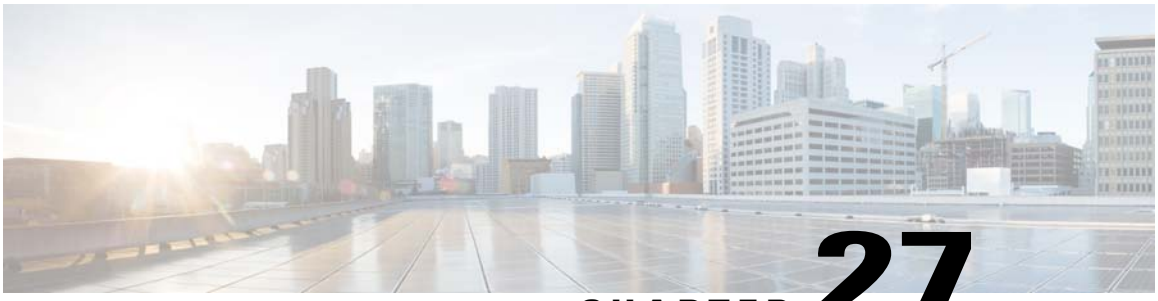


CHAPTER 27

Configuring the Management Interface

Information About the Management Interface

The management interface is the default interface for in-band management of the controller and connectivity to enterprise services such as AAA servers. It is also used for communications between the controller and access points. The management interface has the only consistently "pingable" in-band interface IP address on the controller. You can access the GUI of the controller by entering the management interface IP address of the controller in the address field of either Internet Explorer or Mozilla Firefox browser.

For CAPWAP, the controller requires one management interface to control all inter-controller communications and one AP-manager interface to control all controller-to-access point communications, regardless of the number of ports.

Note To prevent or block a wired or wireless client from accessing the management network on a controller (from the wireless client dynamic interface or VLAN), the network administrator must ensure that only authorized clients gain access to the management network through proper CPU ACLs, or use a firewall between the client dynamic interface and the management network.

Caution Do not map a guest WLAN to the management interface. If the EoIP tunnel breaks, the client could obtain an IP and be placed on the management subnet.

Caution Do not configure wired clients in the same VLAN or subnet of the service port of the controller on the network. If you configure wired clients on the same subnet or VLAN as the service port, it is not possible to access the management interface of the controller.

Configuring the Management Interface (GUI)

Step 1 Choose **Controller > Interfaces** to open the Interfaces page.

Step 2 Click the management link.
The Interfaces > Edit page appears.

Step 3 Set the management interface parameters:

Note The management interface uses the controller's factory-set distribution system MAC address.

- Quarantine and quarantine VLAN ID, if applicable

  Note Select the **Quarantine** check box if you want to configure this VLAN as unhealthy or you want to configure network access control (NAC) out-of-band integration. Doing so causes the data traffic of any client that is assigned to this VLAN to pass through the controller.

- NAT address (only Cisco 2500 Series Controllers and Cisco 5500 Series Controllers are configured for dynamic AP management.)

  Note Select the **Enable NAT Address** check box and enter the external NAT IP address if you want to be able to deploy your Cisco 2500 Series Controllers or Cisco 5500 Series Controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT). NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.

  Note If a Cisco 2500 Series Controllers or Cisco 5500 Series Controller is configured with an external NAT IP address under the management interface, the APs in local mode cannot associate with the controller. The workaround is to either ensure that the management interface has a globally valid IP address or ensure that external NAT IP address is valid internally for the local APs.

  Note The NAT parameters are supported for use only with one-to-one-mapping NAT, where each private client has a direct and fixed mapping to a global address. The NAT parameters do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

- VLAN identifier

  Note Enter 0 for an untagged VLAN or a nonzero value for a tagged VLAN. We recommend using tagged VLANs for the management interface.

- Fixed IP address, IP netmask, and default gateway
- Dynamic AP management (for Cisco 2500 Series Controllers or Cisco 5500 Series Controller only)

  Note For Cisco 5500 Series Controllers, the management interface acts like an AP-manager interface by default. If desired, you can disable the management interface as an AP-manager interface and create another dynamic interface as an AP manager.

- Physical port assignment (for all controllers except the Cisco 2500 Series Controllers or Cisco 5500 Series Controller)
- Primary and secondary DHCP servers
- Access control list (ACL) setting, if required

Step 4 Click **Save Configuration**.

Step 5 If you made any changes to the management or virtual interface, reboot the controller so that your changes take effect.

Configuring the Management Interface (CLI)

Step 1 Enter the **show interface detailed management** command to view the current management interface settings.

Note The management interface uses the controller's factory-set distribution system MAC address.

Step 2 Enter the **config wlan disable** *wlan-number* command to disable each WLAN that uses the management interface for distribution system communication.

Step 3 Enter these commands to define the management interface:

- **config interface address management** *ip-addr ip-netmask gateway*
- **config interface quarantine vlan management** *vlan_id*

  Note Use the **config interface quarantine vlan management** *vlan_id* command to configure a quarantine VLAN on the management interface.

- **config interface vlan management** {*vlan-id* | *0*}

  Note Enter 0 for an untagged VLAN or a nonzero value for a tagged VLAN. We recommend using tagged VLANs for the management interface.

- **config interface ap-manager management** {**enable** | **disable**} (for Cisco 5500 Series Controllers only)

  Note Use the **config interface ap-manager management** {**enable** | **disable**} command to enable or disable dynamic AP management for the management interface. For Cisco 5500 Series Controllers, the management interface acts like an AP-manager interface by default. If desired, you can disable the management interface as an AP-manager interface and create another dynamic interface as an AP manager.

- **config interface port management** *physical-ds-port-number* (for all controllers except the 5500 series)
- **config interface dhcp management** *ip-address-of-primary-dhcp-server* [*ip-address-of-secondary-dhcp-server*]
- **config interface acl management** *access-control-list-name*

Step 4 Enter these commands if you want to be able to deploy your Cisco 5500 Series Controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT):

- **config interface nat-address management** {**enable** | **disable**}
- **config interface nat-address management set** *public_IP_address*

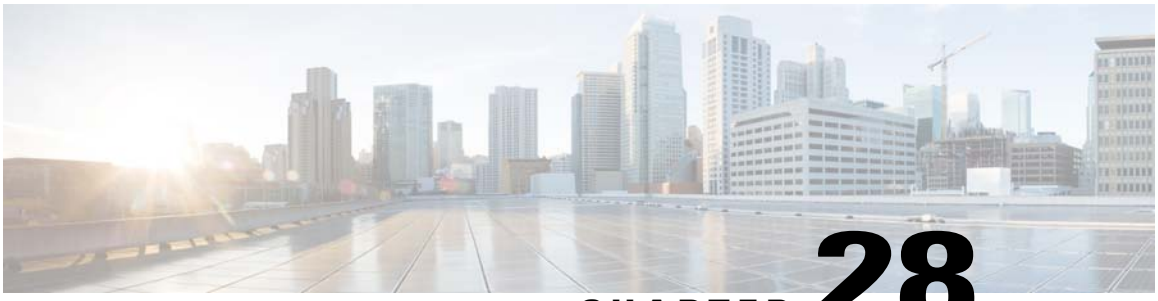
NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.

Note These commands are supported for use only with one-to-one-mapping NAT, where each private client has a direct and fixed mapping to a global address. These commands do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

Step 5 Enter the **save config** command.

Step 6 Enter the **show interface detailed management** command to verify that your changes have been saved.

Step 7 If you made any changes to the management interface, enter the **reset system** command to reboot the controller in order for the changes to take effect.



CHAPTER 28

Configuring the AP-Manager Interface

Information the About AP-Manager Interface

A controller has one or more AP-manager interfaces, which are used for all Layer 3 communications between the controller and lightweight access points after the access points have joined the controller. The AP-manager IP address is used as the tunnel source for CAPWAP packets from the controller to the access point and as the destination for CAPWAP packets from the access point to the controller.

Note The controller does not support transmitting the jumbo frames. To avoid having the controller transmit CAPWAP packets to the AP that will necessitate fragmentation and reassembly, reduce MTU/MSS on the client side.

The AP-manager interface communicates through any distribution system port by listening across the Layer 3 network for access point CAPWAP or LWAPP join messages to associate and communicate with as many lightweight access points as possible.

Restrictions for Configuring AP Manager Interfaces

- The MAC address of the management interface and the AP-manager interface is the same as the base LAG MAC address.
- If only one distribution system port can be used, you should use distribution system port 1.
-

- An AP-manager interface is not required to be configured. The management interface acts like an AP-manager interface by default, and the access points can join on this interface.
- If link aggregation (LAG) is enabled, there can be only one AP-manager interface. But when LAG is disabled, one or more AP-manager interfaces can be created, generally one per physical port.
- Port redundancy for the AP-manager interface is not supported. You cannot map the AP-manager interface to a backup port.

Configuring the AP-Manager Interface (GUI)

Step 1 Choose **Controller > Interfaces** to open the Interfaces page.

Step 2 Click AP-Manager Interface.
The Interface > Edit page appears.

Step 3 Set the AP-Manager Interface parameters:

Note For Cisco 5500 Series Controllers, you are not required to configure an AP-manager interface. The management interface acts like an AP-manager interface by default.

- Physical port assignment
- VLAN identifier

  Note Enter 0 for an untagged VLAN or a nonzero value for a tagged VLAN. We recommend using tagged VLANs for the AP-manager interface.

- Fixed IP address, IP netmask, and default gateway
- Primary and secondary DHCP servers
- Access control list (ACL) name, if required

Step 4 Click **Save Configuration** to save your changes.

Step 5 If you made any changes to the management or virtual interface, reboot the controller so that your changes take effect.

Configuring the AP Manager Interface (CLI)

Before You Begin

For Cisco 5500 Series Controllers, you are not required to configure an AP-manager interface. The management interface acts like an AP-manager interface by default.

Step 1 Enter the **show interface summary** command to view the current interfaces.

Note If the system is operating in Layer 2 mode, the AP-manager interface is not listed.

Step 2 Enter the **show interface detailed ap-manager** command to view the current AP-manager interface settings.

Step 3 Enter the **config wlan disable** *wlan-number* command to disable each WLAN that uses the AP-manager interface for distribution system communication.

Step 4 Enter these commands to define the AP-manager interface:

- **config interface address ap-manager** *ip-addr ip-netmask gateway*
- **config interface vlan ap-manager** {*vlan-id* | *0*}

  Note Enter *0* for an untagged VLAN or a nonzero value for a tagged VLAN. We recommend using tagged VLANs for the AP-manager interface.

- **config interface port ap-manager** *physical-ds-port-number*
- **config interface dhcp ap-manager** *ip-address-of-primary-dhcp-server* [*ip-address-of-secondary-dhcp-server*]
- **config interface acl ap-manager** *access-control-list-name*

Step 5 Enter the **save config** command to save your changes.

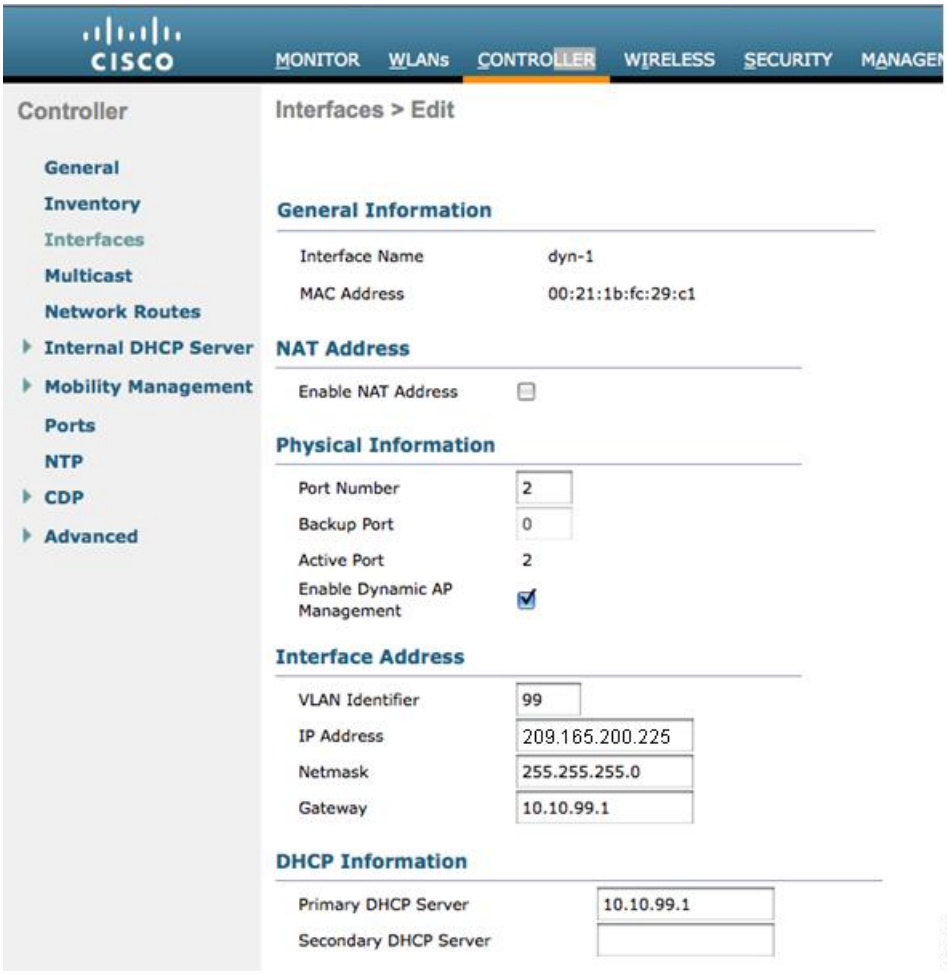
Step 6 Enter the **show interface detailed ap-manager** command to verify that your changes have been saved.

Configuration Example: Configuring AP-Manager on a Cisco 5500 Series Controller

For a Cisco 5500 Series Controller, we recommend that you have eight dynamic AP-manager interfaces and associate them to the eight Gigabit ports of the controller when LAG is not used. If you are using the management interface, which acts like an AP-manager interface by default, you must create only seven more dynamic AP-manager interfaces and associate them to the remaining seven Gigabit ports.

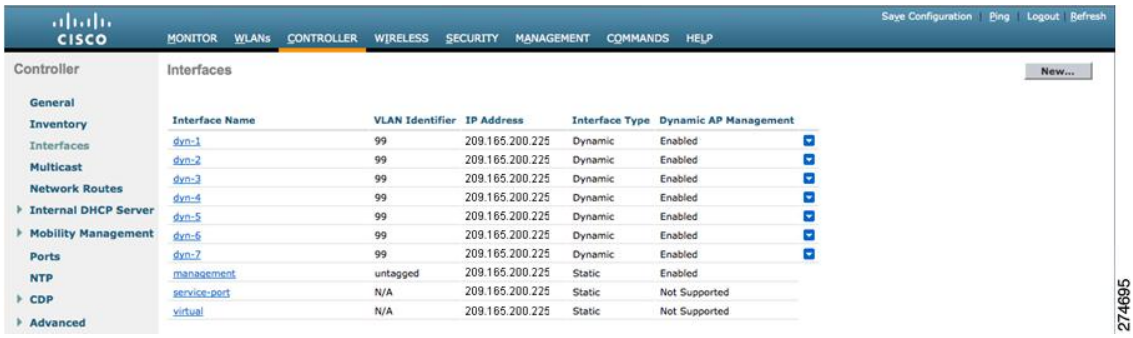
This figure shows a dynamic interface that is enabled as a dynamic AP-manager interface and associated to port number 2.

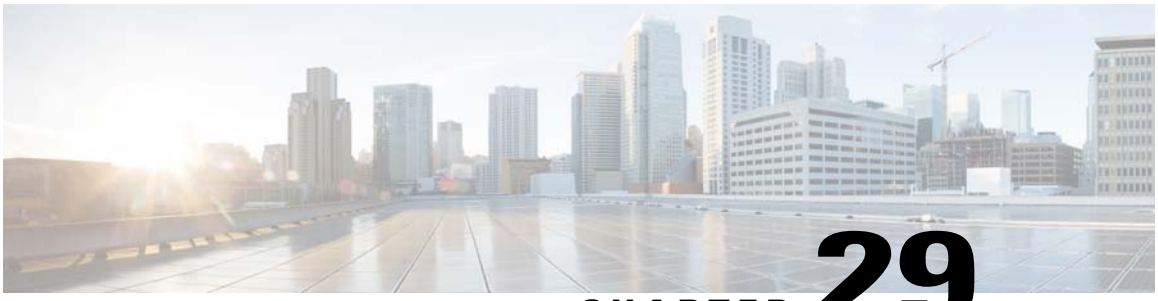
Figure 35: Dynamic Interface Example with Dynamic AP Management



This figure shows a Cisco 5500 Series Controller with LAG disabled, the management interface used as one dynamic AP-manager interface, and seven additional dynamic AP-manager interfaces, each mapped to a different Gigabit port.

Figure 36: Cisco 5500 Series Controller Interface Configuration Example





CHAPTER 29

Configuring Virtual Interfaces

Information About the Virtual Interface

The virtual interface is used to support mobility management, Dynamic Host Configuration Protocol (DHCP) relay, and embedded Layer 3 security such as guest web authentication and VPN termination. It also maintains the DNS gateway host name used by Layer 3 security and mobility managers to verify the source of certificates when Layer 3 web authorization is enabled.

Specifically, the virtual interface plays these two primary roles:

- Acts as the DHCP server placeholder for wireless clients that obtain their IP address from a DHCP server.
- Serves as the redirect address for the web authentication login page.

The virtual interface IP address is used only in communications between the controller and wireless clients. It never appears as the source or destination address of a packet that goes out a distribution system port and onto the switched network. For the system to operate correctly, the virtual interface IP address must be set (it cannot be 0.0.0.0), and no other device on the network can have the same address as the virtual interface. Therefore, the virtual interface must be configured with an unassigned and unused gateway IP address. The virtual interface IP address is not pingable and should not exist in any routing table in your network. In addition, the virtual interface cannot be mapped to a physical port.

Note All controllers within a mobility group must be configured with the same virtual interface IP address. Otherwise, inter-controller roaming may appear to work, but the handoff does not complete, and the client loses connectivity for a period of time.

Configuring Virtual Interfaces (GUI)

Step 1 Choose **Controller > Interfaces** to open the Interfaces page.

Step 2 Click **Virtual.**
The Interfaces > Edit page appears.

Step 3 Enter the following parameters:

- Any fictitious, unassigned, and unused gateway IP address
- DNS gateway hostname

Note To ensure connectivity and web authentication, the DNS server should always point to the virtual interface. If a DNS hostname is configured for the virtual interface, then the same DNS host name must be configured on the DNS server(s) used by the client.

Step 4 Click **Save Configuration**.

Step 5 If you made any changes to the management or virtual interface, reboot the controller so that your changes take effect.

Configuring Virtual Interfaces (CLI)

Step 1 Enter the **show interface detailed virtual** command to view the current virtual interface settings.

Step 2 Enter the **config wlan disable wlan-number** command to disable each WLAN that uses the virtual interface for distribution system communication.

Step 3 Enter these commands to define the virtual interface:

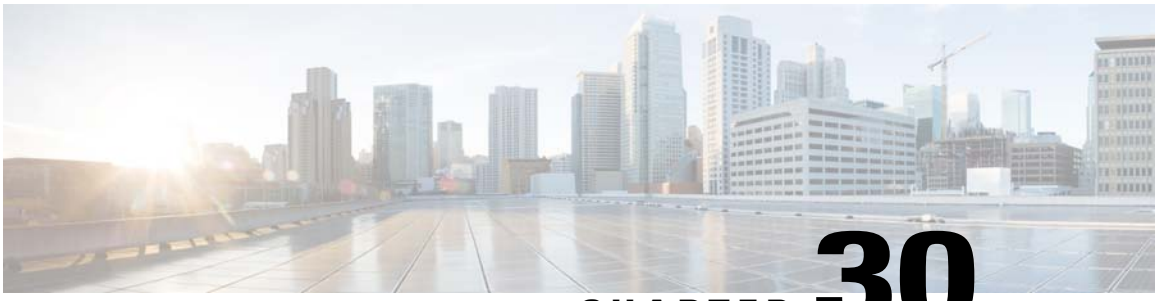
- **config interface address virtual** *ip-address*

  Note For *ip-address*, enter any fictitious, unassigned, and unused gateway IP address.

- **config interface hostname virtual** *dns-host-name*

Step 4 Enter the **reset system** command. At the confirmation prompt, enter Y to save your configuration changes to NVRAM. The controller reboots.

Step 5 Enter the **show interface detailed virtual** command to verify that your changes have been saved.



CHAPTER 30

Configuring Service-Port Interfaces

Information About Service-Port Interfaces

The service-port interface controls communications through and is statically mapped by the system to the service port. The service port can obtain an IP address using DHCP, or it can be assigned a static IP address, but a default gateway cannot be assigned to the service-port interface. Static routes can be defined through the controller for remote network access to the service port.

Restrictions for Configuring Service-Port Interfaces

- Only Cisco 7500 Series Controllers and Cisco 5500 Series Controllers have a physical service-port interface that is reachable from the external network.

Configuring Service-Port Interfaces (GUI)

Step 1 Choose **Controller** > **Interfaces** to open the Interfaces page.

Step 2 Click the service-port link to open the Interfaces > Edit page.

Step 3 Enter the Service-Port Interface parameters:

Note The service-port interface uses the controller's factory-set service-port MAC address.

- DHCP protocol (enabled)
- DHCP protocol (disabled) and IP address and IP netmask

Step 4 Click **Save Configuration** to save your changes.

Step 5 If you made any changes to the management or virtual interface, reboot the controller so that your changes take effect.

Configuring Service-Port Interfaces (CLI)

Step 1 To view the current service-port interface settings, enter this command:
show interface detailed service-port

Note The service-port interface uses the controller's factory-set service-port MAC address.

Step 2 Enter these commands to define the service-port interface:

- To configure the DHCP server, enter this command:

  config interface dhcp service-port enable

- To disable the DHCP server, enter this command:

  config interface dhcp service-port disable

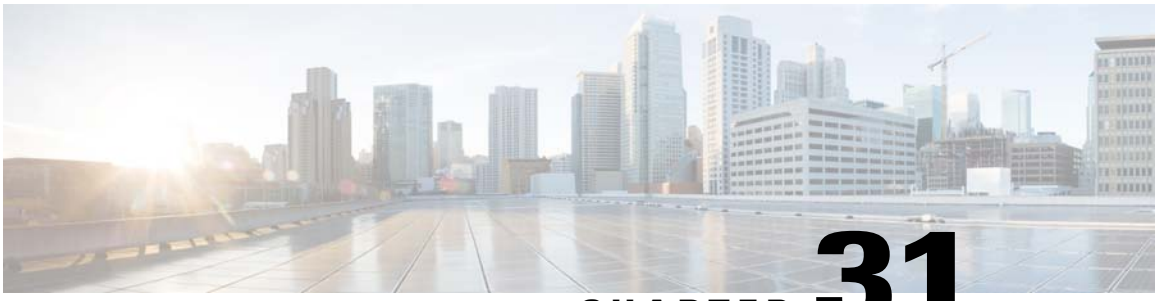
- To configure the IP address, enter this command:

  config interface address service-port *ip-addr ip-netmask*

Step 3 The service port is used for out-of-band management of the controller. If the management workstation is in a remote subnet, you may need to add a route on the controller in order to manage the controller from that remote workstation. To do so, enter this command:
config route add *network-ip-addr ip-netmask gateway*

Step 4 Enter the **save config** command to save your changes.

Step 5 Enter the **show interface detailed service-port** command to verify that your changes have been saved.



CHAPTER 31

Configuring Dynamic Interfaces

Information About Dynamic Interface

Dynamic interfaces, also known as VLAN interfaces, are created by users and designed to be analogous to VLANs for wireless LAN clients. A controller can support up to 512 dynamic interfaces (VLANs). Each dynamic interface is individually configured and allows separate communication streams to exist on any or all of a controller's distribution system ports. Each dynamic interface controls VLANs and other communications between controllers and all other network devices, and each acts as a DHCP relay for wireless clients associated to WLANs mapped to the interface. You can assign dynamic interfaces to distribution system ports, WLANs, the Layer 2 management interface, and the Layer 3 AP-manager interface, and you can map the dynamic interface to a backup port.

You can configure zero, one, or multiple dynamic interfaces on a distribution system port. However, all dynamic interfaces must be on a different VLAN or IP subnet from all other interfaces configured on the port. If the port is untagged, all dynamic interfaces must be on a different IP subnet from any other interface configured on the port.

This table lists the maximum number of VLANs supported on the various controller platforms.

Table 7: Maximum number of VLANs supported on Cisco Wireless Controllers

Wireless Controllers	Maximum VLANs
Cisco Virtual Wireless Controller	512
Cisco Wireless Controller Module for ISR G2	16
Cisco 2500 Series Wireless Controllers	16

Wireless Controllers	Maximum VLANs
Cisco 5500 Series Wireless Controller	512
Cisco Catalyst 6500 Series Wireless Services Module2 (WiSM2)	512
Cisco Flex 7500 Series Cloud Controller	4,096
Cisco 8500 Series Controller	4,096

Pre - requisites for Configuring Dynamic Interfaces

While configuring on the dynamic interface of the controller, you must ensure the following:

-
- You must use tagged VLANs for dynamic interfaces.

Restrictions for Configuring Dynamic Interfaces

The following restrictions apply for configuring the dynamic interfaces on the controller:

- You must not configure a dynamic interface in the same subnetwork as a server that is reachable by the controller CPU, such as a RADIUS server, as it might cause asymmetric routing issues.
- Wired clients cannot access management interface of the Cisco WLC 2500 series using the IP address of the AP Manager interface – when Dynamic AP Management is enabled on a dynamic VLAN.
-
- For SNMP requests that come from a subnet that is configured as a dynamic interface, the controller responds but the response does not reach the device that initiated the conversation.
- If you are using DHCP proxy and/or a RADIUS source interface, ensure that the dynamic interface has a valid routable address. Duplicate or overlapping addresses across controller interfaces are not supported.

Configuring Dynamic Interfaces (GUI)

Step 1 Choose **Controller > Interfaces** to open the Interfaces page.

Step 2 Perform one of the following:

- To create a new dynamic interface, click **New**. The **Interfaces > New page** appears. Go to *Step 3*.
- To modify the settings of an existing dynamic interface, click the name of the interface. The **Interfaces > Edit** page for that interface appears. Go to *Step 5*.

- To delete an existing dynamic interface, hover your cursor over the blue drop-down arrow for the desired interface and choose **Remove**.

Step 3 Enter an interface name and a VLAN identifier, as shown in the figure above.

Step 4 Click **Apply** to commit your changes. The Interfaces > Edit page appears.

Step 5 Configure the following parameters:

- Guest LAN, if applicable
- Quarantine and quarantine VLAN ID, if applicable

  Note Select the **Quarantine** check box if you want to configure this VLAN as unhealthy or you want to configure network access control (NAC) out-of-band integration. Doing so causes the data traffic of any client that is assigned to this VLAN to pass through the controller.

- Physical port assignment (for all controllers except the 5500 series)
- NAT address (only for Cisco 5500 Series Controllers configured for dynamic AP management)

  Note Select the **Enable NAT Address** check box and enter the external NAT IP address if you want to be able to deploy your Cisco 5500 Series Controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT). NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.

  Note The NAT parameters are supported for use only with one-to-one-mapping NAT, where each private client has a direct and fixed mapping to a global address. The NAT parameters do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

- Dynamic AP management

  Note When you enable this feature, this dynamic interface is configured as an AP-manager interface (only one AP-manager interface is allowed per physical port). A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

  Note Set the APs in a VLAN that is different than the dynamic interface configured on the controller. If the APs are in the same VLAN as the dynamic interface, the APs are not registered on the controller and the "LWAPP discovery rejected" and "Layer 3 discovery request not received on management VLAN" errors are logged on the controller.

- VLAN identifier
- Fixed IP address, IP netmask, and default gateway
- Primary and secondary DHCP servers
- Access control list (ACL) name, if required

  Note To ensure proper operation, you must set the Port Number and Primary DHCP Server parameters.

Step 6 Click **Save Configuration** to save your changes.

Step 7 Repeat this procedure for each dynamic interface that you want to create or edit.

Configuring Dynamic Interfaces (CLI)

Step 1 Enter the **show interface summary** command to view the current dynamic interfaces.

Step 2 View the details of a specific dynamic interface by entering this command:
show interface detailed *operator_defined_interface_name*.

Note Interface names that contain spaces must be enclosed in double quotes. For example: **config interface create** *"vlan 25"*

Step 3 Enter the **config wlan disable** *wlan_id* command to disable each WLAN that uses the dynamic interface for distribution system communication.

Step 4 Enter these commands to configure dynamic interfaces:

- **config interface create** *operator_defined_interface_name* {*vlan_id* | *x*}
- **config interface address interface** *ip_addr ip_netmask* [**gateway**]
- **config interface vlan** *operator_defined_interface_name* {*vlan_id* | *o*}
- **config interface port** *operator_defined_interface_name* physical_ds_port_number
- **config interface ap-manager** *operator_defined_interface_name* {**enable** | **disable**}

  Note Use the **config interface ap-manager operator_defined_interface_name** {**enable** | **disable}** command to enable or disable dynamic AP management. When you enable this feature, this dynamic interface is configured as an AP-manager interface (only one AP-manager interface is allowed per physical port). A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

- **config interface dhcp** *operator_defined_interface_name ip_address_of_primary_dhcp_server* [*ip_address_of_secondary_dhcp_server*]
- **config interface quarantine vlan** *interface_name vlan_id*

  Note Use the **config interface quarantine vlan** *interface_name vlan_id* command to configure a quarantine VLAN on any interface.

- **config interface acl** *operator_defined_interface_name* access_control_list_name

Step 5 Enter these commands if you want to be able to deploy your Cisco 5500 Series Controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT):

- **config interface nat-address dynamic-interface** *operator_defined_interface_name* {**enable** | **disable**}
- **config interface nat-address dynamic-interface** *operator_defined_interface_name* **set** *public_IP_address*

NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.

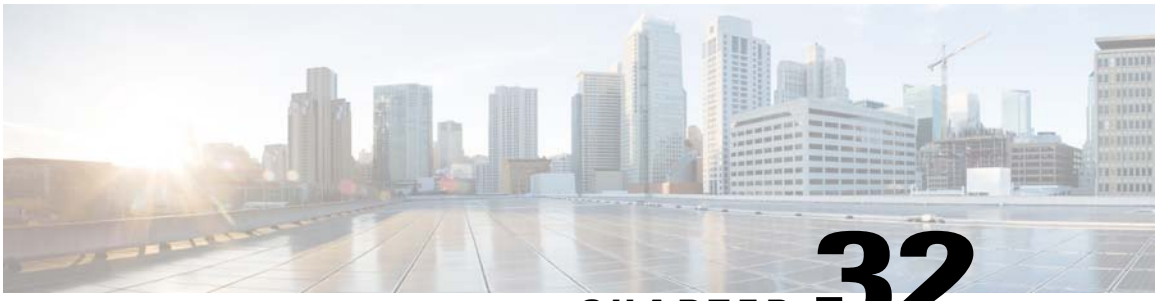
Note These commands are supported for use only with one-to-one-mapping NAT, whereby each private client has a direct and fixed mapping to a global address. These commands do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

Step 6 Enter the **config wlan enable** *wlan_id* command to reenable each WLAN that uses the dynamic interface for distribution system communication.

Step 7 Enter the **save config** command to save your changes.

Step 8 Enter the **show interface detailed** *operator_defined_interface_name* command and *show interface summary* command to verify that your changes have been saved.

Note If desired, you can enter the **config interface delete** *operator_defined_interface_name* command to delete a dynamic interface.



CHAPTER 32

Configuring Ports

Configuring Ports (GUI)

The controller's ports are configured with factory-default settings designed to make the controllers' ports operational without additional configuration. However, you can view the status of the controller's ports and edit their configuration parameters at any time.

Step 1 Choose **Controller** > **Ports** to open the Ports page.
This page shows the current configuration for each of the controller's ports.

If you want to change the settings of any port, click the number for that specific port. The **Port > Configure** page appears.

Note If the management and AP-manager interfaces are mapped to the same port and are members of the same VLAN, you must disable the WLAN before making a port-mapping change to either interface. If the management and AP-manager interfaces are assigned to different VLANs, you do not need to disable the WLAN.

Note The number of parameters available on the Port > Configure page depends on your controller type.

The following show the current status of the port:

- Port Number—Number of the current port.
- Admin Status—Current state of the port. Values: Enable or Disable
- Physical Mode—Configuration of the port physical interface. The mode varies by the controller type.
- Physical Status—The data rate being used by the port. The available data rates vary based on controller type.
  - 2500 series - 1 Gbps full duplex
  - WiSM2 - 10 Gbps full duplex
  - 7500 series - 10 Gbps full duplex
- Link Status—Link status of the port. Values: Link Up or Link Down

- Link Trap—Whether the port is set to send a trap when the link status changes. Values: Enable or Disable
- Power over Ethernet (PoE)—If the connecting device is equipped to receive power through the Ethernet cable and if so, provides –48 VDC. Values: Enable or Disable

Note Some older Cisco access points do not draw PoE even if it is enabled on the controller port. In such cases, contact the Cisco Technical Assistance Center (TAC).

The following is a list of the port's configurable parameters.

1 **Admin Status—**Enables or disables the flow of traffic through the port. Options: Enable or Disable Default: Enable.

Note When a primary port link goes down, messages may get logged internally only and not be posted to a syslog server. It may take up to 40 seconds to restore logging to the syslog server.

2 **Physical Mode—**Determines whether the port's data rate is set automatically or specified by the user. The supported data rates vary based on the controller type. Default: Auto.

3 **Link Trap—**Causes the port to send a trap when the port's link status changes. Options: Enable or Disable Default: Enable.

Step 2 Click **Apply**.

Step 3 Click **Save Configuration**.

Step 4 Click **Back** to return to the Ports page and review your changes.

Step 5 Repeat this procedure for each additional port that you want to configure.

CHAPTER 33

Information About Using Cisco 5500 Series Controller USB Console Port

The USB console port on the Cisco 5500 Series Controllers connects directly to the USB connector of a PC using a USB Type A-to-5-pin mini Type B cable.

Note The 4-pin mini Type B connector is easily confused with the 5-pin mini Type B connector. They are not compatible. Only the 5-pin mini Type B connector can be used.

For operation with Microsoft Windows, the Cisco Windows USB console driver must be installed on any PC connected to the console port. With this driver, you can plug and unplug the USB cable into and from the console port without affecting Windows HyperTerminal operations.

Note Only one console port can be active at a time. When a cable is plugged into the USB console port, the RJ-45 port becomes inactive. Conversely, when the USB cable is removed from the USB port, the RJ-45 port becomes active.

USB Console OS Compatibility

Before You Begin

These operating systems are compatible with the USB console:

- Microsoft Windows 2000, Windows XP, Windows Vista, Windows 7 (Cisco Windows USB console driver required)
- Apple Mac OS X 10.5.2 (no driver required)

- Linux (no driver required)

Step 1 Download the USB_Console.inf driver file as follows:

a) Click this URL to go to the Software Center: http://tools.cisco.com/support/downloads/go/Redirect.x?mdfid=278875243
b) Click **Wireless LAN Controllers**.
c) Click **Standalone Controllers**.
d) Click **Cisco 5500 Series Wireless LAN Controllers**.
e) Click **Cisco 5508 Wireless LAN Controller**.
f) Choose the USB driver file.
g) Save the file to your hard drive.

Step 2 Connect the Type A connector to a USB port on your PC.

Step 3 Connect the mini Type B connector to the USB console port on the controller.

Step 4 When prompted for a driver, browse to the USB_Console.inf file on your PC. Follow the prompts to install the USB driver.

Note Some systems might also require an additional system file. You can download the Usbser.sys file from http://support.microsoft.com/kb/918365.

Changing the Cisco USB Systems Management Console COM Port to an Unused Port

Before You Begin

The USB driver is mapped to COM port 6. Some terminal emulation programs do not recognize a port higher than COM 4. If necessary, you must change the Cisco USB systems management console COM port to an unused port of COM 4 or lower.

Step 1 From your Windows desktop, right-click **My Computer** and choose **Manage**.

Step 2 From the list on the left side, choose **Device Manager**.

Step 3 From the device list on the right side, double-click **Ports (COM & LPT)**.

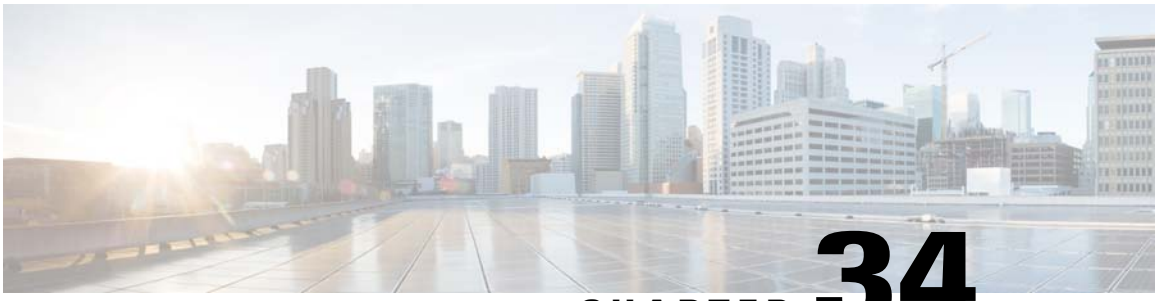
Step 4 Right-click **Cisco USB System Management Console 0108** and choose **Properties**.

Step 5 Click the **Port Settings** tab and click the **Advanced** button.

Step 6 From the COM Port Number drop-down list, choose an unused COM port of 4 or lower.

Step 7 Click **OK** to save and then close the Advanced Settings dialog box.

Step 8 Click **OK** to save and then close the Communications Port Properties dialog box.



CHAPTER 34

Configuring Link Aggregation

Information About Link Aggregation

Link aggregation (LAG) is a partial implementation of the 802.3ad port aggregation standard. It bundles all of the controller's distribution system ports into a single 802.3ad port channel, thereby reducing the number of IP addresses needed to configure the ports on your controller. When LAG is enabled, the system dynamically manages port redundancy and load balances access points transparently to the user.

LAG simplifies controller configuration because you no longer need to configure primary and secondary ports for each interface. If any of the controller ports fail, traffic is automatically migrated to one of the other ports. As long as at least one controller port is functioning, the system continues to operate, access points remain connected to the network, and wireless clients continue to send and receive data.

Note LAG is supported across switches.

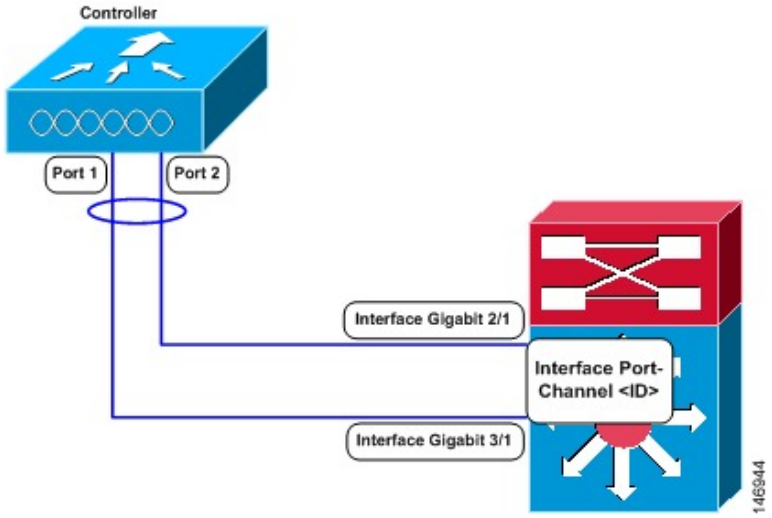
Restrictions for Link Aggregation

- You can bundle all eight ports on a Cisco 5508 Controller into a single link.
- Terminating on two different modules within a single Catalyst 6500 series switch provides redundancy and ensures that connectivity between the switch and the controller is maintained when one module fails. The controller's port 1 is connected to Gigabit interface 3/1, and the controller's port 2 is connected

to Gigabit interface 2/1 on the Catalyst 6500 series switch. Both switch ports are assigned to the same channel group.

- LAG requires the EtherChannel to be configured for 'mode on' on both the controller and the Catalyst switch.
- Once the EtherChannel is configured as on at both ends of the link, the Catalyst switch should not be configured for either Link Aggregation Control Protocol (LACP) or Cisco proprietary Port Aggregation Protocol (PAgP) but be set unconditionally to LAG. Because no channel negotiation is done between the controller and the switch, the controller does not answer to negotiation frames and the LAG is not formed if a dynamic form of LAG is set on the switch. Additionally, LACP and PAgP are not supported on the controller.
- If the recommended load-balancing method cannot be configured on the Catalyst switch, then configure the LAG connection as a single member link or disable LAG on the controller.

Figure 37: Link Aggregation with the Catalyst 6500 Series Neighbor Switch



- You cannot configure the controller's ports into separate LAG groups. Only one LAG group is supported per controller. Therefore, you can connect a controller in LAG mode to only one neighbor device.
- When you enable LAG or make any changes to the LAG configuration, you must immediately reboot the controller.
- When you enable LAG, you can configure only one AP-manager interface because only one logical port is needed. LAG removes the requirement for supporting multiple AP-manager interfaces.
- When you enable LAG, all dynamic AP-manager interfaces and untagged interfaces are deleted, and all WLANs are disabled and mapped to the management interface. Also, the management, static AP-manager, and VLAN-tagged dynamic interfaces are moved to the LAG port.
- Multiple untagged interfaces to the same port are not allowed.
- When you enable LAG, you cannot create interfaces with a primary port other than 29.
- When you enable LAG, all ports participate in LAG by default. You must configure LAG for all of the connected ports in the neighbor switch.

- When you enable LAG, if any single link goes down, traffic migrates to the other links.
- When you enable LAG, only one functional physical port is needed for the controller to pass client traffic.
- When you enable LAG, access points remain connected to the controller until you reboot the controller, which is needed to activate the LAG mode change, and data service for users continues uninterrupted.
- When you enable LAG, you eliminate the need to configure primary and secondary ports for each interface.
- When you enable LAG, the controller sends packets out on the same port on which it received them. If a CAPWAP packet from an access point enters the controller on physical port 1, the controller removes the CAPWAP wrapper, processes the packet, and forwards it to the network on physical port 1. This may not be the case if you disable LAG.
- When you disable LAG, the management, static AP-manager, and dynamic interfaces are moved to port 1.
- When you disable LAG, you must configure primary and secondary ports for all interfaces.
- When you disable LAG, you must assign an AP-manager interface to each port on the controller. Otherwise, access points are unable to join.
- Cisco 5500 Series Controllers support a single static link aggregation bundle.
- LAG is typically configured using the Startup Wizard, but you can enable or disable it at any time through either the GUI or CLI.
- When you enable LAG on Cisco 2500 Series Controller to which the direct-connect access point is associated, the direct connect access point is disconnected since LAG enabling is still in the transition state. You must reboot the controller immediately after enabling LAG.

Enabling Link Aggregation (GUI)

Step 1 Choose **Controller > General** to open the General page.

Step 2 Set the LAG Mode on Next Reboot parameter to Enabled.

Step 3 Click **Apply** to commit your changes.

Step 4 Click **Save Configuration** to save your changes.

Step 5 Reboot the controller.

Step 6 Assign the WLAN to the appropriate VLAN.

Enabling Link Aggregation (CLI)

Step 1 Enter the **config lag enable** command to enable LAG.

Note Enter the **config lag disable** command if you want to disable LAG.

Step 2 Enter the **save config** command to save your settings.

Step 3 Reboot the controller.

Verifying Link Aggregation Settings (CLI)

To verify your LAG settings, enter this command:

show lag summary

Information similar to the following appears:

```
LAG Enabled
```

Configuring Neighbor Devices to Support Link Aggregation

The controller's neighbor devices must also be properly configured to support LAG.

- Each neighbor port to which the controller is connected should be configured as follows:

```
interface GigabitEthernet <interface id>
 switchport
 channel-group <id> mode on
 no shutdown
```

- The port channel on the neighbor switch should be configured as follows:

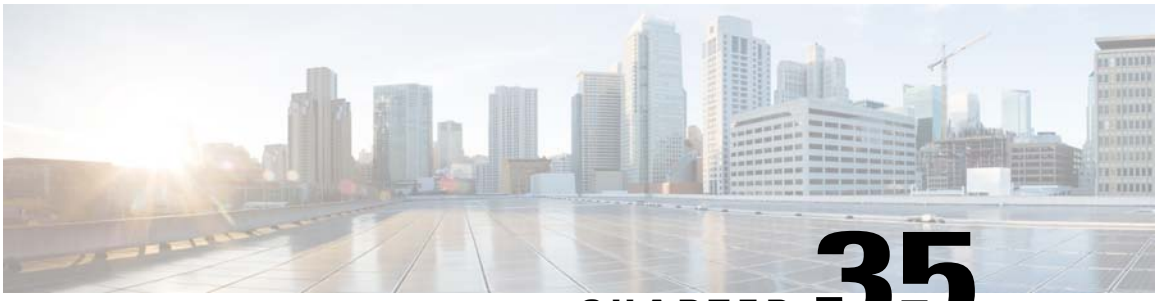
```
interface port-channel <id>
 switchport
 switchport trunk encapsulation dot1q
 switchport trunk native vlan <native vlan id>
 switchport trunk allowed vlan <allowed vlans>
 switchport mode trunk
 no shutdown
```

Choosing Between Link Aggregation and Multiple AP-Manager Interfaces

Cisco 5500 Series Controllers have no restrictions on the number of access points per port, but we recommend using LAG or multiple AP-manager interfaces on each Gigabit Ethernet port to automatically balance the load.

The following factors should help you decide which method to use if your controller is set for Layer 3 operation:

- With LAG, all of the controller ports need to connect to the same neighbor switch. If the neighbor switch goes down, the controller loses connectivity.
- With multiple AP-manager interfaces, you can connect your ports to different neighbor devices. If one of the neighbor switches goes down, the controller still has connectivity. However, using multiple AP-manager interfaces presents certain challenges when port redundancy is a concern.



CHAPTER 35

Configuring Multiple AP-Manager Interfaces

Information About Multiple AP-Manager Interfaces

When you create two or more AP-manager interfaces, each one is mapped to a different port. The ports should be configured in sequential order so that AP-manager interface 2 is on port 2, AP-manager interface 3 is on port 3, and AP-manager interface 4 is on port 4.

Before an access point joins a controller, it sends out a discovery request. From the discovery response that it receives, the access point can tell the number of AP-manager interfaces on the controller and the number of access points on each AP-manager interface. The access point generally joins the AP-manager with the least number of access points. In this way, the access point load is dynamically distributed across the multiple AP-manager interfaces.

Note Access points may not be distributed completely evenly across all of the AP-manager interfaces, but a certain level of load balancing occurs.

Restrictions for Configuring Multiple AP Manager Interfaces

The following restrictions apply while configuring the multiple AP manager interfaces in the controller:

- You must assign an AP-manager interface to each port on the controller.
- Before implementing multiple AP-manager interfaces, you should consider how they would impact your controller's port redundancy.
- Only Cisco 5500 Series Controllers support the use of multiple AP-manager interfaces.

- AP-manager interfaces do not need to be on the same VLAN or IP subnet, and they may or may not be on the same VLAN or IP subnet as the management interface. However, we recommend that you configure all AP-manager interfaces on the same VLAN or IP subnet.
- If the port of one of the AP-manager interfaces fails, the controller clears the state of the access points, and the access points must reboot to reestablish communication with the controller using the normal controller join process. The controller no longer includes the failed AP-manager interface in the CAPWAP or LWAPP discovery responses. The access points then rejoin the controller and are load balanced among the available AP-manager interfaces.

Creating Multiple AP-Manager Interfaces (GUI)

Step 1 Choose **Controller > Interfaces** to open the Interfaces page.

Step 2 Click **New**.
The Interfaces > New page appears.

Step 3 Enter an AP-manager interface name and a VLAN identifier.

Step 4 Click **Apply** to commit your changes. The Interfaces > Edit page appears.

Step 5 Enter the appropriate interface parameters.

Note Every interface supports primary and backup port with the following exceptions

- Dynamic interface is converted to AP manager which does not support backup of port configuration.
- If AP manager is enabled on management interface and when management interface moves to backup port because of primary port failure, the AP manager will be disabled.

Step 6 To make this interface an AP-manager interface, select the **Enable Dynamic AP Management** check box.

Note Only one AP-manager interface is allowed per physical port. A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

Step 7 Click **Save Configuration** to save your settings.

Step 8 Repeat this procedure for each additional AP-manager interface that you want to create.

Creating Multiple AP-Manager Interfaces (CLI)

Step 1 Enter these commands to create a new interface:

- **config interface create** *operator_defined_interface_name* {*vlan_id* | *x*}
- **config interface address** *operator_defined_interface_name ip_addr ip_netmask* [*gateway*]
- **config interface vlan** *operator_defined_interface_name* {*vlan_id* | *o*}
- **config interface port** *operator_defined_interface_name physical_ds_port_number*

- **config interface dhcp** *operator_defined_interface_name ip_address_of_primary_dhcp_server* [*ip_address_of_secondary_dhcp_server*]
- **config interface quarantine vlan** *interface_name vlan_id*

  Note Use this command to configure a quarantine VLAN on any interface.

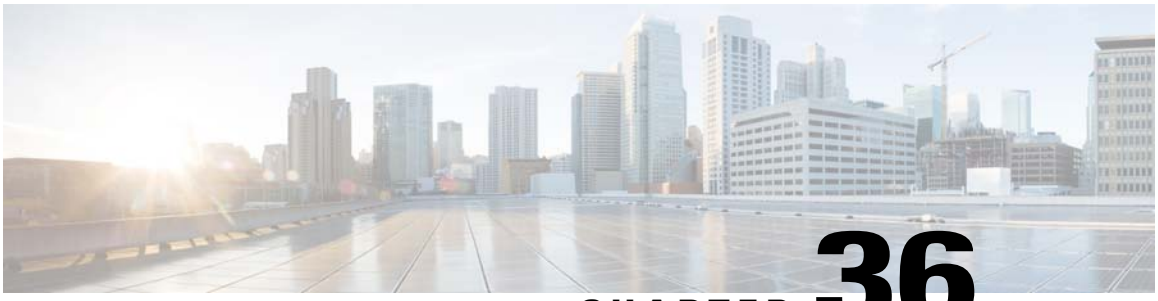
- **config interface acl** *operator_defined_interface_name access_control_list_name*

Step 2 To make this interface an AP-manager interface, enter this command:
{**config interface ap-manager** *operator_defined_interface_name* **enable | disable**}

Note Only one AP-manager interface is allowed per physical port. A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

Step 3 Enter **save config** command to save your changes.

Step 4 Repeat this procedure for each additional AP-manager interface that you want to create.



CHAPTER 36

Configuring VLAN Select

Information About VLAN Select

Whenever a wireless client connects to a wireless network (WLAN), the client is placed in a VLAN that is associated with the WLAN. In a large venue such as an auditorium, a stadium, or a conference where there may be numerous wireless clients, having only a single WLAN to accommodate many clients might be a challenge.

The VLAN select feature enables you to use a single WLAN that can support multiple VLANs. Clients can get assigned to one of the configured VLANs. This feature enables you to map a WLAN to a single or multiple interface VLANs using interface groups. Wireless clients that associate to the WLAN get an IP address from a pool of subnets identified by the interfaces. The IP address is derived by an algorithm based on the MAC address of the wireless client. This feature also extends the current AP group architecture where AP groups can override an interface or interface group to which the WLAN is mapped to, with multiple interfaces using the interface groups. This feature also provides the solution to auto anchor restrictions where a wireless guest user on a foreign location can get an IP address from multiple subnets based on their foreign locations or foreign controllers from the same anchor controller.

When a client roams from one controller to another, the foreign controller sends the VLAN information as part of the mobility announce message. Based on the VLAN information received, the anchor decides whether the tunnel should be created between the anchor controller and the foreign controller. If the same VLAN is available on the foreign controller, the client context is completely deleted from the anchor and the foreign controller becomes the new anchor controller for the client.

If an interface (int-1) in a subnet is untagged in one controller (Vlan ID 0) and the interface (int-2) in the same subnet is tagged to another controller (Vlan ID 1), then with the VLAN select, client joining the first controller over this interface may not undergo an L2 roam while it moves to the second controller. Hence, for L2 roaming to happen between two controllers with VLAN select, all the interfaces in the same subnet should be either tagged or untagged.

As part of the VLAN select feature, the mobility announce message carries an additional vendor payload that contains the list of VLAN interfaces in an interface group mapped to a foreign controller's WLAN. This VLAN list enables the anchor to differentiate from a local to local or local to foreign handoff.

Restrictions for Configuring VLAN Select

- The VLAN select feature enables you to use a single WLAN that can support multiple VLANs.

Configuring Interface Groups

Information About Interface Groups

Interface groups are logical groups of interfaces. Interface groups facilitate user configuration where the same interface group can be configured on multiple WLANs or while overriding a WLAN interface per AP group. An interface group can exclusively contain either quarantine or nonquarantine interfaces. An interface can be part of multiple interface groups.

A WLAN can be associated with an interface or interface group. The interface group name and the interface name cannot be the same.

This feature also enables you to associate a client to specific subnets based on the foreign controller that they are connected to. The anchor controller WLAN can be configured to maintain a mapping between foreign controller MAC and a specific interface or interface group (Foreign maps) as needed. If this mapping is not configured, clients on that foreign controller gets VLANs associated in a round robin fashion from interface group configured on WLAN.

You can also configure AAA override for interface groups. This feature extends the current access point group and AAA override architecture where access point groups and AAA override can be configured to override the interface group WLAN that the interface is mapped to. This is done with multiple interfaces using interface groups.

This feature enables network administrators to configure guest anchor restrictions where a wireless guest user at a foreign location can obtain an IP address from multiple subnets on the foreign location and controllers from within the same anchor controller.

Restrictions for Configuring Interface Groups

- The priority order for configuring VLAN interface select for WLAN is:
  - AAA override
  - AP group
  - DHCP server override
  - Interface group

Creating Interface Groups (GUI)

Step 1 Choose **Controller** > **Interface Groups**.
The Interface Groups page appears with the list of interface groups already created.

Note To remove an interface group, hover your mouse pointer over the blue drop-down icon and choose **Remove**.

Step 2 Click **Add Group**.
The Add New Interface Group page appears.

Step 3 Enter the details of the interface group:

- **Interface Group Name—**Specify the name of the interface group.
- **Description—**Add a brief description of the interface group.

Step 4 Click **Add**.

Creating Interface Groups (CLI)

- **config interface group** {**create** | **delete**} *interface_group_name***—**Creates or deletes an interface group
- **config interface group description** *interface_group_name description***—**Adds a description to the interface group

Adding Interfaces to Interface Groups (GUI)

Step 1 Choose **Controller > Interface Groups**.
The Interface Groups page appears with a list of all interface groups.

Step 2 Click the name of the interface group to which you want to add interfaces.
The Interface Groups > Edit page appears.

Step 3 Choose the interface name that you want to add to this interface group from the Interface Name drop-down list.

Step 4 Click **Add Interface** to add the interface to the Interface group.

Step 5 Repeat Steps 2 and 3 if you want to add multiple interfaces to this interface group.

Note To remove an interface from the interface group, hover your mouse pointer over the blue drop-down arrow and choose **Remove**.

Adding Interfaces to Interface Groups (CLI)

To add interfaces to interface groups, use the **config interface group interface add** *interface_group interface_name* command.

Viewing VLANs in Interface Groups (CLI)

To view a list of VLANs in the interface groups, use the **show interface group detailed** *interface-group-name* command.

Adding an Interface Group to a WLAN (GUI)

Step 1 Choose the **WLAN** tab.
The WLANs page appears listing the available WLANs.

Step 2 Click the WLAN ID of the WLAN to which you want to add the interface group.

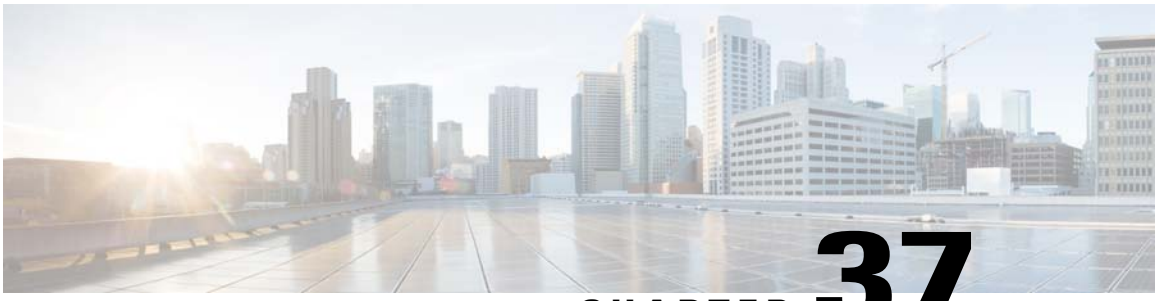
Step 3 In the **General** tab, choose the interface group from the Interface/Interface Group (G) drop-down list.

Step 4 Click **Apply**.

Note Suppose that the interface group that you add to a WLAN has RADIUS Server Overwrite interface enabled. In this case, when a client requests for authentication, the controller selects the first IP address from the interface group as the RADIUS server.

Adding an Interface Group to a WLAN (CLI)

To add an interface group to a WLAN, enter the **config wlan interface** *wlan_id interface_group_name* command.



CHAPTER 37

Configuring Interface Groups

Information About Interface Groups

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Creating Interface Groups (CLI)

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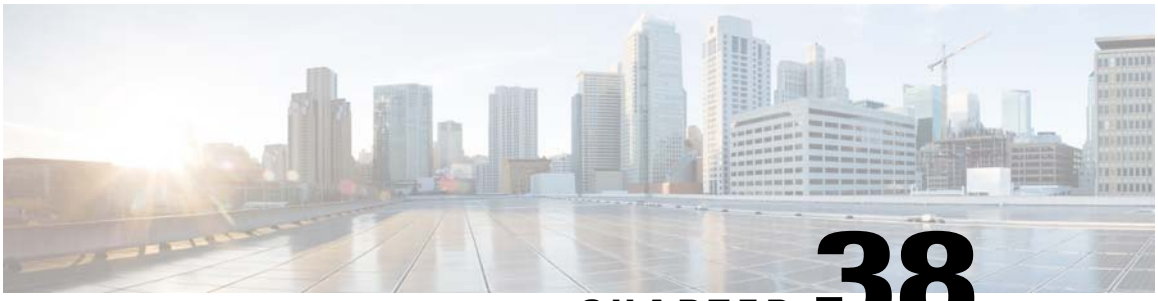


CHAPTER 38

Configuring Multicast Optimization

Information About Multicast Optimization

Prior to the 7.0.116.0 release, multicast was based on the grouping of the multicast address and the VLAN as one entity, MGID. With VLAN select and VLAN pooling, there is a possibility that you might increase duplicate packets. With the VLAN select feature, every client listens to the multicast stream on a different VLAN. As a result, the controller creates different MGIDs for each multicast address and VLAN. Therefore, the upstream router sends one copy for each VLAN, which results, in the worst case, in as many copies as there are VLANs in the pool. Since the WLAN is still the same for all clients, multiple copies of the multicast packet are sent over the air. To suppress the duplication of a multicast stream on the wireless medium and between the controller and access points, you can use the multicast optimization feature.

