



**LevelOne**

**WAC-1000 / WAC-1001**  
**Wireless LAN Controller**  
**User's Manual**

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# Introduction



**Tip:** In order to achieve the best results, it is proposed to upgrade Windows Internet Explorer browser to Version 10.0 or above.

## 0.1 Manual Description

**This manual applies to wireless controllers.**

This manual description is applied to the features and functions of wireless controllers on the LevelOne ReOS\_SE software platform, and provides the methods and steps of WEB-based interface configuration. Users shall guarantee the software version they use are consistent with the contents in this manual. Because of the product version upgrade or other reasons, the content of this manual will be updated on an irregular basis.

## 0.2 Interface style

The WEB management interface follows the usage of browsers, as shown below:



: Selected to represent that only this function is used.



: Selected to represent that the function described in this option is selected.



: Click to execute the action of the button.



: Enter the relevant parameters.



: The list box is used to find the options to be chosen.



: The drop-down box is used to find options to be chosen.

## 0.3 Basic conventions

### 1) Icon description



Router



Switch



WAC-1000/ WAC-1001



AP



Modem



Server



Wired client



Wireless client



PDA

## 2) Symbol appointment

- ◆ Refers to basic parameters, describing the basic meaning of the parameters. If a parameter contains "※", which means this parameter is a required item.
- ⊕ Means tips, pointing out the priorities, considerations.
- Means to list the contents of parallel relationship.

## 0.4 Factory configuration

1) The factory configuration of interfaces are shown in the following table.

Type of interfaces	IP address/subnet mask
LAN port	192.168.1.252/255.255.255.0

Table 0- 1 Factory configuration of interfaces

2) The factory user name of the system administrator is admin, and the factory password is admin (case-sensitive).

# Chapter 1 Product Overview

This chapter focuses on the functions and features of LevelOne ReOS\_SE software platform WAC-1000 / WAC-1001.

## 1.1 Key characteristics

- Automatically find and associate the LevelOne wireless AP, without the need to do any configuration of AP, to achieve the centralized management of AP
- Support real-time monitoring the AP status, automatically detect the AP for working correctly, and display the status information of each AP in the admin interface
- Support the DHCP server functions
- Be able to configure related properties such as wireless parameters
- Support the backup and import of WEB configuration files
- Support HTTP remote management
- UPLINK port can provide professional lightning protection chip
- Added the 2.4GHz/5GHz RF template, to be in line with the IEEE802.11a/b/g/n protocol standard, be able to support the 802.11AC protocol, and provide the wireless transmission rate up to 867 Mbps
- Only support 802.11 g, 802.11 n, 802.11 g/n, 802.11 b/g/n; only 802.11 a, 802.11 a/n mixed, 802.11 vhtAC/AN/a mixed, 802.11 vhtAC/AN mixed and other wireless modes
- Support wireless security mechanism control, and provide WEP, WPA Enterprise, WPA2-Enterprise, WPA-PSK, WPA2-PSK and a variety of wireless security mechanisms
- Support the SSID broadcasting control, to effectively prevent SSID broadcasting leaks
- Support the Wi-Fi Multimedia (WMM) function
- Support the wireless MAC address filtering function, with configurable blacklists
- WEB configuration interface, an easy and quick wizard
- Support the WEB upgrading mode, convenient for function extension

## 1.2 Specifications of product

- Comply with IEEE802.3 Ethernet, IEEE802.3u Fast Ethernet, IEEE802.3 standards
- Each physical port supports automated negotiation function
- Each physical port supports MDI/MDI - X adaptive switch - adapter mode
- Provide status indicators
- Working environment: Temperature: 0~40°C

Height: 0~4000m

Relative humidity: 10%~90%, no condensation

# Chapter 2 Hardware installation

This chapter summarizes the appearance of ReOS\_SE software platform WAC - 1000 / WAC - 1001, then describes how to install the device.

## 2.1 Panel description

The front panel has 5 LAN ports (10/100M), an external USB interface, and the casing size is 9 inches. The front panel is shown in the schematic diagram below.



Figure 2- 1 Front Panel -- WAC-1000

### 2.1.1 Description of LED lights

LED lights	Description	Function
PWR	Power LED	It is constantly on when the power supply is working properly.
SYS	System Status LED	It flashes at the frequency of 2 times per second, when the system burden is heavy, the flashing frequency drops; normally on or normally off in failure.
Link/Act	Port Status LED	When a device is properly connected to a port, the status LED that corresponds to the port stays lit, and it will flash if there is flow.
USB	USB Port Status LED	USB light is on, which means the USB interface is being used.

Table 0-1 Description of LEDs

### 2.1.2 Description of interfaces

Interface	Meaning	Notes	Remarks
LAN	LAN ports	Integrated with multiple switched Ethernet ports.	LAN (RJ-45) port supports adaptive positive and negative lines.
USB	USB port	Provide an external USB interface.	Connect the USB disk, to store the software, profiles, etc. obtained by devices.

Table 0-2 Description of Ports

### 2.1.3 Reset button

Reset button can be used to recover the device's factory configuration when you forget the administrator password. Method: In the process of charged operation, hold down the Reset button for more than 5 seconds, then release the button, and the device will be returned to the factory settings, and automatically restart.

**Note:** The above operations will delete all the original device configuration, please use it with care!



## 2.2 Installation Guidelines

- 1) Make sure that your workbench or standard rack is level and stable.
- 2) Do not place heavy objects on the Device.
- 3) Make sure that there is proper heat dissipation and adequate ventilation around the Device.
- 4) Position the Device out of direct sunlight and away from sources of heat and ignition.
- 5) Please use the supplied power cord.

## 2.3 Items Required for Installation

- 1) Broadband Internet connection
- 2) Tools and equipment:
  - (1) Broadband modem (optional)
  - (2) PC with an Ethernet card and TCP/IP installed
  - (3) Network devices like hub, switch, wireless access point
  - (4) Phillips screwdriver
  - (5) Power outlet.

## 2.4 Installing the Device

Before you install the Device, make sure your Internet connection is working properly. If it is not, please contact your ISP.

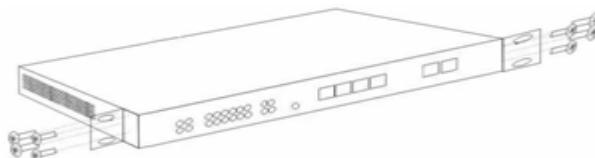
### 1) Installing the Device on a Flat Surface

- (1) Make sure the Device is powered off.
- (2) Place the Device upside down on a sturdy, flat bench with a power outlet nearby. Verify that the bench is well grounded.
- (3) Remove the adhesive backing from the supplied rubber feet. Attach the four rubber feet to the round recessed areas on the bottom of the Device.
- (4) Turn the Device over to make it right side up on the bench

### 2) Installing the Device in a 19-inch Standard Rack

Follow these steps to install the Device in a 19-inch standard rack:

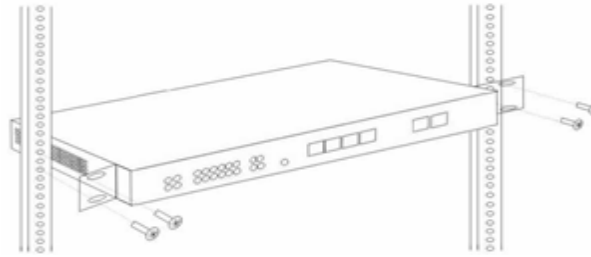
- (1) Make sure the Device is powered off.
- (2) Make sure the rack is stable and well grounded.
- (3) Attach the supplied rack-mount brackets to the left and right side of the Device with the supplied screws, and secure the brackets tightly, as shown in *Figure 2- 2*.



**Figure 2- 2 Attaching Brackets to the Device 1**

(3) Insert the Device into the rack, and align the brackets in the rack.

(4) Use the supplied screws to secure the Device in the rack, as shown in *Figure 2- 3*.



**Figure 2- 3 Mounting the Device in a Rack 2**

## 2.5 Connecting the Device

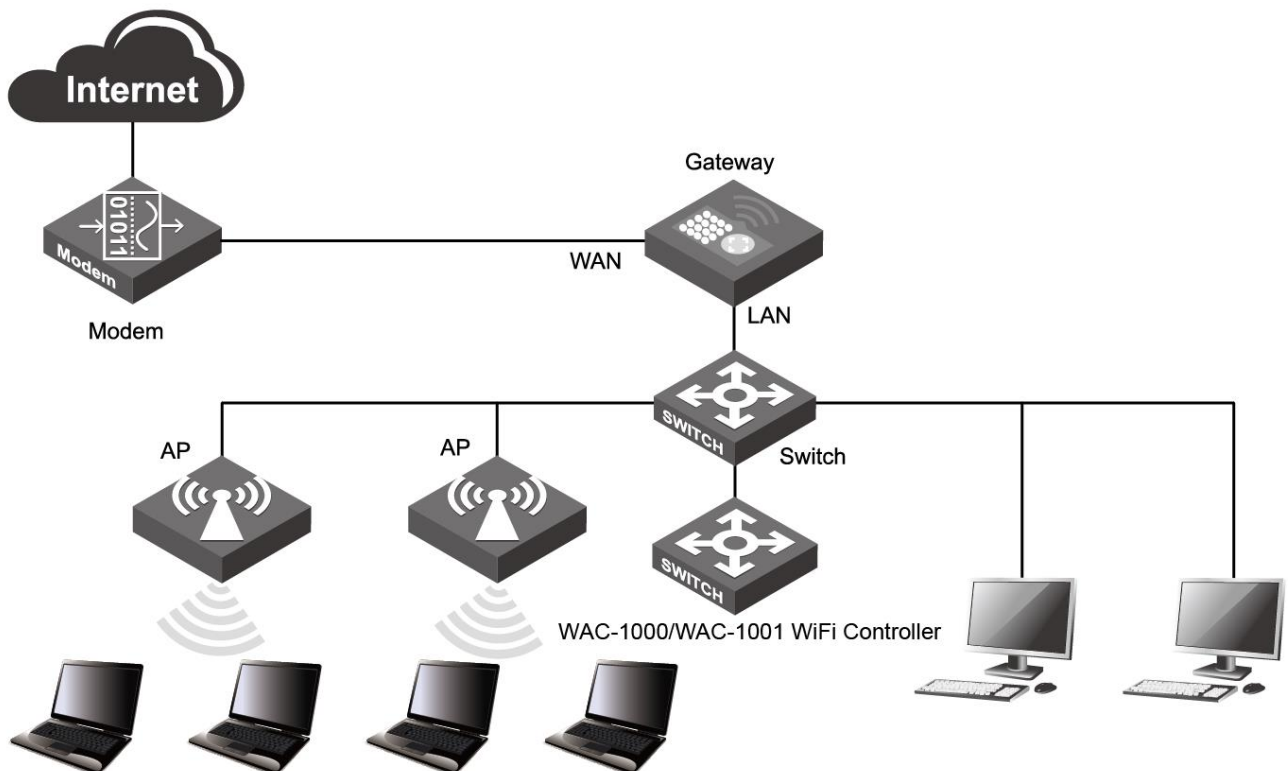
Follow these steps to connect the Device:

1) Connect the Device to the local network

Connect one end of an Ethernet cable to one of the LAN ports on the Device, and the other end to a network port on a PC, hub, switch or wireless access point. Repeat this step to connect more PCs or other network devices to the Device.

2) Power on the Device.

Before you power on the Device, make sure that the power supply is normal and well grounded.



**Figure 2-4 Connecting the Device to Network**

# Chapter 3      Logging to the Device

This chapter describes how to configure TCP/IP settings on your computer, and how to login to the Device. In addition, it briefly describes the layout of the Device's Web interface.

## 3.1 Configuring Your Computer

To configure the Device via Web UI, you need to properly configure TCP/IP settings on the computer that you use to manage the Device. To do this, follow these steps:

Step 1 Connect the computer to a LAN port of the Device, or connect the computer to the Device wirelessly.

Step 2 Install TCP/IP protocol on your computer. If it is already installed, please skip this step.

Step 3 Do one the following to configure TCP/IP settings on your computer:

- ① If you want to want to set the IP address and other settings manually, select **Use the following IP address**, set the IP address to an unused one in the 192.168.1.0/24 subnet, subnet mask to 255.255.255.0, and default gateway to 192.168.1.1. Note: the Device's default LAN IP address is 192.168.1.1 with a subnet mask of 255.255.255.0.
- ② If a DHCP server is available on your network, and you want IP settings to be assigned automatically, select **Obtain an IP address automatically**.

Step 4 Use the Ping command to verify network connectivity between the computer and the Device. Open the command prompt on the computer, type **ping 192.168.1.252**, and then press **Enter**. The following uses Windows XP as an example.

A successful ping will look like this:

```
Pinging 192.168.1.252 with 32 bytes of data:
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Ping statistics for 192.168.1.252:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

A n unsuccessful ping will look like this:

