QoS Configuration

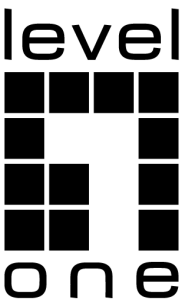

Table of Contents

Chapter 1 QoS Configuration 1
1.1 QoS Overview 1
1.1.1 QoS Concept 1
1.1.2 Terminal-To-Terminal QoS Model 1
1.1.3 Queue Algorithm of QoS 2
1.2 QoS Configuration Task List 3
1.3 QoS Configuration Tasks 3
1.3.1 Setting the Global cos Priority Queue 3
1.3.2 Configuring global cos to local priority mapping 4
1.3.3 Setting the Bandwidth of the CoS Priority Queue 4
1.3.4 Setting the Schedule Policy of the CoS Priority Queue 5
1.3.5 Configuring the minimum bandwidth and maximum bandwidth of the cos priority queue of the port 5
1.3.6 Setting the Default CoS Value of a Port 6
1.3.7 Setting the CoS Priority Queue Based on DSCP 6
1.3.8 Establishing the QoS Policy Mapping 7
1.3.9 Setting the Description of the QoS Policy Mapping 7
1.3.10 Setting the Matchup Data Flow of the QoS Policy Mapping 7
1.3.11 Setting the Actions of the Matchup Data Flow of the QoS Policy Mapping 9
1.3.12 Applying the QoS Policy on a Port 11
1.3.13 Configuring Trust Mode 11
1.3.14 Displaying the QoS Policy Mapping Table 12
1.4 QoS Configuration Example 12
1.4.1 Example for Applying the QoS Policy on a Port 12

Chapter 1 QoS Configuration

If you care to use your bandwidth sufficiently and your network resources efficiently, you must pay attention to QoS configuration.

1.1 QoS Overview

1.1.1 QoS Concept

In general, the switch works in best-effort served mode in which the switch treats all flows equally and tries its best to deliver all flows. Thus if congestion occurs all flows have the same chance to be discarded. However in a real network different flows have different significances, and the QoS function of the switch can provide different services to different flows based on their own significances, in which the important flows will receive a better service.

As to classify the importance of flows, there are two main ways on the current network:

- The tag in the 802.1Q frame header has two bytes and 3 bits are used to present the priority of the packet. There are 8 priorities, among which 0 means the lowest priority and 7 means the highest priority.
- The DSCP field in IP header of the IP packet uses the bottom 6 bits in the TOS domain of the IP header.

In real network application the edge switch distributes different priorities to different flows based on their significance and then different services will be provided to different flows based on their priorities, which is the way to realize the terminal-to-terminal QoS.

Additionally, you can also configure a switch in a network, enabling the switch to process those packets with specific attributes (according to the MAC layer or the L3 information of packets) specially. This kind of behaviors are called as the one-leap behaviors.

The QoS function of the switch optimizes the usage of limited network bandwidth so that the entire performance of the network is greatly improved.

1.1.2 Terminal-To-Terminal QoS Model

The service model describes a group of terminal-to-terminal QoS abilities, that is, the abilities for a network to transmit specific network communication services from one terminal to another terminal.

1. Differentiated service

As to the differentiated service, if a special service is to be transmitted in a network, each packet should be specified with a corresponding QoS tag. This designation can

be embodied in different modes, such as, use IP priority status setting in IP data packet. The switch uses this QoS rule to conduct classification and complete the intelligent queuing. The QoS of the switch provides Strict Priority (SP), Weighted Round Robin (WRR), and Weighted Fair Queuing (WFQ).

1.1.3 Queue Algorithm of QoS

Each queue algorithm is the important basis to realize QoS. The QoS of the switch provides the following algorithms: Strict Priority (SP), Weighted Round Robin (WRR), and Weighted Fair Queuing (WFQ).

1. Strict Priority

This algorithm means to first provide service to the flow with the highest priority and after the highest-priority flow comes the service for the next-to-highest flow. This algorithm provides a comparatively good service to those flows with relatively high priority, but its shortage is also explicit that the flows with low priority cannot get service and wait to die.

2. Weighted Round Robin

Weighted Round Robin (WRR) is an effective solution to the defect of Strict Priority (SP), in which the low-priority queues always die out. WRR is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority. After the queue with highest priority has used up all its bandwidth, the system automatically provides service to those queues with next highest priority.