Multicast optimization enables you to create a multicast VLAN which you can use for multicast traffic. You can configure one of the VLANs of the WLAN as a multicast VLAN where multicast groups are registered. Clients are allowed to listen to a multicast stream on the multicast VLAN. The MGID is generated using mulicast VLAN and multicast IP addresses. If multiple clients on the VLAN pool of the same WLAN are listening to a single multicast IP address, a single MGID is generated. The controller makes sure that all multicast streams from the clients on this VLAN pool always go out on the multicast VLAN to ensure that the upstream router has one entry for all the VLANs of the VLAN pool. Only one multicast stream hits the VLAN pool even if the clients are on different VLANs. Therefore, the multicast packets that are sent out over the air is just one stream.

Configuring a Multicast VLAN (GUI)

Step 1 Choose **WLANs** > **WLAN ID**. The WLAN > Edit page appears.

Step 2 In the **General** tab, select the **Multicast VLAN feature** check box to enable multicast VLAN for the WLAN. The Multicast Interface drop-down list appears.

Step 3 Choose the VLAN from the Multicast Interface drop-down list.

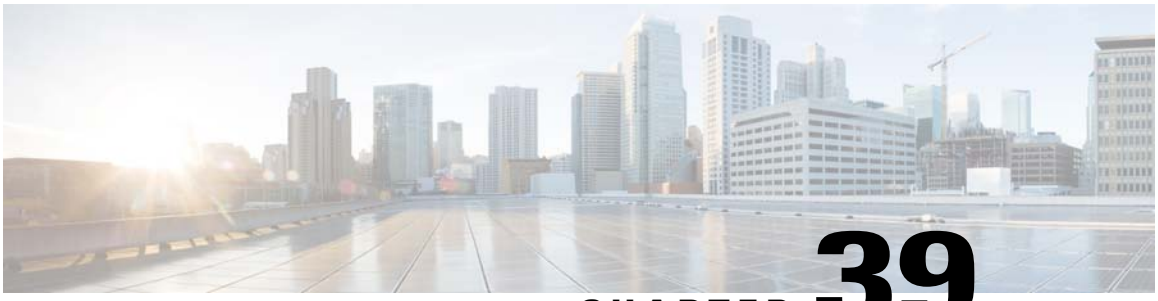
Step 4 Click **Apply**.

Configuring a Multicast VLAN (CLI)

Use the **config wlan multicast interface** *wlan_id* **enable** *interface_name* command to configure the multicast VLAN feature.

PART III

Configuring VideoStream



CHAPTER 39

Configuring VideoStream

Information about VideoStream

The IEEE 802.11 wireless multicast delivery mechanism does not provide a reliable way to acknowledge lost or corrupted packets. As a result, if any multicast packet is lost in the air, it is not sent again which may cause an IP multicast stream unviewable.

The VideoStream feature makes the IP multicast stream delivery reliable over the air, by converting the multicast frame to a unicast frame over the air. Each VideoStream client acknowledges receiving a video IP multicast stream.

Prerequisites for VideoStream

Make sure that the multicast feature is enabled. We recommend configuring IP multicast on the controller with multicast-multicast mode.

Check for the IP address on the client machine. The machine should have an IP address from the respective VLAN.

Verify that the access points have joined the controllers.

Make sure that the clients are able to associate to the configured WLAN at 802.11n speed.

Restrictions for Configuring VideoStream

VideoStream is supported in the 7.0.98.0 and later controller software releases.

VideoStream is supported on the following access points: Cisco Aironet 3600, 3500, 1260, 1250, 1240, 1140, 1130, and 1040.

Configuring VideoStream (GUI)

Step 1 Configure the multicast feature by following these steps:

a) Choose **Wireless** > **MediaStream** > **General**.

b) Select or unselect the **Multicast Direct feature** check box. The default value is disabled.

Note Enabling the multicast direct feature does not automatically reset the existing client state. The wireless clients must rejoin the multicast stream after enabling the multicast direct feature on the controller.

c) In the **Session Message Config** area, select **Session announcement State** check box to enable the session announcement mechanism. If the session announcement state is enabled, clients are informed each time a controller is not able to serve the multicast direct data to the client.

d) In the **Session announcement URL** text box, enter the URL where the client can find more information when an error occurs during the multicast media stream transmission.

e) In the **Session announcement e-mail** text box, enter the e-mail address of the person who can be contacted.

f) In the **Session announcement Phone** text box, enter the phone number of the person who can be contacted.

g) In the **Session announcement Note** text box, enter a reason as to why a particular client cannot be served with a multicast media.

h) Click **Apply**.

Step 2 Add a media stream by following these steps:

a) Choose **Wireless** > **Media Stream** > **Streams** to open the Media Stream page.

b) Click **Add New** to configure a new media stream. The **Media Stream > New** page appears.

Note The Stream Name, Multicast Destination Start IP Address (IPv4 or IPv6), and Multicast Destination End IP Address (IPv4 or IPv6) text boxes are mandatory. You must enter information in these text boxes.

c) In the **Stream Name** text box, enter the media stream name. The stream name can be up to 64 characters.

d) In the **Multicast Destination Start IP Address (IPv4 or IPv6)** text box, enter the start (IPv4 or IPv6) address of the multicast media stream.

e) In the **Multicast Destination End IP Address (IPv4 or IPv6)** text box, enter the end (IPv4 or IPv6) address of the multicast media stream.

Note Ensure that the Multicast Destination Start and End IP addresses are of the same type, that is both addresses should be of either IPv4 or IPv6 type.

f) In the **Maximum Expected Bandwidth** text box, enter the maximum expected bandwidth that you want to assign to the media stream. The values can range between 1 to 35000 kbps.

Note We recommend that you use a template to add a media stream to the controller.

g) From the **Select from Predefined Templates** drop-down list under Resource Reservation Control (RRC) Parameters, choose one of the following options to specify the details about the resource reservation control:

- Very Coarse (below 300 kbps)
- Coarse (below 500 kbps)
- Ordinary (below 750 kbps)
- Low (below 1 Mbps)
- Medium (below 3 Mbps)

- High (below 5 Mbps)

Note When you select a predefined template from the drop-down list, the following text boxes under the Resource Reservation Control (RRC) Parameters list their default values that are assigned with the template.

- Average Packet Size (100-1500 bytes)—Specifies the average packet size. The value can be in the range of 100 to 1500 bytes. The default value is 1200.
- RRC Periodic update—Enables the RRC (Resource Reservation Control Check) Periodic update. By default, this option is enabled. RRC periodically updates the admission decision on the admitted stream according to the correct channel load. As a result, it may deny certain low priority admitted stream requests.
- RRC Priority (1-8)—Specifies the priority bit set in the media stream. The priority can be any number between 1 and 8. The larger the value means the higher the priority is. For example, a priority of 1 is the lowest value and a value of 8 is the highest value. The default priority is 4. The low priority stream may be denied in the RRC periodic update.
- Traffic Profile Violation—Specifies the action to perform in case of a violation after a re-RRC. Choose an action from the drop-down list. The possible values are as follows:

  Drop—Specifies that a stream is dropped on periodic revaluation.

  Fallback—Specifies that a stream is demoted to Best Effort class on periodic reevaluation.

  The default value is **drop**.

h) Click **Apply**.

Step 3 Enable the media stream for multicast-direct by following these steps:

a) Choose **WLANs** > WLAN ID to open the WLANs > Edit page.
b) Click the **QoS** tab and select Gold (Video) from the Quality of Service (QoS) drop-down list.
c) Click **Apply**.

Step 4 Set the EDCA parameters to voice and video optimized (optional) by following these steps:

a) Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **EDCA Parameters**.
b) From the **EDCA Profile** drop-down list, choose the Voice and Video Optimized option.
c) Click **Apply**.

Step 5 Enable the admission control on a band for video (optional) by following these steps:

Note Keep the voice bandwidth allocation to a minimum for better performance.

a) Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **Media** to open the 802.11a/n (5 GHZ) or 802.11b/g/n > Media page.
b) Click the **Video** tab.
c) Select the **Admission Control (ACM)** check box to enable bandwidth-based CAC for this radio band. The default value is disabled.
d) Click **Apply**.

Step 6 Configure the video bandwidth by following these steps:

Note The template bandwidth that is configured for a media stream should be more than the bandwidth for the source media stream.

Note The voice configuration is optional. Keep the voice bandwidth allocation to a minimum for better performance.

a) Disable all WMM WLANs.

b) Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **Media** to open the 802.11a/n (5 GHZ) or 802.11b/g/n > Media page.
c) Click the **Video** tab.
d) Select the **Admission Control (ACM)** check box to enable the video CAC for this radio band. The default value is disabled.
e) In the Max RF Bandwidth field, enter the percentage of the maximum bandwidth allocated to clients for video applications on this radio band. Once the client reaches the value specified, the access point rejects new requests on this radio band.
f) The range is 5 to 85%.
g) The default value is 9%.
h) Click **Apply**.
i) Reenable all WMM WLANs and click **Apply**.

Step 7 Configure the media bandwidth by following these steps:

a) Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **Media** to open the 802.11a (or 802.11b) > Media > Parameters page.
b) Click the **Media** tab to open the Media page.
c) Select the **Unicast Video Redirect** check box to enable Unicast Video Redirect. The default value is disabled.
d) In the **Maximum Media Bandwidth (0-85%)** text box, enter the percentage of the maximum bandwidth to be allocated for media applications on this radio band. Once the client reaches a specified value, the access point rejects new calls on this radio band.
e) The default value is 85%; valid values are from 0% to 85%.
f) In the **Client Minimum Phy Rate** text box, enter the minimum transmission data rate to the client. If the transmission data rate is below the phy rate, either the video will not start or the client may be classified as a bad client. The bad client video can be demoted for better effort QoS or subject to denial.
g) In the **Maximum Retry Percent (0-100%)** text box, enter the percentage of maximum retries that are allowed. The default value is 80. If it exceeds 80, either the video will not start or the client might be classified as a bad client. The bad client video can be demoted for better effort QoS or subject to denial.
h) Select the **Multicast Direct Enable** check box to enable the Multicast Direct Enable field. The default value is enabled.
i) From the **Max Streams per Radio** drop-down list, choose the maximum number of streams allowed per radio from the range 0 to 20. The default value is set to No-limit. If you choose No-limit, there is no limit set for the number of client subscriptions.
j) From the **Max Streams per Client** drop-down list, choose the maximum number of streams allowed per client from the range 0 to 20. The default value is set to No-limit. If you choose No-limit, there is no limit set for the number of client subscriptions.
k) Select the **Best Effort QoS Admission** check box to enable best-effort QoS admission.
l) Click **Apply**.

Step 8 Enable a WLAN by following these steps:

a) Choose **WLANS** > WLAN ID. The WLANs > Edit page appears.
b) Select the **Status** check box.
c) Click **Apply**.

Step 9 Enable the 802.11 a/n or 802.11 b/g/n network by following these steps:

a) Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **Network**.
b) Select the **802.11a** or **802.11b/g Network Status** check box to enable the network status.
c) Click **Apply**.

Step 10 Verify that the clients are associated with the multicast groups and group IDs by following these steps:

a) Choose **Monitor > Clients**. The Clients page appears.
b) Check if the 802.11a/n or 802.11b/g/n network clients have the associated access points.
c) Choose **Monitor > Multicast**. The Multicast Groups page appears.
d) Select the **MGID** check box for the VideoStream to the clients.
e) Click **MGID**. The Multicast Group Detail page appears. Check the Multicast Status details.

Configuring VideoStream (CLI)

Step 1 Configure the multicast-direct feature on WLANs media stream by entering this command:
config wlan media-stream multicast-direct {*wlan_id* | **all**} {**enable** | **disable**}

Step 2 Enable or disable the multicast feature by entering this command:
config media-stream multicast-direct {**enable** | **disable**}

Step 3 Configure various message configuration parameters by entering this command:
config media-stream message {**state** [**enable** | **disable**] | **url** *url* | **email** *email* | **phone** *phone _number* | **note** *note*}

Step 4 Save your changes by entering this command:
save config

Step 5 Configure various global media-stream configurations by entering this command:
config media-stream add multicast-direct stream-name *media_stream_name start_IP end_IP* [**template** {**very-coarse** | **coarse** | **ordinary** | **low-resolution** | **med-resolution** | **high-resolution**} | **detail** {**Max_bandwidth** *bandwidth* | **packet size** *packet_size* | **Re-evaluation** *re-evaluation* {*periodic* | *initial*}} **video** *video* **priority** {**drop** | **fallback**}

- The Resource Reservation Control (RRC) parameters are assigned with the predefined values based on the values assigned to the template.
- The following templates are used to assign RRC parameters to the media stream:
  - Very Coarse (below 3000 kbps)
  - Coarse (below 500 kbps)
  - Ordinary (below 750 kbps)
  - Low Resolution (below 1 mbps)
  - Medium Resolution (below 3 mbps)
  - High Resolution (below 5 mbps)

Step 6 Delete a media stream by entering this command:
config media-stream delete *media_stream_name*

Step 7 Enable a specific enhanced distributed channel access (EDC) profile by entering this command:
config advanced{ **802.11a** | **802.11b**} **edca-parameters optimized-video-voice**

Step 8 Enable the admission control on the desired bandwidth by entering the following commands:

- Enable bandwidth-based voice CAC for 802.11a or 802.11b/g network by entering this command:

  config {**802.11a** | **802.11b**} **cac voice acm enable**

- Set the percentage of the maximum bandwidth allocated to clients for voice applications on the 802.11a or 802.11b/g network by entering this command:

  config {**802.11a** | **802.11b**} **cac voice max-bandwidth** *bandwidth*

- Configure the percentage of the maximum allocated bandwidth reserved for roaming voice clients on the 802.11a or 802.11b/g network by entering this command:

  config {**802.11a** | **802.11b**} **cac voice roam-bandwidth** *bandwidth*

Note For TSpec and SIP based CAC for video calls, only Static method is supported.

Step 9 Set the maximum number of streams per radio and/or per client by entering these commands:

- Set the maximum limit to the number multicast streams per radio by entering this command:

  config {**802.11a** | **802.11b**} **media-stream multicast-direct radio-maximum** [*value* | **no-limit**]

- Set the maximum number of multicast streams per client by entering this command:

  config {**802.11a** | **802.11b**} **media-stream multicast-direct client-maximum** [*value* | **no-limit**]

Step 10 Save your changes by entering this command:
save config

Viewing and Debugging Media Streams

- See the configured media streams by entering this command:

  show wlan *wlan_id*

- See the details of the media stream name by entering this command:

  show 802.11{a | b | h} media-stream *media-stream_name*

- See the clients for a media stream by entering this command:

  show 802.11a media-stream client *media-stream-name*

- See a summary of the media stream and client information by entering this command:

  show media-stream group summary

- See details about a particular media stream group by entering this command:

  show media-stream group detail *media_stream_name*

- See details of the 802.11a or 802.11b media resource reservation configuration by entering this command:

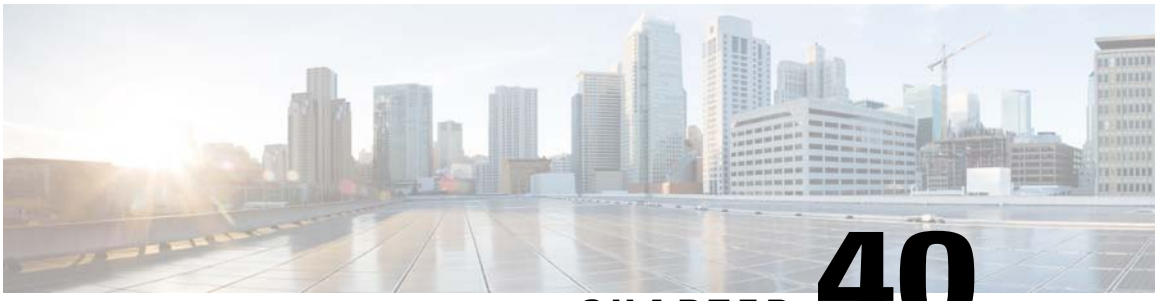
  show {802.11a | 802.11b} media-stream rrc

- Enable debugging of the media stream history by entering this command:

debug media-stream history {enable | disable}

PART IV

Configuring Security Solutions



CHAPTER 40

Cisco Unified Wireless Network Solution Security

Security Overview

The Cisco Unified Wireless Network (UWN) security solution bundles potentially complicated Layer 1, Layer 2, and Layer 3 802.11 Access Point security components into a simple policy manager that customizes system-wide security policies on a per-WLAN basis. The Cisco UWN security solution provides simple, unified, and systematic security management tools.

One of the biggest hurdles to WLAN deployment in the enterprise is WEP encryption, which is a weak standalone encryption method. A newer problem is the availability of low-cost access points, which can be connected to the enterprise network and used to mount man-in-the-middle and denial-of-service attacks.

Layer 1 Solutions

The Cisco UWN security solution ensures that all clients gain access within a user-set number of attempts. If a client fails to gain access within that limit, it is automatically excluded (blocked from access) until the user-set timer expires. The operating system can also disable SSID broadcasts on a per-WLAN basis.

Layer 2 Solutions

If a higher level of security and encryption is required, you can also implement industry-standard security solutions such as Extensible Authentication Protocol (EAP), Wi-Fi Protected Access (WPA), and WPA2. The Cisco UWN solution WPA implementation includes AES (Advanced Encryption Standard), TKIP and Michael (temporal key integrity protocol and message integrity code checksum) dynamic keys, or WEP (Wired

Equivalent Privacy) static keys. Disabling is also used to automatically block Layer 2 access after a user-set number of failed authentication attempts.

Regardless of the wireless security solution selected, all Layer 2 wired communications between controllers and lightweight access points are secured by passing data through CAPWAP tunnels.

Restrictions for Layer 2 Solutions

Cisco Aironet client adapter version 4.2 does not authenticate if WPA/WPA2 is used with CCKM as auth key management and a 2 second latency between the controller and AP.

Layer 3 Solutions

The WEP problem can be further solved using industry-standard Layer 3 security solutions such as passthrough VPNs (virtual private networks).

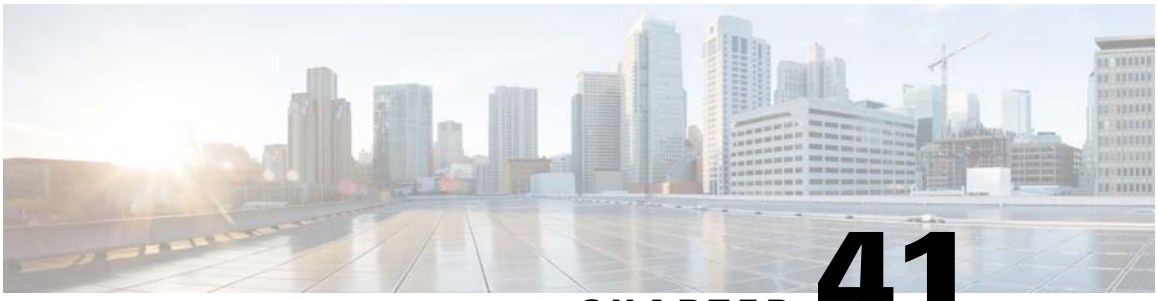
The Cisco UWN solution supports local and RADIUS MAC (media access control) filtering. This filtering is best suited to smaller client groups with a known list of 802.11 access card MAC addresses.

The Cisco UWN solution supports local and RADIUS user/password authentication. This authentication is best suited to small to medium client groups.

Integrated Security Solutions

The integrated security solutions are as follows:

- Cisco Unified Wireless Network (UWN) solution operating system security is built around a 802.1X AAA (authorization, authentication and accounting) engine, which allows users to rapidly configure and enforce a variety of security policies across the Cisco UWN solution.
- The controllers and lightweight access points are equipped with system-wide authentication and authorization protocols across all ports and interfaces, maximizing system security.
- Operating system security policies are assigned to individual WLANs, and lightweight access points simultaneously broadcast all (up to 16) configured WLANs, which can eliminate the need for additional access points, which can increase interference and degrade system throughput.
- Operating system security uses the RRM function to continually monitor the air space for interference and security breaches and to notify the user when they are detected.
- Operating system security works with industry-standard authorization, authentication, and accounting (AAA) servers.



CHAPTER 41

Configuring RADIUS

Information About RADIUS

Remote Authentication Dial-In User Service (RADIUS) is a client/server protocol that provides centralized security for users attempting to gain management access to a network. It serves as a backend database similar to local and TACACS+ and provides authentication and accounting services:

- **Authentication—**The process of verifying users when they attempt to log into the controller.

  Users must enter a valid username and password in order for the controller to authenticate users to the RADIUS server. If multiple databases are configured, you can specify the sequence in which the backend database must be tired.

- **Accounting—**The process of recording user actions and changes.

  Whenever a user successfully executes an action, the RADIUS accounting server logs the changed attributes, the user ID of the person who made the change, the remote host where the user is logged in, the date and time when the command was executed, the authorization level of the user, and a description of the action performed and the values provided. If the RADIUS accounting server becomes unreachable, users are able to continue their sessions uninterrupted.

RADIUS uses User Datagram Protocol (UDP) for its transport. It maintains a database and listens on UDP port 1812 for incoming authentication requests and UDP port 1813 for incoming accounting requests. The controller, which requires access control, acts as the client and requests AAA services from the server. The traffic between the controller and the server is encrypted by an algorithm defined in the protocol and a shared secret key configured on both devices.

You can configure multiple RADIUS accounting and authentication servers. For example, you may want to have one central RADIUS authentication server but several RADIUS accounting servers in different regions. If you configure multiple servers of the same type and the first one fails or becomes unreachable, the controller automatically tries the second one, then the third one if necessary, and so on.

When a management user is authenticated using a RADIUS server, only the PAP protocol is used. For web authentication users, PAP, MSCHAPv2 and MD5 security mechanisms are supported.

RADIUS Server Support

- You can configure up to 17 RADIUS authentication and accounting servers each.
- If multiple RADIUS servers are configured for redundancy, the user database must be identical in all the servers for the backup to work properly.
- One Time Passwords (OTPs) are supported on the controller using RADIUS. In this configuration, the controller acts as a transparent passthrough device. The controller forwards all client requests to the RADIUS server without inspecting the client behavior. When using OTP, the client must establish a single connection to the controller to function properly. The controller currently does not have any intelligence or checks to correct a client that is trying to establish multiple connections.
- To create a read-only controller user on the RADIUS sever, you must set the service type to NAS prompt instead of Callback NAS prompt. If you set the service type to Callback NAS Prompt, the user authentication fails while setting it to NAS prompt gives the user read-only access to the controller.

  Also, the Callback Administrative service type gives the user the lobby ambassador privileges to the controller.

Radius ACS Support

- You must configure RADIUS on both your CiscoSecure Access Control Server (ACS) and your controller.
- RADIUS is supported on CiscoSecure ACS version 3.2 and later releases. See the CiscoSecure ACS documentation for the version that you are running.

Primary and Fallback RADIUS Servers

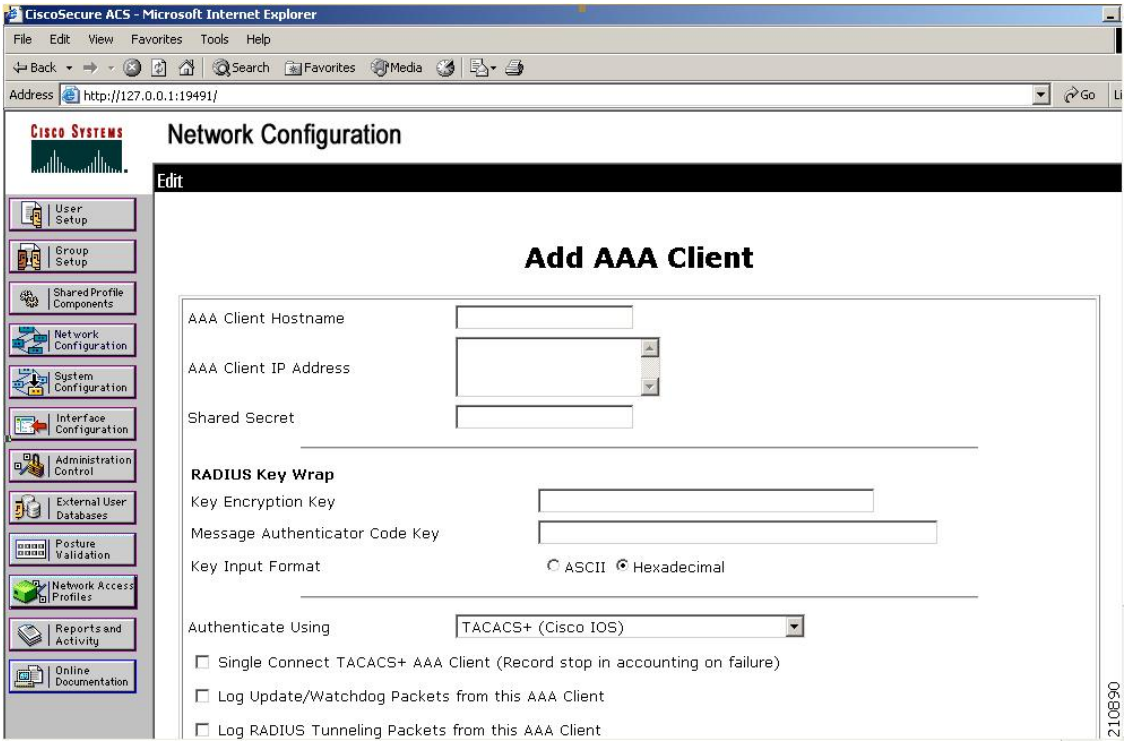
The primary RADIUS server (the server with the lowest server index) is assumed to be the most preferable server for the controller. If the primary server becomes unresponsive, the controller switches to the next active backup server (the server with the next lowest server index). The controller continues to use this backup server, unless you configure the controller to fall back to the primary RADIUS server when it recovers and becomes responsive or to a more preferable server from the available backup servers.

Configuring RADIUS on the ACS

Step 1 Choose **Network Configuration** on the ACS main page.

Step 2 Choose **Add Entry** under AAA Clients to add your controller to the server. The Add AAA Client page appears.

Figure 38: Add AAA Client Page on CiscoSecure ACS



Step 3 In the **AAA Client Hostname** text box, enter the name of your controller.

Step 4 In the **AAA Client IP Address** text box, enter the IP address of your controller.

Step 5 In the **Shared Secret** text box, enter the shared secret key to be used for authentication between the server and the controller.

Note The shared secret key must be the same on both the server and the controller.

Step 6 From the Authenticate Using drop-down list, choose **RADIUS (Cisco Airespace)**.

Step 7 Click **Submit + Apply** to save your changes.

Step 8 Choose **Interface Configuration** on the ACS main page.

Step 9 Choose **RADIUS (Cisco Aironet)**. The RADIUS (Cisco Aironet) page appears.

Step 10 Under User Group, select the **Cisco-Aironet-Session-Timeout** check box.

Step 11 Click **Submit** to save your changes.

Step 12 On the ACS main page, from the left navigation pane, choose **System Configuration.**

Step 13 Choose **Logging**.

Step 14 When the Logging Configuration page appears, enable all of the events that you want to be logged and save your changes.

Step 15 On the ACS main page, from the left navigation pane, choose **Group Setup**.

Step 16 Choose a previously created group from the Group drop-down list.

Note This step assumes that you have already assigned users to groups on the ACS according to the roles to which they will be assigned.

Step 17 Click **Edit Settings**. The Group Setup page appears.

Step 18 Under **Cisco Aironet Attributes**, select the **Cisco-Aironet-Session-Timeout** check box and enter a session timeout value in the edit box.

Step 19 Specify read-only or read-write access to controllers through RADIUS authentication, by setting the Service-Type attribute (006) to **Callback NAS Prompt** for read-only access or to **Administrative** for read-write privileges. If you do not set this attribute, the authentication process completes successfully (without an authorization error on the controller), but you might be prompted to authenticate again.

Note If you set the Service-Type attribute on the ACS, make sure to select the **Management** check box on the RADIUS Authentication Servers page of the controller GUI.

Step 20 Click **Submit** to save your changes.

Configuring RADIUS (GUI)

Step 1 Choose **Security** > **AAA** > **RADIUS**.

Step 2 Perform one of the following:

- If you want to configure a RADIUS server for authentication, choose **Authentication**.
- If you want to configure a RADIUS server for accounting, choose **Accounting**.

Note The pages used to configure authentication and accounting contain mostly the same text boxes. Therefore, these instructions walk through the configuration only once, using the Authentication pages as examples. You would follow the same steps to configure multiple services and/or multiple servers.

The RADIUS Authentication (or Accounting) Servers page appears.
This page lists any RADIUS servers that have already been configured.

- If you want to delete an existing server, hover your cursor over the blue drop-down arrow for that server and choose **Remove**.

- If you want to make sure that the controller can reach a particular server, hover your cursor over the blue drop-down arrow for that server and choose **Ping**.

Step 3 From the **Call Station ID Type** drop-down list, choose the option that is sent to the RADIUS server in the Access-Request message. The following options are available:

- IP Address
- System MAC Address
- AP MAC Address
- AP MAC Address:SSID
- AP Name:SSID
- AP Name
- AP Group
- Flex Group
- AP Location
- VLAN ID

Note The AP Name:SSID, AP Name, AP Group, Flex Group, AP Location, and VLAN ID options are added in the 7.4 release.

Step 4 Enable RADIUS-to-controller key transport using AES key wrap protection by selecting the **Use AES Key Wrap** check box. The default value is unselected. This feature is required for FIPS customers.

Step 5 Click **Apply**. Perform one of the following:

- To edit an existing RADIUS server, click the server index number for that server. The **RADIUS Authentication (or Accounting) Servers > Edit** page appears.
- To add a RADIUS server, click **New**. The **RADIUS Authentication (or Accounting) Servers > New** page appears.

Step 6 If you are adding a new server, choose a number from the **Server Index (Priority)** drop-down list to specify the priority order of this server in relation to any other configured RADIUS servers providing the same service.

Step 7 If you are adding a new server, enter the IP address of the RADIUS server in the **Server IP Address** text box.

Step 8 From the **Shared Secret Format** drop-down list, choose **ASCII** or **Hex** to specify the format of the shared secret key to be used between the controller and the RADIUS server. The default value is ASCII.

Step 9 In the **Shared Secret** and **Confirm Shared Secret** text boxes, enter the shared secret key to be used for authentication between the controller and the server.

Note The shared secret key must be the same on both the server and the controller.

Step 10 If you are configuring a new RADIUS authentication server and want to enable AES key wrap, which makes the shared secret between the controller and the RADIUS server more secure, follow these steps:

Note AES key wrap is designed for Federal Information Processing Standards (FIPS) customers and requires a key-wrap compliant RADIUS authentication server.

a) Select the **Key Wrap** check box.

b) From the **Key Wrap Format** drop-down list, choose **ASCII** or **HEX** to specify the format of the AES key wrap keys: Key Encryption Key (KEK) and Message Authentication Code Key (MACK).

c) In the **Key Encryption Key (KEK)** text box, enter the 16-byte KEK.

d) In the **Message Authentication Code Key (MACK)** text box, enter the 20-byte KEK.

Step 11 If you are adding a new server, enter the RADIUS server's UDP port number for the interface protocols in the Port Number text box. The valid range is 1 to 65535, and the default value is 1812 for authentication and 1813 for accounting.

Step 12 From the **Server Status** text box, choose **Enabled** to enable this RADIUS server or choose **Disabled** to disable it. The default value is enabled.

Step 13 If you are configuring a new RADIUS authentication server, choose **Enabled** from the **Support for RFC 3576** drop-down list to enable RFC 3576, which is an extension to the RADIUS protocol that allows dynamic changes to a user session, or choose **Disabled** to disable this feature. The default value is Enabled. RFC 3576 includes support for disconnecting users and changing authorizations applicable to a user session and supports disconnect and change-of-authorization (CoA) messages. Disconnect messages cause a user session to be terminated immediately where CoA messages modify session authorization attributes such as data filters.

Step 14 In the **Server Timeout** text box, enter the number of seconds between retransmissions. The valid range is 2 to 30 seconds, and the default value is 2 seconds.
Select the **Key Wrap** check box.

Note We recommend that you increase the timeout value if you experience repeated reauthentication attempts or the controller falls back to the backup server when the primary server is active and reachable.

Step 15 Select the **Network User** check box to enable network user authentication (or accounting), or unselect it to disable this feature. The default value is selected. If you enable this feature, this entry is considered the RADIUS authentication (or accounting) server for network users. If you did not configure a RADIUS server entry on the WLAN, you must enable this option for network users.

Step 16 If you are configuring a RADIUS authentication server, select the **Management** check box to enable management authentication, or unselect it to disable this feature. The default value is selected. If you enable this feature, this entry is considered the RADIUS authentication server for management users, and authentication requests go to the RADIUS server.

Step 17 Select the **IPSec** check box to enable the IP security mechanism, or unselect it to disable this feature. The default value is unselected.

Step 18 If you enabled IPsec in *Step 17*, follow these steps to configure additional IPsec parameters:

a) From the IPSec drop-down list, choose one of the following options as the authentication protocol to be used for IP security: **HMAC MD5** or **HMAC SHA1**. The default value is HMAC SHA1.
A message authentication code (MAC) is used between two parties that share a secret key to validate information transmitted between them. HMAC (Hash MAC) is based on cryptographic hash functions. It can be used in combination with any iterated cryptographic hash function. HMAC MD5 and HMAC SHA1 are two constructs of the HMAC using the MD5 hash function and the SHA1 hash function. HMAC also uses a secret key for calculation and verification of the message authentication values.

b) From the IPSec Encryption drop-down list, choose one of the following options to specify the IP security encryption mechanism:

- **DES—**Data Encryption Standard that is a method of data encryption using a private (secret) key. DES applies a 56-bit key to each 64-bit block of data.
- **3DES—**Data Encryption Standard that applies three keys in succession. This is the default value.
- **AES CBC—**Advanced Encryption Standard that uses keys with a length of 128, 192, or 256 bits to encrypt data blocks with a length of 128, 192, or 256 bits. AES 128 CBC uses a 128-bit data path in Cipher Block Chaining (CBC) mode.

c) From the IKE Phase 1 drop-down list, choose one of the following options to specify the Internet Key Exchange (IKE) protocol: **Aggressive** or **Main**. The default value is Aggressive.
IKE Phase 1 is used to negotiate how IKE should be protected. Aggressive mode passes more information in fewer packets with the benefit of slightly faster connection establishment at the cost of transmitting the identities of the security gateways in the clear.

d) In the Lifetime text box, enter a value (in seconds) to specify the timeout interval for the session. The valid range is 1800 to 57600 seconds, and the default value is 1800 seconds.

e) From the IKE Diffie Hellman Group drop-down list, choose one of the following options to specify the IKE Diffie Hellman group: **Group 1 (768 bits)**, **Group 2 (1024 bits)**, or **Group 5 (1536 bits)**. The default value is Group 1 (768 bits).
Diffie-Hellman techniques are used by two devices to generate a symmetric key through which they can publicly exchange values and generate the same symmetric key. Although all three groups provide security from conventional attacks, Group 5 is considered more secure because of its larger key size. However, computations involving Group 1 and Group 2 based keys might occur slightly faster because of their smaller prime number size.

Step 19 Click **Apply**.

Step 20 Click **Save Configuration**.

Step 21 Repeat the previous steps if you want to configure any additional services on the same server or any additional RADIUS servers.

Step 22 Specify the RADIUS server fallback behavior, as follows:

a) Choose **Security** > **AAA** > **RADIUS > Fallback to open the RADIUS > Fallback Parameters** to open the fallback parameters page.

b) From the **Fallback Mode** drop-down list, choose one of the following options:

- **Off—**Disables RADIUS server fallback. This is the default value.
- **Passive—**Causes the controller to revert to a server with a lower priority from the available backup servers without using extraneous probe messages. The controller ignores all inactive servers for a time period and retries later when a RADIUS message needs to be sent.
- **Active—**Causes the controller to revert to a server with a lower priority from the available backup servers by using RADIUS probe messages to proactively determine whether a server that has been marked inactive is back online. The controller ignores all inactive servers for all active RADIUS requests. Once the primary server receives a response from the recovered ACS server, the active fallback RADIUS server no longer sends probe messages to the server requesting the active probe authentication.

c) If you enabled Active fallback mode in *Step b*, enter the name to be sent in the inactive server probes in the **Username** text box. You can enter up to 16 alphanumeric characters. The default value is “cisco-probe.”

d) If you enabled Active fallback mode in *Step b*, enter the probe interval value (in seconds) in the Interval in **Sec** text box. The interval serves as inactive time in passive mode and probe interval in active mode. The valid range is 180 to 3600 seconds, and the default value is 300 seconds.

Step 23 Specify the order of authentication when multiple databases are configured by choosing **Security** > **Priority Order** > **Management User**. The Priority Order > Management User page appears.

Step 24 In the Order Used for Authentication text box, specify which servers have priority when the controller attempts to authenticate management users. Use the **>** and **<** buttons to move servers between the Not Used and Order Used for Authentication text boxes. After the desired servers appear in the Order Used for **Authentication** text box, use the **Up** and **Down** buttons to move the priority server to the top of the list.

By default, the local database is always queried first. If the username is not found, the controller switches to the RADIUS server if configured for RADIUS or to the TACACS+ server if configured for TACACS+. The default setting is local and then RADIUS.

Step 25 Click **Apply**.

Step 26 Click **Save Configuration**.

Configuring RADIUS (CLI)

- Specify whether the IP address, system MAC address, AP MAC address, AP Ethernet MAC address of the originator will be sent to the RADIUS server in the Access-Request message by entering this command:
  config radius callStationIdType {**ipaddr** | **macaddr** | **ap-macaddr-only** | **ap-macaddr-ssid** | | | **ap-group-name** | **ap-location** | **ap-name** | **ap-name-ssid** | **flex-group-name** | **vlan-id**}

Note The default is System MAC Address.

Caution Do not use callStation IdType for IPv6-only clients.

- Specify the delimiter to be used in the MAC addresses that are sent to the RADIUS authentication or accounting server in Access-Request messages by entering this command:
  config radius {**auth** | **acct**} **mac-delimiter** {*colon* | *hyphen* | *single-hyphen* | *none*}

  where

  - **colon** sets the delimiter to a colon (the format is xx:xx:xx:xx:xx:xx).
  - **hyphen** sets the delimiter to a hyphen (the format is xx-xx-xx-xx-xx-xx). This is the default value.
  - **single-hyphen** sets the delimiter to a single hyphen (the format is xxxxxx-xxxxxx).
  - **none** disables delimiters (the format is xxxxxxxxxxxx).

- Configure a RADIUS authentication server by entering these commands:
  - **config radius auth add index server_ip_address port#** {**ascii** | **hex**} **shared_secret—**Adds a RADIUS authentication server.
  - **config radius auth keywrap** {**enable** | **disable**}**—**Enables AES key wrap, which makes the shared secret between the controller and the RADIUS server more secure. AES key wrap is designed for Federal Information Processing Standards (FIPS) customers and requires a key-wrap compliant RADIUS authentication server.
  - **config radius auth keywrap add {ascii** | **hex**} *kek mack index***—**Configures the AES key wrap attributes

    where

- *kek* specifies the 16-byte Key Encryption Key (KEK).
- *mack* specifies the 20-byte Message Authentication Code Key (MACK).
- *index* specifies the index of the RADIUS authentication server on which to configure the AES key wrap.

- **config radius auth rfc3576 {enable | disable}** *index*—Enables or disables RFC 3576, which is an extension to the RADIUS protocol that allows dynamic changes to a user session. RFC 3576 includes support for disconnecting users and changing authorizations applicable to a user session and supports disconnect and change-of-authorization (CoA) messages. Disconnect messages cause a user session to be terminated immediately where CoA messages modify session authorization attributes such as data filters.
- **config radius auth retransmit-timeout** *index timeout*—Configures the retransmission timeout value for a RADIUS authentication server.
- **config radius auth network** *index* **{enable | disable}**—Enables or disables network user authentication. If you enable this feature, this entry is considered the RADIUS authentication server for network users. If you did not configure a RADIUS server entry on the WLAN, you must enable this option for network users.
- **config radius auth management** *index* **{enable | disable}**—Enables or disables management authentication. If you enable this feature, this entry is considered the RADIUS authentication server for management users, and authentication requests go to the RADIUS server.
- **config radius auth ipsec** {**enable** | **disable**} *index*—Enables or disables the IP security mechanism.
- **config radius auth ipsec authentication** {**hmac-md5** | **hmac-sha1**} *index*—Configures the authentication protocol to be used for IP security.
- **config radius auth ipsec encryption** {**3des** | **aes | des | none**} *index*—Configures the IP security encryption mechanism.
- **config radius auth ipsec ike dh-group** {**group-1** | **group-2** | **group-5**} *index*—Configures the IKE Diffie-Hellman group.
- **config radius auth ipsec ike lifetime** *interval index*—Configures the timeout interval for the session.
- **config radius auth ipsec ike phase1** {**aggressive** | **main**} *index*—Configures the Internet Key Exchange (IKE) protocol.
- **config radius auth** {**enable** | **disable**} *index*—Enables or disables a RADIUS authentication server.
- **config radius auth delete** *index*—Deletes a previously added RADIUS authentication server.

- Configure a RADIUS accounting server by entering these commands:
  - **config radius acct add** *index server_ip_address port#* {**ascii** | **hex**} *shared_secret*—Adds a RADIUS accounting server.
  - **config radius acct server-timeout** *index timeout*—Configures the retransmission timeout value for a RADIUS accounting server.
  - **config radius acct network** *index* **{enable | disable}**—Enables or disables network user accounting. If you enable this feature, this entry is considered the RADIUS accounting server for network

users. If you did not configure a RADIUS server entry on the WLAN, you must enable this option for network users.

- **config radius acct ipsec** {**enable** | **disable**} *index*—Enables or disables the IP security mechanism.
- **config radius acct ipsec authentication** {**hmac-md5** | **hmac-sha1**} *index*—Configures the authentication protocol to be used for IP security.
- **config radius acct ipsec encryption** {**3des | aes | des | none**} *index*—Configures the IP security encryption mechanism.
- **config radius acct ipsec ike dh-group {group-1 | group-2 | group-5}** *index*—Configures the IKE Diffie Hellman group.
- **config radius acct ipsec ike lifetime** *interval index*—Configures the timeout interval for the session.
- **config radius acct ipsec ike phase1** {**aggressive** | **main**} *index*—Configures the Internet Key Exchange (IKE) protocol.
- **config radius acct** {**enable** | **disable**} index—Enables or disables a RADIUS accounting server.
- **config radius acct delete index—**Deletes a previously added RADIUS accounting server.

- Configure the RADIUS server fallback behavior by entering this command:
  config radius fallback-test mode {off | passive | active}

  where

  - **off** disables RADIUS server fallback.
  - **passive** causes the controller to revert to a server with a lower priority from the available backup servers without using extraneous probe messages. The controller simply ignores all inactive servers for a time period and retries later when a RADIUS message needs to be sent.
  - **active** causes the controller to revert to a server with a lower priority from the available backup servers by using RADIUS probe messages to proactively determine whether a server that has been marked inactive is back online. The controller simply ignores all inactive servers for all active RADIUS requests. Once the primary server receives a response from the recovered ACS server, the active fallback RADIUS server no longer sends probe messages to the server requesting the active probe authentication.

- If you enabled Active mode in *Step 5*, enter these commands to configure additional fallback parameters:
  - **config radius fallback-test username** *username*—Specifies the name to be sent in the inactive server probes. You can enter up to 16 alphanumeric characters for the *username parameter*.
  - **config radius fallback-test interval** *interval*—Specifies the probe interval value (in seconds).

- Save your changes by entering this command:
  save config
- Configure the order of authentication when multiple databases are configured by entering this command:
  config aaa auth mgmt *AAA_server_type AAA_server_type*

  where *AAA_server_type is* local, radius, or tacacs.

  To see the current management authentication server order, enter the show aaa auth command.

- See RADIUS statistics by entering these commands:
  - **show radius summary**—Shows a summary of RADIUS servers and statistics with AP Ethernet MAC configurations.
  - **show radius auth statistics**—Shows the RADIUS authentication server statistics.
  - **show radius acct statistics**—Shows the RADIUS accounting server statistics.
  - **show radius rfc3576 statistics**—Shows a summary of the RADIUS RFC-3576 server.
- See active security associations by entering these commands:
  - **show ike {brief | detailed}** *ip_or_mac_addr*—Shows a brief or detailed summary of active IKE security associations.
  - **show ipsec {brief | detailed}** *ip_or_mac_addr*—Shows a brief or detailed summary of active IPSec security associations.
- Clear the statistics for one or more RADIUS servers by entering this command:
  clear stats radius {**auth** | **acct**} {*index* | **all**}
- Make sure that the controller can reach the RADIUS server by entering this command:
  ping *server_ip_address*

RADIUS Authentication Attributes Sent by the Controller

The following tables identify the RADIUS authentication attributes sent between the controller and the RADIUS server in access-request and access-accept packets.

Table 8: Authentication Attributes Sent in Access-Request Packets

Attribute ID	Description
1	User-Name
2	Password
3	CHAP-Password
4	NAS-IP-Address
5	NAS-Port
6	Service-Type[4]
12	Framed-MTU
30	Called-Station-ID (MAC address)
31	Calling-Station-ID (MAC address)
32	NAS-Identifier
33	Proxy-State
60	CHAP-Challenge

Attribute ID	Description
61	NAS-Port-Type
79	EAP-Message
243	TPLUS-Role

4 To specify read-only or read-write access to controllers through RADIUS authentication, you must set the Service-Type attribute (6) on the RADIUS server to **Callback NAS Prompt** for read-only access or to **Administrative** for read-write privileges.

Table 9: Authentication Attributes Honored in Access-Accept Packets (Cisco)

Attribute ID	Description
1	Cisco-LEAP-Session-Key
2	Cisco-Keywrap-Msg-Auth-Code
3	Cisco-Keywrap-NonCE
4	Cisco-Keywrap-Key
5	Cisco-URL-Redirect
6	Cisco-URL-Redirect-ACL

Note These Cisco-specific attributes are not supported: Auth-Algo-Type and SSID.

Table 10: Authentication Attributes Honored in Access-Accept Packets (Standard)

Attribute ID	Description
6	Service-Type. To specify read-only or read-write access to controllers through RADIUS authentication, you must set the Service-Type attribute (6) on the RADIUS server to Callback NAS Prompt for read-only access or to Administrative for read-write privileges.
8	Framed-IP-Address
25	Class
26	Vendor-Specific
27	Timeout
29	Termination-Action
40	Acct-Status-Type
64	Tunnel-Type
79	EAP-Message

81	Tunnel-Group-ID

Note Message authentication is not supported.

Table 11: Authentication Attributes Honored in Access-Accept Packets (Microsoft)

Attribute ID	Description
11	MS-CHAP-Challenge
16	MS-MPPE-Send-Key
17	MS-MPPE-Receive-Key
25	MS-MSCHAP2-Response
26	MS-MSCHAP2-Success

Table 12: Authentication Attributes Honored in Access-Accept Packets (Airespace)

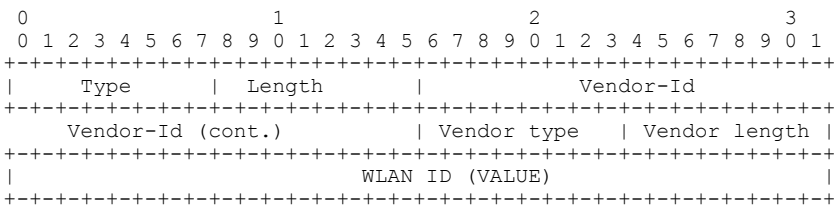
Attribute ID	Description
1	VAP-ID
3	DSCP
4	8021P-Type
5	VLAN-Interface-Name
6	ACL-Name
7	Data-Bandwidth-Average-Contract
8	Real-Time-Bandwidth-Average-Contract
9	Data-Bandwidth-Burst-Contract
10	Real-Time-Bandwidth-Burst-Contract
11	Guest-Role-Name
13	Data-Bandwidth-Average-Contract-US
14	Real-Time-Bandwidth-Average-Contract-US
15	Data-Bandwidth-Burst-Contract-US
16	Real-Time-Bandwidth-Burst-Contract-US

Authentication Attributes Honored in Access-Accept Packets (Airespace)

This section lists the RADIUS authentication Airespace attributes currently supported on the Cisco WLC.

VAP ID

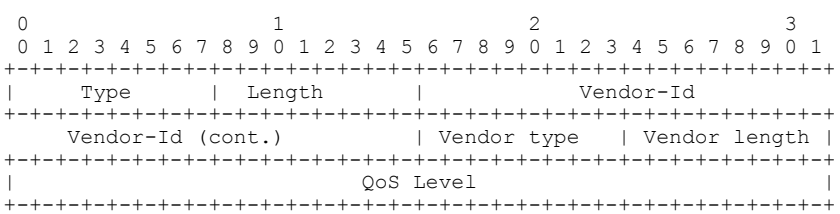
This attribute indicates the WLAN ID of the WLAN to which the client should belong. When the WLAN-ID attribute is present in the RADIUS Access Accept, the system applies the WLAN-ID (SSID) to the client station after it authenticates. The WLAN ID is sent by the Cisco WLC in all instances of authentication except IPsec. In case of web authentication, if the Cisco WLC receives a WLAN-ID attribute in the authentication response from the AAA server, and it does not match the ID of the WLAN, authentication is rejected. Other types of security methods do not do this. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 1
- Vendor length – 4
- Value – ID of the WLAN to which the client should belong.

QoS-Level

This attribute indicates the QoS level to be applied to the mobile client's traffic within the switching fabric, as well as over the air. This example shows a summary of the QoS-Level Attribute format. The fields are transmitted from left to right.

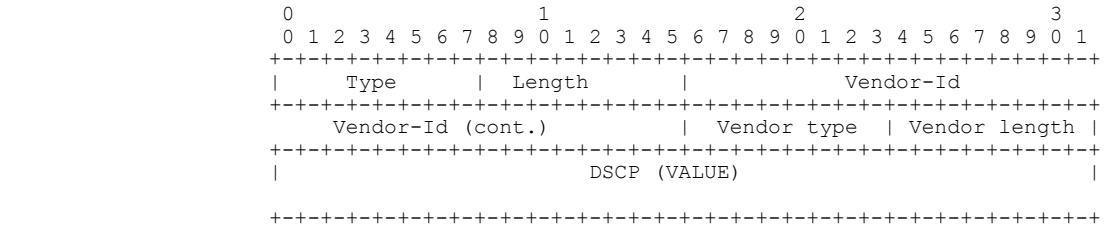


- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 2
- Vendor length – 4

- Value – Three octets:
  - 3 – Bronze (Background)
  - 0 – Silver (Best Effort)
  - 1 – Gold (Video)
  - 2 – Platinum (Voice)

Differentiated Services Code Point (DSCP)

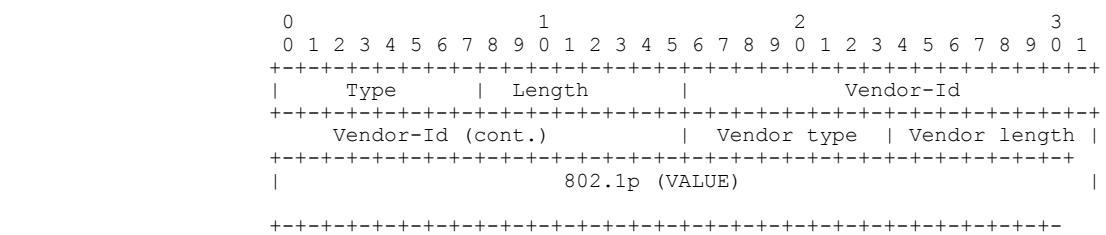
DSCP is a packet header code that can be used to provide differentiated services based on the QoS levels. This attribute defines the DSCP value to be applied to a client. When present in a RADIUS Access Accept, the DSCP value overrides the DSCP value specified in the WLAN profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 3
- Vendor length – 4
- Value – DSCP value to be applied for the client.

802.1p Tag Type

802.1p VLAN tag received from the client, defining the access priority. This tag maps to the QoS Level for client-to-network packets. This attribute defines the 802.1p priority to be applied to the client. When present in a RADIUS Access Accept, the 802.1p value overrides the default specified in the WLAN profile. The fields are transmitted from left to right.

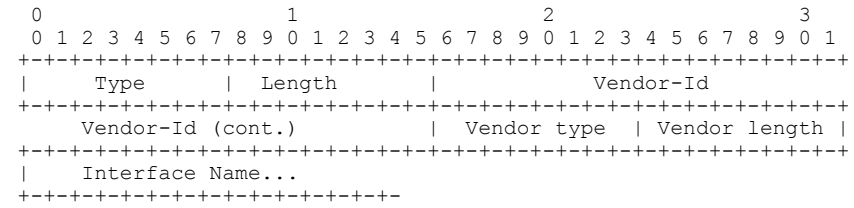


- Type – 26 for Vendor-Specific

- Length – 10
- Vendor-Id – 14179
- Vendor type – 4
- Vendor length – 3
- Value – 802.1p priority to be applied to a client.

VLAN Interface Name

This attribute indicates the VLAN interface a client is to be associated to. A summary of the Interface-Name Attribute format is shown below. The fields are transmitted from left to right.

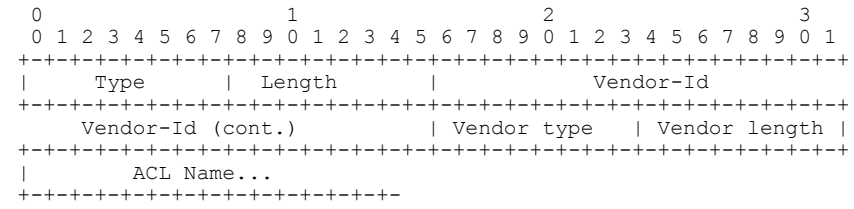


- Type – 26 for Vendor-Specific
- Length – >7
- Vendor-Id – 14179
- Vendor type – 5
- Vendor length – >0
- Value – A string that includes the name of the interface the client is to be assigned to.

Note This attribute only works when MAC filtering is enabled or if 802.1X or WPA is used as the security policy.

ACL-Name

This attribute indicates the ACL name to be applied to the client. A summary of the ACL-Name Attribute format is shown below. The fields are transmitted from left to right.

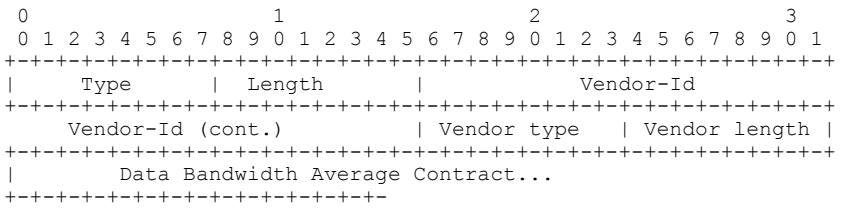


- Type – 26 for Vendor-Specific
- Length – >7

- Vendor-Id – 14179
- Vendor type – 6
- Vendor length – >0
- Value – A string that includes the name of the ACL to use for the client

Data Bandwidth Average Contract

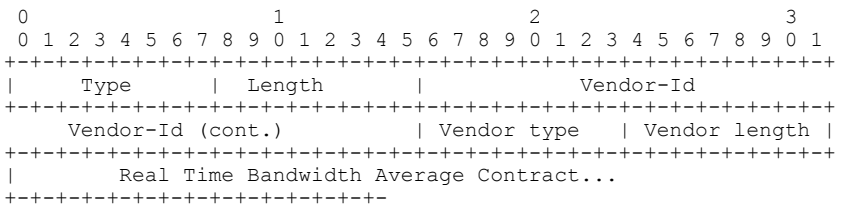
This attribute is a rate limiting value. It indicates the Data Bandwidth Average Contract that will be applied for a client for non-realtime traffic such as TCP. This value is specific for downstream direction from wired to wireless. When present in a RADIUS Access Accept, the Data Bandwidth Average Contract value overrides the Average Data Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 7
- Vendor length – 4
- Value – A value in kbps

Real Time Bandwidth Average Contract

This attribute is a rate limiting value. It indicates the Data Bandwidth Average Contract that will be applied to a client for realtime traffic such as UDP. This value is specific for downstream direction from wired to wireless. When present in a RADIUS Access Accept, the Real Time Bandwidth Average Contract value overrides the Average Real-Time Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.

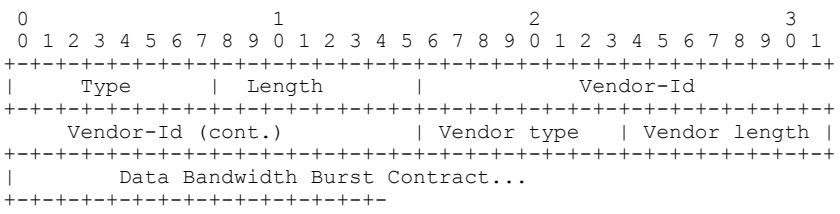


- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179

- Vendor type – 8
- Vendor length – 4
- Value – A value in kbps

Data Bandwidth Burst Contract

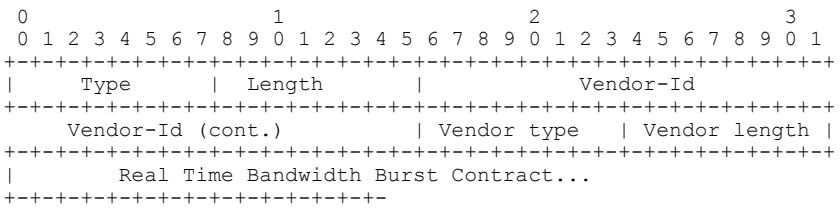
This attribute is a rate limiting value. It indicates the Data Bandwidth Burst Contract that will be applied to a client for non-realtime traffic such as TCP. This value is specific to downstream direction from wired to wireless. When present in a RADIUS Access Accept, the Data Bandwidth Burst Contract value overrides the Burst Data Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 9
- Vendor length – 4
- Value – A value in kbps

Real Time Bandwidth Burst Contract

This attribute is a rate limiting value. It indicates the Data Bandwidth Burst Contract that will be applied to a client for realtime traffic such as UDP. This value is specific to downstream direction from wired to wireless. When present in a RADIUS Access Accept, the Real Time Bandwidth Burst Contract value overrides the Burst Real-Time Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.