```
Pinging 192.168.1.252 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 192.168.1.252:
```

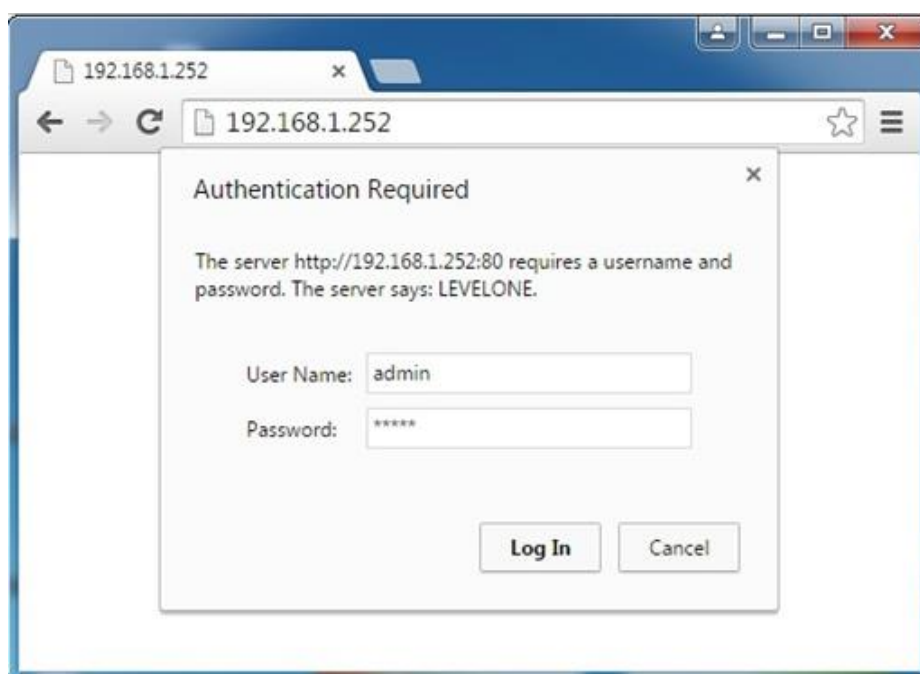
If the Ping command is successful, the connection between the computer and the Device is working properly. If the Ping command fails, please do the following:

- ① **Check physical connection:** Verify that the LAN LED on the Device and the LED on your computer's network card are lit.
- ② **Check TCP/IP settings:** Verify that your computer is on the same subnet as the Device's LAN interface. E.g., if the Device's LAN IP address is 192.168.1.1 (default), the computer's IP address must be an unused IP address in the 192.168.1.0/24 subnet.

## 3.2 Logging to the Device

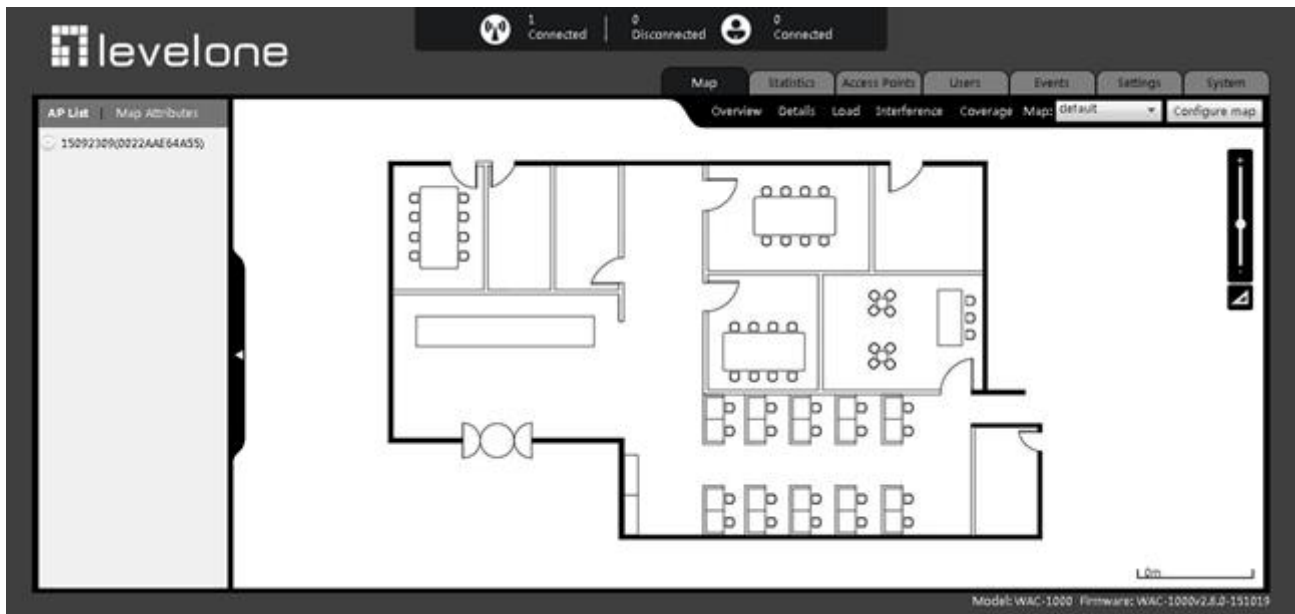
No matter what operating system is installed on your computer, such as, MS Windows, Macintosh, UNIX, or Linux, and so on, you can configure the Device through the Web browser (e.g., Internet Explorer, Firefox).

To login to the Device, do the following: Launch a Web browser, enter the Device's LAN IP address (the default is **192.168.1.252**) in the address bar, and then press **Enter**. The login window appears, as shown in *Figure 3-1*. The first time you login to the Device, you should enter the default login information (default user name and password both are **admin**), and then click **OK**.





*Figure 3-1 Web UI Login Window*

If the login is successful, the home page appears, as shown in *Figure 3-2*.



*Figure 3-2 Web UI Home Page*

1) The page shows the number of online and offline APs, and the number of wireless users online, click on the icon  and  to refresh the number of APs and wireless users online. The icons on the top mean as follows:



: Number of APs online, which means the number of online APs currently in the network.



: Number of APs offline, which means the number of offline APs currently in the network.



: Number of wireless users online, which means the total number of wireless users of AP accessing to the AC control in the network.

2) There is a main operation page at the bottom of this page, and in the main operation page, you can configure various functions, view the configuration information and status information and statistics, etc.

If this is the first time for you to log into the device, the main operation page will link directly to the distribution map. In the next chapter, we will tell how to configure the basic parameters needed for the device to work normally.

# Chapter 4 Distribution map

The distribution map shows the distribution of AP in the architectural plan, so as to manage the AP in a more effective manner. In the diagram, you can import several architectural plans, edit the AP distribution locations, view the AP profile, details and other information, detect the AP anomalies, such as interference testing, load testing, etc., and manage a single unit for AP in the diagram.

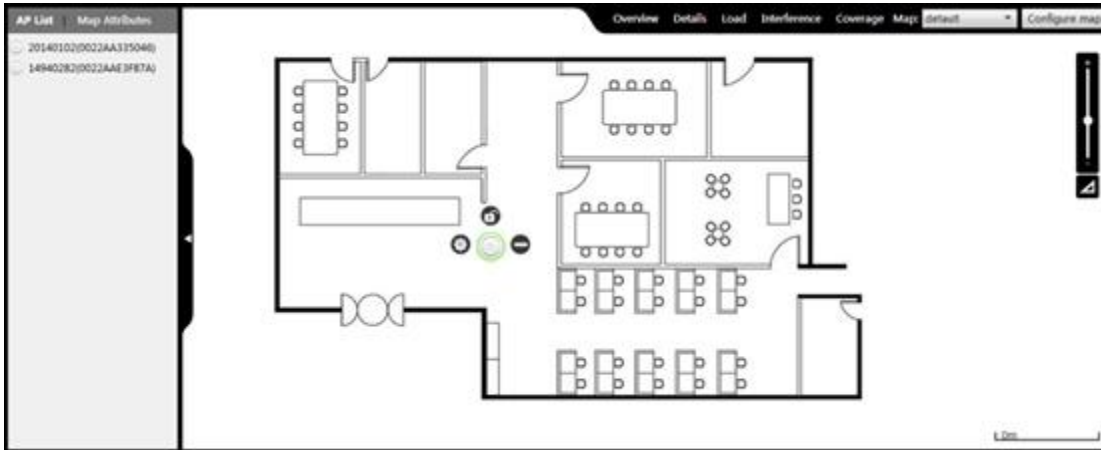


Figure 4- 1 Page of distribution map

This page displays **AP list** and **Map Properties** on the left side.

- ◆ AP list: shows the AP information currently online and have not been added to the map, including the MAC address. Click and drag the AP name to the actual position of the map on the right side, and add the AP to the map. Note: The AP that has been added to the map will not be displayed in the AP list.
- ◆ Drawing properties: Show the number of online APs, offline AP, users, and the name, notes, size and other information of the drawings in the current drawings. Here, the name and note of the drawing can be modified. Or the current drawing can be saved to the local computer.

The right side of this page is the display interface of the distribution map. With manually addition, all the APs you manage will be displayed on the map. AP's online status is represented by colors, green means AP online, while grey means offline AP. Click on the AP icon on the map for single unit management.



: Click to manage the current AP. Please refer to the chapter: [AP Settings](#).



: Click to lock the location of AP on the map.



: Click to delete the current AP on the map.

## 4.1 Summary

Click on **Map** → **Profile**, to display the AP's IP address, MAC address and serial number on the map.

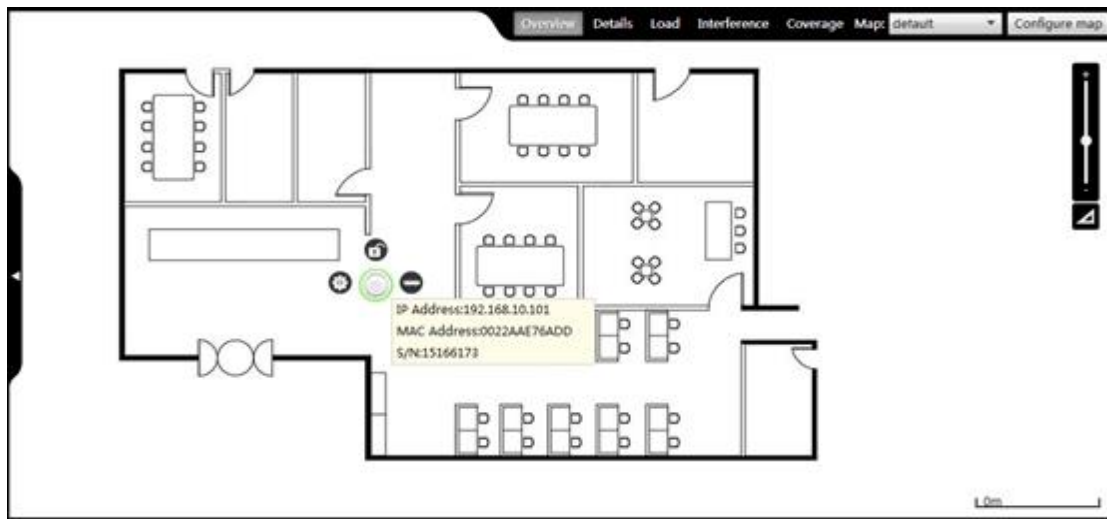


Figure 4- 2 AP Summary

## 4.2 Details

Click **Map→Details**, to display the AP's device name, IP address, MAC address, serial number, online client, channel and SSID on the map.

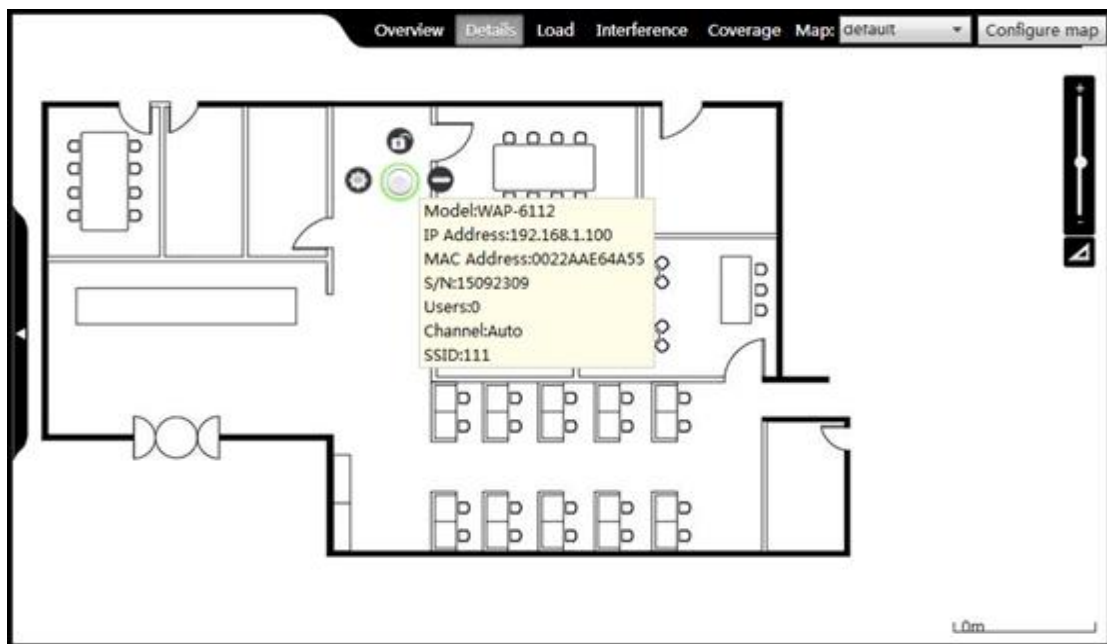


Figure 4- 3 AP Details

- ◆ Device Name: Name of AP.
- ◆ IP address: IP address of AP.
- ◆ MAC address: AP's MAC address.
- ◆ Serial number: AP's serial number.
- ◆ Online client: The number of clients accessed to the AP.
- ◆ Channel: Show the current wireless network frequency where AP works.
- ◆ SSID: SSID (Service Set Identification) is used to uniquely identify a string of wireless network, and is case sensitive.

## 4.3 Load detection

Click on **Map** → **Load detection**, to detect the proportion of the number of wireless clients accessed to AP to the AP carrying capacity. The detection results are represented by colors:

Green: The proportion of the number of clients accessed to AP to the AP carrying capacity is less than 40%.

Orange: The proportion of the number of clients accessed to AP to the AP carrying capacity is more than/equal to and less than 80%.

Red: The proportion of the number of clients accessed to AP to the AP carrying capacity is more than/equal 80%.



Figure 4- 4 Load detection

## 4.4 Interference detection

Click on **Map** → **Interference detection**, to check the interference degree in the same channel between AP and other devices near the AP. The detection results are represented by colors. Green means AP has a low disturbance; orange means AP has a general disturbance, red means AP has a serious disturbance.



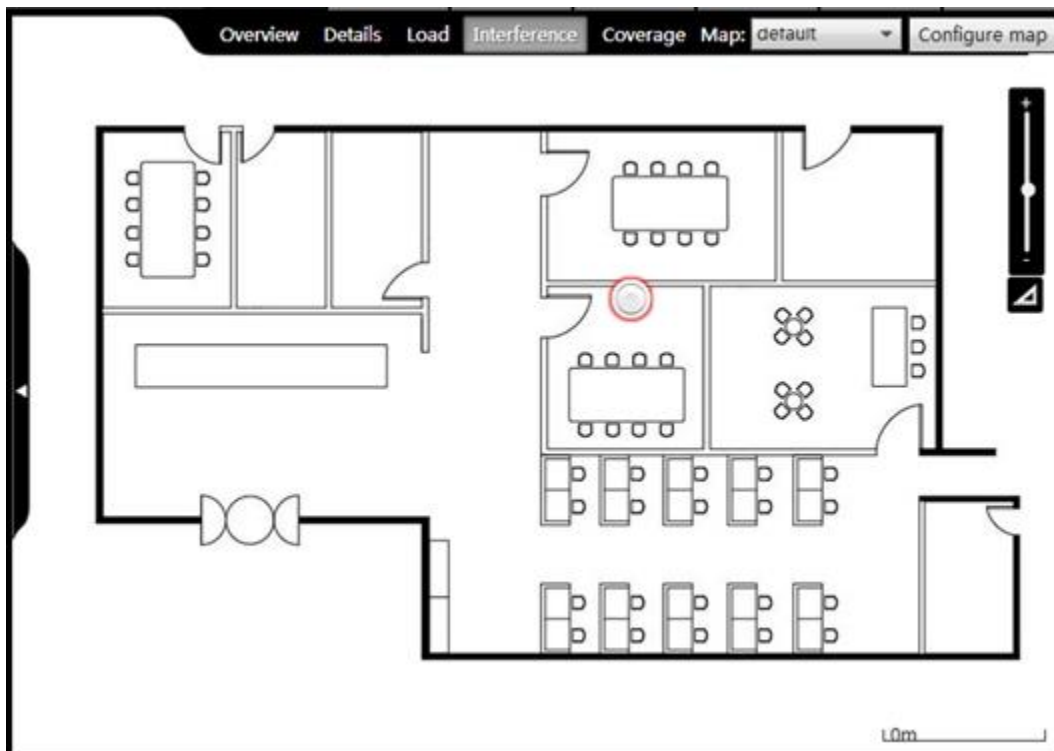


Figure 4- 5 Interference detection

## 4.5 Overlay Plots

Click on **Map** → **Overlay Plot**, to view the coverage area of AP wireless signal. On the map, the coverage area of the AP is displayed by a circle with the AP icon as the center of a circle.

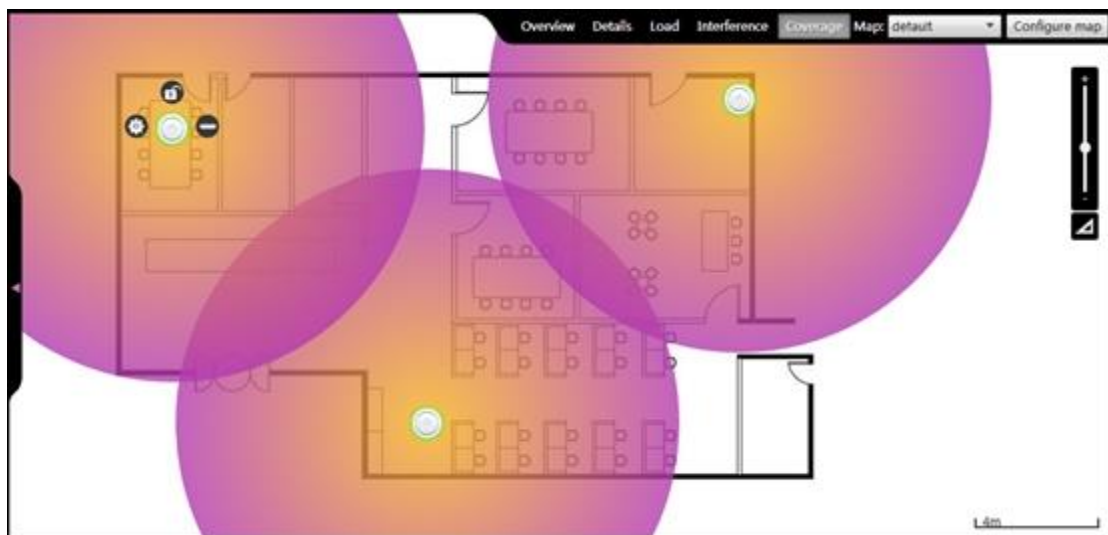



Figure 4- 6 AP Overlay Plot

Before viewing the coverage area chart of AP for the first time, it is required to set the scale of the map. The steps are as follows:

Click , draw a line on the map, click **Next**, and input the actual distance of the straight line drawn on the drawing in the pop-up dialog box, and click **Save**.

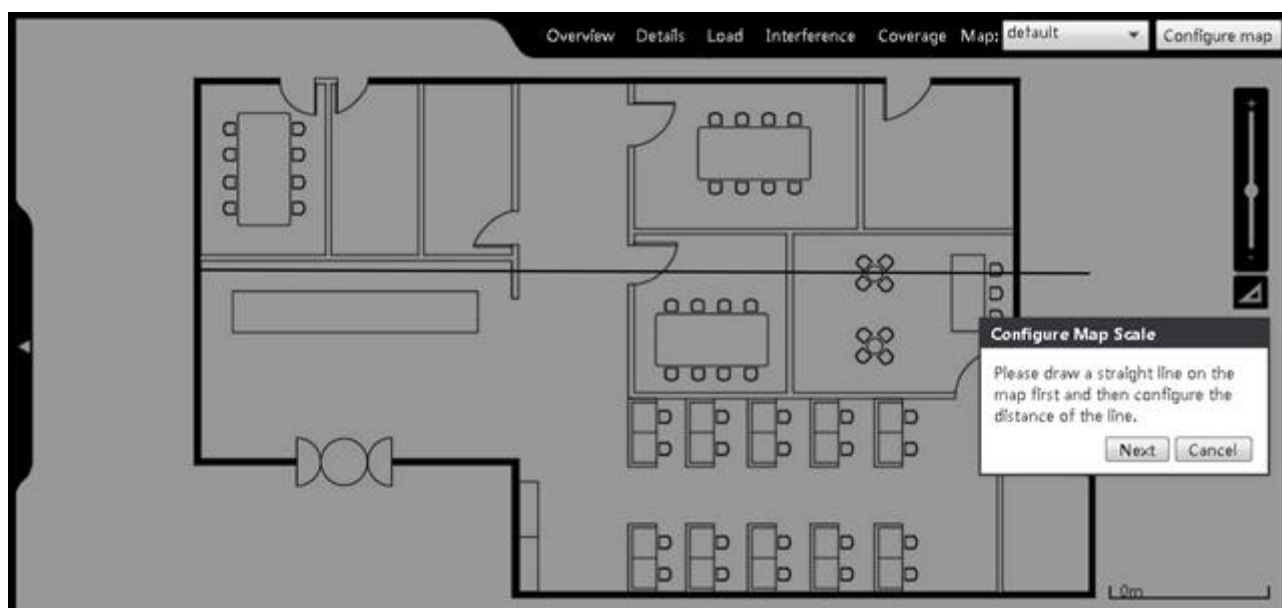


Figure 4- 7 Coverage distance of map

## 4.6 Drawings

The drawings are displayed in the architectural plan in the middle of the page. You can choose different drawings from the drop-down list of the drawing, and can manage the drawings. Click on **Distribution map import** button, to enter the interface as shown below.

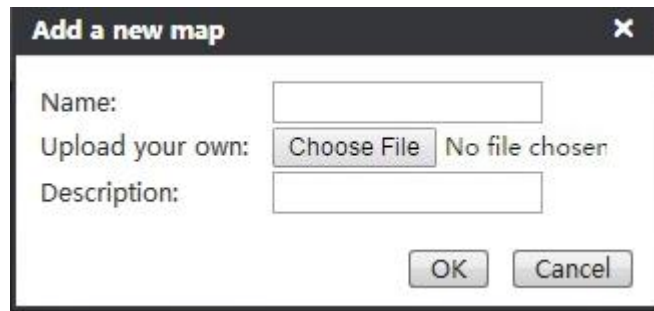


Figure 4- 8 Import drawing interface

- ◆ Name: Shows the drawing name.
- ◆ Number of devices: Shows the number of APs on the drawings.
- ◆ Clients: Shows the number of the accessed terminal devices on the drawing.
- ◆ File size: Shows the drawing size.
- ◆ Notes: Shows the description information of the drawings.
- ◆ Edit: Click to modify the drawing name and note information.
- ◆ Delete: Delete the drawings.

In the top right corner of the page, there are two buttons, **Add** and **Delete**, and you can add new drawings and delete drawings in batch.

- Add drawings: Click **Add** button, and the dialog box pops up, as shown in the figure below, to upload drawings and enter the name and description of the drawing.
- ⊕ **Note:** The drawing name supports only the names that contain upper/lowercase letters, numbers, underline, and the picture name only supports JPG format.



A dialog box titled "Add a new map" with a close button (X) in the top right corner. The dialog contains three input fields: "Name:" with an empty text box, "Upload your own:" with a "Choose File" button and the text "No file chosen", and "Description:" with an empty text box. At the bottom right, there are two buttons: "OK" and "Cancel".

Figure 4- 9 Drawings import

- Delete drawings in batch: Check the multiple drawings to be deleted, and click **Delete** button in the top right side of the page.

# Chapter 5 Statistics

In the statistics menu, the administrator can view the statistics data classified according to the SSID, radio frequency, distribution map and operating system by all wireless LAN clients, the number of accessed wireless clients and APs, the most active wireless clients, the most active APs, total input bandwidth and total output bandwidth and other statistical information.



Fig. 5- 1 Statistical chart

- 1) In the upper left corner of the figure, the statistical information about wireless clients currently online is displayed with sector diagram, and you can choose to display them by classification and statistics of SSID, RF, distribution map or operating system.

In the upper right corner of the figure, the statistical information about wireless clients or APs currently online is displayed with line chart. It can be displayed by hours, days or weeks through classification statistic. The horizontal axis represents point of time, while the vertical axis represents the number of users.

- 3) The lower left corner of the figure shows the information about the most active wireless client and AP, including the name of the wireless client, download traffic and upload flow. Click the name of wireless client to view its details, click on the name of the AP to set up. About how to set up the AP, please refer to the chapter: [AP Settings](#).
- 4) The lower right corner of the figure shows the total input and total output of data traffic of all APs within a specified time.

# Chapter 6 Device

## 6.1 AP Controller

WAC-1000 / WAC-1001 can implement configuration, management, and monitoring of the entire wireless network in a centralized manner. AP management includes: Issuance software, issuance configuration, modification of relevant parameters, etc.