3. Weighted Fair Queuing

Weighted Fair Queuing (WFQ) classifies the packet according to the priority of the traffic. It sets the egress bandwidth based on the weight of each traffic. The bigger the weight, the greater the bandwidth. Thus, it guarantees the fairness of priority services and embodies the weight of different priority services.

4. Deficit Round Robin

DRR is an extension of the RR algorithm. DRR algorithm assigns each queue a constant Q_N (time slice proportional to the weight) and a D_N (difference). QN reflects the long-term average number of bytes that the queue can send. When the initial value of D_N is zero and the queue is empty, reset to zero. When the DRR algorithm serves a new queue, the scheduler resets the counter B_{sent} (representing the number of bytes has sent from the queue). When the following two conditions are met, the DRR algorithm sends packets from the queue: 1. There are packets waiting to be sent in the queue; 2, (Q_N+D_N) is greater than or equal to (B_{sent} plus the length of the next packet in the queue). Otherwise, the queue's difference D_N+1 is set to Q_N+D_N - B_{sent}, and the scheduler moves to the next queue in sequence.

1.2 QoS Configuration Task List

In general, ONU will try its best to deliver each packet and when congestion occurs all packets have the same chance to be discarded. However, in reality different packets have different importance and the comparatively important packets should get the comparatively good service. QoS is a mechanism to provide different priority services to packets with different importance, in which the network can have its better performance and be used efficiently.

This chapter presents how to set QoS on ONU.

The following are QoS configuration tasks:

- Setting the Global cos Priority Queue
- Setting the Bandwidth of the cos Priority Queue
- Setting the Schedule Policy of the CoS Priority Queue
- Configuring the minimum bandwidth and maximum bandwidth of the cos priority queue of the port
- Setting the Default cos Value of a Port
- Setting the cos Priority Queue of a Port
- Setting the CoS Priority Queue based on dscp
- Establishing the QoS Policy Mapping
- Setting the Description of the QoS Policy Mapping
- Setting the Matchup Data Flow of the QoS Policy Mapping
- Setting the Actions of the Matchup Data Flow of the QoS Policy Mapping
- Applying the QoS Policy on a Port
- Configuring Trust Mode
- Displaying the QoS Policy Mapping Table

1.3 QoS Configuration Tasks

1.3.1 Setting the Global cos Priority Queue

The task to set the QoS priority queue is to map 8 CoS values, which are defined by IEEE802.1p, to the priority queues in a switch. This series of switch has 8 priority queues. According to different queues, the switch will take different schedule policies to realize QoS.

If a CoS priority queue is set in global mode, the mapping of CoS priority queue on all ports will be affected. When priority queues are set on a L2 port, the priority queues can only work on this L2 port.

Enter the following management mode and run the following commands one by one to set CoS priority queue.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **cos map** *quid cos1..cosn*	Sets the CoS priority queue. quid stands for the ID of a CoS priority queue. cos1…cosn stands for the IEEE802.1p-defined CoS value.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.2 Configuring global cos to local priority mapping

Re-map the internal CoS priority and congestion bits according to the cos value.

Enter the following management mode and run the following commands one by one to set local priority mapping.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **cos map-local-priority** *cos-value1* {**cos** *cos-value2* | **cng** *cng-bit* }	Set cos to local priority mapping. cos-value1 stands for the CoS value defined by IEEE802.1p, range 0-7. cos-value2 stands for the remapped internal priority cos, range 0-7. cng-bit stands for the congestion bit of cos mapping.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.3 Setting the Bandwidth of the CoS Priority Queue

The bandwidth of priority queue means the bandwidth distribution ratio of each priority queue, which is set when the schedule policy of the CoS priority queue is set to wrr or wfq. This series of switches has 8 priority queues in total.

If this command is run, the bandwidth of all priority queues on all interfaces are affected. This command validates only when the queue schedule mode is set to WRR/WFQ. This command decides the bandwidth weight value of the CoS priority queue when the WRR/WFQ schedule policy is used.

Run the following commands one by one to set the bandwidth of the CoS priority queue.

Command	Purpose
config	Enters the global configuration mode.