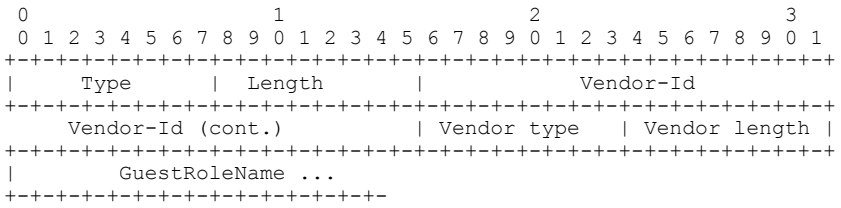


- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 10
- Vendor length – 4

- Value – A value in kbps

Guest Role Name

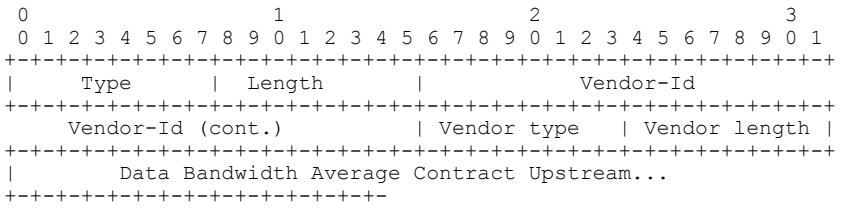
This attribute provides the bandwidth contract values to be applied for an authenticating user. When present in a RADIUS Access Accept, the bandwidth contract values defined for the Guest Role overrides the bandwidth contract values (based on QOS value) specified for the WLAN. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 11
- Vendor length – Variable based on the Guest Role Name length
- Value – A string of alphanumeric characters

Data Bandwidth Average Contract Upstream

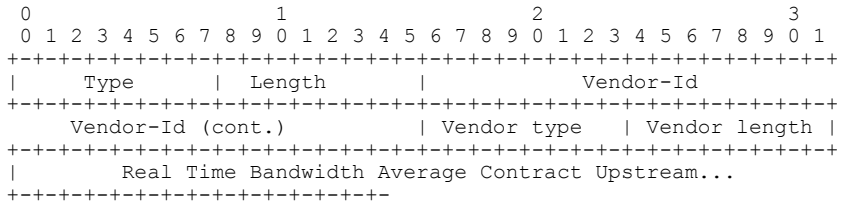
This attribute is a rate limiting value. It indicates the Data Bandwidth Average Contract that will be applied to a client for non-realtime traffic such as TCP. This value is specific to upstream direction from wireless to wired. When present in a RADIUS Access Accept, the Data Bandwidth Average Contract value overrides the Average Data Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 13
- Vendor length – 4
- Value – A value in kbps

Real Time Bandwidth Average Contract Upstream

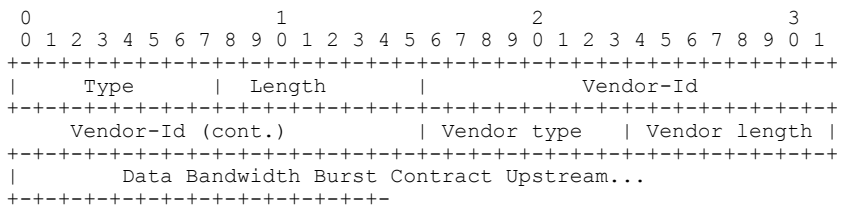
This attribute is a rate limiting value. It indicates the Data Bandwidth Average Contract that will be applied to a client for realtime traffic such as UDP. This value is specific to upstream direction from wireless to wired. When present in a RADIUS Access Accept, the Real Time Bandwidth Average Contract value overrides the Average Real-Time Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 14
- Vendor length – 4
- Value – A value in kbps

Data Bandwidth Burst Contract Upstream

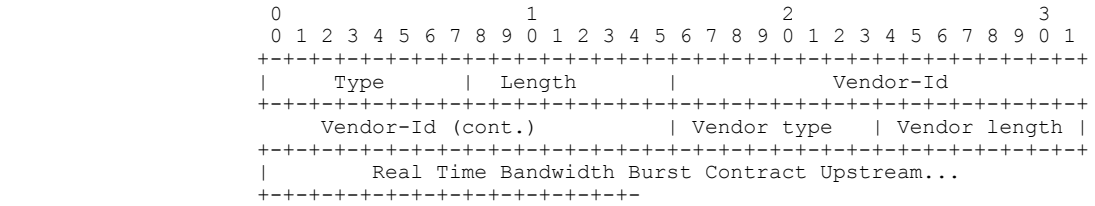
This attribute is a rate limiting value. It indicates the Data Bandwidth Burst Contract that will be applied to a client for non-realtime traffic such as TCP. This value is specific to upstream direction from wireless to wired. When present in a RADIUS Access Accept, the Data Bandwidth Burst Contract value overrides the Burst Data Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 15
- Vendor length – 4
- Value – A value in kbps

Real Time Bandwidth Burst Contract Upstream

This attribute is a rate limiting value. It indicates the Data Bandwidth Burst Contract that will be applied to a client for realtime traffic such as UDP. This value is specific to upstream direction from wireless to wired. When present in a RADIUS Access Accept, the Real Time Bandwidth Burst Contract value overrides the Burst Real-Time Rate value present in the WLAN or QoS Profile. The fields are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 16
- Vendor length – 4
- Value – A value in kbps

RADIUS Accounting Attributes

This table identifies the RADIUS accounting attributes for accounting requests sent from a controller to the RADIUS server.

Table 13: Accounting Attributes for Accounting Requests

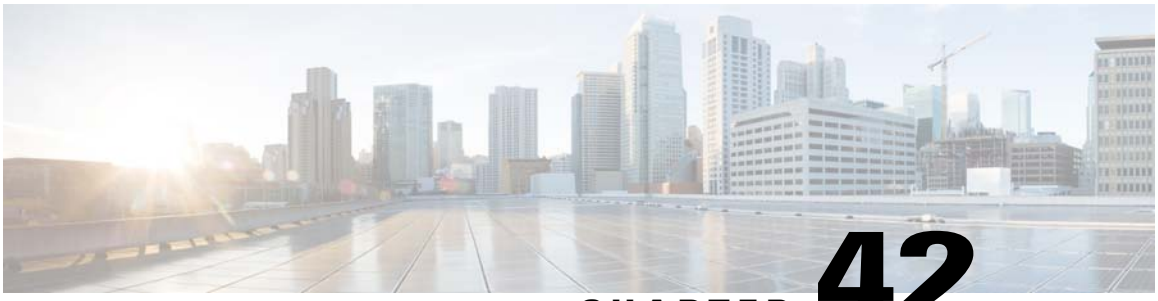
Attribute ID	Description
1	User-Name
4	NAS-IP-Address
5	NAS-Port
8	Framed-IP-Address
25	Class
30	Called-Station-ID (MAC address)
31	Calling-Station-ID (MAC address)
32	NAS-Identifier
40	Accounting-Status-Type
41	Accounting-Delay-Time (Stop and interim messages only)
42	Accounting-Input-Octets (Stop and interim messages only)

Attribute ID	Description
43	Accounting-Output-Octets (Stop and interim messages only)
44	Accounting-Session-ID
45	Accounting-Authentic
46	Accounting-Session-Time (Stop and interim messages only)
47	Accounting-Input-Packets (Stop and interim messages only)
48	Accounting-Output-Packets (Stop and interim messages only)
49	Accounting-Terminate-Cause (Stop messages only)
52	Accounting-Input-Gigawords
53	Accounting-Output-Gigawords
55	Event-Timestamp
64	Tunnel-Type
65	Tunnel-Medium-Type
81	Tunnel-Group-ID

This table lists the different values for the Accounting-Status-Type attribute (40).

Table 14: Accounting-Status-Type Attribute Values

Attribute ID	Description
1	Start
2	Stop
3	Interim-Update
7	Accounting-On
8	Accounting-Off
9-14	Reserved for Tunneling Accounting
15	Reserved for Failed



CHAPTER 42

Configuring TACACS+

Information About TACACS+

Terminal Access Controller Access Control System Plus (TACACS+) is a client/server protocol that provides centralized security for users attempting to gain management access to a controller. It serves as a backend database similar to local and RADIUS. However, local and RADIUS provide only authentication support and limited authorization support while TACACS+ provides three services:

- **Authentication—**The process of verifying users when they attempt to log into the controller.

  Users must enter a valid username and password in order for the controller to authenticate users to the TACACS+ server. The authentication and authorization services are tied to one another. For example, if authentication is performed using the local or RADIUS database, then authorization would use the permissions associated with the user in the local or RADIUS database (which are read-only, read-write, and lobby-admin) and not use TACACS+. Similarly, when authentication is performed using TACACS+, authorization is tied to TACACS+.

  Note When multiple databases are configured, you can use the controller GUI or CLI to specify the sequence in which the backend databases should be tried.

- **Authorization—**The process of determining the actions that users are allowed to take on the controller based on their level of access.

  For TACACS+, authorization is based on privilege (or role) rather than specific actions. The available roles correspond to the seven menu options on the controller GUI: MONITOR, WLAN, CONTROLLER, WIRELESS, SECURITY, MANAGEMENT, and COMMANDS. An additional role, LOBBY, is available for users who require only lobby ambassador privileges. The roles to which users are assigned are

configured on the TACACS+ server. Users can be authorized for one or more roles. The minimum authorization is MONITOR only, and the maximum is ALL, which authorizes the user to execute the functionality associated with all seven menu options. For example, a user who is assigned the role of SECURITY can make changes to any items appearing on the Security menu (or designated as security commands in the case of the CLI). If users are not authorized for a particular role (such as WLAN), they can still access that menu option in read-only mode (or the associated CLI **show** commands). If the TACACS+ authorization server becomes unreachable or unable to authorize, users are unable to log into the controller.

Note If users attempt to make changes on a controller GUI page that are not permitted for their assigned role, a message appears indicating that they do not have sufficient privilege. If users enter a controller CLI command that is not permitted for their assigned role, a message may appear indicating that the command was successfully executed although it was not. In this case, the following additional message appears to inform users that they lack sufficient privileges to successfully execute the command: "Insufficient Privilege! Cannot execute command!"

- **Accounting—**The process of recording user actions and changes.

  Whenever a user successfully executes an action, the TACACS+ accounting server logs the changed attributes, the user ID of the person who made the change, the remote host where the user is logged in, the date and time when the command was executed, the authorization level of the user, and a description of the action performed and the values provided. If the TACACS+ accounting server becomes unreachable, users are able to continue their sessions uninterrupted.

TACACS+ uses Transmission Control Protocol (TCP) for its transport, unlike RADIUS which uses User Datagram Protocol (UDP). It maintains a database and listens on TCP port 49 for incoming requests. The controller, which requires access control, acts as the client and requests AAA services from the server. The traffic between the controller and the server is encrypted by an algorithm defined in the protocol and a shared secret key configured on both devices.

You can configure up to three TACACS+ authentication, authorization, and accounting servers each. For example, you may want to have one central TACACS+ authentication server but several TACACS+ authorization servers in different regions. If you configure multiple servers of the same type and the first one fails or becomes unreachable, the controller automatically tries the second one and then the third one if necessary.

Note If multiple TACACS+ servers are configured for redundancy, the user database must be identical in all the servers for the backup to work properly.

The following are some guidelines about TACACS+:

- You must configure TACACS+ on both your CiscoSecure Access Control Server (ACS) and your controller. You can configure the controller through either the GUI or the CLI.
- TACACS+ is supported on CiscoSecure ACS version 3.2 and later releases. See the CiscoSecure ACS documentation for the version that you are running.
- One Time Passwords (OTPs) are supported on the controller using TACACS. In this configuration, the controller acts as a transparent passthrough device. The controller forwards all client requests to the

TACACS server without inspecting the client behavior. When using OTP, the client must establish a single connection to the controller to function properly. The controller currently does not have any intelligence or checks to correct a client that is trying to establish multiple connections.

- We recommend that you increase the retransmit timeout value for TACACS+ authentication, authorization, and accounting servers if you experience repeated reauthentication attempts or the controller falls back to the backup server when the primary server is active and reachable. The default retransmit timeout value is 2 seconds and you can increase the retransmit timeout value to a maximum of 30 seconds.

TACACS+ VSA

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific attributes (VSAs) between the network access server and the TACACS+ server. The IETF uses attribute 26. VSAs allow vendors to support their own extended attributes that are not suitable for general use.

The Cisco TACACS+ implementation supports one vendor-specific option using the format recommended in the IETF specification. The Cisco vendor ID is 9, and the supported option is vendor type 1, which is named cisco-av-pair. The value is a string with the following format:

```
protocol : attribute separator value *
```

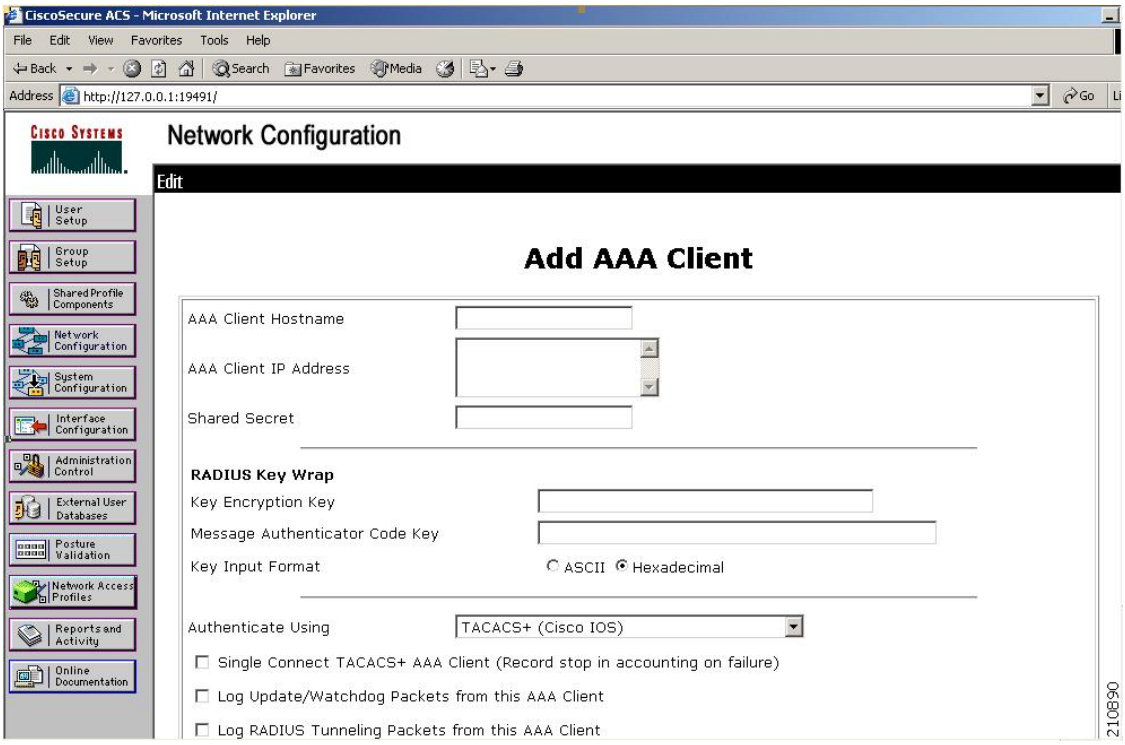
The protocol is a Cisco attribute for a particular type of authorization, the separator is = (equal sign) for mandatory attributes, and * (asterisk) indicates optional attributes.

Configuring TACACS+ on the ACS

Step 1 Choose **Network Configuration** on the ACS main page.

Step 2 Choose **Add Entry** under AAA Clients to add your controller to the server. The Add AAA Client page appears.

Figure 39: Add AAA Client Page on CiscoSecure ACS



Step 3 In the AAA Client Hostname text box, enter the name of your controller.

Step 4 In the AAA Client IP Address text box, enter the IP address of your controller.

Step 5 In the Shared Secret text box, enter the shared secret key to be used for authentication between the server and the controller.

Note The shared secret key must be the same on both the server and the controller.

Step 6 From the Authenticate Using drop-down list, choose **TACACS+ (Cisco IOS)**.

Step 7 Click **Submit + Apply** to save your changes.

Step 8 On the ACS main page, in the left navigation pane, choose **Interface Configuration**.

Step 9 Choose **TACACS+ (Cisco IOS)**. The TACACS+ (Cisco) page appears.

Step 10 Under TACACS+ Services, select the **Shell (exec)** check box.

Step 11 Under New Services, select the first check box and enter **ciscowlc** in the Service text box and **common** in the Protocol text box.

Step 12 Under Advanced Configuration Options, select the **Advanced TACACS+ Features** check box.

Step 13 Click **Submit** to save your changes.

Step 14 On the ACS main page, in the left navigation pane, choose **System Configuration**.

Step 15 Choose **Logging**.

Step 16 When the Logging Configuration page appears, enable all of the events that you want to be logged and save your changes.

Step 17 On the ACS main page, in the left navigation pane, choose **Group Setup.**

Step 18 From the Group drop-down list, choose a previously created group.

Note This step assumes that you have already assigned users to groups on the ACS according to the roles to which they will be assigned.

Step 19 Click **Edit Settings**. The Group Setup page appears.

Step 20 Under **TACACS+ Settings**, select the **ciscowlc common** check box.

Step 21 Select the **Custom Attributes** check box.

Step 22 In the text box below Custom Attributes, specify the roles that you want to assign to this group. The available roles are MONITOR, WLAN, CONTROLLER, WIRELESS, SECURITY, MANAGEMENT, COMMANDS, ALL, and LOBBY. The first seven correspond to the menu options on the controller GUI and allow access to those particular controller features. If a user is not entitled for a particular task, the user is still allowed to access that task in read-only mode. You can enter one or multiple roles, depending on the group's needs. Use ALL to specify all seven roles or LOBBY to specify the lobby ambassador role. Enter the roles using this format:
role*x=ROLE*

For example, to specify the WLAN, CONTROLLER, and SECURITY roles for a particular user group, you would enter the following text:

```
role1=WLAN
role2=CONTROLLER
role3=SECURITY?
```

To give a user group access to all seven roles, you would enter the following text:

```
role1=ALL?
```

Note Make sure to enter the roles using the format shown above. The roles must be in all uppercase letters, and there can be no spaces within the text.

Note You should not combine the MONITOR role or the LOBBY role with any other roles. If you specify one of these two roles in the Custom Attributes text box, users will have MONITOR or LOBBY privileges only, even if additional roles are specified.

Step 23 Click **Submit** to save your changes.

Configuring TACACS+ (GUI)

Step 1 Choose **Security** > **AAA** > **TACACS+**.

Step 2 Perform one of the following:

- If you want to configure a TACACS+ server for authentication, choose **Authentication**.
- If you want to configure a TACACS+ server for authorization, choose **Authorization**.
- If you want to configure a TACACS+ server for accounting, choose **Accounting**.

Note The pages used to configure authentication, authorization, and accounting all contain the same text boxes. Therefore, these instructions walk through the configuration only once, using the Authentication pages as examples. You would follow the same steps to configure multiple services and/or multiple servers.

Note For basic management authentication via TACACS+ to succeed, it is required to configure authentication and authorization servers on the WLC. Accounting configuration is optional.

The TACACS+ (Authentication, Authorization, or Accounting) Servers page appears. This page lists any TACACS+ servers that have already been configured.

- If you want to delete an existing server, hover your cursor over the blue drop-down arrow for that server and choose **Remove**.
- If you want to make sure that the controller can reach a particular server, hover your cursor over the blue drop-down arrow for that server and choose **Ping**.

Step 3 Perform one of the following:

- To edit an existing TACACS+ server, click the server index number for that server. The **TACACS+ (Authentication, Authorization, or Accounting) Servers > Edit** page appears.
- To add a TACACS+ server, click **New**. The **TACACS+ (Authentication, Authorization, or Accounting) Servers > New** page appears.

Step 4 If you are adding a new server, choose a number from the Server Index (Priority) drop-down list to specify the priority order of this server in relation to any other configured TACACS+ servers providing the same service. You can configure up to three servers. If the controller cannot reach the first server, it tries the second one in the list and then the third if necessary.

Step 5 If you are adding a new server, enter the IP address of the TACACS+ server in the **Server IP Address** text box.

Step 6 From the **Shared Secret Format** drop-down list, choose **ASCII** or **Hex** to specify the format of the shared secret key to be used between the controller and the TACACS+ server. The default value is ASCII.

Step 7 In the **Shared Secret** and **Confirm Shared Secret** text boxes, enter the shared secret key to be used for authentication between the controller and the server.

Note The shared secret key must be the same on both the server and the controller.

Step 8 If you are adding a new server, enter the TACACS+ server's TCP port number for the interface protocols in the **Port Number** text box. The valid range is 1 to 65535, and the default value is 49.

Step 9 In the **Server Status** text box, choose **Enabled** to enable this TACACS+ server or choose **Disabled** to disable it. The default value is Enabled.

Step 10 In the **Server Timeout** text box, enter the number of seconds between retransmissions. The valid range is 5 to 30 seconds, and the default value is 5 seconds.

Note We recommend that you increase the timeout value if you experience repeated reauthentication attempts or the controller falls back to the backup server when the primary server is active and reachable.

Step 11 Click **Apply**.

Step 12 Click **Save Configuration**.

Step 13 Repeat the previous steps if you want to configure any additional services on the same server or any additional TACACS+ servers.

Step 14 Specify the order of authentication when multiple databases are configured by choosing **Security** > **Priority Order** > **Management User**. The Priority Order > Management User page appears.

Step 15 In the **Order Used for Authentication** text box, specify which servers have priority when the controller attempts to authenticate management users.

Use the **>** and **<** buttons to move servers between the **Not Used** and **Order Used for Authentication** text boxes. After the desired servers appear in the Order Used for Authentication text box, use the **Up** and **Down** buttons to move the priority server to the top of the list. By default, the local database is always queried first. If the username is not found, the controller switches to the RADIUS server if configured for RADIUS or to the TACACS+ server if configured for TACACS+. The default setting is local and then RADIUS.

Step 16 Click **Apply**.

Step 17 Click **Save Configuration**.

Configuring TACACS+ (CLI)

- Configure a TACACS+ authentication server by entering these commands:
  - **config tacacs auth add** *index server_ip_address port#* {**ascii** | **hex**} *shared_secret*—Adds a TACACS+ authentication server.
  - **config tacacs auth delete** *index*—Deletes a previously added TACACS+ authentication server.
  - **config tacacs auth** {**enable** | **disable**} *index*—Enables or disables a TACACS+ authentication server.
  - **config tacacs auth server-timeout** *index timeout*—Configures the retransmission timeout value for a TACACS+ authentication server.
- Configure a TACACS+ authorization server by entering these commands:
  - **config tacacs athr add** *index server_ip_address port#* {**ascii** | **hex**} *shared_secret*—Adds a TACACS+ authorization server.
  - **config tacacs athr delete** *index*—Deletes a previously added TACACS+ authorization server.

- **config tacacs athr** {**enable** | **disable**} *index*—Enables or disables a TACACS+ authorization server.
- **config tacacs athr server-timeout** *index timeout*—Configures the retransmission timeout value for a TACACS+ authorization server.

- Configure a TACACS+ accounting server by entering these commands:
  - **config tacacs acct add** *index server_ip_address port#* {**ascii** | **hex**} *shared_secret*—Adds a TACACS+ accounting server.
  - **config tacacs acct delete** *index*—Deletes a previously added TACACS+ accounting server.
  - **config tacacs acct** {**enable** | **disable**} *index*—Enables or disables a TACACS+ accounting server.
  - **config tacacs acct server-timeout** *index timeout*—Configures the retransmission timeout value for a TACACS+ accounting server.

- See TACACS+ statistics by entering these commands:
  - **show tacacs summary**—Shows a summary of TACACS+ servers and statistics.
  - **show tacacs auth stats**—Shows the TACACS+ authentication server statistics.
  - **show tacacs athr stats**—Shows the TACACS+ authorization server statistics.
  - **show tacacs acct stats**—Shows the TACACS+ accounting server statistics.

- Clear the statistics for one or more TACACS+ servers by entering this command:
  clear stats tacacs [**auth** | **athr** | **acct**] {*index* | *all*}
- Configure the order of authentication when multiple databases are configured by entering this command. The default setting is local and then radius.
  config aaa auth mgmt [**radius** | **tacacs**]

  See the current management authentication server order by entering the **show aaa auth** command.
- Make sure the controller can reach the TACACS+ server by entering this command:
  ping *server_ip_address*
- Enable or disable TACACS+ debugging by entering this command:
  debug aaa tacacs {**enable** | **disable**}
- Save your changes by entering this command:
  save config

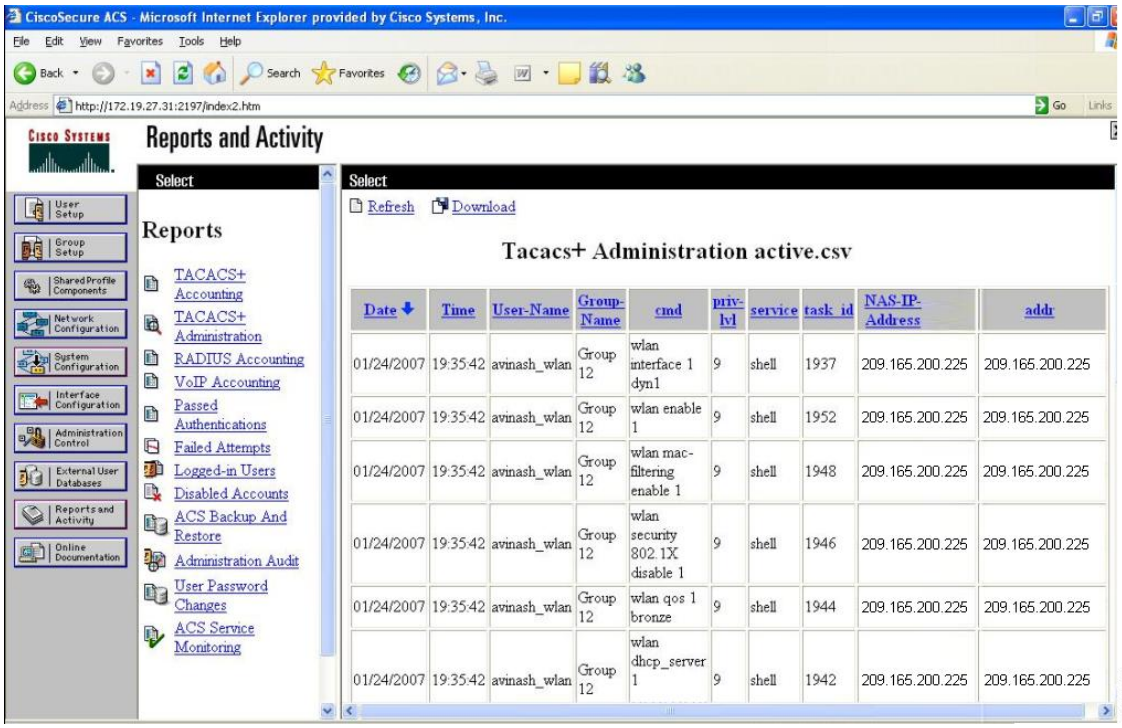
Viewing the TACACS+ Administration Server Logs

Step 1 On the ACS main page, in the left navigation pane, choose **Reports and Activity**.

Step 2 Under Reports, choose **TACACS+ Administration**.

Click the .csv file corresponding to the date of the logs you want to view. The TACACS+ Administration .csv page appears.

Figure 40: TACACS+ Administration .csv Page on CiscoSecure ACS



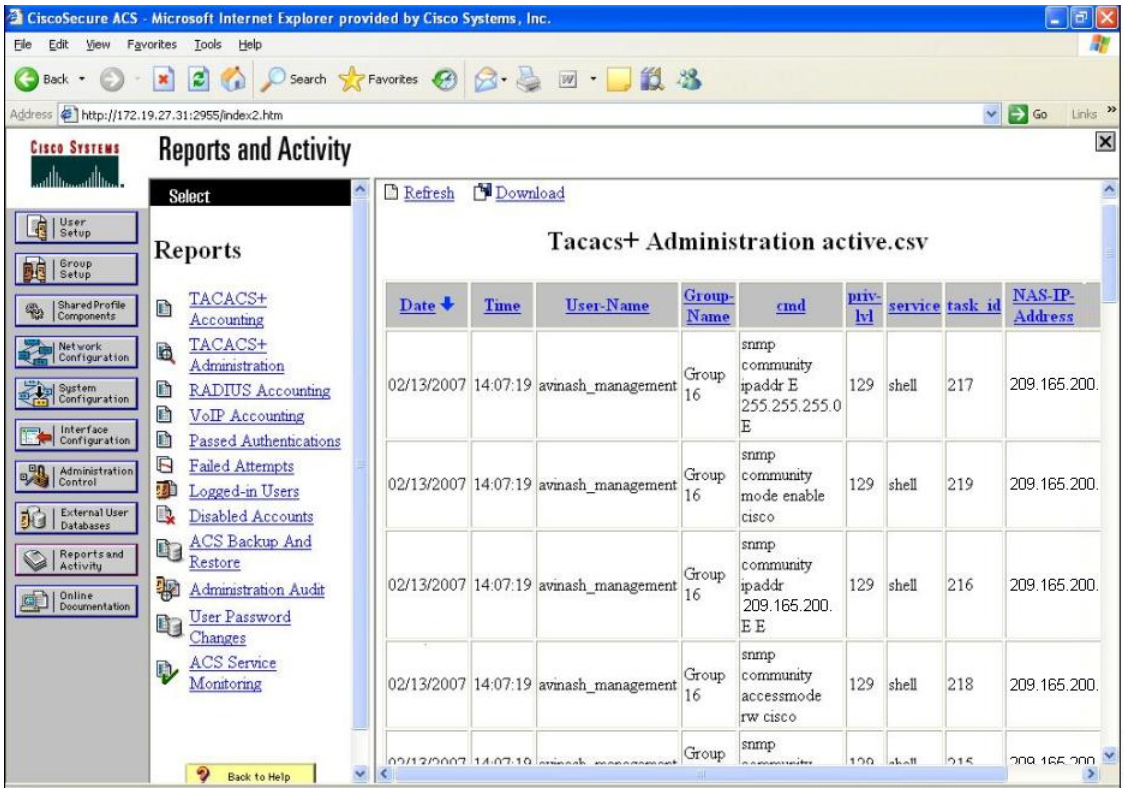
This page displays the following information:

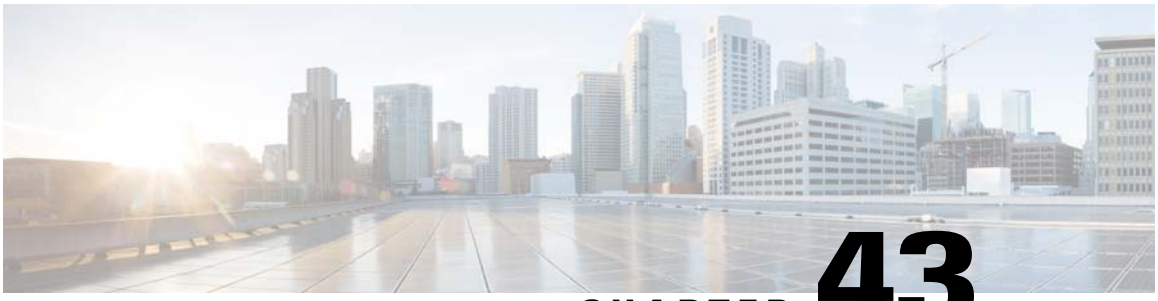
- Date and time the action was taken
- Name and assigned role of the user who took the action
- Group to which the user belongs
- Specific action that the user took
- Privilege level of the user who executed the action
- IP address of the controller
- IP address of the laptop or workstation from which the action was executed

Sometimes a single action (or command) is logged multiple times, once for each parameter in the command. For example, if you enter the **snmp community ipaddr** *ip_address subnet_mask community_name* command, the IP address may be logged on one line while the subnet mask and community name are logged as “E.” On another line, the subnet mask

maybe logged while the IP address and community name are logged as “E.” See the first and third lines in the example in this figure.

Figure 41: TACACS+ Administration .csv Page on CiscoSecure ACS





CHAPTER 43

Configuring Maximum Local Database Entries

Information About Configuring Maximum Local Database Entries

You can configure the controller to specify the maximum number of local database entries used for storing user authentication information. The database entries include local management users (including lobby ambassadors), local network users (including guest users), MAC filter entries, exclusion list entries, and access point authorization list entries. Together they cannot exceed the configured maximum value.

Configuring Maximum Local Database Entries (GUI)

Step 1 Choose **Security** > **AAA** > **General** to open the General page.

Step 2 In the Maximum Local Database Entries text box, enter a value for the maximum number of entries that can be added to the local database the next time the controller reboots. The currently configured value appears in parentheses to the right of the text box. The valid range is 512 to 2048, and the default setting is 2048.
The **Number of Entries, Already Used** text box shows the number of entries currently in the database.

Step 3 Click **Apply** to commit your changes.

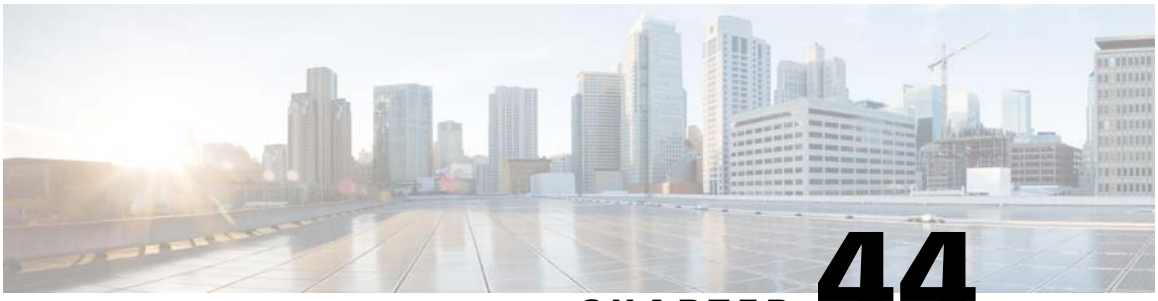
Step 4 Click **Save Configuration** to save your settings.

Configuring Maximum Local Database Entries (CLI)

Step 1 Specify the maximum number of entries that can be added to the local database the next time the controller reboots by entering this command:
config database size *max_entries*

Step 2 Save your changes by entering this command:
save config

Step 3 View the maximum number of database entries and the current database contents by entering this command:
show database summary



CHAPTER 44

Configuring Local Network Users on the Controller

Information About Local Network Users on Controller

You can add local network users to the local user database on the controller. The local user database stores the credentials (username and password) of all the local network users. These credentials are then used to authenticate the users. For example, local EAP may use the local user database as its backend database to retrieve user credentials.

Note The controller passes client information to the RADIUS authentication server first. If the client information does not match a RADIUS database entry, the RADIUS authentication server replies with an authentication failure message. If the RADIUS authentication server does not reply, then the local user database is queried. Clients located in this database are granted access to network services if the RADIUS authentication fails or does not exist.

Configuring Local Network Users for the Controller (GUI)

Step 1 Choose **Security** > **AAA** > **Local Net Users** to open the Local Net Users page.

Note If you want to delete an existing user, hover your cursor over the blue drop-down arrow for that user and choose **Remove**.

Step 2 Perform one of the following:

- To edit an existing local network user, click the username for that user. The Local Net Users > Edit page appears.

- To add a local network user, click **New**. The **Local Net Users > New** page appears.

Step 3 If you are adding a new user, enter a username for the local user in the **User Name** text box. You can enter up to 24 alphanumeric characters.

Note Local network usernames must be unique because they are all stored in the same database.

Step 4 In the **Password** and **Confirm Password** text boxes, enter a password for the local user. You can enter up to 24 alphanumeric characters.

Step 5 If you are adding a new user, select the **Guest User** check box if you want to limit the amount of time that the user has access to the local network. The default setting is unselected.

Step 6 If you are adding a new user and you selected the **Guest User** check box, enter the amount of time (in seconds) that the guest user account is to remain active in the Lifetime text box. The valid range is 60 to 2,592,000 seconds (30 days) inclusive, and the default setting is 86,400 seconds.

Step 7 If you are adding a new user, you selected the **Guest User** check box, and you want to assign a QoS role to this guest user, select the **Guest User Role** check box. The default setting is unselected.

Note If you do not assign a QoS role to a guest user, the bandwidth contracts for this user are defined in the QoS profile for the WLAN.

Step 8 If you are adding a new user and you selected the **Guest User Role** check box, choose the QoS role that you want to assign to this guest user from the Role drop-down list.

Step 9 From the WLAN Profile drop-down list, choose the name of the WLAN that is to be accessed by the local user. If you choose **Any WLAN**, which is the default setting, the user can access any of the configured WLANs.

Step 10 In the **Description** text box, enter a descriptive title for the local user (such as "User 1").

Step 11 Click **Apply** to commit your changes.

Step 12 Click **Save Configuration** to save your changes.

Configuring Local Network Users for the Controller (CLI)

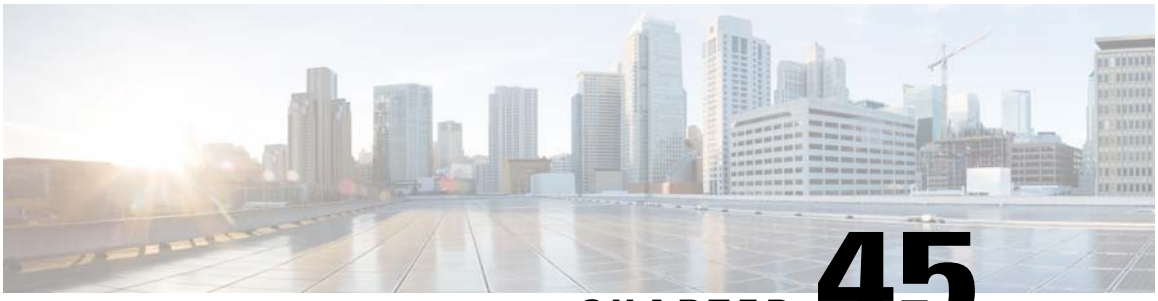
- Configure a local network user by entering these commands:
  - **config netuser add** *username password* **wlan** *wlan_id userType* **permanent description** *description*—Adds a permanent user to the local user database on the controller.
  - **config netuser add** *username password* {**wlan | guestlan} {***wlan_id | guest_lan_id}* **userType guestlifetime** *seconds* **description** *description*—Adds a guest user on a WLAN or wired guest LAN to the local user database on the controller.

Note Instead of adding a permanent user or a guest user to the local user database from the controller, you can choose to create an entry on the RADIUS server for the user and enable RADIUS authentication for the WLAN on which web authentication is performed.

  - **config netuser delete** *username*—Deletes a user from the local user database on the controller.

Note Local network usernames must be unique because they are all stored in the same database.

- See information related to the local network users configured on the controller by entering these commands:
  - **show netuser detail** *username*—Shows the configuration of a particular user in the local user database.
  - **show netuser summary**—Lists all the users in the local user database.
- Save your changes by entering this command:
  save config



CHAPTER 45

Configuring Password Policies

Information About Password Policies

The password policies allows you to enforce strong password checks on newly created passwords for additional management users of controller and access point. The following are the requirements enforced on the new password:

- When the controller is upgraded from old version, all the old passwords are maintained as it is, even though the passwords are weak. After the system upgrade, if strong password checks are enabled, the same is enforced from that time and the strength of previously added passwords will not be checked or altered.
- Depending on the settings done in the Password Policy page, the local management and access point user configuration is affected.

Configuring Password Policies (GUI)

Step 1 Choose **Security** > **AAA** > **Password Policies** to open the Password Policies page.

Step 2 Select the **Password must contain characters from at least 3 different classes** check box if you want your password to contain characters from at least three of the following classes: lower case letters, upper case letters, digits, and special characters.

Step 3 Select the **No character can be repeated more than 3 times consecutively** check box if you do not want character in the new password to repeat more than three times consecutively.

Step 4 Select the **Password cannot be the default words like cisco, admin** check box if you do not want the password to contain words such as Cisco, ocsic, admin, nimda, or any variant obtained by changing the capitalization of letters or by substituting 1, |, or! or substituting 0 for o or substituting $ for s.

Step 5 Select the **Password cannot contain username or reverse of username** check box if you do not want the password to contain a username or the reverse letters of a username.

Step 6 Click **Apply** to commit your changes.

Step 7 Click **Save Configuration** to save your changes.

Configuring Password Policies (CLI)

- Enable or disable strong password check for AP and WLC by entering this command:
  config switchconfig strong-pwd {**case-check** | **consecutive-check** | **default-check** | **username-check** | **all-checks**} {**enable** | **disable**}

  where

  - **case-check—**Checks the occurrence of same character thrice consecutively
  - **consecutive-check—**Checks the default values or its variants are being used.
  - **default-check—**Checks either username or its reverse is being used.
  - **all-checks—**Enables/disables all the strong password checks.

- See the configured options for strong password check by entering this command:
  show switchconfig

  Information similar to the following appears:

```
802.3x Flow Control Mode..................... Disabled
FIPS prerequisite features................... Disabled
secret obfuscation........................... Enabled
Strong Password Check Features:

        case-check ...........Enabled
        consecutive-check ....Enabled
        default-check .......Enabled
        username-check ......Enabled
```

CHAPTER 46

Configuring LDAP

Information About LDAP

An LDAP backend database allows the controller to query an LDAP server for the credentials (username and password) of a particular user. These credentials are then used to authenticate the user. For example, local EAP may use an LDAP server as its backend database to retrieve user credentials.

Fallback LDAP Servers

The LDAP servers are configured on a WLAN for authentication. You require at least two LDAP servers to configure them for fallback behavior. A maximum of three LDAP servers can be configured for the fallback behavior per WLAN. The servers are listed in the priority order for authentication. If the first LDAP server becomes irresponsive, then the controller switches to the next LDAP server. If the second LDAP server becomes irresponsive, then the controller switches again to the third LDAP server.

Note The LDAP backend database supports these local EAP methods: EAP-TLS, EAP-FAST/GTC, and PEAPv1/GTC. LEAP, EAP-FAST/MSCHAPv2, and PEAPv0/MSCHAPv2 are also supported but only if the LDAP server is set up to return a clear-text password.

Note Cisco wireless LAN controllers support Local EAP authentication against external LDAP databases such as Microsoft Active Directory and Novell's eDirectory. For more information about configuring the controller for Local EAP authentication against Novell's eDirectory, see the Configure Unified Wireless Network for Authentication Against Novell's eDirectory Database whitepaper at http://www.cisco.com/en/US/products/ps6366/products_white_paper09186a0080b4cd24.shtml.

Configuring LDAP (GUI)

Step 1 Choose **Security** > **AAA** > **LDAP** to open the LDAP Servers page.

- If you want to delete an existing LDAP server, hover your cursor over the blue drop-down arrow for that server and choose **Remove**.
- If you want to make sure that the controller can reach a particular server, hover your cursor over the blue drop-down arrow for that server and choose **Ping**.

Step 2 Perform one of the following:

- To edit an existing LDAP server, click the index number for that server. The **LDAP Servers > Edit** page appears.
- To add an LDAP server, click **New**. The **LDAP Servers > New** page appears. If you are adding a new server, choose a number from the Server Index (Priority) drop-down list to specify the priority order of this server in relation to any other configured LDAP servers. You can configure up to 17 servers. If the controller cannot reach the first server, it tries the second one in the list and so on.

Step 3 If you are adding a new server, enter the IP address of the LDAP server in the **Server IP Address** text box.

Step 4 If you are adding a new server, enter the LDAP server's TCP port number in the **Port Number** text box. The valid range is 1 to 65535, and the default value is 389.

Step 5 From the **Server Mode** drop-down list, choose **None**.

Step 6 Select the **Enable Server Status** check box to enable this LDAP server or unselect it to disable it. The default value is disabled.

Step 7 From the Simple Bind drop-down list, choose **Anonymous** or **Authenticated** to specify the local authentication bind method for the LDAP server. The Anonymous method allows anonymous access to the LDAP server. The Authenticated method requires that a username and password be entered to secure access. The default value is Anonymous.

Step 8 If you chose **Authenticated** in the previous step, follow these steps:

a) In the Bind Username text box, enter a username to be used for local authentication to the LDAP server. The username can contain up to 80 characters.

Note If the username starts with "cn=" (in lowercase letters), the controller assumes that the username includes the entire LDAP database path and does not append the user base DN. This designation allows the authenticated bind user to be outside the user base DN.

b) In the Bind Username text box, enter a username to be used for local authentication to the LDAP server. The username can contain up to 80 characters.

Step 9 In the User Base DN text box, enter the distinguished name (DN) of the subtree in the LDAP server that contains a list of all the users. For example, ou=organizational unit, .ou=next organizational unit, and o=corporation.com. If the tree containing users is the base DN, type.
o=*corporation*.com
or

dc=*corporation*,dc=com

Step 10 In the User Attribute text box, enter the name of the attribute in the user record that contains the username. You can obtain this attribute from your directory server.

Step 11 In the User Object Type text box, enter the value of the LDAP objectType attribute that identifies the record as a user. Often, user records have several values for the objectType attribute, some of which are unique to the user and some of which are shared with other object types.

Step 12 In the Server Timeout text box, enter the number of seconds between retransmissions. The valid range is 2 to 30 seconds, and the default value is 2 seconds.

Step 13 Click **Apply** to commit your changes.

Step 14 Click **Save Configuration** to save your changes.

Step 15 Specify LDAP as the priority backend database server for local EAP authentication as follows:

a) Choose **Security** > **Local EAP** > **Authentication Priority** to open the Priority Order > Local-Auth page.

b) Highlight **LOCAL** and click **<** to move it to the left User Credentials box.

c) Highlight **LDAP** and click **>** to move it to the right User Credentials box. The database that appears at the top of the right User Credentials box is used when retrieving user credentials.

Note If both LDAP and LOCAL appear in the right User Credentials box with LDAP on the top and LOCAL on the bottom, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If LOCAL is on the top, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

d) Click **Apply** to commit your changes.

e) Click **Save Configuration** to save your changes.

Step 16 (Optional) Assign specific LDAP servers to a WLAN as follows:

a) Choose **WLANs** to open the WLANs page.

b) Click the ID number of the desired WLAN.

c) When the WLANs > Edit page appears, choose the **Security** > **AAA Servers** tabs to open the WLANs > Edit (Security > AAA Servers) page.

d) From the LDAP Servers drop-down lists, choose the LDAP server(s) that you want to use with this WLAN. You can choose up to three LDAP servers, which are tried in priority order.

Note These LDAP servers apply only to WLANs with web authentication enabled. They are not used by local EAP.

e) Click **Apply** to commit your changes.

f) Click **Save Configuration** to save your changes.

Step 17 Specify the LDAP server fallback behavior, as follows:

a) Choose **WLAN** > **AAA Server** to open the Fallback Parameters page.

b) From the LDAP Servers drop-down list, choose the LDAP server in the order of priority when the controller attempts to authenticate management users. The order of authentication is from server.

c) Choose **Security** > **AAA** > **LDAP** to view the list of global LDAP servers configured for the controller.

Configuring LDAP (CLI)

- Configure an LDAP server by entering these commands:
  - **config ldap add** *index server_ip_address port# user_base user_attr user_type* **—** Adds an LDAP server.
  - **config ldap delete** *index***—**Deletes a previously added LDAP server.
  - **config ldap** {**enable** | **disable**} *index***—**Enables or disables an LDAP server.
  - **config ldap simple-bind** {**anonymous** *index* | **authenticated** *index* **username** *username* **password** *password*}**—**Specifies the local authentication bind method for the LDAP server. The anonymous method allows anonymous access to the LDAP server whereas the authenticated method requires that a username and password be entered to secure access. The default value is anonymous. The username can contain up to 80 characters.

    If the username starts with "cn=" (in lowercase letters), the controller assumes that the username includes the entire LDAP database path and does not append the user base DN. This designation allows the authenticated bind user to be outside the user base DN.
  - **config ldap retransmit-timeout** *index timeout***—**Configures the number of seconds between retransmissions for an LDAP server.

- Specify LDAP as the priority backend database server by entering this command:
  config local-auth user-credentials ldap

  If you enter the **config local-auth user-credentials ldap local command**, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If you enter the **config local-auth user-credentials local ldap command**, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.
- (Optional) Assign specific LDAP servers to a WLAN by entering these commands:
  - **config wlan ldap add** *wlan_id server_index***—**Links a configured LDAP server to a WLAN. The LDAP servers specified in this command apply only to WLANs with web authentication enabled. They are not used by local EAP.
  - **config wlan ldap delete** *wlan_id* {*all* | *index*}**—**Deletes a specific or all configured LDAP server(s) from a WLAN.
- View information pertaining to configured LDAP servers by entering these commands:
  - **show ldap summary—**Shows a summary of the configured LDAP servers.

    ```
    Idx  Server Address   Port  Enabled
    ---  ---------------  ----  -------
    1    2.3.1.4           389     No
    2    10.10.20.22       389     Yes
    ```
  - **show ldap** *index***—**Shows detailed LDAP server information. Information like the following appears:

    ```
    Server Index..................................... 2
    Address.......................................... 10.10.20.22
    Port............................................. 389
    ```

```
Enabled..................................... Yes
User DN..................................... ou=active,ou=employees,ou=people,

            o=cisco.com
User Attribute.............................. uid
User Type................................... Person
Retransmit Timeout.......................... 2 seconds
Bind Method ................................ Authenticated
Bind Username.............................. user1
```

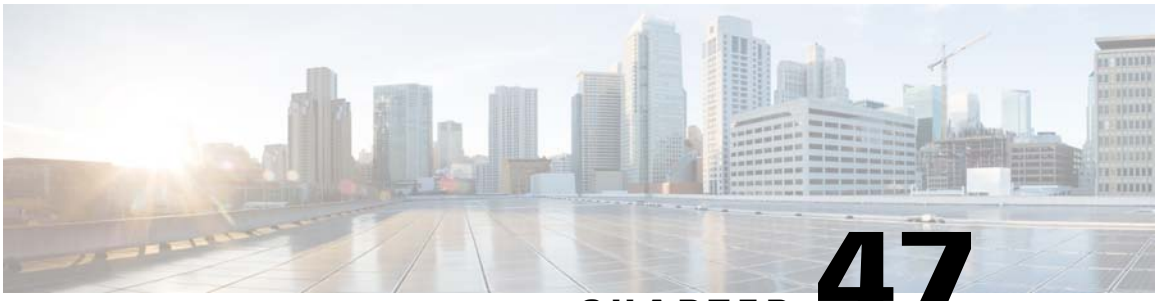
◦ **show ldap statistics—**Shows LDAP server statistics.

```
Server Index................................ 1
Server statistics:
  Initialized OK............................ 0
  Initialization failed..................... 0
  Initialization retries.................... 0
  Closed OK................................. 0
Request statistics:
  Received.................................. 0
  Sent...................................... 0
  OK........................................ 0
  Success................................... 0
  Authentication failed..................... 0
  Server not found.......................... 0
  No received attributes.................... 0
  No passed username........................ 0
  Not connected to server................... 0
  Internal error............................ 0
  Retries................................... 0

Server Index................................ 2
..
```

◦ **show wlan** *wlan_id***—**Shows the LDAP servers that are applied to a WLAN.

- Make sure the controller can reach the LDAP server by entering this command:
  ping *server_ip_address*
- Save your changes by entering this command:
  save config
- Enable or disable debugging for LDAP by entering this command:
  debug aaa ldap {**enable | disable}**



CHAPTER 47

Configuring Local EAP

Information About Local EAP

Local EAP is an authentication method that allows users and wireless clients to be authenticated locally. It is designed for use in remote offices that want to maintain connectivity to wireless clients when the backend system becomes disrupted or the external authentication server goes down. When you enable local EAP, the controller serves as the authentication server and the local user database, which removes dependence on an external authentication server. Local EAP retrieves user credentials from the local user database or the LDAP backend database to authenticate users. Local EAP supports LEAP, EAP-FAST, EAP-TLS, P EAPv0/MSCHAPv2, and PEAPv1/GTC authentication between the controller and wireless clients.

Note The LDAP backend database supports these local EAP methods: EAP-TLS, EAP-FAST/GTC, and PEAPv1/GTC. LEAP, EAP-FAST/MSCHAPv2, and PEAPv0/MSCHAPv2 are also supported but only if the LDAP server is set up to return a clear-text password.

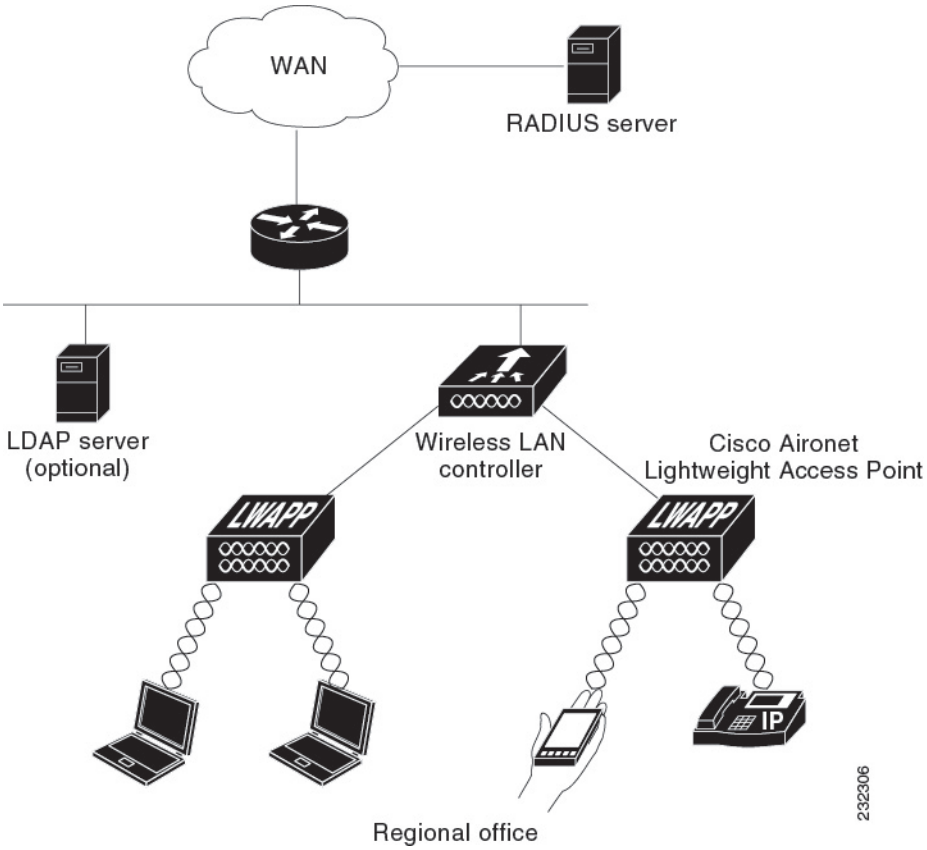
Note Cisco wireless LAN controllers support Local EAP authentication against external LDAP databases such as Microsoft Active Directory and Novell's eDirectory. For more information about configuring the controller for Local EAP authentication against Novell's eDirectory, see the Configure Unified Wireless Network for Authentication Against Novell's eDirectory Database whitepaper at http://www.cisco.com/en/US/products/ps6366/products_white_paper09186a0080b4cd24.shtml.

If any RADIUS servers are configured on the controller, the controller tries to authenticate the wireless clients using the RADIUS servers first. Local EAP is attempted only if no RADIUS servers are found, either because the RADIUS servers timed out or no RADIUS servers were configured. If four RADIUS servers are configured, the controller attempts to authenticate the client with the first RADIUS server, then the second RADIUS server, and then local EAP. If the client attempts to then reauthenticate manually, the controller tries the third

RADIUS server, then the fourth RADIUS server, and then local EAP. If you never want the controller to try to authenticate clients using an external RADIUS server, enter these CLI commands in this order:

- **config wlan disable** *wlan_id*
- **config wlan radius_server auth disable** *wlan_id*
- **config wlan enable** *wlan_id*

Figure 42: Local EAP Example



Restrictions for Local EAP

Local EAP profiles are not supported on Cisco 600 Series OfficeExtend access points.

Configuring Local EAP (GUI)

Before You Begin

Note EAP-TLS, P EAPv0/MSCHAPv2, and PEAPv1/GTC use certificates for authentication, and EAP-FAST uses either certificates or PACs. The controller is shipped with Cisco-installed device and Certificate Authority (CA) certificates. However, if you want to use your own vendor-specific certificates, they must be imported on the controller.

Step 1 If you are configuring local EAP to use one of the EAP types listed in the note above, make sure that the appropriate certificates and PACs (if you will use manual PAC provisioning) have been imported on the controller.

Step 2 If you want the controller to retrieve user credentials from the local user database, make sure that you have properly configured the local network users on the controller.

Step 3 If you want the controller to retrieve user credentials from an LDAP backend database, make sure that you have properly configured an LDAP server on the controller.

Step 4 Specify the order in which user credentials are retrieved from the backend database servers as follows:

a) Choose **Security** > **Local EAP** > **Authentication Priority** to open the **Priority Order > Local-Auth** page.

b) Determine the priority order in which user credentials are to be retrieved from the local and/or LDAP databases. For example, you may want the LDAP database to be given priority over the local user database, or you may not want the LDAP database to be considered at all.

c) When you have decided on a priority order, highlight the desired database. Then use the left and right arrows and the Up and Down buttons to move the desired database to the top of the right User Credentials box.

Note If both LDAP and LOCAL appear in the right User Credentials box with LDAP on the top and LOCAL on the bottom, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If LOCAL is on the top, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

d) Click **Apply** to commit your changes.

Step 5 Specify values for the local EAP timers as follows:

a) Choose **Security** > **Local EAP** > **General** to open the General page.

b) In the **Local Auth Active Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to authenticate wireless clients using local EAP after any pair of configured RADIUS servers fails. The valid range is 1 to 3600 seconds, and the default setting is 100 seconds.

c) In the **Identity Request Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP identity request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.

d) In the **Identity Request Max Retries** text box, enter the maximum number of times that the controller attempts to retransmit the EAP identity request to wireless clients using local EAP. The valid range is 1 to 20 retries, and the default setting is 20 retries.

e) In the **Dynamic WEP Key Index** text box, enter the key index used for dynamic wired equivalent privacy (WEP). The default value is 0, which corresponds to a key index of 1; the valid values are 0 to 3 (key index of 1 to 4).

f) In the **Request Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.

g) In the **Request Max Retries** text box, enter the maximum number of times that the controller attempts to retransmit the EAP request to wireless clients using local EAP. The valid range is 1 to 120 retries, and the default setting is 20 retries.

h) From the **Max-Login Ignore Identity Response** drop-down list, choose **Enable** to limit the number of devices that can be connected to the controller with the same username. You can log in up to eight times from different devices (PDA, laptop, IP phone, and so on) on the same controller. The default value is enabled.

i) In the **EAPOL-Key Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 1 to 5 seconds, and the default setting is 1 second.

Note If the controller and access point are separated by a WAN link, the default timeout of 1 second may not be sufficient.

j) In the **EAPOL-Key Max** Retries text box, enter the maximum number of times that the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 0 to 4 retries, and the default setting is 2 retries.

k) Click **Apply** to commit your changes.

Step 6 Create a local EAP profile, which specifies the EAP authentication types that are supported on the wireless clients as follows:

a) Choose **Security** > **Local EAP** > **Profiles** to open the Local EAP Profiles page.
This page lists any local EAP profiles that have already been configured and specifies their EAP types. You can create up to 16 local EAP profiles.

Note If you want to delete an existing profile, hover your cursor over the blue drop-down arrow for that profile and choose **Remove**.

b) Click **New** to open the **Local EAP Profiles > New** page.

c) In the Profile Name text box, enter a name for your new profile and then click **Apply**.

Note You can enter up to 63 alphanumeric characters for the profile name. Make sure not to include spaces.

d) When the Local EAP Profiles page reappears, click the name of your new profile. The **Local EAP Profiles > Edit** page appears.

e) Select the **LEAP**, **EAP-FAST**, **EAP-TLS,** and/or **PEAP** check boxes to specify the EAP type that can be used for local authentication.