WAC-1000 / WAC-1001 and AP can penetrate three layers of network devices between them for mutual discovery. WAC-1000 / WAC-1001 can normally manage the AP found by the network at the second and third layer.

This chapter mainly introduces the related concepts about AP centralized management and AP centralized management functions, including: AP management, distributed service area, configuration of AP RF templates, AP configuration templates, AP software management, etc.

### 6.1.1 AP Controller Overview

#### 6.1.1.1 Terminology

**Client:** A PC, laptop, or other terminals with a wireless Network Interface Card.

**STA (station):** is a wireless network devices in the network node

**WLAN (Wireless Local Area Network):** A WLAN is a type of local area network that uses high frequency radio waves rather than wires to transmit data.

**AC (Access Controller):** An AC, also known as WLAN controller, is a network device that is used to control and manage access points in the network.

**AP (Access Point):** An AP is a network device that acts as a base station for the wireless LAN, and acts as a bridge between wired and wireless networks.

**Fat AP:** A standalone AP that independently controls and manages wireless clients.

**Fit AP:** A simple AP that relies on WLAN controller to control and manage wireless clients. The access points in Fit AP mode can retrieve firmware and configuration file from the WLAN controller.

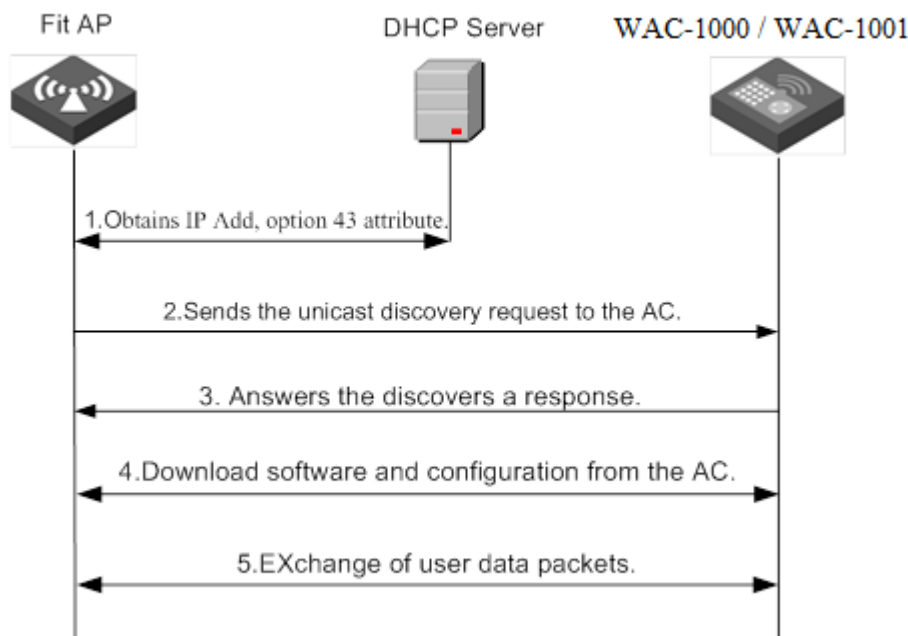
**Intra-Controller Roaming:** Intra-controller roaming occurs when a wireless client roams between APs managed by the same WLAN controller.

**Layer 2 Roaming:** Layer 2 roaming occurs when a wireless client roams between APs on the same subnet and VLAN.

#### 6.1.1.2 Working Principle

For the implementation of Fit AP + WAC-1000 / WAC-1001 solution, the first and crucial step is the issue of Fit AP's registration on the three-layer switch, and the WAC-1000 / WAC-1001 can manage Fit AP only after Fit AP is successful in registration. In the practical applications, it is common for WAC-1000 / WAC-1001 + Fit AP to register by crossing three-layer network. Our device has three ways of implementation: the first is the DNS mode, which requires the support from DNS, DHCP Server, and is relatively complex; the second is the DHCP Option43 attribute mode, that is, using the Option43 attribute of the DHCP Server; the third is to configure the WAC-1000 / WAC-1001 address on AP, and this method is relatively simple.

When the wireless controller WAC-1000 / WAC-1001 is connected with the Fit AP by crossing three-layer network, the Option 43 mode is used; when Fit AP is connected to the wireless controller by crossing three-layer network, Fit AP can directly obtain the IP address of the wireless controller through the Option 43 attribute of DHCP, thus completing the registration on the wireless controller. The specific process is shown in the figure below:



**Figure 6- 1 WAC-1000 / WAC-1001 and AP centralized manager communicate on the second floor**

When the Fit AP and the wireless controller cross three layers of network connection, the registration procedure of the Fit AP in the wireless controller through the Option 43 attribute of DHCP server is as follows:

- 1) Fit AP obtains IP address, option 43 attribute (the attribute carries the IP address of the three-layer switches) through the DHCP server.
- 2) Fit AP will obtain the IP address of three-layer switch from the option 43 attribute, and then sends the unicast discovery request to the wireless controller.
- 3) The wireless controller of the wireless switch that receives the discovery request packet will check if the Fit AP has the access to this machine, and answers that it discovers a response if any.
- 4) Fit AP downloads the latest version of software from wireless controller of the wireless switch.
- 5) Fit AP downloads the latest configuration from the wireless controller.
- 6) Fit AP begins to work normally to exchange of user data packets with the wireless controller.

**Tip:**

- (1) In the process of device operation, while the configuration file is modified on the AP, for instance, it joins in a service area, WAC-1000 / WAC-1001 will save the modified configuration file locally and send it to AP, and the configuration file will be deleted after WAC-1000 / WAC-1001 powers off.
- (2) WAC-1000 / WAC-1001 will delete the configuration file saved before after recovering the AP to its factory configuration remotely.
- (3) The AP uploaded configuration file will not be displayed in the configuration file list.
- (4) AP can start transmitting user data immediately after successfully obtaining the software, configuration file.

### 6.1.1.3 Wireless roaming on the second floor

Wireless roaming means that wireless users can move in the coverage of the same VLAN when there are multiple APs existing in the network environment, and their wireless coverages overlap in a certain range; the wireless network card can automatically find the AP with the highest signal strength nearby, and receive and transmit data via this AP, thus keeping the network connection uninterrupted.

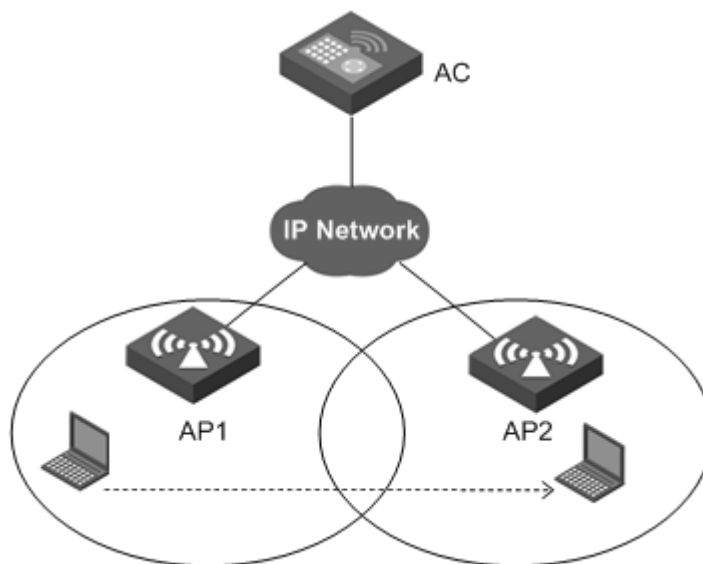


Figure 6- 2 Roaming on the second floor

As shown in the above figure, AP1, AP2 belong to the same VLAN and are associated with AC.

- 1) A terminal is wirelessly associated with AP1, and AP1 connects AC.
- 2) The terminal disconnects its association with AP1, and roams into the AP2 connecting the wireless controller AC in the same VLAN.
- 3) The process that the terminal is connected to AP2 from AP1 is two-layer wireless roaming.

Way of implementation: Configure a service area on the device and enable the roaming function, and add AP1, AP2 into the same service area; when the AP reaches the set roaming threshold, the two-layer wireless roaming can be realized.

## 6.2 Device settings

Click on the **Device** menu, to enter the page of device, and the administrator can view all the APs in the current intranet, to position, restart, set in batch the online AP, or delete all offline APs.

Name/MAC	Model	S/N	IP	Status	Mode/Channel(2.4GHz)	Mode/Channel(5GHz)	Users	Action
0022A6E64A55	WAP-6112	15092309	192.168.1.10	Connected	11b/g/n / Auto(12)		0	[Icons]

Figure 6- 3 Device interface

- ◆ Batch management: After selecting multiple APs, click on the button to do the batch operations to AP, like modifying login passwords, restarting, restoring the factory settings, etc.
- ◆ Clear offline AP: Click to remove all the offline APs.
- ◆ Name/MAC address: Displays the name or MAC address of the current AP. Click on the MAC address to set the AP. For the information about how to set the AP, please refer to the chapter: [AP Settings](#).

- ◆ Model: Displays the model of the current AP.
  - ◆ Serial number: Displays the serial number of the current AP.
  - ◆ IP address: Displays the IP address of the current AP.
  - ◆ Status: Displays the status of the current AP, namely, online and offline.
  - ◆ Model/channel: Displays the channel used by the current AP. When the AP channel is configured to be Auto, the channel actually used can be displayed.
  - ◆ Client: Displays the number of wireless clients currently accessing to the current AP.
  - ◆ Edit: Sets the AP, locations on the map and restarts, etc.
  - ⚙️ : To manage the current AP, please refer to the chapter: [AP Settings](#).
  - 📍 : Locationing button, to locate the AP on the distribution map.
  - 🔄 : Restart the current AP.
- ✚ **Tip:** The AP list only support the display of the information about the AP products in LevelOne WAC series, but the device of other manufacturers does not support it.

## 6.2.1 Batch settings

When there are multiple APs needing to perform the same action, for example, to be set to the same RF template, administrator password, software version, to join the same service area and other operations, you can choose to use the batch setting function.

Click on the **Device** menu, check multiple APs, and click on the **Batch management button** in the top right corner of the page, to do batch setting.




Figure 6- 4 Batch settings

- ◆ RF setting: Select the RF template and **Save** it. Note: RF can only be set in batch, but cannot be set by single unit management.
- ◆ Setting of service area: Choose the service area to be distributed and click the **Join service area** button.
- ◆ System setting: Enter the administrator password and **Save**.
- ◆ System upgrade: First download the latest version of software from the official website of LevelOne, and then upload the upgrade file locally to complete the system upgrade.



## 6.2.2 AP Settings

Do personalized settings for each AP. Click on  behind the AP name to be set, view the details of the AP, set the information about the client, system of AP.

### 6.2.2.1 Details

In the AP list, click the **Name/MAC address** of AP, to show the AP details interface, in which you can view the information about the system, trends statistics, radio frequency of the current AP.

#### 1) System information

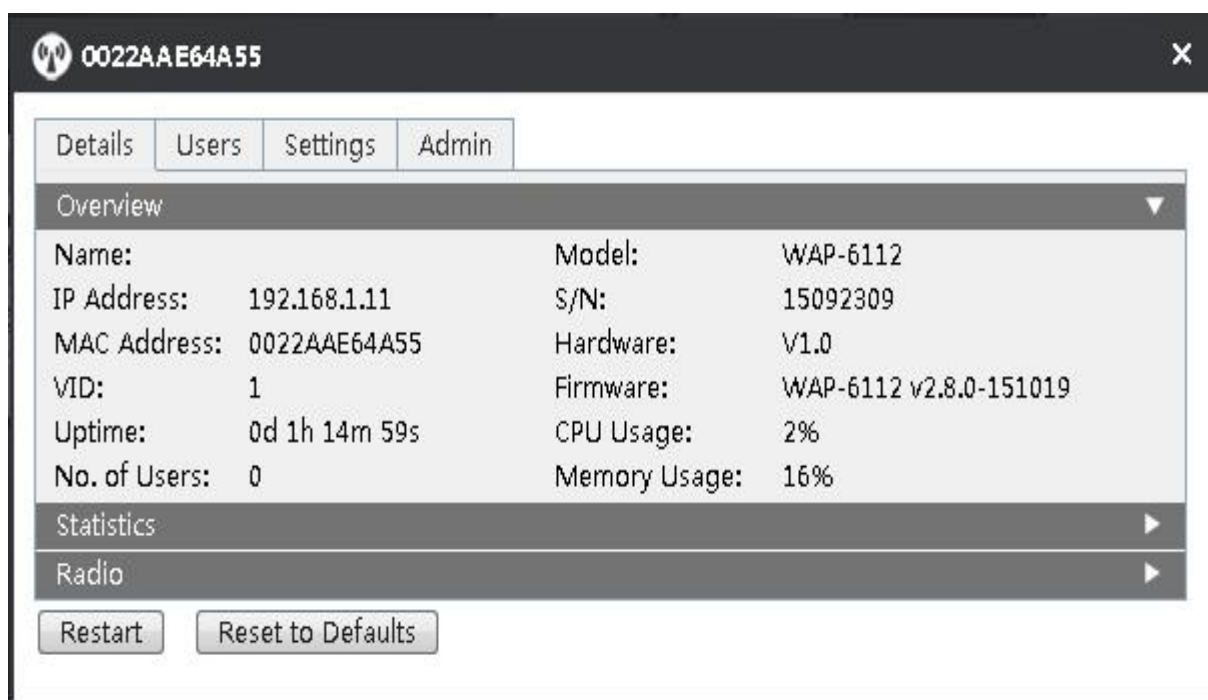


Figure 6- 5 System information

- ◆ Device name: The name of the current AP.
- ◆ IP address: The IP address of the current AP.
- ◆ MAC address: The MAC address of the current AP.
- ◆ VID: Displays the VLAN ID of AP, with a range of 1-4094.
- ◆ Running duration: Displays the running duration of the AP from start to now.
- ◆ Number of clients: Displays the number of wireless terminals access to the current AP.
- ◆ Device model: Displays the model of product of AP.
- ◆ Serial number: Displays the serial number of the AP.
- ◆ Hardware version: Displays the hardware version number of AP.
- ◆ Software version: Displays the software version number of AP.
- ◆ CPU usage: Displays the percentage of CPU.
- ◆ Memory usage: Displays the percentage of memory usage.