[**no**] **scheduler weight bandwidth** *weight1...weightn*	Sets the bandwidth of the CoS priority queue.. weight1…weightn stand for the weights of 8 CoS priority queues of WRR/DRR.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.4 Setting the Schedule Policy of the CoS Priority Queue

A switch has many output queues on each of its port. This series of switches has 8 priority queues. The output queues can adopt the following four schedule modes:

- SP (Sheer Priority): In this algorithm, only when the high-priority queue is null can the packets in the low-priority queue be forwarded, and if there are packets in the high-priority queue these packets will be unconditionally forwarded.
- WRR (Weighted Round Robin) is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority.
- WFQ (Weighted Fair Queuing) is an algorithm that brings each priority queue a certain bandwidth according to the priority of the flow.
- DRR (Defict Round Robin): It assigns a Q_N (time slice proportional to weight) and a D_N (difference) to each queue. For packets waiting to be sent in the queue, when $(Q_N + D_N) > B_{sent}$ (Scheduler reset counter), the packet is sent from the queue. Otherwise, the scheduling moves to the next queue in order, and D_{N+1} is set to $Q_N+D_N-B_{sent}$.

Enter the following configuration mode and set the schedule policy of CoS priority queue.

Command	Purpose
config	Enters the global configuration mode.
[**no**] **scheduler policy** { **sp** | **wrr** | **wfq** | **drr** }	Sets the schedule policy of the CoS priority queue. **sp** means to use the SP schedule policy. **wrr** means to use the WRR schedule policy. wfq means to use the WFQ schedule policy. drr means to use the drr schedule policy.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.5 Configuring the minimum bandwidth and maximum bandwidth of the cos priority queue of the port

The minimum and maximum bandwidth of the port cos priority queue can be configured to change, that is, all flows below the minimum bandwidth will pass through and will not be dropped in the queue, and flows higher than the maximum bandwidth will be discarded.

Enter the management mode and run the following commands to set:

Command	Purpose
config	Enters the global configuration mode.
interface g0/0/1	Enters the to-be-configured port.
[**no**] **cos bandwidth** *quid min-bandwidth max-bandwidth*	quid stands for the priority queue. min-bandwidth stands for the minimum bandwidth. Max-bandwidth stands for the maximum bandwidth.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.6 Setting the Default CoS Value of a Port

If the port of a switch receives a data frame without tag, the switch will add a default CoS priority to it. Setting the default cos value of a port is to set the untagged default CoS value, which is received by the port, to a designated value.

Enter the management mode and run the following commands to set the default CoS value of a port:

Command	Purpose
config	Enters the global configuration mode.
interface g0/0/1	Enters the to-be-configured port.
[**no**] **cos default** *cos*	Sets the CoS value of the received untagged frames. cos stands for the corresponding CoS value.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.7 Setting the CoS Priority Queue Based on DSCP

Based on the DSCP value, the COS queue is mapped again, the DSCP value is modified and the congestion bit is changed.

Enter the management mode and run the following commands to set the default CoS value of a port:

Command	Purpose
config	Enters the global configuration mode.
[**no**]**dscp map** *word* {**cos** *cos-value* | **cng** *cng-bit* }	Word stands for the DSCP range table. Cos-value means to set the mapped priority CoS.. cng-bit configures the mapped congestion bit.

exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.8 Establishing the QoS Policy Mapping

Flow classification means to identify a class of packets with certain attributes by applying a certain regulation and take designated actions towards to these packets.

Do as follows to set up a QoS policy.

Enter the management mode and then run the following commands to establish a new QoS policy mapping.

Command	Purpose
config	Enters the global configuration mode.
[no]policy-map *name*	Enters the configuration mode of the QoS policy map. name stands for the name of the policy.
exit	Exits from the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.9 Setting the Description of the QoS Policy Mapping

Enter the management mode and run the following commands to set the description of a QoS policy mapping. This settings will replace the previous settings.

Command	Purpose
config	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. name stands for the name of the policy.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.10 Setting the Matchup Data Flow of the QoS Policy Mapping

The classification rule of the QoS data flow means the filtration rule configured by the administrator according to management requirements. It can be simple, for example, flows with different priorities can be identified by the ToS field of the IP packet's header, or complicated, for example, the packets can be classified according to the related information about the comprehensive link layer, the network layer and the transmission layer, such as the MAC address, the source address of IP, the destination address or the port ID of the application. In general, the classification standard is limited in the header of an encapsulated packet. It is rare to use the content of a packet as the classification standard.