Note You can specify more than one EAP type per profile. However, if you choose multiple EAP types that use certificates (such as EAP-FAST with certificates, EAP-TLS, PEAPv0/MSCHAPv2, and PEAPv1/GTC), all of the EAP types must use the same certificate (from either Cisco or another vendor).

Note If you select the **PEAP** check box, both PEAPv0/MSCHAPv2 or PEAPv1/GTC are enabled on the controller.

f) If you chose EAP-FAST and want the device certificate on the controller to be used for authentication, select the **Local Certificate Required** check box. If you want to use EAP-FAST with PACs instead of certificates, leave this check box unselected, which is the default setting.

Note This option applies only to EAP-FAST because device certificates are not used with LEAP and are mandatory for EAP-TLS and PEAP.

g) If you chose EAP-FAST and want the wireless clients to send their device certificates to the controller in order to authenticate, select the **Client Certificate Required** check box. If you want to use EAP-FAST with PACs instead of certificates, leave this check box unselected, which is the default setting.

Note This option applies only to EAP-FAST because client certificates are not used with LEAP or PEAP and are mandatory for EAP-TLS.

h) If you chose EAP-FAST with certificates, EAP-TLS, or PEAP, choose which certificates will be sent to the client, the ones from **Cisco** or the ones from another **Vendor**, from the Certificate Issuer drop-down list. The default setting is Cisco.

i) If you chose EAP-FAST with certificates or EAP-TLS and want the incoming certificate from the client to be validated against the CA certificates on the controller, select the **Check against CA certificates** check box. The default setting is enabled.

j) If you chose EAP-FAST with certificates or EAP-TLS and want the common name (CN) in the incoming certificate to be validated against the CA certificates' CN on the controller, select the **Verify Certificate CN Identity** check box. The default setting is disabled.

k) If you chose EAP-FAST with certificates or EAP-TLS and want the controller to verify that the incoming device certificate is still valid and has not expired, select the **Check Certificate Date Validity** check box. The default setting is enabled.

Note Certificate date validity is checked against the current UTC (GMT) time that is configured on the controller. Timezone offset will be ignored.

l) Click **Apply** to commit your changes.

Step 7 If you created an EAP-FAST profile, follow these steps to configure the EAP-FAST parameters:

a) Choose **Security** > **Local EAP** > **EAP-FAST Parameters** to open the EAP-FAST Method Parameters page.

b) In the Server Key and Confirm Server Key text boxes, enter the key (in hexadecimal characters) used to encrypt and decrypt PACs.

c) In the Time to Live for the PAC text box, enter the number of days for the PAC to remain viable. The valid range is 1 to 1000 days, and the default setting is 10 days.

d) In the Authority ID text box, enter the authority identifier of the local EAP-FAST server in hexadecimal characters. You can enter up to 32 hexadecimal characters, but you must enter an even number of characters.

e) In the Authority ID Information text box, enter the authority identifier of the local EAP-FAST server in text format.

f) If you want to enable anonymous provisioning, select the **Anonymous Provision** check box. This feature allows PACs to be sent automatically to clients that do not have one during PAC provisioning. If you disable this feature, PACS must be manually provisioned. The default setting is enabled.

Note If the local and/or client certificates are required and you want to force all EAP-FAST clients to use certificates, unselect the **Anonymous Provision** check box.

g) Click **Apply** to commit your changes.

Step 8 Enable local EAP on a WLAN as follows:

a) Choose **WLANs** to open the WLANs page.

b) Click the ID number of the desired WLAN.

c) When the **WLANs > Edit** page appears, choose the **Security** > **AAA Servers** tabs to open the **WLANs > Edit (Security > AAA Servers)** page.

d) Select the **Local EAP Authentication** check box to enable local EAP for this WLAN.

e) From the EAP Profile Name drop-down list, choose the EAP profile that you want to use for this WLAN.

f) If desired, choose the LDAP server that you want to use with local EAP on this WLAN from the **LDAP Servers** drop-down lists.

g) Click **Apply** to commit your changes.

Step 9 Click **Save Configuration** to save your changes.

Configuring Local EAP (CLI)

Before You Begin

Note EAP-TLS, P EAPv0/MSCHAPv2, and PEAPv1/GTC use certificates for authentication, and EAP-FAST uses either certificates or PACbs. The controller is shipped with Cisco-installed device and Certificate Authority (CA) certificates. However, if you want to use your own vendor-specific certificates, they must be imported on the controller.

Step 1 If you are configuring local EAP to use one of the EAP types listed in the note above, make sure that the appropriate certificates and PACs (if you will use manual PAC provisioning) have been imported on the controller.

Step 2 If you want the controller to retrieve user credentials from the local user database, make sure that you have properly configured the local network users on the controller.

Step 3 If you want the controller to retrieve user credentials from an LDAP backend database, make sure that you have properly configured an LDAP server on the controller.

Step 4 Specify the order in which user credentials are retrieved from the local and/or LDAP databases by entering this command: **config local-auth user-credentials** {*local* | *ldap*}

Note If you enter the **config local-auth user-credentials ldap local** command, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If you enter the **config local-auth user-credentials local ldap command**, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

Step 5 Specify values for the local EAP timers by entering these commands:

- **config local-auth active-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to authenticate wireless clients using local EAP after any pair of configured RADIUS servers fails. The valid range is 1 to 3600 seconds, and the default setting is 100 seconds.
- **config advanced eap identity-request-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP identity request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.
- **config advanced eap identity-request-retries** *retries*—Specifies the maximum number of times that the controller attempts to retransmit the EAP identity request to wireless clients using local EAP. The valid range is 1 to 20 retries, and the default setting is 20 retries.
- **config advanced eap key-index** *index*—Specifies the key index used for dynamic wired equivalent privacy (WEP). The default value is 0, which corresponds to a key index of 1; the valid values are 0 to 3 (key index of 1 to 4).
- **config advanced eap request-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.
- **config advanced eap request-retries** *retries*—Specifies the maximum number of times that the controller attempts to retransmit the EAP request to wireless clients using local EAP. The valid range is 1 to 120 retries, and the default setting is 20 retries.

- **config advanced eap eapol-key-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 1 to 5 seconds, and the default setting is 1 second.

  Note If the controller and access point are separated by a WAN link, the default timeout of 1 second may not be sufficient.

- **config advanced eap eapol-key-retries** *retries*—Specifies the maximum number of times that the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 0 to 4 retries, and the default setting is 2 retries.

- **config advanced eap max-login-ignore-identity-response** {**enable** | **disable**}—When enabled, this command limits the number of devices that can be connected to the controller with the same username. You can log in up to eight times from different devices (PDA, laptop, IP phone, and so on) on the same controller. The default value is enabled.

Step 6 Create a local EAP profile by entering this command:
config local-auth eap-profile add *profile_name*

Note Do not include spaces within the profile name.

Note To delete a local EAP profile, enter the **config local-auth eap-profile delete** *profile_name* command.

Step 7 Add an EAP method to a local EAP profile by entering this command:
config local-auth eap-profile method add *method profile_name*
The supported methods are leap, fast, tls, and peap.

Note If you choose peap, both P EAPv0/MSCHAPv2 or PEAPv1/GTC are enabled on the controller.

Note You can specify more than one EAP type per profile. However, if you create a profile with multiple EAP types that use certificates (such as EAP-FAST with certificates, EAP-TLS, PEAPv0/MSCHAPv2, and PEAPv1/GTC), all of the EAP types must use the same certificate (from either Cisco or another vendor).

Note To delete an EAP method from a local EAP profile, enter the **config local-auth eap-profile method delete** *method profile_name* command:

Step 8 Configure EAP-FAST parameters if you created an EAP-FAST profile by entering this command:
config local-auth method fast *?*

where *?* is one of the following:

- **anon-prov** {**enable** | **disable**}—Configures the controller to allow anonymous provisioning, which allows PACs to be sent automatically to clients that do not have one during PAC provisioning.
- **authority-id** *auth_id*—Specifies the authority identifier of the local EAP-FAST server.
- **pac-ttl** *days*—Specifies the number of days for the PAC to remain viable.
- **server-key** *key*—Specifies the server key used to encrypt and decrypt PACs.

Step 9 Configure certificate parameters per profile by entering these commands:

- **config local-auth eap-profile method fast local-cert** {**enable** | **disable**} *profile_name*— Specifies whether the device certificate on the controller is required for authentication.

  Note This command applies only to EAP-FAST because device certificates are not used with LEAP and are mandatory for EAP-TLS and PEAP.

- **config local-auth eap-profile method fast client-cert** {**enable** | **disable**} *profile_name***—** Specifies whether wireless clients are required to send their device certificates to the controller in order to authenticate.
  Note This command applies only to EAP-FAST because client certificates are not used with LEAP or PEAP and are mandatory for EAP-TLS.
- **config local-auth eap-profile cert-issuer** {**cisco** | **vendor**} *profile_name***—**If you specified EAP-FAST with certificates, EAP-TLS, or PEAP, specifies whether the certificates that will be sent to the client are from Cisco or another vendor.
- **config local-auth eap-profile cert-verify ca-issuer** {**enable** | **disable**} *profile_name***—**If you chose EAP-FAST with certificates or EAP-TLS, specifies whether the incoming certificate from the client is to be validated against the CA certificates on the controller.
- **config local-auth eap-profile cert-verify cn-verify** {**enable** | **disable**} *profile_name***—**If you chose EAP-FAST with certificates or EAP-TLS, specifies whether the common name (CN) in the incoming certificate is to be validated against the CA certificates' CN on the controller.
- **config local-auth eap-profile cert-verify date-valid** {**enable** | **disable**} *profile_name***—**If you chose EAP-FAST with certificates or EAP-TLS, specifies whether the controller is to verify that the incoming device certificate is still valid and has not expired.

Step 10 Enable local EAP and attach an EAP profile to a WLAN by entering this command:
config wlan local-auth enable *profile_name wlan_id*

Note To disable local EAP for a WLAN, enter the **config wlan local-auth disable** *wlan_id command.*

Step 11 Save your changes by entering this command:
save config

Step 12 View information pertaining to local EAP by entering these commands:

- **show local-auth config—**Shows the local EAP configuration on the controller.

```
User credentials database search order:
   Primary ..................................... Local DB

Timer:
    Active timeout ............................. 300

Configured EAP profiles:
   Name ........................................ fast-cert
     Certificate issuer ....................... vendor
     Peer verification options:
       Check against CA certificates ........... Enabled
       Verify certificate CN identity .......... Disabled
       Check certificate date validity ......... Enabled
     EAP-FAST configuration:
       Local certificate required .............. Yes
       Client certificate required ............. Yes
     Enabled methods ......................... fast
     Configured on WLANs ..................... 1

   Name ........................................ tls
     Certificate issuer ....................... vendor
     Peer verification options:
       Check against CA certificates ........... Enabled
       Verify certificate CN identity .......... Disabled
       Check certificate date validity ......... Enabled
     EAP-FAST configuration:
       Local certificate required .............. No
       Client certificate required ............. No
```

```
      Enabled methods ........................... tls
      Configured on WLANs ....................... 2

EAP Method configuration:
   EAP-FAST:
      Server key ................................ <hidden>
      TTL for the PAC ........................... 10
      Anonymous provision allowed ............... Yes
      Accept client on auth prov ................ No
      Authority ID .............................. 436973636f000000000000000000000000
      Authority Information ..................... Cisco A-ID
```

- **show local-auth statistics—**Shows the local EAP statistics.
- **show local-auth certificates—**Shows the certificates available for local EAP.
- **show local-auth user-credentials—**Shows the priority order that the controller uses when retrieving user credentials from the local and/or LDAP databases.
- **show advanced eap—**Shows the timer values for local EAP.

```
EAP-Identity-Request Timeout (seconds)..... 1
EAP-Identity-Request Max Retries........... 20
EAP Key-Index for Dynamic WEP.............. 0
EAP Max-Login Ignore Identity Response..... enable
EAP-Request Timeout (seconds).............. 20
EAP-Request Max Retries.................... 20
EAPOL-Key Timeout (seconds)................ 1
EAPOL-Key Max Retries...................... 2
```

- **show ap stats wlan** *Cisco_AP***—**Shows the EAP timeout and failure counters for a specific access point for each WLAN.
- **show client detail** *client_mac***—**Shows the EAP timeout and failure counters for a specific associated client. These statistics are useful in troubleshooting client association issues.

```
...
Client Statistics:
      Number of Bytes Received................... 10
      Number of Bytes Sent....................... 10
      Number of Packets Received................. 2
      Number of Packets Sent..................... 2
      Number of EAP Id Request Msg Timeouts...... 0
      Number of EAP Id Request Msg Failures...... 0
      Number of EAP Request Msg Timeouts......... 2
      Number of EAP Request Msg Failures......... 1
      Number of EAP Key Msg Timeouts............. 0
      Number of EAP Key Msg Failures............. 0
      Number of Policy Errors.................... 0
      Radio Signal Strength Indicator............ Unavailable
      Signal to Noise Ratio...................... Unavailable
```

- **show wlan** *wlan_id***—**Shows the status of local EAP on a particular WLAN.

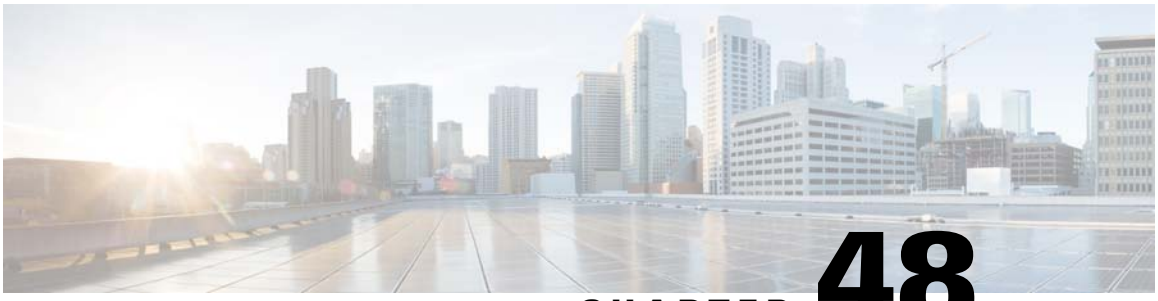
Step 13 (Optional) Troubleshoot local EAP sessions by entering these commands:

- **debug aaa local-auth eap method** {**all** | **errors** | **events** | **packets** | **sm**} {*enable* | *disable*}**—** Enables or disables debugging of local EAP methods.
- **debug aaa local-auth eap framework** {**all** | **errors** | **events** | **packets** | **sm**} {*enable* | *disable*}**—** Enables or disables debugging of the local EAP framework.

  Note In these two debug commands, **sm** is the state machine.

- **clear stats local-auth—**Clears the local EAP counters.
- **clear stats ap wlan** *Cisco_AP***—**Clears the EAP timeout and failure counters for a specific access point for each WLAN.

```
WLAN      1
   EAP Id Request Msg Timeouts.................. 0
   EAP Id Request Msg Timeouts Failures.......... 0
   EAP Request Msg Timeouts..................... 2
   EAP Request Msg Timeouts Failures............. 1
   EAP Key Msg Timeouts......................... 0
   EAP Key Msg Timeouts Failures................ 0
WLAN      2
   EAP Id Request Msg Timeouts.................. 1
   EAP Id Request Msg Timeouts Failures.......... 0
   EAP Request Msg Timeouts..................... 0
   EAP Request Msg Timeouts Failures............. 0
   EAP Key Msg Timeouts......................... 3
EAP Key Msg Timeouts Failures.............. 1
```



CHAPTER 48

Configuring the System for SpectraLink NetLink Telephones

Information About SpectraLink NetLink Telephones

For the best integration with the Cisco UWN solution, SpectraLink NetLink Telephones require an extra operating system configuration step: **enable long preambles**. The radio preamble (sometimes called a header) is a section of data at the head of a packet that contains information that wireless devices need when sending and receiving packets. Short preambles improve throughput performance, so they are enabled by default. However, some wireless devices, such as SpectraLink NetLink phones, require long preambles.

Configuring SpectraLink NetLink Phones

Enabling Long Preambles (GUI)

Step 1 Choose **Wireless** > **802.11b/g/n** > **Network** to open the 802.11b/g Global Parameters page.

Step 2 If the **Short Preamble** check box is selected, continue with this procedure. However, if the Short Preamble check box is unselected (which means that long preambles are enabled), the controller is already optimized for SpectraLink NetLink phones and you do not need to continue this procedure.

Step 3 Unselect the **Short Preamble** check box to enable long preambles.

Step 4 Click **Apply** to update the controller configuration.

Note If you do not already have an active CLI session to the controller, we recommend that you start a CLI session to reboot the controller and watch the reboot process. A CLI session is also useful because the GUI loses its connection when the controller reboots.

Step 5 Choose **Commands** > **Reboot** > **Reboot > Save and Reboot to reboot the controller**. Click OK in response to this prompt:

```
Configuration will be saved and the controller will be rebooted. Click ok to confirm.
```

The controller reboots.

Step 6 Log back onto the controller GUI to verify that the controller is properly configured.

Step 7 Choose **Wireless** > **802.11b/g/n** > **Network** to open the 802.11b/g Global Parameters page. If the **Short Preamble** check box is unselected, the controller is optimized for SpectraLink NetLink phones.

Enabling Long Preambles (CLI)

Step 1 Log on to the controller CLI.

Step 2 Enter the show 802.11b command and select the Short preamble mandatory parameter. If the parameter indicates that short preambles are enabled, continue with this procedure. This example shows that short preambles are enabled:

```
Short Preamble mandatory..................... Enabled
```

However, if the parameter shows that short preambles are disabled (which means that long preambles are enabled), the controller is already optimized for SpectraLink NetLink phones and you do not need to continue this procedure.

Step 3 Disable the 802.11b/g network by entering this command:
config 802.11b disable *network*

You cannot enable long preambles on the 802.11a network.

Step 4 Enable long preambles by entering this command:
config 802.11b preamble *long*

Step 5 Reenable the 802.11b/g network by entering this command:
config 802.11b *enable network*

Step 6 Enter the reset system command to reboot the controller. Enter y when the prompt to save the system changes is displayed. The controller reboots.

Step 7 Verify that the controller is properly configured by logging back into the CLI and entering the show 802.11b command to view these parameters:

```
802.11b Network.............................. Enabled
Short Preamble mandatory..................... Disabled
```

These parameters show that the 802.11b/g network is enabled and that short preambles are disabled.

Configuring Enhanced Distributed Channel Access (CLI)

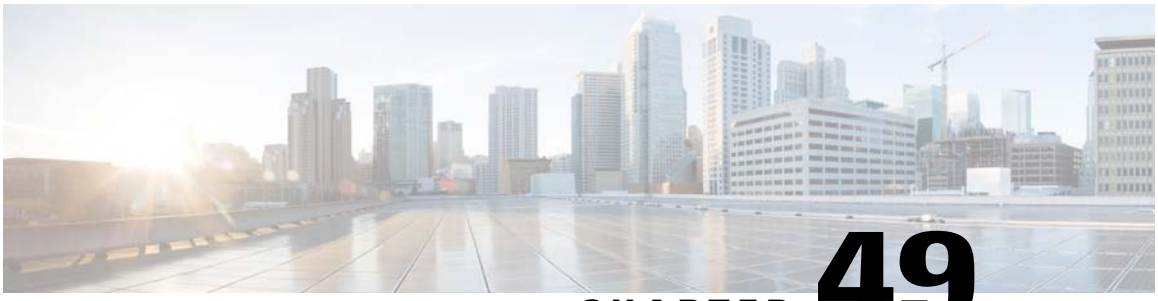
To configure 802.11 enhanced distributed channel access (EDCA) parameters to support SpectraLink phones, use the following CLI commands:

config advanced edca-parameter {**custom-voice** | **optimized-video-voice** | **optimized-voice** | **svp-voice** | **wmm-default**}

where

- **custom-voice** enables custom voice EDCA parameters
- **optimized-video-voice** enables combined video-voice-optimized parameters
- **optimized-voice** enables non-SpectraLink voice-optimized parameters
- **svp-voice** enables SpectraLink voice priority (SVP) parameters
- **wmm-default** enables wireless multimedia (WMM) default parameters

Note To propagate this command to all access points connected to the controller, make sure to disable and then reenable the 802.11b/g network after entering this command.



CHAPTER 49

Configuring RADIUS NAC Support

Information About RADIUS NAC Support

The Cisco Identity Services Engine (ISE) is a next-generation, context-based access control solution that provides the functions of Cisco Secure Access Control System (ACS) and Cisco Network Admission Control (NAC) in one integrated platform.

ISE has been introduced in the 7.0.116.0 release of the Cisco Unified Wireless Network. ISE can be used to provide advanced security for your deployed network. It is an authentication server that you can configure on your controller. When a client associates to the controller on a RADIUS NAC–enabled WLAN, the controller forwards the request to the ISE server.

The ISE server validates the user in the database and on successful authentication, the URL and pre-AUTH ACL are sent to the client. The client then moves to the Posture Required state and is redirected to the URL returned by the ISE server.

Note The client moves to the Central Web Authentication state, if the URL returned by the ISE server has the keyword '**cwa**'.

The NAC agent in the client triggers the posture validation process. On successful posture validation by the ISE server, the client is moved to the run state.

Note Flex local switching with Radius NAC support is added in Release 7.2.110.0. It is not supported in 7.0 Releases and 7.2 Releases. Downgrading 7.2.110.0 and later releases to either 7.2 or 7.0 releases will require you to reconfigure the WLAN for Radius NAC feature to work.

Device Registration

Device registration enables you to authenticate and provision new devices on the WLAN with RADIUS NAC enabled. When the device is registered on the WLAN, it can use the network based on the configured ACL.

Central Web Authentication

In the case of Central Web Authentication (CWA), the web-authentication occurs on the ISE server. The web portal in the ISE server provides a login page to the client. Once the credentials are verified on the ISE server, the client is provisioned. The client remains in the POSTURE_REQD state until a CoA is reached. The credentials and ACLs are received from the ISE server.

Local Web Authentication

Local web authentication is not supported for RADIUS NAC.

This table describes the possible combinations in a typical ISE deployment with Device Registration, CWA and LWA enabled:

Table 15: ISE Network Authentication Flow

WLAN Configuration	CWA	LWA	Device Registration
RADIUS NAC Enabled	Yes	No	Yes
L2 None	No	PSK, Static WEP, CKIP	No
L3 None	N/A	Internal/External	N/A
MAC Filtering Enabled	Yes	No	Yes

Restrictions for RADIUS NAC Support

- A RADIUS NAC-enabled WLAN supports Open Authentication and MAC filtering.
- Radius NAC functionality does not work if the configured accounting server is different from authentication (ISE) server. You should configure the same server as the authentication and accounting server in case ISE functionalities are used. If ISE is used only for ACS functionality, the accounting server can be flexible.
- When clients move from one WLAN to another, the controller retains the client's audit session ID if it returns to the WLAN before the idle timeout occurs. As a result, when clients join the controller before the idle timeout session expires, they are immediately moved to RUN state. The clients are validated if they reassociate with the controller after the session timeout.
- Suppose you have two WLANs, where WLAN 1 is configured on a controller (WLC1) and WLAN2 is configured on another controller (WLC2) and both are RADIUS NAC enabled. The client first connects to WLC1 and moves to the RUN state after posture validation. Assume that the client now moved to WLC2. If the client connects back to WLC1 before the PMK expires for this client in WLC1, the posture

validation is skipped for the client. The client directly moves to RUN state by passing posture validation as the controller retains the old audit session ID for the client that is already known to ISE.

- When deploying RADIUS NAC in your wireless network, do not configure a primary and secondary ISE server. Instead, we recommend that you configure HA between the two ISE servers. Having a primary and secondary ISE setup will require a posture validation to happen before the clients move to RUN state. If HA is configured, the client is automatically moved to RUN state in the fallback ISE server.
- The controller software configured with RADIUS NAC does not support a change of authorization (CoA) on the service port.
- Do not swap AAA server indexes in a live network because clients might get disconnected and have to reconnect to the RADIUS server, which might result in log messages to be appended to the ISE server logs.
- You must enable AAA override on the WLAN to use RADIUS NAC.
- WPA and WPA2 or dot1X must be enabled on the WLAN.
- During slow roaming, the client goes through posture validation.
- Guest tunneling mobility is supported for ISE NAC–enabled WLANs.
- VLAN select is not supported
- Workgroup bridges are not supported.
- The AP Group over NAC is not supported over RADIUS NAC.
- FlexConnect local switching is not supported.
- With RADIUS NAC enabled, the RADIUS server overwrite interface is not supported.
- Any DHCP communication between client and server. We parse the DHCP profiling only once. This is sent to the ISE server only once.
- If the AAA `url-redirect-acl` and `url-redirect` attributes are expected from the AAA server, the AAA override feature must be enabled on the controller.

Configuring RADIUS NAC Support (GUI)

Step 1 Choose the **WLANs** tab.

Step 2 Click the WLAN ID of the WLAN for which you want to enable ISE.
The **WLANs > Edit** page appears.

Step 3 Click the **Advanced** tab.

Step 4 From the **NAC State** drop-down list, choose **Radius NAC**:

- **SNMP NAC—**Uses SNMP NAC for the WLAN.
- **Radius NAC—**Uses Radius NAC for the WLAN.

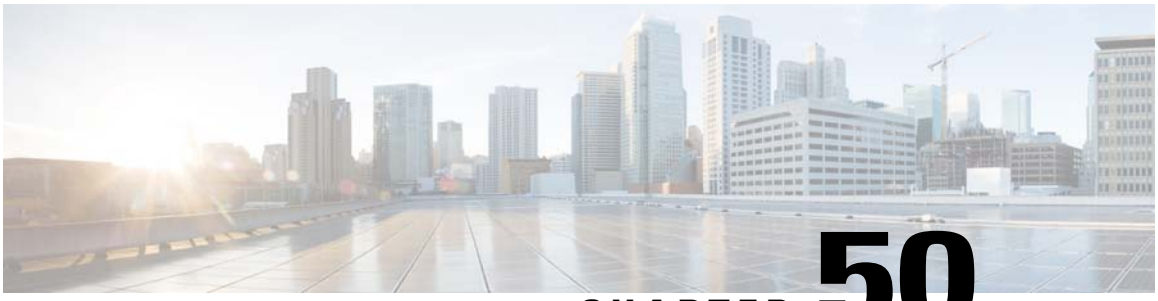
Note AAA override is automatically enabled when you use RADIUS NAC on a WLAN.

Step 5 Click **Apply**.

Configuring RADIUS NAC Support (CLI)

Enter the following command:

config wlan nac radius { **enable** | **disable**} *wlan_id*



CHAPTER 50

Using Management Over Wireless

Information About Management over Wireless

The management over wireless feature allows you to monitor and configure local controllers using a wireless client. This feature is supported for all management tasks except uploads to and downloads from (transfers to and from) the controller.

Enabling Management over Wireless (GUI)

Step 1 Choose **Management > Mgmt Via Wireless** to open the Management Via Wireless page.

Step 2 Select the **Enable Controller Management** to be accessible from Wireless Clients check box to enable management over wireless for the WLAN or unselect it to disable this feature. The default value is unselected.

Step 3 Click **Apply** to commit your changes.

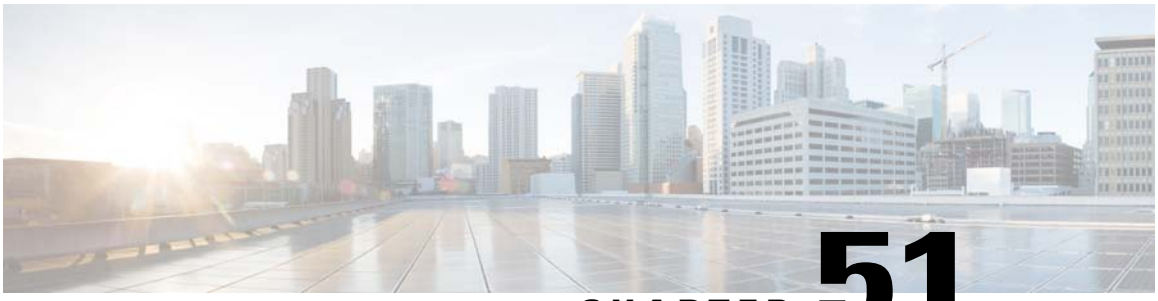
Step 4 Click **Save Configuration** to save your changes.

Enabling Management over Wireless (CLI)

Step 1 Verify whether the management over wireless interface is enabled or disabled by entering this command: **show network summary**

- If disabled: Enable management over wireless by entering this command:**config network mgmt-via-wireless** *enable*
- Otherwise, use a wireless client to associate with an access point connected to the controller that you want to manage.

Step 2 Log into the CLI to verify that you can manage the WLAN using a wireless client by entering this command: **telnet controller-ip-address command**



CHAPTER 51

Using Dynamic Interfaces for Management

Information About Using Dynamic Interfaces for Management

You can access the controller with one of its dynamic interface IP addresses. While wired computers can have only CLI access with the dynamic interface of the WLC, wireless clients have both CLI and GUI access with the dynamic interface.

A device, when the management using dynamic interfaces is disabled, can open an SSH connection, if the protocol is enabled. However, you are not prompted to log on. Additionally, the management address remains accessible from a dynamic interface VLAN, unless a CPU ACL is in place. When management using dynamic interface is enabled along with CPU ACL, the CPU ACL has more priority.

The following are some examples of management access and management access using dynamic interfaces, here the management VLAN IP address of the Cisco WLC is 209.165. 201.1 and dynamic VLAN IP address of the Cisco WLC is 209.165. 202.129:

- Source wired client from Cisco WLC's dynamic interface VLAN accesses the management interface VLAN and tries for management access. This is an example of management access.
- Source wired client from Cisco WLC's management interface VLAN accesses the dynamic interface VLAN and tries for management access. This is an example of management using dynamic interface.
- Source wired client from Cisco WLC's dynamic interface VLAN accesses the dynamic interface VLAN tries and tries for management access. This is an example of management using dynamic interface.
- Source wired client from Layer 3 VLAN interface accesses the dynamic interface or the management interface and tries for management access. This is an example of management using dynamic interface.

Here, management is not the management interface but the configuration access. If the Cisco WLC configuration is accessed from any other IP address on the Cisco WLC other than the management IP, it is management using dynamic interface.

Configuring Management using Dynamic Interfaces (CLI)

Enable or disable management using dynamic interfaces by entering this command:

config network mgmt-via-dynamic-interface {**enable** | **disable**}

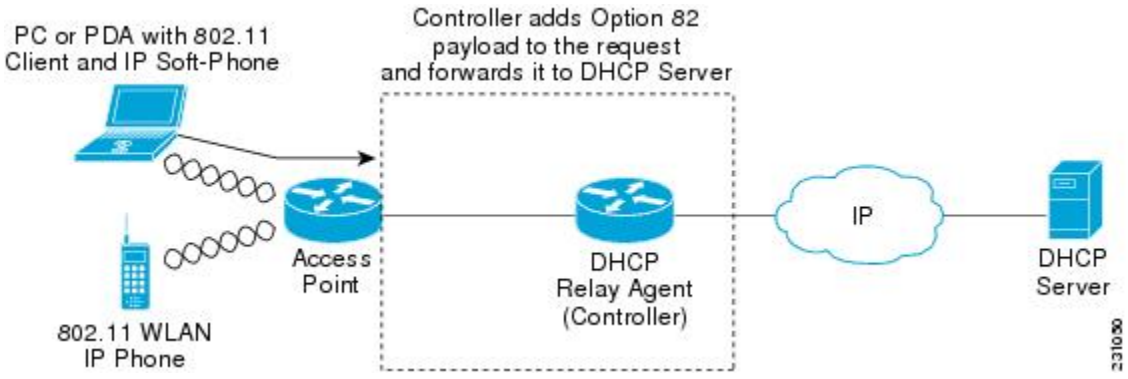
CHAPTER 52

Configuring DHCP Option 82

Information About DHCP Option 82

DHCP option 82 provides additional security when DHCP is used to allocate network addresses. It enables the controller to act as a DHCP relay agent to prevent DHCP client requests from untrusted sources. You can configure the controller to add option 82 information to DHCP requests from clients before forwarding the requests to the DHCP server.

Figure 43: DHCP Option 82



The access point forwards all DHCP requests from a client to the controller. The controller adds the DHCP option 82 payload and forwards the request to the DHCP server. The payload can contain the MAC address or the MAC address and SSID of the access point, depending on how you configure this option.

Note Any DHCP packets that already include a relay agent option are dropped at the controller.

For DHCP option 82 to operate correctly, DHCP proxy must be enabled.

Restrictions for DHCP Option 82

- DHCP option 82 is not supported for use with auto-anchor mobility.

Configuring DHCP Option 82 (GUI)

Step 1 Choose **Controller** > **Advanced** > **DHCP** to open the DHCP Parameters page.

Step 2 Select the **Enable DHCP Proxy** check box to enable DHCP proxy.

Step 3 Choose a DHCP Option 82 Remote ID field format from the drop-down list to specify the format of the DHCP option 82 payload.
For more information about the options available, see the Controller Online Help.

Step 4 Enter the DHCP Timeout. The timeout value is globally applicable.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration** .

What to Do Next

On the controller CLI, you can enable DHCP option 82 on the dynamic interface to which the WLAN is associated by entering this command:

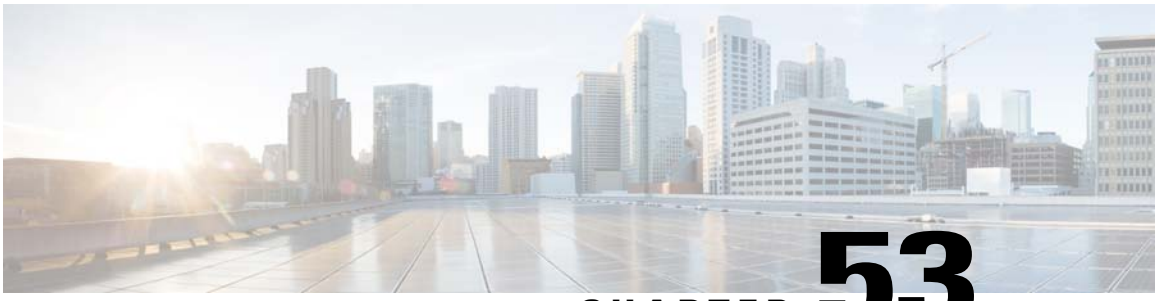
config interface dhcp dynamic-interface *interface-name* **option-82 enable**

Configuring DHCP Option 82 (CLI)

- Configure the format of the DHCP option 82 payload by entering one of these commands:
  - **config dhcp opt-82 remote-id ap_mac—**Adds the MAC address of the access point to the DHCP option 82 payload.
  - **config dhcp opt-82 remote-id ap_mac:ssid—**Adds the MAC address and SSID of the access point to the DHCP option 82 payload.
  - **config dhcp opt-82 remote-id ap-ethmac—**Adds the Ethernet MAC address of the access point to the DHCP option 82 payload.
  - **config dhcp opt-82 remote-id apname:ssid—**Adds the AP name and SSID of the access point to the DHCP option 82 payload.

- **config dhcp opt-82 remote-id ap-group-name—**Adds the AP group name to the DHCP option 82 payload.
- **config dhcp opt-82 remote-id flex-group-name—**Adds the FlexConnect group name to the DHCP option 82 payload.
- **config dhcp opt-82 remote-id ap-location—**Adds the AP location to the DHCP option 82 payload.
- **config dhcp opt-82 remote-id apmac-vlan-id—**Adds the MAC address of the access point and the VLAN ID to the DHCP option 82 payload.
- **config dhcp opt-82 remote-id apname-vlan-id—**Adds the AP name and its VLAN ID to the DHCP option 82 payload.
- **config dhcp opt-82 remote-id ap-ethmac-ssid—**Adds the Ethernet MAC address of the access point and the SSID to the DHCP option 82 payload.

- Enable DHCP Option 82 on the dynamic interface to which the WLAN is associated by entering this command:
  config interface dhcp dynamic-interface *interface-name* **option-82 enable**
- See the status of DHCP option 82 on the dynamic interface by entering the **show interface detailed** *dynamic-interface-name*command.



CHAPTER 53

Configuring and Applying Access Control Lists

Information About Access Control Lists

An Access Control List (ACL) is a set of rules used to limit access to a particular interface (for example, if you want to restrict a wireless client from pinging the management interface of the controller). After ACLs are configured on the controller, they can be applied to the management interface, the AP-manager interface, any of the dynamic interfaces, or a WLAN to control data traffic to and from wireless clients or to the controller central processing unit (CPU) to control all traffic destined for the CPU.

You may also want to create a preauthentication ACL for web authentication. Such an ACL could be used to allow certain types of traffic before authentication is complete.

Both IPv4 and IPv6 ACL are supported. IPv6 ACLs support the same options as IPv4 ACLs including source, destination, source and destination ports.

Note You can enable only IPv4 traffic in your network by blocking IPv6 traffic. That is, you can configure an IPv6 ACL to deny all IPv6 traffic and apply it on specific or all WLANs.

Restrictions for Access Control Lists

- You can define up to 64 ACLs, each with up to 64 rules (or filters) for both IPv4 and IPv6. Each rule has parameters that affect its action. When a packet matches all of the parameters for a rule, the action set for that rule is applied to the packet.
- When you apply CPU ACLs on a Cisco 5500 Series Controller or a Cisco WiSM2, you must permit traffic towards the virtual interface IP address for web authentication.

- All ACLs have an implicit “deny all rule” as the last rule. If a packet does not match any of the rules, it is dropped by the controller.
- If you are using an external web server with a Cisco 5500 Series Controller or a controller network module, you must configure a preauthentication ACL on the WLAN for the external web server.
- If you apply an ACL to an interface or a WLAN, wireless throughput is degraded when downloading from a 1-GBps file server. To improve throughput, remove the ACL from the interface or WLAN, move the ACL to a neighboring wired device with a policy rate-limiting restriction, or connect the file server using 100 Mbps rather than 1 Gbps.
- Multicast traffic received from wired networks that is destined to wireless clients is not processed by WLC ACLs. Multicast traffic initiated from wireless clients, destined to wired networks or other wireless clients on the same controller, is processed by WLC ACLs.
- ACLs are configured on the controller directly or configured through templates. The ACL name must be unique.
- You can configure ACL per client (AAA overridden ACL) or on either an interface or a WLAN. The AAA overridden ACL has the highest priority. However, each interface, WLAN, or per client ACL configuration that you apply can override one another.
- If peer-to-peer blocking is enabled, traffic is blocked between peers even if the ACL allows traffic between them.

Configuring and Applying Access Control Lists (GUI)

Configuring Access Control Lists

Step 1 Choose **Security** > **Access Control Lists** > **Access Control Lists** to open the Access Control Lists page.

Step 2 If you want to see if packets are hitting any of the ACLs configured on your controller, select the **Enable Counters** check box and click **Apply**. Otherwise, leave the check box unselected, which is the default value. This feature is useful when troubleshooting your system.

Note If you want to clear the counters for an ACL, hover your cursor over the blue drop-down arrow for that ACL and choose **Clear Counters**.

Step 3 Add a new ACL by clicking **New**. The Access Control Lists > New page appears.

Step 4 In the Access Control List Name text box, enter a name for the new ACL. You can enter up to 32 alphanumeric characters.

Step 5 Choose the ACL type. There are two types of ACL supported, IPv4 and IPv6.

Step 6 Click **Apply**. When the Access Control Lists page reappears, click the name of the new ACL.

Step 7 When the Access Control Lists > Edit page appears, click **Add New Rule**. The Access Control Lists > Rules > New page appears.

Step 8 Configure a rule for this ACL as follows:

a) The controller supports up to 64 rules for each ACL. These rules are listed in order from 1 to 64. In the Sequence text box, enter a value (between 1 and 64) to determine the order of this rule in relation to any other rules defined for this ACL.

Note If rules 1 through 4 are already defined and you add rule 29, it is added as rule 5. If you add or change a sequence number for a rule, the sequence numbers for other rules adjust to maintain a continuous sequence. For instance, if you change a rule's sequence number from 7 to 5, the rules with sequence numbers 5 and 6 are automatically reassigned as 6 and 7, respectively.

b) From the Source drop-down list, choose one of these options to specify the source of the packets to which this ACL applies:

- **Any—**Any source (this is the default value).
- **IP Address—**A specific source. If you choose this option, enter the IP address and netmask of the source in the text boxes. If you are configuring IPv6 ACL, enter the IPv6 address and prefix length of the destination in the text boxes.

c) From the Destination drop-down list, choose one of these options to specify the destination of the packets to which this ACL applies:

- **Any—**Any destination (this is the default value).
- **IP Address—**A specific destination. If you choose this option, enter the IP address and netmask of the destination in the text boxes. If you are configuring IPv6 ACL, enter the IPv6 address and prefix length of the destination in the text boxes.

d) From the Protocol drop-down list, choose the protocol ID of the IP packets to be used for this ACL. These are the protocol options:

- **Any—**Any protocol (this is the default value)
- **TCP—**Transmission Control Protocol
- **UDP—**User Datagram Protocol
- **ICMP/ICMPv6—**Internet Control Message Protocol

  Note ICMPv6 is only available for IPv6 ACL.
- **ESP—**IP Encapsulating Security Payload
- **AH—**Authentication Header
- **GRE—**Generic Routing Encapsulation
- **IP in IP—**Internet Protocol (IP) in IP (permits or denies IP-in-IP packets)
- **Eth Over IP—**Ethernet-over-Internet Protocol
- **OSPF—**Open Shortest Path First
- **Other—**Any other Internet Assigned Numbers Authority (IANA) protocol

  Note If you choose Other, enter the number of the desired protocol in the Protocol text box. You can find the list of available protocols in the INAI website.

The controller can permit or deny only IP packets in an ACL. Other types of packets (such as ARP packets) cannot be specified.

e) If you chose TCP or UDP in the previous step, two additional parameters appear: Source Port and Destination Port. These parameters enable you to choose a specific source port and destination port or port ranges. The port options

are used by applications that send and receive data to and from the networking stack. Some ports are designated for certain applications such as Telnet, SSH, HTTP, and so on.

Note Source and Destination ports based on the ACL type.

f) From the DSCP drop-down list, choose one of these options to specify the differentiated services code point (DSCP) value of this ACL. DSCP is an IP header text box that can be used to define the quality of service across the Internet.

- **Any—**Any DSCP (this is the default value)
- **Specific—**A specific DSCP from 0 to 63, which you enter in the DSCP edit box

g) From the **Direction** drop-down list, choose one of these options to specify the direction of the traffic to which this ACL applies:

- **Any—**Any direction (this is the default value)
- **Inbound—**From the client
- **Outbound—**To the client

Note If you are planning to apply this ACL to the controller CPU, the packet direction does not have any significance, it is always 'Any'.

h) From the **Action** drop-down list, choose Deny to cause this ACL to block packets or Permit to cause this ACL to allow packets. The default value is Deny.

i) Click **Apply** to commit your changes. The Access Control Lists > Edit page reappears, showing the rules for this ACL.

The **Deny Counters** fields shows the number of times that packets have matched the explicit deny ACL rule. The **Number of Hits** field shows the number of times that packets have matched an ACL rule. You must enable ACL counters on the Access Control Lists page to enable these fields.

Note If you want to edit a rule, click the sequence number of the desired rule to open the Access Control Lists > Rules > Edit page. If you want to delete a rule, hover your cursor over the blue drop-down arrow for the desired rule and choose **Remove**.

j) Repeat this procedure to add any additional rules for this ACL.

Step 9 Click **Save Configuration** to save your changes.

Step 10 Repeat this procedure to add any additional ACLs.

Applying an Access Control List to an Interface

Step 1 Choose **Controller** > **Interfaces**.

Step 2 Click the name of the desired interface. The Interfaces > Edit page for that interface appears.

Step 3 Choose the desired ACL from the ACL Name drop-down list and click Apply. The default is None.

Note Only IPv4 ACL are supported as interface ACL.

Step 4 Click **Save Configuration** to save your changes.

Applying an Access Control List to the Controller CPU

Step 1 Choose **Security** > **Access Control Lists** > **CPU Access Control Lists** to open the CPU Access Control Lists page.

Step 2 Select the **Enable CPU ACL** check box to enable a designated ACL to control the traffic to the controller CPU or unselect the check box to disable the CPU ACL feature and remove any ACL that had been applied to the CPU. The default value is unselected.

Step 3 From the ACL Name drop-down list, choose the ACL that will control the traffic to the controller CPU. None is the default value when the CPU ACL feature is disabled. If you choose None while the CPU ACL Enable check box is selected, an error message appears indicating that you must choose an ACL.

Note This parameter is available only if you have selected the CPU ACL Enable check box.

Note When CPU ACL is enabled, it is applicable to both wireless and wired traffic. Only IPv4 ACL are supported as CPU ACL.

Step 4 Click **Apply** to commit your changes.

Step 5 Click **Save Configuration** to save your changes.

Applying an Access Control List to a WLAN

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN to open the WLANs > Edit page.

Step 3 Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

Step 4 From the **Override Interface ACL** drop-down list, choose the IPv4 or IPv6 ACL that you want to apply to this WLAN. The ACL that you choose overrides any ACL that is configured for the interface. None is the default value.

Note To support centralized access control through AAA server such as ISE or ACS, IPv6 ACL must be configured on the controller and the WLAN must be configured with AAA override enabled feature.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Applying a Preauthentication Access Control List to a WLAN

Step 1 Choose **WLANs** to open the WLANs page.
Step 2 Click the ID number of the desired WLAN to open the WLANs > Edit page.
Step 3 Choose the **Security** and **Layer 3** tabs to open the WLANs > Edit (Security > Layer 3) page.
Step 4 Select the **Web Policy** check box.
Step 5 From the **Preauthentication ACL** drop-down list, choose the desired ACL and click **Apply**. None is the default value.
Step 6 Click **Save Configuration** to save your changes.

Configuring and Applying Access Control Lists (CLI)

Configuring Access Control Lists

Step 1 See all of the ACLs that are configured on the controller by entering this command:
show [**ipv6**] **acl summary**

Step 2 See detailed information for a particular ACL by entering this command:
show [**ipv6**] **acl detailed** *acl_name*
The Counter text box increments each time a packet matches an ACL rule, and the DenyCounter text box increments each time a packet does not match any of the rules.

Note If a traffic/request is allowed from the controller by a permit rule, then the response to the traffic/request in the opposite direction also is allowed and cannot be blocked by a deny rule in the ACL.

Step 3 Enable or disable ACL counters for your controller by entering this command:
config acl counter {**start** | **stop**}

Note If you want to clear the current counters for an ACL, enter the **clear acl counters** *acl_name command.*

Step 4 Add a new ACL by entering this command:
config [ipv6] **acl create** *acl_name*.
You can enter up to 32 alphanumeric characters for the *acl_name* parameter.

Note When you try to create an interface name with space, the controller CLI does not create an interface. For example, if you want to create an interface name int 3, the CLI will not create this since there is a space between int and 3. If you want to use int 3 as the interface name, you need to enclose within single quotes like ‘int 3’.

Step 5 Add a rule for an ACL by entering this command:
config [ipv6] acl rule add acl_name rule_index
Step 6 Configure an ACL rule by entering **config [ipv6] acl rule** command:
Step 7 Save your settings by entering this command:
save config

Note To delete an ACL, enter the **config** [**ipv6**] **acl delete** *acl_name* command. To delete an ACL rule, enter the **config** [**ipv6**] **acl rule delete** *acl_name rule_index* command.

Applying Access Control Lists

Step 1 Perform any of the following:

- To apply an ACL to the data path, enter this command:

  config acl apply acl_name

- To apply an ACL to the controller CPU to restrict the type of traffic (wired, wireless, or both) reaching the CPU, enter this command:
  config acl cpu acl_name {wired | wireless | both}

  Note To see the ACL that is applied to the controller CPU, enter the **show acl cpu command**. To remove the ACL that is applied to the controller CPU, enter the **config acl cpu none** command.

  Note For 2504 and 4400 series WLC, the CPU ACL cannot be used to control the CAPWAP traffic. Use the access-list on the network to control CAPWAP traffic.

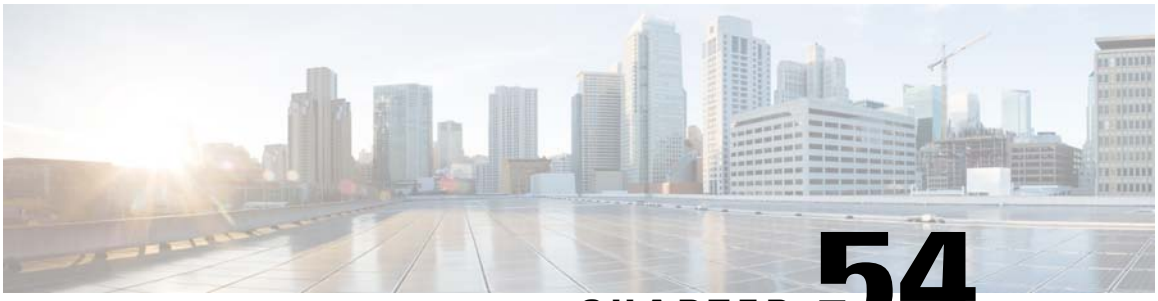
- To apply an ACL to a WLAN, enter this command:
  config wlan acl *wlan_id acl_name*

  Note To see the ACL that is applied to a WLAN, enter the **show wlan** *wlan_id command*. To remove the ACL that is applied to a WLAN, enter the **config wlan acl** *wlan_id* **none** command.

- To apply a preauthentication ACL to a WLAN, enter this command:

  config wlan security web-auth acl *wlan_id acl_name*

Step 2 Save your changes by entering this command:
save config



CHAPTER 54

Configuring Management Frame Protection

Information About Management Frame Protection

Management frame protection (MFP) provides security for the otherwise unprotected and unencrypted 802.11 management messages passed between access points and clients. MFP provides both infrastructure and client support.

- Infrastructure MFP—Protects management frames by detecting adversaries that are invoking denial-of-service attacks, flooding the network with associations and probes, interjecting as rogue access points, and affecting network performance by attacking the QoS and radio measurement frames. Infrastructure MFP is a global setting that provides a quick and effective means to detect and report phishing incidents.

  Specifically, infrastructure MFP protects 802.11 session management functions by adding message integrity check information elements (MIC IEs) to the management frames emitted by access points (and not those emitted by clients), which are then validated by other access points in the network. Infrastructure MFP is passive. It can detect and report intrusions but has no means to stop them.

- Client MFP—Shields authenticated clients from spoofed frames, preventing many of the common attacks against wireless LANs from becoming effective. Most attacks, such as deauthentication attacks, revert to simply degrading performance by contending with valid clients.

  Specifically, client MFP encrypts management frames are sent between access points and CCXv5 clients so that both the access points and clients can take preventative action by dropping spoofed class 3 management frames (that is, management frames passed between an access point and a client that is authenticated and associated). Client MFP leverages the security mechanisms defined by IEEE 802.11i

to protect the following types of class 3 unicast management frames: disassociation, deauthentication, and QoS (WMM) action. Client MFP protects a client-access point session from the most common type of denial-of-service attack. It protects class 3 management frames by using the same encryption method used for the session's data frames. If a frame received by the access point or client fails decryption, it is dropped, and the event is reported to the controller.

To use client MFP, clients must support CCXv5 MFP and must negotiate WPA2 using either TKIP or AES-CCMP. EAP or PSK may be used to obtain the PMK. CCKM and controller mobility management are used to distribute session keys between access points for Layer 2 and Layer 3 fast roaming.

Note To prevent attacks using broadcast frames, access points supporting CCXv5 will not emit any broadcast class 3 management frames (such as disassociation, deauthentication, or action). CCXv5 clients and access points must discard broadcast class 3 management frames.

Client MFP supplements infrastructure MFP rather than replaces it because infrastructure MFP continues to detect and report invalid unicast frames sent to clients that are not client-MFP capable as well as invalid class 1 and 2 management frames. Infrastructure MFP is applied only to management frames that are not protected by client MFP.

Infrastructure MFP consists of three main components:

- Management frame protection—The access point protects the management frames it transmits by adding a MIC IE to each frame. Any attempt to copy, alter, or replay the frame invalidates the MIC, causing any receiving access point configured to detect MFP frames to report the discrepancy. MFP is supported for use with Cisco Aironet lightweight access points.
- Management frame validation—In infrastructure MFP, the access point validates every management frame that it receives from other access points in the network. It ensures that the MIC IE is present (when the originator is configured to transmit MFP frames) and matches the content of the management frame. If it receives any frame that does not contain a valid MIC IE from a BSSID belonging to an access point that is configured to transmit MFP frames, it reports the discrepancy to the network management system. In order for the timestamps to operate properly, all controllers must be Network Time Protocol (NTP) synchronized.
- Event reporting—The access point notifies the controller when it detects an anomaly, and the controller aggregates the received anomaly events and can report the results through SNMP traps to the network management system.

Note Client MFP uses the same event reporting mechanisms as infrastructure MFP.

Infrastructure MFP is enabled by default and can be disabled globally. When you upgrade from a previous software release, infrastructure MFP is disabled globally if access point authentication is enabled because the two features are mutually exclusive. Once infrastructure MFP is enabled globally, signature generation (adding MICs to outbound frames) can be disabled for selected WLANs, and validation can be disabled for selected access points.

Client MFP is enabled by default on WLANs that are configured for WPA2. It can be disabled, or it can be made mandatory (in which case, only clients that negotiate MFP are allowed to associate) on selected WLANs.

Restrictions for Management Frame Protection

- Lightweight access points support infrastructure MFP in local and monitor modes and in FlexConnect mode when the access point is connected to a controller. They support client MFP in local, FlexConnect, and bridge modes.
- OEAP 600 Series Access points do not support MFP.
- Client MFP is supported for use only with CCXv5 clients using WPA2 with TKIP or AES-CCMP.
- Non-CCXv5 clients may associate to a WLAN if client MFP is disabled or optional.
- Error reports generated on a FlexConnect access point in standalone mode cannot be forwarded to the controller and are dropped.

Configuring Management Frame Protection (GUI)

Step 1 Choose **Security> Wireless Protection Policies > AP Authentication/MFP** to open the AP Authentication Policy page.

Step 2 Enable infrastructure MFP globally for the controller by choosing **Management Frame Protection** from the Protection Type drop-down list.

Step 3 Click **Apply** to commit your changes.

Note If more than one controller is included in the mobility group, you must configure a Network Time Protocol (NTP) server on all controllers in the mobility group that are configured for infrastructure MFP.

Step 4 Configure client MFP for a particular WLAN after infrastructure MFP has been enabled globally for the controller as follows:

a) Choose **WLANs**.

b) Click the profile name of the desired **WLAN**. The **WLANs > Edit** page appears.

c) Choose **Advanced**. The WLANs > Edit (Advanced) page appears.

d) Choose **Disabled**, **Optional**, or **Required** from the MFP Client Protection drop-down list. The default value is Optional. If you choose Required, clients are allowed to associate only if MFP is negotiated (that is, if WPA2 is configured on the controller and the client supports CCXv5 MFP and is also configured for WPA2).

Note For Cisco OEAP 600, MFP is not supported. It should either be Disabled or Optional.

e) Click **Apply** to commit your changes.

Step 5 Click **Save Configuration** to save your settings.

Viewing the Management Frame Protection Settings (GUI)

To see the controller's current global MFP settings, choose **Security** > **Wireless Protection Policies** > **Management Frame Protection**. The Management Frame Protection Settings page appears.

On this page, you can see the following MFP settings:

- The **Management Frame Protection** field shows if infrastructure MFP is enabled globally for the controller.
- The **Controller Time Source Valid** field indicates whether the controller time is set locally (by manually entering the time) or through an external source (such as the NTP server). If the time is set by an external source, the value of this field is "True." If the time is set locally, the value is "False." The time source is used for validating the timestamp on management frames between access points of different controllers within a mobility group.
- The **Client Protection** field shows if client MFP is enabled for individual WLANs and whether it is optional or required.

Configuring Management Frame Protection (CLI)

- Enable or disable infrastructure MFP globally for the controller by entering this command:
  config wps mfp infrastructure {enable | disable}
- Enable or disable client MFP on a specific WLAN by entering this command:
  config wlan mfp client {**enable** | **disable**} *wlan_id* [**required**]

  If you enable client MFP and use the optional **required** parameter, clients are allowed to associate only if MFP is negotiated.

Viewing the Management Frame Protection Settings (CLI)

- See the controller's current MFP settings by entering this command:
  show wps mfp summary
- See the current MFP configuration for a particular WLAN by entering this command:
  show wlan wlan_id
- See whether client MFP is enabled for a specific client by entering this command:
  show client detail *client_mac*
- See MFP statistics for the controller by entering this command:
  show wps mfp *statistics*

Note This report contains no data unless an active attack is in progress. Examples of various error types are shown for illustration only. This table is cleared every 5 minutes when the data is forwarded to any network management stations.

Debugging Management Frame Protection Issues (CLI)

- Use this command if you experience any problems with MFP:
  debug wps mfp ? {**enable** | **disable**}

  where ? is one of the following:

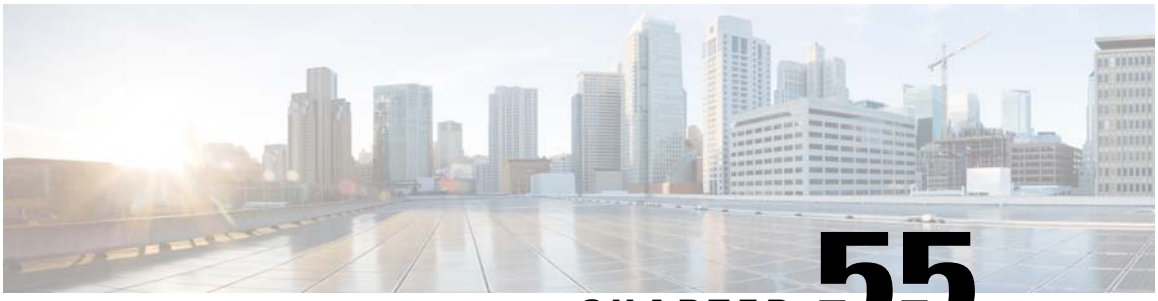
  client—Configures debugging for client MFP messages.

capwap—Configures debugging for MFP messages between the controller and access points.

detail—Configures detailed debugging for MFP messages.

report—Configures debugging for MFP reporting.

mm**—**Configures debugging for MFP mobility (inter-controller) messages.



CHAPTER 55

Configuring Client Exclusion Policies

Configuring Client Exclusion Policies (GUI)

Step 1 Choose **Security** > **Wireless Protection Policies** > **Client Exclusion Policies** to open the Client Exclusion Policies page.

Step 2 Select any of these check boxes if you want the controller to exclude clients for the condition specified. The default value for each exclusion policy is enabled.

- **Excessive 802.11 Association Failures—**Clients are excluded on the sixth 802.11 association attempt, after five consecutive failures.
- **Excessive 802.11 Authentication Failures—**Clients are excluded on the sixth 802.11 authentication attempt, after five consecutive failures.
- **Excessive 802.1X Authentication Failures—**Clients are excluded on the fourth 802.1X authentication attempt, after three consecutive failures.
- **IP Theft or IP Reuse—**Clients are excluded if the IP address is already assigned to another device.
- **Excessive Web Authentication Failures—**Clients are excluded on the fourth web authentication attempt, after three consecutive failures.