## 2) Trend statistics

View the number of users accessing to the current AP at the time points, wireless throughput, packet loss rate and packet error ratio.

Wireless throughput: The wireless upload, download rate of the current AP.

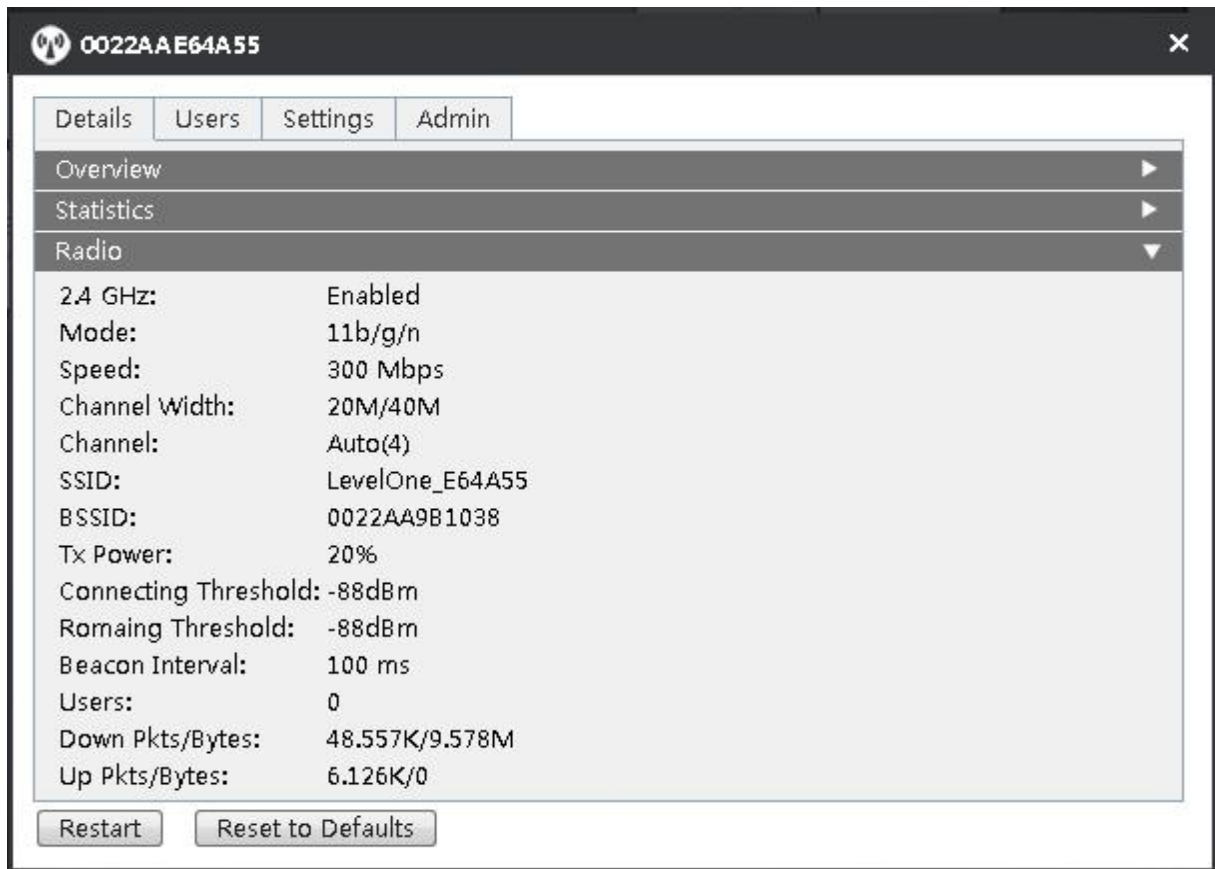
Packet loss rate: Refers to the ratio of the lost error packets to the transmitted data sets in the process of transmitting data packets.

Packet error ratio: Refers to the ratio of the received error packets to the transmitted data sets in the process of transmitting data packets.



Figure 6 - 6 Trend statistics

## 3) RF Information



**Figure 6- 7 Radio frequency information**

- ◆ 2.4GHz: Displays if the AP 2.4 G function is enabled.
- ◆ Mode: Displays the AP wireless working mode.
- ◆ Rate: Displays the AP wireless rate.
- ◆ Channel bandwidth: Displays the channel bandwidth occupied by the wireless data transmission.
- ◆ Channel: Displays the channel used by the current AP. When AP channel is configured to Auto, the channels actually used can be displayed.
- ◆ SSID: The character strings used to uniquely identify a wireless network, which are case sensitive.
- ◆ BSSID: AP wireless MAC address.
- ◆ Transmission power: Displays the AP transmission power.
- ◆ Associated threshold: The minimum threshold set for the STA accessible signal connected by AP, below which the AP does not allow the client to be associated with STA.
- ◆ Roaming threshold: The roaming threshold set for the associated STA, below which the AP will disconnect the association of the client with the STA.
- ◆ Beacon interval: AP will send Beacon frames to the network regularly, and synchronize them with the network. Beacon interval is the periodic time interval for sending Beacon frames, with the value range of 20 ~ 999 milliseconds.
- ◆ Number of clients: The number of accessed wireless clients.
- ◆ Number of received packets/bytes: Displays the number of received packets, bytes.
- ◆ Number of sent packets/bytes: Displays the number of sent packets, bytes.

### 6.2.2.2 Clients

Click on **Device** -> AP name -> **Client**, to enter the page as shown in the figure below, and the page displays the information about the client access to the AP.

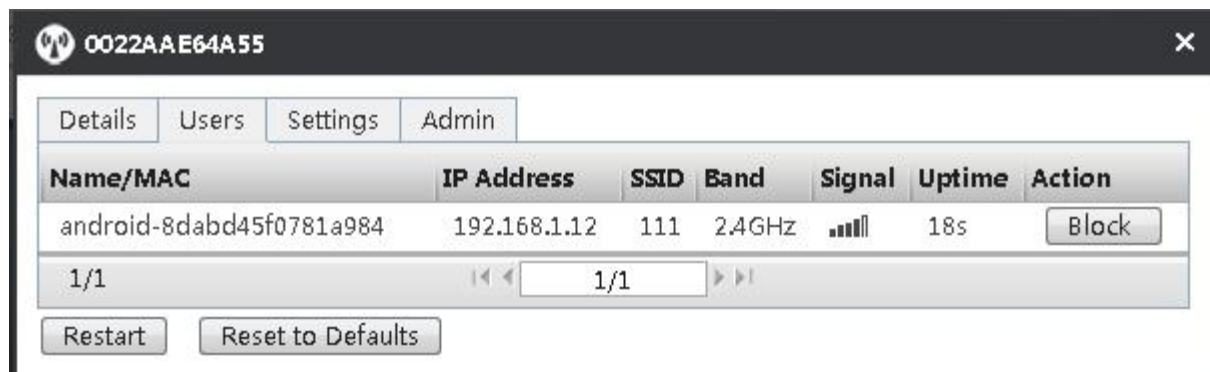


Fig. 6- 8 Client

- ◆ Name/MAC address: Displays the name or MAC address of the wireless client.
- ◆ IP address: Displays the IP address for the wireless client.
- ◆ SSID: The name of the wireless network currently accessed by the wireless client.
- ◆ Frequency band: Displays the frequency band to which the wireless client is connected.
- ◆ Signal: Strength of wireless signals. When a wireless signal has an occupied lattice, it means the signal is strong.
- ◆ Online duration: Displays the online duration of the wireless client.
- ◆ Edit: Click the **Join blacklist** button to add the current wireless client into the blacklist.

### 6.2.2.3 Settings

Click **Device**→AP name→ **Settings** to enter into the AP Settings page, and you can modify the related parameters of RF settings and the distributed service area.

#### 1) Radio frequency settings

Set the related parameters according to the actual needs, and click the **OK** button, to complete the setting of RF parameters.

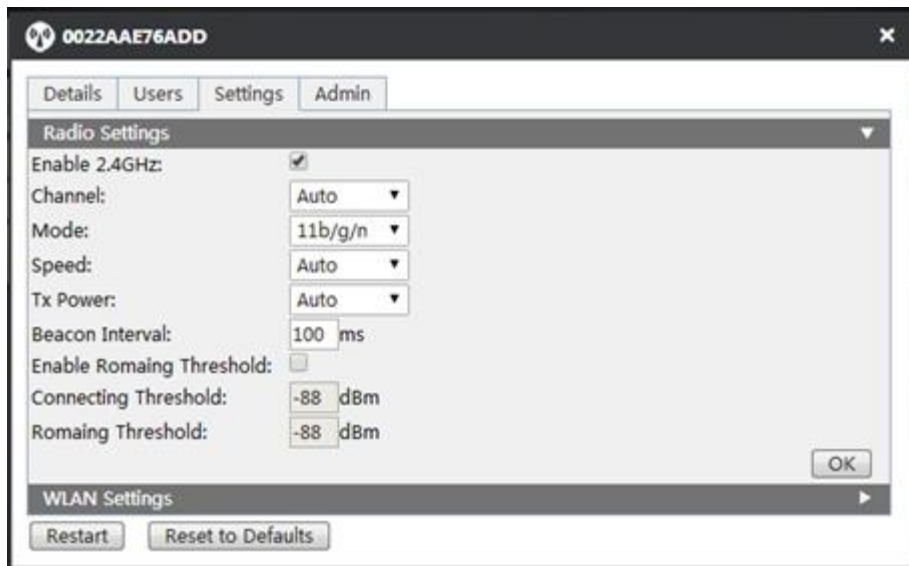


Figure 6- 9 Radio frequency settings

- ◆ Enabling 2.4 GHz frequency band: Checking it means to enable the 2.4 GHz frequency band.
- ◆ Channel: This parameter is used to select the frequency band in which the wireless network works. The wireless devices in the same frequency band will interfere with each other. If there are multiple wireless devices around the AP, please select a frequency different from that of other wireless devices when setting the channel.
- ◆ Mode: Set the wireless work mode of AP. It is recommend to use the 11 b/g/n mode.
- ◆ Wireless rate: Select the AP to use the wireless data transmission rate.
- ◆ Wireless transmission rate: Select the AP to use the transmission power for wireless data transmission.
- ◆ Beacon interval: AP will send Beacon (Beacon) frames to the network regularly, and synchronize them with the network. Beacon interval is the periodic time interval for sending Beacon frames, with the value range of 20 ~ 999 milliseconds.
- ◆ Enabling thresholds: Check it to enable this feature. Only checking this option can the associated threshold and roaming threshold be set.
- ◆ Associated threshold: The minimum threshold set for the STA accessible signal connected by AP, below which the AP does not allow the client to be associated with STA.
- ◆ Roaming threshold: The roaming threshold set for the associated STA, below which the AP will disconnect the association of the client with the STA.

Roaming means that the wireless client can detect other devices with strong wireless signal and access to them when it leaves the coverage area of the current AP signal. Threshold refers to the minimum threshold for the AP signal access. When signal strength is lower than the set threshold, the roaming function is enabled.

## 2) Setting of service area

Check the service area to be distributed, and click **Join service area** button, to distribute a service area for the current AP. Note: One AP can distribute at most four service areas.

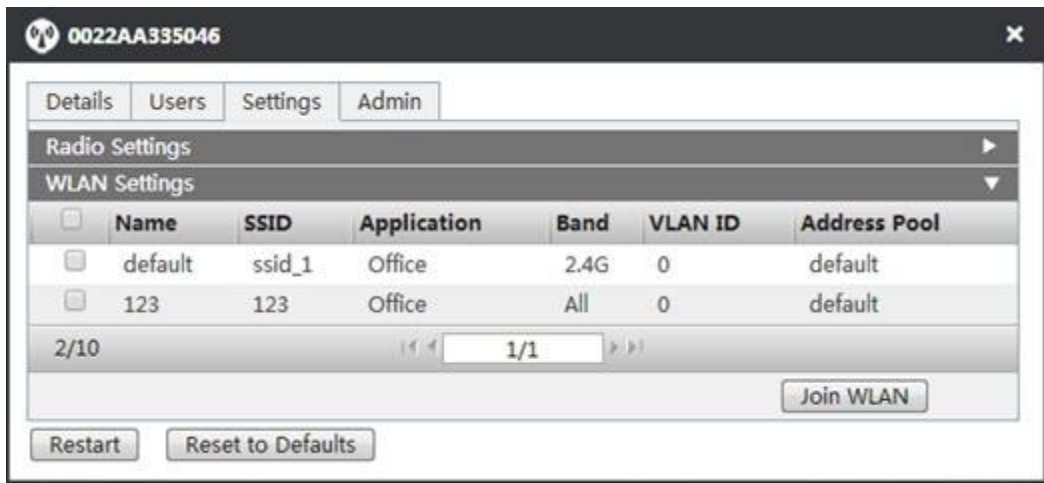


Figure 6- 10 Setting of service area

- ◆ Service area name: Displays the name of the service area.
- ◆ SSID: Displays the name of wireless network.
- ◆ Type: Displays the application type.
- ◆ Frequency band: Supports two frequency bands, 2.4 G / 5 G, in which ALL means that two frequency bands of the service area will be distributed.
- ◆ VLAN ID: Displays the VLAN value, which is between 1-4094.
- ◆ Address pool: Displays the name of the address pool. For the details of setting the beginning and end address of the address pool, please refer to the chapter: [VLAN Settings](#).

#### 6.2.2.4 System

In this interface, the working mode of AP, the way to obtain the IP address of AP and upgrading of the AP software can be set.

The AP's working mode is divided into Fit AP and Fat AP. In the Fat AP mode, AC can manage the AP; in the Fat AP mode, the AP can configure independently without AC management. It is recommended to restart your device for the configuration to take effect if the device is to be switched in modes no matter which mode it works under.

##### 1) System settings

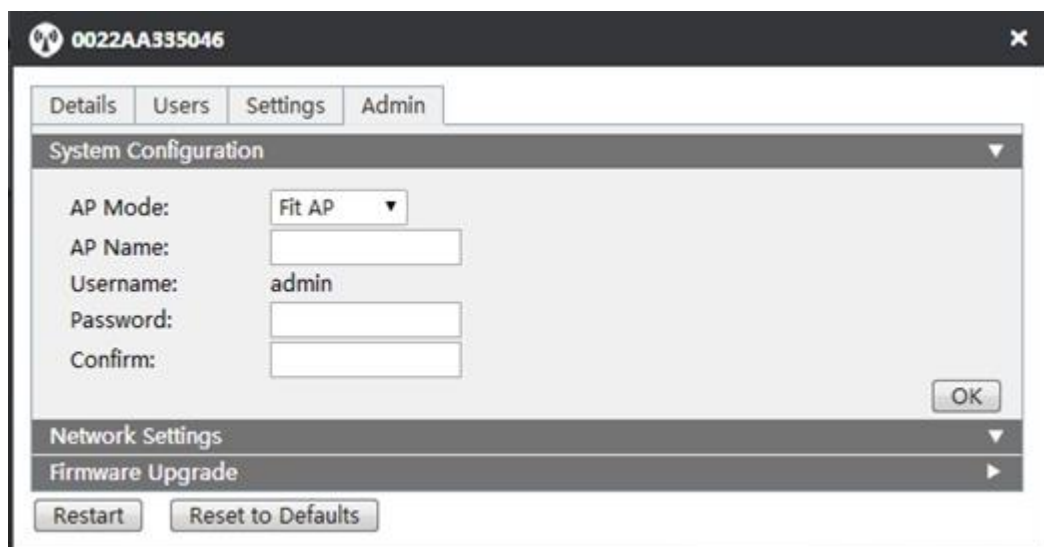


Figure 6- 11 System settings

- ◆ System mode: AP working mode. There are two modes: Fat AP and Fit AP.
- ◆ Device name: Custom AP name.
- ◆ User name: Displays the name of the currently logged administrator.
- ◆ Password: Custom password.
- ◆ Confirming password: Enter the password again.

## 2) Network settings

Set the way to obtain the IP address of AP, including DHCP (dynamic obtaining) or static configuration.

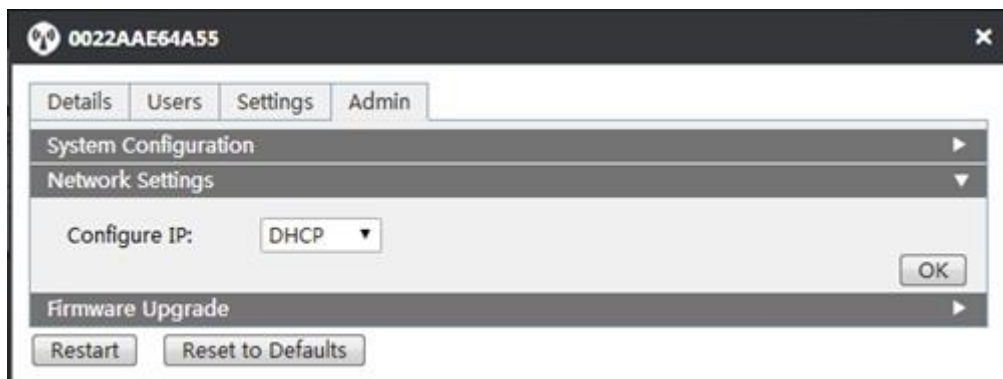


Figure 6- 12 Network settings

## 3) Software upgrade

In the software upgrade interface, you can view the information about the currently running version, or can update system version. First download the latest software from the LevelOne website, and then click **Upgrade** button for system upgrade.

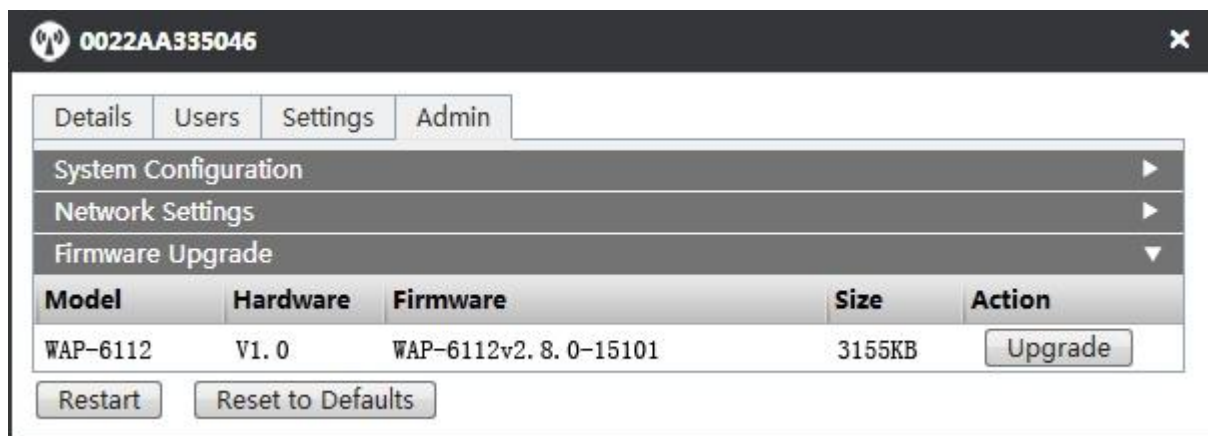


Figure 6- 13 Software upgrade diagram

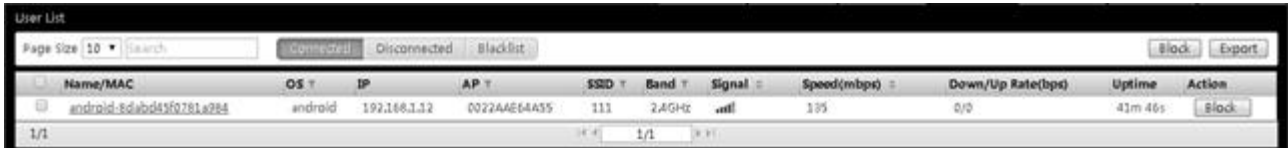


# Chapter 7 Users

On the user page, the administrator can view all the wireless clients in the intranet. Click **Online**, **Offline**, **Blacklist** button to respectively manage the clients in different states.

## 7.1 Setting online

To setup the online clients. In the user page, click the **Export** button in the top right corner to export the list and detailed information of the wireless clients currently online. Check multiple wireless clients, and click on the **Join blacklist** button in the top right corner, to join the wireless clients in the blacklist.



The screenshot shows the 'User List' interface with a table of online clients. The table has columns for Name/MAC, OS, IP, AP, SSID, Band, Signal, Speed, Down/Up Rate, Uptime, and Action. A single client is listed with the following details:

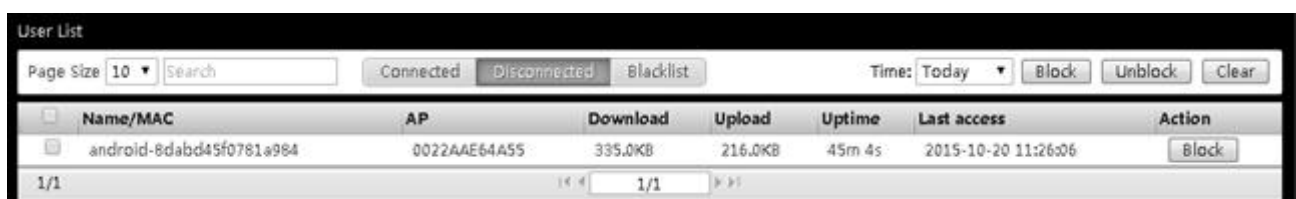
Name/MAC	OS	IP	AP	SSID	Band	Signal	Speed	Down/Up Rate	Uptime	Action
android-8dabdc45f0781a984	android	192.168.1.12	0022AAE64A55	111	2.4GHz	Full	105	0/0	41m 46s	Block

Figure 7- 1 User online interface

- ◆ Name/MAC address: The name/MAC address of wireless clients.
- ◆ Operating systems: The operating system used by wireless clients. Such as Windows, IOS, Android, etc.
- ◆ IP address: IP address of the wireless client.
- ◆ Access point: Displays the name of the AP accessed by the wireless client.
- ◆ SSID: Displays the name of the wireless network accessed by the wireless client.
- ◆ Frequency band: Displays the frequency bands accessed by the wireless client.
- ◆ Signal quality: Displays the strength level of the current wireless signal. Occupied lattice means strong signals.
- ◆ Wireless rate: Displays the wireless rate of wireless clients.
- ◆ Download/Upload rate: Displays the current upload / download rate of the wireless client.
- ◆ Online duration: Displays the online duration of the wireless client.
- ◆ Edit: Click **Join blacklist** button to add a wireless client into the blacklist.

## 7.2 Offline settings

To add the offline clients into the blacklists and other settings. Under this page, you can view the MAC address, access points, download/upload, online time and last access time of offline wireless clients, or can add the offline wireless clients into the blacklist.



The screenshot shows the 'User List' interface with a table of offline clients. The table has columns for Name/MAC, AP, Download, Upload, Uptime, Last access, and Action. A single client is listed with the following details:

Name/MAC	AP	Download	Upload	Uptime	Last access	Action
android-8dabdc45f0781a984	0022AAE64A55	335.0KB	216.0KB	45m 4s	2015-10-20 11:26:06	Block

Figure 7- 2 Offline interface