Enter the management configuration mode, set the matchup data flow of policy and replace the previous settings with this data flow according to the following steps:

Command	Purpose
config	Enters the global configuration mode.
[no]policy-map name	Enters the configuration mode of the QoS policy map. name stands for the name of the policy.
description description-text	Sets the description of the QoS policy. description-text stands for the text to describe the policy.
classify {**seq** *seqnum* }{**any** | **cos** *cos* | **icos** *icos* | **vlan** *vlanid* | **ivlan** *ivlanid* | **ethernet-type** *ethernet-type* | **precedence** *precedence-value* | **dscp** *dscp-value* | **ip** *ip-access-list* | **ipv6** *ipv6-access-list* | **mac** *mac-access-list* | **exp** *expid* | **tag-num** *num* } **no classify** {**seq** *seqnum* } { **cos** | **icos** | **vlan** | **ivlan** | **ethernet-type** | **precedence** | **dscp** | | **ip** | **ipv6** | **mac | exp | tag-num** }	seqnum stands for the entry number, the default is 1 any stands for matching up with any packet. **icos** stands for the matched COS value which ranges between 0 and 7. **icos** stands for the matched inner COS value which ranges between 0 and 7. **vlanid** stands for the matched VLAN, which ranges from 1 to 4094. **ivlanid** stands for the matched inner VLAN,which ranges from 1 to 4094. **ethernet-type** stands for the matched packet type, which is between 0x0600 and 0xFFFF. **precedence-value** stands for the priority field in tos of IP packet, which ranges from 0 to 7. **dscp-value** stands for the dscp field in tos of IP packet, which ranges from 0 to 63. **Ip-access-list** stands for the name of the matched IP access list. The name has 1 to 20 characters. **Ipv6-access-list** stands for the name of the matched IPv6 access list. The name has 1 to 20 characters. Mac-access-list stands for the name of the matched MAC access list. The name has 1 to -20 characters. expid stands for the matched exp priority. tag-num stands for the number of matched tags, 0-1.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.11 Setting the Actions of the Matchup Data Flow of the QoS Policy Mapping

The actions to define the data flow mean to take corresponding actions to a data flow with compliance of the filtration rule, which include bandwidth limit, drop, update, etc.

Enter the management mode and run the following commands to set the action of a policy, matching up the data flow. The action will replace the previous settings.

Command	Purpose
config	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. name stands for the name of the policy.
action{**seq** *seq* | **bandwidth** *max-band* **| copy-to-cpu |** {**cir** *commit-band* **bc** *commit-burst-size* {**pir** *pir-band* **be** *peak-burst-size*} | {**eir** *excess-band* **ebs** *excess-burst-size*} | {**ebs** *excess-burst-size}* [**confirm** { **forward** | **dscp** *dscp-value* | **discardable** {**green** | **yellow** | **red** } | **copy-to-cpu** | **cos** *cos* | **queue** *qid* } | **exceed** {**forward** | **drop** | **dscp** *dscp-value* | **discardable** {**green** | **yellow** | **red**} | **copy-to-cpu** | **cos** *cos* | **queue** *qid*} | **violate** { **forward** | **drop** | **dscp** *dscp-value* | **discardable** {**green** | **yellow** | **red**} | **copy-to-cpu** | **cos** *cos* | **queue** *qid*}][**color-blind**][**tcm-end**]} **| cos** *cos* **| drop | dscp** *dscp-value* **| precedence** *precedence-value* **| forward | icos** *icos* **| ivlan** {**add** *ivlanid* **| del** *ivlanid* **|** *ivlanid*} **| mac** *mac-addr* **| monitor** *session-value* **| queue** *queue-value* **| redirect** *interface-id* **| stat-packet | stat-byte | vlanID** { **add** *vlanid* | *vlanid* } **no action {seq** *seqnum***}** {**bandwidth | copy-to-cpu | cir | cos | drop | dscp | precedence | forward | icos | ivlan | mac | monitor | queue | redirect | stat-packet | stat-byte | vlanID**}	seqnum stands for the entry number, the default is 1 **max-band** stands for the occupied maximum bandwidth: 1-163840. Unit: 64Kbps Configures policing. cir commit-band means guaranteed bandwidth 1-156250, units 64Kbps; bc commit-burst-size means burst packet size 0-4096, unit Kb; pir pir-band means peak bandwidth 1-156250, units 64Kbps; be peak-burst-size means peak burst size 0-4096, units Kb; eir excess-band means the increment of the peak bandwidth minus the guaranteed bandwidth, 1-156250, unit 64Kbps; ebs excess-burst-size means the burst size of eir increment 0-4096, units Kb; confirm { forward | dscp dscp-value | discardable {green | yellow | red } | copy-to-cpu | cos cos | queue qid } Guaranteed bandwidth action, forward does not perform any action; dscp means to modify the dscp value, 0-63; discardable means to set the discard priority, copy-to-cpu means to copy the message to the cpu, cos means to modify the cos value, 0-7; queue means to modify the message queue, 1-8; exceed {forward | drop | dscp dscp-value | discardable {green | yellow | red} | copy-to-cpu | cos cos | queue qid}. When the