Step 3 Click **Apply**.

Step 4 Click **Save Configuration**.

Configuring Client Exclusion Policies (CLI)

Step 1 Enable or disable the controller to exclude clients on the sixth 802.11 association attempt, after five consecutive failures by entering this command:
config wps client-exclusion 802.11-assoc {**enable** | **disable**}

Step 2 Enable or disable the controller to exclude clients on the sixth 802.11 authentication attempt, after five consecutive failures by entering this command:
config wps client-exclusion 802.11-auth {**enable** | **disable**}

Step 3 Enable or disable the controller to exclude clients on the fourth 802.1X authentication attempt, after three consecutive failures by entering this command:
config wps client-exclusion 802.1x-auth {**enable** | **disable**}

Step 4 Enable or disable the controller to exclude clients if the IP address is already assigned to another device by entering this command:
config wps client-exclusion ip-theft {**enable** | **disable**}

Step 5 Enable or disable the controller to exclude clients on the fourth web authentication attempt, after three consecutive failures by entering this command:
config wps client-exclusion web-auth {**enable** | **disable**}

Step 6 Enable or disable the controller to exclude clients for all of the above reasons by entering this command:
config wps client-exclusion all {**enable** | **disable**}

Step 7 Use the following command to add or delete client exclusion entries.
config exclusionlist {**add** MAC [*description*] | **delete** MAC | **description** MAC [*description*]}

Step 8 Save your changes by entering this command:
save config

Step 9 See a list of clients that have been dynamically excluded, by entering this command:
show exclusionlist

Information similar to the following appears:

```
Dynamically Disabled Clients
----------------------------
  MAC Address             Exclusion Reason        Time Remaining (in secs)
  -----------             ----------------        ------------------------

00:40:96:b4:82:55         802.1X Failure           51
```

Step 10 See the client exclusion policy configuration settings by entering this command:
show wps summary

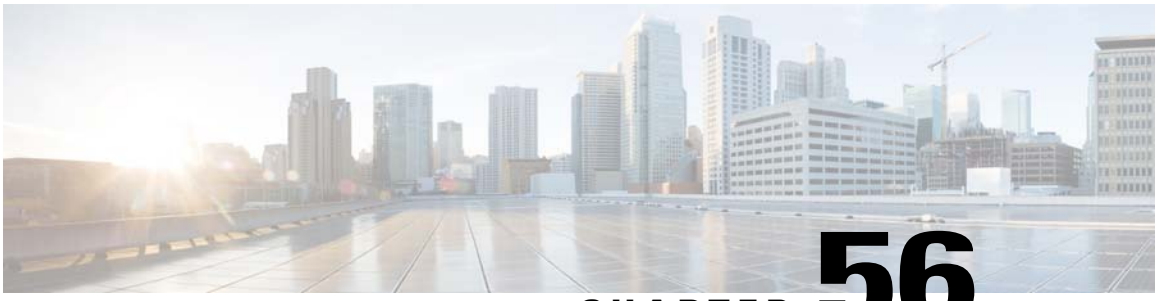
Information similar to the following appears:

```
Auto-Immune
  Auto-Immune..................................... Disabled

Client Exclusion Policy
  Excessive 802.11-association failures.......... Enabled
  Excessive 802.11-authentication failures....... Enabled
```

```
  Excessive 802.1x-authentication.............. Enabled
  IP-theft..................................... Enabled
  Excessive Web authentication failure.......... Enabled

Signature Policy
  Signature Processing......................... Enabled
```



CHAPTER 56

Configuring Identity Networking

Information About Identity Networking

In most wireless LAN systems, each WLAN has a static policy that applies to all clients associated with an SSID. Although powerful, this method has limitations because it requires clients to associate with different SSIDs to inherit different QoS and security policies.

However, the Cisco Wireless LAN solution supports identity networking, which allows the network to advertise a single SSID but allows specific users to inherit different QoS or security policies based on their user profiles. The specific policies that you can control using identity networking are as follows:

- ACL—When the ACL attribute is present in the RADIUS Access Accept, the system applies the ACL name to the client station after it authenticates, which overrides any ACLs that are assigned to the interface.
- VLAN—When a VLAN Interface-name or VLAN tag is present in a RADIUS Access Accept, the system places the client on a specific interface.

Note The VLAN feature only supports MAC filtering, 802.1X, and WPA. The VLAN feature does not support web authentication or IPsec.

- Tunnel Attributes.

Note When any of the other RADIUS attributes (QoS-Level, ACL-Name, Interface-Name, or VLAN-Tag), which are described later in this section, are returned, the Tunnel Attributes must also be returned.

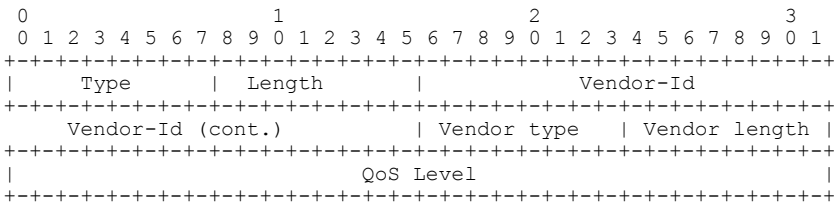
The operating system's local MAC filter database has been extended to include the interface name, allowing local MAC filters to specify to which interface the client should be assigned. A separate RADIUS server can also be used, but the RADIUS server must be defined using the Security menus.

RADIUS Attributes Used in Identity Networking

QoS-Level

This section explains the RADIUS attributes used in identity networking.

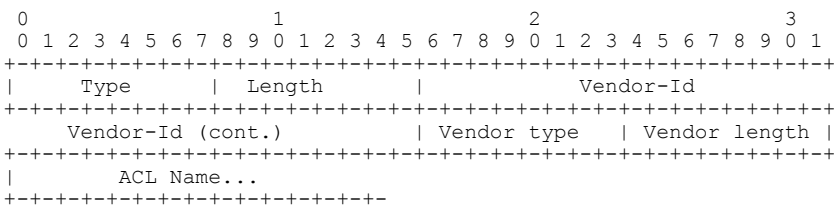
This attribute indicates the QoS level to be applied to the mobile client's traffic within the switching fabric, as well as over the air. This example shows a summary of the QoS-Level Attribute format. The text boxes are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 2
- Vendor length – 4
- Value – Three octets:
  - 3 – Bronze (Background)
  - 0 – Silver (Best Effort)
  - 1 – Gold (Video)
  - 2 – Platinum (Voice)

ACL-Name

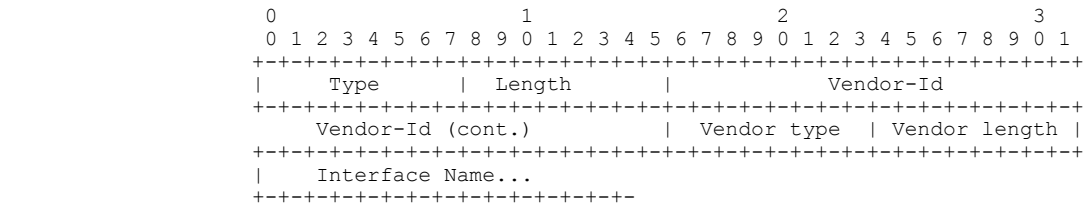
This attribute indicates the ACL name to be applied to the client. A summary of the ACL-Name Attribute format is shown below. The text boxes are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – >7
- Vendor-Id – 14179
- Vendor type – 6
- Vendor length – >0
- Value – A string that includes the name of the ACL to use for the client

Interface Name

This attribute indicates the VLAN Interface a client is to be associated to. A summary of the Interface-Name Attribute format is shown below. The text boxes are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – >7
- Vendor-Id – 14179
- Vendor type – 5
- Vendor length – >0
- Value – A string that includes the name of the interface the client is to be assigned to.

Note This Attribute only works when MAC filtering is enabled or if 802.1X or WPA is used as the security policy.

VLAN Tag

This attribute indicates the group ID for a particular tunneled session and is also known as the Tunnel-Private-Group-ID attribute.

This attribute might be included in the Access-Request packet if the tunnel initiator can predetermine the group resulting from a particular connection and should be included in the Access-Accept packet if this tunnel session is to be treated as belonging to a particular private group. Private groups may be used to associate a tunneled session with a particular group of users. For example, it may be used to facilitate routing of unregistered IP addresses through a particular interface. It should be included in Accounting-Request packets which contain Acct-Status-Type attributes with values of either Start or Stop and which pertain to a tunneled session.

A summary of the Tunnel-Private-Group-ID Attribute format is shown below. The text boxes are transmitted from left to right.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Type     |    Length     |     Tag       |   String...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Type – 81 for Tunnel-Private-Group-ID.
- Length – >= 3
- Tag – The Tag text box is one octet in length and is intended to provide a means of grouping attributes in the same packet which refer to the same tunnel. If the value of the Tag text box is greater than 0x00 and less than or equal to 0x1F, it should be interpreted as indicating which tunnel (of several alternatives) this attribute pertains. If the Tag text box is greater than 0x1F, it should be interpreted as the first byte of the following String text box.
- String – This text box must be present. The group is represented by the String text box. There is no restriction on the format of group IDs.

Note When any of the other RADIUS attributes (QoS-Level, ACL-Name, Interface-Name, or VLAN-Tag) are returned, the Tunnel Attributes must also be returned.

Tunnel Attributes

RFC 2868 defines RADIUS tunnel attributes used for authentication and authorization, and RFC2867 defines tunnel attributes used for accounting. Where the IEEE 802.1X authenticator supports tunneling, a compulsory tunnel may be set up for the Supplicant as a result of the authentication.

In particular, it may be desirable to allow a port to be placed into a particular VLAN, defined in IEEE 8021Q, based on the result of the authentication. This configuration can be used, for example, to allow a wireless host to remain on the same VLAN as it moves within a campus network.

The RADIUS server typically indicates the desired VLAN by including tunnel attributes within the Access-Accept. However, the IEEE 802.1X authenticator may also provide a hint as to the VLAN to be assigned to the Supplicant by including Tunnel attributes within the AccessRequest.

For use in VLAN assignment, the following tunnel attributes are used:

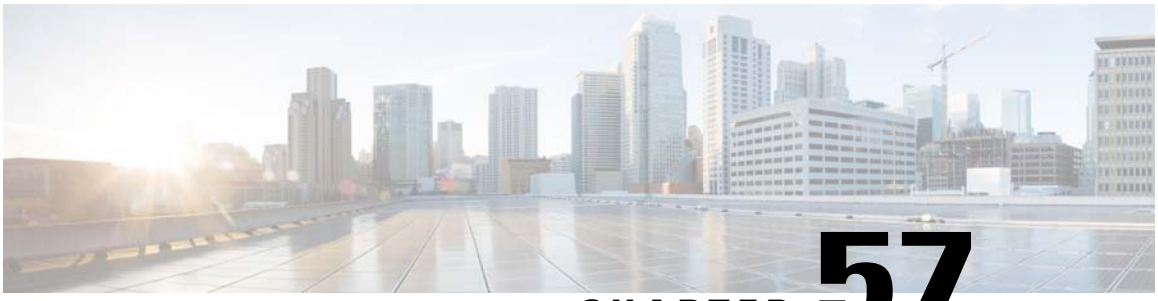
- Tunnel-Type=VLAN (13)
- Tunnel-Medium-Type=802
- Tunnel-Private-Group-ID=VLANID

The VLAN ID is 12 bits, with a value between 1 and 4094, inclusive. Because the Tunnel-Private-Group-ID is of type String as defined in RFC 2868, for use with IEEE 802.1X, the VLANID integer value is encoded as a string.

When Tunnel attributes are sent, it is necessary to fill in the Tag text box. As noted in RFC 2868, section 3.1:

- The Tag text box is one octet in length and is intended to provide a means of grouping attributes in the same packet that refer to the same tunnel. Valid values for this text box are 0x01 through 0x1F, inclusive. If the Tag text box is unused, it must be zero (0x00).

- For use with Tunnel-Client-Endpoint, Tunnel-Server-Endpoint, Tunnel-Private-Group-ID, Tunnel-Assignment-ID, Tunnel-Client-Auth-ID or Tunnel-Server-Auth-ID attributes (but not Tunnel-Type, Tunnel-Medium-Type, Tunnel-Password, or Tunnel-Preference), a tag text box of greater than 0x1F is interpreted as the first octet of the following text box.
- Unless alternative tunnel types are provided, (e.g. for IEEE 802.1X authenticators that may support tunneling but not VLANs), it is only necessary for tunnel attributes to specify a single tunnel. As a result, where it is only desired to specify the VLANID, the tag text box should be set to zero (0x00) in all tunnel attributes. Where alternative tunnel types are to be provided, tag values between 0x01 and 0x1F should be chosen.



CHAPTER 57

Configuring AAA Override

Information About AAA Override

The AAA Override option of a WLAN enables you to configure the WLAN for identity networking. It enables you to apply VLAN tagging, Quality of Service (QoS), and Access Control Lists (ACLs) to individual clients based on the returned RADIUS attributes from the AAA server.

AAA Override for IPv6 ACLs

In order to support centralized access control through a centralized AAA server such as the Cisco Identity Services Engine (ISE) or ACS, the IPv6 ACL can be provisioned on a per-client basis using AAA Override attributes. In order to use this feature, the IPv6 ACL must be configured on the controller and the WLAN must be configured with the AAA Override feature enabled. The actual named AAA attribute for an IPv6 ACL is ***Airespace-IPv6-ACL-Name***, which is similar to the *Airespace-ACL-Name* attribute that is used for provisioning an IPv4-based ACL. The AAA attribute returned contents should be a string equal to the name of the IPv6 ACL as configured on the controller.

Restrictions for AAA Override

- If a client moves to a new interface due to the AAA override and then you apply an ACL to that interface, the ACL does not take effect until the client reauthenticates. To work around this issue, apply the ACL and then enable the WLAN so that all clients connect to the ACL that is already configured on the interface, or disable and then reenable the WLAN after you apply the interface so that the clients can reauthenticate.
- If the ACL returned from the AAA server does not exist on the controller or if the ACL is configured with an incorrect name, then the clients are not allowed to be authenticated.

- With FlexConnect local switching, Multicast is forwarded only for the VLAN that the SSID is mapped to and not to any overridden VLANs.
- When the interface group is mapped to a WLAN and clients connect to the WLAN, the client does not get the IP address in a round robin fashion. The AAA override with interface group is supported.
- Most of the configuration for allowing AAA override is done at the RADIUS server, where you should configure the Access Control Server (ACS) with the override properties you would like it to return to the controller (for example, Interface-Name, QoS-Level, and VLAN-Tag).
- On the controller, enable the Allow AAA Override configuration parameter using the GUI or CLI. Enabling this parameter allows the controller to accept the attributes returned by the RADIUS server. The controller then applies these attributes to its clients.

Updating the RADIUS Server Dictionary File for Proper QoS Values

If you are using a Steel-Belted RADIUS (SBR), FreeRadius, or similar RADIUS server, clients may not obtain the correct QoS values after the AAA override feature is enabled. For these servers, which allow you to edit the dictionary file, you need to update the file to reflect the proper QoS values: Silver is 0, Gold is 1, Platinum is 2, and Bronze is 3. To update the RADIUS server dictionary file, follow these steps:

Note This issue does not apply to the Cisco Secure Access Control Server (ACS).

To update the RADIUS server dictionary file, follow these steps:

1. Stop the SBR service (or other RADIUS service).
2. Save the following text to the `Radius_Install_Directory\Service` folder as `ciscowlan.dct`:

```
##################################################################################
# CiscoWLAN.dct- Cisco Wireless Lan Controllers
#
# (See README.DCT for more details on the format of this file)
##################################################################################

# Dictionary - Cisco WLAN Controllers
#
# Start with the standard Radius specification attributes
#
@radius.dct
#
# Standard attributes supported by Airespace
#
# Define additional vendor specific attributes (VSAs)
#

MACRO Airespace-VSA(t,s) 26 [vid=14179 type1=%t% len1=+2 data=%s%]

ATTRIBUTE   WLAN-Id                 Airespace-VSA(1, integer)     cr
ATTRIBUTE   Aire-QoS-Level          Airespace-VSA(2, integer)     r
VALUE Aire-QoS-Level Bronze     3
VALUE Aire-QoS-Level Silver     0
VALUE Aire-QoS-Level Gold       1
VALUE Aire-QoS-Level Platinum   2

ATTRIBUTE   DSCP                    Airespace-VSA(3, integer)     r
ATTRIBUTE   802.1P-Tag              Airespace-VSA(4, integer)     r
ATTRIBUTE   Interface-Name          Airespace-VSA(5, string)      r
ATTRIBUTE   ACL-Name                Airespace-VSA(6, string)      r
```

```
# This should be last.

##############################################################################
# CiscoWLAN.dct - Cisco WLC dictionary
##############################################################################
```

3 Open the `dictiona.dcm` file (in the same directory) and add the line "@ciscowlan.dct."

4 Save and close the `dictiona.dcm` file.

5 Open the `vendor.ini` file (in the same directory) and add the following text:

```
vendor-product       = Cisco WLAN Controller
dictionary           = ciscowlan
ignore-ports         = no
port-number-usage    = per-port-type
help-id              =
```

6 Save and close the `vendor.ini` file.

7 Start the SBR service (or other RADIUS service).

8 Launch the SBR Administrator (or other RADIUS Administrator).

9 Add a RADIUS client (if not already added). Choose **Cisco WLAN Controller** from the Make/Model drop-down list.

Configuring AAA Override (GUI)

Step 1 Choose **WLANs** to open the **WLANs** page.

Step 2 Click the ID number of the WLAN that you want to configure. The **WLANs > Edit** page appears.

Step 3 Choose the **Advanced** tab.

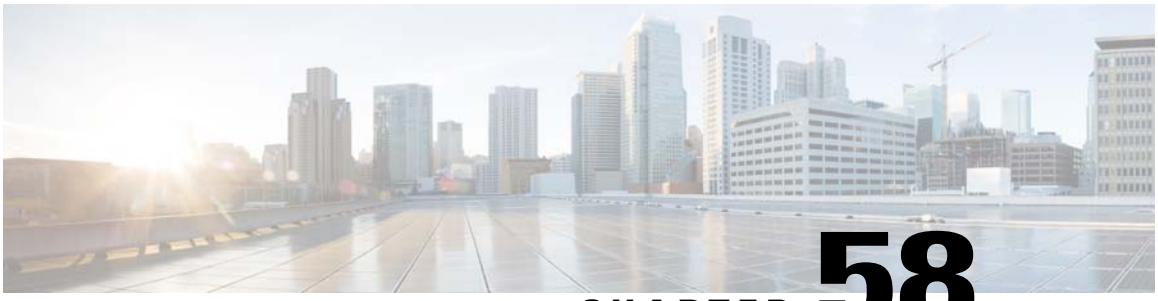
Step 4 Select the **Allow AAA Override** check box to enable AAA override or unselect it to disable this feature. The default value is disabled.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Configuring AAA Override (CLI)

- Configure override of user policy through AAA on a WLAN by entering this command:
  config wlan aaa-override {**enable** | **disable**} *wlan-id*
  For *wlan-id*, enter a value between 1 and 16.
- Configure debugging of 802.1X AAA interactions by entering this command:
  debug dot1x aaa {**enable** | **disable**}



CHAPTER 58

Managing Rogue Devices

Information About Rogue Devices

Rogue access points can disrupt wireless LAN operations by hijacking legitimate clients and using plain-text or other denial-of-service or man-in-the-middle attacks. That is, a hacker can use a rogue access point to capture sensitive information, such as usernames and passwords. The hacker can then transmit a series of Clear to Send (CTS) frames. This action mimics an access point, informing a particular client to transmit, and instructing all the other clients to wait, which results in legitimate clients being unable to access network resources. Wireless LAN service providers have a strong interest in banning rogue access points from the air space.

Because rogue access points are inexpensive and readily available, employees sometimes plug unauthorized rogue access points into existing LANs and build ad hoc wireless networks without their IT department's knowledge or consent. These rogue access points can be a serious breach of network security because they can be plugged into a network port behind the corporate firewall. Because employees generally do not enable any security settings on the rogue access point, it is easy for unauthorized users to use the access point to intercept network traffic and hijack client sessions. Even more alarming, wireless users frequently publish unsecure access point locations, increasing the odds of having enterprise security breached.

The following are some guidelines to manage rogue devices:

- The containment frames are sent immediately after the authorization and associations are detected. The enhanced containment algorithm provides more effective containment of ad hoc clients.
- In a dense RF environment, where maximum rogue access points are suspected, the chances of detecting rogue access points by a local mode access point and FlexConnect mode access point in channel 157 or channel 161 are less when compared to other channels. To mitigate this problem, we recommend that you use dedicated monitor mode access points.
- The local and FlexConnect mode access points are designed to serve associated clients. These access points spend relatively less time performing off-channel scanning: about 50 milliseconds on each channel. If you want to perform high rogue detection, a monitor mode access point must be used. Alternatively, you can reduce the scan intervals from 180 seconds to a lesser value, for example, 120 or 60 seconds,

ensuring that the radio goes off-channel more frequently, which improves the chances of rogue detection. However, the access point will still spend about 50 milliseconds on each channel.

- Rogue detection is disabled by default for OfficeExtend access points because these access points, which are deployed in a home environment, are likely to detect a large number of rogue devices.
- Client card implementations might mitigate the effectiveness of ad hoc containment.
- It is possible to classify and report rogue access points through the use of rogue states and user-defined classification rules that enable rogues to automatically move between states.
- Each controller limits the number of rogue containments to three per radio (or six per radio for access points in the monitor mode).
- Rogue Location Discovery Protocol (RLDP) detects rogue access points that are configured for open authentication.
- RLDP detects rogue access points that use a broadcast Basic Service Set Identifier (BSSID), that is, the access point broadcasts its Service Set Identifier in beacons.
- RLDP detects only those rogue access points that are on the same network. If an access list in the network prevents the sending of RLDP traffic from the rogue access point to the controller, RLDP does not work.
- RLDP does not work on 5-GHz dynamic frequency selection (DFS) channels. However, RLDP works when the managed access point is in the monitor mode on a DFS channel.
- If RLDP is enabled on mesh APs, and the APs perform RLDP tasks, the mesh APs are dissociated from the controller. The workaround is to disable RLDP on mesh APs.
- If RLDP is enabled on nonmonitor APs, client connectivity outages occur when RLDP is in process.
- If the rogue is manually contained, the rogue entry is retained even after the rogue expires.
- If the rogue is contained by any other means, such as auto, rule, and AwIPS preventions, the rogue entry is deleted when it expires.
- The controller will request to AAA server for rogue client validation only once. As a result, if rogue client validation fails on the first attempt then the rogue client will not be detected as a threat any more. To avoid this, add the valid client entries in the authentication server before enabling **Validate Rogue Clients Against AAA**.
- In the 7.4 and earlier releases, if a rogue that was already classified by a rule was not reclassified. In the 7.5 release, this behavior is enhanced to allow reclassification of rogues based on the priority of the rogue rule. The priority is determined by using the rogue report that is received by the controller.

Detecting Rogue Devices

The controller continuously monitors all the nearby access points and automatically discovers and collects information on rogue access points and clients. When the controller discovers a rogue access point, it uses the Rogue Location Discovery Protocol (RLDP) and the rogue detector mode access point is connected to determine if the rogue is attached to your network.

Controller initiates RLDP on rogue devices that have open authenticated and configured. If RLDP uses Flexconnect or local mode access points, then clients are disconnected for that moment. After the RLDP cycle, the clients are reconnected to the access points. As and when rogue access points are seen (auto-configuration), the RLDP process is initiated.

You can configure the controller to use RLDP on all the access points or only on the access points configured for the monitor (listen-only) mode. The latter option facilitates automated rogue access point detection in a

crowded radio frequency (RF) space, allowing monitoring without creating unnecessary interference and without affecting the regular data access point functionality. If you configure the controller to use RLDP on all the access points, the controller always chooses the monitor access point for RLDP operation if a monitor access point and a local (data) access point are both nearby. If RLDP determines that the rogue is on your network, you can choose to contain the detected rogue either manually or automatically.

RLDP detects on wire presence of the rogue access points that are configured with open authentication only once, which is the default retry configuration. Retries can be configured using the **config rogue ap rldp retries** command.

You can initiate or trigger RLDP from controller in three ways:

1. Enter the RLDP initiation command manually from the controller CLI. The equivalent GUI option for initiating RLDP is not supported.
   config rogue ap rldp initiate *mac-address*
2. Schedule RLDP from the controller CLI. The equivalent GUI option for scheduling RLDP is not supported.
   config rogue ap rldp schedule
3. Auto RLDP. You can configure auto RLDP on controller either from controller CLI or GUI but keep in mind the following guidelines:
   - The auto RLDP option can be configured only when the rogue detection security level is set to custom.
   - Either auto RLDP or schedule of RLDP can be enabled at a time.

A rogue access point is moved to a contained state either automatically or manually. The controller selects the best available access point for containment and pushes the information to the access point. The access point stores the list of containments per radio. For auto containment, you can configure the controller to use only the monitor mode access point. The containment operation occurs in the following two ways:

- The container access point goes through the list of containments periodically and sends unicast containment frames. For rogue access point containment, the frames are sent only if a rogue client is associated.
- Whenever a contained rogue activity is detected, containment frames are transmitted.

Individual rogue containment involves sending a sequence of unicast disassociation and deauthentication frames.

Cisco Prime Infrastructure Interaction and Rogue Detection

Cisco Prime Infrastructure supports rule-based classification and uses the classification rules configured on the controller. The controller sends traps to Cisco Prime Infrastructure after the following events:

- If an unknown access point moves to the Friendly state for the first time, the controller sends a trap to Cisco Prime Infrastructure only if the rogue state is Alert. It does not send a trap if the rogue state is Internal or External.
- If a rogue entry is removed after the timeout expires, the controller sends a trap to Cisco Prime Infrastructure for rogue access points categorized as Malicious (Alert, Threat) or Unclassified (Alert). The controller does not remove rogue entries with the following rogue states: Contained, Contained Pending, Internal, and External.

Configuring Rogue Detection (GUI)

Step 1 Make sure that rogue detection is enabled on the corresponding access points. Rogue detection is enabled by default for all access points joined to the controller (except for OfficeExtend access points). However, you can enable or disable rogue detection for individual access points by selecting or unselecting the **Rogue Detection** check box on the **All APs > Details for (Advanced)** page.

Step 2 Choose **Security** > **Wireless Protection Policies** > **Rogue Policies** > **General**.
The **Rogue Policies** page is displayed.

Step 3 Choose one of the following options from the **Rogue Location Discovery Protocol** drop-down list:

- **Disable—**Disables RLDP on all the access points. This is the default value.
- **All APs—**Enables RLDP on all the access points.
- **Monitor Mode APs—**Enables RLDP only on the access points in the monitor mode.

Step 4 In the **Expiration Timeout for Rogue AP and Rogue Client Entries** text box, enter the number of seconds after which the rogue access point and client entries expire and are removed from the list. The valid range is 240 to 3600 seconds, and the default value is 1200 seconds.

Note If a rogue access point or client entry times out, it is removed from the controller only if its rogue state is Alert or Threat for any classification type.

Step 5 To use the AAA server or local database to validate if rogue clients are valid clients, select the **Validate Rogue Clients Against AAA** check box. By default, the check box is unselected.

Step 6 If necessary, select the **Detect and Report Ad-Hoc Networks** check box to enable ad hoc rogue detection and reporting. By default, the check box is selected.

Step 7 In the **Rogue Detection Report Interval** text box, enter the time interval, in seconds, at which APs should send the rogue detection report to the controller. The valid range is 10 seconds to 300 seconds, and the default value is 10 seconds.

Step 8 In the **Rogue Detection Minimum RSSI** text box, enter the minimum Received Signal Strength Indicator (RSSI) value that a rogue entry should have for APs to detect the rogue and for a rogue entry to be created in the controller. The valid range is –128 dBm to –0 dBm, and the default value is 0 dBm.

Note This feature is applicable to all the AP modes. There can be many rogues with very weak RSSI values that do not provide any valuable information in rogue analysis. Therefore, you can use this option to filter rogues by specifying the minimum RSSI value at which APs should detect rogues.

Step 9 In the **Rogue Detection Transient Interval** text box, enter the time interval at which a rogue should be scanned for by the AP after the first time the rogue is scanned. After the rogue is scanned for consistently, updates are sent periodically to the controller. Thus, the APs filter the transient rogues, which are active for a very short period and are then silent. The valid range is between 120 seconds to 1800 seconds, and the default value is 0.
The rogue detection transient interval is applicable to the monitor mode APs only.

This feature has the following advantages:

- Rogue reports from APs to the controller are shorter.
- Transient rogue entries are avoided in the controller.
- Unnecessary memory allocation for transient rogues are avoided.

Step 10 If you want the controller to automatically contain certain rogue devices, enable the following parameters. By default, these parameters are in disabled state.

Caution When you select any of the Auto Contain parameters and click **Apply**, the following message is displayed: "`Using this feature may have legal consequences. Do you want to continue?`" The 2.4-GHz and 5-GHz frequencies in the Industrial, Scientific, and Medical (ISM) band are open to the public and can be used without a license. As such, containing devices on another party's network could have legal consequences.

- **Auto Containment Level—**Set the auto containment level. By default, the auto containment level is set to **1**.
- **Auto Containment only for Monitor mode APs—**Configure the monitor mode access points for auto-containment.
- **Rogue on Wire—**Configure the auto containment of rogues that are detected on the wired network.
- **Using Our SSID—**Configure the auto containment of rogues that are advertising your network's SSID. If you leave this parameter unselected, the controller only generates an alarm when such a rogue is detected.
- **Valid Client on Rogue AP—**Configure the auto containment of a rogue access point to which trusted clients are associated. If you leave this parameter unselected, the controller only generates an alarm when such a rogue is detected.
- **AdHoc Rogue AP—**Configure the auto containment of ad hoc networks detected by the controller. If you leave this parameter unselected, the controller only generates an alarm when such a network is detected.

Step 11 Click **Apply**.

Step 12 Click **Save Configuration**.

Configuring Rogue Detection (CLI)

Step 1 Ensure that rogue detection is enabled on the desired access points. Rogue detection is enabled by default for all the access points that are associated with the controller. You can enable or disable rogue detection for individual access points by entering this command:
config rogue detection {**enable** | **disable**} *cisco-ap command.*

Note To see the current rogue detection configuration for a specific access point, enter the **show ap config general** *Cisco_AP* command.

Note Rogue detection is disabled by default for OfficeExtend access points because these access points, which are deployed in a home environment, are likely to detect a large number of rogue devices.

Step 2 Enable, disable, or initiate RLDP by entering these commands:

- **config rogue ap rldp enable alarm-only—**Enables RLDP on all the access points.
- **config rogue ap rldp enable alarm-only** *monitor_ap_only***—**Enables RLDP only on the access points in the monitor mode.
- **config rogue ap rldp initiate** *rogue_mac_address***—**Initiates RLDP on a specific rogue access point.

- **config rogue ap rldp disable—**Disables RLDP on all the access points.
- **config rogue ap rldp retries—**Specifies the number of times RLDP to be tried per rogue access point. The range is from 1 to 5 and default is 1.

Step 3 Specify the number of seconds after which the rogue access point and client entries expire and are removed from the list by entering this command:
config rogue ap timeout *seconds*
The valid range for the *seconds* parameter is 240 to 3600 seconds (inclusive). The default value is 1200 seconds.

Note If a rogue access point or client entry times out, it is removed from the controller only if its rogue state is Alert or Threat for a classification type.

Step 4 Enable or disable ad hoc rogue detection and reporting by entering this command:
config rogue adhoc {**enable** | **disable**}

Step 5 Enable or disable the AAA server or local database to validate if rogue clients are valid clients by entering this command:
config rogue client aaa {**enable** | **disable**}

Step 6 Specify the time interval, in seconds, at which APs should send the rogue detection report to the controller by entering this command:
config rogue detection monitor-ap report-interval *time in sec*

The valid range for the *time in sec* parameter is 10 seconds to 300 seconds. The default value is 10 seconds.

Note This feature is applicable only to the monitor mode APs.

Step 7 Specify the minimum RSSI value that rogues should have for APs to detect them and for the rogue entries to be created in the controller by entering this command:
config rogue detection min-rssi *rssi in dBm*

The valid range for the *rssi in dBm* parameter is –128 dBm to 0 dBm. The default value is 0 dBm.

Note This feature is applicable to all the AP modes. There can be many rogues with very weak RSSI values that do not provide any valuable information in rogue analysis. Therefore, you can use this option to filter rogues by specifying the minimum RSSI value at which APs should detect rogues.

Step 8 Specify the time interval at which rogues have to be consistently scanned for by APs after the first time the rogues are scanned for by entering this command:
config rogue detection monitor-ap transient-rogue-interval *time in sec*

The valid range for the *time in sec* parameter is 120 seconds to 1800 seconds. The default value is 0.

Note This feature is applicable only to the monitor mode APs.

Using the transient interval values, you can control the time interval at which APs should scan for rogues. APs can also filter rogues based on their transient interval values.

This feature has the following advantages:

- Rogue reports from APs to the controller are shorter.
- Transient rogue entries are avoided in the controller.
- Unnecessary memory allocation for transient rogues are avoided.

Step 9 If you want the controller to automatically contain certain rogue devices, enter these commands.

Caution When you enter any of these commands, the following message is displayed: `Using this feature may have legal consequences. Do you want to continue?` The 2.4-GHz and 5-GHz frequencies in the Industrial, Scientific, and Medical (ISM) band are open to the public and can be used without a license. As such, containing devices on another party's network could have legal consequences.

- **config rogue ap rldp enable auto-contain—**Automatically contains the rogues that are detected on the wired network.
- **config rogue ap ssid auto-contain—**Automatically contains the rogues that are advertising your network's SSID.

  Note If you want the controller to only generate an alarm when such a rogue is detected, enter the **config rogue ap ssid alarm** command.

- **config rogue ap valid-client auto-contain—**Automatically contains a rogue access point to which trusted clients are associated.

  Note If you want the controller to only generate an alarm when such a rogue is detected, enter the **config rogue ap valid-client alarm** command.

- **config rogue adhoc auto-contain—**Automatically contains ad hoc networks detected by the controller.

  Note If you want the controller to only generate an alarm when such a network is detected, enter the **config rogue adhoc alert** command.

- **config rogue auto-contain level** *level monitor_mode_ap_only***—**Sets the auto containment level for the monitor mode access points. The default value is 1.

Step 10 Configure ad hoc rogue classification by entering these commands:

- **config rogue adhoc classify friendly state** {**internal** | **external**} *mac-addr*
- **config rogue adhoc classify malicious state** {**alert** | **contain**} *mac-addr*
- **config rogue adhoc classify unclassified state** {**alert** | **contain**} *mac-addr*

The following is a brief description of the parameters:

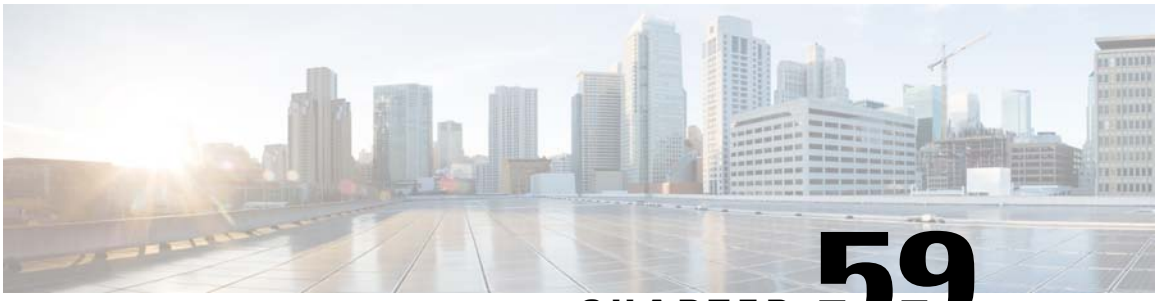
- **internal—**Trusts a foreign ad hoc rogue.
- **external—**Acknowledges the presence of an ad hoc rogue.
- **alert—**Generates a trap when an ad hoc rogue is detected.
- **contain—**Starts containing a rogue ad hoc.

Step 11 Configure RLDP scheduling by entering this command:
config rogue ap rldp schedule { **add** | **delete** | **disable** | **enable** }

- **add—**Enables you to schedule RLDP on a particular day of the week. You must enter the day of the week (for example, **mon**, **tue**, **wed**, and so on) on which you want to schedule RLDP and the start time and end time in HH:MM:SS format. For example: **config rogue ap rldp schedule add mon 22:00:00 23:00:00**.
- **delete—**Enables you to delete the RLDP schedule. You must enter the number of days.
- **disable—** Configure to disable RLDP scheduling.
- **enable—** Configure to enable RLDP scheduling.

Note When you configure RLDP scheduling, it is assumed that the scheduling will occur in the future, that is, after the configuration is saved.

Step 12 Save your changes by entering this command:
save config



CHAPTER 59

Classifying Rogue Access Points

Information About Classifying Rogue Access Points

The controller software enables you to create rules that can organize and display rogue access points as Friendly, Malicious, Custom, or Unclassified. For the Custom type, you must specify a severity score and a classification name.

Note Manual classification and classification that is the result of auto-containment or rogue-on-wire overrides the rogue rule. If you have manually changed the class and/or the state of a rogue AP, then to apply rogue rules to the AP, you must change it to unclassified and alert condition.

By default, none of the classification rules are enabled. Therefore, all unknown access points are categorized as Unclassified. When you create a rule, configure conditions for it, and enable the rule, the unclassified access points are reclassified. Whenever you change a rule, it is applied to all access points (friendly, malicious, custom, and unclassified) in the Alert state only.

You can configure up to 64 rogue classification rules per controller.

You can also apply rogue rules to ad hoc rogues except for client count condition.

The number of rogue clients that can be stored in the database table of a rogue access point is 256.

If a rogue AP or an ad hoc rogue is classified because of an RSSI rogue rule condition, the RSSI value that caused the trigger is displayed on the controller GUI/CLI. The controller includes the classified RSSI, the classified AP MAC address, and rule name in the trap. A new trap is generated for every new classification or change of state due to rogue rule but[3] is rate limited to every half hour for every rogue AP or ad hoc rogue. However, if there is a change of state in containment by rogue rule, the trap is sent immediately. The ‘classified

by,' 'classified at,' and 'classified by rule name' are valid for the non-default classification types, which are Friendly, Malicious, and Custom classifications. For the unclassified types, these fields are not displayed.

Note For the RSSI condition of rogue rule, reclassification occurs only if the RSSI change is more than 2 dBm of the configured RSSI value.

When the controller receives a rogue report from one of its managed access points, it responds as follows:

1. The controller verifies that the unknown access point is in the friendly MAC address list. If it is, the controller classifies the access point as Friendly.
2. If the unknown access point is not in the friendly MAC address list, the controller starts applying rogue classification rules.
3. If the rogue is already classified as Malicious, Alert or Friendly, Internal or External, the controller does not reclassify it automatically. If the rogue is classified differently, the controller reclassifies it automatically only if the rogue is in the Alert state.
4. The controller applies the first rule based on priority. If the rogue access point matches the criteria specified by the rule, the controller classifies the rogue according to the classification type configured for the rule.
5. If the rogue access point does not match any of the configured rules, the controller classifies the rogue as Unclassified.
6. The controller repeats the previous steps for all rogue access points.
7. If RLDP determines that the rogue access point is on the network, the controller marks the rogue state as Threat and classifies it as Malicious automatically, even if no rules are configured. You can then manually contain the rogue (unless you have configured RLDP to automatically contain the rogue), which would change the rogue state to Contained. If the rogue access point is not on the network, the controller marks the rogue state as Alert, and you can manually contain the rogue.
8. If desired, you can manually move the access point to a different classification type and rogue state.

Table 16: Classification Mapping

Rule-Based Classification Type	Rogue States
Friendly	• Internal—If the unknown access point is inside the network and poses no threat to WLAN security, you would manually configure it as Friendly, Internal. An example is the access points in your lab network. • External—If the unknown access point is outside the network and poses no threat to WLAN security, you would manually configure it as Friendly, External. An example is an access point that belongs to a neighboring coffee shop. • Alert—The unknown access point is moved to Alert if it is not in the neighbor list or in the user-configured friendly MAC list.

Rule-Based Classification Type	Rogue States
Malicious	• Alert—The unknown access point is moved to Alert if it is not in the neighbor list or in the user-configured friendly MAC list. • Contained—The unknown access point is contained.
Custom	• Alert—The unknown access point is moved to Alert if it is not in the neighbor list or in the user-configured friendly MAC list. • Contained—The unknown access point is contained.
Unclassified	• Pending—On first detection, the unknown access point is put in the Pending state for 3 minutes. During this time, the managed access points determine if the unknown access point is a neighbor access point. • Alert—The unknown access point is moved to Alert if it is not in the neighbor list or in the user-configured friendly MAC list. • Contained—The unknown access point is contained. • Contained Pending—The unknown access point is marked Contained, but the action is delayed due to unavailable resources.

The classification and state of the rogue access points are configured as follows:

- From Known to Friendly, Internal
- From Acknowledged to Friendly, External
- From Contained to Malicious, Contained

If the rogue state is Contained, you have to uncontain the rogue access point before you can change the classification type. If you want to move a rogue access point from Malicious to Unclassified, you must delete the access point and allow the controller to reclassify it.

Restrictions for Classifying Rogue Access Points

There are some rogue rules. They are:

- Classifying Custom type rogues is tied to rogue rules. Therefore, it is not possible to manually classify a rogue as Custom. Custom class change can occur only using rogue rules.
- There are traps that are sent for containment by rule and for every 30 minutes for rogue classification change. For custom classification, the first trap does not contain the severity score because the trap has existed before the custom classification. The severity score is obtained from the subsequent trap that is generated after 30 minutes if the rogue is classified.
- Rogue rules are applied on every incoming new rogue report in the controller in the order of their priority.

- Once a rogue satisfies a higher priority rule and classified, it does not move down the priority list for the same report.
- Previously classified rogue gets re-classified on every new rogue report with the following restrictions:
  - Rogues which are classified as friendly by rule and whose state is set to ALERT, go through re-classification on receiving the new rogue report.
  - If a rogue is classified as friendly by the administrator manually, then the state is INTERNAL and it does not get re-classified on successive rogue reports.
  - If rogue is classified as malicious, irrespective of the state it does not get re-classified on subsequent rogue reports.
- Transition of the rogue's state from friendly to malicious is possible by multiple rogue rules if some attribute is missing in new rogue report.
- Transition of the rogue's state from malicious to any other classification is not possible by any rogue rule.

Configuring Rogue Classification Rules (GUI)

Step 1 Choose **Security** > **Wireless Protection Policies** > **Rogue Policies** > **Rogue Rules** to open the Rogue Rules page. Any rules that have already been created are listed in priority order. The name, type, and status of each rule is provided.

Note If you ever want to delete a rule, hover your cursor over the blue drop-down arrow for that rule and click **Remove**.

Step 2 Create a new rule as follows:

a) Click **Add Rule**. An Add Rule section appears at the top of the page.
b) In the **Rule Name** text box, enter a name for the new rule. Ensure that the name does not contain any spaces.
c) From the **Rule Type** drop-down list, choose from the following options to classify rogue access points matching this rule as friendly or malicious:
   - **Friendly**
   - **Malicious**
   - **Custom**
d) Configure the notification when the rule is matched from the **Notify** drop-down list to **All**, **Global**, **Local**, or **None**.
e) Configure the state of the rogue AP when the rule is matched from the **State** drop-down list.
f) If you choose the Rule Type as Custom, enter the Severity Score and the Classification Name.
g) Click **Add** to add this rule to the list of existing rules, or click **Cancel** to discard this new rule.

Step 3 Edit a rule as follows:

a) Click the name of the rule that you want to edit. The **Rogue Rule > Edit** page appears.
b) From the Type drop-down list, choose from the following options to classify rogue access points matching this rule:
   - **Friendly**
   - **Malicious**

- **Custom**

c) Configure the notification when the rule is matched from the **Notify** drop-down list to **All**, **Global**, **Local**, or **None**.
d) Configure the state of the rogue AP when the rule is matched from the **State** drop-down list.
e) From the Match Operation text box, choose one of the following:
Match All—If this rule is enabled, a detected rogue access point must meet all of the conditions specified by the rule in order for the rule to be matched and the rogue to adopt the classification type of the rule.

Match Any—If this rule is enabled, a detected rogue access point must meet any of the conditions specified by the rule in order for the rule to be matched and the rogue to adopt the classification type of the rule. This is the default value.

f) To enable this rule, select the **Enable Rule** check box. The default value is unselected.
g) If you choose the Rule Type as Custom, enter the Severity Score and the Classification Name.
h) From the Add Condition drop-down list, choose one or more of the following conditions that the rogue access point must meet and click **Add Condition**.

- **SSID—**Requires that the rogue access point have a specific user-configured SSID. If you choose this option, enter the SSID in the User Configured SSID text box, and click **Add SSID**.
  Note To delete an SSID, highlight the SSID and click **Remove**.

- **RSSI—**Requires that the rogue access point have a minimum received signal strength indication (RSSI) value. For example, if the rogue access point has an RSSI that is greater than the configured value, then the access point could be classified as malicious. If you choose this option, enter the minimum RSSI value in the Minimum RSSI text box. The valid range is –95 to –50 dBm (inclusive), and the default value is 0 dBm.

- **Duration—**Requires that the rogue access point be detected for a minimum period of time. If you choose this option, enter a value for the minimum detection period in the Time Duration text box. The valid range is 0 to 3600 seconds (inclusive), and the default value is 0 seconds.

- **Client Count—**Requires that a minimum number of clients be associated to the rogue access point. For example, if the number of clients associated to the rogue access point is greater than or equal to the configured value, then the access point could be classified as malicious. If you choose this option, enter the minimum number of clients to be associated to the rogue access point in the Minimum Number of Rogue Clients text box. The valid range is 1 to 10 (inclusive), and the default value is 0.

- **No Encryption—**Requires that the rogue access point's advertised WLAN does not have encryption enabled. If a rogue access point has encryption disabled, it is likely that more clients will try to associate to it. No further configuration is required for this option.

  Note Cisco Prime Infrastructure refers to this option as "Open Authentication."

- **Managed SSID—**Requires that the rogue access point's managed SSID (the SSID configured for the WLAN) be known to the controller. No further configuration is required for this option.
  Note The SSID and Managed SSID conditions cannot be used with the Match All operation because these two SSID lists are mutually exclusive. If you define a rule with Match All and have these two conditions configured, the rogue access points are never classified as friendly or malicious because one of the conditions can never be met.

  You can add up to six conditions per rule. When you add a condition, it appears under the Conditions section.

Note If you ever want to delete a condition from this rule, hover your cursor over the blue drop-down arrow for that condition and click **Remove**.

i) Click **Apply**.

Step 4 Click **Save Configuration**.

Step 5 If you want to change the order in which rogue classification rules are applied, follow these steps:

1. Click **Back** to return to the Rogue Rules page.
2. Click **Change Priority** to access the Rogue Rules > Priority page.

   The rogue rules are listed in priority order in the Change Rules Priority text box.
3. Highlight the rule for which you want to change the priority, and click **Up** to raise its priority in the list or **Down** to lower its priority in the list.
4. Continue to move the rules up or down until the rules are in the desired order.
5. Click **Apply**.

Step 6 Classify any rogue access points as friendly and add them to the friendly MAC address list as follows:

- Choose **Security** > **Wireless Protection Policies** > **Rogue Policies** > **Friendly Rogue** to open the Friendly Rogue > Create page.
- In the MAC Address text box, enter the MAC address of the friendly rogue access point.
- Click **Apply**.
- Click **Save Configuration**. This access point is added to the controller's list of friendly access points and should now appear on the Friendly Rogue APs page.

Viewing and Classifying Rogue Devices (GUI)

Before You Begin

Caution When you choose to **contain a rogue device**, the following warning appears: "There may be legal issues following this containment. Are you sure you want to continue?" The 2.4- and 5-GHz frequencies in the Industrial, Scientific, and Medical (ISM) band are open to the public and can be used without a license. As such, containing devices on another party's network could have legal consequences.

Step 1 Choose **Monitor** > **Rogues**.

Step 2 Choose the following options to view the different types of rogue access points detected by the controller:

- **Friendly APs**

- **Malicious APs**
- **Unclassified APs**
- **Custom APs**

The respective rogue APs pages provide the following information: the MAC address and SSID of the rogue access point, channel number, the number of radios that detected the rogue access point, the number of clients connected to the rogue access point, and the current status of the rogue access point.

Note To remove acknowledged rogues from the database, change the rogue state to Alert. If the rogue is no longer present, the rogue data is deleted from the database in 20 minutes.

Note If you ever want to delete a rogue access point from one of these pages, hover your cursor over the blue drop-down arrow and click **Remove**. To delete multiple rogue access points, select the check box corresponding to the row you want to delete and click **Remove**.

Step 3 Get more details about a rogue access point by clicking the MAC address of the access point. The Rogue AP Detail page appears.

This page provides the following information: the MAC address of the rogue device, the type of rogue device (such as an access point), whether the rogue device is on the wired network, the dates and times when the rogue device was first and last reported, and the current status of the device.

The Class Type text box shows the current classification for this rogue access point:

- **Friendly—**An unknown access point that matches the user-defined friendly rules or an existing known and acknowledged rogue access point. Friendly access points cannot be contained.
- **Malicious—**An unknown access point that matches the user-defined malicious rules or is moved manually by the user from the Friendly or Unclassified classification type.

  Note Once an access point is classified as Malicious, you cannot apply rules to it in the future, and it cannot be moved to another classification type. If you want to move a malicious access point to the Unclassified classification type, you must delete the access point and allow the controller to reclassify it.

- **Unclassified—**An unknown access point that does not match the user-defined friendly or malicious rules. An unclassified access point can be contained. It can also be moved to the Friendly or Malicious classification type automatically in accordance with user-defined rules or manually by the user.
- **Custom—**A user-defined classification type that is tied to rogue rules. It is not possible to manually classify a rogue as Custom. Custom class change can occur only using rogue rules.

Step 4 If you want to change the classification of this device, choose a different classification from the Class Type drop-down list.

Note A rogue access point cannot be moved to another class if its current state is Contain.

Step 5 From the Update Status drop-down list, choose one of the following options to specify how the controller should respond to this rogue access point:

- **Internal—**The controller trusts this rogue access point. This option is available if the Class Type is set to Friendly.
- **External—**The controller acknowledges the presence of this rogue access point. This option is available if the Class Type is set to Friendly.
- **Contain—**The controller contains the offending device so that its signals no longer interfere with authorized clients. This option is available if the Class Type is set to Malicious or Unclassified.

- **Alert—**The controller forwards an immediate alert to the system administrator for further action. This option is available if the Class Type is set to Malicious or Unclassified.

The bottom of the page provides information on both the access points that detected this rogue access point and any clients that are associated to it. To see more details for any of the clients, click **Edit** to open the Rogue Client Detail page.

Step 6 Click **Apply**.

Step 7 Click **Save Configuration**.

Step 8 View any rogue clients that are connected to the controller by choosing **Rogue Clients**. The Rogue Clients page appears. This page shows the following information: the MAC address of the rogue client, the MAC address of the access point to which the rogue client is associated, the SSID of the rogue client, the number of radios that detected the rogue client, the date and time when the rogue client was last reported, and the current status of the rogue client.

Step 9 Obtain more details about a rogue client by clicking the MAC address of the client. The Rogue Client Detail page appears. This page provides the following information: the MAC address of the rogue client, the MAC address of the rogue access point to which this client is associated, the SSID and IP address of the rogue client, the dates and times when the rogue client was first and last reported, and the current status of the rogue client.

Step 10 From the Update Status drop-down list, choose one of the following options to specify how the controller should respond to this rogue client:

- **Contain—**The controller contains the offending device so that its signals no longer interfere with authorized clients.
- **Alert—**The controller forwards an immediate alert to the system administrator for further action.

The bottom of the page provides information on the access points that detected this rogue client.

Step 11 Click **Apply**.

Step 12 If desired, you can test the controller's connection to this client by clicking **Ping**.

Step 13 Click **Save Configuration**.

Step 14 See any ad-hoc rogues detected by the controller by choosing **Adhoc Rogues**. The Adhoc Rogues page appears. This page shows the following information: the MAC address, BSSID, and SSID of the ad-hoc rogue, the number of radios that detected the ad-hoc rogue, and the current status of the ad-hoc rogue.

Step 15 Obtain more details about an ad-hoc rogue by clicking the MAC address of the rogue. The Adhoc Rogue Detail page appears.
This page provides the following information: the MAC address and BSSID of the ad-hoc rogue, the dates and times when the rogue was first and last reported, and the current status of the rogue.

Step 16 From the Update Status drop-down list, choose one of the following options to specify how the controller should respond to this ad-hoc rogue:

- **Contain—**The controller contains the offending device so that its signals no longer interfere with authorized clients.
- **Alert—**The controller forwards an immediate alert to the system administrator for further action.
- **Internal—**The controller trusts this rogue access point.
- **External—**The controller acknowledges the presence of this rogue access point.

Step 17 From the Maximum number of APs to contain the rogue drop-down list, choose one of the following options to specify the maximum number of access points used to contain this ad-hoc rogue: **1**, **2**, **3**, or **4**.
The bottom of the page provides information on the access points that detected this ad-hoc rogue.

- **1—**Specifies targeted rogue access point will be contained by one access point. This is the lowest containment level.
- **2—**Specifies targeted rogue access point will be contained by two access points.
- **3—**Specifies targeted rogue access point will be contained by three access points.
- **4—**Specifies targeted rogue access point will be contained by four access points. This is the highest containment level.

Step 18 Click **Apply**.

Step 19 Click **Save Configuration**.

Step 20 View any access points that have been configured to be ignored by choosing **Rogue AP Ignore-List**. The Rogue AP Ignore-List page appears.
This page shows the MAC addresses of any access points that are configured to be ignored. The rogue-ignore list contains a list of any autonomous access points that have been manually added to Cisco Prime Infrastructure maps by the users. The controller regards these autonomous access points as rogues even though the Prime Infrastructure is managing them. The rogue-ignore list allows the controller to ignore these access points. The list is updated as follows:

- When the controller receives a rogue report, it checks to see if the unknown access point is in the rogue-ignore access point list.
- If the unknown access point is in the rogue-ignore list, the controller ignores this access point and continues to process other rogue access points.
- If the unknown access point is not in the rogue-ignore list, the controller sends a trap to the Prime Infrastructure. If the Prime Infrastructure finds this access point in its autonomous access point list, the Prime Infrastructure sends a command to the controller to add this access point to the rogue-ignore list. This access point is then ignored in future rogue reports.
- If a user removes an autonomous access point from the Prime Infrastructure, the Prime Infrastructure sends a command to the controller to remove this access point from the rogue-ignore list.

Configuring Rogue Classification Rules (CLI)

Step 1 Create a rule by entering this command:
config rogue rule add ap priority *priority* **classify** {**friendly** | **malicious**} *rule-name*

If you later want to change the priority of this rule and shift others in the list accordingly, enter the **config rogue rule priority** *priority rule-name* command.

If you later want to change the classification of this rule, enter the **config rogue rule classify** {**friendly** | **malicious**} *rule-name* command.

If you ever want to delete all of the rogue classification rules or a specific rule, enter the {**config rogue rule delete** {**all** | *rule-name*} command.

Step 2 Create a rule by entering these commands:

- Configure a rule for friendly rogues by entering this command:
  config rogue rule add ap priority *priority* **classify friendly notify** {**all** | **global** | **local** | **none**} **state** {**alert** | **internal** | **external**} *rule-name*
- Configure a rule for malicious rogues by entering this command:
  config rogue rule add ap priority *priority* **classify malicious notify** {**all** | **global** | **local** | **none**} **state** {**alert** | **contain**} *rule-name*
- Configure a rule for custom rogues by entering this command:
  config rogue rule add ap priority *priority* **classify custom** *severity-score classification-name* **notify** {**all** | **global** | **local** | **none**} **state** {**alert** | **contain**} *rule-name*

If you later want to change the priority of this rule and shift others in the list accordingly, enter the **config rogue rule priority** *priority rule-name* command.

If you later want to change the classification of this rule, enter the **config rogue rule classify** {**friendly** | **malicious** | **custom** *severity-score classification-name*} *rule-name* command.

If you ever want to delete all of the rogue classification rules or a specific rule, enter the {**config rogue rule delete** {**all** | *rule-name*} command.

Step 3 Configure the state on the rogue AP upon rule match by entering this command:
config rogue rule state {**alert** | **contain** | **internal** | **external**} *rule-name*

Step 4 Configure the notification upon rule match by entering this command:
config rogue rule notify {**all** | **global** | **local** | **none**} *rule-name*

Step 5 Disable all rules or a specific rule by entering this command:
config rogue rule disable {*all* | *rule_name*}

Note A rule must be disabled before you can modify its attributes.

Step 6 Add conditions to a rule that the rogue access point must meet by entering this command:
config rogue rule condition ap set *condition_type condition_value rule_name*

The following condition types are available:

- **ssid—**Requires that the rogue access point have a specific SSID. You should add SSIDs that are not managed by the controller. If you choose this option, enter the SSID for the *condition_value parameter*. The SSID is added to the user-configured SSID list.

  Note If you ever want to delete all of the SSIDs or a specific SSID from the user-configured SSID list, enter the **config rogue rule condition ap delete ssid** {**all** | **ssid**} *rule_name* command.

- **rssi—**Requires that the rogue access point have a minimum RSSI value. For example, if the rogue access point has an RSSI that is greater than the configured value, then the access point could be classified as malicious. If you choose this option, enter the minimum RSSI value for the *condition_value parameter*. The valid range is **–**95 to **–**50 dBm (inclusive), and the default value is 0 dBm.
- **duration—**Requires that the rogue access point be detected for a minimum period of time. If you choose this option, enter a value for the minimum detection period for the *condition_value parameter*. The valid range is 0 to 3600 seconds (inclusive), and the default value is 0 seconds.
- **client-count—**Requires that a minimum number of clients be associated to the rogue access point. For example, if the number of clients associated to the rogue access point is greater than or equal to the configured value, then the access point could be classified as malicious. If you choose this option, enter the minimum number of clients

to be associated to the rogue access point for the *condition_value parameter*. The valid range is 1 to 10 (inclusive), and the default value is 0.

- **managed-ssid—**Requires that the rogue access point's SSID be known to the controller. A *condition_value parameter* is not required for this option.

Note You can add up to six conditions per rule. If you ever want to delete all of the conditions or a specific condition from a rule, enter the **config rogue rule condition ap delete all** *condition_type condition_value rule_name* command.

Step 7 Specify whether a detected rogue access point must meet all or any of the conditions specified by the rule in order for the rule to be matched and the rogue access point to adopt the classification type of the rule by entering this command:
config rogue rule match {**all** | **any**} *rule_name*

Step 8 Enable all rules or a specific rule by entering this command:
config rogue rule enable {**all** | **rule_name**}

Note For your changes to become effective, you must enable the rule.

