Link-local address:
    fe80::260:3eff:fe11:6700%1/64
Global unicast address(es):
(None)
Joined group address(es):
ff02::1:ff11:6700
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

**Address for Multi-segment Network** — Before you can assign an IPv6 address to the switch that will be used to connect to a multi-segment network, you must obtain the following information from your network administrator:

- ◆ Prefix for this network
- ◆ IP address for the switch
- ◆ Default gateway for the network

For networks that encompass several different subnets, you must define the full address, including a network prefix and the host address for the switch. You can specify either the full IPv6 address, or the IPv6 address and prefix length. The prefix length for an IPv6 network is the number of bits (from the left) of the prefix that form the network address, and is expressed as a decimal number. For example, all IPv6 addresses that start with the first byte of 73 (hexadecimal) could be expressed as 73:0:0:0:0:0:0:0/8 or 73::/8.

To generate an IPv6 global unicast address for the switch, complete the following steps:

1. From the global configuration mode prompt, type "interface vlan 1" to access the interface-configuration mode. Press <Enter>.
2. From the interface prompt, type "ipv6 address *ipv6-address*" or "ipv6 address *ipv6-address/prefix-length*," where "prefix-length" indicates the address bits used to form the network portion of the address. (The network address starts from the left of the prefix and should encompass some of the ipv6-address bits.) The remaining bits are assigned to the host interface. Press <Enter>.
3. Type "exit" to return to the global configuration mode prompt. Press <Enter>.
4. To set the IP address of the IPv6 default gateway for the network to which the switch belongs, type "ipv6 default-gateway *gateway*," where "gateway" is the IPv6 address of the default gateway. Press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address 2001:DB8:2222:7272::/64
Console(config-if)#exit
Console(config)#ipv6 default-gateway 2001:DB8:2222:7272::254
Console(config)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled.
Link-local address:
    fe80::200:e8ff:fe94:4000%1/64
Global unicast address(es):
    2001:db8:2222:7272::/64, subnet is 2001:db8:2222:7272::/64
Joined group address(es):
    ff02::1:ff00:0
    ff02::1:ff94:4000
    ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#show ipv6 route
Codes: C - connected, S - static, R - RIP, B - BGP
        O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
        * - candidate default

S*      ::/0 [1/0] via 2001:db8:2222:7272::254, VLAN1
C        2001:db8:2222:7272::/64, VLAN1
C        fe80::/64, VLAN1

Console#
```

## Dynamic Configuration

### *Obtaining an IPv4 Address*

If you select the “bootp” or “dhcp” option, the system will immediately start broadcasting service requests. IP will be enabled but will not function until a BOOTP or DHCP reply has been received. Requests are broadcast every few minutes using exponential backoff until IP configuration information is obtained from a BOOTP or DHCP server. BOOTP and DHCP values can include the IP address, subnet mask, and default gateway. If the DHCP/BOOTP server is slow to respond, you may need to use the “ip dhcp restart client” command to re-start broadcasting service requests.

Note that the “ip dhcp restart client” command can also be used to start broadcasting service requests for all VLANs configured to obtain address assignments through BOOTP or DHCP. It may be necessary to use this command when DHCP is configured on a VLAN, and the member ports which were previously shut down are now enabled.

If the “bootp” or “dhcp” option is saved to the startup-config file (step 6), then the switch will start broadcasting service requests as soon as it is powered on.

To automatically configure the switch by communicating with BOOTP or DHCP address allocation servers on the network, complete the following steps:

- 1.** From the Global Configuration mode prompt, type “interface vlan 1” to access the interface-configuration mode. Press <Enter>.
- 2.** At the interface-configuration mode prompt, use one of the following commands:
  - To obtain IP settings via DHCP, type “ip address dhcp” and press <Enter>.
  - To obtain IP settings via BOOTP, type “ip address bootp” and press <Enter>.
- 3.** Type “end” to return to the Privileged Exec mode. Press <Enter>.
- 4.** Wait a few minutes, and then check the IP configuration settings by typing the “show ip interface” command. Press <Enter>.
- 5.** Then save your configuration changes by typing “copy running-config startup-config.” Enter the startup file name and press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#end
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is 00-E0-0C-00-00-FB
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 192.168.0.2 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Inform is disabled
  DHCP Relay Server: 0.0.0.0
Console#copy running-config startup-config
Startup configuration file name []: startup
\Write to FLASH Programming.

\Write to FLASH finish.
Success.
```

### Obtaining an IPv6 Address

**Link Local Address** — There are several ways to configure IPv6 addresses. The simplest method is to automatically generate a “link local” address (identified by an address prefix in the range of FE80~FEBF). This address type makes the switch accessible over IPv6 for all devices attached to the same local subnet.

To generate an IPv6 link local address for the switch, complete the following steps:

1. From the Global Configuration mode prompt, type “interface vlan 1” to access the interface-configuration mode. Press <Enter>.
2. Type “ipv6 enable” and press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 enable
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled.
Link-local address:
  fe80::7272:cfff:fe83:3466%1/64
Global unicast address(es):
  (None)
Joined group address(es):
  ff02::1:ff94:4000
  ff02::1:ff00:0
  ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

## Enabling SNMP Management Access

The switch can be configured to accept management commands from Simple Network Management Protocol (SNMP) applications such as Edge-Core ECView Pro. You can configure the switch to respond to SNMP requests or generate SNMP traps.

When SNMP management stations send requests to the switch (either to return information or to set a parameter), the switch provides the requested data or sets the specified parameter. The switch can also be configured to send information to SNMP managers (without being requested by the managers) through trap messages, which inform the manager that certain events have occurred.

The switch includes an SNMP agent that supports SNMP version 1, 2c, and 3 clients. To provide management access for version 1 or 2c clients, you must specify a community string. The switch provides a default MIB View (i.e., an SNMPv3 construct) for the default “public” community string that provides read access to the entire MIB tree, and a default view for the “private” community string that provides read/write access to the entire MIB tree. However, you may assign new views to version 1 or 2c community strings that suit your specific security requirements (see [snmp-server view](#) command).

### Community Strings (for SNMP version 1 and 2c clients)

Community strings are used to control management access to SNMP version 1 and 2c stations, as well as to authorize SNMP stations to receive trap messages from the switch. You therefore need to assign community strings to specified users, and set the access level.

The default strings are:

- ◆ **public** - with read-only access. Authorized management stations are only able to retrieve MIB objects.
- ◆ **private** - with read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

To prevent unauthorized access to the switch from SNMP version 1 or 2c clients, it is recommended that you change the default community strings.

To configure a community string, complete the following steps:

1. From the Privileged Exec level global configuration mode prompt, type “snmp-server community *string mode*,” where “string” is the community access string and “mode” is **rw** (read/write) or **ro** (read only). Press <Enter>. (Note that the default mode is read only.)
2. To remove an existing string, simply type “no snmp-server community *string*,” where “string” is the community access string to remove. Press <Enter>.



```
Console(config)#snmp-server community admin rw
Console(config)#snmp-server community private
Console(config)#
```



**Note:** If you do not intend to support access to SNMP version 1 and 2c clients, we recommend that you delete both of the default community strings. If there are no community strings, then SNMP management access from SNMP v1 and v2c clients is disabled.

### Trap Receivers

You can also specify SNMP stations that are to receive traps from the switch. To configure a trap receiver, use the “snmp-server host” command. From the Privileged Exec level global configuration mode prompt, type:

```
“snmp-server host host-address community-string [version {1 | 2c | 3 {auth |
noauth | priv}}]”
```

where “host-address” is the IP address for the trap receiver, “community-string” specifies access rights for a version 1/2c host, or is the user name of a version 3 host, “version” indicates the SNMP client version, and “auth | noauth | priv” means that authentication, no authentication, or authentication and privacy is used for v3 clients. Then press <Enter>. For a more detailed description of these parameters, see the [snmp-server host](#) command. The following example creates a trap host for each type of SNMP client.

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#snmp-server host 10.1.19.98 robin version 2c
Console(config)#snmp-server host 10.1.19.34 barbie version 3 auth
Console(config)#
```

### Configuring Access for SNMP Version 3 Clients

To configure management access for SNMPv3 clients, you need to first create a view that defines the portions of MIB that the client can read or write, assign the view to a group, and then assign the user to a group. The following example creates one view called “mib-2” that includes the entire MIB-2 tree branch, and then another view that includes the IEEE 802.1d bridge MIB. It assigns these respective read and read/write views to a group call “r&d” and specifies group authentication via MD5 or SHA. In the last step, it assigns a v3 user to this group, indicating that MD5 will be used for authentication, provides the password “greenpeace” for authentication, and the password “einstien” for encryption.

```
Console(config)#snmp-server view mib-2 1.3.6.1.2.1 included
Console(config)#snmp-server view 802.1d 1.3.6.1.2.1.17 included
Console(config)#snmp-server group r&d v3 auth read mib-2 write 802.1d
Console(config)#snmp-server user steve group r&d v3 auth md5 greenpeace priv
des56 einstien
Console(config)#
```

For a more detailed explanation on how to configure the switch for access from SNMP v3 clients, refer to [“SNMP Commands” on page 193](#) or to the *Web Management Guide*.

---

## Managing System Files

The switch’s flash memory supports three types of system files that can be managed by the CLI program, the web interface, or SNMP. The switch’s file system allows files to be uploaded and downloaded, copied, deleted, and set as a start-up file.

The types of files are:

- ◆ **Configuration** — This file type stores system configuration information and is created when configuration settings are saved. Saved configuration files can be selected as a system start-up file or can be uploaded via FTP/TFTP to a server for backup. The file named “Factory\_Default\_Config.cfg” contains all the system default settings and cannot be deleted from the system. If the system is booted with the factory default settings, the switch will also create a file named “startup1.cfg” that contains system settings for switch initialization, including information about the unit identifier, and MAC address for the switch. The configuration settings from the factory defaults configuration file are copied to this file, which is then used to boot the switch. See [“Saving or Restoring Configuration Settings” on page 75](#) for more information.
- ◆ **Operation Code** — System software that is executed after boot-up, also known as run-time code. This code runs the switch operations and provides the CLI and web management interfaces.
- ◆ **Diagnostic Code** — Software that is run during system boot-up, also known as POST (Power On Self-Test).



**Note:** The Boot ROM and Loader cannot be uploaded or downloaded from the FTP/TFTP server. You must follow the instructions in the release notes for new firmware, or contact your distributor for help.

---

Due to the size limit of the flash memory, the switch supports only two operation code files. However, you can have as many diagnostic code files and configuration files as available flash memory space allows. The switch has a total of 128 Mbytes of flash memory for system files.

In the system flash memory, one file of each type must be set as the start-up file. During a system boot, the diagnostic and operation code files set as the start-up file are run, and then the start-up configuration file is loaded.

Note that configuration files should be downloaded using a file name that reflects the contents or usage of the file settings. If you download directly to the running-

config, the system will reboot, and the settings will have to be copied from the running-config to a permanent file.

### Upgrading the Operation Code

The following example shows how to download new firmware to the switch and activate it. The TFTP server could be any standards-compliant server running on Windows or Linux. When downloading from an FTP server, the logon interface will prompt for a user name and password configured on the remote server. Note that “anonymous” is set as the default user name.

File names on the switch are case-sensitive. The destination file name should not contain slashes (\ or /), and the maximum length for file names is 32 characters for files on the switch or 128 characters for files on the server. (Valid characters: A-Z, a-z, 0-9, “\_”, “-”)

```

Console#copy tftp file
TFTP server ip address: 10.1.0.19
Choose file type:
1. config: 2. opcode: 2
Source file name: m360.bix
Destination file name: m360.bix
\Write to FLASH Programming.
-Write to FLASH finish.
Success.
Console#config
Console(config)#boot system opcode: m360.bix
Console(config)#exit
Console#dir

```

File Name	Type	Startup	Modify Time	Size(bytes)
-----				
Unit 1:				
m360.bix	OpCode	Y	2013-02-25 15:41:04	25812529
m355.bix	OpCode	N	2012-12-04 13:23:59	25783857
Factory_Default_Config.cfg	Config	N	2012-12-04 13:18:37	455
startup1.cfg	Config	Y	2013-03-21 05:39:15	3463
-----				
Free space for compressed user config files:1593241600				

```

Console#

```

### Saving or Restoring Configuration Settings

Configuration commands only modify the running configuration file and are not saved when the switch is rebooted. To save all your configuration changes in nonvolatile storage, you must copy the running configuration file to the start-up configuration file using the “copy” command.

New startup configuration files must have a name specified. File names on the switch are case-sensitive, can be from 1 to 31 characters, must not contain slashes (\ or /), and the leading letter of the file name must not be a period (.). (Valid characters: A-Z, a-z, 0-9, “\_”, “-”, “.”)

There can be more than one user-defined configuration file saved in the switch’s flash memory, but only one is designated as the “startup” file that is loaded when the switch boots. The **copy running-config startup-config** command always sets

the new file as the startup file. To select a previously saved configuration file, use the **boot system config:***<filename>* command.

The maximum number of saved configuration files depends on available flash memory. The amount of available flash memory can be checked by using the **dir** command.

To save the current configuration settings, enter the following command:

1. From the Privileged Exec mode prompt, type “copy running-config startup-config” and press <Enter>.
2. Enter the name of the start-up file. Press <Enter>.

```
Console#copy running-config startup-config
Startup configuration file name []: startup
\Write to FLASH Programming.

\Write to FLASH finish.
Success.

Console#
```

To restore configuration settings from a backup server, enter the following command:

1. From the Privileged Exec mode prompt, type “copy tftp startup-config” and press <Enter>.
2. Enter the address of the TFTP server. Press <Enter>.
3. Enter the name of the startup file stored on the server. Press <Enter>.
4. Enter the name for the startup file on the switch. Press <Enter>.

```
Console#copy tftp startup-config
TFTP server IP address: 192.168.0.4
Source configuration file name: startup-rd.cfg
Startup configuration file name [startup1.cfg]:

Success.
Console#
```

---

## Automatic Installation of Operation Code and Configuration Settings

### Downloading Operation Code from a File Server

Automatic Operation Code Upgrade can automatically download an operation code file when a file newer than the currently installed one is discovered on the file server. After the file is transferred from the server and successfully written to the file system, it is automatically set as the startup file, and the switch is rebooted.

#### Usage Guidelines

- ◆ If this feature is enabled, the switch searches the defined URL once during the bootup sequence.
- ◆ FTP (port 21) and TFTP (port 69) are both supported. Note that the TCP/UDP port bindings cannot be modified to support servers listening on non-standard ports.
- ◆ The host portion of the upgrade file location URL must be a valid IPv4 IP address. DNS host names are not recognized. Valid IP addresses consist of four numbers, 0 to 255, separated by periods.
- ◆ The path to the directory must also be defined. If the file is stored in the root directory for the FTP/TFTP service, then use the "/" to indicate this (e.g., ftp://192.168.0.1/).
- ◆ The file name must not be included in the upgrade file location URL. The file name of the code stored on the remote server must be Level1-L3.bix (using lower case letters as indicated).
- ◆ The FTP connection is made with PASV mode enabled. PASV mode is needed to traverse some fire walls, even if FTP traffic is not blocked. PASV mode cannot be disabled.
- ◆ The switch-based search function is case-insensitive in that it will accept a file name in upper or lower case (i.e., the switch will accept *Level1-L3.BIX* from the server even though *Level1-L3.bix* was requested). However, keep in mind that the file systems of many operating systems such as Unix and most Unix-like systems (FreeBSD, NetBSD, OpenBSD, and most Linux distributions, etc.) are case-sensitive, meaning that two files in the same directory, *Level1-L3.bix* and *Level1-L3.BIX* are considered to be unique files. Thus, if the upgrade file is stored as *Level1-L3.bix* (or even *Level1-L3.BIX*) on a case-sensitive server, then the switch (requesting *Level1-L3.bix*) will not be upgraded because the server does not recognize the requested file name and the stored file name as being equal. A notable exception in the list of case-sensitive Unix-like operating systems is Mac OS X, which by default is case-insensitive. Please check the documentation for your server's operating system if you are unsure of its file system's behavior.

- ◆ Note that the switch itself does not distinguish between upper and lower-case file names, and only checks to see if the file stored on the server is more recent than the current runtime image.
- ◆ If two operation code image files are already stored on the switch's file system, then the non-startup image is deleted before the upgrade image is transferred.
- ◆ The automatic upgrade process will take place in the background without impeding normal operations (data switching, etc.) of the switch.
- ◆ During the automatic search and transfer process, the administrator cannot transfer or update another operation code image, configuration file, public key, or HTTPS certificate (i.e., no other concurrent file management operations are possible).
- ◆ The upgrade operation code image is set as the startup image after it has been successfully written to the file system.
- ◆ The switch will send an SNMP trap and make a log entry upon all upgrade successes and failures.
- ◆ The switch will immediately restart after the upgrade file is successfully written to the file system and set as the startup image.

To enable automatic upgrade, enter the following commands:

#### 1. Specify the TFTP or FTP server to check for new operation code.

- When specifying a TFTP server, the following syntax must be used, where *filedir* indicates the path to the directory containing the new image:

```
tftp://192.168.0.1[/filedir]/
```

- When specifying an FTP server, the following syntax must be used, where *filedir* indicates the path to the directory containing the new image:

```
ftp://[username[:password@]]192.168.0.1[/filedir]/
```

If the user name is omitted, "anonymous" will be used for the connection. If the password is omitted a null string ("" ) will be used for the connection.

This shows how to specify a TFTP server where new code is stored.

```
Console(config)#upgrade opcode path tftp://192.168.0.1/sm24/  
Console(config)#
```

This shows how to specify an FTP server where new code is stored.

```
Console(config)#upgrade opcode path ftp://admin:billy@192.168.0.1/sm24/  
Console(config)#
```

2. Set the switch to automatically reboot and load the new code after the opcode upgrade is completed.

```
Console(config)#upgrade opcode reload
Console(config)#
```

3. Set the switch to automatically upgrade the current operational code when a new version is detected on the server. When the switch starts up and automatic image upgrade is enabled by this command, the switch will follow these steps when it boots up:
  - a. It will search for a new version of the image at the location specified by **upgrade opcode path** command. The name for the new image stored on the TFTP server must be Level1-L3.bix. If the switch detects a code version newer than the one currently in use, it will download the new image. If two code images are already stored in the switch, the image not set to start up the system will be overwritten by the new version.
  - b. After the image has been downloaded, the switch will send a trap message to log whether or not the upgrade operation was successful.
  - c. It sets the new version as the startup image.
  - d. It then restarts the system to start using the new image.

```
Console(config)#upgrade opcode auto
Console(config)#
```

4. Display the automatic upgrade settings.

```
Console#show upgrade
Auto Image Upgrade Global Settings:
  Status      : Enabled
  Reload Status : Enabled
  Path        :
  File Name   : Level1-L3.bix
Console#
```

### Specifying a DHCP Client Identifier

DHCP servers index their database of address bindings using the client's Media Access Control (MAC) Address or a unique client identifier. The client identifier is used to identify the vendor class and configuration of the switch to the DHCP server, which then uses this information to decide on how to service the client or the type of information to return.

DHCP client Identifier (Option 60) is used by DHCP clients to specify their unique identifier. The client identifier is optional and can be specified while configuring DHCP on the primary network interface. DHCP Option 60 is disabled by default.

The general framework for this DHCP option is set out in RFC 2132 (Option 60). This information is used to convey configuration settings or other identification information about a client, but the specific string to use should be supplied by your service provider or network administrator. Options 60 (vendor-class-identifier), 66 (tftp-server-name) and 67 (bootfile-name) statements can be added to the server daemon's configuration file as described in the following section.

If the DHCP server has an index entry for a switch requesting service, it should reply with the TFTP server name and boot file name. Note that the vendor class identifier can be formatted in either text or hexadecimal, but the format used by both the client and server must be the same.

```
Console(config)#interface vlan 2
Console(config-if)#ip dhcp client class-id hex 0000e8666572
Console(config-if)#
```

### **Downloading a Configuration File and Other Parameters Provided by a DHCP Server**

Information passed on to the switch from a DHCP server may also include a configuration file to be downloaded and the TFTP servers where that file can be accessed, as well as other parameters. If the Factory Default Configuration file is used to provision the switch at startup, in addition to requesting IP configuration settings from the DHCP server, it will also ask for the name of a bootup configuration file and TFTP servers where that file is stored.

If the switch receives information that allows it to download the remote bootup file, it will save this file to a local buffer, and then restart the provision process.

Note the following DHCP client behavior:

- ◆ The bootup configuration file received from a TFTP server is stored on the switch with the original file name. If this file name already exists in the switch, the file is overwritten.
- ◆ If the name of the bootup configuration file is the same as the Factory Default Configuration file, the download procedure will be terminated, and the switch will not send any further DHCP client requests.
- ◆ If the switch fails to download the bootup configuration file based on information passed by the DHCP server, it will not send any further DHCP client requests.
- ◆ If the switch does not receive a DHCP response prior to completing the bootup process, it will continue to send a DHCP client request once a minute. These requests will only be terminated if the switch's address is manually configured, but will resume if the address mode is set back to DHCP.



To successfully transmit a bootup configuration file to the switch, the DHCP daemon (using a Linux based system for this example) must be configured with the following information:

- ◆ Options 60, 66 and 67 statements can be added to the daemon's configuration file.

**Table 1: Options 60, 66 and 67 Statements**

Option	Statement	
	Keyword	Parameter
60	vendor-class-identifier	a string indicating the vendor class identifier
66	tftp-server-name	a string indicating the tftp server name
67	bootfile-name	a string indicating the bootfile name

- ◆ By default, DHCP option 66/67 parameters are not carried in a DHCP server reply. To ask for a DHCP reply with option 66/67 information, the DHCP client request sent by this switch includes a "parameter request list" asking for this information. Besides these items, the client request also includes a "vendor class identifier" that allows the DHCP server to identify the device, and select the appropriate configuration file for download. This information is included in Option 55 and 124.

**Table 2: Options 55 and 124 Statements**

Option	Statement	
	Keyword	Parameter
55	dhcp-parameter-request-list	a list of parameters, separated by a comma ','
124	vendor-class-identifier	a string indicating the vendor class identifier

The following configuration example is provided for a Linux-based DHCP daemon (dhcpd.conf file). In the "Vendor class" section, the server will always send Option 66 and 67 to tell the switch to download the "test" configuration file from server 192.168.255.101.

```
ddns-update-style ad-hoc;

default-lease-time 600;
max-lease-time 7200;

log-facility local7;

server-name "Server1";
Server-identifier 192.168.255.250;
#option 66, 67
option space dynamicProvision code width 1 length 1 hash size 2;
option dynamicProvision.tftp-server-name code 66 = text;
option dynamicProvision.bootfile-name code 67 = text;
```

```
subnet 192.168.255.0 netmask 255.255.255.0 {  
    range 192.168.255.160 192.168.255.200;  
    option routers 192.168.255.101;  
    option tftp-server-name "192.168.255.100"; #Default Option 66  
    option bootfile-name "bootfile";          #Default Option 67  
}  
  
class "Option66,67_1" {                #DHCP Option 60 Vendor class  
two  
    match if option vendor-class-identifier = "GTL-2891.cfg";  
    option tftp-server-name "192.168.255.101";  
    option bootfile-name "test";  
}
```



**Note:** Use "GTL-2891" for the vendor-class-identifier in the dhcpd.conf file.

## Setting the System Clock

Simple Network Time Protocol (SNTP) or Network Time Protocol (NTP) can be used to set the switch's internal clock based on periodic updates from a time server. Maintaining an accurate time on the switch enables the system log to record meaningful dates and times for event entries. You can also manually set the clock. If the clock is not set manually or via SNTP or NTP, the switch will only record the time from the factory default set at the last bootup.

When the SNTP client is enabled, the switch periodically sends a request for a time update to a configured time server. You can configure up to three time server IP addresses. The switch will attempt to poll each server in the configured sequence.

The switch also supports the following time settings:

- ◆ Time Zone – You can specify the offset from Coordinated Universal Time (UTC), also known as Greenwich Mean Time (GMT).
- ◆ Summer Time/Daylight Saving Time (DST) – In some regions, the time shifts by one hour in the fall and spring. The switch supports manual entry for one-time or recurring clock shifts.

### Setting the Time Manually

To manually set the clock to 14:11:36, April 1st, 2013, enter this command.

```
Console#calendar set 14 11 36 1 April 2013  
Console#
```

To set the time zone, enter a command similar to the following.

```
Console(config)#clock timezone Japan hours 8 after-UTC  
Console(config)#
```

To set the time shift for summer time, enter a command similar to the following.

```
Console(config)#clock summer-time SUMMER date 2 april 2013 0 0 30 june 2013 0
0
Console(config)#
```

To display the clock configuration settings, enter the following command.

```
Console#show calendar
Current Time      : Apr  2 15:56:12 2013
Time Zone        : UTC, 08:00
Summer Time      : SUMMER, offset 60 minutes
                  Apr 2 2013 00:00 to Jun 30 2013 00:00
Summer Time in Effect : Yes
Console#
```

**Configuring SNTP** Setting the clock based on an SNTP server can provide more accurate clock synchronization across network switches than manually-configured time. To configure SNTP, set the switch as an SNTP client, and then set the polling interval, and specify a time server as shown in the following example.

```
Console(config)#sntp client
Console(config)#sntp poll 60
Console(config)#sntp server 10.1.0.19
Console(config)#exit
Console#show sntp
Current Time      : Apr  2 16:06:07 2013
Poll Interval     : 60 seconds
Current Mode      : Unicast
SNTP Status       : Enabled
SNTP Server       : 10.1.0.19
Current Server    : 10.1.0.19
Console#
```

**Configuring NTP** Requesting the time from an NTP server is the most secure method. You can enable NTP authentication to ensure that reliable updates are received from only authorized NTP servers. The authentication keys and their associated key number must be centrally managed and manually distributed to NTP servers and clients. The key numbers and key values must match on both the server and client.

When more than one time server is configured, the client will poll all of the time servers, and compare the responses to determine the most reliable and accurate time update for the switch.

To configure NTP time synchronization, enter commands similar to the following.

```
Console(config)#ntp client
Console(config)#ntp authentication-key 45 md5 thisiskey45
Console(config)#ntp authenticate
Console(config)#ntp server 192.168.3.20
```

```
Console(config)#ntp server 192.168.3.21
Console(config)#ntp server 192.168.5.23 key 19
Console(config)#exit
Console#show ntp
Current Time           : Apr 29 13:57:32 2011
Polling                : 1024 seconds
Current Mode           : unicast
NTP Status              : Enabled
NTP Authenticate Status : Enabled
Last Update NTP Server  : 192.168.0.88      Port: 123
Last Update Time        : Mar 12 02:41:01 2013 UTC
NTP Server 192.168.0.88 version 3
NTP Server 192.168.3.21 version 3
NTP Server 192.168.4.22 version 3 key 19
NTP Authentication Key 19 md5 42V68751663T6K11P2J307210R885

Current Time           : Apr  2 16:28:34 2013
Polling                : 1024 seconds
Current Mode           : unicast
NTP Status              : Enabled
NTP Authenticate Status : Enabled
Last Update NTP Server  : 192.168.5.23      Port: 0
Last Update Time        : Apr  2 16:00:00 2013 UTC
NTP Server 192.168.3.20 version 3
NTP Server 192.168.3.21 version 3
NTP Server 192.168.5.23 version 3 key 19
NTP Authentication Key 45 md5 2662T75S5658RU5424180034777
Console#
```

---

# Section II

## Command Line Interface

This section provides a detailed description of the Command Line Interface, along with examples for all of the commands.

This section includes these chapters:

- ◆ ["Using the Command Line Interface" on page 87](#)
- ◆ ["General Commands" on page 101](#)
- ◆ ["System Management Commands" on page 109](#)
- ◆ ["SNMP Commands" on page 193](#)
- ◆ ["Remote Monitoring Commands" on page 219](#)
- ◆ ["Flow Sampling Commands" on page 227](#)
- ◆ ["Authentication Commands" on page 233](#)
- ◆ ["General Security Measures" on page 299](#)
- ◆ ["Access Control Lists" on page 383](#)
- ◆ ["Interface Commands" on page 411](#)
- ◆ ["Link Aggregation Commands" on page 441](#)
- ◆ ["Power over Ethernet Commands" on page 469](#)
- ◆ ["Port Mirroring Commands" on page 455](#)
- ◆ ["Congestion Control Commands" on page 465](#)
- ◆ ["Loopback Detection Commands" on page 483](#)
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- ◆ ["Address Table Commands" on page 497](#)
- ◆ ["Spanning Tree Commands" on page 505](#)
- ◆ ["ERPS Commands" on page 535](#)
- ◆ ["VLAN Commands" on page 567](#)
- ◆ ["Class of Service Commands" on page 613](#)
- ◆ ["Quality of Service Commands" on page 627](#)
- ◆ ["Multicast Filtering Commands" on page 647](#)
- ◆ ["LLDP Commands" on page 773](#)
- ◆ ["CFM Commands" on page 797](#)
- ◆ ["OAM Commands" on page 839](#)
- ◆ ["Domain Name Service Commands" on page 851](#)
- ◆ ["DHCP Commands" on page 861](#)
- ◆ ["IP Interface Commands" on page 885](#)
- ◆ ["VRRP Commands" on page 943](#)
- ◆ ["IP Routing Commands" on page 953](#)
- ◆ ["Multicast Routing Commands" on page 1153](#)

# 2

## Using the Command Line Interface

This chapter describes how to use the Command Line Interface (CLI).



**Note:** You can only access the console interface through the Master unit in the stack.

### Accessing the CLI

When accessing the management interface for the switch over a direct connection to the server's console port, or via a Telnet or Secure Shell connection (SSH), the switch can be managed by entering command keywords and parameters at the prompt. Using the switch's command-line interface (CLI) is very similar to entering commands on a UNIX system.

**Console Connection** To access the switch through the console port, perform these steps:

1. At the console prompt, enter the user name and password. (The default user names are "admin" and "guest" with corresponding passwords of "admin" and "guest.") When the administrator user name and password is entered, the CLI displays the "Console#" prompt and enters privileged access mode (i.e., Privileged Exec). But when the guest user name and password is entered, the CLI displays the "Console>" prompt and enters normal access mode (i.e., Normal Exec).
2. Enter the necessary commands to complete your desired tasks.
3. When finished, exit the session with the "quit" or "exit" command.

After connecting to the system through the console port, the login screen displays:

```
User Access Verification

Username: admin
Password:
  CLI session with the GTL-2891 is opened.
  To end the CLI session, enter [Exit].

Console#
```

**Telnet Connection** Telnet operates over the IP transport protocol. In this environment, your management station and any network device you want to manage over the network must have a valid IP address. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Each address consists of a network portion and host portion. For example, the IP address assigned to this switch, 10.1.0.1, consists of a network portion (10.1.0) and a host portion (1).



**Note:** The IP address for this switch is obtained via DHCP by default.

To access the switch through a Telnet session, you must first set the IP address for the Master unit, and set the default gateway if you are managing the switch from a different IP subnet. For example,

```
Console(config)#interface vlan 1
Console(config-if)#ip address 10.1.0.254 255.255.255.0
Console(config-if)#exit
Console(config)#ip default-gateway 10.1.0.254
Console(config)#
```

If your corporate network is connected to another network outside your office or to the Internet, you need to apply for a registered IP address. However, if you are attached to an isolated network, then you can use any IP address that matches the network segment to which you are attached.

After you configure the switch with an IP address, you can open a Telnet session by performing these steps:

1. From the remote host, enter the Telnet command and the IP address of the device you want to access.
2. At the prompt, enter the user name and system password. The CLI will display the “Vty-*n*” prompt for the administrator to show that you are using privileged access mode (i.e., Privileged Exec), or “Vty-*n*>” for the guest to show that you are using normal access mode (i.e., Normal Exec), where *n* indicates the number of the current Telnet session.
3. Enter the necessary commands to complete your desired tasks.
4. When finished, exit the session with the “quit” or “exit” command.

After entering the Telnet command, the login screen displays:

```
Username: admin
Password:

CLI session with the GTL-2891 is opened.
To end the CLI session, enter [Exit].

Vty-0#
```





**Note:** You can open up to eight sessions to the device via Telnet or SSH.

## Entering Commands

This section describes how to enter CLI commands.

### Keywords and Arguments

A CLI command is a series of keywords and arguments. Keywords identify a command, and arguments specify configuration parameters. For example, in the command “show interfaces status ethernet 1/5,” **show interfaces** and **status** are keywords, **ethernet** is an argument that specifies the interface type, and **1/5** specifies the unit/port.

You can enter commands as follows:

- ◆ To enter a simple command, enter the command keyword.
- ◆ To enter multiple commands, enter each command in the required order. For example, to enable Privileged Exec command mode, and display the startup configuration, enter the following commands. The default password “super” is used to change from Normal Exec to Privileged Exec mode:

```
Console>enable
Password:
Console#show startup-config
```

- ◆ To enter commands that require parameters, enter the required parameters after the command keyword. For example, to set a password for the administrator, enter:

```
Console(config)#username admin password 0 smith
```

### Minimum Abbreviation

The CLI will accept a minimum number of characters that uniquely identify a command. For example, the command “configure” can be entered as **con**. If an entry is ambiguous, the system will prompt for further input.

### Command Completion

If you terminate input with a Tab key, the CLI will print the remaining characters of a partial keyword up to the point of ambiguity. In the “logging history” example, typing **log** followed by a tab will result in printing the command up to “**logging**.”

**Getting Help on Commands** You can display a brief description of the help system by entering the **help** command. You can also display command syntax by using the "?" character to list keywords or parameters.

## Showing Commands

If you enter a "?" at the command prompt, the system will display the first level of keywords or command groups. You can also display a list of valid keywords for a specific command. For example, the command "**show system ?**" displays a list of possible show commands:

```
Console#show ?
  access-group          Access groups
  access-list           Access lists
  accounting            Uses the specified accounting list
  arp                  Information of ARP cache
  authorization         Enables EXEC accounting
  auto-traffic-control  Auto traffic control information
  banner               Banner info
  bridge-ext           Bridge extension information
  cable-diagnostics    Shows the information of cable diagnostics
  calendar             Date and time information
  class-map            Displays class maps
  cluster              Display cluster
  collision-mac-address-table Show collision mac address
  debug               State of each debugging option
  discard             Discard packet
  dns                 DNS information
  dos-protection       Shows the system dos-protection summary
                      information
  dot1q-tunnel        dot1q-tunnel
  dot1x               802.1X content
  efm                 Ethernet First Mile feature
  erps                Displays ERPS configuration
  ethernet            Shows Metro Ethernet information
  garp                GARP properties
  gvrp                GVRP interface information
  history             Shows history information
  hosts              Host information
  interfaces          Shows interface information
  ip                  IP information
  ipv6                IPv6 information
  l2protocol-tunnel   Layer 2 protocol tunneling configuration
  lacp                LACP statistics
  line                TTY line information
  lldp                LLDP
  log                 Log records
  logging             Logging setting
  loop               Shows the information of loopback
  loopback-detection Shows loopback detection information
  mac                 MAC access list
  mac-address-table   Configuration of the address table
  mac-vlan            MAC-based VLAN information
  management          Shows management information
  memory             Memory utilization
  mvr                multicast vlan registration
  mvr6               IPv6 Multicast VLAN registration
  network-access      Shows the entries of the secure port.
  nlm                Show notification log
  ntp                 Network Time Protocol configuration
  policy-map          Displays policy maps
```

port	Port characteristics
port-channel	Port channel information
power	Shows power
power-save	Shows the power saving information
pppoe	Displays PPPoE configuration
privilege	Shows current privilege level
process	Device process
protocol-vlan	Protocol-VLAN information
public-key	Public key information
qos	Quality of Service
queue	Priority queue information
radius-server	RADIUS server information
reload	Shows the reload settings
rmon	Remote monitoring information
route-map	Shows route-map
rspan	Display status of the current RSPAN configuration
running-config	Information on the running configuration
sflow	Shows the sflow information
snmp	Simple Network Management Protocol configuration and statistics
snmp-server	Displays SNMP server configuration
sntp	Simple Network Time Protocol configuration
spanning-tree	Spanning-tree configuration
ssh	Secure shell server connections
startup-config	Startup system configuration
subnet-vlan	IP subnet-based VLAN information
switch	stacking switch
system	System information
tacacs-server	TACACS server information
tech-support	Technical information
time-range	Time range
traffic-segmentation	Traffic segmentation information
udld	Displays UDLD information
upgrade	Shows upgrade information
users	Information about users logged in
version	System hardware and software versions
vlan	Shows virtual LAN settings
vlan-translation	VLAN translation information
voice	Shows the voice VLAN information
vrrp	Shows VRRP
watchdog	Displays watchdog status
web-auth	Shows web authentication configuration
Console#show	

The command “**show interfaces ?**” will display the following information:

Console#show interfaces ?	
brief	Shows brief interface description
counters	Interface counters information
protocol-vlan	Protocol-VLAN information
status	Shows interface status
switchport	Shows interface switchport information
transceiver	Interface of transceiver information
transceiver-threshold	Interface of transceiver-threshold information
Console#	

Show commands which display more than one page of information (e.g., **show running-config**) pause and require you to press the [Space] bar to continue displaying one more page, the [Enter] key to display one more line, or the [a] key to

display the rest of the information without stopping. You can press any other key to terminate the display.

**Partial Keyword Lookup** If you terminate a partial keyword with a question mark, alternatives that match the initial letters are provided. (Remember not to leave a space between the command and question mark.) For example “**s?**” shows all the keywords starting with “s.”

```
Console#show s?  
sflow          snmp            snmp-server    snmp            spanning-tree  
ssh            startup-config subnet-vlan     switch          system  
Console#show s
```

**Negating the Effect of Commands** For many configuration commands you can enter the prefix keyword “**no**” to cancel the effect of a command or reset the configuration to the default value. For example, the **logging** command will log system messages to a host server. To disable logging, specify the **no logging** command. This guide describes the negation effect for all applicable commands.

**Using Command History** The CLI maintains a history of commands that have been entered. You can scroll back through the history of commands by pressing the up arrow key. Any command displayed in the history list can be executed again, or first modified and then executed.

Using the **show history** command displays a longer list of recently executed commands.

**Understanding Command Modes** The command set is divided into Exec and Configuration classes. Exec commands generally display information on system status or clear statistical counters. Configuration commands, on the other hand, modify interface parameters or enable certain switching functions. These classes are further divided into different modes. Available commands depend on the selected mode. You can always enter a question mark “**?**” at the prompt to display a list of the commands available for the current mode. The command classes and associated modes are displayed in the following table:

**Table 3: General Command Modes**

Class	Mode
Exec	Normal Privileged
Configuration	Global* Access Control List CFM Class Map DHCP ERPS IGMP Profile Interface Line Multiple Spanning Tree Policy Map Route Map Router Time Range VLAN Database

\* You must be in Privileged Exec mode to access the Global configuration mode.  
You must be in Global Configuration mode to access any of the other configuration modes.

**Exec Commands** When you open a new console session on the switch with the user name and password “guest,” the system enters the Normal Exec command mode (or guest mode), displaying the “Console>” command prompt. Only a limited number of the commands are available in this mode. You can access all commands only from the Privileged Exec command mode (or administrator mode). To access Privilege Exec mode, open a new console session with the user name and password “admin.” The system will now display the “Console#” command prompt. You can also enter Privileged Exec mode from within Normal Exec mode, by entering the [enable](#) command, followed by the privileged level password “super.”

To enter Privileged Exec mode, enter the following user names and passwords:

```

Username: admin
Password: [admin login password]

CLI session with the GTL-2891 is opened.
To end the CLI session, enter [Exit].

Console#

```

```

Username: guest
Password: [guest login password]

CLI session with the GTL-2891 is opened.
To end the CLI session, enter [Exit].

Console>enable
Password: [privileged level password]
Console#

```

**Configuration Commands** Configuration commands are privileged level commands used to modify switch settings. These commands modify the running configuration only and are not saved when the switch is rebooted. To store the running configuration in non-volatile storage, use the **copy running-config startup-config** command.

The configuration commands are organized into different modes:

- ◆ Global Configuration - These commands modify the system level configuration, and include commands such as **hostname** and **snmp-server community**.
- ◆ Access Control List Configuration - These commands are used for packet filtering.
- ◆ CFM Configuration - Configures connectivity monitoring using continuity check messages, fault verification through loopback messages, and fault isolation by examining end-to-end connections between Provider Edge devices or between Customer Edge devices.
- ◆ Class Map Configuration - Creates a DiffServ class map for a specified traffic type.
- ◆ DHCP Configuration - These commands are used to configure the DHCP server.
- ◆ ERPS Configuration - These commands configure Ethernet Ring Protection Switching for increased availability of Ethernet rings commonly used in service provider networks.
- ◆ IGMP Profile - Sets a profile group and enters IGMP filter profile configuration mode.
- ◆ Interface Configuration - These commands modify the port configuration such as **speed-duplex** and **negotiation**.
- ◆ Line Configuration - These commands modify the console port and Telnet configuration, and include command such as **parity** and **databits**.
- ◆ Multiple Spanning Tree Configuration - These commands configure settings for the selected multiple spanning tree instance.
- ◆ Policy Map Configuration - Creates a DiffServ policy map for multiple interfaces.
- ◆ Route Map Configuration - These commands specify the action (next hop or silently drop) to take when a match is found.
- ◆ Router Configuration - These commands configure global settings for unicast and multicast routing protocols.
- ◆ Time Range - Sets a time range for use by other functions, such as Access Control Lists.

- ◆ VLAN Configuration - Includes the command to create VLAN groups.

To enter the Global Configuration mode, enter the command **configure** in Privileged Exec mode. The system prompt will change to "Console(config)#" which gives you access privilege to all Global Configuration commands.

```
Console#configure
Console(config)#
```

To enter the other modes, at the configuration prompt type one of the following commands. Use the **exit** or **end** command to return to the Privileged Exec mode.

**Table 4: Configuration Command Modes**

Mode	Command	Prompt	Page
Access Control List	access-list arp	Console(config-arp-acl)	<a href="#">406</a>
	access-list ip standard	Console(config-std-acl)	<a href="#">384</a>
	access-list ip extended	Console(config-ext-acl)	<a href="#">384</a>
	access-list ipv6 standard	Console(config-std-ipv6-acl)	<a href="#">391</a>
	access-list ipv6 extended	Console(config-ext-ipv6-acl)	<a href="#">391</a>
	access-list mac	Console(config-mac-acl)	<a href="#">399</a>
CFM	ethernet cfm domain	Console(config-ether-cfm)	<a href="#">803</a>
Class Map	class-map	Console(config-cmap)	<a href="#">628</a>
ERPS	erps domain	Console(config-erps)	<a href="#">538</a>
DHCP	ip dhcp pool	Console(config-dhcp)	<a href="#">871</a>
Interface	interface {ethernet <i>port</i>   port-channel <i>id</i>   vlan <i>id</i> }	Console(config-if)	<a href="#">412</a>
Line	line {console   vty}	Console(config-line)	<a href="#">146</a>
MSTP	spanning-tree mst-configuration	Console(config-mstp)	<a href="#">512</a>
Policy Map	policy-map	Console(config-pmap)	<a href="#">632</a>
Router	router {bgp   ipv6 ospf   ospf   pim   pim6   rip}	Console(config-router)	<a href="#">1062</a>
			<a href="#">961</a>
			<a href="#">980</a>
			<a href="#">1162</a>
			<a href="#">1185</a>
Time Range	time-range	Console(config-time-range)	<a href="#">962</a>
			<a href="#">179</a>
VLAN	vlan database	Console(config-vlan)	<a href="#">573</a>

For example, you can use the following commands to enter interface configuration mode, and then return to Privileged Exec mode

```
Console(config)#interface ethernet 1/5
.
.
Console(config-if)#exit
Console(config)#
```

### Command Line Processing

Commands are not case sensitive. You can abbreviate commands and parameters as long as they contain enough letters to differentiate them from any other currently available commands or parameters. You can use the Tab key to complete partial commands, or enter a partial command followed by the “?” character to display a list of possible matches. You can also use the following editing keystrokes for command-line processing:

**Table 5: Keystroke Commands**

Keystroke	Function
Ctrl-A	Shifts cursor to start of command line.
Ctrl-B	Shifts cursor to the left one character.
Ctrl-C	Terminates the current task and displays the command prompt.
Ctrl-E	Shifts cursor to end of command line.
Ctrl-F	Shifts cursor to the right one character.
Ctrl-K	Deletes all characters from the cursor to the end of the line.
Ctrl-L	Repeats current command line on a new line.
Ctrl-N	Enters the next command line in the history buffer.
Ctrl-P	Enters the last command.
Ctrl-R	Repeats current command line on a new line.
Ctrl-U	Deletes from the cursor to the beginning of the line.
Ctrl-W	Deletes the last word typed.
Esc-B	Moves the cursor back one word.
Esc-D	Deletes from the cursor to the end of the word.
Esc-F	Moves the cursor forward one word.
Delete key or backspace key	Erases a mistake when entering a command.



**Showing Status Information** There are various “show” commands which display configuration settings or the status of specified processes. Many of these commands will not display any information unless the switch is properly configured, and in some cases the interface to which a command applies is up.

For example, if a static router port is configured, the corresponding show command will not display any information unless IGMP snooping is enabled, and the link for the static router port is up.

```

Console#configure
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11
Console(config)#end
Console#show ip igmp snooping mrouter
VLAN M'cast Router Ports Type
----
-----

Console#configure
Console(config)#ip igmp snooping
Console(config)#end
Console#show ip igmp snooping mrouter
VLAN M'cast Router Ports Type
----
-----
1      Eth 1/11          Static
Console#

```

## CLI Command Groups

The system commands can be broken down into the functional groups shown below.

**Table 6: Command Group Index**

Command Group	Description	Page
General	Basic commands for entering privileged access mode, restarting the system, or quitting the CLI	<a href="#">101</a>
System Management	Display and setting of system information, basic modes of operation, maximum frame size, file management, console port and telnet settings, system logs, SMTP alerts, the system clock, and switch clustering	<a href="#">109</a>
Simple Network Management Protocol	Activates authentication failure traps; configures community access strings, and trap receivers	<a href="#">193</a>
Remote Monitoring	Supports statistics, history, alarm and event groups	<a href="#">219</a>
Flow Sampling	Used with a remote sFlow Collector to provide an accurate, detailed and real-time overview of the types and levels of traffic present on the network	<a href="#">227</a>
User Authentication	Configures user names and passwords, command privilege levels, logon access using local or remote authentication, management access through the web server, Telnet server and Secure Shell; as well as port security, IEEE 802.1X port access control, and restricted access based on specified IP addresses, and PPPoE Intermediate Agent	<a href="#">233</a>

**Table 6: Command Group Index** (Continued)

Command Group	Description	Page
General Security Measures	Segregates traffic for clients attached to common data ports; and prevents unauthorized access by configuring valid static or dynamic addresses, web authentication, MAC address authentication, filtering DHCP requests and replies, and discarding invalid ARP responses	<a href="#">299</a>
Access Control List	Provides filtering for IPv4 frames (based on address, protocol, TCP/UDP port number or TCP control code), IPv6 frames (based on address, DSCP traffic class, or next header), or non-IP frames (based on MAC address or Ethernet type)	<a href="#">383</a>
Interface	Configures the connection parameters for all Ethernet ports, aggregated links, and VLANs	<a href="#">411</a>
Link Aggregation	Statically groups multiple ports into a single logical trunk; configures Link Aggregation Control Protocol for port trunks	<a href="#">441</a>
Mirror Port	Mirrors data to another port for analysis without affecting the data passing through or the performance of the monitored port	<a href="#">455</a>
Congestion Control	Sets the input/output rate limits, traffic storm thresholds, and thresholds for broadcast and multicast storms which can be used to trigger configured rate limits or to shut down a port.	<a href="#">465</a>
Loopback Detection	Detects general loopback conditions caused by hardware problems or faulty protocol settings	<a href="#">483</a>
UniDirectional Link Detection	Detect and disables unidirectional links	<a href="#">489</a>
Address Table	Configures the address table for filtering specified addresses, displays current entries, clears the table, or sets the aging time	<a href="#">497</a>
Spanning Tree	Configures Spanning Tree settings for the switch	<a href="#">505</a>
ERPS	Configures Ethernet Ring Protection Switching for increased availability of Ethernet rings commonly used in service provider networks	<a href="#">535</a>
VLANs	Configures VLAN settings, and defines port membership for VLAN groups; also enables or configures private VLANs, protocol VLANs, voice VLANs, and QinQ tunneling	<a href="#">567</a>
Class of Service	Sets port priority for untagged frames, selects strict priority or weighted round robin, relative weight for each priority queue, also sets priority for DSCP	<a href="#">613</a>
Quality of Service	Configures Differentiated Services	<a href="#">627</a>
Multicast Filtering	Configures IGMP multicast filtering, query, profile, and proxy parameters; specifies ports attached to a multicast router; also configures multicast VLAN registration, and IPv6 MLD snooping	<a href="#">647</a>
Link Layer Discovery Protocol	Configures LLDP settings to enable information discovery about neighbor devices	<a href="#">773</a>
Connectivity Fault Management	Configures connectivity monitoring using continuity check messages, fault verification through loopback messages, and fault isolation by examining end-to-end connections between Provider Edge devices or between Customer Edge devices	<a href="#">797</a>
OAM	Configures Operations, Administration and Maintenance remote management tools required to monitor and maintain the links to subscriber CPEs	<a href="#">839</a>

**Table 6: Command Group Index** (Continued)

Command Group	Description	Page
Domain Name Service	Configures DNS services.	<a href="#">851</a>
Dynamic Host Configuration Protocol	Configures DHCP client, relay and server functions	<a href="#">861</a>
Router Redundancy	Configures router redundancy to create primary and backup routers	<a href="#">943</a>
IP Interface	Configures IP address for the switch interfaces; also configures ARP parameters	<a href="#">885</a>
IP Routing	Configures static and dynamic unicast routing	<a href="#">953</a>
Multicast Routing	Configures multicast routing protocols PIM-DM/SM and PIM6-DM/SM	<a href="#">1153</a>
Debug	Displays debugging information for all key functions	
	These commands are not described in this manual. Please refer to the prompt messages included in the CLI interface.	

The access mode shown in the following tables is indicated by these abbreviations:

**ACL** (Access Control List Configuration)  
**CFM** (Connectivity Fault Management Configuration)  
**CM** (Class Map Configuration)  
**ERPS** (Ethernet Ring Protection Switching Configuration)  
**GC** (Global Configuration)  
**IC** (Interface Configuration)  
**IPC** (IGMP Profile Configuration)  
**LC** (Line Configuration)  
**MST** (Multiple Spanning Tree)  
**NE** (Normal Exec)  
**PE** (Privileged Exec)  
**PM** (Policy Map Configuration)  
**RC** (Router Configuration)  
**RM** (Route Map Configuration)  
**VC** (VLAN Database Configuration)



# General Commands

The general commands are used to control the command access mode, configuration mode, and other basic functions.

**Table 7: General Commands**

Command	Function	Mode
<code>prompt</code>	Customizes the CLI prompt	GC
<code>reload</code>	Restarts the system at a specified time, after a specified delay, or at a periodic interval	GC
<code>enable</code>	Activates privileged mode	NE
<code>quit</code>	Exits a CLI session	NE, PE
<code>show history</code>	Shows the command history buffer	NE, PE
<code>configure</code>	Activates global configuration mode	PE
<code>disable</code>	Returns to normal mode from privileged mode	PE
<code>reload</code>	Restarts the system immediately	PE
<code>show reload</code>	Displays the current reload settings, and the time at which next scheduled reload will take place	PE
<code>end</code>	Returns to Privileged Exec mode	any config. mode
<code>exit</code>	Returns to the previous configuration mode, or exits the CLI	any mode
<code>help</code>	Shows how to use help	any mode
<code>?</code>	Shows options for command completion (context sensitive)	any mode

**prompt** This command customizes the CLI prompt. Use the **no** form to restore the default prompt.

## Syntax

**prompt** *string*

**no prompt**

*string* - Any alphanumeric string to use for the CLI prompt.  
(Maximum length: 255 characters)

## Default Setting

Console

## Command Mode

Global Configuration

## Command Usage

This command and the `hostname` command can be used to set the command line prompt as shown in the example below. Using the **no** form of either command will restore the default command line prompt.

## Example

```

Console(config)#prompt RD2
RD2(config)#

```

**reload** (Global Configuration) This command restarts the system at a specified time, after a specified delay, or at a periodic interval. You can reboot the system immediately, or you can configure the switch to reset after a specified amount of time. Use the **cancel** option to remove a configured setting.

## Syntax

```

reload {at hour minute [{month day | day month} [year]] |
in {hour hours | minute minutes | hour hours minute minutes} |
regularity hour minute [period {daily | weekly day-of-week |
monthly day-of-month}] | cancel [at | in | regularity]}

```

**reload at** - A specified time at which to reload the switch.

*hour* - The hour at which to reload. (Range: 0-23)

*minute* - The minute at which to reload. (Range: 0-59)

*month* - The month at which to reload. (january ... december)

*day* - The day of the month at which to reload. (Range: 1-31)

*year* - The year at which to reload. (Range: 1970-2037)

**reload in** - An interval after which to reload the switch.

*hours* - The number of hours, combined with the minutes, before the switch resets. (Range: 0-576)

*minutes* - The number of minutes, combined with the hours, before the switch resets. (Range: 0-59)

**reload regularity** - A periodic interval at which to reload the switch.

*hour* - The hour at which to reload. (Range: 0-23)

*minute* - The minute at which to reload. (Range: 0-59)

*day-of-week* - Day of the week at which to reload.  
(Range: monday ... saturday)

*day-of-month* - Day of the month at which to reload. (Range: 1-31)

**reload cancel** - Cancels the specified reload option.

**Default Setting**

None

**Command Mode**

Global Configuration

**Command Usage**

- ◆ This command resets the entire system.
- ◆ Any combination of reload options may be specified. If the same option is re-specified, the previous setting will be overwritten.
- ◆ When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory by the [copy running-config startup-config](#) command (See [“copy” on page 134](#)).

**Example**

This example shows how to reset the switch after 30 minutes:

```

Console(config)#reload in minute 30
***
*** --- Rebooting at January  1 02:10:43 2016 ---
***

Are you sure to reboot the system at the specified time? <y/n>

```

**enable** This command activates Privileged Exec mode. In privileged mode, additional commands are available, and certain commands display additional information. See [“Understanding Command Modes” on page 92](#).

**Syntax**

**enable** [*level*]

*level* - Privilege level to log into the device.

The device has two predefined privilege levels: 0: Normal Exec,  
15: Privileged Exec. Enter level 15 to access Privileged Exec mode.

**Default Setting**

Level 15

**Command Mode**

Normal Exec

**Command Usage**

- ◆ “super” is the default password required to change the command mode from Normal Exec to Privileged Exec. (To set this password, see the [enable password](#) command.)

- ◆ The “#” character is appended to the end of the prompt to indicate that the system is in privileged access mode.

### Example

```
Console>enable
Password: [privileged level password]
Console#
```

### Related Commands

[disable \(106\)](#)

[enable password \(234\)](#)

**quit** This command exits the configuration program.

### Default Setting

None

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

The **quit** and **exit** commands can both exit the configuration program.

### Example

This example shows how to quit a CLI session:

```
Console#quit

Press ENTER to start session

User Access Verification

Username:
```

**show history** This command shows the contents of the command history buffer.

### Default Setting

None

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

The history buffer size is fixed at 10 Execution commands and 10 Configuration commands.



**Example**

In this example, the show history command lists the contents of the command history buffer:

```

Console#show history
Execution command history:
 2 config
 1 show history

Configuration command history:
 4 interface vlan 1
 3 exit
 2 interface vlan 1
 1 end

Console#

```

The **!** command repeats commands from the Execution command history buffer when you are in Normal Exec or Privileged Exec Mode, and commands from the Configuration command history buffer when you are in any of the configuration modes. In this example, the **!2** command repeats the second command in the Execution history buffer (**config**).

```

Console#!2
Console#config
Console(config)#

```

**configure** This command activates Global Configuration mode. You must enter this mode to modify any settings on the switch. You must also enter Global Configuration mode prior to enabling some of the other configuration modes, such as Interface Configuration, Line Configuration, and VLAN Database Configuration. See [“Understanding Command Modes” on page 92](#).

**Default Setting**

None

**Command Mode**

Privileged Exec

**Example**

```

Console#configure
Console(config)#

```

**Related Commands**

[end \(107\)](#)

**disable** This command returns to Normal Exec mode from privileged mode. In normal access mode, you can only display basic information on the switch's configuration or Ethernet statistics. To gain access to all commands, you must use the privileged mode. See [“Understanding Command Modes” on page 92](#).

**Default Setting**

None

**Command Mode**

Privileged Exec

**Command Usage**

The “>” character is appended to the end of the prompt to indicate that the system is in normal access mode.

**Example**

```
Console#disable
Console>
```

**Related Commands**

[enable \(103\)](#)

**reload (Privileged Exec)** This command restarts the system.



**Note:** When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory by the copy running-config startup-config command.

**Default Setting**

None

**Command Mode**

Privileged Exec

**Command Usage**

This command resets the entire system.

**Example**

This example shows how to reset the switch:

```
Console#reload
System will be restarted, continue <y/n>? y
```

**show reload** This command displays the current reload settings, and the time at which next scheduled reload will take place.

#### Command Mode

Privileged Exec

#### Example

```
Console#show reload
Reloading switch in time:                0 hours 29 minutes.

The switch will be rebooted at January  1 02:11:50 2015.
Remaining Time: 0 days, 0 hours, 29 minutes, 52 seconds.
Console#
```

**end** This command returns to Privileged Exec mode.

#### Default Setting

None

#### Command Mode

Global Configuration, Interface Configuration, Line Configuration, VLAN Database Configuration, and Multiple Spanning Tree Configuration.

#### Example

This example shows how to return to the Privileged Exec mode from the Interface Configuration mode:

```
Console(config-if)#end
Console#
```

**exit** This command returns to the previous configuration mode or exits the configuration program.

#### Default Setting

None

#### Command Mode

Any

### Example

This example shows how to return to the Privileged Exec mode from the Global Configuration mode, and then quit the CLI session:

```
Console(config)#exit
Console#exit

Press ENTER to start session

User Access Verification

Username:
```

## 4

# System Management Commands

The system management commands are used to control system logs, passwords, user names, management options, and display or configure a variety of other system information.

**Table 8: System Management Commands**

Command Group	Function
Device Designation	Configures information that uniquely identifies this switch
Banner Information	Configures administrative contact, device identification and location
System Status	Displays system configuration, active managers, and version information
Fan Control	Forces fans to full speed
Frame Size	Enables support for jumbo frames
File Management	Manages code image or switch configuration files
Line	Sets communication parameters for the serial port, including baud rate and console time-out
Event Logging	Controls logging of error messages
SMTP Alerts	Configures SMTP email alerts
Time (System Clock)	Sets the system clock automatically via NTP/SNTP server or manually
Time Range	Sets a time range for use by other functions, such as Access Control Lists
Switch Clustering	Configures management of multiple devices via a single IP address
Stacking	Includes commands which configure a unit as the stack master, set the 10G ports to stacking mode, or renumber all units in the stack

## Device Designation

This section describes commands used to configure information that uniquely identifies the switch.

**Table 9: Device Designation Commands**

Command	Function	Mode
hostname	Specifies the host name for the switch	GC
snmp-server contact	Sets the system contact string	GC
snmp-server location	Sets the system location string	GC

**hostname** This command specifies or modifies the host name for this device. Use the **no** form to restore the default host name.

### Syntax

**hostname** *name*

**no** hostname

*name* - The name of this host. (Maximum length: 255 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ The host name specified by this command is displayed by the [show system](#) command and on the Show > System web page.
- ◆ This command and the [prompt](#) command can be used to set the command line prompt as shown in the example below. Using the **no** form of either command will restore the default command line prompt.

### Example

```
Console(config)#hostname RD#1  
Console(config)#
```

---

## Banner Information

These commands are used to configure and manage administrative information about the switch, its exact data center location, details of the electrical and network circuits that supply the switch, as well as contact information for the network administrator and system manager. This information is only available via the CLI and is automatically displayed before login as soon as a console or telnet connection has been established.

**Table 10: Banner Commands**

Command	Function	Mode
<a href="#">banner configure</a>	Configures the banner information that is displayed before login	GC
<a href="#">banner configure company</a>	Configures the Company information that is displayed by banner	GC
<a href="#">banner configure dc-power-info</a>	Configures the DC Power information that is displayed by banner	GC

**Table 10: Banner Commands** (Continued)

Command	Function	Mode
<code>banner configure department</code>	Configures the Department information that is displayed by banner	GC
<code>banner configure equipment-info</code>	Configures the Equipment information that is displayed by banner	GC
<code>banner configure equipment-location</code>	Configures the Equipment Location information that is displayed by banner	GC
<code>banner configure ip-lan</code>	Configures the IP and LAN information that is displayed by banner	GC
<code>banner configure lp-number</code>	Configures the LP Number information that is displayed by banner	GC
<code>banner configure manager-info</code>	Configures the Manager contact information that is displayed by banner	GC
<code>banner configure mux</code>	Configures the MUX information that is displayed by banner	GC
<code>banner configure note</code>	Configures miscellaneous information that is displayed by banner under the Notes heading	GC
<code>show banner</code>	Displays all banner information	NE, PE

**banner configure** This command is used to interactively specify administrative information for this device.

#### Syntax

`banner configure`

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

The administrator can batch-input all details for the switch with one command. When the administrator finishes typing the company name and presses the enter key, the script prompts for the next piece of information, and so on, until all information has been entered. Pressing enter without inputting information at any prompt during the script's operation will leave the field empty. Spaces can be used during script mode because pressing the enter key signifies the end of data input. The delete and left-arrow keys terminate the script. The use of the backspace key during script mode is not supported. If, for example, a mistake is made in the company name, it can be corrected with the **banner configure company** command.

### Example

```
Console(config)#banner configure

Company: Level 1
Responsible department: R&D Dept
Name and telephone to Contact the management people
Manager1 name: Sr. Network Admin
      phone number: 123-555-1212
Manager2 name: Jr. Network Admin
      phone number: 123-555-1213
Manager3 name: Night-shift Net Admin / Janitor
      phone number: 123-555-1214
The physical location of the equipment.
City and street address: 12 Straight St. Motown, Zimbabwe
Information about this equipment:
Manufacturer: Edge-Core Networks
ID: 123_unique_id_number
Floor: 2
Row: 7
Rack: 29
Shelf in this rack: 8
Information about DC power supply.
Floor: 2
Row: 7
Rack: 25
Electrical circuit: : ec-177743209-xb
Number of LP:12
Position of the equipment in the MUX:1/23
IP LAN:192.168.1.1
Note: This is a random note about this managed switch and can contain
      miscellaneous information.
Console(config)#
```

**banner configure company** This command is used to configure company information displayed in the banner. Use the **no** form to remove the company name from the banner display.

### Syntax

**banner configure company** *name*

**no banner configure company**

*name* - The name of the company. (Maximum length: 32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

Input strings cannot contain spaces. The **banner configure company** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.



### Example

```
Console(config)#banner configure company Big-Ben  
Console(config)#
```

**banner configure dc-power-info** This command is use to configure DC power information displayed in the banner. Use the **no** form to restore the default setting.

### Syntax

**banner configure dc-power-info floor** *floor-id* **row** *row-id* **rack** *rack-id*  
**electrical-circuit** *ec-id*

**no banner configure dc-power-info [floor | row | rack | electrical-circuit]**

*floor-id* - The floor number.

*row-id* - The row number.

*rack-id* - The rack number.

*ec-id* - The electrical circuit ID.

Maximum length of each parameter: 32 characters

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

Input strings cannot contain spaces. The **banner configure dc-power-info** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

### Example

```
Console(config)#banner configure dc-power-info floor 3 row 15 rack 24  
electrical-circuit 48v-id_3.15.24.2  
Console(config)#
```

**banner configure department** This command is used to configure the department information displayed in the banner. Use the **no** form to restore the default setting.

#### Syntax

**banner configure department** *dept-name*

**no banner configure department**

*dept-name* - The name of the department.  
(Maximum length: 32 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

Input strings cannot contain spaces. The **banner configure department** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

#### Example

```
Console(config)#banner configure department R&D
Console(config)#
```

**banner configure equipment-info** This command is used to configure the equipment information displayed in the banner. Use the **no** form to restore the default setting.

#### Syntax

**banner configure equipment-info manufacturer-id** *mfr-id* **floor** *floor-id*  
**row** *row-id* **rack** *rack-id* **shelf-rack** *sr-id* **manufacturer** *mfr-name*

**no banner configure equipment-info** [**floor** | **manufacturer** | **manufacturer-id** | **rack** | **row** | **shelf-rack**]

*mfr-id* - The name of the device model number.

*floor-id* - The floor number.

*row-id* - The row number.

*rack-id* - The rack number.

*sr-id* - The shelf number in the rack.

*mfr-name* - The name of the device manufacturer.

Maximum length of each parameter: 32 characters

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

Input strings cannot contain spaces. The **banner configure equipment-info** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

### Example

```
Console(config)#banner configure equipment-info manufacturer-id floor 3 row
10 rack 15 shelf-rack 12 manufacturer Edge-Core
Console(config)#
```

## **banner configure equipment-location**

This command is used to configure the equipment location information displayed in the banner. Use the **no** form to restore the default setting.

### Syntax

**banner configure equipment-location** *location*

**no banner configure equipment-location**

*location* - The address location of the device.  
(Maximum length: 32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

Input strings cannot contain spaces. The **banner configure equipment-location** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

### Example

```
Console(config)#banner configure equipment-location
710_Network_Path,_Indianapolis
Console(config)#
```

**banner configure ip-lan** This command is used to configure the device IP address and subnet mask information displayed in the banner. Use the **no** form to restore the default setting.

#### Syntax

**banner configure ip-lan** *ip-mask*

**no banner configure ip-lan**

*ip-mask* - The IP address and subnet mask of the device.  
(Maximum length: 32 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

Input strings cannot contain spaces. The **banner configure ip-lan** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

#### Example

```
Console(config)#banner configure ip-lan 192.168.1.1/255.255.255.0
Console(config)#
```

**banner configure lp-number** This command is used to configure the LP number information displayed in the banner. Use the **no** form to restore the default setting.

#### Syntax

**banner configure lp-number** *lp-num*

**no banner configure lp-number**

*lp-num* - The LP number. (Maximum length: 32 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

Input strings cannot contain spaces. The **banner configure lp-number** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

### Example

```
Console(config)#banner configure lp-number 12  
Console(config)#
```

**banner configure manager-info** This command is used to configure the manager contact information displayed in the banner. Use the **no** form to restore the default setting.

### Syntax

#### **banner configure manager-info**

**name** *mgr1-name* **phone-number** *mgr1-number*  
[**name2** *mgr2-name* **phone-number** *mgr2-number* |  
**name3** *mgr3-name* **phone-number** *mgr3-number*]

**no banner configure manager-info** [**name1** | **name2** | **name3**]

*mgr1-name* - The name of the first manager.

*mgr1-number* - The phone number of the first manager.

*mgr2-name* - The name of the second manager.

*mgr2-number* - The phone number of the second manager.

*mgr3-name* - The name of the third manager.

*mgr3-number* - The phone number of the third manager.

Maximum length of each parameter: 32 characters

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

Input strings cannot contain spaces. The **banner configure manager-info** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

### Example

```
Console(config)#banner configure manager-info name Albert_Einstein phone-  
number 123-555-1212 name2 Lamar phone-number 123-555-1219  
Console(config)#
```

**banner configure mux** This command is used to configure the mux information displayed in the banner. Use the **no** form to restore the default setting.

#### Syntax

**banner configure mux** *muxinfo*

**no banner configure mux**

*muxinfo* - The circuit and PVC to which the switch is connected. (Maximum length: 32 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

Input strings cannot contain spaces. The **banner configure mux** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

#### Example

```
Console(config)#banner configure mux telco-8734212kx_PVC-1/23
Console(config)#
```

**banner configure note** This command is used to configure the note displayed in the banner. Use the **no** form to restore the default setting.

#### Syntax

**banner configure note** *note-info*

**no banner configure note**

*note-info* - Miscellaneous information that does not fit the other banner categories, or any other information of importance to users of the switch CLI. (Maximum length: 150 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

Input strings cannot contain spaces. The **banner configure note** command interprets spaces as data input boundaries. The use of underscores ( `_` ) or other

unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

### Example

```
Console(config)#banner configure note !!!!!ROUTINE_MAINTENANCE_firmware-  
upgrade_0100-0500_GMT-0500_20071022!!!!_20min_network_impact_expected  
Console(config)#
```

**show banner** This command displays all banner information.

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show banner  
Edge-Core  
WARNING - MONITORED ACTIONS AND ACCESSES  
R&D  
  
Albert_Einstein - 123-555-1212  
Lamar - 123-555-1219  
  
Station's information:  
710_Network_Path,_Indianapolis  
  
GTL-2891  
Floor / Row / Rack / Sub-Rack  
3/ 10 / 15 / 12  
DC power supply:  
Power Source A: Floor / Row / Rack / Electrical circuit  
3/ 15 / 24 / 48v-id_3.15.24.2  
Number of LP: 12  
Position MUX: telco-8734212kx_PVC-1/23  
IP LAN: 192.168.1.1/255.255.255.0  
Note: !!!!!ROUTINE_MAINTENANCE_firmware-upgrade_0100-0500_GMT-  
0500_20071022!!!!_20min_network_  
Console#
```

## System Status

This section describes commands used to display system information.

**Table 11: System Status Commands**

Command	Function	Mode
<a href="#">show access-list</a> <a href="#">tcam-utilization</a>	Shows utilization parameters for TCAM	PE
<a href="#">show memory</a>	Shows memory utilization parameters	PE
<a href="#">show process cpu</a>	Shows CPU utilization parameters	PE

**Table 11: System Status Commands** (Continued)

Command	Function	Mode
<code>show process cpu guard</code>	Shows the CPU utilization watermark and threshold	NE
<code>show process cpu task</code>	Shows CPU utilization per process	PE
<code>show running-config</code>	Displays the configuration data currently in use	PE
<code>show startup-config</code>	Displays the contents of the configuration file (stored in flash memory) that is used to start up the system	PE
<code>show system</code>	Displays system information	NE, PE
<code>show tech-support</code>	Displays a detailed list of system settings designed to help technical support resolve configuration or functional problems	PE
<code>show users</code>	Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet clients	NE, PE
<code>show version</code>	Displays version information for the system	NE, PE
<code>show watchdog</code>	Shows if watchdog debugging is enabled	PE
<code>watchdog software</code>	Monitors key processes, and automatically reboots the system if any of these processes are not responding correctly	PE

**show access-list tcam-utilization** This command shows utilization parameters for TCAM (Ternary Content Addressable Memory), including the number policy control entries in use, the number of free entries, and the overall percentage of TCAM in use.

**Command Mode**  
Privileged Exec

**Command Usage**  
Policy control entries (PCEs) are used by various system functions which rely on rule-based searches, including Access Control Lists (ACLs), IP Source Guard filter rules, Quality of Service (QoS) processes, or traps.

For example, when binding an ACL to a port, each rule in an ACL will use two PCEs; and when setting an IP Source Guard filter rule for a port, the system will also use two PCEs.

### Example

```
Console#show access-list tcam-utilization
Total Policy Control Entries : 3072
Free Policy Control Entries  : 3064
Entries Used by System       : 8
Entries Used by User         : 0
TCAM Utilization             : 0.26%
Console#
```



**show memory** This command shows memory utilization parameters, and alarm thresholds.

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

This command shows the amount of memory currently free for use, the amount of memory allocated to active processes, the total amount of system memory, and the alarm thresholds.

### Example

```
Console#show memory
Status Bytes      %
-----
Free    111706112  41
Used    156729344  59
Total   268435456

Alarm Configuration
Rising Threshold      : 90%
Falling Threshold     : 70%

Console#
```

### Related Commands

[memory \(215\)](#)

**show process cpu** This command shows the CPU utilization parameters, alarm status, and alarm thresholds.

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show process cpu
CPU Utilization in the past 5 seconds : 24%

CPU Utilization in the past 60 seconds
Average Utilization      : 24%
Maximum Utilization      : 25%

Alarm Status
Current Alarm Status     : Off
Last Alarm Start Time    : Dec 31 00:00:19 2000
Last Alarm Duration Time : 15 seconds

Alarm Configuration
Rising Threshold         : 90%
Falling Threshold        : 70%

Console#
```

## Related Commands

[process cpu \(215\)](#)

**show process cpu guard** This command shows the CPU utilization watermark and threshold settings.

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show process cpu guard
CPU Guard Configuration
  Status           : Disabled
  High Watermark   : 90%
  Low Watermark    : 70%
  Maximum Threshold : 500pps
  Minimum Threshold : 50pps
  Trap Status      : Disabled
CPU Guard Operation
  Current Threshold : 500pps
```

```
Console#
```

**Table 12: show process cpu guard - display description**

Field	Description
<i>CPU Guard Configuration</i>	
Status	Shows if CPU Guard has been enabled.
High Watermark	If the percentage of CPU usage time is higher than the high-watermark,the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until usage time falls below the low watermark.
Low Watermark	If packet flow has been stopped after exceeding the high watermark, normal flow will be restored after usage falls beneath the low watermark.
Maximum Threshold	If the number of packets being processed by the CPU is higher than the maximum threshold,the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until the number of packets being processed falls below the minimum threshold.
Minimum Threshold	If packet flow has been stopped after exceeding the maximum threshold, normal flow will be restored after usage falls beneath the minimum threshold.
Trap Status	Shows if an alarm message will be generated when utilization exceeds the high watermark or exceeds the maximum threshold.
<i>CPU Guard Operation</i>	
Current Threshold	Shows the configured threshold in packets per second.

## Related Commands

[process cpu guard \(216\)](#)

**show process cpu task** This command shows the CPU utilization per process.

**Command Mode**  
Privileged Exec

### Example

```
Console#show process cpu task
Task                Util (%) Avg (%) Max (%)
-----
AMTRL3_GROUP        0.00    0.00    0.00
APP_PROTOCOL_GR      0.00    0.00    0.00
AUTH_PROC           0.00    0.00    0.00
BGP_TD              0.00    0.00    0.00
CFGDB_TD            0.00    0.00    0.00
CFM_GROUP           0.00    0.00    0.00
CLI_GROUP           0.00    0.00    0.00
CLITASK0            0.00    0.00    0.00
CORE_UTIL_PROC      0.00    0.00    0.00
DHCPSPNP_GROUP      0.00    0.00    0.00
DOT1X_SUP_GROUP     2.00    1.66    3.00
DRIVER_GROUP        1.00    0.50    1.00
DRIVER_GROUP_DI     0.00    0.00    0.00
DRIVER_GROUP_FR     0.00    0.00    0.00
DRIVER_GROUP_TX     0.00    0.00    0.00
FS                  0.00    0.00    0.00
GVRP_GROUP          0.00    0.00    0.00
HTTP_TD            0.00    0.00    0.00
IP_SERVICE_GROU     0.00    0.00    0.00
IPAL_TASK           0.00    0.00    0.00
L2_L4_PROCESS       3.00    2.83    5.00
L2MCAST_GROUP       0.00    0.00    0.00
L2MUX_GROUP         0.00    0.00    0.00
L4_GROUP            0.00    0.00    0.00
LACP_GROUP          0.00    0.00    0.00
NETACCESS_GROUP     0.00    0.00    0.00
NETACCESS_NMTR      0.00    0.33    2.00
NETCFG_GROUP        0.00    0.00    0.00
NETCFG_PROC         0.00    0.00    0.00
NIC                 0.00    0.00    0.00
NMTRDRV            0.00    0.75    2.00
NSM_GROUP           0.00    0.00    0.00
NSM_TD             0.00    0.00    0.00
OAM_GROUP           0.00    0.00    0.00
OAM_TXLBK_TD        0.00    0.00    0.00
OSPF6_PROC          0.00    0.00    0.00
OSPF6_TD            0.00    0.00    0.00
OSPF_GROUP          0.00    0.00    0.00
OSPF_PROC           0.00    0.00    0.00
OSPF_TD            0.00    0.00    0.00
PIM6_SM_TD          0.00    0.00    0.00
PIM_GROUP           0.00    0.00    0.00
PIM_PROC            0.00    0.00    0.00
PIM_SM_TD           0.00    0.00    0.00
```

Console#

**show running-config** This command displays the configuration information currently in use.

### Syntax

**show running-config** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-26)

**vlan** *vlan-id* (Range: 1-4094)

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use the **interface** keyword to display configuration data for the specified interface.
- ◆ Use this command in conjunction with the **show startup-config** command to compare the information in running memory to the information stored in non-volatile memory.
- ◆ This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:
  - MAC address for each switch in the stack
  - SNMP community strings
  - Users (names, access levels, and encrypted passwords)
  - VLAN database (VLAN ID, name and state)
  - VLAN configuration settings for each interface
  - Multiple spanning tree instances (name and interfaces)
  - IP address configured for VLANs
  - Spanning tree settings
  - Interface settings
  - Any configured settings for the console port and Telnet
- ◆ For security reasons, user passwords are only displayed in encrypted format.

### Example

```
Console#show running-config
Building running configuration. Please wait...
!<stackingDB>0000000000000000</stackingDB>
!<stackingMac>01_70-72-cf-83-34-66_03</stackingMac>
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
```

```
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
!<stackingMac>00_00-00-00-00-00-00_00</stackingMac>
!
!---<InitPhaseConfig>
!---</InitPhaseConfig>
!
snmp-server community public ro
snmp-server community private rw
!
snmp-server enable traps authentication
!
username admin access-level 15
username admin password 7 21232f297a57a5a743894a0e4a801fc3
username guest access-level 0
username guest password 7 084e0343a0486ff05530df6c705c8bb4
enable password 7 1b3231655cebb7a1f783eddf27d254ca
!
vlan database
VLAN 1 name DefaultVlan media ethernet state active
!
spanning-tree mst configuration
!
interface ethernet 1/1
...
interface ethernet 1/52
no negotiation
!
interface vlan 1
ip address dhcp
!
interface vlan 1
!
line console
!
line vty
!
end
!
Console#
```

## Related Commands

[show startup-config \(125\)](#)

**show startup-config** This command displays the configuration file stored in non-volatile memory that is used to start up the system.

## Command Mode

Privileged Exec

## Command Usage

- ◆ Use this command in conjunction with the **show running-config** command to compare the information in running memory to the information stored in non-volatile memory.

- ◆ This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:
  - MAC address for each switch in the stack
  - SNMP community strings
  - SNMP trap authentication
  - Users (names and access levels)
  - VLAN database (VLAN ID, name and state)
  - Multiple spanning tree instances (name and interfaces)
  - Interface settings and VLAN configuration settings for each interface
  - IP address for VLANs
  - Any configured settings for the console port and Telnet

### Example

Refer to the example for the running configuration file.

### Related Commands

[show running-config \(124\)](#)

**show system** This command displays system information.

### Default Setting

None

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show system
System Description : GTL-2891
System OID String : 1.3.6.1.4.1.259.10.1.41.104
System Information
System Up Time      : 0 days, 0 hours, 15 minutes, and 38.27 seconds
System Name         :
System Location     :
System Contact      :
MAC Address (Unit 1) : 70-72-CF-83-34-66
Web Server          : Enabled
Web Server Port     : 80
Web Secure Server   : Enabled
Web Secure Server Port : 443
Telnet Server       : Enabled
Telnet Server Port  : 23
Jumbo Frame         : Disabled

System Temperature:
Unit 1
Temperature 1: 42 degrees

Main Power Status   : Up
```

```
Redundant Power Status : Not present
Console#
```

**Table 13: show system – display description**

Parameter	Description
System Description	Brief description of device type.
System OID String	MIB II object ID for switch's network management subsystem.
System Up Time	Length of time the management agent has been up.
System Name	Name assigned to the switch system.
System Location	Specifies the system location.
System Contact	Administrator responsible for the system.
MAC Address	MAC address assigned to this switch.
Web Server/Port	Shows administrative status of web server and UDP port number.
Web Secure Server/Port	Shows administrative status of secure web server and UDP port number.
Telnet Server/Port	Shows administrative status of Telnet server and TCP port number.
Jumbo Frame	Shows if jumbo frames are enabled or disabled.
System Temperature	Temperature at specified thermal detection point.
Main Power Status	Displays the status of the internal power supply.
Redundant Power Status	Displays the status of the redundant power supply.

**show tech-support** This command displays a detailed list of system settings designed to help technical support resolve configuration or functional problems.

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

This command generates a long list of information including detailed system and interface settings. It is therefore advisable to direct the output to a file using any suitable output capture function provided with your terminal emulation program.

### Example

```
Console#show tech-support
```

```
dir:
      File Name                               Type  Startup Modify Time          Size(bytes)
-----
Unit 1:
Level1-L3_V1.5.2.15.bix                      OpCode   Y    2000-12-31 05:52:04        15557428
Factory_Default_Config.cfg                   Config   N    2000-12-31 00:00:32           455
startup1.cfg                                 Config   Y    2000-01-01 02:31:23         2924
-----
Free space for compressed user config files: 65220608
```

```
show apr:
ARP Cache Timeout: 1200 (seconds)
```

IP Address	MAC Address	Type	Interface
192.168.0.2	70-72-CF-83-34-66	other	VLAN1
192.168.0.99	00-60-6E-00-5F-A1	dynamic	VLAN1

```
Total entry : 2
```

```
show interfaces brief:
```

Interface Name	Status	PVID	Pri	Speed/Duplex	Type	Trunk
Eth 1/ 1	Up	1	0	Auto-100full	1000BASE-T	None
Eth 1/ 2	Down	1	0	Auto	1000BASE-T	None
Eth 1/ 3	Down	1	0	Auto	1000BASE-T	None
Eth 1/ 4	Down	1	0	Auto	1000BASE-T	None
Eth 1/ 5	Down	1	0	Auto	1000BASE-T	None
:						

**show users** Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet client.

### Default Setting

None

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

The session used to execute this command is indicated by a "\*" symbol next to the Line (i.e., session) index number.

### Example

```
Console#show users
User Name Accounts:
  User Name                               Privilege Public-Key
  -----
  admin                                   15 None
  guest                                  0 None
  steve                                  15 None

Online Users:
  Line   User Name                               Idle time (h:m:s) Remote IP addr
  -----
*console admin                               0:00:00
VTY 0   admin                               0:00:10 192.168.0.99
SSH 1   steve                               0:00:06 192.168.1.19

Web Online Users:
  Line   User Name                               Idle time (h:m:s) Remote IP Addr
  -----
  HTTP   admin                               0:00:01 192.168.0.99
Console#
```



**show version** This command displays hardware and software version information for the system.

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show version
Unit 1
Serial Number       : EC0000000000
Hardware Version    : R01
EPLD Version        : R00 V0.09
Number of Ports     : 28
Main Power Status   : Up
Redundant Power Status : Not present
Role                : Master
Loader Version      : 0.0.1.3
Linux Kernel Version : 2.6.22.18
Boot ROM Version    : 0.0.0.1
Operation Code Version : 1.2.2.19a
```

```
Console#
```

**Table 14: show version – display description**

Parameter	Description
Serial Number	The serial number of the switch.
Hardware Version	Hardware version of the main board.
EPLD Version	Version number of Erasable Programmable Logic Device.
Number of Ports	Number of built-in ports.
Main Power Status	Displays the status of the internal power supply.
Redundant Power Status	Displays the status of the redundant power supply.
Role	Shows that this switch is operating as Master or Slave.
Loader Version	Version number of loader code.
Linux Kernel Version	Version number of Linux kernel.
Boot ROM Version	Version of Power-On Self-Test (POST) and boot code.
Operation Code Version	Version number of runtime code.

**show watchdog** This command shows if watchdog debugging is enabled.

#### Command Mode

Privileged Exec

#### Example

```
Console#show watchdog

Software Watchdog Information
Status :    Enabled
Console#
```

**watchdog software** This command monitors key processes, and automatically reboots the system if any of these processes are not responding correctly.

#### Syntax

**watchdog software {disable | enable}**

#### Default Setting

Disabled

#### Command Mode

Privileged Exec

#### Example

```
Console#watchdog
Console#
```

---

## Fan Control

This section describes the command used to force fan speed.

**Table 15: Fan Control Commands**

Command	Function	Mode
<b>fan-speed force-full</b>	Forces fans to full speed	GC

**fan-speed force-full** This command sets all fans to full speed. Use the no form to reset the fans to normal operating speed.

#### Syntax

**[no] fan-speed force-full**

**Default Setting**

Normal speed

**Command Mode**

Global Configuration

**Example**

```
Console(config)#fan-speed force-full
Console(config)#
```

## Frame Size

This section describes commands used to configure the Ethernet frame size on the switch.

**Table 16: Frame Size Commands**

Command	Function	Mode
<a href="#">jumbo frame</a>	Enables support for jumbo frames	GC

**jumbo frame** This command enables support for layer 2 jumbo frames for Gigabit and 10 Gigabit Ethernet ports. Use the **no** form to disable it.

**Syntax**

**[no] jumbo frame**

**Default Setting**

Disabled

**Command Mode**

Global Configuration

**Command Usage**

- ◆ This switch provides more efficient throughput for large sequential data transfers by supporting layer 2 jumbo frames on Gigabit and 10 Gigabit Ethernet ports or trunks up to 10240 bytes. Compared to standard Ethernet frames that run only up to 1.5 KB, using jumbo frames significantly reduces the per-packet overhead required to process protocol encapsulation fields.
- ◆ To use jumbo frames, both the source and destination end nodes (such as a computer or server) must support this feature. Also, when the connection is operating at full duplex, all switches in the network between the two end nodes must be able to accept the extended frame size. And for half-duplex connections, all devices in the collision domain would need to support jumbo frames.

- ◆ The current setting for jumbo frames can be displayed with the [show system](#) command.

### Example

```
Console(config)#jumbo frame
Console(config)#
```

### Related Commands

[show system \(126\)](#)

[show ipv6 mtu \(912\)](#)

---

## File Management

### Managing Firmware

Firmware can be uploaded and downloaded to or from an FTP/TFTP server. By saving runtime code to a file on an FTP/TFTP server, that file can later be downloaded to the switch to restore operation. The switch can also be set to use new firmware without overwriting the previous version.

When downloading runtime code, the destination file name can be specified to replace the current image, or the file can be first downloaded using a different name from the current runtime code file, and then the new file set as the startup file.

### Saving or Restoring Configuration Settings

Configuration settings can be uploaded and downloaded to and from an FTP/TFTP server. The configuration file can be later downloaded to restore switch settings.

The configuration file can be downloaded under a new file name and then set as the startup file, or the current startup configuration file can be specified as the destination file to directly replace it. Note that the file "Factory\_Default\_Config.cfg" can be copied to the FTP/TFTP server, but cannot be used as the destination on the switch.

**Table 17: Flash/File Commands**

Command	Function	Mode
<i>General Commands</i>		
<a href="#">boot system</a>	Specifies the file or image used to start up the system	GC
<a href="#">copy</a>	Copies a code image or a switch configuration to or from flash memory or an FTP/TFTP server	PE
<a href="#">delete</a>	Deletes a file or code image	PE
<a href="#">dir</a>	Displays a list of files in flash memory	PE

Table 17: Flash/File Commands (Continued)

Command	Function	Mode
<code>whichboot</code>	Displays the files booted	PE
<i>Automatic Code Upgrade Commands</i>		
<code>upgrade opcode auto</code>	Automatically upgrades the current image when a new version is detected on the indicated server	GC
<code>upgrade opcode path</code>	Specifies an FTP/TFTP server and directory in which the new opcode is stored	GC
<code>upgrade opcode reload</code>	Reloads the switch automatically after the opcode upgrade is completed	GC
<code>show upgrade</code>	Shows the opcode upgrade configuration settings.	PE
<i>TFTP Configuration Commands</i>		
<code>ip tftp retry</code>	Specifies the number of times the switch can retry transmitting a request to a TFTP server	GC
<code>ip tftp timeout</code>	Specifies the time the switch can wait for a response from a TFTP server before retransmitting a request or timing out for the last retry	GC
<code>show ip tftp</code>	Displays information about TFTP settings	PE

## General Commands

**boot system** This command specifies the file or image used to start up the system.

### Syntax

**boot system** [*unit*:] {**boot-rom** | **config** | **opcode**}: *filename*

*unit*\* - Unit identifier. (Range: 1-8)

**boot-rom**\* - Boot ROM.

**config**\* - Configuration file.

**opcode**\* - Run-time operation code.

*filename* - Name of configuration file or code image.

\* The colon (:) is required.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ A colon (:) is required after the specified unit number and file type.
- ◆ If the file contains an error, it cannot be set as the default file.

### Example

```
Console(config)#boot system config: startup
Console(config)#
```

### Related Commands

[dir \(138\)](#)

[whichboot \(139\)](#)

**copy** This command moves (upload/download) a code image or configuration file between the switch's flash memory and an FTP/TFTP server. When you save the system code or configuration settings to a file on an FTP/TFTP server, that file can later be downloaded to the switch to restore system operation. The success of the file transfer depends on the accessibility of the FTP/TFTP server and the quality of the network connection.

### Syntax

**copy file {file | ftp | running-config | startup-config | tftp | unit}**

**copy ftp {add-to-running-config | file | https-certificate | public-key | running-config | startup-config}**

**copy file unit**

**copy running-config {file | ftp | startup-config | tftp}**

**copy startup-config {file | ftp | running-config | tftp}**

**copy tftp {add-to-running-config | file | https-certificate | public-key | running-config | startup-config}**

**copy unit file**

**copy usbdisk file**

**add-to-running-config** - Keyword that adds the settings listed in the specified file to the running configuration.

**file** - Keyword that allows you to copy to/from a file.

**ftp** - Keyword that allows you to copy to/from an FTP server.

**https-certificate** - Keyword that allows you to copy the HTTPS secure site certificate.

**public-key** - Keyword that allows you to copy a SSH key from a TFTP server. (See "Secure Shell" on page 263.)

**running-config** - Keyword that allows you to copy to/from the current running configuration.

**startup-config** - The configuration used for system initialization.

**tftp** - Keyword that allows you to copy to/from a TFTP server.

**unit** - Keyword that allows you to copy to/from a specific unit in the stack.

**usbdisk** - Keyword that allows you to copy to/from a USB memory stick. (USB slot only supports simple data storage devices using a FAT16/32 file system with or without a partition table.)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ The system prompts for data required to complete the copy command.
- ◆ The destination file name should not contain slashes (\ or /), and the maximum length for file names is 32 characters for files on the switch or 127 characters for files on the server. (Valid characters: A-Z, a-z, 0-9, "", "-")
- ◆ The switch supports only two operation code files, but the maximum number of user-defined configuration files is 16.
- ◆ You can use "Factory\_Default\_Config.cfg" as the source to copy from the factory default configuration file, but you cannot use it as the destination.
- ◆ To replace the startup configuration, you must use **startup-config** as the destination.
- ◆ Use the **copy file** unit command to copy a local file to another switch in the stack. Use the **copy unit file** command to copy a file from another switch in the stack.
- ◆ The Boot ROM and Loader cannot be uploaded or downloaded from the FTP/TFTP server. You must follow the instructions in the release notes for new firmware, or contact your distributor for help.
- ◆ For information on specifying an https-certificate, see "Replacing the Default Secure-site Certificate" in the *User Manual*. For information on configuring the switch to use HTTPS for a secure connection, see the [ip http secure-server](#) command.
- ◆ When logging into an FTP server, the interface prompts for a user name and password configured on the remote server. Note that "anonymous" is set as the default user name.
- ◆ The reload command will not be accepted during copy operations to flash memory.

### Example

The following example shows how to download new firmware from a TFTP server:

```
Console#copy tftp file
TFTP server ip address: 10.1.0.19
Choose file type:
  1. config:  2. opcode: 2
Source file name: m360.bix
Destination file name: m360.bix
\Write to FLASH Programming.
-Write to FLASH finish.
Success.
Console#
```

The following example shows how to upload the configuration settings to a file on the TFTP server:

```
Console#copy file tftp
Choose file type:
  1. config:  2. opcode: 1
Source file name: startup
TFTP server ip address: 10.1.0.99
Destination file name: startup.01
TFTP completed.
Success.

Console#
```

The following example shows how to copy the running configuration to a startup file.

```
Console#copy running-config file
destination file name: startup
Write to FLASH Programming.
\Write to FLASH finish.
Success.

Console#
```

The following example shows how to download a configuration file:

```
Console#copy tftp startup-config
TFTP server ip address: 10.1.0.99
Source configuration file name: startup.01
Startup configuration file name [startup]:
Write to FLASH Programming.

\Write to FLASH finish.
Success.

Console#
```



This example shows how to copy a secure-site certificate from an TFTP server. It then reboots the switch to activate the certificate:

```
Console#copy tftp https-certificate
TFTP server ip address: 10.1.0.19
Source certificate file name: SS-certificate
Source private file name: SS-private
Private password: *****

Success.
Console#reload
System will be restarted, continue <y/n>? y
```

This example shows how to copy a public-key used by SSH from an TFTP server. Note that public key authentication via SSH is only supported for users configured locally on the switch.

```
Console#copy tftp public-key
TFTP server IP address: 192.168.1.19
Choose public key type:
  1. RSA:  2. DSA: <1-2>: 1
Source file name: steve.pub
Username: steve
TFTP Download
Success.
Write to FLASH Programming.
Success.

Console#
```

This example shows how to copy a file to an FTP server.

```
Console#copy ftp file
FTP server IP address: 169.254.1.11
User[anonymous]: admin
Password[]: *****
Choose file type:
  1. config:  2. opcode: 2
Source file name: BLANC.BIX
Destination file name: BLANC.BIX
Console#
```

**delete** This command deletes a file or image.

### Syntax

**delete** {file name [*unit*:] filename | public-key username [*dsa* | *rsa*]}

**file** - Keyword that allows you to delete a file.

**name** - Keyword indicating a file.

*unit* - Unit identifier. (Range: 1-8)

*filename* - Name of configuration file or code image.

**public-key** - Keyword that allows you to delete a SSH key on the switch.  
(See “Secure Shell” on page 263.)

*username* – Name of an SSH user. (Range: 1-8 characters)

**dsa** – DSA public key type.

**rsa** – RSA public key type.

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ If the file type is used for system startup, then this file cannot be deleted.
- ◆ “Factory\_Default\_Config.cfg” cannot be deleted.
- ◆ A colon (:) is required after the specified unit number.
- ◆ If the public key type is not specified, then both DSA and RSA keys will be deleted.

### Example

This example shows how to delete the test2.cfg configuration file from flash memory.

```
Console#delete test2.cfg
Console#
```

### Related Commands

[dir \(138\)](#)

[delete public-key \(268\)](#)

**dir** This command displays a list of files in flash memory.

### Syntax

**dir** [*unit*:] {**boot-rom** | **config** | **opcode**}: [*filename*]

*unit* - Unit identifier. (Range: 1-8)

**boot-rom** - Boot ROM (or diagnostic) image file.

**config** - Switch configuration file.

**opcode** - Run-time operation code image file.

*filename* - Name of configuration file or code image. If this file exists but contains errors, information on this file cannot be shown.

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ If you enter the command **dir** without any parameters, the system displays all files.
- ◆ A colon (:) is required after the specified unit number.

File information is shown below:

**Table 18: File Directory Information**

Column Heading	Description
File Name	The name of the file.
File Type	File types: Boot-Rom, Operation Code, and Config file.
Startup	Shows if this file is used when the system is started.
Modify Time	The date and time the file was last modified.
Size	The length of the file in bytes.

### Example

The following example shows how to display all file information:

Console#dir					
File Name	Type	Startup	Modified Time	Size (bytes)	
-----					
Unit 1:					
Level1-L3_V1.2.2.19a.bix	OpCode	N	2000-12-31 01:51:59	18216876	
Level1-L3_V1.5.2.15.bix	OpCode	Y	2000-12-31 05:52:04	15557428	
Factory_Default_Config.cfg	Config	N	2000-12-31 06:24:43	476	
startup1.cfg	Config	Y	2000-12-31 01:46:29	2087	
-----					
Free space for compressed user config files:				49602560	
				Total space:	
				128 MB	
Console#					

**whichboot** This command displays which files were booted when the system powered up.

### Syntax

**whichboot** [unit]

*unit* - Unit identifier. (Range: 1-8)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

This example shows the information displayed by the **whichboot** command. See the table under the **dir** command for a description of the file information displayed by this command.

Console#whichboot				
File Name	Type	Startup	Modified Time	Size (bytes)
-----				
Unit 1:				
Level1-L3_V1.5.2.15.bix	OpCode	Y	2000-12-31 05:52:04	15557428
startup1.cfg	Config	Y	2000-12-31 00:38:59	2054
Console#				

## Automatic Code Upgrade Commands

**upgrade opcode auto** This command automatically upgrades the current operational code when a new version is detected on the server indicated by the [upgrade opcode path](#) command. Use the **no** form of this command to restore the default setting.

### Syntax

**[no] upgrade opcode auto**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ This command is used to enable or disable automatic upgrade of the operational code. When the switch starts up and automatic image upgrade is enabled by this command, the switch will follow these steps when it boots up:
  1. It will search for a new version of the image at the location specified by [upgrade opcode path](#) command. The name for the new image stored on the TFTP server must be Level1-L3.bix. If the switch detects a code version newer than the one currently in use, it will download the new image. If two code images are already stored in the switch, the image not set to start up the system will be overwritten by the new version.
  2. After the image has been downloaded, the switch will send a trap message to log whether or not the upgrade operation was successful.

3. It sets the new version as the startup image.
  4. It then restarts the system to start using the new image.
- ◆ Any changes made to the default setting can be displayed with the [show running-config](#) or [show startup-config](#) commands.

### Example

```
Console(config)#upgrade opcode auto
Console(config)#upgrade opcode path tftp://192.168.0.1/sm24/
Console(config)#
```

If a new image is found at the specified location, the following type of messages will be displayed during bootup.

```
:
Automatic Upgrade is looking for a new image
New image detected: current version 1.1.1.0; new version 1.1.1.2
Image upgrade in progress
The switch will restart after upgrade succeeds
Downloading new image
Flash programming started
Flash programming completed
The switch will now restart
:
```

**upgrade opcode path** This command specifies an TFTP server and directory in which the new opcode is stored. Use the **no** form of this command to clear the current setting.

### Syntax

**upgrade opcode path** *opcode-dir-url*

**no upgrade opcode path**

*opcode-dir-url* - The location of the new code.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ This command is used in conjunction with the [upgrade opcode auto](#) command to facilitate automatic upgrade of new operational code stored at the location indicated by this command.

- ◆ The name for the new image stored on the TFTP server must be Level1-L3.bix. However, note that file name is not to be included in this command.
- ◆ When specifying a TFTP server, the following syntax must be used, where *filedir* indicates the path to the directory containing the new image:

```
tftp://192.168.0.1[/filedir]/
```

- ◆ When specifying an FTP server, the following syntax must be used, where *filedir* indicates the path to the directory containing the new image:

```
ftp://[username[:password@]]192.168.0.1[/filedir]/
```

If the user name is omitted, “anonymous” will be used for the connection. If the password is omitted a null string (“”) will be used for the connection.

### Example

This shows how to specify a TFTP server where new code is stored.

```
Console(config)#upgrade opcode path tftp://192.168.0.1/sm24/  
Console(config)#
```

This shows how to specify an FTP server where new code is stored.

```
Console(config)#upgrade opcode path ftp://admin:billy@192.168.0.1/sm24/  
Console(config)#
```

**upgrade opcode reload** This command reloads the switch automatically after the opcode upgrade is completed. Use the **no** form to disable this feature.

### Syntax

**[no] upgrade opcode reload**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Example

This shows how to specify a TFTP server where new code is stored.

```
Console(config)#upgrade opcode reload  
Console(config)#
```

**show upgrade** This command shows the opcode upgrade configuration settings.

#### Command Mode

Privileged Exec

#### Example

```
Console#show upgrade
Auto Image Upgrade Global Settings:
  Status      : Disabled
  Reload Status : Disabled
  Path        :
  File Name   : Level1-L3.bix
Console#
```

### TFTP Configuration Commands

**ip tftp retry** This command specifies the number of times the switch can retry transmitting a request to a TFTP server after waiting for the configured timeout period and receiving no response. Use the **no** form to restore the default setting.

#### Syntax

**ip tftp retry** *retries*

**no ip tftp retry**

*retries* - The number of times the switch can resend a request to a TFTP server before it aborts the connection. (Range: 1-16)

#### Default Setting

15

#### Command Mode

Global Configuration

#### Example

```
Console(config)#ip tftp retry 10
Console(config)#
```

**ip tftp timeout** This command specifies the time the switch can wait for a response from a TFTP server before retransmitting a request or timing out for the last retry. Use the **no** form to restore the default setting.

#### Syntax

**ip tftp timeout** *seconds*

**no ip tftp timeout**

*seconds* - The the time the switch can wait for a response from a TFTP server before retransmitting a request or timing out. (Range: 1-65535 seconds)

#### Default Setting

5 seconds

#### Command Mode

Global Configuration

#### Example

```
Console(config)#ip tftp timeout 10
Console(config)#
```

**show ip tftp** This command displays information about the TFTP settings configured on this switch.

#### Syntax

**show ip tftp**

#### Command Mode

Privileged Exec

#### Example

```
Console#show ip tftp
TFTP Settings:
  Retries : 15
  Timeout : 5 seconds
Console#
```



## Line

You can access the onboard configuration program by attaching a VT100 compatible device to the server's serial port. These commands are used to set communication parameters for the serial port or Telnet (i.e., a virtual terminal).

**Table 19: Line Commands**

Command	Function	Mode
<code>line</code>	Identifies a specific line for configuration and starts the line configuration mode	GC
<code>accounting commands</code>	Applies an accounting method to commands entered at specific CLI privilege levels	LC
<code>accounting exec</code>	Applies an accounting method to local console, Telnet or SSH connections	LC
<code>authorization exec</code>	Applies an authorization method to local console, Telnet or SSH connections	LC
<code>databits</code> *	Sets the number of data bits per character that are interpreted and generated by hardware	LC
<code>exec-timeout</code>	Sets the interval that the command interpreter waits until user input is detected	LC
<code>login</code>	Enables password checking at login	LC
<code>parity</code> *	Defines the generation of a parity bit	LC
<code>password</code>	Specifies a password on a line	LC
<code>password-thresh</code>	Sets the password intrusion threshold, which limits the number of failed logon attempts	LC
<code>silent-time</code> *	Sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the <code>password-thresh</code> command	LC
<code>speed</code> *	Sets the terminal baud rate	LC
<code>stopbits</code> *	Sets the number of the stop bits transmitted per byte	LC
<code>timeout login response</code>	Sets the interval that the system waits for a login attempt	LC
<code>disconnect</code>	Terminates a line connection	PE
<code>terminal</code>	Configures terminal settings, including escape-character, line length, terminal type, and width	PE
<code>show line</code>	Displays a terminal line's parameters	NE, PE

\* These commands only apply to the serial port.

**line** This command identifies a specific line for configuration, and to process subsequent line configuration commands.

#### Syntax

**line** {console | vty}

**console** - Console terminal line.

**vtty** - Virtual terminal for remote console access (i.e., Telnet).

#### Default Setting

There is no default line.

#### Command Mode

Global Configuration

#### Command Usage

Telnet is considered a virtual terminal connection and will be shown as “VTY” in screen displays such as [show users](#). However, the serial communication parameters (e.g., databits) do not affect Telnet connections.

#### Example

To enter console line mode, enter the following command:

```
Console(config)#line console
Console(config-line)#
```

#### Related Commands

[show line \(155\)](#)

[show users \(128\)](#)

**databits** This command sets the number of data bits per character that are interpreted and generated by the console port. Use the **no** form to restore the default value.

#### Syntax

**databits** {7 | 8}

**no databits**

7 - Seven data bits per character.

8 - Eight data bits per character.

#### Default Setting

8 data bits per character

#### Command Mode

Line Configuration

### Command Usage

The **databits** command can be used to mask the high bit on input from devices that generate 7 data bits with parity. If parity is being generated, specify 7 data bits per character. If no parity is required, specify 8 data bits per character.

### Example

To specify 7 data bits, enter this command:

```
Console(config-line-console)#databits 7
Console(config-line-console)#
```

### Related Commands

[parity \(149\)](#)

**exec-timeout** This command sets the interval that the system waits until user input is detected. Use the **no** form to restore the default.

### Syntax

**exec-timeout** [*seconds*]

**no exec-timeout**

*seconds* - Integer that specifies the timeout interval.  
(Range: 60 - 65535 seconds; 0: no timeout)

### Default Setting

10 minutes

### Command Mode

Line Configuration

### Command Usage

- ◆ If user input is detected within the timeout interval, the session is kept open; otherwise the session is terminated.
- ◆ This command applies to both the local console and Telnet connections.
- ◆ The timeout for Telnet cannot be disabled.
- ◆ Using the command without specifying a timeout restores the default setting.

### Example

To set the timeout to two minutes, enter this command:

```
Console(config-line-console)#exec-timeout 120
Console(config-line-console)#
```

**login** This command enables password checking at login. Use the **no** form to disable password checking and allow connections without a password.

### Syntax

**login** [**local**]

**no login**

**local** - Selects local password checking. Authentication is based on the user name specified with the [username](#) command.

### Default Setting

login local

### Command Mode

Line Configuration

### Command Usage

- ◆ There are three authentication modes provided by the switch itself at login:
  - **login** selects authentication by a single global password as specified by the [password](#) line configuration command. When using this method, the management interface starts in Normal Exec (NE) mode.
  - **login local** selects authentication via the user name and password specified by the [username](#) command (i.e., default setting). When using this method, the management interface starts in Normal Exec (NE) or Privileged Exec (PE) mode, depending on the user's privilege level (0 or 15 respectively).
  - **no login** selects no authentication. When using this method, the management interface starts in Normal Exec (NE) mode.
- ◆ This command controls login authentication via the switch itself. To configure user names and passwords for remote authentication servers, you must use the RADIUS or TACACS software installed on those servers.

### Example

```
Console(config-line-console)#login local
Console(config-line-console)#
```

### Related Commands

[username \(235\)](#)

[password \(149\)](#)

**parity** This command defines the generation of a parity bit. Use the **no** form to restore the default setting.

#### Syntax

**parity** {**none** | **even** | **odd**}

**no parity**

**none** - No parity

**even** - Even parity

**odd** - Odd parity

#### Default Setting

No parity

#### Command Mode

Line Configuration

#### Command Usage

Communication protocols provided by devices such as terminals and modems often require a specific parity bit setting.

#### Example

To specify no parity, enter this command:

```
Console(config-line-console)#parity none
Console(config-line-console)#
```

**password** This command specifies the password for a line. Use the **no** form to remove the password.

#### Syntax

**password** {**0** | **7**} *password*

**no password**

{**0** | **7**} - 0 means plain password, 7 means encrypted password

*password* - Character string that specifies the line password.

(Maximum length: 32 characters plain text or encrypted, case sensitive)

#### Default Setting

No password is specified.

#### Command Mode

Line Configuration

### Command Usage

- ◆ When a connection is started on a line with password protection, the system prompts for the password. If you enter the correct password, the system shows a prompt. You can use the [password-thresh](#) command to set the number of times a user can enter an incorrect password before the system terminates the line connection and returns the terminal to the idle state.
- ◆ The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from an FTP/SFTP server. There is no need for you to manually configure encrypted passwords.

### Example

```
Console(config-line-console)#password 0 secret
Console(config-line-console)#
```

### Related Commands

[login \(148\)](#)

[password-thresh \(150\)](#)

**password-thresh** This command sets the password intrusion threshold which limits the number of failed logon attempts. Use the **no** form to remove the threshold value.

### Syntax

**password-thresh** [*threshold*]

**no password-thresh**

*threshold* - The number of allowed password attempts. (Range: 1-120; 0: no threshold)

### Default Setting

The default value is three attempts.

### Command Mode

Line Configuration

### Command Usage

When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time before allowing the next logon attempt. (Use the [silent-time](#) command to set this interval.) When this threshold is reached for Telnet, the Telnet logon interface shuts down.

### Example

To set the password threshold to five attempts, enter this command:

```
Console(config-line-console)#password-thresh 5
Console(config-line-console)#
```

### Related Commands

[silent-time \(151\)](#)

**silent-time** This command sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the [password-thresh](#) command. Use the **no** form to remove the silent time value.

### Syntax

**silent-time** [*seconds*]

**no silent-time**

*seconds* - The number of seconds to disable console response.  
(Range: 0-65535; where 0 means disabled)

### Default Setting

Disabled

### Command Mode

Line Configuration

### Example

To set the silent time to 60 seconds, enter this command:

```
Console(config-line-console)#silent-time 60
Console(config-line-console)#
```

### Related Commands

[password-thresh \(150\)](#)

**speed** This command sets the terminal line's baud rate. This command sets both the transmit (to terminal) and receive (from terminal) speeds. Use the **no** form to restore the default setting.

### Syntax

**speed** *bps*

**no speed**

*bps* - Baud rate in bits per second.

(Options: 9600, 19200, 38400, 57600, 115200 bps)

### Default Setting

115200 bps

### Command Mode

Line Configuration

### Command Usage

Set the speed to match the baud rate of the device connected to the serial port. Some baud rates available on devices connected to the port might not be supported. The system indicates if the speed you selected is not supported.

### Example

To specify 57600 bps, enter this command:

```
Console(config-line-console)#speed 57600
Console(config-line-console)#
```

**stopbits** This command sets the number of the stop bits transmitted per byte. Use the **no** form to restore the default setting.

### Syntax

**stopbits** {1 | 2}

**no stopbits**

1 - One stop bit

2 - Two stop bits

### Default Setting

1 stop bit

### Command Mode

Line Configuration



### Example

To specify 2 stop bits, enter this command:

```
Console(config-line-console)#stopbits 2
Console(config-line-console)#
```

**timeout login response** This command sets the interval that the system waits for a user to log into the CLI. Use the **no** form to restore the default setting.

### Syntax

**timeout login response** [*seconds*]

**no timeout login response**

*seconds* - Integer that specifies the timeout interval.  
(Range: 10 - 300 seconds)

### Default Setting

300 seconds

### Command Mode

Line Configuration

### Command Usage

- ◆ If a login attempt is not detected within the timeout interval, the connection is terminated for the session.
- ◆ This command applies to both the local console and Telnet connections.
- ◆ The timeout for Telnet cannot be disabled.
- ◆ Using the command without specifying a timeout restores the default setting.

### Example

To set the timeout to two minutes, enter this command:

```
Console(config-line)#timeout login response 120
Console(config-line)#
```

**disconnect** This command terminates an SSH, Telnet, or console connection.

### Syntax

**disconnect** *session-id*

*session-id* – The session identifier for an SSH, Telnet or console connection.  
(Range: 0-8)

## Command Mode

Privileged Exec

## Command Usage

Specifying session identifier "0" will disconnect the console connection. Specifying any other identifiers for an active session will disconnect an SSH or Telnet connection.

## Example

```
Console#disconnect 1
Console#
```

## Related Commands

[show ssh \(272\)](#)

[show users \(128\)](#)

**terminal** This command configures terminal settings, including escape-character, lines displayed, terminal type, width, and command history. Use the **no** form with the appropriate keyword to restore the default setting.

## Syntax

**terminal** {**escape-character** {**ASCII-number** | *character*} | **history** [**size** *size*] | **length** *length* | **terminal-type** {**ansi-bbs** | **vt-100** | **vt-102**} | **width** *width*}

**escape-character** - The keyboard character used to escape from current line input.

**ASCII-number** - ASCII decimal equivalent. (Range: 0-255)

*character* - Any valid keyboard character.

**history** - The number of lines stored in the command buffer, and recalled using the arrow keys. (Range: 0-256)

**length** - The number of lines displayed on the screen. (Range: 24-200, where 0 means not to pause)

**terminal-type** - The type of terminal emulation used.

**ansi-bbs** - ANSI-BBS

**vt-100** - VT-100

**vt-102** - VT-102

**width** - The number of character columns displayed on the terminal. (Range: 0-80)

## Default Setting

Escape Character: 27 (ASCII-number)

History: 10

Length: 24

Terminal Type: VT100  
Width: 80

### Command Mode

Privileged Exec

### Example

This example sets the number of lines displayed by commands with lengthy output such as [show running-config](#) to 48 lines.

```
Console#terminal length 48
Console#
```

**show line** This command displays the terminal line's parameters.

### Syntax

**show line** [**console** | **vty**]

**console** - Console terminal line.

**vty** - Virtual terminal for remote console access (i.e., Telnet).

### Default Setting

Shows all lines

### Command Mode

Normal Exec, Privileged Exec

### Example

To show all lines, enter this command:

```
Console#show line
Terminal Configuration for this session:
Length                : 24
Width                 : 80
History Size          : 10
Escape Character(ASCII-number) : 27
Terminal Type         : VT100

Console Configuration:
Password Threshold    : 3 times
EXEC Timeout          : 600 seconds
Login Timeout         : 300 seconds
Silent Time           : Disabled
Baud Rate             : 115200
Data Bits             : 8
Parity                : None
Stop Bits             : 1

VTY Configuration:
Password Threshold    : 3 times
EXEC Timeout          : 600 seconds
```

```
Login Timeout      : 300 sec.  
Silent Time       : Disabled  
Console#
```

## Event Logging

This section describes commands used to configure event logging on the switch.

**Table 20: Event Logging Commands**

Command	Function	Mode
<a href="#">logging facility</a>	Sets the facility type for remote logging of syslog messages	GC
<a href="#">logging history</a>	Limits syslog messages saved to switch memory based on severity	GC
<a href="#">logging host</a>	Adds a syslog server host IP address that will receive logging messages	GC
<a href="#">logging on</a>	Controls logging of error messages	GC
<a href="#">logging trap</a>	Limits syslog messages saved to a remote server based on severity	GC
<a href="#">clear log</a>	Clears messages from the logging buffer	PE
<a href="#">show log</a>	Displays log messages	PE
<a href="#">show logging</a>	Displays the state of logging	PE

**logging facility** This command sets the facility type for remote logging of syslog messages. Use the **no** form to return the type to the default.

### Syntax

**logging facility** *type*

**no logging facility**

*type* - A number that indicates the facility used by the syslog server to dispatch log messages to an appropriate service. (Range: 16-23)

### Default Setting

23

### Command Mode

Global Configuration

### Command Usage

The command specifies the facility type tag sent in syslog messages. (See RFC 3164.) This type has no effect on the kind of messages reported by the switch. However, it may be used by the syslog server to sort messages or to store messages in the corresponding database.

### Example

```
Console(config)#logging facility 19
Console(config)#
```

**logging history** This command limits syslog messages saved to switch memory based on severity. The **no** form returns the logging of syslog messages to the default level.

### Syntax

**logging history {flash | ram} level**

**no logging history {flash | ram}**

**flash** - Event history stored in flash memory (i.e., permanent memory).

**ram** - Event history stored in temporary RAM (i.e., memory flushed on power reset).

**level** - One of the levels listed below. Messages sent include the selected level down to level 0. (Range: 0-7)

**Table 21: Logging Levels**

Level	Severity Name	Description
7	debugging	Debugging messages
6	informational	Informational messages only
5	notifications	Normal but significant condition, such as cold start
4	warnings	Warning conditions (e.g., return false, unexpected return)
3	errors	Error conditions (e.g., invalid input, default used)
2	critical	Critical conditions (e.g., memory allocation, or free memory error - resource exhausted)
1	alerts	Immediate action needed
0	emergencies	System unusable

### Default Setting

Flash: errors (level 3 - 0)

RAM: debugging (level 7 - 0)

### Command Mode

Global Configuration

### Command Usage

The message level specified for flash memory must be a higher priority (i.e., numerically lower) than that specified for RAM.

### Example

```
Console(config)#logging history ram 0  
Console(config)#
```

**logging host** This command adds a syslog server host IP address that will receive logging messages. Use the **no** form to remove a syslog server host.

### Syntax

**logging host** *host-ip-address* [**port** *udp-port*]

**no logging host** *host-ip-address*

*host-ip-address* - The IPv4 or IPv6 address of a syslog server.

*udp-port* - UDP port number used by the remote server. (Range: 1-65535)

### Default Setting

UPD Port: 514

### Command Mode

Global Configuration

### Command Usage

- ◆ Use this command more than once to build up a list of host IP addresses.
- ◆ The maximum number of host IP addresses allowed is five.

### Example

```
Console(config)#logging host 10.1.0.3  
Console(config)#
```

**logging on** This command controls logging of error messages, sending debug or error messages to a logging process. The **no** form disables the logging process.

### Syntax

**[no] logging on**

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

The logging process controls error messages saved to switch memory or sent to remote syslog servers. You can use the [logging history](#) command to control the type of error messages that are stored in memory. You can use the [logging trap](#) command to control the type of error messages that are sent to specified syslog servers.

### Example

```
Console(config)#logging on
Console(config)#
```

### Related Commands

[logging history \(157\)](#)

[logging trap \(159\)](#)

[clear log \(160\)](#)

**logging trap** This command enables the logging of system messages to a remote server, or limits the syslog messages saved to a remote server based on severity. Use this command without a specified level to enable remote logging. Use the **no** form to disable remote logging.

### Syntax

**logging trap [level *level*]**

**no logging trap [level]**

*level* - One of the syslog severity levels listed in the table on [page 157](#).  
Messages sent include the selected level through level 0.

### Default Setting

Disabled

Level 7

### Command Mode

Global Configuration

### Command Usage

- ◆ Using this command with a specified level enables remote logging and sets the minimum severity level to be saved.
- ◆ Using this command without a specified level also enables remote logging, but restores the minimum severity level to the default.

### Example

```
Console(config)#logging trap level 4
Console(config)#
```

**clear log** This command clears messages from the log buffer.

#### Syntax

**clear log** [**flash** | **ram**]

**flash** - Event history stored in flash memory (i.e., permanent memory).

**ram** - Event history stored in temporary RAM (i.e., memory flushed on power reset).

#### Default Setting

Flash and RAM

#### Command Mode

Privileged Exec

#### Example

```
Console#clear log
Console#
```

#### Related Commands

[show log \(160\)](#)

**show log** This command displays the log messages stored in local memory.

#### Syntax

**show log** {**flash** | **ram**}

**flash** - Event history stored in flash memory (i.e., permanent memory).

**ram** - Event history stored in temporary RAM (i.e., memory flushed on power reset).

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Command Usage

- ◆ All log messages are retained in RAM and Flash after a warm restart (i.e., power is reset through the command interface).
- ◆ All log messages are retained in Flash and purged from RAM after a cold restart (i.e., power is turned off and then on through the power source).



### Example

The following example shows the event message stored in RAM.

```
Console#show log ram
[1] 00:01:30 2001-01-01
    "VLAN 1 link-up notification."
    level: 6, module: 5, function: 1, and event no.: 1
[0] 00:01:30 2001-01-01
    "Unit 1, Port 1 link-up notification."
    level: 6, module: 5, function: 1, and event no.: 1
Console#
```

**show logging** This command displays the configuration settings for logging messages to local switch memory, to an SMTP event handler, or to a remote syslog server.

### Syntax

**show logging {flash | ram | sendmail | trap}**

**flash** - Displays settings for storing event messages in flash memory (i.e., permanent memory).

**ram** - Displays settings for storing event messages in temporary RAM (i.e., memory flushed on power reset).

**sendmail** - Displays settings for the SMTP event handler ([page 166](#)).

**trap** - Displays settings for the trap function.

### Default Setting

None

### Command Mode

Privileged Exec

### Example

The following example shows that system logging is enabled, the message level for flash memory is "errors" (i.e., default level 3 - 0), and the message level for RAM is "debugging" (i.e., default level 7 - 0).

```
Console#show logging flash
Global Configuration:
  Syslog Logging      : Enabled
Flash Logging Configuration:
  History Logging in Flash : Level Errors (3)
Console#show logging ram
Global Configuration:
  Syslog Logging      : Enabled
Ram Logging Configuration:
  History Logging in RAM  : Level Debugging (7)
Console#
```

**Table 22: show logging flash/ram - display description**

Field	Description
Syslog Logging	Shows if system logging has been enabled via the <a href="#">logging on</a> command.
History Logging in Flash	The message level(s) reported based on the <a href="#">logging history</a> command.
History Logging in RAM	The message level(s) reported based on the <a href="#">logging history</a> command.

The following example displays settings for the trap function.

```
Console#show logging trap
Global Configuration:
  Syslog Logging      : Enabled
Remote Logging Configuration:
  Status              : Disabled
  Facility Type       : Local use 7 (23)
  Level Type          : Debugging messages (7)
Console#
```

**Table 23: show logging trap - display description**

Field	Description
<i>Global Configuration</i>	
Syslog logging	Shows if system logging has been enabled via the <a href="#">logging on</a> command.
<i>Remote Logging Configuration</i>	
Status	Shows if remote logging has been enabled via the <a href="#">logging trap</a> command.
Facility Type	The facility type for remote logging of syslog messages as specified in the <a href="#">logging facility</a> command.
Level Type	The severity threshold for syslog messages sent to a remote server as specified in the <a href="#">logging trap</a> command.

#### Related Commands

[show logging sendmail \(166\)](#)

## SMTP Alerts

These commands configure SMTP event handling, and forwarding of alert messages to the specified SMTP servers and email recipients.

**Table 24: Event Logging Commands**

Command	Function	Mode
<a href="#">logging sendmail</a>	Enables SMTP event handling	GC
<a href="#">logging sendmail host</a>	SMTP servers to receive alert messages	GC

Table 24: Event Logging Commands (Continued)

Command	Function	Mode
<code>logging sendmail level</code>	Severity threshold used to trigger alert messages	GC
<code>logging sendmail destination-email</code>	Email recipients of alert messages	GC
<code>logging sendmail source-email</code>	Email address used for “From” field of alert messages	GC
<code>show logging sendmail</code>	Displays SMTP event handler settings	NE, PE

**logging sendmail** This command enables SMTP event handling. Use the **no** form to disable this function.

#### Syntax

**[no] logging sendmail**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#logging sendmail
Console(config)#
```

**logging sendmail host** This command specifies SMTP servers that will be sent alert messages. Use the **no** form to remove an SMTP server.

#### Syntax

**[no] logging sendmail host *ip-address***

*ip-address* - IPv4 address of an SMTP server that will be sent alert messages for event handling.

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

- ◆ You can specify up to three SMTP servers for event handling. However, you must enter a separate command to specify each server.

- ◆ To send email alerts, the switch first opens a connection, sends all the email alerts waiting in the queue one by one, and finally closes the connection.
- ◆ To open a connection, the switch first selects the server that successfully sent mail during the last connection, or the first server configured by this command. If it fails to send mail, the switch selects the next server in the list and tries to send mail again. If it still fails, the system will repeat the process at a periodic interval. (A trap will be triggered if the switch cannot successfully open a connection.)

### Example

```
Console(config)#logging sendmail host 192.168.1.19
Console(config)#
```

**logging sendmail level** This command sets the severity threshold used to trigger alert messages. Use the **no** form to restore the default setting.

### Syntax

**logging sendmail level** *level*

**no logging sendmail level**

*level* - One of the system message levels ([page 157](#)). Messages sent include the selected level down to level 0. (Range: 0-7; Default: 7)

### Default Setting

Level 7

### Command Mode

Global Configuration

### Command Usage

The specified level indicates an event threshold. All events at this level or higher will be sent to the configured email recipients. (For example, using Level 7 will report all events from level 7 to level 0.)

### Example

This example will send email alerts for system errors from level 3 through 0.

```
Console(config)#logging sendmail level 3
Console(config)#
```

**logging sendmail destination-email** This command specifies the email recipients of alert messages. Use the **no** form to remove a recipient.

#### Syntax

**[no] logging sendmail destination-email** *email-address*

*email-address* - The source email address used in alert messages.  
(Range: 1-41 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

You can specify up to five recipients for alert messages. However, you must enter a separate command to specify each recipient.

#### Example

```
Console(config)#logging sendmail destination-email ted@this-company.com
Console(config)#
```

**logging sendmail source-email** This command sets the email address used for the "From" field in alert messages. Use the **no** form to restore the default value.

#### Syntax

**logging sendmail source-email** *email-address*

**no logging sendmail source-email**

*email-address* - The source email address used in alert messages.  
(Range: 1-41 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

You may use an symbolic email address that identifies the switch, or the address of an administrator responsible for the switch.

**Example**

```
Console(config)#logging sendmail source-email bill@this-company.com
Console(config)#
```

**show logging  
sendmail**

This command displays the settings for the SMTP event handler.

**Command Mode**

Privileged Exec

**Example**

```
Console#show logging sendmail
SMTP servers
-----
192.168.1.19

SMTP Minimum Severity Level: 7

SMTP destination email addresses
-----
ted@this-company.com

SMTP Source E-mail Address: bill@this-company.com
SMTP Status: Enabled
Console#
```

**Time**

The system clock can be dynamically set by polling a set of specified time servers (NTP or SNTP). Maintaining an accurate time on the switch enables the system log to record meaningful dates and times for event entries. If the clock is not set, the switch will only record the time from the factory default set at the last bootstrap.

**Table 25: Time Commands**

Command	Function	Mode
<i>SNTP Commands</i>		
<code>sntp client</code>	Accepts time from specified time servers	GC
<code>sntp poll</code>	Sets the interval at which the client polls for time	GC
<code>sntp server</code>	Specifies one or more time servers	GC
<code>show sntp</code>	Shows current SNTP configuration settings	NE, PE
<i>NTP Commands</i>		
<code>ntp authenticate</code>	Enables authentication for NTP traffic	GC
<code>ntp authentication-key</code>	Configures authentication keys	GC
<code>ntp client</code>	Enables the NTP client for time updates from specified servers	GC

Table 25: Time Commands (Continued)

Command	Function	Mode
<code>ntp server</code>	Specifies NTP servers to poll for time updates	GC
<code>show ntp</code>	Shows current NTP configuration settings	NE, PE
<i>Manual Configuration Commands</i>		
<code>clock summer-time (date)</code>	Configures summer time* for the switch's internal clock	GC
<code>clock summer-time (predefined)</code>	Configures summer time* for the switch's internal clock	GC
<code>clock summer-time (recurring)</code>	Configures summer time* for the switch's internal clock	GC
<code>clock timezone</code>	Sets the time zone for the switch's internal clock	GC
<code>calendar set</code>	Sets the system date and time	PE
<code>show calendar</code>	Displays the current date and time setting	NE, PE

\* Daylight savings time.

## SNTP Commands

**sntp client** This command enables SNTP client requests for time synchronization from NTP or SNTP time servers specified with the `sntp server` command. Use the **no** form to disable SNTP client requests.

### Syntax

**[no] sntp client**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ The time acquired from time servers is used to record accurate dates and times for log events. Without SNTP, the switch only records the time starting from the factory default set at the last bootstrap (e.g., Dec 31 07:32:04 2014).
- ◆ This command enables client time requests to time servers specified via the `sntp server` command. It issues time synchronization requests based on the interval set via the `sntp poll` command.

### Example

```
Console(config)#sntp server 10.1.0.19
Console(config)#sntp poll 60
Console(config)#sntp client
Console(config)#end
Console#show sntp
```

```
Current Time: Dec 23 02:52:44 2002
Poll Interval: 60
Current Mode: unicast
SNTP Status : Enabled
SNTP Server 137.92.140.80 0.0.0.0 0.0.0.0
Current Server: 137.92.140.80
Console#
```

#### Related Commands

[sntp server \(168\)](#)

[sntp poll \(168\)](#)

[show sntp \(169\)](#)

**sntp poll** This command sets the interval between sending time requests when the switch is set to SNTP client mode. Use the **no** form to restore to the default.

#### Syntax

**sntp poll** *seconds*

**no sntp poll**

*seconds* - Interval between time requests. (Range: 16-16384 seconds)

#### Default Setting

16 seconds

#### Command Mode

Global Configuration

#### Example

```
Console(config)#sntp poll 60
Console#
```

#### Related Commands

[sntp client \(167\)](#)

**sntp server** This command sets the IP address of the servers to which SNTP time requests are issued. Use the this command with no arguments to clear all time servers from the current list. Use the **no** form to clear all time servers from the current list, or to clear a specific server.

#### Syntax

**sntp server** [*ip1* [*ip2* [*ip3*]]]

**no sntp server** [*ip1* [*ip2* [*ip3*]]]

*ip* - IPv4 or IPv6 address of a time server (NTP or SNTP).  
(Range: 1 - 3 addresses)



**Default Setting**

None

**Command Mode**

Global Configuration

**Command Usage**

This command specifies time servers from which the switch will poll for time updates when set to SNTP client mode. The client will poll the time servers in the order specified until a response is received. It issues time synchronization requests based on the interval set via the [sntp poll](#) command.

**Example**

```
Console(config)#sntp server 10.1.0.19
Console#
```

**Related Commands**[sntp client \(167\)](#)[sntp poll \(168\)](#)[show sntp \(169\)](#)

**show sntp** This command displays the current time and configuration settings for the SNTP client, and indicates whether or not the local time has been properly updated.

**Command Mode**

Normal Exec, Privileged Exec

**Command Usage**

This command displays the current time, the poll interval used for sending time synchronization requests, and the current SNTP mode (i.e., unicast).

**Example**

```
Console#show sntp
Current Time   : Nov  5 18:51:22 2006
Poll Interval  : 16 seconds
Current Mode   : Unicast
SNTP Status    : Enabled
SNTP Server    : 137.92.140.80
                : 137.92.140.90
                : 137.92.140.99
Current Server : 137.92.140.80
Console#
```

## NTP Commands

**ntp authenticate** This command enables authentication for NTP client-server communications. Use the **no** form to disable authentication.

### Syntax

**[no] ntp authenticate**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

You can enable NTP authentication to ensure that reliable updates are received from only authorized NTP servers. The authentication keys and their associated key number must be centrally managed and manually distributed to NTP servers and clients. The key numbers and key values must match on both the server and client.

### Example

```
Console(config)#ntp authenticate
Console(config)#
```

### Related Commands

[ntp authentication-key \(170\)](#)

**ntp authentication-key** This command configures authentication keys and key numbers to use when NTP authentication is enabled. Use the **no** form of the command to clear a specific authentication key or all keys from the current list.

### Syntax

**ntp authentication-key** *number* **md5** *key*

**no ntp authentication-key** [*number*]

*number* - The NTP authentication key ID number. (Range: 1-65535)

**md5** - Specifies that authentication is provided by using the message digest algorithm 5.

*key* - An MD5 authentication key string. The key string can be up to 32 case-sensitive printable ASCII characters (no spaces).

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ The key number specifies a key value in the NTP authentication key list. Up to 255 keys can be configured on the switch. Re-enter this command for each server you want to configure.
- ◆ Note that NTP authentication key numbers and values must match on both the server and client.
- ◆ NTP authentication is optional. When enabled with the **ntp authenticate** command, you must also configure at least one key number using this command.
- ◆ Use the **no** form of this command without an argument to clear all authentication keys in the list.

### Example

```
Console(config)#ntp authentication-key 45 md5 thisiskey45
Console(config)#
```

### Related Commands

[ntp authenticate \(170\)](#)

**ntp client** This command enables NTP client requests for time synchronization from NTP time servers specified with the **ntp servers** command. Use the **no** form to disable NTP client requests.

### Syntax

**[no] ntp client**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ The SNTP and NTP clients cannot be enabled at the same time. First disable the SNTP client before using this command.
- ◆ The time acquired from time servers is used to record accurate dates and times for log events. Without NTP, the switch only records the time starting from the factory default set at the last bootup (e.g., Dec 10 16:04:43 2014).

- ◆ This command enables client time requests to time servers specified via the **ntp servers** command. It issues time synchronization requests based on the interval set via the **ntp poll** command.

### Example

```
Console(config)#ntp client
Console(config)#
```

### Related Commands

[sntp client \(167\)](#)

[ntp server \(172\)](#)

**ntp server** This command sets the IP addresses of the servers to which NTP time requests are issued. Use the **no** form of the command to clear a specific time server or all servers from the current list.

### Syntax

**ntp server** *ip-address* [**key** *key-number*]

**no ntp server** [*ip-address*]

*ip-address* - IP address of an NTP time server.

*key-number* - The number of an authentication key to use in communications with the server. (Range: 1-65535)

### Default Setting

Version number: 3

### Command Mode

Global Configuration

### Command Usage

- ◆ This command specifies time servers that the switch will poll for time updates when set to NTP client mode. It issues time synchronization requests based on the interval set with the **ntp poll** command. The client will poll all the time servers configured, the responses received are filtered and compared to determine the most reliable and accurate time update for the switch.
- ◆ You can configure up to 50 NTP servers on the switch. Re-enter this command for each server you want to configure.
- ◆ NTP authentication is optional. If enabled with the **ntp authenticate** command, you must also configure at least one key number using the **ntp authentication-key** command.
- ◆ Use the **no** form of this command without an argument to clear all configured servers in the list.

### Example

```

Console(config)#ntp server 192.168.3.20
Console(config)#ntp server 192.168.3.21
Console(config)#ntp server 192.168.5.23 key 19
Console(config)#

```

### Related Commands

[ntp client \(171\)](#)

[show ntp \(173\)](#)

**show ntp** This command displays the current time and configuration settings for the NTP client, and indicates whether or not the local time has been properly updated.

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

This command displays the current time, the poll interval used for sending time synchronization requests, and the current NTP mode (i.e., unicast).

### Example

```

Console#show ntp
Current Time           : Apr 29 13:57:32 2011
Polling                : 1024 seconds
Current Mode           : unicast
NTP Status             : Disabled
NTP Authenticate Status : Enabled
Last Update NTP Server : 0.0.0.0      Port: 0
Last Update Time       : Jan  1 00:00:00 1970 UTC
NTP Server 192.168.3.20 version 3
NTP Server 192.168.3.21 version 3
NTP Server 192.168.4.22 version 3 key 19
NTP Authentication Key 19 md5 42V68751663T6K11P2J307210R885
Console#

```

## Manual Configuration Commands

**clock summer-time (date)** This command sets the start, end, and offset times of summer time (daylight savings time) for the switch on a one-time basis. Use the **no** form to disable summer time.

### Syntax

**clock summer-time** *name* **date** *b-date b-month b-year b-hour b-minute e-date e-month e-year e-hour e-minute [offset]*

**no clock summer-time**

*name* - Name of the time zone while summer time is in effect, usually an acronym. (Range: 1-30 characters)

*b-date* - Day of the month when summer time will begin. (Range: 1-31)

*b-month* - The month when summer time will begin. (Options: **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**)

*b-year* - The year summer time will begin.

*b-hour* - The hour summer time will begin. (Range: 0-23 hours)

*b-minute* - The minute summer time will begin. (Range: 0-59 minutes)

*e-date* - Day of the month when summer time will end. (Range: 1-31)

*e-month* - The month when summer time will end. (Options: **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**)

*e-year* - The year summer time will end.

*e-hour* - The hour summer time will end. (Range: 0-23 hours)

*e-minute* - The minute summer time will end. (Range: 0-59 minutes)

*offset* - Summer time offset from the regular time zone, in minutes.  
(Range: 1-120 minutes)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.
- ◆ This command sets the summer-time time zone relative to the currently configured time zone. To specify a time corresponding to your local time when summer time is in effect, you must indicate the number of minutes your summer-time time zone deviates from your regular time zone (that is, the offset).

### Example

The following example sets the 2014 Summer Time ahead by 60 minutes on March 9th and returns to normal time on November 2nd.

```
Console(config)#clock summer-time DEST date march 9 2014 01 59 november 2
2014 01 59 60
Console(config)#
```

**Related Commands**[show sntp \(169\)](#)

**clock summer-time (predefined)** This command configures the summer time (daylight savings time) status and settings for the switch using predefined configurations for several major regions in the world. Use the **no** form to disable summer time.

**Syntax**

**clock summer-time** *name* **predefined** [**australia** | **europe** | **new-zealand** | **usa**]

**no clock summer-time**

*name* - Name of the timezone while summer time is in effect, usually an acronym. (Range: 1-30 characters)

**Default Setting**

Disabled

**Command Mode**

Global Configuration

**Command Usage**

- ◆ In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.
- ◆ This command sets the summer-time time relative to the configured time zone. To specify the time corresponding to your local time when summer time is in effect, select the predefined summer-time time zone appropriate for your location, or manually configure summer time if these predefined configurations do not apply to your location (see [clock summer-time \(date\)](#) or [clock summer-time \(recurring\)](#)).

**Table 26: Predefined Summer-Time Parameters**

Region	Start Time, Day, Week, & Month	End Time, Day, Week, & Month	Rel. Offset
Australia	00:00:00, Sunday, Week 5 of October	23:59:59, Sunday, Week 5 of March	60 min
Europe	00:00:00, Sunday, Week 5 of March	23:59:59, Sunday, Week 5 of October	60 min
New Zealand	00:00:00, Sunday, Week 1 of October	23:59:59, Sunday, Week 3 of March	60 min
USA	00:00:00, Sunday, Week 2 of March	23:59:59, Sunday, Week 1 of November	60 min

**Example**

The following example sets the Summer Time setting to use the predefined settings for the European region.

```
Console(config)#clock summer-time MESZ predefined europe
Console(config)#
```

**Related Commands**

[show sntp \(169\)](#)

**clock summer-time (recurring)** This command allows the user to manually configure the start, end, and offset times of summer time (daylight savings time) for the switch on a recurring basis. Use the **no** form to disable summer-time.

**Syntax**

**clock summer-time** *name recurring b-week b-day b-month b-hour b-minute e-week e-day e-month e-hour e-minute [offset]*

**no clock summer-time**

*name* - Name of the timezone while summer time is in effect, usually an acronym. (Range: 1-30 characters)

*b-week* - The week of the month when summer time will begin. (Range: 1-5)

*b-day* - The day of the week when summer time will begin. (Options: **sunday | monday | tuesday | wednesday | thursday | friday | saturday**)

*b-month* - The month when summer time will begin. (Options: **january | february | march | april | may | june | july | august | september | october | november | december**)

*b-hour* - The hour when summer time will begin. (Range: 0-23 hours)

*b-minute* - The minute when summer time will begin. (Range: 0-59 minutes)

*e-week* - The week of the month when summer time will end. (Range: 1-5)

*e-day* - The day of the week summer time will end. (Options: **sunday | monday | tuesday | wednesday | thursday | friday | saturday**)

*e-month* - The month when summer time will end. (Options: **january | february | march | april | may | june | july | august | september | october | november | december**)

*e-hour* - The hour when summer time will end. (Range: 0-23 hours)

*e-minute* - The minute when summer time will end. (Range: 0-59 minutes)

*offset* - Summer-time offset from the regular time zone, in minutes. (Range: 1-120 minute)

**Default Setting**

Disabled



## Command Mode

Global Configuration

## Command Usage

- ◆ In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.
- ◆ This command sets the summer-time time zone relative to the currently configured time zone. To display a time corresponding to your local time when summer time is in effect, you must indicate the number of minutes your summer-time time zone deviates from your regular time zone (that is, the offset).

## Example

The following example sets a recurring 60 minute offset summer-time to begin on the Friday of the 1st week of March at 01:59 hours and summer time to end on the Saturday of the 2nd week of November at 01:59 hours.

```
Console(config)#clock summer-time MESZ recurring 1 friday march 01 59 3  
saturday november 1 59 60  
Console(config)#
```

## Related Commands

[show sntp \(169\)](#)

**clock timezone** This command sets the time zone for the switch's internal clock.

## Syntax

**clock timezone** *name* **hour** *hours* **minute** *minutes*  
{**before-utc** | **after-utc**}

*name* - Name of timezone, usually an acronym. (Range: 1-30 characters)

*hours* - Number of hours before/after UTC. (Range: 0-12 hours before UTC, 0-13 hours after UTC)

*minutes* - Number of minutes before/after UTC. (Range: 0-59 minutes)

**before-utc** - Sets the local time zone before (east) of UTC.

**after-utc** - Sets the local time zone after (west) of UTC.

## Default Setting

None

## Command Mode

Global Configuration

### Command Usage

This command sets the local time zone relative to the Coordinated Universal Time (UTC, formerly Greenwich Mean Time or GMT), based on the earth's prime meridian, zero degrees longitude. To display a time corresponding to your local time, you must indicate the number of hours and minutes your time zone is east (before) or west (after) of UTC.

### Example

```
Console(config)#clock timezone Japan hours 8 minute 0 after-UTC
Console(config)#
```

### Related Commands

[show sntp \(169\)](#)

**calendar set** This command sets the system clock. It may be used if there is no time server on your network, or if you have not configured the switch to receive signals from a time server.

### Syntax

**calendar set** *hour min sec {day month year | month day year}*

*hour* - Hour in 24-hour format. (Range: 0 - 23)

*min* - Minute. (Range: 0 - 59)

*sec* - Second. (Range: 0 - 59)

*day* - Day of month. (Range: 1 - 31)

*month* - **january | february | march | april | may | june | july | august | september | october | november | december**

*year* - Year (4-digit). (Range: 1970 - 2037)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Note that when SNTP is enabled, the system clock cannot be manually configured.

### Example

This example shows how to set the system clock to 15:12:34, February 1st, 2015.

```
Console#calendar set 15:12:34 1 February 2015
Console#
```

**show calendar** This command displays the system clock.

#### Default Setting

None

#### Command Mode

Normal Exec, Privileged Exec

#### Example

```
Console#show calendar
Current Time       : May 13 14:08:18 2014
Time Zone         : UTC, 08:00
Summer Time       : Not configured
Summer Time in Effect : No
Console#
```

## Time Range

This section describes the commands used to sets a time range for use by other functions, such as Access Control Lists.

**Table 27: Time Range Commands**

Command	Function	Mode
<a href="#">time-range</a>	Specifies the name of a time range, and enters time range configuration mode	GC
<a href="#">absolute</a>	Sets the absolute time range for the execution of a command	TR
<a href="#">periodic</a>	Sets the time range for the periodic execution of a command	TR
<a href="#">show time-range</a>	Shows configured time ranges.	PE

**time-range** This command specifies the name of a time range, and enters time range configuration mode. Use the **no** form to remove a previously specified time range.

#### Syntax

**[no] time-range** *name*

*name* - Name of the time range. (Range: 1-32 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

### Command Usage

- ◆ This command sets a time range for use by other functions, such as Access Control Lists.
- ◆ A maximum of eight rules can be configured for a time range.

### Example

```
Console(config)#time-range r&d  
Console(config-time-range)#
```

### Related Commands

[Access Control Lists \(383\)](#)

**absolute** This command sets the absolute time range for the execution of a command. Use the **no** form to remove a previously specified time.

### Syntax

**absolute start** *hour minute day month year*  
[**end** *hour minutes day month year*]

**absolute end** *hour minutes day month year*

**no absolute**

*hour* - Hour in 24-hour format. (Range: 0-23)

*minute* - Minute. (Range: 0-59)

*day* - Day of month. (Range: 1-31)

*month* - **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** |  
**september** | **october** | **november** | **december**

*year* - Year (4-digit). (Range: 2013-2037)

### Default Setting

None

### Command Mode

Time Range Configuration

### Command Usage

- ◆ If a time range is already configured, you must use the **no** form of this command to remove the current entry prior to configuring a new time range.
- ◆ If both an absolute rule and one or more periodic rules are configured for the same time range (i.e., named entry), that entry will only take effect if the current time is within the absolute time range and one of the periodic time ranges.

### Example

This example configures the time for the single occurrence of an event.

```
Console(config)#time-range r&d
Console(config-time-range)#absolute start 1 1 1 april 2009 end 2 1 1 april
2009
Console(config-time-range)#
```

**periodic** This command sets the time range for the periodic execution of a command. Use the **no** form to remove a previously specified time range.

### Syntax

**[no] periodic {daily | friday | monday | saturday | sunday | thursday | tuesday | wednesday | weekdays | weekend} hour minute to {daily | friday | monday | saturday | sunday | thursday | tuesday | wednesday | weekdays | weekend} hour minute**

**daily** - Daily

**friday** - Friday

**monday** - Monday

**saturday** - Saturday

**sunday** - Sunday

**thursday** - Thursday

**tuesday** - Tuesday

**wednesday** - Wednesday

**weekdays** - Weekdays

**weekend** - Weekends

*hour* - Hour in 24-hour format. (Range: 0-23)

*minute* - Minute. (Range: 0-59)

### Default Setting

None

### Command Mode

Time Range Configuration

### Command Usage

- ◆ If a time range is already configured, you must use the **no** form of this command to remove the current entry prior to configuring a new time range.
- ◆ If both an absolute rule and one or more periodic rules are configured for the same time range (i.e., named entry), that entry will only take effect if the current time is within the absolute time range and one of the periodic time ranges.

### Example

This example configures a time range for the periodic occurrence of an event.

```
Console(config)#time-range sales
Console(config-time-range)#periodic daily 1 1 to 2 1
Console(config-time-range)#
```

**show time-range** This command shows configured time ranges.

### Syntax

**show time-range** [*name*]

*name* - Name of the time range. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show time-range r&d
Time-range r&d:
  absolute start 01:01 01 April 2009
  periodic      Daily 01:01 to      Daily 02:01
  periodic      Daily 02:01 to      Daily 03:01
Console#
```

## Switch Clustering

Switch Clustering is a method of grouping switches together to enable centralized management through a single unit. Switches that support clustering can be grouped together regardless of physical location or switch type, as long as they are connected to the same local network.

**Table 28: Switch Cluster Commands**

Command	Function	Mode
<a href="#">cluster</a>	Configures clustering on the switch	GC
<a href="#">cluster commander</a>	Configures the switch as a cluster Commander	GC
<a href="#">cluster ip-pool</a>	Sets the cluster IP address pool for Members	GC
<a href="#">cluster member</a>	Sets Candidate switches as cluster members	GC
<a href="#">rcommand</a>	Provides configuration access to Member switches	GC
<a href="#">show cluster</a>	Displays the switch clustering status	PE

Table 28: Switch Cluster Commands (Continued)

Command	Function	Mode
<a href="#">show cluster members</a>	Displays current cluster Members	PE
<a href="#">show cluster candidates</a>	Displays current cluster Candidates in the network	PE

### Using Switch Clustering

- ◆ A switch cluster has a primary unit called the “Commander” which is used to manage all other “Member” switches in the cluster. The management station can use either Telnet or the web interface to communicate directly with the Commander through its IP address, and then use the Commander to manage the Member switches through the cluster’s “internal” IP addresses.
- ◆ Clustered switches must be in the same Ethernet broadcast domain. In other words, clustering only functions for switches which can pass information between the Commander and potential Candidates or active Members through VLAN 4093.
- ◆ Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These “Candidate” switches only become cluster Members when manually selected by the administrator through the management station.
- ◆ The cluster VLAN 4093 is not configured by default. Before using clustering, take the following actions to set up this VLAN:
  1. Create VLAN 4093 (see [“Editing VLAN Groups” on page 573](#)).
  2. Add the participating ports to this VLAN (see [“Configuring VLAN Interfaces” on page 575](#)), and set them to hybrid mode, tagged members, PVID = 1, and acceptable frame type = all.



**Note:** Cluster Member switches can be managed either through a Telnet connection to the Commander, or through a web management connection to the Commander. When using a console connection, from the Commander CLI prompt, use the [rcommand](#) to connect to the Member switch.

**cluster** This command enables clustering on the switch. Use the **no** form to disable clustering.

### Syntax

**[no] cluster**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ To create a switch cluster, first be sure that clustering is enabled on the switch (the default is enabled), then set the switch as a Cluster Commander. Set a Cluster IP Pool that does not conflict with any other IP subnets in the network. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.
- ◆ Switch clusters are limited to the same Ethernet broadcast domain.
- ◆ There can be up to 100 candidates and 36 member switches in one cluster.
- ◆ A switch can only be a Member of one cluster.
- ◆ Configured switch clusters are maintained across power resets and network changes.

### Example

```
Console(config)#cluster
Console(config)#
```

**cluster commander** This command enables the switch as a cluster Commander. Use the **no** form to disable the switch as cluster Commander.

### Syntax

**[no] cluster commander**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These “Candidate” switches only become cluster Members when manually selected by the administrator through the management station.
- ◆ Cluster Member switches can be managed through a Telnet connection to the Commander. From the Commander CLI prompt, use the **command id** command to connect to the Member switch.



### Example

```
Console(config)#cluster commander  
Console(config)#
```

**cluster ip-pool** This command sets the cluster IP address pool. Use the **no** form to reset to the default address.

### Syntax

**cluster ip-pool** *ip-address*

**no cluster ip-pool**

*ip-address* - The base IP address for IP addresses assigned to cluster Members. The IP address must start 10.x.x.x.

### Default Setting

10.254.254.1

### Command Mode

Global Configuration

### Command Usage

- ◆ An “internal” IP address pool is used to assign IP addresses to Member switches in the cluster. Internal cluster IP addresses are in the form 10.x.x.*member-ID*. Only the base IP address of the pool needs to be set since Member IDs can only be between 1 and 36.
- ◆ Set a Cluster IP Pool that does not conflict with addresses in the network IP subnet. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.
- ◆ You cannot change the cluster IP pool when the switch is currently in Commander mode. Commander mode must first be disabled.

### Example

```
Console(config)#cluster ip-pool 10.2.3.4  
Console(config)#
```

**cluster member** This command configures a Candidate switch as a cluster Member. Use the **no** form to remove a Member switch from the cluster.

#### Syntax

**cluster member mac-address** *mac-address* **id** *member-id*

**no cluster member id** *member-id*

*mac-address* - The MAC address of the Candidate switch.

*member-id* - The ID number to assign to the Member switch. (Range: 1-36)

#### Default Setting

No Members

#### Command Mode

Global Configuration

#### Command Usage

- ◆ The maximum number of cluster Members is 36.
- ◆ The maximum number of cluster Candidates is 100.

#### Example

```
Console(config)#cluster member mac-address 00-12-34-56-78-9a id 5
Console(config)#
```

**rcommand** This command provides access to a cluster Member CLI for configuration.

#### Syntax

**rcommand id** *member-id*

*member-id* - The ID number of the Member switch. (Range: 1-36)

#### Command Mode

Privileged Exec

#### Command Usage

- ◆ This command only operates through a Telnet connection to the Commander switch. Managing cluster Members using the local console CLI on the Commander is not supported.
- ◆ There is no need to enter the username and password for access to the Member switch CLI.

### Example

```
Console#rcommand id 1

      CLI session with the GTL-2891 is opened.
      To end the CLI session, enter [Exit].

Vty-0#
```

**show cluster** This command shows the switch clustering configuration.

### Command Mode

Privileged Exec

### Example

```
Console#show cluster
Role           : commander
Interval Heartbeat : 30
Heartbeat Loss Count : 3 seconds
Number of Members   : 1
Number of Candidates : 2
Console#
```

**show cluster members** This command shows the current switch cluster members.

### Command Mode

Privileged Exec

### Example

```
Console#show cluster members
Cluster Members:
ID           : 1
Role         : Active member
IP Address   : 10.254.254.2
MAC Address  : 00-E0-0C-00-00-FE
Description  : GTL-2891
Console#
```

**show cluster candidates** This command shows the discovered Candidate switches in the network.

**Command Mode**  
Privileged Exec

#### Example

```
Console#show cluster candidates
Cluster Candidates:
Role           MAC Address      Description
-----
Candidate join 00-E0-0C-00-00-FE GTL-2891
Candidate      00-12-CF-0B-47-A0 GTL-2891
Console#
```

## Stacking

This section includes commands which configure a unit as the stack master, set the 10G ports to stacking mode, or renumber all units in the stack. For information on how to physically connect units into a stack, see the *Hardware Installation Guide*. For detailed information on how stacking is implemented for this type of switch, refer to [“Stack Operations” on page 63](#).

**Table 29: Stacking Commands**

Command	Function	Mode
<a href="#">switch all renumber</a>	Renumbers stack units	PE
<a href="#">switch master button</a>	Configures a unit as the stack master	PE
<a href="#">switch stacking button</a>	Sets the switch to operate in stacking mode	PE
<a href="#">show switch master button</a>	Shows the status of the master button	PE
<a href="#">show switch stacking button</a>	Shows the status of the stacking button	PE

**switch all renumber** This command resets the switch unit identification numbers in the stack. All stack members are numbered sequentially starting from the top unit for a non-loop stack, or starting from the Master unit for a looped stack.

#### Syntax

**switch all renumber**

#### Default Setting

- ◆ For non-loop stacking, the top unit is unit 1.
- ◆ For loop stacking, the master unit is unit 1.

**Command Mode**  
Privileged Exec

### Command Usage

The system will restart after renumbering is completed.

### Example

This example shows how to renumber all units.

```
Console#switch all renumber
Console#
```

**switch master button** This command configures a unit as the stack master. Use the **no** form to disable the master button.

### Syntax

**[no] switch master button *unit***

*unit* - Unit identifier. (Range: 1-8)

### Default Setting

Disabled

### Command Mode

Privileged Exec

### Command Usage

- ◆ The switch must be rebooted to activate this command. Note that the configured setting is not affected by changes to the start-up configuration file.
- ◆ Set the front panel 10G ports to stacking mode with the [switch stacking button](#) command prior to rebooting the switch.
- ◆ If the stack has not been initialized, the master button must be disabled on all other units in the stack, and those units rebooted.
- ◆ If the stack has been initialized, and this command is used to configure a new stack master, then the master button on the old master must be disabled before rebooting the stack.
- ◆ After the newly configured stack master has been rebooted, the front panel unit identifier will be updated on each unit in the stack.
- ◆ The bootup messages on all slave units will be halted when the master unit is rebooted, and configuration through the CLI will be restricted to the master unit.

### Example

This example shows the current switch set to stack master, the switch rebooted, and the messages displayed after the reboot process completes.

```
Console#switch master button 1
Console#reload
.
.
*****
Finished provision complete ...
Processing hot swap insertion: 57-108, and use default [TRUE]
***** Master sending maintenance packet
---- Master state preemption

Hot swap insertion done.
Pre-provision complete ...
Finished pre-provision complete ...
Provision complete ...
Finished module 2 provision complete ...
Module provision complete.
```

**switch stacking button** This command sets the switch to operate in stacking mode. Use the **no** form to disable this function.

### Syntax

**[no] switch stacking button**

### Default Setting

Disabled

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use this command on all stack members.
- ◆ Use the **switch master button** command to specify one unit as the stack master.
- ◆ Every switch in the stack must be rebooted to activate this command. Note that the configured setting is not affected by changes to the start-up configuration file.

### Example

```
Console#switch stacking button 1
Console#
```

**show switch master button** This command shows the status of the master button.

**Command Mode**  
Privileged Exec

**Command Usage**

- ◆ If the stack has not been initialized, "N" will be displayed in the switch ID field.
- ◆ Use the [switch master button](#) command to specify one unit as the stack master.

**Example**

```
Console#show switch master button
Switch ID  Master-button-pressed
-----
      1              Y
      2              N
Console#
```

**show switch stacking button** This command shows the status of the stacking button.

**Command Mode**  
Privileged Exec

**Command Usage**

Use the [switch stacking button](#) command to set the 10G ports to stacking mode.

**Example**

```
Console#show switch stacking button
Config Status  Active Status
-----
      N              N
Console#
```





# SNMP Commands

SNMP commands control access to this switch from management stations using the Simple Network Management Protocol (SNMP), as well as the error types sent to trap managers.

SNMP Version 3 also provides security features that cover message integrity, authentication, and encryption; as well as controlling user access to specific areas of the MIB tree. To use SNMPv3, first set an SNMP engine ID (or accept the default), specify read and write access views for the MIB tree, configure SNMP user groups with the required security model (i.e., SNMP v1, v2c or v3) and security level (i.e., authentication and privacy), and then assign SNMP users to these groups, along with their specific authentication and privacy passwords.

**Table 30: SNMP Commands**

Command	Function	Mode
<i>General SNMP Commands</i>		
<code>snmp-server</code>	Enables the SNMP agent	GC
<code>snmp-server community</code>	Sets up the community access string to permit access to SNMP commands	GC
<code>snmp-server contact</code>	Sets the system contact string	GC
<code>snmp-server location</code>	Sets the system location string	GC
<code>show snmp</code>	Displays the status of SNMP communications	NE, PE
<i>SNMP Target Host Commands</i>		
<code>snmp-server enable traps</code>	Enables the device to send SNMP traps (i.e., SNMP notifications)	GC
<code>snmp-server host</code>	Specifies the recipient of an SNMP notification operation	GC
<code>snmp-server enable port-traps mac-notification</code>	Enables the device to send SNMP traps (i.e., SNMP notifications) when a dynamic MAC address is added or removed	IC
<code>show snmp-server enable port-traps</code>	Shows if SNMP traps are enabled or disabled for the specified interfaces	PE
<i>SNMPv3 Engine Commands</i>		
<code>snmp-server engine-id</code>	Sets the SNMP engine ID	GC
<code>snmp-server group</code>	Adds an SNMP group, mapping users to views	GC
<code>snmp-server user</code>	Adds a user to an SNMP group	GC
<code>snmp-server view</code>	Adds an SNMP view	GC
<code>show snmp engine-id</code>	Shows the SNMP engine ID	PE
<code>show snmp group</code>	Shows the SNMP groups	PE

Table 30: SNMP Commands (Continued)

Command	Function	Mode
<code>show snmp user</code>	Shows the SNMP users	PE
<code>show snmp view</code>	Shows the SNMP views	PE
<i>Notification Log Commands</i>		
<code>nlm</code>	Enables the specified notification log	GC
<code>snmp-server notify-filter</code>	Creates a notification log and specifies the target host	GC
<code>show nlm oper-status</code>	Shows operation status of configured notification logs	PE
<code>show snmp notify-filter</code>	Displays the configured notification logs	PE
<i>ATC Trap Commands</i>		
<code>snmp-server enable port-traps atc broadcast-alarm-clear</code>	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
<code>snmp-server enable port-traps atc broadcast-alarm-fire</code>	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control	IC (Port)
<code>snmp-server enable port-traps atc broadcast-control-apply</code>	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
<code>snmp-server enable port-traps atc broadcast-control-release</code>	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
<code>snmp-server enable port-traps atc multicast-alarm-clear</code>	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
<code>snmp-server enable port-traps atc multicast-alarm-fire</code>	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control	IC (Port)
<code>snmp-server enable port-traps atc multicast-control-apply</code>	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
<code>snmp-server enable port-traps atc multicast-control-release</code>	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
<i>Connectivity Fault Management Trap Commands</i>		
<code>snmp-server enable traps ethernet cfm cc</code>	Enables SNMP traps for CFM continuity check events	GC
<code>snmp-server enable traps ethernet cfm crosscheck</code>	Enables SNMP traps for CFM continuity check events, in relation to the cross-check operations between statically configured MEPs and those learned via continuity check messages	GC
<i>Transceiver Power Threshold Trap Commands</i>		
<code>transceiver-threshold current</code>	Sends a trap when the transceiver current falls outside the specified thresholds	IC (Port)
<code>transceiver-threshold rx-power</code>	Sends a trap when the power level of the received signal falls outside the specified thresholds	IC (Port)
<code>transceiver-threshold temperature</code>	Sends a trap when the transceiver temperature falls outside the specified thresholds	IC (Port)

**Table 30: SNMP Commands** (Continued)

Command	Function	Mode
<code>transceiver-threshold tx-power</code>	Sends a trap when the power level of the transmitted signal power outside the specified thresholds	IC (Port)
<code>transceiver-threshold voltage</code>	Sends a trap when the transceiver voltage falls outside the specified thresholds	IC (Port)
<i>Additional Trap Commands</i>		
<code>memory</code>	Sets the rising and falling threshold for the memory utilization alarm	GC
<code>process cpu</code>	Sets the rising and falling threshold for the CPU utilization alarm	GC
<code>process cpu guard</code>	Sets the CPU utilization watermark and threshold	GC
<code>show memory</code>	Shows memory utilization parameters	PE
<code>show process cpu</code>	Shows CPU utilization parameters	PE
<code>show process cpu guard</code>	Shows the CPU utilization watermark and threshold	PE
<code>show process cpu task</code>	Shows CPU utilization per process	NE, PE

## General SNMP Commands

**snmp-server** This command enables the SNMPv3 engine and services for all management clients (i.e., versions 1, 2c, 3). Use the **no** form to disable the server.

### Syntax

**[no] snmp-server**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Example

```
Console(config)#snmp-server
Console(config)#
```

**snmp-server community** This command defines community access strings used to authorize management access by clients using SNMP v1 or v2c. Use the **no** form to remove the specified community string.

#### Syntax

**snmp-server community** *string* [**ro** | **rw**]

**no snmp-server community** *string*

*string* - Community string that acts like a password and permits access to the SNMP protocol. (Maximum length: 32 characters, case sensitive; Maximum number of strings: 5)

**ro** - Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.

**rw** - Specifies read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

#### Default Setting

- ◆ public - Read-only access. Authorized management stations are only able to retrieve MIB objects.
- ◆ private - Read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

#### Command Mode

Global Configuration

#### Example

```
Console(config)#snmp-server community alpha rw
Console(config)#
```

**snmp-server contact** This command sets the system contact string. Use the **no** form to remove the system contact information.

#### Syntax

**snmp-server contact** *string*

**no snmp-server contact**

*string* - String that describes the system contact information.  
(Maximum length: 255 characters)

#### Default Setting

None

#### Command Mode

Global Configuration

### Example

```
Console(config)#snmp-server contact Paul
Console(config)#
```

### Related Commands

[snmp-server location \(197\)](#)

**snmp-server location** This command sets the system location string. Use the **no** form to remove the location string.

### Syntax

**snmp-server location** *text*

**no snmp-server location**

*text* - String that describes the system location.  
(Maximum length: 255 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Example

```
Console(config)#snmp-server location WC-19
Console(config)#
```

### Related Commands

[snmp-server contact \(196\)](#)

**show snmp** This command can be used to check the status of SNMP communications.

### Default Setting

None

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

This command provides information on the community access strings, counters for SNMP input and output protocol data units, and whether or not SNMP logging has been enabled with the **snmp-server enable traps** command.

## Example

```
Console#show snmp

SNMP Agent : Enabled

SNMP Traps :
  Authentication : Enabled
  Link-up-down   : Enabled
  MAC-notification : Disabled
  MAC-notification interval : 1 second(s)

SNMP Communities :
  1. public, and the access level is read-only
  2. private, and the access level is read/write

0 SNMP packets input
  0 Bad SNMP version errors
  0 Unknown community name
  0 Illegal operation for community name supplied
  0 Encoding errors
  0 Number of requested variables
  0 Number of altered variables
  0 Get-request PDUs
  0 Get-next PDUs
  0 Set-request PDUs
0 SNMP packets output
  0 Too big errors
  0 No such name errors
  0 Bad values errors
  0 General errors
  0 Response PDUs
  0 Trap PDUs

SNMP Logging: Disabled
Console#
```

## SNMP Target Host Commands

**snmp-server enable traps** This command enables this device to send Simple Network Management Protocol traps or informs (i.e., SNMP notifications). Use the **no** form to disable SNMP notifications.

### Syntax

[no] **snmp-server enable traps** [authentication | link-up-down | ethernet cfm | mac-notification [interval *seconds*]]

**authentication** - Keyword to issue authentication failure notifications.

**link-up-down** - Keyword to issue link-up or link-down notifications.

**ethernet cfm** - Connectivity Fault Management traps. For more information on these traps, see [“CFM Commands” on page 797](#).

**mac-notification** - Keyword to issue trap when a dynamic MAC address is added or removed.

**interval** - Specifies the interval between issuing two consecutive traps. (Range: 1-3600 seconds; Default: 1 second)

### Default Setting

Issue authentication and link-up-down traps.  
Other traps are disabled.

### Command Mode

Global Configuration

### Command Usage

- ◆ If you do not enter an **snmp-server enable traps** command, no notifications controlled by this command are sent. In order to configure this device to send SNMP notifications, you must enter at least one **snmp-server enable traps** command. If you enter the command with no keywords, both authentication and link-up-down notifications are enabled. If you enter the command with a keyword, only the notification type related to that keyword is enabled.
- ◆ The **snmp-server enable traps** command is used in conjunction with the [snmp-server host](#) command. Use the [snmp-server host](#) command to specify which host or hosts receive SNMP notifications. In order to send notifications, you must configure at least one [snmp-server host](#) command.
- ◆ The authentication, link-up, and link-down traps are legacy notifications, and therefore when used for SNMP Version 3 hosts, they must be enabled in conjunction with the corresponding entries in the Notify View assigned by the [snmp-server group](#) command.

### Example

```
Console(config)#snmp-server enable traps link-up-down
Console(config)#
```

### Related Commands

[snmp-server host \(200\)](#)

**snmp-server host** This command specifies the recipient of a Simple Network Management Protocol notification operation. Use the **no** form to remove the specified host.

### Syntax

**snmp-server host** *host-addr* [**inform** [**retry** *retries* | **timeout** *seconds*]]  
*community-string* [**version** {1 | 2c | 3} {**auth** | **noauth** | **priv**} [**udp-port** *port*]]

**no snmp-server host** *host-addr*

*host-addr* - IPv4 or IPv6 address of the host (the targeted recipient).  
(Maximum host addresses: 5 trap destination IP address entries)

**inform** - Notifications are sent as inform messages. Note that this option is only available for version 2c and 3 hosts. (Default: traps are used)

*retries* - The maximum number of times to resend an inform message if the recipient does not acknowledge receipt. (Range: 0-255; Default: 3)

*seconds* - The number of seconds to wait for an acknowledgment before resending an inform message. (Range: 0-2147483647 centiseconds; Default: 1500 centiseconds)

*community-string* - Password-like community string sent with the notification operation to SNMP V1 and V2c hosts. Although you can set this string using the **snmp-server host** command by itself, we recommend defining it with the [snmp-server community](#) command prior to using the **snmp-server host** command. (Maximum length: 32 characters)

**version** - Specifies whether to send notifications as SNMP Version 1, 2c or 3 traps. (Range: 1, 2c, 3; Default: 1)

**auth** | **noauth** | **priv** - This group uses SNMPv3 with authentication, no authentication, or with authentication and privacy. See "Simple Network Management Protocol" in the *Web Management Guide* for further information about these authentication and encryption options.

*port* - Host UDP port to use. (Range: 1-65535; Default: 162)

### Default Setting

Host Address: None

Notification Type: Traps

SNMP Version: 1

UDP Port: 162



## Command Mode

### Global Configuration

#### Command Usage

- ◆ If you do not enter an **snmp-server host** command, no notifications are sent. In order to configure the switch to send SNMP notifications, you must enter at least one **snmp-server host** command. In order to enable multiple hosts, you must issue a separate **snmp-server host** command for each host.
- ◆ The **snmp-server host** command is used in conjunction with the [snmp-server enable traps](#) command. Use the [snmp-server enable traps](#) command to enable the sending of traps or informs and to specify which SNMP notifications are sent globally. For a host to receive notifications, at least one [snmp-server enable traps](#) command and the **snmp-server host** command for that host must be enabled.
- ◆ Some notification types cannot be controlled with the [snmp-server enable traps](#) command. For example, some notification types are always enabled.
- ◆ Notifications are issued by the switch as trap messages by default. The recipient of a trap message does not send a response to the switch. Traps are therefore not as reliable as inform messages, which include a request for acknowledgement of receipt. Informs can be used to ensure that critical information is received by the host. However, note that informs consume more system resources because they must be kept in memory until a response is received. Informs also add to network traffic. You should consider these effects when deciding whether to issue notifications as traps or informs.

To send an inform to a SNMPv2c host, complete these steps:

1. Enable the SNMP agent ([page 195](#)).
2. Create a view with the required notification messages ([page 208](#)).
3. Create a group that includes the required notify view ([page 205](#)).
4. Allow the switch to send SNMP traps; i.e., notifications ([page 199](#)).
5. Specify the target host that will receive inform messages with the **snmp-server host** command as described in this section.

To send an inform to a SNMPv3 host, complete these steps:

1. Enable the SNMP agent ([page 195](#)).
2. Create a remote SNMPv3 user to use in the message exchange process ([page 206](#)).
3. Create a view with the required notification messages ([page 208](#)).
4. Create a group that includes the required notify view ([page 205](#)).
5. Allow the switch to send SNMP traps; i.e., notifications ([page 199](#)).
6. Specify the target host that will receive inform messages with the **snmp-server host** command as described in this section.

- ◆ The switch can send SNMP Version 1, 2c or 3 notifications to a host IP address, depending on the SNMP version that the management station supports. If the **snmp-server host** command does not specify the SNMP version, the default is to send SNMP version 1 notifications.
- ◆ If you specify an SNMP Version 3 host, then the community string is interpreted as an SNMP user name. The user name must first be defined with the [snmp-server user](#) command. Otherwise, an SNMPv3 group will be automatically created by the **snmp-server host** command using the name of the specified community string, and default settings for the read, write, and notify view.

### Example

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#
```

### Related Commands

[snmp-server enable traps \(199\)](#)

#### **snmp-server enable port-traps mac-notification**

This command enables the device to send SNMP traps (i.e., SNMP notifications) when a dynamic MAC address is added or removed. Use the no form to restore the default setting.

### Syntax

**[no] snmp-server enable port-traps mac-notification**

**mac-notification** - Keyword to issue trap when a dynamic MAC address is added or removed.

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

This command can enable MAC authentication traps on the current interface only if they are also enabled at the global level with the [snmp-server enable traps mac-authentication](#) command.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps mac-notification
Console(config)#
```

**show snmp-server enable port-traps** This command shows if SNMP traps are enabled or disabled for the specified interfaces.

#### Syntax

**show snmp-server enable port-traps interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

#### Command Mode

Privileged Exec

#### Example

```
Console#show snmp-server enable port-traps interface
Interface MAC Notification Trap
-----
Eth 1/1                                     No
Eth 1/2                                     No
Eth 1/3                                     No
:
```

## SNMPv3 Commands

**snmp-server engine-id** This command configures an identification string for the SNMPv3 engine. Use the **no** form to restore the default.

#### Syntax

**snmp-server engine-id** {**local** | **remote** {*ip-address*}} *engineid-string*

**no snmp-server engine-id** {**local** | **remote** {*ip-address*}}

**local** - Specifies the SNMP engine on this switch.

**remote** - Specifies an SNMP engine on a remote device.

*ip-address* - IPv4 or IPv6 address of the remote device.

*engineid-string* - String identifying the engine ID. (Range: 9-64 hexadecimal characters)

#### Default Setting

A unique engine ID is automatically generated by the switch based on its MAC address.

#### Command Mode

Global Configuration

### Command Usage

- ◆ An SNMP engine is an independent SNMP agent that resides either on this switch or on a remote device. This engine protects against message replay, delay, and redirection. The engine ID is also used in combination with user passwords to generate the security keys for authenticating and encrypting SNMPv3 packets.
- ◆ A remote engine ID is required when using SNMPv3 informs. (See the [snmp-server host](#) command.) The remote engine ID is used to compute the security digest for authentication and encryption of packets passed between the switch and a user on the remote host. SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.
- ◆ Trailing zeroes need not be entered to uniquely specify a engine ID. In other words, the value "0123456789" is equivalent to "0123456789" followed by 16 zeroes for a local engine ID.
- ◆ A local engine ID is automatically generated that is unique to the switch. This is referred to as the default engine ID. If the local engine ID is deleted or changed, all SNMP users will be cleared. You will need to reconfigure all existing users ([page 206](#)).

### Example

```
Console(config)#snmp-server engine-id local 1234567890
Console(config)#snmp-server engine-id remote 9876543210 192.168.1.19
Console(config)#
```

### Related Commands

[snmp-server host \(200\)](#)

**snmp-server group** This command adds an SNMP group, mapping SNMP users to SNMP views. Use the **no** form to remove an SNMP group.

### Syntax

```
snmp-server group groupname
    {v1 | v2c | v3 {auth | noauth | priv}}
    [read readview] [write writeview] [notify notifyview]
```

```
no snmp-server group groupname
```

*groupname* - Name of an SNMP group. (Range: 1-32 characters)

**v1** | **v2c** | **v3** - Use SNMP version 1, 2c or 3.

**auth** | **noauth** | **priv** - This group uses SNMPv3 with authentication, no authentication, or with authentication and privacy. See “Simple Network Management Protocol” in the *Web Management Guide* for further information about these authentication and encryption options.

*readview* - Defines the view for read access. (1-32 characters)

*writeview* - Defines the view for write access. (1-32 characters)

*notifyview* - Defines the view for notifications. (1-32 characters)

### Default Setting

Default groups: public<sup>1</sup> (read only), private<sup>2</sup> (read/write)

*readview* - Every object belonging to the Internet OID space (1).

*writeview* - Nothing is defined.

*notifyview* - Nothing is defined.

### Command Mode

Global Configuration

### Command Usage

- ◆ A group sets the access policy for the assigned users.
- ◆ When authentication is selected, the MD5 or SHA algorithm is used as specified in the [snmp-server user](#) command.
- ◆ When privacy is selected, the DES 56-bit algorithm is used for data encryption.
- ◆ For additional information on the notification messages supported by this switch, see the table for “Supported Notification Messages” in the *Web Management Guide*. Also, note that the authentication, link-up and link-down messages are legacy traps and must therefore be enabled in conjunction with the [snmp-server enable traps](#) command.

---

1. No view is defined.

2. Maps to the defaultview.

### Example

```
Console(config)#snmp-server group r&d v3 auth write daily
Console(config)#
```

**snmp-server user** This command adds a user to an SNMP group, restricting the user to a specific SNMP Read, Write, or Notify View. Use the **no** form to remove a user from an SNMP group.

### Syntax

**snmp-server user** *username* *groupname*  
{**v1** | **v2c** | **v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password* [**priv** {**3des** | **aes128** | **aes192** | **aes256** | **des56**} *priv-password*]]

**snmp-server user** *username* *groupname* **remote** *ip-address*  
{**v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password* [**priv** {**3des** | **aes128** | **aes192** | **aes256** | **des56**} *priv-password*]]

**no snmp-server user** *username* {**v1** | **v2c** | **v3** | **remote** *ip-address* **v3**}

*username* - Name of user connecting to the SNMP agent.  
(Range: 1-32 characters)

*groupname* - Name of an SNMP group to which the user is assigned.  
(Range: 1-32 characters)

**remote** - Specifies an SNMP engine on a remote device.

*ip-address* - IPv4 address of the remote device.

**v1** | **v2c** | **v3** - Use SNMP version 1, 2c or 3.

**encrypted** - Accepts the password as encrypted input.

**auth** - Uses SNMPv3 with authentication.

**md5** | **sha** - Uses MD5 or SHA authentication.

*auth-password* - Authentication password. Enter as plain text if the **encrypted** option is not used. Otherwise, enter an encrypted password.  
(Range: 8-32 characters for unencrypted password.)

If the **encrypted** option is selected, enter an encrypted password.  
(Range: 32 characters for MD5 encrypted password, 40 characters for SHA encrypted password)

**3des** - Uses SNMPv3 with privacy with 3DES (168-bit) encryption.

**aes128** - Uses SNMPv3 with privacy with AES128 encryption.

**aes192** - Uses SNMPv3 with privacy with AES192 encryption.

**aes256** - Uses SNMPv3 with privacy with AES256 encryption.

**des56** - Uses SNMPv3 with privacy with DES56 encryption.

*priv-password* - Privacy password. Enter as plain text if the **encrypted** option is not used. Otherwise, enter an encrypted password.  
(Range: 8-32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Local users (i.e., the command does not specify a remote engine identifier) must be configured to authorize management access for SNMPv3 clients, or to identify the source of SNMPv3 trap messages sent from the local switch.
- ◆ Remote users (i.e., the command specifies a remote engine identifier) must be configured to identify the source of SNMPv3 inform messages sent from the local switch.
- ◆ The SNMP engine ID is used to compute the authentication/privacy digests from the password. You should therefore configure the engine ID with the [snmp-server engine-id](#) command before using this configuration command.
- ◆ Before you configure a remote user, use the [snmp-server engine-id](#) command to specify the engine ID for the remote device where the user resides. Then use the **snmp-server user** command to specify the user and the IP address for the remote device where the user resides. The remote agent's SNMP engine ID is used to compute authentication/privacy digests from the user's password. If the remote engine ID is not first configured, the **snmp-server user** command specifying a remote user will fail.
- ◆ SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.

### Example

```
Console(config)#snmp-server user steve r&d v3 auth md5 greenpeace priv des56  
einstien  
Console(config)#snmp-server engine-id remote 192.168.1.19 9876543210  
Console(config)#snmp-server user mark r&d remote 192.168.1.19 v3 auth md5  
greenpeace priv des56 einstien  
Console(config)#
```

**snmp-server view** This command adds an SNMP view which controls user access to the MIB. Use the **no** form to remove an SNMP view.

### Syntax

**snmp-server view** *view-name oid-tree* {**included** | **excluded**}

**no snmp-server view** *view-name*

*view-name* - Name of an SNMP view. (Range: 1-32 characters)

*oid-tree* - Object identifier of a branch within the MIB tree. Wild cards can be used to mask a specific portion of the OID string. (Refer to the examples.)

**included** - Defines an included view.

**excluded** - Defines an excluded view.

### Default Setting

defaultview (includes access to the entire MIB tree)

### Command Mode

Global Configuration

### Command Usage

- ◆ Views are used in the [snmp-server group](#) command to restrict user access to specified portions of the MIB tree.
- ◆ The predefined view “defaultview” includes access to the entire MIB tree.

### Examples

This view includes MIB-2.

```
Console(config)#snmp-server view mib-2 1.3.6.1.2.1 included
Console(config)#
```

This view includes the MIB-2 interfaces table, ifDescr. The wild card is used to select all the index values in this table.

```
Console(config)#snmp-server view ifEntry.2 1.3.6.1.2.1.2.2.1.*.2 included
Console(config)#
```

This view includes the MIB-2 interfaces table, and the mask selects all index entries.

```
Console(config)#snmp-server view ifEntry.a 1.3.6.1.2.1.2.2.1.1.* included
Console(config)#
```



**show snmp engine-id** This command shows the SNMP engine ID.

### Command Mode

Privileged Exec

### Example

This example shows the default engine ID.

```
Console#show snmp engine-id
Local SNMP EngineID: 8000002a8000000000e8666672
Local SNMP EngineBoots: 1

Remote SNMP Engine ID                               IP address
80000000030004e2b316c54321                          192.168.1.19
Console#
```

**Table 31: show snmp engine-id - display description**

Field	Description
Local SNMP Engine ID	String identifying the engine ID.
Local SNMP Engine Boots	The number of times that the engine has (re-)initialized since the snmp EngineID was last configured.
Remote SNMP Engine ID	String identifying an engine ID on a remote device.
IP address	IP address of the device containing the corresponding remote SNMP engine.

**show snmp group** Four default groups are provided – SNMPv1 read-only access and read/write access, and SNMPv2c read-only access and read/write access.

### Command Mode

Privileged Exec

### Example

```
Console#show snmp group
Group Name: r&d
Security Model: v3
Read View: defaultview
Write View: daily
Notify View: none
Storage Type: permanent
Row Status: active

Group Name: public
Security Model: v1
Read View: defaultview
Write View: none
Notify View: none
Storage Type: volatile
Row Status: active
```

```
Group Name: public
Security Model: v2c
Read View: defaultview
Write View: none
Notify View: none
Storage Type: volatile
Row Status: active

Group Name: private
Security Model: v1
Read View: defaultview
Write View: defaultview
Notify View: none
Storage Type: volatile
Row Status: active

Group Name: private
Security Model: v2c
Read View: defaultview
Write View: defaultview
Notify View: none
Storage Type: volatile
Row Status: active

Console#
```

**Table 32: show snmp group - display description**

Field	Description
Group Name	Name of an SNMP group.
Security Model	The SNMP version.
Read View	The associated read view.
Write View	The associated write view.
Notify View	The associated notify view.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.

**show snmp user** This command shows information on SNMP users.

**Command Mode**  
Privileged Exec

### Example

```
Console#show snmp user
Engine ID       : 800001030300e00c0000fd0000
User Name       : steve
Group Name      : rd
Security Model   : v1
Security Level   : Authentication and privacy
Authentication Protocol : None
Privacy Protocol : None
Storage Type     : Nonvolatile
```

```

Row Status          : Active

SNMP remote user
Engine ID           : 0000937564846450000
User Name           : mark
Group Name          : public
Security Model      : v3
Security Level      : Authentication and privacy
Authentication Protocol : MD5
Privacy Protocol    : DES56
Storage Type        : Nonvolatile
Row Status          : Active

Console#

```

**Table 33: show snmp user - display description**

Field	Description
Engine ID	String identifying the engine ID.
User Name	Name of user connecting to the SNMP agent.
Group Name	Name of an SNMP group.
Security Model	The user security model: SNMP v1, v2c or v3.
Security Level	Indicates if authentication or encryption are used.
Authentication Protocol	The authentication protocol used with SNMPv3.
Privacy Protocol	The privacy protocol used with SNMPv3.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.
SNMP remote user	A user associated with an SNMP engine on a remote device.

**show snmp view** This command shows information on the SNMP views.

### Command Mode Privileged Exec

#### Example

```

Console#show snmp view
View Name      : mib-2
Subtree OID    : 1.2.2.3.6.2.1
View Type      : included
Storage Type   : permanent
Row Status     : active

View Name      : defaultview
Subtree OID    : 1
View Type      : included
Storage Type   : volatile
Row Status     : active

Console#

```

Table 34: show snmp view - display description

Field	Description
View Name	Name of an SNMP view.
Subtree OID	A branch in the MIB tree.
View Type	Indicates if the view is included or excluded.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.

## Notification Log Commands

**nlm** This command enables or disables the specified notification log.

### Syntax

**[no] nlm** *filter-name*

*filter-name* - Notification log name. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Notification logging is enabled by default, but will not start recording information until a logging profile specified by the [snmp-server notify-filter](#) command is enabled by the **nlm** command.
- ◆ Disabling logging with this command does not delete the entries stored in the notification log.

### Example

This example enables the notification log A1.

```
Console(config)#nlm A1
Console(config)#
```

**snmp-server notify-filter** This command creates an SNMP notification log. Use the **no** form to remove this log.

### Syntax

**[no] snmp-server notify-filter** *profile-name* **remote** *ip-address*

*profile-name* - Notification log profile name. (Range: 1-32 characters)

*ip-address* - IPv4 or IPv6 address of a remote device. The specified target host must already have been configured using the [snmp-server host](#) command.



**Note:** The notification log is stored locally. It is not sent to a remote device. This remote host parameter is only required to complete mandatory fields in the SNMP Notification MIB.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Systems that support SNMP often need a mechanism for recording Notification information as a hedge against lost notifications, whether there are Traps or Informs that may exceed retransmission limits. The Notification Log MIB (NLM, RFC 3014) provides an infrastructure in which information from other MIBs may be logged.
- ◆ Given the service provided by the NLM, individual MIBs can now bear less responsibility to record transient information associated with an event against the possibility that the Notification message is lost, and applications can poll the log to verify that they have not missed any important Notifications.
- ◆ If notification logging is not configured and enabled, when the switch reboots, some SNMP traps (such as warm start) cannot be logged.
- ◆ To avoid this problem, notification logging should be configured and enabled using the **snmp-server notify-filter** command and [nlm](#) command, and these commands stored in the startup configuration file. Then when the switch reboots, SNMP traps (such as warm start) can now be logged.
- ◆ When this command is executed, a notification log is created (with the default parameters defined in RFC 3014). Notification logging is enabled by default (see the [nlm](#) command), but will not start recording information until a logging profile specified with this command is enabled with the [nlm](#) command.
- ◆ Based on the default settings used in RFC 3014, a notification log can contain up to 256 entries, and the entry aging time is 1440 minutes. Information

recorded in a notification log, and the entry aging time can only be configured using SNMP from a network management station.

- ◆ When a trap host is created with the `snmp-server host` command, a default notify filter will be created as shown in the example under the `show snmp notify-filter` command.

### Example

This example first creates an entry for a remote host, and then instructs the switch to record this device as the remote host for the specified notification log.

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#snmp-server notify-filter A1 remote 10.1.19.23
Console#
```

**show nlm oper-status** This command shows the operational status of configured notification logs.

### Command Mode

Privileged Exec

### Example

```
Console#show nlm oper-status
Filter Name: A1
Oper-Status: Operational
Console#
```

**show snmp notify-filter** This command displays the configured notification logs.

### Command Mode

Privileged Exec

### Example

This example displays the configured notification logs and associated target hosts.