	bandwidth is greater than cir and less than pir, forward does not perform any action, drop discards; dscp means to modify the dscp value, 0-63; discardable means to set the discard priority; copy-to-cpu means to copy the message to the cpu, cos means to modify the cos value, 0-7; queue means to modify the message queue, 1-8; violate { forward | drop | dscp dscp-value | discardable {green | yellow | red} | copy-to-cpu | cos cos | queue; If the bandwidth is greater than pir, forward does not perform any action; drop means to discard, dscp means to modify the dscp value, 0-63; discardable sets the discard priority, copy-to-cpu is used to copy the message to the cpu; cos is used to modify the cos value, 0-7; queue is used to modify the message queue, 1-8; color-blind is used to set color blind mode tcm-end ends policing and configures drop to discard matching packets **drop** means to drop the matched packets. **dscp-value:** Sets the matched DSCP field to dscp-value 0~63. **precedence-value** stands for the priority field in tos of IP packet (5-7 of tos), which ranges from 0 to 7. **Forward:** Conducts no operations to the matched packets. **Icos:** Sets the matched COS field to cos-value 0-7. **ivlanID** used to replace or add the inner vlan ID, which ranges from 1 to 4094. **mac-addr** is used to set the destination mac address. **session-value** is used to set mirroring, which ranges from 1 to 4. **queue-value** is used to set the mapping queue, which ranges from 1 to 8. **Interface-id:** Redirects the egress port of the matched flow. **stat-packet** stands for the number of packets under statistics. **stat-byte** means the number of bytes under

	statistics. **vlanID** is used to replace or add the outer vlan ID, which ranges from 1 to 4094.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.12 Applying the QoS Policy on a Port

The QoS policy can be applied to a port; multiple QoS policies can be applied to the same port and the same QoS policy can also be applied to multiple ports. On the same port, the priorities of the policies which are earlier applied than those of the policies which are later applied. If a packet is set to have two policies and the actions are contradicted, the actions of the firstly matched policies. After a QoS policy is applied on a port, the switch adds a policy to this port by default to block other data flows, which are not allowed to pass through. When all policies on a port are deleted, the switch will automatically remove the default blockage policy from a port.

Enter the following management mode and run the following commands to apply the QoS policy.

Command	Purpose
config	Enters the global configuration mode.
interface g0/0/1	Enters the to-be-configured port.
[**no**] **qos policy** *name* { **ingress**|**egress**}	Applies the QoS policy on a port. name stands for the name of QoS policy mapping. ingress means to exert an influence on the ingress. egress means to exert an influence on the egress.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.13 Configuring Trust Mode

When configuring the trust mode under the global configuration mode, there are three options: cos, dscp or untrust. The data will be mapped to the queue in the option chosen above. If choosing the option: untrust, the priority of the packet will be mapped to the queque by default.

Configuring the trust mode in EXEC mode as the following steps:

Command	Purpose
config	Enters the global configuration mode.
[**no**] **qos trust** { cos | dscp | untrust }	Configuring the trust mode in the global

	configuration mode. Untrust stand for not trust any modes.
exit	Goes back to the EXEC mode.

1.3.14 Displaying the QoS Policy Mapping Table

You can run the show command to display all or some designated QoS policy maps.

Run the following command in management mode to display the QoS policy mapping table.

Command	Purpose
show policy-map [*policy-map-name*]	Displays all or some designated QoS policy maps. policy-map-name stands for the name of QoS mapping table.

1.4 QoS Configuration Example

1.4.1 Example for Applying the QoS Policy on a Port

The following example shows how to configure the policy to change the packet CoS value to 2 on port g0/0/2:

```
ip access-list extended ipacl
permit ip 192.168.20.2 255.255.255.255 192.168.20.210 255.255.255.255
!
policy-map pmap
classify ip ipacl
action cos 2
!
interface g0/0/2
qos policy pmap ingress
!
```