Step 9 Add a new friendly access point entry to the friendly MAC address list or delete an existing friendly access point entry from the list by entering this command:
config rogue ap friendly {**add** | **delete**} *ap_mac_address*

Step 10 Save your changes by entering this command:
save config

Step 11 View the rogue classification rules that are configured on the controller by entering this command:
show rogue rule summary

Step 12 View detailed information for a specific rogue classification rule by entering this command:
show rogue rule detailed *rule_name*

Viewing and Classifying Rogue Devices (CLI)

- View a list of all rogue access points detected by the controller by entering this command:
  show rogue ap summary
- See a list of the friendly rogue access points detected by the controller by entering this command:

  show rogue ap friendly summary
- See a list of the malicious rogue access points detected by the controller by entering this command:

  show rogue ap malicious summary
- See a list of the unclassified rogue access points detected by the controller by entering this command:
  show rogue ap unclassified summary
- See detailed information for a specific rogue access point by entering this command:
  show rogue ap detailed *ap_mac_address*
- See the rogue report (which shows the number of rogue devices detected on different channel widths) for a specific 802.11a/n radio by entering this command:

show ap auto-rf 802.11a *Cisco_AP*

- See a list of all rogue clients that are associated to a rogue access point by entering this command:
  show rogue ap clients *ap_mac_address*
- See a list of all rogue clients detected by the controller by entering this command:
  show rogue client summary
- See detailed information for a specific rogue client by entering this command:
  show rogue client detailed *client_mac_address*
- See a list of all ad-hoc rogues detected by the controller by entering this command:
  show rogue adhoc summary
- See detailed information for a specific ad-hoc rogue by entering this command:
  show rogue adhoc detailed *rogue_mac_address*
- See a summary of ad hoc rogues based on their classification by entering this command:
  show rogue adhoc {**friendly** | **malicious** | **unclassified**} **summary**
- See a list of rogue access points that are configured to be ignore by entering this command:
  show rogue ignore-list

Note See the Viewing and Classifying Rogue Devices (GUI) section for more information on the rogue-ignore access point list.

- Classify a rogue access point as friendly by entering this command:
  config rogue ap classify friendly state {**internal** | **external**} *ap_mac_address*

  where

  internal means that the controller trusts this rogue access point.

  external means that the controller acknowledges the presence of this rogue access point.

Note A rogue access point cannot be moved to the Friendly class if its current state is Contain.

- Mark a rogue access point as malicious by entering this command:
  config rogue ap classify malicious state {**alert** | **contain**} *ap_mac_address*

  where

  alert means that the controller forwards an immediate alert to the system administrator for further action.

  contain means that the controller contains the offending device so that its signals no longer interfere with authorized clients.

Note A rogue access point cannot be moved to the Malicious class if its current state is Contain.

- Mark a rogue access point as unclassified by entering this command:
  config rogue ap classify unclassified state {**alert** | **contain**} *ap_mac_address*

Note A rogue access point cannot be moved to the Unclassified class if its current state is Contain.

alert means that the controller forwards an immediate alert to the system administrator for further action.

contain means that the controller contains the offending device so that its signals no longer interfere with authorized clients.

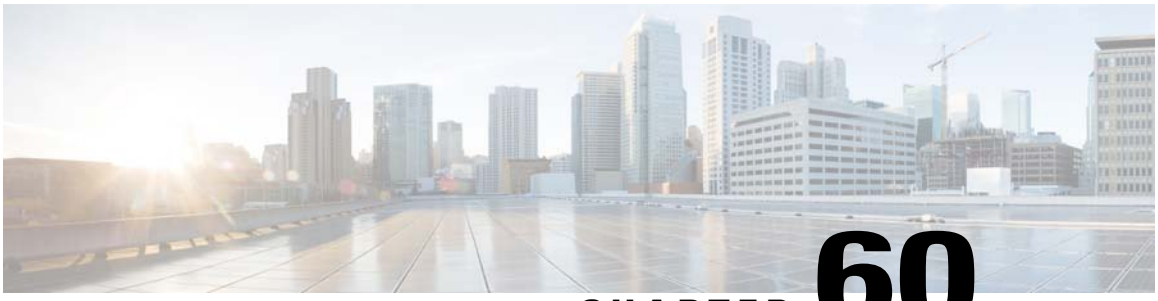
- Choose the maximum number of access points used to contain the ad-hoc rogue by entering this command: **config rogue ap classify unclassified state contain** *rogue_ap_mac_address 1, 2, 3, or 4*
  - **1—**Specifies targeted rogue access point will be contained by one access point. This is the lowest containment level.
  - **2—**Specifies targeted rogue access point will be contained by two access points.
  - **3—**Specifies targeted rogue access point will be contained by three access points.
  - **4—**Specifies targeted rogue access point will be contained by four access points. This is the highest containment level.
- Specify how the controller should respond to a rogue client by entering one of these commands: **config rogue client alert** *client_mac_address***—**The controller forwards an immediate alert to the system administrator for further action.

  config rogue client contain *client_mac_address***—**The controller contains the offending device so that its signals no longer interfere with authorized clients.
- Specify how the controller should respond to an ad-hoc rogue by entering one these commands: **config rogue adhoc alert** *rogue_mac_address***—**The controller forwards an immediate alert to the system administrator for further action.

  config rogue adhoc contain *rogue_mac_address***—**The controller contains the offending device so that its signals no longer interfere with authorized clients.

  config rogue adhoc external *rogue_mac_address***—**The controller acknowledges the presence of this ad-hoc rogue.
- Configure the classification of ad hoc rogues by entering any one of these commands:
  - Friendly state**—config rogue adhoc classify friendly state** {**internal** | **external**} *mac-addr*
  - Malicious state**—config rogue adhoc classify malicious state** {**alert** | **contain**} *mac-addr*
  - Unclassified state**—config rogue adhoc classify unclassified state** {**alert** | **contain**} *mac-addr*
- View a summary of custom rogue AP information by entering this command: **show rogue ap custom summary**
- See custom ad hoc rogue information by entering this command: **show rogue adhoc custom summary**
- Delete the rogue APs by entering this command: **config rogue ap delete** {**class** | **all** | *mac-addr*}
- Delete the rogue clients by entering this command: **config rogue client delete** {**state** | **all** | *mac-addr*}

- Delete the ad hoc rogues by entering this command:
  config rogue adhoc delete {**class** | **all** | *mac-addr*}
- Save your changes by entering this command:
  save config



CHAPTER 60

Configuring Cisco TrustSec SXP

Information About Cisco TrustSec SXP

Cisco TrustSec enables organizations to secure their networks and services through identity-based access control to anyone, anywhere, anytime. The solution also offers data integrity and confidentiality services, policy-based governance, and centralized monitoring, troubleshooting, and reporting services. TrustSec can be combined with personalized, professional service offerings to simplify solution deployment and management, and is a foundational security component to Cisco Borderless Networks.

The Cisco TrustSec security architecture builds secure networks by establishing domains of trusted network devices. Each device in the domain is authenticated by its peers. Communication on the links between devices in the domain is secured with a combination of encryption, message integrity check, and data-path replay protection mechanisms. Cisco TrustSec uses the device and user credentials acquired during authentication for classifying the packets by security groups (SGs) as they enter the network. This packet classification is maintained by tagging packets on ingress to the Cisco TrustSec network so that they can be correctly identified to apply security and other policy criteria along the data path. The tag, called the security group tag (SGT), allows the network to enforce the access control policy by enabling the endpoint device to act upon the SGT to filter traffic.

One of the components of Cisco TrustSec architecture is the security group-based access control. In the security group-based access control component, access policies in the Cisco TrustSec domain are topology-independent, based on the roles (as indicated by security group number) of source and destination devices rather than on network addresses. Individual packets are tagged with the security group number of the source.

Cisco devices use the SGT Exchange Protocol (SXP) to propagate SGTs across network devices that do not have hardware support for Cisco TrustSec. SXP is the software solution to avoid CTS hardware upgrade on all switches. WLC will be supporting SXP as part of TrustSec Architecture. The SXP sends SGT information to the CTS-enabled switches so that appropriate role-based access control lists (RBACLs) can be activated depending on the role information represented by the SGT. By default, the controller always works in the

Speaker mode. To implement the SXP on a network, only the egress distribution switch needs to be CTS-enabled, and all the other switches can be non-CTS-capable switches.

The SXP runs between any access layer and distribution switch or between two distribution switches. The SXP uses TCP as the transport layer. CTS authentication is performed for any host (client) joining the network on the access layer switch similar to an access switch with CTS-enabled hardware. The access layer switch is not CTS hardware enabled. Therefore, data traffic is not encrypted or cryptographically authenticated when it passes through the access layer switch. The SXP is used to pass the IP address of the authenticated device, that is a wireless client, and the corresponding SGT up to the distribution switch. If the distribution switch is CTS hardware enabled, the switch inserts the SGT into the packet on behalf of the access layer switch. If the distribution switch is not CTS hardware enabled, the SXP on the distribution switch passes the IP-SGT mapping to all the distribution switches that have CTS hardware. On the egress side, the enforcement of the RBACL occurs at the egress L3 interface on the distribution switch.

The following are some guidelines for Cisco TrustSec SXP:

- SXP is supported on the following security policies only:
  - WPA2-dot1x
  - WPA-dot1x
  - 802.1x (Dynamic WEP)
  - MAC Filtering using RADIUS servers
  - Web authentication using RADIUS servers for user authentication
- SXP is supported for both IPv4 and IPv6 clients.
- Controller always operates in the Speaker mode.

For more information about Cisco TrustSec, see http://www.cisco.com/en/US/netsol/ns1051/index.html.

Restrictions for Cisco TrustSec SXP

- SXP is not supported on FlexConnect access points.
- SXP is supported only in centrally switched networks that have central authentication.
- By default, SXP is supported for APs that work in local mode only.
- The configuration of the default password should be consistent for both controller and the switch.
- Fault tolerance is not supported because fault tolerance requires local switching on APs.
- Static IP-SGT mapping for local authentication of users is not supported.
- IP-SGT mapping requires authentication with external ACS servers.
- In auto-anchor mobility mode the controller does not update client IP-SGT information through mobility messages. The connected switches of both the controllers must have an SXP connection established between them for IP-SGT mapping updates.

Configuring Cisco TrustSec SXP (GUI)

Step 1 Choose **Security** > **TrustSec SXP** to open the SXP Configuration page. This page lists the following SXP configuration details:

- **Total SXP Connections—**Number of SXP connections that are configured.
- **SXP State—**Status of SXP connections as either disabled or enabled.
- **SXP Mode—**SXP mode of the controller. The controller is always set to Speaker mode for SXP connections.
- **Default Password—**Password for MD5 authentication of SXP messages. We recommend that the password contain a minimum of 6 characters.
- **Default Source IP—**IP address of the management interface. SXP uses the default source IP address for all new TCP connections.
- **Retry Period—**SXP retry timer. The default value is 120 seconds (2 minutes). The valid range is 0 to 64000 seconds. The SXP retry period determines how often the controller retries for an SXP connection. When an SXP connection is not successfully set up, the controller makes a new attempt to set up the connection after the SXP retry period timer expires. Setting the SXP retry period to 0 seconds disables the timer and retries are not attempted.

This page also displays the following information about SXP connections:

- **Peer IP Address—**The IP address of the peer, that is the IP address of the next hop switch to which the controller is connected. There is no effect on the existing TCP connections when you configure a new peer connection.
- **Source IP Address—**The IP address of the source, that is the management IP address of the controller.
- **Connection Status—**Status of the SXP connection.

Step 2 From the **SXP State** drop-down list, choose **Enabled** to enable Cisco TrustSec SXP.

Step 3 Enter the default password that should be used to make an SXP connection. We recommend that the password contain a minimum of 6 characters.

Step 4 In the **Retry Period** box, enter the time in seconds that determines how often the Cisco TrustSec software retries for an SXP connection.

Step 5 Click **Apply**.

Creating a New SXP Connection (GUI)

Step 1 Choose **SECURITY** > **TrustSec SXP** and click **New** to open the SXP Connection > New page.

Step 2 In the **Peer IP Address** text box, enter the IP address of the next hop switch to which the controller is connected.

Step 3 Click **Apply**.

Configuring Cisco TrustSec SXP (CLI)

- Enable or disable the SXP on the controller by entering this command:
  config cts sxp {**enable** | **disable**}
- Configure the default password for MD5 Authentication of SXP messages by entering this command:
  config cts sxp default password *password*
- Configure the IP address of the next hop switch with which the controller is connected by entering this command:
  config cts sxp connection peer *ip-address*
- Configure the interval between connection attempts by entering this command:
  config cts sxp retry period *time-in-seconds*
- Remove an SXP connection by entering this command:

  config cts sxp connection delete *ip-address*
- See a summary of SXP configuration by entering this command:

  show cts sxp summary

  Information similar to the following appears:

```
SXP State..................................... Enable
SXP Mode...................................... Speaker
Default Password.............................. ****
Default Source IP............................. 209.165.200.224
Connection retry open period ................. 120
```

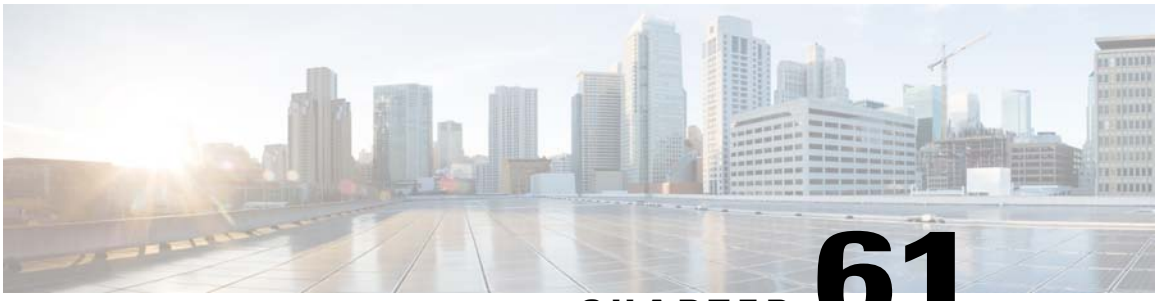
- See the list of SXP connections that are configured by entering this command:
  show cts sxp connections

  Information similar to the following appears:

```
Total num of SXP Connections..................... 1
SXP State..................................... Enable
Peer IP            Source IP          Connection Status
---------------    ---------------    -----------------
209.165.200.229   209.165.200.224             On
```

- Establish connection between the controller and a Cisco Nexus 7000 Series switch by following either of these steps:
  - Enter the following commands:
    1. **config cts sxp version sxp version 1 or 2** *1*
    2. **config cts sxp disable**
    3. **config cts sxp enable**

- If SXP version 2 is used on the controller and version 1 is used on the Cisco Nexus 7000 Series switch, an amount of retry period is required to establish the connection. We recommend that you initially have less interval between connection attempts. The default is 120 seconds.



CHAPTER 61

Configuring Cisco Intrusion Detection System

Information About Cisco Intrusion Detection System

The Cisco Intrusion Detection System/Intrusion Prevention System (CIDS/CIPS) instructs controllers to block certain clients from accessing the wireless network when attacks involving these clients are detected at Layer 3 through Layer 7. This system offers significant network protection by helping to detect, classify, and stop threats including worms, spyware/adware, network viruses, and application abuse. Two methods are available to detect potential attacks:

- IDS sensors
- IDS signatures

You can configure IDS sensors to detect various types of IP-level attacks in your network. When the sensors identify an attack, they can alert the controller to shun the offending client. When you add a new IDS sensor, you register the controller with that IDS sensor so that the controller can query the sensor to get the list of shunned clients.

Shunned Clients

When an IDS sensor detects a suspicious client, it alerts the controller to shun this client. The shun entry is distributed to all controllers within the same mobility group. If the client to be shunned is currently joined to a controller in this mobility group, the anchor controller adds this client to the dynamic exclusion list, and the foreign controller removes the client. The next time that the client tries to connect to a controller, the anchor controller rejects the handoff and informs the foreign controller that the client is being excluded.

Additional Information

The Cisco wireless intrusion prevention system (wIPS) is also supported on the controller through Cisco Prime Infrastructure. See the Configuring wIPS section for more information.

Configuring IDS Sensors (GUI)

Step 1 Choose **Security** > **Advanced** > **CIDs** > Sensors to open the CIDS Sensors List page.

Note If you want to delete an existing sensor, hover your cursor over the blue drop-down arrow for that sensor and choose **Remove**.

Step 2 Click **New** to add a new IDS sensor to the list. The **CIDS Sensor Add** page appears.

Step 3 From the **Index** drop-down list, choose a number (between 1 and 5) to determine the sequence in which the controller consults the IDS sensors. For example, if you choose 1, the controller consults this IDS sensor first.
The controller supports up to five IDS sensors.

Step 4 In the **Server Address** text box, enter the IP address of your IDS server.

Step 5 In the **Port** text box, enter the number of the HTTPS port through which the controller has to communicate with the IDS sensor.
We recommend that you set this parameter to 443 because the sensor uses this value to communicate by default. The default value is 443 and the range is 1 to 65535.

Step 6 In the **Username** text box, enter the name that the controller uses to authenticate to the IDS sensor.

Example:

Note This username must be configured on the IDS sensor and have at least a read-only privilege.

Step 7 In the **Password** and **Confirm Password** text boxes, enter the password that the controller uses to authenticate to the IDS sensor.

Step 8 In the **Query Interval** text box, enter the time (in seconds) for how often the controller should query the IDS server for IDS events.
The default is 60 seconds and the range is 10 to 3600 seconds.

Step 9 Select the **State** check box to register the controller with this IDS sensor or unselected this check box to disable registration. The default value is disabled.

Step 10 Enter a 40-hexadecimal-character security key in the **Fingerprint** text box. This key is used to verify the validity of the sensor and is used to prevent security attacks.

Note Make sure you include colons that appear between every two bytes within the key. For example, enter AA:BB:CC:DD.

Step 11 Click **Apply**. Your new IDS sensor appears in the list of sensors on the CIDS Sensors List page.

Step 12 Click **Save Configuration**.

Viewing Shunned Clients (GUI)

Step 1 Choose **Security** > **Advanced > CIDS** > **Shunned Clients** to open the CIDS Shun List page.
This page shows the IP address and MAC address of each shunned client, the length of time that the client's data packets should be blocked by the controller as requested by the IDS sensor, and the IP address of the IDS sensor that discovered the client.

Step 2 Click **Re-sync** to purge and reset the list as desired.

Note The controller does not take any action on shun entries when the corresponding timers have expired. The shun entry timers are maintained only for the display purpose. The shun entries are cleaned up whenever the controller polls the IPS server. If the CIDS IPS server is not reachable, the shun entries are not removed even if they are timed out on the controller. The shun entries are cleaned up only when the CIDS IPS server is operational again and the controller polls the CIDS IPS server.

Configuring IDS Sensors (CLI)

Step 1 Add an IDS sensor by entering this command:
config wps cids-sensor add index ids_ip_address username password. The index parameter determines the sequence in which the controller consults the IDS sensors. The controller supports up to five IDS sensors. Enter a number (between 1 and 5) to determine the priority of this sensor. For example, if you enter 1, the controller consults this IDS sensor first.

Note The username must be configured on the IDS sensor and have at least a read-only privilege.

Step 2 (Optional) Specify the number of the HTTPS port through which the controller is to communicate with the IDS sensor by entering this command:
config wps cids-sensor port index port

For the port-number parameter, you can enter a value between 1 and 65535. The default value is 443. This step is optional because we recommend that you use the default value of 443. The sensor uses this value to communicate by default.

Step 3 Specify how often the controller should query the IDS server for IDS events by entering this command:
config wps cids-sensor interval index interval

For the interval parameter, you can enter a value between 10 and 3600 seconds. The default value is 60 seconds.

Step 4 Enter a 40-hexadecimal-character security key used to verify the validity of the sensor by entering this command:
config wps cids-sensor fingerprint index sha1 fingerprint

You can get the value of the fingerprint by entering show tls fingerprint on the sensor's console.

Note Make sure to include the colons that appear between every two bytes within the key (for example, AA:BB:CC:DD).

Step 5 Enable or disable this controller's registration with an IDS sensor by entering this command:
config wps cids-sensor {**enable** | **disable**} *index*

Step 6 Enable or disable protection from DoS attacks by entering this command:
The default value is disabled.

Note A potential attacker can use specially crafted packets to mislead the IDS into treating a legitimate client as an attacker. It causes the controller to wrongly disconnect this legitimate client and launches a DoS attack. The auto-immune feature, when enabled, is designed to protect against such attacks. However, conversations using Cisco 792x phones might be interrupted intermittently when the auto-immune feature is enabled. If you experience frequent disruptions when using 792x phones, you might want to disable this feature.

Step 7 Save your settings by entering this command:
save config

Step 8 See the IDS sensor configuration by entering one of these commands:

- **show wps cids-sensor summary**
- **show wps cids-sensor detail** index

Step 9 The second command provides more information than the first.

Step 10 See the auto-immune configuration setting by entering this command:
show wps summary

Information similar to the following appears:

```
Auto-Immune
  Auto-Immune.................................. Disabled

Client Exclusion Policy
  Excessive 802.11-association failures.......... Enabled
  Excessive 802.11-authentication failures....... Enabled
  Excessive 802.1x-authentication................ Enabled
  IP-theft....................................... Enabled
  Excessive Web authentication failure........... Enabled
Signature Policy
  Signature Processing........................... Enabled
```

Step 11 Obtain debug information regarding IDS sensor configuration by entering this command:
debug wps cids enable

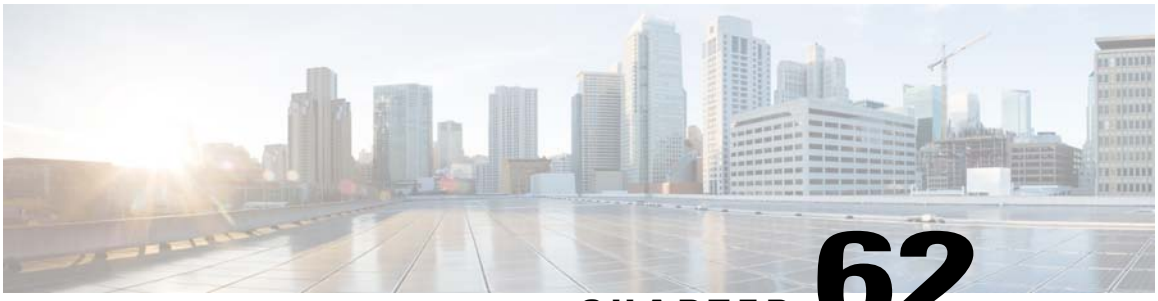
Note If you ever want to delete or change the configuration of a sensor, you must first disable it by entering the config wps cids-sensor disable index command. To delete the sensor, enter the config wps cids-sensor delete index command.

Viewing Shunned Clients (CLI)

Step 1 View the list of clients to be shunned by entering this command:
show wps shun-list

Step 2 Force the controller to synchronize with other controllers in the mobility group for the shun list by entering this command:
config wps shun-list re-sync

Note The controller does not take any action on shun entries when the corresponding timers have expired. The shun entry timers are maintained only for the display purpose. The shun entries are cleaned up whenever the controller polls the IPS server. If the CIDS IPS server is not reachable, the shun entries are not removed even if they are timed out on the controller. The shun entries are cleaned up only when the CIDS IPS server is operational again and the controller polls the CIDS IPS server.



CHAPTER 62

Configuring IDS Signatures

Information About IDS Signatures

You can configure IDS signatures, or bit-pattern matching rules used to identify various types of attacks in incoming 802.11 packets, on the controller. When the signatures are enabled, the access points joined to the controller perform signature analysis on the received 802.11 data or management frames and report any discrepancies to the controller. If an attack is detected, appropriate mitigation is initiated.

Cisco supports 17 standard signatures. These signatures are divided into six main groups. The first four groups contain management signatures, and the last two groups contain data signatures.

- **Broadcast deauthentication frame signatures—**During a broadcast deauthentication frame attack, a hacker sends an 802.11 deauthentication frame to the broadcast MAC destination address of another client. This attack causes the destination client to disassociate from the access point and lose its connection. If this action is repeated, the client experiences a denial of service. When the broadcast deauthentication frame signature (precedence 1) is used to detect such an attack, the access point listens for clients transmitting broadcast deauthentication frames that match the characteristics of the signature. If the access point detects such an attack, it alerts the controller. Depending on how your system is configured, the offending device is contained so that its signals no longer interfere with authorized clients, or the controller forwards an immediate alert to the system administrator for further action, or both.
- **NULL probe response signatures—**During a NULL probe response attack, a hacker sends a NULL probe response to a wireless client adapter. As a result, the client adapter locks up. When a NULL probe response signature is used to detect such an attack, the access point identifies the wireless client and alerts the controller. The NULL probe response signatures are as follows:
  - NULL probe resp 1 (precedence 2)
  - NULL probe resp 2 (precedence 3)

Note Controller does not log historical NULL Probe IDS events within the Signature Events Summary output.

- **Management frame flood signatures—**During a management frame flood attack, a hacker floods an access point with 802.11 management frames. The result is a denial of service to all clients associated or attempting to associate to the access point. This attack can be implemented with different types of management frames: association requests, authentication requests, reassociation requests, probe requests, disassociation requests, deauthentication requests, and reserved management subtypes.

  When a management frame flood signature is used to detect such an attack, the access point identifies management frames matching the entire characteristic of the signature. If the frequency of these frames is greater than the value of the frequency set in the signature, an access point that hears these frames triggers an alarm. The controller generates a trap and forwards it to Cisco Prime Infrastructure.

  The management frame flood signatures are as follows:

  - Assoc flood (precedence 4)
  - Auth flood (precedence 5)
  - Reassoc flood (precedence 6)
  - Broadcast probe flood (precedence 7)
  - Disassoc flood (precedence 8)
  - Deauth flood (precedence 9)
  - Reserved mgmt 7 (precedence 10)
  - Reserved mgmt F (precedence 11)

    The reserved management frame signatures 7 and F are reserved for future use.

- **Wellenreiter signature—**Wellenreiter is a wireless LAN scanning and discovery utility that can reveal access point and client information. When the Wellenreiter signature (precedence 17) is used to detect such an attack, the access point identifies the offending device and alerts the controller.
- **EAPOL flood signature—**During an EAPOL flood attack, a hacker floods the air with EAPOL frames that contain 802.1X authentication requests. As a result, the 802.1X authentication server cannot respond to all of the requests and fails to send successful authentication responses to valid clients. The result is a denial of service to all affected clients. When the EAPOL flood signature (precedence 12) is used to detect such an attack, the access point waits until the maximum number of allowed EAPOL packets is exceeded. It then alerts the controller and proceeds with the appropriate mitigation.
- **NetStumbler signatures—**NetStumbler is a wireless LAN scanning utility that reports access point broadcast information (such as operating channel, RSSI information, adapter manufacturer name, SSID, WEP status, and the latitude and longitude of the device running NetStumbler when a GPS is attached). If NetStumbler succeeds in authenticating and associating to an access point, it sends a data frame with the following strings, depending on the NetStumbler version:

Version	String
3.2.0	“Flurble gronk bloopit, bnip Frundletrune”

Version	String
3.2.3	“All your 802.11b are belong to us”
3.3.0	Sends white spaces

When a NetStumbler signature is used to detect such an attack, the access point identifies the offending device and alerts the controller. The NetStumbler signatures are as follows:

- NetStumbler 3.2.0 (precedence 13)
- NetStumbler 3.2.3 (precedence 14)
- NetStumbler 3.3.0 (precedence 15)
- NetStumbler generic (precedence 16)

A standard signature file exists on the controller by default. You can upload this signature file from the controller, or you can create a custom signature file and download it to the controller or modify the standard signature file to create a custom signature.

Configuring IDS Signatures (GUI)

Uploading or Downloading IDS Signatures

Step 1 If desired, create your own custom signature file.

Step 2 Make sure that you have a Trivial File Transfer Protocol (TFTP) server available. Follow these guidelines when setting up a TFTP server:

- If you are downloading through the service port, the TFTP server must be on the same subnet as the service port because the service port is not routable, or you must create static routes on the controller.
- If you are downloading through the distribution system network port, the TFTP server can be on the same or a different subnet because the distribution system port is routable.
- A third-party TFTP server cannot run on the same computer as the Cisco Prime Infrastructure because the Prime Infrastructure built-in TFTP server and the third-party TFTP server require the same communication port.

Step 3 If you are downloading a custom signature file (*.sig), copy it to the default directory on your TFTP server.

Step 4 Choose **Commands** to open the Download File to Controller page.

Step 5 Perform one of the following:

- If you want to download a custom signature file to the controller, choose **Signature File** from the File Type drop-down list on the Download File to Controller page.
- If you want to upload a standard signature file from the controller, choose **Upload File** and then **Signature File** from the File Type drop-down list on the Upload File from Controller page.

Step 6 From the Transfer Mode drop-down list, choose **TFTP** or **FTP**.

Step 7 In the IP Address text box, enter the IP address of the TFTP or FTP server.

Step 8 If you are downloading the signature file using a TFTP server, enter the maximum number of times that the controller should attempt to download the signature file in the Maximum retries text box.
The range is 1 to 254 and the default value is 10.

Step 9 If you are downloading the signature file using a TFTP server, enter the amount of time in seconds before the controller times out while attempting to download the signature file in the Timeout text box.
The range is 1 to 254 seconds and the default is 6 seconds.

Step 10 In the File Path text box, enter the path of the signature file to be downloaded or uploaded. The default value is "/."

Step 11 In the File Name text box, enter the name of the signature file to be downloaded or uploaded.

Note When uploading signatures, the controller uses the filename that you specify as a base name and then adds "_std.sig" and "_custom.sig" to it in order to upload both standard and custom signature files to the TFTP server. For example, if you upload a signature file called "ids1," the controller automatically generates and uploads both ids1_std.sig and ids1_custom.sig to the TFTP server. If desired, you can then modify ids1_custom.sig on the TFTP server (making sure to set "Revision = custom") and download it by itself.

Step 12 If you are using an FTP server, follow these steps:

1. In the Server Login Username text box, enter the username to log into the FTP server.
2. In the Server Login Password text box, enter the password to log into the FTP server.
3. In the Server Port Number text box, enter the port number on the FTP server through which the download occurs. The default value is 21.

Step 13 Choose **Download** to download the signature file to the controller or **Upload** to upload the signature file from the controller.

Enabling or Disabling IDS Signatures

Step 1 Choose **Security** > **Wireless Protection Policies** > **Standard Signatures** or **Custom Signatures** to open the Standard Signatures page or the Custom Signatures page.
The Standard Signatures page shows the list of Cisco-supplied signatures that are currently on the controller. The Custom Signatures page shows the list of customer-supplied signatures that are currently on the controller. This page shows the following information for each signature:

- The order, or precedence, in which the controller performs the signature checks.
- The name of the signature, which specifies the type of attack that the signature is trying to detect.
- The frame type on which the signature is looking for a security attack. The possible frame types are data and management.
- The action that the controller is directed to take when the signature detects an attack. The possible actions are None and Report.
- The state of the signature, which indicates whether the signature is enabled to detect security attacks.

- A description of the type of attack that the signature is trying to detect.

Step 2 Perform one of the following:

- If you want to allow all signatures (both standard and custom) whose individual states are set to Enabled to remain enabled, select the **Enable Check for All Standard and Custom Signatures** check box at the top of either the Standard Signatures page or the Custom Signatures page. The default value is enabled (or selected). When the signatures are enabled, the access points joined to the controller perform signature analysis on the received 802.11 data or management frames and report any discrepancies to the controller.
- If you want to disable all signatures (both standard and custom) on the controller, unselect the **Enable Check for All Standard and Custom Signatures** check box. If you unselected this check box, all signatures are disabled, even the ones whose individual states are set to Enabled.

Step 3 Click **Apply** to commit your changes.

Step 4 Click the precedence number of the desired signature to enable or disable an individual signature. The **Standard Signature (or Custom Signature) > Detail** page appears.
This page shows much of the same information as the Standard Signatures and Custom Signatures pages but provides these additional details:

- The tracking method used by the access points to perform signature analysis and report the results to the controller. The possible values are as follows:
  - Per Signature—Signature analysis and pattern matching are tracked and reported on a per-signature and per-channel basis.
  - Per MAC—Signature analysis and pattern matching are tracked and reported separately for individual client MAC addresses on a per-channel basis.
  - Per Signature and MAC—Signature analysis and pattern matching are tracked and reported on a per-signature and per-channel basis as well as on a per-MAC-address and per-channel basis.
- The pattern that is being used to detect a security attack

Step 5 In the Measurement Interval text box, enter the number of seconds that must elapse before the signature frequency threshold is reached within the configured interval. The range is 1 to 3600 seconds, and the default value varies per signature.

Step 6 In the Signature Frequency text box, enter the number of matching packets per interval that must be identified at the individual access point level before an attack is detected. The range is 1 to 32,000 packets per interval, and the default value varies per signature.

Step 7 In the Signature MAC Frequency text box, enter the number of matching packets per interval that must be identified per client per access point before an attack is detected. The range is 1 to 32,000 packets per interval, and the default value varies per signature.

Step 8 In the Quiet Time text box, enter the length of time (in seconds) after which no attacks have been detected at the individual access point level and the alarm can stop. The range is 60 to 32,000 seconds, and the default value varies per signature.

Step 9 Select the **State** check box to enable this signature to detect security attacks or unselect it to disable this signature. The default value is enabled (or selected).

Step 10 Click **Apply** to commit your changes. The Standard Signatures or Custom Signatures page reflects the signature's updated state.

Step 11 Click **Save Configuration** to save your changes.

Viewing IDS Signature Events (GUI)

Step 1 Choose **Security** > **Wireless Protection Policies** > **Signature Events Summary** to open the Signature Events Summary page.

Step 2 Click the Signature Type for the signature to see more information on the attacks detected by a particular signature. The Signature Events Detail page appears.
This page shows the following information:

- The MAC addresses of the clients identified as attackers
- The method used by the access point to track the attacks
- The number of matching packets per second that were identified before an attack was detected.
- The number of access points on the channel on which the attack was detected
- The day and time when the access point detected the attack

Step 3 Click the **Detail link** for that attack to see more information for a particular attack. The Signature Events Track Detail page appears.

- The MAC address of the access point that detected the attack
- The name of the access point that detected the attack
- The type of radio (802.11a or 802.11b/g) used by the access point to detect the attack
- The radio channel on which the attack was detected

- The day and time when the access point reported the attack

Configuring IDS Signatures (CLI)

Step 1 If desired, create your own custom signature file.

Step 2 Make sure that you have a TFTP server available.

Step 3 Copy the custom signature file (*.sig) to the default directory on your TFTP server.

Step 4 Specify the download or upload mode by entering the **transfer** {**download** | **upload**} **mode tftp** command.

Step 5 Specify the type of file to be downloaded or uploaded by entering the **transfer** {**download** | **upload**} **datatype signature** command.

Step 6 Specify the IP address of the TFTP server by entering the **transfer** {**download** | **upload**} **serverip** *tftp-server-ip-address* command.

Note Some TFTP servers require only a forward slash (/) as the TFTP server IP address, and the TFTP server automatically determines the path to the correct directory.

Step 7 Specify the download or upload path by entering the **transfer** {**download** | **upload**} *path absolute-tftp-server-path-to-file* command.

Step 8 Specify the file to be downloaded or uploaded by entering the **transfer** {**download** | **upload**} *filename filename.sig* command.

Note When uploading signatures, the controller uses the filename you specify as a base name and then adds "_std.sig" and "_custom.sig" to it in order to upload both standard and custom signature files to the TFTP server. For example, if you upload a signature file called "ids1," the controller automatically generates and uploads both ids1_std.sig and ids1_custom.sig to the TFTP server. If desired, you can then modify ids1_custom.sig on the TFTP server (making sure to set "Revision = custom") and download it by itself.

Step 9 Enter the **transfer** {**download** | **upload**} *start* command and answer y to the prompt to confirm the current settings and start the download or upload.

Step 10 Specify the number of seconds that must elapse before the signature frequency threshold is reached within the configured interval by entering this command:
config wps signature interval *signature_id interval*

where signature_id is a number used to uniquely identify a signature. The range is 1 to 3600 seconds, and the default value varies per signature.

Step 11 Specify the number of matching packets per interval that must be identified at the individual access point level before an attack is detected by entering this command:
config wps signature frequency*signature_id frequency*

The range is 1 to 32,000 packets per interval, and the default value varies per signature.

Step 12 Specify the number of matching packets per interval that must be identified per client per access point before an attack is detected by entering this command:
config wps signature mac-frequency *signature_id mac_frequency*

The range is 1 to 32,000 packets per interval, and the default value varies per signature.

Step 13 Specify the length of time (in seconds) after which no attacks have been detected at the individual access point level and the alarm can stop by entering by entering this command:
config wps signature quiet-time *signature_id quiet_time*

The range is 60 to 32,000 seconds, and the default value varies per signature.

Step 14 Perform one of the following:

- To enable or disable an individual IDS signature, enter this command:

  config wps signature {**standard**| **custom**} **state** *signature_id* {**enable** | **disable**}

- To enable or disable IDS signature processing, which enables or disables the processing of all IDS signatures, enter this command:

  config wps signature {**enable** | **disable**}

  Note If IDS signature processing is disabled, all signatures are disabled, regardless of the state configured for individual signatures.

Step 15 Save your changes by entering this command:
save config

Step 16 If desired, you can reset a specific signature or all signatures to default values. To do so, enter this command:
config wps signature reset {*signature_id* | *all*}

Note You can reset signatures to default values only through the controller CLI.

Viewing IDS Signature Events (CLI)

- See whether IDS signature processing is enabled or disabled on the controller by entering this command:
  show wps summary

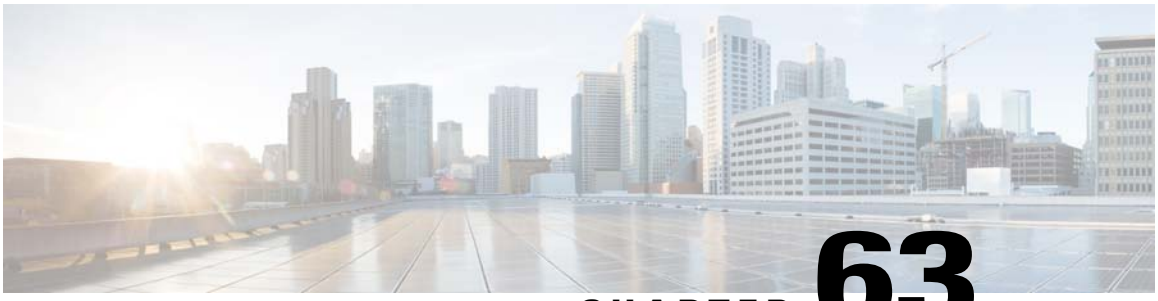
Note If IDS signature processing is disabled, all signatures are disabled, regardless of the state configured for individual signatures.

- See individual summaries of all of the standard and custom signatures installed on the controller by entering this command:
  show wps signature summary
- See the number of attacks detected by the enabled signatures by entering this command:

  show wps signature events summary
- See more information on the attacks detected by a particular standard or custom signature by entering this command:

  show wps signature events {**standard** | **custom**} **precedence# summary**

- See information on attacks that are tracked by access points on a per-signature and per-channel basis by entering this command:
  show wps signature events {**standard** | **custom**} **precedence# detailed per-signature** *source_mac*
- See information on attacks that are tracked by access points on an individual-client basis (by MAC address) by entering this command:
  show wps signature events {**standard** | **custom**} **precedence# detailed per-mac** *source_mac*



CHAPTER 63

Configuring wIPS

Information About wIPS

The Cisco Adaptive wireless Intrusion Prevention System (wIPS) is an advanced approach to wireless threat detection and performance management. It combines network traffic analysis, network device and topology information, signature-based techniques, and anomaly detection to deliver highly accurate and complete wireless threat prevention. With a fully infrastructure-integrated solution, you can continually monitor wireless traffic on both the wired and wireless networks and use that network intelligence to analyze attacks from many sources to more accurately pinpoint and proactively prevent attacks rather than waiting until damage or exposure has occurred.

The Cisco Adaptive wIPS is enabled by the Cisco 3300 Series Mobility Services Engine (MSE), which centralizes the processing of intelligence collected by the continuous monitoring of Cisco Aironet access points. With Cisco Adaptive wIPS functionalities and Cisco Prime Infrastructure integration into the MSE, the wIPS service can configure, monitor, and report wIPS policies and alarms.

Note If your wIPS deployment consists of a controller, access point, and MSE, you must set all the three entities to the UTC time zone.

The Cisco Adaptive wIPS is not configured on the controller. Instead, the Prime Infrastructure forwards the profile configuration to the wIPS service, which forwards the profile to the controller. The profile is stored in flash memory on the controller and sent to access points when they join the controller. When an access point disassociates and joins another controller, it receives the wIPS profile from the new controller.

Local mode or FlexConnect mode access points with a subset of wIPS capabilities is referred to as Enhanced Local Mode access point or ELM AP. You can configure an access point to work in wIPS mode if the access point is in any of the following modes:

- Monitor
- Local
- FlexConnect

The regular local mode or FlexConnect mode access point is extended with a subset of Wireless Intrusion Prevention System (wIPS) capabilities. This feature enables you to deploy your access points to provide protection without needing a separate overlay network.

wIPS ELM has limited capability of detecting off-channel alarms. The access point periodically goes off-channel, and monitors the non-serving channels for a short duration, and triggers alarms if any attack is detected on the channel. But the off-channel alarm detection is best effort and it takes longer time to detect attacks and trigger alarms, which might cause the ELM AP intermittently detect an alarm and clear it because it is not visible. Access points in any of the above modes can periodically send alarms based on the policy profile to the wIPS service through the controller. The wIPS service stores and processes the alarms and generates SNMP traps. The Prime Infrastructure configures its IP address as a trap destination to receive SNMP traps from the MSE.

This table lists all the SNMP trap controls and their respective traps. When a trap control is enabled, all the traps of the trap control are also enabled.

Note The controller uses only SNMPv2 for SNMP trap transmission.

Table 17: SNMP Trap Controls and their respective Traps

Tab Name	Trap Control	Trap
General	Link (Port) Up/Down	linkUp, linkDown
	Spanning Tree	newRoot, topologyChange, stpInstanceNewRootTrap, stpInstanceTopologyChangeTrap
	Config Save	bsnDot11EssCreated, bsnDot11EssDeleted, bsnConfigSaved, ciscoLwappScheduledResetNotif, ciscoLwappClearResetNotif, ciscoLwappResetFailedNotif, ciscoLwappSysInvalidXmlConfig
AP	AP Register	bsnAPDisassociated, bsnAPAssociated
	Ap Interface Up/Down	bsnAPIfUp, bsnAPIfDown

Tab Name	Trap Control	Trap
Client Traps	802.11 Association	bsnDot11StationAssociate
	802.11 Disassociation	bsnDot11StationDisassociate
	802.11 Deauthentication	bsnDot11StationDeauthenticate
	802.11 Failed Authentication	bsnDot11StationAuthenticateFail
	802.11 Failed Association	bsnDot11StationAssociateFail
	Exclusion	bsnDot11StationBlacklisted
	NAC Alert	cldcClientWlanProfileName, cldcClientIPAddress, cldcApMacAddress, cldcClientQuarantineVLAN, cldcClientAccessVLAN
Security Traps	User Authentication	bsnTooManyUnsuccessLoginAttempts, cLWAGuestUserLoggedIn, cLWAGuestUserLoggedOut
	RADIUS Servers Not Responding	bsnRADIUSServerNotResponding, ciscoLwappAAARadiusReqTimedOut
	WEP Decrypt Error	bsnWepKeyDecryptError
	Rogue AP	bsnAdhocRogueAutoContained, bsnRogueApAutoContained, bsnTrustedApHasInvalidEncryption, bsnMaxRogueCountExceeded, bsnMaxRogueCountClear, bsnApMaxRogueCountExceeded, bsnApMaxRogueCountClear, bsnTrustedApHasInvalidRadioPolicy, bsnTrustedApHasInvalidSsid, bsnTrustedApIsMissing
	SNMP Authentication	agentSnmpAuthenticationTrapFlag
	Multiple Users	multipleUsersTrap
Auto RF Profile Traps	Load Profile	bsnAPLoadProfileFailed
	Noise Profile	bsnAPNoiseProfileFailed
	Interference Profile	bsnAPInterferenceProfileFailed
	Coverage Profile	bsnAPCoverageProfileFailed

Tab Name	Trap Control	Trap
Auto RF Update Traps	Channel Update	bsnAPCurrentChannelChanged
	Tx Power Update	bsnAPCurrentTxPowerChanged
Mesh Traps	Child Excluded Parent	ciscoLwappMeshChildExcludedParent
	Parent Change	ciscoLwappMeshParentChange
	Authfailure Mesh	ciscoLwappMeshAuthorizationFailure
	Child Moved	ciscoLwappMeshChildMoved
	Excessive Parent Change	ciscoLwappMeshExcessiveParentChange
	Excessive Children	ciscoLwappMeshExcessiveChildren
	Poor SNR	ciscoLwappMeshAbateSNR, ciscoLwappMeshOnsetSNR
	Console Login	ciscoLwappMeshConsoleLogin
	Excessive Association	ciscoLwappMeshExcessiveAssociation
	Default Bridge Group Name	ciscoLwappMeshDefaultBridgeGroupName

The following are the trap description for the traps mentioned in the *SNMP Trap Controls and their respective Traps* table:

- General Traps
  - SNMP Authentication—The SNMPv2 entity has received a protocol message that is not properly authenticated.

    Note When a user who is configured in SNMP V3 mode tries to access the controller with an incorrect password, the authentication fails and a failure message is displayed. However, no trap logs are generated for the authentication failure.

  - Link (Port) Up/Down—Link changes status from up or down.
  - Link (Port) Up/Down—Link changes status from up or down.
  - Multiple Users—Two users log on with the same ID.
  - Rogue AP—Whenever a rogue access point is detected, this trap is sent with its MAC address; when a rogue access point that was detected earlier no longer exists, this trap is sent.
  - Config Save—Notification sent when the controller configuration is modified.
- Cisco AP Traps

- AP Register—Notification sent when an access point associates or disassociates with the controller.
- AP Interface Up/Down—Notification sent when an access point interface (802.11X) status goes up or down.

- Client Related Traps
  - 802.11 Association—Associate notification that is sent when the client sends an association frame.
  - 802.11 Disassociation—Disassociate notification that is sent when the client sends a disassociation frame.
  - 802.11 Deauthentication—Deauthenticate notification that is sent when the client sends a deauthentication frame.
  - 802.11 Failed Authentication—Authenticate failure notification that is sent when the client sends an authentication frame with a status code other than successful.
  - 802.11 Failed Association—Associate failure notification that is sent when the client sends an association frame with a status code other than successful.
  - Exclusion—Associate failure notification that is sent when a client is Exclusion Listed (blacklisted).
  - Authentication—Authentication notification that is sent when a client is successfully authenticated.
  - Max Clients Limit Reached—Notification that is sent when the maximum number of clients, defined in the Threshold field, have associated with the controller.
  - NAC Alert—Alert that is sent when a client joins an SNMP NAC-enabled WLAN.

    This notification is generated when a client on NAC-enabled SSIDs complete Layer2 authentication to inform about the client's presence to the NAC appliance. cldcClientWlanProfileName represents the profile name of the WLAN that the 802.11 wireless client is connected to. cldcClientIPAddress represents the unique IP address of the client. cldcApMacAddress represents the MAC address of the AP to which the client is associated. cldcClientQuarantineVLAN represents the quarantine VLAN for the client. cldcClientAccessVLAN represents the access VLAN for the client.
  - Association with Stats—Associate notification that is sent with data statistics when a client associates with the controller or roams. The data statistics include transmitted and received bytes and packets.
  - Disassociation with Stats—Disassociate notification that is sent with data statistics when a client disassociates from the controller. The data statistics include transmitted and received bytes and packets, SSID, and session ID.

- Security Traps
  - User Auth Failure—This trap is to inform that a client RADIUS Authentication failure has occurred.
  - RADIUS Server No Response—This trap is to indicate that no RADIUS server(s) are responding to authentication requests sent by the RADIUS client.
  - WEP Decrypt Error—Notification sent when the controller detects a WEP decrypting error.
  - Rouge AP—Whenever a rogue access point is detected, this trap is sent with its MAC address; when a rogue access point that was detected earlier no longer exists, this trap is sent.
  - SNMP Authentication—The SNMPv2 entity has received a protocol message that is not properly authenticated.

Note When a user who is configured in SNMP V3 mode tries to access the controller with an incorrect password, the authentication fails and a failure message is displayed. However, no trap logs are generated for the authentication failure.

- Multiple Users—Two users log on with the same ID.

- SNMP Authentication
  - Load Profile—Notification sent when the Load Profile state changes between PASS and FAIL.
  - Noise Profile—Notification sent when the Noise Profile state changes between PASS and FAIL.
  - Interference Profile—Notification sent when the Interference Profile state changes between PASS and FAIL.
  - Coverage Profile—Notification sent when the Coverage Profile state changes between PASS and FAIL.

- Auto RF Profile Traps
  - Load Profile—Notification sent when the Load Profile state changes between PASS and FAIL.
  - Noise Profile—Notification sent when the Noise Profile state changes between PASS and FAIL.
  - Interference Profile—Notification sent when the Interference Profile state changes between PASS and FAIL.
  - Coverage Profile—Notification sent when the Coverage Profile state changes between PASS and FAIL.

- Auto RF Update Traps
  - Channel Update—Notification sent when the access point dynamic channel algorithm is updated.
  - Tx Power Update—Notification sent when the access point dynamic transmit power algorithm is updated.

- Mesh Traps
  - Child Excluded Parent—Notification send when a defined number of failed association to the controller occurs through a parent mesh node.
  - Notification sent when a child mesh node exceeds the threshold limit of the number of discovery response timeouts. The child mesh node does not try to associate an excluded parent mesh node for the interval defined. The child mesh node remembers the excluded parent MAC address when it joins the network, it informs the controller.
  - Parent Change—Notification is sent by the agent when a child mesh node changes its parent. The child mesh node remembers its previous parent and it informs the controller about the change of its parent when it rejoins the network.
  - Child Moved—Notification sent when a parent mesh node loses connection with its child mesh node.

- Excessive Parent Change—Notification sent when the child mesh node changes its parent frequently. Each mesh node keeps a count of the number of parent changes in a fixed time. If it exceeds the defined threshold then child mesh node informs the controller.
- Excessive Children—Notification sent when the child count exceeds for a RAP and MAP.
- Poor SNR—Notification sent when the child mesh node detects a lower SNR on a backhaul link. For the other trap, a notification is sent to clear a notification when the child mesh node detects an SNR on a backhaul link that is higher then the object defined by 'clMeshSNRThresholdAbate'.
- Console Login—Notification is sent by the agent when login on MAP console is successful or failure after three attempts.
- Default Bridge Group Name—Notification sent when MAP mesh node joins parent using 'default' bridge group name.

Note The remaining traps do not have trap controls. These traps are not generated too frequently and do not require any trap control. Any other trap that is generated by the controller cannot be turned off.

Note In all of the above cases, the controller functions solely as a forwarding device.

Note To download the MIBs, click here.

Restrictions for wIPS

- wIPS ELM is not supported on 1130 and 1240 access points.

Configuring wIPS on an Access Point (GUI)

Step 1 Choose **Wireless** > **Access Points** > **All APs** > *access point name*.

Step 2 Set the **AP Mode** parameter. To configure an access point for wIPS, you must choose one of the following modes from the **AP Mode** drop-down list:

- **Local**
- **FlexConnect**

- **Monitor**

Step 3 Set the **AP Sub Mode** to wIPS by choosing **wIPS** from the **AP Sub Mode** drop-down list.

Step 4 Click **Apply**.

Step 5 Click **Save Configuration**.

Configuring wIPS on an Access Point (CLI)

Step 1 Configure an access point for monitor mode by entering this command:
config ap mode {monitor | local | flexconnect} *Cisco_AP*

Note To configure an access point for wIPS, the access point must be in **monitor**, **local**, or **flexconnect** modes.

Step 2 Enter **Y** when you see the message that the access point will be rebooted if you want to continue.

Step 3 Save your changes by entering this command:
save config

Step 4 Disable the access point radio by entering this command:
config {802.11a | 802.11b} disable *Cisco_AP*

Step 5 Configure the wIPS submode on the access point by entering this command:
config ap mode *ap_mode* **submode wips** *Cisco_AP*

Note To disable wIPS on the access point, enter the **config ap mode** *ap_mode* **submode none** *Cisco_AP command.*

Step 6 Enable wIPS optimized channel scanning for the access point by entering this command:
config ap monitor-mode wips-optimized *Cisco_AP*

The access point scans each channel for 250 milliseconds. It derives the list of channels to be scanned from the monitor configuration. You can choose one of these options:

- **All—**All channels supported by the access point's radio
- **Country—**Only the channels supported by the access point's country of operation
- **DCA—**Only the channel set used by the dynamic channel assignment (DCA) algorithm, which by default includes all of the nonoverlapping channels allowed in the access point's country of operation

The 802.11a or 802.11b Monitor Channels text box in the output of the **show advanced** {**802.11a** | **802.11b**} **monitor** command shows the monitor configuration channel set:

```
Default 802.11b AP monitoring
  802.11b Monitor Mode..................... enable
  802.11b Monitor Channels................. Country channels
  802.11b AP Coverage Interval............. 180 seconds
  802.11b AP Load Interval................. 60 seconds
  802.11b AP Noise Interval................ 180 seconds
```

```
802.11b AP Signal Strength Interval..... 60 seconds
```

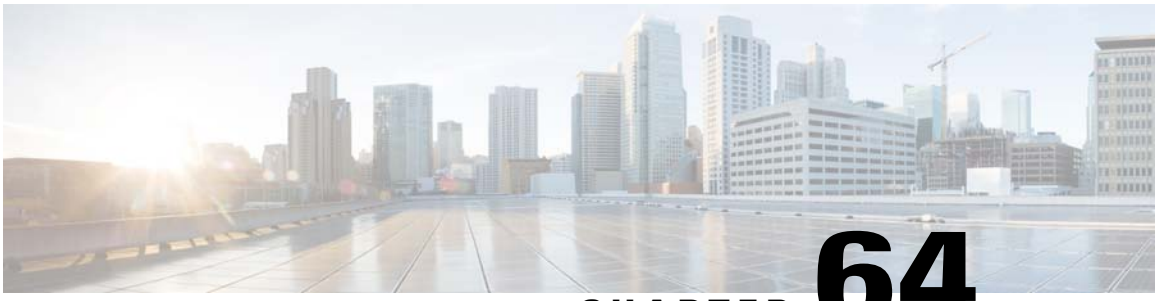
Step 7 Reenable the access point radio by entering this command:
config { **802.11a** | **802.11b**} **enable** *Cisco_AP*

Step 8 Save your changes by entering this command:
save config

Viewing wIPS Information (CLI)

Note You can also view the access point submode from the controller GUI. To do so, choose **Wireless** > **Access Points** > **All APs** > the access point name > the **Advanced** tab. The AP Sub Mode text box shows *wIPS* if the access point in is monitor mode and the wIPS submode is configured on the access point or *None* if the access point is not in monitor mode or the access point is in monitor mode but the wIPS submode is not configured.

- See the wIPS submode on the access point by entering this command:
  show ap config general *Cisco_AP*
- See the wIPS optimized channel scanning configuration on the access point by entering this command:
  show ap monitor-mode summary
- See the wIPS configuration forwarded by Cisco Prime Infrastructure to the controller by entering this command:
  show wps wips summary
- See the current state of wIPS operation on the controller by entering this command:
  show wps wips statistics
- Clear the wIPS statistics on the controller by entering this command:
  clear stats wps wips



CHAPTER 64

Configuring the Wi-Fi Direct Client Policy

Information About the Wi-Fi Direct Client Policy

Devices that are Wi-Fi Direct capable can connect directly to each other quickly and conveniently to do tasks such as printing, synchronization, and sharing of data. Wi-Fi Direct devices may associate with multiple peer-to-peer (P2P) devices and with infrastructure wireless LANs (WLANs) concurrently. You can use the controller to configure the Wi-Fi Direct Client Policy, on a per WLAN basis, where you can allow or disallow association of Wi-Fi devices with infrastructure WLANs, or disable Wi-Fi Direct Client Policy altogether for WLANs.

Restrictions for the Wi-Fi Direct Client Policy

Wi-Fi Direct Client Policy is applicable to WLANs that have APs in local mode only.

Configuring the Wi-Fi Direct Client Policy (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the WLAN ID of the WLAN for which you want to configure the Wi-Fi Direct Client Policy. The **WLANs > Edit** page appears.

Step 3 Click the **Advanced** tab.

Step 4 From the **Wi-Fi Direct Clients Policy** drop-down list, choose one of the following options:

- **Disabled—**Ignores the Wi-Fi Direct status of clients thereby allowing Wi-Fi Direct clients to associate
- **Allow—**Allows Wi-Fi Direct clients to associate with the WLAN
- **Not-Allow—**Disallows the Wi-Fi Direct clients from associating with the WLAN

Step 5 Click **Apply**.

Configuring the Wi-Fi Direct Client Policy (CLI)

Step 1 Configure the Wi-Fi Direct Client Policy on WLANs by entering this command:
config wlan wifidirect {**allow** | **disable** | **not-allow**} *wlan-id*

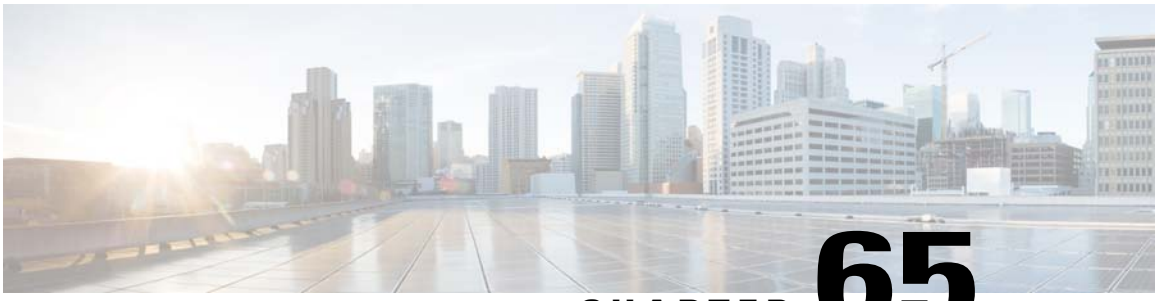
The syntax of the command is as follows:

- **allow—**Allows Wi-Fi Direct clients to associate with the WLAN
- **disable—**Disables the Wi-Fi Direct Client Policy for the WLAN and deauthenticates all Wi-Fi Direct clients
- **not-allow—**Disallows the Wi-Fi Direct clients from associating with the WLAN
- *wlan-id***—**WLAN identifier

Step 2 Save your configuration by entering this command:
save config

Monitoring and Troubleshooting the Wi-Fi Direct Client Policy (CLI)

- Monitor and troubleshoot the Wi-Fi Direct Client Policy by entering theses commands:
  - **show wlan wifidirect** *wlan-id***—**Displays status of the Wi-Fi Direct Client Policy on the WLAN.
  - **show client wifiDirect-stats—**Displays the total number of clients associated and the number of clients rejected if the Wi-Fi Direct Client Policy is enabled.



CHAPTER 65

Configuring Web Auth Proxy

Information About the Web Authentication Proxy

This feature enables clients that have manual web proxy enabled in the browser to facilitate authentication with the controller. If the user's browser is configured with manual proxy settings with a configured port number as 8080 or 3128 and if the client requests any URL, the controller responds with a web page prompting the user to change the Internet proxy settings to automatically detect the proxy settings so that the browser's manual proxy settings information does not get lost. After enabling this settings, the user can get access to the network through the web authentication policy. This functionality is given for port 8080 and 3128 because these are the most commonly used ports for the web proxy server.