```
Console#show snmp notify-filter
Filter profile name      IP address
-----
A1                      10.1.19.23
Console#
```

## Additional Trap Commands

**memory** This command sets an SNMP trap based on configured thresholds for memory utilization. Use the **no** form to restore the default setting.

### Syntax

**memory** {**rising** *rising-threshold* | **falling** *falling-threshold*}

**no memory** {**rising** | **falling**}

*rising-threshold* - Rising threshold for memory utilization alarm expressed in percentage. (Range: 1-100)

*falling-threshold* - Falling threshold for memory utilization alarm expressed in percentage. (Range: 1-100)

### Default Setting

Rising Threshold: 90%

Falling Threshold: 70%

### Command Mode

Global Configuration

### Command Usage

Once the rising alarm threshold is exceeded, utilization must drop beneath the falling threshold before the alarm is terminated, and then exceed the rising threshold again before another alarm is triggered.

### Example

```
Console(config)#memory rising 80
Console(config)#memory falling 60
Console#
```

### Related Commands

[show memory \(121\)](#)

**process cpu** This command sets an SNMP trap based on configured thresholds for CPU utilization. Use the **no** form to restore the default setting.

### Syntax

**process cpu** {**rising** *rising-threshold* | **falling** *falling-threshold*}

**no process cpu** {**rising** | **falling**}

*rising-threshold* - Rising threshold for CPU utilization alarm expressed in percentage. (Range: 1-100)

*falling-threshold* - Falling threshold for CPU utilization alarm expressed in percentage. (Range: 1-100)

### Default Setting

Rising Threshold: 90%  
Falling Threshold: 70%

### Command Mode

Global Configuration

### Command Usage

Once the rising alarm threshold is exceeded, utilization must drop beneath the falling threshold before the alarm is terminated, and then exceed the rising threshold again before another alarm is triggered.

### Example

```
Console(config)#process cpu rising 80
Console(config)#process cpu falling 60
Console#
```

### Related Commands

[show process cpu \(121\)](#)

**process cpu guard** This command sets the CPU utilization high and low watermarks in percentage of CPU time utilized and the CPU high and low thresholds in the number of packets being processed per second. Use the **no** form of this command without any parameters to restore all of the default settings, or with a specific parameter to restore the default setting for that item.

### Syntax

**process cpu guard** [**high-watermark** *high-watermark* |  
**low-watermark** *low-watermark* | **max-threshold** *max-threshold* |  
**min-threshold** *min-threshold* | **trap**]

*high-watermark* - If the percentage of CPU usage time is higher than the high-watermark, the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until usage time falls below the low watermark.

*low-watermark* - If packet flow has been stopped after exceeding the high watermark, normal flow will be restored after usage falls beneath the low watermark.

*max-threshold* - If the number of packets being processed per second by the CPU is higher than the maximum threshold, the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until the number of packets being processed falls below the minimum threshold.

*min-threshold* - If packet flow has been stopped after exceeding the maximum threshold, normal flow will be restored after usage falls beneath the minimum threshold.



**trap** - If traps are enabled, the switch will send an alarm message if CPU utilization exceeds the high watermark in percentage of CPU usage time or exceeds the maximum threshold in the number of packets being processed by the CPU.

#### Default Setting

Guard Status: Disabled

High Watermark: 90%

Low Watermark: 70%

Maximum Threshold: 500 packets per second

Minimum Threshold: 50 packets per second

Trap Status: Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ Once the high watermark is exceeded, utilization must drop beneath the low watermark before the alarm is terminated, and then exceed the high watermark again before another alarm is triggered.
- ◆ Once the maximum threshold is exceeded, utilization must drop beneath the minimum threshold before the alarm is terminated, and then exceed the maximum threshold again before another alarm is triggered.

#### Example

```
Console(config)#process cpu guard high-watermark 80
Console(config)#process cpu guard low-watermark 60
Console(config)#
```

#### Related Commands

[show process cpu guard \(122\)](#)



## Remote Monitoring Commands

Remote Monitoring allows a remote device to collect information or respond to specified events on an independent basis. This switch is an RMON-capable device which can independently perform a wide range of tasks, significantly reducing network management traffic. It can continuously run diagnostics and log information on network performance. If an event is triggered, it can automatically notify the network administrator of a failure and provide historical information about the event. If it cannot connect to the management agent, it will continue to perform any specified tasks and pass data back to the management station the next time it is contacted.

This switch supports mini-RMON, which consists of the Statistics, History, Event and Alarm groups. When RMON is enabled, the system gradually builds up information about its physical interfaces, storing this information in the relevant RMON database group. A management agent then periodically communicates with the switch using the SNMP protocol. However, if the switch encounters a critical event, it can automatically send a trap message to the management agent which can then respond to the event if so configured.

**Table 35: RMON Commands**

Command	Function	Mode
<a href="#">rmon alarm</a>	Sets threshold bounds for a monitored variable	GC
<a href="#">rmon event</a>	Creates a response event for an alarm	GC
<a href="#">rmon collection history</a>	Periodically samples statistics	IC
<a href="#">rmon collection rmon1</a>	Enables statistics collection	IC
<a href="#">show rmon alarms</a>	Shows the settings for all configured alarms	PE
<a href="#">show rmon events</a>	Shows the settings for all configured events	PE
<a href="#">show rmon history</a>	Shows the sampling parameters for each entry	PE
<a href="#">show rmon statistics</a>	Shows the collected statistics	PE

**rmon alarm** This command sets threshold bounds for a monitored variable. Use the **no** form to remove an alarm.

### Syntax

```
rmon alarm index variable interval {absolute | delta}
rising-threshold threshold [event-index] falling-threshold threshold
[event-index] [owner name]
```

```
no rmon alarm index
```

*index* – Index to this entry. (Range: 1-65535)

*variable* – The object identifier of the MIB variable to be sampled. Only variables of the type etherStatsEntry.n.n may be sampled. Note that etherStatsEntry.n uniquely defines the MIB variable, and etherStatsEntry.n.n defines the MIB variable, plus the etherStatsIndex. For example, 1.3.6.1.2.1.16.1.1.1.6.1 denotes etherStatsBroadcastPkts, plus the etherStatsIndex of 1.

*interval* – The polling interval. (Range: 1-31622400 seconds)

**absolute** – The variable is compared directly to the thresholds at the end of the sampling period.

**delta** – The last sample is subtracted from the current value and the difference is then compared to the thresholds.

*threshold* – An alarm threshold for the sampled variable.  
(Range: 0-2147483647)

*event-index* – The index of the event to use if an alarm is triggered. If there is no corresponding entry in the event control table, then no event will be generated. (Range: 1-65535)

*name* – Name of the person who created this entry. (Range: 1-127 characters)

### Default Setting

1.3.6.1.2.1.16.1.1.1.6.1 - 1.3.6.1.2.1.16.1.1.1.6.28  
Taking delta samples every 30 seconds,  
Rising threshold is 892800, assigned to event 0  
Falling threshold is 446400, assigned to event 0

### Command Mode

Global Configuration

### Command Usage

- ◆ If an event is already defined for an index, the entry must be deleted before any changes can be made with this command.
- ◆ If the current value is greater than or equal to the rising threshold, and the last sample value was less than this threshold, then an alarm will be generated. After a rising event has been generated, another such event will not be

generated until the sampled value has fallen below the rising threshold, reaches the falling threshold, and again moves back up to the rising threshold.

- ◆ If the current value is less than or equal to the falling threshold, and the last sample value was greater than this threshold, then an alarm will be generated. After a falling event has been generated, another such event will not be generated until the sampled value has risen above the falling threshold, reaches the rising threshold, and again moves back down to the failing threshold.

### Example

```
Console(config)#rmon alarm 1 1.3.6.1.2.1.16.1.1.1.6.1 15 delta
    rising-threshold 100 1 falling-threshold 30 1 owner mike
Console(config)#
```

**rmon event** This command creates a response event for an alarm. Use the **no** form to remove an event.

### Syntax

**rmon event** *index* [**log**] | [**trap** *community*] | [**description** *string*] | [**owner** *name*]

**no rmon event** *index*

*index* – Index to this entry. (Range: 1-65535)

**log** – Generates an RMON log entry when the event is triggered. Log messages are processed based on the current configuration settings for event logging (see [“Event Logging” on page 156](#)).

**trap** – Sends a trap message to all configured trap managers (see the [snmp-server host](#) command).

*community* – A password-like community string sent with the trap operation to SNMP v1 and v2c hosts. Although this string can be set using the **rmon event** command by itself, it is recommended that the string be defined using the [snmp-server community](#) command prior to using the **rmon event** command. (Range: 1-32 characters)

*string* – A comment that describes this event. (Range: 1-127 characters)

*name* – Name of the person who created this entry. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Global Configuration

**Command Usage**

- ◆ If an event is already defined for an index, the entry must be deleted before any changes can be made with this command.
- ◆ The specified events determine the action to take when an alarm triggers this event. The response to an alarm can include logging the alarm or sending a message to a trap manager.

**Example**

```
Console(config)#rmon event 2 log description urgent owner mike
Console(config)#
```

**rmon collection history** This command periodically samples statistics on a physical interface. Use the no form to disable periodic sampling.

**Syntax**

**rmon collection history controlEntry** *index*

[**buckets** *number* [**interval** *seconds*]] |

[**interval** *seconds*] |

[**owner** *name* [**buckets** *number* [**interval** *seconds*]]]

**no rmon collection history controlEntry** *index*

*index* – Index to this entry. (Range: 1-65535)

*number* – The number of buckets requested for this entry. (Range: 1-65536)

*seconds* – The polling interval. (Range: 1-3600 seconds)

*name* – Name of the person who created this entry.  
(Range: 1-32 characters)

**Default Setting**

1.3.6.1.2.1.16.1.1.1.6.1 - 1.3.6.1.2.1.16.1.1.1.6.28

Buckets: 50

Interval: 30 seconds for even numbered entries,  
1800 seconds for odd numbered entries

**Command Mode**

Interface Configuration (Ethernet)

**Command Usage**

- ◆ By default, each index number equates to a port on the switch, but can be changed to any number not currently in use.
- ◆ If periodic sampling is already enabled on an interface, the entry must be deleted before any changes can be made with this command.
- ◆ The information collected for each sample includes:

input octets, packets, broadcast packets, multicast packets, undersize packets, oversize packets, fragments, jabbers, CRC alignment errors, collisions, drop events, and network utilization.

- ◆ The switch reserves two controlEntry index entries for each port. If a default index entry is re-assigned to another port by this command, the **show running-config** command will display a message indicating that this index is not available for the port to which is normally assigned.

For example, if control entry 15 is assigned to port 5 as shown below, the **show running-config** command will indicate that this entry is not available for port 8.

```
Console(config)#interface ethernet 1/5
Console(config-if)#rmon collection history controlEntry 15
Console(config-if)#end
Console#show running-config
!
interface ethernet 1/5
  rmon collection history controlEntry 15 buckets 50 interval 1800
...
interface ethernet 1/8
  no rmon collection history controlEntry 15
```

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rmon collection history controlentry 21 owner mike buckets
24 interval 60
Console(config-if)#
```

**rmon collection** This command enables the collection of statistics on a physical interface. Use the  
**rmon1** no form to disable statistics collection.

### Syntax

**rmon collection rmon1 controlEntry** *index* [**owner name**]

**no rmon collection rmon1 controlEntry** *index*

*index* – Index to this entry. (Range: 1-65535)

*name* – Name of the person who created this entry.  
 (Range: 1-32 characters)

### Default Setting

Enabled

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ By default, each index number equates to a port on the switch, but can be changed to any number not currently in use.

- ◆ If statistics collection is already enabled on an interface, the entry must be deleted before any changes can be made with this command.
- ◆ The information collected for each entry includes:  
input octets, packets, broadcast packets, multicast packets, undersize packets, oversize packets, fragments, jabbers, CRC alignment errors, collisions, drop events, and packets of specified lengths

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rmon collection rmon1 controlentry 1 owner mike
Console(config-if)#
```

**show rmon alarms** This command shows the settings for all configured alarms.

### Command Mode

Privileged Exec

### Example

```
Console#show rmon alarms
Alarm 1 is valid, owned by
Monitors 1.3.6.1.2.1.16.1.1.1.6.1 every 30 seconds
Taking delta samples, last value was 0
Rising threshold is 892800, assigned to event 0
Falling threshold is 446400, assigned to event 0
:
```

**show rmon events** This command shows the settings for all configured events.

### Command Mode

Privileged Exec

### Example

```
Console#show rmon events
Event 2 is valid, owned by mike
Description is urgent
Event firing causes log and trap to community , last fired 00:00:00
Console#
```

**show rmon history** This command shows the sampling parameters configured for each entry in the history group.

### Command Mode

Privileged Exec



**Example**

```

Console#show rmon history
Entry 1 is valid, and owned by
Monitors 1.3.6.1.2.1.2.2.1.1.1 every 1800 seconds
Requested # of time intervals, ie buckets, is 8
Granted # of time intervals, ie buckets, is 8
Sample # 1 began measuring at 00:00:01
Received 77671 octets, 1077 packets,
61 broadcast and 978 multicast packets,
0 undersized and 0 oversized packets,
0 fragments and 0 jabbers packets,
0 CRC alignment errors and 0 collisions.
# of dropped packet events is 0
Network utilization is estimated at 0
:

```

**show rmon statistics** This command shows the information collected for all configured entries in the statistics group.

**Command Mode**

Privileged Exec

**Example**

```

Console#show rmon statistics
Interface 1 is valid, and owned by
Monitors 1.3.6.1.2.1.2.2.1.1.1 which has
Received 164289 octets, 2372 packets,
120 broadcast and 2211 multicast packets,
0 undersized and 0 oversized packets,
0 fragments and 0 jabbers,
0 CRC alignment errors and 0 collisions.
# of dropped packet events (due to lack of resources): 0
# of packets received of length (in octets):
64: 2245, 65-127: 87, 128-255: 31,
256-511: 5, 512-1023: 2, 1024-1518: 2
:

```



# Flow Sampling Commands

Flow sampling (sFlow) can be used with a remote sFlow Collector to provide an accurate, detailed and real-time overview of the types and levels of traffic present on the network. The sFlow Agent samples 1 out of  $n$  packets from all data traversing the switch, re-encapsulates the samples as sFlow datagrams and transmits them to the sFlow Collector. This sampling occurs at the internal hardware level where all traffic is seen, whereas traditional probes only have a partial view of traffic as it is sampled at the monitored interface. Moreover, the processor and memory load imposed by the sFlow agent is minimal since local analysis does not take place.



**Note:** The terms “collector”, “receiver” and “owner”, in the context of this chapter, all refer to a remote server capable of receiving the sFlow datagrams generated by the sFlow agent of the switch.

**Table 36: sFlow Commands**

Command	Function	Mode
<code>sflow owner</code>	Creates an sFlow collector which the switch uses to send samples to.	PE
<code>sflow polling instance</code>	Configures an sFlow polling data source that takes samples periodically based on time.	PE
<code>sflow sampling instance</code>	Configures an sFlow sampling data source that samples periodically based on a packet count.	PE
<code>show sflow</code>	Shows the global and interface settings for the sFlow process	PE

**sflow owner** This command creates an sFlow collector on the switch. Use the **no** form to remove the sFlow receiver.

## Syntax

**sflow owner** *owner-name* **timeout** *timeout-value*  
 [**destination** {*ipv4-address* | *ipv6-address*}] [**port** *destination-udp-port*]  
 [**max-datagram-size** *max-datagram-size*] [**version** {**v4** | **v5**}]

**no sflow owner** *owner-name*

*owner-name* - Name of the collector. (Range: 1-30 alphanumeric characters)

*timeout-value* - The length of time the sFlow interface is available to send samples to a receiver, after which the owner and associated polling and

sampling data source instances are removed from the configuration.  
(Range: 30-10000000 seconds)

*ipv4-address* - IPv4 address of the sFlow collector. Valid IPv4 addresses consist of four decimal numbers, 0 to 255, separated by periods.

*ipv6-address* - IPv6 address of the sFlow collector. A full IPv6 address including the network prefix and host address bits. An IPv6 address consists of 8 colon-separated 16-bit hexadecimal values. One double colon may be used to indicate the appropriate number of zeros required to fill the undefined fields.

*destination-udp-port* - The UDP port on which the collector is listening for sFlow streams. (Range: 1-65535)

*max-datagram-size* - The maximum size of the sFlow datagram payload.  
(Range: 200-1500 bytes)

**version {v4 | v5}** - Sends either v4 or v5 sFlow datagrams to the receiver.

### Default Setting

No owner is configured

UDP Port: 6343

Version: v4

Maximum Datagram Size: 1400 bytes

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use the **sflow owner** command to create an owner instance of an sFlow collector. If the socket port, maximum datagram size, and datagram version are not specified, then the default values are used.
- ◆ Once an owner is created, the **sflow owner** command can again be used to modify the owner's port number. All other parameter values for the owner will be retained if the port is modified.
- ◆ Use the **no sflow owner** command to remove the collector.
- ◆ When the **sflow owner** command is issued, it's associated timeout value will immediately begin to count down. Once the timeout value has reached zero seconds, the sFlow owner and it's associated sampling sources will be deleted from the configuration.

### Example

This example shows an sflow collector being created on the switch.

```
Console(config)#sflow owner stat_server1 timeout 100 destination
192.168.220.225 port 22500 max-datagram-size 512 version v5
Console(config)#
```

This example shows how to modify the sFlow port number for an already configured collector.

```
Console(config)#sflow owner stat_server1 timeout 100 port 35100
Console(config)#
```

**sflow polling instance** This command enables an sFlow polling data source, for a specified interface, that polls periodically based on a specified time interval. Use the **no** form to remove the polling data source instance from the switch's sFlow configuration.

### Syntax

**sflow polling** {**interface** *interface*} **instance** *instance-id* **receiver** *owner-name* **polling-interval** *seconds*

**no sflow polling** {**interface** *interface*} **instance** *instance-id*

*interface* - The source from which the samples will be taken at specified intervals and sent to a collector.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*instance-id* - An instance ID used to identify the sampling source. (Range: 1)

*owner-name* - The associated receiver, to which the samples will be sent. (Range: 1-30 alphanumeric characters)

**polling-interval** - The time interval at which the sFlow process adds counter values to the sample datagram. (Range: 0-10000000 seconds, 0 disables this feature)

### Default Setting

No sFlow polling instance is configured.

### Command Mode

Privileged Exec

### Command Usage

This command enables a polling data source and configures the interval at which counter values are added to the sample datagram.

### Example

This example sets the polling interval to 10 seconds.

```
Console(config)#interface ethernet 1/9
Console(config-if)#sflow polling-interval 10
Console(config-if)#
```

**sflow sampling instance** This command enables an sFlow data source instance for a specific interface that takes samples periodically based on the number of packets processed. Use the **no** form to remove the sampling data source instance from the switch's sFlow configuration.

### Syntax

**sflow sampling** {**interface** *interface*} **instance** *instance-id* **receiver** *owner-name*  
**sampling-rate** *sample-rate*  
[**max-header-size** *max-header-size*]

**no sflow sample** {**interface** *interface*} **instance** *instance-id*

*interface* - The source from which the samples will be taken and sent to a collector.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*instance-id* - An instance ID used to identify the sampling source. (Range: 1)

*owner-name* - The associated receiver, to which the samples will be sent. (Range: 1-30 alphanumeric characters)

*sample-rate* - The packet sampling rate, or the number of packets out of which one sample will be taken. (Range: 256-16777215 packets)

*max-header-size* - The maximum size of the sFlow datagram header. (Range: 64-256 bytes)

### Default Setting

No sFlow sampling instance id configured.

Maximum Header Size: 128 bytes

### Command Mode

Privileged Exec

### Example

This example enables a sampling data source on Ethernet interface 1/1, an associated receiver named "owner1", and a sampling rate of one out of 100. The maximum header size is also set to 200 bytes.

```
Console# sflow sampling interface ethernet 1/1 instance 1 receiver owner1
sampling-rate 100 max-header-size 200
Console#
```

The following command removes a sampling data source from Ethernet interface 1/1.

```
Console# no sflow sampling interface ethernet 1/1 instance 1
Console#
```

**show sflow** This command shows the global and interface settings for the sFlow process.

### Syntax

**show sflow** [**owner** *owner-name* | **interface** *interface*]

*owner-name* - The associated receiver, to which the samples are sent.  
(Range: 1-30 alphanumeric characters)

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```
Console#show sflow interface ethernet 1/2

Receiver Owner Name   : stat1
Receiver Timeout      : 99633 sec
Receiver Destination  : 192.168.32.32
Receiver Socket Port  : 6343
Maximum Datagram Size : 1400 bytes
Datagram Version      : 4

Data Source           : Eth 1/2
Sampling Instance ID  : 1
Sampling Rate         : 512
Maximum Header Size   : 128 bytes

Console#
```





# Authentication Commands

You can configure this switch to authenticate users logging into the system for management access using local or remote authentication methods. Port-based authentication using IEEE 802.1X can also be configured to control either management access to the uplink ports or client access<sup>3</sup> to the data ports.

**Table 37: Authentication Commands**

Command Group	Function
User Accounts and Privilege Levels	Configures the basic user names and passwords for management access, and assigns a privilege level to specified command groups or individual commands
Authentication Sequence	Defines logon authentication method and precedence
RADIUS Client	Configures settings for authentication via a RADIUS server
TACACS+ Client	Configures settings for authentication via a TACACS+ server
AAA	Configures authentication, authorization, and accounting for network access
Web Server	Enables management access via a web browser
Telnet Server	Enables management access via Telnet
Secure Shell	Provides secure replacement for Telnet
802.1X Port Authentication	Configures host authentication on specific ports using 802.1X
Management IP Filter	Configures IP addresses that are allowed management access
PPPoE Intermediate Agent	Configures relay parameters required for sending authentication messages between a client and broadband remote access servers

3. For other methods of controlling client access, see [“General Security Measures” on page 299](#).

## User Accounts and Privilege Levels

The basic commands required for management access and assigning command privilege levels are listed in this section. This switch also includes other options for password checking via the console or a Telnet connection ([page 145](#)), user authentication via a remote authentication server ([page 233](#)), and host access authentication for specific ports ([page 272](#)).

Table 38: User Access Commands

Command	Function	Mode
<a href="#">enable password</a>	Sets a password to control access to the Privileged Exec level	GC
<a href="#">username</a>	Establishes a user name-based authentication system at login	GC
<a href="#">privilege</a>	Assigns a privilege level to specified command groups or individual commands	GC
<a href="#">show privilege</a>	Shows the privilege level for the current user, or the privilege level for commands modified by the privilege command	PE

**enable password** After initially logging onto the system, you should set the Privileged Exec password. Remember to record it in a safe place. This command controls access to the Privileged Exec level from the Normal Exec level. Use the **no** form to reset the default password.

### Syntax

**enable password** [**level** *level*] {**0** | **7**} *password*

**no enable password** [**level** *level*]

**level** *level* - Sets the command access privileges. (Range: 0-15)

Level 0, 8 and 15 are designed for users (guest), managers (network maintenance), and administrators (top-level access). The other levels can be used to configured specialized access profiles.

Level 0-7 provide the same default access privileges, all within Normal Exec mode under the "Console>" command prompt.

Level 8-14 provide the same default access privileges, including additional commands in Normal Exec mode, and a subset of commands in Privileged Exec mode under the "Console#" command prompt.

Level 15 provides full access to all commands.

The privilege level associated with any command can be changed using the [privilege](#) command.

{**0** | **7**} - 0 means plain password, 7 means encrypted password.

*password* - Password for this privilege level.

(Maximum length: 32 characters plain text or encrypted, case sensitive)

### Default Setting

The default is level 15.

The default password is "super"

### Command Mode

Global Configuration

### Command Usage

- ◆ You cannot set a null password. You will have to enter a password to change the command mode from Normal Exec to Privileged Exec with the [enable](#) command.
- ◆ The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from an FTP server. There is no need for you to manually configure encrypted passwords.

### Example

```
Console(config)#enable password level 15 0 admin
Console(config)#
```

### Related Commands

[enable \(103\)](#)

[authentication enable \(238\)](#)

**username** This command adds named users, requires authentication at login, specifies or changes a user's password (or specify that no password is required), or specifies or changes a user's access level. Use the **no** form to remove a user name.

### Syntax

**username** *name* {**access-level** *level* | **nopassword** | **password** {**0** | **7**} *password*}

**no username** *name*

*name* - The name of the user. (Maximum length: 32 characters, case sensitive. Maximum users: 16)

The device has two predefined users, **guest** which is assigned privilege level **0** (Normal Exec) and has access to a limited number of commands, and **admin** which is assigned privilege level 15 and has full access to all commands.

**access-level** *level* - Specifies command access privileges. (Range: 0-15)

Level 0, 8 and 15 are designed for users (guest), managers (network maintenance), and administrators (top-level access). The other levels can be used to configured specialized access profiles.

Level 0-7 provide the same default access privileges, all within Normal Exec mode under the "Console>" command prompt.

Level 8-14 provide the same default access privileges, including additional commands in Normal Exec mode, and a subset of commands in Privileged Exec mode under the “Console#” command prompt.

Level 15 provides full access to all commands.

The privilege level associated with any command can be changed using the **privilege** command.

Any privilege level can access all of the commands assigned to lower privilege levels. For example, privilege level 8 can access all commands assigned to privilege levels 7-0 according to default settings, and to any other commands assigned to levels 7-0 using the **privilege** command.

**nopassword** - No password is required for this user to log in.

{0 | 7} - 0 means plain password, 7 means encrypted password.

**password** *password* - The authentication password for the user. (Maximum length: 32 characters plain text or encrypted, case sensitive)

### Default Setting

The default access level is 0 (Normal Exec).

The factory defaults for the user names and passwords are:

**Table 39: Default Login Settings**

username	access-level	password
guest	0	guest
admin	15	admin

### Command Mode

Global Configuration

### Command Usage

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from an FTP server. There is no need for you to manually configure encrypted passwords.

### Example

This example shows how to set the access level and password for a user.

```
Console(config)#username bob access-level 15
Console(config)#username bob password 0 smith
Console(config)#
```

**privilege** This command assigns a privilege level to specified command groups or individual commands. Use the **no** form to restore the default setting.

### Syntax

**privilege** *mode* [**all**] **level** *level* *command*

**no privilege** *mode* [**all**] *command*

*mode* - The configuration mode containing the specified *command*.  
(See [“Understanding Command Modes” on page 92](#) and [“Configuration Commands” on page 94](#).)

**all** - Modifies the privilege level for all subcommands under the specified *command*.

**level** *level* - Specifies the privilege level for the specified *command*. Refer to the default settings described for the access level parameter under the [username](#) command. (Range: 0-15)

*command* - Specifies any command contained within the specified *mode*.

### Default Setting

Privilege level 0 provides access to a limited number of the commands which display the current status of the switch, as well as several database clear and reset functions. Level 8 provides access to all display status and configuration commands, except for those controlling various authentication and security features. Level 15 provides full access to all commands.

### Command Mode

Global Configuration

### Example

This example sets the privilege level for the ping command to Privileged Exec.

```
Console(config)#privilege exec level 15 ping
Console(config)#
```

**show privilege** This command shows the privilege level for the current user, or the privilege level for commands modified by the [privilege](#) command.

### Syntax

**show privilege** [**command**]

**command** - Displays the privilege level for all commands modified by the [privilege](#) command.

### Command Mode

Privileged Exec

### Example

This example shows the privilege level for any command modified by the [privilege](#) command.

```
Console#show privilege command
privilege line all level 0 accounting
privilege exec level 15 ping
Console(config)#
```

## Authentication Sequence

Three authentication methods can be specified to authenticate users logging into the system for management access. The commands in this section can be used to define the authentication method and sequence.

Table 40: Authentication Sequence Commands

Command	Function	Mode
<a href="#">authentication enable</a>	Defines the authentication method and precedence for command mode change	GC
<a href="#">authentication login</a>	Defines logon authentication method and precedence	GC

**authentication enable** This command defines the authentication method and precedence to use when changing from Exec command mode to Privileged Exec command mode with the [enable](#) command. Use the **no** form to restore the default.

### Syntax

**authentication enable** {[local] [radius] [tacacs]}

**no authentication enable**

**local** - Use local password only.

**radius** - Use RADIUS server password only.

**tacacs** - Use TACACS server password.

### Default Setting

Local

### Command Mode

Global Configuration

### Command Usage

- ◆ RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

- ◆ RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.
- ◆ You can specify three authentication methods in a single command to indicate the authentication sequence. For example, if you enter “**authentication enable radius tacacs local**,” the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.

### Example

```
Console(config)#authentication enable radius
Console(config)#
```

### Related Commands

[enable password](#) - sets the password for changing command modes (234)

**authentication login** This command defines the login authentication method and precedence. Use the **no** form to restore the default.

### Syntax

**authentication login** {[local] [radius] [tacacs]}

**no authentication login**

**local** - Use local password.

**radius** - Use RADIUS server password.

**tacacs** - Use TACACS server password.

### Default Setting

Local

### Command Mode

Global Configuration

### Command Usage

- ◆ RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.
- ◆ RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.

- ◆ You can specify three authentication methods in a single command to indicate the authentication sequence. For example, if you enter “**authentication login radius tacacs local**,” the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.

### Example

```
Console(config)#authentication login radius
Console(config)#
```

### Related Commands

[username](#) - for setting the local user names and passwords (235)

## RADIUS Client

Remote Authentication Dial-in User Service (RADIUS) is a logon authentication protocol that uses software running on a central server to control access to RADIUS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

Table 41: RADIUS Client Commands

Command	Function	Mode
<a href="#">radius-server acct-port</a>	Sets the RADIUS server network port	GC
<a href="#">radius-server auth-port</a>	Sets the RADIUS server network port	GC
<a href="#">radius-server host</a>	Specifies the RADIUS server	GC
<a href="#">radius-server key</a>	Sets the RADIUS encryption key	GC
<a href="#">radius-server retransmit</a>	Sets the number of retries	GC
<a href="#">radius-server timeout</a>	Sets the interval between sending authentication requests	GC
<a href="#">show radius-server</a>	Shows the current RADIUS settings	PE

**radius-server acct-port** This command sets the RADIUS server network port for accounting messages. Use the **no** form to restore the default.

### Syntax

**radius-server acct-port** *port-number*

**no radius-server acct-port**

*port-number* - RADIUS server UDP port used for accounting messages.  
(Range: 1-65535)



### Default Setting

1813

### Command Mode

Global Configuration

### Example

```
Console(config)#radius-server acct-port 181
Console(config)#
```

**radius-server acct-port** This command sets the RADIUS server network port. Use the **no** form to restore the default.

### Syntax

**radius-server acct-port** *port-number*

**no radius-server acct-port**

*port-number* - RADIUS server UDP port used for authentication messages.  
(Range: 1-65535)

### Default Setting

1812

### Command Mode

Global Configuration

### Example

```
Console(config)#radius-server auth-port 181
Console(config)#
```

**radius-server host** This command specifies primary and backup RADIUS servers, and authentication and accounting parameters that apply to each server. Use the **no** form to remove a specified server, or to restore the default values.

### Syntax

**[no] radius-server index host host-ip-address [acct-port acct-port] [auth-port auth-port] [key key] [retransmit retransmit] [timeout timeout]**

*index* - Allows you to specify up to five servers. These servers are queried in sequence until a server responds or the retransmit period expires.

*host-ip-address* - IP address of server.

*acct-port* - RADIUS server UDP port used for accounting messages.  
(Range: 1-65535)

*auth-port* - RADIUS server UDP port used for authentication messages.  
(Range: 1-65535)

*key* - Encryption key used to authenticate logon access for client. Enclose any string containing blank spaces in double quotes.  
(Maximum length: 48 characters)

*retransmit* - Number of times the switch will try to authenticate logon access via the RADIUS server. (Range: 1-30)

*timeout* - Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

### Default Setting

auth-port - 1812

acct-port - 1813

timeout - 5 seconds

retransmit - 2

### Command Mode

Global Configuration

### Example

```
Console(config)#radius-server 1 host 192.168.1.20 port 181 timeout 10
retransmit 5 key green
Console(config)#
```

**radius-server key** This command sets the RADIUS encryption key. Use the **no** form to restore the default.

### Syntax

**radius-server key** *key-string*

**no radius-server key**

*key-string* - Encryption key used to authenticate logon access for client. Enclose any string containing blank spaces in double quotes.  
(Maximum length: 48 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Example

```
Console(config)#radius-server key green
Console(config)#
```

**radius-server retransmit** This command sets the number of retries. Use the **no** form to restore the default.

#### Syntax

**radius-server retransmit** *number-of-retries*

**no radius-server retransmit**

*number-of-retries* - Number of times the switch will try to authenticate logon access via the RADIUS server. (Range: 1 - 30)

#### Default Setting

2

#### Command Mode

Global Configuration

#### Example

```
Console(config)#radius-server retransmit 5  
Console(config)#
```

**radius-server timeout** This command sets the interval between transmitting authentication requests to the RADIUS server. Use the **no** form to restore the default.

#### Syntax

**radius-server timeout** *number-of-seconds*

**no radius-server timeout**

*number-of-seconds* - Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

#### Default Setting

5

#### Command Mode

Global Configuration

#### Example

```
Console(config)#radius-server timeout 10  
Console(config)#
```

**show radius-server** This command displays the current settings for the RADIUS server.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#show radius-server

Remote RADIUS Server Configuration:

Global Settings:
  Authentication Port Number : 1812
  Accounting Port Number    : 1813
  Retransmit Times          : 2
  Request Timeout           : 5

Server 1:
  Server IP Address         : 192.168.1.1
  Authentication Port Number : 1812
  Accounting Port Number    : 1813
  Retransmit Times          : 2
  Request Timeout           : 5

RADIUS Server Group:
Group Name      Member Index
-----
radius          1
Console#
```

## TACACS+ Client

Terminal Access Controller Access Control System (TACACS+) is a logon authentication protocol that uses software running on a central server to control access to TACACS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

**Table 42: TACACS+ Client Commands**

Command	Function	Mode
<a href="#">tacacs-server host</a>	Specifies the TACACS+ server and optional parameters	GC
<a href="#">tacacs-server key</a>	Sets the TACACS+ encryption key	GC
<a href="#">tacacs-server port</a>	Specifies the TACACS+ server network port	GC
<a href="#">tacacs-server retransmit</a>	Sets the number of retries	GC
<a href="#">tacacs-server timeout</a>	Sets the interval between sending authentication requests	GC
<a href="#">show tacacs-server</a>	Shows the current TACACS+ settings	GC

**tacacs-server host** This command specifies the TACACS+ server and other optional parameters. Use the **no** form to remove the server, or to restore the default values.

### Syntax

**tacacs-server** *index* **host** *host-ip-address* [**key** *key*] [**port** *port-number*]  
[**retransmit** *retransmit*] [**timeout** *timeout*]

**no tacacs-server** *index*

*index* - The index for this server. (Range: 1)

*host-ip-address* - IP address of a TACACS+ server.

*key* - Encryption key used to authenticate logon access for the client.  
Enclose any string containing blank spaces in double quotes.  
(Maximum length: 48 characters)

*port-number* - TACACS+ server TCP port used for authentication messages.  
(Range: 1-65535)

*retransmit* - Number of times the switch will try to authenticate logon  
access via the TACACS+ server. (Range: 1-30)

*timeout* - Number of seconds the switch waits for a reply before resending  
a request. (Range: 1-540)

### Default Setting

authentication port - 49

timeout - 5 seconds

retransmit - 2

### Command Mode

Global Configuration

### Example

```
Console(config)#tacacs-server 1 host 192.168.1.25 port 181 timeout 10  
retransmit 5 key green  
Console(config)#
```

**tacacs-server key** This command sets the TACACS+ encryption key. Use the **no** form to restore the default.

### Syntax

**tacacs-server key** *key-string*

**no tacacs-server key**

*key-string* - Encryption key used to authenticate logon access for the client.  
Enclose any string containing blank spaces in double quotes.  
(Maximum length: 48 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Example

```
Console(config)#tacacs-server key green
Console(config)#
```

**tacacs-server port** This command specifies the TACACS+ server network port. Use the **no** form to restore the default.

### Syntax

**tacacs-server port** *port-number*

**no tacacs-server port**

*port-number* - TACACS+ server TCP port used for authentication messages.  
(Range: 1-65535)

### Default Setting

49

### Command Mode

Global Configuration

### Example

```
Console(config)#tacacs-server port 181
Console(config)#
```

**tacacs-server retransmit** This command sets the number of retries. Use the **no** form to restore the default.

### Syntax

**tacacs-server retransmit** *number-of-retries*

**no tacacs-server retransmit**

*number-of-retries* - Number of times the switch will try to authenticate logon access via the TACACS+ server. (Range: 1 - 30)

### Default Setting

2

### Command Mode

Global Configuration

### Example

```
Console(config)#tacacs-server retransmit 5
Console(config)#
```

**tacacs-server timeout** This command sets the interval between transmitting authentication requests to the TACACS+ server. Use the **no** form to restore the default.

### Syntax

**tacacs-server timeout** *number-of-seconds*

**no tacacs-server timeout**

*number-of-seconds* - Number of seconds the switch waits for a reply before resending a request. (Range: 1-540)

### Default Setting

5

### Command Mode

Global Configuration

### Example

```
Console(config)#tacacs-server timeout 10
Console(config)#
```

**show tacacs-server** This command displays the current settings for the TACACS+ server.

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show tacacs-server

Remote TACACS+ Server Configuration:

Global Settings:
Server Port Number : 49
Retransmit Times   : 2
Timeout            : 5

Server 1:
Server IP Address  : 10.11.12.13
Server Port Number : 49
Retransmit Times   : 2
Timeout            : 4
```

```
TACACS+ Server Group:
Group Name          Member Index
-----
tacacs+             1
Console#
```

## AAA

The Authentication, Authorization, and Accounting (AAA) feature provides the main framework for configuring access control on the switch. The AAA functions require the use of configured RADIUS or TACACS+ servers in the network.

**Table 43: AAA Commands**

Command	Function	Mode
<a href="#">aaa accounting commands</a>	Enables accounting of Exec mode commands	GC
<a href="#">aaa accounting dot1x</a>	Enables accounting of 802.1X services	GC
<a href="#">aaa accounting exec</a>	Enables accounting of Exec services	GC
<a href="#">aaa accounting update</a>	Enables periodic updates to be sent to the accounting server	GC
<a href="#">aaa authorization exec</a>	Enables authorization of Exec sessions	GC
<a href="#">aaa group server</a>	Groups security servers in to defined lists	GC
<a href="#">server</a>	Configures the IP address of a server in a group list	SG
<a href="#">accounting dot1x</a>	Applies an accounting method to an interface for 802.1X service requests	IC
<a href="#">accounting commands</a>	Applies an accounting method to CLI commands entered by a user	Line
<a href="#">accounting exec</a>	Applies an accounting method to local console, Telnet or SSH connections	Line
<a href="#">authorization exec</a>	Applies an authorization method to local console, Telnet or SSH connections	Line
<a href="#">show accounting</a>	Displays all accounting information	PE

**aaa accounting commands** This command enables the accounting of Exec mode commands. Use the **no** form to disable the accounting service.

### Syntax

**aaa accounting commands** *level* {**default** | *method-name*} **start-stop group** {**tacacs+** | *server-group*}

**no aaa accounting commands** *level* {**default** | *method-name*}

*level* - The privilege level for executing commands. (Range: 0-15)

**default** - Specifies the default accounting method for service requests.



*method-name* - Specifies an accounting method for service requests.  
(Range: 1-64 characters)

**start-stop** - Records accounting from starting point and stopping point.

**group** - Specifies the server group to use.

**tacacs+** - Specifies all TACACS+ hosts configured with the [tacacs-server host](#) command.

*server-group* - Specifies the name of a server group configured with the [aaa group server](#) command. (Range: 1-64 characters)

### Default Setting

Accounting is not enabled

No servers are specified

### Command Mode

Global Configuration

### Command Usage

- ◆ The accounting of Exec mode commands is only supported by TACACS+ servers.
- ◆ Note that the **default** and *method-name* fields are only used to describe the accounting method(s) configured on the specified TACACS+ server, and do not actually send any information to the server about the methods to use.

### Example

```
Console(config)#aaa accounting commands 15 default start-stop group tacacs+
Console(config)#
```

**aaa accounting dot1x** This command enables the accounting of requested 802.1X services for network access. Use the **no** form to disable the accounting service.

### Syntax

```
aaa accounting dot1x {default | method-name}
start-stop group {radius | tacacs+ | server-group}
no aaa accounting dot1x {default | method-name}
```

**default** - Specifies the default accounting method for service requests.

*method-name* - Specifies an accounting method for service requests.  
(Range: 1-64 characters)

**start-stop** - Records accounting from starting point and stopping point.

**group** - Specifies the server group to use.

**radius** - Specifies all RADIUS hosts configure with the [radius-server host](#) command.

**tacacs+** - Specifies all TACACS+ hosts configure with the [tacacs-server host](#) command.

*server-group* - Specifies the name of a server group configured with the [aaa group server](#) command. (Range: 1-64 characters)

### Default Setting

Accounting is not enabled

No servers are specified

### Command Mode

Global Configuration

### Command Usage

Note that the **default** and *method-name* fields are only used to describe the accounting method(s) configured on the specified RADIUS or TACACS+ servers, and do not actually send any information to the servers about the methods to use.

### Example

```
Console(config)#aaa accounting dot1x default start-stop group radius
Console(config)#
```

**aaa accounting exec** This command enables the accounting of requested Exec services for network access. Use the **no** form to disable the accounting service.

### Syntax

```
aaa accounting exec {default | method-name}
start-stop group {radius | tacacs+ | server-group}
no aaa accounting exec {default | method-name}
```

**default** - Specifies the default accounting method for service requests.

*method-name* - Specifies an accounting method for service requests.  
(Range: 1-64 characters)

**start-stop** - Records accounting from starting point and stopping point.

**group** - Specifies the server group to use.

**radius** - Specifies all RADIUS hosts configure with the [radius-server host](#) command.

**tacacs+** - Specifies all TACACS+ hosts configure with the [tacacs-server host](#) command.

*server-group* - Specifies the name of a server group configured with the [aaa group server](#) command. (Range: 1-64 characters)

### Default Setting

Accounting is not enabled  
No servers are specified

### Command Mode

Global Configuration

### Command Usage

- ◆ This command runs accounting for Exec service requests for the local console and Telnet connections.
- ◆ Note that the **default** and *method-name* fields are only used to describe the accounting method(s) configured on the specified RADIUS or TACACS+ servers, and do not actually send any information to the servers about the methods to use.

### Example

```
Console(config)#aaa accounting exec default start-stop group tacacs+
Console(config)#
```

**aaa accounting update** This command enables the sending of periodic updates to the accounting server. Use the **no** form to disable accounting updates.

### Syntax

**aaa accounting update** [*periodic interval*]

**no aaa accounting update**

*interval* - Sends an interim accounting record to the server at this interval.  
(Range: 1-2147483647 minutes)

### Default Setting

1 minute

### Command Mode

Global Configuration

### Command Usage

- ◆ When accounting updates are enabled, the switch issues periodic interim accounting records for all users on the system.
- ◆ Using the command without specifying an interim interval enables updates, but does not change the current interval setting.

### Example

```
Console(config)#aaa accounting update periodic 30
Console(config)#
```

**aaa authorization exec** This command enables the authorization for Exec access. Use the **no** form to disable the authorization service.

### Syntax

**aaa authorization exec** {**default** | *method-name*}  
**group** {**tacacs+** | *server-group*}

**no aaa authorization exec** {**default** | *method-name*}

**default** - Specifies the default authorization method for Exec access.

*method-name* - Specifies an authorization method for Exec access.  
(Range: 1-64 characters)

**group** - Specifies the server group to use.

**tacacs+** - Specifies all TACACS+ hosts configured with the [tacacs-server host](#) command.

*server-group* - Specifies the name of a server group configured with the [aaa group server](#) command. (Range: 1-64 characters)

### Default Setting

Authorization is not enabled  
No servers are specified

### Command Mode

Global Configuration

### Command Usage

- ◆ This command performs authorization to determine if a user is allowed to run an Exec shell for local console, Telnet, or SSH connections.
- ◆ AAA authentication must be enabled before authorization is enabled.
- ◆ If this command is issued without a specified named method, the default method list is applied to all interfaces or lines (where this authorization type applies), except those that have a named method explicitly defined.

### Example

```
Console(config)#aaa authorization exec default group tacacs+
Console(config)#
```

**aaa group server** Use this command to name a group of security server hosts. To remove a server group from the configuration list, enter the **no** form of this command.

### Syntax

**[no] aaa group server {radius | tacacs+} group-name**

**radius** - Defines a RADIUS server group.

**tacacs+** - Defines a TACACS+ server group.

*group-name* - A text string that names a security server group.  
(Range: 1-64 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Example

```
Console(config)#aaa group server radius tps
Console(config-sg-radius)#
```

**server** This command adds a security server to an AAA server group. Use the **no** form to remove the associated server from the group.

### Syntax

**[no] server {index | ip-address}**

*index* - Specifies the server index. (Range: RADIUS 1-5, TACACS+ 1)

*ip-address* - Specifies the host IP address of a server.

### Default Setting

None

### Command Mode

Server Group Configuration

### Command Usage

- ◆ When specifying the index for a RADIUS server, that server index must already be defined by the [radius-server host](#) command.
- ◆ When specifying the index for a TACACS+ server, that server index must already be defined by the [tacacs-server host](#) command.

### Example

```
Console(config)#aaa group server radius tps
Console(config-sg-radius)#server 10.2.68.120
Console(config-sg-radius)#
```

**accounting dot1x** This command applies an accounting method for 802.1X service requests on an interface. Use the **no** form to disable accounting on the interface.

### Syntax

**accounting dot1x** {**default** | *list-name*}

**no accounting dot1x**

**default** - Specifies the default method list created with the [aaa accounting dot1x](#) command.

*list-name* - Specifies a method list created with the [aaa accounting dot1x](#) command.

### Default Setting

None

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#accounting dot1x tps
Console(config-if)#
```

**accounting commands** This command applies an accounting method to entered CLI commands. Use the **no** form to disable accounting for entered CLI commands.

### Syntax

**accounting commands** *level* {**default** | *list-name*}

**no accounting commands** *level*

*level* - The privilege level for executing commands. (Range: 0-15)

**default** - Specifies the default method list created with the [aaa accounting commands](#) command.

*list-name* - Specifies a method list created with the [aaa accounting commands](#) command.

### Default Setting

None

## Command Mode

### Line Configuration

#### Example

```
Console(config)#line console
Console(config-line)#accounting commands 15 default
Console(config-line)#
```

**accounting exec** This command applies an accounting method to local console, Telnet or SSH connections. Use the **no** form to disable accounting on the line.

#### Syntax

**accounting exec** {**default** | *list-name*}

**no accounting exec**

**default** - Specifies the default method list created with the [aaa accounting exec](#) command.

*list-name* - Specifies a method list created with the [aaa accounting exec](#) command.

#### Default Setting

None

## Command Mode

### Line Configuration

#### Example

```
Console(config)#line console
Console(config-line)#accounting exec tps
Console(config-line)#exit
Console(config)#line vty
Console(config-line)#accounting exec default
Console(config-line)#
```

**authorization exec** This command applies an authorization method to local console, Telnet or SSH connections. Use the **no** form to disable authorization on the line.

#### Syntax

**authorization exec** {**default** | *list-name*}

**no authorization exec**

**default** - Specifies the default method list created with the [aaa authorization exec](#) command.

*list-name* - Specifies a method list created with the [aaa authorization exec](#) command.

### Default Setting

None

### Command Mode

Line Configuration

### Example

```
Console(config)#line console
Console(config-line)#authorization exec tps
Console(config-line)#exit
Console(config)#line vty
Console(config-line)#authorization exec default
Console(config-line)#
```

**show accounting** This command displays the current accounting settings per function and per port.

### Syntax

```
show accounting [commands [level]] |
[[dot1x [statistics [username user-name | interface interface]] |
exec [statistics] | statistics]
```

**commands** - Displays command accounting information.

*level* - Displays command accounting information for a specifiable command level.

**dot1x** - Displays dot1x accounting information.

**exec** - Displays Exec accounting records.

**statistics** - Displays accounting records.

*user-name* - Displays accounting records for a specifiable username.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show accounting
Accounting Type : dot1x
Method List    : default
Group List     : radius
```



```

Interface      : Eth 1/1

Method List    : tps
Group List     : radius
Interface      : Eth 1/2

Accounting Type : EXEC
Method List     : default
Group List      : tacacs+
Interface       : vty

Accounting Type : Commands 0
Method List     : default
Group List      : tacacs+
Interface       :
:
Accounting Type : Commands 15
Method List     : default
Group List      : tacacs+
Interface       :

Console#

```

## Web Server

This section describes commands used to configure web browser management access to the switch.

**Table 44: Web Server Commands**

Command	Function	Mode
<code>ip http port</code>	Specifies the port to be used by the web browser interface	GC
<code>ip http server</code>	Allows the switch to be monitored or configured from a browser	GC
<code>ip http secure-port</code>	Specifies the TCP port number for HTTPS	GC
<code>ip http secure-server</code>	Enables HTTPS (HTTP/SSL) for encrypted communications	GC

**ip http port** This command specifies the TCP port number used by the web browser interface. Use the **no** form to use the default port.

### Syntax

**ip http port** *port-number*

**no ip http port**

*port-number* - The TCP port to be used by the browser interface.  
(Range: 1-65535)

### Default Setting

80

### Command Mode

Global Configuration

#### Example

```
Console(config)#ip http port 769  
Console(config)#
```

#### Related Commands

[ip http server \(258\)](#)  
[show system \(126\)](#)

**ip http server** This command allows this device to be monitored or configured from a browser. Use the **no** form to disable this function.

#### Syntax

**[no] ip http server**

#### Default Setting

Enabled

### Command Mode

Global Configuration

#### Example

```
Console(config)#ip http server  
Console(config)#
```

#### Related Commands

[ip http port \(257\)](#)  
[show system \(126\)](#)

**ip http secure-port** This command specifies the TCP port number used for HTTPS connection to the switch's web interface. Use the **no** form to restore the default port.

#### Syntax

**ip http secure-port** *port\_number*

**no ip http secure-port**

*port\_number* – The TCP port used for HTTPS. (Range: 1-65535)

#### Default Setting

443

### Command Mode

Global Configuration

### Command Usage

- ◆ You cannot configure the HTTP and HTTPS servers to use the same port.
- ◆ If you change the HTTPS port number, clients attempting to connect to the HTTPS server must specify the port number in the URL, in this format: **https://device:port\_number**

### Example

```
Console(config)#ip http secure-port 1000  
Console(config)#
```

### Related Commands

[ip http secure-server \(259\)](#)

[show system \(126\)](#)

**ip http secure-server** This command enables the secure hypertext transfer protocol (HTTPS) over the Secure Socket Layer (SSL), providing secure access (i.e., an encrypted connection) to the switch's web interface. Use the **no** form to disable this function.

### Syntax

**[no] ip http secure-server**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Both HTTP and HTTPS service can be enabled independently on the switch. However, you cannot configure the HTTP and HTTPS servers to use the same UDP port.
- ◆ If you enable HTTPS, you must indicate this in the URL that you specify in your browser: **https://device[:port\_number]**
- ◆ When you start HTTPS, the connection is established in this way:
  - The client authenticates the server using the server's digital certificate.
  - The client and server negotiate a set of security protocols to use for the connection.
  - The client and server generate session keys for encrypting and decrypting data.

- ◆ The client and server establish a secure encrypted connection.

A padlock icon should appear in the status bar for Internet Explorer 6, Mozilla Firefox 4, or Google Chrome 29, or more recent versions.

The following web browsers and operating systems currently support HTTPS:

**Table 45: HTTPS System Support**

Web Browser	Operating System
Internet Explorer 11 or later	Windows 7, 8, 10
Mozilla Firefox 40 or later	Windows 7, 8, 10, Linux
Google Chrome 45 or later	Windows 7, 8, 10

- ◆ To specify a secure-site certificate, see “Replacing the Default Secure-site Certificate” in the *Web Management Guide*. Also refer to the [copy tftp https-certificate](#) command.
- ◆ Connection to the web interface is not supported for HTTPS using an IPv6 link local address.

### Example

```
Console(config)#ip http secure-server
Console(config)#
```

### Related Commands

[ip http secure-port \(258\)](#)  
[copy tftp https-certificate \(134\)](#)  
[show system \(126\)](#)

## Telnet Server

This section describes commands used to configure Telnet management access to the switch.

**Table 46: Telnet Server Commands**

Command	Function	Mode
<a href="#">ip telnet max-sessions</a>	Specifies the maximum number of Telnet sessions that can simultaneously connect to this system	GC
<a href="#">ip telnet port</a>	Specifies the port to be used by the Telnet interface	GC
<a href="#">ip telnet server</a>	Allows the switch to be monitored or configured from Telnet	GC
<a href="#">show ip telnet</a>	Displays configuration settings for the Telnet server	PE



**Note:** This switch also supports a Telnet client function. A Telnet connection can be made from this switch to another device by entering the **telnet** command at the Privileged Exec configuration level.

**ip telnet max-sessions** This command specifies the maximum number of Telnet sessions that can simultaneously connect to this system. Use the **no** form to restore the default setting.

#### Syntax

**ip telnet max-sessions** *session-count*

**no ip telnet max-sessions**

*session-count* - The maximum number of allowed Telnet session.  
(Range: 0-8)

#### Default Setting

8 sessions

#### Command Mode

Global Configuration

#### Command Usage

A maximum of eight sessions can be concurrently opened for Telnet and Secure Shell (i.e., both Telnet and SSH share a maximum number of eight sessions).

#### Example

```
Console(config)#ip telnet max-sessions 1
Console(config)#
```

**ip telnet port** This command specifies the TCP port number used by the Telnet interface. Use the **no** form to use the default port.

#### Syntax

**ip telnet port** *port-number*

**no telnet port**

*port-number* - The TCP port number to be used by the browser interface.  
(Range: 1-65535)

#### Default Setting

23

### Command Mode

Global Configuration

#### Example

```
Console(config)#ip telnet port 123  
Console(config)#
```

**ip telnet server** This command allows this device to be monitored or configured from Telnet. Use the **no** form to disable this function.

### Syntax

**[no] ip telnet server**

### Default Setting

Enabled

### Command Mode

Global Configuration

#### Example

```
Console(config)#ip telnet server  
Console(config)#
```

**show ip telnet** This command displays the configuration settings for the Telnet server.

### Command Mode

Normal Exec, Privileged Exec

#### Example

```
Console#show ip telnet  
IP Telnet Configuration:  
  
Telnet Status: Enabled  
Telnet Service Port: 23  
Telnet Max Session: 8  
Console#
```

## Secure Shell

This section describes the commands used to configure the SSH server. Note that you also need to install a SSH client on the management station when using this protocol to configure the switch.



**Note:** The switch supports both SSH Version 1.5 and 2.0 clients.

**Table 47: Secure Shell Commands**

Command	Function	Mode
<code>ip ssh authentication-retries</code>	Specifies the number of retries allowed by a client	GC
<code>ip ssh server</code>	Enables the SSH server on the switch	GC
<code>ip ssh server-key size</code>	Sets the SSH server key size	GC
<code>ip ssh timeout</code>	Specifies the authentication timeout for the SSH server	GC
<code>copy tftp public-key</code>	Copies the user's public key from a TFTP server to the switch	PE
<code>delete public-key</code>	Deletes the public key for the specified user	PE
<code>disconnect</code>	Terminates a line connection	PE
<code>ip ssh crypto host-key generate</code>	Generates the host key	PE
<code>ip ssh crypto zeroize</code>	Clear the host key from RAM	PE
<code>ip ssh save host-key</code>	Saves the host key from RAM to flash memory	PE
<code>show ip ssh</code>	Displays the status of the SSH server and the configured values for authentication timeout and retries	PE
<code>show public-key</code>	Shows the public key for the specified user or for the host	PE
<code>show ssh</code>	Displays the status of current SSH sessions	PE
<code>show users</code>	Shows SSH users, including privilege level and public key type	PE

### Configuration Guidelines

The SSH server on this switch supports both password and public key authentication. If password authentication is specified by the SSH client, then the password can be authenticated either locally or via a RADIUS or TACACS+ remote authentication server, as specified by the [authentication login](#) command. If public key authentication is specified by the client, then you must configure authentication keys on both the client and the switch as described in the following section. Note that regardless of whether you use public key or password authentication, you still have to generate authentication keys on the switch and enable the SSH server.

To use the SSH server, complete these steps:

1. Generate a Host Key Pair – Use the `ip ssh crypto host-key generate` command to create a host public/private key pair.
2. Provide Host Public Key to Clients – Many SSH client programs automatically import the host public key during the initial connection setup with the switch. Otherwise, you need to manually create a known hosts file on the management station and place the host public key in it. An entry for a public key in the known hosts file would appear similar to the following example:

```
10.1.0.54 1024 35 15684995401867669259333946775054617325313674890836547254
15020245593199868544358361651999923329781766065830956
108259132128902337654680172627257141342876294130119619556678259566410486957427
888146206519417467729848654686157177393901647793559423035774130980227370877945
4524083971752646358058176716709574804776117
```

3. Import Client's Public Key to the Switch – Use the `copy tftp public-key` command to copy a file containing the public key for all the SSH client's granted management access to the switch. (Note that these clients must be configured locally on the switch with the `username` command.) The clients are subsequently authenticated using these keys. The current firmware only accepts public key files based on standard UNIX format as shown in the following example for an RSA key:

```
1024 35
134108168560989392104094492015542534763164192187295892114317388005553616163105
177594083868631109291232226828519254374603100937187721199696317813662774141689
851320491172048303392543241016379975923714490119380060902539484084827178194372
288402533115952134861022902978982721353267131629432532818915045306393916643
steve@192.168.1.19
```

4. Set the Optional Parameters – Set other optional parameters, including the authentication timeout, the number of retries, and the server key size.
5. Enable SSH Service – Use the `ip ssh server` command to enable the SSH server on the switch.
6. *Authentication* – One of the following authentication methods is employed:

*Password Authentication (for SSH v1.5 or V2 Clients)*

- a. The client sends its password to the server.
- b. The switch compares the client's password to those stored in memory.
- c. If a match is found, the connection is allowed.



**Note:** To use SSH with only password authentication, the host public key must still be given to the client, either during initial connection or manually entered into the known host file. However, you do not need to configure the client's keys.



*Public Key Authentication* – When an SSH client attempts to contact the switch, the SSH server uses the host key pair to negotiate a session key and encryption method. Only clients that have a private key corresponding to the public keys stored on the switch can access it. The following exchanges take place during this process:

*Authenticating SSH v1.5 Clients*

- a. The client sends its RSA public key to the switch.
- b. The switch compares the client's public key to those stored in memory.
- c. If a match is found, the switch uses its secret key to generate a random 256-bit string as a challenge, encrypts this string with the user's public key, and sends it to the client.
- d. The client uses its private key to decrypt the challenge string, computes the MD5 checksum, and sends the checksum back to the switch.
- e. The switch compares the checksum sent from the client against that computed for the original string it sent. If the two checksums match, this means that the client's private key corresponds to an authorized public key, and the client is authenticated.

*Authenticating SSH v2 Clients*

- a. The client first queries the switch to determine if DSA public key authentication using a preferred algorithm is acceptable.
- b. If the specified algorithm is supported by the switch, it notifies the client to proceed with the authentication process. Otherwise, it rejects the request.
- c. The client sends a signature generated using the private key to the switch.
- d. When the server receives this message, it checks whether the supplied key is acceptable for authentication, and if so, it then checks whether the signature is correct. If both checks succeed, the client is authenticated.



---

**Note:** The SSH server supports up to eight client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

**Note:** The SSH server can be accessed using any configured IPv4 or IPv6 interface address on the switch.

---

**ip ssh authentication-retries** This command configures the number of times the SSH server attempts to reauthenticate a user. Use the **no** form to restore the default setting.

#### Syntax

**ip ssh authentication-retries** *count*

**no ip ssh authentication-retries**

*count* – The number of authentication attempts permitted after which the interface is reset. (Range: 1-5)

#### Default Setting

3

#### Command Mode

Global Configuration

#### Example

```
Console(config)#ip ssh authentication-retries 2
Console(config)#
```

#### Related Commands

[show ip ssh \(270\)](#)

**ip ssh server** This command enables the Secure Shell (SSH) server on this switch. Use the **no** form to disable this service.

#### Syntax

**[no] ip ssh server**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ The SSH server supports up to eight client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.
- ◆ The SSH server uses DSA or RSA for key exchange when the client first establishes a connection with the switch, and then negotiates with the client to select either DES (56-bit) or 3DES (168-bit) for data encryption.
- ◆ You must generate DSA and RSA host keys before enabling the SSH server.

### Example

```
Console#ip ssh crypto host-key generate dsa
Console#configure
Console(config)#ip ssh server
Console(config)#
```

### Related Commands

[ip ssh crypto host-key generate \(269\)](#)

[show ssh \(272\)](#)

**ip ssh server-key size** This command sets the SSH server key size. Use the **no** form to restore the default setting.

### Syntax

**ip ssh server-key size** *key-size*

**no ip ssh server-key size**

*key-size* – The size of server key. (Range: 512-896 bits)

### Default Setting

768 bits

### Command Mode

Global Configuration

### Command Usage

The server key is a private key that is never shared outside the switch.  
The host key is shared with the SSH client, and is fixed at 1024 bits.

### Example

```
Console(config)#ip ssh server-key size 512
Console(config)#
```

**ip ssh timeout** This command configures the timeout for the SSH server. Use the **no** form to restore the default setting.

### Syntax

**ip ssh timeout** *seconds*

**no ip ssh timeout**

*seconds* – The timeout for client response during SSH negotiation.  
(Range: 1-120)

### Default Setting

120 seconds

### Command Mode

Global Configuration

### Command Usage

The **timeout** specifies the interval the switch will wait for a response from the client during the SSH negotiation phase. Once an SSH session has been established, the timeout for user input is controlled by the [exec-timeout](#) command for vty sessions.

### Example

```
Console(config)#ip ssh timeout 60
Console(config)#
```

### Related Commands

[exec-timeout \(147\)](#)

[show ip ssh \(270\)](#)

**delete public-key** This command deletes the specified user's public key.

### Syntax

**delete public-key** *username* [**dsa** | **rsa**]

*username* – Name of an SSH user. (Range: 1-8 characters)

**dsa** – DSA public key type.

**rsa** – RSA public key type.

### Default Setting

Deletes both the DSA and RSA key.

### Command Mode

Privileged Exec

### Example

```
Console#delete public-key admin dsa
Console#
```

## **ip ssh crypto host-key generate**

This command generates the host key pair (i.e., public and private).

### **Syntax**

**ip ssh crypto host-key generate [dsa | rsa]**

**dsa** – DSA (Version 2) key type.

**rsa** – RSA (Version 1) key type.

### **Default Setting**

Generates both the DSA and RSA key pairs.

### **Command Mode**

Privileged Exec

### **Command Usage**

- ◆ The switch uses only RSA Version 1 for SSHv1.5 clients and DSA Version 2 for SSHv2 clients.
- ◆ This command stores the host key pair in memory (i.e., RAM). Use the [ip ssh save host-key](#) command to save the host key pair to flash memory.
- ◆ Some SSH client programs automatically add the public key to the known hosts file as part of the configuration process. Otherwise, you must manually create a known hosts file and place the host public key in it.
- ◆ The SSH server uses this host key to negotiate a session key and encryption method with the client trying to connect to it.

### **Example**

```
Console#ip ssh crypto host-key generate dsa
Console#
```

### **Related Commands**

[ip ssh crypto zeroize \(269\)](#)

[ip ssh save host-key \(270\)](#)

## **ip ssh crypto zeroize**

This command clears the host key from memory (i.e. RAM).

### **Syntax**

**ip ssh crypto zeroize [dsa | rsa]**

**dsa** – DSA key type.

**rsa** – RSA key type.

### **Default Setting**

Clears both the DSA and RSA key.

### Command Mode

Privileged Exec

### Command Usage

- ◆ This command clears the host key from volatile memory (RAM). Use the **no ip ssh save host-key** command to clear the host key from flash memory.
- ◆ The SSH server must be disabled before you can execute this command.

### Example

```
Console#ip ssh crypto zeroize dsa
Console#
```

### Related Commands

[ip ssh crypto host-key generate \(269\)](#)

[ip ssh save host-key \(270\)](#)

[no ip ssh server \(266\)](#)

**ip ssh save host-key** This command saves the host key from RAM to flash memory.

### Syntax

**ip ssh save host-key**

### Default Setting

Saves both the DSA and RSA key.

### Command Mode

Privileged Exec

### Example

```
Console#ip ssh save host-key dsa
Console#
```

### Related Commands

[ip ssh crypto host-key generate \(269\)](#)

**show ip ssh** This command displays the connection settings used when authenticating client access to the SSH server.

### Command Mode

Privileged Exec

### Example

```

Console#show ip ssh
SSH Enabled - Version 2.0
Negotiation Timeout : 120 seconds; Authentication Retries : 3
Server Key Size      : 768 bits
Console#

```

**show public-key** This command shows the public key for the specified user or for the host.

### Syntax

**show public-key [user [username]] host**

*username* – Name of an SSH user. (Range: 1-32 characters)

### Default Setting

Shows all public keys.

### Command Mode

Privileged Exec

### Command Usage

- ◆ If no parameters are entered, all keys are displayed. If the user keyword is entered, but no user name is specified, then the public keys for all users are displayed.
- ◆ When an RSA key is displayed, the first field indicates the size of the host key (e.g., 1024), the second field is the encoded public exponent (e.g., 35), and the last string is the encoded modulus. When a DSA key is displayed, the first field indicates that the encryption method used by SSH is based on the Digital Signature Standard (DSS), and the last string is the encoded modulus.

### Example

```

Console#show public-key host
Host:
RSA:
1024 65537 13236940658254764031382795526536375927835525327972629521130241
071942106165575942459093923609695405036277525755625100386613098939383452310
332802149888661921595568598879891919505883940181387440468908779160305837768
185490002831341625008348718449522087429212255691665655296328163516964040831
5547660664151657116381
DSA:
ssh-dss AAAB3NzaC1kc3MAAACBAPWKZTPbsRIB8ydEXcxM3dyV/yrDbKStIlnzD/Dg0h2Hxc
YV44sXZ2JXhamLK6P8bvuiyacWbUW/a4PATp1KMSdqsKeh3hKoA3vRRSy1N2XFfAKx15fwFfv
JlPdOkFgzLGMInvSNYQwiQXbKTBH0Z4mUZpe85PWxDZMacNBpJBrRAAAAFQChb4vsdfQGNiJwbv
wrNLaQ77isiwAAAIEAsy5YWDC99ebYHNRj5kh47wy4i8cZvH+/p9cnrfwFTMU01VFDly3IR
2G395NLy5Qd7ZDxfA9mCOFT/yyEfbbobMJZi8oGCstSN0xrZZVnMqWrTYfdrKX7YKBw/Kjw6Bm
iFq7O+jAhf1Dg451oAc27s6TLdtny1wRq/ow2eTCD5nekAAACBAJ8rMccXTxHLFAczWS7EjOy
Dbs1oBfPuSAb4oAsyjKXKVYNLQkTLZfcFRu41bS2KV5LAWecsigF/+DjKGWtPNIQqabKgYCw2
o/dVzX4Gg+yqdTlYmGA7fHGm8ARGeig4ssFKy4Z6DmYPXFum1Yg0fhLwuHpOSKdxT3kk475S7
w0W
Console#

```

**show ssh** This command displays the current SSH server connections.

### Command Mode

Privileged Exec

### Example

```
Console#show ssh
Connection Version State Username Encryption
1          2.0    Session-Started   admin    ctos aes128-cbc-hmac-md5
          stoc aes128-cbc-hmac-md5
Console#
```

**Table 48: show ssh - display description**

Field	Description
Connection	The session number. (Range: 1-8)
Version	The Secure Shell version number.
State	The authentication negotiation state. (Values: Negotiation-Started, Authentication-Started, Session-Started)
Username	The user name of the client.

## 802.1X Port Authentication

The switch supports IEEE 802.1X (dot1x) port-based access control that prevents unauthorized access to the network by requiring users to first submit credentials for authentication. Client authentication is controlled centrally by a RADIUS server using EAP (Extensible Authentication Protocol).

**Table 49: 802.1X Port Authentication Commands**

Command	Function	Mode
<i>General Commands</i>		
<a href="#">dot1x default</a>	Resets all dot1x parameters to their default values	GC
<a href="#">dot1x eapol-pass-through</a>	Passes EAPOL frames to all ports in STP forwarding state when dot1x is globally disabled	GC
<a href="#">dot1x system-auth-control</a>	Enables dot1x globally on the switch.	GC
<i>Authenticator Commands</i>		
<a href="#">dot1x intrusion-action</a>	Sets the port response to intrusion when authentication fails	IC
<a href="#">dot1x max-reauth-req</a>	Sets the maximum number of times that the switch sends an EAP-request/identity frame to the client before restarting the authentication process	IC
<a href="#">dot1x max-req</a>	Sets the maximum number of times that the switch retransmits an EAP request/identity packet to the client before it times out the authentication session	IC



**Table 49: 802.1X Port Authentication Commands** (Continued)

Command	Function	Mode
<code>dot1x operation-mode</code>	Allows single or multiple hosts on an dot1x port	IC
<code>dot1x port-control</code>	Sets dot1x mode for a port interface	IC
<code>dot1x re-authentication</code>	Enables re-authentication for all ports	IC
<code>dot1x timeout quiet-period</code>	Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client	IC
<code>dot1x timeout re-authperiod</code>	Sets the time period after which a connected client must be re-authenticated	IC
<code>dot1x timeout supp-timeout</code>	Sets the interval for a supplicant to respond	IC
<code>dot1x timeout tx-period</code>	Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet	IC
<code>dot1x re-authenticate</code>	Forces re-authentication on specific ports	PE
<i>Supplicant Commands</i>		
<code>dot1x identity profile</code>	Configures dot1x supplicant user name and password	GC
<code>dot1x max-start</code>	Sets the maximum number of times that a port supplicant will send an EAP start frame to the client	IC
<code>dot1x pae supplicant</code>	Enables dot1x supplicant mode on an interface	IC
<code>dot1x timeout auth-period</code>	Sets the time that a supplicant port waits for a response from the authenticator	IC
<code>dot1x timeout held-period</code>	Sets the time a port waits after the maximum start count has been exceeded before attempting to find another authenticator	IC
<code>dot1x timeout start-period</code>	Sets the time that a supplicant port waits before resending an EAPOL start frame to the authenticator	IC
<i>Information Display Commands</i>		
<code>show dot1x</code>	Shows all dot1x related information	PE

## General Commands

**dot1x default** This command sets all configurable dot1x authenticator global and port settings to their default values.

### Command Mode

Global Configuration

### Command Usage

This command resets the following commands to their default settings:

- ◆ `dot1x system-auth-control`
- ◆ `dot1x eapol-pass-through`
- ◆ `dot1x port-control`
- ◆ `dot1x port-control multi-host max-count`

- ◆ dot1x operation-mode
- ◆ dot1x max-req
- ◆ dot1x timeout quiet-period
- ◆ dot1x timeout tx-period
- ◆ dot1x timeout re-authperiod
- ◆ dot1x timeout sup-timeout
- ◆ dot1x re-authentication
- ◆ dot1x intrusion-action

### Example

```
Console(config)#dot1x default
Console(config)#
```

**dot1x eapol-pass-through** This command passes EAPOL frames through to all ports in STP forwarding state when dot1x is globally disabled. Use the **no** form to restore the default.

### Syntax

**[no] dot1x eapol-pass-through**

### Default Setting

Discards all EAPOL frames when dot1x is globally disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ When this device is functioning as intermediate node in the network and does not need to perform dot1x authentication, the **dot1x eapol pass-through** command can be used to forward EAPOL frames from other switches on to the authentication servers, thereby allowing the authentication process to still be carried out by switches located on the edge of the network.
- ◆ When this device is functioning as an edge switch but does not require any attached clients to be authenticated, the **no dot1x eapol-pass-through** command can be used to discard unnecessary EAPOL traffic.

### Example

This example instructs the switch to pass all EAPOL frame through to any ports in STP forwarding state.

```
Console(config)#dot1x eapol-pass-through
Console(config)#
```

**dot1x system-auth-control** This command enables IEEE 802.1X port authentication globally on the switch. Use the **no** form to restore the default.

#### Syntax

**[no] dot1x system-auth-control**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dot1x system-auth-control
Console(config)#
```

### Authenticator Commands

**dot1x intrusion-action** This command sets the port's response to a failed authentication, either to block all traffic, or to assign all traffic for the port to a guest VLAN. Use the **no** form to reset the default.

#### Syntax

**dot1x intrusion-action {block-traffic | guest-vlan}**

**no dot1x intrusion-action**

**block-traffic** - Blocks traffic on this port.

**guest-vlan** - Assigns the user to the Guest VLAN.

#### Default

block-traffic

#### Command Mode

Interface Configuration

#### Command Usage

- ◆ For guest VLAN assignment to be successful, the VLAN must be configured and set as active (see the [vlan database](#) command) and assigned as the guest VLAN for the port (see the [network-access guest-vlan](#) command).
- ◆ A port can only be assigned to the guest VLAN in case of failed authentication, if [switchport mode](#) is set to Hybrid.

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x intrusion-action guest-vlan
Console(config-if)#
```

**dot1x max-reauth-req** This command sets the maximum number of times that the switch sends an EAP-request/identity frame to the client before restarting the authentication process. Use the **no** form to restore the default.

### Syntax

**dot1x max-reauth-req** *count*

**no dot1x max-reauth-req**

*count* – The maximum number of requests (Range: 1-10)

### Default

2

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-reauth-req 2
Console(config-if)#
```

**dot1x max-req** This command sets the maximum number of times the switch port will retransmit an EAP request/identity packet to the client before it times out the authentication session. Use the **no** form to restore the default.

### Syntax

**dot1x max-req** *count*

**no dot1x max-req**

*count* – The maximum number of requests (Range: 1-10)

### Default

2

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-req 2
Console(config-if)#
```

**dot1x operation-mode** This command allows hosts (clients) to connect to an 802.1X-authorized port. Use the **no** form with no keywords to restore the default to single host. Use the **no** form with the **multi-host max-count** keywords to restore the default maximum count.

### Syntax

**dot1x operation-mode {single-host | multi-host [max-count *count*] | mac-based-auth}**

**no dot1x operation-mode [multi-host max-count]**

**single-host** – Allows only a single host to connect to this port.

**multi-host** – Allows multiple host to connect to this port.

**max-count** – Keyword for the maximum number of hosts.

*count* – The maximum number of hosts that can connect to a port.  
(Range: 1-1024; Default: 5)

**mac-based** – Allows multiple hosts to connect to this port, with each host needing to be authenticated.

### Default

Single-host

### Command Mode

Interface Configuration

### Command Usage

- ◆ The “max-count” parameter specified by this command is only effective if the dot1x mode is set to “auto” by the [dot1x port-control](#) command.
- ◆ In “multi-host” mode, only one host connected to a port needs to pass authentication for all other hosts to be granted network access. Similarly, a port can become unauthorized for all hosts if one attached host fails re-authentication or sends an EAPOL logoff message.
- ◆ In “mac-based-auth” mode, each host connected to a port needs to pass authentication. The number of hosts allowed access to a port operating in this mode is limited only by the available space in the secure address table (i.e., up to 1024 addresses).

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x operation-mode multi-host max-count 10
Console(config-if)#
```

**dot1x port-control** This command sets the dot1x mode on a port interface. Use the **no** form to restore the default.

### Syntax

**dot1x port-control {auto | force-authorized | force-unauthorized}**

**no dot1x port-control**

**auto** – Requires a dot1x-aware connected client to be authorized by the RADIUS server. Clients that are not dot1x-aware will be denied access.

**force-authorized** – Configures the port to grant access to all clients, either dot1x-aware or otherwise.

**force-unauthorized** – Configures the port to deny access to all clients, either dot1x-aware or otherwise.

### Default

force-authorized

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x port-control auto
Console(config-if)#
```

**dot1x re-authentication** This command enables periodic re-authentication for a specified port. Use the **no** form to disable re-authentication.

### Syntax

**[no] dot1x re-authentication**

### Command Mode

Interface Configuration

### Command Usage

- ◆ The re-authentication process verifies the connected client's user ID and password on the RADIUS server. During re-authentication, the client remains

connected the network and the process is handled transparently by the dot1x client software. Only if re-authentication fails is the port blocked.

- ◆ The connected client is re-authenticated after the interval specified by the `dot1x timeout re-authperiod` command. The default is 3600 seconds.

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x re-authentication
Console(config-if)#
```

### Related Commands

`dot1x timeout re-authperiod` (279)

**dot1x timeout quiet-period** This command sets the time that a switch port waits after the maximum request count (see [page 276](#)) has been exceeded before attempting to acquire a new client. Use the **no** form to reset the default.

### Syntax

**dot1x timeout quiet-period** *seconds*

**no dot1x timeout quiet-period**

*seconds* - The number of seconds. (Range: 1-65535)

### Default

60 seconds

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout quiet-period 350
Console(config-if)#
```

**dot1x timeout re-authperiod** This command sets the time period after which a connected client must be re-authenticated. Use the **no** form of this command to reset the default.

### Syntax

**dot1x timeout re-authperiod** *seconds*

**no dot1x timeout re-authperiod**

*seconds* - The number of seconds. (Range: 1-65535)

### Default

3600 seconds

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout re-authperiod 300
Console(config-if)#
```

**dot1x timeout supp-timeout** This command sets the time that an interface on the switch waits for a response to an EAP request from a client before re-transmitting an EAP packet. Use the **no** form to reset to the default value.

### Syntax

**dot1x timeout supp-timeout** *seconds*

**no dot1x timeout supp-timeout**

*seconds* - The number of seconds. (Range: 1-65535)

### Default

30 seconds

### Command Mode

Interface Configuration

### Command Usage

This command sets the timeout for EAP-request frames other than EAP-request/identity frames. If dot1x authentication is enabled on a port, the switch will initiate authentication when the port link state comes up. It will send an EAP-request/identity frame to the client to request its identity, followed by one or more requests for authentication information. It may also send other EAP-request frames to the client during an active connection as required for reauthentication.

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout supp-timeout 300
Console(config-if)#
```



**dot1x timeout tx-period** This command sets the time that an interface on the switch waits during an authentication session before re-transmitting an EAP packet. Use the **no** form to reset to the default value.

#### Syntax

**dot1x timeout tx-period** *seconds*

**no dot1x timeout tx-period**

*seconds* - The number of seconds. (Range: 1-65535)

#### Default

30 seconds

#### Command Mode

Interface Configuration

#### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout tx-period 300
Console(config-if)#
```

**dot1x re-authenticate** This command forces re-authentication on all ports or a specific interface.

#### Syntax

**dot1x re-authenticate** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Command Usage

The re-authentication process verifies the connected client's user ID and password on the RADIUS server. During re-authentication, the client remains connected the network and the process is handled transparently by the dot1x client software. Only if re-authentication fails is the port blocked.

#### Example

```
Console#dot1x re-authenticate
Console#
```

## Supplicant Commands

**dot1x identity profile** This command sets the dot1x supplicant user name and password. Use the **no** form to delete the identity settings.

### Syntax

**dot1x identity profile** {**username** *username* | **password** *password*}

**no dot1x identity profile** {**username** | **password**}

*username* - Specifies the supplicant user name. (Range: 1-8 characters)

*password* - Specifies the supplicant password. (Range: 1-8 characters)

### Default

No user name or password

### Command Mode

Global Configuration

### Command Usage

The global supplicant user name and password are used to identify this switch as a supplicant when responding to an MD5 challenge from the authenticator. These parameters must be set when this switch passes client authentication requests to another authenticator on the network (see the [dot1x pae supplicant](#) command).

### Example

```
Console(config)#dot1x identity profile username steve
Console(config)#dot1x identity profile password excess
Console(config)#
```

**dot1x max-start** This command sets the maximum number of times that a port supplicant will send an EAP start frame to the client before assuming that the client is 802.1X unaware. Use the **no** form to restore the default value.

### Syntax

**dot1x max-start** *count*

**no dot1x max-start**

*count* - Specifies the maximum number of EAP start frames.  
(Range: 1-65535)

### Default

3

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-start 10
Console(config-if)#
```

**dot1x pae supplicant** This command enables dot1x supplicant mode on a port. Use the **no** form to disable dot1x supplicant mode on a port.

### Syntax

**[no] dot1x pae supplicant**

### Default

Disabled

### Command Mode

Interface Configuration

### Command Usage

- ◆ When devices attached to a port must submit requests to another authenticator on the network, configure the identity profile parameters (see [dot1x identity profile](#) command) which identify this switch as a supplicant, and enable dot1x supplicant mode for those ports which must authenticate clients through a remote authenticator using this command. In this mode the port will not respond to dot1x messages meant for an authenticator.
- ◆ This switch can be configured to serve as the authenticator on selected ports by setting the control mode to “auto” (see the [dot1x port-control](#) command), and as a supplicant on other ports by the setting the control mode to “force-authorized” and enabling dot1x supplicant mode with this command.
- ◆ A port cannot be configured as a dot1x supplicant if it is a member of a trunk or LACP is enabled on the port.

### Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#dot1x pae supplicant
Console(config-if)#
```

**dot1x timeout auth-period** This command sets the time that a supplicant port waits for a response from the authenticator. Use the **no** form to restore the default setting.

#### Syntax

**dot1x timeout auth-period** *seconds*

**no dot1x timeout auth-period**

*seconds* - The number of seconds. (Range: 1-65535)

#### Default

30 seconds

#### Command Mode

Interface Configuration

#### Command Usage

This command sets the time that the supplicant waits for a response from the authenticator for packets other than EAPOL-Start.

#### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout auth-period 60
Console(config-if)#
```

**dot1x timeout held-period** This command sets the time that a supplicant port waits before resending its credentials to find a new authenticator. Use the **no** form to reset the default.

#### Syntax

**dot1x timeout held-period** *seconds*

**no dot1x timeout held-period**

*seconds* - The number of seconds. (Range: 1-65535)

#### Default

60 seconds

#### Command Mode

Interface Configuration

#### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout held-period 120
Console(config-if)#
```

**dot1x timeout start-period** This command sets the time that a supplicant port waits before resending an EAPOL start frame to the authenticator. Use the **no** form to restore the default setting.

#### Syntax

**dot1x timeout start-period** *seconds*

**no dot1x timeout start-period**

*seconds* - The number of seconds. (Range: 1-65535)

#### Default

30 seconds

#### Command Mode

Interface Configuration

#### Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout start-period 60
Console(config-if)#
```

## Information Display Commands

**show dot1x** This command shows general port authentication related settings on the switch or a specific interface.

#### Syntax

**show dot1x** [**statistics**] [**interface** *interface*]

**statistics** - Displays dot1x status for each port.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Command Usage

This command displays the following information:

- ◆ *Global 802.1X Parameters* – Shows whether or not 802.1X port authentication is globally enabled on the switch ([page 275](#)).

- ◆ *Authenticator Parameters* – Shows whether or not EAPOL pass-through is enabled ([page 274](#)).
- ◆ *Supplicant Parameters* – Shows the supplicant user name used when the switch responds to an MD5 challenge from an authenticator ([page 282](#)).
- ◆ *802.1X Port Summary* – Displays the port access control parameters for each interface that has enabled 802.1X, including the following items:
  - Type – Administrative state for port access control (Enabled, Authenticator, or Supplicant).
  - Operation Mode – Allows single or multiple hosts ([page 277](#)).
  - Control Mode – Dot1x port control mode ([page 278](#)).
  - Authorized – Authorization status (yes or n/a - not authorized).
- ◆ *802.1X Port Details* – Displays the port access control parameters for each interface, including the following items:
  - Reauthentication – Periodic re-authentication ([page 278](#)).
  - Reauth Period – Time after which a connected client must be re-authenticated ([page 279](#)).
  - Quiet Period – Time a port waits after Max Request Count is exceeded before attempting to acquire a new client ([page 279](#)).
  - TX Period – Time a port waits during authentication session before re-transmitting EAP packet ([page 281](#)).
  - Supplicant Timeout – Supplicant timeout.
  - Server Timeout – Server timeout. A RADIUS server must be set before the correct operational value of 10 seconds will be displayed in this field.
  - Reauth Max Retries – Maximum number of reauthentication attempts.
  - Max Request – Maximum number of times a port will retransmit an EAP request/identity packet to the client before it times out the authentication session ([page 276](#)).
  - Operation Mode– Shows if single or multiple hosts (clients) can connect to an 802.1X-authorized port.
  - Port Control–Shows the dot1x mode on a port as auto, force-authorized, or force-unauthorized ([page 278](#)).
  - Intrusion Action– Shows the port response to intrusion when authentication fails ([page 275](#)).
  - Supplicant– MAC address of authorized client.
- ◆ *Authenticator PAE State Machine*
  - State – Current state (including initialize, disconnected, connecting, authenticating, authenticated, aborting, held, force\_authorized, force\_unauthorized).
  - Reauth Count– Number of times connecting state is re-entered.
  - Current Identifier– The integer (0-255) used by the Authenticator to identify the current authentication session.

#### ◆ Backend State Machine

- State – Current state (including request, response, success, fail, timeout, idle, initialize).
- Request Count– Number of EAP Request packets sent to the Supplicant without receiving a response.
- Identifier (Server)– Identifier carried in the most recent EAP Success, Failure or Request packet received from the Authentication Server.

#### ◆ Reauthentication State Machine

State – Current state (including initialize, reauthenticate).

#### Example

```

Console#show dot1x
Global 802.1X Parameters
  System Auth Control      : Enabled

Authenticator Parameters:
  EAPOL Pass Through      : Disabled

Supplicant Parameters:
  Identity Profile Username : steve

802.1X Port Summary

Port      Type      Operation Mode Control Mode    Authorized
-----
Eth 1/ 1 Disabled    Single-Host    Force-Authorized Yes
Eth 1/ 2 Disabled    Single-Host    Force-Authorized Yes
.
.
Eth 1/27 Disabled    Single-Host    Force-Authorized Yes
Eth 1/28 Enabled      Single-Host    Auto           Yes

802.1X Port Details

802.1X Authenticator is enabled on port 1/1
802.1X Supplicant is disabled on port 1/1
.
.
802.1X Authenticator is enabled on port 28
Reauthentication      : Enabled
Reauth Period         : 3600
Quiet Period          : 60
TX Period              : 30
Supplicant Timeout    : 30
Server Timeout        : 10
Reauth Max Retries    : 2
Max Request           : 2
Operation Mode        : Multi-host
Port Control          : Auto
Intrusion Action      : Block traffic

Supplicant             : 00-e0-29-94-34-65

Authenticator PAE State Machine
State                  : Authenticated
Reauth Count           : 0
  
```

```
Current Identifier : 3

Backend State Machine
State             : Idle
Request Count     : 0
Identifier(Server) : 2

Reauthentication State Machine
State             : Initialize

Console#
```

## Management IP Filter

This section describes commands used to configure IP management access to the switch.

**Table 50: Management IP Filter Commands**

Command	Function	Mode
<code>management</code>	Configures IP addresses that are allowed management access	GC
<code>show management</code>	Displays the switch to be monitored or configured from a browser	PE

**management** This command specifies the client IP addresses that are allowed management access to the switch through various protocols. A list of up to 15 IP addresses or IP address groups can be specified. Use the **no** form to restore the default setting.

### Syntax

**[no] management {all-client | http-client | snmp-client | telnet-client} start-address [end-address]**

**all-client** - Adds IP address(es) to all groups.

**http-client** - Adds IP address(es) to the web group.

**snmp-client** - Adds IP address(es) to the SNMP group.

**telnet-client** - Adds IP address(es) to the Telnet group.

*start-address* - A single IP address, or the starting address of a range.

*end-address* - The end address of a range.

### Default Setting

All addresses

### Command Mode

Global Configuration



### Command Usage

- ◆ The management interfaces are open to all IP addresses by default. Once you add an entry to a filter list, access to that interface is restricted to the specified addresses.
- ◆ If anyone tries to access a management interface on the switch from an invalid address, the switch will reject the connection, enter an event message in the system log, and send a trap message to the trap manager.
- ◆ IP address can be configured for SNMP, web, and Telnet access respectively. Each of these groups can include up to five different sets of addresses, either individual addresses or address ranges.
- ◆ When entering addresses for the same group (i.e., SNMP, web, or Telnet), the switch will not accept overlapping address ranges. When entering addresses for different groups, the switch will accept overlapping address ranges.
- ◆ You cannot delete an individual address from a specified range. You must delete the entire range, and re-enter the addresses.
- ◆ You can delete an address range just by specifying the start address, or by specifying both the start address and end address.

### Example

This example restricts management access to the indicated addresses.

```
Console(config)#management all-client 192.168.1.19
Console(config)#management all-client 192.168.1.25 192.168.1.30
Console#
```

**show management** This command displays the client IP addresses that are allowed management access to the switch through various protocols.

### Syntax

**show management {all-client | http-client | snmp-client | telnet-client}**

**all-client** - Displays IP addresses for all groups.

**http-client** - Displays IP addresses for the web group.

**snmp-client** - Displays IP addresses for the SNMP group.

**telnet-client** - Displays IP addresses for the Telnet group.

### Command Mode

Privileged Exec

### Example

```
Console#show management all-client
Management Ip Filter
  HTTP-Client:
    Start IP address      End IP address
    -----
    1. 192.168.1.19        192.168.1.19
    2. 192.168.1.25        192.168.1.30

  SNMP-Client:
    Start IP address      End IP address
    -----
    1. 192.168.1.19        192.168.1.19
    2. 192.168.1.25        192.168.1.30

  TELNET-Client:
    Start IP address      End IP address
    -----
    1. 192.168.1.19        192.168.1.19
    2. 192.168.1.25        192.168.1.30

Console#
```

## PPPoE Intermediate Agent

This section describes commands used to configure the PPPoE Intermediate Agent (PPPoE IA) relay parameters required for passing authentication messages between a client and broadband remote access servers.

**Table 51: PPPoE Intermediate Agent Commands**

Command	Function	Mode
<a href="#">pppoe intermediate-agent</a>	Enables the PPPoE IA globally on the switch	GC
<a href="#">pppoe intermediate-agent port-enable</a>	Enables the PPPoE IA on an interface	IC
<a href="#">pppoe intermediate-agent port-format-type</a>	Sets the circuit-id or remote-id for an interface	IC
<a href="#">pppoe intermediate-agent port-format-type remote-id-delimiter</a>	Sets the remote-id delimiter for an interface	IC
<a href="#">pppoe intermediate-agent trust</a>	Sets the trust mode for an interface	IC
<a href="#">pppoe intermediate-agent vendor-tag strip</a>	Enables the stripping of vendor tags from PPPoE Discovery packets sent from a PPPoE server	IC
<a href="#">clear pppoe intermediate-agent statistics</a>	Clears PPPoE IA statistics	PE
<a href="#">show pppoe intermediate-agent info</a>	Displays PPPoE IA configuration settings	PE
<a href="#">show pppoe intermediate-agent statistics</a>	Displays PPPoE IA statistics	PE

**pppoe intermediate-agent** This command enables the PPPoE Intermediate Agent globally on the switch. Use the **no** form to disable this feature.

### Syntax

**[no] pppoe intermediate-agent**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ The switch inserts a tag identifying itself as a PPPoE Intermediate Agent residing between the attached client requesting network access and the ports connected to broadband remote access servers (BRAS). The switch extracts access-loop information from the client's PPPoE Active Discovery Request, and forwards this information to all trusted ports designated by the **pppoe intermediate-agent trust** command. The BRAS detects the presence of the subscriber's circuit-ID tag inserted by the switch during the PPPoE discovery phase, and sends this tag as a NAS-port-ID attribute in PPP authentication and AAA accounting requests to a RADIUS server.
- ◆ PPPoE IA must be enabled globally by this command before this feature can be enabled on an interface using the **pppoe intermediate-agent port-enable** command.

### Example

```
Console(config)#pppoe intermediate-agent
Console(config)#
```

**pppoe intermediate-agent format-type** This command sets the access node identifier or generic error message the switch. Use the **no** form to restore the default settings.

### Syntax

**pppoe intermediate-agent format-type {access-node-identifier *id-string* | generic-error-message *error-message*}**

**no pppoe intermediate-agent format-type {access-node-identifier | generic-error-message}**

*id-string* - String identifying this switch as an PPPoE IA to the PPPoE server.  
(Range: 1-48 ASCII characters)

*error-message* - An error message notifying the sender that the PPPoE Discovery packet was too large.

### Default Setting

- ◆ Access Node Identifier: IP address of the first IPv4 interface on the switch.
- ◆ Generic Error Message: PPPoE Discover packet too large to process. Try reducing the number of tags added.

### Command Mode

Global Configuration

### Command Usage

- ◆ The switch uses the access-node-identifier to generate the circuit-id for PPPoE discovery stage packets sent to the BRAS, but does not modify the source or destination MAC address of these PPPoE discovery packets.
- ◆ These messages are forwarded to all trusted ports designated by the `pppoe intermediate-agent trust` command.

### Example

```
Console(config)#pppoe intermediate-agent format-type access-node-identifier  
billibong  
Console(config)#
```

### `pppoe intermediate-agent port-enable`

This command enables the PPPoE IA on an interface. Use the **no** form to disable this feature.

### Syntax

**[no] pppoe intermediate-agent port-enable**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

PPPoE IA must also be enabled globally on the switch for this command to take effect.

### Example

```
Console(config)#interface ethernet 1/5  
Console(config-if)#pppoe intermediate-agent port-enable  
Console(config-if)#
```

**pppoe  
intermediate-agent  
port-format-type**

This command sets the circuit-id or remote-id for an interface. Use the **no** form to restore the default settings.

**Syntax**

**pppoe intermediate-agent port-format-type {circuit-id | remote-id}**  
*id-string*

**circuit-id** - String identifying the circuit identifier (or interface) on this switch to which the user is connected. (Range: 1-10 ASCII characters)

**remote-id** - String identifying the remote identifier (or interface) on this switch to which the user is connected. (Range: 1-63 ASCII characters)

**Default Setting**

circuit-id: unit/port:vlan-id or 0/trunk-id:vlan-id  
remote-id: port MAC address

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ The PPPoE server extracts the Line-ID tag from PPPoE discovery stage messages, and uses the Circuit-ID field of that tag as a NAS-Port-ID attribute in AAA access and accounting requests.
- ◆ The switch intercepts PPPoE discovery frames from the client and inserts a unique line identifier using the PPPoE Vendor-Specific tag (0x0105) to PPPoE Active Discovery Initiation (PADI) and Request (PADR) packets. The switch then forwards these packets to the PPPoE server. The tag contains the Line-ID of the customer line over which the discovery packet was received, entering the switch (or access node) where the intermediate agent resides.
- ◆ Outgoing PAD Offer (PADO) and Session-confirmation (PADS) packets sent from the PPPoE Server include the Circuit-ID tag inserted by the switch, and should be stripped out of PADO and PADS packets which are to be passed directly to end-node clients using the [pppoe intermediate-agent vendor-tag strip](#) command.
- ◆ If the remote-id is unspecified, the port name will be used for this parameter. If the port name is not configured, the remote-id is set to the port MAC (yy-yy-yy-yy-yy-yy#), where # is the default delimiter.

**Example**

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent port-format-type circuit-id
GTL-2891
Console(config-if)#
```

**pppoe  
intermediate-agent  
port-format-type  
remote-id-delimiter**

This command sets the remote-id delimiter for an interface. Use the **enable** keyword to enable the delimiter. Use the **no** form with the **enable** keyword to disable the delimiter. Use the **no** form without any keywords to restore the default settings.

**Syntax**

**pppoe intermediate-agent port-format-type remote-id-delimiter**  
**{enable | *ascii-code*}**

*ascii-code* - ASCII character of delimiter. (Range: 0-255)

**Default Setting**

Disabled

ASCII code: 35 ("#")

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

If the delimiter is enabled and it occurs in the remote ID string, the string will be truncated at that point.

**Example**

This command enables the delimiter for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent port-format-type remote-id-
delimiter
Console(config-if)#
```

**pppoe  
intermediate-agent  
trust**

This command sets an interface to trusted mode to indicate that it is connected to a PPPoE server. Use the **no** form to set an interface to untrusted mode.

**Syntax**

**[no] pppoe intermediate-agent trust**

**Default Setting**

Untrusted

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ Set any interfaces connecting the switch to a PPPoE Server as trusted. Interfaces that connect the switch to users (PPPoE clients) should be set as untrusted.

- ◆ At least one trusted interface must be configured on the switch for the PPPoE IA to function.

### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent trust
Console(config-if)#
```

### pppoe intermediate-agent vendor-tag strip

This command enables the stripping of vendor tags from PPPoE Discovery packets sent from a PPPoE server. Use the **no** form to disable this feature.

#### Syntax

**[no] pppoe intermediate-agent vendor-tag strip**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

This command only applies to trusted interfaces. It is used to strip off vendor-specific tags (which carry subscriber and line identification information) in PPPoE Discovery packets received from an upstream PPPoE server before forwarding them to a user.

### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent vendor-tag strip
Console(config-if)#
```

### clear pppoe intermediate-agent statistics

This command clears statistical counters for the PPPoE Intermediate Agent.

#### Syntax

**clear pppoe intermediate-agent statistics interface** *[interface]*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

## Command Mode

### Privileged Exec

### Example

```
Console#clear pppoe intermediate-agent statistics interface
Console#
```

**show pppoe intermediate-agent info** This command displays configuration settings for the PPPoE Intermediate Agent.

**Syntax**

```
show pppoe intermediate-agent info [interface [interface]]
                                interface
                                ethernet unit/port
                                unit - Unit identifier. (Range: 1-8)
                                port - Port number. (Range: 1-28)
                                port-channel channel-id (Range: 1-16)
```

## Command Mode

### Privileged Exec

### Example

```
Console#show pppoe intermediate-agent info
PPPoE Intermediate Agent Global Status           : Enabled
PPPoE Intermediate Agent Vendor ID              : 3561
PPPoE Intermediate Agent Admin Access Node Identifier : 192.168.0.2
PPPoE Intermediate Agent Oper Access Node Identifier : 192.168.0.2
PPPoE Intermediate Agent Admin Generic Error Message :
PPPoE Intermediate Agent Oper Generic Error Message :
PPPoE Discover packet too large to process. Try reducing the number of tags
added.
Console#show pppoe intermediate-agent info interface ethernet 1/1
Interface PPPoE IA Trusted Vendor-Tag Strip Admin Circuit-ID Admin Remote-ID
-----
Eth 1/2  Yes      Yes      Yes      1/2:vid      00-00-E8-94-40-02
          R-ID Delimiter Delimiter ASCII Oper Circuit-ID Oper Remote-ID
          -----
          Yes              3 1/2:vid      00-00-E8-94-40-02

Console#
```



**show pppoe intermediate-agent statistics** This command displays statistics for the PPPoE Intermediate Agent.  
**Syntax**

**show pppoe intermediate-agent statistics interface** *[interface]*  
*interface*  
**ethernet** *unit/port*  
*unit* - Unit identifier. (Range: 1-8)  
*port* - Port number. (Range: 1-28)  
**port-channel** *channel-id* (Range: 1-16)

**Command Mode**  
Privileged Exec

**Example**

```
Console#show pppoe intermediate-agent statistics interface ethernet 1/1
Eth 1/1 statistics
-----
Received :      All      PADI      PADO      PADR      PADS      PADT
-----
              3          0          0          0          0          3

Dropped  : Response from untrusted  Request towards untrusted  Malformed
-----
                          0                          0          0

Console#
```

**Table 52: show pppoe intermediate-agent statistics - display description**

Field	Description
PADI	PPPoE Active Discovery Initiation
PADO	PPPoE Active Discovery Offer
PADR	PPPoE Active Discovery Request
PADS	PPPoE Active Discovery Session-Confirmation
PADT	PPPoE Active Discovery Terminate



# General Security Measures

This switch supports many methods of segregating traffic for clients attached to each of the data ports, and for ensuring that only authorized clients gain access to the network. Port-based authentication using IEEE 802.1X is commonly used for these purposes. In addition to these method, several other options of providing client security are described in this chapter. These include port-based authentication, which can be configured to allow network client access by specifying a fixed set of MAC addresses. The addresses assigned to DHCP clients can also be carefully controlled with IP Source Guard and DHCP Snooping commands.

**Table 53: General Security Commands**

Command Group	Function
Port Security*	Configures secure addresses for a port
802.1X Port Authentication*	Configures host authentication on specific ports using 802.1X
Network Access*	Configures MAC authentication and dynamic VLAN assignment
Web Authentication*	Configures Web authentication
Access Control Lists*	Provides filtering for IP frames (based on address, protocol, TCP/UDP port number or TCP control code) or non-IP frames (based on MAC address or Ethernet type)
DHCPv4 Snooping*	Filters untrusted DHCPv4 messages on unsecure ports by building and maintaining a DHCPv4 snooping binding table
DHCPv6 Snooping*	Filters untrusted DHCPv6 messages on unsecure ports by building and maintaining a DHCPv6 snooping binding table
IPv4 Source Guard*	Filters IP traffic on insecure ports for which the source address cannot be identified via DHCP snooping nor static source bindings
IPv6 Source Guard*	Filters IPv6 traffic on insecure ports for which the source address cannot be identified via DHCPv6 snooping nor static source bindings
ND Snooping	Maintains IPv6 prefix table and user address binding table which can be used for stateless address auto-configuration or for address filtering by IPv6 Source Guard
ARP Inspection	Validates the MAC-to-IP address bindings in ARP packets
DoS Protection	Protects against Denial-of-Service attacks
Port-based Traffic Segmentation	Configures traffic segmentation for different client sessions based on specified downlink and uplink ports

\* The priority of execution for these filtering commands is Port Security, Port Authentication, Network Access, Web Authentication, Access Control Lists, DHCP Snooping, and then IP Source Guard.

## Port Security

These commands can be used to enable port security on a port.

When MAC address learning is disabled on an interface, only incoming traffic with source addresses already stored in the dynamic or static address table for this port will be authorized to access the network.

When using port security, the switch stops learning new MAC addresses on the specified port when it has reached a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table for this port will be authorized to access the network. The port will drop any incoming frames with a source MAC address that is unknown or has been previously learned from another port. If a device with an unauthorized MAC address attempts to use the switch port, the intrusion will be detected and the switch can automatically take action by disabling the port and sending a trap message.

**Table 54: Management IP Filter Commands**

Command	Function	Mode
<code>mac-address-table static</code>	Maps a static address to a port in a VLAN	GC
<code>mac-learning</code>	Enables MAC address learning on the selected physical interface or VLAN	IC
<code>port security</code>	Configures a secure port	IC
<code>port security mac-address-as-permanent</code>	Saves the MAC addresses learned by port security as static entries.	PE
<code>show mac-address-table</code>	Displays entries in the bridge-forwarding database	PE
<code>show port security</code>	Displays port security status and secure address count	PE

**mac-learning** This command enables MAC address learning on the selected interface. Use the **no** form to disable MAC address learning.

### Syntax

**[no] mac-learning**

### Default Setting

Enabled

### Command Mode

Interface Configuration (Ethernet or Port Channel)

### Command Usage

- ◆ The **no mac-learning** command immediately stops the switch from learning new MAC addresses on the specified port or trunk. Incoming traffic with source addresses not stored in the static address table, will be flooded. However, if a

security function such as 802.1X or DHCP snooping is enabled and mac-learning is disabled, then only incoming traffic with source addresses stored in the static address table will be accepted, all other packets are dropped. Note that the dynamic addresses stored in the address table when MAC address learning is disabled are flushed from the system, and no dynamic addresses are subsequently learned until MAC address learning has been re-enabled.

- ◆ The mac-learning commands cannot be used if 802.1X Port Authentication has been globally enabled on the switch with the [dot1x system-auth-control](#) command, or if MAC Address Security has been enabled by the [port security](#) command on the same interface.

### Example

The following example disables MAC address learning for port 2.

```
Console(config)#interface ethernet 1/2
Console(config-if)#no mac-learning
Console(config-if)#
```

### Related Commands

[show interfaces status \(426\)](#)

**port security** This command enables or configures port security. Use the **no** form without any keywords to disable port security. Use the **no** form with the appropriate keyword to restore the default settings for a response to security violation or for the maximum number of allowed addresses.

### Syntax

**port security** [**action** {**shutdown** | **trap** | **trap-and-shutdown**} | **max-mac-count** *address-count*]

**no port security** [**action** | **max-mac-count**]

**action** - Response to take when port security is violated.

**shutdown** - Disable port only.

**trap** - Issue SNMP trap message only.

**trap-and-shutdown** - Issue SNMP trap message and disable port.

**max-mac-count**

*address-count* - The maximum number of MAC addresses that can be learned on a port. (Range: 0 - 1024, where 0 means disabled)

### Default Setting

Status: Disabled

Action: None

Maximum Addresses: 0

## Command Mode

### Interface Configuration (Ethernet)

## Command Usage

- ◆ The default maximum number of MAC addresses allowed on a secure port is zero (that is, port security is disabled). To use port security, you must configure the maximum number of addresses allowed on a port using the **port security max-mac-count** command.
- ◆ When port security is enabled using the **port security** command, or the maximum number or allowed addresses is set to a value lower than the current limit after port security has been enabled, the switch first clears all dynamically learned entries from the address table. It then starts learning new MAC addresses on the specified port, and stops learning addresses when it reaches a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table will be accepted.
- ◆ To configure the maximum number of address entries which can be learned on a port, specify the maximum number of dynamic addresses allowed. The switch will learn up to the maximum number of allowed address pairs <source MAC address, VLAN> for frames received on the port. (The specified maximum address count is effective when port security is enabled or disabled.) Note that you can manually add additional secure addresses to a port using the [mac-address-table static](#) command. When the port has reached the maximum number of MAC addresses, the port will stop learning new addresses. The MAC addresses already in the address table will be retained and will not be aged out.
- ◆ MAC addresses that port security has learned, can be saved in the configuration file as static entries. See command [port security mac-address-as-permanent](#).
- ◆ If port security is enabled, and the maximum number of allowed addresses are set to a non-zero value, any device not in the address table that attempts to use the port will be prevented from accessing the switch.
- ◆ If a port is disabled due to a security violation, it must be manually re-enabled using the [no shutdown](#) command.
- ◆ A secure port has the following restrictions:
  - Cannot be connected to a network interconnection device.
  - Cannot be a trunk port.
  - RSPAN and port security are mutually exclusive functions. If port security is enabled on a port, that port cannot be set as an RSPAN uplink port. Also, when a port is configured as an RSPAN uplink port, source port, or destination port, port security cannot be enabled on that port.

### Example

The following example enables port security for port 5, and sets the response to a security violation to issue a trap message:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port security action trap
```

### Related Commands

[show interfaces status \(426\)](#)

[shutdown \(418\)](#)

[mac-address-table static \(499\)](#)

**port security** Use this command to save the MAC addresses that port security has learned as static entries.  
**mac-address-as-permanent**

### Syntax

**port security mac-address-as-permanent** [**interface** *interface*]

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

This example shows the switch saving the MAC addresses learned by port security on ethernet port 1/3.

```
Console#port security mac-address-as-permanent interface ethernet 1/3
Console#
```

**show port security** This command displays port security status and the secure address count.

### Syntax

**show port security** [**interface** *interface*]

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

## Command Mode

### Privileged Exec

## Example

This example shows the port security settings and number of secure addresses for all ports.

```
Console#show port security
Global Port Security Parameters
Secure MAC Aging Mode : Disabled

Port Security Port Summary
Port      Port Security Port Status  Intrusion Action  MaxMacCnt  CurrMacCnt
-----
Eth 1/ 1 Disabled      Secure/Down  None          0          2
Eth 1/ 2 Enabled       Secure/Up    None          10         0
Eth 1/ 3 Disabled      Secure/Down  None          0          0
Eth 1/ 4 Disabled      Secure/Down  None          0          0
Eth 1/ 5 Disabled      Secure/Down  None          0          0
.
.
.
```

**Table 55: show port security - display description**

Field	Description
Port Security	The configured status (enabled or disabled).
Port Status	The operational status: <ul style="list-style-type: none"><li>◆ Secure/Down – Port security is disabled.</li><li>◆ Secure/Up – Port security is enabled.</li><li>◆ Shutdown – Port is shut down due to a response to a port security violation.</li></ul>
Intrusion Action	The configured intrusion response.
MaxMacCnt	The maximum number of addresses which can be stored in the address table for this interface (either dynamic or static).
CurrMacCnt	The current number of secure entries in the address table.

The following example shows the port security settings and number of secure addresses for a specific port. The Last Intrusion MAC and Last Time Detected Intrusion MAC fields show information about the last detected intrusion MAC address. These fields are not applicable if no intrusion has been detected or port security is disabled. The MAC Filter ID field is configured by the [network-access port-mac-filter](#) command. If this field displays Disabled, then any unknown source MAC address can be learned as a secure MAC address. If it displays a filter identifier, then only source MAC address entries in MAC Filter table can be learned as secure MAC addresses.

```
Console#show port security interface ethernet 1/2
Global Port Security Parameters
Secure MAC Aging Mode : Disabled
```



```
Port Security Details
Port                  : 1/2
Port Security        : Enabled
Port Status          : Secure/Up
Intrusion Action      : None
Max MAC Count        : 0
Current MAC Count     : 0
MAC Filter           : Disabled
Last Intrusion MAC    : NA
Last Time Detected Intrusion MAC : NA
Console#
```

This example shows information about a detected intrusion.

```
Console#show port security interface ethernet 1/2
Global Port Security Parameters
Secure MAC Aging Mode : Disabled

Port Security Details
Port                  : 1/2
Port Security        : Enabled
Port Status          : Secure/Up
Intrusion Action      : None
Max MAC Count        : 0
Current MAC Count     : 0
MAC Filter           : Disabled
Last Intrusion MAC    : 00-10-22-00-00-01
Last Time Detected Intrusion MAC : 2010/7/29 15:13:03
Console#
```

## Network Access (MAC Address Authentication)

Network Access authentication controls access to the network by authenticating the MAC address of each host that attempts to connect to a switch port. Traffic received from a specific MAC address is forwarded by the switch only if the source MAC address is successfully authenticated by a central RADIUS server. While authentication for a MAC address is in progress, all traffic is blocked until authentication is completed. Once successfully authenticated, the RADIUS server may optionally assign VLAN and QoS settings for the switch port.

**Table 56: Network Access Commands**

Command	Function	Mode
<a href="#">network-access aging</a>	Enables MAC address aging	GC
<a href="#">network-access mac-filter</a>	Adds a MAC address to a filter table	GC
<a href="#">mac-authentication reauth-time</a>	Sets the time period after which a connected MAC address must be re-authenticated	GC
<a href="#">network-access dynamic-qos</a>	Enables the dynamic quality of service feature	IC
<a href="#">network-access dynamic-vlan</a>	Enables dynamic VLAN assignment from a RADIUS server	IC
<a href="#">network-access guest-vlan</a>	Specifies the guest VLAN	IC

**Table 56: Network Access Commands** (Continued)

Command	Function	Mode
<a href="#">network-access link-detection</a>	Enables the link detection feature	IC
<a href="#">network-access link-detection link-down</a>	Configures the link detection feature to detect and act upon link-down events	IC
<a href="#">network-access link-detection link-up</a>	Configures the link detection feature to detect and act upon link-up events	IC
<a href="#">network-access link-detection link-up-down</a>	Configures the link detection feature to detect and act upon both link-up and link-down events	IC
<a href="#">network-access max-mac-count</a>	Sets the maximum number of MAC addresses that can be authenticated on a port via all forms of authentication	IC
<a href="#">network-access mode mac-authentication</a>	Enables MAC authentication on an interface	IC
<a href="#">network-access port-mac-filter</a>	Enables the specified MAC address filter	IC
<a href="#">mac-authentication intrusion-action</a>	Determines the port response when a connected host fails MAC authentication.	IC
<a href="#">mac-authentication max-mac-count</a>	Sets the maximum number of MAC addresses that can be authenticated on a port via MAC authentication	IC
<a href="#">clear network-access</a>	Clears authenticated MAC addresses from the address table	PE
<a href="#">show network-access</a>	Displays the MAC authentication settings for port interfaces	PE
<a href="#">show network-access mac-address-table</a>	Displays information for entries in the secure MAC address table	PE
<a href="#">show network-access mac-filter</a>	Displays information for entries in the MAC filter tables	PE

**network-access aging** Use this command to enable aging for authenticated MAC addresses stored in the secure MAC address table. Use the **no** form of this command to disable address aging.

#### Syntax

**[no] network-access aging**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ Authenticated MAC addresses are stored as dynamic entries in the switch's secure MAC address table and are removed when the aging time expires. The address aging time is determined by the [mac-address-table aging-time](#) command.

- ◆ This parameter applies to authenticated MAC addresses configured by the MAC Address Authentication process described in this section, as well as to any secure MAC addresses authenticated by 802.1X, regardless of the 802.1X Operation Mode (Single-Host, Multi-Host, or MAC-Based authentication as described on [page 277](#)).
- ◆ The maximum number of secure MAC addresses supported for the switch system is 1024.

### Example

```
Console(config)#network-access aging
Console(config)#
```

**network-access mac-filter** Use this command to add a MAC address into a filter table. Use the **no** form of this command to remove the specified MAC address.

### Syntax

**[no] network-access mac-filter *filter-id***  
**mac-address *mac-address* [*mask mask-address*]**

*filter-id* - Specifies a MAC address filter table. (Range: 1-64)

*mac-address* - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

*mask* - Specifies a MAC address bit mask for a range of addresses.

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Specified addresses are exempt from network access authentication.
- ◆ This command is different from configuring static addresses with the [mac-address-table static](#) command in that it allows you configure a range of addresses when using a mask, and then to assign these addresses to one or more ports with the [network-access port-mac-filter](#) command.
- ◆ Up to 64 filter tables can be defined.
- ◆ There is no limitation on the number of entries that can entered in a filter table.

### Example

```
Console(config)#network-access mac-filter 1 mac-address 11-22-33-44-55-66
Console(config)#
```

**mac-authentication reauth-time** Use this command to set the time period after which a connected MAC address must be re-authenticated. Use the **no** form of this command to restore the default value.

#### Syntax

**mac-authentication reauth-time** *seconds*

**no mac-authentication reauth-time**

*seconds* - The reauthentication time period. (Range: 120-1000000 seconds)

#### Default Setting

1800

#### Command Mode

Global Configuration

#### Command Usage

- ◆ The reauthentication time is a global setting and applies to all ports.
- ◆ When the reauthentication time expires for a secure MAC address it is reauthenticated with the RADIUS server. During the reauthentication process traffic through the port remains unaffected.

#### Example

```
Console(config)#mac-authentication reauth-time 300
Console(config)#
```

**network-access dynamic-qos** Use this command to enable the dynamic QoS feature for an authenticated port. Use the **no** form to restore the default.

#### Syntax

**[no] network-access dynamic-qos**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration

#### Command Usage

- ◆ The RADIUS server may optionally return dynamic QoS assignments to be applied to a switch port for an authenticated user. The "Filter-ID" attribute

(attribute 11) can be configured on the RADIUS server to pass the following QoS information:

**Table 57: Dynamic QoS Profiles**

Profile	Attribute Syntax	Example
DiffServ	<b>service-policy-in</b> = <i>policy-map-name</i>	service-policy-in=p1
Rate Limit	<b>rate-limit-input</b> = <i>rate (kbps)</i>	rate-limit-input=100 (kbps)
	<b>rate-limit-output</b> = <i>rate (kbps)</i>	rate-limit-output=200 (kbps)
802.1p	<b>switchport-priority-default</b> = <i>value</i>	switchport-priority-default=2
IP ACL	<b>ip-access-group-in</b> = <i>ip-acl-name</i>	ip-access-group-in=ipv4acl
IPv6 ACL	<b>ipv6-access-group-in</b> = <i>ipv6-acl-name</i>	ipv6-access-group-in=ipv6acl
MAC ACL	<b>mac-access-group-in</b> = <i>mac-acl-name</i>	mac-access-group-in=macAcl

- ◆ When the last user logs off of a port with a dynamic QoS assignment, the switch restores the original QoS configuration for the port.
- ◆ When a user attempts to log into the network with a returned dynamic QoS profile that is different from users already logged on to the same port, the user is denied access.
- ◆ While a port has an assigned dynamic QoS profile, any manual QoS configuration changes only take effect after all users have logged off of the port.



**Note:** Any configuration changes for dynamic QoS are not saved to the switch configuration file.

### Example

The following example enables the dynamic QoS feature on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access dynamic-qos
Console(config-if)#
```

**network-access dynamic-vlan** Use this command to enable dynamic VLAN assignment for an authenticated port. Use the **no** form to disable dynamic VLAN assignment.

### Syntax

**[no] network-access dynamic-vlan**

### Default Setting

Enabled

## Command Mode

### Interface Configuration

## Command Usage

- ◆ When enabled, the VLAN identifiers returned by the RADIUS server through the 802.1X authentication process will be applied to the port, providing the VLANs have already been created on the switch. GVRP is not used to create the VLANs.
- ◆ The VLAN settings specified by the first authenticated MAC address are implemented for a port. Other authenticated MAC addresses on the port must have same VLAN configuration, or they are treated as an authentication failure.
- ◆ If dynamic VLAN assignment is enabled on a port and the RADIUS server returns no VLAN configuration, the authentication is still treated as a success, and the host assigned to the default untagged VLAN.
- ◆ When the dynamic VLAN assignment status is changed on a port, all authenticated addresses are cleared from the secure MAC address table.

## Example

The following example enables dynamic VLAN assignment on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access dynamic-vlan
Console(config-if)#
```

**network-access guest-vlan** Use this command to assign all traffic on a port to a guest VLAN when 802.1x authentication or MAC authentication is rejected. Use the **no** form of this command to disable guest VLAN assignment.

## Syntax

**network-access guest-vlan** *vlan-id*

**no network-access guest-vlan**

*vlan-id* - VLAN ID (Range: 1-4094)

## Default Setting

Disabled

## Command Mode

### Interface Configuration

## Command Usage

- ◆ The VLAN to be used as the guest VLAN must be defined and set as active (See the [vlan database](#) command).

- ◆ When used with 802.1X authentication, the intrusion-action must be set for “guest-vlan” to be effective (see the [dot1x intrusion-action](#) command).
- ◆ A port can only be assigned to the guest VLAN in case of failed authentication, if [switchport mode](#) is set to Hybrid.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access guest-vlan 25
Console(config-if)#
```

**network-access link-detection** Use this command to enable link detection for the selected port. Use the **no** form of this command to restore the default.

### Syntax

**[no] network-access link-detection**

### Default Setting

Disabled

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection
Console(config-if)#
```

**network-access link-detection link-down** Use this command to detect link-down events. When detected, the switch can shut down the port, send an SNMP trap, or both. Use the **no** form of this command to disable this feature.

### Syntax

**network-access link-detection link-down**  
**action [shutdown | trap | trap-and-shutdown]**

**no network-access link-detection**

**action** - Response to take when port security is violated.

**shutdown** - Disable port only.

**trap** - Issue SNMP trap message only.

**trap-and-shutdown** - Issue SNMP trap message and disable the port.

### Default Setting

Disabled

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection link-down action trap
Console(config-if)#
```

### network-access link-detection link-up

Use this command to detect link-up events. When detected, the switch can shut down the port, send an SNMP trap, or both. Use the **no** form of this command to disable this feature.

### Syntax

**network-access link-detection link-up**  
**action [shutdown | trap | trap-and-shutdown]**

**no network-access link-detection**

**action** - Response to take when port security is violated.

**shutdown** - Disable port only.

**trap** - Issue SNMP trap message only.

**trap-and-shutdown** - Issue SNMP trap message and disable the port.

### Default Setting

Disabled

### Command Mode

Interface Configuration

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection link-up action trap
Console(config-if)#
```



**network-access link-detection link-up-down** Use this command to detect link-up and link-down events. When either event is detected, the switch can shut down the port, send an SNMP trap, or both. Use the **no** form of this command to disable this feature.

#### Syntax

**network-access link-detection link-up-down  
action [shutdown | trap | trap-and-shutdown]**

**no network-access link-detection**

**action** - Response to take when port security is violated.

**shutdown** - Disable port only.

**trap** - Issue SNMP trap message only.

**trap-and-shutdown** - Issue SNMP trap message and disable the port.

#### Default Setting

Disabled

#### Command Mode

Interface Configuration

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection link-up-down action trap
Console(config-if)#
```

**network-access max-mac-count** Use this command to set the maximum number of MAC addresses that can be authenticated on a port interface via all forms of authentication. Use the **no** form of this command to restore the default.

#### Syntax

**network-access max-mac-count** *count*

**no network-access max-mac-count**

*count* - The maximum number of authenticated IEEE 802.1X and MAC addresses allowed. (Range: 1-2048)

#### Default Setting

1024

#### Command Mode

Interface Configuration

### Command Usage

The maximum number of MAC addresses per port is 1024, and the maximum number of secure MAC addresses supported for the switch system is 1024. When the limit is reached, all new MAC addresses are treated as authentication failures.

### Example

```
Console(config-if)#network-access max-mac-count 5  
Console(config-if)#
```

**network-access mode mac-authentication** Use this command to enable network access authentication on a port. Use the **no** form of this command to disable network access authentication.

### Syntax

**[no] network-access mode mac-authentication**

### Default Setting

Disabled

### Command Mode

Interface Configuration

### Command Usage

- ◆ When enabled on a port, the authentication process sends a Password Authentication Protocol (PAP) request to a configured RADIUS server. The user name and password are both equal to the MAC address being authenticated.
- ◆ On the RADIUS server, PAP user name and passwords must be configured in the MAC address format XX-XX-XX-XX-XX-XX (all in upper case).
- ◆ Authenticated MAC addresses are stored as dynamic entries in the switch secure MAC address table and are removed when the aging time expires. The maximum number of secure MAC addresses supported for the switch system is 1024.
- ◆ Configured static MAC addresses are added to the secure address table when seen on a switch port. Static addresses are treated as authenticated without sending a request to a RADIUS server.
- ◆ MAC authentication, 802.1X, and port security cannot be configured together on the same port. Only one security mechanism can be applied.
- ◆ MAC authentication cannot be configured on trunk ports.
- ◆ When port status changes to down, all MAC addresses are cleared from the secure MAC address table. Static VLAN assignments are not restored.

- ◆ The RADIUS server may optionally return a VLAN identifier list. VLAN identifier list is carried in the "Tunnel-Private-Group-ID" attribute. The VLAN list can contain multiple VLAN identifiers in the format "1u,2t," where "u" indicates untagged VLAN and "t" tagged VLAN. The "Tunnel-Type" attribute should be set to "VLAN," and the "Tunnel-Medium-Type" attribute set to "802."

### Example

```
Console(config-if)#network-access mode mac-authentication
Console(config-if)#
```

**network-access port-mac-filter** Use this command to enable the specified MAC address filter. Use the **no** form of this command to disable the specified MAC address filter.

### Syntax

**network-access port-mac-filter** *filter-id*

**no network-access port-mac-filter**

*filter-id* - Specifies a MAC address filter table. (Range: 1-64)

### Default Setting

None

### Command Mode

Interface Configuration

### Command Mode

- ◆ Entries in the MAC address filter table can be configured with the [network-access mac-filter](#) command.
- ◆ Only one filter table can be assigned to a port.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access port-mac-filter 1
Console(config-if)#
```

**mac-authentication intrusion-action** Use this command to configure the port response to a host MAC authentication failure. Use the **no** form of this command to restore the default.

#### Syntax

**mac-authentication intrusion-action {block traffic | pass traffic}**  
**no mac-authentication intrusion-action**

#### Default Setting

Block Traffic

#### Command Mode

Interface Configuration

#### Example

```
Console(config-if)#mac-authentication intrusion-action block-traffic  
Console(config-if)#
```

**mac-authentication max-mac-count** Use this command to set the maximum number of MAC addresses that can be authenticated on a port via MAC authentication. Use the **no** form of this command to restore the default.

#### Syntax

**mac-authentication max-mac-count *count***  
**no mac-authentication max-mac-count**

*count* - The maximum number of MAC-authenticated MAC addresses allowed. (Range: 1-1024)

#### Default Setting

1024

#### Command Mode

Interface Configuration

#### Example

```
Console(config-if)#mac-authentication max-mac-count 32  
Console(config-if)#
```

**clear network-access** Use this command to clear entries from the secure MAC addresses table.

### Syntax

**clear network-access mac-address-table** [**static** | **dynamic**]  
[**address** *mac-address*] [**interface** *interface*]

**static** - Specifies static address entries.

**dynamic** - Specifies dynamic address entries.

*mac-address* - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#clear network-access mac-address-table interface ethernet 1/1
Console#
```

**show network-access** Use this command to display the MAC authentication settings for port interfaces.

### Syntax

**show network-access** [**interface** *interface*]

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Default Setting

Displays the settings for all interfaces.

### Command Mode

Privileged Exec

### Example

```
Console#show network-access interface ethernet 1/1
Global secure port information
Reauthentication Time                : 1800
MAC Address Aging                   : Disabled

Port : 1/1
MAC Authentication                  : Disabled
MAC Authentication Intrusion Action : Block traffic
MAC Authentication Maximum MAC Counts : 1024
Maximum MAC Counts                  : 1024
Dynamic VLAN Assignment             : Enabled
Dynamic QoS Assignment              : Disabled
MAC Filter ID                       : Disabled
Guest VLAN                          : Disabled
Link Detection                      : Disabled
Detection Mode                      : Link-down
Detection Action                    : Trap
Console#
```

**show network-access mac-address-table** Use this command to display secure MAC address table entries.

### Syntax

**show network-access mac-address-table** [**static** | **dynamic**]  
[**address** *mac-address* [*mask*]] [**interface** *interface*] [**sort** {**address** | **interface**}]

**static** - Specifies static address entries.

**dynamic** - Specifies dynamic address entries.

*mac-address* - Specifies a MAC address entry.  
(Format: xx-xx-xx-xx-xx-xx)

*mask* - Specifies a MAC address bit mask for filtering displayed addresses.

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**sort** - Sorts displayed entries by either MAC address or interface.

### Default Setting

Displays all filters.

### Command Mode

Privileged Exec

### Command Usage

When using a bit mask to filter displayed MAC addresses, a 1 means “care” and a 0 means “don't care”. For example, a MAC of 00-00-01-02-03-04 and mask FF-FF-FF-

00-00-00 would result in all MACs in the range 00-00-01-00-00-00 to 00-00-01-FF-FF-FF to be displayed. All other MACs would be filtered out.

### Example

```
Console#show network-access mac-address-table
Interface MAC Address      RADIUS Server  Time           Attribute
-----
1/1        00-00-01-02-03-04 172.155.120.17 00d06h32m50s   Static
1/1        00-00-01-02-03-05 172.155.120.17 00d06h33m20s   Dynamic
1/1        00-00-01-02-03-06 172.155.120.17 00d06h35m10s   Static
1/3        00-00-01-02-03-07 172.155.120.17 00d06h34m20s   Dynamic

Console#
```

**show network-access mac-filter** Use this command to display information for entries in the MAC filter tables.

### Syntax

**show network-access mac-filter** [*filter-id*]

*filter-id* - Specifies a MAC address filter table. (Range: 1-64)

### Default Setting

Displays all filters.

### Command Mode

Privileged Exec

### Example

```
Console#show network-access mac-filter
Filter ID MAC Address      MAC Mask
-----
1 00-00-01-02-03-08 FF-FF-FF-FF-FF-FF

Console#
```

## Web Authentication

Web authentication allows stations to authenticate and access the network in situations where 802.1X or Network Access authentication are infeasible or impractical. The web authentication feature allows unauthenticated hosts to request and receive a DHCP assigned IP address and perform DNS queries. All other traffic, except for HTTP protocol traffic, is blocked. The switch intercepts HTTP protocol traffic and redirects it to a switch-generated web page that facilitates user name and password authentication via RADIUS. Once authentication is successful, the web browser is forwarded on to the originally requested web page. Successful authentication is valid for all hosts connected to the port.



**Note:** RADIUS authentication must be activated and configured for the web authentication feature to work properly (see [“Authentication Sequence” on page 238](#)).

**Note:** Web authentication cannot be configured on trunk ports.

Table 58: Web Authentication

Command	Function	Mode
<a href="#">web-auth login-attempts</a>	Defines the limit for failed web authentication login attempts	GC
<a href="#">web-auth quiet-period</a>	Defines the amount of time to wait after the limit for failed login attempts is exceeded.	GC
<a href="#">web-auth session-timeout</a>	Defines the amount of time a session remains valid	GC
<a href="#">web-auth system-auth-control</a>	Enables web authentication globally for the switch	GC
<a href="#">web-auth</a>	Enables web authentication for an interface	IC
<a href="#">web-auth re-authenticate (Port)</a>	Ends all web authentication sessions on the port and forces the users to re-authenticate	PE
<a href="#">web-auth re-authenticate (IP)</a>	Ends the web authentication session associated with the designated IP address and forces the user to re-authenticate	PE
<a href="#">show web-auth</a>	Displays global web authentication parameters	PE
<a href="#">show web-auth interface</a>	Displays interface-specific web authentication parameters and statistics	PE
<a href="#">show web-auth summary</a>	Displays a summary of web authentication port parameters and statistics	PE



**web-auth login-attempts** This command defines the limit for failed web authentication login attempts. After the limit is reached, the switch refuses further login attempts until the quiet time expires. Use the **no** form to restore the default.

#### Syntax

**web-auth login-attempts** *count*

**no web-auth login-attempts**

*count* - The limit of allowed failed login attempts. (Range: 1-3)

#### Default Setting

3 login attempts

#### Command Mode

Global Configuration

#### Example

```
Console(config)#web-auth login-attempts 2
Console(config)#
```

**web-auth quiet-period** This command defines the amount of time a host must wait after exceeding the limit for failed login attempts, before it may attempt web authentication again. Use the **no** form to restore the default.

#### Syntax

**web-auth quiet-period** *time*

**no web-auth quiet period**

*time* - The amount of time the host must wait before attempting authentication again. (Range: 1-180 seconds)

#### Default Setting

60 seconds

#### Command Mode

Global Configuration

#### Example

```
Console(config)#web-auth quiet-period 120
Console(config)#
```

**web-auth session-timeout** This command defines the amount of time a web-authentication session remains valid. When the session timeout has been reached, the host is logged off and must re-authenticate itself the next time data transmission takes place. Use the **no** form to restore the default.

#### Syntax

**web-auth session-timeout** *timeout*

**no web-auth session timeout**

*timeout* - The amount of time that an authenticated session remains valid.  
(Range: 300-3600 seconds)

#### Default Setting

3600 seconds

#### Command Mode

Global Configuration

#### Example

```
Console(config)#web-auth session-timeout 1800
Console(config)#
```

**web-auth system-auth-control** This command globally enables web authentication for the switch. Use the **no** form to restore the default.

#### Syntax

**[no] web-auth system-auth-control**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

Both **web-auth system-auth-control** for the switch and **web-auth** for an interface must be enabled for the web authentication feature to be active.

#### Example

```
Console(config)#web-auth system-auth-control
Console(config)#
```

**web-auth** This command enables web authentication for an interface. Use the no form to restore the default.

### Syntax

**[no] web-auth**

### Default Setting

Disabled

### Command Mode

Interface Configuration

### Command Usage

Both **web-auth system-auth-control** for the switch and **web-auth** for a port must be enabled for the web authentication feature to be active.

### Example

```
Console(config-if)#web-auth
Console(config-if)#
```

**web-auth re-authenticate (Port)** This command ends all web authentication sessions connected to the port and forces the users to re-authenticate.

### Syntax

**web-auth re-authenticate interface** *interface*

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#web-auth re-authenticate interface ethernet 1/2
Console#
```

**web-auth re-authenticate (IP)** This command ends the web authentication session associated with the designated IP address and forces the user to re-authenticate.

#### Syntax

**web-auth re-authenticate interface** *interface ip*

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*ip* - IPv4 formatted IP address

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#web-auth re-authenticate interface ethernet 1/2 192.168.1.5
Console#
```

**show web-auth** This command displays global web authentication parameters.

#### Command Mode

Privileged Exec

#### Example

```
Console#show web-auth
Global Web-Auth Parameters
  System Auth Control      : Enabled
  Session Timeout          : 3600
  Quiet Period             : 60
  Max Login Attempts       : 3
Console#
```

**show web-auth interface** This command displays interface-specific web authentication parameters and statistics.

### Syntax

**show web-auth interface** *interface*

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```
Console#show web-auth interface ethernet 1/2
Web Auth Status      : Enabled

Host Summary

IP address      Web-Auth-State Remaining-Session-Time
-----
1.1.1.1         Authenticated    295
1.1.1.2         Authenticated    111
Console#
```

**show web-auth summary** This command displays a summary of web authentication port parameters and statistics.

### Command Mode

Privileged Exec

### Example

```
Console#show web-auth summary
Global Web-Auth Parameters
System Auth Control      : Enabled
Port      Status      Authenticated Host Count
----
1/ 1      Disabled      0
1/ 2      Enabled       8
1/ 3      Disabled      0
1/ 4      Disabled      0
1/ 5      Disabled      0
:
```

## DHCPv4 Snooping

DHCPv4 snooping allows a switch to protect a network from rogue DHCPv4 servers or other devices which send port-related information to a DHCPv4 server. This information can be useful in tracking an IP address back to a physical port. This section describes commands used to configure DHCPv4 snooping.

**Table 59: DHCP Snooping Commands**

Command	Function	Mode
<code>ip dhcp snooping</code>	Enables DHCP snooping globally	GC
<code>ip dhcp snooping information option</code>	Enables or disables the use of DHCP Option 82 information, and specifies frame format for the remote-id	GC
<code>ip dhcp snooping information option encode no-subtype</code>	Disables use of sub-type and sub-length for the CID/RID in Option 82 information	GC
<code>ip dhcp snooping information option remote-id</code>	Sets the remote ID to the switch's IP address, MAC address, arbitrary string, TR-101 compliant node identifier, or removes VLAN ID from the end of the TR101 field	GC
<code>ip dhcp snooping information option tr101 board-id</code>	Sets the board identifier used in Option 82 information based on TR-101 syntax	GC
<code>ip dhcp snooping information policy</code>	Sets the information option policy for DHCP client packets that include Option 82 information	GC
<code>ip dhcp snooping limit rate</code>	Sets the maximum number of DHCP packets that can be trapped for DHCP snooping	GC
<code>ip dhcp snooping verify mac-address</code>	Verifies the client's hardware address stored in the DHCP packet against the source MAC address in the Ethernet header	GC
<code>ip dhcp snooping vlan</code>	Enables DHCP snooping on the specified VLAN	GC
<code>ip dhcp snooping information option circuit-id</code>	Specifies DHCP Option 82 circuit-id suboption information	IC
<code>ip dhcp snooping trust</code>	Configures the specified interface as trusted	IC
<code>clear ip dhcp snooping binding</code>	Clears DHCP snooping binding table entries from RAM	PE
<code>clear ip dhcp snooping database flash</code>	Removes all dynamically learned snooping entries from flash memory.	PE
<code>ip dhcp snooping database flash</code>	Writes all dynamically learned snooping entries to flash memory	PE
<code>show ip dhcp snooping</code>	Shows the DHCP snooping configuration settings	PE
<code>show ip dhcp snooping binding</code>	Shows the DHCP snooping binding table entries	PE

**ip dhcp snooping** This command enables DHCP snooping globally. Use the **no** form to restore the default setting.

### Syntax

**[no] ip dhcp snooping**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Network traffic may be disrupted when malicious DHCP messages are received from an outside source. DHCP snooping is used to filter DHCP messages received on an unsecure interface from outside the network or fire wall. When DHCP snooping is enabled globally by this command, and enabled on a VLAN interface by the **ip dhcp snooping vlan** command, DHCP messages received on an untrusted interface (as specified by the **no ip dhcp snooping trust** command) from a device not listed in the DHCP snooping table will be dropped.
- ◆ When enabled, DHCP messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCP snooping.
- ◆ Table entries are only learned for trusted interfaces. Each entry includes a MAC address, IP address, lease time, VLAN identifier, and port identifier.
- ◆ When DHCP snooping is enabled, the rate limit for the number of DHCP messages that can be processed by the switch is 100 packets per second. Any DHCP packets in excess of this limit are dropped.
- ◆ Filtering rules are implemented as follows:
  - If global DHCP snooping is disabled, all DHCP packets are forwarded.
  - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, all DHCP packets are forwarded for a *trusted* port. If the received packet is a DHCP ACK message, a dynamic DHCP snooping entry is also added to the binding table.
  - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is *not trusted*, it is processed as follows:
    - If the DHCP packet is a reply packet from a DHCP server (including OFFER, ACK or NAK messages), the packet is dropped.

- If the DHCP packet is from a client, such as a DECLINE or RELEASE message, the switch forwards the packet only if the corresponding entry is found in the binding table.
  - If the DHCP packet is from client, such as a DISCOVER, REQUEST, INFORM, DECLINE or RELEASE message, the packet is forwarded if MAC address verification is disabled (as specified by the `ip dhcp snooping verify mac-address` command). However, if MAC address verification is enabled, then the packet will only be forwarded if the client's hardware address stored in the DHCP packet is the same as the source MAC address in the Ethernet header.
  - If the DHCP packet is not a recognizable type, it is dropped.
  - If a DHCP packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.
  - If a DHCP packet is from server is received on a trusted port, it will be forwarded to both trusted and untrusted ports in the same VLAN.
- ◆ If DHCP snooping is globally disabled, all dynamic bindings are removed from the binding table.
  - ◆ *Additional considerations when the switch itself is a DHCP client* – The port(s) through which the switch submits a client request to the DHCP server must be configured as trusted (using the `ip dhcp snooping trust` command). Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCP server. Also, when the switch sends out DHCP client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCP server, any packets received from untrusted ports are dropped.

### Example

This example enables DHCP snooping globally for the switch.

```
Console(config)#ip dhcp snooping
Console(config)#
```

### Related Commands

`ip dhcp snooping vlan (335)`

`ip dhcp snooping trust (337)`



## ip dhcp snooping information option

This command enables the use of DHCP Option 82 information for the switch, and specifies the frame format to use for the remote-id when Option 82 information is generated by the switch. Use the **no** form without any keywords to disable this function, the no form with the encode no-subtype keyword to enable use of sub-type and sub-length in CID/RID fields, or the **no** form with the **remote-id** keyword to set the remote ID to the switch's MAC address encoded in hexadecimal.

### Syntax

#### ip dhcp snooping information option

[**encode no-subtype**] [**remote-id** {**ip-address** [**encode** {**ascii** | **hex**}}] |  
**mac-address** [**encode** {**ascii** | **hex**}}] [**string** *string*]

#### no ip dhcp snooping information option [**encode no-subtype**]

[**remote-id** [**ip-address** **encode**] | [**mac-address** **encode**]]

**encode no-subtype** - Disables use of sub-type and sub-length fields in circuit-ID (CID) and remote-ID (RID) in Option 82 information.

**mac-address** - Inserts a MAC address in the remote ID sub-option for the DHCP snooping agent (that is, the MAC address of the switch's CPU).

**ip-address** - Inserts an IP address in the remote ID sub-option for the DHCP snooping agent (that is, the IP address of the management interface).

**encode** - Indicates encoding in ASCII or hexadecimal.

*string* - An arbitrary string inserted into the remote identifier field.  
(Range: 1-32 characters)

### Default Setting

Option 82: Disabled

CID/RID sub-type: Enabled

Remote ID: MAC address (hexadecimal)

### Command Mode

Global Configuration

### Command Usage

- ◆ DHCP provides a relay mechanism for sending information about the switch and its DHCP clients to the DHCP server. Known as DHCP Option 82, it allows compatible DHCP servers to use the information when assigning IP addresses, or to set other services or policies for clients.
- ◆ When the DHCP Snooping Information Option 82 is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server.
- ◆ When the DHCP Snooping Information Option is enabled, clients can be identified by the switch port to which they are connected rather than just their MAC address. DHCP client-server exchange messages are then forwarded

directly between the server and client without having to flood them to the entire VLAN.

- ◆ DHCP snooping must be enabled for the DHCP Option 82 information to be inserted into packets. When enabled, the switch will only add/remove option 82 information in incoming DHCP packets but not relay them. Packets are processed as follows:
  - If an incoming packet is a DHCP request packet with option 82 information, it will modify the option 82 information according to settings specified with [ip dhcp snooping information policy](#) command.
  - If an incoming packet is a DHCP request packet without option 82 information, enabling the DHCP snooping information option will add option 82 information to the packet.
  - If an incoming packet is a DHCP reply packet with option 82 information, enabling the DHCP snooping information option will remove option 82 information from the packet.

### Example

This example enables the DHCP Snooping Information Option.

```
Console(config)#ip dhcp snooping information option
Console(config)#
```

### **ip dhcp snooping information option encode no-subtype**

This command disables the use of sub-type and sub-length fields for the circuit-ID (CID) and remote-ID (RID) in Option 82 information generated by the switch. Use the **no** form to enable the use of these fields.

### Syntax

**[no] ip dhcp snooping information option encode no-subtype**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Command Usage

See the Command Usage section under the [ip dhcp snooping information option circuit-id](#) command for a description of how these fields are included in TR-101 syntax.

**EXAMPLE**

This example enables the use of sub-type and sub-length fields for the circuit-ID (CID) and remote-ID (RID).

```
Console(config)#no ip dhcp snooping information option encode no-subtype
Console(config)#
```

### ip dhcp snooping information option remote-id

This command sets the remote ID to the switch's IP address, MAC address, arbitrary string, TR-101 compliant node identifier, or removes VLAN ID from end of TR101 field. Use the **no** form to restore the default setting.

**Syntax****ip dhcp snooping information option remote-id**

**{ip-address [encode {ascii | hex}] |  
mac-address [encode {ascii | hex}] | string |  
tr101 {node-identifier {ip | sysname} | no-vlan-field}**

**no ip dhcp snooping information option remote-id**

**[ip-address encode] | [mac-address encode] | [tr101 no-vlan-field]**

**mac-address** - Inserts a MAC address in the remote ID sub-option for the DHCP snooping agent (that is, the MAC address of the switch's CPU).

**ip-address** - Inserts an IP address in the remote ID sub-option for the DHCP snooping agent (that is, the IP address of the management interface).

**encode** - Indicates encoding in ASCII or hexadecimal.

**string** - An arbitrary string inserted into the remote identifier field.  
(Range: 1-32 characters)

**tr101 node-identifier** - The remote ID generated by the switch is based on TR-101 syntax (R-124, Access\_Node\_ID).

**ip** - Specifies the switch's IP address as the node identifier.

**sysname** - Specifies the system name as the node identifier.

**tr101 no-vlan-field** - Do not add ":VLAN" in TR101 field for untagged packets.

**Default Setting**

MAC address: hexadecimal

tr101 no-vlan-field: disabled

**Command Mode**

Global Configuration

**Command Usage**

The format for TR101 option 82 is: "<IP> eth <SID>/<PORT>[:<VLAN>]". Note that the SID (Switch ID) is always 0. By default the PVID is added to the end of the TR101 field for untagged packets. For tagged packets, the VLAN ID is always added. Use

the **ip dhcp snooping information option remote-id tr101 no-vlan-field** command to remove the VLAN ID from the end of the TR101 field for untagged packets. Use the **no** form of this command to add the PVID for untagged packets at the end of the TR101 field.

### Example

This example sets the remote ID to the switch's IP address.

```
Console(config)#ip dhcp snooping information option remote-id tr101
node-identifier ip
Console(config)#
```

### **ip dhcp snooping information option tr101 board-id**

This command sets the board identifier used in Option 82 information based on TR-101 syntax. Use the **no** form to remove the board identifier.

### Syntax

**ip dhcp snooping information option tr101 board-id** *board-id*

**no ip dhcp snooping information option tr101 board-id**

*board-id* – TR101 Board ID. (Range: 0-9)

### Default Setting

not defined

### Command Mode

Global Configuration

### Example

This example sets the board ID to 0.

```
Console(config)#ip dhcp snooping information option tr101 board-id 0
Console(config)#
```

**ip dhcp snooping information policy** This command sets the DHCP snooping information option policy for DHCP client packets that include Option 82 information.

#### Syntax

**ip dhcp snooping information policy {drop | keep | replace}**

**drop** - Drops the client's request packet instead of relaying it.

**keep** - Retains the Option 82 information in the client request, and forwards the packets to trusted ports.

**replace** - Replaces the Option 82 information circuit-id and remote-id fields in the client's request with information about the relay agent itself, inserts the relay agent's address (when DHCP snooping is enabled), and forwards the packets to trusted ports.

#### Default Setting

replace

#### Command Mode

Global Configuration

#### Command Usage

When the switch receives DHCP packets from clients that already include DHCP Option 82 information, the switch can be configured to set the action policy for these packets. The switch can either drop the DHCP packets, keep the existing information, or replace it with the switch's relay information.

#### Example

```
Console(config)#ip dhcp snooping information policy drop
Console(config)#
```

**ip dhcp snooping limit rate** This command sets the maximum number of DHCP packets that can be trapped by the switch for DHCP snooping. Use the **no** form to restore the default setting.

#### Syntax

**ip dhcp snooping limit rate** *rate*

**no dhcp snooping limit rate**

*rate* - The maximum number of DHCP packets that may be trapped for DHCP snooping. (Range: 1-2048 packets/second)

#### Default Setting

Disabled

#### Command Mode

Global Configuration

### Example

This example sets the DHCP snooping rate limit to 100 packets per second.

```
Console(config)#ip dhcp snooping limit rate 100
Console(config)#
```

### **ip dhcp snooping verify mac-address**

This command verifies the client's hardware address stored in the DHCP packet against the source MAC address in the Ethernet header. Use the **no** form to disable this function.

### Syntax

**[no] ip dhcp snooping verify mac-address**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Command Usage

If MAC address verification is enabled, and the source MAC address in the Ethernet header of the packet is not same as the client's hardware address in the DHCP packet, the packet is dropped.

### Example

This example enables MAC address verification.

```
Console(config)#ip dhcp snooping verify mac-address
Console(config)#
```

### Related Commands

[ip dhcp snooping \(327\)](#)

[ip dhcp snooping vlan \(335\)](#)

[ip dhcp snooping trust \(337\)](#)

**ip dhcp snooping vlan** This command enables DHCP snooping on the specified VLAN. Use the **no** form to restore the default setting.

### Syntax

**[no] ip dhcp snooping vlan** *vlan-id*

*vlan-id* - ID of a configured VLAN (Range: 1-4094)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ When DHCP snooping is enabled globally using the [ip dhcp snooping](#) command, and enabled on a VLAN with this command, DHCP packet filtering will be performed on any untrusted ports within the VLAN as specified by the [ip dhcp snooping trust](#) command.
- ◆ When the DHCP snooping is globally disabled, DHCP snooping can still be configured for specific VLANs, but the changes will not take effect until DHCP snooping is globally re-enabled.
- ◆ When DHCP snooping is globally enabled, and then disabled on a VLAN, all dynamic bindings learned for this VLAN are removed from the binding table.

### Example

This example enables DHCP snooping for VLAN 1.

```
Console(config)#ip dhcp snooping vlan 1
Console(config)#
```

### Related Commands

[ip dhcp snooping \(327\)](#)

[ip dhcp snooping trust \(337\)](#)

ip dhcp snooping  
information option  
circuit-id

This command specifies DHCP Option 82 circuit-id suboption information. Use the **no** form to use the default settings.

Syntax

**ip dhcp snooping information option circuit-id string** *string* |  
    {tr101 {node-identifier {ip | sysname} | no-vlan-field}}

**no dhcp snooping information option circuit-id** [tr101 no-vlan-field]

*string* - An arbitrary string inserted into the circuit identifier field.  
(Range: 1-32 characters)

**tr101 node-identifier** - The remote ID generated by the switch is based on TR-101 syntax (R-124, Access\_Node\_ID).

**ip** - Specifies the switch's IP address as the node identifier.

**sysname** - Specifies the system name as the node identifier.

**tr101 no-vlan-field** - Do not add ":VLAN" in TR101 field for untagged packets.

Default Setting  
VLAN-Unit-Port

Command Mode  
Interface Configuration (Ethernet, Port Channel)

Command Usage

- ◆ DHCP provides a relay mechanism for sending information about the switch and its DHCP clients to the DHCP server. DHCP Option 82 allows compatible DHCP servers to use the information when assigning IP addresses, to set other services or policies for clients. For more information of this process, refer to the Command Usage section under the [ip dhcp snooping information option](#) command.
- ◆ Option 82 information generated by the switch is based on TR-101 syntax as shown below:

Table 60: Option 82 information

82	3-69	1	1-67	x1	x2	x3	x4	x5	x63
opt82	opt-len	sub-opt1	string-len	R-124 string					

The circuit identifier used by this switch starts at sub-option1 and goes to the end of the R-124 string. The R-124 string includes the following information:

- sub-type - Distinguishes different types of circuit IDs.
- sub-length - Length of the circuit ID type



- access node identifier - ASCII string. Default is the MAC address of the switch's CPU. This field is set by the `ip dhcp snooping information option` command,
- eth - The second field is the fixed string "eth"
- slot - The slot represents the stack unit for this system.
- port - The port which received the DHCP request. If the packet arrives over a trunk, the value is the ifIndex of the trunk.
- vlan - Tag of the VLAN which received the DHCP request.

Note that the sub-type and sub-length fields can be enabled or disabled using the `ip dhcp snooping information option` command.

- The `ip dhcp snooping information option circuit-id` command can be used to modify the default settings described above.
- ◆ The format for TR101 option 82 is: "<IP> eth <SID>/<PORT>[:<VLAN>]". Note that the SID (Switch ID) is always 0. By default the PVID is added to the end of the TR101 field for untagged packets. For tagged packets, the VLAN ID is always added. Use the `ip dhcp snooping information option remote-id tr101 no-vlan-field` command to remove the VLAN ID from the end of the TR101 field for untagged packets. Use the `no` form of this command to add the PVID for untagged packets at the end of the TR101 field.

### Example

This example sets the DHCP Snooping Information circuit-id suboption string.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip dhcp snooping information option circuit-id string mv2
Console(config-if)#
```

**ip dhcp snooping trust** This command configures the specified interface as trusted. Use the `no` form to restore the default setting.

### Syntax

**[no] ip dhcp snooping trust**

### Default Setting

All interfaces are untrusted

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or fire wall.

- ◆ Set all ports connected to DHCP servers within the local network or fire wall to trusted, and all other ports outside the local network or fire wall to untrusted.
- ◆ When DHCP snooping is enabled globally using the [ip dhcp snooping](#) command, and enabled on a VLAN with [ip dhcp snooping vlan](#) command, DHCP packet filtering will be performed on any untrusted ports within the VLAN according to the default status, or as specifically configured for an interface with the **no ip dhcp snooping trust** command.
- ◆ When an untrusted port is changed to a trusted port, all the dynamic DHCP snooping bindings associated with this port are removed.
- ◆ *Additional considerations when the switch itself is a DHCP client* – The port(s) through which it submits a client request to the DHCP server must be configured as trusted.

### Example

This example sets port 5 to untrusted.

```
Console(config)#interface ethernet 1/5
Console(config-if)#no ip dhcp snooping trust
Console(config-if)#
```

### Related Commands

[ip dhcp snooping \(327\)](#)

[ip dhcp snooping vlan \(335\)](#)

### clear ip dhcp snooping binding

This command clears DHCP snooping binding table entries from RAM. Use this command without any optional keywords to clear all entries from the binding table.

### Syntax

**clear ip dhcp snooping binding** [*mac-address* **vlan** *vlan-id*]

*mac-address* - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

*vlan-id* - ID of a configured VLAN (Range: 1-4094)

### Command Mode

Privileged Exec

### Example

```
Console#clear ip dhcp snooping binding 11-22-33-44-55-66 vlan 1
Console#
```

**clear ip dhcp snooping database flash** This command removes all dynamically learned snooping entries from flash memory.

**Command Mode**  
Privileged Exec

#### Example

```
Console#clear ip dhcp snooping database flash
Console#
```

**ip dhcp snooping database flash** This command writes all dynamically learned snooping entries to flash memory.

**Command Mode**  
Privileged Exec

#### Command Usage

This command can be used to store the currently learned dynamic DHCP snooping entries to flash memory. These entries will be restored to the snooping table when the switch is reset. However, note that the lease time shown for a dynamic entry that has been restored from flash memory will no longer be valid.

#### Example

```
Console#ip dhcp snooping database flash
Console#
```

**show ip dhcp snooping** This command shows the DHCP snooping configuration settings.

**Command Mode**  
Privileged Exec

#### Example

```
Console#show ip dhcp snooping
DHCP Snooping Information Option Status: disabled
DHCP Snooping Information Option Sub-option Format: extra subtype included
DHCP Snooping Information Option Remote ID: MAC Address (hex encoded)
DHCP Snooping Information Option Remote ID TR101 VLAN Field: enabled
DHCP Snooping Information Option TR101 Board ID: none
DHCP Snooping Information Policy: replace
DHCP Snooping is configured on the following VLANs:
  1,
Verify Source MAC-Address: enabled
DHCP Snooping rate limit: unlimited
Interface Trusted Circuit-ID mode Circuit-ID Value Circuit-ID TR101 VLAN Field
-----
Eth 1/1 No VLAN-Unit-Port --- enabled
Eth 1/2 No VLAN-Unit-Port --- enabled
Eth 1/3 No VLAN-Unit-Port --- enabled
Eth 1/4 No VLAN-Unit-Port --- enabled
Eth 1/5 No Vlan-Unit-Port --- enabled
.
.
```

**show ip dhcp snooping binding** This command shows the DHCP snooping binding table entries.

**Command Mode**  
Privileged Exec

#### Example

```
Console#show ip dhcp snooping binding
MAC Address IP Address Lease(sec) Type VLAN Interface
-----
11-22-33-44-55-66 192.168.0.99 0 Dynamic-DHCPSNP 1 Eth 1/5
Console#
```

## DHCPv6 Snooping

DHCPv6 snooping allows a switch to protect a network from rogue DHCPv6 servers or other devices which send port-related information to a DHCPv6 server. This information can be useful in tracking an IP address back to a physical port. This section describes commands used to configure DHCPv6 snooping.

**Table 61: DHCP Snooping Commands**

Command	Function	Mode
<code>ipv6 dhcp snooping</code>	Enables DHCPv6 snooping globally	GC
<code>ipv6 dhcp snooping option remote-id</code>	Enables insertion of DHCPv6 Option 37 relay agent remote-id	GC
<code>ipv6 dhcp snooping option remote-id policy</code>	Sets the information option policy for DHCPv6 client packets that include Option 37 information	GC
<code>ipv6 dhcp snooping vlan</code>	Enables DHCPv6 snooping on the specified VLAN	GC
<code>ipv6 dhcp snooping max-binding</code>	Sets the maximum number of entries which can be stored in the binding database for an interface	IC
<code>ipv6 dhcp snooping trust</code>	Configures the specified interface as trusted	IC
<code>clear ipv6 dhcp snooping binding</code>	Clears DHCPv6 snooping binding table entries from RAM	PE
<code>clear ipv6 dhcp snooping statistics</code>	Clears statistical counters for DHCPv6 snooping client, server and relay packets	PE
<code>show ipv6 dhcp snooping</code>	Shows the DHCPv6 snooping configuration settings	PE
<code>show ipv6 dhcp snooping binding</code>	Shows the DHCPv6 snooping binding table entries	PE
<code>show ipv6 dhcp snooping statistics</code>	Shows statistics for DHCPv6 snooping client, server and relay packets	PE

**ipv6 dhcp snooping** This command enables DHCPv6 snooping globally. Use the **no** form to restore the default setting.

### Syntax

**[no] ipv6 dhcp snooping**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Network traffic may be disrupted when malicious DHCPv6 messages are received from an outside source. DHCPv6 snooping is used to filter DHCPv6 messages received on an unsecure interface from outside the network or fire

wall. When DHCPv6 snooping is enabled globally by this command, and enabled on a VLAN interface by the `ipv6 dhcp snooping vlan` command, DHCP messages received on an untrusted interface (as specified by the `no ipv6 dhcp snooping trust` command) from a device not listed in the DHCPv6 snooping table will be dropped.

- ◆ When enabled, DHCPv6 messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCPv6 snooping.
- ◆ Table entries are only learned for trusted interfaces. Each entry includes a MAC address, IPv6 address, lease time, binding type, VLAN identifier, and port identifier.
- ◆ When DHCPv6 snooping is enabled, the rate limit for the number of DHCPv6 messages that can be processed by the switch is 100 packets per second. Any DHCPv6 packets in excess of this limit are dropped.
- ◆ Filtering rules are implemented as follows:
  - If global DHCPv6 snooping is disabled, all DHCPv6 packets are forwarded.
  - If DHCPv6 snooping is enabled globally, and also enabled on the VLAN where the DHCPv6 packet is received, DHCPv6 packets are forwarded for a *trusted* port as described below.
  - If DHCPv6 snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is *not trusted*, DHCP packets are processed according to message type as follows:

#### *DHCP Client Packet*

- Request: Update entry in binding cache, recording client's DHCPv6 Unique Identifier (DUID), server's DUID, Identity Association (IA) type, IA Identifier, and address (4 message exchanges to get IPv6 address), and forward to trusted port.
- Solicit: Add new entry in binding cache, recording client's DUID, IA type, IA ID (2 message exchanges to get IPv6 address with rapid commit option, otherwise 4 message exchanges), and forward to trusted port.
- Decline: If no matching entry is found in binding cache, drop this packet.
- Renew, Rebind, Release, Confirm: If no matching entry is found in binding cache, drop this packet.
- If the DHCPv6 packet is not a recognizable type, it is dropped.

If a DHCPv6 packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.

#### DHCP Server Packet

- If a DHCP server packet is received on an untrusted port, drop this packet and add a log entry in the system.
- If a DHCPv6 Reply packet is received from a server on a trusted port, it will be processed in the following manner:
  - A.** Check if IPv6 address in IA option is found in binding table:
    - If yes, continue to C.
    - If not, continue to B.
  - B.** Check if IPv6 address in IA option is found in binding cache:
    - If yes, continue to C.
    - If not, check failed, and forward packet to trusted port.
  - C.** Check status code in IA option:
    - If successful, and entry is in binding table, update lease time and forward to original destination.
    - If successful, and entry is in binding cache, move entry from binding cache to binding table, update lease time and forward to original destination.
    - Otherwise, remove binding entry. and check failed.
- If a DHCPv6 Relay packet is received, check the relay message option in Relay-Forward or Relay-Reply packet, and process client and server packets as described above.
- ◆ If DHCPv6 snooping is globally disabled, all dynamic bindings are removed from the binding table.
- ◆ *Additional considerations when the switch itself is a DHCPv6 client* – The port(s) through which the switch submits a client request to the DHCPv6 server must be configured as trusted (using the `ipv6 dhcp snooping trust` command). Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCPv6 server. Also, when the switch sends out DHCPv6 client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCPv6 server, any packets received from untrusted ports are dropped.

#### Example

This example enables DHCPv6 snooping globally for the switch.

```
Console(config)#ipv6 dhcp snooping
Console(config)#
```

### Related Commands

[ipv6 dhcp snooping vlan \(346\)](#)

[ipv6 dhcp snooping trust \(347\)](#)

### **ipv6 dhcp snooping option remote-id**

This command enables the insertion of remote-id option 37 information into DHCPv6 client messages. Remote-id option information such as the port attached to the client, DUID, and VLAN ID is used by the DHCPv6 server to assign preassigned configuration data specific to the DHCPv6 client. Use the **no** form of the command to disable this function.

### Syntax

**[no] ipv6 dhcp snooping option remote-id**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ DHCPv6 provides a relay mechanism for sending information about the switch and its DHCPv6 clients to the DHCPv6 server. Known as DHCPv6 Option 37, it allows compatible DHCPv6 servers to use the information when assigning IP addresses, or to set other services or policies for clients.
- ◆ When DHCPv6 Snooping Information Option 37 is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCPv6 request packets forwarded by the switch and in reply packets sent back from the DHCPv6 server.
- ◆ When the DHCPv6 Snooping Option 37 is enabled, clients can be identified by the switch port to which they are connected rather than just their MAC address. DHCPv6 client-server exchange messages are then forwarded directly between the server and client without having to flood them to the entire VLAN.
- ◆ DHCPv6 snooping must be enabled for the DHCPv6 Option 37 information to be inserted into packets. When enabled, the switch will either drop, keep or remove option 37 information in incoming DHCPv6 packets. Packets are processed as follows:
  - If an incoming packet is a DHCPv6 request packet with option 37 information, it will modify the option 37 information according to settings specified with [ipv6 dhcp snooping option remote-id policy](#) command.
  - If an incoming packet is a DHCPv6 request packet without option 37 information, enabling the DHCPv6 snooping information option will add option 37 information to the packet.



- If an incoming packet is a DHCPv6 reply packet with option 37 information, enabling the DHCPv6 snooping information option will remove option 37 information from the packet.
- ◆ When this switch inserts Option 37 information in DHCPv6 client request packets, the switch's MAC address (hexadecimal) is used for the remote ID.

### Example

This example enables the DHCPv6 Snooping Remote-ID Option.

```
Console(config)#ipv6 dhcp snooping option remote-id
Console(config)#
```

### ipv6 dhcp snooping option remote-id policy

This command sets the remote-id option policy for DHCPv6 client packets that include Option 37 information. Use the **no** form to disable this function.

#### Syntax

**ipv6 dhcp snooping option remote-id policy {drop | keep | replace}**

**no ipv6 dhcp snooping option remote-id policy**

**drop** - Drops the client's request packet instead of relaying it.

**keep** - Retains the Option 37 information in the client request, and forwards the packets to trusted ports.

**replace** - Replaces the Option 37 remote-ID in the client's request with the relay agent's remote-ID (when DHCPv6 snooping is enabled), and forwards the packets to trusted ports.

#### Default Setting

drop

#### Command Mode

Global Configuration

#### Command Usage

When the switch receives DHCPv6 packets from clients that already include DHCP Option 37 information, the switch can be configured to set the action policy for these packets. The switch can either drop the DHCPv6 packets, keep the existing information, or replace it with the switch's relay agent information.

### Example

This example configures the switch to keep existing remote-id option 37 information within DHCPv6 client packets and forward it.

```
Console(config)#ipv6 dhcp snooping option remote-id policy keep
Console(config)#
```

**ipv6 dhcp snooping  
vlan** This command enables DHCPv6 snooping on the specified VLAN. Use the **no** form to restore the default setting.

#### Syntax

**[no] ipv6 dhcp snooping vlan** {*vlan-id* | *vlan-range*}

*vlan-id* - ID of a configured VLAN (Range: 1-4094)

*vlan-range* - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When DHCPv6 snooping enabled globally using the [ipv6 dhcp snooping](#) command, and enabled on a VLAN with this command, DHCPv6 packet filtering will be performed on any untrusted ports within the VLAN as specified by the [ipv6 dhcp snooping trust](#) command.
- ◆ When the DHCPv6 snooping is globally disabled, DHCPv6 snooping can still be configured for specific VLANs, but the changes will not take effect until DHCPv6 snooping is globally re-enabled.
- ◆ When DHCPv6 snooping is enabled globally, and then disabled on a VLAN, all dynamic bindings learned for this VLAN are removed from the binding table.

#### Example

This example enables DHCPv6 snooping for VLAN 1.

```
Console(config)#ipv6 dhcp snooping vlan 1
Console(config)#
```

#### Related Commands

[ipv6 dhcp snooping \(341\)](#)

[ipv6 dhcp snooping trust \(347\)](#)

**ipv6 dhcp snooping max-binding** This command sets the maximum number of entries which can be stored in the binding database for an interface. Use the **no** form to restore the default setting.

#### Syntax

**ipv6 dhcp snooping max-binding** *count*

**no ipv6 dhcp snooping max-binding**

*count* - Maximum number of entries. (Range: 1-5)

#### Default Setting

5

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Example

This example sets the maximum number of binding entries to 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 dhcp snooping max-binding 1
Console(config-if)#
```

**ipv6 dhcp snooping trust** This command configures the specified interface as trusted. Use the **no** form to restore the default setting.

#### Syntax

**[no] ipv6 dhcp snooping trust**

#### Default Setting

All interfaces are untrusted

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or fire wall.
- ◆ Set all ports connected to DHCPv6 servers within the local network or fire wall to trusted, and all other ports outside the local network or fire wall to untrusted.
- ◆ When DHCPv6 snooping is enabled globally using the [ipv6 dhcp snooping](#) command, and enabled on a VLAN with [ipv6 dhcp snooping vlan](#) command, DHCPv6 packet filtering will be performed on any untrusted ports within the

VLAN according to the default status, or as specifically configured for an interface with the **no ipv6 dhcp snooping trust** command.

- ◆ When an untrusted port is changed to a trusted port, all the dynamic DHCPv6 snooping bindings associated with this port are removed.
- ◆ *Additional considerations when the switch itself is a DHCPv6 client* – The port(s) through which it submits a client request to the DHCPv6 server must be configured as trusted.

### Example

This example sets port 5 to untrusted.

```
Console(config)#interface ethernet 1/5
Console(config-if)#no ipv6 dhcp snooping trust
Console(config-if)#
```

### Related Commands

[ipv6 dhcp snooping \(341\)](#)

[ipv6 dhcp snooping vlan \(346\)](#)

### clear ipv6 dhcp snooping binding

This command clears DHCPv6 snooping binding table entries from RAM. Use this command without any optional keywords to clear all entries from the binding table.

### Syntax

**clear ipv6 dhcp snooping binding** [*mac-address ipv6-address*]

*mac-address* - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

*ipv6-address* - Corresponding IPv6 address. This address must be entered according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

### Command Mode

Privileged Exec

### Example

```
Console(config)#clear ipv6 dhcp snooping binding 00-12-cf-01-02-03 2001::1
Console(config)#
```

**clear ipv6 dhcp snooping statistics** This command clears statistical counters for DHCPv6 snooping client, server and relay packets.

**Command Mode**  
Privileged Exec

### Example

```
Console(config)#clear ipv6 dhcp snooping statistics
Console(config)#
```

**show ipv6 dhcp snooping** This command shows the DHCPv6 snooping configuration settings.

**Command Mode**  
Privileged Exec

### Example

```
Console#show ipv6 dhcp snooping
Global DHCPv6 Snooping status: disabled
DHCPv6 Snooping remote-id option status: disabled
DHCPv6 Snooping remote-id policy: drop
DHCPv6 Snooping is configured on the following VLANs:
1,
Interface      Trusted      Max-binding  Current-binding
-----
Eth 1/1        No           5             0
Eth 1/2        No           5             0
Eth 1/3        No           5             0
Eth 1/4        No           5             0
Eth 1/5        Yes          5             0
.
.
```

**show ipv6 dhcp snooping binding** This command shows the DHCPv6 snooping binding table entries.

**Command Mode**  
Privileged Exec

### Example

```
Console#show ipv6 dhcp snooping binding
NA - Non-temporary address
TA - Temporary address
-----
Link-layer Address: 00-13-49-aa-39-26
IPv6 Address      Lifetime  VLAN Port  Type
-----
2001:b021:1435:5612:ab3c:6792:a452:6712  2591998  1  Eth 1/5  NA
-----
Link-layer Address: 00-12-cf-01-02-03
```

```

IPv6 Address                               Lifetime  VLAN Port  Type
-----
2001:b000::1    2591912    1 Eth 1/3    NA
Console#

```

**show ipv6 dhcp snooping statistics** This command shows statistics for DHCPv6 snooping client, server and relay packets.

**Command Mode**  
Privileged Exec

### Example

```

Console#show ipv6 dhcp snooping statistics
DHCPv6 Snooping Statistics:
  Client Packet: Solicit, Request, Confirm, Renew, Rebind,
                  Decline, Release, Information-request
  Server Packet: Advertise, Reply, Reconfigure
  Relay Packet:  Relay-forward, Relay-reply
State  Client  Server  Relay  Total
-----
Received    10      9      0     19
Sent         9      9      0     18
Dropped     1      0      0      1
Console#

```

## IPv4 Source Guard

IPv4 Source Guard is a security feature that filters IPv4 traffic on network interfaces based on manually configured entries in the IPv4 Source Guard table, or dynamic entries in the DHCPv4 Snooping table when enabled (see [“DHCPv4 Snooping” on page 326](#)). IPv4 source guard can be used to prevent traffic attacks caused when a host tries to use the IPv4 address of a neighbor to access the network. This section describes commands used to configure IPv4 Source Guard.

**Table 62: IPv4 Source Guard Commands**

Command	Function	Mode
<a href="#">ip source-guard binding</a>	Adds a static address to the source-guard binding table	GC
<a href="#">ip source-guard</a>	Configures the switch to filter inbound traffic based on source IP address, or source IP address and corresponding MAC address	IC
<a href="#">ip source-guard max-binding</a>	Sets the maximum number of entries that can be bound to an interface	IC
<a href="#">ip source-guard mode</a>	Sets the source-guard learning mode to search for addresses in the ACL binding table or the MAC address binding table	IC
<a href="#">clear ip source-guard binding blocked</a>	Remove all blocked records	PE

Table 62: IPv4 Source Guard Commands (Continued)

Command	Function	Mode
<code>show ip source-guard</code>	Shows whether source guard is enabled or disabled on each interface	PE
<code>show ip source-guard binding</code>	Shows the source guard binding table	PE

**ip source-guard binding** This command adds a static address to the source-guard ACL or MAC address binding table. Use the **no** form to remove a static entry.

### Syntax

**ip source-guard binding** [**mode** {**acl** | **mac**}] *mac-address*  
**vlan** *vlan-id* *ip-address* **interface ethernet** *unit/port-list*

**no ip source-guard binding** [**mode** {**acl** | **mac**}] *mac-address* **vlan** *vlan-id*

**mode** - Specifies the binding mode.

**acl** - Adds binding to ACL table.

**mac** - Adds binding to MAC address table.

*mac-address* - A valid unicast MAC address.

*vlan-id* - ID of a configured VLAN for an ACL filtering table or a range of VLANs for a MAC address filtering table. To specify a list separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094)

*ip-address* - A valid unicast IP address, including classful types A, B or C.

*unit* - Unit identifier. (Range: 1-8)

*port-list* - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers. (Range: 1-28)

### Default Setting

No configured entries

### Command Mode

Global Configuration

### Command Usage

- ◆ If the binding mode is not specified in this command, the entry is bound to the ACL table by default.
- ◆ Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding), VLAN identifier, and port identifier.
- ◆ All static entries are configured with an infinite lease time, which is indicated with a value of zero by the `show ip source-guard` command (page 356).

- ◆ When source guard is enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping, or static addresses configured in the source guard binding table with this command.
- ◆ An entry with same MAC address and a different VLAN ID cannot be added to the binding table .
- ◆ Static bindings are processed as follows:
  - A valid static IP source guard entry will be added to the binding table in ACL mode if one of the following conditions is true:
    - If there is no binding entry with the same VLAN ID and MAC address, a new entry will be added to the binding table using the type of static IP source guard binding.
    - If there is an entry with the same VLAN ID and MAC address, and the type of entry is static IP source guard binding, then the new entry will replace the old one.
    - If there is an entry with the same VLAN ID and MAC address, and the type of the entry is dynamic DHCP snooping binding, then the new entry will replace the old one and the entry type will be changed to static IP source guard binding.
  - A valid static IP source guard entry will be added to the binding table in MAC mode if one of the following conditions are true:
    - If there is no binding entry with the same IP address and MAC address, a new entry will be added to the binding table using the type of static IP source guard binding entry.
    - If there is a binding entry with same IP address and MAC address, then the new entry shall replace the old one.
- ◆ Only unicast addresses are accepted for static bindings.

### Example

This example configures a static source-guard binding on port 5. Since the binding mode is not specified, the entry is bound to the ACL table by default.

```
Console(config)#ip source-guard binding 11-22-33-44-55-66 vlan 1 192.168.0.99
interface ethernet 1/5
Console(config-if)#
```

### Related Commands

[ip source-guard \(353\)](#)

[ip dhcp snooping \(327\)](#)

[ip dhcp snooping vlan \(335\)](#)



**ip source-guard** This command configures the switch to filter inbound traffic based on source IP address, or source IP address and corresponding MAC address. Use the **no** form to disable this function.

### Syntax

**ip source-guard {sip | sip-mac}**

**no ip source-guard**

**sip** - Filters traffic based on IP addresses stored in the binding table.

**sip-mac** - Filters traffic based on IP addresses and corresponding MAC addresses stored in the binding table.

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Source guard is used to filter traffic on an insecure port which receives messages from outside the network or fire wall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.
- ◆ Setting source guard mode to "sip" or "sip-mac" enables this function on the selected port. Use the "sip" option to check the VLAN ID, source IP address, and port number against all entries in the binding table. Use the "sip-mac" option to check these same parameters, plus the source MAC address. Use the **no ip source guard** command to disable this function on the selected port.
- ◆ When enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping, or static addresses configured in the source guard binding table.
- ◆ Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding, VLAN identifier, and port identifier).
- ◆ Static addresses entered in the source guard binding table with the **ip source-guard binding** command are automatically configured with an infinite lease time. Dynamic entries learned via DHCP snooping are configured by the DHCP server itself.
- ◆ If the IP source guard is enabled, an inbound packet's IP address (sip option) or both its IP address and corresponding MAC address (sip-mac option) will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- ◆ Filtering rules are implemented as follows:
  - If DHCPv4 snooping is disabled (see [page 327](#)), IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for

the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, the packet will be forwarded.

- If the DHCP snooping is enabled, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, or dynamic DHCP snooping binding, the packet will be forwarded.
- If IP source guard is enabled on an interface for which IP source bindings (dynamically learned via DHCP snooping or manually configured) are not yet configured, the switch will drop all IP traffic on that port, except for DHCP packets allowed by DHCP snooping.
- Only unicast addresses are accepted for static bindings.

### Example

This example enables IP source guard on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard sip
Console(config-if)#
```

### Related Commands

[ip source-guard binding \(351\)](#)

[ip dhcp snooping \(327\)](#)

[ip dhcp snooping vlan \(335\)](#)

**ip source-guard max-binding** This command sets the maximum number of entries that can be bound to an interface. Use the **no** form to restore the default setting.

### Syntax

**ip source-guard [mode {acl | mac}] max-binding *number***

**no ip source-guard [mode {acl | mac}] max-binding**

**mode** - Specifies the learning mode.

**acl** - Searches for addresses in the ACL table.

**mac** - Searches for addresses in the MAC address table.

***number*** - The maximum number of IP addresses that can be mapped to an interface in the binding table. (Range: 1-16 for ACL mode; 1-1024 for MAC mode)

### Default Setting

Mode: ACL

Maximum Binding: 5

## Command Mode

Interface Configuration (Ethernet)

## Command Usage

- ◆ This command sets the maximum number of address entries that can be mapped to an interface in the binding table for the specified mode (ACL binding table or MAC address table) including dynamic entries discovered by DHCP snooping and static entries set by the `ip source-guard` command.
- ◆ The maximum binding for ACL mode restricts the number of “active” entries per port. If binding entries exceed the maximum number in IP source guard, only the maximum number of binding entries will be set. Dynamic binding entries exceeding the maximum number will be created but will not be active.
- ◆ The maximum binding for MAC mode restricts the number of MAC addresses learned per port. Authenticated IP traffic with different source MAC addresses cannot be learned if it would exceed this maximum number.

## Example

This example sets the maximum number of allowed entries in the binding table for port 5 to one entry. The mode is not specified, and therefore defaults to the ACL binding table.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard max-binding 1
Console(config-if)#
```

**ip source-guard mode** This command sets the source-guard learning mode to search for addresses in the ACL binding table or the MAC address binding table. Use the **no** form to restore the default setting.

## Syntax

**ip source-guard mode {acl | mac}**

**no ip source-guard mode**

**mode** - Specifies the learning mode.

**acl** - Searches for addresses in the ACL binding table.

**mac** - Searches for addresses in the MAC address binding table.

## Default Setting

ACL

## Command Mode

Interface Configuration (Ethernet)

### Command Usage

There are two modes for the filtering table:

- ◆ ACL - IP traffic will be forwarded if it passes the checking process in the ACL mode binding table.
- ◆ MAC - A MAC entry will be added in MAC address table if IP traffic passes the checking process in MAC mode binding table.

### Example

This command sets the binding table mode for the specified interface to MAC mode:

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard mode mac
Console(config-if)#
```

### **clear ip source-guard binding blocked**

This command clears source-guard binding table entries from RAM.

#### Syntax

**clear ip source-guard binding blocked**

### Command Mode

Privileged Exec

### Command Usage

When IP Source-Guard detects an invalid packet it creates a blocked record. These records can be viewed using the [show ip source-guard binding blocked](#) command. A maximum of 512 blocked records can be stored before the switch overwrites the oldest record with new blocked records. Use the **clear ip source-guard binding blocked** command to clear this table.

### Example

This command clears the blocked record table.

```
Console(config)#clear ip source-guard binding blocked
Console(config)#
```

### **show ip source-guard**

This command shows whether source guard is enabled or disabled on each interface.

### Command Mode

Privileged Exec

### Example

```

Console#show ip source-guard

Interface  Filter-type  Filter-table  ACL Table  MAC Table
-----  -
Eth 1/1    DISABLED    ACL           5          1024
Eth 1/2    DISABLED    ACL           5          1024
Eth 1/3    DISABLED    ACL           5          1024
Eth 1/4    DISABLED    ACL           5          1024
Eth 1/5    DISABLED    ACL           5          1024
:

```

**show ip source-guard binding** This command shows the source guard binding table.

### Syntax

**show ip source-guard binding** [**dhcp-snooping** | **static** [**acl** | **mac**] | **blocked** [**vlan** *vlan-id* | **interface** *interface*]

**dhcp-snooping** - Shows dynamic entries configured with DHCP Snooping commands (see [page 326](#))

**static** - Shows static entries configured with the [ip source-guard binding](#) command.

**acl** - Shows static entries in the ACL binding table.

**mac** - Shows static entries in the MAC address binding table.

**blocked** - Shows MAC addresses which have been blocked by IP Source Guard.

*vlan-id* - ID of a configured VLAN (Range: 1-4094)

*interface* - Specifies a port interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```

Console#show ip source-guard binding
MAC Address  IP Address  Type      VLAN  Interface
-----
00-10-b5-f4-d0-01  10.2.44.96  static-acl  1    Eth 1/1
Console#

```

## IPv6 Source Guard

IPv6 Source Guard is a security feature that filters IPv6 traffic on non-routed, Layer 2 network interfaces based on manually configured entries in the IPv6 Source Guard table, or dynamic entries in the Neighbor Discovery Snooping table or DHCPv6 Snooping table when either snooping protocol is enabled (see [“DHCPv6 Snooping” on page 341](#)). IPv6 source guard can be used to prevent traffic attacks caused when a host tries to use the IPv6 address of a neighbor to access the network. This section describes commands used to configure IPv6 Source Guard.

**Table 63: IPv6 Source Guard Commands**

Command	Function	Mode
<a href="#">ipv6 source-guard binding</a>	Adds a static address to the source-guard binding table	GC
<a href="#">ipv6 source-guard</a>	Configures the switch to filter inbound traffic based on source IP address	IC
<a href="#">ipv6 source-guard max-binding</a>	Sets the maximum number of entries that can be bound to an interface	IC
<a href="#">show ipv6 source-guard</a>	Shows whether source guard is enabled or disabled on each interface	PE
<a href="#">show ipv6 source-guard binding</a>	Shows the source guard binding table	PE

**ipv6 source-guard binding** This command adds a static address to the source-guard binding table. Use the **no** form to remove a static entry.

### Syntax

**ipv6 source-guard binding** *mac-address* **vlan** *vlan-id* *ipv6-address*  
**interface** *interface*

**no ipv6 source-guard binding** *mac-address* **vlan** *vlan-id*

*mac-address* - A valid unicast MAC address.

*vlan-id* - ID of a configured VLAN (Range: 1-4094)

*ipv6-address* - Corresponding IPv6 address. This address must be entered according to RFC 2373 “IPv6 Addressing Architecture,” using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Default Setting

No configured entries

### Command Mode

Global Configuration

### Command Usage

- ◆ Table entries include an associated MAC address, IPv6 global unicast address, entry type (Static-IPv6-SG-Binding, Dynamic-ND-Snooping, Dynamic-DHCPv6-Snooping), VLAN identifier, and port identifier.
- ◆ Traffic filtering is based only on the source IPv6 address, VLAN ID, and port number.
- ◆ All static entries are configured with an infinite lease time, which is indicated with a value of zero by the `show ipv6 source-guard` command.
- ◆ When source guard is enabled, traffic is filtered based upon dynamic entries learned via ND snooping, DHCPv6 snooping, or static addresses configured in the source guard binding table with this command.
- ◆ An entry with same MAC address and a different VLAN ID cannot be added to the binding table .
- ◆ Static bindings are processed as follows:
  - If there is no entry with same MAC address and IPv6 address, a new entry is added to binding table using static IPv6 source guard binding.
  - If there is an entry with same MAC address and IPv6 address, and the type of entry is static IPv6 source guard binding, then the new entry will replace the old one.
  - If there is an entry with same MAC address and IPv6 address, and the type of the entry is either a dynamic ND snooping binding or DHCPv6 snooping binding, then the new entry will replace the old one and the entry type will be changed to static IPv6 source guard binding.
  - Only unicast addresses are accepted for static bindings.

### Example

This example configures a static source-guard binding on port 5.

```
Console(config)#ipv6 source-guard binding 00-ab-11-cd-23-45 vlan 1 2001::1
interface ethernet 1/5
Console(config)#
```

### Related Commands

[ipv6 source-guard \(360\)](#)  
[ipv6 dhcp snooping \(341\)](#)  
[ipv6 dhcp snooping vlan \(346\)](#)

**ipv6 source-guard** This command configures the switch to filter inbound traffic based on the source IP address stored in the binding table. Use the **no** form to disable this function.

### Syntax

**ipv6 source-guard sip**  
**no ipv6 source-guard**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Source guard is used to filter traffic on an insecure port which receives messages from outside the network or fire wall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.
- ◆ This command checks the VLAN ID, IPv6 global unicast source IP address, and port number against all entries in the binding table. Use the **no ipv6 source guard** command to disable this function on the selected port.
- ◆ After IPv6 source guard is enabled on an interface, the switch initially blocks all IPv6 traffic received on that interface, except for ND packets allowed by ND snooping and DHCPv6 packets allowed by DHCPv6 snooping. A port access control list (ACL) is applied to the interface. Traffic is then filtered based upon dynamic entries learned via ND snooping or DHCPv6 snooping, or static addresses configured in the source guard binding table. The port allows only IPv6 traffic with a matching entry in the binding table and denies all other IPv6 traffic.
- ◆ Table entries include a MAC address, IPv6 global unicast address, entry type (Static-IPv6-SG-Binding, Dynamic-ND-Snooping, Dynamic-DHCPv6-Snooping), VLAN identifier, and port identifier.
- ◆ Static addresses entered in the source guard binding table with the [ipv6 source-guard binding](#) command are automatically configured with an infinite lease time. Dynamic entries learned via DHCPv6 snooping are configured by the DHCPv6 server itself.



- ◆ If IPv6 source guard is enabled, an inbound packet's source IPv6 address will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- ◆ Filtering rules are implemented as follows:
  - If ND snooping and DHCPv6 snooping are disabled, IPv6 source guard will check the VLAN ID, source IPv6 address, and port number. If a matching entry is found in the binding table and the entry type is static IPv6 source guard binding, the packet will be forwarded.
  - If ND snooping or DHCPv6 snooping is enabled, IPv6 source guard will check the VLAN ID, source IP address, and port number. If a matching entry is found in the binding table and the entry type is static IPv6 source guard binding, dynamic ND snooping binding, or dynamic DHCPv6 snooping binding, the packet will be forwarded.
  - If IPv6 source guard is enabled on an interface for which IPv6 source bindings (dynamically learned via ND snooping or DHCPv6 snooping, or manually configured) are not yet configured, the switch will drop all IPv6 traffic on that port, except for ND packets and DHCPv6 packets allowed by DHCPv6 snooping.
  - Only IPv6 global unicast addresses are accepted for static bindings.

### Example

This example enables IP source guard on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ipv6 source-guard sip
Console(config-if)#
```

### RELATED COMMANDS

[ipv6 source-guard binding \(358\)](#)

[ipv6 dhcp snooping \(341\)](#)

[ipv6 dhcp snooping vlan \(346\)](#)

**ipv6 source-guard max-binding** This command sets the maximum number of entries that can be bound to an interface. Use the **no** form to restore the default setting.

### Syntax

**ipv6 source-guard max-binding** *number*

**no ipv6 source-guard max-binding**

*number* - The maximum number of IPv6 addresses that can be mapped to an interface in the binding table. (Range: 1-5)

### Default Setting

5

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ This command sets the maximum number of address entries that can be mapped to an interface in the binding table, including both dynamic entries discovered by ND snooping, DHCPv6 snooping, and static entries set by the `ipv6 source-guard` command.
- ◆ IPv6 source guard maximum bindings must be set to a value higher than DHCPv6 snooping maximum bindings and ND snooping maximum bindings.
- ◆ If IPv6 source guard, ND snooping, and DHCPv6 snooping are enabled on a port, the dynamic bindings used by ND snooping, DHCPv6 snooping, and IPv6 source guard static bindings cannot exceed the maximum allowed bindings set by the **ipv6 source-guard max-binding** command. In other words, no new entries will be added to the IPv6 source guard binding table.
- ◆ If IPv6 source guard is enabled on a port, and the maximum number of allowed bindings is changed to a lower value, precedence is given to deleting entries learned through DHCPv6 snooping, ND snooping, and then manually configured IPv6 source guard static bindings, until the number of entries in the binding table reaches the newly configured maximum number of allowed bindings.