# 7.3 Blacklist settings

To remove the wireless clients from the blacklist and other settings. Under this page, you can view such information as the name of the blacklist user/MAC address and the time of being pulled into the blacklist or can remove the blacklist.

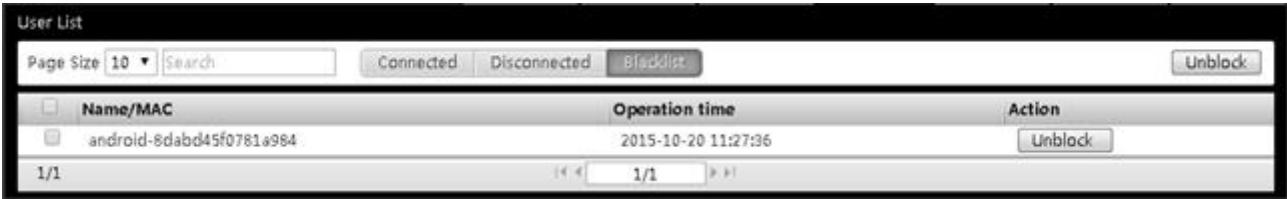
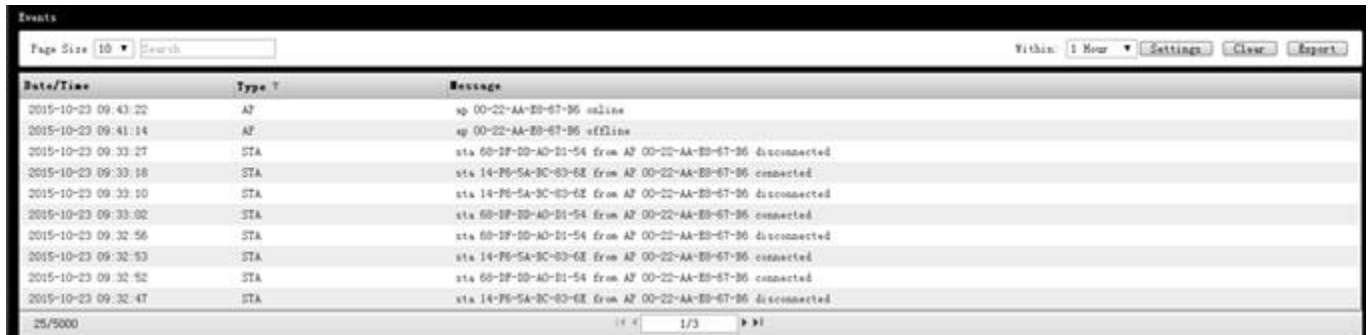


Figure 7- 3 Blacklist interface

# Chapter 8 Log

In the **Log** page, the system records the AP online/offline logs, wireless client online/offline logs, wireless client number alarm log and other information. You can set to display the categories of log information, or can delete and export log information.



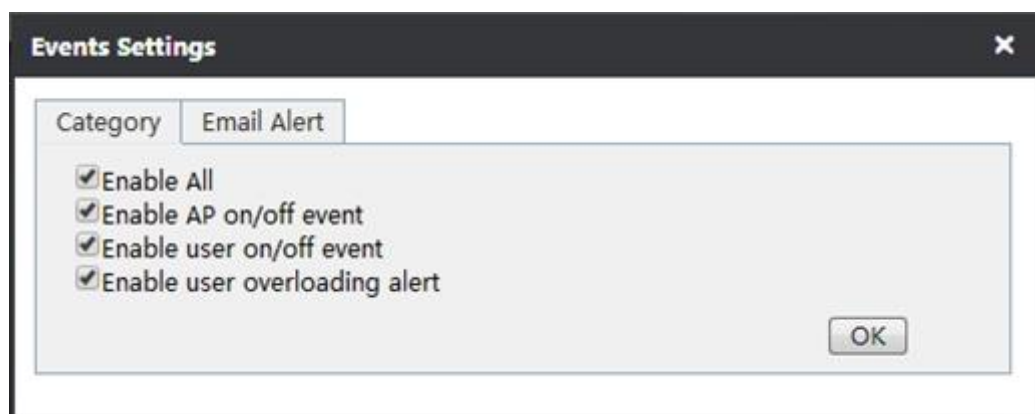
The screenshot shows a web interface titled "Events". At the top, there is a "Page Size" dropdown set to "10", a search bar, and a "Within: 1 Hour" filter. Below these are "Settings", "Clear", and "Export" buttons. The main area is a table with three columns: "Date/Time", "Type", and "Message". The table contains several rows of log entries, including AP online/offline events and STA connection/disconnection events. At the bottom, there is a "25/5000" indicator and a "1/3" page navigation control.

Date/Time	Type	Message
2015-10-23 09:43:22	AP	ap 00-22-AA-E8-67-B6 online
2015-10-23 09:41:14	AP	ap 00-22-AA-E8-67-B6 offline
2015-10-23 09:33:27	STA	sta 60-1F-D0-A0-D1-54 from AP 00-22-AA-E8-67-B6 disconnected
2015-10-23 09:33:18	STA	sta 14-P6-5A-9C-83-6E from AP 00-22-AA-E8-67-B6 connected
2015-10-23 09:33:10	STA	sta 14-P6-5A-9C-83-6E from AP 00-22-AA-E8-67-B6 disconnected
2015-10-23 09:33:02	STA	sta 60-1F-D0-A0-D1-54 from AP 00-22-AA-E8-67-B6 connected
2015-10-23 09:32:56	STA	sta 60-1F-D0-A0-D1-54 from AP 00-22-AA-E8-67-B6 disconnected
2015-10-23 09:32:53	STA	sta 14-P6-5A-9C-83-6E from AP 00-22-AA-E8-67-B6 connected
2015-10-23 09:32:52	STA	sta 60-1F-D0-A0-D1-54 from AP 00-22-AA-E8-67-B6 connected
2015-10-23 09:32:47	STA	sta 14-P6-5A-9C-83-6E from AP 00-22-AA-E8-67-B6 disconnected

Figure 8- 1 Log information interface

## 1) Setting the log categories

Click on **Log**→**Setting**→**Category**, to display the interface as shown in the figure below, and check the log information categories to be monitored and click **Save**.



The screenshot shows a dialog box titled "Events Settings" with a close button (X) in the top right corner. Inside the dialog, there are two tabs: "Category" (selected) and "Email Alert". Under the "Category" tab, there is a list of four items, each with a checked checkbox: "Enable All", "Enable AP on/off event", "Enable user on/off event", and "Enable user overloading alert". An "OK" button is located at the bottom right of the dialog.

Figure 8- 2 Log settings - Category

- ◆ Select all: Checking it means to enable the options in the list.
- ◆ Enable online/offline logs of AP: Checking it to enable online/offline logs of AP, and record the online/offline information of AP.
- ◆ Enable online/offline logs of wireless clients: Checking it to enable online/offline logs of wireless clients, and record the online/offline information of wireless clients.
- ◆ Enable number alarm logs of wireless clients: Checking it means to the enable wireless client number alarm log, to record the information about more than 20 wireless connections.

## 2) Monitoring log

Click **Log**→**Settings**→**Monitoring**, to show the interface in the figure below, and configure the name, email address, password, etc. of the server that sends the monitoring log information, and click **Save**.

**Events Settings**

Category | Email Alert

Enable: ☐

Title:

SMTP server:  (Format:smtp.xx.com)

Mail address:  (Mail server account)

Password:

Receipt address:

Sending interval:  minutes

**Note** It is suggested to use Gmail, yahoo mail address.

OK

Figure 8- 3 Log settings - Monitoring

- ◆ Enable log monitoring: Checking it means to enable this feature.
- ◆ Email subject: Sets the subject name for monitoring.
- ◆ Outgoing Server: Fills the sending server address.
- ◆ Sender mailbox: Fills in the name of sender mailbox, such as 163. com.
- ◆ Sender password: Fills in the password of sender mailbox.
- ◆ Receiver mailbox: Fills in the name of receiver mailbox.
- ◆ Sending time interval: Displays the time interval for sending log information.
- ⊕ **Tips:** It is recommended to use Gmail, Yahoo mail.

# Chapter 9 Settings

This chapter describes how to configure service areas, radio frequency template, load balancing, software version, etc. on the WAC-1000 / WAC-1001, and these configurations can be distributed to the AP as a template.

## 9.1 Service area

In the service area, the list of configured service areas has been displayed, and the parameters of each service area in the list can be modified. The configured service areas are distributed by AP to the wireless clients to access. Also you can add, delete a service area.

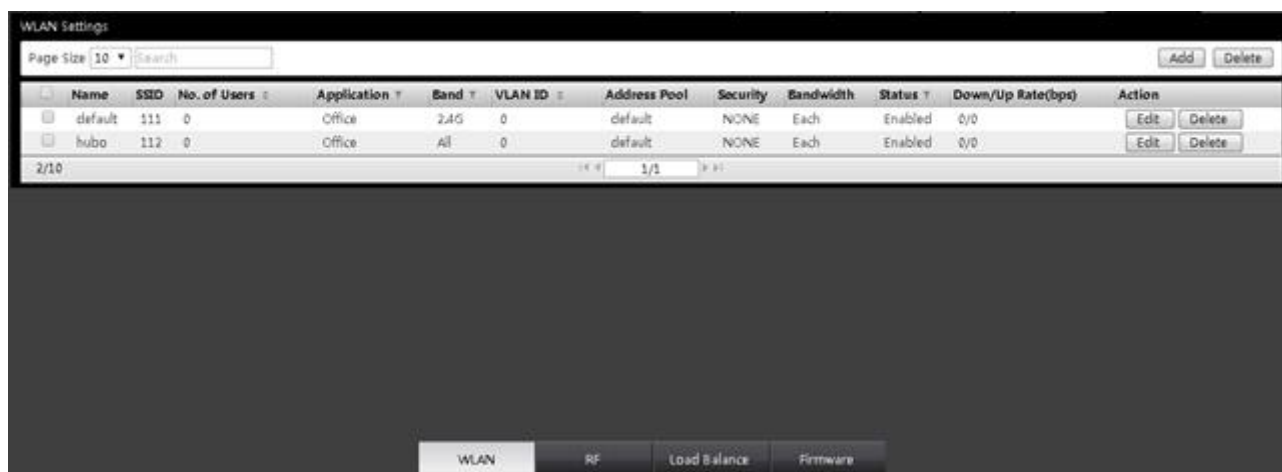


Figure 9- 1 Setting interface

Click the **Edit** button on the right side of the service area to be modified, to modify the parameters of the service parameters. Click the **Delete** button on the right side of the service area to be deleted, to delete the service area.

Click on the **Add button** at the top right corner of the service area page, and a dialog box pops up as shown in figure 9-2, you can respectively set wireless, VLAN, security, bandwidth, and add a service area.

Below is a detailed description of the meaning of the parameters on the interfaces for adding service areas.

## 9.1.1 Wireless settings

The screenshot shows the 'WLAN Settings' window with the '2 VLAN' tab selected. The 'Name' and 'SSID' fields are empty. The 'Application' is set to 'Office'. Under 'Broadcast/Multicast', 'Broadcast Filter' is 'Disabled', 'DTIM Interval' is '1 Beacon', 'Multicast Transmission Optimization' is 'Disabled', 'Dynamic Multicast Optimization' is 'Disabled', and 'DMO Channel Utilization Threshold' is '1%'. Under 'Transmission Rates', '2.4GHz' has a minimum of '1' and a maximum of '54', and '5GHz' has a minimum of '6' and a maximum of '54'. On the right, under 'RF', 'Airtime' and 'Each Radio' are unchecked, and all WMM shares are set to '1%'. Under 'Miscellaneous', 'Content Filtering' is 'Disabled', 'Band' is 'All', 'Inactivity Timeout' is '100 Sec', 'Hide SSID' is unchecked, 'Max Clients Threshold' is '0', 'Local Probe Request Threshold' is '0', 'Auto upgrade' is checked, and 'Client Isolation' is unchecked. 'Next' and 'Cancel' buttons are at the bottom right.

Figure 9- 2 Wireless settings

- ◆ Service area name: Defines the name of the service area.
- ◆ SSID: (Service Set Identification) defines the SSID of the service area, and a string for uniquely identifying a wireless network, case sensitive.
- ◆ Main use: Employees, voice, visitors, etc. can be selected. The access levels of these three from high to low are as follows: Employees, voice, visitors.
- ◆ Broadcast filtering: Choose the way to broadcast packet filtering.
- ◆ DTIM interval: Selects the number of beacon intervals between 1 and 10 beacons.
- ◆ Multicast transmission optimization: Selects whether to enable optimization of multicast transmission.
- ◆ Dynamic multicast transmission: Selects to enable optimal dynamic multicast transmission or not.
- ◆ DMO channel using threshold value: The higher the percentage is, the higher the priority is.
- ◆ 2.4GHz: Able to stably reach the Internet by setting the minimum and maximum transmission rate of 2.4GHz.
- ◆ 5GHz: Able to stably reach the Internet by setting the minimum and maximum transmission rate of 5GHz.
- ◆ Air interface: Checking it to enable this feature.
- ◆ Each radio: Checking it to enable the radio function.
- ◆ Background WMM sharing: Sets the percentage of the background WMM share, in order to ensure establishing a stable connection with network resources, and providing a high quality data network connection performance.

- ◆ Most effective WMM sharing: Sets the percentage of the most effective WMM sharing, in order to ensure establishing a stable connection with network resources, and providing a high quality network connecting performance.
- ◆ Video WMM sharing: Sets the percentage of the video WMM sharing, in order to ensure establishing a stable connection with network resources, and providing a high quality video network connecting performance.
- ◆ Voice WMM sharing: Sets the percentage of the language WMM sharing, in order to ensure establishing a stable connection with network resources, and providing high quality voice network connecting performance.
- ◆ Content filtering: Checking it to enable this feature.
- ◆ Frequency band: Selects the frequency band that the service area supports. 2.4 GHz, 5 GHz, ALL are available.
- ◆ Inactivity timeout: The default is 100 seconds.
- ◆ Hide SSID: Checking it to enable this feature. After hiding SSID, access is possible only when the SSID name is manually entered for search and the wireless network is connected, or before enabling this feature, you have already connect to the wireless network, so it can be automatically accessed.
- ◆ Limit of the maximum number of clients: Controls the number of clients accessed by AP. It is recommended not to exceed 20, 0 means no restriction.
- ◆ Limit of local detection request: Set the threshold for local detection.
- ◆ Automatic update: Automatically checked by default. It means the new service area will be automatically distributed to all the online APs. When the number of automatically updated service areas exceeds 4, the new service areas will not be automatically distributed.
- ◆ Client Isolation: Isolates the mutual access between the connected terminal devices.

## 9.1.2 VLAN settings

Figure 9- 3 VLAN settings

- ◆ Client VLAN-making ways: Default or Static mode is available. Default means the DHCP address pools in the non-VLAN, while Static means the DHCP address pool that can define the VLAN attributes.
- ◆ VLAN ID: Sets the VLAN ID, with the range of value of 1-4094.

- ◆ Enable the DHCP server of the device: Checking it to mean the DHCP server is enabled on this device.