Note The web authentication proxy redirect ports are not blocked through CPU ACL. If a CPU ACL is configured to block the port 8080, 3128, and one random port as part of web authentication proxy configuration, those ports are not blocked because the webauth rules take higher precedence than the CPU ACL rules unless the client is in the webauth_req state.

A web browser has the following three types of Internet settings that you can configure:

- Auto detect
- System Proxy
- Manual

In a manual proxy server configuration, the browser uses the IP address of a proxy server and a port. If this configuration is enabled on the browser, the wireless client communicates with the IP address of the destination proxy server on the configured port. In a web authentication scenario, the controller does not listen to such proxy ports and the client is not able to establish a TCP connection with the controller. The user is unable to get any login page to authentication and get access to the network.

When a wireless client enters a web-authenticated WLAN, the client tries to access a URL. If a manual proxy configuration is configured on the client's browser, all the web traffic going out from the client will be destined to the proxy IP and port configured on the browser.

- A TCP connection is established between the client and the proxy server IP address that the controller proxies for.
- The client processes the DHCP response and obtains a JavaScript file from the controller. The script disables all proxy configurations on the client for that session.

Note For external clients, the controller sends the login page as is (with or without JavaScipt).

- Any requests that bypass the proxy configuration. The controller can then perform web-redirection, login, and authentication.
- When the client goes out of the network, and then back into its own network, a DHCP refresh occurs and the client continues to use the old proxy configuration configured on the browser.
- If the external DHCP server is used with webauth proxy, then DHCP option 252 must be configured on the DHCP server for that scope. The value of option 252 will have the format http://<virtual ip>/proxy.js. No extra configuration is needed for internal DHCP servers.

Note When you configure FIPS mode with secure web authentication, we recommend that you use Mozilla Firefox as your browser.

Configuring the Web Authentication Proxy (GUI)

Step 1 Choose **Controller > General**

Step 2 From the **WebAuth Proxy Redirection Mode** drop-down list, choose **Enabled** or **Disabled**.

Step 3 In the **WebAuth Proxy Redirection Port** text box, enter the port number of the web auth proxy.
This text box consists of the port numbers on which the controller listens to for web authentication proxy redirection. By default, the three ports 80, 8080, and 3128 are assumed. If you configured the web authentication redirection port to any port other than these values, you must specify that value.

Step 4 Click **Apply**.

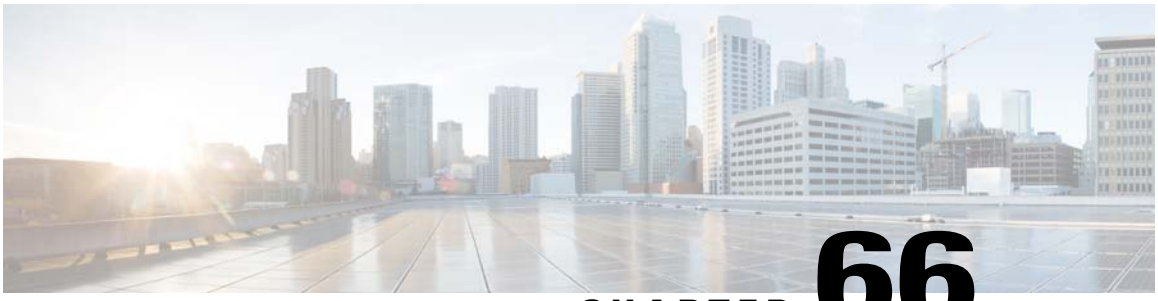
Configuring the Web Authentication Proxy (CLI)

- Enable web authentication proxy redirection by entering this command:
  config network web-auth proxy-redirect {**enable** | **disable**}
- Configure the secure web (https) authentication for clients by entering this command:

config network web-auth secureweb {**enable** | **disable**}
The default secure web (https) authentication for clients is enabled.

Note If you configure to disallow secure web (https) authentication for clients using the **config network web-auth secureweb disable** command, then you must reboot the Cisco WLC to implement the change.

- Set the web authentication port number by entering this command:
  config network web-auth port *port-number*
  This parameter specifies the port numbers on which the controller listens to for web authentication proxy redirection. By default, the three ports 80, 8080, and 3128 are assumed. If you configured the web authentication redirection port to any port other than these values, you must specify that value.
- See the current status of the web authentication proxy configuration by entering one of the following commands:
  - **show network summary**
  - **show running-config**



CHAPTER 66

Detecting Active Exploits

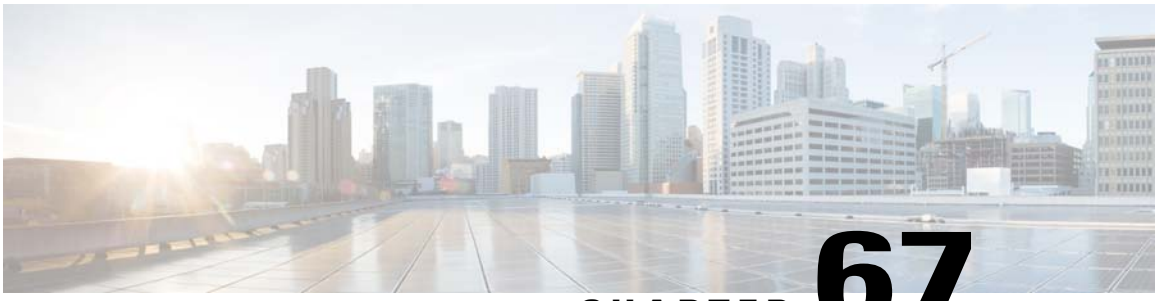
Detecting Active Exploits

The controller supports three active exploit alarms that serve as notifications of potential threats. They are enabled by default and therefore require no configuration on the controller.

- **ASLEAP detection—**The controller raises a trap event if an attacker launches a LEAP crack tool. The trap message is visible in the controller's trap log.
- **Fake access point detection—**The controller tweaks the fake access point detection logic to avoid false access point alarms in high-density access point environments.
- **Honeypot access point detection—**The controller raises a trap event if a rogue access point is using managed SSIDs (WLANs configured on the controller). The trap message is visible in the controller's trap log.

PART V

Working with WLANs



CHAPTER 67

Overview

Information About WLANs

This feature enables you to control up to 512 WLANs for lightweight access points. Each WLAN has a separate WLAN ID, a separate profile name, and a WLAN SSID. All controllers publish up to 16 WLANs to each connected access point, but you can create up to the maximum number of WLANs supported and then selectively publish these WLANs (using access point groups) to different access points to better manage your wireless network.

You can configure WLANs with different SSIDs or with the same SSID. An SSID identifies the specific wireless network that you want the controller to access.

Prerequisites for WLANs

- You can associate up to 16 WLANs with each access point group and assign specific access points to each group. Each access point advertises only the enabled WLANs that belong to its access point group. The access point (AP) does not advertise disabled WLANs in its access point group or WLANs that belong to another group.
- We recommend that you assign one set of VLANs for WLANs and a different set of VLANs for management interfaces to ensure that controllers properly route VLAN traffic.
- The controller uses different attributes to differentiate between WLANs with the same Service Set Identifier (SSID).
  - WLANs with the same SSID and same Layer 2 policy cannot be created if the WLAN ID is lower than 17.
  - Two WLANs with IDs that are greater than 17 and that have the same SSID and same Layer 2 policy is allowed if WLANs are added in different AP groups.

Note This requirement ensures that clients never detect the SSID present on the same access point radio.

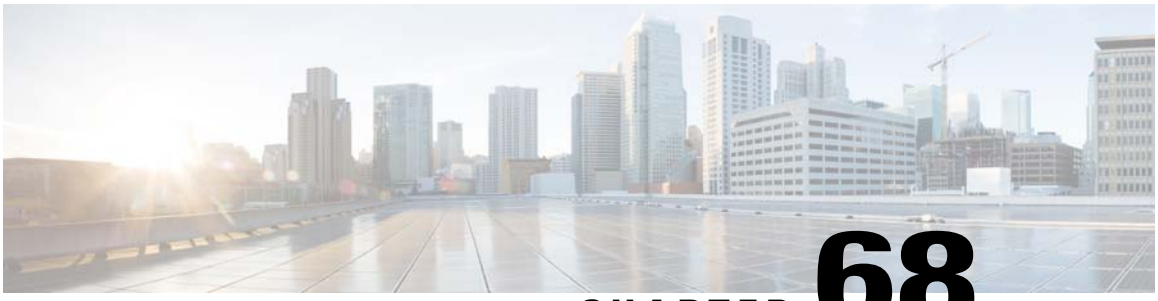
Restrictions for WLANs

- Peer-to-peer blocking does not apply to multicast traffic.
- The WLAN name and SSID can have up to 32 characters. Spaces are not allowed in the WLAN profile name and SSID.
- You cannot map a WLAN to VLAN0, and you cannot map VLANs 1002 to 1006.
- Dual stack clients with a static-IPv4 address is not supported.
- When creating a WLAN with the same SSID, you must create a unique profile name for each WLAN.
- All OfficeExtend access points should be in the same access point group, and that group should contain no more than 15 WLANs. A controller with OfficeExtend access points in an access point group publishes only up to 15 WLANs to each connected OfficeExtend access point because it reserves one WLAN for the personal SSID.
- The Cisco Flex 7500 Series Controller does not support the 802.1X security variants on a centrally switched WLAN. For example, the following configurations are not allowed on a centrally switched WLAN:
  - WPA1/WPA2 with 802.1X AKM
  - WPA1/WPA2 with CCKM
  - Dynamic-WEP
  - Conditional webauth
  - Splash WEB page redirect
  - If you want to configure your WLAN in any of the above combinations, the WLAN must be configured to use local switching.
- If you configured your WLAN with EAP Passthrough and if you downgrade to an earlier controller version, you might encounter XML validation errors during the downgrade process. This problem is because EAP Passthrough is not supported in earlier releases. The configuration will default to the default security settings (WPA2/802.1X).

Note The OEAP 600 Series access point supports a maximum of two WLANs and one remote LAN. If you have configured more than two WLANs and one remote LAN, you can assign the 600 Series access point to an AP group. The support for two WLANs and one remote LAN still applies to the AP Group If the 600 Series OEAP is in the default group, the WLAN or remote LAN IDs must be lower than 8.

- Profile name of WLAN can be of max 31 characters for a locally switched WLAN. For central switched WLAN, the profile name can be of 32 characters.
- When multiple WLANs with the same SSID get assigned to the same AP radio, you must have a unique Layer 2 security policy so that clients can safely select between them.

Caution Some clients might not be able to connect to WLANs properly if they detect the same SSID with multiple security policies. Use this feature with care.



CHAPTER 68

Configuring WLANs

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Information About WLANs

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You can configure WLANs with different SSIDs or with the same SSID. An SSID identifies the specific wireless network that you want the controller to access.

Creating and Removing WLANs (GUI)

Step 1 Choose **WLANs** to open the WLANs page.
This page lists all of the WLANs currently configured on the controller. For each WLAN, you can see its WLAN ID, profile name, type, SSID, status, and security policies.

The total number of WLANs appears in the upper right-hand corner of the page. If the list of WLANs spans multiple pages, you can access these pages by clicking the page number links.

Note If you want to delete a WLAN, hover your cursor over the blue drop-down arrow for that WLAN and choose **Remove,** or select the check box to the left of the WLAN, choose **Remove Selected** from the drop-down list, and click **Go**. A message appears asking you to confirm your decision. If you proceed, the WLAN is removed from any access point group to which it is assigned and from the access point's radio.

Step 2 Create a new WLAN by choosing **Create New** from the drop-down list and clicking **Go**. The **WLANs > New** page appears.

Note When you upgrade to controller software release 5.2 or later releases, the controller creates the default-group access point group and automatically populates it with the first 16 WLANs (WLANs with IDs 1 through 16, or fewer if 16 WLANs are not configured). This default group cannot be modified (you cannot add WLANs to it nor delete WLANs from it). It is dynamically updated whenever the first 16 WLANs are added or deleted. If an access point does not belong to an access point group, it is assigned to the default group and uses the WLANs in that group. If an access point joins the controller with an undefined access point group name, the access point keeps its group name but uses the WLANs in the default-group access point group.

Step 3 From the Type drop-down list, choose **WLAN** to create a WLAN.

Note If you want to create a guest LAN for wired guest users, choose **Guest LAN**.

Step 4 In the Profile Name text box, enter up to 32 characters for the profile name to be assigned to this WLAN. The profile name must be unique.

Step 5 In the WLAN SSID text box, enter up to 32 characters for the SSID to be assigned to this WLAN.

Step 6 From the WLAN ID drop-down list, choose the ID number for this WLAN.

Note If the Cisco OEAP 600 is in the default group, the WLAN/Remote LAN IDs need to be set as lower than ID 8.

Step 7 Click **Apply** to commit your changes. The WLANs > Edit page appears.

Note You can also open the WLANs > Edit page from the WLANs page by clicking the ID number of the WLAN that you want to edit.

Step 8 Use the parameters on the General, Security, QoS, and Advanced tabs to configure this WLAN. See the sections in the rest of this chapter for instructions on configuring specific features for WLANs.

Step 9 On the General tab, select the **Status** check box to enable this WLAN. Be sure to leave it unselected until you have finished making configuration changes to the WLAN.

Step 10 Click **Apply** to commit your changes.

Step 11 Click **Save Configuration** to save your changes.

Enabling and Disabling WLANs (GUI)

Step 1 Choose **WLANs** to open the WLANs page.
This page lists all of the WLANs currently configured on the controller.

Step 2 Enable or disable WLANs from the WLANs page by selecting the check boxes to the left of the WLANs that you want to enable or disable, choosing **Enable Selected** or **Disable Selected** from the drop-down list, and clicking **Go**.

Step 3 Click **Apply**.

Creating and Deleting WLANs (CLI)

- Create a new WLAN by entering this command:

  config wlan create wlan_id {**profile_name** | **foreign_ap**} *ssid*

Note If you do not specify an **ssid**, the **profile_name** parameter is used for both the profile name and the SSID.

Note When WLAN 1 is created in the configuration wizard, it is created in enabled mode. Disable it until you have finished configuring it. When you create a new WLAN using the **config wlan create** command, it is created in disabled mode. Leave it disabled until you have finished configuring it.

- Delete a WLAN by entering this command:

  config wlan delete {**wlan_id** | **foreign_ap**}

Note An error message appears if you try to delete a WLAN that is assigned to an access point group. If you proceed, the WLAN is removed from the access point group and from the access point's radio.

Enabling and Disabling WLANs (CLI)

- Enable a WLAN (for example, after you have finished making configuration changes to the WLAN) by entering this command:
  config wlan enable {*wlan_id* | **foreign_ap** | **all**}

Note If the command fails, an error message appears (for example, "Request failed for wlan 10 - Static WEP key size does not match 802.1X WEP key size").

- Disable a WLAN (for example, before making any modifications to a WLAN) by entering this command:
  config wlan disable {*wlan_id* | **foreign_ap** | **all**}
  where

  wlan_id is a WLAN ID between 1 and 512.

  foreign_ap is a third-party access point.

  all is all WLANs.

Note If the management and AP-manager interfaces are mapped to the same port and are members of the same VLAN, you must disable the WLAN before making a port-mapping change to either interface. If the management and AP-manager interfaces are assigned to different VLANs, you do not need to disable the WLAN.

Viewing WLANs (CLI)

- View the list of existing WLANs and to see whether they are enabled or disabled by entering this command:

show wlan summary

Searching WLANs (GUI)

Step 1 On the WLANs page, click **Change Filter**. The Search WLANs dialog box appears.

Step 2 Perform one of the following:

- To search for WLANs based on profile name, select the **Profile Name** check box and enter the desired profile name in the edit box.
- To search for WLANs based on SSID, select the **SSID** check box and enter the desired SSID in the edit box.
- To search for WLANs based on their status, select the **Status** check box and choose **Enabled** or **Disabled** from the drop-down list.

Step 3 Click **Find**. Only the WLANs that match your search criteria appear on the WLANs page, and the Current Filter field at the top of the page specifies the search criteria used to generate the list (for example, None, Profile Name:user1, SSID:test1, Status: disabled).

Note To clear any configured search criteria and display the entire list of WLANs, click **Clear Filter**.

Assigning WLANs to Interfaces

Use these commands to assign a WLAN to an interface:

- Assign a WLAN to an interface by entering this command:

  config wlan interface {*wlan_id* | *foreignAp*} *interface_id*

  - Use the *interface_id* option to assign the WLAN to a specific interface.
  - Use the *foreignAp* option to use a third-party access point.

- Verify the interface assignment status by entering the **show wlan summary** command.

Configuring Network Access Identifier (CLI)

You can configure a network access server identifier (NAS-ID) on each WLAN profile, VLAN interface, or AP group. The NAS-ID is sent to the RADIUS server by the controller through an authentication request to classify users to different groups so that the RADIUS server can send a customized authentication response.

If you configure a NAS-ID for an AP group, this NAS-ID overrides the NAS-ID that is configured for a WLAN profile or the VLAN interface. If you configure a NAS-ID for a WLAN profile, this NAS-ID overrides the NAS-ID that is configured for the VLAN interface.

- Configure a NAS-ID for a WLAN profile by entering this command:

config wlan nasid {*nas-id-string* | **none**} *wlan-id*

- Configure a NAS-ID for a VLAN interface by entering this command:

  config interface nasid {*nas-id-string* | **none**} *interface-name*

- Configure a NAS-ID for an AP group by entering this command:

  config wlan apgroup nasid {*nas-id-string* | **none**} *apgroup-name*

When the controller communicates with the RADIUS server, the NAS-ID attribute is replaced with the configured NAS-ID in an AP group, a WLAN, or a VLAN interface.

The NAS-ID that is configured on the controller for an AP group, a WLAN, or a VLAN interface is used for authentication. The configuration of NAS-ID is not propagated across controllers.

CHAPTER 69

Setting the Client Count per WLAN

Restrictions for Setting Client Count for WLANs

- The maximum number of clients for each WLAN feature is not supported when you use FlexConnect local authentication.
- The maximum number of clients for each WLAN feature is supported only for access points that are in connected mode.
- When a WLAN has reached the limit on the maximum number of clients connected to it or an AP radio and a new client tries to join the WLAN, the client cannot connect to the WLAN until an existing client gets disconnected.
- Roaming clients are considered as new clients. The new client can connect to a WLAN, which has reached the maximum limit on the number of connected clients, only when an existing client gets disconnected.

Note For more information about the number of clients that are supported, see the product data sheet of your controller.

Information About Setting the Client Count per WLAN

You can set a limit to the number of clients that can connect to a WLAN, which is useful in scenarios where you have a limited number of clients that can connect to a controller. For example, consider a scenario where the controller can serve up to 256 clients on a WLAN and these clients can be shared between enterprise users (employees) and guest users. You can set a limit on the number of guest clients that can access a given WLAN. The number of clients that you can configure for each WLAN depends on the platform that you are using.

Configuring the Client Count per WLAN (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to limit the number of clients. The **WLANs > Edit** page appears.

Step 3 Click the **Advanced** tab.

Step 4 In the **Maximum Allowed Clients** text box, enter the maximum number of clients that are to be allowed.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Configuring the Maximum Number of Clients per WLAN (CLI)

Step 1 Determine the WLAN ID for which you want to configure the maximum clients by entering this command:
show wlan summary

Get the WLAN ID from the list.

Step 2 Configure the maximum number of clients for each WLAN by entering this command:
config wlan max-associated-clients *max-clients wlan-id*

Configuring the Maximum Number of Clients for each AP Radio per WLAN (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the **WLAN** for which you want to limit the number of clients. The WLANs > Edit page appears.

Step 3 In the **Advanced** tab, enter the maximum allowed clients for each access point radio in the Maximum Allowed Clients Per AP Radio text box. You can configure up to 200 clients.

Step 4 Click **Apply**.

Configuring the Maximum Number of Clients for each AP Radio per WLAN (CLI)

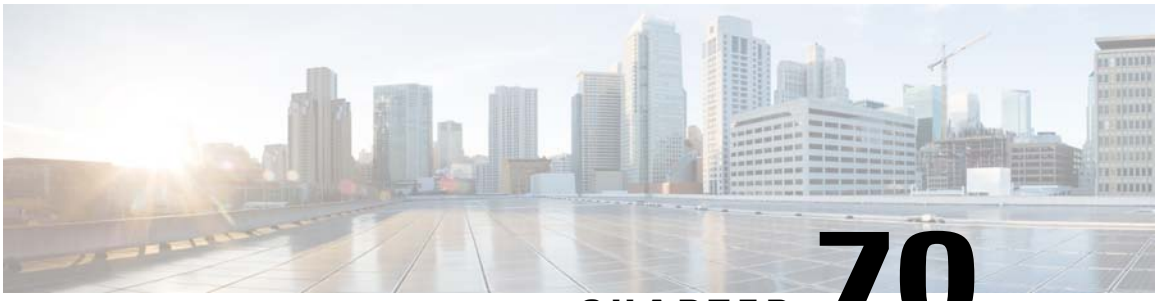
Step 1 Determine the WLAN ID for which you want to configure the maximum clients for each radio by entering this command: **show wlan summary**

Obtain the WLAN ID from the list.

Step 2 Configure the maximum number of clients for each WLAN by entering this command: **config wlan max-radio-clients** *client_count*

You can configure up to 200 clients.

Step 3 See the configured maximum associated clients by entering the **show 802.11a** command.



CHAPTER 70

Configuring DHCP

Restrictions for Configuring DHCP for WLANs

- The controller internal DHCP server does not support Cisco Aironet 600 Series OfficeExtend Access Point.
- Internal DHCP servers are not supported in Cisco Flex 7500 Series Controllers. As a workaround, you can use External DHCP servers.
- For WLANs with local switching and central DHCP feature enabled, clients with static IP addresses are not allowed. Enabling central DHCP will internally enable DHCP required option.

Information About the Dynamic Host Configuration Protocol

You can configure WLANs to use the same or different Dynamic Host Configuration Protocol (DHCP) servers or no DHCP server. Two types of DHCP servers are available: internal and external.

Internal DHCP Servers

The controllers contain an internal DHCP server. This server is typically used in branch offices that do not already have a DHCP server. The wireless network generally contains a maximum of 10 access points or fewer, with the access points on the same IP subnet as the controller. The internal server provides DHCP addresses to wireless clients, direct-connect access points, and DHCP requests that are relayed from access points. Only lightweight access points are supported. When you want to use the internal DHCP server, you must set the management interface IP address of the controller as the DHCP server IP address.

DHCP option 43 is not supported on the internal server. Therefore, the access point must use an alternative method to locate the management interface IP address of the controller, such as local subnet broadcast, Domain Name System (DNS), or priming.

An internal DHCP server pool only serves the wireless clients of that controller, not clients of other controllers. Also, an internal DHCP server can serve only wireless clients, not wired clients.

When clients use the internal DHCP server of the controller, IP addresses are not preserved across reboots. As a result, multiple clients can be assigned with the same IP address. To resolve any IP address conflicts, clients must release their existing IP address and request a new one. Wired guest clients are always on a Layer 2 network connected to a local or foreign controller.

Note DHCPv6 is not supported in the internal DHCP servers.

External DHCP Servers

The operating system is designed to appear as a DHCP Relay to the network and as a DHCP server to clients with industry-standard external DHCP servers that support DHCP Relay, which means that each controller appears as a DHCP Relay agent to the DHCP server and as a DHCP server at the virtual IP address to wireless clients.

Because the controller captures the client IP address that is obtained from a DHCP server, it maintains the same IP address for that client during intra controller, inter controller, and inter-subnet client roaming.

Note External DHCP servers can support DHCPv6.

DHCP Assignments

You can configure DHCP on a per-interface or per-WLAN basis. We recommend that you use the primary DHCP server address that is assigned to a particular interface.

You can assign DHCP servers for individual interfaces. You can configure the management interface, AP-manager interface, and dynamic interface for a primary and secondary DHCP server, and you can configure the service-port interface to enable or disable DHCP servers. You can also define a DHCP server on a WLAN. In this case, the server overrides the DHCP server address on the interface assigned to the WLAN.

Security Considerations

For enhanced security, we recommend that you require all clients to obtain their IP addresses from a DHCP server. To enforce this requirement, you can configure all WLANs with a DHCP Addr. Assignment Required setting, which disallows client static IP addresses. If DHCP Addr. Assignment Required is selected, clients must obtain an IP address via DHCP. Any client with a static IP address is not allowed on the network. The controller monitors DHCP traffic because it acts as a DHCP proxy for the clients.

Note WLANs that support management over wireless must allow management (device-servicing) clients to obtain an IP address from a DHCP server.

If slightly less security is tolerable, you can create WLANs with DHCP Addr. Assignment Required disabled. Clients then have the option of using a static IP address or obtaining an IP address from a designated DHCP server.

Note DHCP Addr. Assignment Required is not supported for wired guest LANs.

You can create separate WLANs with DHCP Addr. Assignment Required configured as disabled. This is applicable only if DHCP proxy is enabled for the controller. You must not define the primary/secondary configuration DHCP server you should disable the DHCP proxy. These WLANs drop all DHCP requests and force clients to use a static IP address. These WLANs do not support management over wireless connections.

Configuring DHCP (GUI)

To configure a primary DHCP server for a management, AP-manager, or dynamic interface, see the Configuring Ports and Interfaces chapter.
When you want to use the internal DHCP server, you must set the management interface IP address of the controller as the DHCP server IP address.

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to assign an interface. The **WLANs > Edit (General)** page appears.

Step 3 On the **General** tab, unselect the **Status** check box and click Apply to disable the WLAN.

Step 4 Reclick the ID number of the WLAN.

Step 5 On the **General** tab, choose the interface for which you configured a primary DHCP server to be used with this WLAN from the **Interface** drop-down list.

Step 6 Choose the **Advanced** tab to open the **WLANs > Edit (Advanced)** page.

Step 7 If you want to define a DHCP server on the WLAN that will override the DHCP server address on the interface assigned to the WLAN, select the **DHCP Server Override** check box and enter the IP address of the desired DHCP server in the **DHCP Server IP Addr** text box. The default value for the check box is disabled.

Note The preferred method for configuring DHCP is to use the primary DHCP address assigned to a particular interface instead of the DHCP server override.

Note DHCP Server override is applicable only for the default group.

Note If a WLAN has the DHCP server override option enabled and the controller has DHCP proxy enabled, any interface mapped to the WLAN must have a DHCP server IP address or the WLAN must be configured with a DHCP server IP address.

Step 8 If you want to require all clients to obtain their IP addresses from a DHCP server, select the **DHCP Addr. Assignment Required** check box. When this feature is enabled, any client with a static IP address is not allowed on the network. The default value is disabled.

Note DHCP Addr. Assignment Required is not supported for wired guest LANs.

Step 9 Click **Apply**.

Step 10 On the General tab, select the **Status** check box and click **Apply** to reenable the WLAN.

Step 11 Click **Save Configuration**.

Configuring DHCP (CLI)

Step 1 Disable the WLAN by entering this command:
config wlan disable *wlan-id*

Step 2 Specify the interface for which you configured a primary DHCP server to be used with this WLAN by entering this command:
config wlan interface wlan-id *interface_name*

Step 3 If you want to define a DHCP server on the WLAN that will override the DHCP server address on the interface assigned to the WLAN, enter this command:
config wlan dhcp_server *wlan-id dhcp_server_ip_address*

Note The preferred method for configuring DHCP is to use the primary DHCP address assigned to a particular interface instead of the DHCP server override. If you enable the override, you can use the **show wlan** command to verify that the DHCP server has been assigned to the WLAN.

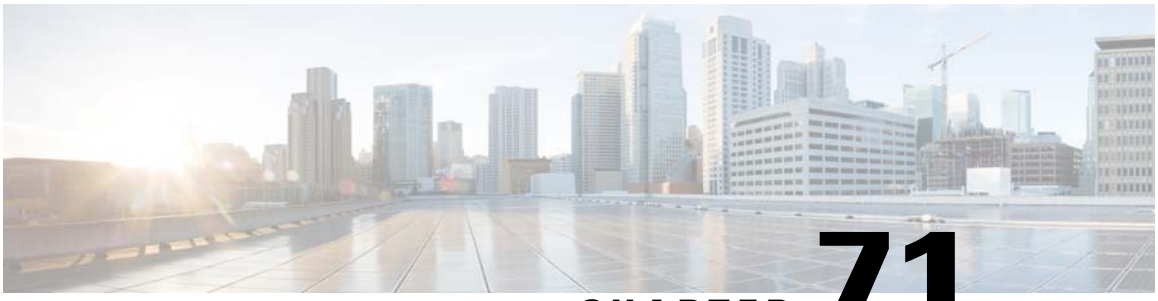
Note If a WLAN has the DHCP server override option enabled and the controller has DHCP proxy enabled, any interface mapped to the WLAN must have a DHCP server IP address or the WLAN must be configured with a DHCP server IP address.

Step 4 Reenable the WLAN by entering this command:
config wlan enable *wlan-id*

Debugging DHCP (CLI)

Use these commands to debug DHCP:

- **debug dhcp packet** {**enable** | **disable**}—Enables or disables debugging of DHCP packets.
- **debug dhcp message** {**enable** | **disable**}—Enables or disables debugging of DHCP error messages.
- **debug dhcp service-port** {**enable** | **disable**}—Enables or disables debugging of DHCP packets on the service port.



CHAPTER 71

Configuring DHCP Scopes

Restrictions for Configuring DHCP Scopes

You can configure up to 16 DHCP scopes.

Information About DHCP Scopes

Controllers have built-in DHCP relay agents. However, when you desire network segments that do not have a separate DHCP server, the controllers can have built-in DHCP scopes that assign IP addresses and subnet masks to wireless clients. Typically, one controller can have one or more DHCP scopes that each provide a range of IP addresses.

DHCP scopes are needed for internal DHCP to work. Once DHCP is defined on the controller, you can then point the primary DHCP server IP address on the management, AP-manager, and dynamic interfaces to the controller's management interface.

Configuring DHCP Scopes (GUI)

Step 1 Choose **Controller** > **Internal DHCP Server** > **DHCP Scope** to open the DHCP Scopes page. This page lists any DHCP scopes that have already been configured.

Note If you ever want to delete an existing DHCP scope, hover your cursor over the blue drop-down arrow for that scope and choose **Remove**.

Step 2 Click **New** to add a new DHCP scope. The DHCP Scope > New page appears.

Step 3 In the Scope Name text box, enter a name for the new DHCP scope.

Step 4 Click **Apply**. When the DHCP Scopes page reappears, click the name of the new scope. The DHCP Scope > Edit page appears.

Step 5 In the Pool Start Address text box, enter the starting IP address in the range assigned to the clients.

Note This pool must be unique for each DHCP scope and must not include the static IP addresses of routers or other servers.

Step 6 In the Pool End Address text box, enter the ending IP address in the range assigned to the clients.

Note This pool must be unique for each DHCP scope and must not include the static IP addresses of routers or other servers.

Step 7 In the Network text box, enter the network served by this DHCP scope. This IP address is used by the management interface with Netmask applied, as configured on the Interfaces page.

Step 8 In the Netmask text box, enter the subnet mask assigned to all wireless clients.

Step 9 In the Lease Time text box, enter the amount of time (from 0 to 65536 seconds) that an IP address is granted to a client.

Step 10 In the Default Routers text box, enter the IP address of the optional router connecting the controllers. Each router must include a DHCP forwarding agent, which allows a single controller to serve the clients of multiple controllers.

Step 11 In the DNS Domain Name text box, enter the optional domain name system (DNS) domain name of this DHCP scope for use with one or more DNS servers.

Step 12 In the DNS Servers text box, enter the IP address of the optional DNS server. Each DNS server must be able to update a client's DNS entry to match the IP address assigned by this DHCP scope.

Step 13 In the Netbios Name Servers text box, enter the IP address of the optional Microsoft Network Basic Input Output System (NetBIOS) name server, such as the Internet Naming Service (WINS) server.

Step 14 From the Status drop-down list, choose **Enabled** to enable this DHCP scope or choose **Disabled** to disable it.

Step 15 Click **Apply** to commit your changes.

Step 16 Click **Save Configuration** to save your changes.

Step 17 Choose **DHCP Allocated Leases** to see the remaining lease time for wireless clients. The DHCP Allocated Lease page appears, showing the MAC address, IP address, and remaining lease time for the wireless clients.

Configuring DHCP Scopes (CLI)

Step 1 Create a new DHCP scope by entering this command:
config dhcp create-scope scope

Note If you ever want to delete a DHCP scope, enter this command: **config dhcp delete-scope scope**.

Step 2 Specify the starting and ending IP address in the range assigned to the clients by entering this command:
config dhcp address-pool *scope start end*

Note This pool must be unique for each DHCP scope and must not include the static IP addresses of routers or other servers.

Step 3 Specify the network served by this DHCP scope (the IP address used by the management interface with the Netmask applied) and the subnet mask assigned to all wireless clients by entering this command:
config dhcp network *scope network netmask*

Step 4 Specify the amount of time (from 0 to 65536 seconds) that an IP address is granted to a client by entering this command:
config dhcp lease *scope lease_duration*

Step 5 Specify the IP address of the optional router connecting the controllers by entering this command:
config dhcp default-router *scope router_1* [*router_2*] [*router_3*]

Each router must include a DHCP forwarding agent, which allows a single controller to serve the clients of multiple controllers.

Step 6 Specify the optional domain name system (DNS) domain name of this DHCP scope for use with one or more DNS servers by entering this command:
config dhcp domain *scope domain*

Step 7 Specify the IP address of the optional DNS server(s) by entering this command:
config dhcp dns-servers scope *dns1* [*dns2*] [*dns3*]

Each DNS server must be able to update a client's DNS entry to match the IP address assigned by this DHCP scope

Step 8 Specify the IP address of the optional Microsoft Network Basic Input Output System (NetBIOS) name server, such as the Internet Naming Service (WINS) server by entering this command:
config dhcp netbios-name-server *scope wins1* [*wins2*] [*wins3*]

Step 9 Enable or disable this DHCP scope by entering this command:
config dhcp {**enable** | **disable**} *scope*

Step 10 Save your changes by entering this command:
save config

Step 11 See the list of configured DHCP scopes by entering this command:
show dhcp summary

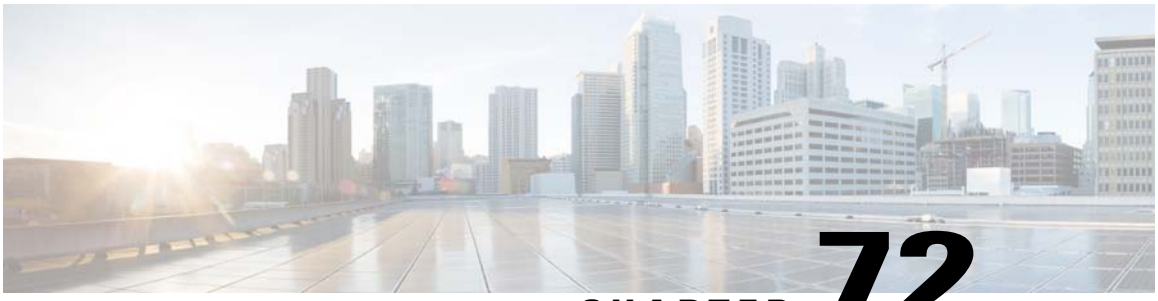
Information similar to the following appears:

```
Scope Name           Enabled          Address Range
Scope 1       No       0.0.0.0 -> 0.0.0.0
Scope 2      No    0.0.0.0 -> 0.0.0.0
```

Step 12 Display the DHCP information for a particular scope by entering this command:
show dhcp *scope*

Information similar to the following appears:

```
Enabled..................................... No
Lease Time.................................. 0
Pool Start.................................. 0.0.0.0
Pool End.................................... 0.0.0.0
Network..................................... 0.0.0.0
Netmask..................................... 0.0.0.0
Default Routers............................. 0.0.0.0 0.0.0.0 0.0.0.0
DNS Domain..................................
DNS......................................... 0.0.0.0 0.0.0.0 0.0.0.0
Netbios Name Servers........................ 0.0.0.0 0.0.0.0 0.0.0.0
```



CHAPTER 72

Configuring MAC Filtering for WLANs

Restrictions for MAC Filtering

- MAC filtering cannot be configured for Guest LANs.

Information About MAC Filtering of WLANs

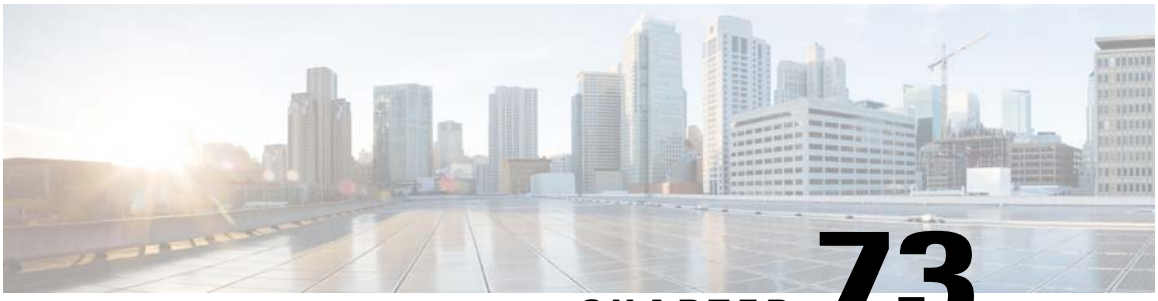
When you use MAC filtering for client or administrator authorization, you need to enable it at the WLAN level first. If you plan to use local MAC address filtering for any WLAN, use the commands in this section to configure MAC filtering for a WLAN.

Enabling MAC Filtering

Use these commands to enable MAC filtering on a WLAN:

- Enable MAC filtering by entering the **config wlan mac-filtering enable** *wlan_id* command.
- Verify that you have MAC filtering enabled for the WLAN by entering the **show wlan** command.

When you enable MAC filtering, only the MAC addresses that you add to the WLAN are allowed to join the WLAN. MAC addresses that have not been added are not allowed to join the WLAN.



CHAPTER 73

Configuring Local MAC Filters

Prerequisites for Configuring Local MAC Filters

You must have AAA enabled on the WLAN to override the interface name.

Information About Local MAC Filters

Controllers have built-in MAC filtering capability, similar to that provided by a RADIUS authorization server.

Configuring Local MAC Filters (CLI)

- Create a MAC filter entry on the controller by entering the **config macfilter add** *mac_addr wlan_id* [*interface_name*] [*description*] [*IP_addr*] command.

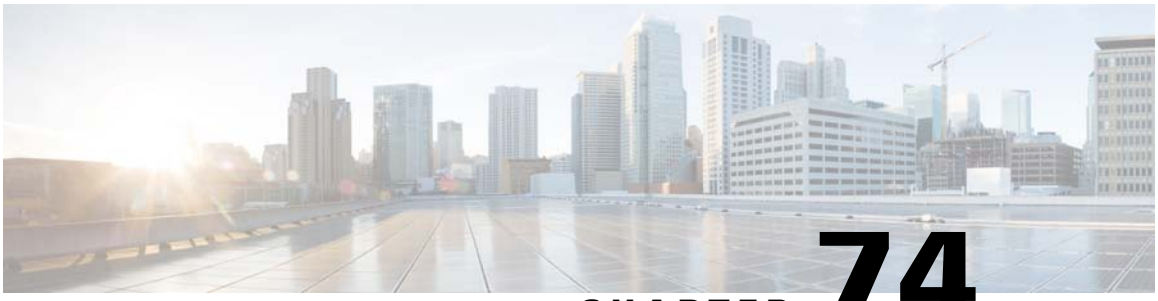
  The following parameters are optional:

  - *mac_addr*—MAC address of the client.
  - *wlan_id*—WLAN id on which the client is associating.
  - *interface_name*—The name of the interface. This interface name is used to override the interface configured to the WLAN.
  - *description*—A brief description of the interface in double quotes (for example, “Interface1”).
  - *IP_addr*—The IP address which is used for a passive client with the MAC address specified by the mac addr value above.

- Assign an IP address to an existing MAC filter entry, if one was not assigned in the **config macfilter add** command by entering the **config macfilter ip-address** *mac_addr IP_addr* command.

- Verify that MAC addresses are assigned to the WLAN by entering the **show macfilter** command.

Note If MAC filtering is configured, the controller tries to authenticate the wireless clients using the RADIUS servers first. Local MAC filtering is attempted only if no RADIUS servers are found, either because the RADIUS servers timed out or no RADIUS servers were configured.



CHAPTER 74

Configuring Timeouts

Configuring a Timeout for Disabled Clients

Information About Configuring a Timeout for Disabled Clients

You can configure a timeout for disabled clients. Clients who fail to authenticate three times when attempting to associate are automatically disabled from further association attempts. After the timeout period expires, the client is allowed to retry authentication until it associates or fails authentication and is excluded again. Use these commands to configure a timeout for disabled clients.

Configuring Timeout for Disabled Clients (CLI)

- Configure the timeout for disabled clients by entering the **config wlan exclusionlist** *wlan_id timeout* command. The valid timeout range is 1 to 2147483647 seconds. A value of 0 permanently disables the client.
- Verify the current timeout by entering the **show wlan** command.

Configuring Session Timeout

Information About Session Timeouts

You can configure a WLAN with a session timeout. The session timeout is the maximum time for a client session to remain active before requiring reauthorization.

Configuring a Session Timeout (GUI)

Configurable session timeout range is:

- 300-86400 for 802.1x.
- 0-65535 for all other security types.

Note If you configure session timeout as 0, it means disabling session-timeout, in case of open system, and 86400 seconds for all other system types.

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to assign a session timeout.

Step 3 When the **WLANs > Edit** page appears, choose the **Advanced** tab. The **WLANs > Edit (Advanced)** page appears.

Step 4 Select the **Enable Session Timeout** check box to configure a session timeout for this WLAN. Not selecting the checkbox is equal to setting it to 0, which is the maximum value for a session timeout for each session type.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Configuring a Session Timeout (CLI)

Step 1 Configure a session timeout for wireless clients on a WLAN by entering this command:
config wlan session-timeout *wlan_id timeout*

The default value is 1800 seconds for the following Layer 2 security types: 802.1X, Static WEP+802.1X, WPA+WPA2 with 802.1X, CCKM, or 802.1X+CCKM authentication key management and 0 seconds for all other Layer 2 security types (Open WLAN/CKIP/Static WEP). A value of 0 is equivalent to no timeout.

Step 2 Save your changes by entering this command:
save config

Step 3 See the current session timeout value for a WLAN by entering this command:
show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 9
Profile Name..................................... test12
Network Name (SSID).............................. test12
...
Number of Active Clients......................... 0
Exclusionlist Timeout............................ 60 seconds
Session Timeout.................................. 1800 seconds
```

. . .

Configuring the User Idle Timeout

Information About the User Idle Timeout Per WLAN

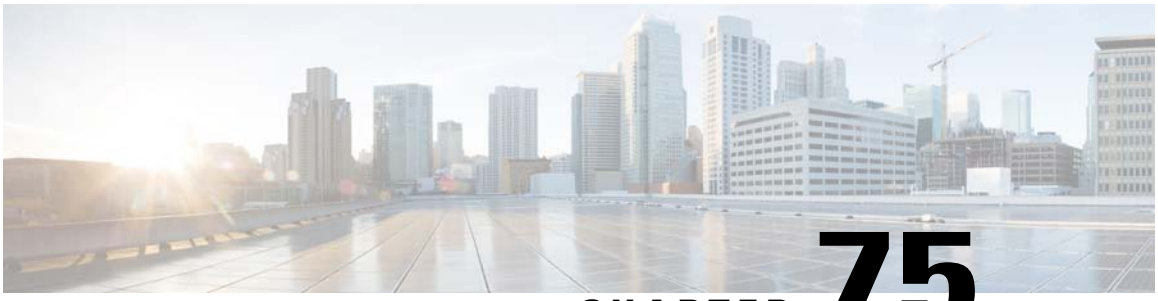
This is an enhancement to the present implementation of the user idle timeout feature, which is applicable to all WLAN profiles on the controller. With this enhancement, you can configure a user idle timeout for an individual WLAN profile. This user idle timeout is applicable to all the clients that belong to this WLAN profile.

You can also configure a threshold triggered timeout where if a client has not sent a threshold quota of data within the specified user idle timeout, the client is considered to be inactive and is deauthenticated. If the data sent by the client is more than the threshold quota specified within the user idle timeout, the client is considered to be active and the controller refreshes for another timeout period. If the threshold quota is exhausted within the timeout period, the timeout period is refreshed.

Suppose the user idle timeout is specified as 120 seconds and the user idle threshold is specified as 10 megabytes. After a period of 120 seconds, if the client has not sent 10 megabytes of data, the client is considered to be inactive and is deauthenticated. If the client has exhausted 10 megabytes within 120 seconds, the timeout period is refreshed.

Configuring Per-WLAN User Idle Timeout (CLI)

- Configure user idle timeout for a WLAN by entering this command:
  config wlan usertimeout *timeout-in-seconds wlan-id*
- Configure user idle threshold for a WLAN by entering this command:
  config wlan user-idle-threshold *value-in-bytes wlan-id*



CHAPTER 75

Configuring the DTIM Period

Information About DTIM Period

In the 802.11 networks, lightweight access points broadcast a beacon at regular intervals, which coincides with the Delivery Traffic Indication Map (DTIM). After the access point broadcasts the beacon, it transmits any buffered broadcast and multicast frames based on the value set for the DTIM period. This feature allows power-saving clients to wake up at the appropriate time if they are expecting broadcast or multicast data.

Typically, the DTIM value is set to 1 (to transmit broadcast and multicast frames after every beacon) or 2 (to transmit after every other beacon). For instance, if the beacon period of the 802.11 network is 100 ms and the DTIM value is set to 1, the access point transmits buffered broadcast and multicast frames 10 times per second. If the beacon period is 100 ms and the DTIM value is set to 2, the access point transmits buffered broadcast and multicast frames 5 times per second. Either of these settings are suitable for applications, including Voice Over IP (VoIP), that expect frequent broadcast and multicast frames.

However, the DTIM value can be set as high as 255 (to transmit broadcast and multicast frames after every 255th beacon) if all 802.11 clients have power save enabled. Because the clients have to listen only when the DTIM period is reached, they can be set to listen for broadcasts and multicasts less frequently which results in a longer battery life. For example, if the beacon period is 100 ms and you set the DTIM value to 100, the access point transmits buffered broadcast and multicast frames once every 10 seconds. This rate allows the power-saving clients to sleep longer before they have to wake up and listen for broadcasts and multicasts, which results in a longer battery life.

Note A beacon period, which is specified in milliseconds on the controller, is converted internally by the software to 802.11 Time Units (TUs), where 1 TU = 1.024 milliseconds. On Cisco's 802.11n access points, this value is rounded to the nearest multiple of 17 TUs. For example, a configured beacon period of 100 ms results in an actual beacon period of 104 ms.

Many applications cannot tolerate a long time between broadcast and multicast messages, which results in poor protocol and application performance. We recommend that you set a low DTIM value for 802.11 networks that support such clients.

You can configure the DTIM period for the 802.11 radio networks on specific WLANs. For example, you might want to set different DTIM values for voice and data WLANs.

Configuring the DTIM Period (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure the DTIM period.

Step 3 Unselect the **Status** check box to disable the WLAN.

Step 4 Click **Apply**.

Step 5 Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

Step 6 Under DTIM Period, enter a value between 1 and 255 (inclusive) in the 802.11a/n and 802.11b/g/n text boxes. The default value is 1 (transmit broadcast and multicast frames after every beacon).

Step 7 Click **Apply**.

Step 8 Choose the **General** tab to open the WLANs > Edit (General) page.

Step 9 Select the **Status** check box to reenable the WLAN.

Step 10 Click **Save Configuration**.

Configuring the DTIM Period (CLI)

Step 1 Disable the WLAN by entering this command:
config wlan disable *wlan_id*

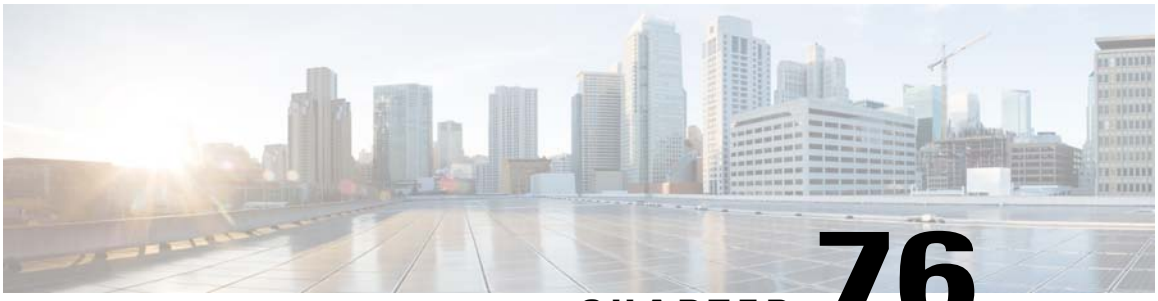
Step 2 Configure the DTIM period for a 802.11 radio network on a specific WLAN by entering this command:
config wlan dtim {**802.11a** | **802.11b**} *dtim wlan_id*

where *dtim* is a value between 1 and 255 (inclusive). The default value is 1 (transmit broadcast and multicast frames after every beacon).

Step 3 Reenable the WLAN by entering this command:
config wlan enable *wlan_id*

Step 4 Save your changes by entering this command:
save config

Step 5 Verify the DTIM period by entering this command:
show wlan *wlan_id*



CHAPTER 76

Configuring Peer-to-Peer Blocking

Restrictions for Peer-to-Peer Blocking

- In controller software releases prior to 4.2, the controller forwards Address Resolution Protocol (ARP) requests upstream (just like all other traffic). In controller software release 4.2 or later releases, ARP requests are directed according to the behavior set for peer-to-peer blocking.
- Peer-to-peer blocking does not apply to multicast traffic.
- If you upgrade to controller software release 4.2 or later releases from a previous release that supports global peer-to-peer blocking, each WLAN is configured with the peer-to-peer blocking action of forwarding traffic to the upstream VLAN.
- In FlexConnect, solution peer-to-peer blocking configuration cannot be applied only to a particular FlexConnect AP or a subset of APs. It is applied to all FlexConnect APs that broadcast the SSID.
- Unified solution for central switching clients supports peer-to-peer upstream-forward. However, this is not supported in the FlexConnect solution. This is treated as peer-to-peer drop and client packets are dropped.
- Unified solution for central switching clients supports peer-to-peer blocking for clients associated with different APs. However, this solution targets only clients connected to the same AP. FlexConnect ACLs can be used as a workaround for this limitation.

Information About Peer-to-Peer Blocking

Peer-to-peer blocking is applied to individual WLANs, and each client inherits the peer-to-peer blocking setting of the WLAN to which it is associated. Peer-to-Peer enables you to have more control over how traffic is directed. For example, you can choose to have traffic bridged locally within the controller, dropped by the controller, or forwarded to the upstream VLAN.

Peer-to-peer blocking is supported for clients that are associated with the local switching WLAN.

Per WLAN, peer-to-peer configuration is pushed by the controller to FlexConnect AP. In controller software releases prior to 4.2, peer-to-peer blocking is applied globally to all clients on all WLANs and causes traffic between two clients on the same VLAN to be transferred to the upstream VLAN rather than being bridged by the controller. This behavior usually results in traffic being dropped at the upstream switch because switches do not forward packets out the same port on which they are received.

Configuring Peer-to-Peer Blocking (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure peer-to-peer blocking.

Step 3 Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

Step 4 Choose one of the following options from the P2P Blocking drop-down list:

- **Disabled—**Disables peer-to-peer blocking and bridges traffic locally within the controller whenever possible. This is the default value.

  Note Traffic is never bridged across VLANs in the controller.

- **Drop—**Causes the controller to discard the packets.
- **Forward-UpStream—**Causes the packets to be forwarded on the upstream VLAN. The device above the controller decides what action to take regarding the packets.

  Note To enable peer-to-peer blocking on a WLAN configured for FlexConnect local switching, select **Drop** from the P2P Blocking drop-down list and select the **FlexConnect Local Switching** check box.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Configuring Peer-to-Peer Blocking (CLI)

Step 1 Configure a WLAN for peer-to-peer blocking by entering this command:
config wlan peer-blocking {**disable** | **drop** | **forward-upstream**} *wlan_id*

Step 2 Save your changes by entering this command:
save config

Step 3 See the status of peer-to-peer blocking for a WLAN by entering this command:
show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... test
Network Name (SSID).............................. test
Status........................................... Enabled
...
...
...
Peer-to-Peer Blocking Action..................... Disabled
Radio Policy..................................... All
Local EAP Authentication..................... Disabled
```

CHAPTER 77

Configuring Layer2 Security

Prerequisites for Layer 2 Security

WLANs with the same SSID must have unique Layer 2 security policies so that clients can make a WLAN selection based on information advertised in beacon and probe responses. The available Layer 2 security policies are as follows:

- None (open WLAN)
- Static WEP or 802.1X

Note Because static WEP and 802.1X are both advertised by the same bit in beacon and probe responses, they cannot be differentiated by clients. Therefore, they cannot both be used by multiple WLANs with the same SSID.

- CKIP
- WPA/WPA2

Note Although WPA and WPA2 cannot be used by multiple WLANs with the same SSID, you can configure two WLANs with the same SSID with WPA/TKIP with PSK and Wi-Fi Protected Access (WPA)/Temporal Key Integrity Protocol (TKIP) with 802.1X, or with WPA/TKIP with 802.1X or WPA/AES with 802.1X.

Configuring Static WEP Keys (CLI)

Controllers can control static WEP keys across access points. Use these commands to configure static WEP for WLANs:

- Disable the 802.1X encryption by entering this command:

  config wlan security 802.1X *disable wlan_id*

- Configure 40/64-bit or 104/128-bit WEP keys by entering this command:

  config wlan security static-wep-key encryption *wlan_id* {**40** | **104**} {**hex** | **ascii**} **key** *key_index*

  - Use the **40** or **104** option to specify 40/64-bit or 104/128-bit encryption. The default setting is 104/128.
  - Use the **hex** or **ascii** option to specify the character format for the WEP key.
  - Enter 10 hexadecimal digits (any combination of 0-9, a-f, or A-F) or five printable ASCII characters for 40-bit/64-bit WEP keys or enter 26 hexadecimal or 13 ASCII characters for 104-bit/128-bit keys.
  - Enter a key index (sometimes called a *key slot*). The default value is 0, which corresponds to a key index of 1; the valid values are 0 to 3 (key index of 1 to 4).

Configuring Dynamic 802.1X Keys and Authorization (CLI)

Controllers can control 802.1X dynamic WEP keys using Extensible Authentication Protocol (EAP) across access points and support 802.1X dynamic key settings for WLANs.

Note To use LEAP with lightweight access points and wireless clients, make sure to choose **Cisco-Aironet** as the RADIUS server type when configuring the CiscoSecure Access Control Server (ACS).

- Check the security settings of each WLAN by entering this command:

  show wlan *wlan_id*

  The default security setting for new WLANs is 802.1X with dynamic keys enabled. To maintain robust Layer 2 security, leave 802.1X configured on your WLANs.

- Disable or enable the 802.1X authentication by entering this command:

  config wlan security 802.1X {**enable** | **disable**} *wlan_id*

  After you enable 802.1X authentication, the controller sends EAP authentication packets between the wireless client and the authentication server. This command allows all EAP-type packets to be sent to and from the controller.

Note The controller performs both web authentication and 802.1X authentication in the same WLAN. The clients are initially authenticated with 802.1X. After a successful authentication, the client must provide the web authentication credentials. After a successful web authentication, the client is moved to the run state.

- Change the 802.1X encryption level for a WLAN by entering this command:

  config wlan security 802.1X encryption *wlan_id* **[0 | 40 | 104]**

  - Use the **0** option to specify no 802.1X encryption.
  - Use the **40** option to specify 40/64-bit encryption.
  - Use the **104** option to specify 104/128-bit encryption. (This is the default encryption setting.)

Configuring 802.11r BSS Fast Transition

Restrictions for 802.11r Fast Transition

- This feature is not supported on Mesh access points.
- For the access points in FlexConnect mode:
  - 802.11r Fast Transition is supported only in central and locally switched WLANs.
  - This feature is not supported for the WLANs enabled for local authentication.
- This feature is not supported on Linux-based APs such as Cisco 600 Series OfficeExtend Access Points.
- 802.11r client association is not supported on access points in standalone mode.
- 802.11r fast roaming is not supported on access points in standalone mode.
- 802.11r fast roaming between local authentication and central authentication WLAN is not supported.
- 802.11r fast roaming is not supported if the client uses Over-the-DS preauthentication in standalone mode.
- EAP LEAP method is not supported. WAN link latency prevents association time to a maximum of 2 seconds.
- The service from standalone AP to client is only supported until the session timer expires.
- TSpec is not supported for 802.11r fast roaming. Therefore, RIC IE handling is not supported.
- If WAN link latency exists, fast roaming is also delayed. Voice or data maximum latency should be verified. The controller handles 802.11r Fast Transition authentication request during roaming for both Over-the-Air and Over-the-DS methods.
- This feature is supported only on open and WPA2 configured WLANs.
- Legacy clients cannot associate with a WLAN that has 802.11r enabled if the driver of the supplicant that is responsible for parsing the Robust Security Network Information Exchange (RSN IE) is old and

not aware of the additional AKM suites in the IE. Due to this limitation, clients cannot send association requests to WLANs. These clients, however, can still associate with non-802.11r WLANs. Clients that are 802.11r capable can associate as 802.11i clients on WLANs that have both 802.11i and 802.11r Authentication Key Management Suites enabled.

The workaround is to enable or upgrade the driver of the legacy clients to work with the new 802.11r AKMs, after which the legacy clients can successfully associate with 802.11r enabled WLANs.

Another workaround is to have two SSIDs with the same name but with different security settings (FT and non-FT).

- Fast Transition resource request protocol is not supported because clients do not support this protocol. Also, the resource request protocol is an optional protocol.
- To avoid any Denial of Service (DoS) attack, each controller allows a maximum of three Fast Transition handshakes with different APs.

Information About 802.11r Fast Transition

802.11r, which is the IEEE standard for fast roaming, introduces a new concept of roaming where the initial handshake with the new AP is done even before the client roams to the target AP, which is called Fast Transition (FT). The initial handshake allows the client and APs to do the Pairwise Transient Key (PTK) calculation in advance. These PTK keys are applied to the client and AP after the client does the reassociation request or response exchange with new target AP.

802.11r provides two methods of roaming:

- Over-the-Air
- Over-the-DS (Distribution System)

The FT key hierarchy is designed to allow clients to make fast BSS transitions between APs without requiring reauthentication at every AP. WLAN configuration contains a new Authenticated Key Management (AKM) type called FT (Fast Transition).