### Example

This example sets the maximum number of allowed entries in the binding table for port 5 to one entry.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ipv6 source-guard max-binding 1
Console(config-if)#
```

**show ipv6 source-guard** This command shows whether IPv6 source guard is enabled or disabled on each interface, and the maximum allowed bindings.

### Command Mode

Privileged Exec

### Example

```
Console#show ipv6 source-guard
Interface  Filter-type  Max-binding
-----
Eth 1/1    DISABLED      5
Eth 1/2    DISABLED      5
Eth 1/3    DISABLED      5
Eth 1/4    DISABLED      5
Eth 1/5    SIP           1
Eth 1/6    DISABLED      5
```

:

**show ipv6  
source-guard binding**

This command shows the IPv6 source guard binding table.

**Syntax****show ipv6 source-guard binding [dynamic | static]****dynamic** - Shows dynamic entries configured with ND Snooping or DHCPv6 Snooping commands (see [page 341](#))**static** - Shows static entries configured with the [ipv6 source-guard binding](#) command.**Command Mode**

Privileged Exec

**Example**

```

Console#show ipv6 source-guard binding
MAC Address      IPv6 Address      VLAN Interface Type
-----
00AB-11CD-2345    2001::1           1   Eth 1/5   STA
Console#

```

## ARP Inspection

ARP Inspection validates the MAC-to-IP address bindings in Address Resolution Protocol (ARP) packets. It protects against ARP traffic with invalid address bindings, which forms the basis for certain “man-in-the-middle” attacks. This is accomplished by intercepting all ARP requests and responses and verifying each of these packets before the local ARP cache is updated or the packet is forwarded to the appropriate destination, dropping any invalid ARP packets.

ARP Inspection determines the validity of an ARP packet based on valid IP-to-MAC address bindings stored in a trusted database – the DHCP snooping binding database. ARP Inspection can also validate ARP packets against user-configured ARP access control lists (ACLs) for hosts with statically configured IP addresses.

This section describes commands used to configure ARP Inspection.

**Table 64: ARP Inspection Commands**

Command	Function	Mode
<a href="#">ip arp inspection</a>	Enables ARP Inspection globally on the switch	GC
<a href="#">ip arp inspection filter</a>	Specifies an ARP ACL to apply to one or more VLANs	GC
<a href="#">ip arp inspection log-buffer logs</a>	Sets the maximum number of entries saved in a log message, and the rate at these messages are sent	GC

**Table 64: ARP Inspection Commands** (Continued)

Command	Function	Mode
<code>ip arp inspection validate</code>	Specifies additional validation of address components in an ARP packet	GC
<code>ip arp inspection vlan</code>	Enables ARP Inspection for a specified VLAN or range of VLANs	GC
<code>ip arp inspection limit</code>	Sets a rate limit for the ARP packets received on a port	IC
<code>ip arp inspection trust</code>	Sets a port as trusted, and thus exempted from ARP Inspection	IC
<code>show ip arp inspection configuration</code>	Displays the global configuration settings for ARP Inspection	PE
<code>show ip arp inspection interface</code>	Shows the trust status and inspection rate limit for ports	PE
<code>show ip arp inspection log</code>	Shows information about entries stored in the log, including the associated VLAN, port, and address components	PE
<code>show ip arp inspection statistics</code>	Shows statistics about the number of ARP packets processed, or dropped for various reasons	PE
<code>show ip arp inspection vlan</code>	Shows configuration setting for VLANs, including ARP Inspection status, the ARP ACL name, and if the DHCP Snooping database is used after ACL validation is completed	PE

**ip arp inspection** This command enables ARP Inspection globally on the switch. Use the **no** form to disable this function.

#### Syntax

**[no] ip arp inspection**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When ARP Inspection is enabled globally with this command, it becomes active only on those VLANs where it has been enabled with the `ip arp inspection vlan` command.
- ◆ When ARP Inspection is enabled globally and enabled on selected VLANs, all ARP request and reply packets on those VLANs are redirected to the CPU and their switching is handled by the ARP Inspection engine.
- ◆ When ARP Inspection is disabled globally, it becomes inactive for all VLANs, including those where ARP Inspection is enabled.

- ◆ When ARP Inspection is disabled, all ARP request and reply packets bypass the ARP Inspection engine and their manner of switching matches that of all other packets.
- ◆ Disabling and then re-enabling global ARP Inspection will not affect the ARP Inspection configuration for any VLANs.
- ◆ When ARP Inspection is disabled globally, it is still possible to configure ARP Inspection for individual VLANs. These configuration changes will only become active after ARP Inspection is globally enabled again.

### Example

```
Console(config)#ip arp inspection
Console(config)#
```

**ip arp inspection filter** This command specifies an ARP ACL to apply to one or more VLANs. Use the **no** form to remove an ACL binding. Use the **no** form to remove an ACL binding.

### Syntax

**ip arp inspection filter** *arp-acl-name* **vlan** {*vlan-id* | *vlan-range*} [**static**]

**no ip arp inspection filter** *arp-acl-name* **vlan** {*vlan-id* | *vlan-range*}

*arp-acl-name* - Name of an ARP ACL. (Maximum length: 16 characters)

*vlan-id* - VLAN ID. (Range: 1-4094)

*vlan-range* - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

**static** - ARP packets are only validated against the specified ACL, address bindings in the DHCP snooping database is not checked.

### Default Setting

ARP ACLs are not bound to any VLAN  
Static mode is not enabled

### Command Mode

Global Configuration

### Command Usage

- ◆ ARP ACLs are configured with the commands described [on page 406](#).
- ◆ If static mode is enabled, the switch compares ARP packets to the specified ARP ACLs. Packets matching an IP-to-MAC address binding in a permit or deny rule are processed accordingly. Packets not matching any of the ACL rules are dropped. Address bindings in the DHCP snooping database are not checked.

- ◆ If static mode is not enabled, packets are first validated against the specified ARP ACL. Packets matching a deny rule are dropped. All remaining packets are validated against the address bindings in the DHCP snooping database.

### Example

```
Console(config)#ip arp inspection filter sales vlan 1
Console(config)#
```

**ip arp inspection log-buffer logs** This command sets the maximum number of entries saved in a log message, and the rate at which these messages are sent. Use the **no** form to restore the default settings.

### Syntax

**ip arp inspection log-buffer logs** *message-number* **interval** *seconds*

**no ip arp inspection log-buffer logs**

*message-number* - The maximum number of entries saved in a log message. (Range: 0-256, where 0 means no events are saved and no messages sent)

*seconds* - The interval at which log messages are sent. (Range: 0-86400)

### Default Setting

Message Number: 20

Interval: 10 seconds

### Command Mode

Global Configuration

### Command Usage

- ◆ ARP Inspection must be enabled with the **ip arp inspection** command before this command will be accepted by the switch.
- ◆ By default, logging is active for ARP Inspection, and cannot be disabled.
- ◆ When the switch drops a packet, it places an entry in the log buffer. Each entry contains flow information, such as the receiving VLAN, the port number, the source and destination IP addresses, and the source and destination MAC addresses.
- ◆ If multiple, identical invalid ARP packets are received consecutively on the same VLAN, then the logging facility will only generate one entry in the log buffer and one corresponding system message.
- ◆ The maximum number of entries that can be stored in the log buffer is determined by the *message-number* parameter. If the log buffer fills up before a message is sent, the oldest entry will be replaced with the newest one.

- ◆ The switch generates a system message on a rate-controlled basis determined by the *seconds* values. After the system message is generated, all entries are cleared from the log buffer.

### Example

```
Console(config)#ip arp inspection log-buffer logs 1 interval 10
Console(config)#
```

**ip arp inspection validate** This command specifies additional validation of address components in an ARP packet. Use the **no** form to restore the default setting.

### Syntax

**ip arp inspection validate**  
{**dst-mac** [**ip** [**allow-zeros**] [**src-mac**]] |  
**ip** [**allow-zeros**] [**src-mac**]] | **src-mac**}

#### **no ip arp inspection validate**

**dst-mac** - Checks the destination MAC address in the Ethernet header against the target MAC address in the ARP body. This check is performed for ARP responses. When enabled, packets with different MAC addresses are classified as invalid and are dropped.

**ip** - Checks the ARP body for invalid and unexpected IP addresses. Addresses include 0.0.0.0, 255.255.255.255, and all IP multicast addresses. Sender IP addresses are checked in all ARP requests and responses, while target IP addresses are checked only in ARP responses.

**allow-zeros** - Allows sender IP address to be 0.0.0.0.

**src-mac** - Checks the source MAC address in the Ethernet header against the sender MAC address in the ARP body. This check is performed on both ARP requests and responses. When enabled, packets with different MAC addresses are classified as invalid and are dropped.

### Default Setting

No additional validation is performed

### Command Mode

Global Configuration

### Command Usage

By default, ARP Inspection only checks the IP-to-MAC address bindings specified in an ARP ACL or in the DHCP Snooping database.

### Example

```
Console(config)#ip arp inspection validate dst-mac
Console(config)#
```

**ip arp inspection vlan** This command enables ARP Inspection for a specified VLAN or range of VLANs. Use the **no** form to disable this function.

### Syntax

**[no] ip arp inspection vlan** {*vlan-id* | *vlan-range*}

*vlan-id* - VLAN ID. (Range: 1-4094)

*vlan-range* - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

### Default Setting

Disabled on all VLANs

### Command Mode

Global Configuration

### Command Usage

- ◆ When ARP Inspection is enabled globally with the **ip arp inspection** command, it becomes active only on those VLANs where it has been enabled with this command.
- ◆ When ARP Inspection is enabled globally and enabled on selected VLANs, all ARP request and reply packets on those VLANs are redirected to the CPU and their switching is handled by the ARP Inspection engine.
- ◆ When ARP Inspection is disabled globally, it becomes inactive for all VLANs, including those where ARP Inspection is enabled.
- ◆ When ARP Inspection is disabled, all ARP request and reply packets bypass the ARP Inspection engine and their manner of switching matches that of all other packets.
- ◆ Disabling and then re-enabling global ARP Inspection will not affect the ARP Inspection configuration for any VLANs.
- ◆ When ARP Inspection is disabled globally, it is still possible to configure ARP Inspection for individual VLANs. These configuration changes will only become active after ARP Inspection is globally enabled again.

### Example

```
Console(config)#ip arp inspection vlan 1,2
Console(config)#
```



**ip arp inspection limit** This command sets a rate limit for the ARP packets received on a port. Use the **no** form to restore the default setting.

### Syntax

**ip arp inspection limit** {rate *pps* | **none**}

**no ip arp inspection limit**

*pps* - The maximum number of ARP packets that can be processed by the CPU per second on trusted or untrusted ports. (Range: 0-2048, where 0 means that no ARP packets can be forwarded)

**none** - There is no limit on the number of ARP packets that can be processed by the CPU.

### Default Setting

15

### Command Mode

Interface Configuration (Port, Static Aggregation)

### Command Usage

- ◆ This command applies to both trusted and untrusted ports.
- ◆ When the rate of incoming ARP packets exceeds the configured limit, the switch drops all ARP packets in excess of the limit.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip arp inspection limit rate 150
Console(config-if)#
```

**ip arp inspection trust** This command sets a port as trusted, and thus exempted from ARP Inspection. Use the **no** form to restore the default setting.

### Syntax

**[no] ip arp inspection trust**

### Default Setting

Untrusted

### Command Mode

Interface Configuration (Port, Static Aggregation)

### Command Usage

Packets arriving on untrusted ports are subject to any configured ARP Inspection and additional validation checks. Packets arriving on trusted ports bypass all of these checks, and are forwarded according to normal switching rules.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip arp inspection trust
Console(config-if)#
```

**show ip arp inspection configuration** This command displays the global configuration settings for ARP Inspection.

### Command Mode

Privileged Exec

### Example

```
Console#show ip arp inspection configuration

ARP Inspection Global Information:

Global IP ARP Inspection Status : disabled
Log Message Interval           : 1 s
Log Message Number             : 5
Need Additional Validation(s)   : Yes
Additional Validation Type      : Destination MAC address
Console#
```

**show ip arp inspection interface** This command shows the trust status and ARP Inspection rate limit for ports.

### Syntax

**show ip arp inspection interface** *[interface]*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```
Console#show ip arp inspection interface ethernet 1/1

Port Number      Trust Status      Rate Limit (pps)
-----
Eth 1/1          Trusted          150
Console#
```

**show ip arp inspection log** This command shows information about entries stored in the log, including the associated VLAN, port, and address components.

**Command Mode**  
Privileged Exec

### Example

```
Console#show ip arp inspection log
Total log entries number is 1

Num VLAN Port Src IP Address Dst IP Address Src MAC Address Dst MAC Address
--- --
1 1 11 192.168.2.2 192.168.2.1 00-04-E2-A0-E2-7C FF-FF-FF-FF-FF-FF
Console#
```

**show ip arp inspection statistics** This command shows statistics about the number of ARP packets processed, or dropped for various reasons.

**Command Mode**  
Privileged Exec

### Example

```
Console#show ip arp inspection statistics

ARP packets received : 150
ARP packets dropped due to rate limit : 5
Total ARP packets processed by ARP Inspection : 150
ARP packets dropped by additional validation (source MAC address) : 0
ARP packets dropped by additional validation (destination MAC address): 0
ARP packets dropped by additional validation (IP address) : 0
ARP packets dropped by ARP ACLs : 0
ARP packets dropped by DHCP snooping : 0

Console#
```

**show ip arp inspection vlan** This command shows the configuration settings for VLANs, including ARP Inspection status, the ARP ACL name, and if the DHCP Snooping database is used after ARP ACL validation is completed.

### Syntax

**show ip arp inspection vlan** *[vlan-id | vlan-range]*

*vlan-id* - VLAN ID. (Range: 1-4094)

*vlan-range* - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

**Command Mode**  
Privileged Exec

### Example

```
Console#show ip arp inspection vlan 1
```

VLAN ID	DAI Status	ACL Name	ACL Status
1	disabled	sales	static

```
Console#
```

## Denial of Service Protection

A denial-of-service attack (DoS attack) is an attempt to block the services provided by a computer or network resource. This kind of attack tries to prevent an Internet site or service from functioning efficiently or at all. In general, DoS attacks are implemented by either forcing the target to reset, to consume most of its resources so that it can no longer provide its intended service, or to obstruct the communication media between the intended users and the target so that they can no longer communicate adequately.

This section describes commands used to protect against DoS attacks.

**Table 65: DoS Protection Commands**

Command	Function	Mode
<a href="#">dos-protection echo-charge</a>	Protects against DoS echo/charge attacks	GC
<a href="#">dos-protection smurf</a>	Protects against DoS smurf attacks	GC
<a href="#">dos-protection tcp-flooding</a>	Protects against DoS TCP-flooding attacks	GC
<a href="#">dos-protection tcp-null-scan</a>	Protects against DoS TCP-null-scan attacks	GC
<a href="#">dos-protection tcp-syn-fin-scan</a>	Protects against DoS TCP-SYN/FIN-scan attacks	GC
<a href="#">dos-protection tcp-udp-port-zero</a>	Protects against attacks which set the Layer 4 source or destination port to zero	GC
<a href="#">dos-protection tcp-xmas-scan</a>	Protects against DoS TCP-XMAS-scan attacks	GC
<a href="#">dos-protection udp-flooding</a>	Protects against DoS UDP-flooding attacks	GC
<a href="#">dos-protection win-nuke</a>	Protects against DoS WinNuke attacks	GC
<a href="#">show dos-protection</a>	Shows the configuration settings for DoS protection	PE

**dos-protection echo-charge** This command protects against DoS echo/charge attacks in which the echo service repeats anything sent to it, and the charge (character generator) service generates a continuous stream of data. When used together, they create an infinite loop and result in a denial-of-service. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit.

### Syntax

**[no] dos-protection echo-charge [bit-rate-in-kilo rate]**

*rate* – Maximum allowed rate. (Range: 64-2000 kbits/second)

### Default Setting

Disabled, 1000 kbits/second

### Command Mode

Global Configuration

### Example

```
Console(config)#dos-protection echo-charge bit-rate-in-kilo 65
Console(config)#
```

**dos-protection smurf** This command protects against DoS smurf attacks in which a perpetrator generates a large amount of spoofed ICMP Echo Request traffic to the broadcast destination IP address (255.255.255.255), all of which uses a spoofed source address of the intended victim. The victim should crash due to the many interrupts required to send ICMP Echo response packets. Use the **no** form to disable this feature.

### Syntax

**[no] dos-protection smurf**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Example

```
Console(config)#dos-protection smurf
Console(config)#
```

**dos-protection tcp-flooding** This command protects against DoS TCP-flooding attacks in which a perpetrator sends a succession of TCP SYN requests (with or without a spoofed-Source IP) to a target and never returns ACK packets. These half-open connections will bind resources on the target, and no new connections can be made, resulting in a denial of service. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit..

#### Syntax

**[no] dos-protection tcp-flooding [bit-rate-in-kilo rate]**

*rate* – Maximum allowed rate. (Range: 64-2000 kbits/second)

#### Default Setting

Disabled, 1000 kbits/second

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dos-protection tcp-flooding bit-rate-in-kilo 65
Console(config)#
```

**dos-protection tcp-null-scan** This command protects against DoS TCP-null-scan attacks in which a TCP NULL scan message is used to identify listening TCP ports. The scan uses a series of strangely configured TCP packets which contain a sequence number of 0 and no flags. If the target's TCP port is closed, the target replies with a TCP RST (reset) packet. If the target TCP port is open, it simply discards the TCP NULL scan. Use the **no** form to disable this feature.

#### Syntax

**[no] dos-protection tcp-null-scan**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dos-protection tcp-null-scan
Console(config)#
```

**dos-protection tcp-syn-fin-scan** This command protects against DoS TCP-SYN/FIN-scan attacks in which a TCP SYN/ FIN scan message is used to identify listening TCP ports. The scan uses a series of strangely configured TCP packets which contain SYN (synchronize) and FIN (finish) flags. If the target's TCP port is closed, the target replies with a TCP RST (reset) packet. If the target TCP port is open, it simply discards the TCP SYN FIN scan. Use the **no** form to disable this feature.

#### Syntax

**[no] dos-protection tcp-syn-fin-scan**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dos-protection syn-fin-scan
Console(config)#
```

**dos-protection tcp-udp-port-zero** This command protects against DoS attacks in which the TCP or UDP source port or destination port is set to zero. This technique may be used as a form of DoS attack, or it may just indicate a problem with the source device. When this command is enabled, the switch will drop these packets. Use the **no** form to restore the default setting.

#### Syntax

**[no] dos-protection tcp-udp-port-zero**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dos-protection tcp-udp-port-zero
Console(config)#
```

**dos-protection tcp-xmas-scan** This command protects against DoS TCP-xmas-scan in which a so-called TCP XMAS scan message is used to identify listening TCP ports. This scan uses a series of strangely configured TCP packets which contain a sequence number of 0 and the URG, PSH and FIN flags. If the target's TCP port is closed, the target replies with a TCP RST packet. If the target TCP port is open, it simply discards the TCP XMAS scan. Use the **no** form to disable this feature.

#### Syntax

**[no] dos-protection tcp-xmas-scan**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dos-protection tcp-xmas-scan
Console(config)#
```

**dos-protection udp-flooding** This command protects against DoS UDP-flooding attacks in which a perpetrator sends a large number of UDP packets (with or without a spoofed-Source IP) to random ports on a remote host. The target will determine that application is listening at that port, and reply with an ICMP Destination Unreachable packet. It will be forced to send many ICMP packets, eventually leading it to be unreachable by other clients. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit.

#### Syntax

**[no] dos-protection udp-flooding [bit-rate-in-kilo rate]**

*rate* – Maximum allowed rate. (Range: 64-2000 kbits/second)

#### Default Setting

Disabled, 1000 kbits/second

#### Command Mode

Global Configuration

#### Example

```
Console(config)#dos-protection udp-flooding bit-rate-in-kilo 65
Console(config)#
```



**dos-protection win-uke** This command protects against DoS WinNuke attacks in which affected the Microsoft Windows 3.1x/95/NT operating systems. In this type of attack, the perpetrator sends the string of OOB out-of-band (OOB) packets contained a TCP URG flag to the target computer on TCP port 139 (NetBIOS), casing it to lock up and display a “Blue Screen of Death.” This did not cause any damage to, or change data on, the computer’s hard disk, but any unsaved data would be lost. Microsoft made patches to prevent the WinNuke attack, but the OOB packets still put the service in a tight loop that consumed all available CPU time. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit.

### Syntax

**[no] dos-protection win-uke [bit-rate-in-kilo rate]**

*rate* – Maximum allowed rate. (Range: 64-2000 kbits/second)

### Default Setting

Disabled, 1000 kbits/second

### Command Mode

Global Configuration

### Example

```
Console(config)#dos-protection win-uke bit-rate-in-kilo65
Console(config)#
```

**show dos-protection** This command shows the configuration settings for the DoS protection commands.

### Command Mode

Privileged Exec

### Example

```
Console#show dos-protection
Global DoS Protection:

Echo/Chargen Attack      : Disabled, 1000 kilobits per second
Smurf Attack             : Enabled
TCP Flooding Attack      : Disabled, 1000 kilobits per second
TCP Null Scan            : Enabled
TCP SYN/FIN Scan         : Enabled
TCP/UDP Packets with Port 0 : Enabled
TCP XMAS Scan            : Enabled
UDP Flooding Attack      : Disabled, 1000 kilobits per second
WinNuke Attack           : Disabled, 1000 kilobits per second
Console#
```

## Port-based Traffic Segmentation

If tighter security is required for passing traffic from different clients through downlink ports on the local network and over uplink ports to the service provider, port-based traffic segmentation can be used to isolate traffic for individual clients.

Traffic belonging to each client is isolated to the allocated downlink ports. But the switch can be configured to either isolate traffic passing across a client's allocated uplink ports from the uplink ports assigned to other clients, or to forward traffic through the uplink ports used by other clients, allowing different clients to share access to their uplink ports where security is less likely to be compromised.

**Table 66: Commands for Configuring Traffic Segmentation**

Command	Function	Mode
<code>traffic-segmentation</code>	Enables traffic segmentation	GC
<code>traffic-segmentation session</code>	Creates a client session	GC
<code>traffic-segmentation uplink/ downlink</code>	Configures uplink/downlink ports for client sessions	GC
<code>traffic-segmentation uplink-to-uplink</code>	Specifies whether or not traffic can be forwarded between uplink ports assigned to different client sessions	GC
<code>show traffic-segmentation</code>	Displays the configured traffic segments	PE

**traffic-segmentation** This command enables traffic segmentation. Use the **no** form to disable traffic segmentation.

### Syntax

**[no] traffic-segmentation**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Traffic segmentation provides port-based security and isolation between ports within the VLAN. Data traffic on the downlink ports can only be forwarded to, and from, the designated uplink port(s). Data cannot pass between downlink ports in the same segmented group, nor to ports which do not belong to the same group.
- ◆ Traffic segmentation and normal VLANs can exist simultaneously within the same switch. Traffic may pass freely between uplink ports in segmented groups and ports in normal VLANs.

- ◆ When traffic segmentation is enabled, the forwarding state for the uplink and downlink ports assigned to different client sessions is shown below.

**Table 67: Traffic Segmentation Forwarding**

Destination Source	Session #1 Downlinks	Session #1 Uplinks	Session #2 Downlinks	Session #2 Uplinks	Normal Ports
<b>Session #1 Downlink Ports</b>	Blocking	Forwarding	Blocking	Blocking	Blocking
<b>Session #1 Uplink Ports</b>	Forwarding	Forwarding	Blocking	Blocking/ Forwarding*	Forwarding
<b>Session #2 Downlink Ports</b>	Blocking	Blocking	Blocking	Forwarding	Blocking
<b>Session #2 Uplink Ports</b>	Blocking	Blocking/ Forwarding*	Forwarding	Forwarding	Forwarding
<b>Normal Ports</b>	Forwarding	Forwarding	Forwarding	Forwarding	Forwarding

\* The forwarding state for uplink-to-uplink ports is configured by the [traffic-segmentation uplink-to-uplink](#) command.

- ◆ When traffic segmentation is disabled, all ports operate in normal forwarding mode based on the settings specified by other functions such as VLANs and spanning tree protocol.
- ◆ Enter the **traffic-segmentation** command without any parameters to enable traffic segmentation. Then set the interface members for segmented groups using the [traffic-segmentation uplink/downlink](#) command.
- ◆ Enter **no traffic-segmentation** to disable traffic segmentation and clear the configuration settings for segmented groups.

### Example

This example enables traffic segmentation globally on the switch.

```
Console(config)#traffic-segmentation
Console(config)#
```

**traffic-segmentation session** This command creates a traffic-segmentation client session. Use the **no** form to remove a client session.

### Syntax

**[no] traffic-segmentation session session-id**

*session-id* – Traffic segmentation session. (Range: 1-4)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Use this command to create a new traffic-segmentation client session.
- ◆ Using the **no** form of this command will remove any assigned uplink or downlink ports, restoring these interfaces to normal operating mode.

### Example

```
Console(config)#traffic-segmentation session 1
Console(config)#
```

**traffic-segmentation uplink/downlink** This command configures the uplink and down-link ports for a segmented group of ports. Use the **no** form to remove a port from the segmented group.

### Syntax

**[no] traffic-segmentation [session session-id] {uplink interface-list [downlink interface-list] | downlink interface-list}**

*session-id* – Traffic segmentation session. (Range: 1-4)

**uplink** – Specifies an uplink interface.

**downlink** – Specifies a downlink interface.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

Session 1 if not defined

No segmented port groups are defined.

### Command Mode

Global Configuration

### Command Usage

- ◆ A port cannot be configured in both an uplink and downlink list.
- ◆ A port can only be assigned to one traffic-segmentation session.
- ◆ When specifying an uplink or downlink, a list of ports may be entered by using a hyphen or comma in the *port* field. Note that lists are not supported for the *channel-id* field.

- ◆ A downlink port can only communicate with an uplink port in the same session. Therefore, if an uplink port is not configured for a session, the assigned downlink ports will not be able to communicate with any other ports.
- ◆ If a downlink port is not configured for the session, the assigned uplink ports will operate as normal ports.

### Example

This example enables traffic segmentation, and then sets port 10 as the uplink and ports 5-8 as downlinks.

```
Console(config)#traffic-segmentation
Console(config)#traffic-segmentation uplink ethernet 1/10
downlink ethernet 1/5-8
Console(config)#
```

**traffic-segmentation uplink-to-uplink** This command specifies whether or not traffic can be forwarded between uplink ports assigned to different client sessions. Use the **no** form to restore the default.

### Syntax

**[no] traffic-segmentation uplink-to-uplink {blocking | forwarding}**

**blocking** – Blocks traffic between uplink ports assigned to different sessions.

**forwarding** – Forwards traffic between uplink ports assigned to different sessions.

### Default Setting

Blocking

### Command Mode

Global Configuration

### Example

This example enables forwarding of traffic between uplink ports assigned to different client sessions.

```
Console(config)#traffic-segmentation uplink-to-uplink forwarding
Console(config)#
```

**show traffic-segmentation** This command displays the configured traffic segments.

**Command Mode**  
Privileged Exec

### Example

```
Console#show traffic-segmentation
```

```
Private VLAN Status      : Enabled
Uplink-to-Uplink Mode    : Forwarding
```

Session	Uplink Ports	Downlink Ports
1	Ethernet 1/1	Ethernet 1/2 Ethernet 1/3 Ethernet 1/4

```
Console#
```

# Access Control Lists

Access Control Lists (ACL) provide packet filtering for IPv4 frames (based on address, protocol, Layer 4 protocol port number or TCP control code), IPv6 frames (based on address, DSCP traffic class, or next header type), or any frames (based on MAC address or Ethernet type). To filter packets, first create an access list, add the required rules, and then bind the list to a specific port. This section describes the Access Control List commands.

**Table 68: Access Control List Commands**

Command Group	Function
IPv4 ACLs	Configures ACLs based on IPv4 addresses, TCP/UDP port number, protocol type, and TCP control code
IPv6 ACLs	Configures ACLs based on IPv6 addresses, DSCP traffic class, or next header type
MAC ACLs	Configures ACLs based on hardware addresses, packet format, and Ethernet type
ARP ACLs	Configures ACLs based on ARP messages addresses
ACL Information	Displays ACLs and associated rules; shows ACLs assigned to each port

## IPv4 ACLs

The commands in this section configure ACLs based on IPv4 addresses, TCP/UDP port number, protocol type, and TCP control code. To configure IPv4 ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

**Table 69: IPv4 ACL Commands**

Command	Function	Mode
<code>access-list ip</code>	Creates an IP ACL and enters configuration mode for standard or extended IPv4 ACLs	GC
<code>ip access-group</code>	Binds an IPv4 ACL to all ports for ingress traffic	GC
<code>permit, deny</code>	Filters packets matching a specified source IPv4 address	IPv4-STD-ACL
<code>permit, deny</code>	Filters packets meeting the specified criteria, including source and destination IPv4 address, TCP/UDP port number, protocol type, and TCP control code	IPv4-EXT-ACL
<code>ip access-group</code>	Binds an IPv4 ACL to a port	IC
<code>show ip access-group</code>	Shows port assignments for IPv4 ACLs	PE
<code>show ip access-list</code>	Displays the rules for configured IPv4 ACLs	PE

**access-list ip** This command adds an IP access list and enters configuration mode for standard or extended IPv4 ACLs. Use the **no** form to remove the specified ACL.

### Syntax

**[no] access-list ip {standard | extended} *acl-name***

**standard** – Specifies an ACL that filters packets based on the source IP address.

**extended** – Specifies an ACL that filters packets based on the source or destination IP address, and other more specific criteria.

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list.
- ◆ To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- ◆ An ACL can contain up to 64 rules.

### Example

```
Console(config)#access-list ip standard david
Console(config-std-acl)#
```

### Related Commands

[permit, deny \(386\)](#)

[ip access-group \(Interface Configuration\) \(389\)](#)

[show ip access-list \(390\)](#)



**ip access-group** (Global Configuration) This command binds an IPv4 ACL to all ports for ingress traffic. Use the **no** form to remove the port.

### Syntax

**ip access-group** *acl-name* **in**  
[**time-range** *time-range-name*] [**counter**]

**no ip access-group** *acl-name* **in**

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**in** – Indicates that this list applies to ingress packets.

*time-range-name* - Name of the time range. (Range: 1-16 characters)

**counter** – Enables counter for ACL statistics.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

If an ACL is already bound to a port and you bind a different ACL to it, the switch will replace the old binding with the new one.

### Example

```
Console(config)#ip access-group david in
Console(config)#
```

### Related Commands

[show ip access-list \(390\)](#)

[Time Range \(179\)](#)

**permit, deny** This command adds a rule to a Standard IPv4 ACL. The rule sets a filter condition for packets emanating from the specified source. Use the **no** form to remove a rule.  
(Standard IP ACL)

### Syntax

```
{permit | deny} {any | source bitmask | host source}  
[time-range time-range-name]  
no {permit | deny} {any | source bitmask | host source}
```

**any** – Any source IP address.

*source* – Source IP address.

*bitmask* – Dotted decimal number representing the address bits to match.

**host** – Keyword followed by a specific IP address.

*time-range-name* - Name of the time range. (Range: 1-16 characters)

### Default Setting

None

### Command Mode

Standard IPv4 ACL

### Command Usage

- ◆ New rules are appended to the end of the list.
- ◆ Address bit masks are similar to a subnet mask, containing four integers from 0 to 255, each separated by a period. The binary mask uses 1 bits to indicate “match” and 0 bits to indicate “ignore.” The bitmask is bitwise ANDed with the specified source IP address, and then compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.

### Example

This example configures one permit rule for the specific address 10.1.1.21 and another rule for the address range 168.92.16.x – 168.92.31.x using a bitmask.

```
Console(config-std-acl)#permit host 10.1.1.21  
Console(config-std-acl)#permit 168.92.16.0 255.255.240.0  
Console(config-std-acl)#
```

### Related Commands

[access-list ip \(384\)](#)

[Time Range \(179\)](#)

**permit, deny** (Extended IPv4 ACL) This command adds a rule to an Extended IPv4 ACL. The rule sets a filter condition for packets with specific source or destination IP addresses, protocol types, source or destination protocol ports, or TCP control codes. Use the **no** form to remove a rule.

### Syntax

```
{permit | deny} [protocol-number | udp ]
  {any | source address-bitmask | host source}
  {any | destination address-bitmask | host destination}
  [dscp dscp] [precedence precedence]
  [source-port sport [bitmask]]
  [destination-port dport [port-bitmask]]
  [time-range time-range-name]
```

```
no {permit | deny} [protocol-number | udp]
  {any | source address-bitmask | host source}
  {any | destination address-bitmask | host destination}
  [dscp dscp] [precedence precedence]
  [source-port sport [bitmask]]
  [destination-port dport [port-bitmask]]
```

```
{permit | deny} tcp
  {any | source address-bitmask | host source}
  {any | destination address-bitmask | host destination}
  [dscp dscp] [precedence precedence]
  [source-port sport [bitmask]]
  [destination-port dport [port-bitmask]]
  [control-flag control-flags flag-bitmask]
  [time-range time-range-name]
```

```
no {permit | deny} tcp
  {any | source address-bitmask | host source}
  {any | destination address-bitmask | host destination}
  [dscp dscp] [precedence precedence]
  [source-port sport [bitmask]]
  [destination-port dport [port-bitmask]]
  [control-flag control-flags flag-bitmask]
```

*protocol-number* – A specific protocol number. (Range: 0-255)

*source* – Source IP address.

*destination* – Destination IP address.

*address-bitmask* – Decimal number representing the address bits to match.

**host** – Keyword followed by a specific IP address.

*dscp* – DSCP priority level. (Range: 0-63)

*precedence* – IP precedence level. (Range: 0-7)

*sport* – Protocol<sup>4</sup> source port number. (Range: 0-65535)

*dport* – Protocol<sup>4</sup> destination port number. (Range: 0-65535)

4. Includes TCP, UDP or other protocol types.

*port-bitmask* – Decimal number representing the port bits to match.  
(Range: 0-65535)

*control-flags* – Decimal number (representing a bit string) that specifies flag bits in byte 14 of the TCP header. (Range: 0-63)

*flag-bitmask* – Decimal number representing the code bits to match.

*time-range-name* - Name of the time range. (Range: 1-16 characters)

### Default Setting

None

### Command Mode

Extended IPv4 ACL

### Command Usage

- ◆ All new rules are appended to the end of the list.
- ◆ Address bit masks are similar to a subnet mask, containing four integers from 0 to 255, each separated by a period. The binary mask uses 1 bits to indicate “match” and 0 bits to indicate “ignore.” The bit mask is bitwise ANDed with the specified source IP address, and then compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.
- ◆ The control-code bitmask is a decimal number (representing an equivalent bit mask) that is applied to the control code. Enter a decimal number, where the equivalent binary bit “1” means to match a bit and “0” means to ignore a bit. The following bits may be specified:
  - 1 (fin) – Finish
  - 2 (syn) – Synchronize
  - 4 (rst) – Reset
  - 8 (psh) – Push
  - 16 (ack) – Acknowledgement
  - 32 (urg) – Urgent pointer

For example, use the code value and mask below to catch packets with the following flags set:

- SYN flag valid, use “control-code 2 2”
- Both SYN and ACK valid, use “control-code 18 18”
- SYN valid and ACK invalid, use “control-code 2 18”

### Example

This example accepts any incoming packets if the source address is within subnet 10.7.1.x. For example, if the rule is matched; i.e., the rule (10.7.1.0 & 255.255.255.0) equals the masked address (10.7.1.2 & 255.255.255.0), the packet passes through.

```
Console(config-ext-acl)#permit 10.7.1.1 255.255.255.0 any
Console(config-ext-acl)#
```

This allows TCP packets from class C addresses 192.168.1.0 to any destination address when set for destination TCP port 80 (i.e., HTTP).

```
Console(config-ext-acl)#permit 192.168.1.0 255.255.255.0 any destination-port 80
Console(config-ext-acl)#
```

This permits all TCP packets from class C addresses 192.168.1.0 with the TCP control code set to "SYN."

```
Console(config-ext-acl)#permit tcp 192.168.1.0 255.255.255.0 any control-flag 2 2
Console(config-ext-acl)#
```

### Related Commands

[access-list ip \(384\)](#)

[Time Range \(179\)](#)

### **ip access-group** (Interface Configuration)

This command binds an IPv4 ACL to a port. Use the **no** form to remove the port.

#### Syntax

**ip access-group** *acl-name* {**in** | **out**}  
[**time-range** *time-range-name*] [**counter**]

**no ip access-group** *acl-name* {**in** | **out**}

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**in** – Indicates that this list applies to ingress packets.

**out** – Indicates that this list applies to egress packets.

*time-range-name* - Name of the time range. (Range: 1-32 characters)

**counter** – Enables counter for ACL statistics.

#### Default Setting

None

#### Command Mode

Interface Configuration (Ethernet)

#### Command Usage

If an ACL is already bound to a port and you bind a different ACL to it, the switch will replace the old binding with the new one.

### Example

```
Console(config)#int eth 1/2
Console(config-if)#ip access-group david in
Console(config-if)#
```

### Related Commands

[show ip access-list \(390\)](#)

[Time Range \(179\)](#)

**show ip access-group** This command shows the ports assigned to IP ACLs.

### Command Mode

Privileged Exec

### Example

```
Console#show ip access-group
Interface ethernet 1/2
  IP access-list david in
Global
  IP access-list david in
Console#
```

### Related Commands

[ip access-group \(Interface Configuration\) \(389\)](#)

**show ip access-list** This command displays the rules for configured IPv4 ACLs.

### Syntax

**show ip access-list** {**standard** | **extended**} [*acl-name*]

**standard** – Specifies a standard IP ACL.

**extended** – Specifies an extended IP ACL.

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

### Command Mode

Privileged Exec

### Example

```
Console#show ip access-list standard
IP standard access-list david:
  permit host 10.1.1.21
  permit 168.92.0.0 255.255.15.0
Console#
```

**Related Commands**[permit, deny \(386\)](#)[ip access-group \(Interface Configuration\) \(389\)](#)

---

**IPv6 ACLs**

The commands in this section configure ACLs based on IPv6 addresses, DSCP traffic class, or next header type. To configure IPv6 ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

**Table 70: IPv6 ACL Commands**

Command	Function	Mode
<a href="#">access-list ipv6</a>	Creates an IPv6 ACL and enters configuration mode for standard or extended IPv6 ACLs	GC
<a href="#">ipv6 access-group</a>	Binds an IPv6 ACL to all ports for ingress traffic	GC
<a href="#">permit, deny</a>	Filters packets matching a specified source IPv6 address	IPv6- STD-ACL
<a href="#">permit, deny</a>	Filters packets meeting the specified criteria, including source or destination IPv6 address, DSCP traffic class, or next header type	IPv6- EXT-ACL
<a href="#">ipv6 access-group</a>	Binds an IPv6 ACL to a port	IC
<a href="#">show ipv6 access-group</a>	Shows port assignments for IPv6 ACLs	PE
<a href="#">show ipv6 access-list</a>	Displays the rules for configured IPv6 ACLs	PE

**access-list ipv6** This command adds an IP access list and enters configuration mode for standard or extended IPv6 ACLs. Use the **no** form to remove the specified ACL.

**Syntax**

**[no] access-list ipv6 {standard | extended} *acl-name***

**standard** – Specifies an ACL that filters packets based on the source IP address.

**extended** – Specifies an ACL that filters packets based on the destination IP address, and other more specific criteria.

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**Default Setting**

None

**Command Mode**

Global Configuration

### Command Usage

- ◆ When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list. To create an ACL, you must add at least one rule to the list.
- ◆ To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- ◆ An ACL can contain up to 64 rules.

### Example

```
Console(config)#access-list ipv6 standard david
Console(config-std-ipv6-acl)#
```

### Related Commands

[permit, deny \(Standard IPv6 ACL\) \(393\)](#)

[permit, deny \(Extended IPv6 ACL\) \(394\)](#)

[ipv6 access-group \(Interface Configuration\) \(397\)](#)

[show ipv6 access-list \(398\)](#)

**ipv6 access-group** This command binds an IPv6 ACL to all ports for ingress traffic. Use the **no** form to remove the port.  
(Global Configuration)

### Syntax

**ipv6 access-group** *acl-name* **in**  
[*time-range time-range-name*] [**counter**]

**no ipv6 access-group** *acl-name* **in**

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**in** – Indicates that this list applies to ingress packets.

*time-range-name* - Name of the time range. (Range: 1-32 characters)

**counter** – Enables counter for ACL statistics.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

If a port is already bound to an ACL and you bind it to a different ACL, the switch will replace the old binding with the new one.



### Example

```
Console(config)#ipv6 access-group standard david in  
Console(config)#
```

### Related Commands

[show ipv6 access-list \(398\)](#)

[Time Range \(179\)](#)

**permit, deny** (Standard IPv6 ACL) This command adds a rule to a Standard IPv6 ACL. The rule sets a filter condition for packets emanating from the specified source. Use the **no** form to remove a rule.

### Syntax

```
{permit | deny} {any | host source-ipv6-address |  
  source-ipv6-address/prefix-length}  
[time-range time-range-name]
```

```
no {permit | deny} {any | host source-ipv6-address |  
  source-ipv6-address/prefix-length}
```

**any** – Any source IP address.

**host** – Keyword followed by a specific IP address.

*source-ipv6-address* - An IPv6 source address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128)

*time-range-name* - Name of the time range. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Standard IPv6 ACL

### Command Usage

New rules are appended to the end of the list.

### Example

This example configures one permit rule for the specific address 2009:DB9:2229::79 and another rule for the addresses with the network prefix 2009:DB9:2229:5::/64.

```
Console(config-std-ipv6-acl)#permit host 2009:DB9:2229::79
Console(config-std-ipv6-acl)#permit 2009:DB9:2229:5::/64
Console(config-std-ipv6-acl)#
```

### Related Commands

[access-list ipv6 \(391\)](#)

[Time Range \(179\)](#)

**permit, deny** This command adds a rule to an Extended IPv6 ACL. The rule sets a filter condition (Extended IPv6 ACL) for packets with specific source or destination IP addresses, or next header type. Use the **no** form to remove a rule.

### Syntax

```
[no] {permit | deny} next-header
    {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}
    {any | destination-ipv6-address[/prefix-length]}
    [dscp dscp]
```

```
{permit | deny} udp
    {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}
    {any | destination-ipv6-address[/prefix-length]}
    [dscp dscp] [next-header next-header]
    [source-port sport [bitmask]]
    [destination-port dport [port-bitmask]]
    [time-range time-range-name]
```

```
no {permit | deny} udp
    {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}
    {any | destination-ipv6-address[/prefix-length]}
    [dscp dscp] [next-header next-header]
    [source-port sport [bitmask]]
    [destination-port dport [port-bitmask]]
```

```
{permit | deny} icmp
    {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}
    {any | destination-ipv6-address[/prefix-length]}
    [dscp dscp] [icmp-type icmp-type]
    [time-range time-range-name]
```

```
no {permit | deny} icmp
    {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}
    {any | destination-ipv6-address[/prefix-length]}
    [dscp dscp] [icmp-type icmp-type]
```

```
{permit | deny} tcp
    {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}
```

```
{any | destination-ipv6-address[/prefix-length]}  
[dscp dscp]  
[source-port sport [bitmask]]  
[destination-port dport [port-bitmask]]  
[time-range time-range-name]
```

```
no {permit | deny} tcp  
  {any | host source-ipv6-address | source-ipv6-address[/prefix-length]}  
  {any | destination-ipv6-address[/prefix-length]}  
  [dscp dscp]  
  [source-port sport [bitmask]]  
  [destination-port dport [port-bitmask]]
```

**any** – Any IP address (an abbreviation for the IPv6 prefix ::/0).

**host** – Keyword followed by a specific source IP address.

*source-ipv6-address* - An IPv6 source address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*destination-ipv6-address* - An IPv6 destination address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (The switch only checks the first 8 bits of the destination address.)

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128 for source prefix, 0-8 for destination prefix)

*dscp* – DSCP traffic class. (Range: 0-63)

*icmp-tpe* – ICMP message type. (Range: 0-255)

*next-header* – Identifies the type of header immediately following the IPv6 header. (Range: 0-255)

*sport* – Protocol<sup>5</sup> source port number. (Range: 0-65535)

*dport* – Protocol<sup>4</sup> destination port number. (Range: 0-65535)

*port-bitmask* – Decimal number representing the port bits to match. (Range: 0-65535)

*time-range-name* - Name of the time range. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Extended IPv6 ACL

---

5. Includes TCP and UDP..

### Command Usage

- ◆ All new rules are appended to the end of the list.
- ◆ Optional internet-layer information is encoded in separate headers that may be placed between the IPv6 header and the upper-layer header in a packet. There are a small number of such extension headers, each identified by a distinct Next Header value. IPv6 supports the values defined for the IPv4 Protocol field in RFC 1700, including these commonly used headers:

0	: Hop-by-Hop Options	(RFC 2460)
6	: TCP Upper-layer Header	(RFC 1700)
17	: UDP Upper-layer Header	(RFC 1700)
43	: Routing	(RFC 2460)
44	: Fragment	(RFC 2460)
51	: Authentication	(RFC 2402)
50	: Encapsulating Security Payload	(RFC 2406)
60	: Destination Options	(RFC 2460)

### Example

This example accepts any incoming packets if the destination address is 2009:DB9:2229::79/8.

```
Console(config-ext-ipv6-acl)#permit any 2009:DB9:2229::79/8
Console(config-ext-ipv6-acl)#
```

This allows packets to any destination address when the DSCP value is 5.

```
Console(config-ext-ipv6-acl)#permit any any dscp 5
Console(config-ext-ipv6-acl)#
```

This allows any packets sent from any source to any destination when the next header is 43."

```
Console(config-ext-ipv6-acl)#permit any any next-header 43
Console(config-ext-ipv6-acl)#
```

Here is a more detailed example for setting the CPU rate limit for SNMP packets.

```
Set ACL
Console(config)#access-list ip extended snmp-acl
Console(config-ext-acl)#permit UDP any any destination-port 161
Console(config-ext-acl)#permit UDP any any destination-port 162
Console(config-ext-acl)#exit

Set class map
Console(config)#class-map snmp-class
Console(config-cmap)#match access-list snmp-acl
Console(config-cmap)#
```

```

Set policy map and rate-limit
Console(config)#policy-map cpu-rate-limit-policy
Console(config-pmap)#class snmp-class
Console(config-pmap-c)police flow 10000 20000 conform-action transmit
        violate-action drop
Console(config-pmap-c)#exit
Console(config-pmap)#exit

Bind the service-policy to control-plane
Console(config)#control-plane
Console(config)#interface ethernet 1/1
Console(config-if)#service-policy input cpu-rate-limit-policy
Console(config-if)#

```

### Related Commands

[access-list ipv6 \(391\)](#)

[Time Range \(179\)](#)

**ipv6 access-group** This command binds an IPv6 ACL to a port. Use the **no** form to remove the port.  
(Interface Configuration)

### Syntax

```
ipv6 access-group acl-name {in | out}
[time-range time-range-name] [counter]
```

```
no ipv6 access-group acl-name {in | out}
```

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**in** – Indicates that this list applies to ingress packets.

**out** – Indicates that this list applies to egress packets.

*time-range-name* - Name of the time range. (Range: 1-32 characters)

**counter** – Enables counter for ACL statistics.

### Default Setting

None

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

If a port is already bound to an ACL and you bind it to a different ACL, the switch will replace the old binding with the new one.

### Example

```

Console(config)#interface ethernet 1/2
Console(config-if)#ipv6 access-group standard david in
Console(config-if)#

```

### Related Commands

[show ipv6 access-list \(398\)](#)  
[Time Range \(179\)](#)

**show ipv6 access-group** This command shows the ports assigned to IPv6 ACLs.

### Command Mode

Privileged Exec

### Example

```
Console#show ipv6 access-group
Interface ethernet 1/2
  IPv6 standard access-list david in
Global
  IPv6 standard access-list david in
Console#
```

### Related Commands

[ipv6 access-group \(Interface Configuration\) \(397\)](#)

**show ipv6 access-list** This command displays the rules for configured IPv6 ACLs.

### Syntax

**show ipv6 access-list {standard | extended} [acl-name]**

**standard** – Specifies a standard IPv6 ACL.

**extended** – Specifies an extended IPv6 ACL.

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

### Command Mode

Privileged Exec

### Example

```
Console#show ipv6 access-list standard
IPv6 standard access-list david:
  permit host 2009:DB9:2229::79
  permit 2009:DB9:2229:5::/64
Console#
```

### Related Commands

[permit, deny \(Standard IPv6 ACL\) \(393\)](#)  
[permit, deny \(Extended IPv6 ACL\) \(394\)](#)  
[ipv6 access-group \(Interface Configuration\) \(397\)](#)

## MAC ACLs

The commands in this section configure ACLs based on hardware addresses, packet format, and Ethernet type. The ACLs can further specify optional IP and IPv6 addresses including protocol type and upper layer ports. To configure MAC ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

**Table 71: MAC ACL Commands**

Command	Function	Mode
<code>access-list mac</code>	Creates a MAC ACL and enters configuration mode	GC
<code>mac access-group</code>	Binds a MAC ACL to all ports for ingress traffic	GC
<code>permit, deny</code>	Filters packets matching a specified source and destination address, packet format, and Ethernet type. They can be further specified using optional IP and IPv6 addresses including protocol type and upper layer ports.	MAC-ACL
<code>mac access-group</code>	Binds a MAC ACL to a port	IC
<code>show mac access-group</code>	Shows port assignments for MAC ACLs	PE
<code>show mac access-list</code>	Displays the rules for configured MAC ACLs	PE

**access-list mac** This command enters MAC ACL configuration mode. Rules can be added to filter packets matching a specified MAC source or destination address (i.e., physical layer address), or Ethernet protocol type. Rules can also be used to filter packets based on IPv4/v6 addresses, including Layer 4 ports and protocol types. Use the **no** form to remove the specified ACL.

### Syntax

**[no] access-list mac** *acl-name*

*acl-name* – Name of the ACL. (Maximum length: 32 characters,)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list.
- ◆ To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- ◆ An ACL can contain up to 2048 rules.

### Example

```
Console(config)#access-list mac jerry
Console(config-mac-acl)#
```

### Related Commands

[permit, deny \(401\)](#)

[mac access-group \(Interface Configuration\) \(404\)](#)

[show mac access-list \(405\)](#)

**mac access-group** (Global Configuration) This command binds a MAC ACL to all ports for ingress traffic. Use the **no** form to remove this binding.

### Syntax

**mac access-group** *acl-name* **in**  
[**time-range** *time-range-name*] [**counter**]

**no mac access-group** *acl-name* **in**

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**in** – Indicates that this list applies to ingress packets.

*time-range-name* - Name of the time range. (Range: 1-16 characters)

**counter** – Enables counter for ACL statistics.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

If an ACL is already bound to a port and you bind a different ACL to it, the switch will replace the old binding with the new one.

### Example

```
Console(config)#mac access-group jerry in
Console(config)#
```

### Related Commands

[show mac access-list \(405\)](#)

[Time Range \(179\)](#)



**permit, deny (MAC ACL)** This command adds a rule to a MAC ACL. The rule filters packets matching a specified MAC source or destination address (i.e., physical layer address), or Ethernet protocol type. Rules can also filter packets based on IPv4/v6 addresses, including Layer 4 ports and protocol types. Use the **no** form to remove a rule.

### Syntax

```
{permit | deny}
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [vid vid vid-bitmask]
  {{ip {any | host source-ip | source-ip network-mask}
    {any | host destination-ip | destination-ip network-mask}
  }
  {ipv6 {any | host source-ipv6 | source-ipv6/prefix-length}
    {any | host destination-ipv6 | destination-ipv6/prefix-length}}
  [time-range time-range-name]

no {permit | deny}
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [vid vid vid-bitmask]
  [ethertype ethertype [ethertype-bitmask]]
  {{ip {any | host source-ip | source-ip network-mask}
    {any | host destination-ip | destination-ip network-mask}
  }
  {ipv6 {any | host source-ipv6 | source-ipv6/prefix-length}
    {any | host destination-ipv6 | destination-ipv6/prefix-length}}
```



**Note:** The default is for Ethernet II packets.

```
{permit | deny} tagged-eth2
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [cos cos cos-bitmask] [vid vid vid-bitmask]
  [ethertype ethertype [ethertype-bitmask]]
  {{ip {any | host source-ip | source-ip network-mask}
    {any | host destination-ip | destination-ip network-mask}
  }
  {ipv6 {any | host source-ipv6 | source-ipv6/prefix-length}
    {any | host destination-ipv6 | destination-ipv6/prefix-length}}
  [time-range time-range-name]

no {permit | deny} tagged-eth2
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [ethertype ethertype [ethertype-bitmask]]
  {{ip {any | host source-ip | source-ip network-mask}
    {any | host destination-ip | destination-ip network-mask}
  }
  {ipv6 {any | host source-ipv6 | source-ipv6/prefix-length}
    {any | host destination-ipv6 | destination-ipv6/prefix-length}}
```

```
{permit | deny} untagged-eth2
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [ethertype ethertype [ethertype-bitmask]]
  {{ip {any | host source-ip | source-ip network-mask}
    {any | host destination-ip | destination-ip network-mask}
  ipv6 {any | host source-ipv6 | source-ipv6/prefix-length}
    {any | host destination-ipv6 | destination-ipv6/prefix-length}}
  [time-range time-range-name]
```

```
no {permit | deny} untagged-eth2
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [ethertype ethertype [ethertype-bitmask]]
  {{ip {any | host source-ip | source-ip network-mask}
    {any | host destination-ip | destination-ip network-mask}
  ipv6 {any | host source-ipv6 | source-ipv6/prefix-length}
    {any | host destination-ipv6 | destination-ipv6/prefix-length}}
```

```
{permit | deny} tagged-802.3
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [vid vid vid-bitmask]
  [time-range time-range-name]
```

```
no {permit | deny} tagged-802.3
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
```

```
{permit | deny} untagged-802.3
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
  [time-range time-range-name]
```

```
no {permit | deny} untagged-802.3
  {any | host source | source address-bitmask}
  {any | host destination | destination address-bitmask}
```

**tagged-eth2** – Tagged Ethernet II packets.

**untagged-eth2** – Untagged Ethernet II packets.

**tagged-802.3** – Tagged Ethernet 802.3 packets.

**untagged-802.3** – Untagged Ethernet 802.3 packets.

**any** – Any MAC, IPv4 or IPv6 source or destination address.

**host** – A specific MAC, IPv4 or IPv6 address.

*source* – Source MAC, IPv4 or IPv6 address.

*destination* – Destination MAC, IPv4 or IPv6 address.

*address-bitmask*<sup>6</sup> – Bitmask for MAC address (in hexadecimal format).

---

6. For all bitmasks, “1” means relevant and “0” means ignore.

*network-mask* – Network mask for IP subnet. This mask identifies the host address bits used for routing to specific subnets.

*prefix-length* – Length of IPv6 prefix. A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128)

*vid* – VLAN ID. (Range: 1-4094)

*vid-bitmask*<sup>6</sup> – VLAN bitmask. (Range: 1-4095)

*ethertype* – A specific Ethernet protocol number. (Range: 0-ffff hex)

*ethertype-bitmask*<sup>6</sup> – Protocol bitmask. (Range: 0-ffff hex)

*protocol* – IP protocol or IPv6 next header. (Range: 0-255)

For information on next headers, see [permit, deny \(Extended IPv6 ACL\)](#).

*sport*<sup>7</sup> – Protocol source port number. (Range: 0-65535)

*dport*<sup>7</sup> – Protocol destination port number. (Range: 0-65535)

*port-bitmask* – Decimal number representing the port bits to match. (Range: 0-65535)

*time-range-name* – Name of the time range. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

MAC ACL

### Command Usage

- ◆ New rules are added to the end of the list.
- ◆ The **ethertype** option can only be used to filter Ethernet II formatted packets.
- ◆ A detailed listing of Ethernet protocol types can be found in RFC 1060. A few of the more common types include the following:
  - 0800 - IP
  - 0806 - ARP
  - 8137 - IPX

### Example

This rule permits packets from any source MAC address to the destination address 00-e0-29-94-34-de where the Ethernet type is 0800.

```
Console(config-mac-acl)#permit any host 00-e0-29-94-34-de ethertype 0800
Console(config-mac-acl)#
```

7. Includes TCP, UDP or other protocol types.

### Related Commands

[access-list mac \(399\)](#)

[Time Range \(179\)](#)

**mac access-group** This command binds a MAC ACL to a port. Use the **no** form to remove the port.  
(Interface Configuration)

### Syntax

**mac access-group** *acl-name* {**in** | **out**}  
[**time-range** *time-range-name*] [**counter**]

**no mac access-group** *acl-name* {**in** | **out**}

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**in** – Indicates that this list applies to ingress packets.

**out** – Indicates that this list applies to egress packets.

*time-range-name* - Name of the time range. (Range: 1-32 characters)

**counter** – Enables counter for ACL statistics.

### Default Setting

None

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

If an ACL is already bound to a port and you bind a different ACL to it, the switch will replace the old binding with the new one.

### Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#mac access-group jerry in
Console(config-if)#
```

### Related Commands

[show mac access-list \(405\)](#)

[Time Range \(179\)](#)

**show mac access-group** This command shows the ports assigned to MAC ACLs.

**Command Mode**  
Privileged Exec

#### Example

```
Console#show mac access-group
Interface ethernet 1/5
  MAC access-list M5 in
Global
  MAC access-list M5 in
Console#
```

#### Related Commands

[mac access-group \(Interface Configuration\) \(404\)](#)

**show mac access-list** This command displays the rules for configured MAC ACLs.

#### Syntax

**show mac access-list** [*acl-name*]

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

**Command Mode**  
Privileged Exec

#### Example

```
Console#show mac access-list
MAC access-list jerry:
  permit any 00-e0-29-94-34-de ethertype 0800
Console#
```

#### Related Commands

[permit, deny \(401\)](#)

[mac access-group \(Interface Configuration\) \(404\)](#)

## ARP ACLs

The commands in this section configure ACLs based on the IP or MAC address contained in ARP request and reply messages. To configure ARP ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more VLANs using the `ip arp inspection vlan` command.

Table 72: ARP ACL Commands

Command	Function	Mode
<code>access-list arp</code>	Creates a ARP ACL and enters configuration mode	GC
<code>permit, deny</code>	Filters packets matching a specified source or destination address in ARP messages	ARP-ACL
<code>show access-list arp</code>	Displays the rules for configured ARP ACLs	PE

**access-list arp** This command adds an ARP access list and enters ARP ACL configuration mode. Use the **no** form to remove the specified ACL.

### Syntax

**[no] access-list arp** *acl-name*

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list. To create an ACL, you must add at least one rule to the list.
- ◆ To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- ◆ An ACL can contain up to 2048 rules.

### Example

```
Console(config)#access-list arp factory
Console(config-arp-acl)#
```

### Related Commands

`permit, deny` (407)

`show access-list arp` (408)

**permit, deny (ARPAcl)** This command adds a rule to an ARP ACL. The rule filters packets matching a specified source or destination address in ARP messages. Use the **no** form to remove a rule.

### Syntax

```
[no] {permit | deny}
    ip {any | host source-ip | source-ip ip-address-bitmask}
    mac {any | host source-mac | source-mac mac-address-bitmask} [log]
```

This form indicates either request or response packets.

```
[no] {permit | deny} request
    ip {any | host source-ip | source-ip ip-address-bitmask}
    mac {any | host source-mac | source-mac mac-address-bitmask} [log]
```

```
[no] {permit | deny} response
    ip {any | host source-ip | source-ip ip-address-bitmask}
    {any | host destination-ip | destination-ip ip-address-bitmask}
    mac {any | host source-mac | source-mac mac-address-bitmask}
    [any | host destination-mac | destination-mac mac-address-bitmask] [log]
```

*source-ip* – Source IP address.

*destination-ip* – Destination IP address with bitmask.

*ip-address-bitmask*<sup>8</sup> – IPv4 number representing the address bits to match.

*source-mac* – Source MAC address.

*destination-mac* – Destination MAC address range with bitmask.

*mac-address-bitmask*<sup>8</sup> – Bitmask for MAC address (in hexadecimal format).

**log** - Logs a packet when it matches the access control entry.

### Default Setting

None

### Command Mode

ARP ACL

### Command Usage

New rules are added to the end of the list.

### Example

This rule permits packets from any source IP and MAC address to the destination subnet address 192.168.0.0.

```
Console(config-arp-acl)#$permit response ip any 192.168.0.0 255.255.0.0 mac
any any
Console(config-mac-acl)#
```

8. For all bitmasks, binary “1” means relevant and “0” means ignore.

## Related Commands

[access-list arp \(406\)](#)

**show access-list arp** This command displays the rules for configured ARP ACLs.

## Syntax

**show access-list arp** [*acl-name*]

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

## Command Mode

Privileged Exec

## Example

```
Console#show access-list arp
ARP access-list factory:
  permit response ip any 192.168.0.0 255.255.0.0 mac any any
Console#
```

## Related Commands

[permit, deny \(407\)](#)

## ACL Information

This section describes commands used to display ACL information.

**Table 73: ACL Information Commands**

Command	Function	Mode
<a href="#">clear access-list hardware counters</a>	Clears hit counter for rules in all ACLs, or in a specified ACL	PE
<a href="#">show access-group</a>	Shows the ACLs assigned to each port	PE
<a href="#">show access-list</a>	Show all ACLs and associated rules	PE

**clear access-list hardware counters** This command clears the hit counter for the rules in all ACLs, or for the rules in a specified ACL.

## Syntax

**clear access-list hardware counters**

[**direction** {**in** | **out**} [**interface** *interface*]] |  
[**interface** *interface*] | [**name** *acl-name*]

**in** – Clears counter for ingress rules.

**out** – Clears counter for egress rules.



*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

### Command Mode

Privileged Exec

### Example

```
Console#clear access-list hardware counters
Console#
```

**show access-group** This command shows the port assignments of ACLs.

### Command Mode

Privileged Executive

### Example

```
Console#show access-group
Interface ethernet 1/2
  IP access-list david
  MAC access-list jerry
Console#
```

**show access-list** This command shows all ACLs and associated rules.

### Syntax

#### show access-list

```
[[arp [acl-name]] |
ip [extended [acl-name] | standard [acl-name]] |
ipv6 [extended [acl-name] | standard [acl-name]] |
mac [acl-name]] | [tcam-utilization] | [hardware counters]]
```

**arp** – Shows ingress or egress rules for ARP ACLs.

**hardware counters** – Shows statistics for all ACLs.<sup>9</sup>

**ip extended** – Shows ingress or egress rules for Extended IPv4 ACLs.

**ip standard** – Shows ingress or egress rules for Standard IPv4 ACLs.

**ipv6 extended** – Shows ingress or egress rules for Extended IPv6 ACLs.

**ipv6 standard** – Shows ingress or egress rules for Standard IPv6 ACLs.

9. Due to a hardware limitation, this option only displays statistics for permit rules.

**mac** – Shows ingress or egress rules for MAC ACLs.

**tcam-utilization** – Shows the percentage of user configured ACL rules as a percentage of total ACL rules

*acl-name* – Name of the ACL. (Maximum length: 32 characters)

## Command Mode

Privileged Exec

## Example

```
Console#show access-list
IP standard access-list david:
  permit host 10.1.1.21
  permit 168.92.0.0 255.255.15.0
IP extended access-list bob:
  permit 10.7.1.1 255.255.255.0 any
  permit 192.168.1.0 255.255.255.0 any destination-port 80 80
  permit 192.168.1.0 255.255.255.0 any protocol tcp control-code 2 2
MAC access-list jerry:
  permit any host 00-30-29-94-34-de ethertype 800 800
IP extended access-list A6:
  deny tcp any any control-flag 2 2
  permit any any
Console#
```

# Interface Commands

These commands are used to display or set communication parameters for an Ethernet port, aggregated link, or VLAN; or perform cable diagnostics on the specified interface.

**Table 74: Interface Commands**

Command	Function	Mode
<i>Interface Configuration</i>		
<code>interface</code>	Configures an interface type and enters interface configuration mode	GC
<code>alias</code>	Configures an alias name for the interface	IC
<code>capabilities</code>	Advertises the capabilities of a given interface for use in autonegotiation	IC
<code>description</code>	Adds a description to an interface configuration	IC
<code>discard</code>	Discards CDP or PVST packets	IC
<code>flowcontrol</code>	Enables flow control on a given interface	IC
<code>media-type</code>	Forces transceiver mode to use for SFP+ port	IC
<code>negotiation</code>	Enables autonegotiation of a given interface	IC
<code>shutdown</code>	Disables an interface	IC
<code>speed-duplex</code>	Configures the speed and duplex operation of a given interface when autonegotiation is disabled	IC
<code>clear counters</code>	Clears statistics on an interface	PE
<code>show discard</code>	Displays if CDP and PVST packets are being discarded	PE
<code>show interfaces brief</code>	Displays a summary of key information, including operational status, native VLAN ID, default priority, speed/duplex mode, and port type	PE
<code>show interfaces counters</code>	Displays statistics for the specified interfaces	NE, PE
<code>show interfaces status</code>	Displays status for the specified interface	NE, PE
<code>show interfaces switchport</code>	Displays the administrative and operational status of an interface	NE, PE
<i>Transceiver Threshold Configuration</i>		
<code>transceiver-monitor</code>	Sends a trap when any of the transceiver's operational values fall outside specified thresholds	IC
<code>transceiver-threshold-auto</code>	Uses default threshold settings obtained from the transceiver to determine when an alarm or trap message should be sent	IC
<code>transceiver-threshold current</code>	Sets thresholds for transceiver current which can be used to trigger an alarm or warning message	IC

**Table 74: Interface Commands** (Continued)

Command	Function	Mode
<code>transceiver-threshold rx-power</code>	Sets thresholds for the transceiver power level of the received signal which can be used to trigger an alarm or warning message	IC
<code>transceiver-threshold temperature</code>	Sets thresholds for the transceiver temperature which can be used to trigger an alarm or warning message	IC
<code>transceiver-threshold tx-power</code>	Sets thresholds for the transceiver power level of the transmitted signal which can be used to trigger an alarm or warning message	IC
<code>transceiver-threshold voltage</code>	Sets thresholds for the transceiver voltage which can be used to trigger an alarm or warning message	IC
<code>show interfaces transceiver</code>	Displays the temperature, voltage, bias current, transmit power, and receive power	PE
<code>show interfaces transceiver-threshold</code>	Displays the alarm/warning thresholds for temperature, voltage, bias current, transmit power, and receive power	PE
<i>Cable Diagnostics</i>		
<code>test cable-diagnostics</code>	Performs cable diagnostics on the specified port	PE
<code>show cable-diagnostics</code>	Shows the results of a cable diagnostics test	PE
<i>Power Savings</i>		
<code>power-save</code>	Enables power savings mode on the specified port	IC
<code>show power-save</code>	Shows the configuration settings for power savings	PE

## Interface Configuration

**interface** This command configures an interface type and enters interface configuration mode. Use the **no** form with a trunk to remove an inactive interface. Use the no form with a Layer 3 VLAN (normal type) to change it back to a Layer 2 interface.

### Syntax

**[no] interface** *interface*

*interface*

**ethernet** *unit/port-list*

*unit* - Unit identifier. (Range: 1-8)

*port-list* - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* (Range: 1-4094)

### Default Setting

None

## Command Mode

Global Configuration

### Example

To specify several different ports, enter the following command:

```
Console(config)#interface ethernet 1/17-20,23
Console(config-if)#
```

**alias** This command configures an alias name for the interface. Use the **no** form to remove the alias name.

### Syntax

**alias** *string*

**no alias**

*string* - A mnemonic name to help you remember what is attached to this interface. (Range: 1-64 characters)

### Default Setting

None

## Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

The alias is displayed in the running-configuration file. An example of the value which a network manager might store in this object for a WAN interface is the (Telco's) circuit number/identifier of the interface.

### Example

The following example adds an alias to port 4.

```
Console(config)#interface ethernet 1/4
Console(config-if)#alias finance
Console(config-if)#
```

**capabilities** This command advertises the port capabilities of a given interface during auto-negotiation. Use the **no** form with parameters to remove an advertised capability, or the **no** form without parameters to restore the default values.

### Syntax

**[no] capabilities {1000full | 100full | 100half | 10full | 10half | flowcontrol}**

**1000full** - Supports 1 Gbps full-duplex operation

**100full** - Supports 100 Mbps full-duplex operation

**100half** - Supports 100 Mbps half-duplex operation

**10full** - Supports 10 Mbps full-duplex operation

**10half** - Supports 10 Mbps half-duplex operation

**flowcontrol** - Supports flow control

### Default Setting

1000BASE-SX/LX/ZX (SFP+): 1000full

10GBASE-SR/LR/ER (SFP+): 10Gfull

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ 10GBASE-SFP+ connections are fixed at 10G, full duplex. When auto-negotiation is enabled, the only attribute which can be advertised is flow control.
- ◆ The 1000BASE-T standard does not support forced mode. Auto-negotiation should always be used to establish a connection over any 1000BASE-T port or trunk.
- ◆ When auto-negotiation is enabled with the [negotiation](#) command, the switch will negotiate the best settings for a link based on the **capabilities** command. When auto-negotiation is disabled, you must manually specify the link attributes with the [speed-duplex](#) and [flowcontrol](#) commands.

### Example

The following example configures Ethernet port 5 capabilities to include 100half and 100full.

```
Console(config)#interface ethernet 1/5
Console(config-if)#capabilities 100half
Console(config-if)#capabilities 100full
Console(config-if)#capabilities flowcontrol
Console(config-if)#
```

### Related Commands

[negotiation \(418\)](#)

[speed-duplex \(419\)](#)

[flowcontrol \(416\)](#)

**description** This command adds a description to an interface. Use the **no** form to remove the description.

### Syntax

**description** *string*

**no description**

*string* - Comment or a description to help you remember what is attached to this interface. (Range: 1-64 characters)

### Default Setting

None

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

The description is displayed by the [show interfaces status](#) command and in the running-configuration file. An example of the value which a network manager might store in this object is the name of the manufacturer, and the product name.

### Example

The following example adds a description to port 4.

```
Console(config)#interface ethernet 1/4
Console(config-if)#description RD-SW#3
Console(config-if)#
```

**discard** This command discards CDP or PVST packets. Use the **no** form to forward the specified packet type to other ports configured the same way.

### Syntax

**[no] discard {cdp | pvst}**

**cdp** – Cisco Discovery Protocol

**pvst** – Per-VLAN Spanning Tree

### Default Setting

Default - Forward CDP and PVST packets

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

Use the no discard command to allow CDP or PVST packets to be forwarded to other ports in the same VLAN which are also configured to forward the specified packet type.

### Example

The following example forwards CDP packets entering port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#no discard cdp
Console(config-if)#
```

**flowcontrol** This command enables flow control. Use the **no** form to disable flow control.

### Syntax

**[no] flowcontrol**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ 1000BASE-T does not support forced mode. Auto-negotiation should always be used to establish a connection over any 1000BASE-T port or trunk.
- ◆ Flow control can eliminate frame loss by “blocking” traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3-2002 (formally IEEE 802.3x) for full-duplex operation.
- ◆ To force flow control on or off (with the **flowcontrol** or **no flowcontrol** command), use the **no negotiation** command to disable auto-negotiation on the selected interface.
- ◆ When using the **negotiation** command to enable auto-negotiation, the optimal settings will be determined by the **capabilities** command. To enable flow control under auto-negotiation, “flowcontrol” must be included in the capabilities list for any port



### Example

The following example enables flow control on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#flowcontrol
Console(config-if)#no negotiation
Console(config-if)#
```

### Related Commands

[negotiation \(418\)](#)

[capabilities \(414\)](#)

**media-type** This command forces the transceiver mode to use for SFP+ ports. Use the **no** form to restore the default mode.

### Syntax

**media-type** {**none** | **sfp-forced** [*mode*]}

**no media-type**

**none** - Mode is not forced.

**sfp-forced** - Forces transceiver mode for the SFP+ port.

*mode*

**1000sfp** - Always uses 1000BASE SFP mode.

**10gsfp** - Always uses 10GBASE SFP mode.

### Default Setting

None

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

Available sfp-forced modes include:

GTL-2891:                      Ports 25-28 (10G SFP+) support 1000sfp

### Example

This forces the switch to use the 1000sfp mode for SFP port 28.

```
Console(config)#interface ethernet 1/28
Console(config-if)#media-type sfp-forced 1000sfp
Console(config-if)#
```

**negotiation** This command enables auto-negotiation for a given interface. Use the **no** form to disable auto-negotiation.

#### Syntax

**[no] negotiation**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)



**Note:** Auto-negotiation is not supported for 1000BASE SFP transceivers used in 10G SFP+ Ports 25-28.

#### Example

The following example configures port 10 to use auto-negotiation.

```
Console(config)#interface ethernet 1/10
Console(config-if)#negotiation
Console(config-if)#
```

#### Related Commands

[capabilities \(414\)](#)

[speed-duplex \(419\)](#)

**shutdown** This command disables an interface. To restart a disabled interface, use the **no** form.

#### Syntax

**[no] shutdown**

#### Default Setting

All interfaces are enabled.

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

This command allows you to disable a port due to abnormal behavior (e.g., excessive collisions), and then re-enable it after the problem has been resolved. You may also want to disable a port for security reasons.

### Example

The following example disables port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#shutdown
Console(config-if)#
```

**speed-duplex** This command configures the speed and duplex mode of a given interface when auto-negotiation is disabled. Use the **no** form to restore the default.

### Syntax

**speed-duplex {100full | 100half | 10full | 10half}**

**no speed-duplex**

**100full** - Forces 100 Mbps full-duplex operation

**100half** - Forces 100 Mbps half-duplex operation

**10full** - Forces 10 Mbps full-duplex operation

**10half** - Forces 10 Mbps half-duplex operation

### Default Setting

- ◆ Auto-negotiation is enabled by default.
- ◆ When auto-negotiation is disabled, the default speed-duplex setting is **100full** for 1000BASE-T ports.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ The 1000BASE-T standard does not support forced mode. Auto-negotiation should always be used to establish a connection over any 1000BASE-T port or trunk. If not used, the success of the link process cannot be guaranteed when connecting to other types of switches.
- ◆ To force operation to the speed and duplex mode specified in a **speed-duplex** command, use the **no negotiation** command to disable auto-negotiation on the selected interface.
- ◆ When using the **negotiation** command to enable auto-negotiation, the optimal settings will be determined by the **capabilities** command. To set the speed/duplex mode under auto-negotiation, the required mode must be specified in the capabilities list for an interface.

### Example

The following example configures port 5 to 100 Mbps, half-duplex operation.

```
Console(config)#interface ethernet 1/5
Console(config-if)#speed-duplex 100half
Console(config-if)#no negotiation
Console(config-if)#
```

### Related Commands

[negotiation \(418\)](#)

[capabilities \(414\)](#)

**clear counters** This command clears statistics on an interface.

### Syntax

**clear counters** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Statistics are only initialized for a power reset. This command sets the base value for displayed statistics to zero for the current management session. However, if you log out and back into the management interface, the statistics displayed will show the absolute value accumulated since the last power reset.

### Example

The following example clears statistics on port 5.

```
Console#clear counters ethernet 1/5
Console#
```

**show discard** This command displays whether or not CDP and PVST packets are being discarded.

### Command Mode

Privileged Exec

### Example

In this example, "Default" means that the packets are not discarded.

```
Console#show discard
Port      CDP      PVST
-----
Eth 1/ 1  Default Default
Eth 1/ 2  Default Default
Eth 1/ 3  Default Default
Eth 1/ 4  Default Default
Eth 1/ 5  Default Default
Eth 1/ 6  Default Default
:
```

**show interfaces brief** This command displays a summary of key information, including operational status, native VLAN ID, default priority, speed/duplex mode, and port type for all ports.

### Command Mode

Privileged Exec

### Command Usage

- ◆ If an SFP transceiver is inserted in a port, the Type field will show the SFP type as interpreted from Ethernet Compliance Codes (Data Byte 6 in Address A0h). The Ethernet Compliance Code is a bitmap value, of which one bit is supposedly turned on. However, if the read-out is not recognizable (e.g., 2 or more bits on, or all 0s), the Type field just displays the raw data (hexadecimal value).
- ◆ The Type field will always display "NA" for a trunk entry because a trunk allows for mixed port types such as 1000Base T and 1000Base SFP.

### Example

```
Console#show interfaces brief
Interface Name      Status      PVID Pri Speed/Duplex  Type      Trunk
-----
Eth 1/ 1            Down        1   0 Auto        1000BASE-T  None
Eth 1/ 2            Down        1   0 Auto        1000BASE-T  None
Eth 1/ 3            Down        1   0 Auto        1000BASE-T  None
Eth 1/ 4            Down        1   0 Auto        1000BASE-T  None
Eth 1/ 5            Down        1   0 Auto        1000BASE-T  None
Eth 1/ 6            Down        1   0 Auto        1000BASE-T  None
:
```

**show interfaces counters** This command displays interface statistics.

#### Syntax

```
show interfaces counters [interface]  
interface  
ethernet unit/port  
unit - Unit identifier. (Range: 1-8)  
port - Port number. (Range: 1-28)  
port-channel channel-id (Range: 1-16)
```

#### Default Setting

Shows the counters for all interfaces.

#### Command Mode

Normal Exec, Privileged Exec

#### Command Usage

If no interface is specified, information on all interfaces is displayed.

#### Example

```
Console#show interfaces counters ethernet 1/1  
Ethernet 1/ 1  
===== IF table Stats =====  
          2166458 Octets Input  
        14734059 Octets Output  
          14707 Unicast Input  
          19806 Unicast Output  
              0 Discard Input  
              0 Discard Output  
              0 Error Input  
              0 Error Output  
              0 Unknown Protocols Input  
              0 QLen Output  
===== Extended Iftable Stats =====  
          23 Multi-cast Input  
          5525 Multi-cast Output  
          170 Broadcast Input  
           11 Broadcast Output  
===== Ether-like Stats =====  
              0 Alignment Errors  
              0 FCS Errors  
              0 Single Collision Frames  
              0 Multiple Collision Frames  
              0 SQE Test Errors  
              0 Deferred Transmissions  
              0 Late Collisions  
              0 Excessive Collisions  
              0 Internal Mac Transmit Errors  
              0 Internal Mac Receive Errors  
              0 Frames Too Long  
              0 Carrier Sense Errors  
              0 Symbol Errors
```

```

0 Pause Frames Input
0 Pause Frames Output
===== RMON Stats =====
0 Drop Events
16900558 Octets
40243 Packets
170 Broadcast PKTS
23 Multi-cast PKTS
0 Undersize PKTS
0 Oversize PKTS
0 Fragments
0 Jabbers
0 CRC Align Errors
0 Collisions
21065 Packet Size <= 64 Octets
3805 Packet Size 65 to 127 Octets
2448 Packet Size 128 to 255 Octets
797 Packet Size 256 to 511 Octets
2941 Packet Size 512 to 1023 Octets
9187 Packet Size 1024 to 1518 Octets
===== Port Utilization =====
111 Octets Input in kbits per second
0 Packets Input per second
0.00 % Input Utilization
606 Octets Output in kbits per second
1 Packets Output per second
0.00 % Output Utilization
Console#

```

**Table 75: show interfaces counters - display description**

Parameter	Description
<i>IF Table Stats</i>	
Octets Input	The total number of octets received on the interface, including framing characters.
Octets Output	The total number of octets transmitted out of the interface, including framing characters.
Unicast Input	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
Unicast Output	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.
Discard Input	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Discard Output	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Error Input	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Error Output	The number of outbound packets that could not be transmitted because of errors.
Unknown Protocols Input	The number of packets received which were discarded because of an unknown or unsupported protocol.

**Table 75: show interfaces counters - display description** (Continued)

Parameter	Description
QLen Output	The length of the output packet queue (in packets).
<i>Extended IF Table Stats</i>	
Multicast Input	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer.
Multicast Output	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a multicast address at this sub-layer, including those that were discarded or not sent.
Broadcast Input	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer.
Broadcast Output	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent.
<i>Etherlike Statistics</i>	
Alignment Errors	The number of alignment errors (missynchronized data packets).
FCS Errors	A count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check. This count does not include frames received with frame-too-long or frame-too-short error.
Single Collision Frames	The number of successfully transmitted frames for which transmission is inhibited by exactly one collision.
Multiple Collision Frames	A count of successfully transmitted frames for which transmission is inhibited by more than one collision.
SQE Test Errors	A count of times that the SQE TEST ERROR message is generated by the PLS sublayer for a particular interface.
Deferred Transmissions	A count of frames for which the first transmission attempt on a particular interface is delayed because the medium was busy.
Late Collisions	The number of times that a collision is detected later than 512 bit-times into the transmission of a packet.
Excessive Collisions	A count of frames for which transmission on a particular interface fails due to excessive collisions. This counter does not increment when the interface is operating in full-duplex mode.
Internal MAC Transmit Errors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error.
Internal MAC Receive Errors	A count of frames for which reception on a particular interface fails due to an internal MAC sublayer receive error.
Frames Too Long	A count of frames received on a particular interface that exceed the maximum permitted frame size.
Carrier Sense Errors	The number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.



**Table 75: show interfaces counters - display description** (Continued)

Parameter	Description
Symbol Errors	<p>For an interface operating at 100 Mb/s, the number of times there was an invalid data symbol when a valid carrier was present.</p> <p>For an interface operating in half-duplex mode at 1000 Mb/s, the number of times the receiving media is non-idle (a carrier event) for a period of time equal to or greater than slotTime, and during which there was at least one occurrence of an event that causes the PHY to indicate 'Data reception error' or 'carrier extend error' on the GMII.</p> <p>For an interface operating in full-duplex mode at 1000 Mb/s, the number of times the receiving media is non-idle (a carrier event) for a period of time equal to or greater than minFrameSize, and during which there was at least one occurrence of an event that causes the PHY to indicate 'Data reception error' on the GMII</p>
<i>RMON Statistics</i>	
Octets	Total number of octets of data received on the network. This statistic can be used as a reasonable indication of Ethernet utilization.
Packets	The total number of packets (bad, broadcast and multicast) received.
Broadcast Packets	The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Packets	The total number of good packets received that were directed to this multicast address.
Undersize Packets	The total number of packets received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
Oversize Packets	The total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets) and were otherwise well formed.
Fragments	The total number of frames received that were less than 64 octets in length (excluding framing bits, but including FCS octets) and had either an FCS or alignment error.
Jabbers	The total number of frames received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS or alignment error.
<i>CRC Align Errors</i>	
Collisions	The best estimate of the total number of collisions on this Ethernet segment.
64 Octets	The total number of packets (including bad packets) received and transmitted that were less than 64 octets in length (excluding framing bits but including FCS octets).
65-127 Octets	The total number of packets (including bad packets) received and transmitted where the number of octets fall within the specified range (excluding framing bits but including FCS octets).
128-255 Octets	
256-511 Octets	
512-1023 Octets	
1024-1518 Octets	
1519-1536 Octets	
<i>Utilization Statistics</i>	
Octets input per second	Number of octets entering this interface in kbits per second.
Packets input per second	Number of packets entering this interface in packets per second.

**Table 75: show interfaces counters - display description** (Continued)

Parameter	Description
Input utilization	The input utilization rate for this interface.
Octets output per second	Number of octets leaving this interface in kbits per second.
Packets output per second	Number of packets leaving this interface in packets per second.
Output utilization	The output utilization rate for this interface.

**show interfaces status** This command displays the status for an interface.

### Syntax

**show interfaces status** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* (Range: 1-4094)

### Default Setting

Shows the status for all interfaces.

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

If no interface is specified, information on all interfaces is displayed.

### Example

```
Console#show interfaces status ethernet 1/1
Information of Eth 1/1
Basic Information:
  Port Type           : 1000BASE-T
  MAC Address         : 00-E0-0C-00-00-FE
Configuration:
  Name                :
  Port Admin          : Up
  Speed-duplex        : Auto
  Capabilities        : 10half, 10full, 100half, 100full, 1000full
  Broadcast Storm     : Enabled
  Broadcast Storm Limit : 500 packets/second
  Multicast Storm     : Disabled
  Multicast Storm Limit : 500 packets/second
  Unknown Unicast Storm : Disabled
  Unknown Unicast Storm Limit : 500 packets/second
  Flow Control        : Disabled
  VLAN Trunking       : Disabled
```

```

LACP                        : Disabled
MAC Learning                : Enabled
Media Type                  : None
Current Status:
Link Status                  : Up
Port Operation Status       : Up
Operation Speed-duplex      : 100full
Up Time                     : 0w 0d 1h 11m 2s (4262 seconds)
Flow Control Type           : None
Max Frame Size              : 1518 bytes (1522 bytes for tagged frames)
MAC Learning Status         : Enabled
Console#

```

**show interfaces switchport** This command displays the administrative and operational status of the specified interfaces.

### Syntax

**show interfaces switchport** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

Shows all interfaces.

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

If no interface is specified, information on all interfaces is displayed.

### Example

This example shows the configuration setting for port 1.

```

Console#show interfaces switchport ethernet 1/1
Information of Eth 1/1
Broadcast Threshold          : Enabled, 500 packets/second
Multicast Threshold          : Disabled
Unknown Unicast Threshold    : Disabled
LACP Status                  : Disabled
Ingress Rate Limit           : Disabled, 1000M bits per second
Egress Rate Limit            : Disabled, 1000M bits per second
VLAN Membership Mode         : Hybrid
Ingress Rule                  : Disabled
Acceptable Frame Type        : All frames
Native VLAN                   : 1
Priority for Untagged Traffic : 0
GVRP Status                  : Disabled

```

```

Allowed VLAN           :      1 (u)
Forbidden VLAN         :
802.1Q Tunnel Status   : Disabled
802.1Q Tunnel Mode     : Normal
802.1Q Tunnel TPID     : 8100 (Hex)
Layer 2 Protocol Tunnel : None
Console#

```

**Table 76: show interfaces switchport - display description**

Field	Description
Broadcast Threshold	Shows if broadcast storm suppression is enabled or disabled; if enabled it also shows the threshold level ( <a href="#">page 467</a> ).
Multicast Threshold	Shows if multicast storm suppression is enabled or disabled; if enabled it also shows the threshold level ( <a href="#">page 467</a> ).
Unknown-unicast Threshold	Shows if unknown unicast storm suppression is enabled or disabled; if enabled it also shows the threshold level ( <a href="#">page 467</a> ).
LACP Status	Shows if Link Aggregation Control Protocol has been enabled or disabled ( <a href="#">page 445</a> ).
Ingress/Egress Rate Limit	Shows if rate limiting is enabled, and the current rate limit ( <a href="#">page 1023</a> ).
VLAN Membership Mode	Indicates membership mode as Trunk or Hybrid ( <a href="#">page 579</a> ).
Ingress Rule	Shows if ingress filtering is enabled or disabled ( <a href="#">page 578</a> ).
Acceptable Frame Type	Shows if acceptable VLAN frames include all types or tagged frames only ( <a href="#">page 576</a> ).
Native VLAN	Indicates the default Port VLAN ID ( <a href="#">page 580</a> ).
Priority for Untagged Traffic	Indicates the default priority for untagged frames ( <a href="#">page 616</a> ).
GVRP Status	Shows if GARP VLAN Registration Protocol is enabled or disabled ( <a href="#">page 570</a> ).
Allowed VLAN	Shows the VLANs this interface has joined, where "(u)" indicates untagged and "(t)" indicates tagged ( <a href="#">page 577</a> ).
Forbidden VLAN	Shows the VLANs this interface can not dynamically join via GVRP ( <a href="#">page 570</a> ).
802.1Q-tunnel Status	Shows if 802.1Q tunnel is enabled on this interface ( <a href="#">page 584</a> ).
802.1Q-tunnel Mode	Shows the tunnel mode as Normal, 802.1Q Tunnel or 802.1Q Tunnel Uplink ( <a href="#">page 585</a> ).
802.1Q-tunnel TPID	Shows the Tag Protocol Identifier used for learning and switching packets ( <a href="#">page 588</a> ).
Layer 2 Protocol Tunnel	Shows if L2 Protocol Tunnel is enabled for spanning tree protocol ( <a href="#">page 593</a> ).

## Transceiver Threshold Configuration

**transceiver-monitor** This command sends a trap when any of the transceiver's operational values fall outside of specified thresholds. Use the **no** form to disable trap messages.

### Syntax

**transceiver-monitor**

### Default Setting

Disabled

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Example

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-monitor
Console#
```

**transceiver-threshold-auto** This command uses default threshold settings obtained from the transceiver to determine when an alarm or warning message should be sent. Use the **no** form to disable this feature.

### Syntax

**transceiver-threshold-auto**

### Default Setting

Enabled

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Example

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold-auto
Console#
```

**transceiver-threshold current** This command sets thresholds for transceiver current which can be used to trigger an alarm or warning message.

### Syntax

**transceiver-threshold current** {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

**high-alarm** – Sets the high current threshold for an alarm message.

**high-warning** – Sets the high current threshold for a warning message.

**low-alarm** – Sets the low current threshold for an alarm message.

**low-warning** – Sets the low current threshold for a warning message.

*threshold-value* – The threshold of the transceiver current.

(Range: 0-13100 in units of 0.01 mA)

### Default Setting

High Alarm: 100 mA

High Warning: 90 mA

Low Warning: 7 mA

Low Alarm: 6 mA

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Command Usage

- ◆ If trap messages are enabled with the [transceiver-monitor](#) command, and a high-threshold alarm or warning message is sent if the current value is greater than or equal to the threshold, and the last sample value was less than the threshold. After a rising event has been generated, another such event will not be generated until the sampled value has fallen below the high threshold and reaches the low threshold.
- ◆ If trap messages are enabled with the [transceiver-monitor](#) command, and a low-threshold alarm or warning message is sent if the current value is less than or equal to the threshold, and the last sample value was greater than the threshold. After a falling event has been generated, another such event will not be generated until the sampled value has risen above the low threshold and reaches the high threshold.
- ◆ Threshold events are triggered as described above to avoid a hysteresis effect which would continuously trigger event messages if the power level were to fluctuate just above and below either the high threshold or the low threshold.
- ◆ Trap messages enabled by the [transceiver-monitor](#) command are sent to any management station configured by the [snmp-server host](#) command.

### Example

The following example sets alarm thresholds for the transceiver current at port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#transceiver-threshold current low-alarm 100
Console(config-if)#transceiver-threshold rx-power high-alarm 700
Console#
```

**transceiver-threshold rx-power** This command sets thresholds for the transceiver power level of the received signal which can be used to trigger an alarm or warning message.

### Syntax

**transceiver-threshold rx-power {high-alarm | high-warning | low-alarm | low-warning} threshold-value**

**high-alarm** – Sets the high power threshold for an alarm message.

**high-warning** – Sets the high power threshold for a warning message.

**low-alarm** – Sets the low power threshold for an alarm message.

**low-warning** – Sets the low power threshold for a warning message.

*threshold-value* – The power threshold of the received signal.

(Range: -4000 - 820 in units of 0.01 dBm)

### Default Setting

High Alarm: -3.00 dBm

High Warning: -3.50 dBm

Low Warning: -21.00 dBm

Low Alarm: -21.50 dBm

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Command Usage

- ◆ The threshold value is the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
- ◆ Refer to the Command Usage section under the [transceiver-threshold current](#) command for more information on configuring transceiver thresholds.
- ◆ Trap messages enabled by the [transceiver-monitor](#) command are sent to any management station configured by the [snmp-server host](#) command.

### Example

The following example sets alarm thresholds for the signal power received at port 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold rx-power low-alarm -21
Console(config-if)#transceiver-threshold rx-power high-alarm -3
Console#
```

**transceiver-threshold temperature** This command sets thresholds for the transceiver temperature which can be used to trigger an alarm or warning message.

### Syntax

**transceiver-threshold temperature {high-alarm | high-warning | low-alarm | low-warning} threshold-value**

**high-alarm** – Sets the high temperature threshold for an alarm message.

**high-warning** – Sets the high temperature threshold for a warning message.

**low-alarm** – Sets the low temperature threshold for an alarm message.

**low-warning** – Sets the low temperature threshold for a warning message.

*threshold-value* – The threshold of the transceiver temperature.  
(Range: -12800 - 12800 in units of 0.01 Celsius)

### Default Setting

High Alarm: 75.00 °C

High Warning: 70.00 °C

Low Alarm: -123.00 °C

Low Warning: 0.00 °C

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Command Usage

- ◆ Refer to the Command Usage section under the [transceiver-threshold current](#) command for more information on configuring transceiver thresholds.
- ◆ Trap messages enabled by the [transceiver-monitor](#) command are sent to any management station configured by the [snmp-server host](#) command.



### Example

The following example sets alarm thresholds for the transceiver temperature at port 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold temperature low-alarm 97
Console(config-if)#transceiver-threshold temperature high-alarm -83
Console#
```

**transceiver-threshold tx-power** This command sets thresholds for the transceiver power level of the transmitted signal which can be used to trigger an alarm or warning message.

### Syntax

**transceiver-threshold tx-power {high-alarm | high-warning | low-alarm | low-warning} threshold-value**

**high-alarm** – Sets the high power threshold for an alarm message.

**high-warning** – Sets the high power threshold for a warning message.

**low-alarm** – Sets the low power threshold for an alarm message.

**low-warning** – Sets the low power threshold for a warning message.

*threshold-value* – The power threshold of the transmitted signal.  
(Range: -4000 - 820 in units of 0.01 dBm)

### Default Setting

High Alarm: -9.00 dBm

High Warning: -9.50 dBm

Low Warning: -21.00 dBm

Low Alarm: -21.50 dBm

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Command Usage

- ◆ The threshold value is the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
- ◆ Refer to the Command Usage section under the [transceiver-threshold current](#) command for more information on configuring transceiver thresholds.
- ◆ Trap messages enabled by the [transceiver-monitor](#) command are sent to any management station configured by the [snmp-server host](#) command.

### Example

The following example sets alarm thresholds for the signal power transmitted at port 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold tx-power low-alarm 8
Console(config-if)#transceiver-threshold tx-power high-alarm -3
Console#
```

**transceiver-threshold voltage** This command sets thresholds for the transceiver voltage which can be used to trigger an alarm or warning message.

### Syntax

**transceiver-threshold voltage {high-alarm | high-warning | low-alarm | low-warning} threshold-value**

**high-alarm** – Sets the high voltage threshold for an alarm message.

**high-warning** – Sets the high voltage threshold for a warning message.

**low-alarm** – Sets the low voltage threshold for an alarm message.

**low-warning** – Sets the low voltage threshold for a warning message.

*threshold-value* – The threshold of the transceiver voltage.  
(Range: 0-655 in units of 0.01 Volt)

### Default Setting

High Alarm: 3.50 Volts  
High Warning: 3.45 Volts  
Low Warning: 3.15 Volts  
Low Alarm: 3.10 Volts

### Command Mode

Interface Configuration (SFP/SFP+ Ports)

### Command Usage

- ◆ Refer to the Command Usage section under the [transceiver-threshold current](#) command for more information on configuring transceiver thresholds.
- ◆ Trap messages enabled by the [transceiver-monitor](#) command are sent to any management station configured by the [snmp-server host](#) command.

### Example

The following example sets alarm thresholds for the transceiver voltage at port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#transceiver-threshold voltage low-alarm 4
Console(config-if)#transceiver-threshold voltage high-alarm 2
Console#
```

### show interfaces transceiver

This command displays identifying information for the specified transceiver, including connector type and vendor-related parameters, as well as the temperature, voltage, bias current, transmit power, and receive power.

### Syntax

**show interfaces transceiver** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (SFP+ ports 25-28)

### Default Setting

Shows all SFP interfaces.

### Command Mode

Privileged Exec

### Command Usage

The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose problems with optical devices. This feature, referred to as Digital Diagnostic Monitoring (DDM) in the command display, provides information on transceiver parameters including temperature, supply voltage, laser bias current, laser power, and received optical power, and related alarm thresholds.

### Example

```
Console#show interfaces transceiver ethernet 1/49
Information of Eth 1/49
Connector Type       : LC
Fiber Type           : [0x00]
Eth Compliance Codes : 1000BASE-ZX
Baud Rate             : 1300 MBd
Vendor OUI           : 00-00-5F
Vendor Name          : SumitomoElectric
Vendor PN            : SCP6G94-FN-BWH
Vendor Rev           : Z
Vendor SN            : SE08T712Z00006
Date Code            : 10-09-14
DDM Info
```

```
Temperature      : 35.64 degree C
Vcc              : 3.25 V
Bias Current     : 12.13 mA
TX Power         : 2.36 dBm
RX Power         : -24.20 dBm
DDM Thresholds
-----
Temperature(Celsius)  -45.00   -40.00   85.00   90.00
Voltage(Volts)        2.90     3.00     3.60     3.70
Current(mA)           1.00     3.00    50.00    60.00
TxPower(dBm)          -11.50   -10.50   -2.00    -1.00
RxPower(dBm)          -23.98   -23.01   -1.00     0.00
Console#
```

**show interfaces transceiver-threshold** This command Displays the alarm/warning thresholds for temperature, voltage, bias current, transmit power, and receive power. Syntax

### Syntax

**show interfaces transceiver-threshold** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (SFP+ ports 25-28)

### Default Setting

Shows all SFP interfaces.

### Command Mode

Privileged Exec

### Command Usage

- ◆ The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose problems with optical devices. This feature, referred to as Digital Diagnostic Monitoring (DDM) in the command display, provides information on transceiver parameters including temperature, supply voltage, laser bias current, laser power, received optical power, and related alarm thresholds.
- ◆ The DDM thresholds displayed by this command only apply to ports which have a DDM-compliant transceiver inserted.

### Example

```
Console#show interfaces transceiver-threshold ethernet 1/25
Information of Eth 1/25
DDM Thresholds
Transceiver-monitor      : Disabled
Transceiver-threshold-auto : Enabled
```

	Low Alarm	Low Warning	High Warning	High Alarm
-----	-----	-----	-----	-----
Temperature (Celsius)	-123.00	0.00	70.00	75.00
Voltage (Volts)	3.10	3.15	3.45	3.50
Current (mA)	6.00	7.00	90.00	100.00
TxPower (dBm)	-12.00	-11.50	-9.50	-9.00
RxPower (dBm)	-21.50	-21.00	-3.50	-3.00
Console#				

## Cable Diagnostics

**test cable-diagnostics** This command performs cable diagnostics on the specified port to diagnose any cable faults (short, open, etc.) and report the cable length.

### Syntax

**test cable-diagnostics interface** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (SFP+ ports 1-24)

### Command Mode

Privileged Exec

### Command Usage

- ◆ Cable diagnostics are performed using Digital Signal Processing (DSP) test methods. DSP analyses the cable by sending a pulsed signal into the cable, and then examining the reflection of that pulse.
- ◆ This cable test is only accurate for Ethernet cables 7 - 100 meters long.
- ◆ The test takes approximately 5 seconds. Use the [show cable-diagnostics](#) command to display the results of the test, including common cable failures, as well as the status and approximate length of each cable pair.
- ◆ Ports are linked down while running cable diagnostics.
- ◆ To ensure more accurate measurement of the length to a fault, first disable power-saving mode (using the [no power-save](#) command) on the link partner before running cable diagnostics.

### Example

```
Console#test cable-diagnostics interface ethernet 1/24
Console#
```

**show cable-diagnostics** This command shows the results of a cable diagnostics test.

#### Syntax

**show cable-diagnostics interface** *[interface]*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (SFP+ ports 1-24)

#### Command Mode

Privileged Exec

#### Command Usage

- ◆ The results include common cable failures, as well as the status and approximate distance to a fault, or the approximate cable length if no fault is found.
- ◆ For link-down ports, the reported distance to a fault is accurate to within +/- 2 meters. For link-up ports, the accuracy is +/- 10 meters.
- ◆ Potential conditions which may be listed by the diagnostics include:
  - OK: Correctly terminated pair
  - Open: Open pair, no link partner
  - Short: Shorted pair
  - Not Supported: This message is displayed for any Gigabit Ethernet ports linked up at a speed lower than 1000 Mbps.
  - Impedance mismatch: Terminating impedance is not in the reference range.

#### Example

```
Console#show cable-diagnostics interface ethernet 1/24
Port      Type Link      Pair A   Pair B   Pair C   Pair D   Last
          Status meters   meters   meters   meters   Updated
-----
Eth 1/24 GE  Down      NC (0)   NC (0)   NC (0)   NC (0)   2000-12-31 08:28:59
Console#
```

## Power Savings

**power-save** This command enables power savings mode on the specified port. Use the **no** form to disable this feature.

### Syntax

**[no] power-save**

### Default Setting

Enabled

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ IEEE 802.3 defines the Ethernet standard and subsequent power requirements based on cable connections operating at 100 meters. Enabling power saving mode can reduce power used for cable lengths of 60 meters or less, with more significant reduction for cables of 20 meters or less, and continue to ensure signal integrity.
- ◆ Power saving mode only applies to the Gigabit Ethernet ports using copper media.
- ◆ Power savings can be enabled on Gigabit Ethernet RJ-45 ports.
- ◆ The power-saving methods provided by this switch include:
  - Power saving when there is no link partner:

Under normal operation, the switch continuously auto-negotiates to find a link partner, keeping the MAC interface powered up even if no link connection exists. When using power-savings mode, the switch checks for energy on the circuit to determine if there is a link partner. If none is detected, the switch automatically turns off the transmitter, and most of the receive circuitry (entering Sleep Mode). In this mode, the low-power energy-detection circuit continuously checks for energy on the cable. If none is detected, the MAC interface is also powered down to save additional energy. If energy is detected, the switch immediately turns on both the transmitter and receiver functions, and powers up the MAC interface.
  - Power saving when there is a link partner:

Traditional Ethernet connections typically operate with enough power to support at least 100 meters of cable even though average network cable length is shorter. When cable length is shorter, power consumption can be reduced since signal attenuation is proportional to cable length. When power-savings mode is enabled, the switch analyzes cable length to

determine whether or not it can reduce the signal amplitude used on a particular link.



**Note:** Power savings can only be implemented on Gigabit Ethernet ports using twisted-pair cabling. Power-savings mode on a active link only works when connection speed is 1 Gbps, and line length is less than 60 meters.

### Example

```
Console(config)#interface ethernet 1/24
Console(config-if)#power-save
Console(config-if)#
```

**show power-save** This command shows the configuration settings for power savings.

### Syntax

**show power-save** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (SFP+ ports 1-24)

### Command Mode

Privileged Exec

### Example

```
Console#show power-save interface ethernet 1/24
Power Saving Status:
 Ethernet 1/24 : Enabled
Console#
```



# Link Aggregation Commands

Ports can be statically grouped into an aggregate link (i.e., trunk) to increase the bandwidth of a network connection or to ensure fault recovery. Or you can use the Link Aggregation Control Protocol (LACP) to automatically negotiate a trunk link between this switch and another network device. For static trunks, the switches have to comply with the Cisco EtherChannel standard. For dynamic trunks, the switches have to comply with LACP. This switch supports up to 26 trunks. For example, a trunk consisting of two 1000 Mbps ports can support an aggregate bandwidth of 4 Gbps when operating at full duplex.

**Table 77: Link Aggregation Commands**

Command	Function	Mode
<i>Manual Configuration Commands</i>		
<code>interface port-channel</code>	Configures a trunk and enters interface configuration mode for the trunk	GC
<code>port channel load-balance</code>	Sets the load-distribution method among ports in aggregated links	GC
<code>channel-group</code>	Adds a port to a trunk	IC (Ethernet)
<i>Dynamic Configuration Commands</i>		
<code>lacp</code>	Configures LACP for the current interface	IC (Ethernet)
<code>lacp admin-key</code>	Configures a port's administration key	IC (Ethernet)
<code>lacp port-priority</code>	Configures a port's LACP port priority	IC (Ethernet)
<code>lacp system-priority</code>	Configures a port's LACP system priority	IC (Ethernet)
<code>lacp admin-key</code>	Configures an port channel's administration key	IC (Port Channel)
<code>lacp timeout</code>	Configures the timeout to wait for next LACPDU	IC (Port Channel)
<i>Trunk Status Display Commands</i>		
<code>show interfaces status port-channel</code>	Shows trunk information	NE, PE
<code>show lacp</code>	Shows LACP information	PE
<code>show port-channel load-balance</code>	Shows the load-distribution method used on aggregated links	PE

## Guidelines for Creating Trunks

### *General Guidelines –*

- ◆ Finish configuring trunks before you connect the corresponding network cables between switches to avoid creating a loop.
- ◆ A trunk can have up to 8 ports.
- ◆ The ports at both ends of a connection must be configured as trunk ports.
- ◆ All ports in a trunk must be configured in an identical manner, including communication mode (i.e., speed and duplex mode), VLAN assignments, and CoS settings.
- ◆ Any of the Gigabit ports on the front panel can be trunked together, including ports of different media types.
- ◆ All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN via the specified port-channel.
- ◆ STP, VLAN, and IGMP settings can only be made for the entire trunk via the specified port-channel.

### *Dynamically Creating a Port Channel –*

Ports assigned to a common port channel must meet the following criteria:

- ◆ Ports must have the same LACP system priority.
- ◆ Ports must have the same port admin key (Ethernet Interface).
- ◆ If the port channel admin key ([lACP admin key](#) - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key ([lACP admin key](#) - Ethernet Interface) used by the interfaces that joined the group.
- ◆ However, if the port channel admin key is set, then the port admin key must be set to the same value for a port to be allowed to join a channel group.
- ◆ If a link goes down, LACP port priority is used to select the backup link.

## Manual Configuration Commands

**port channel load-balance** This command sets the load-distribution method among ports in aggregated links (for both static and dynamic trunks). Use the **no** form to restore the default setting.

### Syntax

**port channel load-balance {dst-ip | dst-mac | src-dst-ip | src-dst-mac | src-ip | src-mac}**

**no port channel load-balance**

**dst-ip** - Load balancing based on destination IP address.

**dst-mac** - Load balancing based on destination MAC address.

**src-dst-ip** - Load balancing based on source and destination IP address.

**src-dst-mac** - Load balancing based on source and destination MAC address.

**src-ip** - Load balancing based on source IP address.

**src-mac** - Load balancing based on source MAC address.

### Default Setting

src-dst-ip

### Command Mode

Global Configuration

### Command Usage

- ◆ This command applies to all static and dynamic trunks on the switch.
- ◆ To ensure that the switch traffic load is distributed evenly across all links in a trunk, select the source and destination addresses used in the load-balance calculation to provide the best result for trunk connections:
  - **dst-ip**: All traffic with the same destination IP address is output on the same link in a trunk. This mode works best for switch-to-router trunk links where traffic through the switch is destined for many different hosts. Do not use this mode for switch-to-server trunk links where the destination IP address is the same for all traffic.
  - **dst-mac**: All traffic with the same destination MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is destined for many different hosts. Do not use this mode for switch-to-router trunk links where the destination MAC address is the same for all traffic.
  - **src-dst-ip**: All traffic with the same source and destination IP address is output on the same link in a trunk. This mode works best for switch-to-router trunk links where traffic through the switch is received from and destined for many different hosts.
  - **src-dst-mac**: All traffic with the same source and destination MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is received from and destined for many different hosts.
  - **src-ip**: All traffic with the same source IP address is output on the same link in a trunk. This mode works best for switch-to-router or switch-to-server trunk links where traffic through the switch is received from many different hosts.

- **src-mac:** All traffic with the same source MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is received from many different hosts.

### Example

```
Console(config)#port-channel load-balance dst-ip
Console(config)#
```

**channel-group** This command adds a port to a trunk. Use the **no** form to remove a port from a trunk.

### Syntax

**channel-group** *channel-id*

**no channel-group**

*channel-id* - Trunk index (Range: 1-16)

### Default Setting

The current port will be added to this trunk.

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ When configuring static trunks, the switches must comply with the Cisco EtherChannel standard.
- ◆ Use **no channel-group** to remove a port group from a trunk.
- ◆ Use **no interface port-channel** to remove a trunk from the switch.

### Example

The following example creates trunk 1 and then adds port 10:

```
Console(config)#interface port-channel 1
Console(config-if)#exit
Console(config)#interface ethernet 1/10
Console(config-if)#channel-group 1
Console(config-if)#
```

## Dynamic Configuration Commands

**lacp** This command enables 802.3ad Link Aggregation Control Protocol (LACP) for the current interface. Use the **no** form to disable it.

### Syntax

**[no] lacp**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ The ports on both ends of an LACP trunk must be configured for full duplex, either by forced mode or auto-negotiation.
- ◆ A trunk formed with another switch using LACP will automatically be assigned the next available port-channel ID.
- ◆ If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.
- ◆ If more than eight ports attached to the same target switch have LACP enabled, the additional ports will be placed in standby mode, and will only be enabled if one of the active links fails.

### Example

The following shows LACP enabled on ports 1-3. Because LACP has also been enabled on the ports at the other end of the links, the [show interfaces status port-channel 1](#) command shows that Trunk1 has been established.

```
Console(config)#interface ethernet 1/1
Console(config-if)#lacp
Console(config-if)#interface ethernet 1/2
Console(config-if)#lacp
Console(config-if)#interface ethernet 1/3
Console(config-if)#lacp
Console(config-if)#end
Console#show interfaces status port-channel 1
Information of Trunk 1
Basic Information:
  Port Type           : 1000BASE-T
  MAC Address         : 12-34-12-34-12-3F
Configuration:
  Name                :
  Port Admin          : Up
  Speed-duplex        : Auto
  Capabilities        : 10half, 10full, 100half, 100full, 1000full
  Broadcast Storm     : Enabled
  Broadcast Storm Limit : 500 packets/second
```

```
Multicast Storm      : Disabled
Multicast Storm Limit : 500 packets/second
Unknown Unicast Storm : Disabled
Unknown Unicast Storm Limit : 500 packets/second
Flow Control         : Disabled
VLAN Trunking        : Disabled
MAC Learning         : Enabled
Current status:
Created By           : LACP
Link Status          : Up
Port Operation Status : Up
Operation Speed-duplex : 1000full
Up Time              : 0w 0d 0h 0m 53s (53 seconds)
Flow Control Type    : None
Max Frame Size       : 1518 bytes (1522 bytes for tagged frames)
MAC Learning Status  : Enabled
Member Ports         : Eth1/1, Eth1/2, Eth1/3,
Active Member Ports  : Eth1/1, Eth1/2, Eth1/3,
Console#
```

**lacp admin-key** This command configures a port's LACP administration key. Use the **no** form to (Ethernet Interface) restore the default setting.

### Syntax

**lacp {actor | partner} admin-key key**

**no lacp {actor | partner} admin-key**

**actor** - The local side an aggregate link.

**partner** - The remote side of an aggregate link.

**key** - The port admin key must be set to the same value for ports that belong to the same link aggregation group (LAG). (Range: 0-65535)

### Default Setting

Actor: 1, Partner: 0

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Ports are only allowed to join the same LAG if (1) the LACP system priority matches, (2) the LACP port admin key matches, and (3) the LACP port channel key matches (if configured).
- ◆ If the port channel admin key ([lacp admin key](#) - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key (**lacp admin key** - Ethernet Interface) used by the interfaces that joined the group.
- ◆ Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state.



**Note:** Configuring the partner admin-key does not affect remote or local switch operation. The local switch just records the partner admin-key for user reference.

- ◆ By default, the actor's operational key is determined by port's link speed (1000f - 4, 100f - 3, 10f - 2), and copied to the admin key.

### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor admin-key 120
Console(config-if)#
```

**lacp port-priority** This command configures LACP port priority. Use the **no** form to restore the default setting.

### Syntax

**lacp {actor | partner} port-priority *priority***

**no lacp {actor | partner} port-priority**

**actor** - The local side an aggregate link.

**partner** - The remote side of an aggregate link.

**priority** - LACP port priority is used to select a backup link. (Range: 0-65535)

### Default Setting

32768

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Setting a lower value indicates a higher effective priority.
- ◆ If an active port link goes down, the backup port with the highest priority is selected to replace the downed link. However, if two or more ports have the same LACP port priority, the port with the lowest physical port number will be selected as the backup port.
- ◆ If an LAG already exists with the maximum number of allowed port members, and LACP is subsequently enabled on another port using a higher priority than an existing member, the newly configured port will replace an existing port member that has a lower priority.
- ◆ Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

### Example

```
Console(config)#interface ethernet 1/5  
Console(config-if)#lacp actor port-priority 128
```

**lacp system-priority** This command configures a port's LACP system priority. Use the **no** form to restore the default setting.

### Syntax

**lacp {actor | partner} system-priority *priority***

**no lacp {actor | partner} system-priority**

**actor** - The local side an aggregate link.

**partner** - The remote side of an aggregate link.

*priority* - This priority is used to determine link aggregation group (LAG) membership, and to identify this device to other switches during LAG negotiations. (Range: 0-65535)

### Default Setting

32768

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Port must be configured with the same system priority to join the same LAG.
- ◆ System priority is combined with the switch's MAC address to form the LAG identifier. This identifier is used to indicate a specific LAG during LACP negotiations with other systems.
- ◆ Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

### Example

```
Console(config)#interface ethernet 1/5  
Console(config-if)#lacp actor system-priority 3  
Console(config-if)#
```



**lacp admin-key** (Port Channel) This command configures a port channel's LACP administration key string. Use the **no** form to restore the default setting.

### Syntax

**lacp admin-key** *key*

**no lacp admin-key**

*key* - The port channel admin key is used to identify a specific link aggregation group (LAG) during local LACP setup on this switch.  
(Range: 0-65535)

### Default Setting

0

### Command Mode

Interface Configuration (Port Channel)

### Command Usage

- ◆ Ports are only allowed to join the same LAG if (1) the LACP system priority matches, (2) the LACP port admin key matches, and (3) the LACP port channel key matches (if configured).
- ◆ If the port channel admin key (**lacp admin key** - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key (**lacp admin key** - Ethernet Interface) used by the interfaces that joined the group. Note that when the LAG is no longer used, the port channel admin key is reset to 0.
- ◆ If the port channel admin key is set to a non-default value, the operational key is based upon LACP PDUs received from the partner, and the channel admin key is reset to the default value. The trunk identifier will also be changed by this process.

### Example

```
Console(config)#interface port-channel 1
Console(config-if)#lacp admin-key 3
Console(config-if)#
```

**lacp timeout** This command configures the timeout to wait for the next LACP data unit (LACPDU). Use the no form to restore the default setting.

#### Syntax

**lacp timeout {long | short}**

**no lacp timeout**

**long** - Specifies a slow timeout of 90 seconds.

**short** - Specifies a fast timeout of 3 seconds.

#### Default Setting

long

#### Command Mode

Interface Configuration (Port Channel)

#### Command Usage

- ◆ The timeout configured by this command is set in the LACP timeout bit of the Actor State field in transmitted LACPDU. When the partner switch receives an LACPDU set with a short timeout from the actor switch, the partner adjusts the transmit LACPDU interval to 1 second. When it receives an LACPDU set with a long timeout from the actor, it adjusts the transmit LACPDU interval to 30 seconds.
- ◆ If the actor does not receive an LACPDU from its partner before the configured timeout expires, the partner port information will be deleted from the LACP group.
- ◆ When a dynamic port-channel member leaves a port-channel, the default timeout value will be restored on that port.
- ◆ When a dynamic port-channel is torn down, the configured timeout value will be retained. When the dynamic port-channel is constructed again, that timeout value will be used.

#### Example

```
Console(config)#interface port-channel 1
Console(config-if)#lacp timeout short
Console(config-if)#
```

## Trunk Status Display Commands

**show lacp** This command displays LACP information.

### Syntax

**show lacp** [*port-channel*] {**counters** | **internal** | **neighbors** | **sysid**}

*port-channel* - Local identifier for a link aggregation group. (Range: 1-16)

**counters** - Statistics for LACP protocol messages.

**internal** - Configuration settings and operational state for local side.

**neighbors** - Configuration settings and operational state for remote side.

**sysid** - Summary of system priority and MAC address for all channel groups.

### Default Setting

Port Channel: all

### Command Mode

Privileged Exec

### Example

```
Console#show lacp 1 counters
Port Channel: 1
-----
Eth 1/ 2
-----
LACPDU Sent      : 12
LACPDU Received  : 6
Marker Sent      : 0
Marker Received  : 0
LACPDU Unknown Pkts : 0
LACPDU Illegal Pkts : 0
:
```

**Table 78: show lacp counters - display description**

Field	Description
LACPDU Sent	Number of valid LACPDU transmitted from this channel group.
LACPDU Received	Number of valid LACPDU received on this channel group.
Marker Sent	Number of valid Marker PDU transmitted from this channel group.
Marker Received	Number of valid Marker PDU received by this channel group.
LACPDU Unknown Pkts	Number of frames received that either (1) Carry the Slow Protocols Ethernet Type value, but contain an unknown PDU, or (2) are addressed to the Slow Protocols group MAC Address, but do not carry the Slow Protocols Ethernet Type.
LACPDU Illegal Pkts	Number of frames that carry the Slow Protocols Ethernet Type value, but contain a badly formed PDU or an illegal value of Protocol Subtype.

```

Console#show lacp 1 internal
Port Channel : 1
-----
Oper Key   : 3
Admin Key  : 0
Timeout    : long

Eth 1/ 1
-----
LACPDUs Internal      : 30 seconds
LACP System Priority   : 32768
LACP Port Priority     : 32768
Admin Key             : 3
Oper Key              : 3
Admin State           : defaulted, aggregation, long timeout, LACP-activity
Oper State            : distributing, collecting, synchronization,
                        aggregation, long timeout, LACP-activity
:

```

**Table 79: show lacp internal - display description**

Field	Description
Oper Key	Current operational value of the key for the aggregation port.
Admin Key	Current administrative value of the key for the aggregation port.
Timeout	Time to wait for the next LACPDU before deleting partner port information.
LACPDUs Internal	Number of seconds before invalidating received LACPDU information.
LACP System Priority	LACP system priority assigned to this port channel.
LACP Port Priority	LACP port priority assigned to this interface within the channel group.
Admin State, Oper State	Administrative or operational values of the actor's state parameters: <ul style="list-style-type: none"> <li>◆ Expired – The actor's receive machine is in the expired state;</li> <li>◆ Defaulted – The actor's receive machine is using defaulted operational partner information, administratively configured for the partner.</li> <li>◆ Distributing – If false, distribution of outgoing frames on this link is disabled; i.e., distribution is currently disabled and is not expected to be enabled in the absence of administrative changes or changes in received protocol information.</li> <li>◆ Collecting – Collection of incoming frames on this link is enabled; i.e., collection is currently enabled and is not expected to be disabled in the absence of administrative changes or changes in received protocol information.</li> <li>◆ Synchronization – The System considers this link to be IN_SYNC; i.e., it has been allocated to the correct Link Aggregation Group, the group has been associated with a compatible Aggregator, and the identity of the Link Aggregation Group is consistent with the System ID and operational Key information transmitted.</li> <li>◆ Aggregation – The system considers this link to be aggregatable; i.e., a potential candidate for aggregation.</li> <li>◆ Long timeout – Periodic transmission of LACPDU uses a slow transmission rate.</li> <li>◆ LACP-Activity – Activity control value with regard to this link. (0: Passive; 1: Active)</li> </ul>

```

Console#show lacp 1 neighbors
Port Channel 1 neighbors
-----
Eth 1/ 1
-----
Partner Admin System ID   : 32768, 00-00-00-00-00-00
Partner Oper System ID   : 32768, 00-12-CF-61-24-2F
Partner Admin Port Number : 1
Partner Oper Port Number  : 1
Port Admin Priority       : 32768
Port Oper Priority        : 32768
Admin Key                 : 0
Oper Key                  : 3
Admin State:              defaulted, distributing, collecting,
                           synchronization, long timeout,
Oper State:               distributing, collecting, synchronization,
                           aggregation, long timeout, LACP-activity
:

```

**Table 80: show lacp neighbors - display description**

Field	Description
Partner Admin System ID	LAG partner's system ID assigned by the user.
Partner Oper System ID	LAG partner's system ID assigned by the LACP protocol.
Partner Admin Port Number	Current administrative value of the port number for the protocol Partner.
Partner Oper Port Number	Operational port number assigned to this aggregation port by the port's protocol partner.
Port Admin Priority	Current administrative value of the port priority for the protocol partner.
Port Oper Priority	Priority value assigned to this aggregation port by the partner.
Admin Key	Current administrative value of the Key for the protocol partner.
Oper Key	Current operational value of the Key for the protocol partner.
Admin State	Administrative values of the partner's state parameters. (See preceding table.)
Oper State	Operational values of the partner's state parameters. (See preceding table.)

```

Console#show lacp sysid
Port Channel      System Priority    System MAC Address
-----
                1          32768      00-30-F1-8F-2C-A7
                2          32768      00-30-F1-8F-2C-A7
                3          32768      00-30-F1-8F-2C-A7
                4          32768      00-30-F1-8F-2C-A7
                5          32768      00-30-F1-8F-2C-A7
                6          32768      00-30-F1-8F-2C-A7
                7          32768      00-30-F1-D4-73-A0
                8          32768      00-30-F1-D4-73-A0
                9          32768      00-30-F1-D4-73-A0
               10          32768      00-30-F1-D4-73-A0
               11          32768      00-30-F1-D4-73-A0
               12          32768      00-30-F1-D4-73-A0
:

```

**Table 81: show lacp sysid - display description**

Field	Description
Channel group	A link aggregation group configured on this switch.
System Priority*	LACP system priority for this channel group.
System MAC Address*	System MAC address.

\* The LACP system priority and system MAC address are concatenated to form the LAG system ID.

**show port-channel load-balance** This command shows the load-distribution method used on aggregated links.

**Command Mode**  
Privileged Exec

**Example**

```
Console#show port-channel load-balance
Trunk Load Balance Mode: Destination IP address
Console#
```

# Port Mirroring Commands

Data can be mirrored from a local port on the same switch or from a remote port on another switch for analysis at the target port using software monitoring tools or a hardware probe. This switch supports the following mirroring modes.

**Table 82: Port Mirroring Commands**

Command	Function
Local Port Mirroring	Mirrors data to another port for analysis without affecting the data passing through or the performance of the monitored port
RSPAN Mirroring	Mirrors data from remote switches over a dedicated VLAN

## Local Port Mirroring Commands

This section describes how to mirror traffic from a source port to a target port.

**Table 83: Mirror Port Commands**

Command	Function	Mode
<code>port monitor</code>	Configures a mirror session	IC
<code>show port monitor</code>	Shows the configuration for a mirror port	PE

**port monitor** This command configures a mirror session. Use the **no** form to clear a mirror session.

### Syntax

**port monitor** {*interface* [**rx** | **tx** | **both**] | **vlan** *vlan-id* | **mac-address** *mac-address* | **access-list** *acl-name*}

**no port monitor** {*interface* | **vlan** *vlan-id* | **mac-address** *mac-address* | **access-list** *acl-name*}

*interface*

**ethernet** *unit/port* (source port)

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**rx** - Mirror received packets.

**tx** - Mirror transmitted packets.

**both** - Mirror both received and transmitted packets.

*vlan-id* - VLAN ID (Range: 1-4094)

*mac-address* - MAC address in the form of xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

*acl-name* – Name of the ACL. (Maximum length: 32 characters, no spaces or other special characters)

### Default Setting

- ◆ No mirror session is defined.
- ◆ When enabled for an interface, default mirroring is for both received and transmitted packets.
- ◆ When enabled for a VLAN or a MAC address, mirroring is restricted to received packets.

### Command Mode

Interface Configuration (Ethernet, destination port)

### Command Usage

- ◆ You can mirror traffic from any source port to a destination port for real-time analysis. You can then attach a logic analyzer or RMON probe to the destination port and study the traffic crossing the source port in a completely unobtrusive manner.
- ◆ Set the destination port by specifying an Ethernet interface with the [interface](#) configuration command, and then use the [port monitor](#) command to specify the source of the traffic to mirror. Note that the destination port cannot be a trunk or trunk member port.
- ◆ All VLAN mirror sessions must share the same target port, preferably one that is not a member of the source VLAN.
- ◆ When mirroring traffic from a port, the mirror port and monitor port speeds should match, otherwise traffic may be dropped from the monitor port. When mirroring traffic from a VLAN, traffic may also be dropped under heavy loads.
- ◆ When VLAN mirroring and port mirroring are both enabled, the target port can receive a mirrored packet twice; once from the source mirror port and again from the source mirror VLAN.
- ◆ When mirroring traffic from a MAC address, ingress traffic with the specified source address entering any port in the switch, other than the target port, will be mirrored to the destination port.
- ◆ Spanning Tree BPDU packets are not mirrored to the target port.



- ◆ When mirroring VLAN traffic or packets based on a source MAC address, the target port cannot be set to the same target port as that used for basic port mirroring.
- ◆ You can create multiple mirror sessions, but all sessions must share the same destination port.
- ◆ The destination port cannot be a trunk or trunk member port.
- ◆ ACL-based mirroring is only used for ingress traffic. To mirror an ACL, follow these steps:
  1. Use the **access-list** command to add an ACL.
  2. Use the **access-group** command to add a mirrored port to access control list.
  3. Use the **port monitor access-list** command to specify the destination port to which traffic matching the ACL will be mirrored.

### Example

The following example configures the switch to mirror all packets from port 6 to 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port monitor ethernet 1/6 both
Console(config-if)#
```

This example configures port 2 to monitor packets matching the MAC address 00-12-CF-XX-XX-XX received by port 1:

```
Console(config)#access-list mac m1
Console(config-mac-acl)#permit 00-12-cf-00-00-00 ff-ff-ff-00-00-00 any
Console(config-mac-acl)#exit
Console(config)#interface ethernet 1/1
Console(config-if)#mac access-group m1 in
Console(config-if)#interface ethernet 1/2
Console(config-if)#port monitor access-list m1
Console(config-if)#
```

**show port monitor** This command displays mirror information.

### Syntax

**show port monitor** [*interface* | **vlan** *vlan-id* | **mac-address** *mac-address*]

*interface* - **ethernet** *unit/port* (source port)

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*vlan-id* - VLAN ID (Range: 1-4094)

*mac-address* - MAC address in the form of xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

### Default Setting

Shows all sessions.

### Command Mode

Privileged Exec

### Command Usage

This command displays the currently configured source port, destination port, and mirror mode (i.e., RX, TX, RX/TX).

### Example

The following shows mirroring configured from port 6 to port 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port monitor ethernet 1/6
Console(config-if)#end
Console#show port monitor
Port Mirroring
-----
Destination Port (listen port):Eth1/5
Source Port (monitored port)  :Eth1/6
Mode                          :RX/TX
Console#
```

## RSPAN Mirroring Commands

Remote Switched Port Analyzer (RSPAN) allows you to mirror traffic from remote switches for analysis on a local destination port.

**Table 84: RSPAN Commands**

Command	Function	Mode
<code>vlan rspan</code>	Creates a VLAN dedicated to carrying RSPAN traffic	VC
<code>rspan source</code>	Specifies the source port and traffic type to be mirrored	GC
<code>rspan destination</code>	Specifies the destination port to monitor the mirrored traffic	GC
<code>rspan remote vlan</code>	Specifies the RSPAN VLAN, switch role (source, intermediate or destination), and the uplink ports	GC
<code>no rspan session</code>	Deletes a configured RSPAN session	GC
<code>show rspan</code>	Displays the configuration settings for an RSPAN session	PE

### Configuration Guidelines

Take the following steps to configure an RSPAN session:

1. Use the [vlan rspan](#) command to configure a VLAN to use for RSPAN. (Default VLAN 1 is prohibited.)
2. Use the [rspan source](#) command to specify the interfaces and the traffic type (RX, TX or both) to be monitored.
3. Use the [rspan destination](#) command to specify the destination port for the traffic mirrored by an RSPAN session.
4. Use the [rspan remote vlan](#) command to specify the VLAN to be used for an RSPAN session, to specify the switch's role as a source, intermediate relay, or destination of the mirrored traffic, and to configure the uplink ports designated to carry this traffic.

### RSPAN Limitations

The following limitations apply to the use of RSPAN on this switch:

- ◆ *RSPAN Ports* – Only ports can be configured as an RSPAN source, destination, or uplink; static and dynamic trunks are not allowed. A port can only be configured as one type of RSPAN interface – source, destination, or uplink. Also, note that the source port and destination port cannot be configured on the same switch.

Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN uplink or destination port – access ports are not allowed (see [switchport mode](#)).

- ◆ *Local/Remote Mirror* – The destination of a local mirror session (created with the [port monitor](#) command) cannot be used as the destination for RSPAN traffic.

Only one mirror session is allowed, including both local and remote mirroring. If local mirroring is enabled, then no session can be configured for RSPAN.

- ◆ *Spanning Tree* – If the spanning tree is disabled, BPDUs will not be flooded onto the RSPAN VLAN.

MAC address learning is not supported on RSPAN uplink ports when RSPAN is enabled on the switch. Therefore, even if spanning tree is enabled after RSPAN has been configured, MAC address learning will still not be re-started on the RSPAN uplink ports.

- ◆ *IEEE 802.1X* – RSPAN and 802.1X are mutually exclusive functions. When 802.1X is enabled globally, RSPAN uplink ports cannot be configured, even though RSPAN source and destination ports can still be configured. When RSPAN uplink ports are enabled on the switch, 802.1X cannot be enabled globally.

RSPAN uplink ports cannot be configured to use IEEE 802.1X Port Authentication, but RSPAN source ports and destination ports can be configured to use it

- ◆ *Port Security* – If port security is enabled on any port, that port cannot be set as an RSPAN uplink port, even though it can still be configured as an RSPAN source or destination port. Also, when a port is configured as an RSPAN uplink port, port security cannot be enabled on that port.

**rspan source** Use this command to specify the source port and traffic type to be mirrored remotely. Use the **no** form to disable RSPAN on the specified port, or with a traffic type keyword to disable mirroring for the specified type.

### Syntax

**[no] rspan session** *session-id* **source interface** *interface-list* [**rx** | **tx** | **both**]

*session-id* – A number identifying this RSPAN session. (Range: 1)

Only one mirror session is allowed, including both local and remote mirroring. If local mirroring is enabled with the [port monitor](#) command, then no session can be configured for RSPAN.

*interface-list* – One or more source ports. Use a hyphen to indicate a consecutive list of ports or a comma between non-consecutive ports.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**rx** - Mirror received packets.

**tx** - Mirror transmitted packets.

**both** - Mirror both received and transmitted packets.

### Default Setting

Both TX and RX traffic is mirrored

### Command Mode

Global Configuration

### Command Usage

- ◆ One or more source ports can be assigned to the same RSPAN session, either on the same switch or on different switches.
- ◆ Only ports can be configured as an RSPAN source – static and dynamic trunks are not allowed.
- ◆ Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN source port – access ports are not allowed (see [switchport mode](#)).

- ◆ The source port and destination port cannot be configured on the same switch.

### Example

The following example configures the switch to mirror received packets from port 2 and 3:

```
Console(config)#rspan session 1 source interface ethernet 1/2
Console(config)#rspan session 1 source interface ethernet 1/3
Console(config)#
```

**rspan destination** Use this command to specify the destination port to monitor the mirrored traffic. Use the **no** form to disable RSPAN on the specified port.

### Syntax

**rspan session** *session-id* **destination interface** *interface* [**tagged** | **untagged**]

**no rspan session** *session-id* **destination interface** *interface*

*session-id* – A number identifying this RSPAN session. (Range: 1)

Only one mirror session is allowed, including both local and remote mirroring. If local mirroring is enabled with the [port monitor](#) command, then no session can be configured for RSPAN.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**tagged** - Traffic exiting the destination port carries the RSPAN VLAN tag.

**untagged** - Traffic exiting the destination port is untagged.

### Default Setting

Traffic exiting the destination port is untagged.

### Command Mode

Global Configuration

### Command Usage

- ◆ Only one destination port can be configured on the same switch per session, but a destination port can be configured on more than one switch for the same session.
- ◆ Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN destination port – access ports are not allowed (see [switchport mode](#)).
- ◆ Only ports can be configured as an RSPAN destination – static and dynamic trunks are not allowed.

- ◆ The source port and destination port cannot be configured on the same switch.
- ◆ A destination port can still send and receive switched traffic, and participate in any Layer 2 protocols to which it has been assigned.

### Example

The following example configures port 4 to receive mirrored RSPAN traffic:

```
Console(config)#rspan session 1 destination interface ethernet 1/2
Console(config)#
```

**rspan remote vlan** Use this command to specify the RSPAN VLAN, switch role (source, intermediate or destination), and the uplink ports. Use the **no** form to disable the RSPAN on the specified VLAN.

### Syntax

**[no] rspan session** *session-id* **remote vlan** *vlan-id*  
**{source | intermediate | destination}** **uplink** *interface*

*session-id* – A number identifying this RSPAN session. (Range: 1)

Only one mirror session is allowed, including both local and remote mirroring. If local mirroring is enabled with the [port monitor](#) command, then no session can be configured for RSPAN.

*vlan-id* - ID of configured RSPAN VLAN. (Range: 1-4094)

Use the [vlan rspan](#) command to reserve a VLAN for RSPAN mirroring before enabling RSPAN with this command.

**source** - Specifies this device as the source of remotely mirrored traffic.

**intermediate** - Specifies this device as an intermediate switch, transparently passing mirrored traffic from one or more sources to one or more destinations.

**destination** - Specifies this device as a switch configured with a destination port which is to receive mirrored traffic for this session.

**uplink** - A port configured to receive or transmit remotely mirrored traffic.

*interface* - **ethernet** *unit/port*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN uplink port – access ports are not allowed (see [switchport mode](#)).
- ◆ Only one uplink port can be configured on a source switch, but there is no limitation on the number of uplink ports configured on an intermediate or destination switch.
- ◆ Only destination and uplink ports will be assigned by the switch as members of this VLAN. Ports cannot be manually assigned to an RSPAN VLAN with the [switchport allowed vlan](#) command. Nor can GVRP dynamically add port members to an RSPAN VLAN. Also, note that the [show vlan](#) command will not display any members for an RSPAN VLAN, but will only show configured RSPAN VLAN identifiers.

### Example

The following example enables RSPAN on VLAN 2, specifies this device as an RSPAN destination switch, and the uplink interface as port 3:

```
Console(config)#rspan session 1 remote vlan 2 destination uplink ethernet 1/3
Console(config)#
```

**no rspan session** Use this command to delete a configured RSPAN session.

### Syntax

**no rspan session** *session-id*

*session-id* – A number identifying this RSPAN session. (Range: 1)

Only one mirror session is allowed, including both local and remote mirroring. If local mirroring is enabled with the [port monitor](#) command, then no session can be configured for RSPAN.

### Command Mode

Global Configuration

### Command Usage

The **no rspan session** command must be used to disable an RSPAN VLAN before it can be deleted from the VLAN database (see the [vlan](#) command).

### Example

```
Console(config)#no rspan session 1
Console(config)#
```

**show rspan** Use this command to displays the configuration settings for an RSPAN session.

### Syntax

**show rspan session** [*session-id*]

*session-id* – A number identifying this RSPAN session. (Range: 1)

Only one mirror session is allowed, including both local and remote mirroring. If local mirroring is enabled with the [port monitor](#) command, then no session can be configured for RSPAN.

### Command Mode

Privileged Exec

### Example

```
Console#show rspan session
RSPAN Session ID           : 1
Source Ports (mirrored ports) : None
  RX Only                   : None
  TX Only                    : None
  BOTH                       : None
Destination Port (monitor port) : Eth 1/2
Destination Tagged Mode      : Untagged
Switch Role                  : Destination
RSPAN VLAN                   : 2
RSPAN Uplink Ports           : Eth 1/3
Operation Status              : Up
Console#
```



## Congestion Control Commands

The switch can set the maximum upload or download data transfer rate for any port. It can control traffic storms by setting a maximum threshold for broadcast traffic or multicast traffic. It can also set bounding thresholds for broadcast and multicast storms which can be used to automatically trigger rate limits or to shut down a port.

**Table 85: Congestion Control Commands**

Command Group	Function
<a href="#">Rate Limiting</a>	Sets the input and output rate limits for a port.
<a href="#">Storm Control</a>	Sets the traffic storm threshold for each port.
<a href="#">Automatic Traffic Control</a>	Sets thresholds for broadcast and multicast storms which can be used to trigger configured rate limits or to shut down a port.

### Rate Limit Commands

Rate limit commands allow the network manager to control the maximum rate for traffic transmitted or received on an interface. Rate limiting is configured on interfaces at the edge of a network to limit traffic into or out of the network. Packets that exceed the acceptable amount of traffic are dropped.

Rate limiting can be applied to individual ports or trunks. When an interface is configured with this feature, the traffic rate will be monitored by the hardware to verify conformity. Non-conforming traffic is dropped.

**Table 86: Rate Limit Commands**

Command	Function	Mode
<a href="#">rate-limit</a>	Configures the maximum input or output rate for an interface	IC

**rate-limit** This command defines the rate limit for a specific interface. Use this command without specifying a rate to enable rate limiting. Use the **no** form to disable rate limiting.

### Syntax

**rate-limit** {input | output} [*rate*]

**no rate-limit** {input | output}

**input** – Input rate for specified interface

**output** – Output rate for specified interface

*rate* – Maximum value in kbps.

(Range: 64 - 1000000 kbits per second for Gigabit Ethernet ports;

64 - 10000000 kbits per second for 10 Gigabit Ethernet ports)

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

Using both rate limiting and storm control on the same interface may lead to unexpected results. It is therefore not advisable to use both of these commands on the same interface.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rate-limit input 64
Console(config-if)#
```

### Related Command

[show interfaces switchport \(427\)](#)

## Storm Control Commands

Storm control commands can be used to configure broadcast, multicast, and unknown unicast storm control thresholds. Traffic storms may occur when a device on your network is malfunctioning, or if application programs are not well designed or properly configured. If there is too much traffic on your network, performance can be severely degraded or everything can come to complete halt.

You can protect your network from traffic storms by setting a threshold for broadcast, multicast or unknown unicast traffic. Any packets exceeding the specified threshold will then be dropped.

**Table 87: Rate Limit Commands**

Command	Function	Mode
<code>switchport packet-rate</code> *	Configures broadcast, multicast, and unknown unicast storm control thresholds	IC
<code>show interfaces switchport</code>	Displays the administrative and operational status of an interface	NE, PE

\* Enabling hardware-level storm control with this command on a port will disable software-level automatic storm control on the same port if configured by the `auto-traffic-control` command.

**switchport packet-rate** This command configures broadcast, multicast and unknown unicast storm control. Use the **no** form to restore the default setting.

### Syntax

**switchport {broadcast | multicast | unknown-unicast} packet-rate rate**

**no switchport {broadcast | multicast | unknown-unicast}**

**broadcast** - Specifies storm control for broadcast traffic.

**multicast** - Specifies storm control for multicast traffic.

**unknown-unicast** - Specifies storm control for unknown unicast traffic.

**rate** - Threshold level as a rate; i.e. (Range: 500-14881000 pps at an increment of 500 pps)

### Default Setting

Broadcast Storm Control: Enabled, 500 pps

Multicast Storm Control: Disabled

Unknown Unicast Storm Control: Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ When traffic exceeds the threshold specified for broadcast and multicast or unknown unicast traffic, packets exceeding the threshold are dropped until the rate falls back down beneath the threshold.
- ◆ Traffic storms can be controlled at the hardware level using this command or at the software level using the [auto-traffic-control](#) command. However, only one of these control types can be applied to a port. Enabling hardware-level storm control on a port will disable automatic storm control on that port.
- ◆ The rate limits set by this command are also used by automatic storm control when the control response is set to rate limiting by the [auto-traffic-control action](#) command.
- ◆ Using both rate limiting and storm control on the same interface may lead to unexpected results. It is therefore not advisable to use both of these commands on the same interface.



---

**Note:** Due to a chip limitation, this switch shares a common storm control threshold for unknown unicast, broadcast, and multicast traffic. The last storm control threshold set will be applied to all of these traffic types.

---

### Example

The following shows how to configure broadcast storm control at 600 packets per second:

```
Console(config)#interface ethernet 1/5
Console(config-if)#switchport broadcast packet-rate 600
Console(config-if)#
```

### Related Commands

[show interfaces switchport \(427\)](#)

## Automatic Traffic Control Commands

Automatic Traffic Control (ATC) configures bounding thresholds for broadcast and multicast storms which can be used to trigger configured rate limits or to shut down a port.

**Table 88: ATC Commands**

Command	Function	Mode
<i>Threshold Commands</i>		
<code>auto-traffic-control apply-timer</code>	Sets the time at which to apply the control response after ingress traffic has exceeded the upper threshold	GC
<code>auto-traffic-control release-timer</code>	Sets the time at which to release the control response after ingress traffic has fallen beneath the lower threshold	GC
<code>auto-traffic-control*</code>	Enables automatic traffic control for broadcast or multicast storms	IC (Port)
<code>auto-traffic-control action</code>	Sets the control action to limit ingress traffic or shut down the offending port	IC (Port)
<code>auto-traffic-control alarm-clear-threshold</code>	Sets the lower threshold for ingress traffic beneath which a cleared storm control trap is sent	IC (Port)
<code>auto-traffic-control alarm-fire-threshold</code>	Sets the upper threshold for ingress traffic beyond which a storm control response is triggered after the apply timer expires	IC (Port)
<code>auto-traffic-control auto-control-release</code>	Automatically releases a control response	IC (Port)
<code>auto-traffic-control control-release</code>	Manually releases a control response	PE
<i>SNMP Trap Commands</i>		
<code>snmp-server enable port-traps atc broadcast-alarm-clear</code>	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
<code>snmp-server enable port-traps atc broadcast-alarm-fire</code>	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control	IC (Port)
<code>snmp-server enable port-traps atc broadcast-control-apply</code>	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
<code>snmp-server enable port-traps atc broadcast-control-release</code>	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
<code>snmp-server enable port-traps atc multicast-alarm-clear</code>	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
<code>snmp-server enable port-traps atc multicast-alarm-fire</code>	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control	IC (Port)

**Table 88: ATC Commands** (Continued)

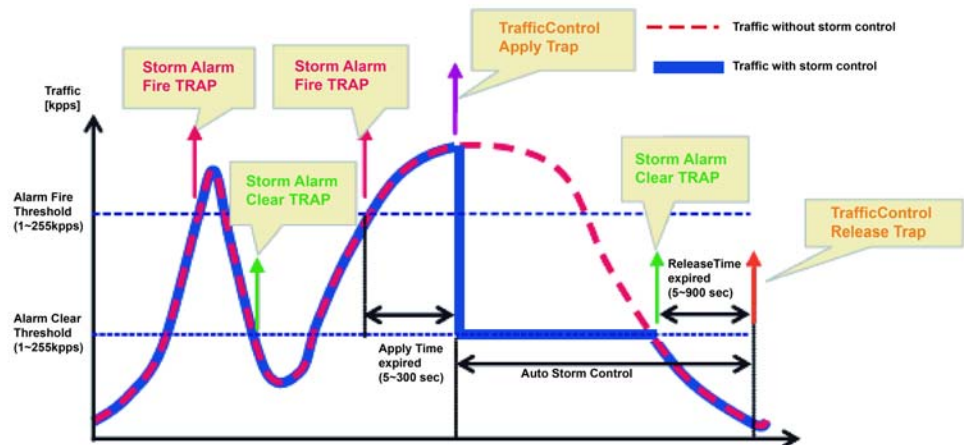
Command	Function	Mode
<code>snmp-server enable port-traps atc multicast-control-apply</code>	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
<code>snmp-server enable port-traps atc multicast-control-release</code>	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
<i>ATC Display Commands</i>		
<code>show auto-traffic-control</code>	Shows global configuration settings for automatic storm control	PE
<code>show auto-traffic-control interface</code>	Shows interface configuration settings and storm control status for the specified port	PE

\* Enabling automatic storm control on a port will disable hardware-level storm control on the same port if configured by the `switchport packet-rate` command.

### Usage Guidelines

ATC includes storm control for broadcast or multicast traffic. The control response for either of these traffic types is the same, as shown in the following diagrams.

**Figure 1: Storm Control by Limiting the Traffic Rate**

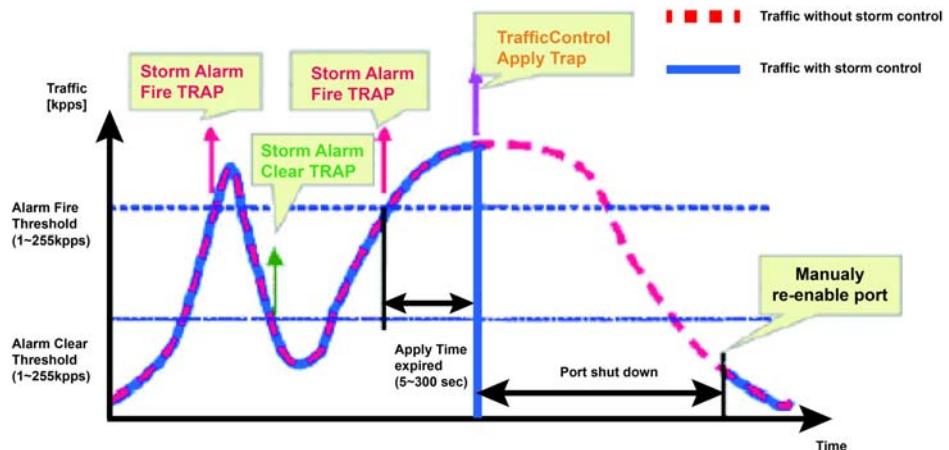


The key elements of this diagram are described below:

- ◆ **Alarm Fire Threshold** – The highest acceptable traffic rate. When ingress traffic exceeds the threshold, ATC sends a Storm Alarm Fire Trap and logs it.
- ◆ When traffic exceeds the alarm fire threshold and the apply timer expires, a traffic control response is applied, and a Traffic Control Apply Trap is sent and logged.
- ◆ **Alarm Clear Threshold** – The lower threshold beneath which a control response can be automatically terminated after the release timer expires. When ingress traffic falls below this threshold, ATC sends a Storm Alarm Clear Trap and logs it.

- ◆ When traffic falls below the alarm clear threshold after the release timer expires, traffic control (for rate limiting) will be stopped and a Traffic Control Release Trap sent and logged. Note that if the control action has shut down a port, it can only be manually re-enabled using the [auto-traffic-control control-release](#) command).
- ◆ The traffic control response of rate limiting can be released automatically or manually. The control response of shutting down a port can only be released manually.

Figure 2: Storm Control by Shutting Down a Port



The key elements of this diagram are the same as that described in the preceding diagram, except that automatic release of the control response is not provided. When traffic control is applied, you must manually re-enable the port.

### Functional Limitations

Automatic storm control is a software level control function. Traffic storms can also be controlled at the hardware level using the [switchport packet-rate](#) command. However, only one of these control types can be applied to a port. Enabling automatic storm control on a port will disable hardware-level storm control on that port.

## Threshold Commands

**auto-traffic-control apply-timer** This command sets the time at which to apply the control response after ingress traffic has exceeded the upper threshold. Use the **no** form to restore the default setting.

### Syntax

**auto-traffic-control** {**broadcast** | **multicast**} **apply-timer** *seconds*

**no auto-traffic-control** {**broadcast** | **multicast**} **apply-timer**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

*seconds* - The interval after the upper threshold has been exceeded at which to apply the control response. (Range: 5-300 seconds)

#### Default Setting

300 seconds

#### Command Mode

Global Configuration

#### Command Usage

After the apply timer expires, a control action may be triggered as specified by the [auto-traffic-control action](#) command and a trap message sent as specified by the [snmp-server enable port-traps atc broadcast-control-apply](#) command or [snmp-server enable port-traps atc multicast-control-apply](#) command.

#### Example

This example sets the apply timer to 200 seconds for all ports.

```
Console(config)#auto-traffic-control broadcast apply-timer 200
Console(config)#
```

#### **auto-traffic-control release-timer**

This command sets the time at which to release the control response after ingress traffic has fallen beneath the lower threshold. Use the **no** form to restore the default setting.

#### Syntax

**auto-traffic-control {broadcast | multicast} release-timer *seconds***

**no auto-traffic-control {broadcast | multicast} release-timer**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

*seconds* - The time at which to release the control response after ingress traffic has fallen beneath the lower threshold. (Range: 5-900 seconds)

#### Default Setting

900 seconds

#### Command Mode

Global Configuration

#### Command Usage

This command sets the delay after which the control response can be terminated. The [auto-traffic-control auto-control-release](#) command must be used to enable or disable the automatic release of a control response of rate-limiting. To re-enable a



port which has been shut down by automatic traffic control, you must manually re-enable the port using the [auto-traffic-control control-release](#) command.

### Example

This example sets the release timer to 800 seconds for all ports.

```
Console(config)#auto-traffic-control broadcast release-timer 800
Console(config)#
```

**auto-traffic-control** This command enables automatic traffic control for broadcast or multicast storms. Use the **no** form to disable this feature.

### Syntax

**[no] auto-traffic-control {broadcast | multicast}**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Automatic storm control can be enabled for either broadcast or multicast traffic. It cannot be enabled for both of these traffic types at the same time.
- ◆ Automatic storm control is a software level control function. Traffic storms can also be controlled at the hardware level using the [switchport packet-rate](#) command. However, only one of these control types can be applied to a port. Enabling automatic storm control on a port will disable hardware-level storm control on that port.

### Example

This example enables automatic storm control for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast
Console(config-if)#
```

**auto-traffic-control action** This command sets the control action to limit ingress traffic or shut down the offending port. Use the **no** form to restore the default setting.

### Syntax

**auto-traffic-control** {**broadcast** | **multicast**} **action** {**rate-control** | **shutdown**}

**no auto-traffic-control** {**broadcast** | **multicast**} **action**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

**rate-control** - If a control response is triggered, the rate of ingress traffic is limited based on the threshold configured by the [auto-traffic-control alarm-clear-threshold](#) command.

**shutdown** - If a control response is triggered, the port is administratively disabled. A port disabled by automatic traffic control can only be manually re-enabled.

### Default Setting

rate-control

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ When the upper threshold is exceeded and the apply timer expires, a control response will be triggered based on this command.
- ◆ When the control response is set to rate limiting by this command, the rate limits are determined by the [auto-traffic-control alarm-clear-threshold](#) command.
- ◆ If the control response is to limit the rate of ingress traffic, it can be automatically terminated once the traffic rate has fallen beneath the lower threshold and the release timer has expired.
- ◆ If a port has been shut down by a control response, it will not be re-enabled by automatic traffic control. It can only be manually re-enabled using the [auto-traffic-control control-release](#) command.

### Example

This example sets the control response for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast action shutdown
Console(config-if)#
```

**auto-traffic-control alarm-clear-threshold** This command sets the lower threshold for ingress traffic beneath which a control response for rate limiting will be released after the Release Timer expires, if so configured by the [auto-traffic-control auto-control-release](#) command. Use the **no** form to restore the default setting.

### Syntax

**auto-traffic-control {broadcast | multicast} alarm-clear-threshold *threshold***

**no auto-traffic-control {broadcast | multicast} alarm-clear-threshold**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

*threshold* - The lower threshold for ingress traffic beneath which a cleared storm control trap is sent. (Range: 1-255 kilo-packets per second)

### Default Setting

128 kilo-packets per second

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ Once the traffic rate falls beneath the lower threshold, a trap message may be sent if configured by the [snmp-server enable port-traps atc broadcast-alarm-clear](#) command or [snmp-server enable port-traps atc multicast-alarm-clear](#) command.
- ◆ If rate limiting has been configured as a control response, it will be discontinued after the traffic rate has fallen beneath the lower threshold, and the release timer has expired. Note that if a port has been shut down by a control response, it will not be re-enabled by automatic traffic control. It can only be manually re-enabled using the [auto-traffic-control control-release](#) command.

### Example

This example sets the clear threshold for automatic storm control for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast alarm-clear-threshold 155
Console(config-if)#
```

**auto-traffic-control alarm-fire-threshold** This command sets the upper threshold for ingress traffic beyond which a storm control response is triggered after the apply timer expires. Use the **no** form to restore the default setting.

#### Syntax

**auto-traffic-control {broadcast | multicast} alarm-fire-threshold *threshold***

**no auto-traffic-control {broadcast | multicast} alarm-fire-threshold**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

*threshold* - The upper threshold for ingress traffic beyond which a storm control response is triggered after the apply timer expires. (Range: 1-255 kilo-packets per second)

#### Default Setting

128 kilo-packets per second

#### Command Mode

Interface Configuration (Ethernet)

#### Command Usage

- ◆ Once the upper threshold is exceeded, a trap message may be sent if configured by the [snmp-server enable port-traps atc broadcast-alarm-fire](#) command or [snmp-server enable port-traps atc multicast-alarm-fire](#) command.
- ◆ After the upper threshold is exceeded, the control timer must first expire as configured by the [auto-traffic-control apply-timer](#) command before a control response is triggered if configured by the [auto-traffic-control action](#) command.

#### Example

This example sets the trigger threshold for automatic storm control for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast alarm-fire-threshold 255
Console(config-if)#
```

**auto-traffic-control auto-control-release** This command automatically releases a control response of rate-limiting after the time specified in the [auto-traffic-control release-timer](#) command has expired.

#### Syntax

**auto-traffic-control {broadcast | multicast} auto-control-release**

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

### Command Mode

Interface Configuration (Ethernet)

### Command Usage

- ◆ This command can be used to automatically stop a control response of rate-limiting after the specified action has been triggered and the release timer has expired.
- ◆ To release a control response which has shut down a port after the specified action has been triggered and the release timer has expired, use the [auto-traffic-control control-release](#) command.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast auto-control-release
Console(config-if)#
```

**auto-traffic-control control-release** This command manually releases a control response.

### Syntax

**auto-traffic-control {broadcast | multicast} control-release**  
**interface** *interface*

**broadcast** - Specifies automatic storm control for broadcast traffic.

**multicast** - Specifies automatic storm control for multicast traffic.

*interface*

**ethernet** *unit/port-list*

*unit* - Unit identifier. (Range: 1-8)

*port-list* - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers. (Range: 1-28)

### Command Mode

Privileged Exec

### Command Usage

This command can be used to manually stop a control response of rate-limiting or port shutdown any time after the specified action has been triggered.

### Example

```
Console#auto-traffic-control broadcast control-release interface ethernet 1/1
Console#
```

## SNMP Trap Commands

**snmp-server enable port-traps atc broadcast-alarm-clear** This command sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered. Use the **no** form to disable this trap.

### Syntax

**[no] snmp-server enable port-traps atc broadcast-alarm-clear**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet)

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-alarm-clear
Console(config-if)#
```

### Related Commands

[auto-traffic-control action \(474\)](#)

[auto-traffic-control alarm-clear-threshold \(475\)](#)

**snmp-server enable port-traps atc broadcast-alarm-fire** This command sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control. Use the **no** form to disable this trap.

### Syntax

**[no] snmp-server enable port-traps atc broadcast-alarm-fire**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet)

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-alarm-fire
Console(config-if)#
```

### Related Commands

[auto-traffic-control alarm-fire-threshold \(476\)](#)

**snmp-server  
enable port-traps atc  
broadcast-control-  
apply**

This command sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control and the apply timer expires. Use the **no** form to disable this trap.

**Syntax**

**[no] snmp-server enable port-traps atc broadcast-control-apply**

**Default Setting**

Disabled

**Command Mode**

Interface Configuration (Ethernet)

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-control-apply
Console(config-if)#
```

**Related Commands**

[auto-traffic-control alarm-fire-threshold \(476\)](#)

[auto-traffic-control apply-timer \(471\)](#)

**snmp-server  
enable port-traps atc  
broadcast-control-  
release**

This command sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires. Use the **no** form to disable this trap.

**Syntax**

**[no] snmp-server enable port-traps atc broadcast-control-release**

**Default Setting**

Disabled

**Command Mode**

Interface Configuration (Ethernet)

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-control-
release
Console(config-if)#
```

**Related Commands**

[auto-traffic-control alarm-clear-threshold \(475\)](#)

[auto-traffic-control action \(474\)](#)

[auto-traffic-control release-timer \(472\)](#)

**snmp-server enable port-traps atc multicast-alarm-clear** This command sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered. Use the **no** form to disable this trap.

#### Syntax

**[no] snmp-server enable port-traps atc multicast-alarm-clear**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (Ethernet)

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-alarm-clear
Console(config-if)#
```

#### Related Commands

[auto-traffic-control action \(474\)](#)

[auto-traffic-control alarm-clear-threshold \(475\)](#)

**snmp-server enable port-traps atc multicast-alarm-fire** This command sends a trap when multicast traffic exceeds the upper threshold for automatic storm control. Use the **no** form to disable this trap.

#### Syntax

**[no] snmp-server enable port-traps atc multicast-alarm-fire**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (Ethernet)

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-alarm-fire
Console(config-if)#
```

#### Related Commands

[auto-traffic-control alarm-fire-threshold \(476\)](#)



**snmp-server  
enable port-traps atc  
multicast-control-  
apply**

This command sends a trap when multicast traffic exceeds the upper threshold for automatic storm control and the apply timer expires. Use the **no** form to disable this trap.

**Syntax**

**[no] snmp-server enable port-traps atc multicast-control-apply**

**Default Setting**

Disabled

**Command Mode**

Interface Configuration (Ethernet)

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-control-apply
Console(config-if)#
```

**Related Commands**

[auto-traffic-control alarm-fire-threshold \(476\)](#)

[auto-traffic-control apply-timer \(471\)](#)

**snmp-server  
enable port-traps atc  
multicast-control-  
release**

This command sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires. Use the **no** form to disable this trap.

**Syntax**

**[no] snmp-server enable port-traps atc multicast-control-release**

**Default Setting**

Disabled

**Command Mode**

Interface Configuration (Ethernet)

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-control-
release
Console(config-if)#
```

**Related Commands**

[auto-traffic-control alarm-clear-threshold \(475\)](#)

[auto-traffic-control action \(474\)](#)

[auto-traffic-control release-timer \(472\)](#)

## ATC Display Commands

**show auto-traffic-control** This command shows global configuration settings for automatic storm control.

### Command Mode

Privileged Exec

### Example

```
Console#show auto-traffic-control

Storm-control: Broadcast
  Apply-timer (sec)   : 300
  release-timer (sec) : 900

Storm-control: Multicast
  Apply-timer(sec)    : 300
  release-timer(sec)  : 900
Console#
```

**show auto-traffic-control interface** This command shows interface configuration settings and storm control status for the specified port.

### Syntax

**show auto-traffic-control interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```
Console#show auto-traffic-control interface ethernet 1/1
Eth 1/1 Information
-----
Storm Control:          Broadcast          Multicast
State:                  Disabled           Disabled
Action:                 rate-control       rate-control
Auto Release Control:   Disabled           Disabled
Alarm Fire Threshold(Kpps): 128             128
Alarm Clear Threshold(Kpps):128             128
Trap Storm Fire:        Disabled           Disabled
Trap Storm Clear:       Disabled           Disabled
Trap Traffic Apply:     Disabled           Disabled
Trap Traffic Release:   Disabled           Disabled

Console#
```

# Loopback Detection Commands

The switch can be configured to detect general loopback conditions caused by hardware problems or faulty protocol settings. When enabled, a control frame is transmitted on the participating ports, and the switch monitors inbound traffic to see if the frame is looped back.

**Table 89: Loopback Detection Commands**

Command	Function	Mode
<code>loopback-detection</code>	Enables loopback detection globally on the switch or on a specified interface	GC, IC
<code>loopback-detection action</code>	Specifies the response to take for a detected loopback condition	GC
<code>loopback-detection recover-time</code>	Specifies the interval to wait before releasing an interface from shutdown state	GC
<code>loopback-detection transmit-interval</code>	Specifies the interval at which to transmit loopback detection control frames	GC
<code>loopback detection trap</code>	Configures the switch to send a trap when a loopback condition is detected or the switch recover from a loopback	GC
<code>loopback-detection release</code>	Manually releases all interfaces currently shut down by the loopback detection feature	PE
<code>show loopback-detection</code>	Shows loopback detection configuration settings for the switch or for a specified interface	PE

## Usage Guidelines

- ◆ The default settings for the control frame transmit interval and recover time may be adjusted to improve performance for your specific environment. The shutdown mode may also need to be changed once you determine what kind of packets are being looped back.
- ◆ General loopback detection provided by the commands described in this section and loopback detection provided by the spanning tree protocol cannot both be enabled at the same time. If loopback detection is enabled for the spanning tree protocol, general loopback detection cannot be enabled on the same interface.
- ◆ When a loopback event is detected on an interface or when an interface is released from a shutdown state caused by a loopback event, a trap message is sent and the event recorded in the system log.
- ◆ Loopback detection must be enabled both globally and on an interface for loopback detection to take effect.

**loopback-detection** This command enables loopback detection globally on the switch or on a specified interface. Use the **no** form to disable loopback detection.

#### Syntax

**[no] loopback-detection**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

Loopback detection must be enabled globally for the switch by this command and enabled for a specific interface for this function to take effect.

#### Example

This example enables general loopback detection on the switch, disables loopback detection provided for the spanning tree protocol on port 1, and then enables general loopback detection for that port.

```
Console(config)#loopback-detection
Console(config)#interface ethernet 1/1
Console(config-if)#no spanning-tree loopback-detection
Console(config-if)#loopback-detection
Console(config)#
```

**loopback-detection action** This command specifies the protective action the switch takes when a loopback condition is detected. Use the **no** form to restore the default setting.

#### Syntax

**loopback-detection action {block | none | shutdown}**

**no loopback-detection action**

**block** - When a loopback is detected on a port which a member of a specific VLAN, packets belonging to that VLAN are dropped at the offending port.

**none** - No action is taken.

**shutdown** - Shuts down the interface.

#### Default Setting

Shut down

#### Command Mode

Global Configuration

### Command Usage

- ◆ When the response to a detected loopback condition is set to block user traffic, loopback detection control frames may be untagged or tagged depending on the port's VLAN membership type.
- ◆ When the response to a detected loopback condition is set to block user traffic, ingress filtering for the port is enabled automatically if not already enabled by the `switchport ingress-filtering` command. The port's original setting for ingress filtering will be restored when loopback detection is disabled.
- ◆ When a port receives a control frame sent by itself, this means that the port is in a looped state, and the VLAN in the frame payload is also in a looped state with the wrong VLAN tag. The looped port is therefore shut down.
- ◆ Use the `loopback-detection recover-time` command to set the time to wait before re-enabling an interface shut down by the loopback detection process.
- ◆ When the loopback detection response is changed, any ports placed in shutdown state by the loopback detection process will be immediately restored to operation regardless of the remaining recover time.

### Example

This example sets the loopback detection mode to block user traffic.

```
Console(config)#loopback-detection action block
Console(config)#
```

**loopback-detection recover-time** This command specifies the interval to wait before the switch automatically releases an interface from shutdown state. Use the **no** form to restore the default setting.

### Syntax

**loopback-detection recover-time** *seconds*

**no loopback-detection recover-time**

*seconds* - Recovery time from shutdown state. (Range: 60-1,000,000 seconds, or 0 to disable automatic recovery)

### Default Setting

60 seconds

### Command Mode

Global Configuration

**Command Usage**

- ◆ When the loopback detection mode is changed, any ports placed in shutdown state by the loopback detection process will be immediately restored to operation regardless of the remaining recover time.
- ◆ If the recovery time is set to zero, all ports placed in shutdown state can be restored to operation using the `loopback-detection release` command. To restore a specific port, use the `no shutdown` command.

**Example**

```
Console(config)#loopback-detection recover-time 120
Console(config-if)#
```

**loopback-detection transmit-interval** This command specifies the interval at which to transmit loopback detection control frames. Use the **no** form to restore the default setting.

**Syntax**

**loopback-detection transmit-interval** *seconds*

**no loopback-detection transmit-interval**

*seconds* - The transmission interval for loopback detection control frames.  
(Range: 1-32767 seconds)

**Default Setting**

10 seconds

**Command Mode**

Global Configuration

**Example**

```
Console(config)#loopback-detection transmit-interval 60
Console(config)#
```

**loopback detection trap** This command sends a trap when a loopback condition is detected, or when the switch recovers from a loopback condition. Use the **no** form to restore the default state.

**Syntax**

**loopback-detection trap** [**both** | **detect** | **none** | **recover**]

**no loopback-detection trap**

**both** - Sends an SNMP trap message when a loopback condition is detected, or when the switch recovers from a loopback condition.

**detect** - Sends an SNMP trap message when a loopback condition is detected.

**none** - Does not send an SNMP trap for loopback detection or recovery.

**recover** - Sends an SNMP trap message when the switch recovers from a loopback condition.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

Refer to the [loopback-detection recover-time](#) command for information on conditions which constitute loopback recovery.

### Example

```
Console(config)#loopback-detection trap both
Console(config)#
```

**loopback-detection release** This command releases all interfaces currently shut down by the loopback detection feature.

### Syntax

**loopback-detection release**

### Command Mode

Privileged Exec

### Example

```
Console#loopback-detection release
Console(config)#
```

**show loopback-detection** This command shows loopback detection configuration settings for the switch or for a specified interface.

### Syntax

**show loopback-detection** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```
Console#show loopback-detection
Loopback Detection Global Information
Global Status      : Enabled
Transmit Interval  : 10
Recover Time       : 60
Action             : Shutdown
Trap               : None
Loopback Detection Port Information
Port      Admin State Oper State
-----
Eth 1/ 1  Enabled     Normal
Eth 1/ 2  Disabled    Disabled
Eth 1/ 3  Disabled    Disabled
:
Console#show loopback-detection ethernet 1/1
Loopback Detection Information of Eth 1/1
Admin State : Enabled
Oper State  : Normal
Looped VLAN : None
Console#
```



# UniDirectional Link Detection Commands

The switch can be configured to detect and disable unidirectional Ethernet fiber or copper links. When enabled, the protocol advertises a port's identity and learns about its neighbors on a specific LAN segment; and stores information about its neighbors in a cache. It can also send out a train of echo messages under circumstances that require fast notifications or re-synchronization of the cached information.

**Table 90: UniDirectional Link Detection Commands**

Command	Function	Mode
<code>udld detection-interval</code>	Sets the amount of time the switch remains in detection state after discovering a neighbor	GC
<code>udld message-interval</code>	Configures the message interval between UDLD probe messages	GC
<code>udld recovery</code>	Automatically recovers from UDLD disabled port state after a period specified by the <code>udld recovery-interval</code> command	GC
<code>udld recovery-interval</code>	Specifies the period after which to automatically recover from UDLD disabled port state	GC
<code>udld aggressive</code>	Sets UDLD to aggressive mode on an interface	IC
<code>udld port</code>	Enables UDLD on a port	IC
<code>show udld</code>	Shows UDLD configuration settings and operational status	PE

**udld detection-interval** This command sets the amount of time the switch remains in detection state after discovering a neighbor. Use the **no** form to restore the default setting.

## Syntax

**udld detection-interval** *detection-interval*

**no detection-interval**

*detection-interval* – The amount of time the switch remains in detection state after discovering a neighbor through UDLD. (Range: 5-255 seconds)

## Default Setting

5 seconds

## Command Mode

Global Configuration

### Command Usage

When a neighbor device is discovered by UDLD, the switch enters “detection state” and remains in this state for specified detection-interval. After the detection-interval expires, the switch tries to decide whether or the link is unidirectional based on the information collected during “detection state.”

### Example

```
Console(config)#udld detection-interval 10
Console(config)#
```

**udld message-interval** This command configures the message interval between UDLD probe messages for ports in the advertisement phase and determined to be bidirectional. Use the **no** form to restore the default setting.

### Syntax

**udld message-interval** *message-interval*

**no message-interval**

*message-interval* – The interval at which a port sends UDLD probe messages after linkup or detection phases. (Range: 7-90 seconds)

### Default Setting

15 seconds

### Command Mode

Global Configuration

### Command Usage

During the detection phase, messages are exchanged at the maximum rate of one per second. After that, if the protocol reaches a stable state and determines that the link is bidirectional, the message interval is increased to a configurable value based on a curve known as M1(t), a time-based function described in RFC 5171.

If the link is deemed anything other than bidirectional at the end of the detection phase, this curve becomes a flat line with a fixed value of Mfast (7 seconds).

If the link is instead deemed bidirectional, the curve will use Mfast for the first four subsequent message transmissions and then transition to an Mslow value for all other steady-state transmissions. Mslow is the value configured by this command.

### Example

This example sets the message interval to 10 seconds.

```
Console(config)#udld message-interval 10
Console(config)#
```

**udld recovery** This command configures the switch to automatically recover from UDLD disabled port state after a period specified by the **udld recovery-interval** command. Use the **no** form to disable this feature.

#### Syntax

**[no] udld recovery**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

When automatic recovery state is changed by this command, any ports shut down by UDLD will be reset.

#### Example

```
Console(config)#udld recovery
Console(config)#
```

**udld recovery-interval** This command specifies the period after which to automatically recover from UDLD disabled port state. Use the **no** form to restore the default setting.

**udld recovery-interval** *recovery-interval*

**no recovery-interval**

*recovery-interval* – The interval after which a port is reset after being placed in UDLD disabled state. (Range: 30-86400 seconds)

#### Default Setting

7 seconds

#### Command Mode

Global Configuration

#### Command Usage

- ◆ This command is only applicable when automatic recovery has been enabled with the **udld recovery** command.
- ◆ When the recovery interval is changed by this command, any ports shut down by UDLD will be reset.

### Example

```
Console(config)#udld recovery-interval 15
Console(config)#
```

**udld aggressive** This command sets UDLD to aggressive mode on an interface. Use the **no** form to restore the default setting.

### Syntax

**[no] udld aggressive**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet Port)

### Command Usage

UDLD can function in two modes: normal mode and aggressive mode.

- ◆ In normal mode, determination of link status at the end of the detection process is always based on information received in UDLD messages: whether that's information about the exchange of proper neighbor identification or the absence of such. Hence, albeit bound by a timer, normal mode determinations are always based on gleaned information, and as such are "event-based." If no such information can be obtained (e.g., because of a bidirectional loss of connectivity), UDLD follows a conservative approach to minimize false positives during the detection process and deems a port to be in "undetermined" state. In other words, normal mode will shut down a port only if it can explicitly determine that the associated link is faulty for an extended period of time.
- ◆ In aggressive mode, UDLD will also shut down a port if it loses bidirectional connectivity with the neighbor for the same extended period of time (as that mentioned above for normal mode) and subsequently fails repeated last-resort attempts to re-establish communication with the other end of the link. This mode of operation assumes that loss of communication with the neighbor is a meaningful network event in itself, and a symptom of a serious connectivity problem. Because this type of detection can be event-less, and lack of information cannot always be associated to an actual malfunction of the link, this mode is recommended only in certain scenarios (typically only on point-to-point links where no communication failure between two neighbors is admissible).

### Example

This example enables UDLD aggressive mode on port 1.

```

Console(config)#interface ethernet 1/1
Console(config-if)#udld aggressive
Console(config-if)#

```

**udld port** This command enables UDLD on a port. Use the **no** form to disable UDLD on an interface.

### Syntax

**[no] udld port**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet Port)

### Command Usage

- ◆ UDLD requires that all the devices connected to the same LAN segment be running the protocol in order for a potential mis-configuration to be detected and for prompt corrective action to be taken.
- ◆ Whenever a UDLD device learns about a new neighbor or receives a resynchronization request from an out-of-synch neighbor, it (re)starts the detection process on its side of the connection and sends N echo messages in reply. (This mechanism implicitly assumes that N packets are sufficient to get through a link and reach the other end, even though some of them might get dropped during the transmission.)

Since this behavior must be the same on all the neighbors, the sender of the echoes expects to receive an echo in reply. If the detection process ends without the proper echo information being received, the link is considered to be unidirectional.

### Example

```

Console(config)#interface ethernet 1/1
Console(config-if)#udld port
Console(config-if)#

```

**show udld** This command shows UDLD configuration settings and operational status for the switch or for a specified interface.

### Syntax

**show udld** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```

Console#show udld
Message Interval   : 15
Detection Interval : 5 seconds
Recovery           : Disabled
Recovery Interval  : 300 seconds

Interface UDLD      Mode      Oper State      Msg Invl
                   Port State  Det Invl
-----
Eth 1/ 1  Disabled Normal    Disabled        7 s
                   Unknown      5 s
Eth 1/ 2  Disabled Normal    Disabled        7 s
                   Unknown      5 s
Eth 1/ 3  Disabled Normal    Disabled        7 s
                   Unknown      5 s
Eth 1/ 4  Disabled Normal    Disabled        7 s
                   Unknown      5 s
Eth 1/ 5  Disabled Normal    Disabled        7 s
                   Unknown      5 s
:
Console#show udld interface ethernet 1/1
Interface UDLD      Mode      Oper State      Msg Invl
                   Port State  Det Invl
-----
Eth 1/ 1  Disabled Normal    Disabled        7 s
                   Unknown      5 s

Console#

```

**Table 91: show udld - display description**

Field	Description
Message Interval	The interval between UDLD probe messages for ports in advertisement phase
Detection Interval	The period the switch remains in detection state after discovering a neighbor
Recovery	Shows if automatic recovery from UDLD disabled port state is enabled

**Table 91: show udld - display description** (Continued)

Field	Description
Recovery Interval	Shows the period after which to recover from UDLD disabled port state if automatic recovery is enabled
UDLD	Shows if UDLD is enabled or disabled on a port
Mode	Shows if UDLD is functioning in Normal or Aggressive mode
Oper State	Shows the UDLD operational state (Disabled, Link down, Link up, Advertisement, Detection, Disabled port, Advertisement - Single neighbor, Advertisement - Multiple neighbors)
Port State	Shows the UDLD port state (Unknown, Bidirectional, Unidirectional, Transmit-to-receive loop, Mismatch with neighbor state reported, Neighbor's echo is empty) The state is Unknown if the link is down or not connected to a UDLD-capable device. The state is Bidirectional if the link has a normal two-way connection to a UDLD-capable device. All other states indicate mis-wiring.
Msg Invl	The interval between UDLD probe messages used for the indicated operational state
Det Invl	The period the switch remains in detection state after discovering a neighbor
Timeout	The time that UDLD waits for echoes from a neighbor device during the detection window





# Address Table Commands

These commands are used to configure the address table for filtering specified addresses, displaying current entries, clearing the table, or setting the aging time.

**Table 92: Address Table Commands**

Command	Function	Mode
<code>mac-address-table aging-time</code>	Sets the aging time of the address table	GC
<code>mac-address-table hash-lookup-depth</code>	Sets the hash lookup depth of MAC address table	GC
<code>mac-address-table static</code>	Maps a static address to a port in a VLAN	GC
<code>clear collision-mac-address-table</code>	Removes all entries from the collision MAC address table	PE
<code>clear mac-address-table dynamic</code>	Removes any learned entries from the forwarding database	PE
<code>show collision-mac-address-table</code>	Shows a shows a list of MAC addresses that cannot be learned by the switch due to hash collisions	PE
<code>show mac-address-table</code>	Displays entries in the bridge-forwarding database	PE
<code>show mac-address-table aging-time</code>	Shows the aging time for the address table	PE
<code>show mac-address-table count</code>	Shows the number of MAC addresses used and the number of available MAC addresses	PE
<code>show mac-address-table hash-lookup-depth</code>	Shows the hash lookup depth of MAC address table	PE

**mac-address-table aging-time** This command sets the aging time for entries in the address table. Use the **no** form to restore the default aging time.

## Syntax

**mac-address-table aging-time** *seconds*

**no mac-address-table aging-time**

*seconds* - Aging time. (Range: 6-7200 seconds; 0 to disable aging)

## Default Setting

300 seconds

## Command Mode

Global Configuration

### Command Usage

The aging time is used to age out dynamically learned forwarding information.

### Example

```
Console(config)#mac-address-table aging-time 100
Console(config)#
```

**mac-address-table hash-lookup-depth** This command sets the hash lookup depth used when searching the MAC address table. Use the **no** form to restore the default setting.

### Syntax

**mac-address-table hash-lookup-depth** *depth*

**no mac-address-table hash-lookup-depth**

*depth* - The depth used in the hash lookup process. (Range: 4-32, in multiples of 4)

### Default Setting

4

### Command Mode

Global Configuration

### Command Usage

Using the default depth of 4, MAC address collisions tend to increase once more than 8K entries have been learned. Setting the depth to a larger value reduces the occurrence of hash collisions, but can also decrease forwarding performance.

### Example

```
Console(config)#mac-address-table hash-lookup-depth 5
Console(config)#
```

**mac-address-table static** This command maps a static address to a destination port in a VLAN. Use the **no** form to remove an address.

### Syntax

**mac-address-table static** *mac-address* **interface** *interface* **vlan** *vlan-id* [*action*]

**no mac-address-table static** *mac-address* **vlan** *vlan-id*

*mac-address* - MAC address.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

*vlan-id* - VLAN ID (Range: 1-4094)

*action* -

**delete-on-reset** - Assignment lasts until the switch is reset.

**permanent** - Assignment is permanent.

### Default Setting

No static addresses are defined. The default mode is **permanent**.

### Command Mode

Global Configuration

### Command Usage

The static address for a host device can be assigned to a specific port within a specific VLAN. Use this command to add static addresses to the MAC Address Table. Static addresses have the following characteristics:

- ◆ Static addresses will not be removed from the address table when a given interface link is down.
- ◆ Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.
- ◆ A static address cannot be learned on another port until the address is removed with the **no** form of this command.

### Example

```
Console(config)#mac-address-table static 00-e0-29-94-34-de interface ethernet
1/1 vlan 1 delete-on-reset
Console(config)#
```

**clear collision-mac-address-table** This command removes all entries from the collision MAC address table.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#clear collision-mac-address-table
Console#
```

**clear mac-address-table dynamic** This command removes any learned entries from the forwarding database.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Command Usage

Even if a hash collision for a MAC address is resolved, entries in collision MAC address table are not removed until this command is issued to reset the table, or the system is reset.

#### Example

```
Console#clear mac-address-table dynamic
Console#
```

**show collision-mac-address-table** This command shows a list of MAC addresses that cannot be learned by the switch due to hash collisions.

#### Command Mode

Privileged Exec

#### Example

```
Console#show collision-mac-address-table
MAC Address          VLAN  Collision Count
-----
90-e6-ba-cb-cd-d6    1          2
Total collision mac number: 1
Console#
```

**show mac-address-table** This command shows classes of entries in the bridge-forwarding database.

#### Syntax

**show mac-address-table** [**address** *mac-address* [*mask*]] [**interface** *interface*]  
 [**vlan** *vlan-id*]

[**sort** {**address** | **vlan** | **interface**}]

*mac-address* - MAC address.

*mask* - Bits to match in the address.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

*vlan-id* - VLAN ID (Range: 1-4094)

**sort** - Sort by address, vlan or interface.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Command Usage

- ◆ The MAC Address Table contains the MAC addresses associated with each interface. Note that the Type field may include the following types:
  - Learn - Dynamic address entries
  - Config - Static entry
  - Security - Port Security
- ◆ The mask should be hexadecimal numbers (representing an equivalent bit mask) in the form xx-xx-xx-xx-xx-xx that is applied to the specified MAC address. Enter hexadecimal numbers, where an equivalent binary bit "0" means to match a bit and "1" means to ignore a bit. For example, a mask of 00-00-00-00-00-00 means an exact match, and a mask of FF-FF-FF-FF-FF-FF means "any."
- ◆ The maximum number of address entries is 16K.

#### Example

```
Console#show mac-address-table
Interface MAC Address      VLAN Type      Life Time
-----
CPU      00-E0-00-00-00-01      1 CPU      Delete on Reset
Eth 1/ 1 00-E0-0C-10-90-09  1 Learn      Delete on Timeout
```

```
Eth 1/ 1 00-E0-29-94-34-64      1 Learn      Delete on Timeout
Console#
```

**show mac-address-table aging-time** This command shows the aging time for entries in the address table.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#show mac-address-table aging-time
Aging Status : Enabled
Aging Time: 300 sec.
Console#
```

**show mac-address-table count** This command shows the number of MAC addresses used and the number of available MAC addresses for the overall system or for an interface.

#### Syntax

**show mac-address-table count** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#show mac-address-table count interface ethernet 1/1

MAC Entries for Eth 1/1
Total Address Count      :0
Static Address Count     :0
Dynamic Address Count    :0

Console#show mac-address-table count

Compute the number of MAC Address...
```

```
Maximum number of MAC Address which can be created in the system:
Total Number of MAC Address      : 16384
Number of Static MAC Address     : 1024
```

```
Current number of entries which have been created in the system:
Total Number of MAC Address      : 3
Number of Static MAC Address     : 1
Number of Dynamic MAC Address    : 2
Console#
```

**show mac-address-table hash-lookup-depth** This command shows the hash lookup depth used when searching the MAC address table.

#### Syntax

**show mac-address-table hash-lookup-depth**

#### Command Mode

Privileged Exec

#### Example

```
Console#show mac-address-table hash-lookup-depth
Configured Hash Lookup Depth: 4
Activated Hash Lookup Depth: 4
Console#
```





# Spanning Tree Commands

This section includes commands that configure the Spanning Tree Algorithm (STA) globally for the switch, and commands that configure STA for the selected interface.

**Table 93: Spanning Tree Commands**

Command	Function	Mode
<code>spanning-tree</code>	Enables the spanning tree protocol	GC
<code>spanning-tree cisco-prestandard</code>	Configures spanning tree operation to be compatible with Cisco prestandard versions	GC
<code>spanning-tree forward-time</code>	Configures the spanning tree bridge forward time	GC
<code>spanning-tree hello-time</code>	Configures the spanning tree bridge hello time	GC
<code>spanning-tree max-age</code>	Configures the spanning tree bridge maximum age	GC
<code>spanning-tree mode</code>	Configures STP, RSTP or MSTP mode	GC
<code>spanning-tree pathcost method</code>	Configures the path cost method for RSTP/MSTP	GC
<code>spanning-tree priority</code>	Configures the spanning tree bridge priority	GC
<code>spanning-tree mst configuration</code>	Changes to MSTP configuration mode	GC
<code>spanning-tree system-bpdu-flooding</code>	Floods BPDUs to all other ports or just to all other ports in the same VLAN when global spanning tree is disabled	GC
<code>spanning-tree tc-prop</code>	Configures a topology change propagation domain	GC
<code>spanning-tree transmission-limit</code>	Configures the transmission limit for RSTP/MSTP	GC
<code>max-hops</code>	Configures the maximum number of hops allowed in the region before a BPDU is discarded	MST
<code>mst priority</code>	Configures the priority of a spanning tree instance	MST
<code>mst vlan</code>	Adds VLANs to a spanning tree instance	MST
<code>name</code>	Configures the name for the multiple spanning tree	MST
<code>revision</code>	Configures the revision number for the multiple spanning tree	MST
<code>spanning-tree bpdu-filter</code>	Filters BPDUs for edge ports	IC
<code>spanning-tree bpdu-guard</code>	Shuts down an edge port if it receives a BPDU	IC
<code>spanning-tree cost</code>	Configures the spanning tree path cost of an interface	IC
<code>spanning-tree edge-port</code>	Enables fast forwarding for edge ports	IC
<code>spanning-tree link-type</code>	Configures the link type for RSTP/MSTP	IC

Table 93: Spanning Tree Commands (Continued)

Command	Function	Mode
<code>spanning-tree loopback-detection</code>	Enables BPDU loopback detection for a port	IC
<code>spanning-tree loopback-detection action</code>	Configures the response for loopback detection to block user traffic or shut down the interface	IC
<code>spanning-tree loopback-detection release-mode</code>	Configures loopback release mode for a port	IC
<code>spanning-tree loopback-detection trap</code>	Enables BPDU loopback SNMP trap notification for a port	IC
<code>spanning-tree mst cost</code>	Configures the path cost of an instance in the MST	IC
<code>spanning-tree mst port-priority</code>	Configures the priority of an instance in the MST	IC
<code>spanning-tree port-bpdu-flooding</code>	Floods BPDUs to other ports when global spanning tree is disabled	IC
<code>spanning-tree port-priority</code>	Configures the spanning tree priority of an interface	IC
<code>spanning-tree root-guard</code>	Prevents a designated port from passing superior BPDUs	IC
<code>spanning-tree spanning-disabled</code>	Disables spanning tree for an interface	IC
<code>spanning-tree tc-prop-stop</code>	Stops propagation of topology change information	IC
<code>spanning-tree loopback-detection release</code>	Manually releases a port placed in discarding state by loopback-detection	PE
<code>spanning-tree protocol-migration</code>	Re-checks the appropriate BPDU format	PE
<code>show spanning-tree</code>	Shows spanning tree configuration for the common spanning tree (i.e., overall bridge), a selected interface, or an instance within the multiple spanning tree	PE
<code>show spanning-tree mst configuration</code>	Shows the multiple spanning tree configuration	PE
<code>show spanning-tree tc-prop</code>	Shows configuration of topology change propagation domains	PE

**spanning-tree** This command enables the Spanning Tree Algorithm globally for the switch. Use the **no** form to disable it.

#### Syntax

**[no] spanning-tree**

#### Default Setting

Spanning tree is enabled.

#### Command Mode

Global Configuration

### Command Usage

The Spanning Tree Algorithm (STA) can be used to detect and disable network loops, and to provide backup links between switches, bridges or routers. This allows the switch to interact with other bridging devices (that is, an STA-compliant switch, bridge or router) in your network to ensure that only one route exists between any two stations on the network, and provide backup links which automatically take over when a primary link goes down.

### Example

This example shows how to enable the Spanning Tree Algorithm for the switch:

```
Console(config)#spanning-tree
Console(config)#
```

**spanning-tree cisco-prestandard** This command configures spanning tree operation to be compatible with Cisco prestandard versions. Use the **no** form to restore the default setting.

**[no] spanning-tree cisco-prestandard**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

Cisco prestandard versions prior to Cisco IOS Release 12.2(25)SEC do not fully follow the IEEE standard, causing some state machine procedures to function incorrectly. The command forces the spanning tree protocol to function in a manner compatible with Cisco prestandard versions.

### Example

```
Console(config)#spanning-tree cisco-prestandard
Console(config)#
```

**spanning-tree forward-time** This command configures the spanning tree bridge forward time globally for this switch. Use the **no** form to restore the default.

### Syntax

**spanning-tree forward-time** *seconds*

**no spanning-tree forward-time**

*seconds* - Time in seconds. (Range: 4 - 30 seconds)

The minimum value is the higher of 4 or  $[(\text{max-age} / 2) + 1]$ .

**Default Setting**

15 seconds

**Command Mode**

Global Configuration

**Command Usage**

This command sets the maximum time (in seconds) a port will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to the discarding state; otherwise, temporary data loops might result.

**Example**

```
Console(config)#spanning-tree forward-time 20
Console(config)#
```

**spanning-tree hello-time** This command configures the spanning tree bridge hello time globally for this switch. Use the **no** form to restore the default.

**Syntax****spanning-tree hello-time** *time***no spanning-tree hello-time***time* - Time in seconds. (Range: 1-10 seconds).The maximum value is the lower of 10 or  $[(\text{max-age} / 2) - 1]$ .**Default Setting**

2 seconds

**Command Mode**

Global Configuration

**Command Usage**

This command sets the time interval (in seconds) at which the root device transmits a configuration message.

**Example**

```
Console(config)#spanning-tree hello-time 5
Console(config)#
```

**Related Commands**[spanning-tree forward-time \(507\)](#)[spanning-tree max-age \(509\)](#)

**spanning-tree max-age** This command configures the spanning tree bridge maximum age globally for this switch. Use the **no** form to restore the default.

#### Syntax

**spanning-tree max-age** *seconds*

**no spanning-tree max-age**

*seconds* - Time in seconds. (Range: 6-40 seconds)

The minimum value is the higher of 6 or [2 x (hello-time + 1)].

The maximum value is the lower of 40 or [2 x (forward-time - 1)].

#### Default Setting

20 seconds

#### Command Mode

Global Configuration

#### Command Usage

This command sets the maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconverge. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network.

#### Example

```
Console(config)#spanning-tree max-age 40
Console(config)#
```

#### Related Commands

[spanning-tree forward-time \(507\)](#)

[spanning-tree hello-time \(508\)](#)

**spanning-tree mode** This command selects the spanning tree mode for this switch. Use the **no** form to restore the default.

#### Syntax

**spanning-tree mode** {**stp** | **rstp** | **mstp**}

**no spanning-tree mode**

**stp** - Spanning Tree Protocol (IEEE 802.1D)

**rstp** - Rapid Spanning Tree Protocol (IEEE 802.1w)

**mstp** - Multiple Spanning Tree (IEEE 802.1s)

## Default Setting

rstp

## Command Mode

Global Configuration

## Command Usage

- ◆ **Spanning Tree Protocol**  
This option uses RSTP set to STP forced compatibility mode. It uses RSTP for the internal state machine, but sends only 802.1D BPDUs. This creates one spanning tree instance for the entire network. If multiple VLANs are implemented on a network, the path between specific VLAN members may be inadvertently disabled to prevent network loops, thus isolating group members. When operating multiple VLANs, we recommend selecting the MSTP option.
- ◆ **Rapid Spanning Tree Protocol**  
RSTP supports connections to either STP or RSTP nodes by monitoring the incoming protocol messages and dynamically adjusting the type of protocol messages the RSTP node transmits, as described below:
  - **STP Mode** – If the switch receives an 802.1D BPDU after a port's migration delay timer expires, the switch assumes it is connected to an 802.1D bridge and starts using only 802.1D BPDUs.
  - **RSTP Mode** – If RSTP is using 802.1D BPDUs on a port and receives an RSTP BPDU after the migration delay expires, RSTP restarts the migration delay timer and begins using RSTP BPDUs on that port.
- ◆ **Multiple Spanning Tree Protocol**
  - To allow multiple spanning trees to operate over the network, you must configure a related set of bridges with the same MSTP configuration, allowing them to participate in a specific set of spanning tree instances.
  - A spanning tree instance can exist only on bridges that have compatible VLAN instance assignments.
  - Be careful when switching between spanning tree modes. Changing modes stops all spanning-tree instances for the previous mode and restarts the system in the new mode, temporarily disrupting user traffic.

## Example

The following example configures the switch to use Rapid Spanning Tree:

```
Console(config)#spanning-tree mode rstp
Console(config)#
```

**spanning-tree pathcost method** This command configures the path cost method used for Rapid Spanning Tree and Multiple Spanning Tree. Use the **no** form to restore the default.

#### Syntax

**spanning-tree pathcost method {long | short}**

**no spanning-tree pathcost method**

**long** - Specifies 32-bit based values that range from 1-200,000,000.  
This method is based on the IEEE 802.1w Rapid Spanning Tree Protocol.

**short** - Specifies 16-bit based values that range from 1-65535.  
This method is based on the IEEE 802.1 Spanning Tree Protocol.

#### Default Setting

Long method

#### Command Mode

Global Configuration

#### Command Usage

- ◆ The path cost method is used to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. Note that path cost ([page 519](#)) takes precedence over port priority ([page 527](#)).
- ◆ The path cost methods apply to all spanning tree modes (STP, RSTP and MSTP). Specifically, the long method can be applied to STP since this mode is supported by a backward compatible mode of RSTP.

#### Example

```
Console(config)#spanning-tree pathcost method long
Console(config)#
```

**spanning-tree priority** This command configures the spanning tree priority globally for this switch. Use the **no** form to restore the default.

#### Syntax

**spanning-tree priority *priority***

**no spanning-tree priority**

*priority* - Priority of the bridge. (Range – 0-61440, in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440)

#### Default Setting

32768

**Command Mode**

Global Configuration

**Command Usage**

Bridge priority is used in selecting the root device, root port, and designated port. The device with the highest priority (i.e., lower numeric value) becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.

**Example**

```
Console(config)#spanning-tree priority 40000
Console(config)#
```

**spanning-tree  
mst configuration**

This command changes to Multiple Spanning Tree (MST) configuration mode.

**Default Setting**

No VLANs are mapped to any MST instance.  
The region name is set the switch's MAC address.

**Command Mode**

Global Configuration

**Example**

```
Console(config)#spanning-tree mst configuration
Console(config-mstp)#
```

**Related Commands**[mst vlan \(516\)](#)[mst priority \(515\)](#)[name \(516\)](#)[revision \(517\)](#)[max-hops \(514\)](#)**spanning-tree  
system-bpdu-flooding**

This command configures the system to flood BPDUs to all other ports on the switch or just to all other ports in the same VLAN when spanning tree is disabled globally on the switch or disabled on a specific port. Use the **no** form to restore the default.

**Syntax**

**spanning-tree system-bpdu-flooding {to-all | to-vlan}**

**no spanning-tree system-bpdu-flooding**

**to-all** - Floods BPDUs to all other ports on the switch.

**to-vlan** - Floods BPDUs to all other ports within the receiving port's native VLAN (i.e., as determined by port's PVID).



**Default Setting**

Floods to all other ports in the same VLAN.

**Command Mode**

Global Configuration

**Command Usage**

The **spanning-tree system-bpdu-flooding** command has no effect if BPDU flooding is disabled on a port (see the [spanning-tree port-bpdu-flooding](#) command).

**Example**

```
Console(config)#spanning-tree system-bpdu-flooding
Console(config)#
```

**spanning-tree tc-prop** This command configures a topology change propagation domain. Use the **no** form to remove a propagation domain.

**Syntax**

**spanning-tree tc-prop group** *group-id* {**ethernet** *interface* | **port-channel** *trunk-id*}

*group-id* - Group identifier. (Range: 1-255)

*interface* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

*trunk-id* - Trunk index (Range: 1-16)

**Default Setting**

All ports and trunks belong to a common group.

**Command Mode**

Global Configuration

**Command Usage**

A port can only belong to one group. When an interface is added to a group, it is removed from the default group. When a TCN BPDU or BPDU with the TC flag set is received on an interface, that interface will only notify members in same group to propagate this topology change.

**Example**

```
Console(config)#spanning-tree tc-prop group 1 ethernet 1/1-5
Console(config)#
```

**spanning-tree transmission-limit** This command configures the minimum interval between the transmission of consecutive RSTP/MSTP BPDUs. Use the **no** form to restore the default.

**Syntax**

**spanning-tree transmission-limit** *count*

**no spanning-tree transmission-limit**

*count* - The transmission limit in seconds. (Range: 1-10)

**Default Setting**

3

**Command Mode**

Global Configuration

**Command Usage**

This command limits the maximum transmission rate for BPDUs.

**Example**

```
Console(config)#spanning-tree transmission-limit 4
Console(config)#
```

**max-hops** This command configures the maximum number of hops in the region before a BPDU is discarded. Use the **no** form to restore the default.

**Syntax**

**max-hops** *hop-number*

*hop-number* - Maximum hop number for multiple spanning tree.  
(Range: 1-40)

**Default Setting**

20

**Command Mode**

MST Configuration

**Command Usage**

An MSTI region is treated as a single node by the STP and RSTP protocols. Therefore, the message age for BPDUs inside an MSTI region is never changed. However, each

spanning tree instance within a region, and the internal spanning tree (IST) that connects these instances use a hop count to specify the maximum number of bridges that will propagate a BPDU. Each bridge decrements the hop count by one before passing on the BPDU. When the hop count reaches zero, the message is dropped.

### Example

```
Console(config-mstp)#max-hops 30
Console(config-mstp)#
```

**mst priority** This command configures the priority of a spanning tree instance. Use the **no** form to restore the default.

### Syntax

**mst** *instance-id* **priority** *priority*

**no mst** *instance-id* **priority**

*instance-id* - Instance identifier of the spanning tree. (Range: 0-4094)

*priority* - Priority of the a spanning tree instance.

(Range: 0-61440 in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440)

### Default Setting

32768

### Command Mode

MST Configuration

### Command Usage

- ◆ MST priority is used in selecting the root bridge and alternate bridge of the specified instance. The device with the highest priority (i.e., lowest numerical value) becomes the MSTI root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.
- ◆ You can set this switch to act as the MSTI root device by specifying a priority of 0, or as the MSTI alternate device by specifying a priority of 16384.

### Example

```
Console(config-mstp)#mst 1 priority 4096
Console(config-mstp)#
```

**mst vlan** This command adds VLANs to a spanning tree instance. Use the **no** form to remove the specified VLANs. Using the **no** form without any VLAN parameters to remove all VLANs.

### Syntax

**[no] mst instance-id vlan vlan-range**

*instance-id* - Instance identifier of the spanning tree. (Range: 0-4094)

*vlan-range* - Range of VLANs. (Range: 1-4094)

### Default Setting

none

### Command Mode

MST Configuration

### Command Usage

- ◆ Use this command to group VLANs into spanning tree instances. MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load, preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.
- ◆ By default all VLANs are assigned to the Internal Spanning Tree (MSTI 0) that connects all bridges and LANs within the MST region. This switch supports up to 65 instances. You should try to group VLANs which cover the same general area of your network. However, remember that you must configure all bridges within the same MSTI Region ([page 516](#)) with the same set of instances, and the same instance (on each bridge) with the same set of VLANs. Also, note that RSTP treats each MSTI region as a single node, connecting all regions to the Common Spanning Tree.

### Example

```
Console(config-mstp)#mst 1 vlan 2-5
Console(config-mstp)#
```

**name** This command configures the name for the multiple spanning tree region in which this switch is located. Use the **no** form to clear the name.

### Syntax

**name name**

*name* - Name of the spanning tree.

### Default Setting

Switch's MAC address

## Command Mode

MST Configuration

## Command Usage

The MST region name and revision number ([page 517](#)) are used to designate a unique MST region. A bridge (i.e., spanning-tree compliant device such as this switch) can only belong to one MST region. And all bridges in the same region must be configured with the same MST instances.

## Example

```

Console(config-mstp)#name R&D
Console(config-mstp)#

```

## Related Commands

[revision \(517\)](#)

**revision** This command configures the revision number for this multiple spanning tree configuration of this switch. Use the **no** form to restore the default.

## Syntax

**revision** *number*

*number* - Revision number of the spanning tree. (Range: 0-65535)

## Default Setting

0

## Command Mode

MST Configuration

## Command Usage

The MST region name ([page 516](#)) and revision number are used to designate a unique MST region. A bridge (i.e., spanning-tree compliant device such as this switch) can only belong to one MST region. And all bridges in the same region must be configured with the same MST instances.

## Example

```

Console(config-mstp)#revision 1
Console(config-mstp)#

```

## Related Commands

[name \(516\)](#)

**spanning-tree bpd-filter** This command allows you to avoid transmitting BPDUs on configured edge ports that are connected to end nodes. Use the **no** form to disable this feature.

#### Syntax

**[no] spanning-tree bpd-filter**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ This command stops all Bridge Protocol Data Units (BPDUs) from being transmitted on configured edge ports to save CPU processing time. This function is designed to work in conjunction with edge ports which should only connect end stations to the switch, and therefore do not need to process BPDUs. However, note that if a trunking port connected to another switch or bridging device is mistakenly configured as an edge port, and BPDU filtering is enabled on this port, this might cause a loop in the spanning tree.
- ◆ BPDU filter can only be configured on an interface if the edge port attribute is not disabled (that is, if edge port is set to enabled or auto with the [spanning-tree edge-port](#) command).

#### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#spanning-tree bpd-filter
Console(config-if)#
```

#### Related Commands

[spanning-tree edge-port \(521\)](#)

**spanning-tree bpd-guard** This command shuts down an edge port (i.e., an interface set for fast forwarding) if it receives a BPDU. Use the **no** form without any keywords to disable this feature, or with a keyword to restore the default settings.