- ◆ Name: Name of custom address pool.
- ◆ IP address range: Sets the range for Intranet users to obtain the IP address.
- ◆ Subnet mask/gateway address: The subnet mask/gateway addresses assigned by the DHCP server to the intranet computers, mobile phones and other clients automatically.
- ◆ Lease term: The leasing time for the Intranet computers to obtain the IP address assigned by the device (Unit: Minutes).
- ◆ Primary DHCP server: The primary DNS server IP address assigned by the DHCP server to the Intranet computers, mobile phones and clients automatically.
- ◆ Secondary DNS server: The secondary DNS server IP address assigned by the DHCP server to the Intranet computers, mobile phones and other clients automatically.
- ◆ Option43: By modifying the variable length fields of option 43 in the DHCP protocol packets, it is used to carry the IP address of AC, and let AP analyze the AC address carried by option 43, so it is used for discovering AC. There are four options, Disable, HEX fixed-length, ASCII indefinite length, Custom.

### 9.1.3 Security settings

To make access authentication for such clients as computers, mobile phones that want to join the service area, password authentication and free of authentication are now provided. Password authentication provides three wireless security mechanisms, namely WEP, WPA/WPA2 and WPA-PSK/WPA2-PSK. The following sections will introduce the configuration parameters and their meanings.

#### 9.1.3.1 WEP

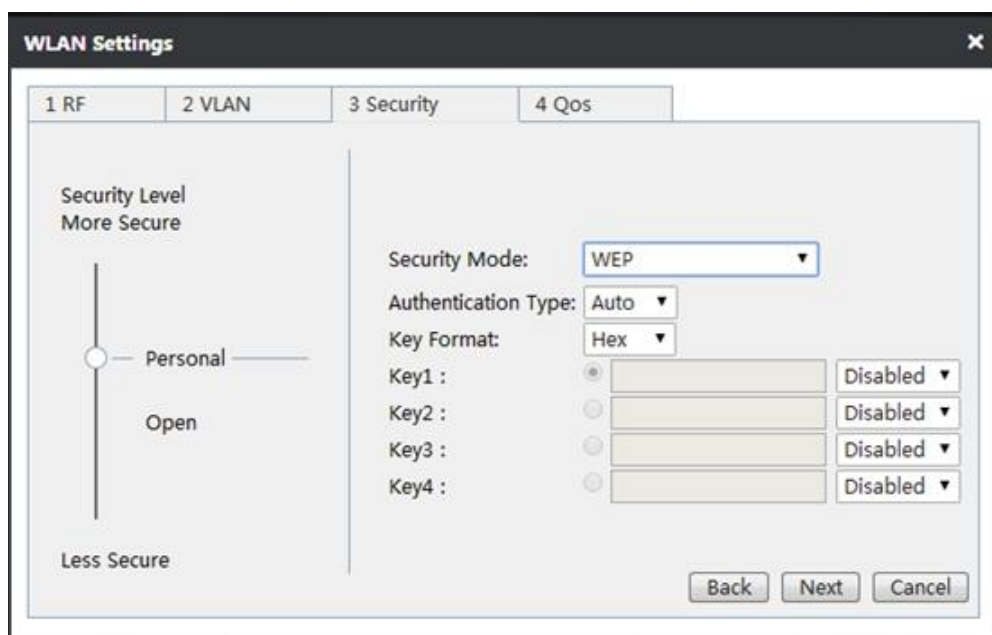


Figure 9- 4 WEP

- ◆ Authentication type: When using the WEP encryption mechanism, three options, automatic, open systems, Shared keys are provided:
  - Auto: Means that the device can automatically choose Open System or Pre-shared key mode according to the requests of wireless clients.
  - Open system: At this point, the wireless clients can pass the authentication and associate with the wireless devices on the premise of not providing authentication key. To perform data transmission, you must provide the correct key.

- Shared key: At this point, the client must provide the correct key to pass the authentication, otherwise it cannot be associated with the wireless devices, and cannot perform data transmission.
- ◆ Key format: Two formats, hexadecimal code and ASCII code are provided:
  - When the hexadecimal code is used, the key characters can be 0 ~ 9, A, B, C, D, E, F.
  - When the ASCII code is used, the key characters can be all ASCII codes.
- ◆ Key selection: The user can enter 1 ~ 4 keys according to needs, and these 4 keys can use different key types.
- ◆ WEP key: Sets the key value, and the length of the key is affected by key types:
  - When choosing a 64 - bit key, you can input 9 hexadecimal characters or 5 ASCII characters.
  - When choosing a 128 - bit key, you can input 26 hexadecimal characters or 9 ASCII characters.
- ◆ Key types: Selects key types, and provides three options, Disable, 64 bits, 128 bits. Among them, Disable means not to use the current key, but 64 bits, 128 bits, and used to specify the length of the WEP key.

### 9.1.3.2 WPA/WPA2

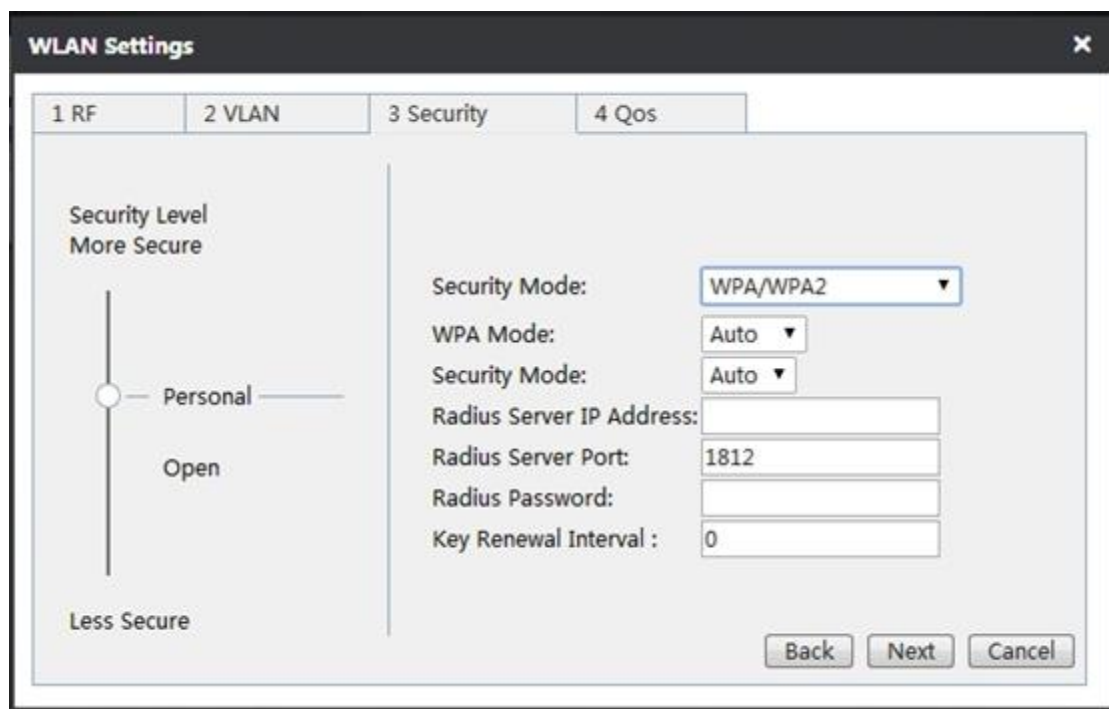


Figure 9- 5 WPA/WPA2

- ◆ Security mechanism: Choose "WPA/WPA2" here, which means that the device will use WPA or WPA2 security mechanism. Under the security mechanism, the device will use the Radius server for authentication and obtaining the key.
- ◆ WPA version: Sets up the safe mode this device will use:
  - Auto: Means that the device can automatically choose WPA or WPA2 safe mode according to the requests of wireless client.
  - WPA: Means that this device will use the safe mode of WPA.
  - WPA2: Means that the device will use the safe mode of WPA2.
- ◆ Encryption algorithm: It is used to encrypt wireless data, with the options like Auto, TKIP and AES.



- Auto: Means that the device will automatically choose encryption algorithms according to needs.
- TKIP: Means that all wireless data will use TKIP as the encryption algorithm.
- AES: Means that all wireless data will use AES as the encryption algorithm.
- ◆ Radius Server IP: It is the IP address of the Radius server used for identify authentication of the wireless hosts.
- ◆ Radius port: The Port number of service used by the Radius server for identifying the authentication of the wireless hosts.
- ◆ Radius password: Sets the password for accessing the Radius service.
- ◆ Key update cycle: It is the timed update cycle used to specify the key. Value range is 60 ~ 86400, in the unit of seconds. The default value is 3600, which means no update when the value is 0.

### 9.1.3.3 WPA-PSK/WPA2-PSK

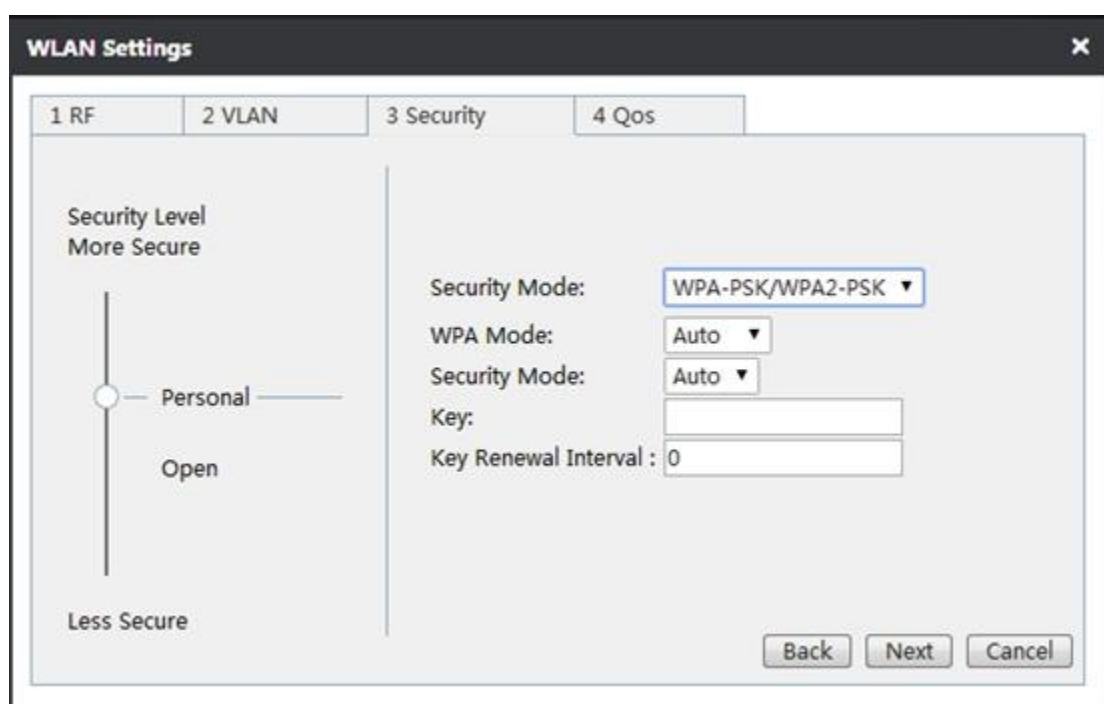


Figure 9- 6 WPA-PSK/WPA2-PSK

- ◆ Security mechanism: Here, you can select "WPA-PSK /WPA2-PSK", which means that the device will use WPA-PSK /WPA2-PSK security mechanism. Under this security mechanism, this device will use the WPA mode based on the Pre-Shared key.
- ◆ WPA version: Sets up the safe mode this device will use:
  - Auto: Means that the device can automatically choose WPA-PSK or WPA2-PSK safe mode according to the requests of wireless clients.
  - WPA: Means that the device will use the safe mode of WPA-PSK.
  - WPA2: Means that the device will use the safe mode of WPA2-PSK.
- ◆ Encryption algorithm: It is used to encrypt wireless data, with the options like Auto, TKIP and AES.
  - Auto: Means that the device will automatically choose encryption algorithms according to needs.
  - TKIP: Means that all wireless data will use TKIP as the encryption algorithm.

- AES: Means that all wireless data will use AES as the encryption algorithm.
- ◆ Pre-shared key: The preset initialization key, with the value of 8 ~ 63 characters.
- ◆ Key update cycle: It is the timed update cycle used to specify the key. Value range is 60 ~ 86400, in the unit of seconds. The default value is 3600, which means no update when the value is 0.

### 9.1.3.4 No security mechanism

No security mechanism: Means that the client can access to the network without using any security mechanism for authentication.

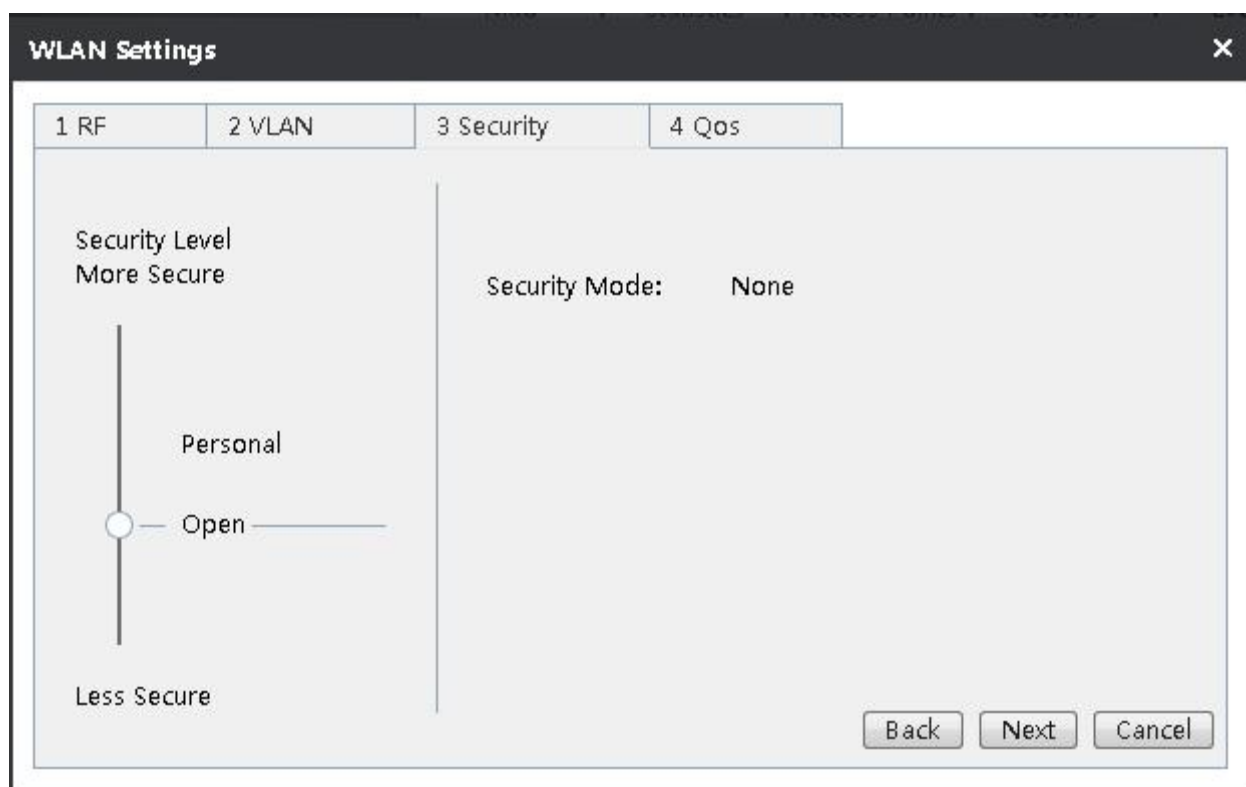


Figure 9- 7 No security mechanism

### 9.1.4 Bandwidth setting

To set the speed limit for the wireless clients like computers, mobile phones, etc. that join the service area.

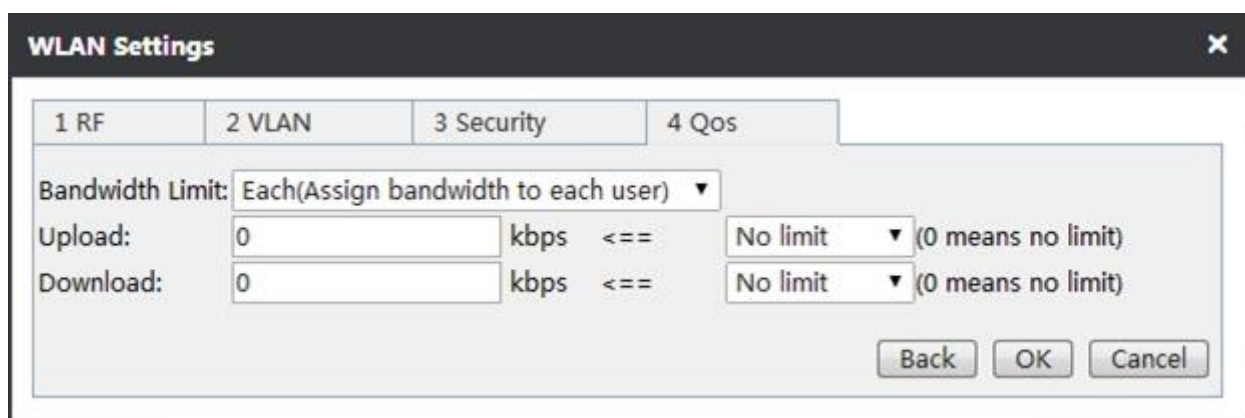


Figure 9- 8 Broadband restrictions

- ◆ Bandwidth limitation: The available options are divided into exclusive and shared; Exclusive means each IP address in this range uses the bandwidth; Shared means the IP address in this range shares the bandwidth.
- ◆ Uplink/downlink bandwidth: Upload speed limit, download speed limit. Here, the maximum upload and download rate of IP address in this range can be set. 0 means no limitation.
- ◆ Back: Click to return to the interface at the next higher level.
- ◆ Finish: Click on the complete configuration.
- ◆ Cancel: Cancel the configuration information.

## 9.2 Radio frequency template

Set the radio frequency template for AP to distribute wireless RF parameters. Note: The radio frequency templates can only be distributed to AP in batch.

The radio frequency template page shows the list of RF templates, in which all the parameters can be modified. The radio frequency templates can also be deleted or added.

RF Settings

Page Size 10 Search

AddDelete

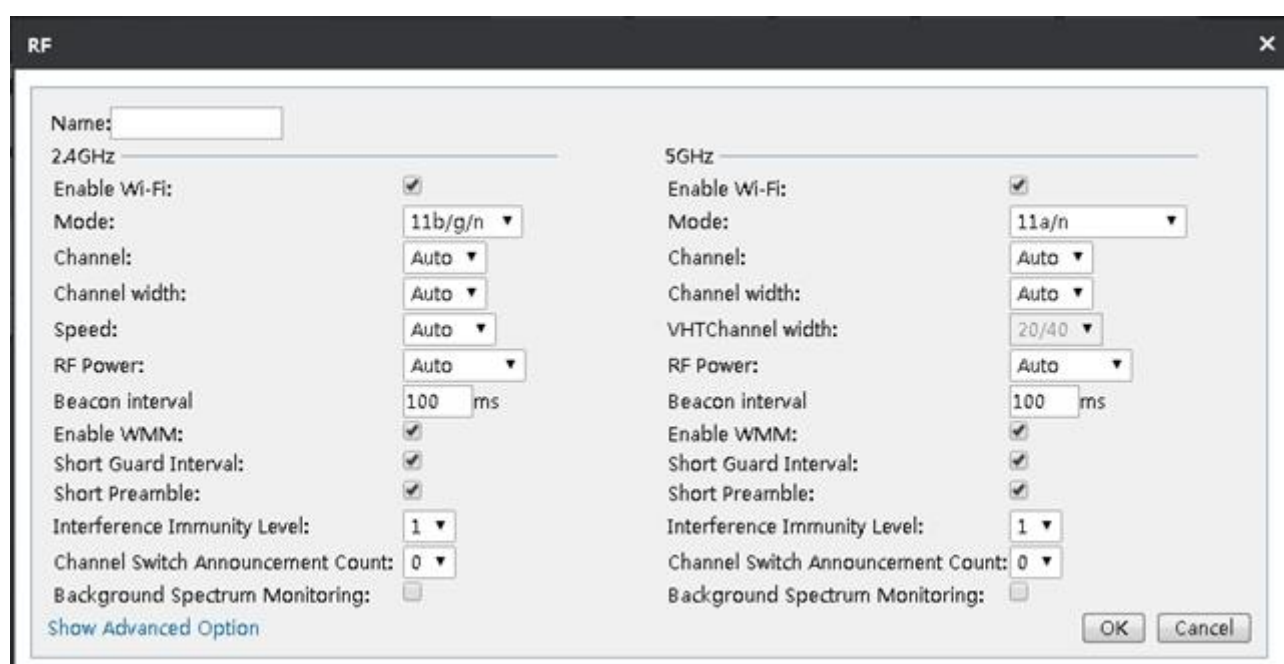
2.4Ghz						5Ghz				
<input type="checkbox"/>	Name	Mode ▾	Channel	RF Power ▾	Users ▾	Mode ▾	Channel	RF Power ▾	Users ▾	Edit
<input type="checkbox"/>	1	11b/g/n	Auto	Auto	128	11vht AC/AN/A	Auto	Auto	128	EditDelete
<input type="checkbox"/>	2	11b/g/n	Auto	Auto	128	11vht AC/AN	153	Auto	128	EditDelete

2/241/1

Figure 9- 9 RF template interface

Click the **Edit** button on the right side of the radio frequency template to be modified, to modify the parameters of the radio frequency template. Click the **Delete** button on the right side of the radio frequency template to be deleted, to delete the radio frequency template.

In the **Settings→RF template** page, click the **Add** button, and a dialog box pops up as shown in the figure below, and you can set the parameters set, and add a radio frequency template. Below is a detailed description of the meaning of the parameters of the interfaces in adding radio frequency templates.



Name: [ ]

2.4GHz

Enable Wi-Fi: ☒
Mode: 11b/g/n
Channel: Auto
Channel width: Auto
Speed: Auto
RF Power: Auto
Beacon interval: 100 ms
Enable WMM: ☒
Short Guard Interval: ☒
Short Preamble: ☒
Interference Immunity Level: 1
Channel Switch Announcement Count: 0
Background Spectrum Monitoring: ☐
Show Advanced Option

5Ghz

Enable Wi-Fi: ☒
Mode: 11a/n
Channel: Auto
Channel width: Auto
VHTChannel width: 20/40
RF Power: Auto
Beacon interval: 100 ms
Enable WMM: ☒
Short Guard Interval: ☒
Short Preamble: ☒
Interference Immunity Level: 1
Channel Switch Announcement Count: 0
Background Spectrum Monitoring: ☐

OK Cancel

Figure 9- 10 Radio frequency template

- ◆ Template name: The name of the radio frequency template.
- ◆ Enable wireless function: Checking it to enable the wireless function of two frequency bands, 2.4 GHz and 5 GHz.
- ◆ Mode: Chooses the wireless working mode.
- ◆ Channel: This parameter is used to select frequency bands in which the wireless network works. The wireless devices in the same frequency will interfere with each other, and if there are multiple wireless devices around the AP, please select a different frequency from that of other wireless devices in setting channels.
- ◆ Channel bandwidth: Selects the bandwidth of corresponding channels.
- ◆ Wireless rate: Selects the wireless transmission rate.
- ◆ Wireless transmission power: Selects the wireless transmission power.
- ◆ Beacon interval: AP will send Beacon frames to the network regularly, and synchronize with the network. Beacon interval is the periodic time interval for sending Beacon frames. Value range is 20~999 milliseconds.
- ◆ Enable WMM: Checking to enable the WMM function.