#### Syntax

**spanning-tree bpd-guard [auto-recovery [interval interval]]**

**no spanning-tree bpd-guard [auto-recovery [interval]]**

**auto-recovery** - Automatically re-enables an interface after the specified interval.

*interval* - The time to wait before re-enabling an interface. (Range: 30-86400 seconds)

**Default Setting**

BPDU Guard: Disabled

Auto-Recovery: Disabled

Auto-Recovery Interval: 300 seconds

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ An edge port should only be connected to end nodes which do not generate BPDUs. If a BPDU is received on an edge port, this indicates an invalid network configuration, or that the switch may be under attack by a hacker. If an interface is shut down by BPDU Guard, it must be manually re-enabled using the `no spanning-tree spanning-disabled` command if the auto-recovery interval is not specified.
- ◆ BPDU guard can only be configured on an interface if the edge port attribute is not disabled (that is, if edge port is set to enabled or auto with the `spanning-tree edge-port` command).

**Example**

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#spanning-tree bpdu-guard
Console(config-if)#
```

**Related Commands**[spanning-tree edge-port \(521\)](#)[spanning-tree spanning-disabled \(529\)](#)

**spanning-tree cost** This command configures the spanning tree path cost for the specified interface. Use the **no** form to restore the default auto-configuration mode.

**Syntax****spanning-tree cost** *cost***no spanning-tree cost**

*cost* - The path cost for the port. (Range: 0 for auto-configuration, 1-65535 for short path cost method, 1-200,000,000 for long path cost method)<sup>10</sup>

**Table 94: Recommended STA Path Cost Range**

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1D-2004)
Ethernet	50-600	200,000-20,000,000
Fast Ethernet	10-60	20,000-2,000,000

**Table 94: Recommended STA Path Cost Range** (Continued)

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1D-2004)
Gigabit Ethernet	3-10	2,000-200,000
10G Ethernet	1-5	200-20,000

### Default Setting

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost “0” is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535.

**Table 95: Default STA Path Costs**

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1D-2004)
Ethernet	65,535	1,000,000
Fast Ethernet	65,535	100,000
Gigabit Ethernet	10,000	10,000
10G Ethernet	1,000	1,000

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ This command is used by the Spanning Tree Algorithm to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media.
- ◆ Path cost takes precedence over port priority.
- ◆ When the path cost method ([page 511](#)) is set to short, the maximum value for path cost is 65,535.

### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree cost 50
Console(config-if)#
```

10. Use the [spanning-tree pathcost method](#) command to set the path cost method. The range displayed in the CLI prompt message shows the maximum value for path cost. However, note that the switch still enforces the rules for path cost based on the specified path cost method (long or short).



**spanning-tree edge-port** This command specifies an interface as an edge port. Use the **no** form to restore the default.

#### Syntax

**spanning-tree edge-port [auto]**

**no spanning-tree edge-port**

**auto** - Automatically determines if an interface is an edge port.

#### Default Setting

Auto

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes cannot cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related time out problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device.
- ◆ When edge port is set as auto, the operational state is determined automatically by the Bridge Detection State Machine described in 802.1D-2004, where the edge port state may change dynamically based on environment changes (e.g., receiving a BPDU or not within the required interval).

#### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#
```

**spanning-tree link-type** This command configures the link type for Rapid Spanning Tree and Multiple Spanning Tree. Use the **no** form to restore the default.

#### Syntax

**spanning-tree link-type {auto | point-to-point | shared}**

**no spanning-tree link-type**

**auto** - Automatically derived from the duplex mode setting.

**point-to-point** - Point-to-point link.

**shared** - Shared medium.

#### Default Setting

auto

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ Specify a point-to-point link if the interface can only be connected to exactly one other bridge, or a shared link if it can be connected to two or more bridges.
- ◆ When automatic detection is selected, the switch derives the link type from the duplex mode. A full-duplex interface is considered a point-to-point link, while a half-duplex interface is assumed to be on a shared link.
- ◆ RSTP only works on point-to-point links between two bridges. If you designate a port as a shared link, RSTP is forbidden. Since MSTP is an extension of RSTP, this same restriction applies.

#### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree link-type point-to-point
```

**spanning-tree loopback-detection** This command enables the detection and response to Spanning Tree loopback BPDU packets on the port. Use the **no** form to disable this feature.

#### Syntax

**[no] spanning-tree loopback-detection**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ If Port Loopback Detection is not enabled and a port receives its own BPDU, then the port will drop the loopback BPDU according to IEEE Standard 802.1W-2001 9.3.4 (Note 1).
- ◆ Port Loopback Detection will not be active if Spanning Tree is disabled on the switch.

**Example**

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection
```

**spanning-tree  
loopback-detection  
action**

This command configures the response for loopback detection to block user traffic or shut down the interface. Use the **no** form to restore the default.

**Syntax**

**spanning-tree loopback-detection action {block | shutdown *duration*}**

**no spanning-tree loopback-detection action**

**block** - Blocks user traffic.

**shutdown** - Shuts down the interface.

*duration* - The duration to shut down the interface.  
(Range: 60-86400 seconds)

**Default Setting**

block, 60 seconds

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ If an interface is shut down by this command, and the release mode is set to "auto" with the [spanning-tree loopback-detection release-mode](#) command, the selected interface will be automatically enabled when the shutdown interval has expired.
- ◆ If an interface is shut down by this command, and the release mode is set to "manual," the interface can be re-enabled using the [spanning-tree loopback-detection release](#) command.

**Example**

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection action shutdown 600
Console(config-if)#
```

**spanning-tree loopback-detection release-mode** This command configures the release mode for a port that was placed in the discarding state because a loopback BPDU was received. Use the **no** form to restore the default.

### Syntax

**spanning-tree loopback-detection release-mode {auto | manual}**

**no spanning-tree loopback-detection release-mode**

**auto** - Allows a port to automatically be released from the discarding state when the loopback state ends.

**manual** - The port can only be released from the discarding state manually.

### Default Setting

auto

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ If the port is configured for automatic loopback release, then the port will only be returned to the forwarding state if one of the following conditions is satisfied:
  - The port receives any other BPDU except for its own, or;
  - The port's link status changes to link down and then link up again, or;
  - The port ceases to receive its own BPDUs in a forward delay interval.
- ◆ If Port Loopback Detection is not enabled and a port receives its own BPDU, then the port will drop the loopback BPDU according to IEEE Standard 802.1W-2001 9.3.4 (Note 1).
- ◆ Port Loopback Detection will not be active if Spanning Tree is disabled on the switch.
- ◆ When configured for manual release mode, then a link down / up event will not release the port from the discarding state. It can only be released using the **spanning-tree loopback-detection release** command.

### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection release-mode manual
Console(config-if)#
```

**spanning-tree loopback-detection trap** This command enables SNMP trap notification for Spanning Tree loopback BPDU detections. Use the **no** form to restore the default.

#### Syntax

**[no] spanning-tree loopback-detection trap**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection trap
```

**spanning-tree mst cost** This command configures the path cost on a spanning instance in the Multiple Spanning Tree. Use the **no** form to restore the default auto-configuration mode.

#### Syntax

**spanning-tree mst *instance-id* cost *cost***

**no spanning-tree mst *instance-id* cost**

*instance-id* - Instance identifier of the spanning tree. (Range: 0-4094)

*cost* - Path cost for an interface. (Range: 0 for auto-configuration, 1-65535 for short path cost method<sup>11</sup>, 1-200,000,000 for long path cost method)

The recommended path cost range is listed in [Table 94 on page 519](#).

#### Default Setting

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost "0" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535. The default path costs are listed in [Table 95 on page 520](#).

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ Each spanning-tree instance is associated with a unique set of VLAN IDs.
- ◆ This command is used by the multiple spanning-tree algorithm to determine the best path between devices. Therefore, lower values should be assigned to

<sup>11</sup>. Use the [spanning-tree pathcost method](#) command to set the path cost method.

interfaces attached to faster media, and higher values assigned to interfaces with slower media.

- ◆ Use the **no spanning-tree mst cost** command to specify auto-configuration mode.
- ◆ Path cost takes precedence over interface priority.

### Example

```
Console(config)#interface Ethernet 1/5
Console(config-if)#spanning-tree mst 1 cost 50
Console(config-if)#
```

### Related Commands

[spanning-tree mst port-priority \(526\)](#)

**spanning-tree mst port-priority** This command configures the interface priority on a spanning instance in the Multiple Spanning Tree. Use the **no** form to restore the default.

### Syntax

**spanning-tree mst** *instance-id* **port-priority** *priority*

**no spanning-tree mst** *instance-id* **port-priority**

*instance-id* - Instance identifier of the spanning tree. (Range: 0-4094)

*priority* - Priority for an interface. (Range: 0-240 in steps of 16)

### Default Setting

128

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ This command defines the priority for the use of an interface in the multiple spanning-tree. If the path cost for all interfaces on a switch are the same, the interface with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.
- ◆ Where more than one interface is assigned the highest priority, the interface with lowest numeric identifier will be enabled.

### Example

```
Console(config)#interface Ethernet 1/5
Console(config-if)#spanning-tree mst 1 port-priority 0
Console(config-if)#
```

**Related Commands**[spanning-tree mst cost \(525\)](#)

**spanning-tree port-bpdu-flooding** This command floods BPDUs to other ports when spanning tree is disabled globally or disabled on a specific port. Use the **no** form to restore the default setting.

**Syntax****[no] spanning-tree port-bpdu-flooding****Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ When enabled, BPDUs are flooded to all other ports on the switch or to all other ports within the receiving port's native VLAN as specified by the [spanning-tree system-bpdu-flooding](#) command.
- ◆ The [spanning-tree system-bpdu-flooding](#) command has no effect if BPDU flooding is disabled on a port by the **spanning-tree port-bpdu-flooding** command.

**Example**

```

Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-bpdu-flooding
Console(config-if)#

```

**spanning-tree port-priority** This command configures the priority for the specified interface. Use the **no** form to restore the default.

**Syntax****spanning-tree port-priority *priority*****no spanning-tree port-priority***priority* - The priority for a port. (Range: 0-240, in steps of 16)**Default Setting**

128

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ This command defines the priority for the use of a port in the Spanning Tree Algorithm. If the path cost for all ports on a switch are the same, the port with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.
- ◆ Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled.
- ◆ The criteria used for determining the port role is based on root bridge ID, root path cost, designated bridge, designated port, port priority, and port number, in that order and as applicable to the role under question.

**Example**

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-priority 0
```

**Related Commands**

[spanning-tree cost \(519\)](#)

**spanning-tree root-guard** This command prevents a designated port from taking superior BPDUs into account and allowing a new STP root port to be elected. Use the **no** form to disable this feature.

**Syntax**

**[no] spanning-tree root-guard**

**Default Setting**

Disabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ A bridge with a lower bridge identifier (or same identifier and lower MAC address) can take over as the root bridge at any time.
- ◆ When Root Guard is enabled, and the switch receives a superior BPDU on this port, it is set to the Discarding state until it stops receiving superior BPDUs for a fixed recovery period. While in the discarding state, no traffic is forwarded across the port.
- ◆ Root Guard can be used to ensure that the root bridge is not formed at a suboptimal location. Root Guard should be enabled on any designated port connected to low-speed bridges which could potentially overload a slower link by taking over as the root port and forming a new spanning tree topology. It



could also be used to form a border around part of the network where the root bridge is allowed.

- ◆ When spanning tree is initialized globally on the switch or on an interface, the switch will wait for 20 seconds to ensure that the spanning tree has converged before enabling Root Guard.

### Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#spanning-tree root-guard
Console(config-if)#
```

**spanning-tree spanning-disabled** This command disables the spanning tree algorithm for the specified interface. Use the **no** form to re-enable the spanning tree algorithm for the specified interface.

### Syntax

**[no] spanning-tree spanning-disabled**

### Default Setting

Enabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Example

This example disables the spanning tree algorithm for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree spanning-disabled
Console(config-if)#
```

**spanning-tree tc-prop-stop** This command stops the propagation of topology change notifications (TCN). Use the **no** form to allow propagation of TCN messages.

### Syntax

**[no] spanning-tree tc-prop-stop**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

When this command is enabled on an interface, topology change information originating from the interface will still be propagated.

This command should not be used on an interface which is purposely configured in a ring topology.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#spanning-tree tc-prop-stop
Console(config-if)#
```

### spanning-tree loopback-detection release

This command manually releases a port placed in discarding state by loopback-detection.

### Syntax

**spanning-tree loopback-detection release** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Command Mode

Privileged Exec

### Command Usage

Use this command to release an interface from discarding state if loopback detection release mode is set to “manual” by the [spanning-tree loopback-detection release-mode](#) command and BPDU loopback occurs.

### Example

```
Console#spanning-tree loopback-detection release ethernet 1/1
Console#
```

**spanning-tree protocol-migration** This command re-checks the appropriate BPDU format to send on the selected interface.

### Syntax

**spanning-tree protocol-migration** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Command Mode

Privileged Exec

### Command Usage

If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the **spanning-tree protocol-migration** command at any time to manually re-check the appropriate BPDU format to send on the selected interfaces (i.e., RSTP or STP-compatible).

### Example

```
Console#spanning-tree protocol-migration ethernet 1/5
Console#
```

**show spanning-tree** This command shows the configuration for the common spanning tree (CST), for all instances within the multiple spanning tree (MST), or for a specific instance within the multiple spanning tree (MST).

### Syntax

**show spanning-tree** [*interface* | **mst** *instance-id* | **brief** | **stp-enabled-only**]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

*instance-id* - Instance identifier of the multiple spanning tree.  
(Range: 0-4094)

**brief** - Shows a summary of global and interface settings.

**stp-enabled-only** - Displays global settings, and settings for interfaces for which STP is enabled.

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use the **show spanning-tree** command with no parameters to display the spanning tree configuration for the switch for the Common Spanning Tree (CST) and for every interface in the tree.
- ◆ Use the **show spanning-tree interface** command to display the spanning tree configuration for an interface within the Common Spanning Tree (CST).
- ◆ Use the **show spanning-tree mst** command to display the spanning tree configuration for all instances within the Multiple Spanning Tree (MST), including global settings and settings for active interfaces.
- ◆ Use the **show spanning-tree mst instance-id** command to display the spanning tree configuration for an instance within the Multiple Spanning Tree (MST), including global settings and settings for all interfaces.

### Example

```
Console#show spanning-tree
Spanning Tree Information
-----
Spanning Tree Mode           : MSTP
Spanning Tree Enabled/Disabled : Enabled
Instance                     : 0
```

```

VLANs Configured           : 1-4094
Priority                    : 32768
Bridge Hello Time (sec.)   : 2
Bridge Max. Age (sec.)     : 20
Bridge Forward Delay (sec.) : 15
Root Hello Time (sec.)     : 2
Root Max. Age (sec.)       : 20
Root Forward Delay (sec.)  : 15
Max. Hops                  : 20
Remaining Hops             : 20
Designated Root            : 32768.0.0001ECF8D8C6
Current Root Port          : 21
Current Root Cost          : 100000
Number of Topology Changes : 5
Last Topology Change Time (sec.): 11409
Transmission Limit        : 3
Path Cost Method           : Long
Flooding Behavior          : To VLAN
Cisco Prestandard          : Disabled
-----
Eth 1/ 1 Information
-----
Admin Status               : Enabled
Role                       : Disabled
State                      : Discarding
External Admin Path Cost   : 0
Internal Admin Path Cost   : 0
External Oper Path Cost    : 100000
Internal Oper Path Cost    : 100000
Priority                   : 128
Designated Cost            : 100000
Designated Port            : 128.1
Designated Root            : 32768.0.0001ECF8D8C6
Designated Bridge          : 32768.0.123412341234
Forward Transitions        : 4
Admin Edge Port            : Disabled
Oper Edge Port             : Disabled
Admin Link Type            : Auto
Oper Link Type             : Point-to-point
Flooding Behavior          : Enabled
Spanning-Tree Status      : Enabled
Loopback Detection Status  : Enabled
Loopback Detection Release Mode : Auto
Loopback Detection Trap    : Disabled
Loopback Detection Action  : Block
Root Guard Status          : Disabled
BPDU Guard Status          : Disabled
BPDU Guard Auto Recovery   : Disabled
BPDU Guard Auto Recovery Interval : 300
BPDU Filter Status         : Disabled
TC Propagate Stop          : Disabled

```

```

.
.
.

```

This example shows a brief summary of global and interface setting for the spanning tree.

```

Console#show spanning-tree brief
Spanning Tree Mode        : RSTP
Spanning Tree Enabled/Disabled : Enabled
Designated Root           : 32768.0000E8944000

```

```

Current Root Port (Eth)      : 1/24
Current Root Cost            : 10000

Interface Pri Designated      Designated Oper   STP   Role State Oper
              Bridge ID        Port ID   Cost   Status          Edge
-----
Eth 1/ 1  128 32768.0000E89382A0 128.1    100000 EN    DESG FWD  No
Eth 1/ 2  128 32768.0000E89382A0 128.2    10000  EN    DISB BLK  No
Eth 1/ 3  128 32768.0000E89382A0 128.3    10000  EN    DISB BLK  No
Eth 1/ 4  128 32768.0000E89382A0 128.4    10000  EN    DISB BLK  No
Eth 1/ 5  128 32768.0000E89382A0 128.5    10000  EN    DISB BLK  No
.
.
.

```

**show spanning-tree mst configuration** This command shows the configuration of the multiple spanning tree.

**Command Mode**  
Privileged Exec

#### Example

```

Console#show spanning-tree mst configuration
Mstp Configuration Information
-----
Configuration Name : R&D
Revision Level     :0

Instance VLANs
-----
      0      1-4094
Console#

```

**show spanning-tree tc-prop** This command shows the configuration of topology change propagation domains.

#### Syntax

**show spanning-tree tc-prop [group group-id]**  
*group-id* - Group identifier. (Range: 1-255)

**Command Mode**  
Privileged Exec

#### Example

```

Console#show spanning-tree tc-prop group 1
Group 1
  Eth 1/ 1, Eth 1/ 2, Eth 1/ 3, Eth 1/ 4, Eth 1/ 5
Console#

```

## ERPS Commands

The G.8032 recommendation, also referred to as Ethernet Ring Protection Switching (ERPS), can be used to increase the availability and robustness of Ethernet rings.

This chapter describes commands used to configure ERPS.

**Table 96: ERPS Commands**

Command	Function	Mode
<code>erps</code>	Enables ERPS globally on the switch	GC
<code>erps domain</code>	Creates an ERPS ring and enters ERPS configuration mode	GC
<code>control-vlan</code>	Adds a Control VLAN to an ERPS ring	ERPS
<code>enable</code>	Activates the current ERPS ring	ERPS
<code>guard-timer</code>	Sets the timer to prevent ring nodes from receiving outdated R-APS messages	ERPS
<code>holdoff-timer</code>	Sets the timer to filter out intermittent link faults	ERPS
<code>major-domain</code>	Specifies the ERPS ring used for sending control packets	ERPS
<code>meg-level</code>	Sets the Maintenance Entity Group level for a ring	ERPS
<code>mep-monitor</code>	Specifies the CCM MEPs used to monitor the link on a ring node	ERPS
<code>node-id</code>	Sets the MAC address for a ring node	ERPS
<code>non-erps-dev-protect</code>	Sends non-standard health-check packets when in protection state	ERPS
<code>non-revertive</code>	Enables non-revertive mode, which requires the protection state on the RPL to manually cleared	ERPS
<code>propagate-tc</code>	Enables propagation of topology change messages from a secondary ring to the primary ring	ERPS
<code>raps-def-mac</code>	Sets the switch's MAC address to be used as the node identifier in R-APS messages	ERPS
<code>raps-without-vc</code>	Terminates the R-APS channel at the primary ring to sub-ring interconnection nodes	ERPS
<code>ring-port</code>	Configures a node's connection to the ring through the east or west interface	ERPS
<code>rpl neighbor</code>	Configures a ring node to be the RPL neighbor	ERPS
<code>rpl owner</code>	Configures a ring node to be the RPL owner	ERPS
<code>version</code>	Specifies compatibility with ERPS version 1 or 2	ERPS
<code>wtr-timer</code>	Sets timer to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure	ERPS

Table 96: ERPS Commands (Continued)

Command	Function	Mode
<code>clear erps statistics</code>	Clears statistics, including SF, NR, NR-RB, FS, MS, Event, and Health protocol messages	PE
<code>erps clear</code>	Manually clears protection state which has been invoked by a Forced Switch or Manual Switch command, and the node is operating under non-revertive mode; or before the WTR or WTB timer expires when the node is operating in revertive mode	PE
<code>erps forced-switch</code>	Blocks the specified ring port	PE
<code>erps manual-switch</code>	Blocks the specified ring port, in the absence of a failure or an erps forced-switch command	PE
<code>show erps</code>	Displays status information for all configured rings, or for a specified ring	PE

### Configuration Guidelines for ERPS

1. Create an ERPS ring: Create a ring using the `erps domain` command. The ring name is used as an index in the G.8032 database.
2. Configure the east and west interfaces: Each node on the ring connects to it through two ring ports. Use the `ring-port` command to configure one port connected to the next node in the ring to the east (or clockwise direction); and then use the `ring-port` command again to configure another port facing west in the ring.
3. Configure the RPL owner: Configure one node in the ring as the Ring Protection Link (RPL) owner using the `rpl owner` command. When this switch is configured as the RPL owner, the west ring port is set as being connected to the RPL. Under normal operations (Idle state), the RPL is blocked to ensure that a loop cannot form in the ring. If a signal failure brings down any other link in the ring, the RPL will be unblocked (Protection state) to ensure proper connectivity among all ring nodes until the failure is recovered.
4. Configure ERPS timers: Use the `guard-timer` command to set the timer is used to prevent ring nodes from receiving outdated R-APS messages, the `holdoff-timer` command to filter out intermittent link faults, and the `wtr-timer` command to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure.
5. Configure the ERPS Control VLAN (CVLAN): Use the `control-vlan` command to create the VLAN used to pass R-APS ring maintenance commands. The CVLAN must NOT be configured with an IP address. In addition, only ring ports may be added to the CVLAN (prior to configuring the VLAN as a CVLAN). No other ports can be members of this VLAN (once set as a CVLAN). Also, the ring ports of the CVLAN must be tagged. Failure to observe these restrictions can result in a loop in the network.



6. Enable ERPS: Before enabling a ring as described in the next step, first use the `erps` command to globally enable ERPS on the switch. If ERPS has not yet been enabled or has been disabled with the `no erps` command, no ERPS rings will work.
7. Enable an ERPS ring: Before an ERPS ring can work, it must be enabled using the `enable` command. When configuration is completed and the ring enabled, R-APS messages will start flowing in the control VLAN, and normal traffic will begin to flow in the data VLANs. To stop a ring, it can be disabled on any node using the `no enable` command.
8. Display ERPS status information: Use the `show erps` command to display general ERPS status information or detailed ERPS status information for a specific ring.

**erps** This command enables ERPS on the switch. Use the **no** form to disable this feature.

### Syntax

**[no] erps**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

ERPS must be enabled globally on the switch before it can be enabled on an ERPS ring using the `enable` command.

### Example

```
Console(config)#erps
Console(config)#
```

### Related Commands

[enable \(539\)](#)

**erps domain** This command creates an ERPS ring and enters ERPS configuration mode for the specified domain. Use the **no** form to delete a ring.

### Syntax

**erps domain** *ring-name* [**id** *ring-id*]

**no erps domain** *ring-name*

*ring-name* - Name of a specific ERPS ring. (Range: 1-12 characters)

*ring-id* - ERPS ring identifier used in R-APS messages. (Range: 1-255)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Service Instances within each ring are based on a unique maintenance association for the specific users, distinguished by the ring name, maintenance level, maintenance association's name, and assigned VLAN. Up to 6 ERPS rings can be configured on the switch.
- ◆ R-APS information is carried in an R-APS PDUs. The last octet of the MAC address is designated as the Ring ID (01-19-A7-00-00-[Ring ID]). If use of the default MAC address is disabled with the **no raps-def-mac** command, then the Ring ID configured by the **erps domain** command will be used in R-APS PDUs.

### Example

```
Console(config)#erps domain r&d id 1
Console(config-erps)#
```

**control-vlan** This command specifies a dedicated VLAN used for sending and receiving ERPS protocol messages. Use the **no** form to remove the Control VLAN.

### Syntax

[**no**] **control-vlan** *vlan-id*

*vlan-id* - VLAN ID (Range: 1-4094)

### Default Setting

None

### Command Mode

ERPS Configuration

### Command Usage

- ◆ Configure one control VLAN for each ERPS ring. First create the VLAN to be used as the control VLAN ([vlan](#), [page 574](#)), add the ring ports for the east and west interface as tagged members to this VLAN ([switchport allowed vlan](#), [page 577](#)), and then use the [control-vlan](#) command to add it to the ring.
- ◆ The following restrictions are recommended to avoid creating a loop in the network or other problems which may occur under some situations:
  - The Control VLAN must not be configured as a Layer 3 interface (with an IP address), a dynamic VLAN (with GVRP enabled), nor as a private VLAN.
  - In addition, only ring ports may be added to the Control VLAN. No other ports can be members of this VLAN.
  - Also, the ring ports of the Control VLAN must be tagged.
- ◆ Once the ring has been activated with the [enable](#) command, the configuration of the control VLAN cannot be modified. Use the [no enable](#) command to stop the ERPS ring before making any configuration changes to the control VLAN.

### Example

```

Console(config)#vlan database
Console(config-vlan)#vlan 2 name rdc media ethernet state active
Console(config-vlan)#exit
Console(config)#interface ethernet 1/12
Console(config-if)#switchport allowed vlan add 2 tagged
Console(config-if)#interface ethernet 1/11
Console(config-if)#switchport allowed vlan add 2 tagged
Console(config-if)#exit
Console(config)#erps domain rd1
Console(config-erps)#control-vlan 2
Console(config-erps)#

```

**enable** This command activates the current ERPS ring. Use the **no** form to disable the current ring.

### Syntax

**[no] enable**

### Default Setting

Disabled

### Command Mode

ERPS Configuration

### Command Usage

- ◆ Before enabling a ring, the global ERPS function should be enabled with the [erps](#) command, the east and west ring ports configured on each node with the

**ring-port** command, the RPL owner specified with the **rpl owner** command, and the control VLAN configured with the **control-vlan** command.

- ◆ Once enabled, the RPL owner node and non-owner node state machines will start, and the ring will enter idle state if no signal failures are detected.

### Example

```
Console(config-erps)#enable
Console(config-erps)#
```

### Related Commands

[erps \(537\)](#)

**guard-timer** This command sets the guard timer to prevent ring nodes from receiving outdated R-APS messages. Use the **no** form to restore the default setting.

### Syntax

**guard-timer** *milliseconds*

*milliseconds* - The guard timer is used to prevent ring nodes from receiving outdated R-APS messages. During the duration of the guard timer, all received R-APS messages are ignored by the ring protection control process, giving time for old messages still circulating on the ring to expire. (Range: 10-2000 milliseconds, in steps of 10 milliseconds)

### Default Setting

500 milliseconds

### Command Mode

ERPS Configuration

### Command Usage

The guard timer duration should be greater than the maximum expected forwarding delay for an R-APS message to pass around the ring. A side-effect of the guard timer is that during its duration, a node will be unaware of new or existing ring requests transmitted from other nodes.

### Example

```
Console(config-erps)#guard-timer 300
Console(config-erps)#
```

**holdoff-timer** This command sets the timer to filter out intermittent link faults. Use the **no** form to restore the default setting.

### Syntax

**holdoff-timer** *milliseconds*

*milliseconds* - The hold-off timer is used to filter out intermittent link faults. Faults will only be reported to the ring protection mechanism if this timer expires. (Range: 0-10000 milliseconds, in steps of 100 milliseconds)

### Default Setting

0 milliseconds

### Command Mode

ERPS Configuration

### Command Usage

In order to coordinate timing of protection switches at multiple layers, a hold-off timer may be required. Its purpose is to allow, for example, a server layer protection switch to have a chance to fix the problem before switching at a client layer.

When a new defect or more severe defect occurs (new Signal Failure), this event will not be reported immediately to the protection switching mechanism if the provisioned hold-off timer value is non-zero. Instead, the hold-off timer will be started. When the timer expires, whether a defect still exists or not, the timer will be checked. If one does exist, that defect will be reported to the protection switching mechanism. The reported defect need not be the same one that started the timer.

### Example

```
Console(config-erps)#holdoff-timer 300
Console(config-erps)#
```

**major-domain** This command specifies the ERPS ring used for sending control packets. Use the **no** form to remove the current setting.

### Syntax

**major-domain** *name*

**no major-domain**

*name* - Name of the ERPS ring used for sending control packets.  
(Range: 1-32 characters)

### Default Setting

None

**Command Mode**

ERPS Configuration

**Command Usage**

- ◆ This switch can support up to six rings. However, ERPS control packets can only be sent on one ring. This command is used to indicate that the current ring is a secondary ring, and to specify the major ring which will be used to send ERPS control packets.
- ◆ The Ring Protection Link (RPL) is the west port and can not be configured. So the physical port on a secondary ring must be the west port. In other words, if a domain has two physical ring ports, this ring can only be a major ring, not a secondary ring (or sub-domain) which can have only one physical ring port. This command will therefore fail if the east port is already configured (see the [ring-port](#) command).

**Example**

```
Console(config-erps) #major-domain rd0
Console(config-erps) #
```

**meg-level** This command sets the Maintenance Entity Group level for a ring. Use the **no** form to restore the default setting.

**Syntax****meg-level** *level*

*level* - The maintenance entity group (MEG) level which provides a communication channel for ring automatic protection switching (R-APS) information. (Range: 0-7)

**Default Setting**

1

**Command Mode**

ERPS Configuration

**Command Usage**

- ◆ This parameter is used to ensure that received R-APS PDUs are directed for this ring. A unique level should be configured for each local ring if there are many R-APS PDUs passing through this switch.
- ◆ If CFM continuity check messages are used to monitor the link status of an ERPS ring node as specified by the [mep-monitor](#) command, then the MEG level set by the **meg-level** command must match the authorized maintenance level of the CFM domain to which the specified MEP belongs. The MEP's primary VLAN must also be the same as that used for the ERPS ring's control VLAN.

### Example

```
Console(config-erps)#meg-level 0
Console(config-erps)#
```

### Related Commands

[ethernet cfm domain \(803\)](#)[ethernet cfm mep \(808\)](#)

**mep-monitor** This command specifies the CFM MEPs used to monitor the link on a ring node. Use the **no** form to restore the default setting.

### Syntax

**mep-monitor** {**east** | **west**} **mep** *mpid*

**east** - Connects to next ring node to the east.

**west** - Connects to next ring node to the west.

*mpid* – Maintenance end point identifier. (Range: 1-8191)

### Default Setting

None

### Command Mode

ERPS Configuration

### Command Usage

- ◆ If this command is used to monitor the link status of an ERPS node with CFM continuity check messages, then the MEG level set by the [meg-level](#) command must match the authorized maintenance level of the CFM domain to which the specified MEP belongs.
- ◆ To ensure complete monitoring of a ring node, use the **mep-monitor** command to specify the CFM MEPs used to monitor both the east and west ports of the ring node.
- ◆ If CFM determines that a MEP node which has been configured to monitor a ring port with this command has gone down, this information is passed to ERPS, which in turn processes it as a ring node failure. For more information on how ERPS recovers from a node failure, refer to “Ethernet Ring Protection Switching” in the *Web Management Guide*.

### Example

```
Console(config-erps)#mep-monitor east mep 1
Console(config-erps)#
```

**Related Commands**[ethernet cfm domain \(803\)](#)[ethernet cfm mep \(808\)](#)

**node-id** This command sets the MAC address for a ring node. Use the **no** form to restore the default setting.

**Syntax**

**node-id** *mac-address*

*mac-address* – A MAC address unique to the ring node. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

**Default Setting**

CPU MAC address

**Command Mode**

ERPS Configuration

**Command Usage**

- ◆ The ring node identifier is used to identify a node in R-APS messages for both automatic and manual switching recovery operations.

For example, a node that has one ring port in SF condition and detects that the condition has been cleared, will continuously transmit R-APS (NR) messages with its own Node ID as priority information over both ring ports, informing its neighbors that no request is present at this node. When another recovered node holding the link blocked receives this message, it compares the Node ID information with its own. If the received R-APS (NR) message has a higher priority, this unblocks its ring ports. Otherwise, the block remains unchanged.

- ◆ The node identifier may also be used for debugging, such as to distinguish messages when a node is connected to more than one ring.

**Example**

```
Console(config-erps) #node-id 00-12-CF-61-24-2D
Console(config-erps) #
```

**non-erps-dev-protect** This command sends non-standard health-check packets when an owner node enters protection state without any link down event having been detected through SF messages. Use the **no** form to disable this feature.

**Syntax**

**[no] non-erps-dev-protect**



**Default Setting**

Disabled

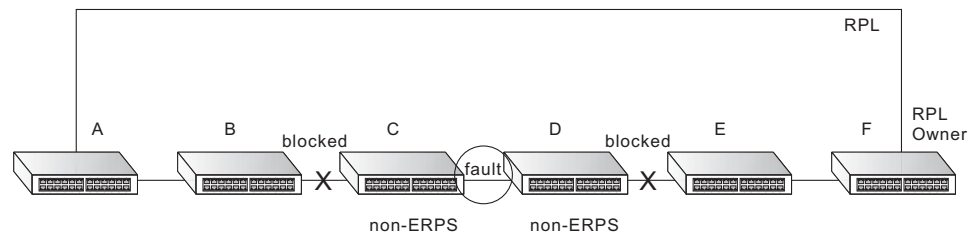
**Command Mode**

ERPS Configuration

**Command Usage**

- ◆ The RPL owner node detects a failed link when it receives R-APS (SF - signal fault) messages from nodes adjacent to the failed link. The owner then enters protection state by unblocking the RPL. However, using this standard recovery procedure may cause a non-ERPS device to become isolated when the ERPS device adjacent to it detects a continuity check message (CCM) loss event and blocks the link between the non-ERPS device and ERPS device.

CCMs are propagated by the Connectivity Fault Management (CFM) protocol as described under [“CFM Commands” on page 797](#). If the standard recovery procedure were used as shown in the following figure, and node E detected CCM loss, it would send an R-APS (SF) message to the RPL owner and block the link to node D, isolating that non-ERPS device.

**Figure 3: Non-ERPS Device Protection**

When non-ERPS device protection is enabled on the ring, the ring ports on the RPL owner node and non-owner nodes will not be blocked when signal loss is detected by CCM loss events.

- ◆ When non-ERPS device protection is enabled on an RPL owner node, it will send non-standard health-check packets to poll the ring health when it enters the protection state. It does not use the normal procedure of waiting to receive an R-APS (NR - no request) message from nodes adjacent to the recovered link. Instead, it waits to see if the non-standard health-check packets loop back. If they do, indicating that the fault has been resolved, the RPL will be blocked.

After blocking the RPL, the owner node will still transmit an R-APS (NR, RB - ring blocked) message. ERPS-compliant nodes receiving this message flush their forwarding database and unblock previously blocked ports. The ring is now returned to Idle state.

**Example**

```
Console(config-erps) #non-erps-dev-protect
Console(config-erps) #
```

**non-revertive** This command enables non-revertive mode, which requires the protection state on the RPL to manually cleared. Use the **no** form to restore the default revertive mode.

### Syntax

**[no] non-revertive**

### Default Setting

Disabled

### Command Mode

ERPS Configuration

### Command Usage

- ◆ Revertive behavior allows the switch to automatically return the RPL from Protection state to Idle state through the exchange of protocol messages.

Non-revertive behavior for Protection, Forced Switch, and Manual Switch states are basically the same. Non-revertive behavior requires the [erps clear](#) command to used to return the RPL from Protection state to Idle state.

- ◆ Recovery for Protection Switching – A ring node that has one or more ring ports in an SF (Signal Fail) condition, upon detecting the SF condition cleared, keeps at least one of its ring ports blocked for the traffic channel and for the R-APS channel, until the RPL is blocked as a result of ring protection reversion, or until there is another higher priority request (e.g., an SF condition) in the ring.

A ring node that has one ring port in an SF condition and detects the SF condition cleared, continuously transmits the R-APS (NR – no request) message with its own Node ID as the priority information over both ring ports, informing that no request is present at this ring node and initiates a guard timer. When another recovered ring node (or nodes) holding the link block receives this message, it compares the Node ID information with its own Node ID. If the received R-APS (NR) message has the higher priority, this ring node unblocks its ring ports. Otherwise, the block remains unchanged. As a result, there is only one link with one end blocked.

The ring nodes stop transmitting R-APS (NR) messages when they accept an R-APS (NR, RB – RPL Blocked), or when another higher priority request is received.

- Recovery with Revertive Mode – When all ring links and ring nodes have recovered and no external requests are active, reversion is handled in the following way:
  - a. The reception of an R-APS (NR) message causes the RPL Owner Node to start the WTR (Wait-to-Restore) timer.
  - b. The WTR timer is cancelled if during the WTR period a higher priority request than NR is accepted by the RPL Owner Node or is declared locally at the RPL Owner Node.
  - c. When the WTR timer expires, without the presence of any other higher priority request, the RPL Owner Node initiates reversion by blocking its

traffic channel over the RPL, transmitting an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and performing a flush FDB action.

- d. The acceptance of the R-APS (NR, RB) message causes all ring nodes to unblock any blocked non-RPL link that does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF (do not flush) indication, all ring nodes flush the FDB.
- Recovery with Non-revertive Mode – In non-revertive operation, the ring does not automatically revert when all ring links and ring nodes have recovered and no external requests are active. Non-revertive operation is handled in the following way:
  - a. The RPL Owner Node does not generate a response on reception of an R-APS (NR) messages.
  - b. When other healthy ring nodes receive the NR (Node ID) message, no action is taken in response to the message.
  - c. When the operator issues the **erps clear** command for non-revertive mode at the RPL Owner Node, the non-revertive operation is cleared, the RPL Owner Node blocks its RPL port, and transmits an R-APS (NR, RB) message in both directions, repeatedly.
  - d. Upon receiving an R-APS (NR, RB) message, any blocking node should unblock its non-failed ring port. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush the FDB.
- ◆ Recovery for Forced Switching – An **erps forced-switch** command is removed by issuing the **erps clear** command to the same ring node where Forced Switch mode is in effect. The clear command removes any existing local operator commands, and triggers reversion if the ring is in revertive behavior mode.

The ring node where the Forced Switch was cleared keeps the ring port blocked for the traffic channel and for the R-APS channel, due to the previous Forced Switch command. This ring port is kept blocked until the RPL is blocked as a result of ring protection reversion, or until there is another higher priority request (e.g., an SF condition) in the ring.

The ring node where the Forced Switch was cleared continuously transmits the R-APS (NR) message on both ring ports, informing other nodes that no request is present at this ring node. The ring nodes stop transmitting R-APS (NR) messages when they accept an RAPS (NR, RB) message, or when another higher priority request is received.

If the ring node where the Forced Switch was cleared receives an R-APS (NR) message with a Node ID higher than its own Node ID, it unblocks any ring port which does not have an SF condition and stops transmitting R-APS (NR) message over both ring ports.

- Recovery with revertive mode is handled in the following way:
  - a. The reception of an R-APS (NR) message causes the RPL Owner Node to start the WTB timer.

- b.** The WTB timer is cancelled if during the WTB period a higher priority request than NR is accepted by the RPL Owner Node or is declared locally at the RPL Owner Node.
  - c.** When the WTB timer expires, in the absence of any other higher priority request, the RPL Owner Node initiates reversion by blocking the traffic channel over the RPL, transmitting an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and flushes the FDB.
  - d.** The acceptance of the R-APS (NR, RB) message causes all ring nodes to unblock any blocked non-RPL that does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush their FDB. This action unblocks the ring port which was blocked as a result of an operator command.
- a.** The RPL Owner Node, upon reception of an R-APS(NR) message and in the absence of any other higher priority request does not perform any action.
    - b.** Then, after the operator issues the **erps clear** command at the RPL Owner Node, this ring node blocks the ring port attached to the RPL, transmits an R-APS (NR, RB) message on both ring ports, informing the ring that the RPL is blocked, and flushes its FDB.
    - c.** The acceptance of the R-APS (NR, RB) message triggers all ring nodes to unblock any blocked non-RPL which does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush their FDB. This action unblocks the ring port which was blocked as result of an operator command.
- ◆ Recovery for Manual Switching – An **erps manual-switch** command is removed by issuing the **erps clear** command at the same ring node where the Manual Switch is in effect. The clear command removes any existing local operator commands, and triggers reversion if the ring is in revertive behavior mode.

The ring node where the Manual Switch was cleared keeps the ring port blocked for the traffic channel and for the R-APS channel, due to the previous Manual Switch command. This ring port is kept blocked until the RPL is blocked as a result of ring protection reversion, or until there is another higher priority request (e.g., an SF condition) in the ring.

The Ethernet Ring Node where the Manual Switch was cleared continuously transmits the R-APS (NR) message on both ring ports, informing that no request is present at this ring node. The ring nodes stop transmitting R-APS (NR) messages when they accept an RAPS (NR, RB) message, or when another higher priority request is received.

If the ring node where the Manual Switch was cleared receives an R-APS (NR) message with a Node ID higher than its own Node ID, it unblocks any ring port which does not have an SF condition and stops transmitting R-APS (NR) message on both ring ports.

- Recovery with revertive mode is handled in the following way:
  - a. The RPL Owner Node, upon reception of an R-APS (NR) message and in the absence of any other higher priority request, starts the WTB timer and waits for it to expire. While the WTB timer is running, any latent R-APS (MS) message is ignored due to the higher priority of the WTB running signal.
  - b. When the WTB timer expires, it generates the WTB expire signal. The RPL Owner Node, upon reception of this signal, initiates reversion by blocking the traffic channel on the RPL, transmitting an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and flushes its FDB.
  - c. The acceptance of the R-APS (NR, RB) message causes all ring nodes to unblock any blocked non-RPL that does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all Ethernet Ring Nodes flush their FDB. This action unblocks the ring port which was blocked as a result of an operator command.
- Recovery with non-revertive mode is handled in the following way:
  - a. The RPL Owner Node, upon reception of an R-APS (NR) message and in the absence of any other higher priority request does not perform any action.
  - b. Then, after the operator issues the `erps clear` command at the RPL Owner Node, this ring node blocks the ring port attached to the RPL, transmits an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and flushes its FDB.
  - c. The acceptance of the R-APS (NR, RB) message triggers all ring nodes to unblock any blocked non-RPL which does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush their FDB. This action unblocks the ring port which was blocked as result of an operator command.

### Example

```
Console(config-erps) #non-revertive
Console(config-erps) #
```

**propagate-tc** This command enables propagation of topology change messages for a secondary ring to the primary ring. Use the **no** form to disable this feature.

### Syntax

**[no] propagate-tc**

### Default Setting

Disabled

**Command Mode**

ERPS Configuration

**Command Usage**

- ◆ When a secondary ring detects a topology change, it can pass a message about this event to the major ring. When the major ring receives this kind of message from a secondary ring, it can clear the MAC addresses on its ring ports to help the secondary ring restore its connections more quickly through protection switching.
- ◆ When the MAC addresses are cleared, data traffic may flood onto the major ring. The data traffic will become stable after the MAC addresses are learned again. The major ring will not be broken, but the bandwidth of data traffic on the major ring may suffer for a short period of time due to this flooding behavior.

**Example**

```
Console(config-erps) #propagate-tc
Console(config-erps) #
```

**raps-def-mac** This command sets the switch's MAC address to be used as the node identifier in R-APS messages. Use the **no** form to use the node identifier specified in the G8032 standards.

**Syntax**

**[no] raps-def-mac**

**Default Setting**

Enabled

**Command Mode**

ERPS Configuration

**Command Usage**

- ◆ When ring nodes running ERPSv1 and ERPSv2 co-exist on the same ring, the Ring ID of each ring node must be configured as "1".
- ◆ If this command is disabled, the following strings are used as the node identifier:
  - ERPSv1: 01-19-A7-00-00-01
  - ERPSv2: 01-19-A7-00-00-[Ring ID]

**Example**

```
Console(config-erps) #raps-def-mac
Console(config-erps) #
```

**raps-without-vc** This command terminates the R-APS channel at the primary ring to sub-ring interconnection nodes. Use the **no** form to restore the default setting.

### Syntax

**[no] raps-without-vc**

### Default Setting

R-APS with Virtual Channel

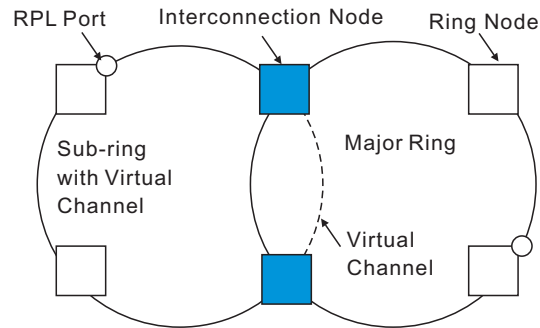
### Command Mode

ERPS Configuration

### Command Usage

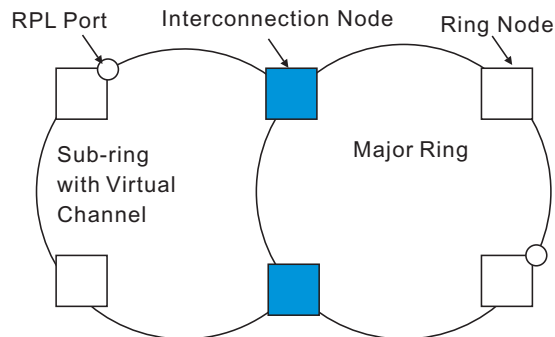
- ◆ A sub-ring may be attached to a primary ring with or without a virtual channel. A virtual channel is used to connect two interconnection points on the sub-ring, tunneling R-APS control messages across an arbitrary Ethernet network topology. If a virtual channel is not used to cross the intermediate Ethernet network, data in the traffic channel will still flow across the network, but the all R-APS messages will be terminated at the interconnection points.
- ◆ Sub-ring with R-APS Virtual Channel – When using a virtual channel to tunnel R-APS messages between interconnection points on a sub-ring, the R-APS virtual channel may or may not follow the same path as the traffic channel over the network. R-APS messages that are forwarded over the sub-ring's virtual channel are broadcast or multicast over the interconnected network. For this reason the broadcast/multicast domain of the virtual channel should be limited to the necessary links and nodes. For example, the virtual channel could span only the interconnecting rings or sub-rings that are necessary for forwarding R-APS messages of this sub-ring. Care must also be taken to ensure that the local RAPS messages of the sub-ring being transported over the virtual channel into the interconnected network can be uniquely distinguished from those of other interconnected ring R-APS messages. This can be achieved by, for example, by using separate VIDs for the virtual channels of different sub-rings.

Note that the R-APS virtual channel requires a certain amount of bandwidth to forward R-APS messages on the interconnected Ethernet network where a sub-ring is attached. Also note that the protection switching time of the sub-ring may be affected if R-APS messages traverse a long distance over an R-APS virtual channel.

**Figure 4: Sub-ring with Virtual Channel**

- ◆ **Sub-ring without R-APS Virtual Channel** – Under certain circumstances it may not be desirable to use a virtual channel to interconnect the sub-ring over an arbitrary Ethernet network. In this situation, the R-APS messages are terminated on the interconnection points. Since the sub-ring does not provide an R-APS channel nor R-APS virtual channel beyond the interconnection points, R-APS channel blocking is not employed on the normal ring links to avoid channel segmentation. As a result, a failure at any ring link in the sub-ring will cause the R-APS channel of the sub-ring to be segmented, thus preventing R-APS message exchange between some of the sub-ring's ring nodes.

No R-APS messages are inserted or extracted by other rings or sub-rings at the interconnection nodes where a sub-ring is attached. Hence there is no need for either additional bandwidth or for different VIDs/Ring IDs for the ring interconnection. Furthermore, protection switching time for a sub-ring is independent from the configuration or topology of the interconnected rings. In addition, this option always ensures that an interconnected network forms a tree topology regardless of its interconnection configuration. This means that it is not necessary to take precautions against forming a loop which is potentially composed of a whole interconnected network.

**Figure 5: Sub-ring without Virtual Channel**

### Example

```
Console(config-erps)#raps-without-vc
Console(config-erps)#
```



**ring-port** This command configures a node's connection to the ring through the east or west interface. Use the **no** form to disassociate a node from the ring.

### Syntax

**ring-port** {**east** | **west**} **interface** *interface*

**east** - Connects to next ring node to the east.

**west** - Connects to next ring node to the west.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

Not associated

### Command Mode

ERPS Configuration

### Command Usage

- ◆ Each node must be connected to two neighbors on the ring. For convenience, the ports connected are referred to as east and west ports. Alternatively, the closest neighbor to the east should be the next node in the ring in a clockwise direction, and the closest neighbor to the west should be the next node in the ring in a counter-clockwise direction.
- ◆ Note that a ring port cannot be configured as a member of a spanning tree, a dynamic trunk, or a static trunk.
- ◆ If a port channel (static trunk) is specified as a ring port, it can not be destroyed before it is removed from the domain configuration.
- ◆ A static trunk will be treated as a signal fault, if it contains no member ports or all of its member ports are in signal fault.
- ◆ If a static trunk is configured as a ring port prior to assigning any member ports, spanning tree will be disabled for the first member port assigned to the static trunk.

### Example

```
Console(config-erps)#ring-port east interface ethernet 1/12
Console(config-erps)#
```

**rpl neighbor** This command configures a ring node to be the Ring Protection Link (RPL) neighbor. Use the **no** form to restore the default setting.

#### Syntax

**rpl neighbor**

**no rpl**

#### Default Setting

None (that is, neither owner nor neighbor)

#### Command Mode

ERPS Configuration

#### Command Usage

- ◆ The RPL neighbor node, when configured, is a ring node adjacent to the RPL that is responsible for blocking its end of the RPL under normal conditions (i.e., the ring is established and no requests are present in the ring) in addition to the block at the other end by the RPL Owner Node. The RPL neighbor node may participate in blocking or unblocking its end of the RPL, but is not responsible for activating the reversion behavior.
- ◆ Only one RPL owner can be configured on a ring. If the switch is set as the RPL owner for an ERPS domain, the west ring port is set as one end of the RPL. If the switch is set as the RPL neighbor for an ERPS domain, the east ring port is set as the other end of the RPL.
- ◆ The east and west connections to the ring must be specified for all ring nodes using the [ring-port](#) command. When this switch is configured as the RPL neighbor, the east ring port is set as being connected to the RPL.
- ◆ Note that is not mandatory to declare a RPL neighbor.

#### Example

```
Console(config-erps)#rpl neighbor
Console(config-erps)#
```

**rpl owner** This command configures a ring node to be the Ring Protection Link (RPL) owner. Use the **no** form to restore the default setting.

#### Syntax

**rpl owner**

**no rpl**

#### Default Setting

None (that is, neither owner nor neighbor)

## Command Mode

### ERPS Configuration

## Command Usage

- ◆ Only one RPL owner can be configured on a ring. The owner blocks traffic on the RPL during Idle state, and unblocks it during Protection state (that is, when a signal fault is detected on the ring or the protection state is enabled with the [erps forced-switch](#) or [erps manual-switch](#) command).
- ◆ The east and west connections to the ring must be specified for all ring nodes using the [ring-port](#) command. When this switch is configured as the RPL owner, the west ring port is automatically set as being connected to the RPL.

## Example

```
Console(config-erps)#rpl owner
Console(config-erps)#
```

**version** This command specifies compatibility with ERPS version 1 or 2.

## Syntax

**version {1 | 2}**

1 - ERPS version 1 based on ITU-T G.8032/Y.1344.

2 - ERPS version 2 based on ITU-T G.8032/Y.1344 Version 2.

## Default Setting

2

## Command Mode

### ERPS Configuration

## Command Usage

- ◆ In addition to the basic features provided by version 1, version 2 also supports:
  - Multi-ring/ladder network support
  - Revertive/Non-revertive recovery
  - Forced Switch (FS) and Manual Switch (MS) commands for manually blocking a particular ring port
  - Flush FDB (forwarding database) logic which reduces amount of flush FDB operations in the ring
  - Support of multiple ERP instances on a single ring
- ◆ Version 2 is backward compatible with Version 1. If version 2 is specified, the inputs and commands are forwarded transparently. If set to version 1, MS and FS operator commands are filtered, and the switch set to revertive mode.

- ◆ The version number is automatically set to “1” when a ring node, supporting only the functionalities of G.8032v1, exists on the same ring with other nodes that support G.8032v2.
- ◆ When ring nodes running G.8032v1 and G.8032v2 co-exist on a ring, the ring ID of each node is configured as “1”.
- ◆ In version 1, the MAC address 01-19-A7-00-00-01 is used for the node identifier. The `raps-def-mac` command has no effect.

### Example

```
Console(config-erps)#version 1
Console(config-erps)#
```

**wtr-timer** This command sets the wait-to-restore timer which is used to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure. Use the **no** form to restore the default setting.

### Syntax

**wtr-timer** *minutes*

*minutes* - The wait-to-restore timer is used to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure.  
(Range: 5-12 minutes)

### Default Setting

5 minutes

### Command Mode

ERPS Configuration

### Command Usage

If the switch goes into ring protection state due to a signal failure, after the failure condition is cleared, the RPL owner will start the wait-to-restore timer and wait until it expires to verify that the ring has stabilized before blocking the RPL and returning to the Idle (normal operating) state.

### Example

```
Console(config-erps)#wtr-timer 10
Console(config-erps)#
```

**clear erps statistics** This command clears statistics, including SF, NR, NR-RB, FS, MS, Event, and Health protocol messages.

### Syntax

**clear erps statistics** [**domain** *ring-name*]

*ring-name* - Name of a specific ERPS ring. (Range: 1-12 characters)

### Command Mode

Privileged Exec

### Example

```
Console#clear erps statistics domain r&d
Console#
```

**erps clear** This command manually clears the protection state which has been invoked by a forced switch or manual switch command, and the node is operating under non-revertive mode; or before the WTR or WTB timer expires when the node is operating in revertive mode.

### Syntax

**erps clear domain** *ring-name*

*ring-name* - Name of a specific ERPS ring. (Range: 1-12 characters)

### Command Mode

Privileged Exec

### Command Usage

- ◆ Two steps are required to make a ring operating in non-revertive mode return to Idle state from forced switch or manual switch state:
  1. Issue an **erps clear** command to remove the forced switch command on the node where a local forced switch command is active.
  2. Issue an **erps clear** command on the RPL owner node to trigger the reversion.
- ◆ The **erps clear** command will also stop the WTR and WTB delay timers and reset their values.
- ◆ More detailed information about using this command for non-revertive mode is included under the Command Usage section for the [non-revertive](#) command.

**Example**

```
Console#erps clear domain r&d
Console#
```

**erps forced-switch** This command blocks the specified ring port.

**Syntax**

**erps forced-switch** [**domain** *ring-name*] {**east** | **west**}

*ring-name* - Name of a specific ERPS ring. (Range: 1-12 characters)

**east** - East ring port.

**west** - West ring port.

**Command Mode**

Privileged Exec

**Command Usage**

- ◆ A ring with no pending request has a logical topology with the traffic channel blocked at the RPL and unblocked on all other ring links. In this situation, the **erps forced-switch** command triggers protection switching as follows:
  - a. The ring node where a forced switch command was issued blocks the traffic channel and R-APS channel on the ring port to which the command was issued, and unblocks the other ring port.
  - b. The ring node where the forced switch command was issued transmits R-APS messages indicating FS over both ring ports. R-APS (FS) messages are continuously transmitted by this ring node while the local FS command is the ring node's highest priority command (see [Table 97 on page 559](#)). The R-APS (FS) message informs other ring nodes of the FS command and that the traffic channel is blocked on one ring port.
  - c. A ring node accepting an R-APS (FS) message, without any local higher priority requests unblocks any blocked ring port. This action subsequently unblocks the traffic channel over the RPL.
  - d. The ring node accepting an R-APS (FS) message, without any local higher priority requests stops transmission of R-APS messages.
  - e. The ring node receiving an R-APS (FS) message flushes its FDB.
- ◆ Protection switching on a forced switch request is completed when the above actions are performed by each ring node. At this point, traffic flows around the ring are resumed. From this point on the following rules apply regarding processing of further forced switch commands:

While an existing forced switch request is present in a ring, any new forced switch request is accepted, except on a ring node having a prior local forced switch request. The ring nodes where further forced switch commands are issued block the traffic channel and R-APS channel on the ring port at which the forced switch was issued. The ring node where the forced switch command was issued transmits an R-APS message over both ring ports indicating FS. R-APS (FS) messages are continuously transmitted by this ring node while the local FS command is the ring node's highest priority command. As such, two or more forced switches are allowed in the ring, which may inadvertently cause the segmentation of an ring. It is the responsibility of the operator to prevent this effect if it is undesirable.

Ring protection requests, commands and R-APS signals have the priorities as specified in the following table.

**Table 97: ERPS Request/State Priority**

Request / State and Status	Type	Priority
Clear	local	highest
FS	local	
R-APS (FS)	remote	
local SF*	local	
local clear SF	local	
R-APS (SF)	remote	
R-APS (MS)	remote	
MS	local	
WTR Expires	local	
WTR Running	local	
WTB Expires	local	
WTB Running	local	
R-APS (NR, RB)	remote	
R-APS (NR)	remote	lowest

\* If an Ethernet Ring Node is in the Forced Switch state, local SF is ignored.

- ◆ Recovery for forced switching under revertive and non-revertive mode is described under the Command Usage section for the [non-revertive](#) command.
- ◆ When a ring is under an FS condition, and the node at which an FS command was issued is removed or fails, the ring remains in FS state because the FS command can only be cleared at node where the FS command was issued. This results in an unrecoverable FS condition.

When performing a maintenance procedure (e.g., replacing, upgrading) on a ring node (or a ring link), it is recommended that FS commands be issued at the two adjacent ring nodes instead of directly issuing a FS command at the ring

node under maintenance in order to avoid falling into the above mentioned unrecoverable situation.

### Example

```
Console#erps forced-switch domain r&d west
Console#
```

**erps manual-switch** This command blocks the specified ring port, in the absence of a failure or an [erps forced-switch](#) command.

### Syntax

**erps manual-switch** [**domain** *ring-name*] {**east** | **west**}

*ring-name* - Name of a specific ERPS ring. (Range: 1-12 characters)

**east** - East ring port.

**west** - West ring port.

### Command Mode

Privileged Exec

### Command Usage

- ◆ A ring with no request has a logical topology with the traffic channel blocked at the RPL and unblocked on all other ring links. In this situation, the **erps manual-switch** command triggers protection switching as follows:
  - a. If no other higher priority commands exist, the ring node, where a manual switch command was issued, blocks the traffic channel and R-APS channel on the ring port to which the command was issued, and unblocks the other ring port.
  - b. If no other higher priority commands exist, the ring node where the manual switch command was issued transmits R-APS messages over both ring ports indicating MS. R-APS (MS) message are continuously transmitted by this ring node while the local MS command is the ring node's highest priority command (see [Table 97 on page 559](#)). The R-APS (MS) message informs other ring nodes of the MS command and that the traffic channel is blocked on one ring port.
  - c. If no other higher priority commands exist and assuming the ring node was in Idle state before the manual switch command was issued, the ring node flushes its local FDB.
  - d. A ring node accepting an R-APS (MS) message, without any local higher priority requests unblocks any blocked ring port which does not have an SF condition. This action subsequently unblocks the traffic channel over the RPL.



- e. A ring node accepting an R-APS (MS) message, without any local higher priority requests stops transmitting R-APS messages.
  - f. A ring node receiving an R-APS (MS) message flushes its FDB.
- ◆ Protection switching on a manual switch request is completed when the above actions are performed by each ring node. At this point, traffic flows around the ring are resumed. From this point on, the following rules apply regarding processing of further manual switch commands:
    - a. While an existing manual switch request is present in the ring, any new manual switch request is rejected. The request is rejected at the ring node where the new request is issued and a notification is generated to inform the operator that the new MS request was not accepted.
    - b. A ring node with a local manual switch command which receives an R-APS (MS) message with a different Node ID clears its manual switch request and starts transmitting R-APS (NR) messages. The ring node keeps the ring port blocked due to the previous manual switch command.
    - c. An ring node with a local manual switch command that receives an R-APS message or a local request of higher priority than R-APS (MS) clear its manual switch request. The ring node then processes the new higher priority request.
  - ◆ Recovery for manual switching under revertive and non-revertive mode is described under the Command Usage section for the **non-revertive** command.

### Example

```
Console#erps manual-switch domain r&d west
Console#
```

**show erps** This command displays status information for all configured rings, or for a specified ring

### Syntax

**show erps** [**domain** *ring-name*] [**statistics**]

**domain** - Keyword to display ERPS ring configuration settings.

*ring-name* - Name of a specific ERPS ring. (Range: 1-32 characters)

**statistics** - Keyword to display ERPS ring statistics.

### Command Mode

Privileged Exec

**Example**

This example displays a summary of all the ERPS rings configured on the switch.

```

Console#show erps
ERPS Status           : Enabled
Number of ERPS Domains : 1

Domain      ID  Enabled Ver  MEL Ctrl VLAN State      Type      Revertive
-----
r&d        1  Yes    2    1      1 Idle    RPL Owner  Yes

W/E  Interface Port State Local SF Local FS Local MS MEP  RPL
----
West Eth 1/ 1 Blocking No      No      No      Yes
East Eth 1/ 3 Forwarding No      No      No      No

```

Console#

**Table 98: show erps - summary display description**

Field	Description
<i>Node Information</i>	
ERPS Status	Shows whether ERPS is enabled on the switch.
Number of ERPS Domains	Shows the number of ERPS rings configured on the switch.
Domain	Displays the name of each ring followed by a brief list of status information
ID	ERPS ring identifier used in R-APS messages.
Enabled	Shows if the specified ring is enabled.
Ver	Shows the ERPS version.
MEL	The maintenance entity group (MEG) level providing a communication channel for ring automatic protection switching (R-APS) information.
Ctrl VLAN	Shows the Control VLAN ID.
State	Shows the following ERPS states:  Init – The ERPS ring has started but has not yet determined the status of the ring.  Idle – If all nodes in a ring are in this state, it means that all the links in the ring are up. This state will switch to protection state if a link failure occurs.  Protection – If a node in this state, it means that a link failure has occurred. This state will switch to idle state if all the failed links recover.
Type	Shows ERPS node type as None, RPL Owner or RPL Neighbor.
Revertive	Shows if revertive or non-revertive recovery is selected.
<i>Interface Information</i>	
W/E	Shows information on the west and east ring port for this node.
Interface	The port or trunk which is configured as a ring port.

**Table 98: show erps - summary display description** (Continued)

Field	Description
Port State	The operational state:  Blocking – The transmission and reception of traffic is blocked and the forwarding of R-APS messages is blocked, but the transmission of locally generated R-APS messages is allowed and the reception of all R-APS messages is allowed.  Forwarding – The transmission and reception of traffic is allowed; transmission, reception and forwarding of R-APS messages is allowed.  Unknown – The interface is not in a known state (includes the domain being disabled).
Local SF	A signal fault generated on a link to the local node.
Local FS	Shows if a forced switch command was issued on this interface.
Local MS	Shows if a manual switch command was issued on this interface.
MEP	The CFM MEP used to monitor the status on this link.
RPL	Shows if this node is connected to the RPL.

This example displays detailed information for the specified ERPS ring.

```

Console#show erps domain rd1
Domain      ID  Enabled Ver  MEL  Ctrl  VLAN  State      Type      Revertive
-----
r&d         1  Yes      2    1      1  Idle      RPL Owner  Yes

Major Domain Node ID      R-APS With VC
-----
00-E0-0C-00-00-FD Yes

R-APS Def MAC Propagate TC Non-ERPS Device Protect
-----
Yes          No          No

Holdoff  Guard  WTB  WTR  WTB Expire WTR Expire
-----
0 ms    500 ms 5500 ms 5 min

W/E  Interface Port State Local SF Local FS Local MS MEP  RPL
-----
West Eth 1/ 1 Blocking No      No      No      Yes
East Eth 1/ 3 Forwarding No      No      No      No

```

Console#

[Table 98 on page 562](#) describes most of the parameters shown by **show erps domain** command. The following table includes the remaining parameters.

**Table 99: show erps domain - detailed display description**

Field	Description
Major Domain	Name of the ERPS major domain.
Node ID	A MAC address unique to this ring node.

**Table 99: show erps domain - detailed display description** (Continued)

Field	Description
R-APS with VC	The R-APS Virtual Channel is the R-APS channel connection used to tunnel R-APS messages between two interconnection nodes of a sub-ring in another Ethernet ring or network.
R-APS Def MAC	Indicates if the switch's MAC address is used to identify the node in R-APS messages.
Propagate TC	Shows if the ring is configured to propagate topology change notification messages.
Non-ERPS Device Protect	Shows if the RPL owner node is configured to send non-standard health-check packets when it enters protection state without any link down event having been detected through SF messages
Holdoff	The hold-off timer interval used to filter out intermittent link faults.
Guard	The guard timer interval used to prevent ring nodes from receiving outdated R-APS messages.
WTB	The wait-to-block timer interval used to delay reversion after a Forced Switch or Manual Switch has been cleared.
WTR	The wait-to-restore timer interval used to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure.
WTB Expire	The time before the wait-to-block timer expires.
WTR Expire	The time before the wait-to-restore timer expires.

This example displays statistics for all configured ERPS rings.

```

Console#show erps statistics
ERPS statistics for domain r&d :
Interface      Local SF      Local Clear SF
-----
(W) Eth 1/ 1 0
              SF      NR      NR-RB      FS      MS
-----
Sent          0      62      948      0      0
Received      0      0      0      0      0
Ignored       0      0      0      0      0
              EVENT    HEALTH
-----
Sent          0      0
Received      0      0
Ignored       0      0

Interface      Local SF      Local Clear SF
-----
(E) Eth 1/ 3 0
              SF      NR      NR-RB      FS      MS
-----
Sent          0      62      948      0      0
Received      0      0      0      0      0
Ignored       0      0      0      0      0
              EVENT    HEALTH
-----
Sent          0      0
Received      0      0
Ignored       0      0
Console#

```

**Table 100: show erps statistics - detailed display description**

Field	Description
Interface	The direction, and port or trunk which is configured as a ring port.
Local SF	A signal fault generated on a link to the local node.
Local Clear SF	The number of times a clear command was issued to terminate protection state entered through a forced switch or manual switch
SF	The number of signal fault messages
NR	The number of no request messages
NR-RB	The number no request - RPL blocked messages
FS	The number of forced switch messages
MS	The number of manual switch messages
EVENT	Any request/state message, excluding FS, SF, MS, and NR
HEALTH	The number of non-standard health-check messages



# VLAN Commands

A VLAN is a group of ports that can be located anywhere in the network, but communicate as though they belong to the same physical segment. This section describes commands used to create VLAN groups, add port members, specify how VLAN tagging is used, and enable automatic VLAN registration for the selected interface.

**Table 101: VLAN Commands**

Command Group	Function
<a href="#">GVRP and Bridge Extension Commands</a>	Configures GVRP settings that permit automatic VLAN learning; shows the configuration for bridge extension MIB
<a href="#">Editing VLAN Groups</a>	Sets up VLAN groups, including name, VID and state
<a href="#">Configuring VLAN Interfaces</a>	Configures VLAN interface parameters, including ingress and egress tagging mode, ingress filtering, PVID, and GVRP
<a href="#">Displaying VLAN Information</a>	Displays VLAN groups, status, port members, and MAC addresses
<a href="#">Configuring IEEE 802.1Q Tunneling</a>	Configures 802.1Q Tunneling (QinQ Tunneling)
<a href="#">Configuring L2CP Tunneling*</a>	Configures Layer 2 Control Protocol (L2CP) tunneling, either by discarding, processing, or transparently passing control packets across a QinQ tunnel
<a href="#">Configuring VLAN Translation*</a>	Maps VLAN ID between customer and service provider for networks that do not support IEEE 802.1Q tunneling
<a href="#">Configuring Protocol-based VLANs</a>	Configures protocol-based VLANs based on frame type and protocol
<a href="#">Configuring IP Subnet VLANs</a>	Configures IP Subnet-based VLANs
<a href="#">Configuring MAC Based VLANs</a>	Configures MAC-based VLANs
<a href="#">Configuring Voice VLANs</a>	Configures VoIP traffic detection and enables a Voice VLAN

\* These functions are not compatible.

## GVRP and Bridge Extension Commands

GARP VLAN Registration Protocol defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network. This section describes how to enable GVRP for individual interfaces and globally for the switch, as well as how to display default configuration settings for the Bridge Extension MIB.

**Table 102: GVRP and Bridge Extension Commands**

Command	Function	Mode
<code>bridge-ext gvrp</code>	Enables GVRP globally for the switch	GC
<code>garp timer</code>	Sets the GARP timer for the selected function	IC
<code>switchport forbidden vlan</code>	Configures forbidden VLANs for an interface	IC
<code>switchport gvrp</code>	Enables GVRP for an interface	IC
<code>show bridge-ext</code>	Shows the global bridge extension configuration	PE
<code>show garp timer</code>	Shows the GARP timer for the selected function	NE, PE
<code>show gvrp configuration</code>	Displays GVRP configuration for the selected interface	NE, PE

**bridge-ext gvrp** This command enables GVRP globally for the switch. Use the **no** form to disable it.

### Syntax

**[no] bridge-ext gvrp**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

GVRP defines a way for switches to exchange VLAN information in order to register VLAN members on ports across the network. This function should be enabled to permit automatic VLAN registration, and to support VLANs which extend beyond the local switch.

### Example

```
Console(config)#bridge-ext gvrp
Console(config)#
```



**garp timer** This command sets the values for the join, leave and leaveall timers. Use the **no** form to restore the timers' default values.

### Syntax

**garp timer {join | leave | leaveall} timer-value**

**no garp timer {join | leave | leaveall}**

**{join | leave | leaveall}** - Timer to set.

*timer-value* - Value of timer.

Ranges:

join: 20-1000 centiseconds

leave: 60-3000 centiseconds

leaveall: 500-18000 centiseconds

### Default Setting

join: 20 centiseconds

leave: 60 centiseconds

leaveall: 1000 centiseconds

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Group Address Registration Protocol is used by GVRP and GMRP to register or deregister client attributes for client services within a bridged LAN. The default values for the GARP timers are independent of the media access method or data rate. These values should not be changed unless you are experiencing difficulties with GMRP or GVRP registration/deregistration.
- ◆ Timer values are applied to GVRP for all the ports on all VLANs.
- ◆ Timer values must meet the following restrictions:
  - leave > (2 x join)
  - leaveall > leave



**Note:** Set GVRP timers on all Layer 2 devices connected in the same network to the same values. Otherwise, GVRP may not operate successfully.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#garp timer join 100
Console(config-if)#
```

**Related Commands**  
[show garp timer \(572\)](#)

**switchport forbidden vlan** This command configures forbidden VLANs. Use the **no** form to remove the list of forbidden VLANs.

**Syntax**

**switchport forbidden vlan** {**add** *vlan-list* | **remove** *vlan-list*}

**no switchport forbidden vlan**

**add** *vlan-list* - List of VLAN identifiers to add.

**remove** *vlan-list* - List of VLAN identifiers to remove.

*vlan-list* - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094).

**Default Setting**

No VLANs are included in the forbidden list.

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ This command prevents a VLAN from being automatically added to the specified interface via GVRP.
- ◆ If a VLAN has been added to the set of allowed VLANs for an interface, then you cannot add it to the set of forbidden VLANs for that same interface.
- ◆ GVRP cannot be enabled for ports set to Access mode (see the [switchport mode](#) command).

**Example**

The following example shows how to prevent port 1 from being added to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport forbidden vlan add 3
Console(config-if)#
```

**switchport gvrp** This command enables GVRP for a port. Use the **no** form to disable it.

**Syntax**

**[no] switchport gvrp**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

GVRP cannot be enabled for ports set to Access mode using the [switchport mode](#) command.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport gvrp
Console(config-if)#
```

**show bridge-ext** This command shows the configuration for bridge extension commands.

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show bridge-ext
Maximum Supported VLAN Numbers      : 4094
Maximum Supported VLAN ID           : 4094
Extended Multicast Filtering Services : No
Static Entry Individual Port         : Yes
VLAN Version Number                  : 2
VLAN Learning                        : IVL
Configurable PVID Tagging            : Yes
Local VLAN Capable                   : No
Traffic Classes                      : Enabled
Global GVRP Status                   : Disabled
Console#
```

**Table 103: show bridge-ext - display description**

Field	Description
Maximum Supported VLAN Numbers	The maximum number of VLANs supported on this switch.
Maximum Supported VLAN ID	The maximum configurable VLAN identifier supported on this switch.
Extended Multicast Filtering Services	This switch does not support the filtering of individual multicast addresses based on GMRP (GARP Multicast Registration Protocol).

**Table 103: show bridge-ext - display description** (Continued)

Field	Description
Static Entry Individual Port	This switch allows static filtering for unicast and multicast addresses. (Refer to the <a href="#">mac-address-table static</a> command.)
VLAN Version Number	Based on IEEE 802.1Q, "1" indicates Bridges that support only single spanning tree (SST) operation, and "2" indicates Bridges that support multiple spanning tree (MST) operation.
VLAN Learning	This switch uses Independent VLAN Learning (IVL), where each port maintains its own filtering database.
Configurable PVID Tagging	This switch allows you to override the default Port VLAN ID (PVID used in frame tags) and egress status (VLAN-Tagged or Untagged) on each port. (Refer to the <a href="#">switchport allowed vlan</a> command.)
Local VLAN Capable	This switch does not support multiple local bridges outside of the scope of 802.1Q defined VLANs.
Traffic Classes	This switch provides mapping of user priorities to multiple traffic classes. (Refer to <a href="#">"Class of Service Commands" on page 613.</a> )
Global GVRP Status	GARP VLAN Registration Protocol defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network. This field shows if GVRP is globally enabled or disabled. (Refer to the <a href="#">bridge-ext gvrp</a> command.)

**show garp timer** This command shows the GARP timers for the selected interface.

### Syntax

**show garp timer** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

Shows all GARP timers.

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show garp timer ethernet 1/1
Eth 1/ 1 GARP Timer Status:
Join Timer      : 20 centiseconds
Leave Timer      : 60 centiseconds
Leave All Timer  : 1000 centiseconds
Console#
```

## Related Commands

[garp timer \(569\)](#)

**show gvrp configuration** This command shows if GVRP is enabled.

### Syntax

```
show gvrp configuration [interface]
    interface
        ethernet unit/port
            unit - Unit identifier. (Range: 1-8)
            port - Port number. (Range: 1-28)
        port-channel channel-id (Range: 1-16)
```

### Default Setting

Shows both global and interface-specific configuration.

### Command Mode

Normal Exec, Privileged Exec

### Example

```
Console#show gvrp configuration ethernet 1/7
Eth 1/ 7:
  GVRP Configuration : Disabled
Console#
```

## Editing VLAN Groups

Table 104: Commands for Editing VLAN Groups

Command	Function	Mode
<a href="#">vlan database</a>	Enters VLAN database mode to add, change, and delete VLANs	GC
<a href="#">vlan</a>	Configures a VLAN, including VID, name and state	VC

**vlan database** This command enters VLAN database mode. All commands in this mode will take effect immediately.

### Default Setting

None

## Command Mode

Global Configuration

## Command Usage

- ◆ Use the VLAN database command mode to add, change, and delete VLANs. After finishing configuration changes, you can display the VLAN settings by entering the `show vlan` command.
- ◆ Use the `interface vlan` command mode to define the port membership mode and add or remove ports from a VLAN. The results of these commands are written to the running-configuration file, and you can display this file by entering the `show running-config` command.

## Example

```
Console(config)#vlan database
Console(config-vlan)#
```

## Related Commands

[show vlan \(582\)](#)

**vlan** This command configures a VLAN. Use the **no** form to restore the default settings or delete a VLAN.

## Syntax

**vlan** *vlan-id* [**name** *vlan-name*] **media ethernet** [**state** {**active** | **suspend**}] [**rspan**]

**no vlan** *vlan-id* [**name** | **state**]

*vlan-id* - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094)

**name** - Keyword to be followed by the VLAN name.

*vlan-name* - ASCII string from 1 to 32 characters.

**media ethernet** - Ethernet media type.

**state** - Keyword to be followed by the VLAN state.

**active** - VLAN is operational.

**suspend** - VLAN is suspended. Suspended VLANs do not pass packets.

**rspan** - Keyword to create a VLAN used for mirroring traffic from remote switches. The VLAN used for RSPAN cannot include VLAN 1 (the switch's default VLAN). Nor should it include VLAN 4093 (which is used for switch clustering). Configuring VLAN 4093 for other purposes may cause problems in the Clustering operation. For more information on configuring RSPAN through the CLI, see ["RSPAN Mirroring Commands" on page 458](#).

### Default Setting

By default only VLAN 1 exists and is active.

### Command Mode

VLAN Database Configuration

### Command Usage

- ◆ **no vlan** *vlan-id* deletes the VLAN.
- ◆ **no vlan** *vlan-id* **name** removes the VLAN name.
- ◆ **no vlan** *vlan-id* **state** returns the VLAN to the default state (i.e., active).
- ◆ You can configure up to 4094 VLANs on the switch.

### Example

The following example adds a VLAN, using VLAN ID 105 and name RD5. The VLAN is activated by default.

```
Console(config)#vlan database
Console(config-vlan)#vlan 105 name RD5 media ethernet
Console(config-vlan)#
```

### Related Commands

[show vlan \(582\)](#)

## Configuring VLAN Interfaces

Table 105: Commands for Configuring VLAN Interfaces

Command	Function	Mode
<a href="#">interface vlan</a>	Enters interface configuration mode for a specified VLAN	IC
<a href="#">switchport acceptable-frame-types</a>	Configures frame types to be accepted by an interface	IC
<a href="#">switchport allowed vlan</a>	Configures the VLANs associated with an interface	IC
<a href="#">switchport forbidden vlan</a>	Configures forbidden VLANs for an interface	IC
<a href="#">switchport gvrp</a>	Enables GVRP for an interface	IC
<a href="#">switchport ingress-filtering</a>	Enables ingress filtering on an interface	IC
<a href="#">switchport mode</a>	Configures VLAN membership mode for an interface	IC
<a href="#">switchport native vlan</a>	Configures the PVID (native VLAN) of an interface	IC
<a href="#">switchport priority default</a>	Sets a port priority for incoming untagged frames	IC
<a href="#">vlan-trunking</a>	Allows unknown VLANs to cross the switch	IC

**interface vlan** This command enters interface configuration mode for VLANs, which is used to configure VLAN parameters for a physical interface. Use the **no** form to change a Layer 3 normal VLAN back to a Layer 2 interface.

#### Syntax

**[no] interface vlan** *vlan-id*

*vlan-id* - ID of the configured VLAN. (Range: 1-4094)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Command Usage

- ◆ Creating a “normal” VLAN with the **vlan** command initializes it as a Layer 2 interface. To change it to a Layer 3 interface, use the **interface** command to enter interface configuration for the desired VLAN, enter any Layer 3 configuration commands, and save the configuration settings.
- ◆ To change a Layer 3 normal VLAN back to a Layer 2 VLAN, use the **no interface** command.

#### Example

The following example shows how to set the interface configuration mode to VLAN 1, and then assign an IP address to the VLAN:

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.254 255.255.255.0
Console(config-if)#
```

#### Related Commands

[shutdown \(418\)](#)

[interface \(412\)](#)

[vlan \(574\)](#)

**switchport acceptable-frame-types** This command configures the acceptable frame types for a port. Use the **no** form to restore the default.

#### Syntax

**switchport acceptable-frame-types** {**all** | **tagged**}

**no switchport acceptable-frame-types**

**all** - The port accepts all frames, tagged or untagged.

**tagged** - The port only receives tagged frames.



### Default Setting

All frame types

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

When set to receive all frame types, any received frames that are untagged are assigned to the default VLAN.

### Example

The following example shows how to restrict the traffic received on port 1 to tagged frames:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport acceptable-frame-types tagged
Console(config-if)#
```

### Related Commands

[switchport mode \(579\)](#)

**switchport allowed vlan** This command configures VLAN groups on the selected interface. Use the **no** form to restore the default.

### Syntax

**switchport allowed vlan {add *vlan-list* [tagged | untagged] | remove *vlan-list*}**

**no switchport allowed vlan**

**add** *vlan-list* - List of VLAN identifiers to add.

**remove** *vlan-list* - List of VLAN identifiers to remove.

*vlan-list* - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094).

### Default Setting

All ports are assigned to VLAN 1 by default.  
The default frame type is untagged.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ A port, or a trunk with switchport mode set to **hybrid**, must be assigned to at least one VLAN as untagged.

- ◆ If a trunk has switchport mode set to **trunk** (i.e., 1Q Trunk), then you can only assign an interface to VLAN groups as a tagged member.
- ◆ Frames are always tagged within the switch. The tagged/untagged parameter used when adding a VLAN to an interface tells the switch whether to keep or remove the tag from a frame on egress.
- ◆ If none of the intermediate network devices nor the host at the other end of the connection supports VLANs, the interface should be added to these VLANs as an untagged member. Otherwise, it is only necessary to add at most one VLAN as untagged, and this should correspond to the native VLAN for the interface.
- ◆ If a VLAN on the forbidden list for an interface is manually added to that interface, the VLAN is automatically removed from the forbidden list for that interface.

### Example

The following example shows how to add VLANs 1, 2, 5 and 6 to the allowed list as tagged VLANs for port 1:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 1,2,5,6 tagged
Console(config-if)#
```

### **switchport ingress-filtering**

This command enables ingress filtering for an interface. Use the **no** form to restore the default.

### Syntax

**[no] switchport ingress-filtering**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Ingress filtering only affects tagged frames.
- ◆ If ingress filtering is disabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be flooded to all other ports (except for those VLANs explicitly forbidden on this port).
- ◆ If ingress filtering is enabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be discarded.

- ◆ Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STA. However, they do affect VLAN dependent BPDU frames, such as GMRP.

### Example

The following example shows how to set the interface to port 1 and then enable ingress filtering:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport ingress-filtering
Console(config-if)#
```

**switchport mode** This command configures the VLAN membership mode for a port. Use the **no** form to restore the default.

### Syntax

**switchport mode {access | hybrid | trunk}**

**no switchport mode**

**access** - Specifies an access VLAN interface. The port transmits and receives untagged frames on a single VLAN only.

**hybrid** - Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames.

**trunk** - Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that identify the source VLAN. Note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are also transmitted as tagged frames.

### Default Setting

All ports are in hybrid mode with the PVID set to VLAN 1.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

Access mode is mutually exclusive with VLAN trunking (see the [vlan-trunking](#) command). If VLAN trunking is enabled on an interface, then that interface cannot be set to access mode, and vice versa.

### Example

The following shows how to set the configuration mode to port 1, and then set the switchport mode to hybrid:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport mode hybrid
Console(config-if)#
```

### Related Commands

[switchport acceptable-frame-types \(576\)](#)

**switchport native vlan** This command configures the PVID (i.e., default VLAN ID) for a port. Use the **no** form to restore the default.

### Syntax

**switchport native vlan** *vlan-id*

**no switchport native vlan**

*vlan-id* - Default VLAN ID for a port. (Range: 1-4094)

### Default Setting

VLAN 1

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ When using Access mode, and an interface is assigned to a new VLAN, its PVID is automatically set to the identifier for that VLAN. When using Hybrid mode, the PVID for an interface can be set to any VLAN for which it is an untagged member.
- ◆ If acceptable frame types is set to **all** or switchport mode is set to **hybrid**, the PVID will be inserted into all untagged frames entering the ingress port.

### Example

The following example shows how to set the PVID for port 1 to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport native vlan 3
Console(config-if)#
```

**vlan-trunking** This command allows unknown VLAN groups to pass through the specified interface. Use the **no** form to disable this feature.

### Syntax

**[no] vlan-trunking**

### Default Setting

Disabled

### Command Mode

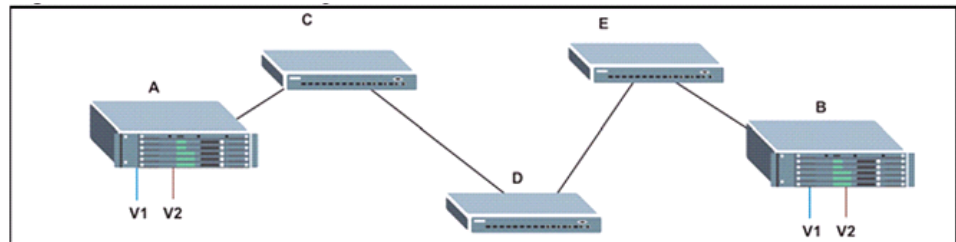
Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Use this command to configure a tunnel across one or more intermediate switches which pass traffic for VLAN groups to which they do not belong.

The following figure shows VLANs 1 and 2 configured on switches A and B, with VLAN trunking being used to pass traffic for these VLAN groups across switches C, D and E.

**Figure 6: Configuring VLAN Trunking**



Without VLAN trunking, you would have to configure VLANs 1 and 2 on all intermediate switches – C, D and E; otherwise these switches would drop any frames with unknown VLAN group tags. However, by enabling VLAN trunking on the intermediate switch ports along the path connecting VLANs 1 and 2, you only need to create these VLAN groups in switches A and B. Switches C, D and E automatically allow frames with VLAN group tags 1 and 2 (groups that are unknown to those switches) to pass through their VLAN trunking ports.

- ◆ VLAN trunking is mutually exclusive with the “access” switchport mode (see the [switchport mode](#) command). If VLAN trunking is enabled on an interface, then that interface cannot be set to access mode, and vice versa.
- ◆ To prevent loops from forming in the spanning tree, all unknown VLANs will be bound to a single instance (either STP/RSTP or an MSTP instance, depending on the selected STA mode).
- ◆ If both VLAN trunking and ingress filtering are disabled on an interface, packets with unknown VLAN tags will still be allowed to enter this interface and will be flooded to all other ports where VLAN trunking is enabled. (In other words, VLAN trunking will still be effectively enabled for the unknown VLAN).

### Example

The following example enables VLAN trunking on ports 9 and 10 to establish a path across the switch for unknown VLAN groups:

```
Console(config)#interface ethernet 1/9
Console(config-if)#vlan-trunking
Console(config-if)#interface ethernet 1/10
Console(config-if)#vlan-trunking
Console(config-if)#
```

## Displaying VLAN Information

This section describes commands used to display VLAN information.

**Table 106: Commands for Displaying VLAN Information**

Command	Function	Mode
<code>show interfaces status vlan</code>	Displays status for the specified VLAN interface	NE, PE
<code>show interfaces switchport</code>	Displays the administrative and operational status of an interface	NE, PE
<code>show vlan</code>	Shows VLAN information	NE, PE

**show vlan** This command shows VLAN information.

### Syntax

**show vlan** [**id** *vlan-id* | **name** *vlan-name*]

**id** - Keyword to be followed by the VLAN ID.

*vlan-id* - ID of the configured VLAN. (Range: 1-4094)

**name** - Keyword to be followed by the VLAN name.

*vlan-name* - ASCII string from 1 to 32 characters.

### Default Setting

Shows all VLANs.

### Command Mode

Normal Exec, Privileged Exec

### Example

The following example shows how to display information for VLAN 1:

```
Console#show vlan id 1

VLAN ID:          1
Type:              Static
Name:              DefaultVlan
Status:            Active
Ports/Port Channels : Eth1/ 1(S) Eth1/ 2(S) Eth1/ 3(S) Eth1/ 4(S) Eth1/ 5(S)
                      Eth1/ 6(S) Eth1/ 7(S) Eth1/ 8(S) Eth1/ 9(S) Eth1/10(S)
                      Eth1/11(S) Eth1/12(S) Eth1/13(S) Eth1/14(S) Eth1/15(S)
                      Eth1/16(S) Eth1/17(S) Eth1/18(S) Eth1/19(S) Eth1/20(S)
                      Eth1/21(S) Eth1/22(S) Eth1/23(S) Eth1/24(S) Eth1/25(S)
                      Eth1/26(S) Eth1/27(S) Eth1/28(S)

Console#
```

## Configuring IEEE 802.1Q Tunneling

IEEE 802.1Q tunneling (QinQ tunneling) uses a single Service Provider VLAN (SPVLAN) for customers who have multiple VLANs. Customer VLAN IDs are preserved and traffic from different customers is segregated within the service provider's network even when they use the same customer-specific VLAN IDs. QinQ tunneling expands VLAN space by using a VLAN-in-VLAN hierarchy, preserving the customer's original tagged packets, and adding SPVLAN tags to each frame (also called double tagging).

This section describes commands used to configure QinQ tunneling.

**Table 107: 802.1Q Tunneling Commands**

Command	Function	Mode
<code>dot1q-tunnel system-tunnel-control</code>	Configures the switch to operate in normal mode or QinQ mode	GC
<code>switchport dot1q-tunnel mode</code>	Configures an interface as a QinQ tunnel port	IC
<code>switchport dot1q-tunnel service match cvid</code>	Creates a CVLAN to SPVLAN mapping entry	IC
<code>switchport dot1q-tunnel tpid</code>	Sets the Tag Protocol Identifier (TPID) value of a tunnel port	IC
<code>show dot1q-tunnel</code>	Displays the configuration of QinQ tunnel ports	PE
<code>show interfaces switchport</code>	Displays port QinQ operational status	PE

### *General Configuration Guidelines for QinQ*

1. Configure the switch to QinQ mode (`dot1q-tunnel system-tunnel-control`).
2. Create a SPVLAN (`vlan`).
3. Configure the QinQ tunnel access port to dot1Q-tunnel access mode (`switchport dot1q-tunnel mode`).
4. Set the Tag Protocol Identifier (TPID) value of the tunnel access port. This step is required if the attached client is using a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The standard ethertype value is 0x8100. (See `switchport dot1q-tunnel tpid`.)
5. Configure the QinQ tunnel access port to join the SPVLAN as an untagged member (`switchport allowed vlan`).
6. Configure the SPVLAN ID as the native VID on the QinQ tunnel access port (`switchport native vlan`).
7. Configure the QinQ tunnel uplink port to dot1Q-tunnel uplink mode (`switchport dot1q-tunnel mode`).

8. Configure the QinQ tunnel uplink port to join the SPVLAN as a tagged member ([switchport allowed vlan](#)).

#### *Limitations for QinQ*

- ◆ The native VLAN for the tunnel uplink ports and tunnel access ports cannot be the same. However, the same service VLANs can be set on both tunnel port types.
- ◆ IGMP Snooping should not be enabled on a tunnel access port.
- ◆ If the spanning tree protocol is enabled, be aware that a tunnel access or tunnel uplink port may be disabled if the spanning tree structure is automatically reconfigured to overcome a break in the tree. It is therefore advisable to disable spanning tree on these ports.

**dot1q-tunnel system-tunnel-control** This command sets the switch to operate in QinQ mode. Use the **no** form to disable QinQ operating mode.

#### **Syntax**

**[no] dot1q-tunnel system-tunnel-control**

#### **Default Setting**

Disabled

#### **Command Mode**

Global Configuration

#### **Command Usage**

QinQ tunnel mode must be enabled on the switch for QinQ interface settings to be functional.

#### **Example**

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#
```

#### **Related Commands**

[show dot1q-tunnel](#) (589)  
[show interfaces switchport](#) (427)



**switchport dot1q-tunnel mode** This command configures an interface as a QinQ tunnel port. Use the **no** form to disable QinQ on the interface.

#### Syntax

**switchport dot1q-tunnel mode {access | uplink}**

**no switchport dot1q-tunnel mode**

**access** – Sets the port as an 802.1Q tunnel access port.

**uplink** – Sets the port as an 802.1Q tunnel uplink port.

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ QinQ tunneling must be enabled on the switch using the [dot1q-tunnel system-tunnel-control](#) command before the **switchport dot1q-tunnel mode** interface command can take effect.
- ◆ When a tunnel uplink port receives a packet from a customer, the customer tag (regardless of whether there are one or more tag layers) is retained in the inner tag, and the service provider's tag added to the outer tag.
- ◆ When a tunnel uplink port receives a packet from the service provider, the outer service provider's tag is stripped off, and the packet passed on to the VLAN indicated by the inner tag. If no inner tag is found, the packet is passed onto the native VLAN defined for the uplink port.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#
```

#### Related Commands

[show dot1q-tunnel](#) (589)

[show interfaces switchport](#) (427)

**switchport** This command creates a CVLAN to SPVLAN mapping entry. Use the **no** form to  
**dot1q-tunnel service** delete a VLAN mapping entry.  
**match cvid**

#### Syntax

**switchport dot1q-tunnel service svid match cvid cvid**

*svid* - VLAN ID for the outer VLAN tag (Service Provider VID). (Range: 1-4094)

*cvid* - VLAN ID for the inner VLAN tag (Customer VID). (Range: 1-4094)

#### Default Setting

Default mapping uses the PVID of the ingress port on the edge router for the SPVID.

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ The inner VLAN tag of a customer packet entering the edge router of a service provider's network is mapped to an outer tag indicating the service provider VLAN that will carry this traffic across the 802.1Q tunnel. This process is performed in a transparent manner.
- ◆ When priority bits are found in the inner tag, these are also copied to the outer tag. This allows the service provider to differentiate service based on the indicated priority and appropriate methods of queue management at intermediate nodes across the tunnel.
- ◆ Rather than relying on standard service paths and priority queuing, QinQ VLAN mapping can be used to further enhance service by defining a set of differentiated service pathways to follow across the service provider's network for traffic arriving from specified inbound customer VLANs.
- ◆ Note that all customer interfaces should be configured as access interfaces (that is, a user-to-network interface) and service provider interfaces as uplink interfaces (that is, a network-to-network interface). Use the [switchport dot1q-tunnel mode uplink](#) command to set an interface to access or uplink mode.

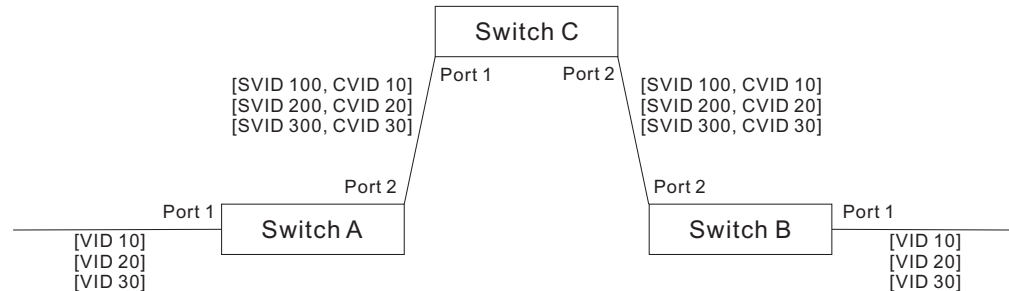
#### Example

This example sets the SVID to 99 in the outer tag for egress packets exiting port 1 when the packet's CVID is 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel service 99 match cvid 2
Console(config-if)#
```

The following example maps C-VLAN 10 to S-VLAN 100, C-VLAN 20 to S-VLAN 200 and C-VLAN 30 to S-VLAN 300 for ingress traffic on port 1 of Switches A and B.

**Figure 7: Mapping QinQ Service VLAN to Customer VLAN**



Step 1. Configure Switch A and B.

**1. Create VLANs 100, 200 and 300.**

```
Console(config)#vlan database
Console(config-vlan)#vlan 100,200,300 media ethernet state active
```

**2. Enable QinQ.**

```
Console(config)#dot1q-tunnel system-tunnel-control
```

**3. Configure port 2 as a tagged member of VLANs 100, 200 and 300 using uplink mode.**

```
Console(config)#interface ethernet 1/2
Console(config-if)#switchport allowed vlan add 100,200,300 tagged
Console(config-if)#switchport dot1q-tunnel mode uplink
```

**4. Configures port 1 as an untagged member of VLANs 100, 200 and 300 using access mode.**

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 100,200,300 untagged
Console(config-if)#switchport dot1q-tunnel mode access
```

**5. Configure the following selective QinQ mapping entries.**

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel service 100 match cvid 10
Console(config-if)#switchport dot1q-tunnel service 200 match cvid 20
Console(config-if)#switchport dot1q-tunnel service 300 match cvid 30
```

**6. Configures port 1 as member of VLANs 10, 20 and 30 to avoid filtering out incoming frames tagged with VID 10, 20 or 30 on port 1**

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 10,20,30
```

**7. Verify configuration settings.**

```
Console#show dot1q-tunnel service
802.1Q Tunnel Service Subscriptions
```

Port	Match	C-VID	S-VID
Eth 1/ 1		10	100
Eth 1/ 1		20	200
Eth 1/ 1		30	300

## Step 2. Configure Switch C.

### 1. Create VLAN 100, 200 and 300.

```
Console(config)#vlan database
Console(config-vlan)#vlan 100,200,300 media ethernet state active
```

### 2. Configure port 1 and port 2 as tagged members of VLAN 100, 200 and 300.

```
Console(config)#interface ethernet 1/1,2
Console(config-if)#switchport allowed vlan add 100,200,300 tagged
```

**switchport dot1q-tunnel tpid** This command sets the Tag Protocol Identifier (TPID) value of a tunnel port. Use the **no** form to restore the default setting.

### Syntax

**switchport dot1q-tunnel tpid** *tpid*

**no switchport dot1q-tunnel tpid**

*tpid* – Sets the ethertype value for 802.1Q encapsulation. This identifier is used to select a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The standard ethertype value is 0x8100. (Range: 0800-FFFF hexadecimal)

### Default Setting

0x8100

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Use the **switchport dot1q-tunnel tpid** command to set a custom 802.1Q ethertype value on the selected interface. This feature allows the switch to interoperate with third-party switches that do not use the standard 0x8100 ethertype to identify 802.1Q-tagged frames. For example, 0x1234 is set as the custom 802.1Q ethertype on a trunk port, incoming frames containing that ethertype are assigned to the VLAN contained in the tag following the ethertype field, as they would be with a standard 802.1Q trunk. Frames arriving on the port containing any other ethertype are looked upon as untagged frames, and assigned to the native VLAN of that port.
- ◆ The specified ethertype only applies to ports configured in Uplink mode using the **switchport dot1q-tunnel mode** command. If the port is in normal mode (i.e., unspecified), the TPID is always 8100. If the port is in Access mode, received packets are processed as untagged packets.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel tpid 9100
Console(config-if)#
```

## Related Commands

[show interfaces switchport \(427\)](#)

**show dot1q-tunnel** This command displays information about QinQ tunnel ports.

## Syntax

**show dot1q-tunnel** [**interface** *interface* [**service** *svid*] | **service** [*svid*]]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

*svid* - VLAN ID for the outer VLAN tag (SPVID). (Range: 1-4094)

## Command Mode

Privileged Exec

## Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#interface ethernet 1/2
Console(config-if)#switchport dot1q-tunnel mode uplink
Console(config-if)#end
Console#show dot1q-tunnel
802.1Q Tunnel Status : Enabled

Port      Mode    TPID (hex)
-----
Eth 1/ 1 Access      8100
Eth 1/ 2 Uplink      8100
Eth 1/ 3 Normal      8100
:
:
Console#show dot1q-tunnel interface ethernet 1/5
802.1Q Tunnel Service Subscriptions

Port      Match C-VID S-VID
-----
Eth 1/ 5          1  100

Console#show dot1q-tunnel service 100
802.1Q Tunnel Service Subscriptions

Port      Match C-VID S-VID
-----
Eth 1/ 5          1  100
Eth 1/ 6          1  100

Console#
```

## Related Commands

[switchport dot1q-tunnel mode \(585\)](#)

## Configuring L2CP Tunneling

This section describes the commands used to configure Layer 2 Protocol Tunneling (L2PT).

**Table 108: L2 Protocol Tunnel Commands**

Command	Function	Mode
<a href="#">l2protocol-tunnel tunnel-dmac</a>	Configures the destination address for Layer 2 Protocol Tunneling	GC
<a href="#">switchport l2protocol-tunnel</a>	Enables Layer 2 Protocol Tunneling for the specified protocol	IC
<a href="#">show l2protocol-tunnel</a>	Shows settings for Layer 2 Protocol Tunneling	PE

**[l2protocol-tunnel tunnel-dmac](#)** This command configures the destination address for Layer 2 Protocol Tunneling (L2PT). Use the **no** form to restore the default setting.

### Syntax

**[l2protocol-tunnel tunnel-dmac](#) *mac-address***

*mac-address* – The switch rewrites the destination MAC address in all upstream L2PT protocol packets (i.e, STP BPDUs) to this value, and forwards them on to uplink ports. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

### Default Setting

01-12-CF-.00-00-02, proprietary tunnel address

### Command Mode

Global Configuration

### Command Usage

- ◆ When L2PT is not used, protocol packets (such as STP) are flooded to 802.1Q access ports on the same edge switch, but filtered from 802.1Q tunnel ports. This creates disconnected protocol domains in the customer's network.
- ◆ L2PT can be used to pass various types of protocol packets belonging to the same customer transparently across a service provider's network. In this way, normally segregated network segments can be configured to function inside a common protocol domain.
- ◆ L2PT encapsulates protocol packets entering ingress ports on the service provider's edge switch, replacing the destination MAC address with a

proprietary MAC address (for example, the spanning tree protocol uses 01-80-C2-00-00-02), a reserved address for other specified protocol types (as defined in IEEE 802.1ad – Provider Bridges), or a user-defined address. All intermediate switches carrying this traffic across the service provider's network treat these encapsulated packets in the same way as normal data, forwarding them across to the tunnel's egress port. The egress port decapsulates these packets, restores the proper protocol and MAC address information, and then floods them onto the same VLANs at the customer's remote site (via all of the appropriate tunnel ports and access ports<sup>12</sup> connected to the same metro VLAN).

- ◆ The way in which L2PT processes packets is based on the following criteria – (1) packet is received on a QinQ uplink port, (2) packet is received on a QinQ access port, or (3) received packet is Cisco-compatible L2PT (i.e., as indicated by a proprietary MAC address).

*Processing protocol packets defined in IEEE 802.1ad – Provider Bridges*

- ◆ When an IEEE 802.1ad protocol packet is received on an uplink port (i.e., an 802.1Q tunnel ingress port connecting the edge switch to the service provider network)
  - with the destination address 01-80-C2-00-00-00,0B~0F (C-VLAN tag), it is forwarded to all QinQ uplink ports and QinQ access ports in the same S-VLAN for which L2PT is enabled for that protocol.
  - with the destination address 01-80-C2-00-00-01~0A (S-VLAN tag), it is filtered, decapsulated, and processed locally by the switch if the protocol is supported.
- ◆ When a protocol packet is received on an access port (i.e., an 802.1Q trunk port connecting the edge switch to the local customer network)
  - with the destination address 01-80-C2-00-00-00,0B~0F (C-VLAN), and
    - L2PT is enabled on the port, the frame is forwarded to all QinQ uplink ports and QinQ access ports on which L2PT is enabled for that protocol in the same S-VLAN.
    - L2PT is disabled on the port, the frame is decapsulated and processed locally by the switch if the protocol is supported.
  - with destination address 01-80-C2-00-00-01~0A (S-VLAN), the frame is filtered, decapsulated, and processed locally by the switch if the protocol is supported.

---

12. Access ports in this context are 802.1Q trunk ports.

*Processing Cisco-compatible protocol packets*

- ◆ When a Cisco-compatible L2PT packet is received on an uplink port, and
  - recognized as a CDP/VTP/STP/PVST+ protocol packet (where STP means STP/RSTP/MSTP), it is forwarded to the following ports in the same S-VLAN: (a) all access ports for which L2PT has been disabled, and (b) all uplink ports.
  - recognized as a Generic Bridge PDU Tunneling (GBPT) protocol packet (i.e., having the destination address 01-00-0C-CD-CD-D0), it is forwarded to the following ports in the same S-VLAN:
    - other access ports for which L2PT is enabled after decapsulating the packet and restoring the proper protocol and MAC address information.
    - all uplink ports.
- ◆ When a Cisco-compatible L2PT packet is received on an access port, and
  - recognized as a CDP/VTP/STP/PVST+ protocol packet, and
    - L2PT is enabled on this port, it is forwarded to the following ports in the same S-VLAN: (a) other access ports for which L2PT is enabled, and (b) uplink ports after rewriting the destination address to make it a GBPT protocol packet (i.e., setting the destination address to 01-00-0C-CD-CD-D0).
    - L2PT is disabled on this port, it is forwarded to the following ports in the same S-VLAN: (a) other access ports for which L2PT is disabled, and (b) all uplink ports.
  - recognized as a GBPT protocol packet (i.e., having the destination address 01-00-0C-CD-CD-D0), and
    - L2PT is enabled on this port, it is forwarded to other access ports in the same S-VLAN for which L2PT is enabled
    - L2PT is disabled on this port, it is forwarded to the following ports in the same S-VLAN: (a) other access ports for which L2PT is disabled, and (b) all uplink ports.
- ◆ For L2PT to function properly, QinQ must be enabled on the switch using the `dot1q-tunnel system-tunnel-control` command, and the interface configured to 802.1Q tunnel mode using the `switchport dot1q-tunnel mode` command.



### Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#l2protocol-tunnel tunnel-dmac 01-80-C2-00-00-01
Console(config)#
```

**switchport l2protocol-tunnel** This command enables Layer 2 Protocol Tunneling (L2PT) for the specified protocol. Use the **no** form to disable L2PT for the specified protocol.

### Syntax

**switchport l2protocol-tunnel {cdp | lldp | pvst+ | spanning-tree | vtp}**

**cdp** - Cisco Discovery Protocol

**lldp** - Link Layer Discovery Protocol

**pvst+** - Cisco Per VLAN Spanning Tree Plus

**spanning-tree** - Spanning Tree (STP, RSTP, MSTP)

**vtp** - Cisco VLAN Trunking Protocol

### Default Setting

Disabled for all protocols

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Refer to the Command Usage section for the [l2protocol-tunnel tunnel-dmac](#) command.
- ◆ For L2PT to function properly, QinQ must be enabled on the switch using the [dot1q-tunnel system-tunnel-control](#) command, and the interface configured to 802.1Q tunnel mode using the [switchport dot1q-tunnel mode](#) command.

### Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#switchport l2protocol-tunnel spanning-tree
Console(config-if)#
```

**show l2protocol-tunnel** This command shows settings for Layer 2 Protocol Tunneling (L2PT).

**Command Mode**  
Privileged Exec

#### Example

```
Console#show l2protocol-tunnel
Layer 2 Protocol Tunnel

Tunnel MAC Address : 01-12-CF-00-00-00

Interface  Protocol
-----
Eth 1/ 1   Spanning Tree

Console#
```

## Configuring VLAN Translation

QinQ tunneling uses double tagging to preserve the customer's VLAN tags on traffic crossing the service provider's network. However, if any switch in the path crossing the service provider's network does not support this feature, then the switches directly connected to that device can be configured to swap the customer's VLAN ID with the service provider's VLAN ID for upstream traffic, or the service provider's VLAN ID with the customer's VLAN ID for downstream traffic.

This section describes commands used to configure VLAN translation.

**Table 109: VLAN Translation Commands**

Command	Function	Mode
<a href="#">switchport vlan-translation</a>	Maps VLAN IDs between the customer and service provider	IC
<a href="#">show vlan-translation</a>	Displays the configuration settings for VLAN translation	PE

**switchport vlan-translation** This command maps VLAN IDs between the customer and service provider.

#### Syntax

**switchport vlan-translation** *original-vlan new-vlan*

**no switchport vlan-translation** *original-vlan*

*original-vlan* - The original VLAN ID. (Range: 1-4094)

*new-vlan* - The new VLAN ID. (Range: 1-4094)

#### Default Setting

Disabled

## Command Mode

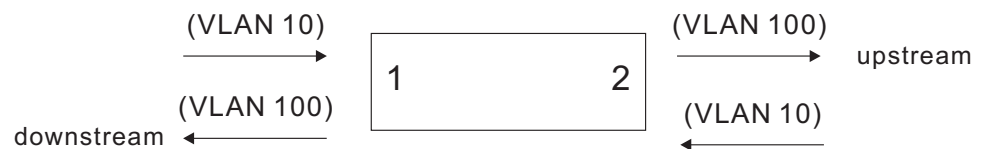
### Interface Configuration (Ethernet)

## Command Usage

- ◆ If the next switch upstream does not support QinQ tunneling, then use this command to map the customer's VLAN ID to the service provider's VLAN ID for the upstream port. Similarly, if the next switch downstream does not support QinQ tunneling, then use this command to map the service provider's VLAN ID to the customer's VLAN ID for the downstream port. Note that one command maps both the *original-vlan* to *new-vlan* for ingress traffic and the *new-vlan* to *original-vlan* for egress traffic on the specified port.

For example, assume that the upstream switch does not support QinQ tunneling. If the command **switchport vlan-translation 10 100** is used to map VLAN 10 to VLAN 100 for upstream traffic entering port 1, and VLAN 100 to VLAN 10 for downstream traffic leaving port 1, then the VLAN IDs will be swapped as shown below.

**Figure 8: Configuring VLAN Translation**



- ◆ The maximum number of VLAN translation entries is 8 per port, and up to 96 for the system. However, note that configuring a large number of entries may degrade the performance of other processes that also use the TCAM, such as IP Source Guard filter rules, Quality of Service (QoS) processes, QinQ, MAC-based VLANs, VLAN translation, or traps.
- ◆ If VLAN translation is set on an interface with this command, and the same interface is also configured as a QinQ access port with the [switchport dot1q-tunnel mode](#) command, VLAN tag assignments will be determined by the QinQ process, not by VLAN translation.

## Example

This example configures VLAN translation for Port 1 as described in the Command Usage section above.

```
Console(config)#vlan database
Console(config-vlan)#vlan 10 media ethernet state active
Console(config-vlan)#vlan 100 media ethernet state active
Console(config-vlan)#exit
Console(config)#interface ethernet 1/1,2
Console(config-if)#switchport allowed vlan add 10 tagged
Console(config-if)#switchport allowed vlan add 100 tagged
Console(config-if)#interface ethernet 1/1
Console(config-if)#switchport vlan-translation 10 100
Console(config-if)#end
Console#show vlan-translation

Interface Old VID New VID
-----
Eth 1/ 1      10     100
```

```
Console#
```

**show vlan-translation** This command displays the configuration settings for VLAN translation.

### Syntax

**show vlan-translation** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

### Example

```
Console#show vlan-translation
```

```
Interface Old VID New VID
-----
Eth 1/ 1      10    100
```

```
Console#
```

## Configuring Protocol-based VLANs

The network devices required to support multiple protocols cannot be easily grouped into a common VLAN. This may require non-standard devices to pass traffic between different VLANs in order to encompass all the devices participating in a specific protocol. This kind of configuration deprives users of the basic benefits of VLANs, including security and easy accessibility.

To avoid these problems, you can configure this switch with protocol-based VLANs that divide the physical network into logical VLAN groups for each required protocol. When a frame is received at a port, its VLAN membership can then be determined based on the protocol type in use by the inbound packets.

**Table 110: Protocol-based VLAN Commands**

Command	Function	Mode
<a href="#">protocol-vlan</a> <a href="#">protocol-group</a>	Create a protocol group, specifying the supported protocols	GC
<a href="#">protocol-vlan</a> <a href="#">protocol-group</a>	Maps a protocol group to a VLAN	IC

Table 110: Protocol-based VLAN Commands (Continued)

Command	Function	Mode
<code>show protocol-vlan protocol-group</code>	Shows the configuration of protocol groups	PE
<code>show interfaces protocol-vlan protocol-group</code>	Shows the interfaces mapped to a protocol group and the corresponding VLAN	PE

To configure protocol-based VLANs, follow these steps:

1. First configure VLAN groups for the protocols you want to use (page 574). Although not mandatory, we suggest configuring a separate VLAN for each major protocol running on your network. Do not add port members at this time.
2. Create a protocol group for each of the protocols you want to assign to a VLAN using the `protocol-vlan protocol-group` command (Global Configuration mode).
3. Then map the protocol for each interface to the appropriate VLAN using the `protocol-vlan protocol-group` command (Interface Configuration mode).

### protocol-vlan protocol-group (Configuring Groups)

This command creates a protocol group, or to add specific protocols to a group. Use the **no** form to remove a protocol group.

#### Syntax

**protocol-vlan protocol-group** *group-id* [{**add** | **remove**}  
**frame-type** *frame* **protocol-type** *protocol*]

**no protocol-vlan protocol-group** *group-id*

*group-id* - Group identifier of this protocol group. (Range: 1-2147483647)

*frame*<sup>13</sup> - Frame type used by this protocol. (Options: ethernet, rfc\_1042, llc\_other)

*protocol* - Protocol type. The only option for the llc\_other frame type is ipx\_raw. The options for all other frames types include: arp, ip, ipv6, rarp.

#### Default Setting

No protocol groups are configured.

#### Command Mode

Global Configuration

13. SNAP frame types are not supported by this switch due to hardware limitations.

### Example

The following creates protocol group 1, and specifies Ethernet frames with IP and ARP protocol types:

```
Console(config)#protocol-vlan protocol-group 1 add frame-type ethernet
protocol-type ip
Console(config)#protocol-vlan protocol-group 1 add frame-type ethernet
protocol-type arp
Console(config)#
```

### protocol-vlan protocol-group (Configuring Interfaces)

This command maps a protocol group to a VLAN for the current interface. Use the **no** form to remove the protocol mapping for this interface.

#### Syntax

**protocol-vlan protocol-group** *group-id* **vlan** *vlan-id* **priority** *priority*

**no protocol-vlan protocol-group** *group-id* **vlan**

*group-id* - Group identifier of this protocol group. (Range: 1-2147483647)

*vlan-id* - VLAN to which matching protocol traffic is forwarded.  
(Range: 1-4094)

*priority* - The priority assigned to untagged ingress traffic.  
(Range: 0-7, where 7 is the highest priority)

#### Default Setting

No protocol groups are mapped for any interface.

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ When creating a protocol-based VLAN, only assign interfaces via this command. If you assign interfaces using any of the other VLAN commands (such as the [vlan](#) command), these interfaces will admit traffic of any protocol type into the associated VLAN.
- ◆ When MAC-based, IP subnet-based, and protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.
- ◆ When a frame enters a port that has been assigned to a protocol VLAN, it is processed in the following manner:
  - If the frame is tagged, it will be processed according to the standard rules applied to tagged frames.
  - If the frame is untagged and the protocol type matches, the frame is forwarded to the appropriate VLAN.

- If the frame is untagged but the protocol type does not match, the frame is forwarded to the default VLAN for this interface.

### Example

The following example maps the traffic entering Port 1 which matches the protocol type specified in protocol group 1 to VLAN 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#protocol-vlan protocol-group 1 vlan 2 priority 0
Console(config-if)#
```

**show protocol-vlan protocol-group** This command shows the frame and protocol type associated with protocol groups.

### Syntax

**show protocol-vlan protocol-group** [*group-id*]

*group-id* - Group identifier for a protocol group. (Range: 1-2147483647)

### Default Setting

All protocol groups are displayed.

### Command Mode

Privileged Exec

### Example

This shows protocol group 1 configured for IP over Ethernet:

```
Console#show protocol-vlan protocol-group

Protocol Group ID   Frame Type   Protocol Type
-----
                  1          ethernet    08 00
Console#
```

**show interfaces protocol-vlan protocol-group** This command shows the mapping from protocol groups to VLANs for the selected interfaces.

### Syntax

**show interfaces protocol-vlan protocol-group** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

The mapping for all interfaces is displayed.

### Command Mode

Privileged Exec

### Example

This shows that traffic entering Port 1 that matches the specifications for protocol group 1 will be mapped to VLAN 2:

```
Console#show interfaces protocol-vlan protocol-group
```

Port	ProtocolGroup ID	VLAN ID
Eth 1/1	1	vlan2

```
Console#
```

## Configuring IP Subnet VLANs

When using IEEE 802.1Q port-based VLAN classification, all untagged frames received by a port are classified as belonging to the VLAN whose VID (PVID) is associated with that port.

When IP subnet-based VLAN classification is enabled, the source address of untagged ingress frames are checked against the IP subnet-to-VLAN mapping table. If an entry is found for that subnet, these frames are assigned to the VLAN indicated in the entry. If no IP subnet is matched, the untagged frames are classified as belonging to the receiving port's VLAN ID (PVID).

**Table 111: IP Subnet VLAN Commands**

Command	Function	Mode
<a href="#">subnet-vlan</a>	Defines the IP Subnet VLANs	GC
<a href="#">show subnet-vlan</a>	Displays IP Subnet VLAN settings	PE



**subnet-vlan** This command configures IP Subnet VLAN assignments. Use the **no** form to remove an IP subnet-to-VLAN assignment.

### Syntax

**subnet-vlan subnet** *ip-address mask* **vlan** *vlan-id* [**priority** *priority*]

**no subnet-vlan subnet** {*ip-address mask* | **all**}

*ip-address* – The IP address that defines the subnet. Valid IP addresses consist of four decimal numbers, 0 to 255, separated by periods.

*mask* – This mask identifies the host address bits of the IP subnet.

*vlan-id* – VLAN to which matching IP subnet traffic is forwarded.  
(Range: 1-4094)

*priority* – The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority)

### Default Setting

Priority: 0

### Command Mode

Global Configuration

### Command Usage

- ◆ Each IP subnet can be mapped to only one VLAN ID. An IP subnet consists of an IP address and a subnet mask. The specified VLAN need not be an existing VLAN.
- ◆ When an untagged frame is received by a port, the source IP address is checked against the IP subnet-to-VLAN mapping table, and if an entry is found, the corresponding VLAN ID is assigned to the frame. If no mapping is found, the PVID of the receiving port is assigned to the frame.
- ◆ The IP subnet cannot be a broadcast or multicast IP address.
- ◆ When MAC-based, IP subnet-based, and protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.

### Example

The following example assigns traffic for the subnet 192.168.12.192, mask 255.255.255.224, to VLAN 4.

```
Console(config)#subnet-vlan subnet 192.168.12.192 255.255.255.224 vlan 4
Console(config)#
```

**show subnet-vlan** This command displays IP Subnet VLAN assignments.

#### Command Mode

Privileged Exec

#### Command Usage

- ◆ Use this command to display subnet-to-VLAN mappings.
- ◆ The last matched entry is used if more than one entry can be matched.

#### Example

The following example displays all configured IP subnet-based VLANs.

```
Console#show subnet-vlan
IP Address      Mask              VLAN ID  Priority
-----
192.168.12.0    255.255.255.128   1        0
192.168.12.128  255.255.255.192   3        0
192.168.12.192  255.255.255.224   4        0
192.168.12.224  255.255.255.240   5        0
192.168.12.240  255.255.255.248   6        0
192.168.12.248  255.255.255.252   7        0
192.168.12.252  255.255.255.254   8        0
192.168.12.254  255.255.255.255   9        0
192.168.12.255  255.255.255.255  10       0
Console#
```

## Configuring MAC Based VLANs

When using IEEE 802.1Q port-based VLAN classification, all untagged frames received by a port are classified as belonging to the VLAN whose VID (PVID) is associated with that port.

When MAC-based VLAN classification is enabled, the source address of untagged ingress frames are checked against the MAC address-to-VLAN mapping table. If an entry is found for that address, these frames are assigned to the VLAN indicated in the entry. If no MAC address is matched, the untagged frames are classified as belonging to the receiving port's VLAN ID (PVID).

**Table 112: MAC Based VLAN Commands**

Command	Function	Mode
mac-vlan	Defines the IP Subnet VLANs	GC
show mac-vlan	Displays IP Subnet VLAN settings	PE

**mac-vlan** This command configures MAC address-to-VLAN mapping. Use the **no** form to remove an assignment.

### Syntax

**mac-vlan mac-address** *mac-address* [**mask** *mask-address*] **vlan** *vlan-id*  
[**priority** *priority*]

**no mac-vlan mac-address** {*mac-address* [**mask** *mask-address*] | **all**}

*mac-address* – The source MAC address to be matched. Configured MAC addresses can only be unicast addresses. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

*mask-address* - Identifies a range of MAC addresses. The mask can be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx, where an equivalent binary value "1" means relevant and "0" means ignore.

*vlan-id* – VLAN to which the matching source MAC address traffic is forwarded. (Range: 1-4094)

*priority* – The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ The MAC-to-VLAN mapping applies to all ports on the switch.
- ◆ Source MAC addresses can be mapped to only one VLAN ID.
- ◆ Configured MAC addresses cannot be broadcast or multicast addresses.
- ◆ When MAC-based, IP subnet-based, and protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.

### Example

The following example assigns traffic from source MAC address 00-00-00-11-22-33 to VLAN 10.

```
Console(config)#mac-vlan mac-address 00-00-00-11-22-33 mask FF-FF-FF-FF-00-00
vlan 10
Console(config)#
```

**show mac-vlan** This command displays MAC address-to-VLAN assignments.

#### Command Mode

Privileged Exec

#### Command Usage

Use this command to display MAC address-to-VLAN mappings.

#### Example

The following example displays all configured MAC address-based VLANs.

```
Console#show mac-vlan
MAC Address          VLAN ID  Priority
-----
00-00-00-11-22-33    10       0
Console#
```

## Configuring Voice VLANs

The switch allows you to specify a Voice VLAN for the network and set a CoS priority for the VoIP traffic. VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port to the Voice VLAN. Alternatively, switch ports can be manually configured.

**Table 113: Voice VLAN Commands**

Command	Function	Mode
<code>voice vlan</code>	Defines the Voice VLAN ID	GC
<code>voice vlan aging</code>	Configures the aging time for Voice VLAN ports	GC
<code>voice vlan mac-address</code>	Configures VoIP device MAC addresses	GC
<code>switchport voice vlan</code>	Sets the Voice VLAN port mode	IC
<code>switchport voice vlan priority</code>	Sets the VoIP traffic priority for ports	IC
<code>switchport voice vlan rule</code>	Sets the automatic VoIP traffic detection method for ports	IC
<code>switchport voice vlan security</code>	Enables Voice VLAN security on ports	IC
<code>show voice vlan</code>	Displays Voice VLAN settings	PE

**voice vlan** This command enables VoIP traffic detection and defines the Voice VLAN ID. Use the **no** form to disable the Voice VLAN.

### Syntax

**voice vlan** *voice-vlan-id*

**no voice vlan**

*voice-vlan-id* - Specifies the voice VLAN ID. (Range: 1-4094)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ When IP telephony is deployed in an enterprise network, it is recommended to isolate the Voice over IP (VoIP) network traffic from other data traffic. Traffic isolation helps prevent excessive packet delays, packet loss, and jitter, which results in higher voice quality. This is best achieved by assigning all VoIP traffic to a single VLAN.
- ◆ VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port as a tagged member of the Voice VLAN.
- ◆ Only one Voice VLAN is supported and it must already be created on the switch before it can be specified as the Voice VLAN.
- ◆ The Voice VLAN ID cannot be modified when the global auto-detection status is enabled (see the [switchport voice vlan](#) command).

### Example

The following example enables VoIP traffic detection and specifies the Voice VLAN ID as 1234.

```
Console(config)#voice vlan 1234
Console(config)#
```

**voice vlan aging** This command sets the Voice VLAN ID time out. Use the **no** form to restore the default.

#### Syntax

**voice vlan aging** *minutes*

**no voice vlan**

*minutes* - Specifies the port Voice VLAN membership time out.  
(Range: 5-43200 minutes)

#### Default Setting

1440 minutes

#### Command Mode

Global Configuration

#### Command Usage

The Voice VLAN aging time is the time after which a port is removed from the Voice VLAN when VoIP traffic is no longer received on the port.

The VoIP aging time starts to count down when the OUI's MAC address expires from the MAC address table. Therefore, the MAC address aging time should be added to the overall aging time. For example, if you configure the MAC address table aging time to 30 seconds, and voice VLAN aging time to 5 minutes, then after 5.5 minutes, a port will be removed from the voice VLAN when VoIP traffic is no longer received on the port. Alternatively, if you clear the MAC address table manually, then the switch will also start counting down the voice VLAN aging time.

#### Example

The following example configures the Voice VLAN aging time as 3000 minutes.

```
Console(config)#voice vlan aging 3000
Console(config)#
```

**voice vlan mac-address** This command specifies MAC address ranges to add to the OUI Telephony list. Use the **no** form to remove an entry from the list.

#### Syntax

**voice vlan mac-address** *mac-address* **mask** *mask-address*  
[**description** *description*]

**no voice vlan mac-address** *mac-address* **mask** *mask-address*

*mac-address* - Defines a MAC address OUI that identifies VoIP devices in the network. (For example, 01-23-45-00-00-00)

*mask-address* - Identifies a range of MAC addresses. (Range: 80-00-00-00-00-00 to FF-FF-FF-FF-FF-FF)

*description* - User-defined text that identifies the VoIP devices. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ VoIP devices attached to the switch can be identified by the manufacturer's Organizational Unique Identifier (OUI) in the source MAC address of received packets. OUI numbers are assigned to manufacturers and form the first three octets of device MAC addresses. The MAC OUI numbers for VoIP equipment can be configured on the switch so that traffic from these devices is recognized as VoIP.
- ◆ Setting a mask of FF-FF-FF-00-00-00 identifies all devices with the same OUI (the first three octets). Other masks restrict the MAC address range. Setting a mask of FF-FF-FF-FF-FF-FF specifies a single MAC address.

### Example

The following example adds a MAC OUI to the OUI Telephony list.

```
Console(config)#voice vlan mac-address 00-12-34-56-78-90 mask ff-ff-ff-00-00-00 description A new phone
Console(config)#
```

**switchport voice vlan** This command specifies the Voice VLAN mode for ports. Use the **no** form to disable the Voice VLAN feature on the port.

### Syntax

**switchport voice vlan {manual | auto}**

**no switchport voice vlan**

**manual** - The Voice VLAN feature is enabled on the port, but the port must be manually added to the Voice VLAN.

**auto** - The port will be added as a tagged member to the Voice VLAN when VoIP traffic is detected on the port.

### Default Setting

Disabled

### Command Mode

Interface Configuration

### Command Usage

- ◆ When auto is selected, you must select the method to use for detecting VoIP traffic, either OUI or 802.1ab (LLDP) using the [switchport voice vlan rule](#) command. When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list using the [voice vlan mac-address](#) command.
- ◆ All ports are set to VLAN hybrid mode by default. Prior to enabling VoIP for a port (by setting the VoIP mode to Auto or Manual as described below), ensure that VLAN membership is not set to access mode using the [switchport mode](#) command.

### Example

The following example sets port 1 to Voice VLAN auto mode.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan auto
Console(config-if)#
```

**switchport voice vlan priority** This command specifies a CoS priority for VoIP traffic on a port. Use the **no** form to restore the default priority on a port.

### Syntax

**switchport voice vlan priority** *priority-value*

**no switchport voice vlan priority**

*priority-value* - The CoS priority value. (Range: 0-6)

### Default Setting

6

### Command Mode

Interface Configuration

### Command Usage

Specifies a CoS priority to apply to the port VoIP traffic on the Voice VLAN. The priority of any received VoIP packet is overwritten with the new priority when the Voice VLAN feature is active for the port.

### Example

The following example sets the CoS priority to 5 on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan priority 5
Console(config-if)#
```



**switchport voice vlan rule** This command selects a method for detecting VoIP traffic on a port. Use the **no** form to disable the detection method on the port.

#### Syntax

**[no] switchport voice vlan rule {oui | lldp}**

**oui** - Traffic from VoIP devices is detected by the Organizationally Unique Identifier (OUI) of the source MAC address.

**lldp** - Uses LLDP to discover VoIP devices attached to the port.

#### Default Setting

OUI: Enabled

LLDP: Disabled

#### Command Mode

Interface Configuration

#### Command Usage

- ◆ When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list (see the [voice vlan mac-address](#) command. MAC address OUI numbers must be configured in the Telephony OUI list so that the switch recognizes the traffic as being from a VoIP device.
- ◆ LLDP checks that the “telephone bit” in the system capability TLV is turned on. See [“LLDP Commands” on page 773](#) for more information on LLDP.

#### Example

The following example enables the OUI method on port 1 for detecting VoIP traffic.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan rule oui
Console(config-if)#
```

**switchport voice vlan security** This command enables security filtering for VoIP traffic on a port. Use the **no** form to disable filtering on a port.

#### Syntax

**[no] switchport voice vlan security**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration

### Command Usage

- ◆ Security filtering discards any non-VoIP packets received on the port that are tagged with the voice VLAN ID. VoIP traffic is identified by source MAC addresses configured in the Telephony OUI list, or through LLDP that discovers VoIP devices attached to the switch. Packets received from non-VoIP sources are dropped.
- ◆ When enabled, be sure the MAC address ranges for VoIP devices are configured in the Telephony OUI list ([voice vlan mac-address](#)).

### Example

The following example enables security filtering on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan security
Console(config-if)#
```

**show voice vlan** This command displays the Voice VLAN settings on the switch and the OUI Telephony list.

### Syntax

**show voice vlan {oui | status}**

**oui** - Displays the OUI Telephony list.

**status** - Displays the global and port Voice VLAN settings.

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show voice vlan status
Global Voice VLAN Status
Voice VLAN Status      : Enabled
Voice VLAN ID          : 1234
Voice VLAN aging time  : 1440 minutes

Voice VLAN Port Summary
Port      Mode      Security Rule      Priority Remaining Age
                                   (minutes)
-----
Eth 1/ 1 Auto      Enabled OUI                6 100
Eth 1/ 2 Disabled Disabled OUI                6 NA
Eth 1/ 3 Manual    Enabled OUI                5 100
Eth 1/ 4 Auto      Enabled OUI                6 100
Eth 1/ 5 Disabled Disabled OUI                6 NA
Eth 1/ 6 Disabled Disabled OUI                6 NA
Eth 1/ 7 Disabled Disabled OUI                6 NA
Eth 1/ 8 Disabled Disabled OUI                6 NA
```

```
Eth 1/ 9 Disabled Disabled OUI          6 NA
Eth 1/10 Disabled Disabled OUI          6 NA
```

```
Console#show voice vlan oui
```

OUI	Address	Mask	Description
00-12-34-56-78-9A	FF-FF-FF-00-00-00		old phones
00-11-22-33-44-55	FF-FF-FF-00-00-00		new phones
00-98-76-54-32-10	FF-FF-FF-FF-FF-FF		Chris' phone

```
Console#
```



## Class of Service Commands

The commands described in this section allow you to specify which data packets have greater precedence when traffic is buffered in the switch due to congestion. This switch supports CoS with eight priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues. The default priority can be set for each interface, also the queue service mode and the mapping of frame priority tags to the switch's priority queues can be configured.

**Table 114: Priority Commands**

Command Group	Function
Priority Commands (Layer 2)	Configures the queue mode, queue weights, and default priority for untagged frames
Priority Commands (Layer 3 and 4)	Sets the default priority processing method (CoS or DSCP), maps priority tags for internal processing, maps values from internal priority table to CoS values used in tagged egress packets for Layer 2 interfaces, maps internal per hop behavior to hardware queues

### Priority Commands (Layer 2)

This section describes commands used to configure Layer 2 traffic priority on the switch.

**Table 115: Priority Commands (Layer 2)**

Command	Function	Mode
<code>queue mode</code>	Sets the queue mode to Weighted Round-Robin (WRR), strict priority, or a combination of strict and weighted queuing	GC
<code>queue weight</code>	Assigns round-robin weights to the priority queues	GC
<code>switchport priority default</code>	Sets a port priority for incoming untagged frames	IC
<code>show interfaces switchport</code>	Displays the administrative and operational status of an interface	PE
<code>show queue mode</code>	Shows the current queue mode	PE
<code>show queue weight</code>	Shows weights assigned to the weighted queues	PE

**queue mode** This command sets the scheduling mode used for processing each of the class of service (CoS) priority queues. The options include strict priority, Weighted Round-Robin (WRR), or a combination of strict and weighted queuing. Use the **no** form to restore the default value.

### Syntax

**queue mode** {**strict** | **wrr** | **strict-wrr** [*queue-type-list*]}

**no queue mode**

**strict** - Services the egress queues in sequential order, transmitting all traffic in the higher priority queues before servicing lower priority queues. This ensures that the highest priority packets are always serviced first, ahead of all other traffic.

**wrr** - Weighted Round-Robin shares bandwidth at the egress ports by using scheduling weights (based on the [queue weight](#) command), and servicing each queue in a round-robin fashion.

**strict-wrr** - Uses strict or weighted service as specified for each queue.

*queue-type-list* - Indicates if the queue is a normal or strict type.  
(Options: 0 indicates a normal queue, 1 indicates a strict queue)

### Default Setting

WRR

### Command Mode

Global Configuration

### Command Usage

- ◆ The switch can be set to service the port queues based on strict priority, WRR, or a combination of strict and weighted queueing.
- ◆ Strict priority requires all traffic in a higher priority queue to be processed before lower priority queues are serviced.
- ◆ Weighted Round Robin (WRR) uses a predefined relative weight for each queue that determines the percentage of service time the switch services each queue before moving on to the next queue. This prevents the head-of-line blocking that can occur with strict priority queuing. Use the [queue weight](#) command to assign weights for WRR queueing to the eight priority queues.
- ◆ If Strict and WRR mode is selected, a combination of strict and weighted service is used as specified for each queue. The queues assigned to use strict or WRR priority should be specified using the *queue-type-list* parameter.
- ◆ A weight can be assigned to each of the weighted queues (and thereby to the corresponding traffic priorities). This weight sets the frequency at which each queue is polled for service, and subsequently affects the response time for software applications assigned a specific priority value.

- ◆ Service time is shared at the egress ports by defining scheduling weights for WRR, or for the queuing mode that uses a combination of strict and weighted queuing. Service time is allocated to each queue by calculating a precise number of bytes per second that will be serviced on each round.
- ◆ The specified queue mode applies to all interfaces.

### Example

The following example sets the queue mode to strict priority service mode:

```
Console(config)#queue mode strict
Console(config)#
```

### Related Commands

[queue weight \(615\)](#)

[show queue mode \(617\)](#)

**queue weight** This command assigns weights to the eight class of service (CoS) priority queues when using weighted queuing, or one of the queuing modes that use a combination of strict and weighted queuing. Use the **no** form to restore the default weights.

### Syntax

**queue weight** *weight0...weight7*

**no queue weight**

*weight0...weight7* - The ratio of weights for queues 0 - 7 determines the weights used by the WRR scheduler. (Range: 1-255)

### Default Setting

Weights 1, 2, 4, 6, 8, 10, 12, 14 are assigned to queues 0 - 7 respectively.

### Command Mode

Global Configuration

### Command Usage

- ◆ This command shares bandwidth at the egress port by defining scheduling weights for Weighted Round-Robin, or for the queuing mode that uses a combination of strict and weighted queuing ([page 614](#)).
- ◆ Bandwidth is allocated to each queue by calculating a precise number of bytes per second that will be serviced on each round.

### Example

The following example shows how to assign round-robin weights of 1 - 8 to the CoS priority queues 0 - 7.

```
Console(config)#queue weight 1 2 3 4 5 6 7 8
Console(config)#
```

### Related Commands

[queue mode \(614\)](#)

[show queue weight \(617\)](#)

**switchport priority default** This command sets a priority for incoming untagged frames. Use the **no** form to restore the default value.

### Syntax

**switchport priority default** *default-priority-id*

**no switchport priority default**

*default-priority-id* - The priority number for untagged ingress traffic. The priority is a number from 0 to 7. Seven is the highest priority.

### Default Setting

The priority is not set, and the default value for untagged frames received on the interface is zero.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ The precedence for priority mapping is IP DSCP, and then default switchport priority.
- ◆ The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.
- ◆ The switch provides eight priority queues for each port. It can be configured to use strict priority queuing, Weighted Round Robin (WRR), or a combination of strict and weighted queuing using the [queue mode](#) command. Inbound frames that do not have VLAN tags are tagged with the input port's default ingress user priority, and then placed in the appropriate priority queue at the output port. The default priority for all ingress ports is zero. Therefore, any inbound frames that do not have priority tags will be placed in queue 2 of the output port. (Note that if the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission.)



### Example

The following example shows how to set a default priority on port 3 to 5:

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport priority default 5
Console(config-if)#
```

### Related Commands

[show interfaces switchport \(427\)](#)

**show queue mode** This command shows the current queue mode.

### Command Mode

Privileged Exec

### Example

```
Console#show queue mode

Queue Mode : Weighted Round Robin Mode
Console#
```

**show queue weight** This command displays the weights used for the weighted queues.

### Command Mode

Privileged Exec

### Example

```
Console#show queue weight
Queue ID  Weight
-----  -
0         1
1         2
2         4
3         6
4         8
5        10
6        12
7        14
Console#
```

## Priority Commands (Layer 3 and 4)

This section describes commands used to configure Layer 3 and 4 traffic priority mapping on the switch.

**Table 116: Priority Commands (Layer 3 and 4)**

Command	Function	Mode
<code>qos map cos-dscp</code>	Maps CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	GC
<code>qos map dscp-mutation</code>	Maps DSCP values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	GC
<code>qos map phb-queue</code>	Maps internal per-hop behavior values to hardware queues	GC
<code>qos map trust-mode</code>	Sets QoS mapping to DSCP or CoS	IC
<code>show qos map cos-dscp</code>	Shows ingress CoS to internal DSCP map	PE
<code>show qos map dscp-mutation</code>	Shows ingress DSCP to internal DSCP map	PE
<code>show qos map phb-queue</code>	Shows internal per-hop behavior to hardware queue map	PE
<code>show qos map trust-mode</code>	Shows the QoS mapping mode	PE

\* The default settings used for mapping priority values to internal DSCP values and back to the hardware queues are designed to optimize priority services for the majority of network applications. It should not be necessary to modify any of the default settings unless a queuing problem occurs with a particular application.

**qos map cos-dscp** This command maps CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for priority processing. Use the **no** form to restore the default settings.

### Syntax

**qos map cos-dscp** *phb drop-precedence* **from** *cos0 cfi0...cos7 cfi7*

**no qos map cos-dscp** *cos0 cfi0...cos7 cfi7*

*phb* - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

*drop-precedence* - Drop precedence used for controlling traffic congestion.  
(Range: 0 - Green, 3 - Yellow, 1 - Red)

*cos* - CoS value in ingress packets. (Range: 0-7)

*cfi* - Canonical Format Indicator. Set to this parameter to "0" to indicate that the MAC address information carried in the frame is in canonical format.  
(Range: 0-1)

## Default Setting

**Table 117: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence**

CoS	CFI	0	1
0		(0,0)	(0,0)
1		(1,0)	(1,0)
2		(2,0)	(2,0)
3		(3,0)	(3,0)
4		(4,0)	(4,0)
5		(5,0)	(5,0)
6		(6,0)	(6,0)
7		(7,0)	(7,0)

## Command Mode

Global Configuration (Port)

## Command Usage

- ◆ The default mapping of CoS to PHB values shown in [Table 117](#) is based on the recommended settings in IEEE 802.1p for mapping CoS values to output queues.
- ◆ Enter a value pair for the internal per-hop behavior and drop precedence, followed by the keyword “from” and then up to eight CoS/CFI paired values separated by spaces.
- ◆ If a packet arrives with a 802.1Q header but it is not an IP packet, then the CoS/CFI-to-PHB/Drop Precedence mapping table is used to generate priority and drop precedence values for internal processing. Note that priority tags in the original packet are not modified by this command.
- ◆ The internal DSCP consists of three bits for per-hop behavior (PHB) which determines the queue to which a packet is sent; and two bits for drop precedence (namely color) which is used to control traffic congestion.
- ◆ The specified mapping applies to all interfaces.

## Example

```
Console(config)#qos map cos-dscp 0 0 from 0 1
Console(config)#
```

**qos map dscp-mutation** This command maps DSCP values in incoming packets to per-hop behavior and drop precedence values for priority processing. Use the **no** form to restore the default settings.

### Syntax

**qos map dscp-mutation** *phb drop-precedence* **from** *dscp0 ... dscp7*

**no qos map dscp-mutation** *dscp0 ... dscp7*

*phb* - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

*drop-precedence* - Drop precedence used for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

*dscp* - DSCP value in ingress packets. (Range: 0-63)

### Default Setting

**Table 118: Default Mapping of DSCP Values to Internal PHB/Drop Values**

	ingress-dscp1	0	1	2	3	4	5	6	7	8	9
ingress-dscp10											
0		0,0	0,1	0,0	0,3	0,0	0,1	0,0	0,3	1,0	1,1
1		1,0	1,3	1,0	1,1	1,0	1,3	2,0	2,1	2,0	2,3
2		2,0	2,1	2,0	2,3	3,0	3,1	3,0	3,3	3,0	3,1
3		3,0	3,3	4,0	4,1	4,0	4,3	4,0	4,1	4,0	4,3
4		5,0	5,1	5,0	5,3	5,0	5,1	6,0	5,3	6,0	6,1
5		6,0	6,3	6,0	6,1	6,0	6,3	7,0	7,1	7,0	7,3
6		7,0	7,1	7,0	7,3						

The ingress DSCP is composed of ingress-dscp10 (most significant digit in the left column) and ingress-dscp1 (least significant digit in the top row (in other words,  $\text{ingress-dscp} = \text{ingress-dscp10} * 10 + \text{ingress-dscp1}$ ); and the corresponding internal-dscp is shown at the intersecting cell in the table.

The ingress DSCP is bitwise ANDed with the binary value 11 to determine the drop precedence. If the resulting value is 10 binary, then the drop precedence is set to 0.

### Command Mode

Global Configuration (Port)

### Command Usage

- ◆ Enter a value pair for the internal per-hop behavior and drop precedence, followed by the keyword “from” and then up to eight DSCP values separated by spaces.
- ◆ This map is only used when the QoS mapping mode is set to “DSCP” by the **qos map trust-mode** command, and the ingress packet type is IPv4.

- ◆ Two QoS domains can have different DSCP definitions, so the DSCP-to-PHB/Drop Precedence mutation map can be used to modify one set of DSCP values to match the definition of another domain. The mutation map should be applied at the receiving port (ingress mutation) at the boundary of a QoS administrative domain.
- ◆ The specified mapping applies to all interfaces.

### Example

This example changes the priority for all packets entering port 1 which contain a DSCP value of 1 to a per-hop behavior of 3 and a drop precedence of 1. Referring to [Table 118](#), note that the DSCP value for these packets is now set to 25 ( $3 \times 2^3 + 1$ ) and passed on to the egress interface.

```
Console(config)#qos map dscp-mutation 3 1 from 1
Console(config)#
```

**qos map phb-queue** This command determines the hardware output queues to use based on the internal per-hop behavior value. Use the **no** form to restore the default settings.

### Syntax

**qos map phb-queue** *queue-id* **from** *phb0 ... phb7*

**no map phb-queue** *phb0 ... phb7*

*phb* - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

*queue-id* - The ID of the priority queue. (Range: 0-7, where 7 is the highest priority queue)

### Default Setting

**Table 119: Mapping Internal Per-hop Behavior to Hardware Queues**

Per-hop Behavior	0	1	2	3	4	5	6	7
Hardware Queues	2	0	1	3	4	5	6	7

### Command Mode

Global Configuration (Port)

### Command Usage

- ◆ Enter a queue identifier, followed by the keyword “from” and then up to eight internal per-hop behavior values separated by spaces.
- ◆ Egress packets are placed into the hardware queues according to the mapping defined by this command.

### Example

```
Console(config)##qos map phb-queue 0 from 1 2 3
Console(config)#
```

**qos map trust-mode** This command sets QoS mapping to DSCP or CoS. Use the **no** form to restore the default setting.

### Syntax

**qos map trust-mode {dscp | cos}**

**no qos map trust-mode**

**dscp** - Sets the QoS mapping mode to DSCP.

**cos** - Sets the QoS mapping mode to CoS.

### Default Setting

CoS

### Command Mode

Interface Configuration (Port)

### Command Usage

- ◆ If the QoS mapping mode is set to DSCP with this command, and the ingress packet type is IPv4, then priority processing will be based on the DSCP value in the ingress packet.
- ◆ If the QoS mapping mode is set to DSCP, and a non-IP packet is received, the packet's CoS and CFI (Canonical Format Indicator) values are used for priority processing if the packet is tagged. For an untagged packet, the default port priority (see [page 616](#)) is used for priority processing.
- ◆ If the QoS mapping mode is set to CoS with this command, and the ingress packet type is IPv4, then priority processing will be based on the CoS and CFI values in the ingress packet.

For an untagged packet, the default port priority (see [page 616](#)) is used for priority processing.

### Example

This example sets the QoS priority mapping mode to use DSCP based on the conditions described in the Command Usage section.

```
Console(config)#interface 1/1
Console(config-if)#qos map trust-mode cos
Console(config-if)#
```

**show qos map cos-dscp** This command shows ingress CoS/CFI to internal DSCP map.

#### Syntax

**show qos map cos-dscp interface** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Example

```
Console#show qos map cos-dscp interface ethernet 1/5
CoS Information of Eth 1/5
CoS-DSCP map. (x,y), x: PHB, y: drop precedence:
CoS   : CFI    0          1
-----
0      (0,0)      (0,0)
1      (1,0)      (1,0)
2      (2,0)      (2,0)
3      (3,0)      (3,0)
4      (4,0)      (4,0)
5      (5,0)      (5,0)
6      (6,0)      (6,0)
7      (7,0)      (7,0)
Console#
```

**show qos map dscp-mutation** This command shows the ingress DSCP to internal DSCP map.

#### Syntax

**show qos map dscp-mutation interface** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Command Usage

This map is only used when the QoS mapping mode is set to "DSCP" by the [qos map trust-mode](#) command, and the ingress packet type is IPv4.

### Example

The ingress DSCP is composed of “d1” (most significant digit in the left column) and “d2” (least significant digit in the top row (in other words, ingress DSCP = d1 \* 10 + d2); and the corresponding Internal DSCP and drop precedence is shown at the intersecting cell in the table.

```
Console#show qos map dscp-mutation interface ethernet 1/5
Information of Eth 1/5
DSCP mutation map.(x,y),x: PHB,y: drop precedence:
d1: d2 0      1      2      3      4      5      6      7      8      9
-----
0 :   (0,0) (0,1) (0,0) (0,3) (0,0) (0,1) (0,0) (0,3) (1,0) (1,1)
1 :   (1,0) (1,3) (1,0) (1,1) (1,0) (1,3) (2,0) (2,1) (2,0) (2,3)
2 :   (2,0) (2,1) (2,0) (2,3) (3,0) (3,1) (3,0) (3,3) (3,0) (3,1)
3 :   (3,0) (3,3) (4,0) (4,1) (4,0) (4,3) (4,0) (4,1) (4,0) (4,3)
4 :   (5,0) (5,1) (5,0) (5,3) (5,0) (5,1) (6,0) (5,3) (6,0) (6,1)
5 :   (6,0) (6,3) (6,0) (6,1) (6,0) (6,3) (7,0) (7,1) (7,0) (7,3)
6 :   (7,0) (7,1) (7,0) (7,3)
Console#
```

**show qos map phb-queue** This command shows internal per-hop behavior to hardware queue map.

### Syntax

```
show qos map phb-queue interface interface
                                ethernet unit/port
                                unit - Unit identifier. (Range: 1-8)
                                port - Port number. (Range: 1-28)
```

### Command Mode

Privileged Exec

### Example

```
Console#show qos map phb-queue interface ethernet 1/5
Information of Eth 1/5
PHB Queue Map:
PHB:      0      1      2      3      4      5      6      7
-----
Queue:    2      0      1      3      4      5      6      7
Console#
```



**show qos map trust-mode** This command shows the QoS mapping mode.

#### Syntax

**show qos map trust-mode interface** *interface*

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Example

The following shows that the trust mode is set to CoS:

```
Console#show qos map trust-mode interface ethernet 1/5
Information of Eth 1/5
  CoS Map Mode:          CoS mode
Console#
```



## Quality of Service Commands

The commands described in this section are used to configure Differentiated Services (DiffServ) classification criteria and service policies. You can classify traffic based on access lists, IP Precedence or DSCP values, or VLANs. Using access lists allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet.

**Table 120: Quality of Service Commands**

Command	Function	Mode
<a href="#">class-map</a>	Creates a class map for a type of traffic	GC
<a href="#">description</a>	Specifies the description of a class map	CM
<a href="#">match</a>	Defines the criteria used to classify traffic	CM
<a href="#">rename</a>	Redefines the name of a class map	CM
<a href="#">policy-map</a>	Creates a policy map for multiple interfaces	GC
<a href="#">description</a>	Specifies the description of a policy map	PM
<a href="#">class</a>	Defines a traffic classification for the policy to act on	PM
<a href="#">rename</a>	Redefines the name of a policy map	PM
<a href="#">police flow</a>	Defines an enforcer for classified traffic based on a metered flow rate	PM-C
<a href="#">police srtcm-color</a>	Defines an enforcer for classified traffic based on a single rate three color meter	PM-C
<a href="#">police trtcm-color</a>	Defines an enforcer for classified traffic based on a two rate three color meter	PM-C
<a href="#">set cos</a>	Serves IP traffic by setting a class of service value for matching packets for internal processing	PM-C
<a href="#">set ip dscp</a>	Serves IP traffic by setting a IP DSCP value for matching packets for internal processing	PM-C
<a href="#">set phb</a>	Serves IP traffic by setting a per-hop behavior value for matching packets for internal processing	PM-C
<a href="#">service-policy (Ethernet)</a>	Applies a policy map defined by the <a href="#">policy-map</a> command to a particular interface	IC
<a href="#">show class-map</a>	Displays the QoS class maps which define matching criteria used for classifying traffic	PE
<a href="#">show policy-map</a>	Displays the QoS policy maps which define classification criteria for ingress or egress traffic, and may include policers for bandwidth limitations	PE
<a href="#">show policy-map interface</a>	Displays the configuration of all classes configured for all service policies on the specified interface	PE

To create a service policy for a specific category of ingress traffic, follow these steps:

1. Use the **class-map** command to designate a class name for a specific category of traffic, and enter the Class Map configuration mode.
2. Use the **match** command to select a specific type of traffic based on an access list, an IPv4 DSCP value, IPv4 Precedence value, IPv6 DSCP value, a VLAN, a CoS value, or a source port.
3. Use the **policy-map** command to designate a policy name for a specific manner in which ingress traffic will be handled, and enter the Policy Map configuration mode.
4. Use the **class** command to identify the class map, and enter Policy Map Class configuration mode. A policy map can contain up to 16 class maps.
5. Use the **set phb**, **set cos** or **set ip dscp** command to modify the per-hop behavior, the class of service value in the VLAN tag, or the priority bits in the IP header (IP DSCP value) for the matching traffic class, and use one of the **police** commands to monitor parameters such as the average flow and burst rate, and drop any traffic that exceeds the specified rate, or just reduce the DSCP service level for traffic exceeding the specified rate.
6. Use the **service-policy (Ethernet)** command to assign a policy map to a specific interface.




---

**Note:** Create a Class Map before creating a Policy Map.

---

**class-map** This command creates a class map used for matching packets to the specified class, and enters Class Map configuration mode. Use the **no** form to delete a class map.

#### Syntax

**[no] class-map** *class-map-name* [**match-any**]

*class-map-name* - Name of the class map. (Range: 1-32 characters)

**match-any** - Match any condition within a class map.

#### Default Setting

match-any

#### Command Mode

Global Configuration

### Command Usage

- ◆ First enter this command to designate a class map and enter the Class Map configuration mode. Then use [match](#) commands to specify the criteria for ingress traffic that will be classified under this class map.
- ◆ One or more class maps can be assigned to a policy map ([page 632](#)). The policy map is then bound by a service policy to an interface ([page 642](#)). A service policy defines packet classification, service tagging, and bandwidth policing. Once a policy map has been bound to an interface, no additional class maps may be added to the policy map, nor any changes made to the assigned class maps with the [match](#) or **set** commands.

### Example

This example creates a class map call “rd-class,” and sets it to match packets marked for DSCP service value 3:

```
Console(config)#class-map rd-class match-any
Console(config-cmap)#match ip dscp 3
Console(config-cmap)#
```

### Related Commands

[show class-map \(643\)](#)

**description** This command specifies the description of a class map or policy map.

### Syntax

**description** *string*

*string* - Description of the class map or policy map. (Range: 1-64 characters)

### Command Mode

Class Map Configuration

Policy Map Configuration

### Example

```
Console(config)#class-map rd-class#1
Console(config-cmap)#description "matches packets marked for DSCP service
value 3"
Console(config-cmap)#
```

**match** This command defines the criteria used to classify traffic. Use the **no** form to delete the matching criteria.

### Syntax

```
[no] match {access-list acl-name | cos cos | ip dscp dscp |  
ip precedence ip-precedence | ipv6 dscp dscp | source-port interface |  
vlan vlan}
```

*acl-name* - Name of the access control list. Any type of ACL can be specified, including standard or extended IPv4/IPv6 ACLs and MAC ACLs.

(Range: 1-16 characters)

*cos* - A Class of Service value. (Range: 0-7)

*dscp* - A Differentiated Service Code Point value. (Range: 0-63)

*ip-precedence* - An IP Precedence value. (Range: 0-7)

*interface*

*unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*vlan* - A VLAN. (Range:1-4094)

### Default Setting

None

### Command Mode

Class Map Configuration

### Command Usage

- ◆ First enter the **class-map** command to designate a class map and enter the Class Map configuration mode. Then use **match** commands to specify the fields within ingress or egress packets that must match to qualify for this class map.
- ◆ If an ingress or egress packet matches an ACL specified by this command, any deny rules included in the ACL will be ignored.
- ◆ If match criteria includes an IP ACL or IP priority rule, then a VLAN rule cannot be included in the same class map.
- ◆ If match criteria includes a MAC ACL or VLAN rule, then neither an IP ACL nor IP priority rule can be included in the same class map.
- ◆ Up to 16 match entries can be included in a class map.

**Example**

This example creates a class map called “rd-class#1,” and sets it to match packets marked for DSCP service value 3.

```
Console(config)#class-map rd-class#1 match-any
Console(config-cmap)#match ip dscp 3
Console(config-cmap)#
```

This example creates a class map call “rd-class#2,” and sets it to match packets marked for IP Precedence service value 5.

```
Console(config)#class-map rd-class#2 match-any
Console(config-cmap)#match ip precedence 5
Console(config-cmap)#
```

This example creates a class map call “rd-class#3,” and sets it to match packets marked for VLAN 1.

```
Console(config)#class-map rd-class#3 match-any
Console(config-cmap)#match vlan 1
Console(config-cmap)#
```

**rename** This command redefines the name of a class map or policy map.

**Syntax**

**rename** *map-name*

*map-name* - Name of the class map or policy map. (Range: 1-32 characters)

**Command Mode**

Class Map Configuration

Policy Map Configuration

**Example**

```
Console(config)#class-map rd-class#1
Console(config-cmap)#rename rd-class#9
Console(config-cmap)#
```

**policy-map** This command creates a policy map that can be attached to multiple interfaces, and enters Policy Map configuration mode. Use the **no** form to delete a policy map.

### Syntax

**[no] policy-map** *policy-map-name*

*policy-map-name* - Name of the policy map. (Range: 1-32 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Use the **policy-map** command to specify the name of the policy map, and then use the **class** command to configure policies for traffic that matches the criteria defined in a class map.
- ◆ A policy map can contain multiple class statements that can be applied to the same interface with the **service-policy (Ethernet)** command.
- ◆ Create a Class Map ([page 632](#)) before assigning it to a Policy Map.

### Example

This example creates a policy called “rd-policy,” uses the **class** command to specify the previously defined “rd-class,” uses the **set** command to classify the service that incoming packets will receive, and then uses the **police flow** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set cos 0
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
violate-action drop
Console(config-pmap-c)#
```

**class** This command defines a traffic classification upon which a policy can act, and enters Policy Map Class configuration mode. Use the **no** form to delete a class map.

### Syntax

**[no] class** *class-map-name*

*class-map-name* - Name of the class map. (Range: 1-32 characters)

### Default Setting

None



## Command Mode

### Policy Map Configuration

#### Command Usage

- ◆ Use the **policy-map** command to specify a policy map and enter Policy Map configuration mode. Then use the **class** command to enter Policy Map Class configuration mode. And finally, use the **set** command and one of the **police** commands to specify the match criteria, where the:
  - **set phb** command sets the per-hop behavior value in matching packets. (This modifies packet priority for internal processing only.)
  - **set cos** command sets the class of service value in matching packets. (This modifies packet priority in the VLAN tag.)
  - **set ip dscp** command sets the IP DSCP value in matching packets. (This modifies packet priority in the IP header.)
  - **police** commands define parameters such as the maximum throughput, burst rate, and response to non-conforming traffic.
- ◆ Up to 200 classes can be included in a policy map.

#### Example

This example creates a policy called “rd-policy,” uses the **class** command to specify the previously defined “rd-class,” uses the **set phb** command to classify the service that incoming packets will receive, and then uses the **police flow** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4,000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
violate-action drop
Console(config-pmap-c)#
```

**police flow** This command defines an enforcer for classified traffic based on the metered flow rate. Use the no form to remove a policer.

### Syntax

```
[no] police flow committed-rate committed-burst
conform-action transmit
violate-action {drop| new-dscp}
```

*committed-rate* - Committed information rate (CIR) in kilobits per second.  
(Range: 0-10000000 kbps at a granularity of 64 kbps or maximum port speed, whichever is lower)

*committed-burst* - Committed burst size (BC) in bytes.  
(Range: 64-16000000 at a granularity of 4k bytes)

**conform-action** - Action to take when packet is within the CIR and BC.  
(There are enough tokens to service the packet, the packet is set green).

**violate-action** - Action to take when packet exceeds the CIR and BC. (There are not enough tokens to service the packet, the packet is set red).

**transmit** - Transmits without taking any action.

**drop** - Drops packet as required by violate-action.

*new-dscp* - Differentiated Service Code Point (DSCP) value. (Range: 0-63)

### Default Setting

None

### Command Mode

Policy Map Class Configuration

### Command Usage

- ◆ You can configure up to 16 policers (i.e., class maps) for ingress or egress ports.
- ◆ The *committed-rate* cannot exceed the configured interface speed, and the *committed-burst* cannot exceed 16 Mbytes.
- ◆ Policing is based on a token bucket, where bucket depth (i.e., the maximum burst before the bucket overflows) is by specified the *committed-burst* field, and the average rate tokens are added to the bucket is by specified by the *committed-rate* option. Note that the token bucket functions similar to that described in RFC 2697 and RFC 2698.
- ◆ The behavior of the meter is specified in terms of one token bucket (C), the rate at which the tokens are incremented (CIR – Committed Information Rate), and the maximum size of the token bucket (BC – Committed Burst Size).

The token bucket C is initially full, that is, the token count  $T_c(0) = BC$ . Thereafter, the token count  $T_c$  is updated CIR times per second as follows:

- If  $T_c$  is less than BC,  $T_c$  is incremented by one, else

- Tc is not incremented.

When a packet of size B bytes arrives at time t, the following happens:

- If  $Tc(t) - B \geq 0$ , the packet is green and Tc is decremented by B down to the minimum value of 0, else
- else the packet is red and Tc is not decremented.

### Example

This example creates a policy called “rd-policy,” uses the `class` command to specify the previously defined “rd-class,” uses the `set phb` command to classify the service that incoming packets will receive, and then uses the **police flow** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police flow 100000 4000 conform-action transmit
violate-action drop
Console(config-pmap-c)#
```

**police srtcm-color** This command defines an enforcer for classified traffic based on a single rate three color meter (srTCM). Use the **no** form to remove a policer.

### Syntax

**[no] police {srtcm-color-blind | srtcm-color-aware}**

*committed-rate committed-burst excess-burst*

**conform-action transmit**

**exceed-action {drop | new-dscp}**

**violate action {drop | new-dscp}**

**srtcm-color-blind** - Single rate three color meter in color-blind mode.

**srtcm-color-aware** - Single rate three color meter in color-aware mode.

*committed-rate* - Committed information rate (CIR) in kilobits per second.  
(Range: 0-10000000 kbps at a granularity of 64 kbps or maximum port speed, whichever is lower)

*committed-burst* - Committed burst size (BC) in bytes.  
(Range: 64-16000000 at a granularity of 4k bytes)

*excess-burst* - Excess burst size (BE) in bytes.  
(Range: 64-1600000 at a granularity of 4k bytes)

**conform-action** - Action to take when rate is within the CIR and BC. (There are enough tokens in bucket BC to service the packet, packet is set green).

**exceed-action** - Action to take when rate exceeds the CIR and BC but is within the BE. (There are enough tokens in bucket BE to service the packet, the packet is set yellow.)

**violate-action** - Action to take when rate exceeds the BE. (There are not enough tokens in bucket BE to service the packet, the packet is set red.)

**transmit** - Transmits without taking any action.

**drop** - Drops packet as required by exceed-action or violate-action.

*new-dscp* - Differentiated Service Code Point (DSCP) value. (Range: 0-63)

### Default Setting

None

### Command Mode

Policy Map Class Configuration

### Command Usage

- ◆ You can configure up to 16 policers (i.e., class maps) for ingress or egress ports.
- ◆ The *committed-rate* cannot exceed the configured interface speed, and the *committed-burst* and *excess-burst* cannot exceed 16 Mbytes.
- ◆ The srTCM as defined in RFC 2697 meters a traffic stream and processes its packets according to three traffic parameters – Committed Information Rate (CIR), Committed Burst Size (BC), and Excess Burst Size (BE).
- ◆ The PHB label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion. A packet is marked green if it doesn't exceed the CIR and BC, yellow if it does exceed the CIR and BC, but not the BE, and red otherwise.
- ◆ The meter operates in one of two modes. In the color-blind mode, the meter assumes that the packet stream is uncolored. In color-aware mode the meter assumes that some preceding entity has pre-colored the incoming packet stream so that each packet is either green, yellow, or red. The marker (re)colors an IP packet according to the results of the meter. The color is coded in the DS field [RFC 2474] of the packet.
- ◆ The behavior of the meter is specified in terms of its mode and two token buckets, C and E, which both share the common rate CIR. The maximum size of the token bucket C is BC and the maximum size of the token bucket E is BE.

The token buckets C and E are initially full, that is, the token count  $T_c(0) = BC$  and the token count  $T_e(0) = BE$ . Thereafter, the token counts  $T_c$  and  $T_e$  are updated CIR times per second as follows:

- If  $T_c$  is less than BC,  $T_c$  is incremented by one, else
- if  $T_e$  is less than BE,  $T_e$  is incremented by one, else
- neither  $T_c$  nor  $T_e$  is incremented.

When a packet of size B bytes arrives at time t, the following happens if srTCM is configured to operate in color-blind mode:

- If  $T_c(t) - B \geq 0$ , the packet is green and  $T_c$  is decremented by B down to the minimum value of 0, else
- if  $T_e(t) - B \geq 0$ , the packets is yellow and  $T_e$  is decremented by B down to the minimum value of 0,
- else the packet is red and neither  $T_c$  nor  $T_e$  is decremented.

When a packet of size B bytes arrives at time t, the following happens if srTCM is configured to operate in color-aware mode:

- If the packet has been precolored as green and  $T_c(t) - B \geq 0$ , the packet is green and  $T_c$  is decremented by B down to the minimum value of 0, else
- If the packet has been precolored as yellow or green and if
- $T_e(t) - B \geq 0$ , the packets is yellow and  $T_e$  is decremented by B down to the minimum value of 0, else the packet is red and neither  $T_c$  nor  $T_e$  is decremented.

The metering policy guarantees a deterministic behavior where the volume of green packets is never smaller than what has been determined by the CIR and BC, that is, tokens of a given color are always spent on packets of that color. Refer to RFC 2697 for more information on other aspects of srTCM.

### Example

This example creates a policy called “rd-policy,” uses the `class` command to specify the previously defined “rd-class,” uses the `set phb` command to classify the service that incoming packets will receive, and then uses the **police srtcm-color-blind** command to limit the average bandwidth to 100,000 Kbps, the committed burst rate to 4000 bytes, the excess burst rate to 6000 bytes, to remark any packets exceeding the committed burst size, and to drop any packets exceeding the excess burst size.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police srtcm-color-blind 100000 4000 6000 conform-
  action transmit exceed-action 0 violate-action drop
Console(config-pmap-c)#
```

**police trtcm-color** This command defines an enforcer for classified traffic based on a two rate three color meter (trTCM). Use the **no** form to remove a policer.

### Syntax

```
[no] police {trtcm-color-blind | trtcm-color-aware}
      committed-rate committed-burst peak-rate peak-burst
      conform-action transmit
      exceed-action {drop | new-dscp}
      violate action {drop | new-dscp}
```

**trtcm-color-blind** - Two rate three color meter in color-blind mode.

**trtcm-color-aware** - Two rate three color meter in color-aware mode.

*committed-rate* - Committed information rate (CIR) in kilobits per second.  
(Range: 0-10000000 kbps at a granularity of 64 kbps or maximum port speed, whichever is lower)

*committed-burst* - Committed burst size (BC) in bytes.  
(Range: 64-16000000 at a granularity of 4k bytes)

*peak-rate* - Peak information rate (PIR) in kilobits per second.  
(Range: 0-10000000 kbps at a granularity of 64 kbps or maximum port speed, whichever is lower)

*peak-burst* - Peak burst size (BP) in bytes.  
(Range: 64-16000000 at a granularity of 4k bytes)

**conform-action** - Action to take when rate is within the CIR and BP. (Packet size does not exceed BP and there are enough tokens in bucket BC to service the packet, the packet is set green.)

**exceed-action** - Action to take when rate exceeds the CIR but is within the PIR. (Packet size exceeds BC but there are enough tokens in bucket BP to service the packet, the packet is set yellow.)

**violate-action** - Action to take when rate exceeds the PIR. (There are not enough tokens in bucket BP to service the packet, the packet is set red.)

**drop** - Drops packet as required by exceed-action or violate-action.

**transmit** - Transmits without taking any action.

*new-dscp* - Differentiated Service Code Point (DSCP) value. (Range: 0-63)

### Default Setting

None

### Command Mode

Policy Map Class Configuration

### Command Usage

- ◆ You can configure up to 16 policers (i.e., class maps) for ingress ports.
- ◆ The *committed-rate* and *peak-rate* cannot exceed the configured interface speed, and the *committed-burst* and *peak-burst* cannot exceed 16 Mbytes.
- ◆ The trTCM as defined in RFC 2698 meters a traffic stream and processes its packets based on two rates – Committed Information Rate (CIR) and Peak Information Rate (PIR), and their associated burst sizes - Committed Burst Size (BC) and Peak Burst Size (BP).
- ◆ The PHB label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion. A packet is marked red if it exceeds the PIR. Otherwise it is marked either yellow or green depending on whether it exceeds or doesn't exceed the CIR.

The trTCM is useful for ingress policing of a service, where a peak rate needs to be enforced separately from a committed rate.

- ◆ The meter operates in one of two modes. In the color-blind mode, the meter assumes that the packet stream is uncolored. In color-aware mode the meter assumes that some preceding entity has pre-colored the incoming packet stream so that each packet is either green, yellow, or red. The marker (re)colors an IP packet according to the results of the meter. The color is coded in the DS field [RFC 2474] of the packet.
- ◆ The behavior of the meter is specified in terms of its mode and two token buckets, P and C, which are based on the rates PIR and CIR, respectively. The maximum size of the token bucket P is BP and the maximum size of the token bucket C is BC.
- ◆ The token buckets P and C are initially (at time 0) full, that is, the token count  $Tp(0) = BP$  and the token count  $Tc(0) = BC$ . Thereafter, the token count Tp is incremented by one PIR times per second up to BP and the token count Tc is incremented by one CIR times per second up to BC.

When a packet of size B bytes arrives at time t, the following happens if trTCM is configured to operate in color-blind mode:

- If  $Tp(t) - B < 0$ , the packet is red, else
- if  $Tc(t) - B < 0$ , the packet is yellow and Tp is decremented by B, else
- the packet is green and both Tp and Tc are decremented by B.

When a packet of size B bytes arrives at time t, the following happens if trTCM is configured to operate in color-aware mode:

- If the packet has been precolored as red or if  $Tp(t) - B < 0$ , the packet is red, else
  - if the packet has been precolored as yellow or if  $Tc(t) - B < 0$ , the packet is yellow and Tp is decremented by B, else
  - the packet is green and both Tp and Tc are decremented by B.
- ◆ The trTCM can be used to mark a IP packet stream in a service, where different, decreasing levels of assurances (either absolute or relative) are given to packets which are green, yellow, or red. Refer to RFC 2698 for more information on other aspects of trTCM.

### Example

This example creates a policy called "rd-policy," uses the `class` command to specify the previously defined "rd-class," uses the `set phb` command to classify the service that incoming packets will receive, and then uses the **`police trtcm-color-blind`** command to limit the average bandwidth to 100,000 Kbps, the committed burst rate to 4000 bytes, the peak information rate to 1,000,000 kbps, the peak burst size to 6000, to remark any packets exceeding the committed burst size, and to drop any packets exceeding the peak information rate.

```

Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police trtcm-color-blind 100000 4000 100000 6000
    conform-action transmit exceed-action 0 violate-action drop
Console(config-pmap-c)#

```

**set cos** This command modifies the class of service (CoS) value for a matching packet (as specified by the **match** command) in the packet's VLAN tag. Use the **no** form to remove this setting.

### Syntax

**[no] set cos** *cos-value*

*cos-value* - Class of Service value. (Range: 0-7)

### Default Setting

None

### Command Mode

Policy Map Class Configuration

### Command Usage

- ◆ The **set cos** command is used to set the CoS value in the VLAN tag for matching packets.
- ◆ The **set cos** and **set phb** command function at the same level of priority. Therefore setting either of these commands will overwrite any action already configured by the other command.

### Example

This example creates a policy called "rd-policy," uses the **class** command to specify the previously defined "rd-class," uses the **set cos** command to classify the service that incoming packets will receive, and then uses the **police flow** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```

Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set cos 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
    violate-action drop
Console(config-pmap-c)#

```



**set ip dscp** This command modifies the IP DSCP value in a matching packet (as specified by the [match](#) command). Use the **no** form to remove this traffic classification.

### Syntax

**[no] set ip dscp** *new-dscp*

*new-dscp* - New Differentiated Service Code Point (DSCP) value.  
(Range: 0-63)

### Default Setting

None

### Command Mode

Policy Map Class Configuration

### Command Usage

The **set ip dscp** command is used to set the priority values in the packet's ToS field for matching packets.

### Example

This example creates a policy called "rd-policy," uses the [class](#) command to specify the previously defined "rd-class," uses the **set ip dscp** command to classify the service that incoming packets will receive, and then uses the [police flow](#) command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set ip dscp 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
violate-action drop
Console(config-pmap-c)#
```

**set phb** This command services IP traffic by setting a per-hop behavior value for a matching packet (as specified by the [match](#) command) for internal processing. Use the **no** form to remove this setting.

### Syntax

**[no] set phb** *phb-value*

*phb-value* - Per-hop behavior value. (Range: 0-7)

### Default Setting

None

### Command Mode

Policy Map Class Configuration

### Command Usage

- ◆ The **set phb** command is used to set an internal QoS value in hardware for matching packets (see Table 118, "Default Mapping of DSCP Values to Internal PHB/Drop Values"). The QoS label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion by the **police srctm-color** command and **police trctm-color** command.
- ◆ The **set cos** and **set phb** command function at the same level of priority. Therefore setting either of these commands will overwrite any action already configured by the other command.

### Example

This example creates a policy called "rd-policy," uses the **class** command to specify the previously defined "rd-class," uses the **set phb** command to classify the service that incoming packets will receive, and then uses the **police flow** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
violate-action drop
Console(config-pmap-c)#
```

**service-policy** **(Ethernet)** This command applies a policy map defined by the **policy-map** command to the ingress or egress side of a particular interface. Use the **no** form to remove this mapping.

### Syntax

**[no] service-policy {input | output} policy-map-name**

**input** - Apply to the input traffic.

**output** - Apply to the output traffic.

*policy-map-name* - Name of the policy map for this interface.  
(Range: 1-32 characters)

### Default Setting

No policy map is attached to an interface.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Only one policy map can be assigned to an interface.

- ◆ First define a class map, then define a policy map, and finally use the **service-policy** command to bind the policy map to the required interface.

### Example

This example applies a service policy to an ingress interface.

```
Console(config)#interface ethernet 1/1
Console(config-if)#service-policy input rd-policy
Console(config-if)#
```

**show class-map** This command displays the QoS class maps which define matching criteria used for classifying traffic.

### Syntax

**show class-map** [*class-map-name*]

*class-map-name* - Name of the class map. (Range: 1-32 characters)

### Default Setting

Displays all class maps.

### Command Mode

Privileged Exec

### Example

```
Console#show class-map
Class Map match-any rd-class#1
Description:
  Match ip dscp 10
  Match access-list rd-access
  Match ip dscp 0

Class Map match-any rd-class#2
  Match ip precedence 5

Class Map match-any rd-class#3
  Match vlan 1

Console#
```

**show policy-map** This command displays the QoS policy maps which define classification criteria for ingress or egress traffic, and may include policers for bandwidth limitations.

### Syntax

**show policy-map** [*policy-map-name* [**class** *class-map-name*]]

*policy-map-name* - Name of the policy map. (Range: 1-32 characters)

*class-map-name* - Name of the class map. (Range: 1-32 characters)

### Default Setting

Displays all policy maps and all classes.

### Command Mode

Privileged Exec

### Example

```
Console#show policy-map
Policy Map rd-policy
Description:
  class rd-class
  set PHB 3
  class finance-class
  police flow 100 64 conform-action transmit violate-action drop-(missing-
  priority)
-bundle 1 100 rd-class, finance-class
Console#show policy-map rd-policy class rd-class
Policy Map rd-policy
  class rd-class
    set PHB 3
Console#
```

**show policy-map interface** This command displays the service policy assigned to the specified interface.

### Syntax

**show policy-map interface** *interface* {**input** | **output**}

*interface*

*unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

### Command Mode

Privileged Exec

**Example**

```
Console#show policy-map interface 1/5 input
Service-policy rd-policy
Console#
```



# Multicast Filtering Commands

This switch uses IGMP (Internet Group Management Protocol) to check for any attached hosts that want to receive a specific multicast service. It identifies the ports containing hosts requesting a service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service.

**Table 121: Multicast Filtering Commands**

Command Group	Function
IGMP Snooping	Configures multicast groups via IGMP snooping or static assignment, sets the IGMP version, enables proxy reporting, displays current snooping settings, and displays the multicast service and group members
IGMP Filtering and Throttling	Configures IGMP filtering and throttling
MLD Snooping	Configures multicast snooping for IPv6
MLD Filtering and Throttling	Configures MLD filtering and throttling for IPv6.
Multicast VLAN Registration for IPv4	Configures a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation for normal traffic
Multicast VLAN Registration for IPv6	Configures a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation for normal traffic
IGMP (Layer 3)	Configures the IGMP protocol used with multicast routing in IPv4 networks
IGMP Proxy Routing	Collects and sends multicast group membership information onto the upstream interface based on IGMP messages monitored on downstream interfaces, and forwards multicast traffic based on that information
MLD (Layer 3)	Configures the MLD protocol used with multicast routing in IPv6 networks
MLD Proxy Routing	Collects and sends multicast group membership information onto the upstream interface based on MLD messages monitored on downstream interfaces, and forwards multicast traffic based on that information

## IGMP Snooping

This section describes commands used to configure IGMP snooping on the switch.

**Table 122: IGMP Snooping Commands**

Command	Function	Mode
<code>ip igmp snooping</code>	Enables IGMP snooping	GC
<code>ip igmp snooping priority</code>	Assigns a priority to all multicast traffic	GC
<code>ip igmp snooping proxy-reporting</code>	Enables IGMP Snooping with Proxy Reporting	GC
<code>ip igmp snooping querier</code>	Allows this device to act as the querier for IGMP snooping	GC
<code>ip igmp snooping router-alert-option-check</code>	Discards any IGMPv2/v3 packets that do not include the Router Alert option	GC
<code>ip igmp snooping router-port-expire-time</code>	Configures the querier timeout	GC
<code>ip igmp snooping tcn-flood</code>	Floods multicast traffic when a Spanning Tree topology change occurs	GC
<code>ip igmp snooping tcn-query-solicit</code>	Sends an IGMP Query Solicitation when a Spanning Tree topology change occurs	GC
<code>ip igmp snooping unregistered-data-flood</code>	Floods unregistered multicast traffic into the attached VLAN	GC
<code>ip igmp snooping unsolicited-report-interval</code>	Specifies how often the upstream interface should transmit unsolicited IGMP reports (when proxy reporting is enabled)	GC
<code>ip igmp snooping version</code>	Configures the IGMP version for snooping	GC
<code>ip igmp snooping version-exclusive</code>	Discards received IGMP messages which use a version different to that currently configured	GC
<code>ip igmp snooping vlan general-query-suppression</code>	Suppresses general queries except for ports attached to downstream multicast hosts	GC
<code>ip igmp snooping vlan immediate-leave</code>	Immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate-leave is enabled for the parent VLAN	GC
<code>ip igmp snooping vlan last-memb-query-count</code>	Configures the number of IGMP proxy query messages that are sent out before the system assumes there are no local members	GC
<code>ip igmp snooping vlan last-memb-query-intvl</code>	Configures the last-member-query interval	GC
<code>ip igmp snooping vlan mrd</code>	Sends multicast router solicitation messages	GC
<code>ip igmp snooping vlan proxy-address</code>	Configures a static address for proxy IGMP query and reporting	GC
<code>ip igmp snooping vlan proxy-reporting</code>	Enables IGMP Snooping with Proxy Reporting	GC
<code>ip igmp snooping vlan query-interval</code>	Configures the interval between sending IGMP general queries	GC
<code>ip igmp snooping vlan query-resp-intvl</code>	Configures the maximum time the system waits for a response to general queries	GC



Table 122: IGMP Snooping Commands (Continued)

Command	Function	Mode
<code>ip igmp snooping vlan static</code>	Adds an interface as a member of a multicast group	GC
<code>ip igmp snooping vlan version</code>	Configures the IGMP version for snooping	GC
<code>ip igmp snooping vlan version-exclusive</code>	Discards received IGMP messages which use a version different to that currently configured	GC
<code>clear ip igmp snooping groups dynamic</code>	Clears multicast group information dynamically learned through IGMP snooping	PE
<code>clear ip igmp snooping statistics</code>	Clears IGMP snooping statistics	PE
<code>show ip igmp snooping</code>	Shows the IGMP snooping, proxy, and query configuration	PE
<code>show ip igmp snooping group</code>	Shows known multicast group, source, and host port mapping	PE
<code>show ip igmp snooping mrouter</code>	Shows multicast router ports	PE
<code>show ip igmp snooping statistics</code>	Shows IGMP snooping protocol statistics for the specified interface	PE

**ip igmp snooping** This command enables IGMP snooping globally on the switch or on a selected VLAN interface. Use the **no** form to disable it.

### Syntax

**[no] ip igmp snooping [vlan *vlan-id*]**

*vlan-id* - VLAN ID (Range: 1-4094)

### Default Setting

Enabled

### Command Mode

Global Configuration

### Command Usage

- ◆ When IGMP snooping is enabled globally, the per VLAN interface settings for IGMP snooping take precedence.
- ◆ When IGMP snooping is disabled globally, snooping can still be configured per VLAN interface, but the interface settings will not take effect until snooping is re-enabled globally.

### Example

The following example enables IGMP snooping globally.

```
Console(config)#ip igmp snooping
Console(config)#
```

**ip igmp snooping priority** This command assigns a priority to all multicast traffic. Use the **no** form to restore the default setting.

### Syntax

**ip igmp snooping priority** *priority*

**no ip igmp snooping priority**

*priority* - The CoS priority assigned to all multicast traffic. (Range: 0-7, where 7 is the highest priority)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

This command can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

### Example

```
Console(config)#ip igmp snooping priority 6
Console(config)#
```

### Related Commands

[show ip igmp snooping \(666\)](#)

**ip igmp snooping proxy-reporting** This command enables IGMP Snooping with Proxy Reporting. Use the **no** form to restore the default setting.

#### Syntax

**[no] ip igmp snooping proxy-reporting**

**ip igmp snooping vlan *vlan-id* proxy-reporting {enable | disable}**

**no ip igmp snooping vlan *vlan-id* proxy-reporting**

*vlan-id* - VLAN ID (Range: 1-4094)

**enable** - Enable on the specified VLAN.

**disable** - Disable on the specified VLAN.

#### Default Setting

Global: Disabled

VLAN: Based on global setting

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When proxy reporting is enabled with this command, the switch performs "IGMP Snooping with Proxy Reporting" (as defined in DSL Forum TR-101, April 2006), including last leave, and query suppression. Last leave sends out a proxy query when the last member leaves a multicast group, and query suppression means that specific queries are not forwarded from an upstream multicast router to hosts downstream from this device.
- ◆ If the IGMP proxy reporting is configured on a VLAN, this setting takes precedence over the global configuration.

#### Example

```
Console(config)#ip igmp snooping proxy-reporting
Console(config)#
```

**ip igmp snooping querier** This command enables the switch as an IGMP querier. Use the **no** form to disable it.

#### Syntax

**[no] ip igmp snooping querier**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

### Command Usage

- ◆ IGMP snooping querier is not supported for IGMPv3 snooping (see [ip igmp snooping version](#)).
- ◆ If enabled, the switch will serve as querier if elected. The querier is responsible for asking hosts if they want to receive multicast traffic.

### Example

```
Console(config)#ip igmp snooping querier
Console(config)#
```

### **ip igmp snooping router-alert-option- check**

This command discards any IGMPv2/v3 packets that do not include the Router Alert option. Use the **no** form to ignore the Router Alert Option when receiving IGMP messages.

### Syntax

**[no] ip igmp snooping router-alert-option-check**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

As described in Section 9.1 of RFC 3376 for IGMP Version 3, the Router Alert Option can be used to protect against DOS attacks. One common method of attack is launched by an intruder who takes over the role of querier, and starts overloading multicast hosts by sending a large number of group-and-source-specific queries, each with a large source list and the Maximum Response Time set to a large value.

To protect against this kind of attack, (1) routers should not forward queries. This is easier to accomplish if the query carries the Router Alert option. (2) Also, when the switch is acting in the role of a multicast host (such as when using proxy routing), it should ignore version 2 or 3 queries that do not contain the Router Alert option.

### Example

```
Console(config)#ip igmp snooping router-alert-option-check
Console(config)#
```

**ip igmp snooping router-port-expire-time** This command configures the querier timeout. Use the **no** form to restore the default.

#### Syntax

**ip igmp snooping router-port-expire-time** *seconds*

**no ip igmp snooping router-port-expire-time**

*seconds* - The time the switch waits after the previous querier stops before it considers it to have expired. (Range: 1-65535;  
Recommended Range: 300-500)

#### Default Setting

300 seconds

#### Command Mode

Global Configuration

#### Example

The following shows how to configure the timeout to 400 seconds:

```
Console(config)#ip igmp snooping router-port-expire-time 400
Console(config)#
```

**ip igmp snooping tcn-flood** This command enables flooding of multicast traffic if a spanning tree topology change notification (TCN) occurs. Use the **no** form to disable flooding.

#### Syntax

**[no] ip igmp snooping tcn-flood**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When a spanning tree topology change occurs, the multicast membership information learned by the switch may be out of date. For example, a host linked to one port before the topology change (TC) may be moved to another port after the change. To ensure that multicast data is delivered to all receivers, by default, a switch in a VLAN (with IGMP snooping enabled) that receives a Bridge Protocol Data Unit (BPDU) with the TC bit set (by the root bridge) will enter into "multicast flooding mode" for a period of time until the topology has stabilized and the new locations of all multicast receivers are learned.

- ◆ If a topology change notification (TCN) is received, and all the uplink ports are subsequently deleted, a timeout mechanism is used to delete all of the currently learned multicast channels.
- ◆ When a new uplink port starts up, the switch sends unsolicited reports for all current learned channels out through the new uplink port.
- ◆ By default, the switch immediately enters into “multicast flooding mode” when a spanning tree topology change occurs. In this mode, multicast traffic will be flooded to all VLAN ports. If many ports have subscribed to different multicast groups, flooding may cause excessive loading on the link between the switch and the end host. Flooding may be disabled to avoid this, causing multicast traffic to be delivered only to those ports on which multicast group members have been learned.
- ◆ When the spanning tree topology changes, the root bridge sends a proxy query to quickly re-learn the host membership/port relations for multicast channels. The root bridge also sends an unsolicited Multicast Router Discover (MRD) request to quickly locate the multicast routers in this VLAN.

The proxy query and unsolicited MRD request are flooded to all VLAN ports except for the receiving port when the switch receives such packets.

### Example

The following example enables TCN flooding.

```
Console(config)#ip igmp snooping tcn-flood
Console(config)#
```

### **ip igmp snooping tcn-query-solicit**

This command instructs the switch to send out an IGMP general query solicitation when a spanning tree topology change notification (TCN) occurs. Use the **no** form to disable this feature.

### Syntax

**[no] ip igmp snooping tcn-query-solicit**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ When the root bridge in a spanning tree receives a topology change notification for a VLAN where IGMP snooping is enabled, it issues a global IGMP leave message (query solicitation). When a switch receives this solicitation, it floods it to all ports in the VLAN where the spanning tree change occurred.

When an upstream multicast router receives this solicitation, it will also immediately issues an IGMP general query.

- ◆ The **ip igmp snooping tcn query-solicit** command can be used to send a query solicitation whenever it notices a topology change, even if the switch is not the root bridge in the spanning tree.

### Example

The following example instructs the switch to issue an IGMP general query whenever it receives a spanning tree topology change notification.

```
Console(config)#ip igmp snooping tcn query-solicit
Console(config)#
```

### ip igmp snooping unregistered-data- flood

This command floods unregistered multicast traffic into the attached VLAN. Use the **no** form to drop unregistered multicast traffic.

#### Syntax

**[no] ip igmp snooping unregistered-data-flood**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

Once the table used to store multicast entries for IGMP snooping and multicast routing is filled, no new entries are learned. If no router port is configured in the attached VLAN, and unregistered-flooding is disabled, any subsequent multicast traffic not found in the table is dropped, otherwise it is flooded throughout the VLAN.

### Example

```
Console(config)#ip igmp snooping unregistered-data-flood
Console(config)#
```

**ip igmp snooping unsolicited-report-interval** This command specifies how often the upstream interface should transmit unsolicited IGMP reports when proxy reporting is enabled. Use the **no** form to restore the default value.

#### Syntax

**ip igmp snooping unsolicited-report-interval** *seconds*

**no ip igmp snooping unsolicited-report-interval**

*seconds* - The interval at which to issue unsolicited reports. (Range: 1-65535 seconds)

#### Default Setting

400 seconds

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When a new upstream interface (that is, uplink port) starts up, the switch sends unsolicited reports for all currently learned multicast channels out through the new upstream interface.
- ◆ This command only applies when proxy reporting is enabled (see [page 651](#)).

#### Example

```
Console(config)#ip igmp snooping unsolicited-report-interval 5
Console(config)#
```

**ip igmp snooping version** This command configures the IGMP snooping version. Use the **no** form to restore the default.

#### Syntax

**ip igmp snooping [vlan *vlan-id*] version {1 | 2 | 3}**

**no ip igmp snooping version**

*vlan-id* - VLAN ID (Range: 1-4094)

**1** - IGMP Version 1

**2** - IGMP Version 2

**3** - IGMP Version 3

#### Default Setting

Global: IGMP Version 2

VLAN: Not configured, based on global setting



### Command Mode

Global Configuration

### Command Usage

- ◆ This command configures the IGMP report/query version used by IGMP snooping. Versions 1 - 3 are all supported, and versions 2 and 3 are backward compatible, so the switch can operate with other devices, regardless of the snooping version employed.
- ◆ If the IGMP snooping version is configured on a VLAN, this setting takes precedence over the global configuration.

### Example

The following configures the global setting for IGMP snooping to version 1.

```
Console(config)#ip igmp snooping version 1
Console(config)#
```

### ip igmp snooping version-exclusive

This command discards any received IGMP messages (except for multicast protocol packets) which use a version different to that currently configured by the [ip igmp snooping version](#) command. Use the **no** form to disable this feature.

### Syntax

**ip igmp snooping [vlan *vlan-id*] version-exclusive**

**no ip igmp snooping version-exclusive**

*vlan-id* - VLAN ID (Range: 1-4094)

### Default Setting

Global: Disabled

VLAN: Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ If version exclusive is disabled on a VLAN, then this setting is based on the global setting. If it is enabled on a VLAN, then this setting takes precedence over the global setting.
- ◆ When this function is disabled, the currently selected version is backward compatible (see the [ip igmp snooping version](#) command).

### Example

```
Console(config)#ip igmp snooping version-exclusive
Console(config)#
```

**ip igmp snooping vlan general-query-suppression** This command suppresses general queries except for ports attached to downstream multicast hosts. Use the **no** form to flood general queries to all ports except for the multicast router port.

#### Syntax

**[no] ip igmp snooping vlan *vlan-id* general-query-suppression**

*vlan-id* - VLAN ID (Range: 1-4094)

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ By default, general query messages are flooded to all ports, except for the multicast router through which they are received.
- ◆ If general query suppression is enabled, then these messages are forwarded only to downstream ports which have joined a multicast service.

#### Example

```
Console(config)#ip igmp snooping vlan 1 general-query-suppression
Console(config)#
```

**ip igmp snooping vlan immediate-leave** This command immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate-leave is enabled for the parent VLAN. Use the **no** form to restore the default.

#### Syntax

**ip igmp snooping vlan *vlan-id* immediate-leave [by-host-ip]**

**no ip igmp snooping vlan *vlan-id* immediate-leave**

*vlan-id* - VLAN ID (Range: 1-4094)

**by-host-ip** - Specifies that the member port will be deleted only when there are no hosts joining this group.

#### Default Setting

Disabled

#### Command Mode

Global Configuration

### Command Usage

- ◆ If immediate-leave is *not* used, a multicast router (or querier) will send a group-specific query message when an IGMPv2/v3 group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the timeout period. (The timeout for this release is currently defined by `ip igmp snooping vlan last-memb-query-intvl` \* `ip igmp robustval`).
- ◆ If immediate-leave is used, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one IGMP-enabled device, either a service host or a neighbor running IGMP snooping.
- ◆ If the “by-host-ip” option is used, the router/querier will not send out a group-specific query when an IGMPv2/v3 leave message is received. But will check if there are other hosts joining the multicast group. Only when all hosts on that port leave the group will the member port be deleted.
- ◆ This command is only effective if IGMP snooping is enabled, and IGMPv2 or IGMPv3 snooping is used.

### Example

The following shows how to enable immediate leave.

```
Console(config)#ip igmp snooping vlan 1 immediate-leave
Console(config)#
```

**ip igmp snooping vlan last-memb-query-count** This command configures the number of IGMP proxy group-specific or group-and-source-specific query messages that are sent out before the system assumes there are no more local members. Use the **no** form to restore the default.

### Syntax

**ip igmp snooping vlan *vlan-id* last-memb-query-count *count***

**no ip igmp snooping vlan *vlan-id* last-memb-query-count**

*vlan-id* - VLAN ID (Range: 1-4094)

*count* - The number of proxy group-specific or group-and-source-specific query messages to issue before assuming that there are no more group members. (Range: 1-255)

### Default Setting

2

### Command Mode

Global Configuration

### Command Usage

This command will take effect only if IGMP snooping proxy reporting or IGMP querier is enabled ([page 651](#)).

### Example

```
Console(config)#ip igmp snooping vlan 1 last-memb-query-count 7
Console(config)#
```

### **ip igmp snooping vlan last-memb-query- intvl**

This command configures the last-member-query interval. Use the **no** form to restore the default.

### Syntax

**ip igmp snooping vlan *vlan-id* last-memb-query-intvl *interval***

**no ip igmp snooping vlan *vlan-id* last-memb-query-intvl**

*vlan-id* - VLAN ID (Range: 1-4094)

*interval* - The interval to wait for a response to a group-specific or group-and-source-specific query message. (Range: 1-31744 tenths of a second)

### Default Setting

10 (1 second)

### Command Mode

Global Configuration

### Command Usage

- ◆ When a multicast host leaves a group, it sends an IGMP leave message. When the leave message is received by the switch, it checks to see if this host is the last to leave the group by sending out an IGMP group-specific or group-and-source-specific query message, and starts a timer. If no reports are received before the timer expires, the group record is deleted, and a report is sent to the upstream multicast router.
- ◆ A reduced value will result in reduced time to detect the loss of the last member of a group or source, but may generate more bursty traffic.
- ◆ This command will take effect only if IGMP snooping proxy reporting is enabled ([page 651](#)).

### Example

```
Console(config)#ip igmp snooping vlan 1 last-memb-query-intvl 700
Console(config)#
```

**ip igmp snooping vlan mrd** This command enables sending of multicast router solicitation messages. Use the **no** form to disable these messages.

### Syntax

**[no] ip igmp snooping vlan *vlan-id* mrd**

*vlan-id* - VLAN ID (Range: 1-4094)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Multicast Router Discovery (MRD) uses multicast router advertisement, multicast router solicitation, and multicast router termination messages to discover multicast routers. Devices send solicitation messages in order to solicit advertisement messages from multicast routers. These messages are used to discover multicast routers on a directly attached link. Solicitation messages are also sent whenever a multicast forwarding interface is initialized or re-initialized. Upon receiving a solicitation on an interface with IP multicast forwarding and MRD enabled, a router will respond with an advertisement.
- ◆ Advertisements are sent by routers to advertise that IP multicast forwarding is enabled. These messages are sent unsolicited periodically on all router interfaces on which multicast forwarding is enabled. They are sent upon the expiration of a periodic timer, as a part of a router's start up procedure, during the restart of a multicast forwarding interface, and on receipt of a solicitation message. When the multicast services provided to a VLAN is relatively stable, the use of solicitation messages is not required and may be disabled using the **no ip igmp snooping vlan mrd** command.
- ◆ This command may also be used to disable multicast router solicitation messages when the upstream router does not support MRD, to reduce the loading on a busy upstream router, or when IGMP snooping is disabled in a VLAN.

### Example

This example disables sending of multicast router solicitation messages on VLAN 1.

```
Console(config)#no ip igmp snooping vlan 1 mrd
Console(config)#
```

**ip igmp snooping vlan proxy-address** This command configures a static source address for locally generated query and report messages used by IGMP proxy reporting. Use the **no** form to restore the default source address.

### Syntax

**[no] ip igmp snooping vlan *vlan-id* proxy-address *source-address***

*vlan-id* - VLAN ID (Range: 1-4094)

*source-address* - The source address used for proxied IGMP query and report, and leave messages. (Any valid IP unicast address)

### Default Setting

0.0.0.0

### Command Mode

Global Configuration

### Command Usage

IGMP Snooping uses a null IP address of 0.0.0.0 for the source of IGMP query messages which are proxied to downstream hosts to indicate that it is not the elected querier, but is only proxying these messages as defined in RFC 4541. The switch also uses a null address in IGMP reports sent to upstream ports.

Many hosts do not implement RFC 4541, and therefore do not understand query messages with the source address of 0.0.0.0. These hosts will therefore not reply to the queries, causing the multicast router to stop sending traffic to them.

To resolve this problem, the source address in proxied IGMP query and report messages can be replaced with any valid unicast address (other than the router's own address) using this command.

### Rules Used for Proxy Reporting

When IGMP Proxy Reporting is disabled, the switch will use a null IP address for the source of IGMP query and report messages unless a proxy query address has been set.

When IGMP Proxy Reporting is enabled, the source address is based on the following criteria:

- ◆ If a proxy query address is configured, the switch will use that address as the source IP address in general and group-specific query messages sent to downstream hosts, and in report and leave messages sent upstream from the multicast router port.
- ◆ If a proxy query address is not configured, the switch will use the VLAN's IP address as the IP source address in general and group-specific query messages sent downstream, and use the source address of the last IGMP message received from a downstream host in report and leave messages sent upstream from the multicast router port.

### Example

The following example sets the source address for proxied IGMP query messages to 10.0.1.8.

```
Console(config)#ip igmp snooping vlan 1 proxy-address 10.0.1.8
Console(config)#
```

**ip igmp snooping vlan query-interval** This command configures the interval between sending IGMP general queries. Use the **no** form to restore the default.

### Syntax

**ip igmp snooping vlan *vlan-id* query-interval *interval***

**no ip igmp snooping vlan *vlan-id* query-interval**

*vlan-id* - VLAN ID (Range: 1-4094)

*interval* - The interval between sending IGMP general queries.  
(Range: 2-31744 seconds)

### Default Setting

125 seconds

### Command Mode

Global Configuration

### Command Usage

- ◆ An IGMP general query message is sent by the switch at the interval specified by this command. When this message is received by downstream hosts, all receivers build an IGMP report for the multicast groups they have joined.
- ◆ This command applies when the switch is serving as the querier ([page 651](#)), or as a proxy host when IGMP snooping proxy reporting is enabled ([page 651](#)).

### Example

```
Console(config)#ip igmp snooping vlan 1 query-interval 150
Console(config)#
```

**ip igmp snooping vlan query-resp-intvl** This command configures the maximum time the system waits for a response to general queries. Use the **no** form to restore the default.

#### Syntax

**ip igmp snooping vlan** *vlan-id* **query-resp-intvl** *interval*

**no ip igmp snooping vlan** *vlan-id* **query-resp-intvl**

*vlan-id* - VLAN ID (Range: 1-4094)

*interval* - The maximum time the system waits for a response to general queries. (Range: 10-31740 tenths of a second)

#### Default Setting

100 (10 seconds)

#### Command Mode

Global Configuration

#### Command Usage

This command applies when the switch is serving as the querier ([page 651](#)), or as a proxy host when IGMP snooping proxy reporting is enabled ([page 651](#)).

#### Example

```
Console(config)#ip igmp snooping vlan 1 query-resp-intvl 20
Console(config)#
```

**ip igmp snooping vlan static** This command adds a port to a multicast group. Use the **no** form to remove the port.

#### Syntax

**[no] ip igmp snooping vlan** *vlan-id* **static** *ip-address* *interface*

*vlan-id* - VLAN ID (Range: 1-4094)

*ip-address* - IP address for multicast group

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

#### Default Setting

None



**Command Mode**

Global Configuration

**Command Usage**

- ◆ Static multicast entries are never aged out.
- ◆ When a multicast entry is assigned to an interface in a specific VLAN, the corresponding traffic can only be forwarded to ports within that VLAN.

**Example**

The following shows how to statically configure a multicast group on a port.

```
Console(config)#ip igmp snooping vlan 1 static 224.0.0.12 ethernet 1/5
Console(config)#
```

**clear ip igmp  
snooping groups  
dynamic**

This command clears multicast group information dynamically learned through IGMP snooping.

**Syntax****clear ip igmp snooping groups dynamic****Command Mode**

Privileged Exec

**Command Usage**

This command only clears entries learned through IGMP snooping. Statically configured multicast address are not cleared.

**Example**

```
Console#clear ip igmp snooping groups dynamic
Console#
```

**clear ip igmp  
snooping statistics**

This command clears IGMP snooping statistics.

**Syntax****clear ip igmp snooping statistics [interface *interface*]***interface***ethernet** *unit/port**unit* - Unit identifier. (Range: 1-8)*port* - Port number. (Range: 1-28)**port-channel** *channel-id* (Range: 1-16)**vlan** *vlan-id* - VLAN identifier (Range: 1-4094)

## Command Mode

Privileged Exec

## Example

```
Console#clear ip igmp snooping statistics
Console#
```

**show ip igmp snooping** This command shows the IGMP snooping, proxy, and query configuration settings.

## Syntax

**show ip igmp snooping [vlan *vlan-id*]**

*vlan-id* - VLAN ID (1-4094)

## Command Mode

Privileged Exec

## Command Usage

This command displays global and VLAN-specific IGMP configuration settings.

## Example

The following shows the current IGMP snooping configuration:

```
Console#show ip igmp snooping
IGMP Snooping                : Enabled
Router Port Expire Time      : 300 s
Router Alert Check           : Disabled
Router Port Mode              : Forward
TCN Flood                     : Disabled
TCN Query Solicit            : Disabled
Unregistered Data Flood      : Disabled
802.1p Forwarding Priority    : Disabled
Unsolicited Report Interval  : 400 s
Version Exclusive             : Disabled
Version                       : 2
Proxy Reporting               : Disabled
Report Suppression            : Disabled
Querier                       : Disabled

VLAN 1:
-----
IGMP Snooping                : Enabled
IGMP Snooping Running Status : Inactive
Version                      : Using global Version (2)
Version Exclusive             : Using global status (Disabled)
Immediate Leave               : Disabled
Last Member Query Interval    : 10 (unit: 1/10s)
Last Member Query Count       : 2
General Query Suppression     : Disabled
Query Interval                : 125
Query Response Interval       : 100 (unit: 1/10s)
Proxy Query Address            : 0.0.0.0
Proxy Reporting                : Using global status (Disabled)
Report Suppression            : Using global status (Disabled)
```

```

Multicast Router Discovery      : Disabled

VLAN Static Group      Port
-----
1      224.1.1.1      Eth 1/ 1
:

```

**show ip igmp snooping group** This command shows known multicast group, source, and host port mappings for the specified VLAN interface, or for all interfaces if none is specified.

### Syntax

**show ip igmp snooping group** [**host-ip-addr** *ip-address interface* | **igmpsnp** | **sort-by-port** | **user** | **vlan** *vlan-id* [**user** | **igmpsnp**]]

*ip-address* - IP address for multicast group

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**igmpsnp** - Display only entries learned through IGMP snooping.

**sort-by-port** - Display entries sorted by port.

**user** - Display only the user-configured multicast entries.

*vlan-id* - VLAN ID (1-4094)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Member types displayed include IGMP or USER, depending on selected options.

### Example

The following shows the multicast entries learned through IGMP snooping for VLAN 1.

```

Console#show ip igmp snooping group vlan 1
Bridge Multicast Forwarding Entry Count:1
Flag: R - Router port, M - Group member port
      H - Host counts (number of hosts join the group on this port).
      P - Port counts (number of ports join the group).
Up time: Group elapsed time (d:h:m:s).
Expire : Group remaining time (m:s).

```

```
VLAN Group      Port      Up time      Expire Count
-----
 1 224.1.1.1      Eth 1/ 1 (R) 00:00:00:37      2 (P)
                  Eth 1/ 2 (M)              0 (H)
Console#
```

**show ip igmp snooping mrouter** This command displays information on statically configured and dynamically learned multicast router ports.

#### Syntax

**show ip igmp snooping mrouter** [vlan *vlan-id*]

*vlan-id* - VLAN ID (Range: 1-4094)

#### Default Setting

Displays multicast router ports for all configured VLANs.

#### Command Mode

Privileged Exec

#### Command Usage

Multicast router port types displayed include Static or Dynamic.

#### Example

The following shows the ports in VLAN 1 which are attached to multicast routers.

```
Console#show ip igmp snooping mrouter vlan 1
VLAN M'cast Router Port Type      Expire
-----
 1   Eth 1/4              Dynamic 0:4:28
 1   Eth 1/10             Static
Console#
```

**show ip igmp snooping statistics** This command shows IGMP snooping protocol statistics for the specified interface.

#### Syntax

**show ip igmp snooping statistics**

{**input** [**interface** *interface*] |

**output** [**interface** *interface*] |

**query** [vlan *vlan-id*]}

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* - VLAN ID (Range: 1-4094)

**query** - Displays IGMP snooping-related statistics.

### Default Setting

None

### Command Mode

Privileged Exec

### Example

The following shows IGMP protocol statistics input:

```

Console#show ip igmp snooping statistics input interface ethernet 1/1
Input Statistics:
Interface Report    Leave    G Query  G(-S)-S Query Drop    Join Succ Group
-----
Eth 1/ 1           23        11        4          10        5        14        5
Console#

```

**Table 123: show ip igmp snooping statistics input - display description**

Field	Description
Interface	Shows interface.
Report	The number of IGMP membership reports received on this interface.
Leave	The number of leave messages received on this interface.
G Query	The number of general query messages received on this interface.
G(-S)-S Query	The number of group specific or group-and-source specific query messages received on this interface.
Drop	The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, or packet content not allowed.
Join Succ	The number of times a multicast group was successfully joined.
Group	The number of multicast groups active on this interface.

The following shows IGMP protocol statistics output:

```

Console#show ip igmp snooping statistics output interface ethernet 1/1
Output Statistics:
Interface Report    Leave    G Query  G(-S)-S Query Drop    Group
-----
Eth 1/ 1           12        0        1          0        0        0
Console#

```

**Table 124: show ip igmp snooping statistics output - display description**

Field	Description
Interface	Shows interface.
Report	The number of IGMP membership reports sent from this interface.
Leave	The number of leave messages sent from this interface.
G Query	The number of general query messages sent from this interface.
G(-S)-S Query	The number of group specific or group-and-source specific query messages sent from this interface.
Drop	The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, or packet content not allowed.
Group	The number of multicast groups active on this interface.

The following shows IGMP query-related statistics for VLAN 1:

```

Console#show ip igmp snooping statistics query vlan 1
Other Querier           : None
Other Querier Expire    : 0 (m) : 0 (s)
Other Querier Uptime    : 0 (h) : 0 (m) : 0 (s)
Self Querier            : 192.168.2.12
Self Querier Expire     : 0 (m) : 0 (s)
Self Querier Uptime     : 0 (h) : 0 (m) : 0 (s)
General Query Received  : 0
General Query Sent      : 0
Specific Query Received : 0
Specific Query Sent     : 0
Warn Rate Limit         : 0 sec.
V1 Warning Count        : 0
V2 Warning Count        : 0
V3 Warning Count        : 0
Console#

```

**Table 125: show ip igmp snooping statistics vlan query - display description**

Field	Description
Other Querier	IP address of remote querier on this interface.
Other Querier Expire	Time after which remote querier is assumed to have expired.
Other Querier Uptime	Time remote querier has been up.
Self Querier	IP address of local querier on this interface.
Self Querier Expire	Time after which local querier is assumed to have expired.
Self Querier Uptime	Time local querier has been up.
General Query Received	The number of general queries received on this interface.
General Query Sent	The number of general queries sent from this interface.
Specific Query Received	The number of specific queries received on this interface.
Specific Query Sent	The number of specific queries sent from this interface.

Table 125: show ip igmp snooping statistics vlan query - display description

Field	Description
Warn Rate Limit	The rate at which received query messages of the wrong version type cause the Vx warning count to increment. Note that "0 sec" means that the Vx warning count is incremented for each wrong message version received.
V1 Warning Count	The number of times the query version received (Version 1) does not match the version configured for this interface.
V2 Warning Count	The number of times the query version received (Version 2) does not match the version configured for this interface.
V3 Warning Count	The number of times the query version received (Version 3) does not match the version configured for this interface.

## IGMP Filtering and Throttling

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For example, an IP/TV service based on a specific subscription plan. The IGMP filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and IGMP throttling limits the number of simultaneous multicast groups a port can join.

Table 126: IGMP Filtering and Throttling Commands

Command	Function	Mode
<code>ip igmp filter</code>	Enables IGMP filtering and throttling on the switch	GC
<code>ip igmp profile</code>	Sets a profile number and enters IGMP filter profile configuration mode	GC
<code>permit, deny</code>	Sets a profile access mode to permit or deny	IPC
<code>range</code>	Specifies one or a range of multicast addresses for a profile	IPC
<code>ip igmp authentication</code>	Enables RADIUS authentication for IGMP JOIN requests.	IC
<code>ip igmp filter</code>	Assigns an IGMP filter profile to an interface	IC
<code>ip igmp max-groups</code>	Specifies an IGMP throttling number for an interface	IC
<code>ip igmp max-groups action</code>	Sets the IGMP throttling action for an interface	IC
<code>ip igmp query-drop</code>	Drops any received IGMP query packets	IC
<code>ip multicast-data-drop</code>	Drops all multicast data packets	IC
<code>show ip igmp authentication</code>	Displays IGMP authentication settings for interfaces	PE
<code>show ip igmp filter</code>	Displays the IGMP filtering status	PE
<code>show ip igmp profile</code>	Displays IGMP profiles and settings	PE
<code>show ip igmp query-drop</code>	Shows if the interface is configured to drop IGMP query packets	PE

**Table 126: IGMP Filtering and Throttling Commands** (Continued)

Command	Function	Mode
<code>show ip igmp throttle interface</code>	Displays the IGMP throttling setting for interfaces	PE
<code>show ip multicast-data-drop</code>	Shows if the interface is configured to drop multicast data packets	PE

**ip igmp filter** (Global Configuration) This command globally enables IGMP filtering and throttling on the switch. Use the **no** form to disable the feature.

#### Syntax

**[no] ip igmp filter**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ IGMP filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An IGMP filter profile can contain one or more, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, IGMP join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the IGMP join report is forwarded as normal. If a requested multicast group is denied, the IGMP join report is dropped.
- ◆ IGMP filtering and throttling only applies to dynamically learned multicast groups, it does not apply to statically configured groups.
- ◆ The IGMP filtering feature operates in the same manner when MVR6 is used to forward multicast traffic.

#### Example

```
Console(config)#ip igmp filter
Console(config)#
```



**ip igmp profile** This command creates an IGMP filter profile number and enters IGMP profile configuration mode. Use the **no** form to delete a profile number.

#### Syntax

**[no] ip igmp profile** *profile-number*

*profile-number* - An IGMP filter profile number. (Range: 1-4294967295)

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

A profile defines the multicast groups that a subscriber is permitted or denied to join. The same profile can be applied to many interfaces, but only one profile can be assigned to one interface. Each profile has only one access mode; either permit or deny.

#### Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#
```

**permit, deny** This command sets the access mode for an IGMP filter profile. Use the **no** form to delete a profile number.

#### Syntax

**{permit | deny}**

#### Default Setting

Deny

#### Command Mode

IGMP Profile Configuration

#### Command Usage

- ◆ Each profile has only one access mode; either permit or deny.
- ◆ When the access mode is set to permit, IGMP join reports are processed when a multicast group falls within the controlled range. When the access mode is set to deny, IGMP join reports are only processed when a multicast group is not in the controlled range.

### Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#permit
Console(config-igmp-profile)#
```

**range** This command specifies multicast group addresses for a profile. Use the **no** form to delete addresses from a profile.

### Syntax

**[no] range** *low-ip-address* [*high-ip-address*]

*low-ip-address* - A valid IP address of a multicast group or start of a group range.

*high-ip-address* - A valid IP address for the end of a multicast group range.

### Default Setting

None

### Command Mode

IGMP Profile Configuration

### Command Usage

Enter this command multiple times to specify more than one multicast address or address range for a profile.

### Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#range 239.1.1.1
Console(config-igmp-profile)#range 239.2.3.1 239.2.3.100
Console(config-igmp-profile)#
```

**ip igmp authentication** This command enables IGMP authentication on the specified interface. When enabled and an IGMP JOIN request is received, an authentication request is sent to a configured RADIUS server. Use the **no** form to disable IGMP authentication.

### Syntax

**[no] ip igmp authentication**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ If IGMP authentication is enabled on an interface, and a join report is received on the interface, the switch will send an access request to the RADIUS server to perform authentication.
- ◆ Only when the RADIUS server responds with an authentication success message will the switch learn the group report. Once the group is learned, the switch will not send an access request to the RADIUS server when receiving the same report again within a one (1) day period.
- ◆ If the RADIUS server responds that authentication failed or the timer expires, the report will be dropped and the group will not be learned. The entry (host MAC, port number, VLAN ID, and group IP) will be put in the “authentication failed list”.
- ◆ The “authentication failed list” is valid for the period of the interval defined by the command `ip igmp snooping vlan query-interval`. When receiving the same report during this interval, the switch will not send the access request to the RADIUS server.
- ◆ If the interface leaves the group and subsequently rejoins the same group, the join report needs to again be authenticated.

- ◆ When receiving an IGMP v3 report message, the switch will send the access request to the RADIUS server only when the record type is either IS\_EX or TO\_EX, and the source list is empty. Other types of packets will not initiate RADIUS authentication.

IS\_EX (MODE\_IS\_EXCLUDE) - Indicates that the interface's filter mode is EXCLUDE for the specified multicast address. The Source Address fields in this Group Record contain the interface's source list for the specified multicast address, if not empty.

TO\_EX (CHANGE\_TO\_EXCLUDE\_MODE) - Indicates that the interface has changed to EXCLUDE filter mode for the specified multicast address. The Source Address fields in this Group Record contain the interface's new source list for the specified multicast address, if not empty.

- ◆ When a report is received for the first time and is being authenticated, whether authentication succeeds or fails, the report will still be sent to the multicast-router port.
- ◆ The following table shows the RADIUS server Attribute Value Pairs used for authentication:

**Table 127: IGMP Authentication RADIUS Attribute Value Pairs**

Attribute Name	AVP Type	Entry
USER_NAME	1	User MAC address
USER_PASSWORD	2	User MAC address
NAS_IP_ADDRESS	4	Switch IP address

Table 127: IGMP Authentication RADIUS Attribute Value Pairs (Continued)

Attribute Name	AVP Type	Entry
NAS_PORT	5	User Port Number
FRAMED_IP_ADDRESS	8	Multicast Group ID

### Example

This example shows how to enable IGMP Authentication on all of the switch's Ethernet interfaces.

```
Console(config)#interface ethernet 1/1-28
Console(config-if)#ip igmp authentication
Console#
```

### Related Commands

[show ip igmp authentication](#)

**ip igmp filter** (Interface Configuration) This command assigns an IGMP filtering profile to an interface on the switch. Use the **no** form to remove a profile from an interface.

### Syntax

**[no] ip igmp filter** *profile-number*

*profile-number* - An IGMP filter profile number. (Range: 1-4294967295)

### Default Setting

None

### Command Mode

Interface Configuration

### Command Usage

- ◆ The IGMP filtering profile must first be created with the [ip igmp profile](#) command before being able to assign it to an interface.
- ◆ Only one profile can be assigned to an interface.
- ◆ A profile can also be assigned to a trunk interface. When ports are configured as trunk members, the trunk uses the filtering profile assigned to the first port member in the trunk.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp filter 19
Console(config-if)#
```

**ip igmp max-groups** This command sets the IGMP throttling number for an interface on the switch. Use the **no** form to restore the default setting.

#### Syntax

**ip igmp max-groups** *number*

**no ip igmp max-groups**

*number* - The maximum number of multicast groups an interface can join at the same time. (Range: 1-1024)

#### Default Setting

1024

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace” (see the [ip igmp max-groups action](#) command). If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.
- ◆ IGMP throttling can also be set on a trunk interface. When ports are configured as trunk members, the trunk uses the throttling settings of the first port member in the trunk.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp max-groups 10
Console(config-if)#
```

**ip igmp max-groups action** This command sets the IGMP throttling action for an interface on the switch.

#### Syntax

**ip igmp max-groups action** {**deny** | **replace**}

**deny** - The new multicast group join report is dropped.

**replace** - The new multicast group replaces an existing group.

#### Default Setting

Deny

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace.” If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp max-groups action replace
Console(config-if)#
```

**ip igmp query-drop** This command drops any received IGMP query packets. Use the **no** form to restore the default setting.

### Syntax

**[no] ip igmp query-drop**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

This command can be used to drop any query packets received on the specified interface. If this switch is acting as a Querier, this prevents it from being affected by messages received from another Querier.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp query-drop
Console(config-if)#
```

**ip multicast-data-drop** This command drops all multicast data packets. Use the **no** form to disable this feature.

### Syntax

**[no] ip multicast-data-drop**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

This command can be used to stop multicast services from being forwarded to users attached to the downstream port (i.e., the interfaces specified by this command).

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip multicast-data-drop
Console(config-if)#
```

### show ip igmp authentication

This command displays the interface settings for IGMP authentication.

### Syntax

**show ip igmp authentication interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Using this command without specifying an interface displays information for all interfaces.

### Example

```
Console#show ip igmp authentication
Ethernet 1/1: Enabled
Ethernet 1/2: Enabled
Ethernet 1/3: Enabled
:
Ethernet 1/27: Enabled
Ethernet 1/28: Enabled
Other ports/port channels are disabled
Console#
```

**show ip igmp filter** This command displays the global and interface settings for IGMP filtering.

### Syntax

**show ip igmp filter** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show ip igmp filter
IGMP filter enabled
Console#show ip igmp filter interface ethernet 1/1
Ethernet 1/1 information
-----
IGMP Profile 19
Deny
Range 239.1.1.1 239.1.1.1
Range 239.2.3.1 239.2.3.100
Console#
```

**show ip igmp profile** This command displays IGMP filtering profiles created on the switch.

### Syntax

**show ip igmp profile** [*profile-number*]

*profile-number* - An existing IGMP filter profile number.  
(Range: 1-4294967295)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show ip igmp profile
IGMP Profile 19
IGMP Profile 50
```



```

Console#show ip igmp profile 19
IGMP Profile 19
  Deny
  Range 239.1.1.1 239.1.1.1
  Range 239.2.3.1 239.2.3.100
Console#

```

**show ip igmp query-drop** This command shows if the specified interface is configured to drop IGMP query packets.

### Syntax

**show ip igmp throttle interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Using this command without specifying an interface displays all interfaces.

### Example

```

Console#show ip igmp query-drop interface ethernet 1/1
Ethernet 1/1: Enabled
Console#

```

**show ip igmp throttle interface** This command displays the interface settings for IGMP throttling.

### Syntax

**show ip igmp throttle interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Using this command without specifying an interface displays information for all interfaces.

### Example

```
Console#show ip igmp throttle interface ethernet 1/1
Eth 1/1 Information
                        Status : FALSE
                        Action  : Deny
      Max Multicast Groups : 1024
      Current Multicast Groups : 0
```

```
Console#
```

**show ip multicast-data-drop** This command shows if the specified interface is configured to drop multicast data packets.

### Syntax

**show ip igmp throttle interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Using this command without specifying an interface displays all interfaces.

### Example

```
Console#show ip multicast-data-drop interface ethernet 1/1
Ethernet 1/1: Enabled
Console#
```

## MLD Snooping

Multicast Listener Discovery (MLD) snooping operates on IPv6 traffic and performs a similar function to IGMP snooping for IPv4. That is, MLD snooping dynamically configures switch ports to limit IPv6 multicast traffic so that it is forwarded only to ports with users that want to receive it. This reduces the flooding of IPv6 multicast packets in the specified VLANs.

There are two versions of the MLD protocol, version 1 and version 2. MLDv1 control packets include Listener Query, Listener Report, and Listener Done messages (equivalent to IGMPv2 query, report, and leave messages). MLDv2 control packets include MLDv2 query and report messages, as well as MLDv1 report and done messages.

Remember that IGMP Snooping and MLD Snooping are independent functions, and can therefore both function at the same time.

**Table 128: MLD Snooping Commands**

Command	Function	Mode
<code>ipv6 mld snooping</code>	Enables MLD Snooping globally	GC
<code>ipv6 mld snooping querier</code>	Allows the switch to act as the querier for MLD snooping	GC
<code>ipv6 mld snooping query-interval</code>	Configures the interval between sending MLD general query messages	GC
<code>ipv6 mld snooping query-max-response-time</code>	Configures the maximum response time for a general queries	GC
<code>ipv6 mld snooping proxy-reporting</code>	Enables MLD Snooping with Proxy Reporting	GC
<code>ipv6 mld snooping robustness</code>	Configures the robustness variable	GC
<code>ipv6 mld snooping router-port-expire-time</code>	Configures the router port expire time	GC
<code>ipv6 mld snooping unknown-multicast mode</code>	Sets an action for unknown multicast packets	GC
<code>ipv6 mld snooping unknown-multicast mode</code>	Sets an action for unknown multicast packets	GC
<code>ipv6 mld snooping version</code>	Configures the MLD Snooping version	GC
<code>ipv6 mld snooping vlan immediate-leave</code>	Removes a member port of an IPv6 multicast service if a leave packet is received at that port and MLD immediate-leave is enabled for the parent VLAN	GC
<code>ipv6 mld snooping vlan mrouter</code>	Adds an IPv6 multicast router port	GC
<code>ipv6 mld snooping vlan static</code>	Adds an interface as a member of a multicast group	GC
<code>clear ipv6 mld snooping groups dynamic</code>	Clears multicast group information dynamically learned through MLD snooping	PE

Table 128: MLD Snooping Commands (Continued)

Command	Function	Mode
<code>clear ipv6 mld snooping statistics</code>	Clears MLD snooping statistics	PE
<code>show ipv6 mld snooping</code>	Displays MLD Snooping configuration	PE
<code>show ipv6 mld snooping group</code>	Displays the learned groups	PE
<code>show ipv6 mld snooping group source-list</code>	Displays the learned groups and corresponding source list	PE
<code>show ipv6 mld snooping mrouter</code>	Displays the information of multicast router ports	PE
<code>show ipv6 mld snooping statistics</code>	Shows IGMP snooping protocol statistics for the specified interface	PE

**ipv6 mld snooping** This command enables MLD Snooping globally on the switch. Use the **no** form to disable MLD Snooping.

#### Syntax

**[no] ipv6 mld snooping**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Example

The following example enables MLD Snooping:

```
Console(config)#ipv6 mld snooping
Console(config)#
```

**ipv6 mld snooping querier** This command allows the switch to act as the querier for MLDv2 snooping. Use the **no** form to disable this feature.

#### Syntax

**[no] ipv6 mld snooping querier**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

### Command Usage

- ◆ If enabled, the switch will serve as querier if elected. The querier is responsible for asking hosts if they want to receive multicast traffic.
- ◆ An IPv6 address must be configured on the VLAN interface from which the querier will act if elected. When serving as the querier, the switch uses its own IPv6 address as the query source address.
- ◆ The querier will not start or will disable itself after having started if it detects an IPv6 multicast router on the network.

### Example

```
Console(config)#ipv6 mld snooping querier
Console(config)#
```

**ipv6 mld snooping query-interval** This command configures the interval between sending MLD general queries. Use the **no** form to restore the default.

### Syntax

**ipv6 mld snooping query-interval** *interval*

**no ipv6 mld snooping query-interval**

*interval* - The interval between sending MLD general queries.  
(Range: 60-125 seconds)

### Default Setting

125 seconds

### Command Mode

Global Configuration

### Command Usage

- ◆ This command applies when the switch is serving as the querier.
- ◆ An MLD general query message is sent by the switch at the interval specified by this command. When this message is received by downstream hosts, all receivers build an MLD report for the multicast groups they have joined.

### Example

```
Console(config)#ipv6 mld snooping query-interval 150
Console(config)#
```

**ipv6 mld snooping query-max-response-time** This command configures the maximum response time advertised in MLD general queries. Use the **no** form to restore the default.

#### Syntax

**ipv6 mld snooping query-max-response-time** *seconds*

**no ipv6 mld snooping query-max-response-time**

*seconds* - The maximum response time allowed for MLD general queries.  
(Range: 5-25 seconds)

#### Default Setting

10 seconds

#### Command Mode

Global Configuration

#### Command Usage

This command controls how long the host has to respond to an MLD Query message before the switch deletes the group if it is the last member.

#### Example

```
Console(config)#ipv6 mld snooping query-max-response-time seconds 15
Console(config)#
```

**ipv6 mld snooping proxy-reporting** This command enables IGMP Snooping with Proxy Reporting. Use the **no** form to restore the default setting.

#### Syntax

**[no] ipv6 mld snooping proxy-reporting**

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When proxy reporting is enabled with this command, reports received from downstream hosts are summarized and used to build internal membership states. Proxy-reporting devices may use the all-zeros IP source address when forwarding any summarized reports upstream. For this reason, IGMP membership reports received by the snooping switch must not be rejected because the source IP address is set to 0.0.0.0.

### Example

```
Console(config)#ipv6 mld snooping proxy-reporting  
Console(config)#
```

**ipv6 mld snooping robustness** This command configures the MLD Snooping robustness variable. Use the **no** form to restore the default value.

### Syntax

**ipv6 mld snooping robustness** *value*

**no ipv6 mld snooping robustness**

*value* - The number of the robustness variable. (Range: 2-10)

### Default Setting

2

### Command Mode

Global Configuration

### Command Usage

A port will be removed from the receiver list for a multicast service when no MLD reports are detected in response to a number of MLD queries. The robustness variable sets the number of queries on ports for which there is no report.

### Example

```
Console(config)#ipv6 mld snooping robustness 2  
Console(config)#
```

**ipv6 mld snooping router-port-expire-time** This command configures the MLD query timeout. Use the **no** form to restore the default.

### Syntax

**ipv6 mld snooping router-port-expire-time** *time*

**no ipv6 mld snooping router-port-expire-time**

*time* - Specifies the timeout of a dynamically learned router port.  
(Range: 300-500 seconds)

### Default Setting

300 seconds

### Command Mode

Global Configuration

### Command Usage

The router port expire time is the time the switch waits after the previous querier stops before it considers the router port (i.e., the interface that had been receiving query packets) to have expired.

### Example

```
Console(config)#ipv6 mld snooping router-port-expire-time 300
Console(config)#
```

### ipv6 mld snooping unknown-multicast mode

This command sets the action for dealing with unknown multicast packets. Use the **no** form to restore the default.

### Syntax

**ipv6 mld snooping unknown-multicast mode {flood | to-router-port}**

**no ipv6 mld snooping unknown-multicast mode**

**flood** - Floods the unknown multicast data packets to all ports.

**to-router-port** - Forwards the unknown multicast data packets to router ports.

### Default Setting

to-router-port

### Command Mode

Global Configuration

### Command Usage

- ◆ When set to “flood,” any received IPv6 multicast packets that have not been requested by a host are flooded to all ports in the VLAN.
- ◆ When set to “router-port,” any received IPv6 multicast packets that have not been requested by a host are forwarded to ports that are connected to a detected multicast router.

### Example

```
Console(config)#ipv6 mld snooping unknown-multicast mode flood
Console(config)#
```



**ipv6 mld snooping unsolicited-report-interval** This command specifies how often the upstream interface should transmit unsolicited IGMP reports when proxy reporting is enabled. Use the **no** form to restore the default value.

#### Syntax

**ipv6 mld snooping unsolicited-report-interval** *seconds*

**no ipv6 mld snooping unsolicited-report-interval**

*seconds* - The interval at which to issue unsolicited reports.  
(Range: 1-65535 seconds)

#### Default Setting

400 seconds

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When a new upstream interface (that is, uplink port) starts up, the switch sends unsolicited reports for all currently learned multicast channels out through the new upstream interface.
- ◆ This command only applies when proxy reporting is enabled (see [page 686](#)).

#### Example

```
Console(config)#ipv6 mld snooping unsolicited-report-interval 5
Console(config)#
```

**ipv6 mld snooping version** This command configures the MLD snooping version. Use the **no** form to restore the default.

#### Syntax

**ipv6 mld snooping version** {**1** | **2**}

**1** - MLD version 1.

**2** - MLD version 2.

#### Default Setting

Version 2

#### Command Mode

Global Configuration

### Example

```
Console(config)#ipv6 mld snooping version 1  
Console(config)#
```

### ipv6 mld snooping vlan immediate-leave

This command immediately deletes a member port of an IPv6 multicast service when a leave packet is received at that port and immediate-leave is enabled for the parent VLAN. Use the **no** form to restore the default.

### Syntax

**[no] ipv6 mld snooping vlan *vlan-id* immediate-leave**

*vlan-id* - A VLAN identification number. (Range: 1-4094)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ If MLD immediate-leave is *not* used, a multicast router (or querier) will send a group-specific query message when an MLD group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the specified timeout period.
- ◆ If MLD immediate-leave is enabled, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one MLD-enabled device, either a service host or a neighbor running MLD snooping.

### Example

The following shows how to enable MLD immediate leave.

```
Console(config)#ipv6 mld snooping immediate-leave  
Console(config)#
```

**ipv6 mld snooping** This command statically configures an IPv6 multicast router port. Use the **no** form  
**vlan mrouter** to remove the configuration.

### Syntax

**[no] ipv6 mld snooping vlan** *vlan-id* **mrouter** *interface*

*vlan-id* - VLAN ID (Range: 1-4094)

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

No static multicast router ports are configured.

### Command Mode

Global Configuration

### Command Usage

Depending on your network connections, MLD snooping may not always be able to locate the MLD querier. Therefore, if the MLD querier is a known multicast router/switch connected over the network to an interface (port or trunk) on the switch, you can manually configure that interface to join all the current multicast groups.

### Example

The following shows how to configure port 1 as a multicast router port within VLAN 1:

```
Console(config)#ipv6 mld snooping vlan 1 mrouter ethernet 1/1
Console(config)#
```

**ipv6 mld snooping** This command adds a port to an IPv6 multicast group. Use the **no** form to remove  
**vlan static** the port.

#### Syntax

**[no] ipv6 mld snooping vlan** *vlan-id* **static** *ipv6-address* *interface*

*vlan* - VLAN ID (Range: 1-4094)

*ipv6-address* - An IPv6 address of a multicast group. (Format: X:X:X:X::X)

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

#### Default Setting

None

#### Command Mode

Global Configuration

#### Example

```
Console(config)#ipv6 mld snooping vlan 1 static ff05:0:1:2:3:4:5:6 ethernet  
1/6  
Console(config)#
```

**clear ipv6 mld** This command clears multicast group information dynamically learned through  
**snooping groups** MLD snooping.  
**dynamic**

#### Syntax

**clear ipv6 mld snooping groups dynamic**

#### Command Mode

Privileged Exec

#### Command Usage

This command only clears entries learned through MLD snooping. Statically configured multicast address are not cleared.

#### Example

```
Console#clear ipv6 mld snooping groups dynamic  
Console#
```

**clear ipv6 mld snooping statistics** This command clears MLD snooping statistics.

#### Syntax

**clear ipv6 mld snooping statistics** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* - VLAN identifier (Range: 1-4094)

#### Command Mode

Privileged Exec

#### Example

```
Console#clear ipv6 mld snooping statistics
Console#
```

**show ipv6 mld snooping** This command shows the current MLD Snooping configuration.

#### Syntax

**show ipv6 mld snooping** [**vlan** *vlan-id*]

*vlan-id* - VLAN ID (1-4094)

#### Command Mode

Privileged Exec

#### Example

The following shows MLD Snooping configuration information

```
Console#show ipv6 mld snooping
Service Status           : Disabled
Proxy Reporting          : Disabled
Querier Status           : Disabled
Robustness               : 2
Query Interval           : 125 sec
Query Max Response Time  : 10 sec
Router Port Expiry Time  : 300 sec
Unsolicited Report Interval : 400 sec
Immediate Leave          : Disabled on all VLAN
Immediate Leave By Host  : Disabled on all VLAN
Unknown Flood Behavior    : To Router Port
MLD Snooping Version     : Version 2
```

```
VLAN Group IPv6 Address Port
-----
1 ff05:0:1:2:3:4:5:6 Eth 1/1
Console#
```

**show ipv6 mld snooping group** This command shows known multicast groups, member ports, and the means by which each group was learned.

#### Syntax

**show ipv6 mld snooping group**

#### Command Mode

Privileged Exec

#### Example

The following shows MLD Snooping group configuration information:

```
Console#show ipv6 mld snooping group

Total Entries 3, limit 255

VLAN Multicast IPv6 Address Member port Type
-----
1 FF02::01:01:01:01 Eth 1/1 MLD Snooping
1 FF02::01:01:01:02 Eth 1/1 Multicast Data
1 FF02::01:01:01:02 Eth 1/1 User
Console#
```

**show ipv6 mld snooping group source-list** This command shows known multicast groups, member ports, the means by which each group was learned, and the corresponding source list.

#### Syntax

**show ipv6 mld snooping group source-list** [*ipv6-address* | **vlan** *vlan-id*]

*ipv6-address* - An IPv6 address of a multicast group. (Format: X:X:X:X::X)

*vlan-id* - VLAN ID (1-4094)

#### Command Mode

Privileged Exec

#### Example

The following shows MLD Snooping group mapping information:

```
Console#show ipv6 mld snooping group source-list

VLAN ID : 1
Multicast IPv6 Address : FF02::01:01:01:01
```

```

Member Port          : Eth 1/1
Type                 : MLD Snooping
Filter Mode          : Include
(if exclude filter mode)
Filter Timer elapse   : 10 sec.
Request List         : ::01:02:03:04, ::01:02:03:05, ::01:02:03:06,
                    : ::01:02:03:07
Exclude List         : ::02:02:03:04, ::02:02:03:05, ::02:02:03:06,
                    : ::02:02:03:07
(if include filter mode)
Include List         : ::02:02:03:04, ::02:02:03:05, ::02:02:03:06,
                    : ::02:02:03:06

Option:
  Filter Mode: Include, Exclude

Console#

```

**show ipv6 mld snooping mrouter** This command shows MLD Snooping multicast router information.

#### Syntax

**show ipv6 mld snooping mrouter vlan *vlan-id***

*vlan-id* - A VLAN identification number. (Range: 1-4094)

#### Command Mode

Privileged Exec

#### Example

```

Console#show ipv6 mld snooping mrouter vlan 1
VLAN Multicast Router Port Type      Expire
-----
  1 Eth 1/ 2                      Static

Console#

```

**show ipv6 mld snooping statistics** This command shows MLD snooping protocol statistics for the specified interface.

#### Syntax

##### **show ipv6 mld snooping statistics**

**{input [interface *interface*] |**

**output [interface *interface*] |**

**query [vlan *vlan-id*] |**

**summary interface *interface*}**

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* - VLAN ID (Range: 1-4094)

**query** - Displays IGMP snooping-related statistics.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

The following shows MLD protocol statistics input:

```
Console#show ipv6 mld snooping statistics input interface ethernet 1/1
Input Statistics:
Interface Report    Leave      G Query    G(-S)-S Query Drop    Join Succ Group
-----
Eth 1/ 1           23         11          4                10          5          14          5
Console#
```



## MLD Filtering and Throttling

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For example, an IP/TV service based on a specific subscription plan. The MLD filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and MLD throttling limits the number of simultaneous multicast groups a port can join.

**Table 129: MLD Filtering and Throttling Commands**

Command	Function	Mode
<code>ipv6 mld filter</code>	Enables MLD filtering and throttling on the switch	GC
<code>ipv6 mld profile</code>	Sets a profile number and enters MLD filter profile configuration mode	GC
<code>permit, deny</code>	Sets a profile access mode to permit or deny	IPC
<code>range</code>	Specifies one or a range of multicast addresses for a profile	IPC
<code>ipv6 mld filter</code>	Assigns an MLD filter profile to an interface	IC
<code>ipv6 mld max-groups</code>	Specifies an M:D throttling number for an interface	IC
<code>ipv6 mld max-groups action</code>	Sets the MLD throttling action for an interface	IC
<code>ipv6 mld query-drop</code>	Drops any received MLD query packets	IC
<code>ipv6 multicast-data-drop</code>	Enable multicast data drop mode on a port interface	IC
<code>show ipv6 mld filter</code>	Displays the MLD filtering status	PE
<code>show ipv6 mld profile</code>	Displays MLD profiles and settings	PE
<code>show ipv6 mld query-drop</code>	Shows if the interface is configured to drop MLD query packets	PE
<code>show ipv6 mld throttle interface</code>	Displays the MLD throttling setting for interfaces	PE

**ipv6 mld filter** (Global Configuration) This command globally enables MLD filtering and throttling on the switch. Use the **no** form to disable the feature.

### Syntax

**[no] ipv6 mld filter**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ MLD filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An MLD filter profile

can contain one or more, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, MLD join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the MLD join report is forwarded as normal. If a requested multicast group is denied, the MLD join report is dropped.

- ◆ MLD filtering and throttling only applies to dynamically learned multicast groups, it does not apply to statically configured groups.
- ◆ The MLD filtering feature operates in the same manner when MVR6 is used to forward multicast traffic.

### Example

```
Console(config)#ipv6 mld filter
Console(config)#
```

### Related Commands

[show ipv6 mld filter](#)

**ipv6 mld profile** This command creates an MLD filter profile number and enters MLD profile configuration mode. Use the **no** form to delete a profile number.

### Syntax

**[no] ipv6 mld profile** *profile-number*

*profile-number* - An MLD filter profile number. (Range: 1-4294967295)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

A profile defines the multicast groups that a subscriber is permitted or denied to join. The same profile can be applied to many interfaces, but only one profile can be assigned to one interface. Each profile has only one access mode; either permit or deny.

### Example

```
Console(config)#ipv6 mld profile 19
Console(config-mld-profile)#
```

### Related Commands

[show ipv6 mld profile](#)

**permit, deny** This command sets the access mode for an MLD filter profile. Use the **no** form to delete a profile number.

#### Syntax

{**permit** | **deny**}

#### Default Setting

deny

#### Command Mode

MLD Profile Configuration

#### Command Usage

- ◆ Each profile has only one access mode; either permit or deny.
- ◆ When the access mode is set to permit, MLD join reports are processed when a multicast group falls within the controlled range. When the access mode is set to deny, MLD join reports are only processed when a multicast group is not in the controlled range.

#### Example

```
Console(config)#ipv6 mld profile 19
Console(config-mld-profile)#permit
Console(config-mld-profile)#
```

**range** This command specifies multicast group addresses for a profile. Use the **no** form to delete addresses from a profile.

#### Syntax

[**no**] **range** *low-ipv6-address* [*high-ipv6-address*]

*low-ipv6-address* - A valid IPv6 address (X:X:X::X) of a multicast group or start of a group range.

*high-ipv6-address* - A valid IPv6 address (X:X:X::X) for the end of a multicast group range.

#### Default Setting

None

#### Command Mode

MLD Profile Configuration

#### Command Usage

Enter this command multiple times to specify more than one multicast address or address range for a profile.

### Example

```
Console(config-mld-profile)#range ff01::0101 ff01::0202
Console(config-mld-profile)#
```

**ipv6 mld filter** (Interface Configuration) This command assigns an MLD filtering profile to an interface on the switch. Use the **no** form to remove a profile from an interface.

### Syntax

**[no] ipv6 mld filter** *profile-number*

*profile-number* - An MLD filter profile number. (Range: 1-4294967295)

### Default Setting

None

### Command Mode

Interface Configuration

### Command Usage

- ◆ The MLD filtering profile must first be created with the [ipv6 mld profile](#) command before being able to assign it to an interface.
- ◆ Only one profile can be assigned to an interface.
- ◆ A profile can also be assigned to a trunk interface. When ports are configured as trunk members, the trunk uses the filtering profile assigned to the first port member in the trunk.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld filter 19
Console(config-if)#
```

**ipv6 mld max-groups** This command configures the maximum number of MLD groups that an interface can join. Use the **no** form to restore the default setting.

### Syntax

**ipv6 mld max-groups** *number*

**no ipv6 mld max-groups**

*number* - The maximum number of multicast groups an interface can join at the same time. (Range: 1-255)

### Default Setting

255

## Command Mode

Interface Configuration (Ethernet, Port Channel)

## Command Usage

- ◆ MLD throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace.” If the action is set to deny, any new MLD join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.
- ◆ MLD throttling can also be set on a trunk interface. When ports are configured as trunk members, the trunk uses the throttling settings of the first port member in the trunk.
- ◆ If the maximum number of MLD groups is set to the default value, the running status of MLD throttling will change to false. This means that any configuration for MLD throttling will have no effect until the maximum number of MLD groups is configured to another value.

## Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld max-groups 10
Console(config-if)#
```

**ipv6 mld max-groups action** This command sets the MLD throttling action for an interface on the switch.

## Syntax

**ipv6 mld max-groups action {deny | replace}**

**deny** - The new multicast group join report is dropped.

**replace** - The new multicast group replaces an existing group.

## Default Setting

Deny

## Command Mode

Interface Configuration (Ethernet)

## Command Usage

When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace.” If the action is set to deny, any new MLD join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld max-groups action replace
Console(config-if)#
```

**ipv6 mld query-drop** This command drops any received MLD query packets. Use the no form to restore the default setting.

### Syntax

**[no] ipv6 mld query-drop**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

This command can be used to drop any query packets received on the specified interface. If this switch is acting as a Querier, this prevents it from being affected by messages received from another Querier.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld query-drop
Console(config-if)#
```

**ipv6 multicast-data-drop** Use this command to enable multicast data drop mode on a port interface. Use the no form of the command to disable multicast data drop.

### Syntax

**[no] ipv6 multicast-data-drop**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Example

```
Console(config)#interface ethernet 1/3
Console(config-if)#ipv6 multicast-data-drop
Console(config-if)#
```

**show ipv6 mld filter** This command displays the global and interface settings for MLD filtering.

### Syntax

**show ipv6 mld filter** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show ipv6 mld filter
MLD filter Enabled
Console#show ipv6 mld filter interface ethernet 1/3
Ethernet 1/3 information
-----
MLD Profile 19
Deny
Range ff01::101          ff01::faa
Console#
```

**show ipv6 mld profile** This command displays MLD filtering profiles created on the switch.

### Syntax

**show ipv6 mld profile** [*profile-number*]

*profile-number* - An existing MLD filter profile number.  
(Range: 1-4294967295)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

```
Console#show ipv6 mld profile
MLD Profile 19
MLD Profile 50
Console#show ipv6 mld profile 19
```

```
MLD Profile 19
Deny
Range ff01::101          ff01::faa
Console#
```

**show ipv6 mld query-drop** This command shows if the specified interface is configured to drop MLD query packets.

#### Syntax

**show ipv6 mld query-drop interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Command Usage

Using this command without specifying an interface displays all interfaces.

#### Example

```
Console#show ipv6 mld query-drop interface ethernet 1/1
Ethernet 1/1: Enabled
Console#
```

**show ipv6 mld throttle interface** This command displays the interface settings for MLD throttling.

#### Syntax

**show ipv6 mld throttle interface** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)



### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Using this command without specifying an interface displays information for all interfaces.

### Example

```
Console#show ipv6 mld throttle interface ethernet 1/3
Eth 1/3 Information
  Status           : TRUE
  Action            : Replace
  Max Multicast Groups : 10
  Current Multicast Groups : 0
```

```
Console#
```

## Multicast VLAN Registration for IPv4

This section describes commands used to configure Multicast VLAN Registration for IPv4 (MVR). A single network-wide VLAN can be used to transmit multicast traffic (such as television channels) across a service provider's network. Any multicast traffic entering an MVR VLAN is sent to all subscribers. This can significantly reduce to processing overhead required to dynamically monitor and establish the distribution tree for a normal multicast VLAN. Also note that MVR maintains the user isolation and data security provided by VLAN segregation by passing only multicast traffic into other VLANs to which the subscribers belong.

**Table 130: Multicast VLAN Registration for IPv4 Commands**

Command	Function	Mode
<code>mvr</code>	Globally enables MVR	GC
<code>mvr associated-profile</code>	Binds the MVR group addresses specified in a profile to an MVR domain	GC
<code>mvr domain</code>	Enables MVR for a specific domain	GC
<code>mvr priority</code>	Assigns a priority to all multicast traffic in the MVR VLAN	GC
<code>mvr profile</code>	Maps a range of MVR group addresses to a profile	GC
<code>mvr proxy-query-interval</code>	Configures the interval at which the receiver port sends out general queries.	GC
<code>mvr proxy-switching</code>	Enables MVR proxy switching, where the source port acts as a host, and the receiver port acts as an MVR router with querier service enabled	GC

**Table 130: Multicast VLAN Registration for IPv4 Commands** (Continued)

Command	Function	Mode
<code>mvr robustness-value</code>	Configures the expected packet loss, and thereby the number of times to generate report and group-specific queries	GC
<code>mvr source-port-mode dynamic</code>	Configures the switch to only forward multicast streams which the source port has dynamically joined	GC
<code>mvr upstream-source-ip</code>	Configures the source IP address assigned to all control packets sent upstream	GC
<code>mvr vlan</code>	Specifies the VLAN through which MVR multicast data is received	GC
<code>mvr immediate-leave</code>	Enables immediate leave capability	IC
<code>mvr type</code>	Configures an interface as an MVR receiver or source port	IC
<code>mvr vlan group</code>	Statically binds a multicast group to a port	IC
<code>clear mvr groups dynamic</code>	Clears multicast group information dynamically learned through MVR	PE
<code>clear mvr statistics</code>	Clears MVR statistics	PE
<code>show mvr</code>	Shows information about MVR domain settings, including MVR operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address	PE
<code>show mvr associated-profile</code>	Shows the profiles bound the specified domain	PE
<code>show mvr interface</code>	Shows MVR settings for interfaces attached to the MVR VLAN	PE
<code>show mvr members</code>	Shows information about the current number of entries in the forwarding database, or detailed information about a specific multicast address	PE
<code>show mvr profile</code>	Shows all configured MVR profiles	PE
<code>show mvr statistics</code>	Shows MVR protocol statistics for the specified interface	PE

**mvr** This command enables Multicast VLAN Registration (MVR) globally on the switch. Use the **no** form of this command to globally disable MVR.

### Syntax

**[no] mvr**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the `mvr vlan group` command.

### Example

The following example enables MVR globally.

```
Console(config)#mvr
Console(config)#
```

**mvr associated-profile** This command binds the MVR group addresses specified in a profile to an MVR domain. Use the **no** form of this command to remove the binding.

### Syntax

**[no] mvr domain *domain-id* associated-profile *profile-name***

*domain-id* - An independent multicast domain. (Range: 1-5)

*profile-name* - The name of a profile containing one or more MVR group addresses. (Range: 1-21 characters)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Example

The following an MVR group address profile to domain 1:

```
Console(config)#mvr domain 1 associated-profile rd
Console(config)#
```

### Related Commands

[mvr profile \(709\)](#)

**mvr domain** This command enables Multicast VLAN Registration (MVR) for a specific domain. Use the **no** form of this command to disable MVR for a domain.

### Syntax

**[no] mvr domain *domain-id***

*domain-id* - An independent multicast domain. (Range: 1-5)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the `mvr vlan group` command.

### Example

The following example enables MVR for domain 1:

```
Console(config)#mvr domain 1
Console(config)#
```

**mvr priority** This command assigns a priority to all multicast traffic in the MVR VLAN. Use the **no** form of this command to restore the default setting.

### Syntax

**mvr priority** *priority*

**no mvr priority**

*priority* - The CoS priority assigned to all multicast traffic forwarded into the MVR VLAN. (Range: 0-7, where 7 is the highest priority)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

This command can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

### Example

```
Console(config)#mvr priority 6
Console(config)#
```

### Related Commands

`show mvr`

**mvr profile** This command maps a range of MVR group addresses to a profile. Use the **no** form of this command to remove the profile.

### Syntax

**mvr profile** *profile-name start-ip-address end-ip-address*

**no mvr profile** *profile-name*

*profile-name* - The name of a profile containing one or more MVR group addresses. (Range: 1-21 characters)

*start-ip-address* - Starting IPv4 address for an MVR multicast group. (Range: 224.0.1.0 - 239.255.255.255)

*end-ip-address* - Ending IPv4 address for an MVR multicast group. (Range: 224.0.1.0 - 239.255.255.255)

### Default Setting

No profiles are defined

### Command Mode

Global Configuration

### Command Usage

- ◆ Use this command to statically configure all multicast group addresses that will join the MVR VLAN. Any multicast data associated an MVR group is sent from all source ports to all receiver ports that have registered to receive data from that multicast group.
- ◆ The IP address range from 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.
- ◆ IGMP snooping and MVR share a maximum number of 1024 groups. Any multicast streams received in excess of this limitation will be flooded to all ports in the associated domain.

### Example

The following example maps a range of MVR group addresses to a profile:

```
Console(config)#mvr profile rd 228.1.23.1 228.1.23.10
Console(config)#
```

**mvr proxy-query-interval** This command configures the interval at which the receiver port sends out general queries. Use the **no** form to restore the default setting.

#### Syntax

**mvr proxy-query-interval** *interval*

**no mvr proxy-query-interval**

*interval* - The interval at which the receiver port sends out general queries.  
(Range: 2-31744 seconds)

#### Default Setting

125 seconds

#### Command Mode

Global Configuration

#### Command Usage

This command sets the general query interval at which active receiver ports send out general queries. This interval is only effective when proxy switching is enabled with the [mvr proxy-switching](#) command.

#### Example

This example sets the proxy query interval for MVR proxy switching.

```
Console(config)#mvr proxy-query-interval 250
Console(config)#
```

**mvr proxy-switching** This command enables MVR proxy switching, where the source port acts as a host, and the receiver port acts as an MVR router with querier service enabled. Use the **no** form to disable this function.

#### Syntax

**[no] mvr proxy-switching**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ When MVR proxy-switching is enabled, an MVR source port serves as the upstream or host interface. The source port performs only the host portion of MVR by sending summarized membership reports, and automatically disables MVR router functions.

- ◆ Receiver ports are known as downstream or router interfaces. These interfaces perform the standard MVR router functions by maintaining a database of all MVR subscriptions on the downstream interface. Receiver ports must therefore be configured on all downstream interfaces which require MVR proxy service.
- ◆ When the source port receives report and leave messages, it only forwards them to other source ports.
- ◆ When receiver ports receive any query messages, they are dropped.
- ◆ When changes occurring in the downstream MVR groups are learned by the receiver ports through report and leave messages, an MVR state change report is created and sent to the upstream source port, which in turn forwards this information upstream.
- ◆ When MVR proxy switching is disabled:
  - Any membership reports received from receiver/source ports are forwarded to all source ports.
  - When a source port receives a query message, it will be forwarded to all downstream receiver ports.
  - When a receiver port receives a query message, it will be dropped.

### Example

The following example enable MVR proxy switching.

```
Console(config)#mvr proxy-switching
Console(config)#
```

### Related Commands

[mvr robustness-value \(711\)](#)

**mvr robustness-value** This command configures the expected packet loss, and thereby the number of times to generate report and group-specific queries. Use the **no** form to restore the default setting.

### Syntax

**mvr robustness-value** *value*

**no mvr robustness-value**

*value* - The robustness used for all interfaces. (Range: 1-255)

### Default Setting

2

### Command Mode

Global Configuration

### Command Usage

- ◆ This command is used to set the number of times report messages are sent upstream when changes are learned about downstream groups, and the number of times group-specific queries are sent to downstream receiver ports.
- ◆ This command only takes effect when MVR proxy switching is enabled.

### Example

```
Console(config)#mvr robustness-value 5
Console(config)#
```

### Related Commands

[mvr proxy-switching \(710\)](#)

**mvr source-port-mode dynamic** This command configures the switch to only forward multicast streams which the source port has dynamically joined. Use the **no** form to restore the default setting.

### Syntax

**[no] mvr source-port-mode dynamic**

### Default Setting

Forwards all multicast streams which have been specified in a profile and bound to a domain.

### Command Mode

Global Configuration

### Command Usage

- ◆ By default, the switch forwards any multicast streams within the address range set by a profile, and bound to a domain. The multicast streams are sent to all source ports on the switch and to all receiver ports that have elected to receive data on that multicast address.
- ◆ When the **mvr source-port-mode dynamic** command is used, the switch only forwards multicast streams which the source port has dynamically joined. In other words, both the receiver port and source port must subscribe to a multicast group before a multicast stream is forwarded to any attached client. Note that the requested streams are still restricted to the address range which has been specified in a profile and bound to a domain.



### Example

```
Console(config)#mvr source-port-mode dynamic
Console(config)#
```

**mvr upstream-source-ip** This command configures the source IP address assigned to all MVR control packets sent upstream on all domains or on a specified domain. Use the **no** form to restore the default setting.

### Syntax

**mvr [domain domain-id] upstream-source-ip source-ip-address**

**no mvr [domain domain-id] upstream-source-ip**

*domain-id* - An independent multicast domain. (Range: 1-5)

*source-ip-address* - The source IPv4 address assigned to all MVR control packets sent upstream.

### Default Setting

All MVR reports sent upstream use a null source IP address

### Command Mode

Global Configuration

### Example

```
Console(config)#mvr domain 1 upstream-source-ip 192.168.0.3
Console(config)#
```

**mvr vlan** This command specifies the VLAN through which MVR multicast data is received. Use the **no** form of this command to restore the default MVR VLAN.

### Syntax

**mvr [domain domain-id] vlan vlan-id**

**no mvr [domain domain-id] vlan**

*domain-id* - An independent multicast domain. (Range: 1-5)

*vlan-id* - Specifies the VLAN through which MVR multicast data is received. This is also the VLAN to which all source ports must be assigned. (Range: 1-4094)

### Default Setting

VLAN 1

### Command Mode

Global Configuration

### Command Usage

- ◆ This command specifies the VLAN through which MVR multicast data is received. This is the VLAN to which all source ports must be assigned.
- ◆ The VLAN specified by this command must be an existing VLAN configured with the `vlan` command.
- ◆ MVR source ports can be configured as members of the MVR VLAN using the `switchport allowed vlan` command and `switchport native vlan` command, but MVR receiver ports should not be statically configured as members of this VLAN.

### Example

The following example sets the MVR VLAN to VLAN 2:

```
Console(config)#mvr
Console(config)#mvr domain 1 vlan 2
Console(config)#
```

**mvr immediate-leave** This command causes the switch to immediately remove an interface from a multicast stream as soon as it receives a leave message for that group. Use the **no** form to restore the default settings.

### Syntax

**mvr** [**domain** *domain-id*] **immediate-leave** [**by-host-ip**]

**no mvr** [**domain** *domain-id*] **immediate-leave**

*domain-id* - An independent multicast domain. (Range: 1-5)

**by-host-ip** - Specifies that the member port will be deleted only when there are no hosts joining this group.

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Immediate leave applies only to receiver ports. When enabled, the receiver port is immediately removed from the multicast group identified in the leave message. When immediate leave is disabled, the switch follows the standard rules by sending a group-specific query to the receiver port and waiting for a response to determine if there are any remaining subscribers for that multicast group before removing the port from the group list.
- ◆ If the "by-host-ip" option is used, the router/querier will not send out a group-specific query when an IGMPv2/v3 leave message is received (the same as it

would without this option having been used). Instead of immediately deleting that group, it will look up the record, and only delete the group if there are no other subscribers for it on the member port. Only when all hosts on that port leave the group will the member port be deleted.

- ◆ Using immediate leave can speed up leave latency, but should only be enabled on a port attached to only one multicast subscriber to avoid disrupting services to other group members attached to the same interface.
- ◆ Immediate leave does not apply to multicast groups which have been statically assigned to a port with the `mvr vlan group` command.

### Example

The following enables immediate leave on a receiver port.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr domain 1 immediate-leave
Console(config-if)#
```

**mvr type** This command configures an interface as an MVR receiver or source port. Use the **no** form to restore the default settings.

### Syntax

**[no] mvr [domain *domain-id*] type {receiver | source}**

*domain-id* - An independent multicast domain. (Range: 1-5)

**receiver** - Configures the interface as a subscriber port that can receive multicast data.

**source** - Configures the interface as an uplink port that can send and receive multicast data for the configured multicast groups.

### Default Setting

The port type is not defined.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ A port which is not configured as an MVR receiver or source port can use IGMP snooping to join or leave multicast groups using the standard rules for multicast filtering.
- ◆ Receiver ports can belong to different VLANs, but should not normally be configured as a member of the MVR VLAN. IGMP snooping can also be used to allow a receiver port to dynamically join or leave multicast groups not sourced through the MVR VLAN. Also, note that VLAN membership for MVR receiver ports cannot be set to access mode (see the `switchport mode` command).

- ◆ One or more interfaces may be configured as MVR source ports. A source port is able to both receive and send data for multicast groups which it has joined through the MVR protocol or which have been assigned through the **mvr vlan group** command.
- ◆ Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the **mvr vlan group** command.

### Example

The following configures one source port and several receiver ports on the switch.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr domain 1 type source
Console(config-if)#exit
Console(config)#interface ethernet 1/6
Console(config-if)#mvr domain 1 type receiver
Console(config-if)#exit
Console(config)#interface ethernet 1/7
Console(config-if)#mvr domain 1 type receiver
Console(config-if)#
```

**mvr vlan group** This command statically binds a multicast group to a port which will receive long-term multicast streams associated with a stable set of hosts. Use the **no** form to restore the default settings.

### Syntax

**[no] mvr [domain domain-id] vlan vlan-id group ip-address**

*domain-id* - An independent multicast domain. (Range: 1-5)

*vlan-id* - Receiver VLAN to which the specified multicast traffic is flooded.  
(Range: 1-4094)

**group** - Defines a multicast service sent to the selected port.

*ip-address* - Statically configures an interface to receive multicast traffic from the IPv4 address specified for an MVR multicast group.  
(Range: 224.0.1.0 - 239.255.255.255)

### Default Setting

No receiver port is a member of any configured multicast group.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Multicast groups can be statically assigned to a receiver port using this command.

- ◆ The IP address range from 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.
- ◆ Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the **mvr vlan group** command.
- ◆ The MVR VLAN cannot be specified as the receiver VLAN for static bindings.

### Example

The following statically assigns a multicast group to a receiver port:

```
Console(config)#interface ethernet 1/7
Console(config-if)#mvr domain 1 type receiver
Console(config-if)#mvr domain 1 vlan 3 group 225.0.0.5
Console(config-if)#
```

**clear mvr groups dynamic** This command clears multicast group information dynamically learned through MVR.

### Syntax

**clear mvr groups dynamic**

### Command Mode

Privileged Exec

### Command Usage

This command only clears entries learned through MVR. Statically configured multicast address are not cleared.

### Example

```
Console#clear mvr groups dynamic
Console#
```

**clear mvr statistics** This command clears MVR statistics.

### Syntax

**clear mvr statistics** [**interface** *interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* - VLAN identifier (Range: 1-4094)

### Command Mode

Privileged Exec

### Example

```
Console#clear mvr statistics
Console#
```

**show mvr** This command shows information about MVR domain settings, including MVR operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address.

### Syntax

**show mvr** [**domain** *domain-id*]

*domain-id* - An independent multicast domain. (Range: 1-5)

### Default Setting

Displays configuration settings for all MVR domains.

### Command Mode

Privileged Exec

### Example

The following shows the MVR settings:

```
Console#show mvr
MVR 802.1p Forwarding Priority : Disabled
MVR Proxy Switching           : Enabled
MVR Robustness Value          : 1
MVR Proxy Query Interval      : 125(sec.)
MVR Source Port Mode          : Always Forward

MVR Domain                    : 1
MVR Config Status             : Enabled
MVR Running Status            : Active
MVR Multicast VLAN            : 1
MVR Current Learned Groups    : 10
MVR Upstream Source IP        : 192.168.0.3
:
```

**Table 131: show mvr - display description**

Field	Description
MVR 802.1p Forwarding Priority	Priority assigned to multicast traffic forwarded into the MVR VLAN
MVR Proxy Switching	Shows if MVR proxy switching is enabled
MVR Robustness Value	Shows the number of reports or query messages sent when proxy switching is enabled
MVR Proxy Query Interval	Shows the interval at which the receiver port sends out general queries
MVR Source Port Mode	Shows if the switch forwards all multicast streams, or only those which the source port has dynamically joined
MVR Domain	An independent multicast domain.
MVR Config Status	Shows if MVR is globally enabled on the switch.
MVR Running Status	Indicates whether or not all necessary conditions in the MVR environment are satisfied. (Running status is true as long as MVR Status is enabled, and the specified MVR VLAN exists.)
MVR Multicast VLAN	Shows the VLAN used to transport all MVR multicast traffic.
MVR Current Learned Groups	The current number of MVR group addresses
MVR Upstream Source IP	The source IP address assigned to all upstream control packets.

**show mvr associated-profile** This command shows the profiles bound the specified domain.

#### Syntax

**show mvr [domain *domain-id*] associated-profile**

*domain-id* - An independent multicast domain. (Range: 1-5)

#### Default Setting

Displays profiles bound to all MVR domains.

#### Command Mode

Privileged Exec

#### Example

The following displays the profiles bound to domain 1:

```

Console#show mvr domain 1 associated-profile
Domain ID : 1
MVR Profile Name      Start IP Addr.  End IP Addr.
-----
rd                     228.1.23.1     228.1.23.10
testing                228.2.23.1     228.2.23.10
Console#

```

**show mvr interface** This command shows MVR configuration settings for interfaces attached to the MVR VLAN.

### Syntax

**show mvr [domain *domain-id*] interface**

*domain-id* - An independent multicast domain. (Range: 1-5)

### Default Setting

Displays configuration settings for all attached interfaces.

### Command Mode

Privileged Exec

### Example

The following displays information about the interfaces attached to the MVR VLAN in domain 1:

```
Console#show mvr domain 1 interface
MVR Domain : 1
Flag: H - immediate leave by host ip
Port      Type      Status      Immediate  Static Group Address
-----
Eth 1/ 1 Source  Active/Forwarding
Eth 1/ 2 Receiver Inactive/Discarding Disabled    234.5.6.8 (VLAN2)
Eth 1/ 3 Source  Inactive/Discarding
Eth 1/ 1 Receiver Active/Forwarding Disabled    225.0.0.1 (VLAN1)
                                           225.0.0.9 (VLAN3)
Eth 1/ 4 Receiver Active/Discarding Disabled
Console#
```

**Table 132: show mvr interface - display description**

Field	Description
MVR Domain	An independent multicast domain.
Port	Shows interfaces attached to the MVR.
Type	Shows the MVR port type.
Status	Shows the MVR status and interface status. MVR status for source ports is "ACTIVE" if MVR is globally enabled on the switch. MVR status for receiver ports is "ACTIVE" only if there are subscribers receiving multicast traffic from one of the MVR groups, or a multicast group has been statically assigned to an interface. Also shows if MVR traffic is being forwarded or discarded.
Immediate	Shows if immediate leave is enabled or disabled.
Static Group Address	Shows any static MVR group assigned to an interface, and the receiver VLAN.



**show mvr members** This command shows information about the current number of entries in the forwarding database, detailed information about a specific multicast address, the IP address of the hosts subscribing to all active multicast groups, or the multicast groups associated with each port.

### Syntax

**show mvr** [**domain** *domain-id*] **members** [*ip-address* | **host-ip-address** [*interface*] | **igmp** | **sort-by-port** [*interface*] | **unknown** | **user**]

*domain-id* - An independent multicast domain. (Range: 1-5)

*ip-address* - IPv4 address for an MVR multicast group.  
(Range: 224.0.1.0 - 239.255.255.255)

**members** - The multicast groups assigned to the MVR VLAN.

**host-ip-address** - The subscriber IP addresses.

**igmp** - Entry created by IGMP protocol.

**sort-by-port** - The multicast groups associated with an interface.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**unknown** - Entry created by receiving a multicast stream.

**user** - Snooping entry learned from user's configuration settings.

### Default Setting

Displays configuration settings for all domains and all forwarding entries.

### Command Mode

Privileged Exec

### Example

The following shows information about the number of multicast forwarding entries currently active in domain 1:

```
Console#show mvr domain 1 members
MVR Domain : 1
MVR Forwarding Entry Count :1
Flag: S - Source port, R - Receiver port.
      H - Host counts (number of hosts joined to group on this port).
      P - Port counts (number of ports joined to group).
Up time: Group elapsed time (d:h:m:s).
Expire : Group remaining time (m:s).
```

Group Address	VLAN Port	Up time	Expire Count
234.5.6.7	1	00:00:09:17	2 (P)
	1 Eth 1/ 1(S)		
	2 Eth 1/ 2(R)		

Console#

The following example shows detailed information about a specific multicast address:

```
Console#show mvr domain 1 members 234.5.6.7
MVR Domain : 1
MVR Forwarding Entry Count :1
Flag: S - Source port, R - Receiver port.
      H - Host counts (number of hosts joined to group on this port).
      P - Port counts (number of ports joined to group).
Up time: Group elapsed time (d:h:m:s).
Expire : Group remaining time (m:s).
```

Group Address	VLAN Port	Up time	Expire Count
234.5.6.7	1		2 (P)
	1 Eth 1/ 1(S)		
	2 Eth 1/ 2(R)		

Console#

**Table 133: show mvr members - display description**

Field	Description
Group Address	Multicast group address.
VLAN	VLAN to which this address is forwarded.
Port	Port to which this address is forwarded.
Uptime	Time that this multicast group has been known.
Expire	The time until this entry expires.
Count	The number of times this address has been learned by IGMP snooping.

**show mvr profile** This command shows all configured MVR profiles.

#### Command Mode

Privileged Exec

#### Example

The following shows all configured MVR profiles:

```
Console#show mvr profile
MVR Profile Name      Start IP Addr.  End IP Addr.
-----
rd                     228.1.23.1     228.1.23.10
testing                228.2.23.1     228.2.23.10
Console#
```

**show mvr statistics** This command shows MVR protocol-related statistics for the specified interface.

#### Syntax

**show mvr** [**domain** *domain-id*] **statistics**

**input** [**interface** *interface*] | **output** [**interface** *interface*] |

**query** | **summary** **interface** [*interface* | **mvr-vlan**]

*domain-id* - An independent multicast domain. (Range: 1-5)

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* - VLAN ID (Range: 1-4094)

**query** - Displays MVR query-related statistics.

**summary** - Displays summary of MVR statistics.

**mvr vlan** - Displays summary statistics for the MVR VLAN.

#### Default Setting

Displays statistics for all domains.

#### Command Mode

Privileged Exec

### Example

The following shows MVR protocol-related statistics received:

```
Console#show mvr domain 1 statistics input
MVR Domain : 1 , MVR VLAN: 2
Input Statistics:
Interface Report    Leave    G Query  G(-S)-S Query Drop    Join Succ Group
-----
Eth 1/ 1           23       11        4         10      5        20      9
Eth 1/ 2           12       15        8          3      5        19      4
DVLAN  1            2         0         0          2      2        20      9
MVLAN  1            2         0         0          2      2        20      9
Console#
```

**Table 134: show mvr statistics input - display description**

Field	Description
Interface	Shows interfaces attached to the MVR.
Report	The number of IGMP membership reports received on this interface.
Leave	The number of leave messages received on this interface.
G Query	The number of general query messages received on this interface.
G(-S)-S Query	The number of group specific or group-and-source specific query messages received on this interface.
Drop	The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, packet content not allowed, or MVR group report received
Join Succ	The number of times a multicast group was successfully joined.
Group	The number of MVR groups active on this interface.

The following shows MVR protocol-related statistics sent:

```
Console#show mvr domain 1 statistics output
MVR Domain : 1 , MVR VLAN: 2
Output Statistics:
Interface Report    Leave    G Query  G(-S)-S Query Drop    Group
-----
Eth 1/ 1           12         0         1          0      0      0
Eth 1/ 1           12         0         1          0      0      0
Eth 1/ 2            5         1         4          1      0      0
DVLAN  1            7         2         3          0      0      0
MVLAN  1            7         2         3          0      0      0
Console#
```

**Table 135: show mvr statistics output - display description**

Field	Description
Interface	Shows interfaces attached to the MVR.
Report	The number of IGMP membership reports sent from this interface.

**Table 135: show mvr statistics output - display description** (Continued)

Field	Description
Leave	The number of leave messages sent from this interface.
G Query	The number of general query messages sent from this interface.
G(S)-S Query	The number of group specific or group-and-source specific query messages sent from this interface.

The following shows MVR query-related statistics:

```

Console#show mvr domain 1 statistics query
Domain 1:
  Other Querier           : None
  Other Querier Expire    : 0 (m) : 0 (s)
  Other Querier Uptime    : 0 (h) : 0 (m) : 0 (s)
  Self Querier            : None
  Self Querier Expire     : 0 (m) : 30 (s)
  Self Querier Uptime     : 0 (h) : 9 (m) : 55 (s)
  General Query Received  : 0
  General Query Sent      : 8
  Specific Query Received : 0
  Specific Query Sent     : 3
  Warn Rate Limit        : 0 sec.
  V1 Warning Count       : 0
  V2 Warning Count       : 0
  V3 Warning Count       : 0
Console#

```

**Table 136: show mvr statistics query - display description**

Field	Description
Other Querier	The IP address of the querier on this interface.
Other Querier Expire	The time after which this querier is assumed to have expired.
Other Querier Uptime	Other querier's time up.
Self Querier	This querier's IP address.
Self Querier Expire	This querier's expire time.
Self Querier Uptime	This querier's time up.
General Query Received	The number of general queries received on this interface.
General Query Sent	The number of general queries sent from this interface.
Specific Query Received	The number of specific queries received on this interface.
Specific Query Sent	The number of specific queries sent from this interface.
Warn Rate Limit	Count down from 15 seconds after receiving a Query different from the configured version.
V# Warning Count	Number of queries received on MVR that were configured for IGMP version 1, 2 or 3.

The following shows MVR summary statistics for an interface:

```

Console#show mvr domain 1 statistics summary interface ethernet 1/1
Domain 1:
Number of Groups: 0
Querier:      :
Transmit      :
  General     : 0
  Group Specific : 0
Received      :
  General     : 0
  Group Specific : 0
V1 Warning Count: 0
V2 Warning Count: 0
V3 Warning Count: 0
Report & Leave: :
Transmit      :
  Report      : 7
  Leave       : 4
Received      :
  Report      : 0
  Leave       : 0
Join Success   : 0
Filter Drop    : 0
Source Port Drop: 0
Others Drop    : 0
Console#

```

**Table 137: show mvr statistics summary interface - display description**

Field	Description
Domain	An independent multicast domain.
Number of Groups	Number of groups learned on this port.
Querier	
Transmit	
General	Number of general queries transmitted.
Group Specific	Number of group specific queries transmitted.
Received	
General	Number of general queries received.
Group Specific	Number of group specific queries received.
V# Warning Count	Number of queries received on MVR that were configured for IGMP version 1, 2 or 3.
Report & Leave	
Transmit	
Report	Number of transmitted reports.
Leave	Number of transmitted leaves.
Received	
Report	Number of reports received.
Leave	Number of leaves received.
Join Success	Number of join reports processed successfully.
Filter Drop	Number of report/leave messages dropped by IGMP filter.
Source Port Drop	Number of report/leave messages dropped by MVR source port.
Others Drop	Number of report/leave messages dropped for other reasons.

The following shows MVR summary statistics for the MVR VLAN:

```

Console#show mvr domain 1 statistics summary interface mvr-vlan
Domain 1:
Number of Groups: 0
Querier:      :
  Other Querier : None
  Other Expire  : 0(m):0(s)
  Other Uptime  : 0(h):0(m):0(s)
  Self Querier  : None
  Self Expire   : 1(m):45(s)
  Self Uptime   : 0(h):14(m):54(s)
Transmit      :
  General      : 11
  Group Specific : 3
Received      :
  General      : 0
  Group Specific : 0
V1 Warning Count: 0
V2 Warning Count: 0
V3 Warning Count: 0

Report & Leave:
  Host IP Addr : 192.168.0.66
  Unsolicit Expire : 5(m):4(s)

Transmit      :
  Report       : 7
  Leave        : 4
Received      :
  Report       : 6
  Leave        : 0
Join Success   : 6
Filter Drop    : 0

Source Port Drop: 0
Others Drop     : 0
Console#

```

**Table 138: show mvr statistics summary interface mvr vlan - description**

Field	Description
Domain	An independent multicast domain.
Number of Groups	Number of groups learned on this port.
Querier	
Other Querier	Other IGMP querier's IP address.
Other Expire	Other querier's expire time.
Other Uptime	Other querier's time up.
Self Querier	This querier's IP address.
Self Expire	This querier's expire time.
Self Uptime	This querier's time up.
Transmit	
General	Number of general queries sent from receiver port.
Group Specific	Number of group specific queries sent from receiver port.
Received	
General	Number of general queries received.
Group Specific	Number of group specific queries received.
V# Warning Count	Number of queries received on MVR that were configured by IGMP version 1, 2 or 3.
Report & Leave	
Host IP Addr	Source IP address used to send report/leave messages from source port.
Unsolicit Expire	Expiration time for unsolicit reports sent out from source port

**Table 138: show mvr statistics summary interface mvr vlan - description**

Field	Description
Transmit	
Report	Number of reports sent out from source port.
Leave	Number of leaves sent out from source port.
Received	
Report	Number of reports received.
Leave	Number of leaves received.
Join Success	Number of join reports processed successfully.
Filter Drop	Number of report/leave messages dropped by IGMP filter.
Source Port Drop	Number of report/leave messages dropped by MVR source port.
Others Drop	Number of report/leave messages dropped for other reasons.

## Multicast VLAN Registration for IPv6

This section describes commands used to configure Multicast VLAN Registration for IPv6 (MVR6). A single network-wide VLAN can be used to transmit multicast traffic (such as television channels) across a service provider's network. Any multicast traffic entering an MVR6 VLAN is sent to all subscribers. This can significantly reduce to processing overhead required to dynamically monitor and establish the distribution tree for a normal multicast VLAN. Also note that MVR6 maintains the user isolation and data security provided by VLAN segregation by passing only multicast traffic into other VLANs to which the subscribers belong.

**Table 139: Multicast VLAN Registration for IPv6 Commands**

Command	Function	Mode
<code>mvr6 associated-profile</code>	Binds the MVR6 group addresses specified in a profile to an MVR6 domain	GC
<code>mvr6 domain</code>	Enables MVR6 for a specific domain	GC
<code>mvr6 priority</code>	Assigns a priority to all multicast traffic in the MVR6 VLAN	GC
<code>mvr6 profile</code>	Maps a range of MVR6 group addresses to a profile	GC
<code>mvr6 proxy-query-interval</code>	Configures the interval at which the receiver port sends out general queries.	GC
<code>mvr6 proxy-switching</code>	Enables MVR6 proxy switching, where the source port acts as a host, and the receiver port acts as an MVR6 router with querier service enabled	GC
<code>mvr6 robustness-value</code>	Configures the expected packet loss, and thereby the number of times to generate report and group-specific queries	GC
<code>mvr6 source-port-mode dynamic</code>	Configures the switch to only forward multicast streams which the source port has dynamically joined	GC



Table 139: Multicast VLAN Registration for IPv6 Commands (Continued)

Command	Function	Mode
<code>mvr6 upstream-source-ip</code>	Configures the source IP address assigned to all control packets sent upstream	GC
<code>mvr6 vlan</code>	Specifies the VLAN through which MVR6 multicast data is received	GC
<code>mvr6 immediate-leave</code>	Enables immediate leave capability	IC
<code>mvr6 type</code>	Configures an interface as an MVR6 receiver or source port	IC
<code>mvr6 vlan group</code>	Statically binds a multicast group to a port	IC
<code>clear mvr6 groups dynamic</code>	Clears multicast group information dynamically learned through MVR6	PE
<code>clear mvr6 statistics</code>	Clears the MVR6 statistics globally or on a per-interface basis.	PE
<code>show mvr6</code>	Shows information about MVR6 domain settings, including MVR6 operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address	PE
<code>show mvr6 associated-profile</code>	Shows the profiles bound the specified domain	PE
<code>show mvr6 interface</code>	Shows MVR6 settings for interfaces attached to the MVR6 VLAN	PE
<code>show mvr6 members</code>	Shows information about the current number of entries in the forwarding database, or detailed information about a specific multicast address	PE
<code>show mvr6 profile</code>	Shows all configured MVR6 profiles	PE
<code>show mvr6 statistics</code>	Shows MVR6 protocol statistics for the specified interface	PE

**mvr6 associated-profile** This command binds the MVR6 group addresses specified in a profile to an MVR6 domain. Use the **no** form of this command to remove the binding.

#### Syntax

**[no] mvr6 domain** *domain-id* **associated-profile** *profile-name*

*domain-id* - An independent multicast domain. (Range: 1-5)

*profile-name* - The name of a profile containing one or more MVR6 group addresses. (Range: 1-21 characters)

#### Default Setting

Disabled

#### Command Mode

Global Configuration

### Command Usage

MVR6 domains can be associated with more than one MVR6 profile. But since MVR6 domains cannot share the group range, an MVR6 profile can only be associated with one MVR6 domain.

### Example

The following an MVR6 group address profile to domain 1:

```
Console(config)#mvr6 domain 1 associated-profile rd
Console(config)#
```

**mvr6 domain** This command enables Multicast VLAN Registration Version 6 (MVR6) for a specific domain. Use the **no** form of this command to disable MVR6 for a domain.

### Syntax

**[no] mvr6 domain** *domain-id*

*domain-id* - An independent multicast domain. (Range: 1-5)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

When MVR6 is enabled on a domain, any multicast data associated with an MVR6 group is sent from all designated source ports, to all receiver ports that have registered to receive data from that multicast group.

### Example

The following example enables MVR6 for domain 1:

```
Console(config)#mvr6 domain 1
Console(config)#
```

**mvr6 priority** This command assigns a priority to all multicast traffic in the MVR6 VLAN. Use the **no** form of this command to restore the default setting.

#### Syntax

**mvr6 priority** *priority*

**no mvr6 priority**

*priority* - The CoS priority assigned to all multicast traffic forwarded into the MVR6 VLAN. (Range: 0-7, where 7 is the highest priority)

#### Default Setting

Disabled

#### Command Mode

Global Configuration

#### Command Usage

This command can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

#### Example

```
Console(config)#mvr6 priority 6
Console(config)#
```

#### RELATED COMMANDS

[show mvr6 \(741\)](#)

**mvr6 profile** This command maps a range of MVR6 group addresses to a profile. Use the **no** form of this command to remove the profile.

#### Syntax

**mvr6 profile** *profile-name start-ip-address end-ip-address*

*profile-name* - The name of a profile containing one or more MVR6 group addresses. (Range: 1-21 characters)

*start-ip-address* - Starting IPv6 address for an MVR6 multicast group. This parameter must be a full IPv6 address including the network prefix and host address bits.

*end-ip-address* - Ending IPv6 address for an MVR6 multicast group. This parameter must be a full IPv6 address including the network prefix and host address bits.

#### Default Setting

No profiles are defined

### Command Mode

Global Configuration

### Command Usage

- ◆ Use this command to statically configure all multicast group addresses that will join the MVR6 VLAN. Any multicast data associated with an MVR6 group is sent from all source ports, and to all receiver ports that have registered to receive data from that multicast group.
- ◆ All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (Note that the IP address ff02::X is reserved.)
- ◆ The MVR6 group address range assigned to a profile cannot overlap with the group address range of any other profile.

### Example

The following example maps a range of MVR6 group addresses to a profile:

```
Console(config)#mvr6 profile rd ff01:0:0:0:0:0:fe ff01:0:0:0:0:0:ff
Console(config)#
```

**mvr6 proxy-query-interval** This command configures the interval at which the receiver port sends out general queries. Use the **no** form to restore the default setting.

### Syntax

**mvr6 proxy-query-interval** *interval*

**no mvr6 proxy-query-interval**

*interval* - The interval at which the receiver port sends out general queries.  
(Range: 2-31744 seconds)

### Default Setting

125 seconds

### Command Mode

Global Configuration

### Command Usage

This command sets the general query interval at which active receiver ports send out general queries. This interval is only effective when proxy switching is enabled with the [mvr6 proxy-switching](#) command.

### Example

This example sets the proxy query interval for MVR6.

```
Console(config)#mvr6 proxy-query-interval 228  
Console(config)#
```

**mvr6 proxy-switching** This command enables MVR6 proxy switching, where the source port acts as a host, and the receiver port acts as an MVR6 router with querier service enabled. Use the **no** form to disable this function.

### Syntax

**[no] mvr6 proxy-switching**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Command Usage

- ◆ When MVR6 proxy-switching is enabled, an MVR6 source port serves as the upstream or host interface, and the MVR6 receiver port serves as the querier. The source port performs only the host portion of MVR6 by sending summarized membership reports, and automatically disables MVR6 router functions.
- ◆ Receiver ports are known as downstream or router interfaces. These interfaces perform the standard MVR6 router functions by maintaining a database of all MVR6 subscriptions on the downstream interface. Receiver ports must therefore be configured on all downstream interfaces which require MVR6 proxy service.
- ◆ When the source port receives report and leave messages, it only forwards them to other source ports.
- ◆ When receiver ports receive any query messages, they are dropped.
- ◆ When changes occurring in the downstream MVR6 groups are learned by the receiver ports through report and leave messages, an MVR6 state change report is created and sent to the upstream source port, which in turn forwards this information upstream.
- ◆ When MVR6 proxy switching is disabled:
  - Any membership reports received from receiver/source ports are forwarded to all source ports.

- When a source port receives a query message, it will be forwarded to all downstream receiver ports.
- When a receiver port receives a query message, it will be dropped.

### Example

The following example enable MVR6 proxy switching.

```
Console(config)#mvr6 proxy-switching
Console(config)#
```

### Related Commands

[mvr6 robustness-value \(734\)](#)

**mvr6 robustness-value** This command configures the expected packet loss, and thereby the number of times to generate report and group-specific queries. Use the **no** form to restore the default setting.

### Syntax

**mvr6 robustness-value** *value*

**no mvr6 robustness-value**

*value* - The robustness used for all interfaces. (Range: 1-10)

### Default Setting

2

### Command Mode

Global Configuration

### Command Usage

- ◆ This command sets the number of times report messages are sent upstream when changes are learned about downstream groups, and the number of times group-specific queries are sent to downstream receiver ports.
- ◆ This command only takes effect when MVR6 proxy switching is enabled.

### Example

```
Console(config)#mvr6 robustness-value 5
Console(config)#
```

### Related Commands

[mvr6 proxy-switching \(733\)](#)

**mvr6 source-port-mode dynamic** This command configures the switch to only forward multicast streams which the source port has dynamically joined. Use the **no** form to restore the default setting.

#### Syntax

**[no] mvr6 source-port-mode dynamic**

#### Default Setting

Forwards all multicast streams which have been specified in a profile and bound to a domain.

#### Command Mode

Global Configuration

#### Command Usage

- ◆ By default, the switch forwards any multicast streams within the address range set by a profile, and bound to a domain. The multicast streams are sent to all source ports on the switch and to all receiver ports that have elected to receive data on that multicast address.
- ◆ When the **mvr6 source-port-mode dynamic** command is used, the switch only forwards multicast streams which the source port has dynamically joined. In other words, both the receiver port and source port must subscribe to a multicast group before a multicast stream is forwarded to any attached client. Note that the requested streams are still restricted to the address range which has been specified in a profile and bound to a domain.

#### Example

```
Console(config)#mvr6 source-port-mode dynamic
Console(config)#
```

**mvr6 upstream-source-ip** This command configures the source IPv6 address assigned to all MVR6 control packets sent upstream on the specified domain. Use the **no** form to restore the default setting.

#### Syntax

**mvr6 domain *domain-id* upstream-source-ip *source-ip-address***

**no mvr6 domain *domain-id* upstream-source-ip**

*domain-id* - An independent multicast domain. (Range: 1-5)

*source-ip-address* – The source IPv6 address assigned to all MVR6 control packets sent upstream. This parameter must be a full IPv6 address including the network prefix and host address bits.

#### Default Setting

All MVR6 reports sent upstream use a null source IP address

### Command Mode

Global Configuration

### Command Usage

All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (Note that the IP address ff02::X is reserved.)

### Example

```
Console(config)#mvr6 domain 1 upstream-source-ip 2001:DB8:2222:7223::72
Console(config)#
```

**mvr6 vlan** This command specifies the VLAN through which MVR6 multicast data is received. Use the **no** form of this command to restore the default MVR6 VLAN.

### Syntax

**mvr6 domain** *domain-id* **vlan** *vlan-id*

**no mvr6 domain** *domain-id* **vlan**

*domain-id* - An independent multicast domain. (Range: 1-5)

*vlan-id* - Specifies the VLAN through which MVR6 multicast data is received. This is also the VLAN to which all source ports must be assigned. (Range: 1-4094)

### Default Setting

VLAN 1

### Command Mode

Global Configuration

### Command Usage

MVR6 source ports can be configured as members of the MVR6 VLAN using the [switchport allowed vlan](#) command and [switchport native vlan](#) command, but MVR6 receiver ports should not be statically configured as members of this VLAN.

### Example

The following example sets the MVR6 VLAN to VLAN 1:

```
Console(config)#mvr6 domain 1 vlan 1
Console(config)#
```



**mvr6 immediate-leave** This command causes the switch to immediately remove an interface from a multicast stream as soon as it receives a leave message for that group. Use the **no** form to restore the default settings.

### Syntax

**[no] mvr6 domain *domain-id* immediate-leave [by-host-ip]**

*domain-id* - An independent multicast domain. (Range: 1-5)

**by-host-ip** - Specifies that the member port will be deleted only when there are no hosts joining this group.

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Immediate leave applies only to receiver ports. When enabled, the receiver port is immediately removed from the multicast group identified in the leave message. When immediate leave is disabled, the switch follows the standard rules by sending a group-specific query to the receiver port and waiting for a response to determine if there are any remaining subscribers for that multicast group before removing the port from the group list.
- ◆ If the “by-host-ip” option is used, the router/querier will not send out a group-specific query when an MLDv1/v2 Listener Done message is received (the same as it would without this option having been used). Instead of immediately deleting that group, it will look up the record, and only delete the group if there are no other subscribers for it on the member port. Only when all hosts on that port leave the group will the member port be deleted.
- ◆ Using immediate leave can speed up leave latency, but should only be enabled on a port attached to only one multicast subscriber to avoid disrupting services to other group members attached to the same interface.
- ◆ Immediate leave does not apply to multicast groups which have been statically assigned to a port with the **mvr6 vlan group** command.

### Example

The following enables immediate leave on a receiver port.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr6 domain 1 immediate-leave
Console(config-if)#
```

**mvr6 type** This command configures an interface as an MVR6 receiver or source port. Use the **no** form to restore the default settings.

### Syntax

**[no] mvr6 domain** *domain-id* **type** {**receiver** | **source**}

*domain-id* - An independent multicast domain. (Range: 1-5)

**receiver** - Configures the interface as a subscriber port that can receive multicast data.

**source** - Configures the interface as an uplink port that can send and receive multicast data for the configured multicast groups. Note that the source port must be manually configured as a member of the MVR6 VLAN using the [switchport allowed vlan](#) command.

### Default Setting

The port type is not defined.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ A port configured as an MVR6 receiver or source port can join or leave multicast groups configured under MVR6. A port which is not configured as an MVR6 receiver or source port can use MLD snooping to join or leave multicast groups using the standard rules for multicast filtering (see [“MLD Snooping” on page 683](#)).
- ◆ Receiver ports can belong to different VLANs, but should not be configured as a member of the MVR6 VLAN. MLD snooping can be used to allow a receiver port to dynamically join or leave multicast groups not sourced through the MVR6 VLAN. Also, note that VLAN membership for MVR6 receiver ports cannot be set to access mode (see the [switchport mode](#) command).
- ◆ One or more interfaces may be configured as MVR6 source ports. A source port is able to both receive and send data for multicast groups which it has joined through the MVR6 protocol or which have been assigned through the [mvr6 vlan group](#) command.  
  
All source ports must belong to the MVR6 VLAN.  
  
Subscribers should not be directly connected to source ports.
- ◆ The same port cannot be configured as a source port in one MVR6 domain and as a receiver port in another domain.

### Example

The following configures one source port and several receiver ports on the switch.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr6 domain 1 type source
Console(config-if)#exit
Console(config)#interface ethernet 1/6
Console(config-if)#mvr6 domain 1 type receiver
Console(config-if)#exit
Console(config)#interface ethernet 1/7
Console(config-if)#mvr6 domain 1 type receiver
Console(config-if)#
```

**mvr6 vlan group** This command statically binds a multicast group to a port which will receive long-term multicast streams associated with a stable set of hosts. Use the **no** form to restore the default settings.

### Syntax

**[no] mvr6 domain domain-id vlan vlan-id group ip-address**

*domain-id* - An independent multicast domain. (Range: 1-5)

*vlan-id* - Receiver VLAN to which the specified multicast traffic is flooded.  
(Range: 1-4094)

**group** - Defines a multicast service sent to the selected port.

*ip-address* - Statically configures an interface to receive multicast traffic from the IPv6 address specified for an MVR6 multicast group. This parameter must be a full IPv6 address including the network prefix and host address bits.

### Default Setting

No receiver port is a member of any configured multicast group.

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Multicast groups can be statically assigned to a receiver port using this command. The assigned address must fall within the range set by the [mvr6 associated-profile](#) command.
- ◆ All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (Note that the IP address ff02::X is reserved.)
- ◆ The MVR6 VLAN cannot be specified as the receiver VLAN for static bindings.

### Example

The following statically assigns a multicast group to a receiver port:

```
Console(config)#interface ethernet 1/2
Console(config-if)#mvr6 domain 1 type receiver
Console(config-if)#mvr6 domain 1 vlan 2 group ff00::1
Console(config-if)#
```

**clear mvr6 groups dynamic** This command clears multicast group information dynamically learned through MVR6.

### Syntax

**clear mvr6 groups dynamic** [**domain** *domain-id*]

*domain-id* - An independent multicast domain. (Range: 1-5)

### Command Mode

Privileged Exec

### Command Usage

This command only clears entries learned through MVR6. Statically configured multicast addresses are not cleared.

### Example

```
Console#clear mvr6 groups dynamic
Console#
```

**clear mvr6 statistics** Use this command to clear the MVR6 statistics.

### Syntax

**clear mvr6 statistics** [**interface** {**ethernet** *unit/port* | **port-channel** *channel-id* | **vlan** *vlan-id*}]

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* (Range: 1-4094)

### Command Mode

Privileged Exec

### Command Usage

If the interface option is not used then all MVR6 statistics are cleared. Otherwise using the interface option will only clear MVR6 statistics for the specified interface.

### Example

The following shows how to clear all the MVR6 statistics:

```
Console#clear mvr6 statistics
Console#
```

**show mvr6** This command shows information about MVR6 domain settings, including MVR6 operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address.

### Syntax

**show mvr6** [**domain** *domain-id*]

*domain-id* - An independent multicast domain. (Range: 1-5)

### Default Setting

Displays configuration settings for all MVR6 domains.

### Command Mode

Privileged Exec

### Example

The following shows the MVR6 settings:

```
Console#show mvr6
MVR6 802.1p Forwarding Priority: Disabled
MVR6 Proxy Switching           : Enabled
MVR6 Robustness Value          : 1
MVR6 Proxy Query Interval      : 125(sec.)
MVR6 Source Port Mode          : Always Forward

Domain                         : 1
MVR6 Config Status             : Enabled
MVR6 Running Status            : Active
MVR6 Multicast VLAN             : 1
MVR6 Current Learned Groups    : 0
MVR6 Upstream Source IP        : FF05::25
:
```

**Table 140: show mvr6 - display description**

Field	Description
MVR6 802.1p Forwarding Priority	Priority assigned to multicast traffic forwarded into the MVR6 VLAN
MVR6 Proxy Switching	Shows if MVR6 proxy switching is enabled

**Table 140: show mvr6 - display description** (Continued)

Field	Description
MVR6 Robustness Value	Shows the number of reports or query messages sent when proxy switching is enabled
MVR6 Proxy Query Interval	The interval at which the receiver port sends out general queries
MVR6 Source Port Mode	Shows if the switch only forwards multicast streams which the source port has dynamically joined or always forwards multicast streams
Domain	An independent multicast domain.
MVR6 Config Status	Shows if MVR6 is globally enabled on the switch.
MVR6 Running Status	Indicates whether or not all necessary conditions in the MVR environment are satisfied. (Running status is true as long as MVR Status is enabled, and the specified MVR VLAN exists, and a source port with a valid link has been configured (using the <a href="#">mvr6 type</a> command.)
MVR6 Multicast VLAN	Shows the VLAN used to transport all MVR multicast traffic.
MVR6 Upstream Source IP	The source IP address assigned to all upstream control packets.

**show mvr6 associated-profile** This command shows the profiles bound the specified domain.

#### Syntax

**show mvr6 [domain *domain-id*] associated-profile**

*domain-id* - An independent multicast domain. (Range: 1-5)

#### Default Setting

Displays profiles bound to all MVR domains.

#### Command Mode

Privileged Exec

#### Example

The following displays the profiles bound to domain 1:

```
Console#show mvr6 domain 1 associated-profile
Domain ID : 1
MVR6 Profile Name      Start IPv6 Addr.      End IPv6 Addr.
-----
rd                      ff01::fe              ff01::ff
Console#
```

**show mvr6 interface** This command shows MVR6 configuration settings for interfaces attached to the MVR6 VLAN.

### Syntax

**show mvr6 [domain *domain-id*] interface**

*domain-id* - An independent multicast domain. (Range: 1-5)

### Default Setting

Displays configuration settings for all attached interfaces.

### Command Mode

Privileged Exec

### Example

The following displays information about the interfaces attached to the MVR6 VLAN in domain 1:

```

Console#show mvr6 domain 1 interface
MVR6 Domain : 1
Port      Type      Status              Immediate Leave  Static Group Address
-----
Eth1/ 1   Source   Active/Forwarding
Eth1/ 2   Receiver Active/Forwarding  Disabled         ff00::1 (VLAN2)
Console#

```

**Table 141: show mvr6 interface - display description**

Field	Description
Port	Shows interfaces attached to the MVR6.
Type	Shows the MVR6 port type.
Status	Shows the MVR6 status and interface status. MVR6 status for source ports is "ACTIVE" if MVR6 is globally enabled on the switch. MVR6 status for receiver ports is "ACTIVE" only if there are subscribers receiving multicast traffic from one of the MVR6 groups, or a multicast group has been statically assigned to an interface.
Immediate	Shows if immediate leave is enabled or disabled.
Static Group Address	Shows any static MVR6 group assigned to an interface, and the receiver VLAN.

**show mvr6 members** This command shows information about the current number of entries in the forwarding database, or detailed information about a specific multicast address.

### Syntax

**show mvr6 [domain *domain-id*] members [*ip-address*]**

*domain-id* - An independent multicast domain. (Range: 1-5)

*ip-address* - IPv6 address for an MVR6 multicast group.

### Default Setting

Displays configuration settings for all domains and all forwarding entries.

### Command Mode

Privileged Exec

### Example

The following shows information about the number of multicast forwarding entries currently active in domain 1:

```
Console#show mvr6 domain 1 members
MVR6 Domain : 1
MVR6 Forwarding Entry Count :1
Flag: S - Source port, R - Receiver port.
      H - Host counts (number of hosts join the group on this port).
      P - Port counts (number of forwarding ports).
Up time: Group elapsed time (d:h:m:s).
Expire : Group remaining time (m:s).

Group Address          VLAN Port          Up time          Expire Count
-----
ff05::101              2                  00:00:00:19      2 (P)
                        2  Eth1/ 2 (S)
                        1  Eth1/ 4 (R)
                        0 (H)

Console#
```

The following example shows detailed information about a specific multicast address:

```
Console#show mvr6 domain 1 members ff00::1
MVR6 Domain : 1
MVR6 Forwarding Entry Count :1
Flag: S - Source port, R - Receiver port.
      H - Host counts (number of hosts join the group on this port).
      P - Port counts (number of forwarding ports).
Up time: Group elapsed time (d:h:m:s).
Expire : Group remaining time (m:s).

Group Address          VLAN Port          Up time          Expire Count
-----
ff00::1                2                  00:00:03:18      2 (P)
                        2  Eth1/ 2 (S)
                        1  Eth1/ 4 (R)
                        0 (H)

Console#
```



**Table 142: show mvr6 members - display description**

Field	Description
Group Address	Multicast group address.
VLAN	VLAN to which this address is forwarded.
Port	Port to which this address is forwarded.
Up time	Time that this multicast group has been known.
Expire	The time until this entry expires.
Count	The number of times this address has been learned by Multicast Listening Discovery (MLD snooping).

**show mvr6 profile** This command shows all configured MVR6 profiles.

#### Command Mode

Privileged Exec

#### Example

The following shows all configured MVR6 profiles:

```

Console#show mvr6 profile
MVR6 Profile Name      Start IPv6 Addr.      End IPv6 Addr.
-----
rd                      ff01::fe              ff01::ff
Console#

```

**show mvr6 statistics** This command shows MVR6 protocol-related statistics for the specified interface.

#### Syntax

**show mvr6 statistics** {input | output} [interface *interface*]

**show mvr6 domain** *domain-id* **statistics** {input [interface *interface*] |  
output [interface *interface*] | query | summary {ethernet *interface* |  
mvr-vlan | port-channel *channel-id*}}

*domain-id* - An independent multicast domain. (Range: 1-5)

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

**vlan** *vlan-id* - VLAN ID (Range: 1-4094)

**query** - Displays MVR6 query-related statistics.

**summary** - Displays MVR summary information.

**mvr vlan** - Displays summary statistics for the MVR VLAN.

### Default Setting

Displays statistics for all domains.

### Command Mode

Privileged Exec

### Example

The following shows MVR6 protocol-related statistics received:

```
Console#show mvr6 domain 1 statistics input
MVR6 Domain 1, MVR6 VLAN 2:
Input Statistics:
Interface Report    Leave    G Query  G(-S)-S Query Drop    Join Succ Group
-----
Eth 1/ 1           23       11        4         10        5       20       9
Eth 1/ 2           12       15        8          3         5       19       4
DVLAN  1            2        0         0          2         2       20       9
MVLAN  2            2        0         0          2         2       20       9
Console#
```

**Table 143: show mvr6 statistics input - display description**

Field	Description
Interface	Shows interfaces attached to the MVR6.
Report	The number of IGMP membership reports received on this interface.
Leave	The number of leave messages received on this interface.
G Query	The number of general query messages received on this interface.
G(-S)-S Query	The number of group specific or group-and-source specific query messages received on this interface.
Drop	The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, packet content not allowed, or MVR6 group report received
Join Succ	The number of times a multicast group was successfully joined.
Group	The number of MVR6 groups active on this interface.

The following shows MVR6 protocol-related statistics sent:

```
Console#show mvr6 domain 1 statistics output
MVR6 Domain 1, MVR6 VLAN 2:
Output Statistics:
Interface Report    Done    G Query  G(-S)-S Query Drop    Group
-----
Eth 1/ 1           12        0        1          0        0       0
Eth 1/ 3            5        1        4          1        0       0
DVLAN  1            7        2        3          0        0       0
```

```
MVLAN 2 7 2 3 0 0 0
Console#
```

**Table 144: show mvr6 statistics output - display description**

Field	Description
Interface	Shows interfaces attached to the MVR6.
Report	The number of IGMP membership reports sent from this interface.
Leave	The number of leave messages sent from this interface.
G Query	The number of general query messages sent from this interface.
G(S)-S Query	The number of group specific or group-and-source specific query messages sent from this interface.
Group	The number of MVR groups active on this interface.

The following shows MVR query-related statistics:

```
Console#show mvr6 domain 1 statistics query
Other Querier Address      : fe80::2e0:cff:fe00:fb/64
Other Querier Uptime       : 0 (h) : 0 (m) : 0 (s)
Other Querier Expire Time  : 0 (m) : 0 (s)
Self Querier Address       : None
Self Querier Uptime        : 0 (h) : 13 (m) : 16 (s)
Self Querier Expire Time   : 3 (m) : 23 (s)
General Query Received     : 0
General Query Sent         : 0
Specific Query Received    : 0
Specific Query Sent        : 0
Console#
```

**Table 145: show mvr6 statistics query - display description**

Field	Description
Other Querier Address	The IPv6 address of the querier on this interface.
Other Querier Uptime	Other querier's time up.
Other Querier Expire Time	The time after which this querier is assumed to have expired.
Self Querier Address	This querier's IPv6 address.
Self Querier Uptime	This querier's time up.
Self Querier Expire Time	This querier's expire time.
General Query Received	The number of general queries received on this interface.
General Query Sent	The number of general queries sent from this interface.
Specific Query Received	The number of specific queries received on this interface.
Specific Query Sent	The number of specific queries sent from this interface.

## IGMP (Layer 3)

This section describes commands used to configure Layer 3 Internet Group Management Protocol (IGMP) on the switch.

**Table 146: IGMP Commands (Layer 3)**

Command	Function	Mode
<code>ip igmp</code>	Enables IGMP for the specified interface	IC
<code>ip igmp last-member-query-interval</code>	Configures the frequency at which to send query messages in response to receiving a leave message	IC
<code>ip igmp max-resp-interval</code>	Configures the maximum host response time	IC
<code>ip igmp query-interval</code>	Configures frequency for sending host query messages	IC
<code>ip igmp robustval</code>	Configures the expected packet loss	IC
<code>ip igmp static-group</code>	Configures the router to be a static member of a multicast group on the specified VLAN interface	IC
<code>ip igmp version</code>	Configures IGMP version used on this interface	IC
<code>clear ip igmp group</code>	Deletes entries from the IGMP cache	PE
<code>show ip igmp groups</code>	Displays information for IGMP groups	PE
<code>show ip igmp interface</code>	Displays multicast information for the specified interface	PE

**ip igmp** This command enables IGMP on a VLAN interface. Use the **no** form of this command to disable IGMP on the specified interface.

### Syntax

**[no] ip igmp**

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ IGMP (including query functions) can be enabled for specific VLAN interfaces at Layer 3 through the **ip igmp** command.
- ◆ When a multicast routing protocol, such as PIM, is enabled, IGMP is also enabled.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip igmp
Console(config-if)#end
```

```

Console#show ip igmp interface
  IGMP                               : Enabled
  IGMP Version                       : 2
  IGMP Proxy                         : Disabled
  IGMP Unsolicited Report Interval   : 400 sec
  Robustness Variable                 : 2
  Query Interval                     : 125 sec
  Query Max Response Time             : 100 (resolution in 0.1 sec)
  Last Member Query Interval          : 10 (resolution in 0.1 sec)
  Querier                            : 0.0.0.0
  Joined Groups :
  Static Groups :

Console#

```

### Related Commands

[ip igmp snooping \(649\)](#)

[show ip igmp snooping \(666\)](#)

**ip igmp last-member-query-interval** This command configures the frequency at which to send IGMP group-specific or IGMPv3 group-source-specific query messages in response to receiving a group-specific or group-source-specific leave message. Use the **no** form to restore the default setting.

### Syntax

**ip igmp last-member-query-interval** *seconds*

**no ip igmp last-member-query-interval**

*seconds* - The frequency at which the switch sends group-specific or group-source-specific queries upon receipt of a leave message. (Range: 1-255 tenths of a second)

### Default Setting

10 (1 second)

### Command Mode

Interface Configuration (VLAN)

### Command Usage

When the switch receives an IGMPv2 or IGMPv3 leave message from a host that wants to leave a multicast group, source or channel, it sends a number of group-specific or group-source-specific query messages at intervals defined by this command. If no response is received after this period, the switch stops forwarding for the group, source or channel.

### Example

```

Console(config)#interface vlan 1
Console(config-if)#ip igmp last-member-query-interval 20
Console(config-if)#

```

**ip igmp max-resp-interval** This command configures the maximum response time advertised in IGMP queries. Use the **no** form of this command to restore the default.

#### Syntax

**ip igmp max-resp-interval** *seconds*

**no ip igmp max-resp-interval**

*seconds* - The report delay advertised in IGMP queries.  
(Range: 0-255 tenths of a second)

#### Default Setting

100 (10 seconds)

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ IGMPv1 does not support a configurable maximum response time for query messages. It is fixed at 10 seconds for IGMPv1.
- ◆ By varying the Maximum Response Interval, the burstiness of IGMP messages passed on the subnet can be tuned; where larger values make the traffic less bursty, as host responses are spread out over a larger interval.
- ◆ The number of seconds represented by the maximum response interval must be less than the Query Interval ([page 750](#)).

#### Example

The following shows how to configure the maximum response time to 20 seconds.

```
Console(config-if)#ip igmp query-max-response-time 200
Console(config-if)#
```

#### Related Commands

[ip igmp version \(753\)](#)

[ip igmp query-interval \(750\)](#)

**ip igmp query-interval** This command configures the frequency at which host query messages are sent. Use the **no** form to restore the default.

#### Syntax

**ip igmp query-interval** *seconds*

**no ip igmp query-interval**

*seconds* - The frequency at which the switch sends IGMP host-query messages. (Range: 1-255 seconds)

### Default Setting

125 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Multicast routers send host query messages to determine the interfaces that are connected to downstream hosts requesting a specific multicast service. Only the designated multicast router for a subnet sends host query messages, which are addressed to the multicast address 224.0.0.1, and uses a time-to-live (TTL) value of 1.
- ◆ For IGMP Version 1, the designated router is elected according to the multicast routing protocol that runs on the LAN. But for IGMP Version 2 and 3, the designated querier is the lowest IP-addressed multicast router on the subnet.

### Example

The following shows how to configure the query interval to 100 seconds.

```
Console(config-if)#ip igmp query-interval 100
Console(config-if)#
```

### Related Commands

[ip igmp max-resp-interval \(750\)](#)

**ip igmp robustval** This command specifies the robustness (expected packet loss) for this interface. Use the **no** form of this command to restore the default value.

### Syntax

**ip igmp robustval** *robust-value*

**no ip igmp robustval**

*robust-value* - The robustness of this interface. (Range: 1-255)

### Default Setting

2

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The robustness value is used in calculating the appropriate range for other IGMP variables, such as the Group Membership Interval, as well as the Other Querier Present Interval, and the Startup Query Count (RFC 3376).

- ◆ Routers adopt the robustness value from the most recently received query. If the querier's robustness variable (QRV) is zero, indicating that the QRV field does not contain a declared robustness value, the switch will set the robustness variable to the value statically configured by this command. If the QRV exceeds 7, the maximum value of the QRV field, the robustness value is set to zero, meaning that this device will not advertise a QRV in any query messages it subsequently sends.

### Example

```
Console(config-if)#ip igmp robustness-variable 3
Console(config-if)#
```

**ip igmp static-group** This command configures the router to be a static member of a multicast group on the specified VLAN interface. Use the **no** form to remove the static mapping.

### Syntax

**ip igmp static-group** *group-address* [**source** *source-address*]

**no ip igmp static-group**

*group-address* - IP multicast group address. (The group addresses specified cannot be in the range of 224.0.0.1 - 239.255.255.255.)

*source-address* - Source address for a multicast server transmitting traffic to the corresponding multicast group address.

### Default Setting

None

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Group addresses within the entire multicast group address range can be specified with this command. However, if any address within the source-specific multicast (SSM) address range (default 232/8) is specified, but no source address is included in the command, the request to join the multicast group will fail unless the next node up the reverse path tree has statically mapped this group to a specific source address. Also, if an address outside of the SSM address range is specified, and a specific source address is included in the command, the request to join the multicast group will also fail if the next node up the reverse path tree has enabled the PIM-SSM protocol.
- ◆ If a static group is configured for an any-source multicast (\*,G), a source address cannot subsequently be defined for this group without first deleting the entry.



- ◆ If a static group is configured for one or more source-specific multicasts (S,G), an any-source multicast (\*,G) cannot subsequently be defined for this group without first deleting all of the associated (S,G) entries.
- ◆ Using the **no** form of this command to delete a static group without specifying the source address will delete all any-source and source-specific multicast entries for the specified group.
- ◆ The switch supports a maximum of 16 static group entries.

### Example

The following example assigns VLAN 1 as a static member of the specified multicast group.

```
Console(config)#interface vlan1
Console(config-if)#ip igmp static-group 225.1.1.1
```

**ip igmp version** This command configures the IGMP version used on an interface. Use the **no** form of this command to restore the default.

### Syntax

**ip igmp version {1 | 2 | 3}**

**no ip igmp version**

**1** - IGMP Version 1

**2** - IGMP Version 2

**3** - IGMP Version 3

### Default Setting

IGMP Version 2

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ All routers on the subnet must support the same version. However, the multicast hosts on the subnet may support any of the IGMP versions 1 - 3.
- ◆ If the switch receives an IGMP Version 1 Membership Report, it sets a timer to note that there are Version 1 hosts which are members of the group for which it heard the report.

If there are Version 1 hosts present for a particular group, the switch will ignore any Leave Group messages that it receives for that group.

### Example

```
Console(config-if)#ip igmp version 1
Console(config-if)#
```

**clear ip igmp group** This command deletes entries from the IGMP cache.

### Syntax

**clear ip igmp group** [*group-address* | **interface** *interface*]

*group-address* - IP address of the multicast group.

*interface*

**vlan** *vlan-id* - VLAN ID. (Range: 1-4094)

### Default Setting

Deletes all entries in the cache if no options are selected.

### Command Mode

Privileged Exec

### Command Usage

Enter the address for a multicast group to delete all entries for the specified group.  
Enter the interface option to delete all multicast groups for the specified interface.  
Enter no options to clear all multicast groups from the cache.

### Example

The following example clears all multicast group entries for VLAN 1.

```
Console#clear ip igmp interface vlan1
Console#
```

**show ip igmp groups** This command displays information on multicast groups active on the switch and learned through IGMP.

### Syntax

**show ip igmp groups** [{*group-address* | *interface*} [**detail**] | **detail**]

*group-address* - IP multicast group address.

*interface*

**vlan** *vlan-id* - VLAN ID. (Range: 1-4094)

**detail** - Displays detailed information about the multicast process and source addresses when available.

**Command Mode**  
Privileged Exec**Command Usage**

To display information about multicast groups, IGMP must first be enabled on the interface to which a group has been assigned using the `ip igmp` command, and multicast routing must be enabled globally on the system using the `ip multicast-routing` command.

**Example**

The following shows options for displaying IGMP group information by interface, group address, and static listing.

```

Console#show ip igmp groups
Group Address      Interface VLAN  Last Reporter    Uptime    Expire    V1 Timer
-----
      224.0.17.17              1    192.168.1.10    0:0:1     0:4:19    0:0:0
Console#show ip igmp groups 234.5.6.8
Group Address      Interface VLAN  Last Reporter    Uptime    Expire    V1 Timer
-----
      224.0.17.17              1    192.168.1.10    0:0:1     0:4:19    0:0:0
Console#show ip igmp groups interface vlan 1
Group Address      Interface VLAN  Last Reporter    Uptime    Expire    V1 Timer
-----
      224.0.17.17              1    192.168.1.10    0:0:1     0:4:19    0:0:0
Console#

```

**Table 147: show ip igmp groups - display description**

Field	Description
Group Address	IP multicast group address with subscribers directly attached or downstream from the switch.
Interface VLAN	The interface on the switch that has received traffic directed to the multicast group address.
Last Reporter	The IP address of the source of the last membership report received for this multicast group address on this interface.
Uptime	The time elapsed since this entry was created.
Expire	The time remaining before this entry will be aged out. (The default is 260 seconds.) This field displays "stopped" if the Group Mode is INCLUDE.
V1 Timer	The time remaining until the switch assumes that there are no longer any IGMP Version 1 members on the IP subnet attached to this interface. <ul style="list-style-type: none"> <li>♦ If the switch receives an IGMP Version 1 Membership Report, it sets a timer to note that there are Version 1 hosts present which are members of the group for which it heard the report.</li> <li>♦ If there are Version 1 hosts present for a particular group, the switch will ignore any Leave Group messages that it receives for that group.</li> </ul>

The following shows the information displayed in a detailed listing for a dynamically learned multicast group.

```
Console#show ip igmp groups detail
Interface      : VLAN 1
Group          : 224.1.2.3
Uptime         : 0h:0m:12s
Group mode     : Include
Last reporter  : 0.0.0.0
Group Source List:
Source Address  Uptime      v3 Exp      Fwd
-----
192.1.2.3      0h:0m:12s      0h:0m:0s Yes
Console#
```

**Table 148: show ip igmp groups detail - display description**

Field	Description
Interface	The interface on the switch that has received traffic directed to the multicast group address.
Group	IP multicast group address with subscribers directly attached or downstream from the switch, or a static multicast group assigned to this interface.
Uptime	The time elapsed since this entry was created.
Group mode	In INCLUDE mode, reception of packets sent to the specified multicast address is requested only from those IP source addresses listed in the source-list parameter. In EXCLUDE mode, reception of packets sent to the given multicast address is requested from all IP source addresses except for those listed in the source-list parameter, and where the source timer status has expired. Note that EXCLUDE mode does not apply to SSM addresses.
Last Reporter	The IP address of the source of the last membership report received for this multicast group address on this interface.
Group Source List	A list of zero or more IP unicast addresses from which multicast reception is desired or not desired, depending on the filter mode.
Source Address	The address of one of the multicast servers transmitting traffic to the specified group.
Uptime	The time elapsed since this entry was created.
v3 Exp	The time remaining before this entry will be aged out. The V3 label indicates that the expire time is only provided for sources learned through IGMP Version 3. (The default is 260 seconds.)
Fwd	Indicates whether or not traffic will be forwarded from the multicast source.

**show ip igmp interface** This command shows multicast information for the specified interface.

#### Syntax

```
show ip igmp interface [interface]  
interface  
vlan vlan-id - VLAN ID. (Range: 1-4094)
```

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

The following example shows the IGMP configuration for VLAN 1, as well as the device currently serving as the IGMP querier for active multicast services on this interface.

```
switch#show ip igmp interface vlan 1  
Vlan 1 : up  
  IGMP                               : Disabled  
  IGMP Version                       : 2  
  IGMP Proxy                         : Enabled  
  IGMP Unsolicited-report-interval   : 400 sec  
  Robustness variable                : 2  
  Query Interval                     : 125 sec  
  Query Max Response Time            : 100 (resolution in 0.1 sec)  
  Last Member Query Interval         : 10 (resolution in 0.1 sec)  
  Querier                            : 0.0.0.0  
  Joined Groups :  
  Static Groups :  
switch#
```

## IGMP Proxy Routing

This section describes commands used to configure IGMP Proxy Routing on the switch.

**Table 149: IGMP Proxy Commands**

Command	Function	Mode
<a href="#">ip igmp proxy</a>	Enables IGMP proxy service for multicast routing	IC
<a href="#">ip igmp proxy unsolicited-report-interval</a>	Specifies how often the upstream interface should transmit unsolicited IGMP reports	IC
<a href="#">show ip igmp interface</a>	Displays multicast information for the specified interface	PE

To enable IGMP proxy service, follow these steps:

1. Use the `ip multicast-routing` command to enable IP multicasting globally on the router.
2. Use the `ip igmp proxy` command to enable IGMP proxy on the upstream interface that is attached to an upstream multicast router.
3. Use the `ip igmp` command to enable IGMP on the downstream interfaces from which to forward IGMP membership reports.
4. Optional – Use the `ip igmp proxy unsolicited-report-interval` command to indicate how often the system will send unsolicited reports to the upstream router.

**ip igmp proxy** This command enables IGMP proxy service for multicast routing, forwarding IGMP membership information monitored on downstream interfaces onto the upstream interface in a summarized report. Use the **no** form to disable proxy service.

#### Syntax

**[no] ip igmp proxy**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ When IGMP proxy is enabled on an interface, that interface is known as the upstream or host interface. This interface performs only the host portion of IGMP by sending IGMP membership reports, and automatically disables IGMP router functions.
- ◆ Interfaces with IGMP enabled, but not located in the direction of the multicast tree root are known as downstream or router interfaces. These interfaces perform the standard IGMP router functions by maintaining a database of all IGMP subscriptions on the downstream interface. IGMP must therefore be enabled on all downstream interfaces which require proxy multicast service.
- ◆ When changes occur in the downstream IGMP groups, a IGMP state change report is created and sent to the upstream router.
- ◆ If there is an IGMPv1 or IGMPv2 querier on the upstream network, then the proxy device will act as an IGMPv1 or IGMPv2 host on the upstream interface accordingly. Otherwise, it will act as an IGMPv3 host.

- ◆ Multicast routing protocols are not supported on interfaces where IGMP proxy service is enabled.
- ◆ Only one upstream interface is supported on the system.
- ◆ A maximum of 1024 multicast streams are supported.

### Example

The following example enables multicast routing globally on the switch, configures VLAN 2 as a downstream interface, and then VLAN 1 as the upstream interface.

```
Console(config)#ip multicast-routing
Console(config)#interface vlan2
Console(config-if)#ip igmp
Console(config-if)#exit
Console(config)#interface vlan1
Console(config-if)#ip igmp proxy
Console(config-if)#
```

### ip igmp proxy unsolicited-report- interval

This command specifies how often the upstream interface should transmit unsolicited IGMP reports. Use the **no** form to restore the default value.

#### Syntax

**ip igmp proxy unsolicited-report-interval** *seconds*

**no ip igmp proxy unsolicited-report-interval**

*seconds* - The interval at which to issue unsolicited reports.  
(Range: 1-65535 seconds)

#### Default Setting

400 seconds

#### Command Mode

Interface Configuration (VLAN)

### Example

The following example sets the interval for sending unsolicited IGMP reports to 5 seconds.

```
switch(config)#interface vlan
switch(config-if)#ip igmp proxy unsolicited-report-interval 5
switch(config)#
```

## MLD (Layer 3)

This section describes commands used to configure Layer 3 Multicast Listener Discovery (MLD) on the switch.

**Table 150: MLD Commands (Layer 3)**

Command	Function	Mode
<code>ipv6 mld</code>	Enables MLD for the specified interface	IC
<code>ipv6 mld last-member-query-response-interval</code>	Configures the frequency at which to send query messages in response to receiving a leave message	IC
<code>ipv6 mld max-resp-interval</code>	Configures the maximum host response time	IC
<code>ipv6 mld query-interval</code>	Configures frequency for sending host query messages	IC
<code>ipv6 mld robustval</code>	Configures the expected packet loss	IC
<code>ipv6 mld static-group</code>	Statically binds multicast groups to a VLAN interface	IC
<code>ipv6 mld version</code>	Configures MLD version used on an interface	IC
<code>clear ipv6 mld group</code>	Deletes entries from the MLD cache	PE
<code>show ipv6 mld groups</code>	Displays information for MLD groups	PE
<code>show ip igmp interface</code>	Displays multicast information for an interface	PE

**ipv6 mld** This command enables MLD on a VLAN interface. Use the **no** form of this command to disable MLD on the selected interface.

### Syntax

**[no] ipv6 mld**

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

MLD (including query functions) can be enabled for specific VLAN interfaces at Layer 3 through the **ipv6 mld** command.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mld
Console(config-if)#end
Console#show ipv6 mld interface
VLAN 1 : Up
  MLD                               : Enabled
  MLD Version                       : 2
  MLD Proxy                         : Disabled
```



```

MLD Unsolicited Report Interval : 400 sec
Robustness Variable             : 2
Query Interval                  : 125 sec
Query Max Response Time         : 10 sec
Last Member Query Interval      : 1 sec
Querier                         : ::
Joined Groups                   :
Static Groups                   :

```

```
Console#
```

### ipv6 mld last-member-query-response-interval

This command configures the frequency at which to send MLD group-specific or MLDv2 group-source-specific query messages in response to receiving a group-specific or group-source-specific leave message from the last known active host on the subnet. Use the **no** form to restore the default setting.

#### Syntax

**ipv6 mld last-member-query-response-interval** *seconds*

**no ipv6 mld last-member-query-response-interval**

*seconds* - The frequency at which the switch sends group-specific or group-source-specific queries upon receipt of a leave message. (Range: 1-255 seconds)

#### Default Setting

10 (1 second)

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

When the switch receives an MLD or MLDv2 leave message from a host that wants to leave a multicast group, source or channel, it sends a number of group-specific or group-source-specific query messages at intervals defined by this command. If no response is received after this period, the switch stops forwarding for the group, source or channel.

#### Example

```

Console(config)#interface vlan 1
Console(config-if)#ipv6 mld last-member-query-response-interval 20
Console(config-if)#

```

**ipv6 mld max-resp-interval** This command configures the maximum response time advertised in MLD queries. Use the **no** form of this command to restore the default setting.

#### Syntax

**ipv6 mld max-resp-interval** *seconds*

**no ipv6 mld max-resp-interval**

*seconds* - The report delay advertised in MLD queries.  
(Range: 0-255 seconds)

#### Default Setting

100 (10 seconds)

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ By varying the Maximum Response Interval, the burstiness of MLD messages passed on the subnet can be tuned; where larger values make the traffic less bursty, as host responses are spread out over a larger interval.
- ◆ The number of seconds represented by the maximum response interval must be less than the Query Interval ([page 762](#)).

#### Example

The following shows how to configure the maximum response time to 20 seconds.

```
Console(config-if)#ipv6 mld max-resp-interval 200
Console(config-if)#
```

#### Related Commands

[ipv6 mld query-interval \(762\)](#)

**ipv6 mld query-interval** This command configures the frequency at which host query messages are sent. Use the **no** form to restore the default.

#### Syntax

**ipv6 mld query-interval** *seconds*

**no ipv6 mld query-interval**

*seconds* - The frequency at which the switch sends MLD host-query messages. (Range: 1-255 seconds)

#### Default Setting

125 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Multicast routers send host query messages to determine the interfaces that are connected to downstream hosts requesting a specific multicast service. Only the designated multicast router for a subnet sends host query messages, which are addressed to the link-scope all-nodes multicast address FF02::1, and uses a time-to-live (TTL) value of 1.
- ◆ The designated querier is the lowest IP-addressed multicast router on the subnet.

### Example

The following shows how to configure the query interval to 100 seconds.

```
Console(config-if)#ipv6 mld query-interval 100
Console(config-if)#
```

### Related Commands

[ipv6 mld max-resp-interval \(762\)](#)

**ipv6 mld robustval** This command specifies the robustness (expected packet loss) for this interface. Use the **no** form of this command to restore the default value.

### Syntax

**ipv6 mld robustval** *robust-value*

**no ipv6 mld robustval**

*robust-value* - The robustness of this interface. (Range: 1-255)

### Default Setting

2

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The robustness value is used to compensate for expected packet loss on a link. It indicates the number of refresh packets related to the current MLD state which might be lost without having to terminate that state.
- ◆ Routers adopt the robustness value from the most recently received query. If the query's robustness variable (QRV) is zero, indicating that the QRV field does not contain a declared robustness value, the switch will set the robustness variable to the value statically configured by this command. If the QRV exceeds 7, the maximum value of the QRV field, the robustness value is set to zero,

meaning that this device will not advertise a QRV in any query messages it subsequently sends.

### Example

```
Console(config-if)#ipv6 mld robustval 3  
Console(config-if)#
```

**ipv6 mld static-group** This command statically binds multicast groups to a VLAN interface. Use the **no** form to remove the static mapping.

### Syntax

**ipv6 mld static-group** *group-address* [**source** *source-address*]

**no ipv6 mld static-group** [*group-address* [**source** *source-address*]]

*group-address* - IPv6 multicast group address. (Note that link-local scope addresses FF02:\* are not allowed.)

*source-address* - IPv6 source address for a multicast server transmitting traffic to the corresponding multicast group address.

### Default Setting

None

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ If a static group is configured for an any-source multicast (\*,G), a source address cannot subsequently be defined for this group without first deleting the entry.
- ◆ If a static group is configured for one or more source-specific multicasts (S,G), an any-source multicast (\*,G) cannot subsequently be defined for this group without first deleting all of the associated (S,G) entries.
- ◆ Use the **no** form of this command without specifying a group address to delete all any-source and source-specific multicast entries.
- ◆ Use the **no** form of this command to delete a static group without specifying the source address to delete all any-source and source-specific multicast entries for the specified group.
- ◆ The switch supports a maximum of 64 static group entries.

### Example

The following example assigns VLAN 1 as a static member of the specified multicast group.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mld static-group FFEE::0101
Console(config-if)#
```

**ipv6 mld version** This command configures the MLD version used on an interface. Use the **no** form of this command to restore the default setting.

### Syntax

**ipv6 mld version {1 | 2}**

**no ipv6 mld version**

**1** - MLD Version 1

**2** - MLD Version 2

### Default Setting

MLD Version 2

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ MLDv1 is derived from IGMPv2, and MLDv2 from IGMPv3. IGMP uses IP Protocol 2 message types, and MLD uses IP Protocol 58 message types, which is a subset of the ICMPv6 messages.
- ◆ MLDv2 adds the ability for a node to report interest in listening to packets with a particular multicast address only from specific source addresses as required to support Source-Specific Multicast (SSM), or from all sources except for specific source addresses.
- ◆ MLDv2 supports Source-Specific Multicast (SSM) which builds a reverse tree from a host requesting a service back up to the multicast server.
- ◆ Multicast hosts on the subnet may support either MLD versions 1 or 2.

### Example

```
Console(config-if)#ipv6 mld version 1
Console(config-if)#
```

**clear ipv6 mld group** This command deletes entries from the MLD cache.

#### Syntax

**clear ipv6 mld group** [*group-address* | **interface** *interface*]

*group-address* - IPv6 address of the multicast group.

*interface*

**vlan** *vlan-id* - VLAN ID. (Range: 1-4094)

#### Default Setting

Deletes all entries in the cache if no options are selected.

#### Command Mode

Privileged Exec

#### Command Usage

Enter the address for a multicast group to delete all entries for the specified group.  
Enter the interface option to delete all multicast groups for the specified interface.  
Enter no options to clear all multicast groups from the cache.

#### Example

The following example clears all multicast group entries for VLAN 1.

```
Console#clear ipv6 mld interface vlan 1
Console#
```

**show ipv6 mld groups** This command displays information on multicast groups active on the switch and learned through MLD.

#### Syntax

**show ipv6 mld groups** [{*group-address* | *interface*} [**detail**] | **detail**]

*group-address* - IPv6 multicast group address. (Note that link-local scope addresses FF02:\* are not allowed.)

*interface*

**vlan** *vlan-id* - VLAN ID. (Range: 1-4094)

**detail** - Displays detailed information about the multicast process and source addresses when available.

#### Command Mode

Privileged Exec

#### Command Usage

To display information about multicast groups, MLD must first be enabled on the interface to which a group has been assigned using the [ipv6 mld](#) command, and

multicast routing must be enabled globally on the system using the `ip multicast-routing` command.

### Example

The following shows options for displaying MLD group information.

```

Console#show ipv6 mld groups

Group Address                                Interface VLAN  Uptime    Expire
-----
                                FFEE::101          1    0:1:59    Never

Console#show ipv6 mld groups detail
Interface      : VLAN 1
Group          : FFEE::101
Uptime         : 0h:2m:7s
Group Mode     : Include
Last Reporter  : FE80::0101
Group Source List:
Source Address                                Uptime    Expire    Fwd
-----
                                FFEE::0101  0h:0m:12s  0h:0m:0s  Yes

Console#

```

**Table 151: show ipv6 mld groups - display description**

Field	Description
Group Address	IP multicast group address with subscribers directly attached or downstream from the switch.
Interface VLAN	The interface on the switch that has received traffic directed to the multicast group address.
Uptime	The time elapsed since this entry was created.
Expire	The time remaining before this entry will be aged out. (The default is 260 seconds.) This field displays “stopped” if the Group Mode is INCLUDE.
Group Mode	In Include mode, reception of packets sent to the specified multicast address is requested only from those IP source addresses listed in the source-list parameter. In Exclude mode, reception of packets sent to the given multicast address is requested from all IP source addresses except for those listed in the source-list parameter, and where the source timer status has expired. Note that Exclude mode does not apply to SSM addresses.
Last Reporter	The IP address of the source of the last membership report received for this multicast group address on this interface.
Group Source List	A list of zero or more IP unicast addresses from which multicast reception is desired or not desired, depending on the filter mode.
Source Address	The address of one of the multicast servers transmitting traffic to the specified group.
Fwd	Indicates whether or not traffic will be forwarded from the multicast source.

**show ipv6 mld interface** This command shows multicast information for the specified interface.

#### Syntax

```
show ipv6 mld interface [interface]  
interface  
vlan vlan-id - VLAN ID. (Range: 1-4094)
```

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

The following example shows the MLD configuration for VLAN 1, as well as the device currently serving as the MLD querier for active multicast services on this interface.

```
Console#show ipv6 mld interface vlan 1  
VLAN 1 : Up  
  MLD                               : Enabled  
  MLD Version                       : 2  
  MLD Proxy                         : Disabled  
  MLD Unsolicited Report Interval   : 400 sec  
  Robustness Variable               : 2  
  Query Interval                    : 125 sec  
  Query Max Response Time           : 10  
  Last Member Query Interval        : 1  
  Querier                           : FE80::200:E8FF:FE93:82A0  
  Joined Groups :  
  Static Groups :  
    FFEE::101  
Console#
```

## MLD Proxy Routing

This section describes commands used to configure MLD Proxy Routing on the switch.

**Table 152: IGMP Proxy Commands**

Command	Function	Mode
<a href="#">ipv6 mld proxy</a>	Enables MLD proxy service for multicast routing	IC
<a href="#">ipv6 mld proxy unsolicited-report-interval</a>	Specifies how often the upstream interface should transmit unsolicited IGMP reports	IC
<a href="#">show ipv6 mld interface</a>	Displays multicast information for the specified interface	PE



To enable MLD proxy service, follow these steps:

1. Use the `ipv6 multicast-routing` command to enable IP multicasting globally on the router.
2. Use the `ipv6 mld proxy` command to enable MLD proxy on the upstream interface that is attached to an upstream multicast router.
3. Use the `ipv6 mld` command to enable MLD on the downstream interfaces from which to forward MLD membership reports.
4. Optional – Use the `ipv6 mld proxy unsolicited-report-interval` command to indicate how often the system will send unsolicited reports to the upstream router.

**ipv6 mld proxy** This command enables MLD proxy service for multicast routing, forwarding MLD membership information monitored on downstream interfaces onto the upstream interface in a summarized report. Use the **no** form to disable proxy service.

#### Syntax

**[no] ipv6 mld proxy**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ When MLD proxy is enabled on an interface, that interface is known as the upstream or host interface. This interface performs only the host portion of MLD by sending MLD membership reports, and automatically disables MLD router functions.
- ◆ Interfaces with MLD enabled, but not located in the direction of the multicast tree root are known as downstream or router interfaces. These interfaces perform the standard MLD router functions by maintaining a database of all MLD subscriptions on the downstream interface. MLD must therefore be enabled on all downstream interfaces which require proxy multicast service.
- ◆ When changes occur in the downstream MLD groups, an MLD state change report is created and sent to the upstream router.
- ◆ If there is an MLDv1 querier on the upstream network, then the proxy device will act as an MLDv1 host on the upstream interface accordingly. Otherwise, it will act as an MLDv2 host.

- ◆ Multicast routing protocols are not supported on interfaces where MLD proxy service is enabled.
- ◆ Only one upstream interface is supported on the system.
- ◆ MLD and MLD proxy cannot be enabled on the same interface.
- ◆ A maximum of 1024 multicast streams are supported.

### Example

The following example enables multicast routing globally on the switch, configures VLAN 2 as a downstream interface, and then VLAN 1 as the upstream interface.

```
Console(config)#ip multicast-routing
Console(config)#interface vlan2
Console(config-if)#ipv6 mld
Console(config-if)#exit
Console(config)#interface vlan1
Console(config-if)#ipv6 mld proxy
Console(config-if)#
```

### ipv6 mld proxy unsolicited-report- interval

This command specifies how often the upstream interface should transmit unsolicited MLD reports. Use the **no** form to restore the default value.

#### Syntax

**ipv6 mld proxy unsolicited-report-interval** *seconds*

**no ipv6 mld proxy unsolicited-report-interval**

*seconds* - The interval at which to issue unsolicited reports.  
(Range: 1-65535 seconds)

#### Default Setting

400 seconds

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ The unsolicited report interval only applies to the interface where MLD proxy has been enabled.
- ◆ MLD and MLD proxy cannot be enabled on the same interface.

### Example

The following example sets the interval for sending unsolicited MLD reports to 5 seconds.

```
Console(config)#interface vlan
Console(config-if)#ip igmp proxy unsolicited-report-interval 5
Console(config)#
```



## LLDP Commands

Link Layer Discovery Protocol (LLDP) is used to discover basic information about neighboring devices on the local broadcast domain. LLDP is a Layer 2 protocol that uses periodic broadcasts to advertise information about the sending device. Advertised information is represented in Type Length Value (TLV) format according to the IEEE 802.1AB standard, and can include details such as device identification, capabilities and configuration settings. LLDP also defines how to store and maintain information gathered about the neighboring network nodes it discovers.

Link Layer Discovery Protocol - Media Endpoint Discovery (LLDP-MED) is an extension of LLDP intended for managing endpoint devices such as Voice over IP phones and network switches. The LLDP-MED TLVs advertise information such as network policy, power, inventory, and device location details. LLDP and LLDP-MED information can be used by SNMP applications to simplify troubleshooting, enhance network management, and maintain an accurate network topology.

**Table 153: LLDP Commands**

Command	Function	Mode
<code>lldp</code>	Enables LLDP globally on the switch	GC
<code>lldp holdtime-multiplier</code>	Configures the time-to-live (TTL) value sent in LLDP advertisements	GC
<code>lldp med-fast-start-count</code>	Configures how many medFastStart packets are transmitted	GC
<code>lldp notification-interval</code>	Configures the allowed interval for sending SNMP notifications about LLDP changes	GC
<code>lldp refresh-interval</code>	Configures the periodic transmit interval for LLDP advertisements	GC
<code>lldp reinit-delay</code>	Configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down	GC
<code>lldp tx-delay</code>	Configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables	GC
<code>lldp admin-status</code>	Enables LLDP transmit, receive, or transmit and receive mode on the specified port	IC
<code>lldp basic-tlv management-ip-address</code>	Configures an LLDP-enabled port to advertise the management address for this device	IC
<code>lldp basic-tlv port-description</code>	Configures an LLDP-enabled port to advertise its port description	IC
<code>lldp basic-tlv system-capabilities</code>	Configures an LLDP-enabled port to advertise its system capabilities	IC

Table 153: LLDP Commands (Continued)

Command	Function	Mode
<code>lldp basic-tlv system-description</code>	Configures an LLDP-enabled port to advertise the system description	IC
<code>lldp basic-tlv system-name</code>	Configures an LLDP-enabled port to advertise its system name	IC
<code>lldp dot1-tlv proto-ident*</code>	Configures an LLDP-enabled port to advertise the supported protocols	IC
<code>lldp dot1-tlv proto-vid*</code>	Configures an LLDP-enabled port to advertise port-based protocol related VLAN information	IC
<code>lldp dot1-tlv pvid*</code>	Configures an LLDP-enabled port to advertise its default VLAN ID	IC
<code>lldp dot1-tlv vlan-name*</code>	Configures an LLDP-enabled port to advertise its VLAN name	IC
<code>lldp dot3-tlv link-agg</code>	Configures an LLDP-enabled port to advertise its link aggregation capabilities	IC
<code>lldp dot3-tlv mac-phy</code>	Configures an LLDP-enabled port to advertise its MAC and physical layer specifications	IC
<code>lldp dot3-tlv max-frame</code>	Configures an LLDP-enabled port to advertise its maximum frame size	IC
<code>lldp med-location civic-addr</code>	Configures an LLDP-MED-enabled port to advertise its location identification details	IC
<code>lldp med-notification</code>	Enables the transmission of SNMP trap notifications about LLDP-MED changes	IC
<code>lldp med-tlv inventory</code>	Configures an LLDP-MED-enabled port to advertise its inventory identification details	IC
<code>lldp med-tlv location</code>	Configures an LLDP-MED-enabled port to advertise its location identification details	IC
<code>lldp med-tlv med-cap</code>	Configures an LLDP-MED-enabled port to advertise its Media Endpoint Device capabilities	IC
<code>lldp med-tlv network-policy</code>	Configures an LLDP-MED-enabled port to advertise its network policy configuration	IC
<code>lldp notification</code>	Enables the transmission of SNMP trap notifications about LLDP changes	IC
<code>show lldp config</code>	Shows LLDP configuration settings for all ports	PE
<code>show lldp info local-device</code>	Shows LLDP global and interface-specific configuration settings for this device	PE
<code>show lldp info remote-device</code>	Shows LLDP global and interface-specific configuration settings for remote devices	PE
<code>show lldp info statistics</code>	Shows statistical counters for all LLDP-enabled interfaces	PE

\* Vendor-specific options may or may not be advertised by neighboring devices.

**lldp** This command enables LLDP globally on the switch. Use the **no** form to disable LLDP.

#### Syntax

**[no] lldp**

#### Default Setting

Enabled

#### Command Mode

Global Configuration

#### Example

```
Console(config)#lldp
Console(config)#
```

**lldp holdtime-multiplier** This command configures the time-to-live (TTL) value sent in LLDP advertisements. Use the **no** form to restore the default setting.

#### Syntax

**lldp holdtime-multiplier** *value*

**no lldp holdtime-multiplier**

*value* - Calculates the TTL in seconds based on the following rule:  
minimum of ((Transmission Interval \* Holdtime Multiplier), or 65536)

(Range: 2 - 10)

#### Default Setting

Holdtime multiplier: 4

TTL:  $4 * 30 = 120$  seconds

#### Command Mode

Global Configuration

#### Command Usage

The time-to-live tells the receiving LLDP agent how long to retain all information pertaining to the sending LLDP agent if it does not transmit updates in a timely manner.

#### Example

```
Console(config)#lldp holdtime-multiplier 10
Console(config)#
```

**lldp med-fast-start-count** This command specifies the amount of MED Fast Start LLDPDUs to transmit during the activation process of the LLDP-MED Fast Start mechanism. Use the **no** form to restore the default setting.

#### Syntax

**lldp med-fast-start-count** *packets*

**no lldp med-fast-start-count**

*seconds* - Amount of packets. (Range: 1-10 packets; Default: 4 packets)

#### Default Setting

4 packets

#### Command Mode

Global Configuration

#### Command Usage

This parameter is part of the timer which ensures that the LLDP-MED Fast Start mechanism is active for the port. LLDP-MED Fast Start is critical to the timely startup of LLDP, and therefore integral to the rapid availability of Emergency Call Service.

#### Example

```
Console(config)#lldp med-fast-start-count 6
Console(config)#
```

**lldp notification-interval** This command configures the allowed interval for sending SNMP notifications about LLDP MIB changes. Use the **no** form to restore the default setting.

#### Syntax

**lldp notification-interval** *seconds*

**no lldp notification-interval**

*seconds* - Specifies the periodic interval at which SNMP notifications are sent. (Range: 5 - 3600 seconds)

#### Default Setting

5 seconds

#### Command Mode

Global Configuration

#### Command Usage

- ◆ This parameter only applies to SNMP applications which use data stored in the LLDP MIB for network monitoring or management.



- ◆ Information about changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a notification are included in the transmission. An SNMP agent should therefore periodically check the value of `IldpStatsRemTableLastChangeTime` to detect any `IldpRemTablesChange` notification-events missed due to throttling or transmission loss.

### Example

```
Console(config)#lldp notification-interval 30
Console(config)#
```

**lldp refresh-interval** This command configures the periodic transmit interval for LLDP advertisements. Use the **no** form to restore the default setting.

### Syntax

**lldp refresh-interval** *seconds*

**no lldp refresh-delay**

*seconds* - Specifies the periodic interval at which LLDP advertisements are sent. (Range: 5 - 32768 seconds)

### Default Setting

30 seconds

### Command Mode

Global Configuration

### Example

```
Console(config)#lldp refresh-interval 60
Console(config)#
```

**lldp reinit-delay** This command configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down. Use the **no** form to restore the default setting.

### Syntax

**lldp reinit-delay** *seconds*

**no lldp reinit-delay**

*seconds* - Specifies the delay before attempting to re-initialize LLDP. (Range: 1 - 10 seconds)

### Default Setting

2 seconds

### Command Mode

Global Configuration

### Command Usage

When LLDP is re-initialized on a port, all information in the remote systems LLDP MIB associated with this port is deleted.

### Example

```
Console(config)#lldp reinit-delay 10
Console(config)#
```

**lldp tx-delay** This command configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables. Use the **no** form to restore the default setting.

### Syntax

**lldp tx-delay** *seconds*

**no lldp tx-delay**

*seconds* - Specifies the transmit delay. (Range: 1 - 8192 seconds)

### Default Setting

2 seconds

### Command Mode

Global Configuration

### Command Usage

- ◆ The transmit delay is used to prevent a series of successive LLDP transmissions during a short period of rapid changes in local LLDP MIB objects, and to increase the probability that multiple, rather than single changes, are reported in each transmission.
- ◆ This attribute must comply with the following rule:  
 $(4 * \text{tx-delay}) \leq \text{refresh-interval}$

### Example

```
Console(config)#lldp tx-delay 10
Console(config)#
```

**lldp admin-status** This command enables LLDP transmit, receive, or transmit and receive mode on the specified port. Use the **no** form to disable this feature.

#### Syntax

**lldp admin-status {rx-only | tx-only | tx-rx}**

**no lldp admin-status**

**rx-only** - Only receive LLDP PDUs.

**tx-only** - Only transmit LLDP PDUs.

**tx-rx** - Both transmit and receive LLDP Protocol Data Units (PDUs).

#### Default Setting

tx-rx

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp admin-status rx-only
Console(config-if)#
```

**lldp basic-tlv management-ip-address** This command configures an LLDP-enabled port to advertise the management address for this device. Use the **no** form to disable this feature.

#### Syntax

**[no] lldp basic-tlv management-ip-address**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.
- ◆ The management address TLV may also include information about the specific interface associated with this address, and an object identifier indicating the type of hardware component or protocol entity associated with this address. The interface number and OID are included to assist SNMP applications to perform network discovery by indicating enterprise specific or other starting points for the search, such as the Interface or Entity MIB.

- ◆ Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV.
- ◆ Every management address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv management-ip-address
Console(config-if)#
```

**lldp basic-tlv port-description** This command configures an LLDP-enabled port to advertise its port description. Use the **no** form to disable this feature.

### Syntax

**[no] lldp basic-tlv port-description**

### Default Setting

Enabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

The port description is taken from the ifDescr object in RFC 2863, which includes information about the manufacturer, the product name, and the version of the interface hardware/software.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv port-description
Console(config-if)#
```

**lldp basic-tlv system-capabilities** This command configures an LLDP-enabled port to advertise its system capabilities. Use the **no** form to disable this feature.

### Syntax

**[no] lldp basic-tlv system-capabilities**

### Default Setting

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

The system capabilities identifies the primary function(s) of the system and whether or not these primary functions are enabled. The information advertised by this TLV is described in IEEE 802.1AB.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-capabilities
Console(config-if)#
```

**lldp basic-tlv system-description** This command configures an LLDP-enabled port to advertise the system description. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp basic-tlv system-description**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

The system description is taken from the sysDescr object in RFC 3418, which includes the full name and version identification of the system's hardware type, software operating system, and networking software.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-description
Console(config-if)#
```

**lldp basic-tlv system-name** This command configures an LLDP-enabled port to advertise the system name. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp basic-tlv system-name**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

The system name is taken from the sysName object in RFC 3418, which contains the system's administratively assigned name, and is in turn based on the [hostname](#) command.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-name
Console(config-if)#
```

**lldp dot1-tlv proto-ident** This command configures an LLDP-enabled port to advertise the supported protocols. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp dot1-tlv proto-ident**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

This option advertises the protocols that are accessible through this interface.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv proto-ident
Console(config-if)#
```

**lldp dot1-tlv proto-vid** This command configures an LLDP-enabled port to advertise port-based protocol VLAN information. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp dot1-tlv proto-vid**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

This option advertises the port-based protocol VLANs configured on this interface (see [“Configuring Protocol-based VLANs” on page 596](#)).

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv proto-vid
Console(config-if)#
```

**lldp dot1-tlv pvid** This command configures an LLDP-enabled port to advertise its default VLAN ID. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp dot1-tlv pvid**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

The port's default VLAN identifier (PVID) indicates the VLAN with which untagged or priority-tagged frames are associated (see the [switchport native vlan](#) command).

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv pvid
Console(config-if)#
```

**lldp dot1-tlv vlan-name** This command configures an LLDP-enabled port to advertise its VLAN name. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp dot1-tlv vlan-name**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

This option advertises the name of all VLANs to which this interface has been assigned. See [“switchport allowed vlan” on page 577](#) and [“protocol-vlan protocol-group \(Configuring Interfaces\)” on page 598](#).

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot1-tlv vlan-name
Console(config-if)#
```

**lldp dot3-tlv link-agg** This command configures an LLDP-enabled port to advertise link aggregation capabilities. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp dot3-tlv link-agg**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

This option advertises link aggregation capabilities, aggregation status of the link, and the 802.3 aggregated port identifier if this interface is currently a link aggregation member.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot3-tlv link-agg
Console(config-if)#
```

**lldp dot3-tlv mac-phy** This command configures an LLDP-enabled port to advertise its MAC and physical layer capabilities. Use the **no** form to disable this feature.

**Syntax**

**[no] lldp dot3-tlv mac-phy**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)



### Command Usage

This option advertises MAC/PHY configuration/status which includes information about auto-negotiation support/capabilities, and operational Multistation Access Unit (MAU) type.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot3-tlv mac-phy
Console(config-if)#
```

**lldp dot3-tlv max-frame** This command configures an LLDP-enabled port to advertise its maximum frame size. Use the **no** form to disable this feature.

### Syntax

**[no] lldp dot3-tlv max-frame**

### Default Setting

Enabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

Refer to [“Frame Size” on page 131](#) for information on configuring the maximum frame size for this switch.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot3-tlv max-frame
Console(config-if)#
```

**lldp med-location civic-addr** This command configures an LLDP-MED-enabled port to advertise its location identification details. Use the **no** form to restore the default settings.

### Syntax

**lldp med-location civic-addr** [[**country** *country-code*] | [**what** *device-type*] | [*ca-type* *ca-value*]]

**no lldp med-location civic-addr** [[**country**] | [**what**] | [*ca-type*]]

*country-code* – The two-letter ISO 3166 country code in capital ASCII letters. (Example: DK, DE or US)

*device-type* – The type of device to which the location applies.

0 – Location of DHCP server.

1 – Location of network element closest to client.

2 – Location of client.

*ca-type* – A one-octet descriptor of the data civic address value. (Range: 0-255)

*ca-value* – Description of a location. (Range: 1-32 characters)

### Default Setting

Not advertised

No description

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ Use this command without any keywords to advertise location identification details.
- ◆ Use the *ca-type* to advertise the physical location of the device, that is the city, street number, building and room information. The address location is specified as a type and value pair, with the civic address (CA) type being defined in RFC 4776. The following table describes some of the CA type numbers and provides examples.

**Table 154: LLDP MED Location CA Types**

CA Type	Description	CA Value Example
1	National subdivisions (state, canton, province)	California
2	County, parish	Orange
3	City, township	Irvine
4	City division, borough, city district	West Irvine
5	Neighborhood, block	Riverside

Table 154: LLDP MED Location CA Types (Continued)

CA Type	Description	CA Value Example
6	Group of streets below the neighborhood level	Exchange
18	Street suffix or type	Avenue
19	House number	320
20	House number suffix	A
21	Landmark or vanity address	Tech Center
26	Unit (apartment, suite)	Apt 519
27	Floor	5
28	Room	509B

Any number of CA type and value pairs can be specified for the civic address location, as long as the total does not exceed 250 characters.

- ◆ For the location options defined for *device-type*, normally option **2** is used to specify the location of the client device. In situations where the client device location is not known, **0** and **1** can be used, providing the client device is physically close to the DHCP server or network element.

### Example

The following example enables advertising location identification details.

```

Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-location civic-addr
Console(config-if)#lldp med-location civic-addr 1 California
Console(config-if)#lldp med-location civic-addr 2 Orange
Console(config-if)#lldp med-location civic-addr 3 Irvine
Console(config-if)#lldp med-location civic-addr 4 West Irvine
Console(config-if)#lldp med-location civic-addr 6 Exchange
Console(config-if)#lldp med-location civic-addr 18 Avenue
Console(config-if)#lldp med-location civic-addr 19 320
Console(config-if)#lldp med-location civic-addr 27 5
Console(config-if)#lldp med-location civic-addr 28 509B
Console(config-if)#lldp med-location civic-addr country US
Console(config-if)#lldp med-location civic-addr what 2
Console(config-if)#

```

**lldp med-notification** This command enables the transmission of SNMP trap notifications about LLDP-MED changes. Use the **no** form to disable LLDP-MED notifications.

### Syntax

**[no] lldp med-notification**

### Default Setting

Disabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

- ◆ This option sends out SNMP trap notifications to designated target stations at the interval specified by the `lldp notification-interval` command. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), the LLDP-MED MIB (ANSI/TIA 1057), or organization-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.
- ◆ SNMP trap destinations are defined using the `snmp-server host` command.
- ◆ Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of `lldpStatsRemTableLastChangeTime` to detect any `lldpRemTablesChange` notification-events missed due to throttling or transmission loss.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-notification
Console(config-if)#
```

**lldp med-tlv inventory** This command configures an LLDP-MED-enabled port to advertise its inventory identification details. Use the **no** form to disable this feature.

**Syntax****[no] lldp med-tlv inventory****Default Setting**

Enabled

**Command Mode**

Interface Configuration (Ethernet, Port Channel)

**Command Usage**

This option advertises device details useful for inventory management, such as manufacturer, model, software version and other pertinent information.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp med-tlv inventory
Console(config-if)#
```

**lldp med-tlv location** This command configures an LLDP-MED-enabled port to advertise its location identification details. Use the **no** form to disable this feature.

#### Syntax

**[no] lldp med-tlv location**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

This option advertises location identification details.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv location
Console(config-if)#
```

**lldp med-tlv med-cap** This command configures an LLDP-MED-enabled port to advertise its Media Endpoint Device capabilities. Use the **no** form to disable this feature.

#### Syntax

**[no] lldp med-tlv med-cap**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

This option advertises LLDP-MED TLV capabilities, allowing Media Endpoint and Connectivity Devices to efficiently discover which LLDP-MED related TLVs are supported on the switch.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv med-cap
Console(config-if)#
```

**lldp med-tlv network-policy** This command configures an LLDP-MED-enabled port to advertise its network policy configuration. Use the **no** form to disable this feature.

#### Syntax

**[no] lldp med-tlv network-policy**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

This option advertises network policy configuration information, aiding in the discovery and diagnosis of VLAN configuration mismatches on a port. Improper network policy configurations frequently result in voice quality degradation or complete service disruption.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv network-policy
Console(config-if)#
```

**lldp notification** This command enables the transmission of SNMP trap notifications about LLDP changes. Use the **no** form to disable LLDP notifications.

#### Syntax

**[no] lldp notification**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ This option sends out SNMP trap notifications to designated target stations at the interval specified by the [lldp notification-interval](#) command. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), or organization-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.
- ◆ SNMP trap destinations are defined using the [snmp-server host](#) command.
- ◆ Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should

therefore periodically check the value of `lldpStatsRemTableLastChangeTime` to detect any `lldpRemTablesChange` notification-events missed due to throttling or transmission loss.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp notification
Console(config-if)#
```

**show lldp config** This command shows LLDP configuration settings for all ports.

### Syntax

**show lldp config** [**detail** *interface*]

**detail** - Shows configuration summary.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Command Mode

Privileged Exec

### Example

The following example shows all basic LLDP parameters are enabled on Port 1.

```
Console#show lldp config

LLDP Global Configuration

LLDP Enabled                : Yes
LLDP Transmit Interval     : 30 seconds
LLDP Hold Time Multiplier  : 4
LLDP Delay Interval        : 2 seconds
LLDP Re-initialization Delay : 2 seconds
LLDP Notification Interval : 5 seconds
LLDP MED Fast Start Count  : 4

LLDP Port Configuration
Port      Admin Status Notification Enabled
-----
Eth 1/1   Tx-Rx          True
Eth 1/2   Tx-Rx          True
Eth 1/3   Tx-Rx          True
Eth 1/4   Tx-Rx          True
Eth 1/5   Tx-Rx          True
.
.
```

```

Console#show lldp config detail ethernet 1/1
LLDP Port Configuration Detail
Port                               : Eth 1/1
Admin Status                       : Tx-Rx
Notification Enabled               : True
Basic TLVs Advertised              : port-description
                                   system-name
                                   system-description
                                   system-capabilities
                                   management-ip-address

802.1 specific TLVs Advertised : port-vid
                                   vlan-name
                                   proto-vlan
                                   proto-ident

802.3 specific TLVs Advertised : mac-phy
                                   link-agg
                                   max-frame

MED Notification Status            : Enabled
MED Enabled TLVs Advertised        : med-cap
                                   network-policy
                                   location
                                   ext-poe
                                   inventory

MED Location Identification:
Location Data Format : Civic Address LCI
Civic Address Status : Enabled
Country Name        : US
What                 : 2
CA-Type              : 1
CA-Value             : Alabama
CA-Type              : 2
CA-Value             : Tuscaloosa

Console#

```

**show lldp info local-device** This command shows LLDP global and interface-specific configuration settings for this device.

### Syntax

**show lldp info local-device** [**detail** *interface*]

**detail** - Shows configuration summary.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Command Mode

Privileged Exec



## Example

```

Console#show lldp info local-device
LLDP Local Global Information
Chassis Type : MAC Address
Chassis ID   : 00-01-02-03-04-05
System Name  :
System Description : GTL-2891
System Capabilities Support : Bridge, Router
System Capabilities Enabled : Bridge, Router
Management Address : 192.168.0.101 (IPv4)

LLDP Port Information
Port      PortID Type      PortID      Port Description
-----
Eth 1/1   MAC Address      00-12-CF-DA-FC-E9 Ethernet Port on unit 0, port 1
Eth 1/2   MAC Address      00-12-CF-DA-FC-EA Ethernet Port on unit 0, port 2
Eth 1/3   MAC Address      00-12-CF-DA-FC-EB Ethernet Port on unit 0, port 3
Eth 1/4   MAC Address      00-12-CF-DA-FC-EC Ethernet Port on unit 0, port 4
.
.
Console#show lldp info local-device detail ethernet 1/1
LLDP Local Port Information Detail
Port          : Eth 1/1
Port ID Type  : MAC Address
Port ID       : 00-12-CF-DA-FC-E9
Port Description : Ethernet Port on unit 1, port 1
MED Capability : LLDP-MED Capabilities
                  Network Policy
                  Location Identification
                  Inventory

Console#

```

**show lldp info remote-device** This command shows LLDP global and interface-specific configuration settings for remote devices attached to an LLDP-enabled port.

## Syntax

**show lldp info remote-device** [**detail** *interface*]

**detail** - Shows detailed information.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

## Command Mode

Privileged Exec

**Example**

Note that an IP phone or other end-node device which advertises LLDP-MED capabilities must be connected to the switch for information to be displayed in the “LLDP-MED Capability” and other related fields.

```
Console#show lldp info remote-device
LLDP Remote Devices Information
  Interface Chassis ID          Port ID          System Name
  -----
Eth 1/1    00-E0-0C-00-00-FD 00-E0-0C-00-01-02
```

```
Console#show lldp info remote-device detail ethernet 1/1
LLDP Remote Devices Information Detail
```

```
-----
Index           : 2
Chassis Type    : MAC Address
Chassis ID     : 70-72-CF-91-1C-B2
Port ID Type    : MAC Address
Port ID        : 70-72-CF-91-1C-B4
Time To Live    : 120 seconds
Port Description : Ethernet Port on unit 1, port 2
System Description : GTL-2891
System Capabilities : Bridge, Router
Enabled Capabilities : Bridge, Router
```

```
Management Address : 192.168.0.4 (IPv4)
```

```
Port VLAN ID : 1
```

```
Port and Protocol VLAN ID : supported, disabled
```

```
VLAN Name : VLAN 1 - DefaultVlan
```

```
Protocol Identity (Hex) : 88-CC
```

```
MAC/PHY Configuration/Status
```

```
Port Auto-neg Supported : Yes
Port Auto-neg Enabled   : Yes
Port Auto-neg Advertised Cap (Hex) : 6C00
Port MAU Type           : 16
```

```
Power via MDI
```

```
Power Class : PSE
Power MDI Supported : Yes
Power MDI Enabled : Yes
Power Pair Controllable : No
Power Pairs : Spare
Power Classification : Class 1
```

```
Link Aggregation
```

```
Link Aggregation Capable : Yes
Link Aggregation Enable : No
Link Aggregation Port ID : 0
```

```
Max Frame Size : 1522
```

```
Console#
```

The following example shows information which is displayed for end-node device which advertises LLDP-MED TLVs.

```
...
LLDP-MED Capability :
  Device Class                : Network Connectivity
  Supported Capabilities      : LLDP-MED Capabilities
                              Network Policy
                              Location Identification
                              Extended Power via MDI - PSE
                              Inventory
  Current Capabilities        : LLDP-MED Capabilities
                              Location Identification
                              Extended Power via MDI - PSE
                              Inventory

Location Identification :
  Location Data Format       : Civic Address LCI
  Country Name              : TW
  What                      : 2
Extended Power via MDI :
  Power Type                : PSE
  Power Source              : Unknown
  Power Priority            : Unknown
  Power Value               : 0 Watts
Inventory :
  Hardware Revision         : R0A
  Firmware Revision        : 1.2.6.0
  Software Revision        : 1.2.6.0
  Serial Number            : S123456
  Manufacture Name         : Prye
  Model Name               : VP101
  Asset ID                 : 340937
Console#
```

**show lldp info statistics** This command shows statistics based on traffic received through all attached LLDP-enabled interfaces.

### Syntax

**show lldp info statistics** [**detail** *interface*]

**detail** - Shows configuration summary.

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Command Mode

Privileged Exec

**Example**

```

Console#show lldp info statistics
LLDP Global Statistics
Neighbor Entries List Last Updated : 485 seconds
New Neighbor Entries Count         : 2
Neighbor Entries Deleted Count     : 1
Neighbor Entries Dropped Count     : 0
Neighbor Entries Ageout Count      : 1

LLDP Port Statistics
Port      NumFramesRecvd NumFramesSent NumFramesDiscarded
-----
Eth 1/1      12          12          0
Eth 1/2      17          17          0
Eth 1/3       0           0           0
Eth 1/4       0           0           0
Eth 1/5       0           0           0
:
Console#show lldp info statistics detail ethernet 1/1
LLDP Port Statistics Detail
Port Name      : Eth 1/1
Frames Discarded : 0
Frames Invalid  : 0
Frames Received : 12
Frames Sent     : 12
TLVs Unrecognized : 0
TLVs Discarded  : 0
Neighbor Ageouts : 1
Console#

```

## CFM Commands

Connectivity Fault Management (CFM) is an OAM protocol that includes proactive connectivity monitoring using continuity check messages, fault verification through loop back messages, and fault isolation by examining end-to-end connections between provider edge devices or between customer edge devices.

CFM is implemented as a service level protocol based on service instances which encompass only that portion of the metropolitan area network supporting a specific customer. CFM can also provide controlled management access to a hierarchy of maintenance domains (such as the customer, service provider, and equipment operator).

The following list of commands support functions for defining the CFM structure, including domains, maintenance associations, and maintenance access points. It also provides commands for fault detection through continuity check messages for all known maintenance points, and cross-check messages for statically configured maintenance points located on other devices. Fault verification is supported through loop back messages, and fault isolation through link trace messages. Fault notification is also provided by SNMP alarms which are automatically generated by maintenance points when connectivity faults or configuration errors are detected in the local maintenance domain.

**Table 155: CFM Commands**

Command	Function	Mode
<i>Defining CFM Structures</i>		
<code>ethernet cfm ais level</code>	Configures the maintenance level at which Alarm Indication Signal information will be sent	GC
<code>ethernet cfm ais ma</code>	Enables the MEPs within the specified MA to send frames with AIS information	GC
<code>ethernet cfm ais period</code>	Configures the interval at which AIS information is sent	GC
<code>ethernet cfm ais suppress alarm</code>	Suppresses AIS messages following the detection of defect conditions	GC
<code>ethernet cfm domain</code>	Defines a CFM maintenance domain, sets the authorized maintenance level, and enters CFM configuration mode; also specifies the MIP creation method for MAs within this domain	GC
<code>ethernet cfm enable</code>	Enables CFM processing globally on the switch	GC
<code>ma index name</code>	Creates a maintenance association within the current maintenance domain, maps it to a customer service instance, and sets the manner in which MIPs are created for this service instance	CFM

Table 155: CFM Commands (Continued)

Command	Function	Mode
<code>ma index name-format</code>	Specifies the name format for the maintenance association as IEEE 802.1ag character based, or ITU-T SG13/SG15 Y.1731 defined ICC-based format	CFM
<code>ethernet cfm mep</code>	Sets an interface as a domain boundary, defines it as a maintenance end point (MEP), and sets direction of the MEP in regard to sending and receiving CFM messages	IC
<code>ethernet cfm port-enable</code>	Enables CFM processing on an interface	IC
<code>clear ethernet cfm ais mpid</code>	Clears AIS defect information for the specified MEP	PE
<code>show ethernet cfm configuration</code>	Displays CFM configuration settings, including global settings, SNMP traps, and interface settings	PE
<code>show ethernet cfm md</code>	Displays configured maintenance domains	PE
<code>show ethernet cfm ma</code>	Displays configured maintenance associations	PE
<code>show ethernet cfm maintenance-points local</code>	Displays maintenance points configured on this device	PE
<code>show ethernet cfm maintenance-points local detail mep</code>	Displays detailed CFM information about a specified local MEP in the continuity check database	PE
<code>show ethernet cfm maintenance-points remote detail</code>	Displays detailed CFM information about a specified remote MEP in the continuity check database	PE
<i>Continuity Check Operations</i>		
<code>ethernet cfm cc ma interval</code>	Sets the transmission delay between continuity check messages	GC
<code>ethernet cfm cc enable</code>	Enables transmission of continuity check messages within a specified maintenance association	GC
<code>snmp-server enable traps ethernet cfm cc</code>	Enables SNMP traps for CFM continuity check events	GC
<code>mep archive-hold-time</code>	Sets the time that data from a missing MEP is kept in the continuity check database before being purged	CFM
<code>clear ethernet cfm maintenance-points remote</code>	Clears the contents of the continuity check database	PE
<code>clear ethernet cfm errors</code>	Clears continuity check errors logged for the specified maintenance domain and maintenance level	PE
<code>show ethernet cfm errors</code>	Displays CFM continuity check errors logged on this device	PE
<i>Cross Check Operations</i>		
<code>ethernet cfm mep crosscheck start-delay</code>	Sets the maximum delay that a device waits for remote MEPs to come up before starting the cross-check operation	GC
<code>snmp-server enable traps ethernet cfm crosscheck</code>	Enables SNMP traps for CFM continuity check events, in relation to the cross-check operations between statically configured MEPs and those learned via continuity check messages	GC
<code>mep crosscheck mpid</code>	Statically defines a remote MEP in a maintenance association	CFM

Table 155: CFM Commands (Continued)

Command	Function	Mode
<code>ethernet cfm mep crosscheck</code>	Enables cross-checking between the list of configured remote MEPs within a maintenance association and MEPs learned through continuity check messages	PE
<code>show ethernet cfm maintenance-points remote crosscheck</code>	Displays information about remote maintenance points configured statically in a cross-check list	PE
<i>Link Trace Operations</i>		
<code>ethernet cfm linktrace cache</code>	Enables caching of CFM data learned through link trace messages	GC
<code>ethernet cfm linktrace cache hold-time</code>	Sets the hold time for CFM link trace cache entries	GC
<code>ethernet cfm linktrace cache size</code>	Sets the maximum size for the link trace cache	GC
<code>ethernet cfm linktrace</code>	Sends CFM link trace messages to the MAC address for a MEP	PE
<code>clear ethernet cfm linktrace-cache</code>	Clears link trace messages logged on this device	PE
<code>show ethernet cfm linktrace-cache</code>	Displays the contents of the link trace cache	PE
<i>Loopback Operations</i>		
<code>ethernet cfm loopback</code>	Sends CFM loopback messages to a MAC address for a MEP or MIP	PE
<i>Fault Generator Operations</i>		
<code>mep fault-notify alarm-time</code>	Sets the time a defect must exist before a fault alarm is issued	CFM
<code>mep fault-notify lowest-priority</code>	Sets the lowest priority defect that is allowed to generate a fault alarm	CFM
<code>mep fault-notify reset-time</code>	Configures the time after a fault alarm has been issued, and no defect exists, before another fault alarm can be issued	CFM
<code>show ethernet cfm fault-notify-generator</code>	Displays configuration settings for the fault notification generator	PE
<i>Delay Measure Operations</i>		
<code>ethernet cfm delay-measure two-way</code>	Sends periodic delay-measure requests to a specified MEP within a maintenance association	PE

*Basic Configuration Steps for CFM*

1. Configure the maintenance domains with the `ethernet cfm domain` command.
2. Configure the maintenance associations with the `ma index name` command.
3. Configure the local maintenance end points (MEPs) which will serve as the domain service access points for the specified maintenance association using the `ethernet cfm mep` command.

4. Enter a static list of MEPs assigned to other devices within the same maintenance association using the `mep crosscheck mpid` command. This allows CFM to automatically verify the functionality of these remote end points by cross-checking the static list configured on this device against information learned through continuity check messages.
5. Enable CFM globally on the switch with the `ethernet cfm enable` command.
6. Enable CFM on the local MEPs with the `ethernet cfm port-enable` command.
7. Enable continuity check operations with the `ethernet cfm cc enable` command.
8. Enable cross-check operations with the `ethernet cfm mep crosscheck` command.