- ◆ Short Guard Interval: Checking it to enable this function.
- ◆ Short Preamble: Checking it to enable this function.
- ◆ Interference immunity level: Chooses the level of interference immunity, with a range of 1 to 5.
- ◆ Channel switching notice number: Selects the number of channel switching notices, ranging 1-9.
- ◆ Background spectrum monitoring: Checking to enable this function.

Advanced options:

- ◆ Frequency switching mode: Includes four modes, Disabled, Optimized 5 GHZ, Mandatory 5 GHZ, Frequency balancing.
- Optimized 5GHz: Guides the STA supporting dual frequency to be connected to AP first via 5GHz.
- Mandatory 5GHz: For STA that supports dual frequency, only STA is allowed to be connected to AP through the 5 GHz radio frequency.
- Frequency balancing: AP guides STA to be distributed in balance on the 2.4 GHz and 5 GHz radio frequencies.
- ◆ 2.4GHz client: Sets the maximum number of wireless clients in the AP 2.4GHz band.
- ◆ 5GHz client: Sets the maximum number of wireless clients in the AP 5GHz band.

## 9.3 Load balancing

When the covering area overlaps between the APs, these APs can be set up for load balancing, and by setting this parameter, the wireless clients in the overlapped area can be distributed in balance according to the actual machine amount of APs, so as to improve the quality of network service. The load balance groups can be modified, deleted, added, etc.



Figure 9-11 Load balancing

- Modify load balancing group: Click on the **Edit** button to modify the current load balancing configuration.
- Delete load balancing group: Click on the **Delete** button behind the corresponding load balancing group.
- Add load balancing group: Click on the **Add** button, and an interface pops up as shown in the following figure, and you can configure the AP members needing to achieving load balancing.

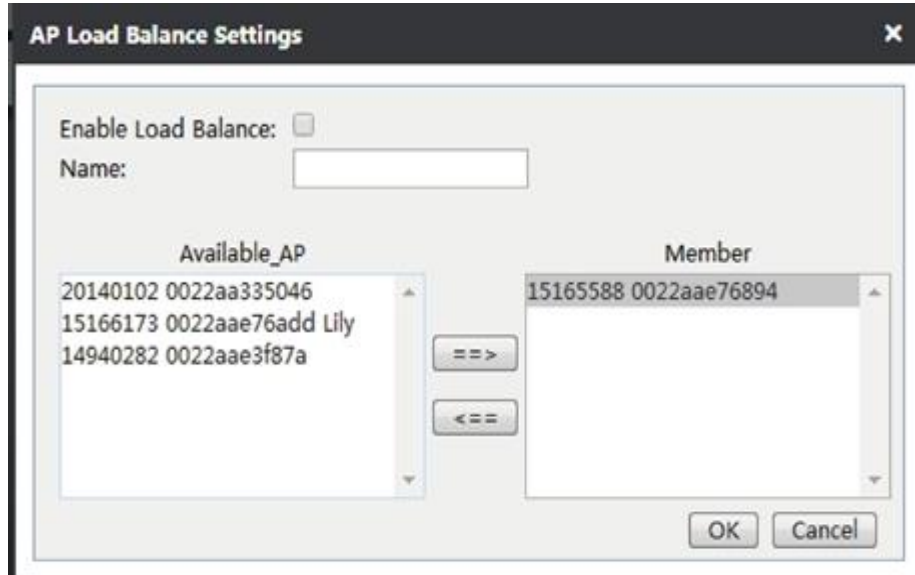


Figure 9- 12 Load balancing

- ◆ Enable load balancing: Clicking to check this option can enable the load balancing function.
- ◆ Load balancing group name: Sets the name of the AP load balancing group.
- ◆ List of APs available: Displays the basic information of the current AP.
- ◆ Load balancing group member: Displays the basic information of the APs that have enabled the load balancing function. (A load balancing group's configuration range is 2 ~ 10 sets of AP.)

## 9.4 Software management

To manage the versions of AP software. To understand the information of the current AP software version stored in the memory by viewing the software list, or upload the latest version of the AP software. If the model of the uploaded software version is the same as that stored in the memory, it will cover the old version.

After checking "Auto upgrade", all the APs in this model will be automatically upgraded in the restarting of AP. Note: Only when the version of the uploaded software is higher than that of the current AP, the system will automatically be upgraded. If you want to upgrade an AP or more than one AP, please upgrade the corresponding AP under the **Device** menu.



Figure 9- 13 Software management

## 9.5 AP centralized management configuration instance

### Requirements:

A small business now bought three sets of AP, and wants to set up a wireless network within the company, and must meet the following requirements:

- 1) The wireless network can cover the whole office area of the company.
- 2) With this wireless network, the company employees can use wireless terminals to access to the enterprise's internal resources and the Internet, while outsiders can only use the wireless terminals to access to the Internet, but cannot access to the enterprise's internal resources.
- 3) The number of clients on three APs should be as consistent as possible.

### Analysis:

- 1) To achieve the coverage of wireless network in the whole office area: Install the three APs in the corresponding office area reasonably, to realize a seamless connection through the two-layer roaming.
- 2) Create two service areas on the WAC-1000 / WAC-1001, one for the company's employees, and the other for outsiders. And three sets of AP are added into these two service areas (to achieve 2-layer roaming of wireless network), to enable the corresponding personnel to access to network resources in any position of the office area through the wireless network.
- 3) Add three APs into the same load balancing group on WAC-1000 / WAC-1001, to realize load balancing between the APs.
- 4) Prevent outsiders from accessing to the internal resources by making a strategy on WAC-1000 / WAC-1001.

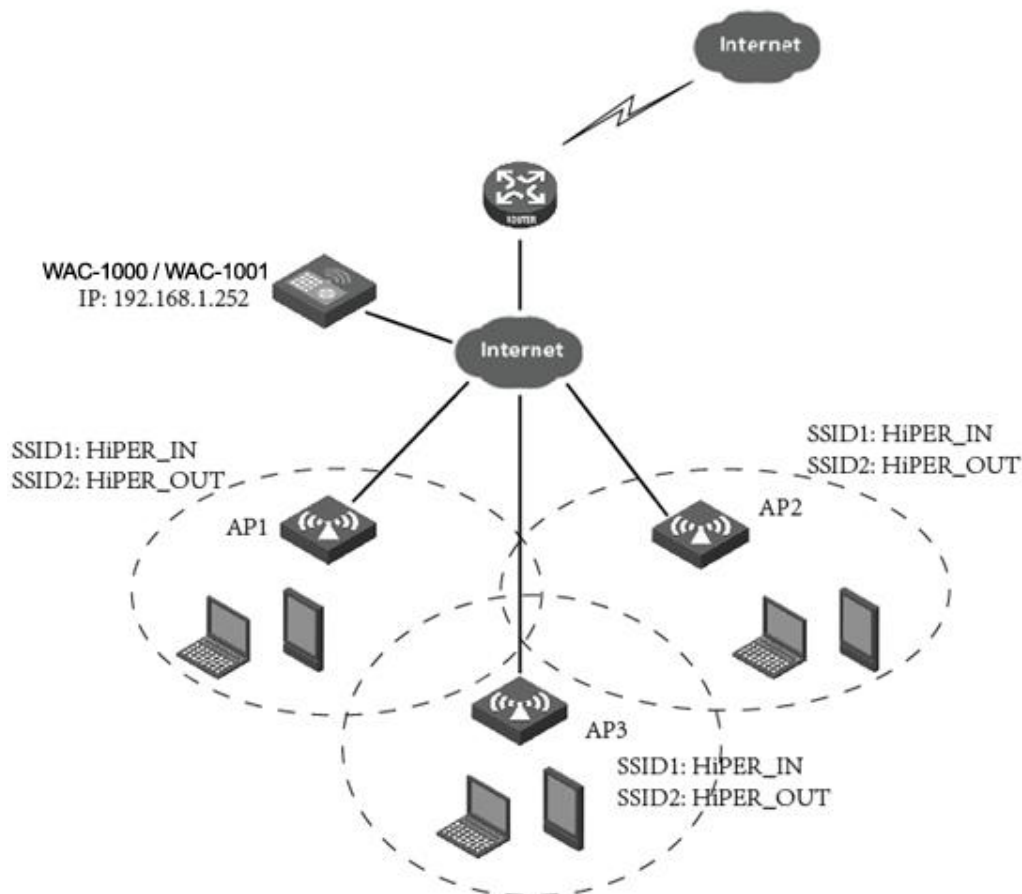




Figure 9- 14 AP centralized management configuration instance

### Configuration steps:

#### 1) Access configuration

Connect the WAC - 1000 / WAC – 1000 in bypass mode of the company network, here, the upper interface VLAN connected to WAC-1000 / WAC-1001 is VLAN10.

#### 2) Interface configuration

Log in to WAC-1000 / WAC-1001, to configure the LAN port, WAN port of the device, to complete the basic configuration on the Internet. Here, the LAN port IP address is 192.168.1.252.

#### 3) Service area configuration

Enter the **Settings**→**Service area** page, to configure service area as default, S2.

The SSID of Service area default is set to HiPER\_IN, enable SSID broadcasting, the encryption mode is set to WPA-PSK/WPA2-PSK, the pre-shared key is 1234567890, and the AP management VLAN range is set to 10.

The configuration of Service area S2 is shown in the figure below, SSID is set to HiPER\_OUT, the SSID broadcasting is enabled, and the encryption mode is WPA-PSK/WPA2-PSK, and the AP management VLAN range is set to 10.

**WLAN Settings**

1 RF | 2 VLAN | 3 Security | 4 Qos

Name:

SSID:

Application: ☒ Office ☐ Voice ☐ Guest

Broadcast/Multicast

Broadcast Filter:

DTIM Interval:

Multicast Transmission Optimization:

Dynamic Multicast Optimization:

DMO Channel Utilization Threshold:  %

Transmission Rates

2.4GHz: Min  Max

5GHz: Min  Max

Hide Advanced Option

RF

Airtime: ☐

Each Radio: ☐

Background WMM Share:  %

Best effort WMM Share:  %

Video WMM Share:  %

Voice WMM Share:  %

Miscellaneous

Content Filtering:

Band:

Inactivity Timeout:  Sec

Hide SSID: ☐

Max Clients Threshold:

Local Probe Request Threshold:


Auto upgrade: ☒

Client Isolation: ☐

Next Cancel

Figure 9- 15 Service area configuration

#### 4) Remote management

After the DHCP server, service area, etc. are configured, you can enter the **Device** page, and click on the top  of page, and remotely manage the three APs after the corresponding APs are shown respectively.

In the remote management page, click on the AP name → **Settings** → **Service settings**. After entering the service area list page, check the service areas whose names are default, S2, and then click the **Join service** button. Add other two APs into these two service areas in the same way.

#### 5) AP load balancing

Enter the **Settings** → **Load balancing** page, click the **Add** button, to enter the load balancing group configuration interface, and check Enable load balancing group, and input the name of load balancing group, HiPER\_NEW, add three APs into the load balancing group, and click **Save**.

With the above configuration, the enterprise employees can access to the network through HiPER\_IN; the outsiders can access to the network through HiPER\_OUT.

## 9.6 AP centralized management configuration instance (Three layer management)

### 9.6.1 Typical environment I (option43/ option60 for the application of the ACCESS port and 3 layer switches)

#### 1) Demand:

Analyze the WAC-1000 / WAC-1001 address in the AP through the option43 field, and discover AC by three layers.

VLAN is divided into three parts on the 3-layer switch, VLAN1, VLAN2, VLAN3 respectively, and WAP-6201 is on the access interface to which VLAN2 of the 3-layer switch, and the IP address for VLAN2 virtual interface is 192.168.2.254. WAP-6111 is on the access interface to which VLAN3 of the 3-layer switch, and the IP address for VLAN3 virtual interface is 192.168.3.254. The IP address of AC LAN is 192.168.1.252, and the IP for VLAN1 virtual interface is 192.168.1.254. The pool of the corresponding VLAN is created for the virtual interface in the VLANs, and the IP address of option43 with the field of WAC-1000 /WAC-1001 is defined. The dotted decimal format is 192.168.1.252; the dotted hexadecimal format is 0104C0A801FC, here, 01 represents fixed identifier while 04 represents the character length of 4 bytes. And configure the option60 field format as ASCII, and the character content as LEVELONE, this is AP supported field.

#### 2) Environment topology

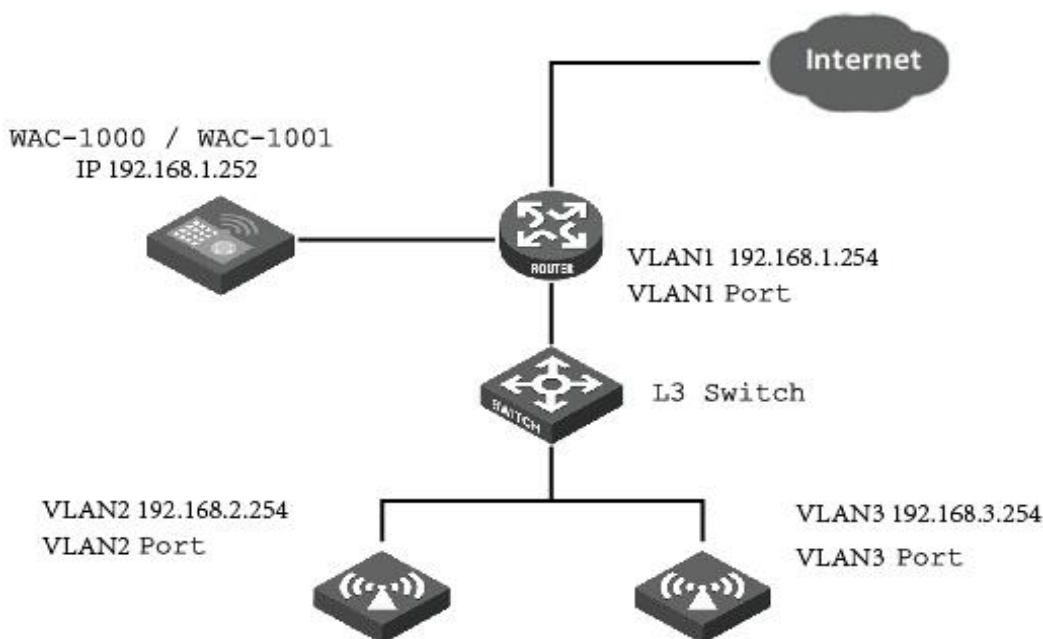




Figure 9- 16 Three-layer environment

### 3) Operation procedures

(1) Click **System**—>**Administration**, and configure the TCP/IP address of WAC - 1000 / WAC - 1001 in the figure below.

The screenshot shows a 'System' configuration window with a dark title bar and a light gray background. It has four tabs: 'Info', 'Admin', 'Time', and 'System'. The 'System' tab is selected. Inside the 'System' tab, there are two columns of configuration fields. The left column contains: 'VLAN ID:' with value '0', 'IP Address:' with value '192.168.1.252', 'Subnet Mask:' with value '255.255.255.0', 'Gateway IP Address:' with value '192.168.1.1', 'Primary DNS :' with value '200.200.200.251', 'Secondary DNS :' with value '0.0.0.0', 'WLAN Controller' (empty), and 'Controller IP Address:' (empty). The right column contains: 'Admin User' (empty), 'Username: admin', 'Password:' (empty), and 'Confirm:' (empty). At the bottom left is a blue link 'Show Advanced Option'. At the bottom right are 'OK' and 'Cancel' buttons.

Figure 9- 17 AC IP address configuration

(2) telnet 192.168.1.254 enters into a switch, to create a VLAN virtual interface, divide the VLAN, configure the dhcp pool corresponding to the VLAN, and configure option43 and option60 within the corresponding dhcp pool, and the detailed configuration is as follows:

```
no service password-encryption
```

```
hostname GTL-2890
```

```
sysLocation China
```

```
authentication line console login local
```

```
service dhcp
```

```
ip dhcp excluded-address 192.168.2.1
```

```
ip dhcp excluded-address 192.168.2.254
```

```
ip dhcp excluded-address 192.168.3.1
```

```
ip dhcp excluded-address 192.168.3.254
```

```
ip dhcp pool vlan2
```

```
network-address 192.168.2.0 255.255.255.0
```

```
lease 0 2 0
```

```
default-router 192.168.2.254
```

```

dns-server 200.200.200.251 8.8.8.8
option 43 ip 192.168.1.252
option 60 ascii LEVELONE
ip dhcp pool vlan3
network-address 192.168.3.0 255.255.255.0
lease 0 2 0
default-router 192.168.3.254
dns-server 200.200.200.251 8.8.8.8
option 43 hex 0104C0A801FC
option 60 ascii LEVELONE
vlan 1-3
Interface Ethernet1/0/7
switchport access vlan 2
Interface Ethernet1/0/8
switchport access vlan 2
Interface Ethernet1/0/9
switchport access vlan 3
Interface Ethernet1/0/10
switchport access vlan 3
interface Vlan1
ip address 192.168.1.254 255.255.255.0
interface Vlan2
ip address 192.168.2.254 255.255.255.0
interface Vlan3
ip address 192.168.3.254 255.255.255.0
ip route 0.0.0.0/0 192.168.1.252
no login
end

```

(3) Enter the centralized management list of A WAC-1000 / WAC-1001C, and view WAC-1000 / WAC-1001 to check if two APs are discovered, and the IP address of the AP are 192.168.2.0 network segment address and 192.168.3.0 network segment address respectively.

(4) Enter the WAC-1000 / WAC-1001 service area page, create a new service area, to be distributed to two sets of AP, and see if they can take effect.

AP Settings									
<div> Map Statistics Access Points Users Events Settings System </div>									
<div> Page Size: 10 <input type="text" value="Search"/> <span>Configure</span> <span>Delete Disconnected APs</span> </div>									
<input type="checkbox"/>	Name/MAC	Model	S/N	IP	Status	Mode/Channel(2.4GHz)	Mode/Channel(5GHz)	Users	Action
<input type="checkbox"/>	0022AAE6AA4E	WAP-611Z	15092302	192.168.2.2	Connected	11b/g/n / Auto(13)		0	
<input type="checkbox"/>	0022AAE6AA4D	WAP-6202	15092301	192.168.3.5	Connected	11b/g/n / Auto(2)		0	
<input type="checkbox"/>	0022AAE6AA4F	WAP2500N	15092303	192.168.3.4	Connected	11b/g/n / Auto	11a/n / Auto(153)	0	
<input type="checkbox"/>	0022AAE79A0D	WAP-6111H	15166173	192.168.3.1	Connected	11b/g/n / Auto(4)		0	
<input type="checkbox"/>	0022AA315046	WAP2500N	20140102	192.168.3.2	Connected	11b/g/n / Auto	11a/n / Auto(157)	0	
<div> 5/32 <div> 1/1 </div> </div>									

Figure 9- 18 AP management list

# Chapter 10 System management

This chapter introduces the system configuration and related information about WAC-1000 / WAC-1001.

## 10.1 Information

In the **System**—>**Information** page, the administrator can view the system information, and timely know any potential problems happening to or possibly existing in the network, thus improving network performance, and enhancing network security. The details of the system are shown below.

The screenshot shows the 'System' window with the 'Info' tab selected. It displays system information in two columns: Time and Resource on the left, and Device and Network on the right.

Time		Resource	
Current Time:	2015-8-26 17:06:11	CPU Usage:	1%
Up Time:	0 d 0 h 36 m 50 s	Memory Usage:	24%
		Flash Disk Usage:	7%

Device		Network	
Model:	WAC-1000	IP Address:	192.168.1.252
S/N:	4294967295	Subnet Mask:	255.255.255.0
Hardware:	V1.0	Gateway IP Address:	192.168.1.1
Firmware:	WAC-1000v2.8.0-150825	MAC Address:	0022aaffffff

Figure 10- 1 System information

## 10.2 Management

Under this page, you can modify the IP address of WAC-1000 / WAC-1001, the address of wireless controllers, and user names and passwords, etc., which is detailed in the following figure.

The screenshot shows the 'System' window with the 'Admin' tab selected. It displays configuration fields for network settings, user management, and WLAN controller settings.

Network Settings		User Management	
VLAN ID:	0	Admin User:	
IP Address:	192.168.1.252	Username:	admin
Subnet Mask:	255.255.255.0	Password:	
Gateway IP Address:	192.168.1.1	Confirm:	
Primary DNS :	200.200.200.254		
Secondary DNS :	0.0.0.0		

WLAN Controller		Miscellaneous	
Controller IP Address:	192.168.1.252	MAC Address:	0022AAD8AD55
		Negotiation Mode:	Auto
		Enable Port Mirroring:	<input checked="" type="checkbox"/>
		Monitoring Port:	1

Hide Advanced Option

OK Cancel

Figure 10- 2 Systems management

- ◆ Manage VLAN: Sets the needed VLAN ID, in the range of 0-4094.
- ◆ Manage IP address: Sets the AC's management IP address.
- ◆ Subnet mask: Sets the subnet mask.
- ◆ Gateway address: Sets the gateway address.
- ◆ Primary DNS server: Sets the IP address of the primary DNS server.
- ◆ Secondary DNS server: Sets the IP address of the secondary DNS server.
- ◆ Wireless controller address: Sets the IP address of wireless controllers.
- ◆ Password: Administrator password.
- ◆ Confirm password: The password for administrators to confirm.
- ◆ MAC address: The device MAC address. It is suggested not to modify the MAC address of the LAN port freely.
- ◆ Interface mode: Sets the duplex mode and rate for interfaces. Options are: Auto (adaptive), 10M-FD (10M full duplex), 10M-HD (10M half duplex), 100M-FD (100M full duplex), 100M-HD (100M half duplex). The default is Auto, which is usually not required to be modified, and if there are any compatibility issues, or the device used does not support automatic consultation function, then Ethernet consultation type can be set here.
- ◆ Enable port mirror: Checking it to enable this feature.
- ◆ Monitoring port: Any one of ports 1 ~ 5 can be selected, and the monitoring port is LAN1 by default.
- ⊕ **Tip:** After modifying the IP address of LAN port, you must use a new IP address to log into the device, and the IP for logging in to the host is on the same network segment.

## 10.3 Clock

In order to guarantee that the functions of the device relating to time work normally, the clock of the device needs to be accurately set, to make it synchronize with the local standard time. The device provides two ways of system time setting, "Manual setup time" and "Network time synchronization". It is recommended to use "Network time synchronization", and the device will automatically get the standard time from the Internet.

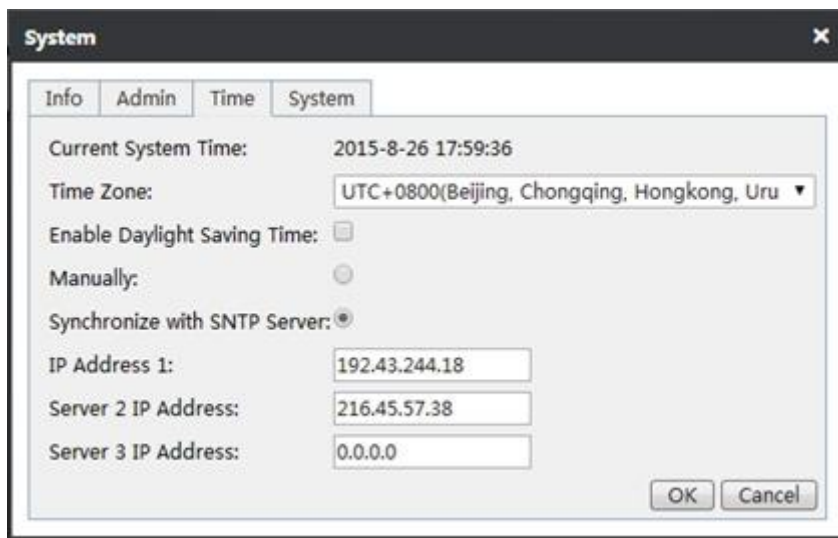


Figure 10- 3 Clock management

- ◆ Current system time: Displays the current date and time information of the device (unit: Y-M-D, H:M:S).

- ◆ Time zone selection: Selects the international time zone in which the device resides. Only choosing a correct time zone can the network time synchronization function work properly.
- ◆ Manual time setting: Manually enters the current date and time (unit: Y-M-D, H:M:S).
- ◆ Network time synchronization: After using the network time synchronization function to set up the right NTP server, and when the device is connected to the Internet, it will automatically synchronize the time with the set NTP server. The two NTP server addresses preset by the system by default are 111.43.244.18, 216.45.57.38, which generally requires no change. If you need to know more about the NTP knowledge and the server, just visit <http://www.ntp.org>.
- ⊕ **Tip:** It is recommended to set the device clock to synchronization with network time. Only when the system time is properly configured can the configurations related to time, such as firewall work normally!

## 10.4 Systems

In the **System**—>**Page**, you can back up the WAC-1000 / WAC-1001 configuration files to the local PC, import the new configuration file to the system, restore the factory configuration and view the information of the currently running version.

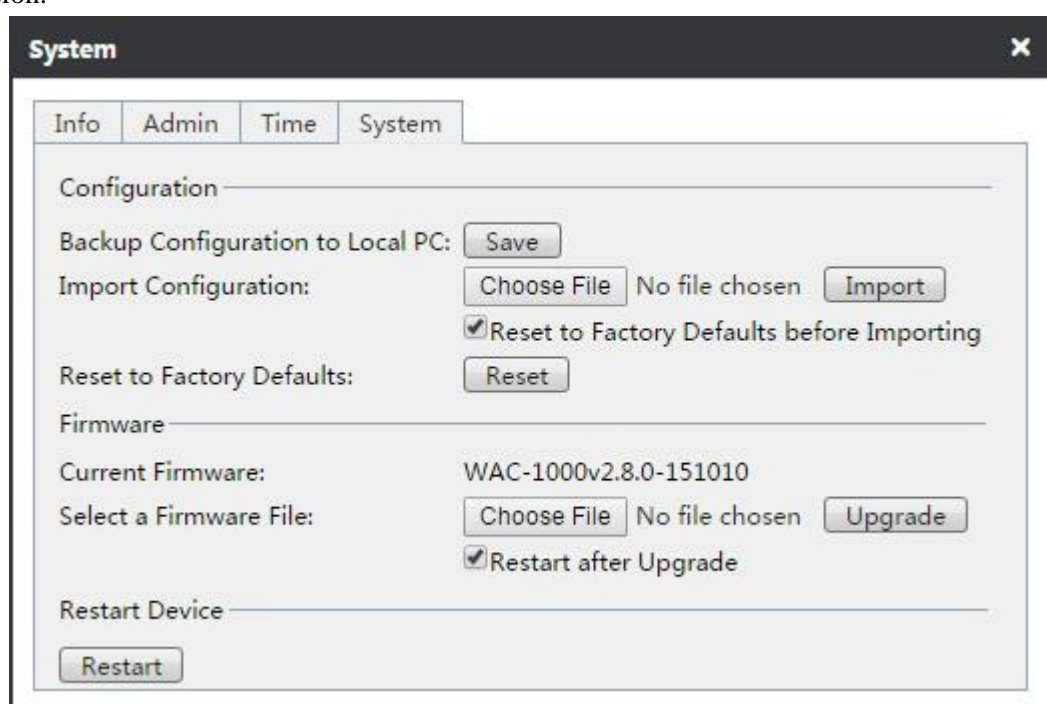


Figure 10- 4 System configuration

- ◆ Back up configuration file: Click on the **Save** button in the above figure, to back up the WAC - 1000 / WAC - 1000 configuration file to the local PC, and the the format of the configuration file is .xml.
- ◆ Import configuration file: Click on the **Select files** button in the above figure, and then import the configuration file from the local PC. If you have checked the check box **Restore factory configuration before import**, and then click the **Import** button, and the device will be recovered to the factory configuration before importing the new configuration file.
- ⊕ **Note:** Please do not close the device power supply in the process of loading configuration, in order to avoid unexpected errors.
- ◆ Restore factory configuration: Click the **Restore** button in the above figure and restart the device, to restore the factory configuration.
- ⊕ **Tip:**
  - ① Recovery of device factory settings will delete all the custom configurations. It is strongly recommended that before restoring the factory configuration, first back up its configuration files.
  - ② The user name and password of the device's factory administrator are as follows: admin, and the default LAN port IP address/subnet mask is: 192.168.1.252/255.255.255.0.

### Steps for upgrading the WAC-1000 / WAC-1001 software:

- ① Download the latest version of software of the same model from the LevelOne official website. It is recommended to back up the current configuration of the system before upgrade.
- ② Click on the **Select file button** under the software upgrade configuration in the above figure, and find the latest version of software on the local computer.
- ③ After selecting the software, click on the **Upgrade** button, to upgrade the software on your device.



#### **Tip:**

- ① It is strongly recommended that upgrade is made when the device load is low (less users).
- ② Upgrading device software on a regular basis enables the device to get more functions or to have a better working performance. The right software upgrade will not change the current device settings.
- ③ During the upgrade process, the device's power supply cannot be shut down, otherwise it will cause unpredictable errors and even irreversible damages to the hardware.
- ④ The software will automatically restart to take effect after the completion of upgrade, without human intervention.

# Chapter 11 FAQ

## A - 1 Device is used as wireless client, why can a wireless connection not be established?

After confirming that the device is powered normally and connected normally, please check the following configurations of the wireless devices in the network:

1. The "AP SSID" values set by the wireless client are consistent with the SSID of the associated wireless device or not.
2. The "AP MAC" values set by the wireless client are consistent with the MAC address of the associated wireless device or not.
3. The safe mode and key set by the wireless client are consistent with those of the associated wireless device or not.
4. The associated device has already enabled the wireless feature, and has been the AP mode or not.

## A - 2 How to restore the device to the factory settings?



**Tip:** The following method will delete all original configurations of the device, so please use it with care.

### Case I: Know the administrator password

Under normal circumstances, you can directly enter the **System management- > Configuration management** page, and then click **restore** to manually restart the device, and the device can be restored to its factory configuration.

### Case II: Forget the administrator password

If you forget the administrator password, you will not be able to enter the WEB interface, and now you can only use the Reset button to restore the factory configuration. Method: In the process of charged operation, hold down the Reset button for more than 5 seconds, then release the button, and the device will be returned to the factory settings, and automatically restart.



# Appendix A List of Common IP

Protocol	Protocol No.	Full name
IP	0	Internet Protocol
ICMP	1	Internet Protocol Message Protocol
IGMP	2	Internet Group Management
GGP	3	Gateway-Gateway Protocol
IPINIP	4	IP in IP Tunnel Driver
TCP	6	Transmission Control Protocol
EGP	8	Exterior Gateway Protocol
IGP	9	Interior Gateway Protocol
PUP	9	PARC Universal Packet Protocol
UDP	17	User Datagram Protocol
HMP	20	Host Monitoring Protocol
XNS-IDP	22	Xerox NS IDP
RDP	27	Reliable Datagram Protocol
GRE	47	General Routing Encapsulation
ESP	50	Encap Security Payload
AH	51	Authentication Header
RVD	66	MIT Remote Virtual Disk
EIGRP	88	Enhanced Interior Gateway Routing Protocol
OSPF	89	Open Shortest Path First

## Appendix B Common service ports

<b>Characters</b>	Enter	ESC	Space	!	"	#	\$	%	&	'	(	)	*	+	,
<b>ASCII</b>	0D	1B	20	21	22	23	24	25	26	27	28	29	2A	2B	2C
<b>Characters</b>	-	.	/	0	1	2	3	4	5	6	7	8	9	:	;
<b>ASCII</b>	2D	2E	2F	30	31	32	33	34	35	36	37	38	39	3A	3B
<b>Characters</b>	<	=	>	?	@	A	B	C	D	E	F	G	H	I	J
<b>ASCII</b>	3C	3D	3E	3F	40	41	42	43	44	45	46	47	48	49	4A
<b>Characters</b>	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
<b>ASCII</b>	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	59
<b>Characters</b>	Z	[	\	]	^	-	a	b	c	d	e	f	g	h	i
<b>ASCII</b>	5A	5B	5C	5D	5E	5F	61	62	63	64	65	66	67	68	69
<b>Characters</b>	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x
<b>ASCII</b>	6A	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	77	78
<b>Characters</b>	y	z	{		}	~									
<b>ASCII</b>	79	7A	7B	7C	7D	7E									

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