Other configuration changes may be required for your particular environment, such as adjusting the interval at which continuity check messages are sent ([page 817](#)), or setting the start-up delay for the cross-check operation ([page 823](#)). You can also enable SNMP traps for events discovered by continuity check messages ([page 819](#)) or cross-check messages ([page 823](#)).

## Defining CFM Structures

**ethernet cfm ais level** This command configures the maintenance level at which Alarm Indication Signal (AIS) information will be sent within the specified MA. Use the **no** form restore the default setting.

### Syntax

**ethernet cfm ais level** *level-id* **md** *domain-name* **ma** *ma-name*

**no ethernet cfm ais level md** *domain-name* **ma** *ma-name*

*level-id* – Maintenance level at which AIS information will be sent.  
(Range: 0-7)

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

### Default Setting

Level 0

### Command Mode

Global Configuration

### Command Usage

The configured AIS level must be higher than the maintenance level of the domain containing the specified MA.



### Example

This example sets the maintenance level for sending AIS messages within the specified MA.

```
Console(config)#ethernet cfm ais level 4 md voip ma rd
Console(config)#
```

**ethernet cfm ais ma** This command enables the MEPs within the specified MA to send frames with AIS information following detection of defect conditions. Use the **no** form to disable this feature.

### Syntax

**[no] ethernet cfm ais md** *domain-name* **ma** *ma-name*

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name<sup>14</sup>. (Range: 1-43 alphanumeric characters)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Each MA name must be unique within the CFM domain.
- ◆ Frames with AIS information can be issued at the client's maintenance level by a MEP upon detecting defect conditions. For example, defect conditions may include:
  - Signal failure conditions if continuity checks are enabled.
  - AIS condition or LCK condition if continuity checks are disabled.
- ◆ A MEP continues to transmit periodic frames with AIS information until the defect condition is removed.

### Example

This example enables the MEPs within the specified MA to send frames with AIS information.

```
Console(config)#ethernet cfm ais md voip ma rd
Console(config)#
```

<sup>14</sup>. The total length of the MD name and MA name cannot exceed 44 characters.

**ethernet cfm ais period** This command configures the interval at which AIS information is sent. Use the **no** form to restore the default setting.

#### Syntax

**ethernet cfm ais period** *period* **md** *domain-name* **ma** *ma-name*

**no ethernet cfm ais period md** *domain-name* **ma** *ma-name*

*period* – The interval at which AIS information is sent.  
(Options: 1 second, 60 seconds)

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

#### Default Setting

1 second

#### Command Mode

Global Configuration

#### Example

This example sets the interval for sending frames with AIS information at 60 seconds.

```
Console(config)#ethernet cfm ais period 60 md voip ma rd
Console(config)#
```

**ethernet cfm ais suppress alarm** This command suppresses sending frames containing AIS information following the detection of defect conditions. Use the **no** form to restore the default setting.

#### Syntax

**[no] ethernet cfm ais suppress alarm md** *domain-name* **ma** *ma-name*

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

#### Default Setting

Suppression is disabled

#### Command Mode

Global Configuration

#### Command Usage

- ◆ For multipoint connectivity, a MEP cannot determine the specific maintenance level entity that has encountered defect conditions upon receiving a frame

with AIS information. More importantly, it cannot determine the associated subset of its peer MEPs for which it should suppress alarms since the received AIS information does not contain that information. Therefore, upon reception of a frame with AIS information, the MEP will suppress alarms for all peer MEPs whether there is still connectivity or not.

- ◆ However, for a point-to-point connection, a MEP has only a single peer MEP for which to suppress alarms when it receives frames with AIS information.
- ◆ If suppression is enabled by this command, upon receiving a frame with AIS information, a MEP detects an AIS condition and suppresses loss of continuity alarms associated with all its peer MEPs. A MEP resumes loss of continuity alarm generation upon detecting loss of continuity defect conditions in the absence of AIS messages.

### Example

This example suppresses sending frames with AIS information.

```
Console(config)#ethernet cfm ais suppress alarm md voip ma rd
Console(config)#
```

**ethernet cfm domain** This command defines a CFM maintenance domain, sets the authorized maintenance level, and enters CFM configuration mode. Use the **no** form to delete a CFM maintenance domain.

### Syntax

**ethernet cfm domain index** *index* **name** *domain-name* **level** *level-id*  
[**mip-creation** *type*]

**no ethernet cfm domain index** *index*

*index* – Domain index. (Range: 1-65535)

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*level-id* – Authorized maintenance level for this domain. (Range: 0-7)

*type* – Specifies the CFM protocol's creation method for maintenance intermediate points (MIPs) in this domain:

**default** – MIPs can be created for any maintenance association (MA) configured in this domain on any bridge port through which the MA's VID can pass.

**explicit** – MIPs can be created for any MA configured in this domain only on bridge ports through which the MA's VID can pass, and only if a maintenance end point (MEP) is created at some lower MA Level.

**none** – No MIP can be created for any MA configured in this domain.

### Default Setting

No maintenance domains are configured.

No MIPs are created for any MA in the specified domain.

### Command Mode

Global Configuration

### Command Usage

- ◆ A domain can only be configured with one name.
- ◆ Where domains are nested, an upper-level hierarchical domain must have a higher maintenance level than the ones it encompasses. The higher to lower level domain types commonly include entities such as customer, service provider, and operator.
- ◆ More than one domain can be configured at the same maintenance level, but a single domain can only be configured with one maintenance level.
- ◆ If MEPs or MAs are configured for a domain using the [ethernet cfm mep](#) command or [ma index name](#) command, they must first be removed before you can remove the domain.
- ◆ Maintenance domains are designed to provide a transparent method of verifying and resolving connectivity problems for end-to-end connections. By default, these connections run between the domain service access points (DSAPs) within each MA defined for a domain, and are manually configured using the [ethernet cfm mep](#) command.

In contrast, MIPs are interconnection points that make up all possible paths between the DSAPs within an MA. MIPs are automatically generated by the CFM protocol when the *mip-creation* option in this command is set to “default” or “explicit,” and the MIP creation state machine is invoked (as defined in IEEE 802.1ag). The default option allows MIPs to be created for all interconnection points within an MA, regardless of the domain’s level in the maintenance hierarchy (e.g., customer, provider, or operator). While the explicit option only generates MIPs within an MA if its associated domain is not at the bottom of the maintenance hierarchy. This option is used to hide the structure of network at the lowest domain level.

The diagnostic functions provided by CFM can be used to detect connectivity failures between any pair of MEPs in an MA. Using MIPs allows these failures to be isolated to smaller segments of the network.

Allowing the CFM to generate MIPs exposes more of the network structure to users at higher domain levels, but can speed up the process of fault detection and recovery. This trade-off should be carefully considered when designing a CFM maintenance structure.

Also note that while MEPs are active agents which can initiate consistency check messages (CCMs), transmit loop back or link trace messages, and maintain the local CCM database. MIPs, on the other hand are passive agents

which can only validate received CFM messages, and respond to loop back and link trace messages.

The MIP creation method defined by the [ma index name](#) command takes precedence over the method defined by this command.

### Example

This example creates a maintenance domain set to maintenance level 3, and enters CFM configuration mode for this domain.

```
Console(config)#ethernet cfm domain index 1 name voip level 3 mip-creation  
explicit  
Console(config-ether-cfm)#
```

### Related Commands

[ma index name \(806\)](#)

**ethernet cfm enable** This command enables CFM processing globally on the switch. Use the **no** form to disable CFM processing globally.

### Syntax

**[no] ethernet cfm enable**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ To avoid generating an excessive number of traps, the complete CFM maintenance structure and process parameters should be configured prior to globally enabling CFM processing with this command. Specifically, the maintenance domains, maintenance associations, and MEPs should be configured on each participating bridge.
- ◆ When CFM is enabled, hardware resources are allocated for CFM processing.

### Example

This example enables CFM globally on the switch.

```
Console(config)#ethernet cfm enable  
Console(config)#
```

**ma index name** This command creates a maintenance association (MA) within the current maintenance domain, maps it to a customer service instance (S-VLAN), and sets the manner in which MIPs are created for this service instance. Use the **no** form with the **vlan** keyword to remove the S-VLAN from the specified MA. Or use the **no** form with only the **index** keyword to remove the MA from the current domain.

### Syntax

**ma index** *index* **name** *ma-name* [**vlan** *vlan-list* [**mip-creation** *type*]]

**no ma index** *index* [**vlan** *vlan-list*]

*index* – MA identifier. (Range: 1-2147483647)

*ma-name* – MA name. (Range: 1-43 alphanumeric characters)

*vlan-list* - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094).

*type* – Specifies the CFM protocol's creation method for maintenance intermediate points (MIPs) in this MA:

**default** – MIPs can be created for this MA on any bridge port through which the MA's VID can pass.

**explicit** – MIPs can be created this MA only on bridge ports through which the MA's VID can pass, and only if a maintenance end point (MEP) is created at some lower MA Level.

**none** – No MIP can be created for this MA.

### Default Setting

10 seconds

### Command Mode

CFM Domain Configuration

### Command Usage

- ◆ The maintenance domain used to enter CFM domain configuration mode, the MA name and VLAN identifier specified by this command, and the DSAPs configured with the [mep crosscheck mpid](#) command create a unique service instance for each customer.
- ◆ If only the MA index and name are entered for this command, the MA will be recorded in the domain database, but will not function. No MEPs can be created until the MA is associated with a service VLAN.
- ◆ Note that multiple domains at the same maintenance level (see the [ethernet cfm domain](#) command) cannot have an MA on the same VLAN. Also, each MA name must be unique within the CFM-managed network.
- ◆ The first VLAN entered in the list by this command is the primary VLAN, and is the VLAN on which all CFM functions are executed.

- ◆ Before removing an MA, first remove all the MEPs configured for it (see the [mep crosscheck mpid](#) command).
- ◆ If the MIP creation method is not defined by this command, the creation method defined by the [ethernet cfm domain](#) command is applied to this MA. For a detailed description of the MIP types, refer to the Command Usage section under the [ethernet cfm domain](#) command.

### Example

This example creates a maintenance association, binds it to VLAN 1, and allows MIPs to be created within this MA using the default method.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#ma index 1 name rd vlan 1 mip-creation default
Console(config-ether-cfm)#
```

**ma index name-format** This command specifies the name format for the maintenance association as IEEE 802.1ag character based, or ITU-T SG13/SG15 Y.1731 defined ICC-based format. Use the **no** form to restore the default setting.

### Syntax

**ma index** *index* **name-format** {**character-string** | **icc-based**}

**no ma index** *index* **name-format**

*index* – MA identifier. (Range: 1-2147483647)

**character-string** – IEEE 802.1ag defined character string format. This is an IETF RFC 2579 DisplayString.

**icc-based** – ITU-T SG13/SG15 Y.1731 defined ICC based format.

### Default Setting

character-string

### Command Mode

CFM Domain Configuration

### Example

This example specifies the name format as character string.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#ma index 1 name-format character-string
Console(config-ether-cfm)#
```

**ethernet cfm mep** This command sets an interface as a domain boundary, defines it as a maintenance end point (MEP), and sets direction of the MEP in regard to sending and receiving CFM messages. Use the **no** form to delete a MEP.

### Syntax

**ethernet cfm mep mpid** *mpid* **md** *domain-name* **ma** *ma-name* [**up**]

**no ethernet cfm mep mpid** *mpid* **ma** *ma-name*

*mpid* – Maintenance end point identifier. (Range: 1-8191)

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

**up** – Indicates that the MEP faces inward toward the switch cross-connect matrix, and transmits CFM messages towards, and receives them from, the direction of the internal bridge relay mechanism. If the **up** keyword is not included in this command, then the MEP is facing away from the switch, and transmits CFM messages towards, and receives them from, the direction of the physical medium.

### Default Setting

No MEPs are configured.

The MEP faces outward (down).

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ CFM elements must be configured in the following order: (1) maintenance domain at the same level as the MEP to be configured (using the **ethernet cfm domain** command), (2) maintenance association within the domain (using the **ma index name** command), and (3) finally the MEP using this command.
- ◆ An interface may belong to more than one domain. This command can be used to configure an interface as a MEP for different MAs in different domains.
- ◆ To change the MEP's MA or the direction it faces, first delete the MEP, and then create a new one.

### Example

This example sets port 1 as a DSAP for the specified maintenance association.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ethernet cfm mep mpid 1 md voip ma rd
Console(config-if)#
```



**ethernet cfm port-enable** This command enables CFM processing on an interface. Use the **no** form to disable CFM processing on an interface.

#### Syntax

**[no] ethernet cfm port-enable**

#### Default Setting

Enabled

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ An interface must be enabled before a MEP can be created with the **ethernet cfm mep** command.
- ◆ If a MEP has been configured on an interface with the **ethernet cfm mep** command, it must first be deleted before CFM can be disabled on that interface.
- ◆ When CFM is disabled, hardware resources previously used for CFM processing on that interface are released, and all CFM frames entering that interface are forwarded as normal data traffic.

#### Example

This example enables CFM on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ethernet cfm port-enable
Console(config-if)#
```

**clear ethernet cfm ais mpid** This command clears AIS defect information for the specified MEP.

#### Syntax

**clear ethernet cfm ais mpid mpid md domain-name ma ma-name**

*mpid* – Maintenance end point identifier. (Range: 1-8191)

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

#### Default Setting

None

#### Command Mode

Privileged Exec

### Command Usage

This command can be used to clear AIS defect entries if a MEP does not exit the AIS state when all errors are resolved.

### Example

This example clears AIS defect entries on port 1.

```
Console#clear ethernet cfm ais mpid 1 md voip ma rd
Console(config)#
```

**show ethernet cfm configuration** This command displays CFM configuration settings, including global settings, SNMP traps, and interface settings.

### Syntax

**show ethernet cfm configuration {global | traps | interface *interface*}**

**global** – Displays global settings including CFM global status, cross-check start delay, and link trace parameters.

**traps** – Displays the status of all continuity check and cross-check traps.

**interface** – Displays CFM status for the specified interface.

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

This example shows the global settings for CFM.

```
Console#show ethernet cfm configuration global
CFM Global Status      : Enabled
Crosscheck Start Delay : 10 seconds
Linktrace Cache Status : Enabled
Linktrace Cache Hold Time : 100 minutes
Linktrace Cache Size   : 100 entries
Console#
```

This example shows the configuration status for continuity check and cross-check traps.

```
Console#show ethernet cfm configuration traps
CC MEP Up Trap           :Disabled
CC MEP Down Trap         :Disabled
CC Configure Trap        :Disabled
CC Loop Trap             :Disabled
Cross Check MEP Unknown Trap :Disabled
Cross Check MEP Missing Trap :Disabled
Cross Check MA Up        :Disabled
Console#
```

**Table 156: show ethernet cfm configuration traps - display description**

Field	Description
CC MEP Up Trap	Sends a trap if a remote MEP is discovered and added to the local database, the port state of a previously discovered remote MEP changes, or a CCM is received from a remote MEP which as an expired entry in the archived database.
CC Mep Down Trap	Sends a trap if this device loses connectivity with a remote MEP, or connectivity has been restored to a remote MEP which has recovered from an error condition.
CC Configure Trap	Sends a trap if this device receives a CCM with the same MPID as its own but with a different source MAC address, indicating that a CFM configuration error exists.
CC Loop Trap	Sends a trap if this device receives a CCM with the same source MAC address and MPID as its own, indicating that a forwarding loop exists.
Cross Check MEP Unknown Trap	A CCM is received from a MEP that has not been configured as a DSAP (see the <a href="#">ethernet cfm mep</a> command), manually configured as a remote MEP (see the <a href="#">mep crosscheck mpid</a> command), nor learned through previous CCM messages.
Cross Check MEP Missing Trap	This device failed to receive three consecutive CCMs from another MEP in the same MA.
Cross Check MA Up	Generates a trap when all remote MEPs belonging to an MA come up.

This example shows the CFM status for port 1.

```
Console#show ethernet cfm configuration interface ethernet 1/1
Ethernet 1/1 CFM Status:Enabled
Console#
```

**show ethernet cfm md** This command displays the configured maintenance domains.

#### Syntax

**show ethernet cfm md** [**level** *level*]

*level* – Maintenance level. (Range: 0-7)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

This example shows all configured maintenance domains.

```
Console#show ethernet cfm md
MD Index  MD Name          Level  MIP Creation  Archive Hold Time (m.)
-----
      1   rd              0    default              100
Console#
```

**show ethernet cfm ma** This command displays the configured maintenance associations.

#### Syntax

**show ethernet cfm ma** [**level** *level*]

*level* – Maintenance level. (Range: 0-7)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Command Usage

For a description of the values displayed in the CC Interval field, refer to the [ethernet cfm cc ma interval](#) command.

#### Example

This example shows all configured maintenance associations.

```
Console#show ethernet cfm ma
MD Name      MA Index MA Name          Primary VID  CC Interval MIP Creation
-----
steve              1   voip              1             4 Default
Console#
```

**show ethernet cfm maintenance-points local** This command displays the maintenance points configured on this device.  
**Syntax**

**show ethernet cfm maintenance-points local**  
**{mep [domain *domain-name* | interface *interface* | level *level-id*] | mip**  
**[domain *domain-name* | level *level-id*]}**

**mep** – Displays only local maintenance end points.  
**mip** – Displays only local maintenance intermediate points.  
*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)  
*interface* – Displays CFM status for the specified interface.

**ethernet *unit/port***  
*unit* - Unit identifier. (Range: 1-8)  
*port* - Port number. (Range: 1-28)

**port-channel *channel-id*** (Range: 1-16)  
*level-id* – Maintenance level for this domain. (Range: 0-7)

**Default Setting**  
None

**Command Mode**  
Privileged Exec

#### Command Usage

- ◆ Use the **mep** keyword with this command to display the MEPs configured on this device as DSAPs through the [ethernet cfm mep](#) command.
- ◆ Using the **mip** keyword with this command to display the MIPs generated on this device by the CFM protocol when the mip-creation method is set to either "default" or "explicit" by the [ethernet cfm domain](#) command or the [ma index name](#) command.

#### Example

This example shows all MEPs configured on this device for maintenance domain rd.

```
Console#show ethernet cfm maintenance-points local mep
MPID MD Name          Level Direct VLAN Port      CC Status MAC Address
-----
1 rd                  0 UP          1 Eth 1/ 1 Enabled  00-12-CF-3A-A8-C0
Console#
```

**show ethernet cfm maintenance-points local detail mep** This command displays detailed CFM information about a local MEP in the continuity check database.

#### Syntax

##### **show ethernet cfm maintenance-points local detail mep**

**[domain *domain-name* | interface *interface* | level *level-id*]**

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*interface* – Displays CFM status for the specified interface.

**ethernet *unit/port***

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel *channel-id*** (Range: 1-16)

*level-id* – Maintenance level for this domain. (Range: 0-7)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

This example shows detailed information about the local MEP on port 1.

```
Console#show ethernet cfm maintenance-points local detail mep interface
ethernet 1/1
MEP Settings:
-----
MPID                : 1
MD Name             : vopu
MA Name             : r&d
MA Name Format       : Character String
Level               : 0
Direction           : Up
Interface           : Eth 1/ 1
CC Status           : Enabled
MAC Address         : 00-E0-0C-00-00-FD
Defect Condition    : No Defect
Received RDI        : False
AIS Status          : Enabled
AIS Period          : 1 seconds
AIS Transmit Level  : Default
Suppress Alarm      : Disabled
Suppressing Alarms  : Disabled

Console#
```

**Table 157: show ethernet cfm maintenance-points local detail mep - display**

Field	Description
MPID	MEP identifier
MD Name	The maintenance domain for this entry.
MA Name	Maintenance association to which this remote MEP belongs
MA Name Format	The format of the Maintenance Association name, including primary VID, character string, unsigned Integer 16, or RFC 2865 VPN ID
Level	Maintenance level of the local maintenance point
Direction	The direction in which the MEP faces on the Bridge port (up or down).
Interface	The port to which this MEP is attached.
CC Status	Shows if the MEP will generate CCM messages.
MAC Address	MAC address of the local maintenance point. (If a CCM for the specified remote MEP has never been received or the local MEP record times out, the address will be set to the initial value of all Fs.)
Defect Condition	Shows the defect detected on the MEP.
Received RDI	Receive status of remote defect indication (RDI) messages on the MEP.
AIS Status	Shows if MEPs within the specified MA are enabled to send frames with AIS information following detection of defect conditions.
AIS Period	The interval at which AIS information is sent.
AIS Transmit Level	The maintenance level at which AIS information will be sent for the specified MEP.
Suppress Alarm	Shows if the specified MEP is configured to suppress sending frames containing AIS information following the detection of defect conditions.
Suppressing Alarms	Shows if the specified MEP is currently suppressing sending frames containing AIS information following the detection of defect conditions.

### show ethernet cfm maintenance-points remote detail

This command displays detailed CFM information about a remote MEP in the continuity check database.

#### Syntax

#### show ethernet cfm maintenance-points remote detail

{**mac** *mac-address* | **mpid** *mpid*}

[**domain** *domain-name* | **level** *level-id* | **ma** *ma-name*]

*mac-address* – MAC address of a remote maintenance point.

This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

*mpid* – Maintenance end point identifier. (Range: 1-8191)

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*level-id* – Authorized maintenance level for this domain. (Range: 0-7)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Use the **mpid** keyword with this command to display information about a specific maintenance point, or use the **mac** keyword to display information about all maintenance points that have the specified MAC address.

### Example

This example shows detailed information about the remote MEP designated by MPID 2.

```
Console#show ethernet cfm maintenance-points remote detail mpid 2
MAC Address           : 00-0D-54-FC-A2-73
Domain/Level          : voip / 3
MA Name                : rd
Primary VLAN           : 1
MPID                   : 2
Incoming Port          : Eth 1/ 2
CC Lifetime            : 645 seconds
Age of Last CC Message : 2 seconds
Frame Loss             : 137
CC Packet Statistics   : 647/1
Port State              : Up
Interface State         : Up
Crosscheck Status      : Enabled

Console#
```

**Table 158: show ethernet cfm maintenance-points remote detail - display**

Field	Description
MAC Address	MAC address of the remote maintenance point. (If a CCM for the specified remote MEP has never been received or the remote MEP record times out, the address will be set to the initial value of all Fs.)
Domain/Level	Maintenance domain and level of the remote maintenance point
MA Name	Maintenance association to which this remote MEP belongs
Primary VLAN	VLAN to which this MEP belongs
MPID	MEP identifier
Incoming Port	Port to which this remote MEP is attached.
CC Lifetime	Length of time to hold messages about this MEP in the CCM database
Age of Last CC Message	Length of time the last CCM message about this MEP has been in the CCM database
Frame Loss	Percentage of transmitted frames lost
CC Packet Statistics (received/error)	The number of CCM packets received successfully and those with errors



**Table 158: show ethernet cfm maintenance-points remote detail - display**

Field	Description
Port State	Port states include: Up – The port is functioning normally. Blocked – The port has been blocked by the Spanning Tree Protocol. No port state – Either no CCM has been received, or no port status TLV was received in the last CCM.
Interface State	Interface states include: No Status – Either no CCM has been received, or no interface status TLV was received in the last CCM. Up – The interface is ready to pass packets. Down – The interface cannot pass packets. Testing – The interface is in some test mode. Unknown – The interface status cannot be determined for some reason. Dormant – The interface is not in a state to pass packets but is in a pending state, waiting for some external event. Not Present – Some component of the interface is missing. isLowerLayerDown – The interface is down due to state of the lower layer interfaces.
Crosscheck Status	Shows if crosscheck function has been enabled.

## Continuity Check Operations

**ethernet cfm cc ma interval** This command sets the transmission delay between continuity check messages (CCMs). Use the **no** form to restore the default settings.

### Syntax

**ethernet cfm cc md** *domain-name* **ma** *ma-name* **interval** *interval-level*

**no ethernet cfm cc ma** *ma-name* **interval**

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

*interval-level* – The transmission delay between connectivity check messages. The setting for this parameter is expressed as levels 4 through 7, which in turn map to specific intervals of time. (CCM interval field options: 4 - 1 second, 5 - 10 seconds, 6 - 1 minute, 7 - 10 minutes)

### Default Setting

4 (1 second)

### Command Mode

Global Configuration

### Command Usage

- ◆ CCMs provide a means to discover other MEPs and to detect connectivity failures in an MA. If any MEP fails to receive three consecutive CCMs from any other MEPs in its MA, a connectivity failure is registered. The interval at which

CCMs are issued should therefore be configured to detect connectivity problems in a timely manner, as dictated by the nature and size of the MA.

- ◆ The maintenance of a MIP CCM database by a MIP presents some difficulty for bridges carrying a large number of Service Instances, and for whose MEPs are issuing CCMs at a high frequency. For this reason, slower CCM transmission rates may have to be used.

### Example

This example sets the transmission delay for continuity check messages to level 7 (60 seconds).

```
Console(config)#ethernet cfm cc md voip ma rd interval 7
Console(config)#
```

### Related Commands

[ethernet cfm cc enable \(818\)](#)

**ethernet cfm cc enable** This command enables the transmission of continuity check messages (CCMs) within a specified maintenance association. Use the **no** form to disable the transmission of these messages.

### Syntax

**[no] ethernet cfm cc enable md** *domain-name* **ma** *ma-name*

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ CCMs are multicast periodically by a MEP in order to discover other MEPs in the same MA, and to assure connectivity to all other MEPs/MIPs in the MA.
- ◆ Each CCM received is checked to verify that the MEP identifier field sent in the message does not match its own MEPID, which would indicate a duplicate MEP or network loop. If these error types are not found, the CCM is stored in the MEP's local database until aged out.
- ◆ If a maintenance point fails to receive three consecutive CCMs from any other MEP in the same MA, a connectivity failure is registered.

- ◆ If a maintenance point receives a CCM with an invalid MEPID or MA level or an MA level lower than its own, a failure is registered which indicates a configuration error or cross-connect error (i.e., overlapping MAs).

### Example

This example enables continuity check messages for the specified maintenance association.

```
Console(config)#ethernet cfm cc enable md voip ma rd
Console(config)#
```

**snmp-server enable traps ethernet cfm cc** This command enables SNMP traps for CFM continuity check events. Use the **no** form to disable these traps.

### Syntax

**[no] snmp-server enable traps ethernet cfm cc [config | loop | mep-down | mep-up]**

**config** – Sends a trap if this device receives a CCM with the same MPID as its own but with a different source MAC address, indicating that a CFM configuration error exists.

**loop** – Sends a trap if this device receives a CCM with the same source MAC address and MPID as its own, indicating that a forwarding loop exists.

**mep-down** – Sends a trap if this device loses connectivity with a remote MEP, or connectivity has been restored to a remote MEP which has recovered from an error condition.

**mep-up** – Sends a trap if a remote MEP is discovered and added to the local database, the port state of a previously discovered remote MEP changes, or a CCM is received from a remote MEP which has an expired entry in the archived database.

### Default Setting

All continuity checks are enabled.

### Command Mode

Global Configuration

### Command Usage

All mep-up traps are suppressed when cross-checking of MEPs is enabled because cross-check traps include more detailed status information.

### Example

This example enables SNMP traps for mep-up events.

```
Console(config)#snmp-server enable traps ethernet cfm cc mep-up
Console(config)#
```

### Related Commands

[ethernet cfm mep crosscheck \(825\)](#)

### mep archive-hold-time

This command sets the time that data from a missing MEP is retained in the continuity check message (CCM) database before being purged. Use the **no** form to restore the default setting.

### Syntax

**mep archive-hold-time** *hold-time*

*hold-time* – The time to retain data for a missing MEP.  
(Range: 1-65535 minutes)

### Default Setting

100 minutes

### Command Mode

CFM Domain Configuration

### Command Usage

A change to the hold time only applies to entries stored in the database after this command is entered.

### Example

This example sets the aging time for missing MEPs in the CCM database to 30 minutes.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep archive-hold-time 30
Console(config-ether-cfm)#
```

### clear ethernet cfm maintenance-points remote

This command clears the contents of the continuity check database.

### Syntax

**clear ethernet cfm maintenance-points remote** [**domain** *domain-name* |  
**level** *level-id*]

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*level-id* – Maintenance level. (Range: 0-7)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Use this command without any keywords to clear all entries in the CCM database. Use the **domain** keyword to clear the CCM database for a specific domain, or the **level** keyword to clear it for a specific maintenance level.

### Example

```
Console#clear ethernet cfm maintenance-points remote domain voip
Console#
```

**clear ethernet cfm errors** This command clears continuity check errors logged for the specified maintenance domain or maintenance level.

### Syntax

**clear ethernet cfm errors** [**domain** *domain-name* | **level** *level-id*]

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*level-id* – Maintenance level. (Range: 0-7)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Use this command without any keywords to clear all entries in the error database. Use the **domain** keyword to clear the error database for a specific domain, or the **level** keyword to clear it for a specific maintenance level.

### Example

```
Console#clear ethernet cfm errors domain voip
Console#
```

**show ethernet cfm errors** This command displays the CFM continuity check errors logged on this device.

#### Syntax

**show ethernet cfm errors** [**domain** *domain-name* | **level** *level-id*]

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*level-id* – Authorized maintenance level for this domain. (Range: 0-7)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#show ethernet cfm errors
Level VLAN MPID Interface Remote MAC Reason MA Name
-----
5      2      40 Eth 1/1 ab.2f.9c.00.05.01 LEAK provider_1_2
Console#
```

**Table 159: show ethernet cfm errors - display description**

Field	Description
Level	Maintenance level associated with this entry.
VLAN	VLAN in which this error occurred.
MPID	Identifier of remote MEP.
Interface	Port at which the error was recorded
Remote MAC	MAC address of remote MEP.
Reason	Error types include:  LEAK – MA x is associated with a specific VID list*, one or more of the VIDs in this MA can pass through the bridge port, no MEP is configured facing outward (down) on any bridge port for this MA, and some other MA y, at a higher maintenance level, and associated with at least one of the VID(s) also in MA x, does have a MEP configured on the bridge port.  VIDS – MA x is associated with a specific VID list* on this MA on the bridge port, and some other MA y, associated with at least one of the VID(s) also in MA x, also has an Up MEP configured facing inward (up) on some bridge port.  EXCESS_LEV – The number of different MD levels at which MIPs are to be created on this port exceeds the bridge's capabilities.  OVERLAP_LEV – A MEP is created for one VID at one maintenance level, but a MEP is configured on another VID at an equivalent or higher level, exceeding the bridge's capabilities.
MA	The maintenance association for this entry.

\* This definition is based on the IEEE 802.1ag standard. Current software for this switch only supports a single VLAN per MA. However, since it may interact with other devices which support multiple VLAN assignments per MA, this error message may be reported.

## Cross Check Operations

**ethernet cfm mep crosscheck start-delay** This command sets the maximum delay that a device waits for remote MEPs to come up before starting the cross-check operation. Use the **no** form to restore the default setting.

### Syntax

**ethernet cfm mep crosscheck start-delay** *delay*

*delay* – The time a device waits for remote MEPs to come up before the cross-check is started. (Range: 1-65535 seconds)

### Default Setting

30 seconds

### Command Mode

Global Configuration

### Command Usage

- ◆ This command sets the delay that a device waits for a remote MEP to come up, and it starts cross-checking the list of statically configured remote MEPs in the local maintenance domain against the MEPs learned through CCMs.
- ◆ The cross-check start delay should be configured to a value greater than or equal to the continuity check message interval to avoid generating unnecessary traps.

### Example

This example sets the maximum delay before starting the cross-check process.

```
Console(config)#ethernet cfm mep crosscheck start-delay 60
Console(config)#
```

**snmp-server enable traps ethernet cfm crosscheck** This command enables SNMP traps for CFM continuity check events, in relation to the cross-check operations between statically configured MEPs and those learned via continuity check messages (CCMs). Use the **no** form to restore/disable these traps.

### Syntax

**[no] snmp-server enable traps ethernet cfm crosscheck** [**ma-up** | **mep-missing** | **mep-unknown**]

**ma-up** – Sends a trap when all remote MEPs in an MA come up.

**mep-missing** – Sends a trap if the cross-check timer expires and no CCMs have been received from a remote MEP configured in the static list.

**mep-unknown** – Sends a trap if an unconfigured MEP comes up.

### Default Setting

All continuity checks are enabled.

### Command Mode

Global Configuration

### Command Usage

- ◆ For this trap type to function, cross-checking must be enabled on the required maintenance associations using the `ethernet cfm mep crosscheck` command.
- ◆ A mep-missing trap is sent if cross-checking is enabled (with the `ethernet cfm mep crosscheck` command), and no CCM is received for a remote MEP configured in the static list (with the `mep crosscheck mpid` command).
- ◆ A mep-unknown trap is sent if cross-checking is enabled, and a CCM is received from a remote MEP that is not configured in the static list.
- ◆ A ma-up trap is sent if cross-checking is enabled, and a CCM is received from all remote MEPs configured in the static list for this maintenance association.

### Example

This example enables SNMP traps for mep-unknown events detected in cross-check operations.

```
Console(config)#snmp-server enable traps ethernet cfm crosscheck mep-unknown
Console(config)#
```

**mep crosscheck mpid** This command statically defines a remote MEP in a maintenance association. Use the **no** form to remove a remote MEP.

### Syntax

**[no] mep crosscheck mpid *mpid* *ma* *ma-name***

*mpid* – Identifier for a maintenance end point which exists on another CFM-enabled device within the same MA. (Range: 1-8191)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

### Default Setting

No remote MEPs are configured.

### Command Mode

CFM Domain Configuration



### Command Usage

- ◆ Use this command to statically configure remote MEPs that exist inside the maintenance association. These remote MEPs are used in the cross-check operation to verify that all endpoints in the specified MA are operational.
- ◆ Remote MEPs can only be configured with this command if domain service access points (DSAPs) have already been created with the [ethernet cfm mep](#) command at the same maintenance level and in the same MA. DSAPs are MEPs that exist on the edge of the domain, and act as primary service access points for end-to-end cross-check, loop-back, and link-trace functions.

### Example

This example defines a static MEP for the specified maintenance association.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#ma index 1 name rd vlan 1
Console(config-ether-cfm)#mep crosscheck mpid 2 ma rd
Console(config-ether-cfm)#
```

### ethernet cfm mep crosscheck

This command enables cross-checking between the static list of MEPs assigned to other devices within the same maintenance association and the MEPs learned through continuity check messages (CCMs). Use the **disable** keyword to stop the cross-check process.

### Syntax

**ethernet cfm mep crosscheck** {**enable** | **disable**} **md** *domain-name*  
**ma** *ma-name*

**enable** – Starts the cross-check process.

**disable** – Stops the cross-check process.

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – MA name. (Range: 1-43 alphanumeric characters)

### Default Setting

Disabled

### Command Mode

Privileged Exec

### Command Usage

- ◆ Before using this command to start the cross-check process, first configure the remote MEPs that exist on other devices inside the maintenance association using the [mep crosscheck mpid](#) command. These remote MEPs are used in the cross-check operation to verify that all endpoints in the specified MA are operational.

- ◆ The cross-check process is disabled by default, and must be manually started using this command with the **enable** keyword.

#### Example

This example enables cross-checking within the specified maintenance association.

```
Console#ethernet cfm mep crosscheck enable md voip ma rd
Console#
```

#### **show ethernet cfm maintenance-points remote crosscheck**

This command displays information about remote MEPs statically configured in a cross-check list.

#### Syntax

**show ethernet cfm maintenance-points remote crosscheck**

[**domain** *domain-name* | **mpid** *mpid*]

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*mpid* – Maintenance end point identifier. (Range: 1-8191)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

This example shows all remote MEPs statically configured on this device.

```
Console#show ethernet cfm maintenance-points remote crosscheck
MPID  MA Name                Level  VLAN  MEP Up  Remote MAC
-----
    2  downtown                4      2   Yes    00-0D-54-FC-A2-73
Console#
```

## Link Trace Operations

#### **ethernet cfm linktrace cache**

This command enables caching of CFM data learned through link trace messages. Use the **no** form to disable caching.

#### Syntax

[**no**] **ethernet cfm linktrace cache**

#### Default Setting

Enabled

## Command Mode

Global Configuration

## Command Usage

- ◆ A link trace message is a multicast CFM frame initiated by a MEP, and forwarded from MIP to MIP, with each MIP generating a link trace reply, up to the point at which the link trace message reaches its destination or can no longer be forwarded.
- ◆ Use this command to enable the link trace cache to store the results of link trace operations initiated on this device. Use the [ethernet cfm linktrace](#) command to transmit a link trace message.
- ◆ Link trace responses are returned from each MIP along the path and from the target MEP. Information stored in the cache includes the maintenance domain name, MA name, MEPID, sequence number, and TTL value.

## Example

This example enables link trace caching.

```
Console(config)#ethernet cfm linktrace cache
Console(config)#
```

**ethernet cfm linktrace cache hold-time** This command sets the hold time for CFM link trace cache entries. Use the **no** form to restore the default setting.

## Syntax

**ethernet cfm linktrace cache hold-time** *minutes*

*minutes* – The aging time for entries stored in the link trace cache.  
(Range: 1-65535 minutes)

## Default Setting

100 minutes

## Command Mode

Global Configuration

## Command Usage

Before setting the aging time for cache entries, the cache must first be enabled with the [ethernet cfm linktrace cache](#) command.

### Example

This example sets the aging time for entries in the link trace cache to 60 minutes.

```
Console(config)#ethernet cfm linktrace cache hold-time 60
Console(config)#
```

**ethernet cfm linktrace cache size** This command sets the maximum size for the link trace cache. Use the **no** form to restore the default setting.

### Syntax

**ethernet cfm linktrace cache size** *entries*

*entries* – The number of link trace responses stored in the link trace cache.  
(Range: 1-4095 entries)

### Default Setting

100 entries

### Command Mode

Global Configuration

### Command Usage

- ◆ Before setting the cache size, the cache must first be enabled with the [ethernet cfm linktrace cache](#) command.
- ◆ If the cache reaches the maximum number of specified entries, or the size is set to a value less than the current number of stored entries, no new entries are added. To add additional entries, the cache size must first be increased with this command, or purged with the [clear ethernet cfm linktrace-cache](#) command.

### Example

This example limits the maximum size of the link trace cache to 500 entries.

```
Console(config)#ethernet cfm linktrace cache size 500
Console(config)#
```

**ethernet cfm linktrace** This command sends CFM link trace messages to the MAC address of a remote MEP.

### Syntax

**ethernet cfm linktrace** {**dest-mep** *destination-mpid* | **src-mep** *source-mpid* | {**dest-mep** *destination-mpid* | *mac-address*} | *mac-address*} **md** *domain-name* **ma** *ma-name* [**tll** *number*]

*destination-mpid* – The identifier of a remote MEP that is the target of the link trace message. (Range: 1-8191)

*source-mpid* – The identifier of a source MEP that will send the link trace message. (Range: 1-8191)

*mac-address* – MAC address of a remote MEP that is the target of the link trace message. This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

*number* – The time to live of the linktrace message. (Range: 0-255 hops)

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ Link trace messages can be targeted to MEPs, not MIPs. Before sending a link trace message, be sure you have configured the target MEP for the specified MA.
- ◆ If the MAC address of target MEP has not been learned by any local MEP, then the linktrace may fail. Use the [show ethernet cfm maintenance-points remote crosscheck](#) command to verify that a MAC address has been learned for the target MEP.
- ◆ Link trace messages (LTMs) are sent as multicast CFM frames, and forwarded from MIP to MIP, with each MIP generating a link trace reply, up to the point at which the LTM reaches its destination or can no longer be forwarded.
- ◆ Link trace messages are used to isolate faults. However, this task can be difficult in an Ethernet environment, since each node is connected through multipoint links. Fault isolation is even more challenging since the MAC address of the target node can age out in several minutes. This can cause the traced path to vary over time, or connectivity lost if faults cause the target MEP to be isolated from other MEPs in an MA.
- ◆ When using the command line or web interface, the source MEP used by to send a link trace message is chosen by the CFM protocol. However, when using SNMP, the source MEP can be specified by the user.

### Example

This example sends a link trace message to the specified MEP with a maximum hop count of 25.

```
Console#linktrace ethernet dest-mep 2 md voip ma rd ttl 25
Console#
```

**clear ethernet cfm linktrace-cache** This command clears link trace messages logged on this device.

**Command Mode**  
Privileged Exec

#### Example

```
Console#clear ethernet cfm linktrace-cache
Console#
```

**show ethernet cfm linktrace-cache** This command displays the contents of the link trace cache.

**Command Mode**  
Privileged Exec

#### Example

```
Console#show ethernet cfm linktrace-cache
Hops MA          IP / Alias      Ingress MAC      Ing. Action Relay
          Forwarded      Egress MAC      Egr. Action
-----
  2 rd          192.168.0.6    00-12-CF-12-12-2D ingOk             Hit
          Not Forwarded
Console#
```

**Table 160: show ethernet cfm linktrace-cache - display description**

Field	Description
Hops	The number hops taken to reach the target MEP.
MA	Name of the MA to which this device belongs.
IP/Alias	IP address or alias of the target device's CPU.
Forwarded	Shows whether or not this link trace message was forwarded. A message is not forwarded if received by the target MEP.
Ingress MAC	MAC address of the ingress port on the target device.
Egress MAC	MAC address of the egress port on the target device.
Ing. Action	Action taken on the ingress port: IngOk – The target data frame passed through to the MAC Relay Entity. IngDown – The bridge port's MAC_Operational parameter is false. This value could be returned, for example, by an operationally Down MEP that has another Down MEP at a higher MD level on the same bridge port that is causing the bridge port's MAC_Operational parameter to be false. IngBlocked – The ingress port can be identified, but the target data frame was not forwarded when received on this port due to active topology management, i.e., the bridge port is not in the forwarding state. IngVid – The ingress port is not in the member set of the LTM's VIDs, and ingress filtering is enabled, so the target data frame was filtered by ingress filtering.

Table 160: show ethernet cfm linktrace-cache - display description (Continued)

Field	Description
Egr. Action	Action taken on the egress port: EgrOk – The targeted data frame was forwarded. EgrDown – The Egress Port can be identified, but that bridge port's MAC_Operational parameter is false. EgrBlocked – The egress port can be identified, but the data frame was not passed through the egress port due to active topology management, i.e., the bridge port is not in the forwarding state. EgrVid – The Egress Port can be identified, but the bridge port is not in the LTM's VID member set, and was therefore filtered by egress filtering.
Relay	Relay action: FDB – Target address found in forwarding database. MPDB – Target address found in the maintenance point database. HIT – Target located on this device.

## Loopback Operations

**ethernet cfm loopback** This command sends CFM loopback messages to a MAC address for a MEP or MIP.

### Syntax

**ethernet cfm loopback** {**dest-mep** *destination-mpid* | **src-mep** *source-mpid* {**dest-mep** *destination-mpid* | *mac-address*} | *mac-address*} **md** *domain-name* **ma** *ma-name* [**count** *transmit-count*] [**size** *packet-size*]

*destination-mpid* – The identifier of a MEP that is the target of the loopback message. (Range: 1-8191)

*source-mpid* – The identifier of a source MEP that will send the loopback message. (Range: 1-8191)

*mac-address* – MAC address of the remote maintenance point that is the target of the loopback message. This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

*transmit-count* – The number of times the loopback message is sent. (Range: 1-1024)

*packet-size* – The size of the loopback message. (Range: 64-1518 bytes)

### Default Setting

Loop back count: One loopback message is sent.

Loop back size: 64 bytes

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use this command to test the connectivity between maintenance points. If the continuity check database does not have an entry for the specified maintenance point, an error message will be displayed.
- ◆ The point from which the loopback message is transmitted (i.e., the DSAP) and the target maintenance point specified in this command must be within the same MA.
- ◆ Loop back messages can be used for fault verification and isolation after automatic detection of a fault or receipt of some other error report. Loopback messages can also be used to confirm the successful restoration or initiation of connectivity. The receiving maintenance point should respond to the loop back message with a loopback reply.
- ◆ When using the command line or web interface, the source MEP used by to send a loopback message is chosen by the CFM protocol. However, when using SNMP, the source MEP can be specified by the user.

### Example

This example sends a loopback message to the specified remote MEP.

```
Console#ethernet cfm loopback dest-mep 1 md voip ma rd  
Console#
```

## Fault Generator Operations

**mep fault-notify alarm-time** This command sets the time a defect must exist before a fault alarm is issued. Use the **no** form to restore the default setting.

### Syntax

**mep fault-notify alarm-time** *alarm-time*

**no fault-notify alarm-time**

*alarm-time* – The time that one or more defects must be present before a fault alarm is generated. (Range: 3-10 seconds)

### Default Setting

3 seconds

### Command Mode

CFM Domain Configuration

### Command Usage

A fault alarm is issued when the MEP fault notification generator state machine detects that a time period configured by this command has passed with one or



more defects indicated, and fault alarms are enabled at or above the priority level set by the [mep fault-notify lowest-priority](#) command.

### Example

This example set the delay time before generating a fault alarm.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep fault-notify alarm-time 10
Console(config-ether-cfm)#
```

**mep fault-notify lowest-priority** This command sets the lowest priority defect that is allowed to generate a fault alarm. Use the **no** form to restore the default setting.

### Syntax

**mep fault-notify lowest-priority** *priority*

**no fault-notify lowest-priority**

*priority* – Lowest priority default allowed to generate a fault alarm.  
(Range: 1-6)

### Default Setting

Priority level 2

### Command Mode

CFM Domain Configuration

### Command Usage

- ◆ A fault alarm can generate an SNMP notification. It is issued when the MEP fault notification generator state machine detects that a configured time period (see the [mep fault-notify alarm-time](#) command) has passed with one or more defects indicated, and fault alarms are enabled at or above the priority level set by this command. The state machine transmits no further fault alarms until it is reset by the passage of a configured time period (see the [mep fault-notify reset-time](#) command) without a defect indication. The normal procedure upon receiving a fault alarm is to inspect the reporting MEP's managed objects using an appropriate SNMP software tool, diagnose the fault, correct it, re-examine the MEP's managed objects to see whether the MEP fault notification generator state machine has been reset, and repeat those steps until the fault is resolved.
- ◆ Only the highest priority defect currently detected is reported in the fault alarm.

- ◆ Priority defects include the following items:

Table 161: Remote MEP Priority Levels

Priority Level	Level Name	Description
1	allDef	All defects.
2	macRemErrXcon	DefMACstatus, DefRemoteCCM, DefErrorCCM, or DefXconCCM.
3	remErrXcon	DefErrorCCM, DefXconCCM or DefRemoteCCM.
4	errXcon	DefErrorCCM or DefXconCCM.
5	xcon	DefXconCCM
6	noXcon	No defects DefXconCCM or lower are to be reported.

Table 162: MEP Defect Descriptions

Field	Description
DefMACstatus	Either some remote MEP is reporting its Interface Status TLV as not isUp, or all remote MEPs are reporting a Port Status TLV that contains some value other than psUp.
DefRemoteCCM	The MEP is not receiving valid CCMs from at least one of the remote MEPs.
DefErrorCCM	The MEP has received at least one invalid CCM whose CCM Interval has not yet timed out.
DefXconCCM	The MEP has received at least one CCM from either another MAID or a lower MD Level whose CCM Interval has not yet timed out.

### Example

This example sets the lowest priority defect that will generate a fault alarm.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep fault-notify lowest-priority 1
Console(config-ether-cfm)#
```

### mep fault-notify reset-time

This command configures the time after a fault alarm has been issued, and no defect exists, before another fault alarm can be issued. Use the **no** form to restore the default setting.

### Syntax

**mep fault-notify reset-time** *reset-time*

**no fault-notify reset-time**

*reset-time* – The time that must pass without any further defects indicated before another fault alarm can be generated. (Range: 3-10 seconds)

### Default Setting

10 seconds

### Command Mode

CFM Domain Configuration

### Example

This example sets the reset time after which another fault alarm can be generated.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep fault-notify reset-time 7
Console(config-ether-cfm)#
```

### show ethernet cfm fault-notify-generator

This command displays configuration settings for the fault notification generator.

### Syntax

**show ethernet cfm fault-notify-generator mep *mpid***

*mpid* – Maintenance end point identifier. (Range: 1-8191)

### Default Setting

None

### Command Mode

Privileged Exec

### Example

This example shows the fault notification settings configured for one MEP.

```
Console#show ethernet cfm fault-notify-generator mep 1
MD Name      MA Name      Highest Defect Lowest Alarm  Alarm Time Reset Time
-----
      voip      rd none      macRemErrXcon      3sec.      10sec.
Console#
```

**Table 163: show fault-notify-generator - display description**

Field	Description
MD Name	The maintenance domain for this entry.
MA Name	The maintenance association for this entry.
Hihest Defect	The highest defect that will generate a fault alarm. (This is disabled by default.)
Lowest Alarm	The lowest defect that will generate a fault alarm (see the <a href="#">mep fault-notify lowest-priority</a> command).

**Table 163: show fault-notify-generator - display description** (Continued)

Field	Description
Alarm Time	The time a defect must exist before a fault alarm is issued (see the <a href="#">mep fault-notify alarm-time</a> command).
Reset Time	The time after a fault alarm has been issued, and no defect exists, before another fault alarm can be issued (see the <a href="#">mep fault-notify reset-time</a> command).

## Delay Measure Operations

**ethernet cfm delay-measure two-way** This command sends periodic delay-measure requests to a specified MEP within a maintenance association.

### Syntax

**ethernet cfm delay-measure two-way** [**src-mep** *source-mpid*] [**dest-mep** *destination-mpid* | *mac-address*] [**md** *domain-name*] [**ma** *ma-name*] [**count** *transmit-count*] [**interval** *interval*] [**size** *packet-size*] [**timeout** *timeout*]

*source-mpid* – The identifier of a source MEP that will send the delay-measure message. (Range: 1-8191)

*destination-mpid* – The identifier of a remote MEP that is the target of the delay-measure message. (Range: 1-8191)

*mac-address* – MAC address of a remote MEP that is the target of the delay-measure message. This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

*domain-name* – Domain name. (Range: 1-43 alphanumeric characters)

*ma-name* – Maintenance association name. (Range: 1-43 alphanumeric characters)

*count* – The number of times to retry sending the message if no response is received before the specified timeout. (Range: 1-5)

*interval* – The transmission delay between delay-measure messages. (Range: 1-5 seconds)

*packet-size* – The size of the delay-measure message. (Range: 64-1518 bytes)

*timeout* – The timeout to wait for a response. (Range: 1-5 seconds)

### Default Setting

Count: 5  
Interval: 1 second  
Size: 64 bytes  
Timeout: 5 seconds

### Command Mode

Privileged Exec

### Command Usage

- ◆ Delay measurement can be used to measure frame delay and frame delay variation between MEPs.
- ◆ A local MEP must be configured for the same MA before you can use this command.
- ◆ If a MEP is enabled to generate frames with delay measurement (DM) information, it periodically sends DM frames to its peer MEP in the same MA., and expects to receive DM frames back from it.
- ◆ Frame delay measurement can be made only for two-way measurements, where the MEP transmits a frame with DM request information with the TxTimeStampf (Timestamp at the time of sending a frame with DM request information), and the receiving MEP responds with a frame with DM reply information with TxTimeStampf copied from the DM request information, RxTimeStampf (Timestamp at the time of receiving a frame with DM request information), and TxTimeStamptb (Timestamp at the time of transmitting a frame with DM reply information):  
$$\text{Frame Delay} = (\text{RxTimeStampb} - \text{TxTimeStampf}) - (\text{TxTimeStamptb} - \text{RxTimeStampf})$$
- ◆ The MEP can also make two-way frame delay variation measurements based on its ability to calculate the difference between two subsequent two-way frame delay measurements.

### Example

This example sends periodic delay-measure requests to a remote MEP.

```

Console#ethernet cfm delay-measure two-way dest-mep 1 md voip ma rd
Type ESC to abort.
Sending 5 Ethernet CFM delay measurement message, timeout is 5 sec.
Sequence  Delay Time (ms.)  Delay Variation (ms.)
-----  -
1          < 10             0
2          < 10             0
3          < 10             0
4          40              40
5          < 10             40
Success rate is 100% (5/5), delay time min/avg/max=0/8/40 ms.
Average frame delay variation is 16 ms.
Console#

```



## OAM Commands

The switch provides OAM (Operation, Administration, and Maintenance) remote management tools required to monitor and maintain the links to subscriber CPEs (Customer Premise Equipment). This section describes functions including enabling OAM for selected ports, loop back testing, and displaying device information.

**Table 164: OAM Commands**

Command	Function	Mode
<code>efm oam</code>	Enables OAM services	IC
<code>efm oam critical-link-event</code>	Enables reporting of critical event or dying gasp	IC
<code>efm oam link-monitor frame</code>	Enables reporting of errored frame link events	IC
<code>efm oam link-monitor frame threshold</code>	Sets the threshold for errored frame link events	IC
<code>efm oam link-monitor frame window</code>	Sets the monitor period for errored frame link events	IC
<code>efm oam mode</code>	Sets the OAM operational mode to active or passive	IC
<code>clear efm oam counters</code>	Clears statistical counters for various OAMPDU message types	PE
<code>clear efm oam event-log</code>	Clears all entries from the OAM event log for the specified port	PE
<code>efm oam remote-loopback</code>	Initiates or terminates remote loopback test	PE
<code>efm oam remote-loopback test</code>	Performs remote loopback test, sending a specified number of packets	PE
<code>show efm oam counters interface</code>	Displays counters for various OAM PDU message types	NE,PE
<code>show efm oam event-log interface</code>	Displays OAM event log	NE,PE
<code>show efm oam remote-loopback interface</code>	Displays results of OAM remote loopback test	NE,PE
<code>show efm oam status interface</code>	Displays OAM configuration settings and event counters	NE,PE
<code>show efm oam status remote interface</code>	Displays information about attached OAM-enabled devices	NE,PE

**efm oam** This command enables OAM functions on the specified port. Use the **no** form to disable this function.

#### Syntax

**[no] efm oam**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration

#### Command Usage

- ◆ If the remote device also supports OAM, both exchange Information OAMPDUs to establish an OAM link.
- ◆ Not all CPEs support OAM functions, and OAM is therefore disabled by default. If the CPE attached to a port supports OAM, then this functionality must first be enabled by the **efm oam** command to gain access to other remote configuration functions.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam
Console(config-if)#
```

**efm oam critical-link-event** This command enables reporting of critical event or dying gasp. Use the **no** form to disable this function.

#### Syntax

**[no] efm oam critical-link-event {critical-event | dying-gasp}**

**critical-event** - If a critical event occurs, the local OAM entity (this switch) indicates this to its peer by setting the appropriate flag in the next OAMPDU to be sent and stores this information in its OAM event log.

**dying-gasp** - If an unrecoverable condition occurs, the local OAM entity indicates this by immediately sending a trap message.

#### Default Setting

Enabled

#### Command Mode

Interface Configuration



**Command Usage**

- ◆ Critical events are vendor-specific and may include various failures, such as abnormal voltage fluctuations, out-of-range temperature detected, fan failure, CRC error in flash memory, insufficient memory, or other hardware faults.
- ◆ Dying gasp events are caused by an unrecoverable failure, such as a power failure or device reset.



**Note:** When system power fails, the switch will always send a dying gasp trap message prior to power down.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam critical-link-event dying-gasp
Console(config-if)#
```

**efm oam  
link-monitor frame**

This command enables reporting of errored frame link events. Use the **no** form to disable this function.

**Syntax**

**[no] efm oam link-monitor frame**

**Default Setting**

Enabled

**Command Mode**

Interface Configuration

**Command Usage**

- ◆ An errored frame is a frame in which one or more bits are errored.
- ◆ If this feature is enabled and an errored frame link event occurs, the local OAM entity (this switch) sends an Event Notification OAMPDU.

**Example**

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam link-monitor frame
Console(config-if)#
```

**efm oam link-monitor frame threshold** This command sets the threshold for errored frame link events. Use the **no** form to restore the default setting.

#### Syntax

**efm oam link-monitor frame threshold** *count*

**no efm oam link-monitor frame threshold**

*count* - The threshold for errored frame link events. (Range: 1-65535)

#### Default Setting

1

#### Command Mode

Interface Configuration

#### Command Usage

If this feature is enabled, an event notification message is sent if the threshold is reached or exceeded within the period specified by the [efm oam link-monitor frame window](#) command. The Errored Frame Event TLV includes the number of errored frames detected during the specified period.

#### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam link-monitor frame threshold 5
Console(config-if)#
```

**efm oam link-monitor frame window** This command sets the monitor period for errored frame link events. Use the **no** form to restore the default setting.

#### Syntax

**efm oam link-monitor frame window** *size*

**no efm oam link-monitor frame window**

*size* - The period of time in which to check the reporting threshold for errored frame link events. (Range: 10-65535 units of 10 milliseconds)

#### Default Setting

10 (units of 100 milliseconds) = 1 second

#### Command Mode

Interface Configuration

#### Command Usage

If this feature is enabled, an event notification message is sent if the threshold specified by the [efm oam link-monitor frame threshold](#) command is reached or

exceeded within the period specified by this command. The Errored Frame Event TLV includes the number of errored frames detected during the specified period.

### Example

This example set the window size to 5 seconds.

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam link-monitor frame window 50
Console(config-if)#
```

**efm oam mode** This command sets the OAM mode on the specified port. Use the **no** form to restore the default setting.

### Syntax

**efm oam mode {active | passive}**

**no efm oam mode**

**active** - All OAM functions are enabled.

**passive** - All OAM functions are enabled, except for OAM discovery, and sending loopback control OAMPDUs.

### Default Setting

Active

### Command Mode

Interface Configuration

### Command Usage

When set to active mode, the selected interface will initiate the OAM discovery process. When in passive mode, it can only respond to discovery messages.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam mode active
Console(config-if)#
```

**clear efm oam counters** This command clears statistical counters for various OAMPDU message types.

#### Syntax

**clear efm oam counters** [*interface-list*]

*interface-list* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Example

```
Console#clear efm oam counters
Console#
```

#### Related Commands

[show efm oam counters interface \(847\)](#)

**clear efm oam event-log** This command clears all entries from the OAM event log for the specified port.

#### Syntax

**clear efm oam event-log** [*interface-list*]

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

#### Command Mode

Privileged Exec

#### Example

```
Console#clear efm oam event-log
Console#
```

**efm oam remote-loopback** This command starts or stops OAM loopback test mode to the attached CPE.

#### Syntax

**efm oam remote-loopback {start | stop} interface**

**start** - Starts remote loopback test mode.

**stop** - Stops remote loopback test mode.

*interface* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Command Usage

- ◆ OAM remote loop back can be used for fault localization and link performance testing. Statistics from both the local and remote DTE can be queried and compared at any time during loop back testing.
- ◆ Use the **efm oam remote-loopback start** command to start OAM remote loop back test mode on the specified port. Afterwards, use the **efm oam remote-loopback test** command to start sending test packets. Then use the **efm oam remote loopback stop** command to terminate testing (if test packets are still being sent) and to terminate loop back test mode.
- ◆ The port that you specify to run this test must be connected to a peer OAM device capable of entering into OAM remote loopback mode.
- ◆ During a remote loopback test, the remote OAM entity loops back every frame except for OAMPDUs and pause frames.
- ◆ During loopback testing, both the switch and remote device are permitted to send OAMPDUs to the peer device and to process any OAMPDUs received from the peer.

#### Example

```
Console#efm oam remote-loopback start 1/1
Loopback operation is processing, please wait.
Enter loopback mode succeeded.
Console#
```

**efm oam remote-loopback test** This command performs a remote loopback test, sending a specified number of packets.

### Syntax

**efm oam remote-loopback test** *interface* [*number-of-packets* [*packet-size*]]

*interface* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

*number-of-packets* - Number of packets to send. (Range: 1-99999999)

*packet-size* - Size of packets to send. (Range: 64-1518 bytes)

### Default Setting

Number of packets: 10,000

Packet size: 64 bytes

### Command Mode

Privileged Exec

### Command Usage

- ◆ You can use this command to perform an OAM remote loopback test on the specified port. The port that you specify to run this test must be connected to a peer OAM device capable of entering into OAM remote loopback mode.
- ◆ During a remote loopback test, the remote OAM entity loops back every frame except for OAMPDUs and pause frames.
- ◆ OAM remote loopback can be used for fault localization and link performance testing. Statistics from both the local and remote DTE can be queried and compared at any time during loopback testing.
- ◆ A summary of the test is displayed after it is finished.

### Example

```
Console#efm oam remote-loopback test 1/1
Loopback test is processing, press ESC to suspend.
....
Port OAM loopback Tx OAM loopback Rx Loss Rate
-----
1/2          1990          1016    48.94 %
Console#
```

**show efm oam counters interface** This command displays counters for various OAM PDU message types.

#### Syntax

**show efm oam counters interface** [*interface-list*]

*interface-list* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

#### Command Mode

Normal Exec, Privileged Exec

#### Example

```
Console#show efm oam counters interface 1/1
Port OAMPDU Type          TX          RX
-----
1/1  Information           1121        1444
1/1  Event Notification     0           0
1/1  Loopback Control       1           0
1/1  Organization Specific 76           0
Console#
```

**show efm oam event-log interface** This command displays the OAM event log for the specified port(s) or for all ports that have logs.

**show efm oam event-log interface** [*interface-list*]

*interface-list* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

#### Command Mode

Normal Exec, Privileged Exec

#### Command Usage

- ◆ When a link event occurs, no matter whether the location is local or remote, this information is entered in the OAM event log.
- ◆ When the log system becomes full, older events are automatically deleted to make room for new entries.

**Example**

```

Console#show efm oam event-log interface 1/1
OAM event log of Eth 1/1:
 00:24:07 2001/01/01
  "Unit 1, Port 1: Dying Gasp at Remote"
Console#

```

This command can show OAM link status changes for link partner as shown in this example.

```

Console#show efm oam event-log interface 1/1
OAM event log of Eth 1/1:
 10:22:55 2013/09/13
  "Unit 1, Port 1: Connection to remote device is up at Local"
 10:22:44 2013/09/13
  "Unit 1, Port 1: Connection to remote device is down at Local"
  <--- When the link is down, this event will be written to OAM event-log
 10:20:02 2013/09/13
  "Unit 1, Port 1: Connection to remote device is up at Local"
  <--- When the link is up, this event will be written to OAM event-log,
Console#clear efm oam event-log
  <--- Use the "clear efm oam event-log" command to clear the event-log.
Console#show efm oam event-log interface 1/1
Console#

```

This command can show OAM dying gasp changes for link partner as shown in this example.

```

Console#show efm oam event-log interface 1/1
  <--- When dying gasp happens and the switch get these packets, it will log
        this event in OAM event-log.
OAM event log of Eth 1/1:
 10:27:21 2013/09/13
  "Unit 1, Port 1: Connection to remote device is down at Local"
 10:27:20 2013/09/13
  "Unit 1, Port 1: Dying Gasp occurred at Remote"
Console#show efm oam event-log interface 1/1
OAM event log of Eth 1/1:
 10:28:31 2013/09/13
  "Unit 1, Port 1: Connection to remote device is up at Local"
 10:28:28 2013/09/13
  "Unit 1, Port 1: Dying Gasp clear occurred at Remote"
  <--- When the remote device comes up, the switch will get OAM packets
        without the dying gasp bit and display "dying gasp event clear".
Console#

```



**show efm oam remote-loopback interface** This command displays the results of an OAM remote loopback test.

#### Syntax

**show efm oam remote-loopback interface** [*interface-list*]

*interface-list* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

#### Command Mode

Normal Exec, Privileged Exec

#### Example

```
Console#show efm oam remote-loopback interface 1/1
Port OAM loopback Tx OAM loopback Rx Loss Rate
-----
1/1          2300          2250      0.01 %
Console#
```

**show efm oam status interface** This command displays OAM configuration settings and event counters.

#### Syntax

**show efm oam status interface** [*interface-list*] [**brief**]

*interface* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

**brief** - Displays a brief list of OAM configuration states.

#### Command Mode

Normal Exec, Privileged Exec

#### Example

```
Console#show efm oam status interface 1/1
OAM information of Eth 1/1:
Basic Information:
Admin State          : Enabled
Operation State      : Operational
Mode                 : Active
Remote Loopback      : Disabled
Remote Loopback Status : No loopback
Dying Gasp           : Enabled
Critical Event        : Enabled
```

```

Link Monitor (Errored Frame)    : Enabled
Link Monitor:
  Errored Frame Window (100msec) : 10
  Errored Frame Threshold        : 1
Console#show efm oam status interface 1/1 brief
$ = local OAM in loopback
* = remote OAM in loopback

Port Admin   Mode   Remote   Dying   Critical Errored
  State      Loopback Gasp    Event   Frame
-----
1/1  Enabled Active Disabled Enabled Enabled Enabled
Console#

```

**show efm oam status remote interface** This command displays information about attached OAM-enabled devices.

### Syntax

**show efm oam status remote interface** [*interface-list*]

*interface-list* - unit/port

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports. (Range: 1-28)

### Command Mode

Normal Exec, Privileged Exec

### Example

```

Console#show efm oam status remote interface 1/1
Port MAC Address      OUI   Remote   Unidirectional Link   MIB Variable
  Loopback            Retrieval
-----
1/1  00-12-CF-6A-07-F6 000084 Enabled Disabled Enabled Disabled
Console#

```

# Domain Name Service Commands

These commands are used to configure Domain Naming System (DNS) services. Entries can be manually configured in the DNS domain name to IP address mapping table, default domain names configured, or one or more name servers specified to use for domain name to address translation.

Note that domain name services will not be enabled until at least one name server is specified with the `ip name-server` command and domain lookup is enabled with the `ip domain-lookup` command.

**Table 165: Address Table Commands**

Command	Function	Mode
<code>ip domain-list</code>	Defines a list of default domain names for incomplete host names	GC
<code>ip domain-lookup</code>	Enables DNS-based host name-to-address translation	GC
<code>ip domain-name</code>	Defines a default domain name for incomplete host names	GC
<code>ip host</code>	Creates a static IPv4 host name-to-address mapping	GC
<code>ip name-server</code>	Specifies the address of one or more name servers to use for host name-to-address translation	GC
<code>ipv6 host</code>	Creates a static IPv6 host name-to-address mapping	GC
<code>clear dns cache</code>	Clears all entries from the DNS cache	PE
<code>clear host</code>	Deletes entries from the host name-to-address table	PE
<code>show dns</code>	Displays the configuration for DNS services	PE
<code>show dns cache</code>	Displays entries in the DNS cache	PE
<code>show hosts</code>	Displays the static host name-to-address mapping table	PE

**ip domain-list** This command defines a list of domain names that can be appended to incomplete host names (i.e., host names passed from a client that are not formatted with dotted notation). Use the **no** form to remove a name from this list.

## Syntax

**[no] ip domain-list** *name*

*name* - Name of the host. Do not include the initial dot that separates the host name from the domain name. (Range: 1-127 characters)

## Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ Domain names are added to the end of the list one at a time.
- ◆ When an incomplete host name is received by the DNS service on this switch, it will work through the domain list, appending each domain name in the list to the host name, and checking with the specified name servers for a match.
- ◆ If there is no domain list, the domain name specified with the [ip domain-name](#) command is used. If there is a domain list, the default domain name is not used.

### Example

This example adds two domain names to the current list and then displays the list.

```
Console(config)#ip domain-list sample.com.jp
Console(config)#ip domain-list sample.com.uk
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS Disabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
Console#
```

### Related Commands

[ip domain-name \(853\)](#)

**ip domain-lookup** This command enables DNS host name-to-address translation. Use the **no** form to disable DNS.

### Syntax

**[no] ip domain-lookup**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ At least one name server must be specified before DNS can be enabled.

- ◆ If one or more name servers are configured, but DNS is not yet enabled and the switch receives a DHCP packet containing a DNS field with a list of DNS servers, then the switch will automatically enable DNS host name-to-address translation.
- ◆ If all name servers are deleted, DNS will automatically be disabled.

### Example

This example enables DNS and then displays the configuration.

```
Console(config)#ip domain-lookup
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS Enabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
    192.168.1.55
    10.1.0.55
Console#
```

### Related Commands

[ip domain-name \(853\)](#)

[ip name-server \(855\)](#)

**ip domain-name** This command defines the default domain name appended to incomplete host names (i.e., host names passed from a client that are not formatted with dotted notation). Use the **no** form to remove the current domain name.

### Syntax

**ip domain-name** *name*

**no ip domain-name**

*name* - Name of the host. Do not include the initial dot that separates the host name from the domain name. (Range: 1-127 characters)

### Default Setting

None

### Command Mode

Global Configuration

### Example

```
Console(config)#ip domain-name sample.com
Console(config)#end
```

```

Console#show dns
Domain Lookup Status:
    DNS Disabled
Default Domain Name:
    sample.com
Domain Name List:
Name Server List:
Console#

```

### Related Commands

[ip domain-list \(851\)](#)

[ip name-server \(855\)](#)

[ip domain-lookup \(852\)](#)

**ip host** This command creates a static entry in the DNS table that maps a host name to an IPv4 address. Use the **no** form to remove an entry.

### Syntax

**[no] ip host** *name address*

*name* - Name of an IPv4 host. (Range: 1-127 characters)

*address* - Corresponding IPv4 address.

### Default Setting

No static entries

### Command Mode

Global Configuration

### Command Usage

Use the **no ip host** command to clear static entries, or the [clear host](#) command to clear dynamic entries.

### Example

This example maps an IPv4 address to a host name.

```

Console(config)#ip host rd5 192.168.1.55
Console(config)#end
Console#show hosts

```

No.	Flag	Type	IP Address	TTL	Domain
0	2	Address	192.168.1.55		rd5

```

Console#

```

**ip name-server** This command specifies the address of one or more domain name servers to use for name-to-address resolution. Use the **no** form to remove a name server from this list.

### Syntax

**[no] ip name-server** *server-address1* [*server-address2* ...  
*server-address6*]

*server-address1* - IPv4 or IPv6 address of domain-name server.

*server-address2* ... *server-address6* - IPv4 or IPv6 address of additional domain-name servers.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

The listed name servers are queried in the specified sequence until a response is received, or the end of the list is reached with no response.

### Example

This example adds two domain-name servers to the list and then displays the list.

```
Console(config)#ip name-server 192.168.1.55 10.1.0.55
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS disabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
    192.168.1.55
    10.1.0.55
Console#
```

### Related Commands

[ip domain-name \(853\)](#)

[ip domain-lookup \(852\)](#)

**ipv6 host** This command creates a static entry in the DNS table that maps a host name to an IPv6 address. Use the **no** form to remove an entry.

### Syntax

**[no] ipv6 host** *name* *ipv6-address*

*name* - Name of an IPv6 host. (Range: 1-127 characters)

*ipv6-address* - Corresponding IPv6 address. This address must be entered according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

### Default Setting

No static entries

### Command Mode

Global Configuration

### Example

This example maps an IPv6 address to a host name.

```
Console(config)#ipv6 host rd6 2001:0db8:1::12
Console(config)#end
Console#show hosts
```

No.	Flag	Type	IP Address	TTL	Domain
0	2	Address	192.168.1.55		rd5
1	2	Address	2001:DB8:1::12		rd6

```
Console#
```

**clear dns cache** This command clears all entries in the DNS cache.

### Command Mode

Privileged Exec

### Example

```
Console#clear dns cache
Console#show dns cache
```

No.	Flag	Type	IP Address	TTL	Host
-----	------	------	------------	-----	------

```
Console#
```



**clear host** This command deletes dynamic entries from the DNS table.

### Syntax

**clear host** {*name* | \*}

*name* - Name of the host. (Range: 1-127 characters)

\* - Removes all entries.

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

Use the **clear host** command to clear dynamic entries, or the **no ip host** command to clear static entries.

### Example

This example clears all dynamic entries from the DNS table.

```
Console#clear host *
Console#
```

**show dns** This command displays the configuration of the DNS service.

### Command Mode

Privileged Exec

### Example

```
Console#show dns
Domain Lookup Status:
  DNS enabled
Default Domain Name:
  sample.com
Domain Name List:
  sample.com.jp
  sample.com.uk
Name Server List:
  192.168.1.55
  10.1.0.55
Console#
```

**show dns cache** This command displays entries in the DNS cache.

### Command Mode

Privileged Exec

### Example

```

Console#show dns cache
No.      Flag   Type   IP Address      TTL   Host
-----
      3      4 Host   209.131.36.158  115   www-real.wa1.b.yahoo.com
      4      4 CNAME  POINTER TO:3    115   www.yahoo.com
      5      4 CNAME  POINTER TO:3    115   www.wa1.b.yahoo.com
Console#

```

**Table 166: show dns cache - display description**

Field	Description
No.	The entry number for each resource record.
Flag	The flag is always "4" indicating a cache entry and therefore unreliable.
Type	This field includes "Host" which specifies the primary name for the owner, and "CNAME" which specifies multiple domain names (or aliases) which are mapped to the same IP address as an existing entry.
IP Address	The IP address associated with this record.
TTL	The time to live reported by the name server.
Host	The host name associated with this record.

**show hosts** This command displays the static host name-to-address mapping table.

### Command Mode

Privileged Exec

### Example

Note that a host name will be displayed as an alias if it is mapped to the same address(es) as a previously configured entry.

```

Console#show hosts
No.  Flag Type   IP Address      TTL   Host
-----
  0   2 Address 192.168.1.55      rd5
  1   2 Address 2001:DB8:1::12    rd6
  3   4 Address 209.131.36.158    65   www-real.wa1.b.yahoo.com
  4   4 CNAME  POINTER TO:3      65   www.yahoo.com
  5   4 CNAME  POINTER TO:3      65   www.wa1.b.yahoo.com
Console#

```

**Table 167: show hosts - display description**

Field	Description
No.	The entry number for each resource record.
Flag	The field displays "2" for a static entry, or "4" for a dynamic entry stored in the cache.
Type	This field includes "Address" which specifies the primary name for the owner, and "CNAME" which specifies multiple domain names (or aliases) which are mapped to the same IP address as an existing entry.
IP Address	The IP address associated with this record.
TTL	The time to live reported by the name server. This field is always blank for static entries.
Host	The host name associated with this record.



## DHCP Commands

These commands are used to configure Dynamic Host Configuration Protocol (DHCP) client, relay, and server functions. Any VLAN interface on this switch can be configured to automatically obtain an IP address through DHCP. This switch can also be configured to relay DHCP client configuration requests to a DHCP server on another network, or it can be configured to provide DHCP service directly to any client.

**Table 168: DHCP Commands**

Command Group	Function
DHCP Client	Allows interfaces to dynamically acquire IP address information
DHCP Relay	Relays DHCP requests from local hosts to a remote DHCP server
DHCP Server	Configures DHCP service using address pools or static bindings

### DHCP Client

Use the commands in this section to allow the switch's VLAN interfaces to dynamically acquire IP address information.

**Table 169: DHCP Client Commands**

Command	Function	Mode
<i>DHCP for IPv4</i>		
<code>ip dhcp client class-id</code>	Specifies the DHCP client identifier for an interface	IC
<code>ip dhcp restart client</code>	Submits a BOOTP or DHCP client request	PE
<i>DHCP for IPv6</i>		
<code>ipv6 dhcp client rapid-commit vlan</code>	Specifies the Rapid Commit option for DHCPv6 message exchange	GC
<code>show ipv6 dhcp duuid</code>	Shows the DHCP Unique Identifier for this switch	PE
<code>show ipv6 dhcp vlan</code>	Shows DHCPv6 information for specified interface	PE

## DHCP for IPv4

**ip dhcp client class-id** This command specifies the DHCP client vendor class identifier for the current interface. Use the **no** form to remove the class identifier from the DHCP packet.

### Syntax

**ip dhcp client class-id** [**text** *text* | **hex** *hex*]

**no ip dhcp client class-id**

*text* - A text string. (Range: 1-32 characters)

*hex* - A hexadecimal value. (Range: 1-64 characters)

### Default Setting

Class identifier option enabled, using the model number as the string

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Use this command without any keyword to restore the default setting.
- ◆ This command is used to identify the vendor class and configuration of the switch to the DHCP server, which then uses this information to decide on how to service the client or the type of information to return.
- ◆ The general framework for this DHCP option is set out in RFC 2132 (Option 60). This information is used to convey configuration settings or other identification information about a client, but the specific string to use should be supplied by your service provider or network administrator. Options 60, 66 and 67 statements can be added to the server daemon's configuration file.

**Table 170: Options 60, 66 and 67 Statements**

Option	Statement	
	Keyword	Parameter
60	vendor-class-identifier	a string indicating the vendor class identifier
66	tftp-server-name	a string indicating the tftp server name
67	bootfile-name	a string indicating the bootfile name

- ◆ By default, DHCP option 66/67 parameters are not carried in a DHCP server reply. To ask for a DHCP reply with option 66/67 information, the DHCP client request sent by this switch includes a "parameter request list" asking for this information. Besides, the client request also includes a "vendor class identifier" set by the **ip dhcp client class-id** command that allows the DHCP server to identify the device, and select the appropriate configuration file for download. This information is included in Option 55 and 124.

Table 171: Options 55 and 124 Statements

Option	Statement	
	Keyword	Parameter
55	dhcp-parameter-request-list	a list of parameters, separated by "
124	vendor-class-identifier	a string indicating the vendor class identifier

- ◆ The server should reply with Option 66 attributes, including the TFTP server name and boot file name.
- ◆ Note that the vendor class identifier can be formatted in either text or hexadecimal using the **ip dhcp client class-id** command, but the format used by both the client and server must be the same.

### Example

```
Console(config)#interface vlan 2
Console(config-if)#ip dhcp client class-id hex 0000e8666572
Console(config-if)#
```

### Related Commands

[ip dhcp restart client \(863\)](#)

**ip dhcp restart client** This command submits a BOOTP or DHCP client request.

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ This command issues a BOOTP or DHCP client request for any IP interface that has been set to BOOTP or DHCP mode through the [ip address](#) command.
- ◆ DHCP requires the server to reassign the client's last address if available.
- ◆ If the BOOTP or DHCP server has been moved to a different domain, the network portion of the address provided to the client will be based on this new domain.

### Example

In the following example, the device is reassigned the same address.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#exit
Console#ip dhcp restart client
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is 00-E0-00-00-00-01
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 192.168.0.2 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Client Vendor Class ID (text): GTL-2891
  DHCP Inform is disabled
  DHCP Relay Server:
Console#
```

### Related Commands

[ip address \(886\)](#)

## DHCP for IPv6

**ipv6 dhcp client rapid-commit vlan** This command specifies the Rapid Commit option for DHCPv6 message exchange for all DHCPv6 client requests submitted from the specified interface. Use the **no** form to disable this option.

### Syntax

**[no] ipv6 dhcp client rapid-commit vlan *vlan-id***

*vlan-id* - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094; Maximum command length: 300 characters)

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ DHCPv6 clients can obtain configuration parameters from a server through a normal four-message exchange (solicit, advertise, request, reply), or through a rapid two-message exchange (solicit, reply). The rapid-commit option must be enabled on both client and server for the two-message exchange to be used.
- ◆ This command allows two-message exchange method for prefix delegation. When enabled, DHCPv6 client requests submitted from the specified interface will include the rapid commit option in all solicit messages.



- ◆ If the rapid commit option has been enabled on the switch with this command, and on the DHCPv6 server, message exchange can be reduced from the normal four step process to a two-step exchange of only solicit and reply messages.

### Example

```
Console(config)#ipv6 dhcp client rapid-commit vlan 2
Console(config)#
```

**show ipv6 dhcp duid** This command shows the DHCP Unique Identifier for this switch.

### Command Mode

Privileged Exec

### Command Usage

DHCPv6 clients and servers are identified by a DHCP Unique Identifier (DUID) included in the client identifier and server identifier options. Static or dynamic address prefixes may be assigned by a DHCPv6 server based on the client's DUID.

### Example

```
Console#show ipv6 dhcp duid
DHCPv6 Unique Identifier (DUID): 0001-0001-4A8158B4-00E00C0000FD
Console#
```

**show ipv6 dhcp vlan** This command shows DHCPv6 information for the specified interface(s).

### Syntax

**show ipv6 dhcp vlan *vlan-list***

*vlan-list* - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094; Maximum command length: 300 characters)

### Command Mode

Privileged Exec

### Command Usage

Each allocation in the DHCPv6 server is identified by a DUID and a IAID. IAID means Interface Association Identifier, and is a binding between the interface and one or more IP addresses.

### Example

```
Console#show ipv6 dhcp vlan 1
VLAN 1 is in DHCP client mode, Rapid-Commit
IAID: C0000F0
List of known servers:
```

```
Server address : FE80::250:FCFF:FEF9:A494
DUID           : 0001-0001-48CFB0D5-F48F2A006801

Server address : FE80::250:FCFF:FEF9:A405
DUID           : 0001-0001-38CF5AB0-F48F2A003917
Console#
```

## RELATED COMMANDS

[ipv6 address \(903\)](#)

## DHCP Relay

This section describes commands used to configure the switch to relay DHCP requests from local hosts to a remote DHCP server.

**Table 172: DHCP Relay Option 82 Commands**

Command	Function	Mode
<i>DHCP Relay for IPv4</i>		
<a href="#">ip dhcp relay server</a>	Specifies DHCP server or relay server addresses	IC
<a href="#">ip dhcp restart relay</a>	Enables DHCP relay agent	PE
<i>DHCP Relay for IPv6</i>		
<a href="#">ipv6 dhcp relay destination</a>	Specifies destination address or VLAN to which client messages are forwarded for relay service	IC
<a href="#">show ipv6 dhcp relay destination</a>	Shows destination addresses or VLAN to which client messages are forwarded for relay service	PE

## DHCP Relay for IPv4

**ip dhcp relay server** This command specifies the DHCP server or relay server addresses to use. Use the **no** form to clear all addresses.

### Syntax

**ip dhcp relay server** *address1* [*address2* [*address3* ...]]

**no ip dhcp relay server**

*address* - IP address of DHCP server. (Range: 1-5 addresses)

### Default Setting

None

### Command Mode

Interface Configuration (VLAN)

### Usage Guidelines

- ◆ DHCP relay service applies to DHCP client requests received on the specified VLAN.
- ◆ This command is used to configure DHCP relay for host devices attached to the switch. If DHCP relay service is enabled, and this switch sees a DHCP client request, it inserts its own IP address into the request so that the DHCP server will know the subnet where the client is located. Then, the switch forwards the packet to a DHCP server on another network. When the server receives the DHCP request, it allocates a free IP address for the DHCP client from its defined scope for the DHCP client's subnet, and sends a DHCP response back to the DHCP relay agent (i.e., this switch). This switch then passes the DHCP response received from the server to the client.
- ◆ You must specify the IP address for at least one active DHCP server. Otherwise, the switch's DHCP relay agent will not be able to forward client requests to a DHCP server. Up to five DHCP servers can be specified in order of preference.  
  
If any of the specified DHCP server addresses are not located in the same network segment with this switch, use the [ip default-gateway](#) or [ipv6 default-gateway](#) command to specify the default router through which this switch can reach other IP subnetworks.
- ◆ To start DHCP relay service, enter the [ip dhcp restart relay](#) command.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip dhcp relay server 192.168.10.19
Console(config-if)#
```

### Related Commands

[ip dhcp restart relay \(867\)](#)

**ip dhcp restart relay** This command enables DHCP relay for the specified VLAN. Use the **no** form to disable it.

### Default Setting

Disabled

### Command Mode

Privileged Exec

### Command Usage

This command is used to configure DHCP relay functions for host devices attached to the switch. If DHCP relay service is enabled, and this switch sees a DHCP request broadcast, it inserts its own IP address into the request so the DHCP server will know the subnet where the client is located. Then, the switch forwards the packet to the DHCP server on another network. When the server receives the DHCP

request, it allocates a free IP address for the DHCP client from its defined scope for the DHCP client's subnet, and sends a DHCP response back to the DHCP relay agent (i.e., this switch). This switch then broadcasts the DHCP response received from the server to the client.

### Example

In the following example, the device is reassigned the same address.

```
Console#ip dhcp restart relay
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is 00-00-E8-93-82-A0
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 10.1.0.254 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Client Vendor Class ID (text): GTL-2891
  DHCP Inform is disabled
  DHCP Relay Server:
Console#
```

### Related Commands

[ip dhcp relay server \(866\)](#)

## DHCP Relay for IPv6

**ipv6 dhcp relay destination** This command specifies the destination address or VLAN to which client messages are forwarded for DHCP service. Use the **no** form to remove an entry.

### Syntax

**[no] ipv6 dhcp relay destination** {*ipv6-address* | **multicast** {**all** | **vlan** *vlan-id*}}

*ipv6-address* - A full IPv6 address including the network prefix and host address bits. This address may designate another relay server or a DHCPv6 server.

**multicast** - All DHCP server multicast address (FF:05::1:3).

**all** - All configured VLANs.

*vlan-id* - ID of configured VLAN. (Range: 1-4094)

### Default Setting

None

### Command Mode

Interface Configuration (VLAN)

### Usage Guidelines

- ◆ This command is used to configure DHCPv6 relay functions for host devices attached to the switch. If DHCPv6 relay service is enabled, and this switch sees a

DHCPv6 request broadcast, it inserts its own IP address into the request so the DHCPv6 server will know the subnet where the client is located. Then, the switch forwards the packet to the next relay agent or DHCPv6 server on another network. When the server receives the DHCPv6 request, it allocates a free IP address for the DHCPv6 client from its defined scope for the DHCPv6 client's subnet, and sends a DHCPv6 response back to the DHCPv6 relay agent (i.e., this switch). This switch then broadcasts the DHCPv6 response received from the server to the client.

- ◆ When the multicast option is used, the switch multicasts the modified client request to all configured VLANs or to a specified VLAN, and enables DHCPv6 relay service for those VLANs.
- ◆ Up to five relay destinations may be configured by repeating this command.
- ◆ When issuing the **no ipv6 dhcp relay destination** command without any arguments, the switch will delete all configured destination addresses and disable DHCP for IPv6 relay for all VLANs.

#### EXAMPLE

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 dhcp relay destination 2001:0DB8:3000:3000::42
Console(config-if)#
```

**show ipv6 dhcp relay destination** This command shows the destination addresses or VLAN to which client messages are forwarded for DHCP relay service.

#### Syntax

**show ipv6 dhcp relay destination interface [vlan *vlan-id*]**

*vlan-id* - ID of configured VLAN. (Range: 1-4094, no leading zeroes)

#### Command Mode

Privileged Exec

#### Example

```
Console#show ipv6 dhcp relay destination interface vlan 1
DHCP relay destination :
VLAN 1 :
  Unicast      : 2001:DB8:3000:3000::42
Console#
```

## DHCP Server

This section describes commands used to configure client address pools for the DHCP service.

**Table 173: DHCP Server Commands**

Command	Function	Mode
<code>ip dhcp excluded-address</code>	Specifies IP addresses that a DHCP server should not assign to DHCP clients	GC
<code>ip dhcp pool</code>	Configures a DHCP address pool on a DHCP Server	GC
<code>service dhcp</code>	Enables the DHCP server feature on this switch	GC
<code>bootfile</code>	Specifies a default boot image for a DHCP client	DC
<code>client-identifier</code> *	Specifies a client identifier for a DHCP client	DC
<code>default-router</code>	Specifies the default router list for a DHCP client	DC
<code>dns-server</code>	Specifies the Domain Name Server (DNS) servers available to a DHCP client	DC
<code>domain-name</code>	Specifies the domain name for a DHCP client	DC
<code>hardware-address</code> *	Specifies the hardware address of a DHCP client	DC
<code>host</code> *	Specifies the IP address and network mask to manually bind to a DHCP client	DC
<code>lease</code>	Sets the duration an IP address is assigned to a DHCP client	DC
<code>netbios-name-server</code>	Configures NetBIOS Windows Internet Naming Service (WINS) name servers available to Microsoft DHCP clients	DC
<code>netbios-node-type</code>	Configures NetBIOS node type for Microsoft DHCP clients	DC
<code>network</code>	Configures the subnet number and mask for a DHCP address pool	DC
<code>next-server</code>	Configures the next server in the boot process of a DHCP client	DC
<code>clear ip dhcp binding</code>	Deletes an automatic address binding from the DHCP server database	PE
<code>show ip dhcp</code>	Displays brief list of DHCP address pools	PE
<code>show ip dhcp binding</code>	Displays address bindings on the DHCP server	PE
<code>show ip dhcp pool</code>	Displays configuration settings for DHCP address pools	PE

\* These commands are used for manually binding an address to a client.

**ip dhcp excluded-address** This command specifies IP addresses that the DHCP server should not assign to DHCP clients. Use the **no** form to remove the excluded IP addresses.

### Syntax

**[no] ip dhcp excluded-address** *low-address* [*high-address*]

*low-address* - An excluded IP address, or the first IP address in an excluded address range.

*high-address* - The last IP address in an excluded address range.

### Default Setting

All IP pool addresses may be assigned.

### Command Mode

Global Configuration

### Example

```
Console(config)#ip dhcp excluded-address 10.1.0.19
Console(config)#
```

**ip dhcp pool** This command configures a DHCP address pool and enter DHCP Pool Configuration mode. Use the **no** form to remove the address pool.

### Syntax

**[no] ip dhcp pool** *name*

*name* - A string or integer. (Range: 1-32 characters)

### Default Setting

DHCP address pools are not configured.

### Command Mode

Global Configuration

### Usage Guidelines

- ◆ After executing this command, the switch changes to DHCP Pool Configuration mode, identified by the (config-dhcp)# prompt.
- ◆ From this mode, first configure address pools for the network interfaces (using the [network](#) command). You can also manually bind an address to a specific client (with the [host](#) command) if required. You can configure up to 8 network address pools, and up to 32 manually bound host address pools (i.e., listing one host address per pool). However, note that any address specified in a [host](#) command must fall within the range of a configured network address pool.

### Example

```
Console(config)#ip dhcp pool R&D  
Console(config-dhcp)#
```

### Related Commands

[network \(879\)](#)

[host \(876\)](#)

**service dhcp** This command enables the DHCP server on this switch. Use the **no** form to disable the DHCP server.

### Syntax

**[no] service dhcp**

### Default Setting

Enabled

### Command Mode

Global Configuration

### Command Usage

If the DHCP server is running, you must restart it to implement any configuration changes.

### Example

```
Console(config)#service dhcp  
Console(config)#
```

**bootfile** This command specifies the name of the default boot image for a DHCP client. This file should be placed on the Trivial File Transfer Protocol (TFTP) server specified with the [next-server](#) command. Use the **no** form to delete the boot image name.

### Syntax

**bootfile filename**

**no bootfile**

*filename* - Name of the file that is used as a default boot image.

### Default Setting

None

### Command Mode

DHCP Pool Configuration



### Example

```
Console(config-dhcp)#bootfile wme.bat  
Console(config-dhcp)#
```

### Related Commands

[next-server \(880\)](#)

**client-identifier** This command specifies the client identifier of a DHCP client. Use the **no** form to remove the client identifier.

### Syntax

**client-identifier** {**text** *text* | **hex** *hex*}

**no client-identifier**

*text* - A text string. (Range: 1-15 characters)

*hex* - The hexadecimal value.

### Default Setting

None

### Command Mode

DHCP Pool Configuration

### Command Usage

- ◆ This command identifies a DHCP client to bind to an address specified in the [host](#) command. If both a client identifier and hardware address are configured for a host address, the client identifier takes precedence over the hardware address in the search procedure.
- ◆ BOOTP clients cannot transmit a client identifier. To bind an address to a BOOTP client, you must associate a hardware address with the host entry.

### Example

```
Console(config-dhcp)#client-identifier text steve  
Console(config-dhcp)#
```

### Related Commands

[host \(876\)](#)

**default-router** This command specifies default routers for a DHCP pool. Use the **no** form to remove the default routers.

#### Syntax

**default-router** *address1* [*address2*]

**no default-router**

*address1* - Specifies the IP address of the primary router.

*address2* - Specifies the IP address of an alternate router.

#### Default Setting

None

#### Command Mode

DHCP Pool Configuration

#### Usage Guidelines

The IP address of the router should be on the same subnet as the client. You can specify up to two routers. Routers are listed in order of preference (starting with *address1* as the most preferred router).

#### Example

```
Console(config-dhcp)#default-router 10.1.0.54 10.1.0.64
Console(config-dhcp)#
```

**dns-server** This command specifies the Domain Name System (DNS) IP servers available to a DHCP client. Use the **no** form to remove the DNS server list.

#### Syntax

**dns-server** *address1* [*address2*]

**no dns-server**

*address1* - Specifies the IP address of the primary DNS server.

*address2* - Specifies the IP address of the alternate DNS server.

#### Default Setting

None

#### Command Mode

DHCP Pool Configuration

#### Usage Guidelines

- ◆ If DNS IP servers are not configured for a DHCP client, the client cannot correlate host names to IP addresses.

- ◆ Servers are listed in order of preference (starting with *address1* as the most preferred server).

### Example

```
Console(config-dhcp)#dns-server 10.1.1.253 192.168.3.19
Console(config-dhcp)#
```

**domain-name** This command specifies the domain name for a DHCP client. Use the **no** form to remove the domain name.

### Syntax

**domain-name** *domain*

**no domain-name**

*domain* - Specifies the domain name of the client.  
(Range: 1-32 characters)

### Default Setting

None

### Command Mode

DHCP Pool Configuration

### Example

```
Console(config-dhcp)#domain-name sample.com
Console(config-dhcp)#
```

**hardware-address** This command specifies the hardware address of a DHCP client. This command is valid for manual bindings only. Use the **no** form to remove the hardware address.

### Syntax

**hardware-address** *hardware-address type*

**no hardware-address**

*hardware-address* - Specifies the MAC address of the client device.

*type* - Indicates the following protocol used on the client device:

- ethernet
- ieee802
- fddi

### Default Setting

If no type is specified, the default protocol is Ethernet.

### Command Mode

DHCP Pool Configuration

### Command Usage

This command identifies a DHCP or BOOTP client to bind to an address specified in the [host](#) command. BOOTP clients cannot transmit a client identifier. To bind an address to a BOOTP client, you must associate a hardware address with the host entry.

### Example

```
Console(config-dhcp) #hardware-address 00-e0-29-94-34-28 ethernet
Console(config-dhcp) #
```

### Related Commands

[host \(876\)](#)

**host** Use this command to specify the IP address and network mask to manually bind to a DHCP client. Use the **no** form to remove the IP address for the client.

### Syntax

**host** *address* [*mask*]

**no host**

*address* - Specifies the IP address of a client.

*mask* - Specifies the network mask of the client.

### Default Setting

None

### Command Mode

DHCP Pool Configuration

### Usage Guidelines

- ◆ Host addresses must fall within the range specified for an existing network pool.
- ◆ When a client request is received, the switch first checks for a network address pool matching the gateway where the request originated (i.e., if the request was forwarded by a relay server). If there is no gateway in the client request (i.e., the request was not forwarded by a relay server), the switch searches for a network pool matching the interface through which the client request was received. It then searches for a manually configured host address that falls within the matching network pool.

- ◆ When searching for a manual binding, the switch compares the client identifier for DHCP clients, and then compares the hardware address for DHCP or BOOTP clients.
- ◆ If no manual binding has been specified for a host entry with the [client-identifier](#) or [hardware-address](#) commands, then the switch will assign an address from the matching network pool.
- ◆ If the mask is unspecified, DHCP examines its address pools. If no mask is found in the pool database, the Class A, B, or C natural mask is used (see [page 879](#)). This command is valid for manual bindings only.
- ◆ The **no host** command only clears the address from the DHCP server database. It does not cancel the IP address currently in use by the host.

### Example

```
Console(config-dhcp)#host 10.1.0.21 255.255.255.0
Console(config-dhcp)#
```

### Related Commands

[client-identifier \(873\)](#)

[hardware-address \(875\)](#)

**lease** This command configures the duration that an IP address is assigned to a DHCP client. Use the **no** form to restore the default value.

### Syntax

**lease** {*days* [*hours*] [*minutes*] | **infinite**}

**no lease**

*days* - Specifies the duration of the lease in numbers of days. (Range: 0-364)

*hours* - Specifies the number of hours in the lease. A *days* value must be supplied before you can configure *hours*. (Range: 0-23)

*minutes* - Specifies the number of minutes in the lease. A *days* and *hours* value must be supplied before you can configure *minutes*. (Range: 0-59)

**infinite** - Specifies that the lease time is unlimited. This option is normally used for addresses manually bound to a BOOTP client via the **host** command.

### Default Setting

One day

### Command Modes

DHCP Pool Configuration

### Command Usage

The lease time configured by this command will be overridden by a DHCP client request that includes an Option 51 lease time.

### Example

The following example leases an address to clients using this pool for 7 days.

```
Console(config-dhcp)#lease 7
Console(config-dhcp)#
```

**netbios-name-server** This command configures NetBIOS Windows Internet Naming Service (WINS) name servers that are available to Microsoft DHCP clients. Use the **no** form to remove the NetBIOS name server list.

### Syntax

**netbios-name-server** *address1* [*address2*]

**no netbios-name-server**

*address1* - Specifies IP address of primary NetBIOS WINS name server.

*address2* - Specifies IP address of alternate NetBIOS WINS name server.

### Default Setting

None

### Command Mode

DHCP Pool Configuration

### Usage Guidelines

Servers are listed in order of preference (starting with *address1* as the most preferred server).

### Example

```
Console(config-dhcp)#netbios-name-server 10.1.0.33 10.1.0.34
Console(config-dhcp)#
```

### Related Commands

[netbios-node-type \(879\)](#)

**netbios-node-type** This command configures the NetBIOS node type for Microsoft DHCP clients. Use the **no** form to remove the NetBIOS node type.

#### Syntax

**netbios-node-type** *type*

**no netbios-node-type**

*type* - Specifies the NetBIOS node type:

**broadcast**

**hybrid** (recommended)

**mixed**

**peer-to-peer**

#### Default Setting

None

#### Command Mode

DHCP Pool Configuration

#### Example

```
Console(config-dhcp)#netbios-node-type hybrid
Console(config-dhcp)#
```

#### Related Commands

[netbios-name-server \(878\)](#)

**network** This command configures the subnet number and mask for a DHCP address pool. Use the **no** form to remove the subnet number and mask.

#### Syntax

**network** *network-number* [*mask*]

**no network**

*network-number* - The IP address of the DHCP address pool.

*mask* - The bit combination that identifies the network (or subnet) and the host portion of the DHCP address pool.

#### Command Mode

DHCP Pool Configuration

#### Usage Guidelines

- ◆ When a client request is received, the switch first checks for a network address pool matching the gateway where the request originated (i.e., if the request was forwarded by a relay server). If there is no gateway in the client request (i.e.,

the request was not forwarded by a relay server), the switch searches for a network pool matching the interface through which the client request was received. It then searches for a manually configured host address that falls within the matching network pool. If no manually configured host address is found, it assigns an address from the matching network address pool. However, if no matching address pool is found the request is ignored.

- ◆ This command is valid for DHCP network address pools only. If the mask is not specified, the class A, B, or C natural mask is used. Subnet addresses are interpreted as class A, B or C, based on the first field in the specified address. In other words, if a subnet address `nnn.xxx.xxx.xxx` is entered, the first field (`nnn`) determines the class:

0 - 127 is class A, only uses the first field in the network address.

128 - 191 is class B, uses the first two fields in the network address.

192 - 223 is class C, uses the first three fields in the network address.

- ◆ The DHCP server assumes that all host addresses are available. You can exclude subsets of the address space by using the `ip dhcp excluded-address` command.

### Example

```
Console(config-dhcp)#network 10.1.0.0 255.255.255.0
Console(config-dhcp)#
```

**next-server** This command configures the next server in the boot process of a DHCP client. Use the **no** form to remove the boot server list.

### Syntax

**[no] next-server** *address*

*address* - Specifies the IP address of the next server in the boot process, which is typically a Trivial File Transfer Protocol (TFTP) server.

### Default Setting

None

### Command Mode

DHCP Pool Configuration

### Example

```
Console(config-dhcp)#next-server 10.1.0.21
Console(config-dhcp)#
```

### Related Commands

[bootfile \(872\)](#)



**clear ip dhcp binding** This command deletes an automatic address binding from the DHCP server database.

### Syntax

**clear ip dhcp binding** {*address* | \*} }

*address* - The address of the binding to clear.

\* - Clears all automatic bindings.

### Default Setting

None

### Command Mode

Privileged Exec

### Usage Guidelines

- ◆ An *address* specifies the client's IP address. If an asterisk (\*) is used as the address parameter, the DHCP server clears all automatic bindings.
- ◆ Use the **no host** command to delete a manual binding.
- ◆ This command is normally used after modifying the address pool, or after moving DHCP service to another device.

### Example.

```
Console#clear ip dhcp binding *
Console#
```

### Related Commands

[show ip dhcp binding \(882\)](#)

**show ip dhcp** This command displays a brief list of DHCP address pools configured on the switch.

### Command Mode

Privileged Exec

### Example

```
Console#show ip dhcp

      Name      Type      IP Address      Mask      Active Pool
-----
tps           Net    192.168.1.0      255.255.255.0  192.168.1.1    - 192.168.1.254

Total entry : 1
Console#
```

**show ip dhcp binding** This command displays address bindings on the DHCP server.

#### Syntax

**show ip dhcp binding** [*address*]

*address* - Specifies the IP address of the DHCP client for which bindings will be displayed.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#show ip dhcp binding

      IP                MAC                Lease Time                Start
              (dd/hh/mm/ss)
-----
      192.1.3.21  00-00-e8-98-73-21                86400 Dec 25 08:01:57 2002
Console#
```

**show ip dhcp pool** This command displays configuration settings for DHCP address pools.

#### Syntax

**show ip dhcp pool** [*host* | *network*]

**host** - Shows detailed settings for host device pools.

**network** - Shows detailed settings for network pools.

#### Default Setting

None

#### Command Mode

Privileged Exec

#### Example

```
Console#show ip dhcp pool
Pool name : R&D
Pool type : Network
Network address      : 192.168.0.1

Subnet mask          : 255.255.255.0

Boot file            :
Client identifier mode : Hex
Client identifier    :
```

```
Default router      : 0.0.0.0
                   : 0.0.0.0
DNS server          : 0.0.0.0
                   : 0.0.0.0
Domain name         :
Hardware type       : None
Hardware address    : 00-00-00-00-00-00
Lease time          : infinite
Netbios name server : 0.0.0.0
                   : 0.0.0.0
Netbios node type   : Hybrid
Next server         : 0.0.0.0
```

Console#

---



## IP Interface Commands

An IP Version 4 and Version 6 address may be used for management access to the switch over the network. Both IPv4 or IPv6 addresses can be used simultaneously to access the switch. You can manually configure a specific IPv4 or IPv6 address or direct the switch to obtain an IPv4 address from a BOOTP or DHCP server when it is powered on. An IPv6 address can either be manually configured or dynamically generated.

An IPv4 address for this switch is obtained via DHCP by default for VLAN 1. You may also need to establish an IPv4 or IPv6 default gateway between this device and management stations that exist on another network segment.

**Table 174: IP Interface Commands**

Command Group	Function
<a href="#">IPv4 Interface</a>	Configures an IPv4 address for the switch
<a href="#">IPv6 Interface</a>	Configures an IPv6 address for the switch
<a href="#">ND Snooping</a>	Maintains IPv6 prefix table and user address binding table which can be used for stateless address auto-configuration or for address filtering by IPv6 Source Guard

### IPv4 Interface

There are no IP addresses assigned to this switch by default. You must manually configure a new address to manage the switch over your network or to connect the switch to existing IP subnets. You may also need to establish a default gateway between this device and management stations or other devices that exist on another network segment (if routing is not enabled).

This section includes commands for configuring IP interfaces, the Address Resolution Protocol (ARP) and Proxy ARP.

**Table 175: IPv4 Interface Commands**

Command Group	Function
<a href="#">Basic IPv4 Configuration</a>	Configures the IP address for interfaces and the gateway router
<a href="#">ARP Configuration</a>	Configures static, dynamic and proxy ARP service
<a href="#">UDP Helper Configuration</a>	Forwards UDP broadcast packets to a specified server

**Basic IPv4 Configuration** This section describes commands used to configure IP addresses for VLAN interfaces on the switch.

**Table 176: Basic IP Configuration Commands**

Command	Function	Mode
<a href="#">ip address</a>	Sets the IP address for the current interface	IC
<a href="#">ip default-gateway</a>	Defines the default gateway through which this switch can reach other subnetworks	GC
<a href="#">show ip interface</a>	Displays the IP settings for this device	PE
<a href="#">show ip route</a>	Displays specified entries in the routing table	PE
<a href="#">show ip traffic</a>	Displays statistics for IP, ICMP, UDP, TCP and ARP protocols	PE
<a href="#">traceroute</a>	Shows the route packets take to the specified host	PE
<a href="#">ping</a>	Sends ICMP echo request packets to another node on the network	NE, PE

**ip address** This command sets the IPv4 address for the currently selected VLAN interface. Use the **no** form to remove an IP address.

#### Syntax

**ip address** *[ip-address netmask [default-gateway ip-address] | secondary]*  
*| bootp | dhcp*

**no ip address** *[ip-address netmask [secondary] | dhcp]*

*ip-address* - IP address

*netmask* - Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets. The network mask can be either in the traditional format xxx.xxx.xxx.xxx or use classless format with the range /5 to /32. For example the subnet 255.255.224.0 would be /19.

**default-gateway** - The default gateway. (Refer to the [ip default-gateway](#) command which provides the same function.)

**secondary** - Specifies that this is a secondary IP address.

**bootp** - Obtains IP address from BOOTP.

**dhcp** - Obtains IP address from DHCP.

#### Default Setting

DHCP

#### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ If this router is directly connected to end node devices (or connected to end nodes via shared media) that will be assigned to a specific subnet, then you must create a router interface for each VLAN that will support routing. The router interface consists of an IP address and subnet mask. This interface address defines both the network number to which the router interface is attached and the router's host number on that network. In other words, a router interface address defines the network and subnetwork numbers of the segment that is connected to that interface, and allows you to send IP packets to or from the router.
- ◆ Before any network interfaces are configured on the router, first create a VLAN for each unique user group, or for each network application and its associated users. Then assign the ports associated with each of these VLANs.
- ◆ An IP address must be assigned to this device to gain management access over the network or to connect the router to existing IP subnets. A specific IP address can be manually configured, or the router can be directed to obtain an address from a BOOTP or DHCP server. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Anything other than this format is not accepted by the configuration program.
- ◆ An interface can have only one primary IP address, but can have many secondary IP addresses. In other words, secondary addresses need to be specified if more than one IP subnet can be accessed through this interface. Note that a secondary address cannot be configured prior to setting the primary IP address, and the primary address cannot be removed if a secondary address is still present. Also, if any router/switch in a network segment uses a secondary address, all other routers/switches in that segment must also use a secondary address from the same network or subnet address space.
- ◆ If **bootp** or **dhcp** options are selected, the system will immediately start broadcasting service requests for all VLANs configured to obtain address assignments through BOOTP or DHCP. IP is enabled but will not function until a BOOTP or DHCP reply has been received. Requests are broadcast periodically by the router in an effort to learn its IP address. (BOOTP and DHCP values can include the IP address, default gateway, and subnet mask). If the DHCP/BOOTP server is slow to respond, you may need to use the [ip dhcp restart client](#) command to re-start broadcasting service requests, or reboot the router.



**Note:** Each VLAN group can be assigned its own IP interface address. You can manage the router via any of these IP addresses.

---

### Example

In the following example, the device is assigned an address in VLAN 1.

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#
```

This example assigns an IP address to VLAN 2 using a classless network mask.

```
Console(config)#interface vlan 2
Console(config-if)#ip address 10.2.2.1/24
Console(config-if)#
```

### Related Commands

[ip dhcp restart client \(863\)](#)

[ip default-gateway \(888\)](#)

[ipv6 address \(903\)](#)

**ip default-gateway** This command specifies the default gateway for destinations not found in local routing tables. Use the **no** form to remove a default gateway.

### Syntax

**ip default-gateway** *gateway*

**no ip default-gateway**

*gateway* - IP address of the default gateway

### Default Setting

No default gateway is established.

### Command Mode

Global Configuration

### Command Usage

- ◆ The default gateway can also be defined using the following Global configuration command: **ip route 0.0.0.0 0.0.0.0** *gateway-address*.
- ◆ Static routes can also be defined using the [ip route](#) command to ensure that traffic to the designated address or subnet passes through a preferred gateway.
- ◆ A default gateway can only be successfully set when a network interface that directly connects to the gateway has been configured on the router.
- ◆ The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address for a default gateway, include zone-id information indicating the VLAN identifier



after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface.

### Example

The following example defines a default gateway for this device:

```
Console(config)#ip default-gateway 192.168.0.1
Console(config)#end
Console#show ip route
Codes: C - connected, S - static, R - RIP, B - BGP
        O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
        * - candidate default

S*      0.0.0.0/0 [1/0] via 192.168.0.1, VLAN1
C       192.168.0.0/24 is directly connected, VLAN1
Console(config)#
```

### Related Commands

[ip address \(886\)](#)

[ip route \(954\)](#)

[ipv6 default-gateway \(902\)](#)

**show ip interface** This command displays the settings of an IPv4 interface.

### Command Mode

Privileged Exec

### Example

```
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
Address is 00-E0-00-00-00-01
Index: 1001, MTU: 1500
Address Mode is DHCP
IP Address: 192.168.0.2 Mask: 255.255.255.0
Proxy ARP is disabled
DHCP Inform is disabled
DHCP Relay Server:
Console#
```

### Related Commands

[ip address \(886\)](#)

[show ipv6 interface \(910\)](#)

**show ip traffic** This command displays statistics for IP, ICMP, UDP, TCP and ARP protocols.

**Command Mode**  
Privileged Exec

### Example

```
Console#show ip traffic
IP Statistics:
IP received
    7845 total received
        header errors
        unknown protocols
        address errors
        discards
    7845 delivers
        reassembly request datagrams
        reassembly succeeded
        reassembly failed
IP sent
    forwards datagrams
    9903 requests
        discards
        no routes
        generated fragments
        fragment succeeded
        fragment failed
ICMP Statistics:
ICMP received
    input
    errors
    destination unreachable messages
    time exceeded messages
    parameter problem message
    echo request messages
    echo reply messages
    redirect messages
    timestamp request messages
    timestamp reply messages
    source quench messages
    address mask request messages
    address mask reply messages
ICMP sent
    output
    errors
    destination unreachable messages
    time exceeded messages
    parameter problem message
    echo request messages
    echo reply messages
    redirect messages
    timestamp request messages
    timestamp reply messages
    source quench messages
    address mask request messages
    address mask reply messages
UDP Statistics:
    input
    no port errors
    other errors
    output
TCP Statistics:
    7841 input
```

```
          input errors
    9897 output
Console#
```

**traceroute** This command shows the route packets take to the specified destination.

### Syntax

**traceroute** *host*

*host* - IP address or alias of the host.

### Default Setting

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use the **traceroute** command to determine the path taken to reach a specified destination.
- ◆ A trace terminates when the destination responds, when the maximum timeout (TTL) is exceeded, or the maximum number of hops is exceeded.
- ◆ The traceroute command first sends probe datagrams with the TTL value set at one. This causes the first router to discard the datagram and return an error message. The trace function then sends several probe messages at each subsequent TTL level and displays the round-trip time for each message. Not all devices respond correctly to probes by returning an "ICMP port unreachable" message. If the timer goes off before a response is returned, the trace function prints a series of asterisks and the "Request Timed Out" message. A long sequence of these messages, terminating only when the maximum timeout has been reached, may indicate this problem with the target device.
- ◆ If the target device does not respond or other errors are detected, the switch will indicate this by one of the following messages:
  - \* - No Response
  - H - Host Unreachable
  - N - Network Unreachable
  - P - Protocol Unreachable
  - O -Other

### Example

```
Console#traceroute 192.168.0.1
Press "ESC" to abort.
Traceroute to 192.168.0.99, 30 hops max, timeout is 3 seconds
Hop  Packet 1 Packet 2 Packet 3 IP Address
-----
 1      20 ms   <10 ms   <10 ms 192.168.0.99

Trace completed.
Console#
```

**ping** This command sends (IPv4) ICMP echo request packets to another node on the network.

### Syntax

**ping** *host* [**count** *count*] [**size** *size*]

*host* - IP address or alias of the host.

*count* - Number of packets to send. (Range: 1-16)

*size* - Number of bytes in a packet. (Range: 32-512 bytes)

The actual packet size will be eight bytes larger than the size specified because the router adds header information.

### Default Setting

count: 5

size: 32 bytes

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

- ◆ Use the ping command to see if another site on the network can be reached.
- ◆ The following are some results of the **ping** command:
  - *Normal response* - The normal response occurs in one to ten seconds, depending on network traffic.
  - *Destination does not respond* - If the host does not respond, a “timeout” appears in ten seconds.
  - *Destination unreachable* - The gateway for this destination indicates that the destination is unreachable.
  - *Network or host unreachable* - The gateway found no corresponding entry in the route table.

- ◆ When pinging a host name, be sure the DNS server has been defined (page 855) and host name-to-address translation enabled (page 852). If necessary, local devices can also be specified in the DNS static host table (page 854).

### Example

```

Console#ping 10.1.0.9
Press ESC to abort.
PING to 10.1.0.9, by 5 32-byte payload ICMP packets, timeout is 5 seconds
response time: 10 ms
response time: 10 ms
response time: 10 ms
response time: 10 ms
response time: 0 ms
Ping statistics for 10.1.0.9:
    5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
    Minimum = 0 ms, Maximum = 10 ms, Average = 8 ms
Console#

```

### Related Commands

[interface \(412\)](#)

**ARP Configuration** This section describes commands used to configure the Address Resolution Protocol (ARP) on the switch.

**Table 177: Address Resolution Protocol Commands**

Command	Function	Mode
<a href="#">arp</a>	Adds a static entry in the ARP cache	GC
<a href="#">arp timeout</a>	Sets the time a dynamic entry remains in the ARP cache	GC
<a href="#">ip proxy-arp</a>	Enables proxy ARP service	IC
<a href="#">clear arp-cache</a>	Deletes all dynamic entries from the ARP cache	PE
<a href="#">show arp</a>	Displays entries in the ARP cache	NE, PE

**arp** This command adds a static entry in the Address Resolution Protocol (ARP) cache. Use the **no** form to remove an entry from the cache.

### Syntax

**arp** *ip-address hardware-address*

**no arp** *ip-address*

*ip-address* - IP address to map to a specified hardware address.

*hardware-address* - Hardware address to map to a specified IP address. (The format for this address is xx-xx-xx-xx-xx-xx.)

### Default Setting

No default entries

### Command Mode

Global Configuration

### Command Usage

- ◆ The ARP cache is used to map 32-bit IP addresses into 48-bit hardware (i.e., Media Access Control) addresses. This cache includes entries for hosts and other routers on local network interfaces defined on this router.
- ◆ The maximum number of static entries allowed in the ARP cache is 128.
- ◆ A static entry may need to be used if there is no response to an ARP broadcast message. For example, some applications may not respond to ARP requests or the response arrives too late, causing network operations to time out.
- ◆ Static entries will not be aged out nor deleted when power is reset. A static entry can only be removed through the configuration interface.

### Example

```
Console(config)#arp 10.1.0.19 01-02-03-04-05-06
Console(config)#
```

### Related Commands

[clear arp-cache \(896\)](#)

[show arp \(896\)](#)

**arp timeout** This command sets the aging time for dynamic entries in the Address Resolution Protocol (ARP) cache. Use the **no** form to restore the default timeout.

### Syntax

**arp timeout** *seconds*

**no arp timeout**

*seconds* - The time a dynamic entry remains in the ARP cache.  
(Range: 300-86400; 86400 seconds is one day)

### Default Setting

1200 seconds (20 minutes)

### Command Mode

Global Configuration

### Command Usage

- ◆ When a ARP entry expires, it is deleted from the cache and an ARP request packet is sent to re-establish the MAC address.
- ◆ The aging time determines how long dynamic entries remain in the cache. If the timeout is too short, the router may tie up resources by repeating ARP requests for addresses recently flushed from the table.

### Example

This example sets the ARP cache timeout for 15 minutes (i.e., 900 seconds).

```
Console(config)#arp timeout 900
Console(config)#
```

**ip proxy-arp** This command enables proxy Address Resolution Protocol (ARP). Use the **no** form to disable proxy ARP.

### Syntax

**[no] ip proxy-arp**

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Proxy ARP allows a non-routing device to determine the MAC address of a host on another subnet or network.
- ◆ End stations that require Proxy ARP must view the entire network as a single network. These nodes must therefore use a smaller subnet mask than that used by the router or other relevant network devices.
- ◆ Extensive use of Proxy ARP can degrade router performance because it may lead to increased ARP traffic and increased search time for larger ARP address tables.

### Example

```
Console(config)#interface vlan 3
Console(config-if)#ip proxy-arp
Console(config-if)#
```

**clear arp-cache** This command deletes all dynamic entries from the Address Resolution Protocol (ARP) cache.

**Command Mode**  
Privileged Exec

**Example**  
This example clears all dynamic entries in the ARP cache.

```
Console#clear arp-cache
This operation will delete all the dynamic entries in ARP Cache.
Do you want to continue this operation (y/n)?
Console#
```

**show arp** This command displays entries in the Address Resolution Protocol (ARP) cache.

**Command Mode**  
Normal Exec, Privileged Exec

#### Command Usage

- ◆ This command displays information about the ARP cache. The first line shows the cache timeout. It also shows each cache entry, including the IP address, MAC address, type (static, dynamic, other), and VLAN interface. Note that entry type "other" indicates local addresses for this router.
- ◆ Static entries are only displayed for VLANs that are up. In other words, static entries are only displayed when configured for the IP subnet of a existing VLAN, and that VLAN is linked up.

**Example**  
This example displays all entries in the ARP cache.

```
Console#show arp
ARP Cache Timeout: 1200 (seconds)

IP Address      MAC Address      Type      Interface
-----
10.1.0.0         FF-FF-FF-FF-FF other      VLAN1
10.1.0.254       00-00-AB-CD-00-00 other      VLAN1
10.1.0.255       FF-FF-FF-FF-FF other      VLAN1
145.30.20.23     09-50-40-30-20-10 dynamic     VLAN3

Total entry : 4
Console#
```



**UDP Helper Configuration** User Datagram Protocol (UDP) Helper allows host applications to forward UDP broadcast packets from this switch to another part of the network. This section describes the commands used to configure UDP Helper.

**Table 178: UDP Helper Commands**

Command	Function	Mode
<code>ip forward-protocol udp</code>	Specifies the UDP destination ports for which broadcast traffic will be forwarded	GC
<code>ip helper</code>	Enables UDP helper globally on the switch	GC
<code>ip helper-address</code>	Specifies the servers to which designated UDP protocol packets are forwarded	IC
<code>show ip helper</code>	Displays configuration settings for UDP helper	PE

**ip forward-protocol udp** This command specifies the UDP destination ports for which broadcast traffic will be forwarded when the UDP helper is enabled. Use the **no** form to remove a UDP port from the forwarding list.

#### Syntax

**[no] ip forward-protocol udp** *destination-port*

*destination-port* - UDP application port for which UDP service requests are forwarded. (Range: 1-65535)

#### Default Setting

The following UDP ports are included in the forwarding list when UDP helper is enabled with the `ip helper` command and a remote server address is configured with the `ip helper-address` command:

- BOOTP client port 67
- BOOTP server port 68
- Domain Name Service port 53
- IEN-116 Name Service port 42
- NetBIOS Datagram Server port 138
- NetBIOS Name Server port 137
- NTP port 37
- TACACS service port 49
- TFTP port 69

#### Command Mode

Global Configuration

#### Command Usage

Up to 100 UDP ports can be specified with this command for forwarding to one or more remote servers.

### Example

This example enables forwarding for DHCPv6 UDP packets.

```
Console(config)#ip forward-protocol udp 547
Console(config)#
```

**ip helper** This command enables UDP helper globally on the switch. Use the **no** form to disable this feature.

### Syntax

**[no] ip helper**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Network hosts occasionally use UDP broadcasts to determine information such as address configuration, and domain name mapping. These broadcasts are confined to the local subnet, either as an all hosts broadcast (all ones broadcast - 255.255.255.255), or a directed subnet broadcast (such as 10.10.10.255). To reduce the number of application servers deployed in a multi-segment network, UDP helper can be used to forward broadcast packets for specified UDP application ports to remote servers located in another network segment.
- ◆ To configure UDP helper, it must be enabled globally with the **ip helper** command. The UDP destination ports for which broadcast traffic will be forwarded must be specified with the **ip forward-protocol udp** command. And the remote servers which are configured to service UDP clients on another network segment specified with the **ip helper-address** command.

### Example

This example enables UDP helper globally on the switch.

```
Console(config)#ip helper
Console(config)#
```

**ip helper-address** This command specifies the application server or subnet (indicated by a directed broadcast address) to which designated UDP broadcast packets are forwarded. Use the **no** form to remove a UDP helper address.

### Syntax

**[no] ip helper-address** *ip-address*

*ip-address* - Host address or directed broadcast address to which UDP broadcast packets are forwarded. (Range: 1-65535)

### Default Setting

None

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Up to 20 helper addresses can be specified with this command.
- ◆ To forward UDP packets with the UDP helper, the clients must be connected to the selected interface, and the interface configured with an IP address.
- ◆ The UDP packets to be forwarded must be specified by the [ip forward-protocol udp](#) command, and the packets meet the following criteria:
  - The MAC address of the received frame must be all-ones broadcast address (ffff.ffff.ffff).
  - The IP destination address must be one of the following:
    - all-ones broadcast (255.255.255.255)
    - subnet broadcast for the receiving interface
  - The IP time-to-live (TTL) value must be at least 2.
  - The IP protocol must be UDP (17).
  - The UDP destination port must be TFTP, Domain Name System (DNS), Time, NetBIOS, BOOTP or DHCP packet, or a UDP port specified by the [ip forward-protocol udp](#) command.
- ◆ If a helper address is specified with this command, but no UDP ports have been specified with the [ip forward-protocol udp](#) command, broadcast traffic for several UDP protocol types will be forwarded by default as described under the [ip forward-protocol udp](#) command.

### Example

This example indicates that designated UDP broadcast packets are to be forwarded to the directed broadcast address of 192.168.2.255.

```
Console(config)#interface vlan 1
Console(config-if)#ip helper-address 192.168.2.255
Console(config-if)#
```

**show ip helper** This command displays configuration settings for UDP helper.

### Command Mode

Privileged Exec

### Command Usage

This command displays all configuration settings for UDP helper, including its functional status, the UDP ports for which broadcast traffic will be forwarded, and the remote servers or subnets to which the traffic will be forwarded.

### Example

```
Console#show ip helper
Helper mechanism is enabled
Forward port list(maximum count: 100)
  547
Total port number now is: 1
Helper address list(maximum count: 1024)
Interface VLAN 1:
  192.168.2.255
Total helper number now is: 1
Console#
```

## IPv6 Interface

This switch supports the following IPv6 interface commands.

**Table 179: IPv6 Configuration Commands**

Command	Function	Mode
<i>Interface Address Configuration and Utilities</i>		
<a href="#">ipv6 default-gateway</a>	Sets an IPv6 default gateway for traffic with no known next hop	GC
<a href="#">ipv6 address</a>	Configures an IPv6 global unicast address, and enables IPv6 on an interface	IC
<a href="#">ipv6 address eui-64</a>	Configures an IPv6 global unicast address for an interface using an EUI-64 interface ID in the low order 64 bits, and enables IPv6 on the interface	IC
<a href="#">ipv6 address link-local</a>	Configures an IPv6 link-local address for an interface and enables IPv6 on the interface	IC

Table 179: IPv6 Configuration Commands (Continued)

Command	Function	Mode
<code>ipv6 enable</code>	Enables IPv6 on an interface that has not been configured with an explicit IPv6 address	IC
<code>ipv6 mtu</code>	Sets the size of the maximum transmission unit (MTU) for IPv6 packets sent on an interface	IC
<code>show ipv6 interface</code>	Displays the usability and configured settings for IPv6 interfaces	PE
<code>show ipv6 mtu</code>	Displays maximum transmission unit (MTU) information for IPv6 interfaces	PE
<code>show ipv6 traffic</code>	Displays statistics about IPv6 traffic	PE
<code>clear ipv6 traffic</code>	Resets IPv6 traffic counters	PE
<code>ping6</code>	Sends IPv6 ICMP echo request packets to another node on the network	PE
<code>tracert6</code>	Shows the route packets take to the specified host	PE
<i>Neighbor Discovery</i>		
<code>ipv6 hop-limit</code>	Configures the maximum number of hops used in router advertisements that are originated by this router	GC
<code>ipv6 nd dad attempts</code>	Configures the number of consecutive neighbor solicitation messages sent on an interface during duplicate address detection	IC
<code>ipv6 nd managed-config-flag</code>	Configures router advertisements to indicate that attached hosts can use stateful autoconfiguration to obtain addresses	IC
<code>ipv6 nd other-config-flag</code>	Configures router advertisements to indicate that attached hosts can obtain autoconfiguration information other than addresses	IC
<code>ipv6 nd ns-interval</code>	Configures the interval between IPv6 neighbor solicitation retransmissions on an interface	IC
<code>ipv6 nd raguard</code>	Blocks incoming Router Advertisement and Router Redirect packets	IC
<code>ipv6 nd reachable-time</code>	Configures the amount of time that a remote IPv6 node is considered reachable after some reachability confirmation event has occurred	IC
<code>ipv6 nd prefix</code>	Configures the IPv6 prefixes to include in router advertisements	IC
<code>ipv6 nd ra interval</code>	Configures the interval between the transmission of router advertisements on an interface	IC
<code>ipv6 nd ra lifetime</code>	Configures the router lifetime value used in router advertisements sent from an interface	IC
<code>ipv6 nd ra router-preference</code>	Configures the default router preference for the router on an interface	IC
<code>ipv6 nd ra suppress</code>	Suppresses router advertisement transmissions on an interface	IC
<code>ipv6 neighbor</code>	Configures a static entry in the IPv6 neighbor discovery cache	GC
<code>clear ipv6 neighbors</code>	Deletes all dynamic entries in the IPv6 neighbor discovery cache	PE

Table 179: IPv6 Configuration Commands (Continued)

Command	Function	Mode
<code>show ipv6 nd raguard</code>	Displays the configuration setting for RA Guard	PE
<code>show ipv6 neighbors</code>	Displays information in the IPv6 neighbor discovery cache	PE

## Interface Address Configuration and Utilities

**ipv6 default-gateway** This command sets an IPv6 default gateway to use for destinations with no known next hop. Use the **no** form to remove a previously configured default gateway.

### Syntax

**ipv6 default-gateway** *ipv6-address*

**no ipv6 default-gateway**

*ipv6-address* - The IPv6 address of the default next hop router to use for destinations with no known next hop.

### Default Setting

No default gateway is defined

### Command Mode

Global Configuration

### Command Usage

- ◆ All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.
- ◆ The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface.
- ◆ An IPv6 default gateway should be defined if the destination has been assigned an IPv6 address that is located in a different IP segment.
- ◆ An IPv6 default gateway can only be successfully set when a network interface that directly connects to the gateway has been configured on the router.

### Example

The following example defines a default gateway for this device:

```
Console(config)#ipv6 default-gateway FE80::269:3EF9:FE19:6780%1
Console(config)#
```

**Related Commands**[show ipv6 route \(959\)](#)[ip default-gateway \(888\)](#)

**ipv6 address** This command configures an IPv6 global unicast address and enables IPv6 on an interface. Use the **no** form without any arguments to remove all IPv6 addresses from the interface, or use the **no** form with a specific IPv6 address to remove that address from the interface.

**Syntax**

**[no] ipv6 address** *ipv6-address[/prefix-length]*

*ipv6-address* - A full IPv6 address including the network prefix and host address bits.

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

**Default Setting**

No IPv6 addresses are defined

**Command Mode**

Interface Configuration (VLAN)

**Command Usage**

- ◆ All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.
- ◆ To connect to a larger network with multiple subnets, you must configure a global unicast address. This address can be manually configured with this command.
- ◆ If a link-local address has not yet been assigned to this interface, this command will assign the specified static global unicast address and also dynamically generate a link-local unicast address for the interface. (The link-local address is made with an address prefix of FE80 and a host portion based the switch's MAC address in modified EUI-64 format.)
- ◆ If a duplicate address is detected, a warning message is sent to the console.

**Example**

This example specifies a full IPv6 address and prefix length.

---

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address 2001:DB8:2222:7272::72/96
Console(config-if)#end
```

```
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
    fe80::7272:cfff:fe83:3466%1/64
Global unicast address(es):
    2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
    ff02::1:ff00:72
    ff02::1:ff83:3466
    ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

### Related Commands

[ipv6 address eui-64 \(904\)](#)

[show ipv6 interface \(910\)](#)

[ip address \(886\)](#)

**ipv6 address eui-64** This command configures an IPv6 address for an interface using an EUI-64 interface ID in the low order 64 bits and enables IPv6 on the interface. Use the **no** form without any arguments to remove all manually configured IPv6 addresses from the interface. Use the **no** form with a specific address to remove it from the interface.

### Syntax

**ipv6 address *ipv6-prefix/prefix-length* eui-64**

**no ipv6 address [*ipv6-prefix/prefix-length* eui-64]**

*ipv6-prefix* - The IPv6 network portion of the address assigned to the interface.

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

### Default Setting

No IPv6 addresses are defined

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The prefix must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double



colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

- ◆ If a link local address has not yet been assigned to this interface, this command will dynamically generate a global unicast address and a link-local address for this interface. (The link-local address is made with an address prefix of FE80 and a host portion based the switch's MAC address in modified EUI-64 format.)
- ◆ Note that the value specified in the ipv6-prefix may include some of the high-order host bits if the specified prefix length is less than 64 bits. If the specified prefix length exceeds 64 bits, then the network portion of the address will take precedence over the interface identifier.
- ◆ If a duplicate address is detected, a warning message is sent to the console.
- ◆ IPv6 addresses are 16 bytes long, of which the bottom 8 bytes typically form a unique host identifier based on the device's MAC address. The EUI-64 specification is designed for devices that use an extended 8-byte MAC address. For devices that still use a 6-byte MAC address (also known as EUI-48 format), it must be converted into EUI-64 format by inverting the universal/local bit in the address and inserting the hexadecimal number FFFE between the upper and lower three bytes of the MAC address.
- ◆ For example, if a device had an EUI-48 address of 28-9F-18-1C-82-35, the global/local bit must first be inverted to meet EUI-64 requirements (i.e., 1 for globally defined addresses and 0 for locally defined addresses), changing 28 to 2A. Then the two bytes FFFE are inserted between the OUI (i.e., company id) and the rest of the address, resulting in a modified EUI-64 interface identifier of 2A-9F-18-FF-FE-1C-82-35.
- ◆ This host addressing method allows the same interface identifier to be used on multiple IP interfaces of a single device, as long as those interfaces are attached to different subnets.

### Example

This example uses the network prefix of 2001:0DB8:0:1::/64, and specifies that the EUI-64 interface identifier be used in the lower 64 bits of the address.

```

Console(config)#interface vlan 1
Console(config-if)#ipv6 address 2001:0DB8:0:1::/64 eui-64
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
    fe80::7272:cfff:fe83:3466%1/64
Global unicast address(es):
    2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
    2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
    ff02::1:ff00:72
    ff02::1:ff83:3466
    ff02::1
  
```

```
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds
```

Console#

### Related Commands

[show ipv6 interface \(910\)](#)

**ipv6 address link-local** This command configures an IPv6 link-local address for an interface and enables IPv6 on the interface. Use the **no** form without any arguments to remove all manually configured IPv6 addresses from the interface. Use the **no** form with a specific address to remove it from the interface.

### Syntax

**ipv6 address** *ipv6-address* **link-local**

**no ipv6 address** [*ipv6-address* **link-local**]

*ipv6-address* - The IPv6 address assigned to the interface.

### Default Setting

No IPv6 addresses are defined

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The specified address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. And the address prefix must be in the range of FE80~FEBF.
- ◆ The address specified with this command replaces a link-local address that was automatically generated for the interface.
- ◆ You can configure multiple IPv6 global unicast addresses per interface, but only one link-local address per interface.
- ◆ If a duplicate address is detected, a warning message is sent to the console.

### Example

This example assigns a link-local address of FE80::269:3EF9:FE19:6779 to VLAN 1. Note that a prefix in the range of FE80~FEBF is required for link-local addresses, and the first 16-bit group in the host address is padded with a zero in the form 0269.

```

Console(config)#interface vlan 1
Console(config-if)#ipv6 address FE80::269:3EF9:FE19:6779 link-local
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
    fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
    2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
    2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
    ff02::1:ff19:6779
    ff02::1:ff00:72
    ff02::1:ff83:3466
    ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#

```

### Related Commands

[ipv6 enable \(907\)](#)

[show ipv6 interface \(910\)](#)

**ipv6 enable** This command enables IPv6 on an interface that has not been configured with an explicit IPv6 address. Use the **no** form to disable IPv6 on an interface that has not been configured with an explicit IPv6 address.

### Syntax

**[no] ipv6 enable**

### Default Setting

IPv6 is disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ This command enables IPv6 on the current VLAN interface and automatically generates a link-local unicast address. The address prefix uses FE80, and the host portion of the address is generated by converting the switch's MAC

address to modified EUI-64 format (see [page 904](#)). This address type makes the switch accessible over IPv6 for all devices attached to the same local subnet.

- ◆ If a duplicate address is detected on the local segment, this interface will be disabled and a warning message displayed on the console.
- ◆ The **no ipv6 enable** command does not disable IPv6 for an interface that has been explicitly configured with an IPv6 address.

### Example

In this example, IPv6 is enabled on VLAN 1, and the link-local address FE80::2E0:CFF:FE00:FD/64 is automatically generated by the switch.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 enable
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
    fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
    2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
    2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
    ff02::1:ff19:6779
    ff02::1:ff00:72
    ff02::1:ff83:3466
    ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

### Related Commands

[ipv6 address link-local \(906\)](#)

[show ipv6 interface \(910\)](#)

**ipv6 mtu** This command sets the size of the maximum transmission unit (MTU) for IPv6 packets sent on an interface. Use the **no** form to restore the default setting.

### Syntax

**ipv6 mtu** *size*

**no ipv6 mtu**

*size* - Specifies the MTU size. (Range: 1280-65535 bytes)

### Default Setting

1500 bytes

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ If a non-default value is configured, an MTU option is included in the router advertisements sent from this device.
- ◆ The maximum value set by this command cannot exceed the MTU of the physical interface, which is currently fixed at 1500 bytes.
- ◆ IPv6 routers do not fragment IPv6 packets forwarded from other routers. However, traffic originating from an end-station connected to an IPv6 router may be fragmented.
- ◆ All devices on the same physical medium must use the same MTU in order to operate correctly.
- ◆ IPv6 must be enabled on an interface before the MTU can be set.

### Example

The following example sets the MTU for VLAN 1 to 1280 bytes:

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mtu 1280
Console(config-if)#
```

### Related Commands

[show ipv6 mtu \(912\)](#)

[jumbo frame \(131\)](#)

**show ipv6 interface** This command displays the usability and configured settings for IPv6 interfaces.

### Syntax

**show ipv6 interface** [**brief** [**vlan** *vlan-id* [*ipv6-prefix/prefix-length*]]]

**brief** - Displays a brief summary of IPv6 operational status and the addresses configured for each interface.

*vlan-id* - VLAN ID (Range: 1-4094)

*ipv6-prefix* - The IPv6 network portion of the address assigned to the interface. The prefix must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*prefix-length* - A decimal value indicating how many of the contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

### Command Mode

Privileged Exec

### Example

This example displays all the IPv6 addresses configured for the switch.

```
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
    fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
    2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
    2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
    ff02::1:ff19:6779
    ff02::1:ff00:72
    ff02::1:ff83:3466
    ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

Table 180: show ipv6 interface - display description

Field	Description
VLAN	A VLAN is marked "up" if the switch can send and receive packets on this interface, "down" if a line signal is not present, or "administratively down" if the interface has been disabled by the administrator.
IPv6	IPv6 is marked "enable" if the switch can send and receive IP traffic on this interface, "disable" if the switch cannot send and receive IP traffic on this interface, or "stalled" if a duplicate link-local address is detected on the interface.
Link-local address	Shows the link-local address assigned to this interface
Global unicast address(es)	Shows the global unicast address(es) assigned to this interface
Joined group address(es)	<p>In addition to the unicast addresses assigned to an interface, a node is required to join the all-nodes multicast addresses FF01::1 and FF02::1 for all IPv6 nodes within scope 1 (interface-local) and scope 2 (link-local), respectively.</p> <p>FF01::1/16 is the transient interface-local multicast address for all attached IPv6 nodes, and FF02::1/16 is the link-local multicast address for all attached IPv6 nodes. The interface-local multicast address is only used for loopback transmission of multicast traffic. Link-local multicast addresses cover the same types as used by link-local unicast addresses, including all nodes (FF02::1), all routers (FF02::2), and solicited nodes (FF02::1:FFXX:XXXX) as described below.</p> <p>A node is also required to compute and join the associated solicited-node multicast addresses for every unicast and anycast address it is assigned. IPv6 addresses that differ only in the high-order bits, e.g. due to multiple high-order prefixes associated with different aggregations, will map to the same solicited-node address, thereby reducing the number of multicast addresses a node must join. In this example, FF02::1:FF90:0/104 is the solicited-node multicast address which is formed by taking the low-order 24 bits of the address and appending those bits to the prefix.</p>
ND DAD	Indicates whether (neighbor discovery) duplicate address detection is enabled.
number of DAD attempts	The number of consecutive neighbor solicitation messages sent on the interface during duplicate address detection.
ND retransmit interval	The interval between IPv6 neighbor solicitation retransmissions sent on an interface during duplicate address detection.
ND advertised retransmit interval	The retransmit interval is included in all router advertisements sent out of an interface so that nodes on the same link use the same time value.
ND reachable time	The amount of time a remote IPv6 node is considered reachable after a reachability confirmation event has occurred
ND advertised reachable time	The reachable time is included in all router advertisements sent out of an interface so that nodes on the same link use the same time value.
ND advertised router lifetime	The length of time during which the prefix is valid for on-link determination.

This example displays a brief summary of IPv6 addresses configured on the switch.

```

Console#show ipv6 interface brief
Interface      VLAN      IPv6      IPv6 Address
-----
VLAN 1         Up        Up        2001:DB8:2222:7273::72/96
VLAN 1         Up        Up        FE80::2E0:CFF:FE00:FD%1/64
Console#

```

### Related Commands

[show ip interface \(889\)](#)

**show ipv6 mtu** This command displays the maximum transmission unit (MTU) cache for destinations that have returned an ICMP packet-too-big message along with an acceptable MTU to this switch.

### Command Mode

Normal Exec, Privileged Exec

### Example

The following example shows the MTU cache for this device:

```
Console#show ipv6 mtu
MTU      Since      Destination Address
1400     00:04:21    5000:1::3
1280     00:04:50    FE80::203:A0FF:FED6:141D
Console#
```

**Table 181: show ipv6 mtu - display description\***

Field	Description
MTU	Adjusted MTU contained in the ICMP packet-too-big message returned from this destination, and now used for all traffic sent along this path.
Since	Time since an ICMP packet-too-big message was received from this destination.
Destination Address	Address which sent an ICMP packet-too-big message.

\* No information is displayed if an IPv6 address has not been assigned to the switch.

**show ipv6 traffic** This command displays statistics about IPv6 traffic passing through this switch.

### Command Mode

Privileged Exec

### Example

The following example shows statistics for all IPv6 unicast and multicast traffic, as well as ICMP, UDP and TCP statistics:

```
Console#show ipv6 traffic
IPv6 Statistics:
IPv6 received
                                total received
                                header errors
                                too big errors
                                no routes
                                address errors
                                unknown protocols
```



```

truncated packets
discards
delivers
reassembly request datagrams
reassembly succeeded
reassembly failed

IPv6 sent

forwards datagrams
requests
discards
no routes
generated fragments
fragment succeeded
fragment failed

ICMPv6 Statistics:
ICMPv6 received

input
errors
destination unreachable messages
packet too big messages
time exceeded messages
parameter problem message
echo request messages
echo reply messages
router solicit messages
router advertisement messages
neighbor solicit messages
neighbor advertisement messages
redirect messages
group membership query messages
group membership response messages
group membership reduction messages
multicast listener discovery version 2 reports

ICMPv6 sent

output
destination unreachable messages
packet too big messages
time exceeded messages
parameter problem message
echo request messages
echo reply messages
router solicit messages
router advertisement messages
neighbor solicit messages
neighbor advertisement messages
redirect messages
group membership query messages
group membership response messages
group membership reduction messages
multicast listener discovery version 2 reports

UDP Statistics:

input
no port errors
other errors
output

Console#

```

**Table 182: show ipv6 traffic - display description**

Field	Description
<i>IPv6 Statistics</i>	
<i>IPv6 received</i>	
total received	The total number of input datagrams received by the interface, including those received in error.
header errors	The number of input datagrams discarded due to errors in their IPv6 headers, including version number mismatch, other format errors, hop count exceeded, IPv6 options, etc.
too big errors	The number of input datagrams that could not be forwarded because their size exceeded the link MTU of outgoing interface.
no routes	The number of input datagrams discarded because no route could be found to transmit them to their destination.
address errors	The number of input datagrams discarded because the IPv6 address in their IPv6 header's destination field was not a valid address to be received at this entity. This count includes invalid addresses (e.g., ::0) and unsupported addresses (e.g., addresses with unallocated prefixes). For entities which are not IPv6 routers and therefore do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.
unknown protocols	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol. This counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the datagrams.
truncated packets	The number of input datagrams discarded because datagram frame didn't carry enough data.
discards	The number of input IPv6 datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). Note that this counter does not include any datagrams discarded while awaiting re-assembly.
delivers	The total number of datagrams successfully delivered to IPv6 user-protocols (including ICMP). This counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the datagrams.
reassembly request datagrams	The number of IPv6 fragments received which needed to be reassembled at this interface. Note that this counter is incremented at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.
reassembly succeeded	The number of IPv6 datagrams successfully reassembled. Note that this counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the fragments.
reassembly failed	The number of failures detected by the IPv6 re-assembly algorithm (for whatever reason: timed out, errors, etc.). Note that this is not necessarily a count of discarded IPv6 fragments since some algorithms (notably the algorithm in RFC 815) can lose track of the number of fragments by combining them as they are received. This counter is incremented at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.

**Table 182: show ipv6 traffic - display description** (Continued)

Field	Description
<i>IPv6 sent</i>	
forwards datagrams	The number of output datagrams which this entity received and forwarded to their final destinations. In entities which do not act as IPv6 routers, this counter will include only those packets which were Source-Routed via this entity, and the Source-Route processing was successful. Note that for a successfully forwarded datagram the counter of the outgoing interface is incremented.
requests	The total number of IPv6 datagrams which local IPv6 user-protocols (including ICMP) supplied to IPv6 in requests for transmission. Note that this counter does not include any datagrams counted in <code>ipv6IfStatsOutForwDatagrams</code> .
discards	The number of output IPv6 datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). Note that this counter would include datagrams counted in <code>ipv6IfStatsOutForwDatagrams</code> if any such packets met this (discretionary) discard criterion.
no routes	The number of input datagrams discarded because no route could be found to transmit them to their destination.
generated fragments	The number of output datagram fragments that have been generated as a result of fragmentation at this output interface.
fragment succeeded	The number of IPv6 datagrams that have been successfully fragmented at this output interface.
fragment failed	The number of IPv6 datagrams that have been discarded because they needed to be fragmented at this output interface but could not be.
<i>ICMPv6 Statistics</i>	
<i>ICMPv6 received</i>	
input	The total number of ICMP messages received by the interface which includes all those counted by <code>ipv6IfIcmpInErrors</code> . Note that this interface is the interface to which the ICMP messages were addressed which may not be necessarily the input interface for the messages.
errors	The number of ICMP messages which the interface received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
destination unreachable messages	The number of ICMP Destination Unreachable messages received by the interface.
packet too big messages	The number of ICMP Packet Too Big messages received by the interface.
time exceeded messages	The number of ICMP Time Exceeded messages received by the interface.
parameter problem message	The number of ICMP Parameter Problem messages received by the interface.
echo request messages	The number of ICMP Echo (request) messages received by the interface.
echo reply messages	The number of ICMP Echo Reply messages received by the interface.
router solicit messages	The number of ICMP Router Solicit messages received by the interface.
router advertisement messages	The number of ICMP Router Advertisement messages received by the interface.

**Table 182: show ipv6 traffic - display description** (Continued)

Field	Description
neighbor solicit messages	The number of ICMP Neighbor Solicit messages received by the interface.
neighbor advertisement messages	The number of ICMP Neighbor Advertisement messages received by the interface.
redirect messages	The number of Redirect messages received by the interface.
group membership query messages	The number of ICMPv6 Group Membership Query messages received by the interface.
group membership response messages	The number of ICMPv6 Group Membership Response messages received by the interface.
group membership reduction messages	The number of ICMPv6 Group Membership Reduction messages received by the interface.
multicast listener discovery version 2 reports	The number of MLDv2 reports received by the interface.
<i>ICMPv6 sent</i>	
output	The total number of ICMP messages which this interface attempted to send. Note that this counter includes all those counted by icmpOutErrors.
destination unreachable messages	The number of ICMP Destination Unreachable messages sent by the interface.
packet too big messages	The number of ICMP Packet Too Big messages sent by the interface.
time exceeded messages	The number of ICMP Time Exceeded messages sent by the interface.
parameter problem message	The number of ICMP Parameter Problem messages sent by the interface.
echo request messages	The number of ICMP Echo (request) messages sent by the interface.
echo reply messages	The number of ICMP Echo Reply messages sent by the interface.
router solicit messages	The number of ICMP Router Solicitation messages sent by the interface.
router advertisement messages	The number of ICMP Router Advertisement messages sent by the interface.
neighbor solicit messages	The number of ICMP Neighbor Solicit messages sent by the interface.
neighbor advertisement messages	The number of ICMP Router Advertisement messages sent by the interface.
redirect messages	The number of Redirect messages sent. For a host, this object will always be zero, since hosts do not send redirects.
group membership query messages	The number of ICMPv6 Group Membership Query messages sent by the interface.
group membership response messages	The number of ICMPv6 Group Membership Response messages sent.
group membership reduction messages	The number of ICMPv6 Group Membership Reduction messages sent.
multicast listener discovery version 2 reports	The number of MLDv2 reports sent by the interface.

Table 182: show ipv6 traffic - display description (Continued)

Field	Description
<i>UDP Statistics</i>	
input	The total number of UDP datagrams delivered to UDP users.
no port errors	The total number of received UDP datagrams for which there was no application at the destination port.
other errors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
output	The total number of UDP datagrams sent from this entity.

**clear ipv6 traffic** This command resets IPv6 traffic counters.

#### Command Mode

Privileged Exec

#### Command Usage

This command resets all of the counters displayed by the [show ipv6 traffic](#) command.

#### Example

```
Console#clear ipv6 traffic
Console#
```

**ping6** This command sends (IPv6) ICMP echo request packets to another node on the network.

#### Syntax

**ping6** {*ipv6-address* | *host-name*} [**count** *count*] [**size** *size*]

*ipv6-address* - The IPv6 address of a neighbor device. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*host-name* - A host name string which can be resolved into an IPv6 address through a domain name server.

*count* - Number of packets to send. (Range: 1-16)

*size* - Number of bytes in a packet. (Range: 0-1500 bytes)

The actual packet size will be eight bytes larger than the size specified because the router adds header information.

### Default Setting

count: 5

size: 32 bytes

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use the **ping6** command to see if another site on the network can be reached, or to evaluate delays over the path.
- ◆ The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface from which the ping is sent.
- ◆ When pinging a host name, be sure the DNS server has been enabled (see [page 852](#)). If necessary, local devices can also be specified in the DNS static host table (see [page 854](#)).
- ◆ When using ping6 with a host name, the router first attempts to resolve the alias into an IPv6 address before trying to resolve it into an IPv4 address.

### Example

```
Console#ping6 FE80::2E0:CFF:FE00:FC%1/64
Press ESC to abort.
PING to FE80::2E0:CFF:FE00:FC%1/64, by 5 32-byte payload ICMP packets,
  timeout is 3 seconds
response time: 20 ms    [FE80::2E0:CFF:FE00:FC] seq_no: 1
response time: 0 ms    [FE80::2E0:CFF:FE00:FC] seq_no: 2
response time: 0 ms    [FE80::2E0:CFF:FE00:FC] seq_no: 3
response time: 0 ms    [FE80::2E0:CFF:FE00:FC] seq_no: 4
response time: 0 ms    [FE80::2E0:CFF:FE00:FC] seq_no: 5
Ping statistics for FE80::2E0:CFF:FE00:FC%1/64:
  5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
  Minimum = 0 ms, Maximum = 20 ms, Average = 4 ms
Console#
```

**traceroute6** This command shows the route packets take to the specified destination.

### Syntax

**traceroute6** {*ipv6-address* | *host-name*} [**max-failures** *failure-count*]

*ipv6-address* - The IPv6 address of a neighbor device. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*host-name* - A host name string which can be resolved into an IPv6 address through a domain name server.

*failure-count* - The maximum number of failures before which the trace route is terminated. (Range: 1-255)

### Default Setting

Maximum failures: 5

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use the **traceroute6** command to determine the path taken to reach a specified destination.
- ◆ The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface from which the ping is sent.
- ◆ A trace terminates when the destination responds, when the maximum timeout (TTL) is exceeded, or the maximum number of hops is exceeded.
- ◆ The traceroute command first sends probe datagrams with the TTL value set at one. This causes the first router to discard the datagram and return an error message. The trace function then sends several probe messages at each subsequent TTL level and displays the round-trip time for each message. Not all devices respond correctly to probes by returning an "ICMP port unreachable" message. If the timer goes off before a response is returned, the trace function prints a series of asterisks and the "Request Timed Out" message. A long sequence of these messages, terminating only when the maximum timeout has been reached, may indicate this problem with the target device.

### Example

```
Console#traceroute6 FE80::2E0:CFF:FE9C:CA10%1
Press "ESC" to abort.
```

```
Traceroute to FE80::2E0:CFF:FE9C:CA10%1/64, 30 hops max, timeout is 3
seconds, 5 max failure(s) before termination.
```

```
Hop Packet 1 Packet 2 Packet 3 IPv6 Address
```

```
-----
1      <10 ms   <10 ms   <10 ms FE80::2E0:CFF:FE9C:CA10%1/64
```

```
Trace completed.
Console#
```

## Neighbor Discovery

**ipv6 hop-limit** This command configures the maximum number of hops used in router advertisements that are originated by this router. Use the **no** form to restore the default setting.

### Syntax

**ipv6 hop-limit** *hops*

**no ipv6 hop-limit**

*hops* - The maximum number of hops in router advertisements and all IPv6 packets. (Range: 1-255)

### Default Setting

1

### Command Mode

Global Configuration

### Example

The following sets the hop limit for router advertisements to 64:

```
Console(config)#ipv6 hop-limit 64
Console(config)#
```

**ipv6 nd dad attempts** This command configures the number of consecutive neighbor solicitation messages sent on an interface during duplicate address detection. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd dad attempts** *count*

**no ipv6 nd dad attempts**

*count* - The number of neighbor solicitation messages sent to determine whether or not a duplicate address exists on this interface. (Range: 0-600)

### Default Setting

3

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Configuring a value of 0 disables duplicate address detection.



- ◆ Duplicate address detection determines if a new unicast IPv6 address already exists on the network before it is assigned to an interface.
- ◆ Duplicate address detection is stopped on any interface that has been suspended (see the [vlan](#) command). While an interface is suspended, all unicast IPv6 addresses assigned to that interface are placed in a “pending” state. Duplicate address detection is automatically restarted when the interface is administratively re-activated.
- ◆ An interface that is re-activated restarts duplicate address detection for all unicast IPv6 addresses on the interface. While duplicate address detection is performed on the interface’s link-local address, the other IPv6 addresses remain in a “tentative” state. If no duplicate link-local address is found, duplicate address detection is started for the remaining IPv6 addresses.
- ◆ If a duplicate address is detected, it is set to “duplicate” state, and a warning message is sent to the console. If a duplicate link-local address is detected, IPv6 processes are disabled on the interface. If a duplicate global unicast address is detected, it is not used. All configuration commands associated with a duplicate address remain configured while the address is in “duplicate” state.
- ◆ If the link-local address for an interface is changed, duplicate address detection is performed on the new link-local address, but not for any of the IPv6 global unicast addresses already associated with the interface.

### Example

The following configures five neighbor solicitation attempts for addresses configured on VLAN 1. The [show ipv6 interface](#) command indicates that the duplicate address detection process is still on-going.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 nd dad attempts 5
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
  fe80::200:e8ff:fe90:0/64
Global unicast address(es):
  2009:db9:2229::79, subnet is 2009:db9:2229:0::/64
Joined group address(es):
  ff01::1/16
  ff02::1/16
  ff02::1:ff00:79/104
  ff02::1:ff90:0/104
IPv6 link MTU is 1500 bytes.
ND DAD is enabled, number of DAD attempts: 5.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

### Related Commands

[ipv6 nd ns-interval \(923\)](#)

[show ipv6 neighbors \(932\)](#)

**ipv6 nd managed-config-flag** This command configures IPv6 router advertisements to indicate to attached hosts that they can use stateful autoconfiguration to obtain addresses. Use the **no** form to clear this flag from router advertisements.

### Syntax

**[no] ipv6 nd managed-config-flag**

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The “managed-address configuration” flag tells hosts that they should use stateful autoconfiguration to obtain addresses from a DHCPv6 server.
- ◆ The [ipv6 nd other-config-flag](#) command is used to tell hosts that they should use stateless address autoconfiguration to get IPv6 address (based on the IPv6 prefixes found in router advertisements) and stateful autoconfiguration to get other non-address parameters (such as DNS server addresses) from DHCPv6 servers.
- ◆ The absence of the “managed-address configuration” flag tells hosts to use only stateless address autoconfiguration (based on IPv6 prefixes found in router advertisements).
- ◆ The “managed address configuration” flag is only a suggestion to attached hosts. They may still use stateful and/or stateless address autoconfiguration. If hosts must be forced to use DHCPv6 for security reasons, ensure that no route prefixes are sent in router advertisements.

### Example

The following tells hosts to use stateful autoconfiguration to obtain addresses:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd managed-config-flag
Console(config)#
```

**ipv6 nd other-config-flag** This command configures IPv6 router advertisements to indicate to attached hosts that they can obtain stateful autoconfiguration information other than addresses. Use the **no** form to clear this flag from router advertisements.

#### Syntax

**[no] ipv6 nd other-config-flag**

#### Default Setting

Disabled

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ The “other-stateful-configuration” flag tells hosts that they should use stateful autoconfiguration to obtain information other than addresses from a DHCPv6 server.
- ◆ Some hosts interpret the “other stateful configuration” flag to indicate that they should use stateless address autoconfiguration to get IPv6 address (based on the IPv6 prefixes found in router advertisements) and stateful autoconfiguration to get other non-address parameters from DHCPv6 servers. In this case, the absence of both the “managed address configuration” flag and the “other stateful configuration” flag is interpreted to mean that they should use only stateless autoconfiguration to obtain addresses.

#### Example

The following tells hosts to use stateful autoconfiguration to obtain other non-address information from a DHCPv6 server:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd other-config-flag
Console(config)#
```

**ipv6 nd ns-interval** This command configures the interval between transmitting IPv6 neighbor solicitation messages on an interface. Use the **no** form to restore the default value.

#### Syntax

**ipv6 nd ns-interval** *milliseconds*

**no ipv6 nd ns-interval**

*milliseconds* - The interval between transmitting IPv6 neighbor solicitation messages. (Range: 1000-3600000)

### Default Setting

1000 milliseconds is used for neighbor discovery operations  
0 milliseconds is advertised in router advertisements

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ When a non-default value is configured, the specified interval is used both for router advertisements and by the router itself.
- ◆ This command specifies the interval between transmitting neighbor solicitation messages when resolving an address, or when probing the reachability of a neighbor. Therefore, avoid using very short intervals for normal IPv6 operations.
- ◆ Setting the neighbor solicitation interval to 0 means that the configured time is unspecified by this router.

### Example

The following sets the interval between sending neighbor solicitation messages to 30000 milliseconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ns-interval 30000
Console(config)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
    fe80::200:e8ff:FE90:0/64
Global unicast address(es):
    2009:db9:2229::79, subnet is 2009:db9:2229:0::/64
Joined group address(es):
    ff01::1/16
    ff02::1/16
    ff02::1:ff00:79/104
    ff02::1:ff90:0/104
IPv6 link MTU is 1500 bytes.
ND DAD is enabled, number of DAD attempts: 5.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds
Console#
```

### Related Commands

[show running-config \(124\)](#)

**ipv6 nd raguard** This command blocks incoming Router Advertisement and Router Redirect packets. Use the **no** form to disable this feature.

### Syntax

**[no] ipv6 nd raguard**

### Default Setting

Disabled

### Command Mode

Interface Configuration (Ethernet, Port Channel)

### Command Usage

- ◆ IPv6 Router Advertisements (RA) convey information that enables nodes to auto-configure on the network. This information may include the default router address taken from the observed source address of the RA message, as well as on-link prefix information. However, unintended mis-configurations, or possibly malicious attacks on the network, may lead to bogus RAs being sent, which in turn can cause operational problems for hosts on the network.
- ◆ This command can be used to block RAs and Router Redirect (RR) messages on the specified interface. Determine which interfaces are connected to known routers, and enable RA Guard on all other untrusted interfaces.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#pv6 nd raguard
Console(config-if)#
```

**ipv6 nd reachable-time** This command configures the amount of time that a remote IPv6 node is considered reachable after some reachability confirmation event has occurred. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd reachable-time** *milliseconds*

**no ipv6 nd reachable-time**

*milliseconds* - The time that a node can be considered reachable after receiving confirmation of reachability. (Range: 0-3600000)

### Default Setting

30000 milliseconds is used for neighbor discovery operations  
0 milliseconds is advertised in router advertisements

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The time limit configured by this parameter allows the router to detect unavailable neighbors. During the neighbor discover process, an IPv6 node will multicast neighbor solicitation messages to search for neighbor nodes. For a neighbor node to be considered reachable, it must respond to the neighbor soliciting node with a neighbor advertisement message to become a confirmed neighbor, after which the reachable timer will be considered in effect for subsequent unicast IPv6 layer communications.
- ◆ This time limit is included in all router advertisements sent out through an interface, ensuring that nodes on the same link use the same time value.
- ◆ Setting the time limit to 0 means that the configured time is unspecified by this router.

### Example

The following sets the reachable time for a remote node to 1000 milliseconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd reachable-time 1000
Console(config)#
```

**ipv6 nd prefix** This command configures the IPv6 prefixes to include in router advertisements. Use the **no** form to remove a prefix.

### Syntax

**ipv6 nd prefix** *ipv6-address/prefix-length* {**default** |  
[*valid-lifetime preferred-lifetime* [**no-autoconfig** | **off-link**]]}

**no ipv6 nd prefix** *ipv6-address/prefix-length*

*ipv6-address* - An IPv6 address including the network prefix and host address bits.

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

**default** - Uses default values for remaining parameters.

*valid-lifetime* - The amount of time that the specified IPv6 prefix is advertised as being valid. (Range: 0-4294967295 seconds)

*preferred-lifetime* - The amount of time that the specified IPv6 prefix is advertised as being preferred. The preferred lifetime is counted down in real time. (Range: 0-4294967295 seconds)

**no-autoconfig** - Indicates to hosts on the local link that the specified prefix cannot be used for IPv6 autoconfiguration.

**off-link** - Indicates that the specified prefix is assigned to the link. Nodes sending traffic to addresses that contain the prefix consider the destination to be locally reachable on the link.

#### Default Setting

<i>valid-lifetime</i>	2592000 seconds
<i>preferred-lifetime</i>	2592000 seconds
<i>no-autoconfig</i>	Disabled
<i>off-link</i>	Disabled

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ Prefixes configured as addresses on an interface using the [ipv6 address](#) command are advertised in router advertisements. If prefixes are configured for advertisement using the **ipv6 nd prefix** command, then only these prefixes are advertised.
- ◆ The preferred lifetime and valid lifetime are counted down in real time. After the preferred lifetime expires, no new connections are made using this prefix. When the valid lifetime expires, this prefix will no longer be advertised.
- ◆ All prefixes are inserted in the routing table as Connected (i.e., on-line), unless specified with the off-link option. If the off-link option is specified, and the prefix is already present in the routing table as a Connected prefix, it will be removed.
- ◆ Do not include the link-local prefix in the list of advertised prefixes.

#### Example

The following configures a network prefix with a valid lifetime of 1000 seconds, and a preferred lifetime of 900 seconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd prefix 2011:0DBF::/35 1000 900
Console(config)#
```

**ipv6 nd ra interval** This command configures the interval between the transmission of IPv6 router advertisements on an interface. Use the **no** form to restore the default interval.

#### Syntax

**ipv6 nd ra interval** *minimum-interval* [*maximum-interval*]

**no ipv6 nd ra interval**

*minimum-interval* - The maximum interval between IPv6 router advertisements. (Range: 4-1800 seconds)

*maximum-interval* - The minimum interval between IPv6 router advertisements. (Range: 3-1350 seconds)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

maximum interval: 600 seconds

minimum interval: 198 seconds

### Command Usage

- ◆ The interval between transmissions should be less than or equal to the IPv6 router advertisement lifetime if you configure a route as a default router by using the **ipv6 nd ra lifetime** command.
- ◆ To prevent synchronization with other IPv6 nodes, the actual interval used is randomly selected from a value between the minimum value set by the system (33% of the maximum RA interval) and the maximum value set by the **ipv6 nd ra interval** command.

### Example

The following sets the maximum RA interval to 1800 seconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra interval 1800
Console(config)#
```

**ipv6 nd ra lifetime** This command configures the router lifetime value used in IPv6 router advertisements sent from an interface. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd ra lifetime** *lifetime*

**no ipv6 nd ra lifetime**

*lifetime* - Router lifetime. (Range: 0-90000 seconds)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

1800 seconds

### Command Usage

- ◆ This command can be used to indicate the usefulness of this router as a default router on this interface.



- ◆ Set the router lifetime to 0 to indicate that this router should not be considered a default router. Set the lifetime to a non-zero value to indicate that it should be considered a default router. When a non-zero value is used, the lifetime should not be less than the router advertisement interval.

### Example

The following sets the router lifetime to 8000 seconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra lifetime 8000
Console(config)#
```

**ipv6 nd ra router-preference** This command configures the default router preference for the router on an interface. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd ra router-preference {high | medium | low}**

**no ipv6 nd ra router-preference**

**high** - Preference for the router is high.

**medium** - Preference for the router is medium.

**low** - Preference for the router is low.

### Command Mode

Interface Configuration (VLAN)

### Default Setting

medium

### Command Usage

Default router preference may be used to prioritize routers which provide equivalent, but not equal-cost, routing, and policy dictates that hosts should prefer one of the routers.

### Example

The following sets the default router preference to high:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra router-preference high
Console(config)#
```

**ipv6 nd ra suppress** This command suppresses router advertisement transmissions on an interface. Use the **no** form to re-enable router advertisements.

#### Syntax

**[no] ipv6 nd ra suppress**

#### Command Mode

Interface Configuration (VLAN, IPv6/v4 Tunnel)

#### Default Setting

Not suppressed

#### Command Usage

This command suppresses periodic unsolicited router advertisements. It does not suppress advertisements sent in response to a router solicitation.

#### Example

The following suppresses router advertisements on the current interface:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra suppress
Console(config)#
```

**ipv6 neighbor** This command configures a static entry in the IPv6 neighbor discovery cache. Use the **no** form to remove a static entry from the cache.

#### Syntax

**ipv6 neighbor *ipv6-address* **vlan** *vlan-id* *hardware-address***

**no ipv6 mtu**

*ipv6-address* - The IPv6 address of a neighbor device that can be reached through one of the network interfaces configured on this switch. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

*vlan-id* - VLAN ID (Range: 1-4094)

*hardware-address* - The 48-bit MAC layer address for the neighbor device. This address must be formatted as six hexadecimal pairs separated by hyphens.

#### Default Setting

None

## Command Mode

### Global Configuration

## Command Usage

- ◆ Address Resolution Protocol (ARP) has been replaced in IPv6 with the Neighbor Discovery Protocol (NDP). The **ipv6 neighbor** command is similar to the **mac-address-table static** command that is implemented using ARP.
- ◆ Static entries can only be configured on an IPv6-enabled interface.
- ◆ The switch does not determine whether a static entry is reachable before placing it in the IPv6 neighbor discovery cache.
- ◆ If the specified entry was dynamically learned through the IPv6 neighbor discovery process, and already exists in the neighbor discovery cache, it is converted to a static entry. Static entries in the IPv6 neighbor discovery cache are not modified if subsequently detected by the neighbor discovery process.
- ◆ Disabling IPv6 on an interface with the **no ipv6 enable** command (see [page 907](#)) deletes all dynamically learned entries in the IPv6 neighbor discovery cache for that interface, but does not delete static entries.

## Example

The following maps a static entry for global unicast address to a MAC address:

```
Console(config)#ipv6 neighbor 2009:DB9:2229::81 vlan 1 30-65-14-01-11-86
Console(config)#end
Console#show ipv6 neighbors
State: I1 - Incomplete, I2 - Invalid, R - Reachable, S - Stale, D - Delay,
       P1 - Probe, P2 - Permanent, U - Unknown
IPv6 Address      Age      Link-layer Addr      State      VLAN
2009:DB9:2229::80  956      12-34-11-11-43-21    R          1
2009:DB9:2229::81  Permanent 30-65-14-01-11-86    R          1
FE80::1034:11FF:FE11:4321 961      12-34-11-11-43-21    R          1
Console#
```

## Related Commands

[show ipv6 neighbors \(932\)](#)

**clear ipv6 neighbors** This command deletes all dynamic entries in the IPv6 neighbor discovery cache.

#### Command Mode

Privileged Exec

#### Example

The following deletes all dynamic entries in the IPv6 neighbor cache:

```
Console#clear ipv6 neighbors
Console#
```

**show ipv6 nd raguard** This command displays the configuration setting for RA Guard.

#### Syntax

**show ipv6 nd raguard** [*interface*]

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

#### Command Mode

Privileged Exec

#### Example

```
Console#show ipv6 nd raguard interface ethernet 1/1
Interface RA Guard
-----
Eth 1/ 1  Yes
Console#
```

**show ipv6 neighbors** This command displays information in the IPv6 neighbor discovery cache.

#### Syntax

**show ipv6 neighbors** [*vlan vlan-id* | *ipv6-address*]

*vlan-id* - VLAN ID (Range: 1-4094)

*ipv6-address* - The IPv6 address of a neighbor device. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

### Default Setting

All IPv6 neighbor discovery cache entries are displayed.

### Command Mode

Privileged Exec

### Example

The following shows all known IPv6 neighbors for this switch:

```

Console#show ipv6 neighbors
State: I1 - Incomplete, I2 - Invalid, R - Reachable, S - Stale, D - Delay,
      P1 - Probe, P2 - Permanent, U - Unknown
IPv6 Address          Age      Link-layer Addr   State VLAN
FE80::2E0:CFF:FE9C:CA10 4       00-E0-0C-9C-CA-10 R      1
Console#

```

**Table 183: show ipv6 neighbors - display description**

Field	Description
IPv6 Address	IPv6 address of neighbor
Age	The time since the address was verified as reachable (in seconds). A static entry is indicated by the value "Permanent."
Link-layer Addr	Physical layer MAC address.
State	<p>The following states are used for dynamic entries:</p> <p>I1 (Incomplete) - Address resolution is being carried out on the entry. A neighbor solicitation message has been sent to the multicast address of the target, but it has not yet returned a neighbor advertisement message.</p> <p>I2 (Invalid) - An invalidated mapping. Setting the state to invalid dis-associates the interface identified with this entry from the indicated mapping (RFC 4293).</p> <p>R (Reachable) - Positive confirmation was received within the last ReachableTime interval that the forward path to the neighbor was functioning. While in REACH state, the device takes no special action when sending packets.</p> <p>S (Stale) - More than the ReachableTime interval has elapsed since the last positive confirmation was received that the forward path was functioning. While in STALE state, the device takes no action until a packet is sent.</p> <p>D (Delay) - More than the ReachableTime interval has elapsed since the last positive confirmation was received that the forward path was functioning. A packet was sent within the last DELAY_FIRST_PROBE_TIME interval. If no reachability confirmation is received within this interval after entering the DELAY state, the switch will send a neighbor solicitation message and change the state to PROBE.</p> <p>P1 (Probe) - A reachability confirmation is actively sought by resending neighbor solicitation messages every RetransTimer interval until confirmation of reachability is received.</p> <p>U (Unknown) - Unknown state.</p> <p>The following states are used for static entries:</p> <p>I1 (Incomplete)-The interface for this entry is down.</p> <p>R (Reachable) - The interface for this entry is up. Reachability detection is not applied to static entries in the IPv6 neighbor discovery cache.</p> <p>P2 (Permanent) - Indicates a static entry.</p>
VLAN	VLAN interface from which the address was reached.

**Related Commands**  
[show mac-address-table \(501\)](#)

## ND Snooping

Neighbor Discover (ND) Snooping maintains an IPv6 prefix table and user address binding table. These tables can be used for stateless address auto-configuration or for address filtering by IPv6 Source Guard.

ND snooping maintains a binding table in the process of neighbor discovery. When it receives an Neighbor Solicitation (NS) packet from a host, it creates a new binding. If it subsequently receives a Neighbor Advertisement (NA) packet, this means that the address is already being used by another host, and the binding is therefore deleted. If it does not receive an NA packet after a timeout period, the binding will be bound to the original host. ND snooping can also maintain a prefix table used for stateless address auto-configuration by monitoring Router Advertisement (RA) packets sent from neighboring routers.

ND snooping can also detect if an IPv6 address binding is no longer valid. When a binding has been timed out, it checks to see if the host still exists by sending an NS packet to the target host. If it receives an NA packet in response, it knows that the target still exists and updates the lifetime of the binding; otherwise, it deletes the binding.

This section describes commands used to configure ND Snooping.

**Table 184: ND Snooping Commands**

Command	Function	Mode
<a href="#">ipv6 nd snooping</a>	Enables ND snooping globally or on a specified VLAN or range of VLANs	GC
<a href="#">ipv6 nd snooping auto-detect</a>	Enables automatic validation of binding table entries by periodically sending NS messages and awaiting NA replies	GC
<a href="#">ipv6 nd snooping auto-detect retransmit count</a>	Sets the number of times to send an NS message to determine if a binding is still valid	GC
<a href="#">ipv6 nd snooping auto-detect retransmit interval</a>	Sets the interval between sending NS messages to determine if a binding is still valid	GC
<a href="#">ipv6 nd snooping prefix timeout</a>	Sets the time to wait for an RA message before deleting an entry in the prefix table	GC
<a href="#">ipv6 nd snooping max-binding</a>	Sets the maximum number of address entries which can be bound to a port	IC
<a href="#">ipv6 nd snooping trust</a>	Configures a port as a trusted interface from which prefix information in RA messages can be added to the prefix table, or NS messages can be forwarded without validation	IC
<a href="#">clear ipv6 nd snooping binding</a>	Clears all entries in the address binding table	PE
<a href="#">clear ipv6 nd snooping prefix</a>	Clears all entries in the prefix table	PE

Table 184: ND Snooping Commands (Continued)

Command	Function	Mode
<code>show ipv6 nd snooping</code>	Shows configuration settings for ND snooping	PE
<code>show ipv6 nd snooping binding</code>	Shows entries in the binding table	PE
<code>show ipv6 nd snooping prefix</code>	Show entries in the prefix table	PE

**ipv6 nd snooping** This command enables ND snooping globally or on a specified VLAN or range of VLANs. Use the **no** form to disable this feature.

### Syntax

**[no] ipv6 nd snooping [vlan {vlan-id | vlan-range}]**

*vlan-id* - VLAN ID. (Range: 1-4094)

*vlan-range* - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ Use this command without any keywords to enable ND snooping globally on the switch. Use the VLAN keyword to enable ND snooping on a specific VLAN or a range of VLANs.
- ◆ Once ND snooping is enabled both globally and on the required VLANs, the switch will start monitoring RA messages to build an address prefix table as described below:
  - If an RA message is received on an untrusted interface, it is dropped. If received on a trusted interface, the switch adds an entry in the prefix table according to the Prefix Information option in the RA message. The prefix table records prefix, prefix length, valid lifetime, as well as the VLAN and port interface which received the message.
  - If an RA message is not received updating a table entry with the same prefix for a specified timeout period, the entry is deleted.
- ◆ Once ND snooping is enabled both globally and on the required VLANs, the switch will start monitoring NS messages to build a dynamic user binding table for use in Duplicate Address Detection (DAD) or for use by other security filtering protocols (e.g., IPv6 Source Guard) as described below:
  - If an NS message is received on an trusted interface, it is forwarded without further processing.

- If an NS message is received on an untrusted interface, and the address prefix does not match any entry in the prefix table, it drops the packet.
- If the message does match an entry in the prefix table, it adds an entry to the dynamic user binding table after a fixed delay, and forwards the packet. Each entry in the dynamic binding table includes the link-layer address, IPv6 address, lifetime, as well as the VLAN and port interface which received the message.
- If an RA message is received in response to the original NS message (indicating a duplicate address) before the dynamic binding timeout period expires, the entry is deleted. Otherwise, when the timeout expires, the entry is dropped if the auto-detection process is not enabled.
- If the auto-detection process is enabled, the switch periodically sends an NS message to determine if the client still exists. If it does not receive an RA message in response after the configured timeout, the entry is dropped. If the switch receives an RA message before the timeout expires, it resets the lifetime for the dynamic binding, and the auto-detection process resumes.

### Example

This example enables ND snooping globally and on VLAN 1.

```
Console(config)#ipv6 nd snooping
Console(config)#ipv6 nd snooping vlan 1
Console(config)#
```

**ipv6 nd snooping auto-detect** This command enables automatic validation of dynamic user binding table entries by periodically sending NS messages and awaiting NA replies. Use the **no** form to disable this feature.

### Syntax

**[no] ipv6 nd snooping auto-detect**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

If auto-detection is enabled, the switch periodically sends an NS message to determine if a client listed in the dynamic binding table still exists. If it does not receive an RA message in response after the configured timeout, the entry is dropped. If the switch receives an RA message before the timeout expires, it resets the lifetime for the dynamic binding, and the auto-detection process resumes.



### Example

```
Console(config)#ipv6 nd snooping auto-detect  
Console(config)#
```

#### ipv6 nd snooping auto-detect retransmit count

This command sets the number of times the auto-detection process sends an NS message to determine if a dynamic user binding is still valid. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd snooping auto-detect retransmit count** *retransmit-times*

**no ipv6 nd snooping auto-detect retransmit count**

*retransmit-times* – The number of times to send an NS message to determine if a client still exists. (Range: 1-5)

### Default Setting

3

### Command Mode

Global Configuration

### Command Usage

The timeout after which the switch will delete a dynamic user binding if no RA message is received is set to the retransmit count x the retransmit interval (see the [ipv6 nd snooping auto-detect retransmit interval](#) command). Based on the default settings, this is 3 seconds.

### Example

```
Console(config)#ipv6 nd snooping auto-detect retransmit count 5  
Console(config)#
```

#### ipv6 nd snooping auto-detect retransmit interval

This command sets the interval between which the auto-detection process sends NS messages to determine if a dynamic user binding is still valid. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd snooping auto-detect retransmit interval** *retransmit-interval*

**no ipv6 nd snooping auto-detect retransmit interval**

*retransmit-interval* – The interval between which the switch sends an NS message to determine if a client still exists. (Range: 1-10 seconds)

### Default Setting

1 second

### Command Mode

Global Configuration

### Command Usage

The timeout after which the switch will delete a dynamic user binding if no RA message is received is set to the retransmit count (see the [ipv6 nd snooping auto-detect retransmit count](#) command) x the retransmit interval. Based on the default settings, this is 3 seconds.

### Example

```
Console(config)#ipv6 nd snooping auto-detect retransmit interval 5
Console(config)#
```

**ipv6 nd snooping prefix timeout** This command sets the time to wait for an RA message before deleting an entry in the prefix table. Use the **no** form to restore the default setting.

### Syntax

**ipv6 nd snooping prefix timeout** *timeout*

**no ipv6 nd snooping prefix timeout**

*timeout* – The time to wait for an RA message to confirm that a prefix entry is still valid. (Range: 3-1800 seconds)

### Default Setting

Set to the valid lifetime field in received RA packet

### Command Mode

Global Configuration

### Command Usage

If ND snooping is enabled and an RA message is received on a trusted interface, the switch will add an entry in the prefix table based upon the Prefix Information contained in the message. If an RA message is not received for a table entry with the same prefix for the specified timeout period, the entry is deleted.

### Example

```
Console(config)#ipv6 nd snooping prefix timeout 200
Console(config)#
```

**ipv6 nd snooping max-binding** This command sets the maximum number of address entries in the dynamic user binding table which can be bound to a port. Use the **no** form to restore the default setting.

#### Syntax

**ipv6 nd snooping max-binding** *max-bindings*

**no ipv6 nd snooping max-binding**

*max-bindings* – The maximum number of address entries in the dynamic user binding table which can be bound to a port. (Range: 1-5)

#### Default Setting

5

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Example

```
Console(config)#ipv6 nd snooping max-binding 200
Console(config)#
```

**ipv6 nd snooping trust** This command configures a port as a trusted interface from which prefix information in RA messages can be added to the prefix table, or NS messages can be forwarded without validation. Use the **no** form to restore the default setting.

#### Syntax

**[no] ipv6 nd snooping trust**

#### Default Setting

Not trusted

#### Command Mode

Interface Configuration (Ethernet, Port Channel)

#### Command Usage

- ◆ In general, interfaces facing toward to the network core, or toward routers supporting the Network Discovery protocol, are configured as trusted interfaces.
- ◆ RA messages received from a trusted interface are added to the prefix table and forwarded toward their destination.
- ◆ NS messages received from a trusted interface are forwarded toward their destination. Nothing is added to the dynamic user binding table.

### Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 nd snooping trust
Console(config-if)#
```

**clear ipv6 nd snooping binding** This command clears all entries in the dynamic user address binding table.

### Syntax

**clear ipv6 nd snooping binding**

### Command Mode

Privileged Exec

### Example

```
Console#clear ipv6 nd snooping binding
Console#show ipv6 nd snooping binding
MAC Address      IPv6 Address      Lifetime  VLAN Interface
-----
Console#
```

**clear ipv6 nd snooping prefix** This command clears all entries in the address prefix table.

### Syntax

**clear ipv6 nd snooping prefix [interface vlan *vlan-id*]**

*vlan-id* - VLAN ID. (Range: 1-4094)

### Command Mode

Privileged Exec

### Example

```
Console#clear ipv6 nd snooping prefix
Console#show ipv6 nd snooping prefix
Prefix entry timeout: (seconds)
Prefix          Len Valid-Time Expire  VLAN Interface
-----
Console#
```

**show ipv6 nd snooping** This command shows the configuration settings for ND snooping.

### Syntax

**show ipv6 nd snooping**

**Command Mode**  
Privileged Exec**Example**

```

Console#show ipv6 nd snooping
Global ND Snooping status: enabled
ND Snooping auto-detection: disabled
ND Snooping auto-detection retransmit count: 3
ND Snooping auto-detection retransmit interval: 1 (second)
ND Snooping is configured on the following VLANs:
VLAN 1,
Interface      Trusted      Max-binding
-----
Eth 1/1        Yes          1
Eth 1/2        No           5
Eth 1/3        No           5
Eth 1/4        No           5
Eth 1/5        No           5
:

```

**show ipv6 nd snooping binding** This command shows all entries in the dynamic user binding table.

**Syntax**

**show ipv6 nd snooping binding**

**Command Mode**  
Privileged Exec**Example**

```

Console#show ipv6 nd snooping binding
MAC Address      IPv6 Address      Lifetime  VLAN Interface
-----
0013-49aa-3926  2001:b001::211:95ff:fe84:cb9e  100      1 Eth 1/1
0012-cf01-0203  2001::1           3400     2 Eth 1/2
Console#

```

**show ipv6 nd snooping prefix** This command shows all entries in the address prefix table.

**Syntax**

**show ipv6 nd snooping prefix [interface vlan *vlan-id*]**

*vlan-id* - VLAN ID. (Range: 1-4094)

**Command Mode**  
Privileged Exec

### Example

```
Console#show ipv6 nd snooping prefix
Prefix entry timeout: 100 (second)
Prefix
-----
2001:b000::                64      2592000      100      1 Eth 1/1
2001::                     64         600        34      2 Eth 1/2
Console#
```

## VRRP Commands

Virtual Router Redundancy Protocol (VRRP) use a virtual IP address to support a primary router and multiple backup routers. The backup routers can be configured to take over the workload if the master router fails, or can also be configured to share the traffic load. The primary goal of router redundancy is to allow a host device which has been configured with a fixed gateway to maintain network connectivity in case the primary gateway goes down.

To configure VRRP, select an interface on each router in the group that will participate in the protocol as the master router or a backup router. To select a specific device as the master router, set the address of this interface as the virtual router address for the group. Now set the same virtual address and a priority on the backup routers, and configure an authentication string. You can also enable the preempt feature which allows a router to take over as the master router when it comes on line if it has a higher priority than the currently active master router.

**Table 185: VRRP Commands**

Command	Function	Mode
<code>vrrp authentication</code>	Configures a key used to authenticate VRRP packets received from other routers	IC
<code>vrrp ip</code>	Enables VRRP and sets the IP address of the virtual router	IC
<code>vrrp preempt</code>	Configures the router to take over as master virtual router for a VRRP group if it has a higher priority than the current master virtual router	IC
<code>vrrp priority</code>	Sets the priority of this router in the VRRP group	IC
<code>vrrp timers advertise</code>	Sets the interval between successive advertisements by the master virtual router	IC
<code>show vrrp</code>	Displays VRRP status information	PE
<code>show vrrp interface</code>	Displays VRRP status information for the specified interface	PE
<code>show vrrp interface counters</code>	Displays VRRP statistics for the specified interface	PE
<code>show vrrp router counters</code>	Displays VRRP statistics	PE

**vrrp authentication** This command specifies the key used to authenticate VRRP packets received from other routers. Use the **no** form to prevent authentication.

#### Syntax

**vrrp group authentication key**

**no vrrp group authentication**

*group* - Identifies the virtual router group. (Range: 1-255)  
The maximum number of groups which can be defined is 64.

*key* - Authentication string. (Range: 1-8 alphanumeric characters)

#### Default Setting

No key is defined.

#### Command Mode

Interface (VLAN)

#### Command Usage

- ◆ All routers in the same VRRP group must be configured with the same authentication key.
- ◆ When a VRRP packet is received from another router in the group, its authentication key is compared to the string configured on this router. If the keys match, the message is accepted. Otherwise, the packet is discarded.
- ◆ Plain text authentication does not provide any real security. It is supported only to prevent a misconfigured router from participating in VRRP.

#### Example

```
Console(config-if)#vrrp 1 authentication bluebird
Console(config-if)#
```

**vrrp ip** This command enables the Virtual Router Redundancy Protocol (VRRP) on an interface and specifies the IP address of the virtual router. Use the **no** form to disable VRRP on an interface and remove the IP address from the virtual router.

#### Syntax

**[no] vrrp group ip ip-address**

*group* - Identifies the virtual router group. (Range: 1-255)  
The maximum number of groups which can be defined is 64.

*ip-address* - The IP address of the virtual router. This is the IP address that end-hosts set as their default gateway.

#### Default Setting

No virtual router groups are configured.



### Command Mode

Interface (VLAN)

### Command Usage

- ◆ The interfaces of all routers participating in a virtual router group must be within the same IP subnet.
- ◆ If the IP address assigned to the virtual router with this command is already configured as the primary address on this interface, this router is considered the Owner, and will assume the role of the Master virtual router in the group.
- ◆ This interface is used for two purposes - to send/receive advertisement messages and to forward on behalf of the virtual router when operating as the Master VRRP router.
- ◆ VRRP is enabled as soon as this command is entered. If you need to customize any of the other parameters for VRRP such as authentication, priority, or advertisement interval, then first configure these parameters before enabling VRRP.

### Example

This example creates VRRP group 1 using the primary interface for VLAN 1 as the VRRP group Owner.

```

Console(config)#interface vlan 1
Console(config-if)#vrrp 1 ip 192.168.1.6
Console(config-if)#

```

**vrrp preempt** This command configures the router to take over as the master virtual router for a VRRP group if it has a higher priority than the current acting master router. Use the **no** form to disable preemption.

### Syntax

**vrrp group preempt** [**delay** *seconds*]

**no vrrp group preempt**

*group* - Identifies the VRRP group. (Range: 1-255)  
 The maximum number of groups which can be defined is 64.

*seconds* - The time to wait before issuing a claim to become the master.  
 (Range: 0-120 seconds)

### Default Setting

Preempt: Enabled

Delay: 0 seconds

### Command Mode

Interface (VLAN)

**Command Usage**

- ◆ If preempt is enabled, and this backup router has a priority higher than the current acting master, it will take over as the new master. However, note that if the original master (i.e., the owner of the VRRP IP address) comes back on line, it will always resume control as the master.
- ◆ The delay can give additional time to receive an advertisement message from the current master before taking control. If the router attempting to become the master has just come on line, this delay also gives it time to gather information for its routing table before actually preempting the currently active router.

**Example**

```
Console(config-if)#vrrp 1 preempt delay 10
Console(config-if)#
```

**Related Commands**

[vrrp priority \(946\)](#)

**vrrp priority** This command sets the priority of this router in a VRRP group. Use the **no** form to restore the default setting.

**Syntax**

**vrrp group priority level**

**no vrrp group priority**

*group* - Identifies the VRRP group. (Range: 1-255)  
The maximum number of groups which can be defined is 64.

*level* - Priority of this router in the VRRP group. (Range: 1-254)

**Default Setting**

Master: 255

Backup: 100

**Command Mode**

Interface (VLAN)

**Command Usage**

- ◆ A router that has a physical interface with the same IP address as that used for the virtual router (that is, the owner of the VRRP IP address) will become the master virtual router. The backup router with the highest priority will become the master router if the current master fails. When the original master router recovers, it will take over as the active master router again.

- ◆ If two or more routers are configured with the same VRRP priority, the router with the highest IP address is elected as the new master router if the current master fails.
- ◆ If the backup preempt function is enabled with the `vrrp preempt` command, and a backup router with a priority higher than the current acting master comes on line, this backup router will take over as the new acting master. However, note that if the original master (i.e., the owner of the VRRP IP address) comes back on line, it will always resume control as the master.
- ◆ If the virtual IP address for the VRRP group is the same as that of the configured device, the priority will automatically be set to 255 prior to using this command.

### Example

```
Console(config-if)#vrrp 1 priority 1
Console(config-if)#
```

### Related Commands

[vrrp preempt \(945\)](#)

**vrrp timers advertise** This command sets the interval at which the master virtual router sends advertisements communicating its state as the master. Use the **no** form to restore the default interval.

### Syntax

**vrrp group timers advertise interval**

**no vrrp group timers advertise**

*group* - Identifies the VRRP group. (Range: 1-255)  
The maximum number of groups which can be defined is 64.

*interval* - Advertisement interval for the master virtual router.  
(Range: 1-255 seconds)

### Default Setting

1 second

### Command Mode

Interface (VLAN)

### Command Usage

- ◆ VRRP advertisements from the current master virtual router include information about its priority and current state as the master.

- ◆ VRRP advertisements are sent to the multicast address 224.0.0.18. Using a multicast address reduces the amount of traffic that has to be processed by network devices that are not part of the designated VRRP group.
- ◆ If the master router stops sending advertisements, backup routers will bid to become the master router based on priority. The dead interval before attempting to take over as the master is three times the hello interval plus half a second

### Example

```
Console(config-if)#vrrp 1 timers advertise 5
Console(config-if)#
```

**show vrrp** This command displays status information for VRRP.

### Syntax

**show vrrp** [**brief** | *group*]

**brief** - Displays summary information for all VRRP groups on this router.

*group* - Identifies a VRRP group. (Range: 1-255)

### Defaults

None

### Command Mode

Privileged Exec

### Command Usage

- ◆ Use this command without any keywords to display the full listing of status information for all VRRP groups configured on this router.
- ◆ Use this command with the **brief** keyword to display a summary of status information for all VRRP groups configured on this router.
- ◆ Specify a group number to display status information for a specific group

### Example

This example displays the full listing of status information for all groups.

```
Console#show vrrp
VLAN 1 - Group 1,
State                               Master
Virtual IP Address                  192.168.1.6
Virtual MAC Address                 00-00-5E-00-01-01
Advertisement Interval               5 sec
Preemption                         Enabled
Min Delay                           10 sec
Priority                            255
```

```

Authentication                SimpleText
Authentication Key            bluebird
Master Router                 192.168.1.6
Master Priority                255
Master Advertisement Interval 5 sec
Master Down Interval          15
Console#

```

**Table 186: show vrrp - display description**

Field	Description
State	VRRP role of this interface (master or backup)
Virtual IP address	Virtual address that identifies this VRRP group
Virtual MAC address	Virtual MAC address derived from the owner of the virtual IP address
Advertisement interval	Interval at which the master virtual router advertises its role as the master
Preemption	Shows whether or not a higher priority router can preempt the current acting master
Min delay	Delay before a router with a higher priority can preempt the current acting master
Priority	Priority of this router
Authentication	Authentication mode used to verify VRRP packets
Authentication key	Key used to authenticate VRRP packets received from other routers
Master Router	IP address of the router currently acting as the VRRP group master
Master priority	The priority of the router currently acting as the VRRP group master
Master Advertisement interval	The advertisement interval configured on the VRRP master.
Master down interval	The down interval configured on the VRRP master (This interval is used by all the routers in the group regardless of their local settings)

This example displays the brief listing of status information for all groups.

```

Console#show vrrp brief
Interface  Grp   State  Virtual Addr  Interval  Preempt  Priority
-----
VLAN 1    1    Master  192.168.0.3   1        E        255
Console#

```

**Table 187: show vrrp brief - display description**

Field	Description
Interface	VLAN interface
Grp	VRRP group
State	VRRP role of this interface (master or backup)

**Table 187: show vrrp brief - display description** (Continued)

Field	Description
Virtual Addr	Virtual address that identifies this VRRP group
Interval	Interval at which the master virtual router advertises its role as the master
Preempt	Shows whether or not a higher priority router can preempt the current acting master
Priority	Priority of this router

**show vrrp interface** This command displays status information for the specified VRRP interface.

### Syntax

**show vrrp interface vlan** *vlan-id* [**brief**]

*vlan-id* - Identifier of configured VLAN interface. (Range: 1-4094)

**brief** - Displays summary information for all VRRP groups on this router.

### Defaults

None

### Command Mode

Privileged Exec

### Example

This example displays the full listing of status information for VLAN 1.

```

Console#show vrrp interface vlan 1
Vlan 1 - Group 1,
State                               Master
Virtual IP Address                  192.168.1.6
Virtual MAC Address                  00-00-5E-00-01-01
Advertisement Interval               5 sec
Preemption                          Enabled
Min Delay                           10 sec
Priority                             1
Authentication                      SimpleText
Authentication Key                  bluebird
Master Router                       192.168.1.6
Master Priority                      1
Master Advertisement Interval       5 sec
Master Down Interval                15
Console#

```

\* Refer to the [show vrrp](#) command for a description of the display items.

**show vrrp interface counters** This command displays counters for VRRP protocol events and errors that have occurred for the specified group and interface.

**show vrrp group interface vlan interface counters**

*group* - Identifies a VRRP group. (Range: 1-255)

*interface* - Identifier of configured VLAN interface. (Range: 1-4094)

**Defaults**

None

**Command Mode**

Privileged Exec

**Example**

```

Console#show vrrp 1 interface vlan 1 counters
Total Number of Times Transitioned to MASTER                : 6
Total Number of Received Advertisements Packets             : 0
Total Number of Received Error Advertisement Interval Packets : 0
Total Number of Received Authentication Failures Packets    : 0
Total Number of Received Error IP TTL VRRP Packets          : 0
Total Number of Received Priority 0 VRRP Packets             : 0
Total Number of Sent Priority 0 VRRP Packets                 : 5
Total Number of Received Invalid Type VRRP Packets          : 0
Total Number of Received Error Address List VRRP Packets    : 0
Total Number of Received Invalid Authentication Type VRRP Packets : 0
Total Number of Received Mismatch Authentication Type VRRP Packets : 0
Total Number of Received Error Packet Length VRRP Packets   : 0
Console#

```

**Table 188: show vrrp interface counters - display description**

Parameter	Description
Times Transitioned to Master	Number of times this router has transitioned to master.
Received Advertisement Packets	Number of VRRP advertisements received by this router.
Received Error Advertisement Interval Packets	Number of VRRP advertisements received for which the advertisement interval is different from the one configured for the local virtual router.
Received Authentication Failure Packets	Number of VRRP packets received that do not pass the authentication check.
Received Error IP TTL VRRP Packets	Number of VRRP packets received by the virtual router with IP TTL (Time-To-Live) not equal to 255.
Received Priority 0 VRRP Packets	Number of VRRP packets received by the virtual router with priority set to 0.
Sent Priority 0 VRRP Packets	Number of VRRP packets sent by the virtual router with priority set to 0. A priority value of zero indicates that the group master has stopped participating in VRRP, and is used to quickly transition a backup unit to master mode without having to wait for the master to time out.
Received Invalid Type VRRP Packets	Number of VRRP packets received by the virtual router with an invalid value in the "type" field.

**Table 188: show vrrp interface counters - display description**

Parameter	Description
Received Error Address List VRRP Packets	Number of packets received for which the address list does not match the locally configured list for the virtual router.
Received Invalid Authentication Type VRRP Packets	Number of packets received with an unknown authentication type.
Received Mismatch Authentication Type VRRP Packets	Number of packets received with "Auth Type" not equal to the locally configured authentication method.
Received Error Packets Length VRRP Packets	Number of packets received with a packet length less than the length of the VRRP header.

**show vrrp router counters** This command displays counters for errors found in VRRP protocol packets.

#### Command Mode

Privileged Exec

#### Example

Note that unknown errors indicate VRRP packets received with an unknown or unsupported version number.

```

Console#show vrrp router counters
  Total Number of VRRP Packets with Invalid Checksum : 0
  Total Number of VRRP Packets with Unknown Error   : 0
  Total Number of VRRP Packets with Invalid VRID    : 0
Console#

```



# IP Routing Commands

After network interfaces are configured for the switch, the paths used to send traffic between different interfaces must be set. If routing is enabled on the switch, traffic will automatically be forwarded between all of the local subnetworks. However, to forward traffic to devices on other subnetworks, either configure fixed paths with static routing commands, or enable a dynamic routing protocol that exchanges information with other routers on the network to automatically determine the best path to any subnetwork.

This section includes commands for both static and dynamic routing. These commands are used to connect between different local subnetworks or to connect the router to the enterprise network.

**Table 193: IP Routing Commands**

Command Group	Function
<a href="#">Global Routing Configuration</a>	Configures global parameters for static and dynamic routing, displays the routing table and statistics for protocols used to exchange routing information
<a href="#">Routing Information Protocol (RIP)</a>	Configures global and interface specific parameters for RIP
<a href="#">Open Shortest Path First (OSPFv2)</a>	Configures global and interface specific parameters for OSPFv2
<a href="#">Open Shortest Path First (OSPFv3)</a>	Configures global and interface specific parameters for OSPFv3
<a href="#">Border Gateway Protocol (BGPv4)</a>	Configures global and interface specific parameters for BGP
<a href="#">Policy-based Routing for BGP</a>	Configures policy-based routing maps for BGP

## Global Routing Configuration

**Table 194: Global Routing Configuration Commands**

Command	Function	Mode
<i>IPv4 Commands</i>		
<a href="#">ip route</a>	Configures static routes	GC
<a href="#">maximum-paths</a>	Sets the maximum number of paths allowed	GC
<a href="#">show ip host-route</a>	Displays the interface associated with known routes	PE
<a href="#">show ip route</a>	Displays specified entries in the routing table	PE
<a href="#">show ip route database</a>	Displays static or dynamically learned entries in the routing table	PE
<a href="#">show ip route summary</a>	Displays summary information for the routing table	PE

Table 194: Global Routing Configuration Commands (Continued)

Command	Function	Mode
<i>IPv6 Commands</i>		
<code>ipv6 route</code>	Configures static routes	GC
<code>show ipv6 route</code>	Displays specified entries in the routing table	PE

## IPv4 Commands

**ip route** This command configures static routes. Use the **no** form to remove static routes.

### Syntax

**ip route** *destination-ip netmask next-hop [distance]*

**no ip route** {*destination-ip netmask next-hop* | \*}

*destination-ip* – IP address of the destination network, subnetwork, or host.

*netmask* – Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.

*next-hop* – IP address of the next hop router used for this route.

*distance* – An administrative distance indicating that this route can be overridden by dynamic routing information if the distance of the dynamic route is less than that configured for the static route. Note that the default administrative distances used by the dynamic unicast routing protocols is 110 for OSPF, 120 for RIP, 20 for eBGP, and 200 for iBGP. (Range: 1-255, Default: 1)

\* – Removes all static routing table entries.

### Default Setting

No static routes are configured.

### Command Mode

Global Configuration

### Command Usage

- ◆ Up to 512 static routes can be configured.
- ◆ Up to eight equal-cost multipaths (ECMP) can be configured for static routing using the `maximum-paths` command.
- ◆ If an administrative distance is defined for a static route, and the same destination can be reached through a dynamic route at a lower administration distance, then the dynamic route will be used.
- ◆ If both static and dynamic paths have the same lowest cost, the first route stored in the routing table, either statically configured or dynamically learned via a routing protocol, will be used.

- ◆ Static routes are included in RIP, OSPF or BGP updates periodically sent by the router if this feature is enabled by the RIP, OSPF or BGP redistribute command (see [page 967](#), [page 988](#), [page 1080](#) respectively).

### Example

This example forwards all traffic for subnet 192.168.1.0 to the gateway router 192.168.5.254, using the default metric of 1.

```
Console(config)#ip route 192.168.1.0 255.255.255.0 192.168.5.254
Console(config)#
```

**maximum-paths** This command sets the maximum number of paths allowed. Use the no form to restore the default settings.

### Syntax

**maximum-paths** *path-count*

**no maximum-paths**

*path-count* - The maximum number of equal-cost paths to the same destination that can be installed in the routing table. (Range: 1-8)

### Default Setting

Enabled, 4 paths

### Command Mode

Global Configuration

### Example

```
Console(config)#maximum-paths 8
Console(config)#
```

**show ip host-route** This command displays the interface associated with known routes.

### COMMAND MODE

Privileged Exec

### EXAMPLE

```
Console#show ip host-route
IP Address      MAC Address      VLAN Port
-----
192.168.0.99    00-E0-29-94-34-64  1 1/1
192.168.1.250   00-00-30-01-01-01  3 1/ 1
10.2.48.2       00-00-30-01-01-02  1 1/ 1
10.2.5.6        00-00-30-01-01-03  1 1/ 2
10.3.9.1        00-00-30-01-01-04  2 1/ 3
```

Console#

**Table 195: show ip host-route - display description**

Field	Description
IP Address	IP address of the destination network, subnetwork, or host.
MAC Address	The physical layer address associated with the IP address.
VLAN	The VLAN that connects to this IP address.
Port	The port that connects to this IP address.

**show ip route** This command displays information in the Forwarding Information Base (FIB).

### Syntax

**show ip route [bgp | connected | database | ospf | rip | static | summary]**

**bgp** – Displays external routes imported from the Border Gateway Protocol (BGP) into this routing domain.

**connected** – Displays all currently connected entries.

**database** – All known routes, including inactive routes.

**ospf** – Displays external routes imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

**rip** – Displays all entries learned through the Routing Information Protocol (RIP).

**static** – Displays all static entries.

**summary** – Displays a brief list of summary information about entries in the routing table, including the maximum number of entries supported, the number of connected routes, the total number of routes currently stored in the routing table, and the number of entries in the FIB.

### Command Mode

Privileged Exec

### Command Usage

- ◆ The FIB contains information required to forward IP traffic. It contains the interface identifier and next hop information for each reachable destination network prefix based on the IP routing table. When routing or topology changes occur in the network, the routing table is updated, and those changes are immediately reflected in the FIB.

The FIB is distinct from the routing table (or, Routing Information Base), which holds all routing information received from routing peers. The forwarding information base contains unique paths only. It does not contain any secondary paths. A FIB entry consists of the minimum amount of information necessary to make a forwarding decision on a particular packet. The typical components

within a forwarding information base entry are a network prefix, a router port identifier, and next hop information.

- ◆ This command only displays routes which are currently accessible for forwarding. The router must be able to directly reach the next hop, so the VLAN interface associated with any dynamic or static route entry must be up. Note that routes currently not accessible for forwarding, may still be displayed by using the [show ip route database](#) command.

### Example

In the following example, note that the entry for RIP displays both the distance and metric for this route.

```
Console#show ip route
Codes: C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default

R       10.1.1.0/24 [120/2] via 192.168.1.10, VLAN1, 00:00:14
C       127.0.0.0/8 is directly connected, lo
C       192.168.1.0/24 is directly connected, VLAN1
Console#
```

**show ip route database** This command displays entries in the Routing Information Base (RIB).

### Command Mode

Privileged Exec

### Command Usage

The RIB contains all available routes learned through dynamic routing protocols, directly attached networks, and any additionally configured routes such as static routes. The RIB contains the set of all available routes from which optimal entries are selected for use by the Forwarding Information Base (see Command Usage under the [show ip route](#) command).

### Example

```
Console#show ip route database
Codes: C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       > - selected route, * - FIB route, p - stale info

C       *> 127.0.0.0/8 is directly connected, lo0
C       *> 192.168.1.0/24 is directly connected, VLAN1
Console#
```

**show ip route summary** This command displays summary information for the routing table.

**Command Mode**  
Privileged Exec

#### Example

In the following example, the numeric identifier following the routing table name (0) indicates the Forwarding Information Base identifier.

```
Console#show ip route summary
IP routing table name is Default-IP-Routing-Table(0)
IP routing table maximum-paths is 8
Connected          2
Total               2
Console#
```

## IPv6 Commands

**ipv6 route** This command configures static IPv6 routes. Use the **no** form to remove static routes.

#### Syntax

**ipv6 route** *destination-ipv6-address/prefix-length*  
{*gateway-address* [*distance*] | *link-local-address%zone-id* [*distance*]}

**no ipv6 route** *destination-ipv6-address/prefix-length*  
{*gateway-address* | *link-local-address%zone-id*}

*destination-ipv6-address* – The IPv6 address of a destination network, subnetwork, or host. This must be a full IPv6 address including the network prefix and host address bits.

*prefix-length* – A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

*gateway-address* – IP address of the next hop router used for this route.

*link-local-address%zone-id* – a link-local address, including a zone-id indicating the VLAN identifier after the % delimiter.

*distance* – An administrative distance indicating that this route can be overridden by dynamic routing information if the distance of the dynamic route is less than that configured for the static route. Note that the default administrative distances used by the dynamic unicast routing protocols is 110 for OSPF, 120 for RIP, 20 for eBGP, and 200 for iBGP. (Range: 1-255, Default: 1)

#### Default Setting

No static routes are configured.

## Command Mode

Global Configuration

## Command Usage

- ◆ Up to 1K static routes can be configured.
- ◆ Up to eight equal-cost multipaths (ECMP) can be configured for static routing using the [maximum-paths](#) command.
- ◆ If an administrative distance is defined for a static route, and the same destination can be reached through a dynamic route at a lower administration distance, then the dynamic route will be used.
- ◆ The default distance of 1 will take precedence over any other type of route, except for local routes.
- ◆ If both static and dynamic paths have the same lowest cost, the first route stored in the routing table, either statically configured or dynamically learned via a routing protocol, will be used.
- ◆ Static routes are included in RIP, OSPF and BGP updates periodically sent by the router if this feature is enabled by the RIP, OSPF or BGP redistribute command (see [page 967](#), [page 988](#), [page 1080](#) respectively).

## Example

This example forwards all traffic for subnet 2001::/64 to the next hop router 2001:DB8:2222:7272::254, using the default metric of 1.

```
Console(config)#ipv6 route 2001::/64 2001:DB8:2222:7272::254
Console(config)#
```

## Related Commands

[show ip route summary \(958\)](#)

**show ipv6 route** This command displays information in the Forwarding Information Base (FIB).

## Syntax

**show ipv6 route** [*ipv6-address*[/*prefix-length*] **database** | **interface**  
[**vlan** *vlan-id*] | **local** | **ospf** | **static**]

*ipv6-address* - A full IPv6 address including the network prefix and host address bits.

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

**database** – All known routes, including inactive routes.

**interface** – Displays all routes that be accessed through this interface.

**local** – Displays all entries for destinations attached directly to this router.

**ospf** – Displays external routes imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

**static** – Displays all static entries.

*vlan-id* - VLAN ID. (Range: 1-4094)

## Command Mode

Privileged Exec

## Command Usage

- ◆ The FIB contains information required to forward IP traffic. It contains the interface identifier and next hop information for each reachable destination network prefix based on the IP routing table. When routing or topology changes occur in the network, the routing table is updated, and those changes are immediately reflected in the FIB.

The FIB is distinct from the routing table (or, Routing Information Base), which holds all routing information received from routing peers. The forwarding information base contains unique paths only. It does not contain any secondary paths. A FIB entry consists of the minimum amount of information necessary to make a forwarding decision on a particular packet. The typical components within a forwarding information base entry are a network prefix, a router port identifier, and next hop information.

- ◆ This command only displays routes which are currently accessible for forwarding. The router must be able to directly reach the next hop, so the VLAN interface associated with any dynamic or static route entry must be up.

## Example

In the following example, note that the last entry displays both the distance and metric for this route.

```
Console#show ipv6 route
Codes: C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
C   ::1/128, lo0
?   FE80::/64, VLAN1 inactive
C   FE80::/64, VLAN1
?   FF00::/8, VLAN1 inactive
O IA 3FFF:1::/32 [110/3]
    via FE80::204:FF:FE05:6, VLAN1

Console#
```



## Routing Information Protocol (RIP)

Table 196: Routing Information Protocol Commands

Command	Function	Mode
<code>router rip</code>	Enables the RIP routing protocol	GC
<code>default-information originate</code>	Generates a default external route into an autonomous system	RC
<code>default-metric</code>	Sets the default metric assigned to external routes imported from other protocols	RC
<code>distance</code>	Defines an administrative distance for external routes learned from other routing protocols	RC
<code>maximum-prefix</code>	Sets the maximum number of RIP routes allowed	RC
<code>neighbor</code>	Defines a neighboring router with which to exchange information	RC
<code>network</code>	Specifies the network interfaces that are to use RIP routing	RC
<code>passive-interface</code>	Stops RIP from sending routing updates on the specified interface	RC
<code>redistribute</code>	Redistribute routes from one routing domain to another	RC
<code>timers basic</code>	Sets basic timers, including update, timeout, garbage collection	RC
<code>version</code>	Specifies the RIP version to use on all network interfaces (if not already specified with a receive version or send version command)	RC
<code>ip rip authentication mode</code>	Specifies the type of authentication used for RIP2 packets	IC
<code>ip rip authentication string</code>	Enables authentication for RIP2 packets and specifies keys	IC
<code>ip rip receive version</code>	Sets the RIP receive version to use on a network interface	IC
<code>ip rip receive-packet</code>	Configures the interface to receive of RIP packets	IC
<code>ip rip send version</code>	Sets the RIP send version to use on a network interface	IC
<code>ip rip send-packet</code>	Configures the interface to send RIP packets	IC
<code>ip rip split-horizon</code>	Enables split-horizon or poison-reverse loop prevention	IC
<code>clear ip rip route</code>	Clears specified data from the RIP routing table	PE
<code>show ip protocols rip</code>	Displays RIP process parameters	PE
<code>show ip rip</code>	Displays information about RIP routes and configuration settings	PE

**router rip** This command enables Routing Information Protocol (RIP) routing for all IP interfaces on the router. Use the **no** form to disable it.

#### Syntax

**[no] router rip**

#### Command Mode

Global Configuration

#### Default Setting

Disabled

#### Command Usage

- ◆ RIP is used to specify how routers exchange routing table information.
- ◆ This command is also used to enter router configuration mode.

#### Example

```
Console(config)#router rip
Console(config-router)#
```

#### Related Commands

[network \(966\)](#)

**default-information originate** This command generates a default external route into the local RIP autonomous system. Use the **no** form to disable this feature.

#### Syntax

**[no] default-information originate**

#### Default Setting

Disabled

#### Command Mode

Router Configuration

#### Command Usage

This command sets a default route for every Layer 3 interface where RIP is enabled. The response packet to external queries marks each active RIP interface as a default router with the IP address 0.0.0.0.

#### Example

```
Console(config-router)#default-information originate
Console(config-router)#
```

### Related Commands

[ip route \(954\)](#)

[redistribute \(967\)](#)

**default-metric** This command sets the default metric assigned to external routes imported from other protocols. Use the **no** form to restore the default value.

### Syntax

**default-metric** *metric-value*

**no default-metric**

*metric-value* – Metric assigned to external routes. (Range: 1-15)

### Default Setting

1

### Command Mode

Router Configuration

### Command Usage

- ◆ This command does not override the metric value set by the [redistribute](#) command. When a metric value has not been configured by the [redistribute](#) command, the **default-metric** command sets the metric value to be used for all imported external routes.
- ◆ The default metric must be used to resolve the problem of redistributing external routes with incompatible metrics.
- ◆ It is advisable to use a low metric when redistributing routes from another protocol into RIP. Using a high metric limits the usefulness of external routes redistributed into RIP. For example, if a metric of 10 is defined for redistributed routes, these routes can only be advertised to routers up to 5 hops away, at which point the metric exceeds the maximum hop count of 15. By defining a low metric of 1, traffic can follow a imported route the maximum number of hops allowed within a RIP domain. However, note that using a low metric can increase the possibility of routing loops. For example, this can occur if there are multiple redistribution points and the router learns about the same external network with a better metric from a redistribution point other than that derived from the original source.

### Example

This example sets the default metric to 5.

```
Console(config-router)#default-metric 5
Console(config-router)#
```

## Related Commands

[redistribute \(967\)](#)

**distance** This command defines an administrative distance for external routes learned from other routing protocols. Use the **no** form to restore the default setting.

### Syntax

**[no] distance** *distance network-address netmask*

*distance* - Administrative distance for external routes. External routes are routes for which the best path is learned from a neighbor external to the local RIP autonomous system. Routes with a distance of 255 are not installed in the routing table. (Range: 1-255)

*network-address* - IP address of a route entry.

*netmask* - Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

### Default Setting

None

### Command Mode

Router Configuration

### Command Usage

- ◆ Administrative distance is used by the routers to select the preferred path when there are two or more different routes to the same destination from two different routing protocols. A smaller administrative distance indicates a more reliable protocol.
- ◆ The administrative distance is applied to all routes learned for the specified network.

### Example

```
Console(config-router)#distance 2 192.168.3.0 255.255.255.0
Console(config-router)#
```

**maximum-prefix** This command sets the maximum number of RIP routes allowed by the system. Use the **no** form to restore the default setting.

### Syntax

**maximum-prefix** *maximum-routes*

**no maximum-prefix**

*maximum-routes* - The maximum number of RIP routes which can be installed in the routing table. (Range: 1-11766)

### Default Setting

11766

### Command Mode

Router Configuration

### Command Usage

All the learned RIP routes may not be copied to the hardware tables in ASIC for fast data forwarding because of hardware resource limitations.

### Example

```
Console(config-router)#maximum-prefix 1024  
Console(config-router)#
```

**neighbor** This command defines a neighboring router with which this router will exchange routing information. Use the **no** form to remove an entry.

### Syntax

**[no] neighbor** *ip-address*

*ip-address* - IP address of a neighboring router.

### Default Setting

No neighbors are defined.

### Command Mode

Router Configuration

### Command Usage

- ◆ This command can be used to configure a static neighbor (specifically for point-to-point links) with which this router will exchange routing information, rather than relying on broadcast or multicast messages generated by the RIP protocol.
- ◆ Use this command in conjunction with the [passive-interface](#) command to control the routing updates sent to specific neighbors.

### Example

```
Console(config-router)#neighbor 10.2.0.254  
Console(config-router)#
```

### Related Commands

[passive-interface \(966\)](#)

**network** This command specifies the network interfaces that will be included in the RIP routing process. Use the **no** form to remove an entry.

### Syntax

**[no] network** {*ip-address netmask* | **vlan** *vlan-id*}

*ip-address* – IP address of a network directly connected to this router.

*netmask* - Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

*vlan-id* - VLAN ID. (Range: 1-4094)

### Default Setting

No networks are specified.

### Command Mode

Router Configuration

### Command Usage

- ◆ RIP only sends and receives updates on interfaces specified by this command. If a network is not specified, the interfaces in that network will not be advertised in any RIP updates.
- ◆ Subnet addresses are interpreted as class A, B or C, based on the first field in the specified address. In other words, if a subnet address *nnn.xxx.xxx.xxx* is entered, the first field (*nnn*) determines the class:
  - 0 - 127 is class A, and only the first field in the network address is used.
  - 128 - 191 is class B, and the first two fields in the network address are used.
  - 192 - 223 is class C, and the first three fields in the network address are used.

### Example

This example includes network interface 10.1.0.0 in the RIP routing process.

```
Console(config-router)#network 10.1.0.0
Console(config-router)#
```

### Related Commands

[router rip \(962\)](#)

**passive-interface** This command stops RIP from sending routing updates on the specified interface. Use the **no** form to disable this feature.

### Syntax

**[no] passive-interface** **vlan** *vlan-id*

*vlan-id* - VLAN ID. (Range: 1-4094)

### Default Setting

Disabled

### Command Mode

Router Configuration

### Command Usage

- ◆ If this command is used to stop sending routing updates on an interface, the attached subnet will still continue to be advertised to other interfaces, and updates from other routers on that interface will continue to be received and processed.
- ◆ Use this command in conjunction with the [neighbor](#) command to control the routing updates sent to specific neighbors.

### Example

```
Console(config-router)#passive-interface vlan1  
Console(config-router)#
```

### Related Commands

[neighbor](#) (965)

**redistribute** This command imports external routing information from other routing domains (that is, directly connected routes, protocols, or static routes) into the autonomous system. Use the **no** form to disable this feature.

### Syntax

**[no] redistribute (bgp | connected | ospf | static) [metric *metric-value*]**

**bgp** - External routes will be imported from the Border Gateway Protocol (BGP) into this routing domain.

**connected** - Imports routes that are established automatically just by enabling IP on an interface.

**ospf** - External routes will be imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

**static** - Static routes will be imported into this routing domain.

*metric-value* - Metric value assigned to all external routes for the specified protocol. (Range: 1-16)

### Default Setting

redistribution - none

metric-value - set by the [default-metric](#) command

### Command Mode

Router Configuration

### Command Usage

- ◆ When a metric value has not been configured by the **redistribute** command, the **default-metric** command sets the metric value to be used for all imported external routes.
- ◆ A route metric must be used to resolve the problem of redistributing external routes with incompatible metrics.
- ◆ It is advisable to use a low metric when redistributing routes from another protocol into RIP. Using a high metric limits the usefulness of external routes redistributed into RIP. For example, if a metric of 10 is defined for redistributed routes, these routes can only be advertised to routers up to 5 hops away, at which point the metric exceeds the maximum hop count of 15. By defining a low metric of 1, traffic can follow a imported route the maximum number of hops allowed within a RIP domain. However, using a low metric can increase the possibility of routing loops. For example, this can occur if there are multiple redistribution points and the router learns about the same external network with a better metric from a redistribution point other than that derived from the original source.

### Example

This example redistributes routes learned from OSPF and sets the metric for all external routes imported from OSPF to a value of 3.

```
Console(config-router)#redistribute ospf metric 3
Console(config-router)#
```

This example redistributes static routes and sets the metric for all of these routes to a value of 3.

```
Console(config-router)#redistribute static metric 3
Console(config-router)#
```

### Related Commands

**default-metric (963)**



**timers basic** This command configures the RIP update timer, timeout timer, and garbage-collection timer. Use the **no** form to restore the defaults.

### Syntax

**timers basic** *update timeout garbage*

**no timers basic**

*update* – Sets the update timer to the specified value.  
(Range: 5-2147483647 seconds)

*timeout* – Sets the timeout timer to the specified value. (Range: 90-360 seconds)

*garbage* – Sets the garbage collection timer to the specified value.  
(Range: 60-240 seconds)

### Default Setting

Update: 30 seconds

Timeout: 180 seconds

Garbage collection: 120 seconds

### Command Mode

Router Configuration

### Command Usage

- ◆ The *update* timer sets the rate at which updates are sent. This is the fundamental timer used to control all basic RIP processes.
- ◆ The *timeout* timer is the time after which there have been no update messages that a route is declared dead. The route is marked inaccessible (i.e., the metric set to infinite) and advertised as unreachable. However, packets are still forwarded on this route.
- ◆ After the *timeout* interval expires, the router waits for an interval specified by the *garbage-collection* timer before removing this entry from the routing table. This timer allows neighbors to become aware of an invalid route prior to it being purged by this device.
- ◆ Setting the update timer to a short interval can cause the router to spend an excessive amount of time processing updates.
- ◆ These timers must be set to the same values for all routers in the network.

### Example

This example sets the update timer to 40 seconds. The timeout timer is subsequently set to 240 seconds, and the garbage-collection timer to 160 seconds.

```
Console(config-router)#timers basic 15
Console(config-router)#
```

**version** This command specifies a RIP version used globally by the router. Use the **no** form to restore the default value.

### Syntax

**version {1 | 2}**

**no version**

**1** - RIP Version 1

**2** - RIP Version 2

### Default Setting

Receive: Accepts RIPv1 or RIPv2 packets

Send: Route information is broadcast to other routers with RIPv2.

### Command Mode

Router Configuration

### Command Usage

- ◆ When this command is used to specify a global RIP version, any VLAN interface not previously set by the [ip rip receive version](#) or [ip rip send version](#) command will use the global RIP version setting.
- ◆ When the **no** form of this command is used to restore the default value, any VLAN interface not previously set by the [ip rip receive version](#) or [ip rip send version](#) command will be set to the default send or receive version.
- ◆ Any configured interface settings take precedence over the global settings.

### Example

This example sets the global version for RIP to send and receive version 2 packets.

```
Console(config-router)#version 2
Console(config-router)#
```

### Related Commands

[ip rip receive version \(972\)](#)

[ip rip send version \(974\)](#)

**ip rip authentication mode** This command specifies the type of authentication that can be used for RIPv2 packets. Use the **no** form to restore the default value.

#### Syntax

**ip rip authentication mode {md5 | text}**

**no ip rip authentication mode**

**md5** - Message Digest 5 (MD5) authentication

**text** - Indicates that a simple password will be used.

#### Default Setting

Text authentication

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ The password to be used for authentication is specified in the [ip rip authentication string](#) command.
- ◆ This command requires the interface to exchange routing information with other routers based on an authorized password. (Note that this command only applies to RIPv2.)
- ◆ For authentication to function properly, both the sending and receiving interface must be configured with the same password or authentication key.
- ◆ MD5 is a one-way hash algorithm that takes the authentication key and produces a 128 bit message digest or “fingerprint.” This makes it computationally infeasible to produce two messages having the same message digest, or to produce any message having a given pre-specified target message digest.

#### Example

This example sets the authentication mode to plain text.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip authentication mode text
Console(config-if)#
```

#### Related Commands

[ip rip authentication string \(972\)](#)

**ip rip authentication string** This command specifies an authentication key for RIPv2 packets. Use the **no** form to delete the authentication key.

#### Syntax

**ip rip authentication string** *key-string*

**no ip rip authentication string**

*key-string* - A password used for authentication.  
(Range: 1-16 characters, case sensitive)

#### Default Setting

No authentication key

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ This command can be used to restrict the interfaces that can exchange RIPv2 routing information. (Note that this command does not apply to RIPv1.)
- ◆ For authentication to function properly, both the sending and receiving interface must be configured with the same password, and authentication enabled by the [ip rip authentication mode](#) command.

#### Example

This example sets an authentication password of "small" to verify incoming routing messages and to tag outgoing routing messages.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip authentication string small
Console(config-if)#
```

#### Related Commands

[ip rip authentication mode \(971\)](#)

**ip rip receive version** This command specifies a RIP version to receive on an interface. Use the **no** form to restore the default value.

#### Syntax

**ip rip receive version** {1 | 2}

**no ip rip receive version**

**1** - Accepts only RIPv1 packets.

**2** - Accepts only RIPv2 packets.

### Default Setting

RIPv1 and RIPv2 packets

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Use this command to override the global setting specified by the RIP [version](#) command.
- ◆ You can specify the receive version based on these options:
  - Use version 1 or version 2 if all routers in the local network are based on RIPv1 or RIPv2, respectively.
  - Use the default of version 1 or 2 if some routers in the local network are using RIPv2, but there are still some older routers using RIPv1.

### Example

This example sets the interface version for VLAN 1 to receive RIPv1 packets.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip receive version 1
Console(config-if)#
```

### Related Commands

[version \(970\)](#)

**ip rip receive-packet** This command configures the interface to receive RIP packets. Use the **no** form to disable this feature.

### Syntax

**[no] ip rip receive-packet**

### Default Setting

Enabled

### Command Mode

Interface Configuration (VLAN)

### Default Setting

Enabled

### Command Usage

Use the **no** form of this command if it is not required to add any dynamic entries to the routing table for an interface. For example, when only static routes are to be allowed for a specific interface.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip rip receive-packet
Console(config-if)#
```

### Related Commands

[ip rip send-packet \(975\)](#)

**ip rip send version** This command specifies a RIP version to send on an interface. Use the **no** form to restore the default value.

### Syntax

**ip rip send version {1 | 2 | 1-compatible}**

**no ip rip send version**

**1** - Sends only RIPv1 packets.

**2** - Sends only RIPv2 packets.

**1-compatible** - Route information is broadcast to other routers with RIPv2.

### Default Setting

1-compatible (Route information is broadcast to other routers with RIPv2)

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ Use this command to override the global setting specified by the RIP [version](#) command.
- ◆ You can specify the send version based on these options:
  - Use version 1 or version 2 if all routers in the local network are based on RIPv1 or RIPv2, respectively.
  - Use "1-compatible" to propagate route information by broadcasting to other routers on the network using RIPv2, instead of multicasting as normally required by RIPv2. (Using this mode allows older RIPv2 routers which only receive RIP broadcast messages to receive all of the information provided by RIPv2, including subnet mask, next hop and authentication information.)

### Example

This example sets the interface version for VLAN 1 to send RIPv1 packets.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip send version 1
Console(config-if)#
```

### Related Commands

[version \(970\)](#)

**ip rip send-packet** This command configures the interface to send RIP packets. Use the **no** form to disable this feature.

**[no] ip rip send-packet**

### Default Setting

Enabled

### Command Mode

Interface Configuration (VLAN)

### Default Setting

Enabled

### Command Usage

The **no** form of this command allows the router to passively monitor route information advertised by other routers attached to the network, without transmitting any RIP updates.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip rip send-packet
Console(config-if)#
```

### Related Commands

[ip rip receive-packet \(973\)](#)

**ip rip split-horizon** This command enables split-horizon or poison-reverse (a variation) on an interface. Use the **no** form to disable this function.

### Syntax

**ip rip split-horizon [poisoned]**

**no ip ip split-horizon**

**poisoned** - Enables poison-reverse on the current interface.

### Command Mode

Interface Configuration (VLAN)

### Default Setting

split-horizon poisoned

### Command Usage

- ◆ Split horizon never propagates routes back to an interface from which they have been acquired.
- ◆ Poison reverse propagates routes back to an interface port from which they have been acquired, but sets the distance-vector metrics to infinity. (This provides faster convergence.)
- ◆ If split-horizon is disabled with the **no rip ip split-horizon** command, and a loop occurs, the hop count for a route may be gradually incremented to infinity (that is, 16) before the route is deemed unreachable.

### Example

This example propagates routes back to the source using poison-reverse.

```
Console(config)#interface vlan 1
Console(config-if)#ip split-horizon poison-reverse
Console(config-if)#
```

**clear ip rip route** This command clears specified data from the RIP routing table.

### Syntax

**clear ip rip route** *{ip-address netmask | all | connected | ospf | rip | static}*

*ip-address* - IP address of a route entry.

*netmask* - Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

**all** - Deletes all entries from the routing table.

**connected** - Deletes all currently connected entries.

**ospf** - Deletes all entries learned through the Open Shortest Path First routing protocol.

**rip** - Deletes all entries learned through the Routing Information Protocol.

**static** - Deletes all static entries.

### Default Setting

None

### Command Mode

Privileged Exec



### Command Usage

Using this command with the "all" parameter clears the RIP table of all routes. To avoid deleting the entire RIP network, use the **redistribute connected** command to make the RIP network a connected route. To delete the RIP routes learned from neighbors and also keep the RIP network intact, use the "rip" parameter with this command (**clear ip rip route rip**).

### Example

This example clears one specific route.

```
Console#clear ip rip route 192.168.1.0 255.255.255.0
Console#
```

**show ip protocols rip** This command displays RIP process parameters.

### Command Mode

Privileged Exec

### Example

```
Console#show ip protocols rip
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-5 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version by interface set, receive version by
  interface set
    Interface  Send      Recv
    VLAN1     1-compatible 1 2
  Routing for Networks:
    10.0.0.0/24
  Routing Information Sources:
    Gateway         Distance  Last Update  Bad Packets  Bad Routes
    10.0.0.2         120      00:00:13     0            0
  The maximum number of RIP routes allowed: 11766
  Distance: Default is 120
Console#
```

**show ip rip** This command displays information about RIP routes and configuration settings. Use this command without any keywords to display all RIP routes.

### Syntax

**show ip rip** [**interface** [**vlan** *vlan-id*]]

**interface** - Shows RIP configuration settings for all interfaces or for a specified interface.

*vlan-id* - VLAN ID. (Range: 1-4094)

## Command Mode Privileged Exec

### Example

```
Console#show ip rip

Codes: R - RIP, Rc - RIP connected, Rs - RIP static,
       C - Connected, S - Static, O - OSPF

      Network          Next Hop          Metric From          Interface Time
Rc 192.168.0.0/24      1                      1                    VLAN1      01:57
Console#show ip rip interface vlan 1
Interface: vlan1
Routing Protocol: RIP
Receive RIPv1 and RIPv2 packets
Send RIPv1 Compatible
Passive interface: Disabled
Authentication mode: (None)
Authentication string: (None)
Split horizon: Enabled with Poisoned Reverse
IP interface address: 192.168.0.2/24
Console#
```

## Open Shortest Path First (OSPFv2)

Table 197: Open Shortest Path First Commands

Command	Function	Mode
<i>General Configuration</i>		
<code>router ospf</code>	Enables or disables OSPFv2	GC
<code>compatible rfc1583</code>	Calculates summary route costs using RFC 1583 (early OSPFv2)	RC
<code>default-information originate</code>	Generates a default external route into an autonomous system	RC
<code>router-id</code>	Sets the router ID for this device	RC
<code>timers spf</code>	Configures the delay after a topology change and the hold time between consecutive SPF calculations	RC
<code>clear ip ospf process</code>	Clears and restarts the OSPF routing process	PE
<i>Route Metrics and Summaries</i>		
<code>area default-cost</code>	Sets the cost for a default summary route sent into a stub or NSSA	RC
<code>area range</code>	Summarizes routes advertised by an ABR	RC
<code>auto-cost reference-bandwidth</code>	Calculates default metrics for an interface based on bandwidth	RC
<code>default-metric</code>	Sets the default metric for external routes imported from other protocols	RC
<code>redistribute</code>	Redistribute routes from one routing domain to another	RC

**Table 197: Open Shortest Path First Commands** (Continued)

Command	Function	Mode
<code>summary-address</code>	Summarizes routes advertised by an ASBR	RC
<i>Area Configuration</i>		
<code>area authentication</code>	Enables authentication for an OSPF area	RC
<code>area nssa</code>	Defines a not-so-stubby that can import external routes	RC
<code>area stub</code>	Defines a stubby area that cannot send or receive LSAs	RC
<code>area virtual-link</code>	Defines a virtual link from an area border routers to the backbone	RC
<code>network area</code>	Assigns specified interface to an area	RC
<i>Interface Configuration</i>		
<code>ip ospf authentication</code>	Specifies the authentication type for an interface	IC
<code>ip ospf authentication-key</code>	Assigns a simple password to be used by neighboring routers	IC
<code>ip ospf cost</code>	Specifies the cost of sending a packet on an interface	IC
<code>ip ospf dead-interval</code>	Sets the interval at which hello packets are not seen before neighbors declare the router down	IC
<code>ip ospf hello-interval</code>	Specifies the interval between sending hello packets	IC
<code>ip ospf message-digest-key</code>	Enables MD5 authentication and sets the key for an interface	IC
<code>ip ospf priority</code>	Sets the router priority used to determine the designated router	IC
<code>ip ospf retransmit-interval</code>	Specifies the time between resending a link-state advertisement	IC
<code>ip ospf transmit-delay</code>	Estimates time to send a link-state update packet over an interface	IC
<code>passive-interface</code>	Suppresses OSPF routing traffic on the specified interface	RC
<i>Display Information</i>		
<code>show ip ospf</code>	Displays general information about the routing processes	PE
<code>show ip ospf border-routers</code>	Displays routing table entries for Area Border Routers (ABR) and Autonomous System Boundary Routers (ASBR)	PE
<code>show ip ospf database</code>	Shows information about different LSAs in the database	PE
<code>show ip ospf interface</code>	Displays interface information	PE
<code>show ip ospf neighbor</code>	Displays neighbor information	PE
<code>show ip ospf route</code>	Displays the OSPF routing table	PE
<code>show ip ospf virtual-links</code>	Displays parameters and the adjacency state of virtual links	PE
<code>show ip protocols ospf</code>	Displays OSPF process parameters	PE

## General Configuration

**router ospf** This command enables Open Shortest Path First (OSPFv2) routing for all IP interfaces on the router and enters router configuration mode. Use the **no** form to disable OSPF for all processes or for a specified process.

### Syntax

**[no] router ospf** *[process-id]*

*process-id* - Process ID must be entered when configuring multiple routing instances. (Range: 1-65535; Default: 1)

### Command Mode

Global Configuration

### Default Setting

No routing process is defined.

### Command Usage

- ◆ OSPF is used to specify how routers exchange routing table information.
- ◆ This command is also used to enter router configuration mode.
- ◆ If the process ID is not defined, the default is instance 1.

### Example

```
Console(config)#router ospf
Console(config-router)#
```

### Related Commands

[network area \(997\)](#)

**compatible rfc1583** This command calculates summary route costs using RFC 1583 (early OSPFv2). Use the **no** form to calculate costs using RFC 2328 (OSPFv2).

### Syntax

**[no] compatible rfc1583**

### Command Mode

Router Configuration

### Default Setting

RFC 1583 compatible

### Command Usage

- ◆ When RFC 1583 compatibility is enabled, only cost is used when choosing among multiple AS-external LSAs advertising the same destination. When disabled, preference is based on type of path (where type 1 external paths are preferred over type 2 external paths, using cost only to break ties (RFC 2328).
- ◆ All routers in an OSPF routing domain should use the same RFC for calculating summary routes.
- ◆ If there are any OSPF routers in an area exchanging summary information (specifically, ABRs) which have not been upgraded to OSPFv2, this command should be used on the newly upgraded OSPFv2 routers to ensure compatibility with routers still running older OSPFv2 code. Once all systems have been upgraded to newer OSPFv2 code, use the no form of this command to restore compatibility for all systems with RFC 2328.

### Example

```
Console(config-router)#compatible rfc1583
Console(config-router)#
```

**default-information originate** This command generates a default external route into an autonomous system. Use the **no** form to disable this feature.

### Syntax

**default-information originate** [**always**] [**metric** *interface-metric*]  
[**metric-type** *metric-type*]

**no default-information originate** [**always** | **metric** | **metric-type**]

**always** - Always advertise itself as a default external route for the local AS regardless of whether the router has a default route. (See ["ip route" on page 954.](#))

*interface-metric* - Metric assigned to the default route. (Range: 0-16777214)

*metric-type* - External link type used to advertise the default route.  
(Options: Type 1, Type 2)

### Command Mode

Router Configuration

### Default Setting

Disabled

Metric: 20

Metric Type: 2

### Command Usage

- ◆ If the **always** parameter is not selected, the router can only advertise a default external route into the AS if it has been configured to import external routes

through other routing protocols or static routing, and such a route is known. (See the [redistribute](#) command.)

- ◆ The metric for the default external route is used to calculate the path cost for traffic passed from other routers within the AS out through the ASBR.
- ◆ When you use this command to redistribute routes into a routing domain (i.e., an Autonomous System, this router automatically becomes an Autonomous System Boundary Router (ASBR). However, an ASBR does not, by default, generate a default route into the routing domain.
  - If you use the **always** keyword, the router will advertise itself as a default external route into the AS, even if a default external route does not actually exist. To define a default route, use the [ip route](#) command.
  - If you do *not* use the **always** keyword, the router can only advertise a default external route into the AS if the [redistribute](#) command is used to import external routes via RIP or static routing, and such a route is known.
- ◆ Type 1 route advertisements add the internal cost to the external route metric. Type 2 routes do not add the internal cost metric. When comparing Type 2 routes, the internal cost is only used as a tie-breaker if several Type 2 routes have the same cost.
- ◆ This command should not be used to generate a default route for a stub or NSSA. To generate a default route for these area types, use the [area stub](#) or [area nssa](#) commands.

### Example

This example assigns a metric of 20 to the default external route advertised into an autonomous system, sending it as a Type 2 external metric.

```
Console(config-router)#default-information originate metric 20 metric-type 2
Console(config-router)#
```

### Related Commands

[ip route \(954\)](#)

[redistribute \(1030\)](#)

**router-id** This command assigns a unique router ID for this device within the autonomous system for the current OSPF process. Use the **no** form to use the default router identification method (i.e., the highest interface address).

### Syntax

**router-id** *ip-address*

**no router-id**

*ip-address* - Router ID formatted as an IPv4 address.

### Command Mode

Router Configuration

### Default Setting

Highest interface address

### Command Usage

- ◆ This command sets the router ID for the OSPF process specified in the [router ospf](#) command.
- ◆ The router ID must be unique for every router in the autonomous system. Using the default setting based on the highest interface address ensures that each router ID is unique. (Note that the router ID cannot be set to 0.0.0.0.)
- ◆ If this router already has registered neighbors, the new router ID will be used when the router is rebooted, or manually restarted by entering the **no router ospf** followed by the **router ospf** command.
- ◆ If the priority values of the routers bidding to be the designated router or backup designated router for an area are equal, the router with the highest ID is elected.

### Example

```
Console(config-router)#router-id 10.1.1.1
Console(config-router)#
```

### Related Commands

[router ospf \(980\)](#)

**timers spf** This command configures the delay after receiving a topology change and starting the shortest path first (SPF) calculation, and the hold time between making two consecutive SPF calculations. Use the **no** form to restore the default values.

### Syntax

**timers spf** *spf-delay* *spf-holdtime*

**no timers spf**

*spf-delay* - The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-2147483647 seconds)

*spf-holdtime* - Minimum time between two consecutive SPF calculations. (Range: 0-2147483647 seconds)

### Command Mode

Router Configuration

### Default Setting

SPF delay: 5 seconds

SPF holdtime: 10 seconds

### Command Usage

- ◆ Setting the SPF holdtime to 0 means that there is no delay between consecutive calculations.
- ◆ Using a low value allows the router to switch to a new path faster, but uses more CPU processing time.

### Example

```
Console(config-router)#timers spf 20
Console(config-router)#
```

**clear ip ospf process** This command clears and restarts the OSPF routing process. Specify the process ID to clear a particular OSPF process. When no process ID is specified, this command clears all running OSPF processes.

### Syntax

**clear ip ospf** [*process-id*] **process**

*process-id* - Specifies the routing process ID. (Range: 1-65535)

### Default Setting

Clears all routing processes.

### Command Mode

Privileged Exec



### Example

```
Console#clear ip ospf process
Console#
```

## Route Metrics and Summaries

**area default-cost** This command specifies a cost for the default summary route sent into a stub or NSSA from an Area Border Router (ABR). Use the **no** form to remove the assigned default cost.

### Syntax

**area** *area-id* **default-cost** *cost*

**no area** *area-id* **default-cost**

*area-id* - Identifies the stub or NSSA. (The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.)

*cost* - Cost for the default summary route sent to a stub or NSSA.  
(Range: 0-16777215)

### Command Mode

Router Configuration

### Default Setting

Default cost: 1

### Command Usage

- ◆ If the default cost is set to "0," the router will not advertise a default route into the attached stub or NSSA.

### Example

```
Console(config-router)#area 10.3.9.0 default-cost 10
Console(config-router)#
```

### Related Commands

[area stub \(993\)](#)

[area nssa \(992\)](#)

**area range** This command summarizes the routes advertised by an Area Border Router (ABR). Use the **no** form to disable this function.

### Syntax

**[no] area *area-id* range *ip-address* *netmask* [advertise | not-advertise]**

*area-id* - Identifies an area for which the routes are summarized. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

*ip-address* - Base address for the routes to summarize.

*netmask* - Network mask for the summary route.

**advertise** - Advertises the specified address range.

**not-advertise** - The summary is not sent, and the routes remain hidden from the rest of the network.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ This command can be used to summarize intra-area routes and advertise this information to other areas through Area Border Routers (ABRs).
- ◆ If the network addresses within an area are assigned in a contiguous manner, the ABRs can advertise a summary route that covers all of the individual networks within the area that fall into the specified range using a single **area range** command.
- ◆ If routes are set to be advertised by this command, the router will issue a Type 3 summary LSA for each address range specified by this command.
- ◆ This router supports up to 64 summary routes for area ranges.

### Example

This example creates a summary address for all area routes in the range of 10.2.x.x.

```
Console(config-router)#area 10.2.0.0 range 10.2.0.0 255.255.0.0 advertise
Console(config-router)#
```

**auto-cost reference-bandwidth** Use this command to calculate the default metrics for an interface based on bandwidth. Use the **no** form to automatically assign costs based on interface type.

#### Syntax

**auto-cost reference-bandwidth** *reference-value*

**no auto-cost reference-bandwidth**

*reference-value* - Bandwidth of interface. (Range: 1-4294967 Mbps)

#### Command Mode

Router Configuration

#### Default Setting

1 Mbps

#### Command Usage

- ◆ The system calculates the cost for an interface by dividing the reference bandwidth by the interface bandwidth. By default, the cost is 1 Mbps for all port types (including 100 Mbps ports, 1 Gigabit ports, and 10 Gigabit ports).
- ◆ A higher reference bandwidth can be used for aggregate links to indicate preferred use as a lower cost interface.
- ◆ The **ip ospf cost** command overrides the cost calculated by the **auto-cost reference-bandwidth** command.

#### Example

This example sets the reference value to 10000, which generates a cost of 100 for 100 Mbps ports, 10 for 1 Gbps ports and 1 for 10 Gbps ports.

```
Console(config-router)#auto-cost reference-bandwidth 10000
Console(config-router)#
```

#### Related Commands

[ip ospf cost \(1001\)](#)

**default-metric** This command sets the default metric for external routes imported from other protocols. Use the **no** form to remove the default metric for the supported protocol types.

#### Syntax

**default-metric** *metric-value*

**no default-metric**

*metric-value* – Metric assigned to all external routes imported from other protocols. (Range: 0-16777214)

### Command Mode

Router Configuration

### Default Setting

20

### Command Usage

- ◆ The default metric must be used to resolve the problem of redistributing external routes from other protocols that use incompatible metrics.
- ◆ This command does not override the metric value set by the [redistribute](#) command. When a metric value has not been configured by the [redistribute](#) command, the **default-metric** command sets the metric value to be used for all imported external routes.

### Example

```
Console(config-router)#default-metric 100
Console(config-router)#
```

### Related Commands

[redistribute \(988\)](#)

**redistribute** This command redistributes external routing information from other routing protocols and static routes into an autonomous system. Use the **no** form to disable this feature or to restore the default settings.

### Syntax

**redistribute** {**bgp** | **connected** | **rip** | **static**} [**metric** *metric-value*]  
[**metric-type** *type-value*] [**tag** *tag-value*]

**no redistribute** {**bgp** | **connected** | **static**} [**metric**] [**metric-type**] [**tag**]

**connected** - Imports all currently connected entries.

**rip** - Imports entries learned through the Routing Information Protocol.

**static** - Static routes will be imported into this Autonomous System.

*metric-value* - Metric assigned to all external routes for the specified protocol. (Range: 0-16777214; Default: 10)

*type-value*

**1** - Type 1 external route

**2** - Type 2 external route (default) - Routers do not add internal route metric to external route metric.

*tag-value* - A tag placed in the AS-external LSA to identify a specific external routing domain, or to pass additional information between routers. (Range: 0-4294967295)

## Command Mode

Router Configuration

## Default Setting

redistribution - none

metric-value - 10

type-metric - 2

## Command Usage

- ◆ This command is used to import routes learned from other routing protocols into the OSPF domain, and to generate AS-external-LSAs.
- ◆ When you redistribute external routes into an OSPF autonomous system (AS), the router automatically becomes an autonomous system boundary router (ASBR). If the **redistribute** command is used in conjunction with the [default-information originate](#) command to generate a “default” external route into the AS, the metric value specified in this command supersedes the metric specified in the [default-information originate](#) command.
- ◆ Metric type specifies the way to advertise routes to destinations outside the AS through External LSAs. When a Type 1 LSA is received by a router, it adds the internal cost to the external route metric. In other words, the cost of the route from any router within the AS is equal to the cost associated with reaching the advertising ASBR, plus the cost of the external route. When a Type 2 LSA is received by a router, it only uses the external route metric to determine route cost.
- ◆ A tag can be used to distinguish between routes learned from different external autonomous systems (other routing protocols). For example, if there are two ASBRs in a routing domain: A and B. ASBR A can be configured to redistribute routes learned from RIP domain 1 (identified by tag 1) and ASBR B can redistribute routes learned from RIP domain 2 (identified by tag 2).

## Example

This example redistributes routes learned from RIP as Type 1 external routes.

```
Console(config-router)#redistribute rip metric-type 1
Console(config-router)#
```

## Related Commands

[default-information originate \(981\)](#)

**summary-address** This command aggregates routes learned from other protocols. Use the **no** form to remove a summary address.

### Syntax

**[no] summary-address** *summary-address netmask*

*summary-address* - Summary address covering a range of addresses.

*netmask* - Network mask for the summary route.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

Redistributing routes from other protocols into OSPF normally requires the router to advertise each route individually in an external LSA. An Autonomous System Boundary Router (ASBR) can be configured to redistribute routes learned from other protocols by advertising an aggregate route into all attached autonomous systems. This helps both to decrease the number of external LSAs and the size of the OSPF link state database.

### Example

This example creates a summary address for all routes contained in 192.168.x.x.

```
Console(config-router)#summary-address 192.168.0.0 255.255.0.0
Console(config-router)#
```

### Related Commands

[area range \(1028\)](#)

[redistribute \(1030\)](#)

## Area Configuration

**area authentication** This command enables authentication for an OSPF area. Use the **no** form to remove authentication for an area.

### Syntax

**[no] area** *area-id authentication [message-digest]*

*area-id* - Identifies an area for which authentication is to be configured. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

**message-digest** - Specifies message-digest (MD5) authentication.

## Command Mode

Router Configuration

## Default Setting

No authentication

## Command Usage

- ◆ Use authentication to prevent routers from inadvertently joining an unauthorized area. Configure routers in the same area with the same password or key. All neighboring routers on the same network with the same password will exchange routing data.
- ◆ Specifying authentication for an area without the **message-digest** keyword sets authentication to Type 1 (simple password). Before specifying plain-text password authentication for an area, configure a password with the **ip ospf authentication-key** interface command. This password is inserted into the OSPF header when routing protocol packets are originated by this device. Assign a separate password to each area for different interfaces.
- ◆ When using simple password authentication, a password is included in the packet. If it does not match the password configured on the receiving router, the packet is discarded. This method provides very little security as it is possible to learn the authentication key by snooping on routing protocol packets.
- ◆ When using Message-Digest 5 (MD5) authentication, the router uses the MD5 algorithm to verify data integrity by creating a 128-bit message digest from the authentication key. Without the proper key and key-id, it is nearly impossible to produce any message that matches the pre-specified target message digest.
- ◆ Before specifying MD5 authentication for an area, configure the message-digest key-id and key with the **ip ospf message-digest-key** interface command.
- ◆ The plain-text authentication-key, or the MD5 *key-id* and *key*, must be used consistently throughout the autonomous system.

## Example

This example enables message-digest authentication for the specified area.

```
Console(config-router)#area 10.3.0.0 authentication
Console(config-router)#
```

## Related Commands

**ip ospf authentication-key (1000)**

**ip ospf message-digest-key (1003)**

**area nssa** This command defines a not-so-stubby area (NSSA). To remove an NSSA, use the **no** form without any optional keywords. To remove an optional attribute, use the **no** form without the relevant keyword.

### Syntax

```
[no] area area-id nssa  
[translator-role [candidate | never | always]] |  
[no-redistribution] | [no-summary] | [default-information-originate  
[metric metric-value | metric-type type-value]]
```

*area-id* - Identifies the NSSA. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

**translator-role** - Indicates NSSA-ABR translator role for Type 5 external LSAs.

**candidate** - Router translates NSSA LSAs to Type-5 external LSAs if elected.

**never** - Router never translates NSSA LSAs to Type-5 external LSAs.

**always** - Router always translates NSSA LSAs to Type-5 external LSAs.

**no-redistribution** - Use this keyword when the router is an NSSA Area Border Router (ABR) and you want the **redistribute** command to import routes only into normal areas, and not into the NSSA. In other words, this keyword prevents the NSSA ABR from advertising external routing information (learned via routers in other areas) into the NSSA.

**no-summary** - Allows an area to retain standard NSSA features, but does not inject inter-area routes into this area.

**default-information-originate** - When the router is an NSSA Area Border Router (ABR) or an NSSA Autonomous System Boundary Router (ASBR), this parameter causes it to generate Type-7 default LSA into the NSSA. This default provides a route to other areas within the AS for an NSSA ABR, or to areas outside the AS for an NSSA ASBR.

**metric-value** - Metric assigned to Type-7 default LSAs.  
(Range: 1-16777214; Default: 1)

*type-value*

**1** - Type 1 external route

**2** - Type 2 external route (default) - Routers do not add internal cost to the external route metric.

### Command Mode

Router Configuration

### Default Setting

No NSSA is configured.

### Command Usage

- ◆ All routers in a NSSA must be configured with the same area ID.



- ◆ An NSSA is similar to a stub, because when the router is an ABR, it can send a default route for other areas in the AS into the NSSA using the **default-information-originate** keyword. However, an NSSA is different from a stub, because when the router is an ASBR, it can import a default external AS route (for routing protocol domains adjacent to the NSSA but not within the OSPF AS) into the NSSA using the **default-information-originate** keyword.
- ◆ External routes advertised into an NSSA can include network destinations outside the AS learned via OSPF, the default route, static routes, routes imported from other routing protocols such as RIP, and networks directly connected to the router that are not running OSPF.
- ◆ NSSA external LSAs (Type 7) are converted by any ABR adjacent to the NSSA into external LSAs (Type-5), and propagated into other areas within the AS.
- ◆ Also, note that unlike stub areas, all Type-3 summary LSAs are always imported into NSSAs to ensure that internal routes are always chosen over Type-7 NSSA external routes.
- ◆ This router supports up to 16 total areas (either normal transit areas, stubs, or NSSAs).

#### EXAMPLE

This example creates a stub area 10.3.0.0, and assigns all interfaces with class B addresses 10.3.x.x to the NSSA. It also instructs the router to generate external LSAs into the NSSA when it is an NSSA ABR or NSSA ASBR.

```
Console(config-router)#area 10.3.0.0 nssa default-information-originate
Console(config-router)#network 10.3.0.0 255.255.0.0 area 10.2.0.0
Console(config-router)#
```

**area stub** This command defines a stub area. To remove a stub, use the **no** form without the optional keyword. To remove the summary attribute, use the **no** form with the summary keyword.

#### Syntax

**[no] area area-id stub [no-summary]**

*area-id* - Identifies the stub area. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

**no-summary** - Stops an Area Border Router (ABR) from sending summary link advertisements into the stub area.

#### Command Mode

Router Configuration

### Default Setting

No stub is configured.

Summary advertisement are sent into the stub.

### Command Usage

- ◆ All routers in a stub must be configured with the same area ID.
- ◆ Routing table space is saved in a stub by blocking Type-4 AS summary LSAs and Type 5 external LSAs. The default setting for this command completely isolates the stub by blocking Type-3 summary LSAs that advertise the default route for destinations external to the local area or the autonomous system.
- ◆ Use the **no-summary** parameter of this command on the ABR attached to the stub to define a totally stubby area. Define an area as a totally stubby area only if routers in the area do not require summary LSAs from other areas.
- ◆ Use the [area default-cost](#) command to specify the cost of a default summary route sent into a stub by an ABR attached to the stub area.

### Example

This example creates a stub area 10.2.0.0, and assigns all interfaces with class B addresses 10.2.x.x to the stub.

```
Console(config-router)#area 10.2.0.0 stub
Console(config-router)#network 10.2.0.0 0.255.255.255 area 10.2.0.0
Console(config-router)#
```

### Related Commands

[area default-cost \(985\)](#)

**area virtual-link** This command defines a virtual link. To remove a virtual link, use the **no** form with no optional keywords. To restore the default value for an attribute, use the **no** form with the required keyword.

#### SYNTAX

```
area area-id virtual-link router-id
    [authentication] [dead-interval seconds] [hello-interval seconds]
    [retransmit-interval seconds] [transmit-delay seconds]
```

```
no area area-id virtual-link router-id
    [authentication | dead-interval | hello-interval | retransmit-interval |
    transmit-delay]
```

```
area area-id virtual-link router-id
    authentication [message-digest | null]
    [authentication-key key | message-digest-key key-id md5 key]
```

```
no area area-id virtual-link router-id
    authentication [authentication-key | message-digest-key key-id]
```

```
area area-id virtual-link router-id
    [authentication-key key | message-digest-key key-id md5 key]
```

```
no area area-id virtual-link router-id
    [authentication-key | message-digest-key key-id]
```

*area-id* - Identifies the transit area for the virtual link. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

*router-id* - Router ID of the virtual link neighbor. This specifies the Area Border Router (ABR) at the other end of the virtual link. To create a virtual link, enter this command for an ABR at both ends of the link. One of the ABRs must be next to the isolated area and the transit area at one end of the link, while the other ABR must be next to the transit area and backbone at the other end of the link.

**dead-interval** *seconds* - Specifies the time that neighbor routers will wait for a hello packet before they declare the router down. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 4 x hello interval, or 40 seconds)

**hello-interval** *seconds* - Specifies the transmit delay between sending hello packets. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase the routing traffic. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 10 seconds)

**retransmit-interval** *seconds* - Specifies the interval at which the ABR retransmits link-state advertisements (LSA) over the virtual link. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. However, note that this value should be larger for virtual links. (Range: 1-3600 seconds; Default: 5 seconds)

**transmit-delay** *seconds* - Estimates the time required to send a link-state update packet over the virtual link, considering the transmission and propagation delays. LSAs have their age incremented by this amount before transmission. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 1 second)

**authentication** - Specifies the authentication mode. If no optional parameters follow this keyword, then plain text authentication is used along with the password specified by the **authentication-key**. If **message-digest** authentication is specified, then the **message-digest-key** and **md5** parameters must also be specified. If the **null** option is specified, then no authentication is performed on any OSPF routing protocol messages.

**message-digest** - Specifies message-digest (MD5) authentication.

**null** - Indicates that no authentication is used.

**authentication-key** *key* - Sets a plain text password (up to 8 characters) that is used by neighboring routers on a virtual link to generate or verify the authentication field in protocol message headers. A separate password can be assigned to each network interface. However, this key must be the same for all neighboring routers on the same network (i.e., autonomous system). This key is only used when authentication is enabled for the backbone.

**message-digest-key** *key-id* **md5** *key* - Sets the key identifier and password to be used to authenticate protocol messages passed between neighboring routers and this router when using message digest (MD5) authentication. The *key-id* is an integer from 0-255, and the *key* is an alphanumeric string up to 16 characters long. If MD5 authentication is used on a virtual link, then it must be enabled on all routers within an autonomous system; and the key identifier and key must also be the same for all routers.

## Command Mode

Router Configuration

## Default Setting

*area-id*: None

*router-id*: None

hello-interval: 10 seconds

retransmit-interval: 5 seconds

transmit-delay: 1 second

dead-interval: 40 seconds

authentication-key: None

message-digest-key: None

## Command Usage

- ◆ All areas must be connected to a backbone area (0.0.0.0) to maintain routing connectivity throughout the autonomous system. If it not possible to physically connect an area to the backbone, you can use a virtual link. A virtual link can provide a logical path to the backbone for an isolated area, or can be

configured as a backup connection that can take over if the normal connection to the backbone fails.

- ◆ A virtual link can be configured between any two backbone routers that have an interface to a common non-backbone area. The two routers joined by a virtual link are treated as if they were connected by an unnumbered point-to-point network.
- ◆ Any area disconnected from the backbone must include the transit area ID and the router ID for a virtual link neighbor that is adjacent to the backbone.

### Example

This example creates a virtual link using the defaults for all optional parameters.

```
Console(config-router)#network 10.4.0.0 0.255.255.0.0 area 10.4.0.0
Console(config-router)#area 10.4.0.0 virtual-link 10.4.3.254
Console(config-router)#
```

This example creates a virtual link using MD5 authentication.

```
Console(config-router)#network 10.4.0.0 0.255.255.0.0 area 10.4.0.0
Console(config-router)#area 10.4.0.0 virtual-link 10.4.3.254 message-digest-
key 5 md5 1d83jdpq
Console(config-router)#
```

### Related Commands

[show ip protocols ospf \(1020\)](#)

**network area** This command defines an OSPF area and the interfaces that operate within this area. Use the **no** form to disable OSPF for a specified interface.

### Syntax

**[no] network** *ip-address netmask area area-id*

*ip-address* - Address of the interfaces to add to the area.

*netmask* - Network mask of the address range to add to the area.

*area-id* - Area to which the specified address or range is assigned. An OSPF area identifies a group of routers that share common routing information. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ An area ID uniquely defines an OSPF broadcast area. The area ID 0.0.0.0 indicates the OSPF backbone for an autonomous system. Each router must be connected to the backbone via a direct connection or a virtual link.
- ◆ Set the area ID to the same value for all routers on a network segment using the network mask to add one or more interfaces to an area.
- ◆ If an address range is overlapped in subsequent network area commands, the router will use the network area with the address range that most closely matches the interface address. Also, note that if a more specific address range is removed from an area, the interface belonging to that range may still remain active if a less specific address range covering that area has been specified.

### Example

This example creates the backbone 0.0.0.0 covering class B addresses 10.1.x.x, and a normal transit area 10.2.9.0 covering the class C addresses 10.2.9.x.

```
Console(config-router)#network 10.1.0.0 255.255.0.0 area 0.0.0.0
Console(config-router)#network 10.2.9.0 255.255.255.0 area 10.1.0.0
Console(config-router)#
```

## Interface Configuration

**ip ospf authentication** This command specifies the authentication type used for an interface. Enter this command without any optional parameters to specify plain text (or simple password) authentication. Use the **no** form to restore the default of no authentication.

### Syntax

**ip ospf** [*ip-address*] **authentication** [**message-digest** | **null**]

**no ip ospf** [*ip-address*] **authentication**

*ip-address* - IP address of the interface. Enter this parameter to specify a unique authentication type for a primary or secondary IP address associated with the current VLAN. If not specified, the command applies to all networks connected to the current interface.

**message-digest** - Specifies message-digest (MD5) authentication.

**null** - Indicates that no authentication is used.

### Command Mode

Interface Configuration (VLAN)

### Default Setting

No authentication

### Command Usage

- ◆ Use authentication to prevent routers from inadvertently joining an unauthorized area. Configure routers in the same area with the same password or key. All neighboring routers on the same network with the same password will exchange routing data.
- ◆ This command creates a password (key) that is inserted into the OSPF header when routing protocol packets are originated by this device. Assign a separate password to each network for different interfaces.
- ◆ When using simple password authentication, a password is included in the packet. If it does not match the password configured on the receiving router, the packet is discarded. This method provides very little security as it is possible to learn the authentication key by snooping on routing protocol packets.
- ◆ When using Message-Digest 5 (MD5) authentication, the router uses the MD5 algorithm to verify data integrity by creating a 128-bit message digest from the authentication key. Without the proper key and key-id, it is nearly impossible to produce any message that matches the pre-specified target message digest.
- ◆ Before specifying plain-text password authentication for an interface, configure a password with the `ip ospf authentication-key` command. Before specifying MD5 authentication for an interface, configure the message-digest key-id and key with the `ip ospf message-digest-key` command.
- ◆ The plain-text authentication-key, or the MD5 *key-id* and *key*, must be used consistently throughout the autonomous system.

### Example

This example enables message-digest authentication for the specified interface.

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf authentication message-digest
Console(config-if)#
```

### Related Commands

`ip ospf authentication-key (1000)`

`ip ospf message-digest-key (1003)`

**ip ospf authentication-key** This command assigns a simple password to be used by neighboring routers to verify the authenticity of routing protocol messages. Use the **no** form to remove the password.

### Syntax

**ip ospf** [*ip-address*] **authentication-key** *key*

**no ip ospf** [*ip-address*] **authentication-key**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*key* - Sets a plain text password. (Range: 1-8 characters)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

No password

### Command Usage

- ◆ Before specifying plain-text password authentication for an interface with the **ip ospf authentication** command, configure a password with this command.
- ◆ This command creates a password (key) that is inserted into the OSPF header when routing protocol packets are originated by this device. Assign a separate password to each network for different interfaces. All neighboring routers on the same network with the same password will exchange routing data.
- ◆ A different password can be assigned to each network interface, but the password must be used consistently on all neighboring routers throughout a network (i.e., autonomous system).

### Example

This example sets a password for the specified interface.

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf authentication-key badboy
Console(config-if)#
```

### Related Commands

**ip ospf authentication** (998)



**ip ospf cost** This command explicitly sets the cost of sending a protocol packet on an interface, where higher values indicate slower ports. Use the **no** form to restore the default value.

### Syntax

**ip ospf** [*ip-address*] **cost** *cost*

**no ip ospf** [*ip-address*] **cost**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*cost* - Link metric for this interface. Use higher values to indicate slower ports. (Range: 1-65535)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

1

### Command Usage

- ◆ The interface cost indicates the overhead required to send packets across a certain interface. This is advertised as the link cost in router link state advertisements.
- ◆ Routes are assigned a metric equal to the sum of all metrics for each interface link in the route.
- ◆ This router uses a default cost of 1 for all port types. Therefore, if any VLAN contains 10 Gbps ports, you may want to reset the cost for other VLANs which do not contain 10 Gbps ports to a value greater than 1.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf cost 10
Console(config-if)#
```

**ip ospf dead-interval** This command sets the interval at which hello packets are not seen before neighbors declare the router down. Use the **no** form to restore the default value.

#### Syntax

**ip ospf** [*ip-address*] **dead-interval** *seconds*

**no ip ospf** [*ip-address*] **dead-interval**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*seconds* - The maximum time that neighbor routers can wait for a hello packet before declaring the transmitting router down. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

#### Command Mode

Interface Configuration (VLAN)

#### Default Setting

40, or four times the interval specified by the [ip ospf hello-interval](#) command.

#### Command Usage

The dead-interval is advertised in the router's hello packets. It must be a multiple of the hello-interval and be the same for all routers on a specific network.

#### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf dead-interval 50
Console(config-if)#
```

#### Related Commands

[ip ospf hello-interval \(1002\)](#)

**ip ospf hello-interval** This command specifies the interval between sending hello packets on an interface. Use the **no** form to restore the default value.

#### Syntax

**ip ospf** [*ip-address*] **hello-interval** *seconds*

**no ip ospf** [*ip-address*] **hello-interval**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*seconds* - Interval at which hello packets are sent from an interface. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

10 seconds

### Command Usage

Hello packets are used to inform other routers that the sending router is still active. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase routing traffic.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf hello-interval 5
Console(config-if)#
```

**ip ospf message-digest-key** This command enables message-digest (MD5) authentication on the specified interface and assigns a key-id and key to be used by neighboring routers. Use the **no** form to remove an existing key.

### Syntax

**ip ospf** [*ip-address*] **message-digest-key** *key-id* **md5** *key*

**no ip ospf** [*ip-address*] **message-digest-key** *key-id*

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*key-id* - Index number of an MD5 key. (Range: 0-255)

*key* - Alphanumeric password used to generate a 128 bit message digest or "fingerprint." (Range: 1-16 characters)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

MD5 authentication is disabled.

### Command Usage

- ◆ Before specifying MD5 authentication for an interface with the **ip ospf authentication** command, configure the message-digest key-id and key with this command.
- ◆ Normally, only one key is used per interface to generate authentication information for outbound packets and to authenticate incoming packets. Neighbor routers must use the same key identifier and key value.

- ◆ When changing to a new key, the router will send multiple copies of all protocol messages, one with the old key and another with the new key. Once all the neighboring routers start sending protocol messages back to this router with the new key, the router will stop using the old key. This rollover process gives the network administrator time to update all the routers on the network without affecting the network connectivity. Once all the network routers have been updated with the new key, the old key should be removed for security reasons.

### Example

This example sets a message-digest key identifier and password.

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf message-digest-key 1 md5 aiebel
Console(config-if)#
```

### Related Commands

[ip ospf authentication \(998\)](#)

**ip ospf priority** This command sets the router priority used when determining the designated router (DR) and backup designated router (BDR) for an area. Use the **no** form to restore the default value.

### Syntax

**ip ospf** [*ip-address*] **priority** *priority*

**no ip ospf** [*ip-address*] **priority**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*priority* - Sets the interface priority for this router. (Range: 0-255)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

1

### Command Usage

- ◆ A designated router (DR) and backup designated router (BDR) are elected for each OSPF network segment based on Router Priority. The DR forms an active adjacency to all other routers in the network segment to exchange routing topology information. If for any reason the DR fails, the BDR takes over this role.
- ◆ Set the priority to zero to prevent a router from being elected as a DR or BDR. If set to any value other than zero, the router with the highest priority will

become the DR and the router with the next highest priority becomes the BDR. If two or more routers are tied with the same highest priority, the router with the higher ID will be elected.

- ◆ If a DR already exists for a network segment when this interface comes up, the new router will accept the current DR regardless of its own priority. The DR will not change until the next time the election process is initiated.
- ◆ Configure router priority for multi-access networks only and not for point-to-point networks.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf priority 5
Console(config-if)#
```

**ip ospf retransmit-interval** This command specifies the time between resending link-state advertisements (LSAs). Use the **no** form to restore the default value.

### Syntax

**ip ospf** [*ip-address*] **retransmit-interval** *seconds*

**no ip ospf** [*ip-address*] **retransmit-interval**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*seconds* - Sets the interval at which LSAs are retransmitted from this interface. (Range: 1-65535)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

5 seconds

### Command Usage

- ◆ A router will resend an LSA to a neighbor if it receives no acknowledgment after the specified retransmit interval. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. Note that this value should be larger for virtual links.
- ◆ Set this interval to a value that is greater than the round-trip delay between any two routers on the attached network to avoid unnecessary retransmissions.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf retransmit-interval 7
Console(config-if)#
```

**ip ospf transmit-delay** This command sets the estimated time to send a link-state update packet over an interface. Use the **no** form to restore the default value.

### Syntax

**ip ospf** [*ip-address*] **transmit-delay** *seconds*

**no ip ospf** [*ip-address*] **transmit-delay**

*ip-address* - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

*seconds* - Sets the estimated time required to send a link-state update.  
(Range: 1-65535)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

1 second

### Command Usage

- ◆ LSAs have their age incremented by this delay before transmission. When estimating the transmit delay, consider both the transmission and propagation delays for an interface. Set the transmit delay according to link speed, using larger values for lower-speed links.
- ◆ If this delay is not added, the time required to transmit an LSA over the link is not taken into consideration by the routing process. On slow links, the router may send packets more quickly than devices can receive them. To avoid this problem, use the transmit delay to force the router to wait a specified interval between transmissions.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf transmit-delay 6
Console(config-if)#
```

**passive-interface** This command suppresses OSPF routing traffic on the specified interface. Use the **no** form to allow routing traffic to be sent and received on the specified interface.

### Syntax

**[no] passive-interface vlan** *vlan-id* [*ip-address*]

*vlan-id* - VLAN ID. (Range: 1-4094)

*ip-address* - An IPv4 address configured on this interface.

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

You can configure an OSPF interface as passive to prevent OSPF routing traffic from exiting or entering that interface. No OSPF adjacency can be formed if one of the interfaces involved is set to passive mode. The specified interface will appear as a stub in the OSPF domain. Also, if you configure an OSPF interface as passive where an adjacency already exists, the adjacency will drop almost immediately.

### Example

```
Console(config-router)#passive-interface vlan 1
Console(config-router)#
```

## Display Information

**show ip ospf** This command shows basic information about the routing configuration.

### Syntax

**show ip ospf** [*process-id*]

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-65535)

### Command Mode

Privileged Exec

### Example

```
Console#show ip ospf
Routing Process "ospf 1" with ID 192.168.1.3
Process uptime is 20 minutes
Conforms to RFC2328, and RFC1583Compatibility flag is disabled
Supports only single TOS(TOS0) routes
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Refresh timer 10 secs
Number of incoming current DD exchange neighbors 0/5
```

```
Number of outgoing current DD exchange neighbors 0/5
Number of external LSA 0. Checksum 0x000000
Number of opaque AS LSA 0. Checksum 0x000000
LSDB database overflow limit is 20480
Number of LSA originated 1
Number of LSA received 0
Number of areas attached to this router: 1

Area 192.168.1.3
  Number of interfaces in this area is 1(1)
  Number of fully adjacent neighbors in this area is 0
  Area has no authentication
  SPF algorithm last executed 00:00:08.739 ago
  SPF algorithm executed 1 times
  Number of LSA 1. Checksum 0x007f09
Console#
```

**Table 198: show ip ospf - display description**

Field	Description
Routing Process with ID	OSPF process ID and router ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Process uptime	The time this process has been running
Conforms to RFC2328	Shows that this router is compliant with OSPF Version 2.
RFC1583 Compatibility flag	Shows whether or not compatibility with the RFC 1583 (an earlier version of OSPFv2) is enabled.
Supports only single TOS (TOS0) routes	Optional Type of Service (ToS) specified in OSPF Version 2, Appendix F.1.2 is not supported, so only one cost per interface can be assigned.
SPF schedule delay	Delay between receiving a change to SPF calculation.
Hold time	Sets the hold time between two consecutive SPF calculations.
Refresh timer	The time between refreshing the LSA database.
Number of current DD exchange neighbors	Number of neighbors currently exchanging database descriptor packets.
Number of external LSA	The number of external link-state advertisements (Type 5 LSAs) in the link-state database. These LSAs advertise information about routes outside of the autonomous system.
Checksum	The sum of the LS checksums of the external link-state advertisements contained in the link-state database.
Number of opaque AS LSA	Number of opaque link-state advertisements (Type 9, 10 and 11 LSAs) in the link-state database. These LSAs advertise information about external applications, and are only used by OSPF for the graceful restart process.
Checksum	The sum of the LS checksums of opaque link-state advertisements contained in the link-state database.
LSDB database overflow limit	The maximum number of LSAs allowed in the external database.



**Table 198: show ip ospf - display description** (Continued)

Field	Description
Number of LSA originated	The number of new link-state advertisements that have been originated.
Number of LSA received	The number of link-state advertisements that have been received.
Number of areas attached to this router	The number of configured areas attached to this router.
Number of interfaces in this area is	The number of interfaces attached to this area
Number of fully adjacent neighbors in this area is	The number of neighbors for which the exchange of recognition protocol messages has been completed and are now fully adjacent
Area has (no) authentication	Shows whether or not the authentication has been enabled
SPF algorithm last executed	The last time the shortest path first algorithm was executed
SPF algorithm executed x times	The number of times the shortest path first algorithm has been executed for this area
Number of LSA	The number of new link-state advertisements that have been originated.
Checksum	The sum of the link-state advertisements' LS checksums contained in this area's link-state database.

**show ip ospf border-routers** This command shows entries in the routing table that lead to an Area Border Router (ABR) or Autonomous System Boundary Router (ASBR).

### Syntax

**show ip ospf [process-id] border-routers**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-65535)

### Command Mode

Privileged Exec

### Example

```

Console#show ip ospf border-routers

OSPF process 1 internal Routing Table

Codes: i - Intra-area route, I - Inter-area route

i 192.168.0.3 [1] via 192.168.0.3, vlan1, ABR, ASBR, Area 0.0.0.0
Console#

```

**show ip ospf database** This command shows information about different OSPF Link State Advertisements (LSAs) stored in this router's database.

### Syntax

**show ip ospf** [*process-id*] **database**  
[**asbr-summary** | **external** | **network** | **nssa-external** | **router** | **summary**]  
[**adv-router** *ip-address* | *link-state-id* | **self-originate**]

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-65535)

**adv-router** - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

*ip-address* - IP address of the specified router. If no address is entered, information about the local router is displayed.

*link-state-id* - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

**self-originate** - Shows LSAs originated by this router.

**asbr-summary** - Shows information about Autonomous System Boundary Router summary LSAs.

**external** - Shows information about external LSAs.

**network** - Shows information about network LSAs.

**nssa-external** - Shows information about NSSA external LSAs.

**router** - Shows information about router LSAs.

**summary** - Shows information about summary LSAs.

### Command Mode

Privileged Exec

### Examples

The following shows output for the **show ip ospf database** command.

```
Console#show ip ospf database
```

```
OSPF Router with ID (192.168.0.2) (Process ID 1)
```

```
Router Link States (Area 0.0.0.0)
```

Link ID	ADV Router	Age	Seq#	CkSum	Link count
192.168.0.2	192.168.0.2	225	0x80000004	0xdac5	1
192.168.0.3	192.168.0.3	220	0x80000004	0xd8c4	1

```

Net Link States (Area 0.0.0.0)

Link ID      ADV Router    Age  Seq#          CkSum
192.168.0.2  192.168.0.2   225  0x80000001    0x9c0f

AS External Link States

Link ID      ADV Router    Age  Seq#          CkSum  Route          Tag
0.0.0.0      192.168.0.2   487  0x80000001    0xd491  E2 0.0.0.0/0  0
0.0.0.0      192.168.0.3   222  0x80000001    0xce96  E2 0.0.0.0/0  0

Console#

```

**Table 199: show ip ospf database - display description**

Field	Description
OSPF Router Process with ID	OSPF process ID and router ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Link ID	Either a Router ID or an IP Address; it identifies the piece of the routing domain that is being described by the advertisement
ADV Router	Advertising router ID
Age	Age of LSA (in seconds)
Seq#	Sequence number of LSA (used to detect older duplicate LSAs)
CkSum	Checksum of the complete contents of the LSA
Link count	Number of interfaces attached to the router
Route	Type 1 or Type 2 external metric (see the <a href="#">redistribute</a> command) and route
Tag	Optional tag if defined (see the <a href="#">redistribute</a> command)

The following shows output when using the **asbr-summary** keyword.

```

Console#show ip ospf database asbr-summary

OSPF Router with ID (0.0.0.0) (Process ID 1)

ASBR-Summary Link States (Area 0.0.0.1)

LS Age: 0
Options: 0x2 (*|---|---|E|)
LS Type: ASBR-summary-LSA
Link State ID: 2.1.0.0 (AS Boundary Router address)
Advertising Router: 192.168.2.1
LS Seq Number: 80000001
Checksum: 0x7b67
Length: 28
Network Mask: /0
TOS: 0 Metric: 10

Console#

```

**Table 200: show ip ospf database summary - display description**

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	Summary Links - LSA describes routes to AS boundary routers
Link State ID	Interface address of the autonomous system boundary router
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Address mask for the network
TOS	Type of Service – This router only supports TOS 0 (or normal service)
Metric	Cost of the link

The following shows output when using the **external** keyword.

```
Console#show ip ospf database external
OSPF Router process 100 with ID (10.10.11.50)
AS External Link States LS age: 298
Options: 0x2 (*|-|-|-|-|E|-)
LS Type: AS-external-LSA
Link State ID: 10.10.100.0 (External Network Number)
Advertising Router: 10.10.11.50
LS Seq Number: 80000001
Checksum: 0x7033
Length: 36
Network Mask: /24
Metric Type: 2 (Larger than any link state path)
TOS: 0
Metric: 20
Forward Address: 10.10.11.50
External Route Tag: 0

OSPF Router with ID (0.0.0.0) (Process ID 1)

AS External Link States

LS Age: 0
Options: 0x2 (*|-|-|-|-|E|-)
LS Type: AS-external-LSA
Link State ID: 0.0.0.0 (External Network Number)
Advertising Router: 192.168.0.2
LS Seq Number: 80000005
Checksum: 0xcc95
Length: 36
Network Mask: /0
Metric Type: 2 (Larger than any link state path)
TOS: 0
```

```
Metric: 1
Forward Address: 0.0.0.0
External Route Tag: 0
```

Console#

**Table 201: show ip ospf database external - display description**

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	AS External Links - LSA describes routes to destinations outside the AS (including default external routes for the AS)
Link State ID	IP network number (External Network Number)
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Address mask for the network
Metric Type	Type 1 or Type 2 external metric (see the <a href="#">redistribute</a> command)
TOS	Type of Service – This router only supports TOS 0 (or normal service)
Metric	Cost of the link
Forward Address	Next hop address. If this field is set to 0.0.0.0, data is forwarded to the originator of the advertisement.
External Route Tag	Optional tag if defined (see the <a href="#">redistribute</a> command)

The following shows output when using the **network** keyword.

```
Console#show ip ospf database network

      OSPF Router with ID (0.0.0.0) (Process ID 1)

      Net Link States (Area 0.0.0.0)

LS Age: 0
Options: 0x2 (*|-|-|-|-|E|-)
LS Type: network-LSA
Link State ID: 192.168.0.2 (address of Designated Router)
Advertising Router: 192.168.0.2
LS Seq Number: 80000005
Checksum: 0x9413
Length: 32
Network Mask: /24
    Attached Router: 192.168.0.2
    Attached Router: 192.168.0.3
```

⋮

**Table 202: show ip ospf database network - display description**

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	Network Link - LSA describes the routers attached to the network
Link State ID	Interface address of the designated router
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Address mask for the network
Attached Router	List of routers attached to the network; i.e., fully adjacent to the designated router, including the designated router itself

The following shows output when using the **router** keyword.

```
Console#show ip ospf database router

      OSPF Router with ID (0.0.0.0) (Process ID 1)

      Router Link States (Area 0.0.0.0)

LS Age: 0
Options: 0x2 (*|-|-|-|-|E|-)
Flags: 0x2 : ASBR
LS Type: router-LSA
Link State ID: 192.168.0.2
Advertising Router: 192.168.0.2
LS Seq Number: 80000008
Checksum: 0xd2c9
Length: 36
  Link connected to: a Transit Network
    (Link ID) Designated Router address: 192.168.0.2
    (Link Data) Router Interface address: 192.168.0.2
    Number of TOS metrics: 0
    TOS 0 Metric: 1
⋮
```

**Table 203: show ip ospf database router - display description**

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
Flags	Indicate if this router is a virtual link endpoint, an ASBR, or an ABR
LS Type	Router Link - LSA describes the router's interfaces.
Link State ID	Router ID of the router that originated the LSA
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Link connected to	Link-state type, including transit network, stub network, or virtual link
Link ID	Link type and corresponding Router ID or network address
Link Data	Router ID for transit network Network's IP address mask for stub network Neighbor Router ID for virtual link
Number of TOS metrics	Type of Service metric – This router only supports TOS 0 (or normal service)
TOS	Type of Service – This router only supports TOS 0 (or normal service)
Metric	Cost of the link

The following shows output when using the **summary** keyword.

```

Console#show ip ospf database summary

      OSPF Router with ID (0.0.0.0) (Process ID 1)

      Summary Link States (Area 0.0.0.0)

LS Age: 1
Options: 0x0 (*|---|---|---|)
LS Type: summary-LSA
Link State ID: 192.168.10.0 (summary Network Number)
Advertising Router: 2.1.0.0
LS Seq Number: 80000005
Checksum: 0x479d
Length: 28
Network Mask: /24
      TOS: 0  Metric: 0
:

```

**Table 204: show ip ospf database summary - display description**

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	Summary Links - LSA describes routes to networks
Link State ID	Router ID of the router that originated the LSA
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Destination network's IP address mask
Metrics	Cost of the link

**show ip ospf interface** This command displays summary information for OSPF interfaces.

### Syntax

**show ip ospf interface [vlan *vlan-id*]**  
*vlan-id* - VLAN ID (Range: 1-4094)

### Command Mode

Privileged Exec

### Example

```
Console#show ip ospf interface vlan 1
VLAN1 is up, line protocol is up
  Internet Address 192.168.0.2/24, Area 0.0.0.0, MTU 1500
  Process ID 1, Router ID 192.168.0.2, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.0.2, Interface Address 192.168.0.2
  Backup Designated Router (ID) 192.168.0.3, Interface Address 192.168.0.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  Hello due in 00:00:10
  Neighbor Count is 1, Adjacent neighbor count is 1
  Hello received 920 sent 975, DD received 5 sent 4
  LS-Req received 1 sent 1, LS-Upd received 14 sent 18
  LS-Ack received 17 sent 13, Discarded 0
Console#
```



**Table 205: show ip ospf interface - display description**

Field	Description
VLAN	VLAN ID and Status of physical link
Internet Address	IP address of OSPF interface
Area	OSPF area to which this interface belongs
MTU	Maximum transfer unit
Process ID	OSPF process ID
Router ID	Router ID
Network Type	Includes broadcast, non-broadcast, or point-to-point networks
Cost	Interface transmit cost
Transmit Delay	Interface transmit delay (in seconds)
State	<ul style="list-style-type: none"> <li>◆ Disabled – OSPF not enabled on this interface</li> <li>◆ Down – OSPF is enabled on this interface, but interface is down</li> <li>◆ Loopback – This is a loopback interface</li> <li>◆ Waiting – Router is trying to find the DR and BDR</li> <li>◆ DR – Designated Router</li> <li>◆ BDR – Backup Designated Router</li> <li>◆ DRoher – Interface is on a multiaccess network, but is not the DR or BDR</li> </ul>
Priority	Router priority
Designated Router	Designated router ID and respective interface address
Backup Designated Router	Backup designated router ID and respective interface address
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit
Neighbor Count	Count of network neighbors and adjacent neighbors
Adjacent neighbor count	Count of adjacent neighbors
Hello	Number of Hello LSAs received and sent
DD	Number of Database Descriptor packets received and sent.
LS-Req	Number of LSA requests
LS-Upd	Number of LSA updates
LS-Ack	Number of LSA acknowledgements
Discarded	Number of LSAs discarded

**show ip ospf neighbor** This command displays information about neighboring routers on each interface within an OSPF area.

### Syntax

**show ip ospf [process-id] neighbor**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-65535)

### Command Mode

Privileged Exec

### Example

```
Console#show ip ospf neighbor
```

ID	Pri	State	Address	Interface
192.168.0.3	1	FULL/BDR	192.168.0.3	VLAN1

```
Console#
```

**Table 206: show ip ospf neighbor - display description**

Field	Description
Neighbor ID	Neighbor's router ID
Pri	Neighbor's router priority
State	OSPF state and identification flag States include: Down – Connection down Attempt – Connection down, but attempting contact (for non-broadcast networks) Init – Have received Hello packet, but communications not yet established Two-way – Bidirectional communications established ExStart – Initializing adjacency between neighbors Exchange – Database descriptions being exchanged Loading – LSA databases being exchanged Full – Neighboring routers now fully adjacent Identification flags include: D – Dynamic neighbor S – Static neighbor DR – Designated router BDR – Backup designated router
Address	IP address of this interface
Interface	The interface to which this neighbor is attached

**show ip ospf route** This command displays the OSPF routing table.

### Syntax

**show ip ospf [process-id] route**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-65535)

### Command Mode

Privileged Exec

### Example

```
Console#show ip ospf route
OSPF process 1:
Codes: C - connected, D - Discard, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2
O  10.10.0.0/24 [10] is directly connected, fe1/1, Area 0.0.0.0
O  10.10.11.0/24 [10] is directly connected, fe1/2, Area 0.0.0.0
O  10.10.11.100/32 [10] is directly connected, lo, Area 0.0.0.0
E2 10.15.0.0/24 [10/50] via 10.10.0.1, VLAN1
IA 172.16.10.0/24 [30] via 10.10.11.50, VLAN2, Area 0.0.0.0
E2 192.168.0.0/16 [10/20] via 10.10.11.50, VLAN2

Console#
```

**show ip ospf virtual-links** This command displays detailed information about virtual links.

### Syntax

**show ip ospf virtual-links**

### Command Mode

Privileged Exec

### Example

```
Console#show ip ospf virtual-links
Virtual Link VLINK1 to router 192.168.0.2 is up
Transit area 0.0.0.1 via interface VLAN1
Local address 192.168.0.3
Remote address 192.168.0.2
Transmit Delay is 1 sec, State Point-To-Point,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:08
Adjacency state Down

Console#
```

**Table 207: show ip ospf virtual-links - display description**

Field	Description
Virtual Link to router	OSPF neighbor and link state (up or down)
Transit area	Common area the virtual link crosses to reach the target router
Local address	The IP address of ABR that serves as an endpoint connecting the isolated area to the common transit area.
Remote address	The IP address this virtual neighbor is using. The neighbor must be an ABR at the other endpoint connecting the common transit area to the backbone itself.
Transmit Delay	Estimated transmit delay (in seconds) on the virtual link
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit

**Related Commands**  
[area virtual-link \(995\)](#)

**show ip protocols ospf** This command displays OSPF process parameters.

**Syntax**

**show ip protocols ospf**

**Command Mode**  
Privileged Exec

**Example**

```
Console#show ip protocols ospf
Routing Protocol is "ospf 200"
Redistributing: rip
Routing for Networks:
 192.30.30.0/24
 192.40.40.0/24
  Routing for Summary Address:
    192.168.1.0/24
    192.168.3.0/24
Distance: (default is 110)
Console#
```

**Table 208: show ip protocols ospf - display description**

Field	Description
Routing Protocol	Name and autonomous system number of this OSPF process.
Redistributing	Shows if route redistribution has been enabled with the <a href="#">redistribute</a> command.
Routing for Networks	Networks for which the OSPF is currently registering routing information.

**Table 208: show ip protocols ospf - display description** (Continued)

Field	Description
Routing for Summary Address	Shows the networks for which route summarization is in effect
Distance	The administrative distance used for external routes learned by OSPF (see the <a href="#">ip route</a> command).

## Open Shortest Path First (OSPFv3)

**Table 209: Open Shortest Path First Commands (Version 3)**

Command	Function	Mode
<i>General Configuration</i>		
<a href="#">router ipv6 ospf</a>	Enables or disables OSPFv3 routing process	GC
<a href="#">abr-type</a>	Sets the criteria used to determine if this router can declare itself an ABR and issue Type 3 and Type 4 summary LSAs	RC
<a href="#">max-current-dd</a>	Sets the maximum number of neighbors with which the switch can concurrently exchange database descriptor packets	RC
<a href="#">router-id</a>	Sets the router ID for this device	RC
<a href="#">timers spf</a>	Configures the delay after a topology change and the hold time between consecutive SPF calculations	RC
<i>Route Metrics and Summaries</i>		
<a href="#">area default-cost</a>	Sets the cost for a default summary route sent into a stub	RC
<a href="#">area range</a>	Summarizes routes advertised by an ABR	RC
<a href="#">default-metric</a>	Sets the default metric for external routes imported from other protocols	RC
<a href="#">redistribute</a>	Redistribute routes from one routing domain to another	RC
<i>Area Configuration</i>		
<a href="#">area stub</a>	Defines a stubby area that cannot send or receive LSAs	RC
<a href="#">area virtual-link</a>	Defines a virtual link from an area border routers to the backbone	RC
<a href="#">ipv6 router ospf area</a>	Binds an area to the selected interface	IC
<a href="#">ipv6 router ospf tag area</a>	Binds an area to the selected interface and process	IC
<i>Interface Configuration</i>		
<a href="#">ipv6 ospf cost</a>	Specifies the cost of sending a packet on an interface	IC
<a href="#">ipv6 ospf dead-interval</a>	Sets the interval at which hello packets are not seen before neighbors declare the router down	IC
<a href="#">ipv6 ospf hello-interval</a>	Specifies the interval between sending hello packets	IC
<a href="#">ipv6 ospf priority</a>	Sets the router priority used to determine the designated router	IC

**Table 209: Open Shortest Path First Commands (Version 3)** (Continued)

Command	Function	Mode
<code>ipv6 ospf retransmit-interval</code>	Specifies the time between resending a link-state advertisement	IC
<code>ipv6 ospf transmit-delay</code>	Estimates time to send a link-state update packet over an interface	IC
<code>passive-interface</code>	Suppresses OSPF routing traffic on the specified interface	RC
<i>Display Information</i>		
<code>show ipv6 ospf</code>	Displays general information about the routing processes	PE
<code>show ipv6 ospf database</code>	Shows information about different LSAs in the database	PE
<code>show ipv6 ospf interface</code>	Displays interface information	PE
<code>show ipv6 ospf neighbor</code>	Displays neighbor information	PE
<code>show ipv6 ospf route</code>	Displays the OSPF routing table	PE
<code>show ipv6 ospf virtual-links</code>	Displays parameters and the adjacency state of virtual links	PE

#### General Guidelines

Follow these basic steps to configure OSPFv3:

1. Assign an IPv6 link-local address to each VLAN interface that will participate in an OSPF routing process. You can automatically generate a link-local address using the `ipv6 enable` command, or manually assign an address to an interface using the `ipv6 address link-local` command.
2. Use the `router ipv6 ospf` command to create a local OSPF router process and enter router configuration mode.
3. Use the `router-id` command to assign a unique identifier to the router. Note that the default router ID of "0.0.0.0" cannot be used with the current software version.
4. Use the `ipv6 router ospf area` command or the `ipv6 router ospf tag area` command to assign an area to each interface that will participate in the specified OSPF process.

## General Configuration

**router ipv6 ospf** This command creates an Open Shortest Path First (OSPFv3) routing process and enters router configuration mode. Use the **no** form to disable OSPF for all processes or for a specified process.

### Syntax

**[no] router ipv6 ospf [tag process-name]**

*process-name* - A process name must be entered when configuring multiple routing instances. (Range: Alphanumeric string up to 16 characters)

### Command Mode

Global Configuration

### Default Setting

Disabled

### Command Usage

- ◆ This command is used to enable an OSPFv3 routing process, and to enter router configuration mode.
- ◆ The *process-name* is only used on the local router to distinguish between different routing processes. It should not be confused with the *instance-id* configured with the **ipv6 router ospf area** command which is used to distinguish between different routing processes running on the same link-local network segment.

### Example

```

Console(config)#router ipv6 ospf tag 0
Console(config-router)#end
Console#show ipv6 ospf
Routing Process "ospf r&d" with ID 192.168.0.2
Process uptime is 1 hour 34 minutes
Supports only single TOS(TOS0) routes
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Number of incoming concurrent DD exchange neighbors 0/5
Number of outgoing concurrent DD exchange neighbors 0/5
Number of external LSA 0. Checksum 0x000000
Number of opaque AS LSA 0. Checksum 0x000000
Number of LSA received 0
Number of areas attached to this router: 1

Area 0.0.0.0 (BACKBONE)
SPF algorithm executed 1 times
Number of LSA 2. Checksum 0x00ab4f

Console#

```

### Related Commands

[ipv6 router ospf area \(1034\)](#)

**abr-type** This command sets the criteria used to determine if this router can declare itself an ABR and issue Type 3 and Type 4 summary LSAs. Use the **no** form to restore the default setting.

### Syntax

**abr-type** { **cisco** | **ibm** | **standard** }

no abr-type

**cisco** - ABR criteria and functional behavior is based on RFC 3509.

**ibm** - ABR criteria and functional behavior is briefly described in RFC 3509, and fully documented in IBM Nways Multiprotocol Routing Services (MRS) 3.3.

**standard** - ABR criteria and functional behavior is based on RFC 2328.

### Command Mode

Router Configuration

### Default Setting

cisco

### Command Usage

- ◆ The basic criteria for a router to serve as an ABR is shown below:
  - Cisco Systems Interpretation: A router is considered to be an ABR if it has more than one area actively attached and one of them is the backbone area.
  - IBM Interpretation: A router is considered to be an ABR if it has more than one actively attached area and the backbone area is configured.
  - Standard Interpretation: A router is considered to be an ABR if it is attached to two or more areas. It does not have to be attached to the backbone area.
- ◆ To successfully route traffic to inter-area and AS external destinations, an ABR must be connected to the backbone. If an ABR has no backbone connection, all traffic destined for areas not connected to it or outside the AS will be dropped. This situation is normally resolved, by configuring a virtual link from the ABR to the backbone area.
- ◆ In both the Cisco and IBM interpretation, a router connected to more than one area cannot issue a Type 1 router LSA declaring itself as an ABR unless it meets the other criteria listed above.

Routing table calculations are changed to allow the router to consider summary-LSAs from all attached areas if it is not an ABR, but has more than one attached area, or it does not have an active backbone connection.



In other words, inter-area routes are calculated by examining summary-LSAs. If the router is an ABR and has an active backbone connection, only backbone summary-LSAs are examined. Otherwise (when either the router is not an ABR or it has no active backbone connection), the router should consider summary-LSAs from all actively attached areas.

This ensures that the summary-LSAs originated by area border routers advertise only intra-area routes into the backbone if the router has an active backbone connection, and advertises both intra-area and inter-area routes into the other areas. Otherwise, the router only advertises intra-area routes into non-backbone areas.

### Example

```
Console(config-router)#abr-type ibm
Console(config-router)#
```

**max-current-dd** This command sets the maximum number of neighbors with which the switch can concurrently exchange database descriptor (DD) packets. Use the **no** form to restore the default setting.

### Syntax

**max-current-dd** *max-packets*

**no max-current-dd**

*max-packets* - The maximum number of neighbors with which the switch can concurrently send or receive DD packets. (Range: 1-65535)

### Command Mode

Router Configuration

### Default Setting

5

### Command Usage

- ◆ This limit applies separately to the number of neighbors to which DD packets can be concurrently sent, and to the number of neighbors from which DD packets can be concurrently received.

### Example

```
Console(config-router)#maximum-current-dd 10
Console(config-router)#
```

### Related Commands

[show ipv6 ospf \(1042\)](#)

**router-id** This command assigns a unique router ID for this device within the autonomous system for the current OSPFv3 process. Use the **no** form to restore the default setting.

### Syntax

**router-id** *ip-address*

no router-id

*ip-address* - Router ID formatted as an IPv4 address.

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

- ◆ This command sets the router ID for the OSPF process specified in the [router ipv6 ospf](#) command.
- ◆ The router ID must be unique for every router in the autonomous system. (Note that the router ID can also be set to 0.0.0.0 or 255.255.255.255).
- ◆ If this router already has registered neighbors, the new router ID will be used when the router is rebooted, or manually restarted by entering the **no router ipv6 ospf** followed by the [router ipv6 ospf](#) command.
- ◆ If the priority values of the routers bidding to be the designated router or backup designated router for an area are equal, the router with the highest ID is elected.
- ◆ The current routing process will not be enabled until a Router ID is configured with this command.

### Example

```
Console(config-router)#router-id 10.1.1.1
Console(config-router)#
```

### Related Commands

[router ipv6 ospf \(1023\)](#)

**timers spf** This command configures the delay after receiving a topology change and starting the shortest path first (SPF) calculation, and the hold time between making two consecutive SPF calculations. Use the **no** form to restore the default values.

### Syntax

**timers spf** *spf-delay* *spf-holdtime*

**no timers spf**

*spf-delay* - The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-2147483647 seconds)

*spf-holdtime* - The minimum time between two consecutive SPF calculations. (Range: 0-2147483647 seconds)

### Command Mode

Router Configuration

### Default Setting

SPF delay: 5 seconds

SPF holdtime: 10 seconds

### Command Usage

- ◆ Setting the SPF holdtime to 0 means that there is no delay between consecutive calculations.
- ◆ Using a low value for the holdtime allows the router to switch to a new path faster, but uses more CPU processing time.

### Example

```
Console(config-router)#timers spf 20
Console(config-router)#
```

## Route Metrics and Summaries

**area default-cost** This command specifies a cost for the default summary route sent into a stub from an Area Border Router (ABR). Use the **no** form to remove the assigned default cost.

### Syntax

**area** *area-id* **default-cost** *cost*

**no area** *area-id* **default-cost**

*area-id* - Identifies the stub. (The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.)

*cost* - Cost for the default summary route sent to a stub.  
(Range: 0-16777215)

### Command Mode

Router Configuration

### Default Setting

Default cost: 1

### Command Usage

If the default cost is set to "0," the router will not advertise a default route into the attached stub.

### Example

```
Console(config)#router ipv6 ospf tag 1
Console(config-router)#area 1 default-cost 1
Console(config-router)#
```

### Related Commands

[area stub \(993\)](#)

**area range** This command summarizes the routes advertised by an Area Border Router (ABR). Use the **no** form to disable this function.

### Syntax

**[no] area area-id range ipv6-prefix/prefix-length {advertise | not-advertise}**

*area-id* - Identifies an area for which the routes are summarized. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

*ipv6-prefix* - A full IPv6 address including the network prefix and host address bits.

*prefix-length* - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the portion of the address to summarize).

**advertise** - Advertises the specified address range.

**not-advertise** - The summary is not sent, and the routes remain hidden from the rest of the network.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ This command can be used to summarize intra-area routes and advertise this information to other areas through Area Border Routers (ABRs).

- ◆ If the network addresses within an area are assigned in a contiguous manner, the ABRs can advertise a summary route that covers all of the individual networks within the area that fall into the specified range using a single **area range** command.
- ◆ If routes are set to be advertised by this command, the router will issue a Type 3 summary LSA for each address range specified by this command.
- ◆ This router supports up to 64 summary routes for area ranges.

### Example

This example creates a summary address for all area routes in the range of 73::/8, or all IPv6 address that start with the first byte 73 (hexadecimal).

```
Console(config-router)#area 1 range 73::/8 advertise
Console(config-router)#
```

**default-metric** This command sets the default metric for external routes imported from other protocols. Use the **no** form to remove the default metric for the supported protocol types.

### Syntax

**default-metric** *metric-value*

no default-metric

*metric-value* – Metric assigned to all external routes imported from other protocols. (Range: 0-16777214)

### Command Mode

Router Configuration

### Default Setting

20

### Command Usage

- ◆ The default metric must be used to resolve the problem of redistributing external routes from other protocols that use incompatible metrics.
- ◆ This command does not override the metric value set by the **redistribute** command. When a metric value has not been configured by the **redistribute** command, the **default-metric** command sets the metric value to be used for all imported external routes.

### Example

```
Console(config-router)#default-metric 100
Console(config-router)#
```

## Related Commands

### redistribute (1030)

**redistribute** This command redistributes external routing information from other routing protocols and static routes into an autonomous system. Use the **no** form to disable this feature or to restore the default settings.

## Syntax

**redistribute** {**connected** | **static**} [**metric** *metric-value*]  
[**metric-type** *type-value*] [**tag** *tag-value*]

**no redistribute** {**connected** | **rip** | **static**} [**metric**] [**metric-type**] [**tag**]

**connected** - Imports all currently connected entries.

**static** - IPv6 static routes will be imported into this Autonomous System.

*metric-value* - Metric assigned to all external routes for the specified protocol. (Range: 0-16777214; Default: 20)

*type-value*

**1** - Type 1 external route

**2** - Type 2 external route (default) - Routers do not add internal route metric to external route metric.

*tag-value* - A tag placed in the AS-external LSA to identify a specific external routing domain, or to pass additional information between routers. (Range: 0-4294967295)

## Command Mode

Router Configuration

## Default Setting

redistribution - none

metric-value - 20

type-metric - 2

## Command Usage

- ◆ This command is used to import routes learned from other routing protocols into the OSPF domain, and to generate AS-external-LSAs.
- ◆ When you redistribute external routes into an OSPF autonomous system (AS), the router automatically becomes an autonomous system boundary router (ASBR).
- ◆ Metric type specifies the way to advertise routes to destinations outside the AS through External LSAs. When a Type 1 LSA is received by a router, it adds the internal cost to the external route metric. In other words, the cost of the route from any router within the AS is equal to the cost associated with reaching the advertising ASBR, plus the cost of the external route. When a Type 2 LSA is

received by a router, it only uses the external route metric to determine route cost.

### Example

This example redistributes automatically connected routes as Type 1 external routes.

```
Console(config-router)#redistribute connected metric-type 1  
Console(config-router)#
```

## Area Configuration

**area stub** This command defines a stub area. To remove a stub, use the **no** form without the optional keyword. To remove the summary attribute, use the **no** form with the summary keyword.

### Syntax

**[no] area area-id stub [no-summary]**

*area-id* - Identifies the stub area. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

**no-summary** - Stops an Area Border Router (ABR) from sending summary link advertisements into the stub area.

### Command Mode

Router Configuration

### Default Setting

No stub is configured.

Summary advertisement are sent into the stub.

### Command Usage

- ◆ All routers in a stub must be configured with the same area ID.
- ◆ Routing table space is saved by stopping an ABR from flooding Type-4 Inter-Area Router and Type 5 AS-External LSAs into the stub. Since no information on external routes is known inside the stub, an ABR will advertise the default route 0::0/0 using a Type 3 Inter-Area Prefix LSA.
- ◆ The default setting for this command blocks Type-4 Inter-Area Router and Type 5 AS-External LSAs. Therefore, any destinations that cannot be matched to an inter-area or intra-area route will have to use the default route.
- ◆ Use the **no-summary** parameter of this command on an ABR attached to the stub to define a totally stubby area, blocking all Type 3 network summary LSAs. Define an area as a totally stubby area only if routers in the area do not require summary LSAs from other areas.

- ◆ Use the **area default-cost** command to specify the cost of a default summary route sent into a stub by an ABR attached to the stub area.

### Example

This example creates a stub area 2, and makes it totally stubby by blocking all Type 3 summary LSAs.

```
Console(config-router)#area 2 stub no-summary
Console(config-router)#
```

### Related Commands

[area default-cost \(1027\)](#)

**area virtual-link** This command defines a virtual link. To remove a virtual link, use the **no** form with no optional keywords. To restore the default value for an attribute, use the **no** form with the required keyword.vvvv

### Syntax

**area** *area-id* **virtual-link** *router-id*  
[**dead-interval** *seconds*] [**hello-interval** *seconds*]  
[**retransmit-interval** *seconds*] [**transmit-delay** *seconds*]

**no area** *area-id* **virtual-link** *router-id*  
[**dead-interval** | **hello-interval** | **retransmit-interval** | **transmit-delay**]

*area-id* - Identifies the transit area for the virtual link. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

*router-id* - Router ID of the virtual link neighbor. This specifies the Area Border Router (ABR) at the other end of the virtual link. To create a virtual link, enter this command for an ABR at both ends of the link. One of the ABRs must be next to the isolated area and the transit area at one end of the link, while the other ABR must be next to the transit area and backbone at the other end of the link.

**dead-interval** *seconds* - Specifies the time that neighbor routers will wait for a hello packet before they declare the router down. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 4 x hello interval, or 40 seconds)

**hello-interval** *seconds* - Specifies the transmit delay between sending hello packets. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase the routing traffic. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 10 seconds)

**retransmit-interval** *seconds* - Specifies the interval at which the ABR retransmits link-state advertisements (LSA) over the virtual link. The retransmit interval should be set to a conservative value that provides an



adequate flow of routing information, but does not produce unnecessary protocol traffic. However, note that this value should be larger for virtual links. (Range: 1-65535 seconds; Default: 5 seconds)

**transmit-delay** *seconds* - Estimates the time required to send a link-state update packet over the virtual link, considering the transmission and propagation delays. LSAs have their age incremented by this amount before transmission. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 1 second)

### Command Mode

Router Configuration

### Default Setting

*area-id*: None

*router-id*: None

**hello-interval**: 10 seconds

**retransmit-interval**: 5 seconds

**transmit-delay**: 1 second

**dead-interval**: 40 seconds

### Command Usage

- ◆ All areas must be connected to a backbone area (0.0.0.0) to maintain routing connectivity throughout the autonomous system. If it not possible to physically connect an area to the backbone, you can use a virtual link. A virtual link can provide a logical path to the backbone for an isolated area, or can be configured as a backup connection that can take over if the normal connection to the backbone fails.
- ◆ A virtual link can be configured between any two backbone routers that have an interface to a common non-backbone area. The two routers joined by a virtual link are treated as if they were connected by an unnumbered point-to-point network.
- ◆ Any area disconnected from the backbone must include the transit area ID and the router ID for a virtual link neighbor that is adjacent to the backbone.

### Example

This example creates a virtual link using the defaults for all optional parameters.

```
Console(config-router)#area 3 virtual-link 192.168.0.9
Console(config-router)#
```

**ipv6 router ospf area** This command binds an OSPF area to the selected interface. Use the **no** form to remove an OSPF area, disable an OSPF process, or remove an instance identifier from an interface.

### Syntax

**[no] ipv6 router ospf area** *area-id* [**tag** *process-name* | **instance-id** *instance-id*]

*area-id* - Area to bind to the current Layer 3 interface. An OSPF area identifies a group of routers that share common routing information. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

*process-name* - A process name must be entered when configuring multiple routing instances. (Range: Alphanumeric string up to 16 characters)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

### Command Mode

Interface Configuration

### Default Setting

None

### Command Usage

- ◆ An area ID uniquely defines an OSPF broadcast area. The area ID 0.0.0.0 indicates the OSPF backbone for an autonomous system. Each router must be connected to the backbone via a direct connection or a virtual link.
- ◆ Set the area ID to the same value for all routers on a network segment.
- ◆ The *process-name* is only used on the local router to distinguish between different routing processes (and must be configured with the **router ipv6 ospf** command before using it in the **ipv6 router ospf area** command).
- ◆ The *instance-id* is used on the link-local network segment to distinguish between different routing processes running on the same link, and allows routers participating in a common routing process to form adjacencies and exchange routing information.
- ◆ The backbone (area 0.0.0.0) must be created before any other area.

### Example

This example creates the backbone 0.0.0.0.

---

```
Console(config)#router ipv6 ospf tag 0
Console(config-router)#router-id 192.168.0.2
Console(config-router)#exit
Console(config)#interface vlan 1
```

```
Console(config-if)#ipv6 router ospf area 0 tag 0 instance-id 0  
Console(config-if)#
```

### Related Commands

[router ipv6 ospf \(1023\)](#)

[router-id \(1026\)](#)

[ipv6 router ospf tag area \(1035\)](#)

**ipv6 router ospf tag area** This command binds an OSPF area to the selected interface and process. Use the **no** form to remove the specified area from an interface.

**[no] ipv6 router ospf tag** *process-name* **area** *area-id*  
**[instance-id** *instance-id*]

*area-id* - Area to bind to the current Layer 3 interface. An OSPF area identifies a group of routers that share common routing information. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

*process-name* - A process name used to distinguish between multiple routing instances configured on the local router. (Range: Alphanumeric string up to 16 characters)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

No areas are defined.

### Command Usage

- ◆ An area ID uniquely defines an OSPF broadcast area. The area ID 0.0.0.0 indicates the OSPF backbone for an autonomous system. Each router must be connected to the backbone via a direct connection or a virtual link.
- ◆ Set the area ID to the same value for all routers on a network segment.
- ◆ The *process-name* is only used on the local router to distinguish between different routing processes (and must be configured with the [router ipv6 ospf](#) command before using it in this command).
- ◆ The *instance-id* is used on the link-local network segment to distinguish between different routing processes running on the same link, and allows routers participating in a common routing process to form adjacencies and exchange routing information.
- ◆ The backbone (area 0.0.0.0) must be created before any other area.

### Example

This example assigns area 0.0.0.1 to the currently selected interface under routing process "1."

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 router ospf tag 1 area 0.0.0.1
Console(config-if)#
```

### Related Commands

[router ipv6 ospf \(1023\)](#)

[router-id \(1026\)](#)

[ipv6 router ospf area \(1034\)](#)

## Interface Configuration

**ipv6 ospf cost** This command explicitly sets the cost of sending a protocol packet on an interface, where higher values indicate slower ports. Use the **no** form to restore the default value.

### Syntax

**ipv6 ospf cost** *cost* [**instance-id** *instance-id*]

**no ipv6 ospf cost** [**instance-id** *instance-id*]

*cost* - Link metric for this interface. Use higher values to indicate slower ports. (Range: 1-65535)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

1

### Command Usage

- ◆ The interface cost indicates the overhead required to send packets across a certain interface. This is advertised as the link cost in router link state advertisements.
- ◆ Routes are assigned a metric equal to the sum of all metrics for each interface link in the route.
- ◆ This router uses a default cost of 1 for all interfaces. Therefore, if you install a 10 Gigabit module, you may need to reset the cost for all other VLAN interfaces with only 1 Gbps ports to a value greater than 1 to reflect the actual interface bandwidth.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf cost 10
Console(config-if)#
```

**ipv6 ospf dead-interval** This command sets the interval at which hello packets are not seen before neighbors declare the router down. Use the **no** form to restore the default value.

### Syntax

**ipv6 ospf dead-interval** *seconds* [**instance-id** *instance-id*]

**no ipv6 ospf dead-interval** [**instance-id** *instance-id*]

*seconds* - The maximum time that neighbor routers can wait for a hello packet before declaring the transmitting router down. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

40 seconds, or four times the interval specified by the [ipv6 ospf hello-interval](#) command.

### Command Usage

The dead-interval is advertised in the router's hello packets. It must be a multiple of the hello-interval and be the same for all routers on a specific network.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf dead-interval 50
Console(config-if)#
```

### Related Commands

[ipv6 ospf hello-interval \(1038\)](#)

**ipv6 ospf hello-interval** This command specifies the interval between sending hello packets on an interface. Use the **no** form to restore the default value.

#### Syntax

**ipv6 ospf hello-interval** *seconds* [**instance-id** *instance-id*]

**no ipv6 ospf hello-interval** [**instance-id** *instance-id*]

*seconds* - Interval at which hello packets are sent from an interface. This interval must be set to the same value for all routers on the network.  
(Range: 1-65535)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

#### Command Mode

Interface Configuration (VLAN)

#### Default Setting

10 seconds

#### Command Usage

Hello packets are used to inform other routers that the sending router is still active. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase routing traffic.

#### Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf hello-interval 5
Console(config-if)#
```

#### Related Commands

[ipv6 ospf dead-interval \(1037\)](#)

**ipv6 ospf priority** This command sets the router priority used when determining the designated router (DR) and backup designated router (BDR) for an area. Use the **no** form to restore the default value.

#### Syntax

**ipv6 ospf priority** *priority* [**instance-id** *instance-id*]

**no ipv6 ospf priority** [**instance-id** *instance-id*]

*priority* - Sets the interface priority for this router. (Range: 0-255)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

## Command Mode

Interface Configuration (VLAN)

## Default Setting

1

## Command Usage

- ◆ A designated router (DR) and backup designated router (BDR) are elected for each OSPF area based on Router Priority. The DR forms an active adjacency to all other routers in the area to exchange routing topology information. If for any reason the DR fails, the BDR takes over this role.
- ◆ Set the priority to zero to prevent a router from being elected as a DR or BDR. If set to any value other than zero, the router with the highest priority will become the DR and the router with the next highest priority becomes the BDR. If two or more routers are tied with the same highest priority, the router with the higher ID will be elected.
- ◆ If a DR already exists for a network segment when this interface comes up, the new router will accept the current DR regardless of its own priority. The DR will not change until the next time the election process is initiated.
- ◆ Configure router priority for multi-access networks only and not for point-to-point networks.

## Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf priority 5
Console(config-if)#
```

**ipv6 ospf retransmit-interval** This command specifies the time between resending link-state advertisements (LSAs). Use the **no** form to restore the default value.

## Syntax

**ipv6 ospf retransmit-interval** *seconds* [**instance-id** *instance-id*]

**no ipv6 ospf retransmit-interval** [**instance-id** *instance-id*]

*seconds* - Sets the interval at which LSAs are retransmitted from this interface. (Range: 1-65535)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

## Command Mode

Interface Configuration (VLAN)

### Default Setting

5 seconds

### Command Usage

- ◆ A router will resend an LSA to a neighbor if it receives no acknowledgment after the specified retransmit interval. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. Note that this value should be larger for virtual links.
- ◆ Set this interval to a value that is greater than the round-trip delay between any two routers on the attached network to avoid unnecessary retransmissions.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf retransmit-interval 7
Console(config-if)#
```

**ipv6 ospf transmit-delay** This command sets the estimated time to send a link-state update packet over an interface. Use the **no** form to restore the default value.

### Syntax

**ipv6 ospf transmit-delay** *seconds* [**instance-id** *instance-id*]

**no ipv6 ospf transmit-delay** [**instance-id** *instance-id*]

*seconds* - Sets the estimated time required to send a link-state update.  
(Range: 1-65535)

*instance-id* - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

### Command Mode

Interface Configuration (VLAN)

### Default Setting

1 second

### Command Usage

- ◆ LSAs have their age incremented by this delay before transmission. When estimating the transmit delay, consider both the transmission and propagation delays for an interface. Set the transmit delay according to link speed, using larger values for lower-speed links.
- ◆ If this delay is not added, the time required to transmit an LSA over the link is not taken into consideration by the routing process. On slow links, the router may send packets more quickly than devices can receive them. To avoid this



problem, use the transmit delay to force the router to wait a specified interval between transmissions.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf transmit-delay 6
Console(config-if)#
```

**passive-interface** This command suppresses OSPF routing traffic on the specified interface. Use the **no** form to allow routing traffic to be sent and received on the specified interface.

### Syntax

**[no] passive-interface vlan** *vlan-id* [*ipv6-address*]

*vlan-id* - VLAN ID. (Range: 1-4094)

*ipv6-address* - A full IPv6 address including the network prefix and host address bits.

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

You can configure an OSPF interface as passive to prevent OSPF routing traffic from exiting or entering that interface. No OSPF adjacency can be formed if one of the interfaces involved is set to passive mode. The specified interface will appear as a stub in the OSPF domain. Also, if you configure an OSPF interface as passive where an adjacency already exists, the adjacency will drop almost immediately.

### Example

```
Console(config-router)#passive-interface vlan 1 73::9
Console(config-router)#
```

## Display Information

**show ipv6 ospf** This command shows basic information about the routing configuration.

### Command Mode

Privileged Exec

### Example

```
Console#show ipv6 ospf
Routing Process "ospf 1" with ID 192.168.0.2
Process uptime is 24 minutes
Supports only single TOS(TOS0) routes
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Number of incoming concurrent DD exchange neighbors 0/5
Number of outgoing concurrent DD exchange neighbors 0/5
Number of external LSA 0. Checksum 0x000000
Number of opaque AS LSA 0. Checksum 0x000000
Number of LSA received 0
Number of areas attached to this router: 2

Area 0.0.0.0 (BACKBONE)
SPF algorithm executed 2 times
Number of LSA 1. Checksum 0x001aa9
Area 0.0.0.1
SPF algorithm executed 2 times
Number of LSA 1. Checksum 0x001aa9
```

Console#

**Table 210: show ip ospf - display description**

Field	Description
<i>Routing Process</i>	
Routing Process	OSPF process name and router ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Process uptime	The time this process has been running
Supports only single TOS (TOS0) routes	Optional Type of Service (ToS) specified in OSPF Version 2, Appendix F.1.2 is not supported, so only one cost per interface can be assigned.
SPF schedule delay	The delay after receiving a topology change notification and starting the SPF calculation.
Hold time	Sets the hold time between two consecutive SPF calculations.
Number of concurrent DD exchange neighbors	Number of neighbors currently exchanging database descriptor packets.
Number of external LSA	The number of external link-state advertisements (Type 5 LSAs) in the link-state database. These LSAs advertise information about routes outside of the autonomous system.
Checksum	The sum of the LS checksums of the external link-state advertisements contained in the link-state database.

**Table 210: show ip ospf - display description** (Continued)

Field	Description
Number of opaque AS LSA	Number of opaque link-state advertisements (Type 9, 10 and 11 LSAs) in the link-state database. These LSAs advertise information about external applications, and are only used by OSPF for the graceful restart process.
Checksum	The sum of the LS checksums of opaque link-state advertisements contained in the link-state database.
Number of LSA received	The number of link-state advertisements that have been received.
Number of areas attached to this router	The number of configured areas attached to this router.
<i>Area Information</i>	
Area	The area identifier. Note that "(Inactive)" will be displayed if no IPv6 address has been configured on the interface.
SPF algorithm executed x times	The number of times the shortest path first algorithm has been executed for this area
Number of LSA	The total number of link-state advertisements in this area's link-state database, excluding AS External LSA's.
Checksum	The sum of the LS checksums of link-state advertisements for this network (area) contained in the link-state database.

**show ipv6 ospf database** This command shows information about different OSPF Link State Advertisements (LSAs) stored in this router's database.

### Syntax

**show ipv6 ospf [tag process-id] database**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-10)

### Command Mode

Privileged Exec

### Examples

The following shows output for the **show ip ospf database** command.

```

Console#show ipv6 ospf database

OSPF Router with ID (192.168.0.2) (TAG: 1)

Link-LSA
Link State ID  ADV Router  Age  Seq#          CkSum  Link
1001           192.168.0.2    71  0x80000001  0x06b7  0

Router-LSA (Area 0)
Link State ID  ADV Router  Age  Seq#          CkSum
0             192.168.0.2    31  0x80000002  0x14b1

```

```
AS-external-LSA
Link State ID   ADV Router   Age   Seq#       CkSum
Console#
```

**Table 211: show ip ospf database - display description**

Field	Description
OSPF Router Process with ID	OSPF router ID and process ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Link State ID	This field identifies the piece of the routing domain that is being described by the advertisement.
ADV Router	Advertising router ID
Age	Age of LSA (in seconds)
Seq#	Sequence number of LSA (used to detect older duplicate LSAs)
CkSum	Checksum of the complete contents of the LSA
Link	Number of interfaces attached to the router

**show ipv6 ospf interface** This command displays summary information for OSPF interfaces.

#### Syntax

**show ipv6 ospf interface [vlan *vlan-id*]**

*vlan-id* - VLAN ID (Range: 1-4094)

#### Command Mode

Privileged Exec

#### Example

```
Console#show ipv6 ospf interface vlan 1
VLAN 1 is up, line protocol is up
Link local Address FE80::200:E8FF:FE93:82A0/64, Area 0.0.0.0
Tag 1, Router ID 192.168.0.2, Network Type BROADCAST, Cost: 1
Transmit Delay is 1 sec, State DR, Priority 1
Designated Router (ID) 192.168.0.2, Interface Address
FE80::200:E8FF:FE93:82A0
No backup designated router on this network
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Neighbor Count is 0, Adjacent neighbor count is 0
Hello received 0 sent 92, DD received 0 sent 0
LS-Req received 0 sent 0, LS-Upd received 0 sent 0
LS-Ack received 0 sent 0, Discarded 0
Console#
```

**Table 212: show ip ospf interface - display description**

Field	Description
VLAN	VLAN ID and Status of physical link
Link local Address	Link local address of OSPF interface
Area	OSPF area to which this interface belongs
Tag	OSPF process identifier string
Router ID	Identifier for this router
Network Type	Includes broadcast, non-broadcast, or point-to-point networks
Cost	Interface transmit cost
Transmit Delay	Interface transmit delay (in seconds)
State	<ul style="list-style-type: none"> <li>♦ Backup – Backup Designated Router</li> <li>♦ Down – OSPF is enabled on this interface, but interface is down</li> <li>♦ DR – Designated Router</li> <li>♦ DROther – Interface is on a multiaccess network, but is not the DR or BDR</li> <li>♦ Loopback – This is a loopback interface</li> <li>♦ PointToPoint – A direct link between two routers.</li> <li>♦ Waiting – Router is trying to find the DR and BDR</li> </ul>
Priority	Router priority
Designated Router	Designated router ID and respective interface address
Backup Designated Router	Backup designated router ID and respective interface address
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit
Neighbor Count	Count of network neighbors and adjacent neighbors
Hello	Number of Hello LSAs received and sent
DD	Number of Database Descriptor packets received and sent
LS-Req	Number of LSA requests
LS-Upd	Number of LSA updates
LS-Ack	Number of LSA acknowledgements
Discarded	Number of LSAs discarded

**show ipv6 ospf neighbor** This command displays information about neighboring routers on each interface within an OSPF area.

### Syntax

**show ipv6 ospf [tag process-id] neighbor**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-10)

## Command Mode

Privileged Exec

## Example

```
Console#show ipv6 ospf neighbor

      ID          Pri      State      Interface ID      Interface
-----
  192.168.0.2      1      FULL/DR      1001      vlan1
Console#
```

**Table 213: show ipv6 ospf neighbor - display description**

Field	Description
ID	Neighbor's router ID
Pri	Neighbor's router priority
State	OSPF state and identification flag States include: Down – Connection down Attempt – Connection down, but attempting contact (for non-broadcast networks) Init – Have received Hello packet, but communications not yet established Two-way – Bidirectional communications established ExStart – Initializing adjacency between neighbors Exchange – Database descriptions being exchanged Loading – LSA databases being exchanged Full – Neighboring routers now fully adjacent Identification flags include: D – Dynamic neighbor S – Static neighbor DR – Designated router BDR – Backup designated router
Interface ID	The Interface identifier that the neighbor advertises in its Hello Packets. This is a 32-bit number uniquely identifying the neighbor router's interface. MIB-II IfIndex is used for this identifier in some implementations.
Interface	The interface to which this neighbor is attached

**show ipv6 ospf route** This command displays the OSPF routing table.

## Syntax

**show ipv6 ospf [tag process-id] route**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-10)

## Command Mode

Privileged Exec

## Example

```

Console#show ipv6 ospf route
Codes: C - connected, S - static, R - RIP, B - BGP
        O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
C   ::1/128, lo0
O   2001:DB8:2222:7272::/64, VLAN1
C   2001:DB8:2222:7272::/64, VLAN1
?   FE80::/64, VLAN1 inactive
C   FE80::/64, VLAN1
?   FF00::/8, VLAN1 inactive

Console#

```

**show ipv6 ospf virtual-links** This command displays detailed information about virtual links.

## Syntax

**show ipv6 ospf** [*tag process-id*] **virtual-links**

*process-id* - The ID of the router process for which information will be displayed. (Range: 1-10)

## Command Mode

Privileged Exec

## Example

```

Console#show ipv6 ospf virtual-links
Virtual Link VLINK1 to router 192.168.0.2 is up
Transit area 0.0.0.1 via interface VLAN1
Local address 192.168.0.3
Remote address 192.168.0.2
Transmit Delay is 1 sec, State Point-To-Point,
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:02
Adjacency state Full

Console#

```

**Table 214: show ipv6 ospf virtual-links - display description**

Field	Description
Virtual Link to router	OSPF neighbor and link state (up or down)
Transit area	Common area the virtual link crosses to reach the target router
Local address	The IP address of ABR that serves as an endpoint connecting the isolated area to the common transit area.
Remote address	The IP address this virtual neighbor is using. The neighbor must be an ABR at the other endpoint connecting the common transit area to the backbone itself.
Transmit Delay	Estimated transmit delay (in seconds) on the virtual link

**Table 214: show ipv6 ospf virtual-links - display description** (Continued)

Field	Description
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit
Hello due	The timeout for the next hello message from the neighbor
Adjacency state	The adjacency state between these neighbors: Down – Connection down Attempt – Connection down, but attempting contact (for non-broadcast networks) Init – Have received Hello packet, but communications not yet established Two-way – Bidirectional communications established ExStart – Initializing adjacency between neighbors Exchange – Database descriptions being exchanged Loading – LSA databases being exchanged Full – Neighboring routers now fully adjacent

**Related Commands**  
[area virtual-link \(1032\)](#)

---

## Border Gateway Protocol (BGPv4)

**BGP Overview** An autonomous system (AS) functions as a separate routing domain under one administrative authority, which implements its own routing policies. An AS exchanges routing information within its boundaries using Interior Gateway Protocols (IGPs) such as RIP or OSPF, and connects to external organizations or to the Internet using an Exterior Gateway Protocol (EGP). BGP version 4 is the primary EGP deployed on the Internet today.

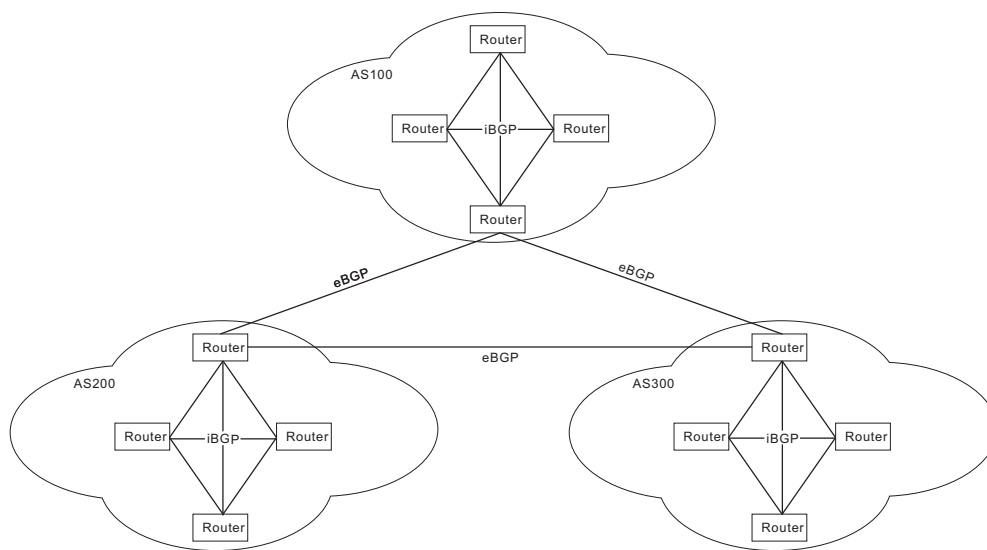
A communication session must be maintained between bordering ASs to support the periodic exchange of routing information. One of the major design choices for BGP is the use of a TCP connection to exchange routing information between peers. Exchanging connectivity information over a reliable transport mechanism effectively delegates all error control functions to TCP.

The other major innovation for BGP is the use of path vectors which carry the full list of transit networks, or ASs, traversed between the source and destination. Loops are prevented simply by checking the path vector to see if same AS is listed twice. This approach solves many of the scalability problems encountered when applying distance-vector or link-state methods to make routing decisions in complex topologies.

**External and Internal BGP** When connecting to the Internet, external BGP (eBGP) is used. Although BGP is widely used as an exterior gateway protocol (EGP), it is also used in many organizations with complex internal networks. Internal networks can be simplified by exchanging routing information among BGP peers within the same organization through internal BGP (iBGP) peering sessions.



Figure 9: Connections for Internal and External BGP



**External BGP** – eBGP interconnects different ASs through border routers, or eBGP peers. These peering routers are commonly connected over a WAN link using a single physical path. Alternatively, multiple eBGP peer connections may be used to provide redundancy or load balancing. Distinct BGP sessions are used between redundancy peers to ensure that if one session fails, another will take over.

BGP uses the AS path attribute to record the ASs that must be followed to reach the prefix for a network aggregate. When a prefix is announced to an eBGP peer, the local AS number is prepended to the AS path. This prevents routing loops by rejecting any prefix announcements that include the local AS number in the AS path. These announcements are also used by eBGP in the best path selection process.

eBGP speakers, can communicate with other external peers or with iBGP peers. A BGP speaker can determine if it is communicating with an external or internal peer by comparing the AS number sent in OPEN messages by a peer with that of its own internal value. If it matches, then this neighbor is an iBGP speaker, and if it does not, then it is an eBGP speaker. An eBGP speaker can advertise prefixes it has learned from another eBGP speaker to a neighboring iBGP speaker; and it can also advertise prefixes it has learned from an iBGP speaker to an eBGP speaker.

**Internal BGP** – In contrast to eBGP peers which have different AS numbers, iBGP peers are configured with the same AS number. All iBGP peers within the same AS should be connected to one another in a full-mesh connection (except when using route reflection). When a prefix is announced from one iBGP peer to another, the AS path is not changed. Since all iBGP peers are fully meshed, they will have the same information in their BGP table, unless routing policies have been modified for some of the peers.

When a iBGP peer receives a prefix announcement, it uses the best path selection algorithm to see if the received announcement is the best path for that prefix. If it is, the peer inserts this route into its routing table, and announces it to all of its peers, both iBGP and eBGP. If it is not the best available path, the peer keeps a copy of it in its routing table so that if path information for that prefix changes (such as if the

current best available path is withdrawn), it can be used to calculate a new best available path.

BGP cannot detect routes and provide reachability information. To ensure that each iBGP peer knows how to reach other, each peer must run some sort of Interior Gateway Protocol (such as static routes, direct routes, RIP or OSPF) which provides neighbor IP addresses. In order to avoid routing loops, an iBGP speaker cannot advertise prefixes it has learned from one iBGP peer to another neighboring iBGP peer.

### **BGP Routing Basics**

Both RIP and OSPF attach a metric, or cost, to each path. These protocols rely on every router attaching the same meaning to each metric, allowing consistent calculation of routes. However, after routing policies are put in place, routers may value some metrics differently, invalidating the basic assumptions upon which RIP and OSPF are based. This makes it unrealistic to run a distance-vector AS-level protocol

BGP uses a path vector routing approach, which is roughly based on a distance-vector approach, where the cost between two adjacent ASes is implicitly assumed to be a single hop. The shortest path from an AS to a remote AS is therefore the path with the shortest number of AS hops. Just note that each AS may be comprised of multiple routers or networks that a packet traverses as it crosses the associated route to the destination, so the AS hop count does not equal to the number of routers along that path.

### **Path Attributes**

The key information passed along with the path vector in routing messages include the following attributes:

- ◆ **ORIGIN** – This attribute indicates how the network of BGP routers first learned of a route, and is set by the first BGP router to introduce the routes to its peers. There are three methods for injecting a prefix into an update message: IGP, EGP and Incomplete.
- ◆ **AS\_PATH** – This attribute lists the autonomous systems that make up the path to the routes' destination. Each entry contains a series of path segments. Each path segment begins with a 1 for SETS or a 2 for SEQUENCES, where a SET indicates that it is an aggregate prefix which was derived from multiple ASes.
- ◆ **NEXT\_HOP** – This attribute indicates the IP address of the router that should be used as the next hop to reach the router's destination. This address is normally that of the router sending the BGP message, but a BGP router may advertise a route on behalf of another router.
- ◆ **MULTI\_EXIT\_DISC (MED)** – The multi-exit discriminator attribute lets an autonomous system set a preference for different routes when there are multiple external links to a neighboring AS. Selection is normally based on the exit point with the lowest metric.

- ◆ **WEIGHT** – This attribute is used locally by a router to select a path when multiple paths are available for a prefix.
- ◆ **LOCAL\_PREF** – This local preference attribute is similar to that of the MED, but within an AS. It sets a metric which is used between BGP speakers within an AS. It can help in selecting an outgoing BGP when an AS has connectivity to multiple ASes or multiple BGP routes even with the same next hop AS.
- ◆ **ATOMIC\_AGGREGATE** – This attribute indicates that the routes were created by aggregating more specific routes. More specific routes may exist for some of these longer prefixes, but the router chose not to send them, so as to reduce the size for the AS path parameters.
- ◆ **AGGRATOR** – This is an optional attribute that identifies the AS and router that originally aggregated the routes.
- ◆ **COMMUNITY** – This attribute associates routing information with a community of users. These communities share a common property, and tagging routes with a community makes it easier for routers to identify that property and enforce appropriate routing policies.
- ◆ **ORIGINATOR\_ID** – This attribute is included when a route reflector reflects a route. Then if the reflector later receives a route with its own originator ID, a potential routing loop can be broken.
- ◆ **CLUSTER\_LIST** – This attribute is of a list of the clusters through which a route has been reflected. Every route reflector adds its own cluster ID to the list. If the reflector receives a route with its own cluster ID, a potential routing loop can be broken.
- ◆ **MP\_REACH\_NLRI** – This attribute describes routes for network protocols other than IPv4. The attribute identifies the protocol with an address family identifier (AFI) and a subsequent address family identifier (SAFI). It contains the address of the next hop router for the destinations, as well as the link level (e.g., Ethernet) addresses for that next hop. It concludes with the destinations expressed as prefixes.
- ◆ **MP\_UNREACH\_NLRI** – This attribute withdraws non-IPv4 routes. It includes the route's AFI, SAFI, and network address prefixes.
- ◆ **EXTENDED-COMMUNITIES** – This attribute provides a mechanism for labeling various information carried in route advertisements. It provides an extended type field to ensure that communities can be assigned for a broad range of uses, without fear of overlap.

## Path Selection

When there are multiple paths to the same prefix (with the same prefix length), the information included in route advertisement is used to select the best path to a destination following the rules shown below.

1. Choose the path with the highest WEIGHT. If the value of this attribute is the same for more than one candidate, go to the next step.
2. Choose the path with the highest LOCAL-PREF. If the value of this attribute is the same for more than one candidate, go to the next step.
3. Choose the path that was generated by the local router with the [network](#) or [aggregate-address](#) command. If the value of this criteria is the same for more than one candidate, go to the next step.
4. Choose the path with the shortest AS\_PATH. If the value of this attribute is the same for more than one candidate, go to the next step. Note that this attribute may be disabled in the selection process using the [bgp bestpath as-path ignore](#) command.
5. Choose the path with the lowest ORIGIN (IGP < EGP < Incomplete). If the value of this criteria is the same for more than one candidate, go to the next step.
6. Choose the path with the lowest MED. By default, the MED attribute is considered only when a prefix is received from neighbors in the same AS. If the value of this criteria is the same for more than one candidate, go to the next step.
7. Choose an eBGP path over an outer confederation, and an outer confederation over an iBGP path. If the value of this criteria is the same for more than one candidate, go to the next step.
8. Choose the path with the lowest IGP metric to the next hop. If the value of this criteria is the same for more than one candidate, go to the next step.
9. Choose the path originated by the BGP router with the lowest router ID.

## Message Types

Four message types are used by BGP. The OPEN message is used by BGP peers to identify their capabilities, the UPDATE message is used to advertise/withdraw prefixes, the NOTIFICATION message is used to send errors or close the session, and the KEEPALIVE messages is used to keep the BGP session up. These message types are described below.

- ◆ OPEN – BGP routers normally wait for BGP connections on TCP port 179. A router that wants to establish an association will first open a TCP connection leading to that port on the peer router. Once the connection has been set, each side sends an OPEN message to negotiate the association's parameters based

on the capabilities advertised in these messages. Open messages include information about the BGP version number in use, the peer's AS number, the hold time, the BGP identifier (i.e., loopback address or the highest value of all the BGP speaker's interfaces), and optional parameter length.

- ◆ **UPDATE** – These messages are used to announce or withdraw IP prefixes, and include the following components: withdrawn route length, withdrawn routes, total path attributes length, path attributes, and network layer reachability information.
- ◆ **NOTIFICATION** – These messages are used to indicate error conditions. The underlying TCP session is closed after a notification message is sent.
- ◆ **KEEPALIVE** – These messages are sent at a set interval and are used to verify that the BGP session is active. The hold timer is reset upon receipt of a KEEPALIVE or UPDATE message. If the hold time is set to zero by both peers, a BGP session can be kept open without generating KEEPALIVE messages.

### Route Aggregation and Dissemination

In the Internet, the number of destinations is larger than most routing protocols can manage. It is not possible for routers to track every possible destination in their routing tables. To overcome this problem BGP relies on route aggregation, whereby multiple destinations are combined in a single advertisement. Routers receiving this information, treat the combined destinations as a single destination, thus reducing the number of individual routes that must be remembered. This also reduces the network overhead required to transmit update packets and maintain routing tables.

In BGP, route aggregation combines the address blocks for networks from two or more ASes into a supernet, and transmits this information to a downstream AS. This supernetted address block is less specific, and only lists the AS number of the AS where the supernetting was done. The `Atomic_Aggregate` attribute indicates that attributes for more specific paths are not included in the aggregated route, and the `Aggregator` attribute indicates the AS and router where the aggregation was done. The aggregator node will now serve as a proxy, using the more specific routes it still maintains in its own routing table.

After inbound routes have been aggregated, the BGP speaker can propagate this information based on export policies for individual neighbors or for defined router groups, using route maps or other more precise routing criteria.

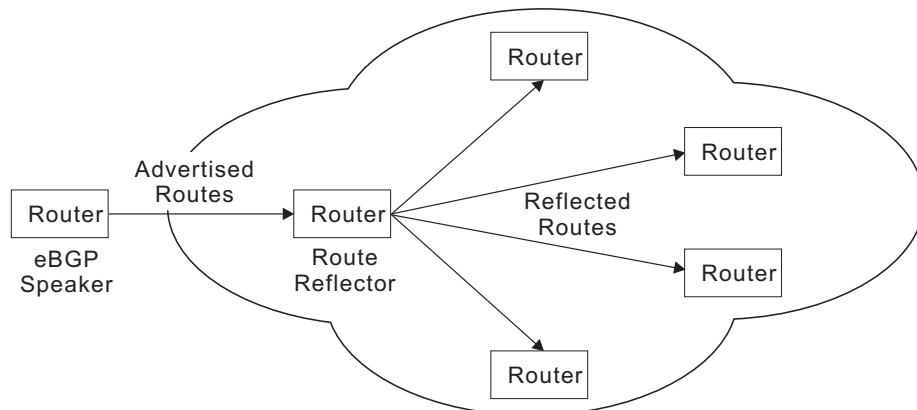
### Internal BGP Scalability

An iBGP speaker cannot advertise IP prefixes it has learned from one iBGP speaker to another neighboring iBGP speaker. iBGP therefore requires full-mesh connectivity among all iBGP speakers. For local networks containing a large number of speakers, this requirement may be difficult to meet. There are several commonly used approaches to resolving this problem, including route reflectors, confederations, and route servers.

## Route Reflectors

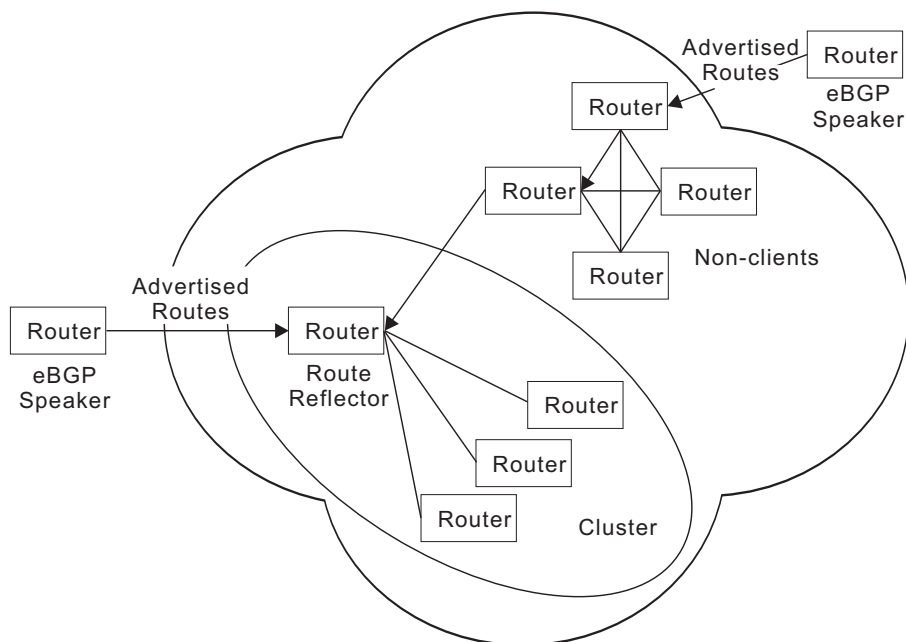
Route reflection designates one or more iBGP speakers as router concentrators or route reflectors, which are allowed to re-advertise routing information within the same autonomous system. It also clusters a subset of iBGP speakers with each route reflector (also known as route reflector clients), and adds several new attributes to help detect routing loops. Using the cluster hierarchy, connections are only required between the route reflector and its clients, overcoming the normal requirement for full-mesh connectivity among all iBGP speakers.

**Figure 10: Connections for Single Route Reflector**



Route reflector clients are not aware that they are connected to a route reflector, and function as though fully meshed within the autonomous system. For redundancy, a cluster may contain more than one route reflector. Each cluster is identified a Cluster-ID. When there is only one route reflector in a cluster, the Cluster-ID is the BGP identifier of the route reflector. If there is more than one route reflector in a cluster, a common identifier can be defined for use by all route reflectors in the cluster.

**Figure 11: Connections for Multiple Route Reflectors**



If there is only one route reflector in a cluster, that router would still have to process the same number of routing messages that would be required if it were in a fully meshed network. It is therefore preferable to use more than one route reflector in a cluster to reduce the overall number of iBGP sessions a single reflector has to handle.

If multiple route reflectors are configured in the same cluster, they must be fully meshed with each other. However, the route reflector clients only need to be connected to its designated route reflector. Once all iBGP routing sessions are established, routing advertisements must follow these rules:

- ◆ Announcements received by a route reflector from another reflector are passed to its clients.
- ◆ Announcements received by a route reflector from a reflector client are passed to other route reflectors in the cluster.
- ◆ Announcements received by a route reflector from an eBGP speaker are passed to all route reflectors in the cluster and to its own clients.

It can now be seen that routing information learned from an iBGP speaker can be passed to another iBGP speaker. This breaks the normal rules for a fully meshed iBGP autonomous system, and other steps are now required to avoid routing loops. These include the addition of the following new attributes:

- ◆ Originator-ID – When a route reflector learns about a route from one of its clients, it adds this attribute to the announcement before reflecting it to other speakers. If a route reflector receives an announcement about a route with an Originator-ID that matches its own router ID, it should drop it.
- ◆ Cluster-List – This is a list of the clusters through which a route announcement has passed. When a route reflector passes on an announcement, it must prepend the local Cluster-ID to this list. The Cluster-List thereby serves a similar function to the AS-Path attribute in detecting routing loops.

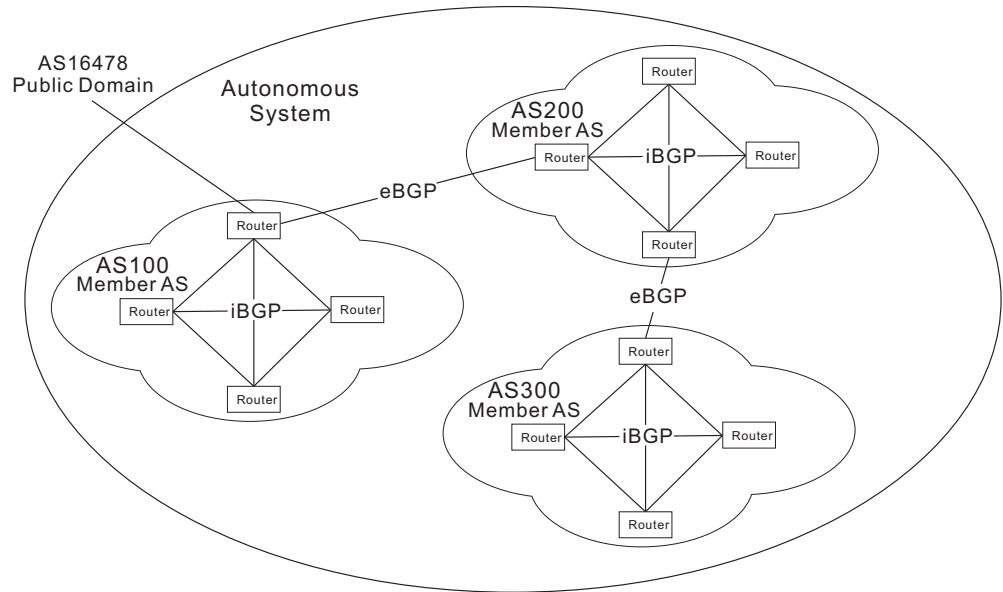
#### Configuration Guidelines

1. Route reflection from this router is enabled by default. If it has been disabled, use the [bgp client-to-client reflection](#) command to restore route reflection via this router.
2. If more than one route reflector is used, use the [bgp cluster-id](#) command to configure the cluster identifier.
3. Use the [neighbor route-reflector-client](#) command configure a neighboring router as a client.

## Confederations

Confederations simply divide an autonomous system into smaller groups. It splits up an AS into multiple sub-ASes, where full mesh connections are maintained only within each sub-AS, and sub-ASes are connected by eBGP. The overall AS is known as a confederation, while the sub-ASes may also be referred to as member ASes. The entire confederation has a unique AS number, while the member ASes may have AS numbers obtained from public AS number space, or use AS number from private AS number space.

**Figure 12: Connections for BGP Confederation**



To prevent looping within the confederation, the AS-Confed-Set and AS-Confed-Sequence path attributes are added. These attributes function in the same manner as AS-Set and AS-Sequence. The following additional requirements are applied for route advertisements passed between member ASes:

- ◆ The Local-Pref for a route may be passed from one member AS to another member AS. This exception to normal practice is allowed within the confederation since this attribute is meant for use by the entire AS.
- ◆ The Next-Hop for a route set by the first BGP speaker in the confederation may be passed from one member AS to another member.
- ◆ When a route advertisement is passed from one member AS to another, the AS-Confed-Sequence must be inserted into the AS-Path along with the AS number of the member AS to help prevent looping.

Border routers that also peer with outside ASes have to modify routing information that leaves the confederation so that the internal structure of the confederation remains hidden to exterior peers, primarily because this information is of no use to another external AS. The information stripped from route advertisements and update messages sent outside of the confederation include AS-Confed-Sequence



and AS-Confed-Set. Neither are AS numbers of member ASes advertised to exterior peers.

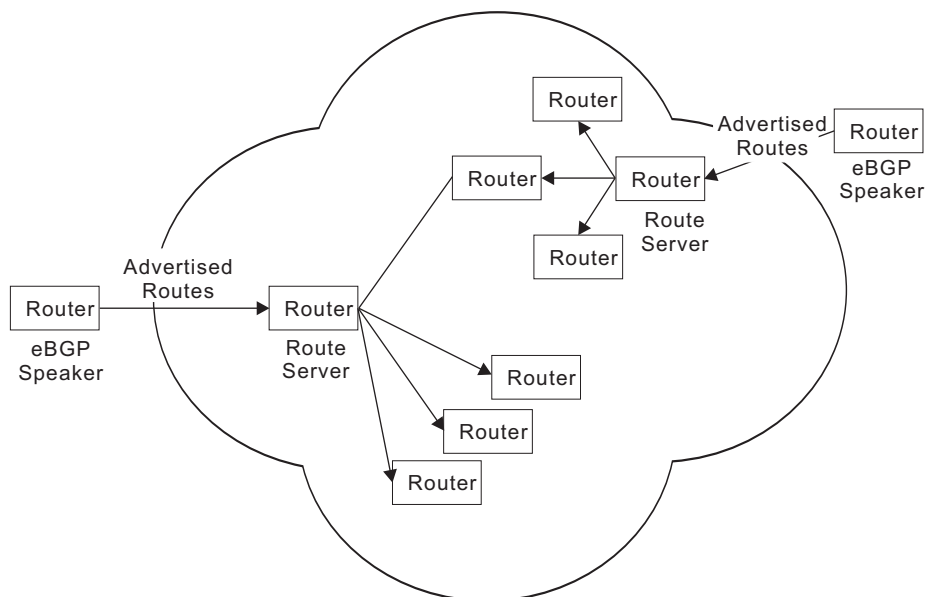
### Configuration Guidelines

1. Use the `bgp confederation identifier` command to configure the identifier for a confederation containing smaller multiple internal autonomous systems.
2. Use the `bgp confederation peer` command to add an internal peer autonomous system to a confederation.

### Route Servers

Route Servers are used to relay routes received from remote ASes to client routers, as well as to relay routes between client routers. Clients maintain BGP sessions only with the assigned route servers. Sessions with more than one server can be used to provide redundancy and load sharing. All routes received from a client router are propagated to other clients through the Route Server. Since all external routes and their attributes are relayed unmodified between client routers, they acquire the same routing information as they would via direct peering in a full mesh configuration.

Figure 13: Connections for Route Server



### Configuration Guidelines

Use the `neighbor route-server-client` command to configure this router as a route server and the specified neighbor as its client.

**Route Flap Dampening** An update message is sent from a BGP speaker to a neighboring speaker whenever any change to a route occurs. A speaker announcing such a route is also responsible for any changes, including withdrawal, change in AS-Path or Next-Hop, to the same neighbor, irrespective of where the change was learned. In practice this may cause a BGP speaker to announce a new route, and then almost immediately withdraw or update the route a few seconds later, repeatedly. Since routing information is propagated to other downstream speakers, there is a ripple effect that creates a cascading storm of updates through the ASes. This causes instability in the routing tables, as well as the computational overhead required to compute the best path, and an increase in convergence time.

Route damping provides a relief mechanism to minimize the effects of route flapping. It can reduce the propagation of updates for flapping routes without impacting the route convergence time for stable routes. When enabled, a route is assigned a penalty each time it flaps (i.e., announced and then quickly withdrawn). If the penalty exceeds 2000 (the suppress limit) the route is suppressed. After the route remains stable for a specified interval (half-life), the penalty is reduced by half. Subsequently, the penalty is reduced every 15 minutes. When the penalty falls below a specified value (reuse limit), the route is unsuppressed.

The penalty never exceeds the maximum penalty, which is computed from specified attributes as shown below:

Maximum penalty = reuse-limit \*  $2^{(\text{max-suppress-time}/\text{half-life})}$

When a route is being “damped,” any updates or withdrawals for this route received from a peer are ignored. This limits the effects of route flapping to a single peering connection. Since most ASes are connected by high-speed links, it is not always necessary to use route damping. However, when invoked, it may be necessary to fine tune the penalty attributes to ensure fair treatment to unstable routes.

#### *Configuration Guidelines*

1. Use the **bgp damping** command to enable route damping.
2. Use the **bgp damping** command to adjust the penalty attributes of *half-life*, *reuse-limit*, *suppress-limit*, and *max-suppress-time*.
3. Use the **clear ip bgp damping** command to clear route damping information and unsuppresses any suppressed routes.

## BGP Command List

Table 215: Border Gateway Protocol Commands – Version 4

Command	Function	Mode
<i>General Configuration</i>		
<code>router bgp</code>	Enables BGPv4 routing process and enters router configuration mode	GC
<code>ip as-path access-list</code>	Configures an autonomous system path access list	GC
<code>ip community-list</code>	Configures a community list	GC
<code>ip extcommunity-list</code>	Configures an extended community list	GC
<code>ip prefix-list</code>	Configures an address prefix list	GC
<code>aggregate-address</code>	Configures an aggregate address in the routing table	RC
<code>bgp client-to-client reflection</code>	Configures route reflection between clients via route reflector	RC
<code>bgp cluster-id</code>	Configures cluster identifier for multiple route reflectors in the same cluster	RC
<code>bgp confederation identifier</code>	Configures the identifier for a confederation containing smaller multiple internal autonomous systems	RC
<code>bgp confederation peer</code>	Adds an internal peer autonomous system to a confederation	RC
<code>bgp dampening</code>	Configures route dampening to reduce the propagation of unstable routes	RC
<code>bgp enforce-first-as</code>	Denies an update received from an external peer that does not list its own autonomous system number at the beginning of the AS path attribute	RC
<code>bgp fast-external-failover</code>	Resets sessions for any directly connected external peers if the link goes down	RC
<code>bgp log-neighbor-changes</code>	Enables logging of neighbor resets (that is, up or down status changes)	RC
<code>bgp network import-check</code>	Checks the existence of the next-hop and its accessibility to IGP	RC
<code>bgp router-id</code>	Sets the router ID for this device	RC
<code>bgp scan-time</code>	Sets the interval at which to validate next hop information for BGP routes	RC
<code>network</code>	Specifies a network to advertise	RC
<code>redistribute</code>	Redistribute routes from one routing domain to another	RC
<code>timers bgp</code>	Sets the Keep Alive time used for maintaining connectivity, and the Hold time to wait for Keep Alive messages before declaring a neighbor down	RC
<code>clear ip bgp</code>	Clears connections using hard or soft re-configuration	PE
<code>clear ip bgp dampening</code>	Clears route dampening information and unsuppresses any suppressed routes	PE

**Table 215: Border Gateway Protocol Commands – Version 4** (Continued)

Command	Function	Mode
<i>Route Metrics and Selection</i>		
<code>bgp always-compare-med</code>	Allows comparison of the Multi Exit Discriminator (MED) for paths advertised from neighbors in different autonomous systems	RC
<code>bgp bestpath as-path ignore</code>	Ignores AS path length in the selection of a path	RC
<code>bgp bestpath compare-confed-aspath</code>	Compare confederation AS path length in addition to external AS path length in the selection of a path	RC
<code>bgp bestpath compare-routerid</code>	Compare similar routes from external peers, and give preference to a route with the lowest router identifier	RC
<code>bgp bestpath med</code>	Enables comparison of MED attribute for paths learned from confederation peers, and the treatment of a route when the MED is missing	RC
<code>bgp default local-preference</code>	Sets the default local preference used for best path selection among local iBGP peers	RC
<code>bgp deterministic-med</code>	Enforces deterministic comparison of the MED attribute between all paths received from the same AS, ensuring that selection of the best path will always be the same, regardless of the order in which the paths are received by the local router	RC
<code>distance</code>	Sets the administrative distance for a specified external BGP (eBGP) route	RC
<code>distance bgp</code>	Sets the administrative distance for BGP external, internal, and local routes	RC
<i>Neighbor Configuration</i>		
<code>neighbor activate</code>	Enables exchange of routing information with a neighboring router or peer group	RC
<code>neighbor advertisement-interval</code>	Configures the interval between sending update messages to a neighbor	RC
<code>neighbor allowas-in</code>	Configures the number of times the AS path for a received route can contain the same AS number	RC
<code>neighbor attribute-unchanged</code>	Configures certain attributes to be kept unchanged for transparent transmission to the specified neighbor	RC
<code>neighbor capability dynamic</code>	Configures dynamic negotiation of capabilities between neighboring routers	RC
<code>neighbor capability orf prefix-list</code>	Configures negotiation of outbound route filter capabilities with neighboring router	RC
<code>neighbor default-originate</code>	Allows the local router to send a default route to a neighbor	RC
<code>neighbor description</code>	Configures the description of a neighbor or peer group	RC
<code>neighbor distribute-list</code>	Filters route updates to/from a neighbor or peer group	RC
<code>neighbor dont-capability-negotiate</code>	Disables capability negotiation when creating connections	RC
<code>neighbor ebgp-multihop</code>	Allows eBGP neighbors to exist in different segments, and configures the maximum hop count (TTL)	RC
<code>neighbor enforce-multihop</code>	Enforces the requirement for all neighbors to form multi-hop connections	RC

**Table 215: Border Gateway Protocol Commands – Version 4** (Continued)

Command	Function	Mode
<code>neighbor filter-list</code>	Filters route updates sent to or received from a neighbor based on an AS path access-list	RC
<code>neighbor interface</code>	Specifies the interface to a neighbor	RC
<code>neighbor maximum-prefix</code>	Sets the maximum number or route prefixes that can be received from a neighbor	RC
<code>neighbor next-hop-self</code>	Configures the local router as the next hop for a neighbor	RC
<code>neighbor override-capability</code>	Overrides the result of capability negotiations, allowing a session to be formed with a peer that does not support capability negotiation	RC
<code>neighbor password</code>	Enables MD5 authentication and sets the key for a neighboring router	RC
<code>neighbor passive</code>	Passively forms a connection with the specified neighbor, not sending a TCP connection request, but waiting a request from the specified neighbor	RC
<code>neighbor peer-group (Creating)</code>	Configures a router peer group which can be easily configured with the same attributes	RC
<code>neighbor peer-group (Group Members)</code>	Assigns routers to a peer group	RC
<code>neighbor port</code>	Specifies the TCP port number of the partner through which communications are carried	RC
<code>neighbor prefix-list</code>	Configures prefix restrictions applied in inbound/outbound route updates to/from specified neighbors	RC
<code>neighbor remote-as</code>	Configures a neighbor and its AS number, identifying the neighbor as a local AS member	RC
<code>neighbor remove-private-as</code>	Removes private autonomous system numbers from outbound routing updates to an external neighbor	RC
<code>neighbor route-map</code>	Specifies the route mapping policy for inbound/outbound routing updates for specified neighbors	RC
<code>neighbor route-reflector-client</code>	Configures this router as a route reflector and the specified neighbor as its client	RC
<code>neighbor route-server-client</code>	Configures this router as a route server and the specified neighbor as its client	RC
<code>neighbor send-community</code>	Configures the router to send community attributes to a neighbor in peering messages	RC
<code>neighbor shutdown</code>	Closes a neighbor connection without canceling the neighbor configuration	RC
<code>neighbor soft-reconfiguration inbound</code>	Configures the switch to store updates in the inbound message buffer, and perform soft re-configuration from this buffer for specified neighbors when required	RC
<code>neighbor strict-capability-match</code>	Forces strict capability matching when establishing connections	RC
<code>neighbor timers</code>	Sets the Keep Alive time and Hold time used for specified neighbors	RC
<code>neighbor timers connect</code>	Sets the time to wait before attempting to reconnect to a neighbor whose TCP connection has failed	RC
<code>neighbor unsuppress-map</code>	Allows specified suppressed routes to be advertised	RC

**Table 215: Border Gateway Protocol Commands – Version 4** (Continued)

Command	Function	Mode
<code>neighbor update-source</code>	Specifies the interface to use for a connection, instead of using the nearest interface	RC
<code>neighbor weight</code>	Assigns a weight to a neighbor connection	RC
<i>Display Information</i>		
<code>show ip bgp</code>	Shows entries in the routing table	PE
<code>show ip bgp attribute-info</code>	Shows internal attribute information	PE
<code>show ip bgp cidr-only</code>	Shows routes which use classless inter-domain routing network masks	
<code>show ip bgp community</code>	Shows routes that belong to specified BGP communities	PE
<code>show ip bgp community-info</code>	Shows permitted community messages	PE
<code>show ip bgp community-list</code>	Shows the routes matching a community-list	PE
<code>show ip bgp dampening</code>	Shows dampened routes	PE
<code>show ip bgp filter-list</code>	Shows routes matching the specified filter list	PE
<code>show ip bgp neighbors</code>	Shows connection information for neighbor sessions	PE
<code>show ip bgp paths</code>	Shows all paths in the database	PE
<code>show ip bgp prefix-list</code>	Shows routes matching the specified prefix-list	PE
<code>show ip bgp regexp</code>	Shows routes matching the AS path regular expression	PE
<code>show ip bgp route-map</code>	Shows routes matching the specified route map	PE
<code>show ip bgp scan</code>	Shows BGP scan status	PE
<code>show ip bgp summary</code>	Shows summary information for all connections	PE
<code>show ip community-list</code>	Shows routes permitted by a community list	PE
<code>show ip extcommunity-list</code>	Shows routes permitted by an extended community list	PE
<code>show ip prefix-list</code>	Shows the specified prefix list	PE
<code>show ip prefix-list detail</code>	Shows detailed information for the specified prefix list	PE
<code>show ip prefix-list summary</code>	Shows summary information for the specified prefix list	PE

## General Configuration

**router bgp** This command enables the Border Gateway Protocol (BGPv4) routing process and enters router configuration mode. Use the **no** form to disable it.

### Syntax

**[no] router bgp** *as-number*

*as-number* – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

## Command Mode

Global Configuration

## Default Setting

No routing process is defined.

## Command Usage

- ◆ To enable BGP routing, you must use this command to establish a BGP routing process. After entering this command, the switch enters router configuration mode.
- ◆ AS numbers in the range 64512-65535 are normally used for private routing domains, and can be removed from the AS path attribute in outbound routing messages using the [neighbor remove-private-as](#) command. Note that AS number 23456 is reserved for the AS-Transitive attribute which is required when setting up a new BGP speaker.
- ◆ Use this command to specify all of the routers within an autonomous system used to exchange interior or exterior BGP routing messages. Repeat this process for any other autonomous system under your administrative control to create a distributed routing core for the exchange of routing information between autonomous systems.

## Example

```
Console(config)#router bgp 100
Console(config-router)#
```

## Related Commands

[network \(1079\)](#)

**ip as-path access-list** This command configures an autonomous system path access list. Use the **no** form with only the access list name to disable its use, or with all parameters to remove a path attribute from the access list.

## Syntax

**ip as-path access-list** *access-list-name* {**deny** | **permit**} *regular-expression*

**no ip as-path access-list** *access-list-name* [{**deny** | **permit**} *regular-expression*]

*access-list-name* – Name of the access list. (Maximum length: 16 characters, no spaces or other special characters)

**deny** – Permits access for messages with matching path attribute.

**permit** – Denies access to messages with matching path attribute.

*regular-expression* – Autonomous system in the access list expressed as a regular expression<sup>15</sup>.

15. Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

### Command Mode

Global Configuration

### Default Setting

No AS path access lists are defined.

### Command Usage

- ◆ If the regular expression in an AS path list is matched, then the deny/permit condition is applied to the routing message.
- ◆ Use this command in conjunction with the [neighbor filter-list](#) command to filter route updates sent to or received from a neighbor, or with the [match as-path](#) route map command to implement a more comprehensive filter for policy-based routing.

### Example

The regular expression in this example uses symbols which instruct the filter to match the character or null string at the beginning and end of an input string.

```
Console(config-router)#ip as-path access-list RD deny ^100$  
Console(config-router)#
```

### Related Commands

[neighbor filter-list \(1098\)](#)

[match as-path \(1134\)](#)

**ip community-list** This command configures a community access list. Use the **no** form with only the access list name to disable its use, or with all parameters to remove a community attribute from the access list.

### Syntax

#### [no] ip community-list

{1-99 | **standard** *community-list-name* {**deny** | **permit**}  
[AA:NN] [**internet**] [**local-as**] [**no-advertise**] [**no-export**]} | {100-500 |  
**expanded** *community-list-name* {**deny** | **permit**} *regular-expression*}

1-99 – Standard community list number that identifies one or more groups of communities.

**standard** *community-list-name* – Name of standard access list. A maximum of 16 communities can be configured in a standard community list (Maximum length: 32 characters, no spaces or other special characters)

**deny** – Denies access to messages with matching community attribute.

**permit** – Permits access for messages with matching community attribute.

AA:NN – Standard community-number to deny or permit. The 4-byte community number is composed of a 2-byte autonomous system number



and a 2-byte network number, separated by one colon. Each 2-byte number can range from 0 to 65535. One or more communities can be entered, separated by a space. Up to 16 community numbers are supported.

**internet** – Specifies the entire Internet. Routes with this community attribute are advertised to all internal and external peers.

**local-as** – Specifies the local autonomous system. Routes with this community attribute are advertised only to peers that are part of the local autonomous system or to peers within a sub-autonomous system of a confederation. These routes are not advertised to external peers or to other sub-autonomous systems within a confederation.

**no-advertise** – Routes with this community attribute are not advertised to any internal or external peer.

**no-export** – Routes with this community attribute are advertised only to peers in the same autonomous system or to other sub-autonomous systems within a confederation. These routes are not advertised to external peers.

100-500 – Expanded community list number that identifies one or more groups of communities.

**expanded** *community-list-name* – Name of expanded access list.  
(Maximum length: 32 characters, no spaces or other special characters)

*regular-expression* – Regular expression indicating the community list number or name<sup>15</sup>.

### Command Mode

Global Configuration

### Default Setting

No community lists are defined.

### Command Usage

- ◆ Standard community lists are used to configure well-known communities or community numbers. Expanded community lists are used to filter communities using a regular expression.
- ◆ When multiple values are entered in the same community list, they form a logical AND condition. When multiple values are configured in separate community lists, they form a logical OR condition, where the first list that matches a condition is processed.
- ◆ If the criteria specified for a community list is matched, then the deny/permit condition is applied to the routing message.
- ◆ If a permit value is applied to a community list, the filter will implicitly deny other community values.

- ◆ By default, the internet community is set with a route if no other communities are defined.
- ◆ Use this command in conjunction with the [neighbor send-community](#) to filter route updates sent to or received from a neighbor, or with the [match community](#) route map command to implement a more comprehensive filter for policy-based routing.

### Example

This example configures a named standard community list LN that permits routes with community value 100:10, denoting that they come from autonomous system 100 and network 10.

```
Console(config)#ip community-list standard LN permit 100:10
Console(config)#
```

### Related Commands

[neighbor send-community \(1110\)](#)

[match community \(1135\)](#)

**ip extcommunity-list** This command configures an extended community access list. Use the **no** form with only the access list name to disable its use, or with the relevant parameters to remove a community attribute from the access list.

### Syntax

#### [no] ip extcommunity-list

{1-99 | **standard** *community-list-name* {**deny** | **permit**}  
[{**rt** | **soo**} *extended-community-value*] |  
{100-500 | **expanded** *community-list-name* {**deny** | **permit**}  
*regular-expression*}

1-99 – Standard community list number that identifies one or more groups of communities.

**standard** *community-list-name* – Name of standard access list. A maximum of 16 extended communities can be configured in a standard community list. (Maximum length: 32 characters, no spaces or other special characters)

**deny** – Denies access to messages with matching extended community attribute.

**permit** – Permits access for messages with matching extended community attribute.

**rt** – The route target extended community attribute.

**soo** – The site of origin extended community attribute.

*extended-community-value* – The route target or site of origin in one of the following formats:

*AAAA:NN* or *AA:NNNN* – Community-number to deny or permit. The community number can either be formatted as a 4-byte autonomous system number and a 2-byte network number, or as a 2-byte autonomous system number and a 4-byte network number, separated by one colon. Each 2-byte number can range from 0 to 65535, and 4-byte numbers from 0 to 4294967295.

*IP:NN* – Community to deny or permit. The community number is composed of a 4-byte IP address (representing the autonomous system number) and a 2-byte network number, separated by one colon. The 2-byte network number can range from 0 to 65535.

One or more community numbers can be entered, separated by a space. Up to 3 community numbers are supported.

100-500 – Expanded community list number that identifies one or more groups of communities.

**expanded** *community-list-name* – Name of expanded access list.  
(Maximum length: 32 characters, no spaces or other special characters)

*regular-expression* – Regular expression indicating the community list number or name. Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

## Command Mode

Global Configuration

## Default Setting

No extended community lists are defined.

## Command Usage

- ◆ Standard community lists are used to configure well-known communities or community numbers. Expanded community lists are used to filter communities using a regular expression.
- ◆ When multiple values are entered in the same community list, they form a logical AND condition. When multiple values are configured in separate community lists, they form a logical OR condition, where the first list that matches a condition is processed.
- ◆ If the criteria specified for a community list is matched, then the deny/permit condition is applied to the routing message.
- ◆ If a permit value is applied to a community list, the filter will implicitly deny other community values.
- ◆ The route target (RT) attribute is used to identify sites that may receive routes tagged with a specific route target. Using this attribute allows that route to be

placed in per-site forwarding tables used for routing traffic received from the corresponding sites.

- ◆ The site of origin (SOO) attribute is used to identify the site from which the provider edge (PE) router learned the route. All routes learned from a particular site are assigned the same site of origin attribute, no matter if a site is connected to a single PE router or multiple PE routers. Filtering based on this extended community attribute can prevent routing loops from occurring when a site is multi-homed.
- ◆ Use this command in conjunction with the [neighbor filter-list](#) to filter route updates sent to or received from a neighbor, or with the [match extcommunity](#) route map command to implement a more comprehensive filter for policy-based routing.

### Example

This example configures a named standard community list LR that permits routes with the route target 100:20, denoting that they destined for the autonomous system 100 and network 20.

```
Console(config)#ip extcommunity-list standard LP permit soo 100:20
Console(config)#
```

### Related Commands

[neighbor filter-list \(1098\)](#)

[match extcommunity \(1136\)](#)

**ip prefix-list** This command configures an IP address prefix list. Use the **no** form with only the prefix list name to disable its use, or with the relevant parameters to remove an attribute from the prefix list.

### Syntax

```
[no] ip prefix-list prefix-list-name [seq sequence-number]
      {deny | permit} any
```

```
[no] ip prefix-list prefix-list-name [seq sequence-number]
      {deny | permit} {ip-address netmask | any}
      [ge min-prefix-length] [le max-prefix-length]
```

*prefix-list-name* – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

*sequence-number* – Applies a sequence number to the entry. If not specified, the entry is added to the bottom of the list, using a default numbering interval of 5. (Range: 1-429496725)

**deny** – Denies access to messages matching specified criteria.

**permit** – Permits access for messages matching specified criteria.

**any** – Any matching criteria.

*ip-address* – An IPv4 address expressed in dotted decimal notation.

*netmask* – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

**ge** – The minimum prefix length to match.

**le** – The maximum prefix length to match.

### Command Mode

Global Configuration

### Default Setting

No prefix lists are defined.

### Command Usage

- ◆ Prefix filtering can be performed on an IP address expressed as a classful network, a subnet, or a single host route.
- ◆ Prefix lists are checked starting from the lowest sequence number and continues through the list until a match is found. Once an entry is found that covers a network, the permit or deny statement is applied to that network, and the search process stops.
- ◆ At least one “permit” statement should be included when more than one entry is defined. Commonly used “Deny” statements can be included at the top of the list to quickly remove unsuitable routing messages. If a list includes all “Deny” statements, then an entry of “permit 0.0.0.0 255.255.255.255 ge 0 le 32” can be included at the bottom of the list to grant passage for all other routing messages.
- ◆ A prefix list can be applied to inbound or outbound updates for a specific peer by entering the [neighbor prefix-list](#) command, or with the [match ip address prefix-list](#) route map command to implement a more comprehensive filter for policy-based routing.

### Example

This example denies access to routing messages for the specified address.

```
Console(config)#ip prefix-list LS deny 10.0.0.0 255.0.0.0 ge 14 le 22
Console(config)#
```

### Related Commands

[neighbor prefix-list \(1105\)](#)

[match ip address \(1136\)](#)

**aggregate-address** This command configures an aggregate address in the routing table. Use the **no** form to delete an aggregate address.

### Syntax

**[no] aggregate-address** *ip-address netmask* [**as-set**] [**summary-only**]

*ip-address* – An IPv4 address expressed in dotted decimal notation.

*netmask* – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

**as-set** – Generates autonomous system set information for the AS path attribute, indicating that a route originated in multiple autonomous systems.

**summary-only** – Sends the summary routes only, ignoring more specific routes.

### Command Mode

Router Configuration

### Default Setting

No aggregate routes are defined.

### Command Usage

- ◆ Using this command without any keywords will create an aggregate entry in the routing table if any more specific routes are available in the specified range. The aggregate route does not include any individual route attributes (e.g., AS-Path or Community). It is advertised as coming from this autonomous system and has the atomic aggregate attribute set to indicate that some information may be missing.
- ◆ Using the **as-set** keyword creates an aggregate route where the advertised path is an AS-Set that consists of all elements contained in all of paths being summarized. AS-Set information can be used to avoid routing loops because it records where the route has been. If a router notes its own AS number in the AS-Set of the aggregate update, it will drop the aggregate to prevent a loop. However, when aggregating tens or hundreds of routes, avoid advertising routing information in this manner, since this route may be frequently withdrawn and updated as AS path reachability information for the summarized routes changes.
- ◆ Using the **summary-only** keyword creates the aggregate route, while at the same time suppressing advertisements of more specific routes to all neighbors.

### Example

```
Console(config-router)#aggregate-address 100.1.0.0 255.255.0.0 summary-only
Console(config-router)#aggregate-address 100.2.0.0 255.255.0.0 summary-only
as-set
Console(config-router)#aggregate-address 100.3.0.0 255.255.0.0 as-set
Console(config-router)#end
```

```

Console#show ip bgp
BGP table version is 0, local router ID is 192.168.0.4
Status codes: s suppressed, d damped, h history, * valid, > best, i -
               internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop          Metric LocPrf Weight Path
*>i192.168.0.0/24    0.0.0.0              0         32768 i

```

**bgp client-to-client reflection** This command restores route reflection via this router. Use the **no** form to disable route reflection.

### Syntax

**[no] bgp client-to-client reflection**

### Command Mode

Router Configuration

### Default Setting

Enabled

### Command Usage

- ◆ Route reflection from this device is enabled by default, but is only functional if a client has been configured with the [neighbor route-reflector-client](#) command.
- ◆ Route reflection is not required if all of the routers in an AS are fully meshed as normally required by interior BGP. However, to make interior BGP more scalable, route reflection or confederations can be used. Route reflection uses one or more route reflectors to reflect routes between specified clients within a cluster. Clients within a reflector cluster therefore need not be fully meshed, and the exchange of routing information is thereby reduced since the clients need not communicate with any routers outside of the cluster.
- ◆ Routing information from an external BGP router is advertised to all cluster clients and non-client peers. Information from a non-client peer is advertised to all clients. And information from cluster members is reflected to all routing peers, both inside and outside of the cluster. using this model, the local AS can be divided into many clusters.
- ◆ Use the [bgp cluster-id](#) command to designate route reflectors within the same cluster so that route reflectors can recognize updates from other route reflectors in the same cluster.

### Example

```

Console(config-router)#bgp client-to-client reflection
Console(config-router)#

```

### Related Commands

[neighbor route-reflector-client \(1108\)](#)

[bgp cluster-id \(1072\)](#)

**bgp cluster-id** This command configures the cluster identifier for multiple route reflectors in the same cluster. Use the **no** form to remove the cluster identifier.

### Syntax

**bgp cluster-id** *cluster-identifier*

**no bgp cluster-id**

*cluster-identifier* – The cluster identifier of this router when acting as a route reflector. This identifier can be expressed in the form an IPv4 address or an integer in the range of 1-4294967295.

### Command Mode

Router Configuration

### Default Setting

The router identifier of a lone route reflector in a cluster.

### Command Usage

- ◆ A cluster of clients will usually have a single route reflector (RR). In that case, the cluster can be identified by the BGP Identifier of the RR. However, this represents a single point of failure. This command is used to designate multiple route reflectors used within the same cluster so that they can recognize updates from other peer route reflectors and discard them to prevent loopbacks.
- ◆ All the route reflectors in the same cluster should be fully meshed and all of them configured with identical sets of client and non-client peers.
- ◆ A route reflector uses the non-transitive cluster-list attribute to avoid routing loops. A cluster-list is a sequence of cluster IDs the route has passed through. When a RR reflects a route from its clients to non-client peers, and vice versa, it appends this ID to the cluster list. Using this attribute, an RR can determine if routing information has looped back to the same cluster due to mis-configuration. If the local cluster ID is found in the cluster list, the advertisement is ignored.

### Example

```
Console(config-router)#bgp cluster-id 192.168.0.0
Console(config-router)#
```

### Related Commands

[bgp client-to-client reflection \(1071\)](#)



**bgp confederation identifier** This command configures the identifier for a confederation containing smaller multiple internal autonomous systems, and declares this router as a member of the confederation. Use the **no** form to remove the confederation identifier.

### Syntax

**bgp confederation identifier** *as-number*

**no bgp confederation identifier**

*as-number* – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

### Command Mode

Router Configuration

### Default Setting

No confederation identifier is configured.

### Command Usage

- ◆ BGP confederations are used to reduce the requirement for fully meshed connections between iBGP peers in the same AS. It works by dividing up a large AS into several smaller ASes, where only the peers in the same smaller AS are fully meshed, thus reducing the number of required connections and routing traffic.
- ◆ Even though different local confederation peers may have external BGP (eBGP) sessions, they exchange routing information among themselves as if they were iBGP peers. Next hop, Multi Exit Discriminator (MED), and local preference information is preserved. By preserving this information, a single Interior Gateway Protocol (IGP) can be used among the local confederations. When viewed from the outside by external peers, the larger AS is still identified as a single entity or autonomous system.
- ◆ Use the [bgp confederation peer](#) command to specify the autonomous systems within a confederation.

### Example

```
Console(config-router)#bgp confederation identifier 600
Console(config-router)#
```

### Related Commands

[bgp confederation peer \(1074\)](#)

**bgp confederation peer** This command adds an internal peer autonomous system to a confederation. Use the **no** form to remove an autonomous system from a confederation.

### Syntax

**bgp confederation peer** *as-number*

**no bgp confederation identifier**

*as-number* – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

### Command Mode

Router Configuration

### Default Setting

No confederation peer is configured.

### Command Usage

- ◆ This command is used to add multiple ASes to a confederation. Each AS is fully meshed within itself, and the AS members are visible internally within the confederation.
- ◆ Use the [bgp confederation identifier](#) command to create a confederation.

### Example

This example divides AS 600 into four smaller ASes 101-104, and assigns a neighboring router as a member of the sub-AS 101.

```
Console(config-router)#bgp confederation identifier 600
Console(config-router)#bgp confederation peer 101
Console(config-router)#bgp confederation peer 102
Console(config-router)#bgp confederation peer 103
Console(config-router)#bgp confederation peer 104
Console(config-router)#neighbor 192.168.0.9 remote-as 101
Console(config-router)#
```

### Related Commands

[bgp confederation identifier \(1073\)](#)

**bgp dampening** This command configures route dampening to reduce the propagation of unstable routes. Use the **no** form to restore the default settings.

### Syntax

**bgp dampening** [*half-life* [*reuse-limit* [*suppress-limit* *max-suppress-time*]]]

### **no dampening**

*half-life* – The time after which a penalty is reduced. The penalty value is reduced to half of the previous value after the half-life time expires.  
(Range: 1-45 minutes)

*reuse-limit* – The point at which the penalty for a flapping route must fall before a route is unsuppressed. (Range: 1-2000)

*suppress-limit* – The point at which to start suppressing a route.  
(Range: 1-2000)

*max-suppress-time* – The maximum time a route can be suppressed.  
(Range: 1-255 minutes)

### Command Mode

Router Configuration

### Default Setting

half-life: 15 minutes

reuse-limit: 750

suppress-limit: 2000

max-suppress-time: 60 minutes (4 x half-life)

### Command Usage

- ◆ Route dampening is used to reduce the frequency of routing updates due to unstable routes. Dampened routes are not used in the BGP decision process nor installed in the routing table.
- ◆ Each time a route flaps, the router assigns the route a penalty of 1000. If BGP receives an attribute change, BGP increases the penalty by 500. Penalties are cumulative, and the penalty for the route is stored in the BGP routing table until it exceeds the suppress limit. At that point, the route state changes to damped.
- ◆ Note that route dampening only applies to external BGP routes.

### Example

```
Console(config-router)#bgp dampening 20 1200 20000 220
Console(config-router)#
```

**bgp enforce-first-as** This command denies an update received from an external peer that does not list its own autonomous system number at the beginning of the AS path attribute. Use the **no** form to disable this feature.

#### Syntax

**[no] bgp enforce-first-as**

#### Command Mode

Router Configuration

#### Default Setting

Disabled

#### Command Usage

This command can be used to prevent a peer from misdirecting traffic by advertising a route as if sourced from another autonomous system.

#### Example

```
Console(config-router)#bgp enforce-first-as
Console(config-router)#
```

**bgp fast-external-failover** This command resets sessions for any directly connected external peers if the link goes down. Use the **no** form to disable this feature.

#### Syntax

**[no] bgp fast-external-failover**

#### Command Mode

Router Configuration

#### Default Setting

Enabled

#### Command Usage

- ◆ This command immediately resets the connection for directly adjacent external peers if the interface goes down for any reason other than TCP timeout.
- ◆ If fast external failover is disabled, the routing process waits until the default hold timer expires to reset the session.

#### Example

```
Console(config-router)#bgp fast-external-failover
Console(config-router)#
```

**bgp log-neighbor-changes** This command enables logging of neighbor resets (that is, up or down status changes). Use the **no** form to disable this feature.

#### Command Mode

Router Configuration

#### Default Setting

Disabled

#### Command Usage

- ◆ This command helps detect network problems by indicating if a neighbor connection is flapping. A high number of neighbor resets might indicate unacceptable error rates or high packet loss in the network.
- ◆ Log messages for neighbor resets are recorded as level 6 messages in the system log file which can be viewed using the [show log ram](#) command.

#### Example

```
Console(config-router)#bgp log-neighbor-changes
Console(config-router)#
```

**bgp network import-check** This command checks for the existence of the next-hop and its accessibility to an Interior Gateway Protocol. Use the **no** form to disable this feature.

#### Syntax

**[no] bgp network import-check**

#### Command Mode

Router Configuration

#### Default Setting

Disabled

#### Command Usage

By default, BGP will advertise a route regardless of the Interior Gateway Protocol (IGP) in use. This command forces the router to verify the existence of the next hop for an advertised route, and to ensure that the route is accessible to an IGP.

#### Example

```
Console(config-router)#bgp network import-check
Console(config-router)#
```

**bgp router-id** This command sets the router ID for this device. Use the **no** form to remove this ID.

#### Syntax

**bgp router-id** *router-id*

**no bgp router-id**

*router-id* – Router ID formatted as an IPv4 address.

#### Command Mode

Router Configuration

#### Default Setting

The highest IP address configured for an interface.

#### Command Usage

- ◆ By default, the router ID is automatically set to the highest IP address configured for a Layer 3 interface. This command can be used manually set the router ID to a fixed value.
- ◆ The router ID must be unique for every router in the autonomous system. Using the default setting based on the highest interface address ensures that each router ID is unique.
- ◆ All neighbor sessions will be reset if the router ID is changed.

#### Example

```
Console(config-router)#bgp router-id 192.168.0.254  
Console(config-router)#
```

**bgp scan-time** This command sets the interval at which to validate next hop information for BGP routes. Use the **no** form to restore the default setting.

#### Syntax

**bgp scan-time** *scan-time*

**no bgp scan-time**

*scan-time* – Next hop validation interval. (Range: 5-60 seconds)

#### Command Mode

Router Configuration

#### Default Setting

60 seconds

### Command Usage

This command sets the interval at which to check the validity of the next hop for all routes in the routing information database. During the interval between scan cycles, IGP instability or other network problems may cause black holes or routing loops to form.

### Example

```
Console(config-router)#bgp scan-time 30
Console(config-router)#
```

**network** This command specifies a network to advertise. Use the **no** form to stop advertising a network.

### Syntax

**network** *ip-address* [*netmask*] [**route-map** *map-name*] [**backdoor**]  
**pathlimit** *tvl*]

**no network** *ip-address* [*netmask*]

*ip-address* – IP address of a to advertise.

*netmask* – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

**map-name** – Name of the route map. The route map can be used to filter the networks to advertise. (Range: 1-80 characters)

**backdoor** – Specifies a backdoor route to a BGP border router that provides better information about the network.

**pathlimit** *tvl* – Maximum number of hops allowed in an AS path. (Range: 0-255)

### Command Mode

Router Configuration

### Default Setting

No networks are configured.

### Command Usage

- ◆ Use this command to specify the networks to advertise to BGP neighbors. BGP networks can be learned from directly connected routes, dynamic routing, or static route sources.
- ◆ BGP only sends and receives updates on interfaces specified by this command. If a network is not specified, the interfaces in that network will not be advertised in any BGP updates.
- ◆ A backdoor network has an administrative distance of 200, making routes learned through interior gateway protocols (RIP, OSPF, iBGP) preferred. A

backdoor network is treated as a local network, except that it not advertised by the local router. A backdoor route should not be sourced at the local router, but should be one that has been learned from external neighbors. However, since these routes are treated as a local network, they are given priority over routes learned through eBGP, even if the distance of the external route is shorter.

### Example

```
Console(config-router)#network 172.16.0.0 255.255.0.0  
Console(config-router)#
```

**redistribute** This command redistributes routes from one routing domain to another. Use the **no** form to stop redistributing an previously configured entry.

### Syntax

**redistribute** {**connected** | **ospf** | **rip** | **static**} [**metric** *metric-value*]  
[**route-map** *map-name*]

**no redistribute** {**connected** | **ospf** | **rip** | **static**}  
[**metric** *metric-value*] [**route-map** *map-name*]

**connected** - Imports routes that are established automatically just by enabling IP on an interface.

**ospf** - External routes will be imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

**rip** - External routes will be imported from the Routing Information Protocol (RIP) into this routing domain.

**static** - Static routes will be imported into this routing domain.

*metric-value* - Metric value assigned to all external routes for the specified protocol. (Range: 1-16)

**map-name** – Name of the route map. The route map can be used to filter the networks to advertise, and to modify their weight or other attributes. (Range: 1-80 characters)

### Command Mode

Router Configuration

### Default Setting

No redistribution is configured.

### Command Usage

- ◆ Use this command to advertise routes that are learned by some other means, such as from another routing protocol or static routing entries. Since all internal routes are maintained by interior gateway protocols such as RIP and OSPF, careful filtering should be used to ensure that only routes that need to be advertised reach the Internet.



- ◆ A route metric must be used to resolve the problem of redistributing external routes with incompatible metrics.

### Example

```
Console(config-router)#redistribute static metric 10  
Console(config-router)#
```

**timers bgp** This command sets the Keep Alive time used for maintaining connectivity, and the Hold time to wait for Keep Alive or Update messages before declaring a neighbor down. Use the **no** form to restore the default settings.

### Syntax

**timers bgp** *keepalive-time hold-time*

**no timers bgp**

*keepalive-time* – The frequency at which the local router sends keep-alive messages to its neighbors. (Range: 0-65535 seconds)

*hold-time* – The maximum interval after which a neighbor is declared dead if a keep-alive or update message has not been received. (Range: 0-65535 seconds)

### Command Mode

Router Configuration

### Default Setting

Keep Alive time: 60 seconds

Hold time: 180 seconds

### Command Usage

- ◆ Use this command to set global BGP timers used for monitoring connectivity to neighboring routers. These timers will be applied to all neighbors unless the [neighbor timers](#) command has been used to explicitly configure other timer settings for a neighbor.
- ◆ When the minimum acceptable hold-time is configured with this command, a remote peer session can be established only if the neighboring router is advertising a hold-time equal to, or greater than, that configured on this device.

### Example

```
Console(config-router)#timers bgp 60 200  
Console(config-router)#
```

**clear ip bgp** This command clears connections using hard or soft re-configuration.

### Syntax

**clear ip bgp** { \* | *as-number* | **external** | **peer-group** *group-name* | *neighbor-address* } [**in** [**prefix-list**] | **out** | **soft** [**in** | **out**]]

**\*** – All BGP peering sessions.

*as-number* – All peering sessions within this autonomous system number.  
(Range: 1-4294967295)

**external** – All eBGP peering sessions.

**peer-group** *group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*neighbor-address* – IPv4 address of a neighbor.

**in** – Inbound sessions.

**prefix-list** – The outbound route filter (ORF) prefix list. This option triggers a new route refresh or soft re-configuration, which updates the ORF prefix list. This option is ignored unless ORF capabilities have been enabled using the [neighbor capability orf prefix-list](#) command or ORF capability information has been received from a sending peer. If ignored, a normal inbound soft reset is performed.

**out** – Outbound sessions.

**soft** – Uses soft re-configuration for the reset, which does not tear down the session.

### Command Mode

Privileged Exec

### Default Setting

None

### Command Usage

- ◆ Use this command to initiate a hard reset or soft re-configuration. A hard reset clears and rebuilds specified peering sessions and routing tables. Soft re-configuration uses stored information to reconfigure and activate routing tables without clearing existing sessions. It uses stored update information to allow you to apply a new BGP policy without disrupting the network.
- ◆ To generate new inbound updates from stored information without resetting peer sessions, you must preconfigure the local router using the [neighbor capability orf prefix-list](#) command, which causes the router to store all received updates. Note that storing updates is memory intensive and should only be applied to critical links.

Outbound soft configuration requires no memory or preconfiguration. Outbound re-configuration can be used on the other side of a peering session to make initiate a new inbound policy on the local side.

- ◆ Use this command to clear peering sessions when changes are made to any BGP access lists, weights, or route-maps.
- ◆ Route refresh (RFC 2918) allows a router to reset inbound routing tables dynamically by exchanging route refresh requests with peers. Route refresh relies on the dynamic exchange of information with supporting peers. It is advertised through BGP capability negotiation, and all BGP routers must support this capability.

### Example

This example assumes that soft re-configuration has been set on the neighboring router.

```
Console(config-router)#clear ip bgp 192.168.0.254 soft in
Console(config-router)#
```

**clear ip bgp dampening** This command clears route dampening information and unsuppresses any currently suppressed routes.

### Syntax

**clear ip bgp dampening** [*ip-address* [*netmask*]]

*ip-address* – IP address of network or peer router.

*netmask* – Network mask that identifies the network address bits.

### Command Mode

Privileged Exec

### Default Setting

None

### Example

If no keywords are entered as in this example, route dampening information is cleared for the entire routing table.

```
Console(config-router)#clear ip bgp dampening
Console(config-router)#
```

## Route Metrics and Selection

**bgp always-compare-med** This command allows comparison of the Multi Exit Discriminator (MED) for paths advertised from neighbors in different autonomous systems. Use the **no** form to disable this feature.

### Syntax

**[no] bgp always-compare-med**

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ The MED is an optional non-transitive<sup>16</sup> attribute used to discriminate among multiple exit points to a neighboring autonomous system. A path with a lower MED is preferred over a path with a higher MED.
- ◆ By default, during best-path selection, the MED is compared only among paths from the same autonomous system. This command allows the comparison of MEDs among different paths regardless of the autonomous system from which the paths are received.
- ◆ The **bgp deterministic-med** command can be used to enforce comparison of the MED value between all paths received from within the same autonomous system.

### Example

This example assumes that a peer router is advertising the same route prefix through the two ASes (100 and 300) to the same AS (200), each of which carries a different MED.

```
Console(config-router)#bgp always-compare-med
Console(config-router)#
```

**bgp bestpath as-path ignore** This command ignores the AS path length in the selection of a path. Use the **no** form to disable this feature.

### Syntax

**[no] bgp bestpath as-path ignore**

<sup>16</sup>. If a router does not understand an optional non-transitive attribute, it will be removed.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Example

```
Console(config-router)#bgp bestpath as-path ignore
Console(config-router)#
```

**bgp bestpath compare-confed-  
aspath** This command compare confederation AS path length in addition to external AS path length in the selection of a path. Use the no form to disable this feature.

### Syntax

**[no] bgp bestpath compare-confed-aspath**

### Command Mode

Router Configuration

### Default Setting

Disabled

### Example

```
Console(config-router)#bgp bestpath compare-confed-aspath
Console(config-router)#
```

**bgp bestpath compare-routerid** This command compares similar routes from external peers, and gives preference to a route with the lowest router identifier. Use the **no** form to restore the default setting.

### Syntax

**[no] bgp bestpath compare-routerid**

### Command Mode

Router Configuration

### Default Setting

When making the best-path selection, the router does not compare identical routes received from different external peers.

### Command Usage

Normally, the first route arriving from different external peers (with other conditions equal) will be chosen as the best route. By using this command, the route with lowest router ID will be selected.

### Example

```
Console(config-router)#bgp bestpath compare-routerid
Console(config-router)#
```

**bgp bestpath med** This command enables comparison of the Multi Exit Discriminator (MED) attribute for paths learned from confederation peers, and the treatment of a route when the MED is missing. Use the **no** form to disable this feature.

### Syntax

**[no] bgp bestpath med** {[**confed**] [**missing-as-worst**]}

**confed** – Compare MED in confederation path.

**missing-as-worst** – Consider as maximum MED value when missing.

### Command Mode

Router Configuration

### Default Setting

When making the best-path selection, the router does not consider the MED.

### Command Usage

- ◆ The MED for paths learned from confederation peers is compared only if no external autonomous systems (AS) appear in the path. If an external AS is within the path, then the external MED is passed transparently through the confederation, and it is not compared.
- ◆ If the missing-as-worst option is disabled, the missing MED is assigned a value of 0, making a path missing the MED attribute the best path.

### Example

```
Console(config-router)#bgp bestpath med config missing-as-worst
Console(config-router)#
```

**bgp default local-preference** This command sets the default local preference used for best path selection among local iBGP peers. Use the **no** form to restore the default setting.

#### Syntax

**bgp default local-preference** *preference*

*preference* – Degree of preference iBGP peers give local routes during BGP best path selection. The higher the value, the more the route is to be preferred. (Range: 0-4294967295)

#### Command Mode

Router Configuration

#### Default Setting

100

#### Command Usage

Local preference is a discretionary attribute applied to a route during the BGP best path selection process. It is exchanged only between iBGP peers, and used to determine local policy.

#### Example

```
Console(config-router)#bgp default local-preference 100
Console(config-router)#
```

**bgp deterministic-med** This command enforces deterministic comparison of the MED attribute between all paths received from the same AS, ensuring that selection of the best path will always be the same, regardless of the order in which the paths are received by the local router. Use the **no** form to disable this feature.

#### Syntax

**[no] bgp deterministic-med**

#### Command Mode

Router Configuration

#### Default Setting

Disabled

#### Command Usage

- ◆ The MED is compared after BGP attributes weight, local preference, AS-path and origin have been compared and are equal. When deterministic comparison of the MED is enabled, all paths for the same route prefix (received from peers within the same AS) are grouped together and arranged according to their MED value. Based on this comparison, the best path is then chosen.

- ◆ The router immediately groups and sorts all local paths when this command is entered. For correct results, deterministic comparison of the MED must be configured in the same manner (enabled or disabled) on all routers in the local AS.
- ◆ If deterministic comparison of the MED is not enabled, route selection can be affected by the order in which routes are received.
- ◆ This command compares the MED when choosing routes advertised by different peers in the same AS. To compare the MED when choosing routes from neighbors in different ASs, use the [bgp always-compare-med](#) command.

### Example

```
Console(config-router)#bgp deterministic-med
Console(config-router)#
```

**distance** This command sets the administrative distance for a specified external BGP (eBGP) routes. Use the **no** form to restore the default setting.

### Syntax

**distance** *distance ip-address netmask [access-list-name]*

**no distance** *ip-address netmask*

*distance* – Administrative distance for an eBGP route. (Range: 1-255)

*ip-address* – IP address of a route entry.

*netmask* – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

*access-list-name* – Name of standard or extended access list.  
(Maximum length: 16 characters, no spaces or other special characters)

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

- ◆ The route distance indicates the trustworthiness of a router. The higher the distance the lower the trust rating. A distance of 255 means that the routing source cannot be trusted and should be ignored.
- ◆ This distance set by this command only applies to external BGP paths routes learned from a neighbor outside of the AS. Use the [distance bgp](#) command to configure the global setting for the distance of eBGP, iBGP, and local routes.



- ◆ If an access-list is specified, it will be applied to received routes. If the received routes are not matched in the access-list or the specified list does not exist, the original distance value will be used.

### Example

```
Console(config-router)#distance 90 10.1.1.64 255.255.255.255  
Console(config-router)#
```

### Related Commands

[distance bgp \(1089\)](#)

**distance bgp** This command sets the administrative distance for external BGP, internal BGP, and local routes. Use the **no** form to restore the default settings.

### Syntax

**distance bgp** *ebgp-distance ibgp-distance local-distance*

**no distance bgp**

*ebgp-distance* – Administrative distance for eBGP routes. (Range: 1-255)

*ibgp-distance* – Administrative distance for iBGP routes. (Range: 1-255)

*local-distance* – Administrative distance for local routes. (Range: 1-255)

### Command Mode

Router Configuration

### Default Setting

eBGP: 20

iBGP: 200

local: 200

### Command Usage

- ◆ External routes are learned from an external autonomous system, and internal routes from a peer within the local autonomous system. Local routes are those configured with the [network](#) command as a back door for the router or for the networks being redistributed from another routing process.
- ◆ The route distance indicates the trustworthiness of a router. The higher the distance the lower the trust rating. A distance of 255 means that the routing source cannot be trusted and should be ignored.
- ◆ This command can be used to indicate that another protocol can provide a better route to a node than that learned via eBGP, or to indicate that some internal routes should be preferred by BGP.

- ◆ Changing the administrative distance of iBGP routes is not recommended. It may cause an accumulation of routing table inconsistencies which can break routing to many parts of the network.

### Example

```
Console(config-router)#distance bgp 20 200 20
Console(config-router)#
```

### Related Commands

[distance \(1088\)](#)

## Neighbor Configuration

**neighbor activate** This command enables the exchange of routing information with a neighboring router or peer group. Use the **no** form to disable the exchange of routing information.

### Syntax

**[no] neighbor {ip-address | group-name} activate**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Enabled

### Command Usage

- ◆ After a connection is opened with a neighboring router, this command is used to enable the exchange of information with the neighbor.
- ◆ The exchange of information is enabled by default for each routing session configured with the [neighbor remote-as](#) command.

### Example

```
Console(config-router)#neighbor 10.1.1.64 activate
Console(config-router)#
```

**neighbor advertisement-interval** This command configures the interval between sending update messages to a neighbor. Use the **no** form to restore the default setting.

#### Syntax

**neighbor** *ip-address* **advertisement-interval** *interval*

**no neighbor** *ip-address* **advertisement-interval**

*ip-address* – IP address of a neighbor.

*interval* – The minimum interval between sending routing updates to the specified neighbor. (Range: 0-600 seconds)

#### Command Mode

Router Configuration

#### Default Setting

iBGP: 5 seconds

eBGP: 30 seconds

#### Command Usage

This command can be used to reduce route flapping. However, the [bgp dampening](#) command can provide more precise control of route flapping.

#### Example

```
Console(config-router)#neighbor 10.1.1.64 advertisement-interval 20
Console(config-router)#
```

**neighbor allowas-in** This command configures the number of times the AS path for a received route can contain the same AS number. Use the **no** form to restore the default setting.

#### Syntax

**neighbor** {*ip-address* | *group-name*} **allowas-in** [*count*]

**no neighbor** {*ip-address* | *group-name*} **allowas-in**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*count* – Maximum number of times the same AS number can appear in the AS path of a received route. (Range: 1-10, or 3 if the count is not undefined)

#### Command Mode

Router Configuration

#### Default Setting

No repeats allowed

### Command Usage

Under standard routing practices, BGP will not accept a route sent from a neighbor if the same AS number appears in the AS path more than once. This could indicate a routing loop, and the route message would therefore be dropped. However, for purposes of traffic engineering (such as degrading the preference for a certain path), this command can be used to configure the number of times the same AS is allowed re-appear in the AS path of a route received from a neighbor.

### Example

```
Console(config-router)#neighbor 10.1.1.64 allowas-in 5
Console(config-router)#
```

### neighbor attribute-unchanged

This command configures certain route attributes to be kept unchanged for transparent transmission to the specified neighbor. Use the **no** form to disable this feature.

### Syntax

**[no] neighbor {ip-address | group-name} attribute-unchanged [as-path]  
[med] [next-hop]**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

**as-path** – AS path attribute

**med** – Multi-Exit Discriminator (MED) attribute

**next-hop** – Next hop attribute

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

If this command is entered without specifying any route attributes, then all three optional attributes are used.

### Example

```
Console(config-router)#neighbor 10.1.1.64 attribute-unchanged
Console(config-router)#
```

**neighbor capability dynamic** This command configures dynamic negotiation of capabilities between neighboring routers. Use the **no** form to disable this feature.

#### Syntax

**[no] neighbor {ip-address | group-name} capability dynamic**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

#### Command Mode

Router Configuration

#### Default Setting

Disabled

#### Command Usage

- ◆ BGP normally requires a router to terminate a peering session if it receives an OPEN message with an unrecognized optional parameter. This command allows new capabilities to be introduced gracefully, without requiring a peering session to be terminated if a negotiated capability is unknown.
- ◆ With dynamic negotiation of capabilities is enabled, the capabilities by both sides are negotiated in OPEN messages, with the partner responding if a capability is supported or sending a NOTIFICATION if not.

#### Example

```
Console(config-router)#neighbor 10.1.1.64 capability dynamic
Console(config-router)#
```

**neighbor capability orf prefix-list** This command configures the negotiation of outbound route filter (ORF) capabilities with a neighboring router. Use the **no** form to disable negotiation.

#### Syntax

**[no] neighbor {ip-address | group-name} orf prefix-list {both | receive | send}**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

**both** – Capability to send and receive the ORF to/from this neighbor.

**receive** – Capability to receive the ORF from this neighbor.

**send** – Capability to send the ORF to this neighbor.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

When this command is entered, the side configured with inbound prefix-list filter rules will transmit its own rules to the peer, and the peer will then use these rules as its own outbound rules, thereby avoiding sending routes which will be denied by its partner.

### Example

```
Console(config-router)#neighbor 10.1.1.64 orf prefix-list both
Console(config-router)#
```

**neighbor default-originate** This command allows the local router to send a default route to a neighbor. Use the **no** form to disable this feature.

### Syntax

**neighbor** {*ip-address* | *group-name*} **default-originate** [**route-map** *map-name*]

**no neighbor** {*ip-address* | *group-name*} **default-originate**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*map-name* – Name of the route map. The route map can be used to filter the criteria used for sending the default route to a neighbor. (Range: 1-80 characters)

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ This command is used to advertise the local router's default route (0.0.0.0) to a neighbor. This route can be used by the neighbor to reach the local router if no other routes are available.
- ◆ If several neighbors supply a default route to the same partner, the best one will be elected according to the standard path selection process.

- ◆ If a route map is specified, the default route 0.0.0.0 is advertised if the route map contains a **match ip address** clause and there is a route that matches an entry in the **ip prefix-list**.

### Example

```
Console(config-router)#neighbor 10.1.1.64 default-originate
Console(config-router)#
```

**neighbor description** This command configures the description of a neighbor or peer group. Use the **no** form to remove a description.

### Syntax

**neighbor** {*ip-address* | *group-name*} **description** *description*

**no neighbor** {*ip-address* | *group-name*} **description**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the **neighbor peer-group** command.

*description* – Descriptive string. (Range: 1-80 characters)

### Command Mode

Router Configuration

### Default Setting

No description specified

### Example

```
Console(config-router)#neighbor 10.1.1.64 description bill's router
Console(config-router)#
```

**neighbor distribute-list** This command filters route updates to/from a neighbor or peer group. Use the **no** form to remove this list.

### Syntax

**neighbor** {*ip-address* | *group-name*} **distribute-list** *access-list-name* {**in** | **out**}

**no neighbor** {*ip-address* | *group-name*} **distribute-list** {**in** | **out**}

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the **neighbor peer-group** command.

*access-list-name* – Name of standard or extended access list.  
(Maximum length: 32 characters, no spaces or other special characters)

**in** – Filters inbound routing messages.

**out** – Filters outbound routing messages.

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

- ◆ If the specified access list for input or output mode does not exist, all input or output route updates will be filtered.
- ◆ The [neighbor prefix-list](#) and the [neighbor distribute-list](#) commands are mutually exclusive for a BGP peer. That is, only one of these commands may be applied in the inbound or outbound direction.

### Example

```
Console(config-router)#neighbor 10.1.1.64 distribute-list RD in
Console(config-router)#
```

**neighbor dont-capability-negotiate** This command disables capability negotiation when creating connections. Use the **no** form to restore the default setting.

### Syntax

**[no] neighbor {ip-address | group-name} dont-capability-negotiate**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Capability negotiation is enabled

### Command Usage

Earlier versions of BGPv4 require that when a BGP speaker receives an Open message with one or more unrecognized Optional Parameters, the speaker must terminate BGP peering. This command can be used when connecting to a partner known to use an older BGP version which does not support capabilities negotiation (RFC 2842), thereby allowing the peering session to continue.



### Example

```
Console(config-router)#neighbor 10.1.1.64 dont-capability-negotiate  
Console(config-router)#
```

## neighbor ebgp-multihop

This command allows eBGP neighbors to exist in different segments, and configures the maximum hop count (TTL). Use the **no** form to restore the default setting.

### Syntax

**neighbor** {*ip-address* | *group-name*} **ebgp-multihop** [*count*]

**no neighbor** {*ip-address* | *group-name*} **ebgp-multihop**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*count* – Maximum hop count. (Range: 1-255)

### Command Mode

Router Configuration

### Default Setting

eBGP neighbors must be located in the same segment.

### Command Usage

- ◆ This command can be used to allow routers in different network segments to create a BGP neighbor relationship.
- ◆ If this command is entered without specifying a count, the hop limit is set at 255.
- ◆ To avoid creating loops through oscillating routes, a multi-hop session will not be established if the only route to a multi-hop peer is the default route.

### Example

```
Console(config-router)#neighbor 10.1.1.64 ebgp-multihop 2  
Console(config-router)#
```

**neighbor enforce-multihop** This command enforces the requirement for all neighbors to form multi-hop connections. Use the **no** form to disable this requirement.

#### Syntax

**[no] neighbor {ip-address | group-name} enforce-multihop**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

#### Command Mode

Router Configuration

#### Default Setting

Not enforced

#### Command Usage

By default, the multi-hop check is only performed on iBGP and eBGP non-direct routes. This command can be used to force the router to perform the multi-hop check on directly connected routes as well. In other words, the router will not perform the next-hop direct-connect check the specified neighbor.

#### Example

```
Console(config-router)#neighbor 10.1.1.64 enforce-multihop
Console(config-router)#
```

**neighbor filter-list** This command filters route updates sent to or received from a neighbor based on an AS path access-list. Use the **no** form to disable route filtering.

#### Syntax

**neighbor {ip-address | group-name} filter-list access-list {in | out}**

**no neighbor {ip-address | group-name} filter-list {in | out}**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*access-list* – Name of an AS-Path access list configured with the [ip as-path access-list](#) command.

**in** – Filter inbound routing updates.

**out** – Filter outbound routing updates.

#### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

Use this command in conjunction with the [ip as-path access-list](#) command to filter route updates sent to or received from a neighbor.

### Example

In this example, the AS path access list “ASPF” is first configured to deny access to any route passing through AS 100. It then enables route filtering by assigning this list to a peer.

```
Console(config)#ip as-path access-list ASPF deny 100
Console(config)#router bgp 100
Console(config-router)#redistribute static
Console(config-router)#neighbor 10.1.1.66 filter-list ASPF out
Console(config-router)#
```

**neighbor interface** This command specifies the interface to a neighbor. Use the **no** form to remove this configuration setting.

### Syntax

**neighbor *ip-address* interface vlan *vlan-id***

**no neighbor *ip-address* interface**

*ip-address* – IP address of a neighbor.

*vlan-id* - VLAN ID. (Range: 1-4094)

### Command Mode

Router Configuration

### Default Setting

None

### Example

```
Console(config-router)#neighbor 10.1.1.64 interface vlan 1
Console(config-router)#
```

**neighbor maximum-prefix** This command sets the maximum number or route prefixes that can be received from a neighbor. Use the **no** form to restore the default setting.

### Syntax

**neighbor** {*ip-address* | *group-name*} **maximum-prefix** *max-count* [*threshold* [**restart** *interval* | **warning**]]

**no neighbor** {*ip-address* | *group-name*} **maximum-prefix**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*max-count* – The maximum number of route prefixes that will be accepted from a neighbor. (Range: 1-4294967295)

*threshold* – The percentage of the maximum number of allowed prefixes at which the router will initiate the specified response.

**restart** – Restarts BGP connection after the threshold is exceeded.

*interval* – Time to wait after a BGP connection has been terminated, before reestablishing the session. (Range: 1-65535 minutes)

**warning** – Sends a log message if the threshold is exceeded.

### Command Mode

Router Configuration

### Default Setting

No limit is set

### Default Usage

- ◆ This command is used to control the maximum number of route prefixes that can be sent by a neighbor. It provides a method to reserve resources for other processes, or to prevent malicious attacks.
- ◆ If the threshold is specified, but neither the **restart** nor **warning** keywords are used), the connection will be closed until the records are cleared with the [clear ip bgp](#) command.

### Example

In this example, the router warns when the number of route prefixes reaches 6, and the connection will be closed when the prefixes hit 13.

```
Console(config-router)#neighbor 10.1.1.64 maximum-prefix 12 50
Console(config-router)#
```

**neighbor next-hop-self** This command configures the local router as the next hop for a neighbor in all routing messages it sends. Use the **no** form to disable this feature.

### Syntax

**[no] neighbor {ip-address | group-name} next-hop-self**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ iBGP routers only connected to other iBGP routers in same segment will not be able to talk with iBGP routers outside of the segment if they are not directly connected with each other. This command can be used in these kinds of networks (i.e., un-meshed or non-broadcast) where iBGP neighbors may not have direct access to all other neighbors on the same IP subnet.
- ◆ Even when a successful BGP relationship seems to have been established within the local AS, you may not be able to see some routes in the routing table. iBGP routers only connected with other iBGP routers in same AS will not be able to talk with routers outside of the AS if they are not directly connected with each other. The **neighbor next-hop-self** command can be used to configure an iBGP router which is directly connected with an eBGP neighbor so that other iBGP routers in the same AS can talk with eBGP routers outside the AS.

### Example

```
Console(config-router)#neighbor 10.1.1.64 next-hop-self
Console(config-router)#
```

**neighbor override-capability** This command overrides the result of capability negotiations, allowing a session to be formed with a peer that does not support capability negotiation. Use the **no** form to disable this feature.

### Syntax

**[no] neighbor {ip-address | group-name} neighbor override-capability**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Example

```
Console(config-router)#neighbor 10.1.1.64 override-capability  
Console(config-router)#
```

**neighbor password** This command enables message-digest (MD5) authentication for the specified neighbor and assigns a password (key) to be used. Use the **no** form to remove an existing key.

### Syntax

**neighbor** {*ip-address* | *group-name*} *password*

**no neighbor** {*ip-address* | *group-name*}

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*password* - Alphanumeric password used to generate a 128 bit message digest or “fingerprint.” (Range: 1-16 characters)

### Command Mode

Router Configuration

### Default Setting

No authentication

### Command Usage

- ◆ When MD5 authentication is configured on a TCP connection between two peers, neighbor authentication occurs whenever routing updates are exchanged. Authentication must be configured with the same password on both peers; otherwise, the connection between them will not be made.
- ◆ If you configure or change the password used for MD5 authentication between two peers, the local router will not tear down the existing session after you configure the password. It will attempt to maintain the peering session using the new password until the BGP hold timer expires. If the password is not entered or changed on the remote router before the hold timer expires, the session will time out.

### Example

```
Console(config-router)#neighbor 10.1.1.64 password frost
Console(config-router)#
```

**neighbor passive** This command passively forms a connection with the specified neighbor, not sending a TCP connection request, but waiting a connection request from the specified neighbor. Use the **no** form to disable this feature.

### Syntax

**[no] neighbor {ip-address | group-name} passive**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

This command configures the local router so that it remains in Active state, waiting for an inbound connection request from a neighbor, and not initiating any outbound connections with the neighbor via an Open message.

### Example

```
Console(config-router)#neighbor 10.1.1.64 passive
Console(config-router)#
```

**neighbor peer-group (Creating)** This command configures a router peer group which can be easily configured with the same attributes. Use the **no** form to remove a peer group.

### Syntax

**[no] neighbor group-name peer-group**

*group-name* – A BGP peer group. (Range: 1-256 characters)

### Command Mode

Router Configuration

### Default Setting

No peer groups are defined.

### Command Usage

- ◆ Neighbors with the same BGP attributes can be grouped into peer groups. This simplifies the application of various policies, such as filter lists. Other configuration settings can be applied to a peer-group using any of the neighbor commands. Any changes made to the peer group affect all members. Use this command to create a peer-group.
- ◆ To assign members to a peer group, use the `neighbor ip-address peer-group group-name` command.

### Example

```
Console(config-router)#neighbor RD peer-group
Console(config-router)#
```

**neighbor peer-group** (Group Members) This command assigns routers to a peer group. Use the **no** form to remove a group member.

### Syntax

**[no] neighbor ip-address peer-group group-name**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group.

### Command Mode

Router Configuration

### Default Setting

No group members are defined.

### Command Usage

To create a peer group, use the `neighbor group-name peer-group` command.

### Example

```
Console(config-router)#neighbor 10.1.1.64 peer-group RD
Console(config-router)#
```

**neighbor port** This command specifies the TCP port number of the partner through which communications are carried. Use the **no** form to restore the default setting.

### Syntax

**neighbor ip-address port port-number**

**no neighbor ip-address port**

*ip-address* – IP address of a neighbor.



*port-number* – TCP port number to use for BGP communications.  
(Range: 0-65535)

### Command Mode

Router Configuration

### Default Setting

179

### Example

```
Console(config-router)#neighbor 10.1.1.64 port 1023  
Console(config-router)#
```

**neighbor prefix-list** This command configures prefix restrictions applied in inbound/outbound route updates to/from specified neighbors. Use the **no** form to remove the neighbor binding for a prefix list.

### Syntax

**neighbor** {*ip-address* | *group-name*} **prefix-list** *list-name* {**in** | **out**}

**no neighbor** {*ip-address* | *group-name*} **prefix-list** {**in** | **out**}

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*list-name* – Name of a prefix-list. The prefix list can be used to filter the networks to import or export. (Range: 1-80 characters)

**in** – Filter inbound routing updates.

**out** – Filter outbound routing updates.

### Command Mode

Router Configuration

### Default Setting

No prefix list restrictions are configured.

### Command Usage

- ◆ First, configure a prefix list with the [ip prefix-list](#) command, and then use this command to specify the neighbors to which it applies, and whether it applies to inbound or outbound messages.
- ◆ Filtering routes based on a prefix list searches for entries matching the router specified by this command. If a match is found and the entry is configured to permit the route, the route will be imported or exported as defined by this command. An empty prefix list permits all prefixes. If a prefix does not match

any entries in a list, the route is denied. When multiple entries in the list match a prefix, the entry with the smallest sequence number is used.

- ◆ The search starts at the top of the prefix list. Once an entry matches, the router stops searching. To reduce the load on system resources, the most commonly used entries should be placed at the top of the list.

### Example

```
Console(config)#ip prefix-list RD permit 100.1.0.0 255.255.0.0 ge 17 le 18
Console(config)#router bgp 200
Console(config-router)#redistribute static
Console(config-router)#neighbor 10.1.1.66 prefix-list RD out
Console(config-router)#
```

**neighbor remote-as** This command configures a neighbor and its AS number, identifying the neighbor as an iBGP or eBGP peer. Use the **no** form to remove a neighbor.

### Syntax

**neighbor** {*ip-address* | *group-name*} **remote-as** *as-number*

**no neighbor** {*ip-address* | *group-name*} **remote-as**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*as-number* – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

### Command Mode

Router Configuration

### Default Setting

No neighbors are configured.

### Command Usage

- ◆ BGP neighbors must be manually configured. A neighbor relationship can only be established if partners are configured on both sides a connection.
- ◆ If the neighbor's AS number is the same as that of the local router, the neighbor is an iBGP peer. If it is different, the neighbor is an eBGP peer.

### Example

```
Console(config-router)#neighbor 10.1.1.64 remote-as 100
Console(config-router)#
```

**neighbor remove-private-as** This command removes private autonomous system numbers from outbound routing updates to an external neighbor. Use the **no** form to disable this feature.

### Syntax

**neighbor** {*ip-address* | *group-name*} **remove-private-as**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ This command only applies to eBGP neighbors. It is used to avoid passing an internal AS number to an external AS. Internal AS numbers range from 64512-65535, and should not be sent to the Internet since they are not valid external AS numbers.
- ◆ This configuration only takes effect when the AS Path attribute of a route contains only internal AS numbers. If the AS Path attribute for a route contains both internal and external AS numbers, the route will not be processed.
- ◆ This command may be used in BGP confederations provided that the private AS numbers appear after the confederation portion of the AS path.

### Example

```
Console(config-router)#neighbor 10.1.1.64 remove-private-as
Console(config-router)#
```

**neighbor route-map** This command specifies the route mapping policy for inbound/outbound routing updates for specified neighbors. Use the **no** form to remove this policy binding.

### Syntax

**neighbor** {*ip-address* | *group-name*} **route-map** *map-name* {**in** | **out**}

**no neighbor** {*ip-address* | *group-name*} **route-map** {**in** | **out**}

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*map-name* – Name of the route map. The route map can be used to filter the networks to advertise or receive based on various attributes.  
(Range: 1-128 characters)

**in** – Filter inbound routing updates.

**out** – Filter outbound routing updates.

### Command Mode

Router Configuration

### Default Setting

No route maps are configured nor bound to any neighbor.

### Command Usage

- ◆ First, use **route-map** command to create a route map, and the **match** and **set** commands to configure the route attributes to act upon. Then use this command to specify neighbors to which the route map is applied.
- ◆ If the specified route map does not exist, all input/output route updates will be filtered.

### Example

```
Console(config-router)#neighbor 10.1.1.64 route-map RD in
Console(config-router)#
```

**neighbor route-reflector-client** This command configures this router as a route reflector and the specified neighbor as its client. Use the **no** form to disable route reflection for the specified neighbor.

### Syntax

**[no] neighbor {ip-address | group-name} route-reflector-client**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the **neighbor peer-group** command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ Route reflection from this device is enabled by default, but is only functional if a client has been configured with this command.

- ◆ Under standard configuration rules, all BGP speakers within the same AS must be fully meshed. Route reflection can be used to reduce the number of connections required between peers. Reflector clients exchange messages only with the route reflector, while the reflector handles message exchanges among each client and other iBGP, eBGP, and non-client routers. For more information on configuring route reflection, refer to the Command Usage section under the [bgp client-to-client reflection](#) command.

### Example

```
Console(config-router)#neighbor 10.1.1.64 route-reflector-client
Console(config-router)#
```

**neighbor route-server-client** This command configures this router as a route server and the specified neighbor as its client. Use the **no** form to disable the route server for the specified neighbor.

### Syntax

**[no] neighbor {ip-address | group-name} route-server-client**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

- ◆ A route server is used as a replacement for full mesh eBGP routing in internet exchange points in a manner similar to the way route reflectors are used in iBGP. Instead of maintaining direct eBGP peering sessions with every other service provider, providers can acquire the same routing information through a single connection to a route server at the Internet exchange.
- ◆ Using a route server reduces the configuration complexity required for an eBGP full mesh, limits CPU and memory requirements for the exchange of peering messages, and avoids the need for negotiating a large number of individual peering agreements.

### Example

In the following example, the router 10.1.1.64 (AS100) is configured as the route server for neighbors 10.1.1.66 (AS200) and 10.1.1.68 (AS300).

```
Console(config)#router bgp 100
Console(config-router)#neighbor 10.1.1.66 remote-as 200
Console(config-router)#neighbor 10.1.1.66 route-server-client
```

```
Console(config-router)#neighbor 10.1.1.68 remote-as 300
Console(config-router)#neighbor 10.1.1.68 route-server-client
Console(config-router)#
```

**neighbor send-community** This command configures the router to send community attributes to a neighbor in peering messages. Use the **no** form to stop sending this attribute to a neighbor.

#### Syntax

**[no] neighbor {ip-address | group-name} send-community**  
**[both | extended | standard]**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

**both** – Sends both extended and standard community attributes.

**extended** – Sends extended community attributes.

**standard** – Standard community attributes.

#### Command Mode

Router Configuration

#### Default Setting

No community attributes are sent. If community type is not specified, then only standard community attributes are sent.

#### Command Usage

Community attributes are used to group destinations into a certain community, and apply routing decisions to the overall community.

#### Example

```
Console(config-router)#neighbor 10.1.1.66 send-community extended
Console(config-router)#
```

#### Related Commands

[set community \(1143\)](#)

**neighbor shutdown** This command closes a neighbor connection without canceling the neighbor configuration. Use the **no** form to restore the connection.

#### Syntax

**[no] neighbor {ip-address | group-name} shutdown**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

None

### Command Usage

- ◆ This command terminates any active sessions for the specified neighbor, and removes any associated routing information.
- ◆ Use the [show ip bgp summary](#) command display the neighbors which have been administratively shut down. Entries with in an Idle (Admin) state have been disabled by the **neighbor shutdown** command.

### Example

```
Console(config-router)#neighbor 10.1.1.66 shutdown
Console(config-router)#
```

### neighbor soft-reconfiguration inbound

This command configures the switch to store updates in the inbound message buffer, and perform soft re-configuration from this buffer for specified neighbors when required. Use the **no** form to disable this feature.

### Syntax

**[no] neighbor {ip-address | group-name} soft-reconfiguration inbound**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

- ◆ Use this command to employ soft reconfiguration for a neighbor. A hard reset clears and rebuilds specified peering sessions and routing tables. Soft reconfiguration uses stored information to reconfigure and activate routing tables without clearing existing sessions. It uses stored update information to allow you to restore a connection or to apply a new BGP policy without disrupting the network. Note that outbound soft reconfiguration does not require inbound soft reconfiguration to be enabled.

- ◆ The command is only available when route refresh capability is not enabled. Route refresh (RFC 2918) allows a router to reset inbound routing tables dynamically by exchanging route refresh requests with peers. Route refresh relies on the dynamic exchange of information with supporting peers. It is advertised through BGP capability negotiation, and all BGP routers must support this capability.
- ◆ To use soft reconfiguration, without preconfiguration, both BGP neighbors must support the soft route refresh capability advertised in open messages sent when a BGP session is established. To see if a BGP router supports this capability, use the [show ip bgp neighbors](#) command.

### Example

```
Console(config-router)#neighbor 11.1.1.120 soft-reconfiguration inbound
Console(config-router)#
```

**neighbor strict-capability-match** This command forces strict capability matching when establishing connections. Use the **no** form to disable this requirement.

### Syntax

**[no] neighbor {ip-address | group-name} strict-capability-match**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

### Command Mode

Router Configuration

### Default Setting

Disabled

### Command Usage

This command specifies that a connection can only be established when the both sides have perfectly matching capabilities.

### Example

```
Console(config-router)#neighbor 10.1.1.66 strict-capability-match
Console(config-router)#
```



**neighbor timers** This command sets the Keep Alive time and Hold time used for specified neighbors. Use the **no** form to restore the default settings.

### Syntax

**[no] neighbor** {*ip-address* | *group-name*} **timers** *keepalive-time* *hold-time*

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*keepalive-time* – The frequency at which the local router sends keep-alive messages to its neighbors. (Range: 0-65535 seconds)

*hold-time* – The maximum interval after which a neighbor is declared dead if a keep-alive or update message has not been received. (Range: 0-65535 seconds)

### Command Mode

Router Configuration

### Default Setting

Keep Alive time: 60 seconds

Hold time: 180 seconds

### Command Usage

- ◆ This command sets the Keep Alive time used for maintaining connectivity, and the Hold time to wait for Keep Alive or Update messages before declaring a neighbor down.
- ◆ This command sets timers for monitoring connectivity to specific neighboring routers, which supercede those applied to all neighbors with the global [timers bgp](#) command.

### Example

```
Console(config-router)#neighbor 10.1.1.66 timers 50 200
Console(config-router)#
```

**neighbor timers connect** This command sets the time to wait before attempting to reconnect to a neighbor whose TCP connection has failed. Use the **no** form to restore the default setting.

### Syntax

**[no] neighbor** *ip-address* **timers connect** *retry-interval*

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*retry-interval* – The amount of time the system waits for the transport protocol connection to complete. If this timer expires, the state remains in Connect state, the timer is reset, and the system tries to initiate a new transport connection. (Range: 0-65535 seconds)

### Command Mode

Router Configuration

### Default Setting

120 seconds

### Command Usage

This command sets the time to wait before attempting to reconnect to a BGP neighbor after having failed to connect. During the idle time specified by the Connect Retry timer, the remote BGP peer can actively establish a BGP session with the local router.

### Example

```
Console(config-router)#neighbor 10.1.1.66 timers connect 100
Console(config-router)#
```

**neighbor unsuppress-map** This command allows routes suppressed by the [aggregate-address](#) (summary-only option) to be advertised to specified neighbors. Use the **no** form to remove this configuration entry.

### Syntax

**[no] neighbor {ip-address | group-name} unsuppress-map map-name**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*map-name* – Name of the route map. The route map can be used to filter the networks to advertise. (Range: 1-80 characters)

### Command Mode

Router Configuration

### Default Setting

No exceptions

### Command Usage

This command is used to leak routes suppressed by the [aggregate-address](#) command (with summary-only option) to specified neighbors. Other routes that meet the route map conditions, but have not been suppressed, will still be sent.

### Example

```
Console(config-router)#neighbor 10.1.1.66 unsuppress-map rmp  
Console(config-router)#
```

**neighbor update-source** This command specifies the interface to use for a TCP connection, instead of using the nearest interface. Use the **no** form to use the default interface.

### Syntax

**[no] neighbor {ip-address | group-name} update-source interface vlan vlan-id**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*vlan-id* - VLAN ID. (Range: 1-4094)

### Command Mode

Router Configuration

### Default Setting

The nearest (best/closest) interface is used.

### Command Usage

By default the nearest interface to the neighbor is used for BGP connections. This command can be used to specify any available interface for a TCP connection.

### Example

```
Console(config-router)#neighbor 10.1.1.66 update-source interface vlan 1  
Console(config-router)#
```

**neighbor weight** This command assigns a weight to routes sent from a neighbor. Use the **no** form to restore the default weight.

### Syntax

**neighbor {ip-address | group-name} weight weight**

**no neighbor {ip-address | group-name} weight**

*ip-address* – IP address of a neighbor.

*group-name* – A BGP peer group containing a list of neighboring routers configured with the [neighbor peer-group](#) command.

*weight* – The weight to be assigned to routes received from this neighbor. (Range: 0-65535)

## Command Mode

Router Configuration

## Default Setting

Routes learned from a neighbor: 0

Static routes sourced by the local router: 32768

## Command Usage

- ◆ Use this command to specify a weight for all the routes learned from a neighbor. The route with the highest weight gets preference over other routes to the same network.
- ◆ Weights assigned using the [set weight](#) command override those assigned by this command.

## Example

```
Console(config-router)#neighbor 10.1.1.66 weight 500
Console(config-router)#
```

## Display Information

**show ip bgp** This command shows entries in the routing table.

## Syntax

**show ip bgp** *ip-address* [*netmask* [**longer-prefixes**]]

*ip-address* – IP address of a route entry.

*netmask* – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

**longer-prefixes** – Specified route and all more specific routes.

## Command Mode

Privileged Exec

## Example

```
Console#show ip bgp
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network        Next Hop           Metric LocPrf Weight Path
*>12.0.0.0         10.1.1.121             0         32768 ?
*>100.1.1.0/24     10.1.1.200             0         32768 ?
*>100.1.2.0/24     10.1.1.200             0         32768 ?
*i192.168.0.0/24  0.0.0.0                0         32768 i

Total number of prefixes 4
Console#
```

**Table 216: show ip bgp - display description**

Field	Description
BGP table version	Internal version number of routing table, incremented per table change.
local router ID	IP address of router.
Status codes	Status of table entry includes these values: <ul style="list-style-type: none"> <li>♦ s – Entry is suppressed.</li> <li>♦ d – Entry is dampened.</li> <li>♦ h – Entry history</li> <li>♦ * – Entry is valid</li> <li>♦ &gt; – Best entry for that network</li> <li>♦ i – Entry learned via internal BGP (iBGP).</li> <li>♦ r – Entry is Routing Information Base (RIB) failure</li> <li>♦ S – Entry is stale.</li> <li>♦ R – Entry removed.</li> </ul>
Origin codes	Origin of table entry includes these values: <ul style="list-style-type: none"> <li>♦ i – Entry originated from an Interior Gateway Protocol (IGP) and was advertised using a <b>network</b> router configuration command.</li> <li>♦ e – Entry originated from an Exterior Gateway Protocol (EGP).</li> <li>♦ ? – Origin of the path undetermined. This normally indicates a route which has been redistributed into BGP from an IGP.</li> </ul>
Network	IP address of network entry.
Next Hop	IP address of the next router used to reach destination network.
Metric	Value of inter-autonomous system metric.
LocPrf	Local preference value defined by the <a href="#">set local-preference</a> route-map configuration command.
Weight	Weight of the route determined by autonomous system filters.
Path	Autonomous system paths used to reach the destination network.
Total number of prefixes	Total number of unique route prefixes in the table.

**show ip bgp attribute-info** This command shows internal attribute hash information.

#### Syntax

**show ip bgp attribute-info**

#### Command Mode

Privileged Exec

### Example

In the following example, Refcnt refers to the number of routes using the indicated next hop.

```
Console#show ip bgp attribute-info
Refcnt  Nexthop
      1 0.0.0.0
      1 10.1.1.64
      3 10.1.1.64
      1 10.1.1.121
      2 10.1.1.200
Console#
```

**show ip bgp cidr-only** This command shows routes which use classless interdomain routing network masks.

### Syntax

**show ip bgp cidr-only**

### Command Mode

Privileged Exec

### Example

This example shows routes that do not match the natural A, B, C or D network masks defined for the earliest IP networks.

```
Console#show ip bgp cidr-only
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop           Metric LocPrf Weight Path
*>3.3.3.0/24        10.10.10.10                0 11 i
*>6.6.6.0/24        0.0.0.0                   32768 i
Console#
```

**show ip bgp community** This command shows routes that belong to specified BGP communities.

### Syntax

**show ip bgp community** **[[AA:NN] [internet] [local-as] [no-advertise]**  
**[no-export]] [exact-match]]**

**AA:NN** – Standard community-number to match. The 4-byte community number is composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon. Each 2-byte number can range from 0 from 65535. One or more communities can be entered, separated by a space. Up to 16 community numbers are supported.

**internet** – Specifies the entire Internet. Routes with this community attribute are advertised to all internal and external peers.

**local-as** – Specifies the local autonomous system. Routes with this community attribute are advertised only to peers that are part of the local autonomous system or to peers within a sub-autonomous system of a confederation. These routes are not advertised to external peers or to other sub-autonomous systems within a confederation.

**no-advertise** – Routes with this community attribute are not advertised to any internal or external peer.

**no-export** – Routes with this community attribute are advertised only to peers in the same autonomous system or to other sub-autonomous systems within a confederation. These routes are not advertised to external peers.

**exact-match** – Displays only routes that match the specified communities exactly.

## Command Mode

Privileged Exec

## Example

```
Console#show ip bgp community
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop          Metric LocPrf Weight Path
*   100.1.1.0/24      0.0.0.0                      32768 700 800 i
*> 172.0.0.0/8        0.0.0.0                      32768 700 800 i

Total number of prefixes 2
Console#
```

## show ip bgp community-info

This command shows community messages permitted by BGP.

## Syntax

**show ip bgp community-info**

## Command Mode

Privileged Exec

## Example

```
Console#show ip bgp community-info
Address      Refcnt  Community
[0x3312558] (3)  100:50
Console#
```

Table 217: show ip bgp community-info - display description

Field	Description
Address	Internal address in memory where the entry is stored.
Refcnt	The number of routes which refer to this community.
Community	4-byte community number composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon

### show ip bgp community-list

This command shows the routes matching a community-list.

#### Syntax

**show ip bgp community-list** {1-99 | 100-500 | *community-list-name*}  
**[exact-match]**

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

*community-list-name* – Name of standard or expanded access list.  
(Maximum length: 32 characters, no spaces or other special characters)

**exact-match** – Displays only routes that match the specified communities exactly.

#### Command Mode

Privileged Exec

#### Example

```
Console#show ip bgp community-list rd
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop          Metric LocPrf Weight Path
*  100.1.1.0/24      0.0.0.0                      32768 700 800 i
*> 172.0.0.0/8       0.0.0.0                      32768 700 800 i
Console#
```



**show ip bgp dampening** This command shows dampened routes.

#### Syntax

**show ip bgp dampening {dampened-paths | flap-statistics | parameters}**

**dampened-paths** – Routes suppressed due to dampening.

**flap-statistics** – Statistics for flapping route prefixes.

**parameters** – Route dampening parameters.

#### Command Mode

Privileged Exec

#### Example

In the following example, “From” indicates the peer that advertised this path, while “Reuse” is the time after which the path will be made available.

```
Console#show ip bgp dampening dampened-paths
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          From          Reuse      Path
*d 100.1.3.0/24     10.1.1.64      00:27:40 100 ?

Total number of prefixes 1
Console#
```

In this example, “Duration” indicates the time since the first flap occurred.

```
Console#show ip bgp dampening flap-statistics
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          From          Flaps Duration Reuse      Path
*d 100.1.3.0/24     10.1.1.64      3      00:06:05 00:27:00 100 ?

Total number of prefixes 1
Console#
```

This example shows the dampening parameters configured on this router.

```
Console#show ip bgp dampening parameters
Dampening 15 750 2000 60
Reachability half-life time      :15 min
Reuse penalty                    :750
Suppress penalty                 :2000
Max suppress time                :60 min
Console#
```

Table 218: show ip bgp dampening parameters- display description

Field	Description
Reachability half-life time	The time after which a penalty is reduced. The penalty value is reduced to half of the previous value after the half-life time expires.
Reuse penalty	The point to which the penalty for a flapping route must fall before a route is unsuppressed.
Suppress penalty	The point at which to start suppressing a route.
Max suppress time	The maximum time a route can be suppressed.

**show ip bgp filter-list** This command shows routes matching the specified filter list.

### Syntax

**show ip bgp filter-list** *access-list-name*

*access-list-name* – Name of a list of autonomous system paths as defined by the [ip as-path access-list](#) command. (Maximum length: 16 characters, no spaces or other special characters)

### Command Mode

Privileged Exec

### Example

```
Console#show ip bgp filter-list rd
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop           Metric LocPrf Weight Path
*> 100.1.1.0/24      10.1.1.64              0             0 100 ?
Total number of prefixes 1
Console#
```

**show ip bgp neighbors** This command shows connection information for neighbor sessions.

### Syntax

**show ip bgp neighbors** [*ip-address* [**advertised-routes** | **received prefix-filter** | **received-routes** | **routes**]]

*ip-address* – IP address of the neighbor.

**advertised-routes** – Shows the routes advertised to a neighbor.

**received prefix-filter** – Shows the prefix-list (outbound route filter) sent from a neighbor.

**received-routes** – Shows all routes, both accepted and rejected, which have been received from a neighbor. To display all received routes from a neighbor, first enable soft reconfiguration with the **neighbor soft-reconfiguration inbound** command.

**routes** – Displays all accepted routes learned from a neighbor.

## Command Mode

### Privileged Exec

```

Console#show ip bgp neighbors 192.168.0.3
BGP neighbor is 192.168.0.3, remote AS 200, local AS 100, external link
Member of peer-group for session parameters
BGP version 4, remote router ID 192.168.0.3
BGP state = Established, up for 00:00:58
Last read 16:40:37, hold time is 180, keepalive interval is 60 seconds
Neighbor capabilities:
  4 Byte AS: advertised and received
  Route refresh: advertised and received (old & new)
  Address family IPv4 Unicast: advertised and received
Message statistics:
  Inq depth is 0
  Outq depth is 0

      Sent          Rcvd
Opens:              1            0
Notifications:     0            0
Updates:            1            1
Keepalives:         2            1
Route Refresh:      0            0
Capability:          0            0
Total:              4            2
Minimum time between advertisement runs is 30 seconds

For address family: IPv4 Unicast
Community attribute sent to this neighbor(both)
Inbound path policy configured
1 accepted prefixes

Connections established 1; dropped 0
Last reset never
Local host: 192.168.0.2, Local port: 179
Foreign host: 192.168.0.3, Foreign port: 3987
Next hop:
Read thread: on  Write thread: off

Console#

```

**Table 219: show ip bgp - display description**

Field	Description
BGP neighbor	IP address of neighbor.
remote AS	Autonomous system number of the neighbor.
local AS	Local autonomous system number.
external link	"external link" is displayed for external BGP neighbors. "internal link" is displayed for iBGP neighbors.
BGP version	BGP version used to communicate with remote router.

**Table 219: show ip bgp - display description** (Continued)

Field	Description
remote router ID	IP address of the neighbor.
BGP state	Stage of session negotiation.
Last read	Time since a message was last received from this neighbor.
hold time	Time to maintain the session with this neighbor without receiving a message.
keepalive interval	Interval at which keepalive messages are transmitted to this neighbor.
Neighbor capabilities	BGP capabilities advertised and received from this neighbor.
Message statistics	Statistics organized by message type.
Minimum time between advertisement runs	Time between transmission of advertisements.
For address family	Address family to which the following information refers.
Local host/port	IP address and TCP port of the local BGP speaker.
Foreign host/port	IP address and TCP port of the neighbor BGP speaker.
Nexthop	IP address of next system via which packets are forwarded to the destination network.
Read thread	The read status for the socket connection with this neighbor.
Write thread	The write status for the socket connection with this neighbor.

**show ip bgp paths** This command shows all paths in the database.

### Syntax

**show ip bgp paths**

### Command Mode

Privileged Exec

### Example

```
Console#show ip bgp paths
Address      RefCnt  ASpath
0x331dad0:0  1
0x331d850:93  1  600
0x331d8d8:249 2  200 300
Console#
```

**Table 220: show ip bgp paths - display description**

Field	Description
Address	Internal address in memory where the path is stored.
Refcnt	The number of routes using this path.
ASpath	The autonomous system path for this route.

**show ip bgp prefix-list** This command shows routes matching the specified prefix-list.

### Syntax

**show ip bgp prefix-list** *list-name*

*list-name* – Name of a prefix-list. The prefix list can be used to filter the networks to import or export as defined by the [match ip address prefix-list](#) command. (Range: 1-80 characters)

### Command Mode

Privileged Exec

### Example

```

Console#show ip bgp prefix-list rd
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop           Metric LocPrf Weight Path
*  100.1.1.0/24      10.1.1.66                0      200 300 ?
*>                 10.1.1.100              0      32768 ?
Console#

```

**show ip bgp regexp** This command shows routes matching the AS path regular expression.

### Syntax

**show ip bgp regexp** *regular-expression*

*regular-expression* – Regular expression indicating the path attributes to match. Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

### Command Mode

Privileged Exec

### Example

```
Console#show ip bgp regexp 100
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

      Network          Next Hop          Metric LocPrf Weight Path
*  100.1.1.0/24        10.1.1.64              0           0 500 100 600 ?
Console#
```

**show ip bgp route-map** This command shows routes matching the specified route map.

### Syntax

**show ip bgp route-map** *map-name*

*map-name* – Name of the route map as defined by the [route-map](#) command. The route map can be used to filter the networks to advertise. (Range: 1-80 characters)

### Command Mode

Privileged Exec

### Example

```
Console#show ip bgp route-map rd
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
               r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

      Network          Next Hop          Metric LocPrf Weight Path
*  100.1.1.0/24        10.1.1.64              0           0 500 100 600 ?
*> 10.1.1.68           10.1.1.68              0           0 300 ?
Console#
```

**show ip bgp scan** This command shows BGP scan status.

### Syntax

**show ip bgp scan**

### Command Mode

Privileged Exec

## Example

```
Console#show ip bgp scan
BGP scan is running
BGP scan interval is 60
Current BGP nexthop cache:
 10.10.10.64 valid [IGP metric 0]
BGP connected route:
 10.10.10.0/24
 10.10.11.0/24
Console#
```

**show ip bgp summary** This command shows summary information for all connections.

## Syntax

**show ip bgp summary**

## Command Mode

Privileged Exec

## Example

In the following example, “Up/Down” refers to the length of time the session has been in the Established state, or the current status if not in Established state.

```
Console#show ip bgp summary
BGP router identifier 192.168.0.2, local AS number 100
RIB entries 0
Peers 1
Peer groups 0
Neighbor      V  AS  MsgRcvd  MsgSent  TblVer  InQ  OutQ  Up/Down  State/PfxRcd
192.168.0.3    4  200    166     168      0     0     0 02:45:00      1

Total number of neighbors 1

Console#
```

**show ip community-list** This command shows routes permitted by a community list.

## Syntax

**show ip community-list** [1-99 | 100-500 | *community-list-name*]

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

*community-list-name* – Name of standard or expanded access list.  
(Maximum length: 32 characters, no spaces or other special characters)

## Command Mode

Privileged Exec

## Example

```
Console#show ip community-list rd
Named Community standard list rd
  permit 100:10
Console#
```

**show ip extcommunity-list** This command shows routes permitted by an extended community list.

## Syntax

**show ip extcommunity-list** [1-99 | 100-500 | *community-list-name*]

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

*community-list-name* – Name of standard or expanded access list.  
(Maximum length: 32 characters, no spaces or other special characters)

## Command Mode

Privileged Exec

## Example

```
Console#show ip extcommunity-list rd
Named extended community standard list rd
  permit RT:192.168.0.0:10
Console#
```

**show ip prefix-list** This command shows the specified prefix list.

## Syntax

**show ip prefix-list** [*prefix-list-name* [*ip-address netmask* [**first-match** | **longer**] | **seq** *sequence-number*]]

*prefix-list-name* – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

*ip-address* – An IPv4 address expressed in dotted decimal notation.

*netmask* – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

**first-match** – First matched prefix.

**longer** – All entries more specific than the specified network/mask.



*sequence-number* – The sequence number of an entry.  
(Range: 1-429496725)

### Command Mode

Privileged Exec

### Example

```
Console#show ip prefix-list rd
ip prefix-list rd: 1 entries
  seq 5 deny 10.0.0.0/8 ge 14 le 22
Console#
```

**show ip prefix-list detail** This command shows detailed information for the specified prefix list.

### Syntax

**show ip prefix-list detail** [*prefix-list-name*]

*prefix-list-name* – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

### Command Mode

Privileged Exec

### Example

```
Console#show ip prefix-list detail rd
ip prefix-list rd:
  count: 1, range entries: 0, sequences: 5 - 5
  seq 5 deny 10.0.0.0/8 ge 14 le 22 (hit count: 0, refcount: 0)
Console#
```

**show ip prefix-list summary** This command shows summary information for the specified prefix list.

### Syntax

**show ip prefix-list summary** [*prefix-list-name*]

*prefix-list-name* – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

### Command Mode

Privileged Exec

### Example

```
Console#show ip prefix-list summary rd
ip prefix-list rd:
  count: 1, range entries: 0, sequences: 5 - 5
Console#
```

## Policy-based Routing for BGP

This section describes commands used to configure policy-based routing (PBR) maps for Border Gateway Protocol (BGP).

Policy-based routing is performed before regular routing. PBR inspects traffic on the interface where the policy is applied and then, based on the policy, makes some decision. First, the traffic is “matched” according to the policy. Second, for each match, there is something “set.” What is set could be that the traffic matches must exit out a different interface, or the traffic could be given a higher priority, or it could choose to just drop that traffic.

Matching of the traffic is usually done with an ACL (access-control list) that is referenced by a route-map. In the route-map, if there is a “match” for the traffic defined in that ACL, then a “set” defines what the administrator wants to happen to that traffic (prioritize it, route it differently, drop it, or other actions). Policies can be based on IP address, port numbers, protocols, or size of packets.

If matching criteria is found and the specified action is to permit the packet, then it will be forwarded to the next hop based on policy-based routing. If the action is to deny the packet, normal unicast routing is used to determine the packet’s next hop, instead of using policy-based routing. If no matching criteria are found in the route map, normal unicast routing is used to determine the packet’s next hop. Although route redistribution is protocol-independent, some of the route-map match and set commands defined in this section are specific to BGP.

Like matches in the same route map subblock are filtered with “or” semantics. If any one match clause is matched in the entire route map subblock, this match is treated as a successful match. Dissimilar match clauses are filtered with “and” semantics. If the first set of conditions is not met, the second match clause is filtered. This process continues until a match occurs or there are no more match clauses.

A route map can have several sequences. A route that does not match at least one match command defined in a route-map will be ignored; that is, the route will not be advertised for outbound route maps nor accepted for inbound route maps.

**Table 221: Policy-based Routing Configuration Commands**

Command	Function	Mode
<code>route-map</code>	Enters route-map configuration mode, allowing route maps to be created or modified	GC
<code>call</code>	Jumps to another route map after match and set commands are executed	RM

**Table 221: Policy-based Routing Configuration Commands** (Continued)

Command	Function	Mode
<code>continue</code>	Goes to a route-map entry with a higher sequence number after a successful match occurs	RM
<code>description</code>	Creates a description of an entry in the route map	RM
<code>match as-path</code>	Sets an AS path access list to match	RM
<code>match community</code>	Sets a BGP community access list to match	RM
<code>match extcommunity</code>	Sets a BGP extended community access list to match	RM
<code>match ip address</code>	Specifies destination addresses to match in a standard access list, extended access list, or prefix list	RM
<code>match ip next-hop</code>	Specifies next hop addresses to match in a standard access list, extended access list, or prefix list	RM
<code>match ip route-source</code>	Specifies the source of routing messages to match in a standard access list, extended access list, or prefix list	RM
<code>match metric</code>	Sets the metric value to match in routing messages	RM
<code>match origin</code>	Sets the originating protocol to match in routing messages	RM
<code>match pathlimit as</code>	Sets the maximum AS path length for propagation of more specific prefixes to match in routing messages	RM
<code>match peer</code>	Sets the peer address to match in routing messages	RM
<code>on-match</code>	Sets the next entry to go to when this entry matches	RM
<code>set aggregator as</code>	Assigns an AS number and IP address to the aggregator attribute of a route	RM
<code>set as-path</code>	Modifies the AS path by prepending or excluding an AS number	RM
<code>set atomic-aggregate</code>	Indicates the loss of some information in the route aggregation process	RM
<code>set comm-list delete</code>	Removes communities from the community attribute of inbound or outbound routing messages	RM
<code>set community</code>	Sets the community attributes of routing messages	RM
<code>set extcommunity</code>	Sets the extended community attributes of routing messages	RM
<code>set ip next-hop</code>	Sets the next-hop for a routing message	RM
<code>set local-preference</code>	Sets the priority within the local AS for a routing message	RM
<code>set metric</code>	Sets the metric value of a route to external neighbors	RM
<code>set origin</code>	Sets the origin code for the routing protocol which generated this message	RM
<code>set originator-id</code>	Sets the IP address of the routing message's originator	RM
<code>set pathlimit ttl</code>	Sets the maximum AS path length for propagation of more specific prefixes in routing messages	RM
<code>set weight</code>	Sets the weight for routing messages	RM
<code>show route-map</code>	Shows the configuration setting for a route map	PE

**route-map** This command enters route-map configuration mode, allowing route maps to be created or modified. Use the **no** form to remove a route map.

### Syntax

**[no] route-map** *map-name* {**deny** | **permit**} *sequence-number*

*map-name* – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

**deny** – Route-map denies set operations.

**permit** – Route-map permits set operations.

*sequence-number* – Sequence to insert to or delete from existing route-map entry. (Range: 1-65535)

### Command Mode

Global Configuration

### Default Setting

Disabled

### Command Usage

- ◆ This command enters the route map configuration mode. In this mode, a new route map can be created, or an existing route map modified.
- ◆ The match commands specify the conditions under which policy routing occurs, and the set commands specify the routing actions to perform if the criteria enforced by the match commands are met.
- ◆ If the match criteria are met for a route map, and the permit keyword specified, the packet is policy routed based on defined set commands.
- ◆ If the match criteria are not met, and the permit keyword specified, the next route map with the same map-name is tested. If a route passes none of the match criteria for the set of route maps sharing the same name, it is not policy routed by that set.
- ◆ If the match criteria are met for the route map and the deny keyword specified, the packet is not policy routed, and no further route maps sharing the same map-name are examined. If the packet is not policy routed, the normal forwarding process is used.
- ◆ Processing for exceptions include the following results:
  - For a deny route-map, if it does not have a match clause, any routing message is matched, and therefore all routes are denied.
  - For a deny route-map which includes a match clause for an access-list, if the access-list does not exist, no routing message will be matched, and therefore all routes are skipped.

- For a permit route-map, if it does not have a match clause, any routing message is matched, and therefore all routes are permitted.
- For a permit route-map which includes a match clause for an access-list, if the access-list does not exist, no routing messages are matched, and therefore all routes are skipped.

### Example

```
Console(config)#route-map r1 permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**call** This command jumps to another route map after match and set commands are executed. Use the **no** form to remove an entry from a route map.

### Syntax

**call** *map-name*

**no call**

*map-name* – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

### Command Mode

Route Map

### Command Usage

Only one call clause is permitted per route map. The call clause executed only after all match and set commands are executed.

### Example

```
Console(config)#route-map r1 permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#call FD
Console(config-route-map)#
```

**continue** This command goes to a route-map entry with a higher sequence number after a successful match occurs. Use the **no** form to remove this entry from a route map.

### Syntax

**continue** [*sequence-number*]

**no continue**

*sequence-number* – Sequence number at which to continue processing. (Range: 1-65535)

## Command Mode

Route Map

## Command Usage

If no match statements precede the call entry, the call is automatically executed. If no sequence number is specified by the call entry, the next entry is executed.

## Example

```
Console(config)#route-map RD permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#continue 3
Console(config-route-map)#
```

**description** This command creates a description of an entry in the route map. Use the **no** form to remove the description.

## Syntax

**description** *text*

**no description**

*text* – Comment describing this route-map rule. (Maximum length: 128 characters, no spaces or other special characters)

## Command Mode

Route Map

## Example

```
Console(config)#route-map RD permit 1
Console(config-route-map)#description AS-Path rule
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match as-path** This command sets a BGP autonomous system path access list to match. Use the **no** form to remove this entry from a route map.

## Syntax

**[no] match as-path** *access-list-name*

*access-list-name* – Name of the access list. (Maximum length: 16 characters, no spaces or other special characters)

## Command Mode

Route Map

### Command Usage

The weights assigned by the **match as-path** and **set weight** route-map commands command override the weight assigned using the BGP **neighbor weight** command.

### Example

```
Console(config)#route-map RD permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

### Related Commands

[ip as-path access-list \(1063\)](#)

**match community** This command sets a BGP community access list to match. Use the **no** form to remove this entry from a route map.

### Syntax

**match community** {1-99 | 100-500 | *community-list-name*} [**exact-match**]

**no match community**

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

*community-list-name* – Name of standard or expanded community list.  
(Maximum length: 32 characters, no spaces or other special characters)

**exact-match** – Must exactly match the specified community list. All and only those communities specified must be present.

### Command Mode

Route Map

### Command Usage

This command matches the community attributes of the BGP routing message following the rules specified with the [ip community-list](#) command.

### Example

```
Console(config)#route-map RD permit 2
Console(config-route-map)#match community 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match extcommunity** This command sets a BGP extended community access list to match. Use the **no** form to remove this entry from a route map.

#### Syntax

**match extcommunity** {1-99 | 100-500} [**exact-match**]

**no match extcommunity**

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

#### Command Mode

Route Map

#### Command Usage

This command matches the extended community attributes of the BGP routing message following the rules specified with the [ip extcommunity-list](#) command.

#### Example

```
Console(config)#route-map RD permit 3
Console(config-route-map)#match extcommunity 160
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match ip address** This command specifies the destination addresses to be matched in a standard access list, an extended access list, or a prefix list. Use the **no** form to remove this entry from a route map.

#### Syntax

**match ip address** {*access-list-name* | **prefix-list** *prefix-list-name*}

**no match ip address**

*access-list-name* – Name of standard or extended access list.  
(Maximum length: 32 characters, no spaces or other special characters)

*prefix-list-name* – Name of a specific prefix list.

#### Command Mode

Route Map

#### Example

```
Console(config)#route-map RD permit 4
Console(config-route-map)#match ip address rd-addresses
Console(config-route-map)#set weight 30
Console(config-route-map)#
```



### Related Commands

[ip prefix-list \(1068\)](#)

[Access Control Lists \(383\)](#)

**match ip next-hop** This command specifies the next-hop addresses to be matched in a standard access list, an extended access list, or a prefix list. Use the **no** form to remove this entry from a route map.

### Syntax

**match ip next-hop** {*access-list-name* | **prefix-list** *prefix-list-name*}

**no match ip next-hop**

*access-list-name* – Name of standard or extended access list.  
(Maximum length: 32 characters, no spaces or other special characters)

*prefix-list-name* – Name of a specific prefix list.

### Command Mode

Route Map

### Command Usage

When inbound update messages are received from a neighbor, next-hop information contained in Network Layer Reachability Information (NLRI) entries is checked against the specified access-list or prefix-list before any routes are learned.

### Example

```
Console(config)#route-map RD permit 5
Console(config-route-map)#match ip next-hop rd-next-hops
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match ip route-source** This command specifies the source of routing messages advertised by routers and access servers to be matched in a standard access list, an extended access list, or a prefix list. Use the **no** form to remove this entry from a route map.

### Syntax

**match ip route-source** {*access-list-name* | **prefix-list** *prefix-list-name*}

**no match ip route-source** [*access-list-name* | **prefix-list**]

*access-list-name* – Name of standard or extended access list.  
(Maximum length: 32 characters, no spaces or other special characters)

*prefix-list-name* – Name of a specific prefix list.

### Command Mode

Route Map

### Command Usage

Note that there may be situations in which the next hop and source router address of the route are not the same.

### Example

```
Console(config)#route-map RD permit 6
Console(config-route-map)#match ip route-source rd-sources
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match metric** This command sets the metric value to match in routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**match metric** *metric-value*

**no match metric**

*metric-value* – The metric value in the routing messages.  
(Range: 0-4294967295)

### Command Mode

Route Map

### Example

```
Console(config)#route-map RD permit 7
Console(config-route-map)#match metric 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match origin** This command sets the originating protocol to match in routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**match origin** {**egp** | **igp** | **incomplete**}

**no match origin**

**egp** – Routes learned from exterior gateway protocols.

**igp** – Routes learned from internal gateway protocols.

**incomplete** – Routes of uncertain origin.

### Command Mode

Route Map

## Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match origin igp
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**match pathlimit as** This command sets the maximum AS path length allowed for propagation of more specific prefixes to match in routing messages. Use the **no** form to remove this entry from a route map.

## Syntax

**match pathlimit as** *as-limit*

**no match pathlimit as**

*as-limit* – Maximum AS path length. (Range: 1-4294967295)

## Command Mode

Route Map

## Command Usage

- ◆ To perform inter-domain traffic engineering, a multi-homed site can advertise its prefix to all of its neighbors via an aggregate address, and also advertise more specific prefixes to a subset of its neighbors. The longest match lookup algorithm then causes traffic for the more specific prefixes to be forwarded to the subset of neighbors with the more specific prefix.

These longer prefixes may be advertised in addition to an aggregate, even when the aggregate advertisement is sufficient for basic reachability. This type of inter-domain traffic engineering is a widely used phenomenon that is contributing to growth in the size of the global routing table.

Traffic engineering via longer prefixes is only effective when the longer prefixes have a different next hop from the less specific prefix. Thus, past the point where the next hops become identical, the longer prefixes provide no value whatsoever. This command can be used to limit the radius of propagation of more specific prefixes by adding a count of the ASes that may be traversed by the more specific prefix.

- ◆ Private AS numbers [RFC1930] and confederation AS members [RFC3065] found in the AS\_PATH are not counted. AS numbers found within an AS\_SET are not counted and an entire AS\_SET is counted as a single AS. Each instance of an AS number that appears multiple times in an AS\_PATH is counted.

If the AS\_PATHLIMIT attribute is attached to a prefix by a private AS, then when the prefix is advertised outside of the parent AS, the AS number contained in the AS\_PATHLIMIT attribute should be replaced by the AS number of the parent AS.

Similarly, if the AS\_PATHLIMIT attribute is attached to a prefix by a member of a confederation, then when the prefix is advertised outside of the confederation

boundary, then the AS number of the confederation member inside of the AS\_PATHLIMIT attribute should be replaced by the confederation's AS number.

### Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match pathlimit as 5
Console(config-route-map)#on match goto 20
Console(config-route-map)#
```

**match peer** This command sets the peer address to match in routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**match peer** {*peer-address* | **local**}

**no match peer** [*peer-address* | **local**]

*peer-address* – IP address of neighboring router sending routing messages.

**local** – Static or redistributed routes.

### Command Mode

Route Map

### Example

```
Console(config)#route-map RD permit 9
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

**on-match** This command sets the next entry to go to when this entry matches. Use the **no** form to remove this entry from a route map.

### Syntax

**on-match peer** {**goto** *sequence-number* | **next**}

**no on-match peer** {**goto** | **next**}

**goto** – On match, go to specified entry.

*sequence-number* – Route-map entry. (Range: 1-65535)

**next** – Go to next entry.

### Command Mode

Route Map

### Command Usage

Use this command when no set action is for a match clause.

### Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match pathlimit as 5
Console(config-route-map)#on match goto 20
Console(config-route-map)#
```

**set aggregator as** This command assigns an AS number and IP address to the aggregator attribute of a route. Use the **no** form to remove this entry from a route map.

### Syntax

**set aggregator as** *as-number ip-address*

**no set aggregator as** [*as-number ip-address*]

*as-number* – Autonomous system number. (Range: 1-4294967295)

*ip-address* – IP address of aggregator.

### Command Mode

Route Map

### Command Usage

Aggregate routes advertised to a neighbor contain an aggregator attribute. This attribute contains an AS number and IP address. The AS number is the creator's AS number (or confed ID in a confederation) and an IP address which is the creator's router-id. The **set aggregator as** command can be used to overwrite the aggregator attribute in routes created locally with the [aggregate-address](#) command, or in routes learned from a neighbor which already carry an aggregator attribute, or to add a new aggregator attribute to a route which has no aggregator attribute.

### Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match pathlimit as 5
Console(config-route-map)#set aggregator 1 192.168.0.0
Console(config-route-map)#
```

**set as-path** This command modifies the AS path by prepending or excluding an AS number. Use the **no** form to remove this entry from a route map.

### Syntax

**set as-path** {**exclude** | **prepend**} *as-number...*

**no set as-path** {**exclude** | **prepend**}

**exclude** – Removes one or more autonomous system numbers from the AS path of the route that is matched.

**prepend** – Appends one or more autonomous system numbers to the AS path of the route that is matched.

*as-number* – Autonomous system number. (Range: 1-4294967295)

### Command Mode

Route Map

### Command Usage

Note that best path selection may be influenced with this command by varying the length of the autonomous system path.

### Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set as-path prepend 2
Console(config-route-map)#
```

**set atomic-aggregate** This command indicates the loss of some information in the route aggregation process. Use the **no** form to remove this entry from a route map.

### Syntax

[no] **set atomic-aggregate**

### Command Mode

Route Map

### Command Usage

The purpose of the atomic-aggregate attribute is to alert BGP speakers along the path that some information have been lost due to the route aggregation process and that the aggregate path might not be the best path to the destination. This attribute should be set when the BGP speaker advertises ONLY the less-specific prefix and suppresses more specific ones.

### Example

```
Console(config)#route-map RD permit 9
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set atomic-aggregate
Console(config-route-map)#
```

**set comm-list delete** This command removes communities from the community attribute of inbound or outbound routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**[no] set comm-list** {1-99 | 100-500 | *community-list-name*} [**delete**]

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

*community-list-name* – Name of standard or expanded community list.  
(Maximum length: 32 characters, no spaces or other special characters)

### Command Mode

Route Map

### Command Usage

When using the [ip community-list](#) command to configure a community access list, each entry of a standard community list should list only one community.

Otherwise, the **set comm-list delete** command will not succeed. For example, in order to be able to delete communities 100 and 200, you must create two separate entries with the [ip community-list](#) command.

### Example

```
Console(config)#route-map RD permit 10
Console(config-route-map)#match peer 192.168.0.77
Console(config-route-map)#set comm-list 10:01 delete
Console(config-route-map)#exit
Console(config)#route-map RD permit 11
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set comm-list 20:01 delete
Console(config-route-map)#
```

**set community** This command sets the community attributes of routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**set community**

[*AA:NN...*]

[**additive** [*AA:NN...*] [**internet**] [**local-as**] [**no-advertise**] [**no-export**]]

[**internet** [*AA:NN...*] [**local-as**] [**no-advertise**] [**no-export**]]

[**local-as** [*AA:NN...*] [**no-advertise**] [**no-export**]]

[**no-advertise** [*AA:NN...*] [**no-export**]]

[**no-export** [*AA:NN...*]]

[**none**]

**no set community**

**AA:NN** – Standard community-number. The 4-byte community number is composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon. Each 2-byte number can range from 0 to 65535. One or more communities can be entered, separated by a space. Up to 16 community numbers are supported.

**additive** – Adds community attributes to already existing community attributes.

**internet** – Specifies the entire Internet. Routes with this community attribute are advertised to all internal and external peers.

**local-as** – Specifies the local autonomous system. Routes with this community attribute are advertised only to peers that are part of the local autonomous system or to peers within a sub-autonomous system of a confederation. These routes are not advertised to external peers or to other sub-autonomous systems within a confederation.

**no-advertise** – Routes with this community attribute are not advertised to any internal or external peer.

**no-export** – Routes with this community attribute are advertised only to peers in the same autonomous system or to other sub-autonomous systems within a confederation. These routes are not advertised to external peers.

**none** – Delete the community attributes from the prefix of this route.

## Command Mode

### Route Map

### Example

```
Console(config)#route-map RD permit 11
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set community 10:01
Console(config-route-map)#exit
Console(config)#route-map RD permit 12
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set community 20:01
Console(config-route-map)#
```

## Related Commands

[set comm-list delete \(1143\)](#)



**set extcommunity** This command sets the extended community attributes of routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**set extcommunity** {**rt** *extended-community-value* |  
**soo** *extended-community-value*}

**no set extcommunity** [**rt** | **soo**]

**rt** – The route target extended community attribute.

**soo** – The site of origin extended community attribute.

*extended-community-value* – The route target or site of origin in one of the following formats:

*AAAA:NN* or *AA:NNNN* – Community-number to deny or permit. The community number can either be formatted as a 4-byte autonomous system number and a 2-byte network number, or as a 2-byte autonomous system number and a 4-byte network number, separated by one colon. Each 2-byte number can range from 0 to 65535, and 4-byte numbers from 0 to 4294967295.

*IP:NN* – Community to deny or permit. The community number is composed of a 4-byte IP address (representing the autonomous system number) and a 2-byte network number, separated by one colon. The 2-byte network number can range from 0 to 65535.

One or more community numbers can be entered, separated by a space. Up to 3 community numbers are supported.

### Command Mode

Route Map

### Command Usage

- ◆ Using the **rt** keyword to specify new route targets replaces existing route targets.
- ◆ The route target (RT) attribute is used to identify sites that may receive routes tagged with a specific route target. Using this attribute allows that route to be placed in per-site forwarding tables used for routing traffic received from the corresponding sites.
- ◆ The site of origin (SOO) attribute is used to identify the site from which the provider edge (PE) router learned the route. All routes learned from a particular site are assigned the same site of origin attribute, no matter if a site is connected to a single PE router or multiple PE routers. Filtering based on this extended community attribute can prevent routing loops from occurring when a site is multi-homed.

### Example

```
Console(config)#route-map RD permit 13
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set extcommunity 100:0 192.168.1.1:1
Console(config-route-map)#
```

**set ip next-hop** This command sets the next-hop for a routing message. Use the **no** form to remove this entry from a route map.

### Syntax

**set ip next-hop** {*ip-address* | **peer-address**}

**no set ip next-hop** [*ip-address*]

*ip-address* – An IPv4 address of the next hop, expressed in dotted decimal notation.

**peer-address** – Sets the next hop as the BGP peering address.

### Command Mode

Route Map

### Command Usage

- ◆ The IP address specified as the next hop need not be an adjacent router.
- ◆ When this command is used with the **peer-address** keyword in an inbound route map received from a BGP peer, the next hop of the received matching routes are set to be the neighbor peer address, overriding any other next hops.
- ◆ When this command is used with the **peer-address** keyword in an outbound route map for a BGP peer, the next hop of the advertised matching routes will be set to be the peering address of the local router, thus disabling next hop calculation. This command therefore has finer granularity than the [neighbor next-hop-self](#) command, because it can set the next hop for some routes, but not others. While the [neighbor next-hop-self](#) command sets the next hop for all routes sent to the specified neighbor(s).

### Example

```
Console(config)#route-map RD permit 14
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set ip next-hop 192.168.0.254
Console(config-route-map)#
```

**set local-preference** This command sets the priority within the local AS for a routing message. Use the **no** form to remove this entry from a route map.

### Syntax

**set local-preference** *preference*

**no set local-preference**

*preference* – Degree of preference iBGP peers give local routes during BGP best path selection. The higher the value, the more the route is to be preferred. (Range: 1-4294967295)

### Command Mode

Route Map

### Command Usage

- ◆ The preference is sent only to routers in the local autonomous system. To specify the metric for inter-autonomous systems, use the [set metric](#) command.
- ◆ A route with a higher local priority level when compared with other routes to the same destination will be preferred over other routes.

### Example

```
Console(config)#route-map RD permit 15
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set local-preference 2
Console(config-route-map)#
```

**set metric** This command sets the metric value of a route to external neighbors. Use the **no** form to restore the default value.

### Syntax

**set metric** [+ | -]*metric-value*

**no set metric**

*metric-value* – Metric value assigned to all external routes for the specified protocol. (Range: 0-4294967295)

### Default Setting

The dynamically learned metric value.

### Command Mode

Route Map

### Command Usage

- ◆ Lower metric values indicate a higher priority.

- ◆ This command can modify the current metric for a route using the "+" or "-" keywords.
- ◆ The metric applies to external routers in the inter-autonomous system. To specify the metric for the local AS, use the [set local-preference](#) command.
- ◆ This path metric is normally only compared with neighbors in the local AS. To extend the comparison to paths advertised from neighbors in different autonomous systems, use the [bgp always-compare-med](#) command.

### Example

```
Console(config)#route-map RD permit 16
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set metric +1
Console(config-route-map)#
```

**set origin** This command sets the BGP origin code for the routing protocol which generated this message. Use the **no** form to remove this entry from a route map.

### Syntax

**set origin {egp | igp | incomplete}**

**no set origin**

**egp** – Exterior gateway protocols.

**igp** – Interior gateway protocols.

**incomplete** – Route origin unknown.

### Default Setting

As indicated in main IP routing table

### Command Mode

Route Map

### Command Usage

EGP is an inter-domain routing protocol which has been superseded by BGP. IGP indicates any intra-domain routing protocol such as RIP or OSPF.

### Example

```
Console(config)#route-map RD permit 16
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set origin egp
Console(config-route-map)#
```

**set originator-id** This command sets the IP address of the routing message's originator. Use the **no** form to remove this entry from a route map.

#### Syntax

**set originator-id** *ip-address*

**no set originator-id**

*ip-address* – An IPv4 address of the route source, expressed in dotted decimal notation.

#### Command Mode

Route Map

#### Command Usage

This attribute is commonly used for loop prevention by rejecting updates that contain the receiving router's own router-ID in the originator-ID attribute.

#### Example

```
Console(config)#route-map RD permit 17
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set originator-id 192.168.0.254
Console(config-route-map)#
```

**set pathlimit ttl** This command sets the maximum AS path length for propagation of more specific prefixes in routing messages. Use the **no** form to remove this entry from a route map.

#### Syntax

**set pathlimit ttl** *tvl-value*

**no set pathlimit ttl**

*tvl-value* – Maximum number of router hops allowed in an AS path.  
(Range: 1-255)

#### Command Mode

Route Map

#### Command Usage

Due to the dynamic changes in connections for network paths, it is not advisable to restrict the number of router hops for any path. However, if the connections to the destination network are relatively stable, the hop count can be restricted to force traffic to follow an alternate path. This method may be used to avoid less heavily congested paths or to route traffic through a preferred provider.

### Example

```
Console(config)#route-map RD permit 18
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set pathlimit ttl 255
Console(config-route-map)#
```

**set weight** This command sets the weight for routing messages. Use the **no** form to remove this entry from a route map.

### Syntax

**set weight** *weight*

**no set weight**

*weight* – The weight assigned to this route. (Range: 0-4294967295)

### Command Mode

Route Map

### Command Usage

- ◆ Weights are used to determine the best path available to the local switch. The route with the highest weight gets preference over other routes to the same network.
- ◆ Weights assigned using this command override those assigned by the [neighbor weight](#) command.

### Example

```
Console(config)#route-map RD permit 19
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set weight 255
Console(config-route-map)#
```

**show route-map** This command shows the configuration setting for a route map.

### Syntax

**show route-map** [*map-name*]

*map-name* – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

### Command Mode

Privileged Exec

### Example

```
Console#show route-map RD
route-map RD, permit, sequence 1
  Match clauses:
    peer 102.168.0.99
  Set clauses:
    comm-list 100 delete
  Call clause:
  Action:
    Exit routemap
Console#
```





# Multicast Routing Commands

Multicast routers can use various kinds of multicast routing protocols to deliver IP multicast packets across different subnetworks. This router supports Protocol Independent Multicasting (PIM). (Note that IGMP will be enabled for any interface that is using multicast routing.)

**Table 222: Multicast Routing Commands**

Command Group	Function
<a href="#">General Multicast Routing</a>	Enables IP multicast routing globally; also displays the IP multicast routing table created from static and dynamic routing information
<a href="#">Static Multicast Routing</a>	Configures static multicast router ports
<a href="#">PIM Multicast Routing</a>	Configures global and interface settings for PIM-DM and PIM-SM

## General Multicast Routing

This section describes commands used to configure multicast routing globally on the switch.

**Table 223: General Multicast Routing Commands**

Command	Function	Mode
<i>IPv4 Commands</i>		
<a href="#">ip multicast-routing</a>	Enables IPv4 multicast routing	GC
<a href="#">show ip mroute</a>	Shows the IPv4 multicast routing table	PE
<i>IPv6 Commands</i>		
<a href="#">ipv6 multicast-routing</a>	Enables IPv6 multicast routing	GC
<a href="#">show ipv6 mroute</a>	Shows the IPv6 multicast routing table	PE

## IPv4 Commands

**ip multicast-routing** This command enables IPv4 multicast routing. Use the **no** form to disable IP multicast routing.

### Syntax

**[no] ip multicast-routing**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ This command is used to enable IPv4 multicast routing globally for the router. A specific multicast routing protocol also needs to be enabled on the interfaces that will support multicast routing using the [router pim](#) command, and then specify the interfaces that will support multicast routing using the [ip pim dense-mode](#) or [ip pim sparse-mode](#) commands.
- ◆ To use multicast routing, IGMP proxy can not enabled on any interface of the device (see [ip igmp proxy](#) on [page 758](#)).

### Example

```
Console(config)#ip multicast-routing
Console(config)#
```

**show ip mroute** This command displays the IPv4 multicast routing table.

### Syntax

**show ip mroute** [*group-address source*] [**summary**]

*group-address* - An IPv4 multicast group address with subscribers directly attached or downstream from this router.

*source* - The IPv4 subnetwork at the root of the multicast delivery tree. This subnetwork contains a known multicast source.

**summary** - Displays summary information for each entry in the IP multicast routing table.

### Command Mode

Privileged Exec

### Command Usage

This command displays information for multicast routing. If no optional parameters are selected, detailed information for each entry in the multicast address table is displayed. If you select a multicast group and source pair, detailed information is displayed only for the specified entry. If the **summary** option is selected, an abbreviated list of information for each entry is displayed on a single line.

### Example

This example shows detailed multicast information for a specified group/source pair

```

Console#show ip mroute 224.0.255.3 192.111.46.8

IP Multicast Forwarding is enabled.

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, s - SSM Channel, C - Connected, P - Pruned,
      F - Register flag, R - RPT-bit set, T - SPT-bit set, J - Join SPT
Interface state: F - Forwarding, P - Pruned, L - Local

(192.168.2.1, 224.0.17.17), uptime 00:00:05
Owner: PIM-DM, Flags: D
Incoming Interface: VLAN2, RPF neighbor: 192.168.2.1
Outgoing Interface List:
VLAN1(F)

Console#

```

**Table 224: show ip mroute - display description**

Field	Description
Flags	<p>The flags associated with this entry:</p> <ul style="list-style-type: none"> <li>◆ D (Dense) - PIM Dense mode in use.</li> <li>◆ S (Sparse) - PIM Sparse mode in use.</li> <li>◆ s (SSM) - A multicast group with the range of IP addresses used for PIM-SSM.</li> <li>◆ C (Connected) - A member of the multicast group is present on this interface.</li> <li>◆ P (Pruned) - This route has been terminated.</li> <li>◆ F (Register flag) - This device is registering for a multicast source.</li> <li>◆ R (RP-bit set) - The (S,G) entry is pointing to the Rendezvous Point (RP), which normally indicates a pruned state along the shared tree for a particular source.</li> <li>◆ T (SPT-bit set) - Multicast packets have been received from a source on the shortest path tree.</li> <li>◆ J (Join SPT) - The rate of traffic arriving over the shared tree has exceeded the SPT-threshold for this group. If the SPT flag is set for (*,G) entries, the next (S,G) packet received will cause the router to join the shortest path tree. If the SPT flag is set for (S,G), the router immediately joins the shortest path tree.</li> </ul>
Interface state	The multicast state for the displayed interface.
group address	IP multicast group address for a requested service.
source	Subnetwork containing the IP multicast source.
uptime	The time elapsed since this entry was created.
Owner	The associated multicast protocol (PIM).

Table 224: show ip mroute - display description (Continued)

Field	Description
Incoming Interface	Interface leading to the upstream neighbor. PIM creates a multicast routing tree based on the unicast routing table. If the related unicast routing table does not exist, PIM will still create a multicast routing entry, but displays "Null" for the upstream interface to indicate that the unicast routing table is not valid. This field may also display "Register" to indicate that a pseudo interface is being used to send or receive PIM-SM register packets.
RPF neighbor	IP address of the multicast router immediately upstream for this group.
Outgoing interface list and flags	The interface(s) on which multicast subscribers have been recorded. The flags associated with each interface indicate: <ul style="list-style-type: none"><li>♦ F (Register flag) - This device is registering for a multicast source.</li><li>♦ P (Pruned) - This route has been terminated.</li><li>♦ L (Local) - Downstream interface has received IGMP report message from host in this subnet.</li></ul>

This example lists all entries in the multicast table in summary form:

```
Console#show ip mroute summary

IP Multicast Forwarding is enabled

IP Multicast Routing Table (Summary)
Flags: F - Forwarding, P - Pruned
-----
   Group          Source      Source Mask      Interface  Owner      Flags
-----
   224.0.17.17    192.168.2.1  255.255.255.255  VLAN2      PIM-DM     F
Total Entry is 1

Console#
```

## IPv6 Commands

**ipv6 multicast-routing** This command enables IPv6 multicast routing. Use the **no** form to disable IP multicast routing.

### Syntax

**[no] ipv6 multicast-routing**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ♦ This command is used to enable IPv6 multicast routing globally for the router. A multicast routing protocol also needs to be enabled on the interfaces that

will support multicast routing using the `router pim6` command, and then specify the interfaces that will support multicast routing using the `ipv6 pim` command.

- ◆ To use multicast routing, MLD proxy can not enabled on any interface of the device (see `ipv6 mld proxy` on page 769).

### Example

```
Console(config)#ipv6 multicast-routing
Console(config)#
```

**show ipv6 mroute** This command displays the IPv6 multicast routing table.

### Syntax

**show ipv6 mroute** [*group-address source*] [**summary**]

*group-address* - An IPv6 multicast group address with subscribers directly attached or downstream from this router.

*source* - The IPv6 subnetwork at the root of the multicast delivery tree. This subnetwork contains a known multicast source.

**summary** - Displays summary information for each entry in the IP multicast routing table.

### Command Mode

Privileged Exec

### Command Usage

This command displays information for multicast routing. If no optional parameters are selected, detailed information for each entry in the multicast address table is displayed. If you select a multicast group and source pair, detailed information is displayed only for the specified entry. If the **summary** option is selected, an abbreviated list of information for each entry is displayed on a single line.

### Example

This example shows detailed multicast information for a specified group/source pair

```
Console#show ipv6 mroute FF02::0101 FE80::0202

IP Multicast Forwarding is enabled.

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, s - SSM Channel, C - Connected, P - Pruned,
       F - Register flag, R - RPT-bit set, T - SPT-bit set, J - Join SPT
Interface state: F - Forwarding, P - Pruned, L - Local

(FF02::0101, FE80::0202), uptime 00:00:05
Owner: PIM-DM, Flags: D
```

```
Incoming Interface: VLAN2, RPF neighbor: FE80::0303
Outgoing Interface List:
VLAN1 (F)
Console#
```

**Table 225: show ip mroute - display description**

Field	Description
Flags	<p>The flags associated with this entry:</p> <ul style="list-style-type: none"> <li>◆ D (Dense) - PIM Dense mode in use.</li> <li>◆ S (Sparse) - PIM Sparse mode in use.</li> <li>◆ s (SSM) - A multicast group with the range of IP addresses used for PIM-SSM.</li> <li>◆ C (Connected) - A member of the multicast group is present on this interface.</li> <li>◆ P (Pruned) - This route has been terminated.</li> <li>◆ F (Register flag) - This device is registering for a multicast source.</li> <li>◆ R (RP-bit set) - The (S,G) entry is pointing to the Rendezvous Point (RP), which normally indicates a pruned state along the shared tree for a particular source.</li> <li>◆ T (SPT-bit set) - Multicast packets have been received from a source on the shortest path tree.</li> <li>◆ J (Join SPT) - The rate of traffic arriving over the shared tree has exceeded the SPT-threshold for this group. If the SPT flag is set for (*,G) entries, the next (S,G) packet received will cause the router to join the shortest path tree. If the SPT flag is set for (S,G), the router immediately joins the shortest path tree.</li> </ul>
Interface state	The multicast state for the displayed interface.
group address	IP multicast group address for a requested service.
source	Subnetwork containing the IP multicast source.
Uptime	The time elapsed since this entry was created.
Owner	The associated multicast protocol (PIM).
Incoming Interface	<p>Interface leading to the upstream neighbor.</p> <p>PIM creates a multicast routing tree based on the unicast routing table. If the related unicast routing table does not exist, PIM will still create a multicast routing entry, but displays "Null" for the upstream interface to indicate that the unicast routing table is not valid. This field may also display "Register" to indicate that a pseudo interface is being used to send or receive PIM-SM register packets.</p>
RPF neighbor	IP address of the multicast router immediately upstream for this group.
Outgoing interface list and flags	<p>The interface(s) on which multicast subscribers have been recorded. The flags associated with each interface indicate:</p> <ul style="list-style-type: none"> <li>◆ F (Register flag) - This device is registering for a multicast source.</li> <li>◆ P (Pruned) - This route has been terminated.</li> <li>◆ L (Local) - Downstream interface has received IGMP report message from host in this subnet.</li> </ul>

This example lists all entries in the multicast table in summary form:

```

Console#show ipv6 mroute summary

IP Multicast Forwarding is disabled

IP Multicast Routing Table (Summary)
Flags: F - Forwarding, P - Pruned, D - PIM-DM, S - PIM-SM, V - DVMRP,
       M - MLD
Group                                Source                                Interface  Flag
-----
Total Entry is 1
Console#

```

## Static Multicast Routing

This section describes commands used to configure static multicast routes on the switch.

**Table 226: Static Multicast Routing Commands**

Command	Function	Mode
<code>ip igmp snooping vlan mrouter</code>	Adds a multicast router port	GC
<code>show ip igmp snooping mrouter</code>	Shows multicast router ports	PE

**ip igmp snooping vlan mrouter** This command statically configures a multicast router port. Use the **no** form to remove the configuration.

### Syntax

**ip igmp snooping vlan** *vlan-id* **mrouter** *interface*

**no ip igmp snooping vlan** *vlan-id* **mrouter** *interface*

*vlan-id* - VLAN ID (Range: 1-4094)

*interface*

**ethernet** *unit/port*

*unit* - Unit identifier. (Range: 1-8)

*port* - Port number. (Range: 1-28)

**port-channel** *channel-id* (Range: 1-16)

### Default Setting

No static multicast router ports are configured.

### Command Mode

Global Configuration

### Command Usage

Depending on your network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router/switch connected over the network to an interface (port or trunk) on your router, you can manually configure that interface to join all the current multicast groups.

### Example

The following shows how to configure port 11 as a multicast router port within VLAN 1:

```
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11
Console(config)#
```

### **show ip igmp snooping mrouter**

This command displays information on statically configured and dynamically learned multicast router ports.

### Syntax

**show ip igmp snooping mrouter** [*vlan vlan-id*]

*vlan-id* - VLAN ID (Range: 1-4094)

### Default Setting

Displays multicast router ports for all configured VLANs.

### Command Mode

Privileged Exec

### Command Usage

Multicast router port types displayed include Static or Dynamic.

### Example

The following shows that port 11 in VLAN 1 is attached to a multicast router:

```
Console#show ip igmp snooping mrouter vlan 1
VLAN M'cast Router Ports Type
-----
  1                Eth 1/11  Static
  2                Eth 1/12  Dynamic
Console#
```



## PIM Multicast Routing

This section describes the PIM commands used for IPv4 and IPv6. Note that PIM can run on an IPv4 network and PIM6 on an IPv6 network simultaneously. Also note that Internet Group Management Protocol (IGMP) is used for IPv4 networks and Multicast Listener Discovery (MLD) for IPv6 networks.

**Table 227: IPv4 and IPv6 PIM Commands**

Command Group	Function
IPv4 PIM Commands	Configures multicast routing for IPv4 PIM.
IPv6 PIM Commands	Configures multicast routing for IPv6 PIM.

**IPv4 PIM Commands** This section describes commands used to configure IPv4 PIM-DM and PIM-SM dynamic multicast routing on the switch.

**Table 228: PIM-DM and PIM-SM Multicast Routing Commands**

Command	Function	Mode
<i>Shared Mode Commands</i>		
<code>router pim</code>	Enables IPv4 PIM globally for the router	GC
<code>ip pim</code>	Enables PIM-DM or PIM-SM on the specified interface	IC
<code>ip pim hello-holdtime</code>	Sets the time to wait for hello messages from a neighboring PIM router before declaring it dead	IC
<code>ip pim hello-interval</code>	Sets the interval between sending PIM hello messages	IC
<code>ip pim join-prune-holdtime</code>	Configures the hold time for the prune state	IC
<code>ip pim lan-prune-delay</code>	Informs downstream routers of the delay before it prunes a flow after receiving a prune request	IC
<code>ip pim override-interval</code>	Specifies the time it takes a downstream router to respond to a lan-prune-delay message	IC
<code>ip pim propagation-delay</code>	Configures the propagation delay required for a LAN prune delay message to reach downstream routers	IC
<code>ip pim trigger-hello-delay</code>	Configures the trigger hello delay	IC
<code>show ip pim interface</code>	Displays information about interfaces configured for PIM	NE, PE
<code>show ip pim neighbor</code>	Displays information about PIM neighbors	NE, PE
<i>PIM-DM Commands</i>		
<code>ip pim graft-retry-interval</code>	Configures the time to wait for a Graft acknowledgement before resending a Graft message	IC
<code>ip pim max-graft-retries</code>	Configures the maximum number of times to resend a Graft message if it has not been acknowledged	IC
<code>ip pim state-refresh origination-interval</code>	Sets the interval between PIM-DM state refresh control messages	IC

**Table 228: PIM-DM and PIM-SM Multicast Routing Commands** (Continued)

Command	Function	Mode
<i>PIM-SM Commands</i>		
<code>ip pim bsr-candidate</code>	Configures the switch as a Bootstrap Router (BSR) candidate	GC
<code>ip pim register-rate-limit</code>	Configures the rate at which register messages are sent by the Designated Router (DR)	GC
<code>ip pim register-source</code>	Configure the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) leading toward the rendezvous point (RP)	GC
<code>ip pim rp-address</code>	Sets a static address for the rendezvous point	GC
<code>ip pim rp-candidate</code>	Configures the switch rendezvous point (RP) candidate	GC
<code>ip pim spt-threshold</code>	Prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode	GC
<code>ip pim dr-priority</code>	Sets the priority value for a DR candidate	IC
<code>ip pim join-prune-interval</code>	Sets the join/prune timer	IC
<code>clear ip pim bsr rp-set</code>	Clears RP entries learned through the BSR	PE
<code>show ip pim bsr-router</code>	Displays information about the BSR	PE
<code>show ip pim rp mapping</code>	Displays active RPs and associated multicast routing entries	PE
<code>show ip pim rp-hash</code>	Displays the RP used for the specified multicast group	PE

## PIM Shared Mode Commands

**router pim** This command enables IPv4 Protocol-Independent Multicast routing globally on the router. Use the **no** form to disable PIM multicast routing.

### Syntax

**[no] router pim**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ This command enables PIM-DM and PIM-SM globally for the router. You also need to enable PIM-DM or PIM-SM for each interface that will support multicast routing using the `ip pim dense-mode` or `ip pim sparse mode` command, and make any changes necessary to the multicast protocol parameters.
- ◆ To use multicast routing, IGMP proxy cannot be enabled on any interface of the device (see the `ip igmp proxy` command).

### Example

```

Console(config)#router pim
Console(config)#exit
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
  PIM Mode           :      Dense Mode
  IP Address          :      192.168.0.2
  Hello Interval      :      30 sec
  Hello HoldTime      :      105 sec
  Triggered Hello Delay :      5 sec
  Join/Prune Holdtime :      210 sec
  Lan Prune Delay     :      Disabled
  Propagation Delay   :      500 ms
  Override Interval   :      2500 ms
  Graft Retry Interval :      3 sec
  Max Graft Retries   :      3
  State Refresh Ori Int :      60 sec

Console#

```

**ip pim** This command enables PIM-DM or PIM-SM on the specified interface. Use the **no** form to disable PIM-DM or PIM-SM on this interface.

### Syntax

**[no] ip pim {dense-mode | sparse-mode}**

**dense-mode** - Enables PIM Dense Mode.

**sparse-mode** - Enables PIM Sparse Mode.

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ To fully enable PIM, you need to enable multicast routing globally for the router with the [ip multicast-routing](#) command, enable PIM globally for the router with the [router pim](#) command, and also enable PIM-DM or PIM-SM for each interface that will participate in multicast routing with this command.
- ◆ If you enable PIM on an interface, you should also enable IGMP on that interface. PIM mode selection determines how the switch populates the multicast routing table, and how it forwards packets received from directly connected LAN interfaces. Dense mode interfaces are always added to the multicast routing table. Sparse mode interfaces are added only when periodic join messages are received from downstream routers, or a group member is directly connected to the interface.

- ◆ Dense-mode interfaces are subject to multicast flooding by default, and are only removed from the multicast routing table when the router determines that there are no group members or downstream routers, or when a prune message is received from a downstream router.
- ◆ Sparse-mode interfaces forward multicast traffic only if a join message is received from a downstream router or if group members are directly connected to the interface. When routers want to receive a multicast flow, they periodically send join messages to the Rendezvous Point (RP), and are subsequently added to the shared path for the specified flow back up to the RP. If routers want to join the source path up through the Shortest Path Source Tree (SPT), they periodically send join messages toward the source. They also send prune messages toward the RP to prune the shared path if they have already connected to the source through the SPT, or if there are no longer any group members connected to the interface.

### Example

```
Console(config)#interface vlan 1
Console(config-if)#ip pim dense-mode
Console(config-if)#end
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
PIM Mode           :      Dense Mode
IP Address          :      192.168.0.2
Hello Interval      :      30 sec
Hello HoldTime      :      105 sec
Triggered Hello Delay :      5 sec
Join/Prune Holdtime :      210 sec
Lan Prune Delay      :      Disabled
Propagation Delay    :      500 ms
Override Interval    :      2500 ms
Graft Retry Interval :      3 sec
Max Graft Retries    :      3
State Refresh Ori Int :      60 sec

Console#
```

**ip pim hello-holdtime** This command configures the interval to wait for hello messages from a neighboring PIM router before declaring it dead. Use the **no** form to restore the default value.

### Syntax

**ip pim hello-holdtime** *seconds*

**no ip pim hello-interval**

*seconds* - The hold time for PIM hello messages. (Range: 1-65535)

### Default Setting

105 seconds

**Command Mode**

Interface Configuration (VLAN)

**Command Usage**

The **ip pim hello-holdtime** should be greater than the value of **ip pim hello-interval**.

**Example**

```
Console(config-if)#ip pim hello-holdtime 210
Console(config-if)#
```

**ip pim hello-interval** This command configures the frequency at which PIM hello messages are transmitted. Use the **no** form to restore the default value.

**Syntax**

**ip pim hello-interval** *seconds*

**no pim hello-interval**

*seconds* - Interval between sending PIM hello messages. (Range: 1-65535)

**Default Setting**

30 seconds

**Command Mode**

Interface Configuration (VLAN)

**Command Usage**

Hello messages are sent to neighboring PIM routers from which this device has received probes, and are used to verify whether or not these neighbors are still active members of the multicast tree.

**Example**

```
Console(config-if)#ip pim hello-interval 60
Console(config-if)#
```

**ip pim join-prune-holdtime** This command configures the hold time for the prune state. Use the **no** form to restore the default value.

**Syntax**

**ip pim join-prune-holdtime** *seconds*

**no ip pim join-prune-holdtime**

*seconds* - The hold time for the prune state. (Range: 0-65535)

### Default Setting

210 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

The multicast interface that first receives a multicast stream from a particular source forwards this traffic to all other PIM interfaces on the router. If there are no requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The prune state is maintained until the join-prune-holdtime timer expires or a graft message is received for the forwarding entry.

### Example

```
Console(config-if)#ip pim join-prune-holdtime 60
Console(config-if)#
```

### **ip pim lan-prune-delay**

This command causes this device to inform downstream routers of how long it will wait before pruning a flow after receiving a prune request. Use the **no** form to disable this feature.

### Syntax

**[no] ip pim lan-prune-delay**

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ When other downstream routers on the same VLAN are notified that this upstream router has received a prune request, they must send a Join to override the prune before the prune delay expires if they want to continue receiving the flow. The message generated by this command effectively prompts any downstream neighbors with hosts receiving the flow to reply with a Join message. If no join messages are received after the prune delay expires, this router will prune the flow.
- ◆ Prune delay is the sum of the effective propagation-delay and effective override-interval, where effective propagation-delay is the largest propagation-delay from those advertised by each neighbor (including this switch), and effective override-interval is the largest override-interval from those advertised by each neighbor (including this switch).

### Example

```
Console(config-if)#ip pim lan-prune-delay  
Console(config-if)#
```

### Related Commands

[ip pim override-interval \(1167\)](#)

[ip pim propagation-delay \(1168\)](#)

**ip pim override-interval** This command configures the override interval, or the time it takes a downstream router to respond to a lan-prune-delay message. Use the **no** form to restore the default setting.

### Syntax

**ip pim override-interval** *milliseconds*

**no ip pim override-interval**

*milliseconds* - The time required for a downstream router to respond to a lan-prune-delay message by sending back a Join message if it wants to continue receiving the flow referenced in the message. (Range: 500-6000 milliseconds)

### Default Setting

2500 milliseconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

The override interval configured by this command and the propagation delay configured by the [ip pim propagation-delay](#) command are used to calculate the LAN prune delay. If a downstream router has group members which want to continue receiving the flow referenced in a LAN prune delay message, then the override interval represents the time required for the downstream router to process the message and then respond by sending a Join message back to the upstream router to ensure that the flow is not terminated.

### Example

```
Console(config-if)#ip pim override-interval 3500  
Console(config-if)#
```

### Related Commands

[ip pim propagation-delay \(1168\)](#)

[ip pim lan-prune-delay \(1166\)](#)

**ip pim propagation-delay** This command configures the propagation delay required for a LAN prune delay message to reach downstream routers. Use the **no** form to restore the default setting.

**ip pim propagation-delay** *milliseconds*

**no ip pim propagation-delay**

*milliseconds* - The time required for a lan-prune-delay message to reach downstream routers attached to the same VLAN interface. (Range: 100-5000 milliseconds)

#### Default Setting

500 milliseconds

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

The override interval configured by the [ip pim override-interval](#) command and the propagation delay configured by this command are used to calculate the LAN prune delay. If a downstream router has group members which want to continue receiving the flow referenced in a LAN prune delay message, then the propagation delay represents the time required for the lan-prune-delay message to be propagated down from the upstream router to all downstream routers attached to the same VLAN interface.

#### Example

```
Console(config-if)#ip pim propagation-delay 600
Console(config-if)#
```

#### Related Commands

[ip pim override-interval \(1167\)](#)

[ip pim lan-prune-delay \(1166\)](#)

**ip pim trigger-hello-delay** This command configures the maximum time before transmitting a triggered PIM Hello message after the router is rebooted or PIM is enabled on an interface. Use the **no** form to restore the default value.

#### Syntax

**ip pim trigger-hello-delay** *seconds*

**no ip pim trigger-hello-delay**

*seconds* - The maximum time before sending a triggered PIM Hello message. (Range: 0-5 seconds)

#### Default Setting

5 seconds



### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ When a router first starts or PIM is enabled on an interface, the hello delay is set to random value between 0 and the trigger-hello-delay. This prevents synchronization of Hello messages on multi-access links if multiple routers are powered on simultaneously.
- ◆ Also, if a Hello message is received from a new neighbor, the receiving router will send its own Hello message after a random delay between 0 and the trigger-hello-delay.

### Example

```
Console(config-if)#ip pim trigger-hello-delay 3
Console(config-if)#
```

**show ip pim interface** This command displays information about interfaces configured for PIM.

### Syntax

**show ip pim interface [vlan *vlan-id*]**

*vlan-id* - VLAN ID (Range: 1-4094)

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

This command displays the PIM settings for the specified interface as described in the preceding pages. It also shows the address of the designated PIM router and the number of neighboring PIM routers.

### Example

```
Console#show ip pim interface vlan 1
PIM is enabled.
VLAN 1 is up.
PIM Mode           :      Dense Mode
IP Address          :      192.168.0.2
Hello Interval      :      30 sec
Hello HoldTime      :      105 sec
Triggered Hello Delay :      5 sec
Join/Prune Holdtime :      210 sec
Lan Prune Delay     :      Disabled
Propagation Delay    :      500 ms
Override Interval    :      2500 ms
Graft Retry Interval :      3 sec
Max Graft Retries    :      3
State Refresh Ori Int :      60 sec
```

Console#

**show ip pim neighbor** This command displays information about PIM neighbors.

#### Syntax

**show ip pim neighbor** [**interface vlan** *vlan-id*]

*vlan-id* - VLAN ID (Range: 1-4094)

#### Default Setting

Displays information for all known PIM neighbors.

#### Command Mode

Normal Exec, Privileged Exec

#### Example

```
Console#show ip pim neighbor
Neighbor Address VLAN Interface Uptime (sec.) Expiration Time (sec) DR
-----
192.168.0.3/32 1 00:00:21 00:01:30
Console#
```

**Table 229: show ip pim neighbor - display description**

Field	Description
Neighbor Address	IP address of the next-hop router.
VLAN Interface	Interface number that is attached to this neighbor.
Uptime	The duration this entry has been active.
Expiration Time	The time before this entry will be removed.
DR	The designated PIM-SM router. If multicast hosts are directly connected to the LAN, then only one of these routers is elected as the DR, and acts on behalf of these hosts, sending periodic Join/Prune messages toward a group-specific RP for each group.

## PIM-DM Commands

**ip pim graft-retry-interval** This command configures the time to wait for a Graft acknowledgement before resending a Graft. Use the **no** form to restore the default value.

#### Syntax

**ip pim graft-retry-interval** *seconds*

**no ip pim graft-retry-interval**

*seconds* - The time before resending a Graft. (Range: 1-10 seconds)

#### Default Setting

3 seconds

**Command Mode**

Interface Configuration (VLAN)

**Command Usage**

A graft message is sent by a router to cancel a prune state. When a router receives a graft message, it must respond with an graft acknowledgement message. If this acknowledgement message is lost, the router that sent the graft message will resend it a number of times (as defined by the `ip pim max-graft-retries` command).

**Example**

```
Console(config-if)#ip pim graft-retry-interval 9
Console(config-if)#
```

**ip pim  
max-graft-retries**

This command configures the maximum number of times to resend a Graft message if it has not been acknowledged. Use the **no** form to restore the default value.

**Syntax****ip pim max-graft-retries** *retries***no ip pim max-graft-retries***retries* - The maximum number of times to resend a Graft. (Range: 1-10)**Default Setting**

3

**Command Mode**

Interface Configuration (VLAN)

**Example**

```
Console(config-if)#ip pim max-graft-retries 5
Console(config-if)#
```

**ip pim state-refresh  
origination-interval**

This command sets the interval between sending PIM-DM state refresh control messages. Use the **no** form to restore the default value.

**Syntax****ip pim state-refresh origination-interval** *seconds***no ip pim max-graft-retries***seconds* - The interval between sending PIM-DM state refresh control messages. (Range: 1-100 seconds)

### Default Setting

60 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ The pruned state times out approximately every three minutes and the entire PIM-DM network is reflooded with multicast packets and prune messages. The state refresh feature keeps the pruned state from timing out by periodically forwarding a control message down the distribution tree, refreshing the prune state on the outgoing interfaces of each router in the tree. This also enables PIM routers to recognize topology changes (sources joining or leaving a multicast group) before the default three-minute state timeout expires.
- ◆ This command is only effectively for interfaces of first hop, PIM-DM routers that are directly connected to the sources of multicast groups.

### Example

```
Console(config-if)#ip pim state-refresh origination-interval 30
Console(config-if)#
```

## PIM-SM Commands

**ip pim bsr-candidate** This command configures the switch as a Bootstrap Router (BSR) candidate. Use the **no** form to restore the default value.

### Syntax

**ip pim bsr-candidate interface vlan *vlan-id* [*hash hash-mask-length*]  
[*priority priority*]**

**no ip pim bsr-candidate**

*vlan-id* - VLAN ID (Range: 1-4094)

*hash-mask-length* - Hash mask length (in bits) used for RP selection (see [ip pim rp-candidate](#) and [ip pim rp-address](#)). The portion of the hash specified by the mask length is ANDed with the group address. Therefore, when the hash function is executed on any BSR, all groups with the same seed hash will be mapped to the same RP. If the mask length is less than 32, then only the first portion of the hash is used, and a single RP will be defined for multiple groups. (Range: 0-32 bits)

*priority* - Priority used by the candidate bootstrap router in the election process. The BSR candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the BSR. Setting the priority to zero means that this router is not eligible to server as the BSR. At least one router in the PIM-SM domain must be set to a value greater than zero. (Range: 0-255)

### Default Setting

Hash Mask Length: 10

Priority: 0

### Command Mode

Global Configuration

### Command Usage

- ◆ When the **ip pim bsr-candidate** command is entered, the router starts sending bootstrap messages to all of its PIM-SM neighbors. The IP address of the designated VLAN is sent as the candidate's BSR address. Each neighbor receiving the bootstrap message compares the BSR address with the address from previous messages. If the current address is the same or a higher address, it accepts the bootstrap message and forwards it. Otherwise, it drops the message.
- ◆ This router will continue to be the BSR until it receives a bootstrap message from another candidate with a higher priority (or a higher IP address if the priorities are the same).
- ◆ To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

### Example

The following example configures the router to start sending bootstrap messages out of the interface for VLAN 1 to all of its PIM-SM neighbors.

```
Console(config)#ip pim bsr-candidate interface vlan 1 hash 20 priority 200
Console(config)#exit
Console#show ip pim bsr-router
PIMv2 Bootstrap information
BSR Address       : 192.168.0.2/32
Uptime           : 00:00:08
BSR Priority      : 200
Hash Mask Length : 20
Expire            : 00:00:57
Role              : Candidate BSR
State            : Elected BSR
Console#
```

**ip pim register-rate-limit** This command configures the rate at which register messages are sent by the Designated Router (DR) for each (source, group) entry. Use the **no** form to restore the default value.

#### Syntax

**ip pim register-rate-limit** *rate*

**no ip pim register-rate-limit**

*rate* - The maximum number of register packets per second. (Range: 1-65535; Default: 0, which means no limit)

#### Default Setting

0

#### Command Mode

Global Configuration

#### Command Usage

This command can be used to relieve the load on the Designated Router (DR) and RP. However, because register messages exceeding the limit are dropped, some receivers may experience data packet loss within the first few seconds in which register messages are sent from bursty sources.

#### Example

This example sets the register rate limit to 500 pps.

```
Console(config)#ip pim register-rate-limit 500
Console(config)#
```

**ip pim register-source** This command configures the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) that leads back toward the rendezvous point (RP). Use the **no** form to restore the default setting.

#### Syntax

**ip pim register-source interface vlan** *vlan-id*

**no ip pim register-source**

*vlan-id* - VLAN ID (Range: 1-4094)

#### Default Setting

The IP address of the DR's outgoing interface that leads back to the RP

#### Command Mode

Global Configuration

### Command Usage

When the source address of a register message is filtered by intermediate network devices, or is not a uniquely routed address to which the RP can send packets, the replies sent from the RP to the source address will fail to reach the DR, resulting in PIM-SM protocol failures. This command can be used to overcome this type of problem by manually configuring the source address of register messages to an interface that leads back to the RP.

### Example

This example sets the register rate limit to 500 pps.

```
Console(config)#ip pim register-source interface vlan 1
Console(config)#
```

**ip pim rp-address** This command sets a static address for the Rendezvous Point (RP) for a particular multicast group. Use the **no** form to remove an RP address or an RP address for a specific group.

### Syntax

**[no] ip pim rp-address** *rp-address* [**group-prefix** *group-address mask*]

*rp-address* - Static IP address of the router that will be an RP for the specified multicast group(s).

*group-address* - An IP multicast group address. If a group address is not specified, the RP is used for all multicast groups.

*mask* - Subnet mask that is used for the group address.

### Default Setting

None

### Command Mode

Global Configuration

### Command Usage

- ◆ The router specified by this command will act as an RP for all multicast groups in the local PIM-SM domain if no groups are specified. A static RP can either be configured for the whole multicast group range 224.0.0.0/4, or for specific group ranges.
- ◆ Using this command to configure multiple static RPs with the same RP address is not allowed. If an IP address is specified that was previously used for an RP, then the older entry is replaced.
- ◆ Multiple RPs can be defined for different groups or group ranges. If a group is matched by more than one entry, the router will use the RP associated with the

longer group prefix length. If the prefix lengths are the same, then the static RP with the highest IP address is chosen.

- ◆ Static definitions for RP addresses may be used together with RP addresses dynamically learned through the bootstrap router (BSR). If an RP address learned by the BSR and one statically configured using this command are both available for a group range, the RP address learned by the BSR is chosen over the one statically configured with this command.
- ◆ All routers within the same PIM-SM domain must be configured with the same RP(s). Selecting an RP through the dynamic election process is therefore preferable for most situations. Using the dynamic RP election process also allows a backup RP to automatically take over if the active RP router becomes unavailable.
- ◆ If the **no** form of this command is used without specifying a multicast group, the default 224.0.0.0 (with the mask 240.0.0.0) is removed. In other words, all multicast groups are removed.

### Example

In the following example, the first PIM-SM command just specifies the RP address 192.168.1.1 to indicate that it will be used to service all multicast groups. The second PIM-SM command includes the multicast groups to be serviced by the RP.

```
Console(config)#ip pim rp-address 192.168.1.1
Console(config)#ip pim rp-address 192.168.2.1 group-prefix 224.9.0.0
255.255.0.0
Console(config)#end
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Groups          : 224.0.0.0/4
RP address      : 192.168.1.1/32
Info source     : static
Uptime         : 00:00:33
Expire          : Never
Groups          : 224.9.0.0/16
RP address      : 192.168.2.1/32
Info source     : static
Uptime         : 00:00:21
Expire          : Never
Console#
```



**ip pim rp-candidate** This command configures the router to advertise itself as a Rendezvous Point (RP) candidate to the bootstrap router (BSR). Use the **no** form to remove this router as an RP candidate.

### Syntax

**ip pim rp-candidate interface vlan** *vlan-id* [**group-prefix** *group-address mask*]  
[**interval** *seconds*] [**priority** *value*]

**no ip pim rp-candidate interface vlan** *vlan-id*

*vlan-id* - VLAN ID (Range: 1-4094)

*group-address* - An IP multicast group address. If a group address is not specified, the RP is advertised for all multicast groups.

*mask* - Subnet mask that is used for the group address.

*seconds* - The interval at which this device advertises itself as an RP candidate. (Range: 60-16383 seconds)

*value* - Priority used by the candidate RP in the election process. The RP candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the RP. Setting the priority to zero means that this router is not eligible to server as the RP. (Range: 0-255)

### Default Setting

Address: 224.0.0.0/4, or the entire IPv4 multicast group family

Interval: 60 seconds

Priority: 0

### Command Mode

Global Configuration

### Command Usage

- ◆ When the **ip pim rp-candidate** command is entered, the router periodically sends PIMv2 messages to the BSR advertising itself as a candidate RP for the specified group addresses. The IP address of the designated VLAN is sent as the candidate's RP address. The BSR places information about all of the candidate RPs in subsequent bootstrap messages. The BSR uses the RP-election hash algorithm to select an active RP for each group range. The election process is performed by the BSR only for its own use. Each PIM-SM router that receives the list of RP candidates from the BSR also elects an active RP for each group range using the same election process.
- ◆ The election process for each group is based on the following criteria:
  - Find all RPs with the most specific group range.
  - Select those with the highest priority (lowest priority value).
  - Compute a hash value based on the group address, RP address, priority, and hash mask included in the bootstrap messages.

- If there is a tie, use the candidate RP with the highest IP address.
- ◆ This distributed election process provides faster convergence and minimal disruption when an RP fails. It also serves to provide load balancing by distributing groups across multiple RPs. Moreover, when an RP fails, the responsible RPs are re-elected on each router, and the groups automatically distributed to the remaining RPs.
- ◆ To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

### Example

The following example configures the router to start advertising itself to the BSR as a candidate RP for the indicated multicast groups.

```
Console(config)#ip pim rp-candidate interface vlan 1 group-prefix 224.0.0.0
255.0.0.0
Console(config)#end
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Groups          : 224.0.0.0/8
RP address      : 192.168.0.2/32
Info source     : 192.168.0.2/32, via bootstrap, priority: 0
Uptime         : 00:00:51
Expire          : 00:01:39
Console#
```

**ip pim spt-threshold** This command prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode. Use the **no** form to allow the router to switch over to SPT mode.

### Syntax

**ip pim spt-threshold infinity** [**group-prefix** *group-address mask*]

**no ip pim spt-threshold infinity**

*group-address* - An IP multicast group address. If a group address is not specified, the command applies to all multicast groups.

*mask* - Subnet mask that is used for the group address.

### Default Setting

The last-hop PIM router joins the shortest path tree immediately after the first packet arrives from a new source.

### Command Mode

Global Configuration

### Command Usage

- ◆ The default path for packets from a multicast source to a receiver is through the RP. However, the path through the RP is not always the shortest path. Therefore, the router uses the RP to forward only the first packet from a new multicast group to its receivers. Afterwards, it calculates the shortest path tree (SPT) directly between the receiver and source, and then uses the SPT to send all subsequent packets from the source to the receiver instead of using the shared tree. Note that when the SPT threshold is not set by this command, the PIM leaf router will join the shortest path tree immediately after receiving the first packet from a new source.
- ◆ This command forces the router to use the shared tree for all multicast groups, or just for the specified multicast groups.
- ◆ Only one entry is allowed for this command.

### Example

This example prevents the switch from using the SPT for multicast groups 224.1.0.0~224.1.255.255.

```
Console(config-if)#ip pim sparse-mode
Console(config-if)#exit
Console(config)#ip multicast-routing
Console(config)#router pim
Console(config)#ip pim spt-threshold infinity group-prefix 224.1.0.0
0.0.255.255
Console#
```

**ip pim dr-priority** This command sets the priority value for a Designated Router (DR) candidate. Use the **no** form to restore the default setting.

### Syntax

**ip pim dr-priority** *priority-value*

**no ip pim dr-priority**

*priority-value* - Priority advertised by a router when bidding to become the DR. (Range: 0-4294967294)

### Default Setting

1

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ More than one PIM-SM router may be connected to an Ethernet or other shared-media LAN. If multicast hosts are directly connected to the LAN, then only one of these routers is elected as the DR, and acts on behalf of these hosts,

sending periodic Join/Prune messages toward a group-specific RP for each group. A single DR is elected per interface (LAN or otherwise) using a simple election process.

- ◆ The router with the highest priority configured on an interface is elected as the DR. If more than one router attached to this interface uses the same priority, then the router with the highest IP address is elected to serve as the DR.
- ◆ If a router does not advertise a priority in its hello messages, it is assumed to have the highest priority and is elected as the DR. If more than one router is not advertising its priority, then the router with the highest IP address is elected to serve as the DR.

### Example

This example sets the priority used in the bidding process for the DR.

```
Console(config)#interface vlan 1
Console(config-if)#ip pim dr-priority 20
Console(config-if)#end
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
PIM Mode           :      Sparse Mode
IP Address          :      192.168.0.2
Hello Interval      :          30 sec
Hello HoldTime      :          105 sec
Triggered Hello Delay :          5 sec
Join/Prune Holdtime :          210 sec
Lan Prune Delay      :      Disabled
Propagation Delay    :          500 ms
Override Interval    :          2500 ms
DR Priority          :          20
Join/Prune Interval  :          60 sec

Console#
```

**ip pim join-prune-interval** This command sets the join/prune timer. Use the **no** form to restore the default setting.

### Syntax

**ip pim join-prune-interval** *seconds*

**no ip pim join-prune-interval**

*seconds* - The interval at which join/prune messages are sent.  
(Range: 1-65535 seconds)

### Default Setting

60 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ By default, the switch sends join/prune messages every 210 seconds to inform other PIM-SM routers about clients who want to join or leave a multicast group.
- ◆ Use the same join/prune message interval on all the PIM-SM routers in the same PIM-SM domain, otherwise the routing protocol's performance will be adversely affected.
- ◆ The multicast interface that first receives a multicast stream from a particular source forwards this traffic only to those interfaces on the router that have requested to join this group. When there are no longer any requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The protocol maintains both the current join state and the pending Reverse Path Tree (RPT) prune state for this (source, group) pair until the join/prune-interval timer expires.

### Example

This example sets the priority used in the bidding process for the DR.

```

Console(config)#interface vlan 1
Console(config-if)#ip pim join-prune-interval 210
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
PIM Mode           :      Sparse Mode
IP Address          :      192.168.0.2
Hello Interval      :          30 sec
Hello HoldTime      :          105 sec
Triggered Hello Delay :          5 sec
Join/Prune Holdtime :          210 sec
Lan Prune Delay      :      Disabled
Propagation Delay    :          500 ms
Override Interval    :          2500 ms
DR Priority          :          20
Join/Prune Interval  :          80 sec

Console#

```

**clear ip pim bsr rp-set** This command clears multicast group to RP mapping entries learned through the PIMv2 bootstrap router (BSR).

### Command Mode

Privileged Exec

### Command Usage

- ◆ This command can be used to update entries in the static multicast forwarding table immediately after making configuration changes to the RP.
- ◆ Use the [show ip pim rp mapping](#) command to display active RPs that are cached with associated multicast routing entries.

### Example

This example clears the RP map.

```
Console#clear ip pim bsr rp-set
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Console#
```

**show ip pim bsr-router** This command displays information about the bootstrap router (BSR).

### Command Mode

Privileged Exec

### Command Usage

This command displays information about the elected BSR.

### Example

This example displays information about the BSR.

```
Console#show ip pim bsr-router
PIMv2 Bootstrap information
BSR Address      : 192.168.0.2/32
Uptime          : 01:01:23
BSR Priority     : 200
Hash Mask Length : 20
Expire          : 00:00:42
Role            : Candidate BSR
State           : Elected BSR
Console#
```

**Table 230: show ip pim bsr-router - display description**

Field	Description
BSR Address	IP address of interface configured as the BSR.
Uptime	The time this BSR has been up and running.
BSR Priority	Priority assigned to this interface for use in the BSR election process.
Hash Mask Length	The number of significant bits used in the multicast group comparison mask. This mask determines the multicast group for which this router can be a BSR.
Expire	The time before this entry will be removed.
Role	Candidate BSR or Non-candidate BSR.

**Table 230: show ip pim bsr-router - display description** (Continued)

Field	Description
State	<p>Operation state of BSR includes:</p> <ul style="list-style-type: none"> <li>◆ No information – No information stored for this device.</li> <li>◆ Accept Any – The router does not know of an active BSR, and will accept the first bootstrap message it sees as giving the new BSR's identity and the RP-set.</li> <li>◆ Accept Preferred – The router knows the identity of the current BSR, and is using the RP-set provided by that BSR. Only bootstrap messages from that BSR or from a C-BSR with higher weight than the current BSR will be accepted.</li> <li>◆ Candidate BSR – Bidding in election process.</li> <li>◆ Pending-BSR – The router is a candidate to be the BSR for the RP-set. Currently, no other router is the preferred BSR, but this router is not yet the elected BSR.</li> <li>◆ Elected BSR – elected to serve as BSR</li> </ul>

**show ip pim rp mapping** This command displays active RPs and associated multicast routing entries.

**Command Mode**  
Privileged Exec

**Example**  
This example displays the RP map.

```

Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Groups          : 224.0.0.0/8
RP address      : 192.168.0.2/32
Info source     : 192.168.0.2/32, via bootstrap, priority: 0
Uptime         : 00:31:09
Expire          : 00:02:21

Console#

```

**Table 231: show ip pim rp mapping - display description**

Field	Description
Groups	The multicast group address, mask length managed by the RP.
RP address	IP address of the RP used for the listed multicast group
Info source	RP that advertised the mapping, how the RP was selected (Static or Bootstrap), and the priority used in the bidding process
Uptime	The time this RP has been up and running
Expire	The time before this entry will be removed

**show ip pim rp-hash** This command displays the RP used for the specified multicast group, and the RP that advertised the mapping.

#### Syntax

**show ip pim rp-hash** *group-address*

*group-address* - An IP multicast group address.

#### Command Mode

Privileged Exec

#### Example

This example displays the RP used for the specified group.

```
Console#show ip pim rp-hash 224.0.1.3
RP address      : 192.168.0.2/32
Info source     : 192.168.0.2/32, via (null)
Console#
```

**Table 232: show ip pim rp-hash - display description**

Field	Description
RP address	IP address of the RP used for the specified multicast group
Info source	RP that advertised the mapping, and how the RP was selected

**IPv6 PIM Commands** This section describes commands used to configure IPv6 PIM dynamic multicast routing on the switch.

**Table 233: PIM-DM and PIM-SM Multicast Routing Commands**

Command	Function	Mode
<i>Shared Mode Commands</i>		
<b>router pim6</b>	Enables IPv6 PIM globally for the router	GC
<b>ipv6 pim</b>	Enables PIM-DM or PIM-SM on the specified interface	IC
<b>ipv6 pim hello-holdtime</b>	Sets the time to wait for hello messages from a neighboring PIM router before declaring it dead	IC
<b>ipv6 pim hello-interval</b>	Sets the interval between sending PIM hello messages	IC
<b>ipv6 pim join-prune-holdtime</b>	Configures the hold time for the prune state	IC
<b>ipv6 pim lan-prune-delay</b>	Informs downstream routers of the delay before it prunes a flow after receiving a prune request	IC
<b>ipv6 pim override-interval</b>	Specifies the time it takes a downstream router to respond to a lan-prune-delay message	IC
<b>ipv6 pim propagation-delay</b>	Configures the propagation delay required for a LAN prune message to reach downstream routers	IC



**Table 233: PIM-DM and PIM-SM Multicast Routing Commands** (Continued)

Command	Function	Mode
<code>ipv6 pim trigger-hello-delay</code>	Configures the trigger hello delay	IC
<code>show ipv6 pim interface</code>	Displays information about interfaces configured for PIM	NE, PE
<code>show ipv6 pim neighbor</code>	Displays information about PIM neighbors	NE, PE
<i>PIM-DM Commands</i>		
<code>ipv6 pim graft-retry-interval</code>	Configures the time to wait for a Graft acknowledgement before resending a Graft message	IC
<code>ipv6 pim max-graft-retries</code>	Configures the maximum number of times to resend a Graft message if it has not been acknowledged	IC
<code>ipv6 pim state-refresh origination-interval</code>	Sets the interval between PIM-DM state refresh control messages	IC
<i>PIM-SM Commands</i>		
<code>ipv6 pim bsr-candidate</code>	Configures the switch as a Bootstrap Router (BSR) candidate	GC
<code>ipv6 pim register-rate-limit</code>	Configures the rate at which register messages are sent by the Designated Router (DR)	GC
<code>ipv6 pim register-source</code>	Configure the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) leading toward the rendezvous point (RP)	GC
<code>ipv6 pim rp-address</code>	Sets a static address for the rendezvous point	GC
<code>ipv6 pim rp-candidate</code>	Configures the switch rendezvous point (RP) candidate	GC
<code>ipv6 pim spt-threshold</code>	Prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode	GC
<code>ipv6 pim dr-priority</code>	Sets the priority value for a DR candidate	IC
<code>ipv6 pim join-prune-interval</code>	Sets the join/prune timer	IC
<code>clear ipv6 pim bsr rp-set</code>	Clears RP entries learned through the BSR	PE
<code>show ipv6 pim bsr-router</code>	Displays information about the BSR	PE
<code>show ipv6 pim rp mapping</code>	Displays active RPs and associated multicast routing entries	PE
<code>show ipv6 pim rp-hash</code>	Displays the RP used for the specified multicast group	PE

## PIM6 Shared Mode Commands

**router pim6** This command enables IPv6 Protocol-Independent Multicast routing globally on the router. Use the **no** form to disable PIM multicast routing.

### Syntax

**[no] router pim6**

### Default Setting

Disabled

### Command Mode

Global Configuration

### Command Usage

- ◆ This command enables PIM-DM and PIM-SM for IPv6 globally for the router. You also need to enable PIM-DM and PIM-SM for each interface that will support multicast routing using the [ipv6 pim](#) command, and make any changes necessary to the multicast protocol parameters.
- ◆ To use PIMv6, IPv6 multicast routing must be enabled on the switch using the [ipv6 multicast-routing](#) command.
- ◆ To use IPv6 multicast routing, MLD proxy cannot be enabled on any interface of the device (see the [ipv6 mld proxy](#) command).

### Example

```
Console(config)#router pim6
Console(config)#
```

**ipv6 pim** This command enables IPv6 PIM-DM or PIM-SM on the specified interface. Use the **no** form to disable IPv6 PIM-DM or PIM-SM on this interface.

### Syntax

**[no] ipv6 pim {dense-mode | sparse-mode}**

**dense-mode** - Enables PIM Dense Mode.

**sparse-mode** - Enables PIM Sparse Mode.

### Default Setting

Disabled

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ To fully enable PIM, you need to enable multicast routing globally for the router with the [ipv6 multicast-routing](#) command, enable PIM globally for the router with the [router pim6](#) command, and also enable PIM-DM or PIM-SM for each interface that will participate in multicast routing with this command.
- ◆ If you enable PIM on an interface, you should also enable MLD (see [“MLD \(Layer 3\)” on page 760](#)) on that interface. PIM mode selection determines how the switch populates the multicast routing table, and how it forwards packets received from directly connected LAN interfaces. Dense mode interfaces are always added to the multicast routing table. Sparse mode interfaces are added only when periodic join messages are received from downstream routers, or a group member is directly connected to the interface.

- ◆ Dense-mode interfaces are subject to multicast flooding by default, and are only removed from the multicast routing table when the router determines that there are no group members or downstream routers, or when a prune message is received from a downstream router.
- ◆ Sparse-mode interfaces forward multicast traffic only if a join message is received from a downstream router or if group members are directly connected to the interface. When routers want to receive a multicast flow, they periodically send join messages to the Rendezvous Point (RP), and are subsequently added to the shared path for the specified flow back up to the RP. If routers want to join the source path up through the Shortest Path Source Tree (SPT), they periodically send join messages toward the source. They also send prune messages toward the RP to prune the shared path if they have already connected to the source through the SPT, or if there are no longer any group members connected to the interface.

### Example

```

Console(config)#interface vlan 1
Console(config-if)#ipv6 pim dense-mode
Console(config-if)#end
Console#show ipv6 pim interface
PIM is enabled.
VLAN 1 is up.
PIM Mode                : Dense Mode
IPv6 Address             : None
Hello Interval           : 30 sec
Hello HoldTime           : 105 sec
Triggered Hello Delay    : 5 sec
Join/Prune Holdtime      : 210 sec
Lan Prune Delay          : Disabled
Propagation Delay        : 500 ms
Override Interval        : 2500 ms
Graft Retry Interval     : 3 sec
Max Graft Retries        : 3
State Refresh Ori Int    : 60 sec

Console#

```

### ipv6 pim hello-holdtime

This command configures the interval to wait for hello messages from a neighboring PIM router before declaring it dead. Use the **no** form to restore the default value.

### Syntax

**ipv6 pim hello-holdtime** *seconds*

**no ipv6 pim hello-interval**

*seconds* - The hold time for PIM hello messages. (Range: 1-65535)

### Default Setting

105 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

The **ip pim hello-holdtime** should be greater than the value of **ipv6 pim hello-interval**.

### Example

```
Console(config-if)#ipv6 pim hello-holdtime 210  
Console(config-if)#
```

**ipv6 pim hello-interval** This command configures the frequency at which PIM hello messages are transmitted. Use the **no** form to restore the default value.

### Syntax

**ipv6 pim hello-interval** *seconds*

**no pimv6 hello-interval**

*seconds* - Interval between sending PIM hello messages. (Range: 1-65535)

### Default Setting

30 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

Hello messages are sent to neighboring PIM routers from which this device has received probes, and are used to verify whether or not these neighbors are still active members of the multicast tree.

### Example

```
Console(config-if)#ipv6 pim hello-interval 60  
Console(config-if)#
```

**ipv6 pim join-prune-holdtime** This command configures the hold time for the prune state. Use the **no** form to restore the default value.

### Syntax

**ipv6 pim join-prune-holdtime** *seconds*

**no ipv6 pim join-prune-holdtime**

*seconds* - The hold time for the prune state. (Range: 0-65535)

**Default Setting**

210 seconds

**Command Mode**

Interface Configuration (VLAN)

**Command Usage**

The multicast interface that first receives a multicast stream from a particular source forwards this traffic to all other PIM interfaces on the router. If there are no requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The prune state is maintained until the join-prune-holdtime timer expires or a graft message is received for the forwarding entry.

**Example**

```
Console(config-if)#ipv6 pim join-prune-holdtime 60
Console(config-if)#
```

**ipv6 pim  
lan-prune-delay**

This command causes this device to inform downstream routers of how long it will wait before pruning a flow after receiving a prune request. Use the **no** form to disable this feature.

**Syntax****[no] ipv6 pim lan-prune-delay****Default Setting**

Disabled

**Command Mode**

Interface Configuration (VLAN)

**Command Usage**

- ◆ When other downstream routers on the same VLAN are notified that this upstream router has received a prune request, they must send a Join to override the prune before the prune delay expires if they want to continue receiving the flow. The message generated by this command effectively prompts any downstream neighbors with hosts receiving the flow to reply with a Join message. If no join messages are received after the prune delay expires, this router will prune the flow.
- ◆ Prune delay is the sum of the effective propagation-delay and effective override-interval, where effective propagation-delay is the largest propagation-delay from those advertised by each neighbor (including this switch), and effective override-interval is the largest override-interval from those advertised by each neighbor (including this switch).

### Example

```
Console(config-if)#ipv6 pim lan-prune-delay  
Console(config-if)#
```

### Related Commands

[ipv6 pim override-interval \(1190\)](#)  
[ipv6 pim propagation-delay \(1191\)](#)

**ipv6 pim override-interval** This command configures the override interval, or the time it takes a downstream router to respond to a lan-prune-delay message. Use the **no** form to restore the default setting.

### Syntax

**ipv6 pim override-interval** *milliseconds*

**no ipv6 pim override-interval**

*milliseconds* - The time required for a downstream router to respond to a lan-prune-delay message by sending back a Join message if it wants to continue receiving the flow referenced in the message. (Range: 500-6000 milliseconds)

### Default Setting

2500 milliseconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

The override interval configured by this command and the propagation delay configured by the [ipv6 pim propagation-delay](#) command are used to calculate the LAN prune delay. If a downstream router has group members which want to continue receiving the flow referenced in a LAN prune delay message, then the override interval represents the time required for the downstream router to process the message and then respond by sending a Join message back to the upstream router to ensure that the flow is not terminated.

### Example

```
Console(config-if)#ipv6 pim override-interval 3500  
Console(config-if)#
```

### Related Commands

[ipv6 pim propagation-delay \(1191\)](#)  
[ipv6 pim lan-prune-delay \(1189\)](#)

**ipv6 pim propagation-delay** This command configures the propagation delay required for a LAN prune delay message to reach downstream routers. Use the **no** form to restore the default setting.

**ipv6 pim propagation-delay** *milliseconds*

**no ipv6 pim propagation-delay**

*milliseconds* - The time required for a lan-prune-delay message to reach downstream routers attached to the same VLAN interface.  
(Range: 100-5000 milliseconds)

#### Default Setting

500 milliseconds

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

The override interval configured by the [ipv6 pim override-interval](#) command and the propagation delay configured by this command are used to calculate the LAN prune delay. If a downstream router has group members which want to continue receiving the flow referenced in a LAN prune delay message, then the propagation delay represents the time required for the lan-prune-delay message to be propagated down from the upstream router to all downstream routers attached to the same VLAN interface.

#### Example

```
Console(config-if)#ipv6 pim propagation-delay 600
Console(config-if)#
```

#### Related Commands

[ipv6 pim override-interval \(1190\)](#)

[ipv6 pim lan-prune-delay \(1189\)](#)

**ipv6 pim trigger-hello-delay** This command configures the maximum time before transmitting a triggered PIM Hello message after the router is rebooted or PIM is enabled on an interface. Use the **no** form to restore the default value.

#### Syntax

**ipv6 pim trigger-hello-delay** *seconds*

**no ipv6 pim trigger-hello-delay**

*seconds* - The maximum time before sending a triggered PIM Hello message. (Range: 0-5)

#### Default Setting

5 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ When a router first starts or PIM is enabled on an interface, the hello delay is set to random value between 0 and the trigger-hello-delay. This prevents synchronization of Hello messages on multi-access links if multiple routers are powered on simultaneously.
- ◆ Also, if a Hello message is received from a new neighbor, the receiving router will send its own Hello message after a random delay between 0 and the trigger-hello-delay.

### Example

```
Console(config-if)#ipv6 pim trigger-hello-delay 3
Console(config-if)#
```

**show ipv6 pim interface** This command displays information about interfaces configured for PIM.

### Syntax

**show ipv6 pim [interface vlan *vlan-id*]**

*vlan-id* - VLAN ID (Range: 1-4094)

### Command Mode

Normal Exec, Privileged Exec

### Command Usage

This command displays the PIM settings for the specified interface as described in the preceding pages. It also shows the address of the designated PIM router and the number of neighboring PIM routers.

### Example

```
Console#show ipv6 pim interface vlan 1
PIM is enabled.
VLAN 1 is up.
PIM Mode                : Dense Mode
IPv6 Address             : fe80::7272:cfff:fe8c:2fef%1
Hello Interval           : 30 sec
Hello HoldTime           : 105 sec
Triggered Hello Delay    : 5 sec
Join/Prune Holdtime      : 210 sec
Lan Prune Delay          : Disabled
Propagation Delay        : 500 ms
Override Interval        : 2500 ms
Graft Retry Interval     : 3 sec
Max Graft Retries        : 3
State Refresh Ori Int    : 60 sec

Console#
```



**show ipv6 pim neighbor** This command displays information about PIM neighbors.

#### Syntax

**show ipv6 pim neighbor** [**interface vlan** *vlan-id*]

*vlan-id* - VLAN ID (Range: 1-4094)

#### Default Setting

Displays information for all known PIM neighbors.

#### Command Mode

Normal Exec, Privileged Exec

#### Example

```

Console#show ipv6 pim neighbor
Neighbor Address          VLAN Interface Uptime   Expire   DR
-----
FF80::0101                VLAN 1         00:01:23 00:01:23 YES
FF80::0202                VLAN 2         1d 11h   Never
Console#

```

**Table 234: show ipv6 pim neighbor - display description**

Field	Description
Neighbor Address	IP address of the next-hop router.
VLAN Interface	Interface number that is attached to this neighbor.
Uptime	The duration this entry has been active.
Expiration Time	The time before this entry will be removed.
DR	The designated PIM6-SM router. If multicast hosts are directly connected to the LAN, then only one of these routers is elected as the DR, and acts on behalf of these hosts, sending periodic Join/Prune messages toward a group-specific RP for each group.

## PIM6-DM Commands

**ipv6 pim graft-retry-interval** This command configures the time to wait for a Graft acknowledgement before resending a Graft. Use the **no** form to restore the default value.

#### Syntax

**ipv6 pim graft-retry-interval** *seconds*

**no ipv6 pim graft-retry-interval**

*seconds* - The time before resending a Graft. (Range: 1-10 seconds)

#### Default Setting

3 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

A graft message is sent by a router to cancel a prune state. When a router receives a graft message, it must respond with an graft acknowledgement message. If this acknowledgement message is lost, the router that sent the graft message will resend it a number of times (as defined by the [ipv6 pim max-graft-retries](#) command).

### Example

```
Console(config-if)#ipv6 pim graft-retry-interval 9
Console(config-if)#
```

### Related Commands

[ipv6 pim override-interval \(1190\)](#)

[ipv6 pim propagation-delay \(1191\)](#)

### **ipv6 pim max-graft-retries**

This command configures the maximum number of times to resend a Graft message if it has not been acknowledged. Use the **no** form to restore the default value.

### Syntax

**ipv6 pim max-graft-retries** *retries*

**no ipv6 pim max-graft-retries**

*retries* - The maximum number of times to resend a Graft. (Range: 1-10)

### Default Setting

3

### Command Mode

Interface Configuration (VLAN)

### Example

```
Console(config-if)#ipv6 pim max-graft-retries 5
Console(config-if)#
```

**ipv6 pim state-refresh origination-interval** This command sets the interval between sending PIM-DM state refresh control messages. Use the **no** form to restore the default value.

#### Syntax

**ipv6 pim state-refresh origination-interval** *seconds*

**no ipv6 pim max-graft-retries**

*seconds* - The interval between sending PIM-DM state refresh control messages. (Range: 1-100 seconds)

#### Default Setting

60 seconds

#### Command Mode

Interface Configuration (VLAN)

#### Command Usage

- ◆ The pruned state times out approximately every three minutes and the entire PIM-DM network is reflooded with multicast packets and prune messages. The state refresh feature keeps the pruned state from timing out by periodically forwarding a control message down the distribution tree, refreshing the prune state on the outgoing interfaces of each router in the tree. This also enables PIM routers to recognize topology changes (sources joining or leaving a multicast group) before the default three-minute state timeout expires.
- ◆ This command is only effectively for interfaces of first hop, PIM-DM routers that are directly connected to sources of multicast groups.

#### Example

```
Console(config-if)#ipv6 pim state-refresh origination-interval 30
Console(config-if)#
```

## PIM6-SM Commands

**ipv6 pim bsr-candidate** This command configures the switch as a Bootstrap Router (BSR) candidate. Use the **no** form to restore the default value.

### Syntax

**ipv6 pim bsr-candidate interface vlan *vlan-id* [*hash hash-mask-length*]  
[*priority priority*]**

**no ipv6 pim bsr-candidate**

*vlan-id* - VLAN ID (Range: 1-4094)

*hash-mask-length* - Hash mask length (in bits) used for RP selection (see [ipv6 pim rp-candidate](#) and [ipv6 pim rp-address](#)). The portion of the hash specified by the mask length is ANDed with the group address. Therefore, when the hash function is executed on any BSR, all groups with the same seed hash will be mapped to the same RP. If the mask length is less than 32, then only the first portion of the hash is used, and a single RP will be defined for multiple groups. (Range: 0-32 bits)

*priority* - Priority used by the candidate bootstrap router in the election process. The BSR candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the BSR. Setting the priority to zero means that this router is not eligible to server as the BSR. At least one router in the PIM6-SM domain must be set to a value greater than zero. (Range: 0-255)

### Default Setting

Hash Mask Length: 10

Priority: 0

### Command Mode

Global Configuration

### Command Usage

- ◆ When the **ipv6 pim bsr-candidate** command is entered, the router starts sending bootstrap messages to all of its PIM6-SM neighbors. The IP address of the designated VLAN is sent as the candidate's BSR address. Each neighbor receiving the bootstrap message compares the BSR address with the address from previous messages. If the current address is the same or a higher address, it accepts the bootstrap message and forwards it. Otherwise, it drops the message.
- ◆ This router will continue to be the BSR until it receives a bootstrap message from another candidate with a higher priority (or a higher IP address if the priorities are the same).
- ◆ To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

### Example

The following example configures the router to start sending bootstrap messages out of the interface for VLAN 1 to all of its PIM-SM neighbors.

```
Console(config)#ipv6 pim bsr-candidate interface vlan 1 hash 20 priority 200
Console(config)#exit
Console#show ipv6 pim bsr-router
PIMv2 Bootstrap information
BSR Address       : 2001:DB8:2222:7272::72
Uptime           : 00:00:08
BSR Priority      : 200
Hash Mask Length : 20
Expire           : 00:00:57
Role             : Candidate BSR
State            : Elected BSR
Console#
```

### ipv6 pim register-rate-limit

This command configures the rate at which register messages are sent by the Designated Router (DR) for each (source, group) entry. Use the **no** form to restore the default value.

### Syntax

**ipv6 pim register-rate-limit** *rate*

**no ipv6 pim register-rate-limit**

*rate* - The maximum number of register packets per second.  
(Range: 1-65535; Default: 0, which means no limit)

### Default Setting

0

### Command Mode

Global Configuration

### Command Usage

This command can be used to relieve the load on the Designated Router (DR) and RP. However, because register messages exceeding the limit are dropped, some receivers may experience data packet loss within the first few seconds in which register messages are sent from bursty sources.

### Example

This example sets the register rate limit to 500 pps.

```
Console(config)#ipv6 pim register-rate-limit 500
Console(config)#
```

**ipv6 pim register-source** This command configures the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) that leads back toward the rendezvous point (RP). Use the **no** form to restore the default setting.

#### Syntax

**ipv6 pim register-source interface vlan *vlan-id***

**no ipv6 pim register-source**

*vlan-id* - VLAN ID (Range: 1-4094)

#### Default Setting

The IP address of the DR's outgoing interface that leads back to the RP

#### Command Mode

Global Configuration

#### Command Usage

When the source address of a register message is filtered by intermediate network devices, or is not a uniquely routed address to which the RP can send packets, the replies sent from the RP to the source address will fail to reach the DR, resulting in PIM6-SM protocol failures. This command can be used to overcome this type of problem by manually configuring the source address of register messages to an interface that leads back to the RP.

#### Example

This example sets the register source address to the interface address for VLAN 1.

```
Console(config)#ipv6 pim register-source interface vlan 1
Console(config)#
```

**ipv6 pim rp-address** This command sets a static address for the Rendezvous Point (RP) for a particular multicast group. Use the **no** form to remove an RP address or an RP address for a specific group.

#### Syntax

**[no] ipv6 pim rp-address *rp-address* [group-prefix *group-prefix*]**

*rp-address* - Static IPv6 address of the router that will be an RP for the specified multicast group(s).

*group-prefix* - An IPv6 network prefix for a multicast group. If a group prefix is not specified, the RP is used for all multicast groups.

#### Default Setting

None

## Command Mode

### Global Configuration

## Command Usage

- ◆ The router specified by this command will act as an RP for all multicast groups in the local PIM6-SM domain if no groups are specified. A static RP can either be configured for the whole multicast group range FF00::/8, or for specific group ranges.
- ◆ Using this command to configure multiple static RPs with the same RP address is not allowed. If an IP address is specified that was previously used for an RP, then the older entry is replaced. (
- ◆ Multiple RPs can be defined for different groups or group ranges. If a group is matched by more than one entry, the router will use the RP associated with the longer group prefix length. If the prefix lengths are the same, then the static RP with the highest IP address is chosen.
- ◆ Static definitions for RP addresses may be used together with RP addresses dynamically learned through the bootstrap router (BSR). If an RP address learned by the BSR and one statically configured using this command are both available for a group range, the RP address learned by the BSR is chosen over the one statically configured with this command.
- ◆ All routers within the same PIM6-SM domain must be configured with the same RP(s). Selecting an RP through the dynamic election process is therefore preferable for most situations. Using the dynamic RP election process also allows a backup RP to automatically take over if the active RP router becomes unavailable.
- ◆ If the **no** form of this command is used without specifying a multicast group, all multicast groups are removed.

## Example

In the following example, the first PIM-SM command just specifies the RP address 192.168.1.1 to indicate that it will be used to service all multicast groups. The second PIM-SM command includes the multicast groups to be serviced by the RP.

```
Console(config)#ipv6 pim rp-address 2001:DB8:2222:7272::72
Console(config)#ipv6 pim rp-address 2001:DB8:2222:7272::72 group-prefix
  FFAA::0101/8
Console(config)#end
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Groups          : FF00::/8
RP address      : 2001:DB8:2222:7272::72/128
Info source     : static
Uptime         : 00:03:10
Expire          : Never
Console#
```

**ipv6 pim rp-candidate** This command configures the router to advertise itself as a Rendezvous Point (RP) candidate to the bootstrap router (BSR). Use the **no** form to remove this router as an RP candidate.

### Syntax

**ipv6 pim rp-candidate interface vlan** *vlan-id*  
[**group-prefix** *group-prefix*] [**interval** *seconds*] [**priority** *value*]

**no ipv6 pim rp-candidate interface vlan** *vlan-id*

*vlan-id* - VLAN ID (Range: 1-4094)

*group-prefix* - An IPv6 network prefix for a multicast group. If a group prefix is not specified, the RP is advertised for all multicast groups.

*seconds* - The interval at which this device advertises itself as an RP candidate. (Range: 60-16383 seconds)

*value* - Priority used by the candidate RP in the election process. The RP candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the RP. Setting the priority to zero means that this router is not eligible to server as the RP. (Range: 0-255)

### Default Setting

Interval: 60 seconds

Priority: 0

### Command Mode

Global Configuration

### Command Usage

- ◆ When the **ipv6 pim rp-candidate** command is entered, the router periodically sends PIMv2 messages to the BSR advertising itself as a candidate RP for the specified group addresses. The IP address of the designated VLAN is sent as the candidate's RP address. The BSR places information about all of the candidate RPs in subsequent bootstrap messages. The BSR uses the RP-election hash algorithm to select an active RP for each group range. The election process is performed by the BSR only for its own use. Each PIM-SM router that receives the list of RP candidates from the BSR also elects an active RP for each group range using the same election process.
- ◆ The election process for each group is based on the following criteria:
  - Find all RPs with the most specific group range.
  - Select those with the highest priority (lowest priority value).
  - Compute a hash value based on the group address, RP address, priority, and hash mask included in the bootstrap messages.
  - If there is a tie, use the candidate RP with the highest IP address.



- ◆ This distributed election process provides faster convergence and minimal disruption when an RP fails. It also serves to provide load balancing by distributing groups across multiple RPs. Moreover, when an RP fails, the responsible RPs are re-elected on each router, and the groups automatically distributed to the remaining RPs.
- ◆ To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

### Example

The following example configures the router to start advertising itself to the BSR as a candidate RP for the indicated multicast groups.

```

Console(config)#ipv6 pim rp-candidate interface vlan 1 group-prefix
  FFAA::0101/8
Console(config)#end
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Groups          : FF00::/8
RP address      : 2001:DB8:2222:7272::72/128
Info source     : 2001:DB8:2222:7272::72/128, via bootstrap, priority: 0
Uptime         : 00:02:35
Expire          : 00:01:55
Console#

```

### ipv6 pim spt-threshold

This command prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode. Use the **no** form to allow the router to switch over to SPT mode.

### Syntax

**ipv6 pim spt-threshold infinity** [**group-prefix** *group-prefix*]

**no ipv6 pim spt-threshold infinity**

*group-prefix* - An IPv6 network prefix for a multicast group. If a group address is not specified, the command applies to all multicast groups. (Range: FFXX:X:X:X::X/<8-128>)

### Default Setting

The last-hop PIM6 router joins the shortest path tree immediately after the first packet arrives from a new source.

### Command Mode

Global Configuration

### Command Usage

- ◆ The default path for packets from a multicast source to a receiver is through the RP. However, the path through the RP is not always the shortest path. Therefore, the router uses the RP to forward only the first packet from a new multicast

group to its receivers. Afterwards, it calculates the shortest path tree (SPT) directly between the receiver and source, and then uses the SPT to send all subsequent packets from the source to the receiver instead of using the shared tree. Note that when the SPT threshold is not set by this command, the PIM leaf router will join the shortest path tree immediately after receiving the first packet from a new source.

- ◆ This command forces the router to use the shared tree for all multicast groups, or just for the specified multicast groups.
- ◆ Only one entry is allowed for this command.

### Example

This example prevents the switch from using the SPT for multicast groups FF01:1::0101/64.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 pim sparse-mode
Console(config-if)#exit
Console(config)#ipv6 multicast-routing
Console(config)#router pim6
Console(config)#ipv6 pim spt-threshold infinity group-prefix FF01:1::0101/64
Console#
```

**ipv6 pim dr-priority** This command sets the priority value for a Designated Router (DR) candidate. Use the **no** form to restore the default setting.

### Syntax

**ipv6 pim dr-priority** *priority-value*

**no ipv6 pim dr-priority**

*priority-value* - Priority advertised by a router when bidding to become the DR. (Range: 0-4294967294)

### Default Setting

1

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ More than one PIM-SM router may be connected to an Ethernet or other shared-media LAN. If multicast hosts are directly connected to the LAN, then only one of these routers is elected as the DR, and acts on behalf of these hosts, sending periodic Join/Prune messages toward a group-specific RP for each group. A single DR is elected per interface (LAN or otherwise) using a simple election process.

- ◆ The router with the highest priority configured on an interface is elected as the DR. If more than one router attached to this interface uses the same priority, then the router with the highest IP address is elected to serve as the DR.
- ◆ If a router does not advertise a priority in its hello messages, it is assumed to have the highest priority and is elected as the DR. If more than one router is not advertising its priority, then the router with the highest IP address is elected to serve as the DR.

### Example

This example sets the priority used in the bidding process for the DR.

```

Console(config)#interface vlan 1
Console(config-if)#ipv6 pim dr-priority 20
Console(config-if)#end
Console#show ipv6 pim interface
PIM is enabled.
VLAN 1 is up.
PIM Mode                : Sparse Mode
IPv6 Address             : FE80::200:E8FF:FE93:82A0
Hello Interval           : 30 sec
Hello HoldTime           : 105 sec
Triggered Hello Delay    : 5 sec
Join/Prune Holdtime      : 210 sec
Lan Prune Delay          : Disabled
Propagation Delay        : 500 ms
Override Interval        : 2500 ms
DR Priority               : 20
Join/Prune Interval      : 60 sec

Console#

```

**ipv6 pim join-prune-interval** This command sets the join/prune timer. Use the **no** form to restore the default setting.

### Syntax

**ipv6 pim join-prune-interval** *seconds*

**no ipv6 pim join-prune-interval**

*seconds* - The interval at which join/prune messages are sent.  
(Range: 1-65535 seconds)

### Default Setting

60 seconds

### Command Mode

Interface Configuration (VLAN)

### Command Usage

- ◆ By default, the switch sends join/prune messages every 210 seconds to inform other PIM-SM routers about clients who want to join or leave a multicast group.

- ◆ Use the same join/prune message interval on all the PIM-SM routers in the same PIM-SM domain, otherwise the routing protocol's performance will be adversely affected.
- ◆ The multicast interface that first receives a multicast stream from a particular source forwards this traffic only to those interfaces on the router that have requested to join this group. When there are no longer any requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The protocol maintains both the current join state and the pending Reverse Path Tree (RPT) prune state for this (source, group) pair until the join/prune-interval timer expires.

### Example

This example sets the priority used in the bidding process for the DR.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 pim join-prune-interval 220
Console#show ipv6 pim interface
PIM is enabled.
VLAN 1 is up.
PIM Mode                : Sparse Mode
IPv6 Address             : FE80::200:E8FF:FE93:82A0
Hello Interval           : 30 sec
Hello HoldTime           : 105 sec
Triggered Hello Delay    : 5 sec
Join/Prune Holdtime      : 210 sec
Lan Prune Delay          : Disabled
Propagation Delay        : 500 ms
Override Interval        : 2500 ms
DR Priority               : 1
Join/Prune Interval      : 220 sec

Console#
```

**clear ipv6 pim bsr rp-set** This command clears multicast group to RP mapping entries learned through the PIMv2 bootstrap router (BSR).

**Command Mode**  
Privileged Exec

### Command Usage

- ◆ This command can be used to update entries in the static multicast forwarding table immediately after making configuration changes to the RP.
- ◆ Use the [show ipv6 pim rp mapping](#) command to display active RPs that are cached with associated multicast routing entries.

### Example

This example clears the RP map.

```
Console#clear ipv6 pim bsr rp-set
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Console#
```

**show ipv6 pim bsr-router** This command displays information about the bootstrap router (BSR).

### Command Mode

Privileged Exec

### Command Usage

This command displays information about the elected BSR.

### Example

This example displays information about the BSR.

```
Console#show ipv6 pim bsr-router
PIMv2 Bootstrap information
BSR address      : 2001:DB8:2222:7272::72/128
Uptime          : 00:00:04
BSR Priority     : 200
Hash mask length : 20
Expire          : 00:02:06
Role            : Candidate BSR
State           : Elected BSR
Console#
```

**Table 235: show ip pim bsr-router - display description**

Field	Description
BSR Address	IP address of interface configured as the BSR.
Uptime	The time this BSR has been up and running.
BSR Priority	Priority assigned to this interface for use in the BSR election process.
Hash Mask Length	The number of significant bits used in the multicast group comparison mask. This mask determines the multicast group for which this router can be a BSR.
Expire	The time before this entry will be removed.

**Table 235: show ip pim bsr-router - display description**

Field	Description
Role	Candidate BSR or Non-candidate BSR.
State	Operation state of BSR includes: <ul style="list-style-type: none"><li>◆ No information – No information stored for this device.</li><li>◆ Accept Any – The router does not know of an active BSR, and will accept the first bootstrap message it sees as giving the new BSR's identity and the RP-set.</li><li>◆ Accept Preferred – The router knows the identity of the current BSR, and is using the RP-set provided by that BSR. Only bootstrap messages from that BSR or from a C-BSR with higher weight than the current BSR will be accepted.</li><li>◆ Candidate BSR – Bidding in election process.</li><li>◆ Pending-BSR – The router is a candidate to be the BSR for the RP-set. Currently, no other router is the preferred BSR, but this router is not yet the elected BSR.</li><li>◆ Elected BSR – elected to serve as BSR</li></ul>

**show ipv6 pim rp mapping** This command displays active RPs and associated multicast routing entries.

**Command Mode**  
Privileged Exec

**Example**  
This example displays the RP map.

```
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Groups          : FF00::/8
RP address      : 2001:DB8:2222:7272::72/128
Info source     : static
Uptime         : 00:23:21
Expire         : Never
Console#
```

**Table 236: show ip pim rp mapping - display description**

Field	Description
Groups	The multicast group address, mask length managed by the RP.
RP address	IP address of the RP used for the listed multicast group
Info source	RP that advertised the mapping, how the RP was selected (Static or Bootstrap), and the priority used in the bidding process
Uptime	The time this RP has been up and running
Expire	The time before this entry will be removed

**show ipv6 pim rp-hash** This command displays the RP used for the specified multicast group, and the RP that advertised the mapping.

#### Syntax

**show ipv6 pim rp-hash** *group-address*

*group-address* - An IP multicast group address.

#### Command Mode

Privileged Exec

#### Example

This example displays the RP used for the specified group.

```
Console#show ipv6 pim rp-hash FF00::  
RP address      : 2001:DB8:2222:7272::72/128  
Info source     : 2001:1::0101, via bootstrap  
Console#
```

**Table 237: show ip pim rp-hash - display description**

Field	Description
RP address	IP address of the RP used for the specified multicast group
Info source	RP that advertised the mapping, and how the RP was selected





# Section III

## Appendices

This section provides additional information and includes these items:

- ◆ [“Troubleshooting” on page 1211](#)
- ◆ [“License Statement / GPL Code Statement” on page 1213](#)





# Troubleshooting

## Problems Accessing the Management Interface

Table 238: Troubleshooting Chart

Symptom	Action
Cannot connect using Telnet, or SNMP software	<ul style="list-style-type: none"><li>◆ Be sure the switch is powered up.</li><li>◆ Check network cabling between the management station and the switch. Make sure the ends are properly connected and there is no damage to the cable. Test the cable if necessary.</li><li>◆ Check that you have a valid network connection to the switch and that the port you are using has not been disabled.</li><li>◆ Be sure you have configured the VLAN interface through which the management station is connected with a valid IP address, subnet mask and default gateway.</li><li>◆ Be sure the management station has an IP address in the same subnet as the switch's IP interface to which it is connected.</li><li>◆ If you are trying to connect to the switch via the IP address for a tagged VLAN group, your management station, and the ports connecting intermediate switches in the network, must be configured with the appropriate tag.</li><li>◆ If you cannot connect using Telnet, you may have exceeded the maximum number of concurrent Telnet/SSH sessions permitted. Try connecting again at a later time.</li></ul>
Cannot connect using Secure Shell	<ul style="list-style-type: none"><li>◆ If you cannot connect using SSH, you may have exceeded the maximum number of concurrent Telnet/SSH sessions permitted. Try connecting again at a later time.</li><li>◆ Be sure the control parameters for the SSH server are properly configured on the switch, and that the SSH client software is properly configured on the management station.</li><li>◆ Be sure you have generated both an RSA and DSA public key on the switch, exported this key to the SSH client, and enabled SSH service. Try using another SSH client or check for updates to your SSH client application.</li><li>◆ Be sure you have set up an account on the switch for each SSH user, including user name, authentication level, and password.</li><li>◆ Be sure you have imported the client's public key to the switch (if public key authentication is used).</li></ul>
Cannot access the on-board configuration program via a serial port connection	<ul style="list-style-type: none"><li>◆ Be sure you have set the terminal emulator program to VT100 compatible, 8 data bits, 1 stop bit, no parity, and the baud rate set to 115200 bps.</li><li>◆ Verify that you are using the RJ-45 to DB-9 null-modem serial cable supplied with the switch. If you use any other cable, be sure that it conforms to the pin-out connections provided in the Installation Guide.</li></ul>
Forgot or lost the password	<ul style="list-style-type: none"><li>◆ Contact your local distributor.</li></ul>

## Using System Logs

If a fault does occur, refer to the Installation Guide to ensure that the problem you encountered is actually caused by the switch. If the problem appears to be caused by the switch, follow these steps:

1. Enable logging.
2. Set the error messages reported to include all categories.
3. Enable SNMP.
4. Enable SNMP traps.
5. Designate the SNMP host that is to receive the error messages.
6. Repeat the sequence of commands or other actions that lead up to the error.
7. Make a list of the commands or circumstances that led to the fault. Also make a list of any error messages displayed.
8. Set up your terminal emulation software so that it can capture all console output to a file. Then enter the “show tech-support” command to record all system settings in this file.
9. Contact your distributor’s service engineer, and send a detailed description of the problem, along with the file used to record your system settings.

For example:

```
Console(config)#logging on
Console(config)#logging history flash 7
Console(config)#snmp-server host 192.168.1.23
:
```



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```

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```

```
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```

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# Glossary

**ACL** Access Control List. ACLs can limit network traffic and restrict access to certain users or devices by checking each packet for certain IP or MAC (i.e., Layer 2) information.

**ARP** Address Resolution Protocol converts between IP addresses and MAC (hardware) addresses. ARP is used to locate the MAC address corresponding to a given IP address. This allows the switch to use IP addresses for routing decisions and the corresponding MAC addresses to forward packets from one hop to the next.

**BGP** Border Gateway Protocol is a protocol used to make core routing decisions on the Internet. It maintains a table of IP networks to register reachability among autonomous systems (AS). BGP makes routing decisions based on path, network policies and/or rule-sets.

**BOOTP** Boot Protocol. BOOTP is used to provide bootup information for network devices, including IP address information, the address of the TFTP server that contains the devices system files, and the name of the boot file.

**CoS** Class of Service is supported by prioritizing packets based on the required level of service, and then placing them in the appropriate output queue. Data is transmitted from the queues using weighted round-robin service to enforce priority service and prevent blockage of lower-level queues. Priority may be set according to the port default, the packet's priority bit (in the VLAN tag), TCP/UDP port number, IP Precedence bit, or DSCP priority bit.

**DHCP** Dynamic Host Control Protocol. Provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.

**DHCP Option 82** A relay option for sending information about the requesting client (or an intermediate relay agent) in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server. This information can be used by DHCP servers to assign fixed IP addresses, or set other services or policies for clients.

**DHCP Snooping** A technique used to enhance network security by snooping on DHCP server messages to track the physical location of hosts, ensure that hosts only use the IP addresses assigned to them, and ensure that only authorized DHCP servers are accessible.

- DiffServ** Differentiated Services provides quality of service on large networks by employing a well-defined set of building blocks from which a variety of aggregate forwarding behaviors may be built. Each packet carries information (DS byte) used by each hop to give it a particular forwarding treatment, or per-hop behavior, at each network node. DiffServ allocates different levels of service to users on the network with mechanisms such as traffic meters, shapers/droppers, packet markers at the boundaries of the network.
- DNS** Domain Name Service. A system used for translating host names for network nodes into IP addresses.
- DSCP** Differentiated Services Code Point Service. DSCP uses a six-bit tag to provide for up to 64 different forwarding behaviors. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding. The DSCP bits are mapped to the Class of Service categories, and then into the output queues.
- EAPOL** Extensible Authentication Protocol over LAN. EAPOL is a client authentication protocol used by this switch to verify the network access rights for any device that is plugged into the switch. A user name and password is requested by the switch, and then passed to an authentication server (e.g., RADIUS) for verification. EAPOL is implemented as part of the IEEE 802.1X Port Authentication standard.
- EUI** Extended Universal Identifier is an address format used by IPv6 to identify the host portion of the network address. The interface identifier in EUI compatible addresses is based on the link-layer (MAC) address of an interface. Interface identifiers used in global unicast and other IPv6 address types are 64 bits long and may be constructed in the EUI-64 format. The modified EUI-64 format interface ID is derived from a 48-bit link-layer address by inserting the hexadecimal number FFFE between the upper three bytes (OUI field) and the lower 3 bytes (serial number) of the link layer address. To ensure that the chosen address is from a unique Ethernet MAC address, the 7th bit in the high-order byte is set to 1 (equivalent to the IEEE Global/Local bit) to indicate the uniqueness of the 48-bit address.
- GARP** Generic Attribute Registration Protocol. GARP is a protocol that can be used by endstations and switches to register and propagate multicast group membership information in a switched environment so that multicast data frames are propagated only to those parts of a switched LAN containing registered endstations. Formerly called Group Address Registration Protocol.
- GMRP** Generic Multicast Registration Protocol. GMRP allows network devices to register end stations with multicast groups. GMRP requires that any participating network devices or end stations comply with the IEEE 802.1p standard.
- GVRP** GARP VLAN Registration Protocol. Defines a way for switches to exchange VLAN information in order to register necessary VLAN members on ports along the Spanning Tree so that VLANs defined in each switch can work automatically over a Spanning Tree network.

- ICMP** Internet Control Message Protocol is a network layer protocol that reports errors in processing IP packets. ICMP is also used by routers to feed back information about better routing choices.
- IEEE 802.1D** Specifies a general method for the operation of MAC bridges, including the Spanning Tree Protocol.
- IEEE 802.1Q** VLAN Tagging—Defines Ethernet frame tags which carry VLAN information. It allows switches to assign endstations to different virtual LANs, and defines a standard way for VLANs to communicate across switched networks.
- IEEE 802.1p** An IEEE standard for providing quality of service (QoS) in Ethernet networks. The standard uses packet tags that define up to eight traffic classes and allows switches to transmit packets based on the tagged priority value.
- IEEE 802.1s** An IEEE standard for the Multiple Spanning Tree Protocol (MSTP) which provides independent spanning trees for VLAN groups.
- IEEE 802.1w** An IEEE standard for the Rapid Spanning Tree Protocol (RSTP) which reduces the convergence time for network topology changes to about 10% of that required by the older IEEE 802.1D STP standard. (Now incorporated in IEEE 802.1D-2004)
- IEEE 802.1X** Port Authentication controls access to the switch ports by requiring users to first enter a user ID and password for authentication.
- IEEE 802.3ac** Defines frame extensions for VLAN tagging.
- IEEE 802.3x** Defines Ethernet frame start/stop requests and timers used for flow control on full-duplex links. (Now incorporated in IEEE 802.3-2002)
- IGMP** Internet Group Management Protocol. A protocol through which hosts can register with their local router for multicast services. If there is more than one multicast switch/router on a given subnetwork, one of the devices is made the “querier” and assumes responsibility for keeping track of group membership.
- IGMP Proxy** Proxies multicast group membership information onto the upstream interface based on IGMP messages monitored on downstream interfaces, and forwards multicast traffic based on that information. There is no need for multicast routing protocols in a simple tree that uses IGMP Proxy.

**IGMP Query** On each subnetwork, one IGMP-capable device will act as the querier — that is, the device that asks all hosts to report on the IP multicast groups they wish to join or to which they already belong. The elected querier will be the device with the lowest IP address in the subnetwork.

**IGMP Snooping** Listening to IGMP Query and IGMP Report packets transferred between IP Multicast Routers and IP Multicast host groups to identify IP Multicast group members.

**In-Band Management** Management of the network from a station attached directly to the network.

**IP Multicast Filtering** A process whereby this switch can pass multicast traffic along to participating hosts.

**IP Precedence** The Type of Service (ToS) octet in the IPv4 header includes three precedence bits defining eight different priority levels ranging from highest priority for network control packets to lowest priority for routine traffic. The eight values are mapped one-to-one to the Class of Service categories by default, but may be configured differently to suit the requirements for specific network applications.

**LACP** Link Aggregation Control Protocol. Allows ports to automatically negotiate a trunked link with LACP-configured ports on another device.

**Layer 2** Data Link layer in the ISO 7-Layer Data Communications Protocol. This is related directly to the hardware interface for network devices and passes on traffic based on MAC addresses.

**Layer 3** Network layer in the ISO 7-Layer Data Communications Protocol. This layer handles the routing functions for data moving from one open system to another.

**Link Aggregation** *See Port Trunk.*

**LLDP** Link Layer Discovery Protocol is used to discover basic information about neighboring devices in the local broadcast domain by using periodic broadcasts to advertise information such as device identification, capabilities and configuration settings.

**MD5** MD5 Message-Digest is an algorithm that is used to create digital signatures. It is intended for use with 32 bit machines and is safer than the MD4 algorithm, which has been broken. MD5 is a one-way hash function, meaning that it takes a message and converts it into a fixed string of digits, also called a message digest.



**MIB** Management Information Base. An acronym for Management Information Base. It is a set of database objects that contains information about a specific device.

**MRD** Multicast Router Discovery is a A protocol used by IGMP snooping and multicast routing devices to discover which interfaces are attached to multicast routers. This process allows IGMP-enabled devices to determine where to send multicast source and group membership messages.

**MSTP** Multiple Spanning Tree Protocol can provide an independent spanning tree for different VLANs. It simplifies network management, provides for even faster convergence than RSTP by limiting the size of each region, and prevents VLAN members from being segmented from the rest of the group.

**Multicast Switching** A process whereby the switch filters incoming multicast frames for services for which no attached host has registered, or forwards them to all ports contained within the designated multicast VLAN group.

**MVR** Multicast VLAN Registration is a method of using a single network-wide multicast VLAN to transmit common services, such as such as television channels or video-on-demand, across a service-provider's network. MVR simplifies the configuration of multicast services by using a common VLAN for distribution, while still preserving security and data isolation for subscribers residing in both the MVR VLAN and other standard groups.

**NTP** Network Time Protocol provides the mechanisms to synchronize time across the network. The time servers operate in a hierarchical-master-slave configuration in order to synchronize local clocks within the subnet and to national time standards via wire or radio.

**OSPF** Open Shortest Path First is a link-state routing protocol that functions better over a larger network such as the Internet, as opposed to distance-vector routing protocols such as RIP. It includes features such as unlimited hop count, authentication of routing updates, and Variable Length Subnet Masks (VLSM).

**Out-of-Band Management** Management of the network from a station not attached to the network.

**Port Authentication** *See IEEE 802.1X.*

**Port Mirroring** A method whereby data on a target port is mirrored to a monitor port for troubleshooting with a logic analyzer or RMON probe. This allows data on the target port to be studied unobstructively.

- Port Trunk** Defines a network link aggregation and trunking method which specifies how to create a single high-speed logical link that combines several lower-speed physical links.
- QinQ** QinQ tunneling is designed for service providers carrying traffic for multiple customers across their networks. It is used to maintain customer-specific VLAN and Layer 2 protocol configurations even when different customers use the same internal VLAN IDs.
- QoS** Quality of Service. QoS refers to the capability of a network to provide better service to selected traffic flows using features such as data prioritization, queuing, congestion avoidance and traffic shaping. These features effectively provide preferential treatment to specific flows either by raising the priority of one flow or limiting the priority of another flow.
- RADIUS** Remote Authentication Dial-in User Service. RADIUS is a logon authentication protocol that uses software running on a central server to control access to RADIUS-compliant devices on the network.
- RIP** Routing Information Protocol seeks to find the shortest route to another device by minimizing the distance-vector, or hop count, which serves as a rough estimate of transmission cost. RIP-2 is a compatible upgrade to RIP. It adds useful capabilities for subnet routing, authentication, and multicast transmissions.
- RMON** Remote Monitoring. RMON provides comprehensive network monitoring capabilities. It eliminates the polling required in standard SNMP, and can set alarms on a variety of traffic conditions, including specific error types.
- RSTP** Rapid Spanning Tree Protocol. RSTP reduces the convergence time for network topology changes to about 10% of that required by the older IEEE 802.1D STP standard.
- SMTP** Simple Mail Transfer Protocol is a standard host-to-host mail transport protocol that operates over TCP, port 25.
- SNMP** Simple Network Management Protocol. The application protocol in the Internet suite of protocols which offers network management services.
- SNTP** Simple Network Time Protocol allows a device to set its internal clock based on periodic updates from a Network Time Protocol (NTP) server. Updates can be requested from a specific NTP server, or can be received via broadcasts sent by NTP servers.

- SSH** Secure Shell is a secure replacement for remote access functions, including Telnet. SSH can authenticate users with a cryptographic key, and encrypt data connections between management clients and the switch.
- STA** Spanning Tree Algorithm is a technology that checks your network for any loops. A loop can often occur in complicated or backup linked network systems. Spanning Tree detects and directs data along the shortest available path, maximizing the performance and efficiency of the network.
- TACACS+** Terminal Access Controller Access Control System Plus. TACACS+ is a logon authentication protocol that uses software running on a central server to control access to TACACS-compliant devices on the network.
- TCP/IP** Transmission Control Protocol/Internet Protocol. Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.
- Telnet** Defines a remote communication facility for interfacing to a terminal device over TCP/IP.
- TFTP** Trivial File Transfer Protocol. A TCP/IP protocol commonly used for software downloads.
- UDP** User Datagram Protocol. UDP provides a datagram mode for packet-switched communications. It uses IP as the underlying transport mechanism to provide access to IP-like services. UDP packets are delivered just like IP packets – connection-less datagrams that may be discarded before reaching their targets. UDP is useful when TCP would be too complex, too slow, or just unnecessary.
- UTC** Universal Time Coordinate. UTC is a time scale that couples Greenwich Mean Time (based solely on the Earth's rotation rate) with highly accurate atomic time. The UTC does not have daylight saving time.
- VLAN** Virtual LAN. A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, and allows users to share information and resources as though located on the same LAN.
- VRRP** Virtual Router Redundancy Protocol uses a virtual IP address to support a primary router and multiple backup routers. The backups can be configured to take over the workload if the master fails or to load share the traffic. The primary goal of VRRP is to allow a host device which has been configured with a fixed gateway to maintain network connectivity in case the primary gateway goes down.

**XModem** A protocol used to transfer files between devices. Data is grouped in 128-byte blocks and error-corrected.

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