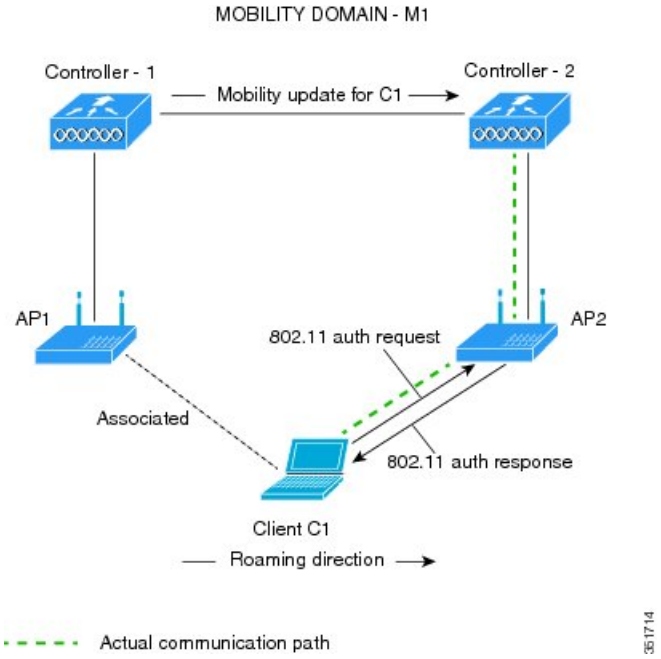
How a Client Roams

For a client to move from its current AP to a target AP using the FT protocols, the message exchanges are performed using one of the following two methods:

- Over-the-Air—The client communicates directly with the target AP using IEEE 802.11 authentication with the FT authentication algorithm.
- Over-the-DS—The client communicates with the target AP through the current AP. The communication between the client and the target AP is carried in FT action frames between the client and the current AP and is then sent through the controller.

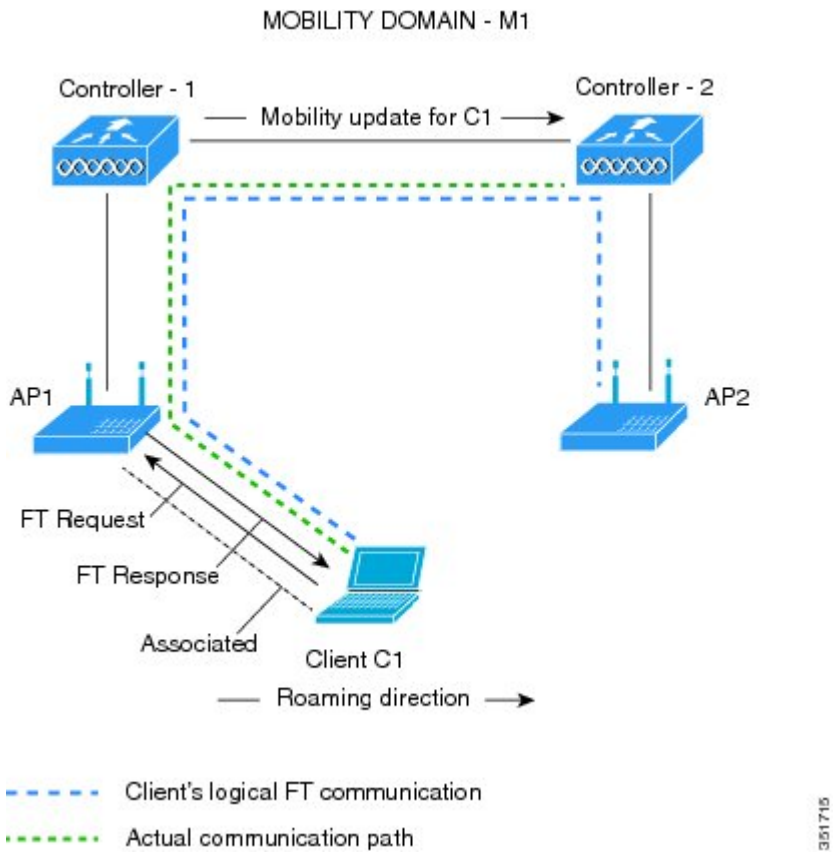
This figure shows the sequence of message exchanges that occur when Over the Air client roaming is configured.

Figure 44: Message Exchanges when Over the Air client roaming is configured



This figure shows the sequence of message exchanges that occur when Over the DS client roaming is configured.

Figure 45: Message Exchanges when Over the DS client roaming is configured



Configuring 802.11r Fast Transition (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the WLAN ID to open the WLANs > Edit page.

Step 3 Choose the **Security** > **Layer 2** tab.

Step 4 From the Layer 2 Security drop-down list, choose **WPA+WPA2**.
The Authentication Key Management parameters for Fast Transition appear.

Step 5 Select or unselect the **Fast Transition** check box to enable or disable Fast Transition on the WLAN.

Step 6 Select or unselect the **Over the DS** check box to enable or disable Fast Transition over a distributed system.
This option is available only if you enable Fast Transition.

Step 7 In the Reassociation Timeout box, enter the number of seconds after which the reassociation attempt of a client to an AP should time out.
The valid range is 1 to 100 seconds.

This option is available only if you enable Fast Transition.

Step 8 Under Authentication Key Management, choose between **FT 802.1X** or **FT PSK**. Select or unselect the corresponding check boxes to enable or disable the keys. If you select the **FT PSK** check box, then, from the PSK Format drop-down list, choose **ASCII** or **Hex** and enter the key value.

Step 9 From the WPA gtk-randomize State drop-down list, choose **Enable** or **Disable** to configure the WPA group temporal key (GTK) randomize state.

Step 10 Click **Apply** to save your settings.

Configuring 802.11r Fast Transition (CLI)

Step 1 To enable or disable 802.11r fast transition parameters, use the **config wlan security ft** {**enable** | **disable**} *wlan-id* command.
By default, the fast transition is disabled.

Step 2 To enable or disable 802.11r fast transition parameters over a distributed system, use the **config wlan security ft over-the-ds** {**enable** | **disable**} *wlan-id* command.
By default, the fast transition over a distributed system is disabled.

Step 3 To enable or disable the authentication key management for fast transition using preshared keys (PSK), use the **config wlan security wpa akm ft-psk** {**enable** | **disable**} *wlan-id* command.
By default, the authentication key management using PSK is disabled.

Step 4 To enable or disable the authentication key management for fast transition using 802.1X, use the **config wlan security wpa akm ft-802.1X** {**enable** | **disable**} *wlan-id* command.
By default, the authentication key management using 802.1X is disabled.

Step 5 To enable or disable 802.11r fast transition reassociation timeout, use the **config wlan security ft reassociation-timeout***timeout-in-seconds wlan-id* command.
The valid range is 1 to 100 seconds. The default value of reassociation timeout is 20 seconds.

Step 6 To enable or disable the authentication key management for fast transition over a distributed system, use the **config wlan security wpa akm ft over-the-ds** {**enable** | **disable**} *wlan-id* command.
By default, the authentication key management for fast transition over a distributed system is enabled.

Step 7 To view the fast transition configuration on a client, use the **show client detailed** *client-mac* command.

Step 8 To view the fast transition configuration on a WLAN, use the **show wlan** *wlan-id* command.

Step 9 To enable or disable debugging of fast transition events, use the **debug ft events** {**enable** | **disable**} command.

Step 10 To enable or disable debugging of key generation for fast transition, use the **debug ft keys** {**enable** | **disable**} command.

Troubleshooting 802.11r BSS Fast Transition

Symptom	Resolution
Non-802.11r legacy clients are no longer connecting.	Check if the WLAN has FT enabled. If so, non-FT WLAN will need to be created.
When configuring WLAN, the FT setup options are not shown.	Check if WPA2 is being used (802.1x / PSK). FT is supported only on WPA2 and OPEN SSIDs.
802.11r clients appear to reauthenticate when they do a Layer 2 roam to a new controller.	Check if the reassociation timeout has been lowered from the default of 20 by navigating to **WLANs** > *WLAN Name* > **Security** > **Layer 2** on the controller GUI.

Configuring MAC Authentication Failover to 802.1X Authentication

You can configure the controller to start 802.1X authentication when MAC authentication with static WEP for the client fails. If the RADIUS server rejects an access request from a client instead of deauthenticating the client, the controller can force the client to undergo an 802.1X authentication. If the client fails the 802.1X authentication too, then the client is deauthenticated.

If MAC authentication is successful and the client requests for an 802.1X authentication, the client has to pass the 802.1X authentication to be allowed to send data traffic. If the client does not choose an 802.1X authentication, the client is declared to be authenticated if the client passes the MAC authentication.

Configuring MAC Authentication Failover to 802.1x Authentication (GUI)

Step 1 Choose **WLANs** > **WLAN ID** to open the WLANs > Edit page.

Step 2 In the **Security** tab, click the **Layer 2** tab.

Step 3 Select the **MAC Filtering** check box.

Step 4 Select the **Mac Auth or Dot1x** check box.

Configuring MAC Authentication Failover to 802.1X Authentication (CLI)

To configure MAC authentication failover to 802.1X authentication, enter this command:
config wlan security 802.1X on-macfilter-failure {**enable** | **disable**} *wlan-id*

Configuring 802.11w

Restrictions for 802.11w

- Cisco's legacy Management Frame Protection is not related to the 802.11w standard that is implemented in the 7.4 release.
- The 802.11w standard is supported on all 802.11n capable APs except those that are configured for FlexConnect operation.
- The 802.11w standard is supported on the following Cisco Wireless LAN Controller model series: 2500, 5500, 8500, and WiSM2.

  The 802.11w standard is not supported on the following Cisco Wireless LAN Controller models: Flex 7500 and Virtual Wireless LAN Controller.
- When 802.11w is set to optional and the keys are set, the AKM suite still shows 802.11w as disabled; this is a Wi-Fi limitation.
- 802.11w cannot be applied on an open WLAN, WEP-encrypted WLAN, or a TKIP-encrypted WLAN.
- The WLAN on which 802.11w is configured must have either WPA2-PSK or WPA2-802.1x security configured.

Information About 802.11w

Wi-Fi is a broadcast medium that enables any device to eavesdrop and participate either as a legitimate or rogue device. Control and management frames such as authentication/deauthentication, association/disassociation, beacons, and probes are used by wireless clients to select an AP and to initiate a session for network services.

Unlike data traffic which can be encrypted to provide a level of confidentiality, these frames must be heard and understood by all clients and therefore must be transmitted as open or unencrypted. While these frames cannot be encrypted, they must be protected from forgery to protect the wireless medium from attacks. For example, an attacker could spoof management frames from an AP to tear down a session between a client and AP.

The 802.11w standard for Management Frame Protection is implemented in the 7.4 release.

The 802.11w protocol applies only to a set of robust management frames that are protected by the Management Frame Protection (PMF) service. These include Disassociation, Deauthentication, and Robust Action frames.

Management frames that are considered as robust action and therefore protected are the following:

- Spectrum Management
- QoS
- DLS
- Block Ack
- Radio Measurement
- Fast BSS Transition

- SA Query
- Protected Dual of Public Action
- Vendor-specific Protected

When 802.11w is implemented in the wireless medium, the following occur:

- Client protection is added by the AP adding cryptographic protection (by including the MIC information element) to deauthentication and disassociation frames preventing them from being spoofed in a DOS attack.
- Infrastructure protection is added by adding a Security Association (SA) teardown protection mechanism consisting of an Association Comeback Time and an SA-Query procedure preventing spoofed association request from disconnecting an already connected client.

Configuring 802.11w (GUI)

Step 1 Choose **WLANs** > WLAN ID to open the WLANs > Edit page.

Step 2 In the **Security** tab, choose the **Layer 2** security tab.

Step 3 From the Layer 2 Security drop-down list, choose **WPA+WPA2**.
The 802.11w IGTK Key is derived using the 4-way handshake, which means that it can only be used on WLANs that are configured for WPA2 security at Layer 2.

Note WPA2 is mandatory and encryption type must be AES. TKIP is not valid.

Step 4 Choose the PMF state from the drop-down list
The following options are available:

- **Disabled—**Disables 802.11w MFP protection on a WLAN
- **Optional—**To be used if the client supports 802.11w.
- **Required—**Ensures that the clients that do not support 802.11w cannot associate with the WLAN.

Step 5 If you choose the PMF state as either **Optional** or **Required**, do the following:

a) In the Comeback Timer box, enter the association comeback interval in milliseconds. It is the time within which the access point reassociates with the client after a valid security association.
b) In the SA Query Timeout box, enter the maximum time before an Security Association (SA) query times out.

Step 6 In the Authentication Key Management section, follow these steps:

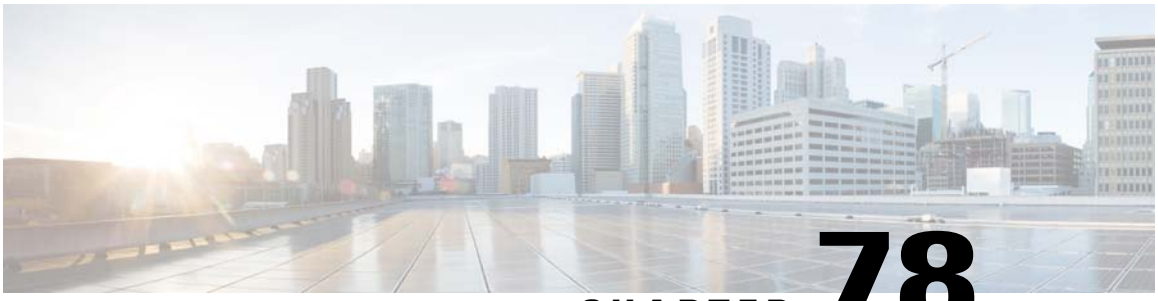
a) Select or unselect the **PMF 802.1X** check box to configure the 802.1X authentication for the protection of management frames.
b) Select or unselect the **PMF PSK** check box to configure the preshared keys for PMF. Choose the PSK format as either ASCII or Hexadecimal and enter the PSK.

Step 7 Click **Apply**.

Step 8 Click **Save Configuration**.

Configuring 802.11w (CLI)

- Configure the 802.1X authentication for PMF by entering this command:
  config wlan security wpa akm pmf 802.1x {**enable** | **disable**} *wlan-id*
- Configure the preshared key support for PMF by entering this command:
  config wlan security wpa akm pmf psk {**enable** | **disable**} *wlan-id*
- If not done, configure a preshared key for a WLAN by entering this command:
  config wlan security wpa akm psk set-key {*ascii* | *hex*} *psk wlan-id*
- Configure protected management frames by entering this command:
  config wlan security pmf {**disable** | **optional** | **required**} *wlan-id*
- Configure the association comeback time settings by entering this command:
  config wlan security pmf association-comeback *timeout-in-seconds wlan-id*
- Configure the SA query retry timeout settings by entering this command:
  config wlan security pmf saquery-retrytimeout *timeout-in-milliseconds wlan-id*
- See the 802.11w configuration status for a WLAN by entering this command:
  show wlan *wlan-id*
- Configure the debugging of PMF by entering this command:
  debug pmf events {**enable** | **disable**}



CHAPTER 78

Configuring a WLAN for Both Static and Dynamic WEP

Restrictions for Configuring Static and Dynamic WEP

- The OEAP 600 series does not support fast roaming for clients. Dual mode voice clients will experience reduced call quality when they roam between the two spectrums on OEAP602 access point. We recommend that you configure voice devices to only connect on one band, either 2.4 GHz or 5.0 GHz.
- The controller software supports CCX versions 1 through 5. CCX support is enabled automatically for every WLAN on the controller and cannot be disabled. The controller stores the CCX version of the client in its client database and uses it to limit client functionality. Clients must support CCXv4 or v5 in order to use CCKM. For more information about CCX, see the Configuring Cisco Client Extensions section.
- In a unified architecture where multiple VLAN clients are supported for a WGB, you also need to configure encryption cipher suite and WEP keys globally, when the WEP encryption is enabled on the WGB. Otherwise, multicast traffic for wired VLAN clients fail.

Information About WLAN for Both Static and Dynamic WEP

You can configure up to four WLANs to support static WEP keys, and you can also configure dynamic WEP on any of these static-WEP WLANs. Follow these guidelines when configuring a WLAN for both static and dynamic WEP:

- The static WEP key and the dynamic WEP key must be the same length.
- When you configure both static and dynamic WEP as the Layer 2 security policy, no other security policies can be specified. That is, you cannot configure web authentication. However, when you configure either static or dynamic WEP as the Layer 2 security policy, you can configure web authentication.

WPA1 and WPA2

Wi-Fi Protected Access (WPA or WPA1) and WPA2 are standards-based security solutions from the Wi-Fi Alliance that provide data protection and access control for wireless LAN systems. WPA1 is compatible with the IEEE 802.11i standard but was implemented prior to the standard's ratification; WPA2 is the Wi-Fi Alliance's implementation of the ratified IEEE 802.11i standard.

By default, WPA1 uses Temporal Key Integrity Protocol (TKIP) and message integrity check (MIC) for data protection while WPA2 uses the stronger Advanced Encryption Standard encryption algorithm using Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP). Both WPA1 and WPA2 use 802.1X for authenticated key management by default. However, these options are also available:

- 802.1X—The standard for wireless LAN security, as defined by IEEE, is called 802.1X for 802.11, or simply 802.1X. An access point that supports 802.1X acts as the interface between a wireless client and an authentication server, such as a RADIUS server, to which the access point communicates over the wired network. If 802.1X is selected, only 802.1X clients are supported.
- PSK—When you choose PSK (also known as WPA preshared key or WPA passphrase), you need to configure a preshared key (or a passphrase). This key is used as the pairwise master key (PMK) between the clients and the authentication server.
- CCKM—Cisco Centralized Key Management (CCKM) uses a fast rekeying technique that enables clients to roam from one access point to another without going through the controller, typically in under 150 milliseconds (ms). CCKM reduces the time required by the client to mutually authenticate with the new access point and derive a new session key during reassociation. CCKM fast secure roaming ensures that there is no perceptible delay in time-sensitive applications such as wireless Voice over IP (VoIP), enterprise resource planning (ERP), or Citrix-based solutions. CCKM is a CCXv4-compliant feature. If CCKM is selected, only CCKM clients are supported.

  When CCKM is enabled, the behavior of access points differs from the controller's for fast roaming in the following ways:

  - If an association request sent by a client has CCKM enabled in a Robust Secure Network Information Element (RSN IE) but CCKM IE is not encoded and only PMKID is encoded in RSN IE, then the controller does not do a full authentication. Instead, the controller validates the PMKID and does a four-way handshake.
  - If an association request sent by a client has CCKM enabled in RSN IE but CCKM IE is not encoded and only PMKID is encoded in RSN IE, then AP does a full authentication. The access point does not use PMKID sent with the association request when CCKM is enabled in RSN IE.

- 802.1X+CCKM—During normal operation, 802.1X-enabled clients mutually authenticate with a new access point by performing a complete 802.1X authentication, including communication with the main RADIUS server. However, when you configure your WLAN for 802.1X and CCKM fast secure roaming, CCKM-enabled clients securely roam from one access point to another without the need to reauthenticate to the RADIUS server. 802.1X+CCKM is considered optional CCKM because both CCKM and non-CCKM clients are supported when this option is selected.

On a single WLAN, you can allow WPA1, WPA2, and 802.1X/PSK/CCKM/802.1X+CCKM clients to join. All of the access points on such a WLAN advertise WPA1, WPA2, and 802.1X/PSK/CCKM/ 802.1X+CCKM information elements in their beacons and probe responses. When you enable WPA1 and/or WPA2, you can also enable one or two ciphers, or cryptographic algorithms, designed to protect data traffic. Specifically, you can enable AES and/or TKIP data encryption for WPA1 and/or WPA2. TKIP is the default value for WPA1, and AES is the default value for WPA2.

Configuring WPA1 +WPA2

Configuring WPA1+WPA2 (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN to open the **WLANs > Edit** page.

Step 3 Choose the **Security** and **Layer 2** tabs to open the **WLANs > Edit (Security > Layer 2)** page.

Step 4 Choose **WPA+WPA2** from the Layer 2 Security drop-down list.

Step 5 Under WPA+WPA2 Parameters, select the **WPA Policy** check box to enable WPA1, select the **WPA2 Policy** check box to enable WPA2, or select both check boxes to enable both WPA1 and WPA2.

Note The default value is disabled for both WPA1 and WPA2. If you leave both WPA1 and WPA2 disabled, the access points advertise in their beacons and probe responses information elements only for the authentication key management method that you choose in Step 7.

Step 6 Select the **AES** check box to enable AES data encryption or the **TKIP** check box to enable TKIP data encryption for WPA1, WPA2, or both. The default values are TKIP for WPA1 and AES for WPA2.

Step 7 Choose one of the following key management methods from the Auth Key Mgmt drop-down list: **802.1X**, **CCKM**, **PSK**, or **802.1X+CCKM**.

Note Cisco OEAP 600 does not support CCKM. You must choose either 802.1X or PSK.

Note For Cisco OEAP 600, the TKIP and AES security encryption settings must be identical for WPA and WPA2.

Step 8 If you chose PSK in Step 7, choose **ASCII** or **HEX** from the PSK Format drop-down list and then enter a preshared key in the blank text box. WPA preshared keys must contain 8 to 63 ASCII text characters or 64 hexadecimal characters.

Note The PSK parameter is a set-only parameter. The value set for the PSK key is not visible to the user for security reasons. For example, if you selected HEX as the key format when setting the PSK key, and later when you view the parameters of this WLAN, the value shown is the default value. The default is ASCII.

Step 9 Click **Apply** to commit your changes.

Step 10 Click **Save Configuration** to save your changes.

Configuring WPA1+WPA2 (CLI)

Step 1 Disable the WLAN by entering this command:
config wlan disable *wlan_id*

Step 2 Enable or disable WPA for the WLAN by entering this command:
config wlan security wpa {**enable** | **disable**} *wlan_id*

Step 3 Enable or disable WPA1 for the WLAN by entering this command:
config wlan security wpa wpa1 {**enable** | **disable**} *wlan_id*

Step 4 Enable or disable WPA2 for the WLAN by entering this command:

config wlan security wpa wpa2 {**enable** | **disable**} *wlan_id*

Step 5 Enable or disable AES or TKIP data encryption for WPA1 or WPA2 by entering one of these commands:

- **config wlan security wpa wpa1 ciphers** {**aes** | **tkip**} {**enable** | disable} *wlan_id*
- **config wlan security wpa wpa2 ciphers** {**aes** | **tkip**} {**enable** | **disable**} *wlan_id*

The default values are TKIP for WPA1 and AES for WPA2.

When you have VLAN configuration on WGB, you need to configure the encryption cipher mode and keys for a particular VLAN, for example, **encryption vlan 80 mode ciphers tkip**. Then, you need configure the encryption cipher mode globally on the multicast interface by entering the following command: **encryption mode ciphers tkip**.

Step 6 Enable or disable 802.1X, PSK, or CCKM authenticated key management by entering this command:
config wlan security wpa akm {**802.1X** | **psk** | **cckm**} {**enable** | disable} *wlan_id*

The default value is 802.1X.

Step 7 If you enabled PSK in *Step 6*, enter this command to specify a preshared key:
config wlan security wpa akm psk set-key {**ascii** | **hex**} *psk-key wlan_id*

WPA preshared keys must contain 8 to 63 ASCII text characters or 64 hexadecimal characters.

Step 8 Enable or disable authentication key management suite for fast transition by entering this command:
config wlan security wpa akm ft {**802.1X** | **psk**} {**enable** | **disable**} *wlan_id*

Note You can now choose between the PSK and the fast transition PSK as the AKM suite.

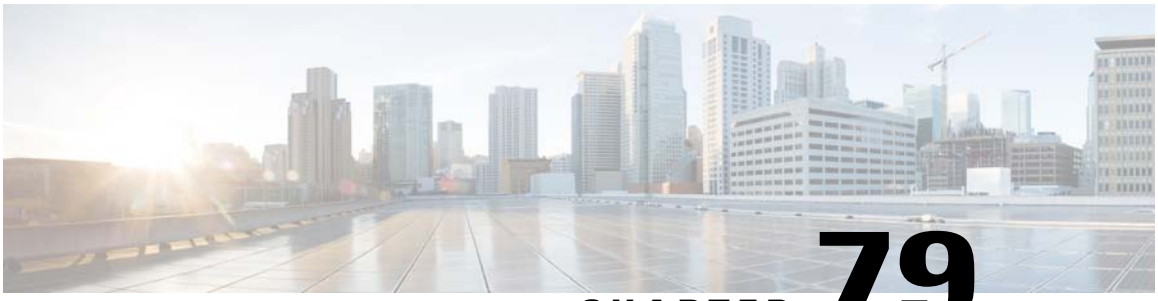
Step 9 Enable or disable randomization of group temporal keys (GTK) between AP and clients by entering this command:
config wlan security wpa gtk-random {**enable** | **disable**} *wlan_id*

Step 10 If you enabled WPA2 with 802.1X authenticated key management or WPA1 or WPA2 with CCKM authenticated key management, the PMK cache lifetime timer is used to trigger reauthentication with the client when necessary. The timer is based on the timeout value received from the AAA server or the WLAN session timeout setting. To see the amount of time remaining before the timer expires, enter this command:
show pmk-cache all

If you enabled WPA2 with 802.1X authenticated key management, the controller supports both opportunistic PMKID caching and sticky (or non-opportunistic) PMKID caching. In sticky PMKID caching (SKC), the client stores multiple PMKIDs, a different PMKID for every AP it associates with. Opportunistic PMKID caching (OKC) stores only one PMKID per client. By default, the controller supports OKC.

Step 11 Enable the WLAN by entering this command:
config wlan enable wlan_id

Step 12 Save your settings by entering this command:
save config



CHAPTER 79

Configuring Sticky Key Caching

Information About Sticky Key Caching

The controller supports sticky key caching (SKC). With sticky key caching, the client receives and stores a different PMKID for every AP it associates with. The APs also maintain a database of the PMKID issued to the client.

In SKC, the client stores each Pairwise Master Key ID (PMKID) against a Pairwise Master Key Security Association (PMKSA). When a client finds an AP for which it has the PMKSA, it sends the PMKID in the association request to the AP. If the PMKSA is alive in the AP, the AP provides support for fast roaming. In SKC, full authentication is done on each new AP to which the client associates and the client must keep the PMKSA associated with all APs. For SKC, PMKSA is a per AP cache that the client stores and PMKSA is precalculated based on the BSSID of the new AP.

Restrictions for Sticky Key Caching

- The controller supports SKC for up to eight APs per client. If a client roams to more than 8 APs per session, the old APs are removed to store the newly cached entries when the client roams. We recommend that you do not use SKC for large scale deployments.
- SKC works only on WPA2-enabled WLANs.
- SKC does not work across controllers in a mobility group.
- SKC works only on local mode APs.

Configuring Sticky Key Caching (CLI)

Step 1 Disable the WLAN by entering this command:
config wlan disable *wlan_id*

Step 2 Enable sticky key caching by entering this command:
config wlan security wpa wpa2 cache sticky enable *wlan_id*

By default, SKC is disabled and opportunistic key caching (OKC) is enabled.

Note SKC works only on WPA2 enabled WLANs.

You can check if SKC is enabled by entering this command:

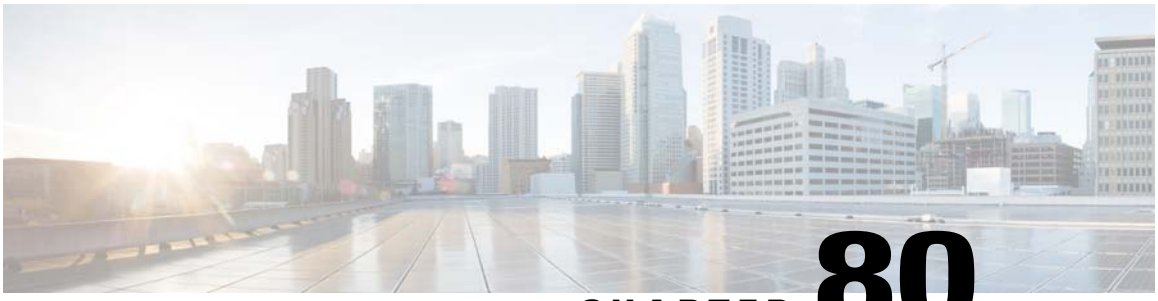
show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 2
Profile Name..................................... new
Network Name (SSID).............................. new
Status........................................... Disabled
MAC Filtering.................................... Disabled
Security
   802.11 Authentication:........................ Open System
   Static WEP Keys............................... Disabled
   802.1X........................................ Disabled
   Wi-Fi Protected Access (WPA/WPA2)............. Enabled
      WPA (SSN IE)............................... Disabled
      WPA2 (RSN IE).............................. Enabled
         TKIP Cipher............................. Disabled
         AES Cipher.............................. Enabled
      Auth Key Management
         802.1x.................................. Disabled
         PSK..................................... Enabled
         CCKM.................................... Disabled
         FT(802.11r)............................. Disabled
         FT-PSK(802.11r)......................... Disabled
      SKC Cache Support..... Enabled
      FT Reassociation Timeout................... 20
      FT Over-The-Air mode....................... Enabled
      FT Over-The-Ds mode........................ Enabled
CCKM tsf Tolerance............................... 1000
   Wi-Fi Direct policy configured................ Disabled
   EAP-Passthrough............................... Disabled
```

Step 3 Enable the WLAN by entering this command:
config wlan enable *wlan_id*

Step 4 Save your settings by entering this command:
save config



CHAPTER 80

Configuring CKIP

Information About CKIP

Cisco Key Integrity Protocol (CKIP) is a Cisco-proprietary security protocol for encrypting 802.11 media. CKIP improves 802.11 security in infrastructure mode using key permutation, a message integrity check (MIC), and a message sequence number. Software release 4.0 or later releases support CKIP with a static key. For this feature to operate correctly, you must enable Aironet information elements (IEs) for the WLAN.

A lightweight access point advertises support for CKIP in beacon and probe response packets by adding an Aironet IE and setting one or both of the CKIP negotiation bits (key permutation and multi-modular hash message integrity check [MMH MIC]). Key permutation is a data encryption technique that uses the basic encryption key and the current initialization vector (IV) to create a new key. MMH MIC prevents bit-flip attacks on encrypted packets by using a hash function to compute message integrity code.

The CKIP settings specified in a WLAN are mandatory for any client attempting to associate. If the WLAN is configured for both CKIP key permutation and MMH MIC, the client must support both. If the WLAN is configured for only one of these features, the client must support only the CKIP feature.

CKIP requires that 5-byte and 13-byte encryption keys be expanded to 16-byte keys. The algorithm to perform key expansion occurs at the access point. The key is appended to itself repeatedly until the length reaches 16 bytes. All lightweight access points support CKIP.

Note CKIP is supported for use only with static WEP. It is not supported for use with dynamic WEP. Therefore, a wireless client that is configured to use CKIP with dynamic WEP is unable to associate to a WLAN that is configured for CKIP. We recommend that you use either dynamic WEP without CKIP (which is less secure) or WPA/WPA2 with TKIP or AES (which are more secure).

Configuring CKIP (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN to open the WLANs > Edit page.

Step 3 Choose the **Advanced** tab.

Step 4 Select the **Aironet IE** check box to enable Aironet IEs for this WLAN and click **Apply**.

Step 5 Choose the **General** tab.

Step 6 Unselect the **Status** check box, if selected, to disable this WLAN and click **Apply**.

Step 7 Choose the **Security** and **Layer 2** tabs to open the WLANs > Edit (Security > Layer 2) page.

Step 8 Choose **CKIP** from the Layer 2 Security drop-down list.

Step 9 Under CKIP Parameters, choose the length of the CKIP encryption key from the Key Size drop-down list.The range is Not Set, 40 bits, or 104 bits and the default is Not Set.

Step 10 Choose the number to be assigned to this key from the Key Index drop-down list. You can configure up to four keys.

Step 11 From the Key Format drop-down list, choose **ASCII** or **HEX** and then enter an encryption key in the Encryption Key text box. 40-bit keys must contain 5 ASCII text characters or 10 hexadecimal characters. 104-bit keys must contain 13 ASCII text characters or 26 hexadecimal characters.

Step 12 Select the **MMH Mode** check box to enable **MMH MIC** data protection for this WLAN. The default value is disabled (or unselected).

Step 13 Select the **Key Permutation** check box to enable this form of CKIP data protection. The default value is disabled (or unselected).

Step 14 Click **Apply** to commit your changes.

Step 15 Choose the **General** tab.

Step 16 Select the **Status** check box to enable this WLAN.

Step 17 Click **Apply** to commit your changes.

Step 18 Click **Save Configuration** to save your changes.

Configuring CKIP (CLI)

Step 1 Disable the WLAN by entering this command:
config wlan disable *wlan_id*

Step 2 Enable Aironet IEs for this WLAN by entering this command:
config wlan ccx aironet-ie enable *wlan_id*

Step 3 Enable or disable CKIP for the WLAN by entering this command:
config wlan security ckip {**enable** | **disable**} *wlan_id*

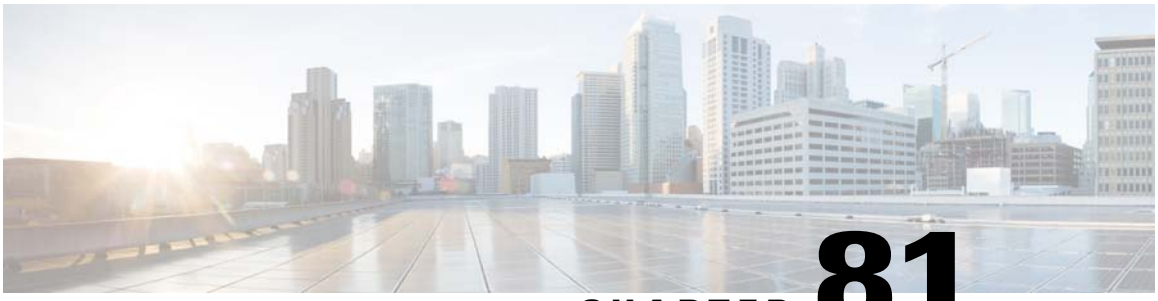
Step 4 Specify a CKIP encryption key for the WLAN by entering this command:
config wlan security ckip akm psk set-key *wlan_id* {**40** | **104**} {**hex** | **ascii**} *key key_index*

Step 5 Enable or disable CKIP MMH MIC for the WLAN by entering this command:
config wlan security ckip mmh-mic {**enable** | **disable**} *wlan_id*

Step 6 Enable or disable CKIP key permutation for the WLAN by entering this command:
config wlan security ckip kp {**enable** | **disable**} *wlan_id*

Step 7 Enable the WLAN by entering this command:
config wlan enable wlan_id

Step 8 Save your settings by entering this command:
save config



CHAPTER 81

Configuring Layer 3 Security

Configuring Layer 3 Security Using VPN Passthrough

Restrictions for Layer 3 Security Using VPN Passthrough

- Layer 2 Tunnel Protocol (L2TP) and IPsec are not supported on controllers.
- Layer 3 security settings are not supported when you disable the client IP address on a WLAN.
- The VPN Passthrough option is not available on Cisco 5500 Series Controllers. However, you can replicate this functionality on the controller by creating an open WLAN using an ACL.

Information About VPN Passthrough

The controller supports VPN passthrough or the “passing through” of packets that originate from VPN clients. An example of VPN passthrough is your laptop trying to connect to the VPN server at your corporate office.

Configuring VPN Passthrough

Configuring VPN Passthrough (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure VPN passthrough. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **Layer 3** tabs to open the WLANs > Edit (Security > Layer 3) page.

Step 4 From the Layer 3 Security drop-down list, choose **VPN Pass-Through.**

Step 5 In the VPN Gateway Address text box, enter the IP address of the gateway router that is terminating the VPN tunnels initiated by the client and passed through the controller.

Step 6 Click **Apply** to commit your changes.

Step 7 Click **Save Configuration** to save your settings.

Configuring VPN Passthrough (CLI)

Use these commands to configure VPN passthrough:

- **config wlan security passthru** {**enable** | **disable**} *wlan_id gateway*

  For *gateway*, enter the IP address of the router that is terminating the VPN tunnel.

- Verify that the passthrough is enabled by entering this command:

  show wlan

Configuring Layer 3 Security Using Web Authentication

Prerequisites for Configuring Web Authentication on a WLAN

- To initiate HTTP/HTTPS web authentication redirection, always use only HTTP URL and not HTTPS URL.
- If the CPU ACLs are configured to block HTTP / HTTPS traffic, after the successful web login authentication, there could be a failure in the redirection page.
- Before enabling web authentication, make sure that all proxy servers are configured for ports other than port 53.
- When you enable web authentication for a WLAN, a message appears indicating that the controller forwards DNS traffic to and from wireless clients prior to authentication. We recommend that you have a firewall or intrusion detection system (IDS) behind your guest VLAN to regulate DNS traffic and to prevent and detect any DNS tunneling attacks.
- If the web authentication is enabled on the WLAN and you also have the CPU ACL rules, the client-based web authentication rules take higher precedence as long as the client is unauthenticated (in the

webAuth_Reqd state). Once the client goes to the RUN state, the CPU ACL rules get applied. Therefore, if the CPU ACL rules are enabled in the controller, an allow rule for the virtual interface IP is required (in any direction) with the following conditions:

- When the CPU ACL does not have an allow ACL rule for both directions.
- When an allow ALL rule exists, but also a DENY rule for port 443 or 80 of higher precedence.

- The allow rule for the virtual IP should be for TCP protocol and port 80 (if secureweb is disabled) or port 443 (if secureweb is enabled). This process is required to allow client's access to the virtual interface IP address, post successful authentication when the CPU ACL rules are in place.

Restrictions for Configuring Web Authentication on a WLAN

- Web authentication is supported only with these Layer 2 security policies: open authentication, open authentication+WEP, and WPA-PSK. With the 7.4 release, web authentication is supported for use with 802.1X.
- Special charecters are not supported in the username field for web-authentication.
- When clients connect to a WebAuth SSID and a preauthorization ACL configured to allow VPN users, the clients will get disconnected from the SSID every few minutes. Webauth SSIDs must not connect without authenticating on the web page.

  You can select the following identity stores to authenticate web-auth user, under **WLANs > Security > AAA servers > Authentication priority** order for web-auth user section:

  - Local
  - RADIUS
  - LDAP

  If multiple identity stores are selected, then the controller checks each identity store in the list, in the order specified, from top to bottom, until authentication for the user succeeds. The authentication fails, if the controller reaches the end of the list and user remains un-authenticated in any of the identity stores.

Information About Web Authentication

WLANs can use web authentication only if VPN passthrough is not enabled on the controller. Web authentication is simple to set up and use and can be used with SSL to improve the overall security of the WLAN.

Configuring Web Authentication

Configuring Web Authentication (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure web authentication. The **WLANs > Edit** page appears.

Step 3 Choose the **Security** and **Layer 3** tabs to open the **WLANs > Edit (Security > Layer 3)** page.

Step 4 Select the **Web Policy** check box.

Step 5 Make sure that the **Authentication** option is selected.

Step 6 Click **Apply** to commit your changes.

Step 7 Click **Save Configuration** to save your settings.

Configuring Web Authentication (CLI)

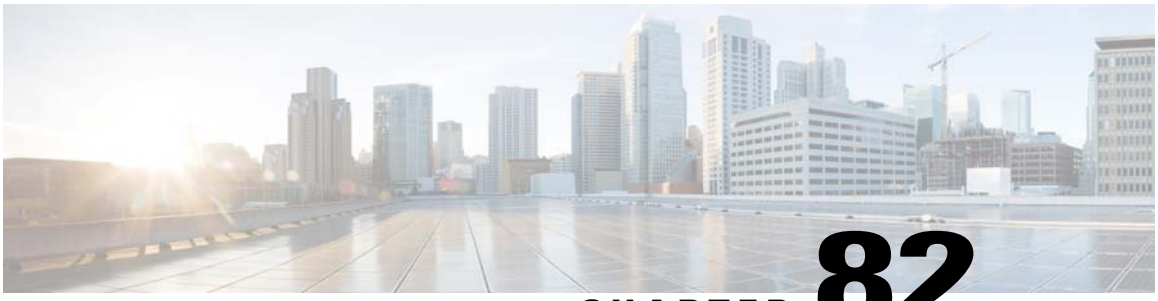
Step 1 Enable or disable web authentication on a particular WLAN by entering this command:
config wlan security web-auth {**enable** | **disable**} *wlan_id*

Step 2 Release the guest user IP address when the web authentication policy timer expires and prevent the guest user from acquiring an IP address for 3 minutes by entering this command:
config wlan webauth-exclude *wlan_id* {**enable** | **disable**}

The default value is disabled. This command is applicable when you configure the internal DHCP scope on the controller. By default, when the web authentication timer expires for a guest user, the user can immediately reassociate to the same IP address before another guest user can acquire it. If there are many guest users or limited IP addresses in the DHCP pool, some guest users might not be able to acquire an IP address.

When you enable this feature on the guest WLAN, the guest user's IP address is released when the web authentication policy timer expires and the guest user is excluded from acquiring an IP address for 3 minutes. The IP address is available for another guest user to use. After 3 minutes, the excluded guest user can reassociate and acquire an IP address, if available.

Step 3 See the status of web authentication by entering this command:
show wlan *wlan_id*



CHAPTER 82

Configuring Captive Bypassing

Information About Captive Bypassing

WISPr is a draft protocol that enables users to roam between different wireless service providers. Some devices (For example, Apple iOS devices) have a mechanism using which they can determine if the device is connected to Internet, based on an HTTP WISPr request made to a designated URL. This mechanism is used for the device to automatically open a web browser when a direct connection to the internet is not possible. This enables the user to provide his credentials to access the internet. The actual authentication is done in the background every time the device connects to a new SSID.

This HTTP request triggers a web authentication interception in the controller as any other page requests are performed by a wireless client. This interception leads to a web authentication process, which will be completed normally. If the web authentication is being used with any of the controller splash page features (URL provided by a configured RADIUS server), the splash page may never be displayed because the WISPr requests are made at very short intervals, and as soon as one of the queries is able to reach the designated server, any web redirection or splash page display process that is performed in the background is aborted, and the device processes the page request, thus breaking the splash page functionality.

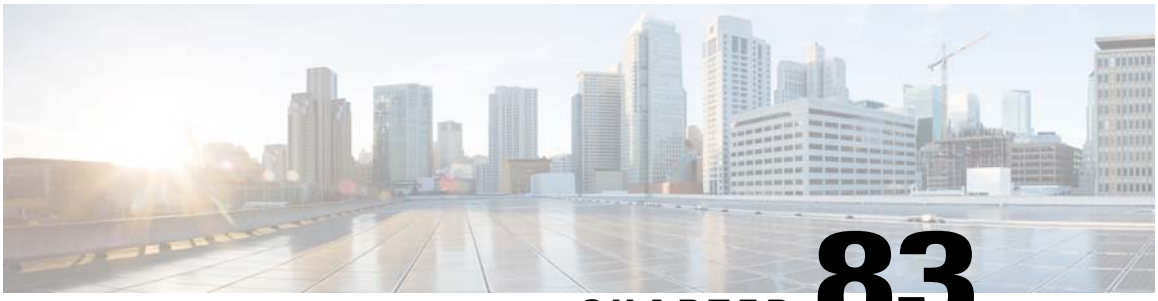
For example, Apple introduced an iOS feature to facilitate network access when captive portals are present. This feature detects the presence of a captive portal by sending a web request on connecting to a wireless network. This request is directed to http://www.apple.com/library/test/success.html for Apple IOS version 6 and older, and to several possible target URLs for Apple IOS version 7 and later. If a response is received, then the Internet access is assumed to be available and no further interaction is required. If no response is received, then the Internet access is assumed to be blocked by the captive portal and Apple's Captive Network Assistant (CNA) auto-launches the pseudo-browser to request portal login in a controlled window. The CNA may break when redirecting to an ISE captive portal. The controller prevents this pseudo-browser from popping up.

You can now configure the controller to bypass WISPr detection process, so the web authentication interception is only done when a user requests a web page leading to splash page load in user context, without the WISPr detection being performed in the background.

Configuring Captive Bypassing (CLI)

Use these commands to configure captive bypassing:

- **config network web-auth captive-bypass** {**enable** | **disable**}—Enables or disables the controller to support bypass of captive portals at the network level.
- **show network summary**—Displays the status for the WISPr protocol detection feature.



CHAPTER 83

Configuring a Fallback Policy with MAC Filtering and Web Authentication

Information About Fallback Policy with MAC Filtering and Web Authentication

You can configure a fallback policy mechanism that combines Layer 2 and Layer 3 security. In a scenario where you have both MAC filtering and web authentication implemented, when a client tries to connect to a WLAN using the MAC filter (RADIUS server), if the client fails the authentication, you can configure the authentication to fall back to web authentication. When a client passes the MAC filter authentication, the web authentication is skipped and the client is connected to the WLAN. With this feature, you can avoid disassociations based on only a MAC filter authentication failure.

Configuring a Fallback Policy with MAC Filtering and Web Authentication (GUI)

Note Before configuring a fallback policy, you must have MAC filtering enabled.

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure the fallback policy for web authentication. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **Layer 3** tabs to open the WLANs > Edit (Security > Layer 3) page.

Step 4 From the Layer 3 Security drop-down list, choose **None.**

Step 5 Select the **Web Policy** check box.

Note The controller forwards DNS traffic to and from wireless clients prior to authentication.

The following options are displayed:

- Authentication
- Passthrough
- Conditional Web Redirect
- Splash Page Web Redirect
- On MAC Filter Failure

Step 6 Click **On MAC Filter Failure**.

Step 7 Click **Apply** to commit your changes.

Step 8 Click **Save Configuration** to save your settings.

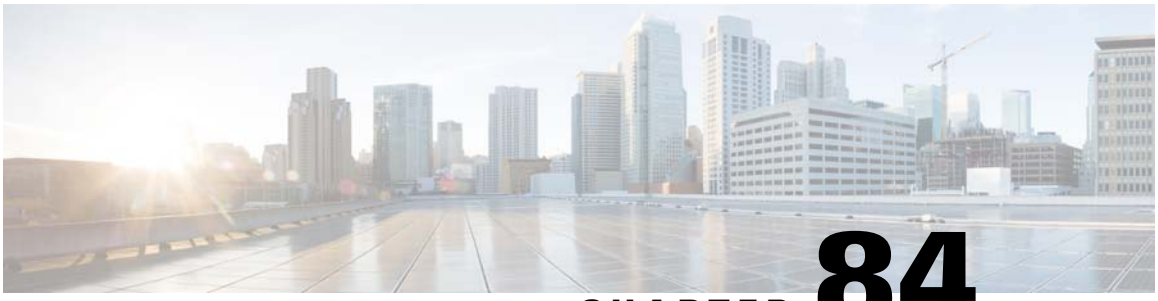
Configuring a Fallback Policy with MAC Filtering and Web Authentication (CLI)

Note Before configuring a fallback policy, you must have MAC filtering enabled. To know more about how to enable MAC filtering, see the Information About MAC Filtering of WLANs, on page 541 section.

Step 1 Enable or disable web authentication on a particular WLAN by entering this command:
config wlan security web-auth on-macfilter-failure *wlan-id*

Step 2 See the web authentication status by entering this command:
show wlan *wlan_id*

```
FT Over-The-Ds mode.............................. Enabled
CKIP ..................................... Disabled
   IP Security.................................. Disabled
   IP Security Passthru......................... Disabled
   Web Based Authentication..................... Enabled-On-MACFilter-Failure
        ACL..................................... Unconfigured
        Web Authentication server precedence:
        1....................................... local
        2....................................... radius
        3....................................... ldap
```



CHAPTER 84

Assigning QoS Profiles

Information About QoS Profiles

Cisco UWN solution WLANs support four levels of QoS: Platinum/Voice, Gold/Video, Silver/Best Effort (default), and Bronze/Background. You can configure the voice traffic WLAN to use Platinum QoS, assign the low-bandwidth WLAN to use Bronze QoS, and assign all other traffic between the remaining QoS levels.

The WLAN QoS level defines a specific 802.11e user priority (UP) for over-the-air traffic. This UP is used to derive the over-the-wire priorities for non-WMM traffic, and it also acts as the ceiling when managing WMM traffic with various levels of priorities.

The wireless rate limits can be defined on both upstream and downstream traffic. Rate limits can be defined per SSID and/or specified as a maximum rate limit for all clients. These rate limits can be individually configured.

The access point uses this QoS-profile-specific UP in accordance with the values in the following table to derive the IP DSCP value that is visible on the wired LAN.

Table 18: Access Point QoS Translation Values

AVVID Traffic Type	AVVID IP DSCP	QoS Profile	AVVID 802.1p	IEEE 802.11e UP
Network control	56 (CS7)	Platinum	7	7
Inter-network control (CAPWAP control, 802.11 management)	48 (CS6)	Platinum	6	7
Voice	46 (EF)	Platinum	5	6
Interactive video	34 (AF41)	Gold	4	5

AVVID Traffic Type	AVVID IP DSCP	QoS Profile	AVVID 802.1p	IEEE 802.11e UP
Mission critical	26 (AF31)	Gold	3	4
Transactional	18 (AF21)	Silver	2	3
Bulk data	10 (AF11)	Bronze	1	2
Best effort	0 (BE)	Silver	0	0
Scavenger	2	Bronze	0	1

Note The IEEE 802.11e UP value for DSCP values that are not mentioned in the table is calculated by considering 3 MSB bits of DSCP.

For example, the IEEE 802.11e UP value for DSCP 32 (100 000 in binary), would be the decimal equivalent of the MSB (100) which is 4. The 802.11e UP value of DSCP 32 is 4.

Assigning a QoS Profile to a WLAN (GUI)

Before You Begin

If you have not already done so, configure one or more QoS profiles using the instructions in the Configuring QoS Profiles (GUI) section.

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN to which you want to assign a QoS profile.

Step 3 When the **WLANs > Edit** page appears, choose the **QoS** tab.

Step 4 From the **Quality of Service (QoS)** drop-down list, choose one of the following:

- **Platinum** (**voice**)
- **Gold (video)**
- **Silver (best effort)**
- **Bronze** (**background**)

Note Silver (best effort) is the default value.

Step 5 To define the data rates on a per-user basis, do the following:

a) Define the average data rate for TCP traffic per user by entering the rate in Kbps in the Average Data Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

b) Define the peak data rate for TCP traffic per user by entering the rate in Kbps in the Burst Data Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

Note The burst data rate should be greater than or equal to the average data rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Ensure that you configure the average data rate before you configure the burst data rate.

c) Define the average real-time rate for UDP traffic per user by entering the rate in Kbps in the Average Real-Time Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

Note Average Data Rate is used to measure TCP traffic while Average Real-time rate is used for UDP traffic. They are measured in kbps for all the entries. The values for Average Data Rate and Average Real-time rate can be different because they are applied to different upper layer protocols such as TCP and UDP. These different values for the rates do not impact the bandwidth.

d) Define the peak real-time rate for UDP traffic per user by entering the rate in Kbps in the Burst Real-Time Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

Note The burst real-time rate should be greater than or equal to the average real-time rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Step 6 To define the data rates on a per-SSID basis, do the following:

a) Define the average data rate TCP traffic per SSID by entering the rate in Kbps in the Average Data Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

b) Define the peak data rate for TCP traffic per SSID by entering the rate in Kbps in the Burst Data Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

Note The burst data rate should be greater than or equal to the average data rate. Otherwise, the QoS policy may block traffic in the WLANs.

c) Define the average real-time rate for UDP traffic per SSID by entering the rate in Kbps in the Average Real-Time Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

d) Define the peak real-time rate for UDP traffic per SSID by entering the rate in Kbps in the Burst Real-Time Rate text boxes. A value of 0 indicates that the value specified in the selected QoS profile will take effect.

Note The burst real-time rate should be greater than or equal to the average real-time rate. Otherwise, the QoS policy may block traffic in the WLANs.

Step 7 Click **Apply**.

Step 8 Click **Save Configuration**.

Assigning a QoS Profile to a WLAN (CLI)

If you have not already done so, configure one or more QoS profiles using the instructions in the Configuring QoS Profiles (CLI) section.

Step 1 Assign a QoS profile to a WLAN by entering this command:
config wlan qos *wlan_id* {**bronze** | **silver** | **gold** | **platinum**}

Silver is the default value.

Step 2 To override QoS profile rate limit parameters, enter this command:

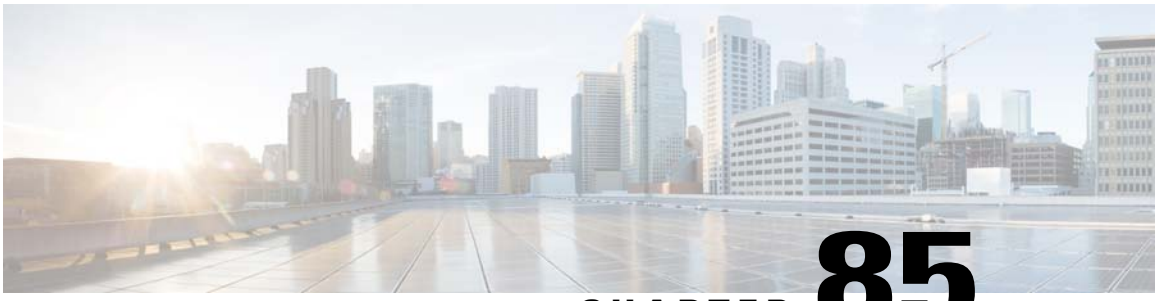
config wlan override-rate-limit *wlan-id* {**average-data-rate** | **average-realtime-rate** | **burst-data-rate** | **burst-realtime-rate**} {**per-ssid** | **per-client**} {**downstream** | **upstream**} *rate*

Step 3 Enter the **save config** command.

Step 4 Verify that you have properly assigned the QoS profile to the WLAN by entering this command: **show wlan** *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... test
Network Name (SSID).............................. test
Status........................................... Enabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Number of Active Clients......................... 0
Exclusionlist.................................... Disabled
Session Timeout.................................. 0
Interface........................................ management
WLAN ACL......................................... unconfigured
DHCP Server...................................... 1.100.163.24
DHCP Address Assignment Required................. Disabled
Quality of Service............................... Silver (best effort)
WMM.............................................. Disabled
...
```



CHAPTER 85

Configuring QoS Enhanced BSS

Prerequisites for Using QoS Enhanced BSS on Cisco 7921 and 7920 Wireless IP Phones

Follow these guidelines to use Cisco 7921 and 7920 Wireless IP Phones with controllers:

- Aggressive load balancing must be disabled for each controller. Otherwise, the initial roam attempt by the phone may fail, causing a disruption in the audio path.
- The Dynamic Transmit Power Control (DTPC) information element (IE) must be enabled using the **config 802.11b dtpc enable** command. The DTPC IE is a beacon and probe information element that allows the access point to broadcast information on its transmit power. The 7921 or 7920 phone uses this information to automatically adjust its transmit power to the same level as the access point to which it is associated. In this manner, both devices are transmitting at the same level.
- Both the 7921 and 7920 phones and the controllers support Cisco Centralized Key Management (CCKM) fast roaming.
- When configuring WEP, there is a difference in nomenclature for the controller and the 7921 or 7920 phone. Configure the controller for 104 bits when using 128-bit WEP for the 7921 or 7920.
- For standalone 7921 phones, load-based CAC must be enabled, and the WMM Policy must be set to Required on the WLAN.
- The controller supports traffic classification (TCLAS) coming from 7921 phones using firmware version 1.1.1. This feature ensures proper classification of voice streams to the 7921 phones.
- When using a 7921 phone with the 802.11a radio of a 1242 series access point, set the 24-Mbps data rate to Supported and choose a lower Mandatory data rate (such as 12 Mbps). Otherwise, the phone might experience poor voice quality.

Restrictions for QoS Enhanced BSS

- The OEAP 600 Series access points do not support CAC.
- QBSS is disabled by default.
- 7920 phones are non-WMM phones with limited CAC functionality. The phones look at the channel utilization of the access point to which they are associated and compare that to a threshold that is beaconed by the access point. If the channel utilization is less than the threshold, the 7920 places a call. In contrast, 7921 phones are full-fledged WMM phones that use traffic specifications (TSPECs) to gain access to the voice queue before placing a phone call. The 7921 phones work well with load-based CAC, which uses the percentage of the channel set aside for voice and tries to limit the calls accordingly.

  Because 7921 phones support WMM and 7920 phones do not, capacity and voice quality problems can arise if you do not properly configure both phones when they are used in a mixed environment. To enable both 7921 and 7920 phones to co-exist on the same network, make sure that load-based CAC and 7920 AP CAC are both enabled on the controller and the WMM Policy is set to Allowed. These settings become particularly important if you have many more 7920 users than 7921 users.
- We recommend that aggressive load balancing always be turned off either through the controller GUI or CLI in any wireless network that is supporting voice, regardless of vendor. When aggressive load balancing is turned on, voice clients can hear an audible artifact when roaming, if the handset is refused at its first reassociation attempt.

Information About QoS Enhanced BSS

The QoS Enhanced Basis Service Set (QBSS) information element (IE) enables the access points to communicate their channel usage to wireless devices. Because access points with high channel usage might not be able to handle real-time traffic effectively, the 7921 or 7920 phone uses the QBSS value to determine if they should associate to another access point. You can enable QBSS in these two modes:

- Wi-Fi Multimedia (WMM) mode, which supports devices that meet the 802.11E QBSS standard (such as Cisco 7921 IP Phones)
- 7920 support mode, which supports Cisco 7920 IP Phones on your 802.11b/g network

  The 7920 support mode has two options:

  - Support for 7920 phones that require call admission control (CAC) to be configured on and advertised by the client device (these are typically older 7920 phones)
  - Support for 7920 phones that require CAC to be configured on and advertised by the access point (these are typically newer 7920 phones)

    When access point-controlled CAC is enabled, the access point sends out a Cisco proprietary CAC Information Element (IE) and does not send out the standard QBSS IE.

Configuring QBSS (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure WMM mode.

Step 3 When the **WLANs > Edit** page appears, choose the **QoS** tab to open the **WLANs > Edit (Qos)** page.

Step 4 From the WMM Policy drop-down list, choose one of the following options, depending on whether you want to enable WMM mode for 7921 phones and other devices that meet the WMM standard:

- **Disabled—**Disables WMM on the WLAN. This is the default value.
- **Allowed—**Allows client devices to use WMM on the WLAN.
- **Required—**Requires client devices to use WMM. Devices that do not support WMM cannot join the WLAN.

Step 5 Select the **7920 AP CAC** check box if you want to enable 7920 support mode for phones that require access point-controlled CAC. The default value is unselected.

Step 6 Select the **7920 Client CAC** check box if you want to enable 7920 support mode for phones that require client-controlled CAC. The default value is unselected.

Note You cannot enable both WMM mode and client-controlled CAC mode on the same WLAN.

Step 7 Click **Apply** to commit your changes.

Step 8 Click **Save Configuration** to save your changes.

Configuring QBSS (CLI)

Step 1 Determine the ID number of the WLAN to which you want to add QBSS support by entering this command:
show wlan summary

Step 2 Disable the WLAN by entering this command:
config wlan disable *wlan_id*

Step 3 Configure WMM mode for 7921 phones and other devices that meet the WMM standard by entering this command:
config wlan wmm {**disabled** | **allowed** | **required**} *wlan_id*

where

- **disabled** disables WMM mode on the WLAN.
- **allowed** allows client devices to use WMM on the WLAN.
- **required** requires client devices to use WMM. Devices that do not support WMM cannot join the WLAN.

Step 4 Enable or disable 7920 support mode for phones that require client-controlled CAC by entering this command:
config wlan 7920-support client-cac-limit {**enable** | **disable**} *wlan_id*

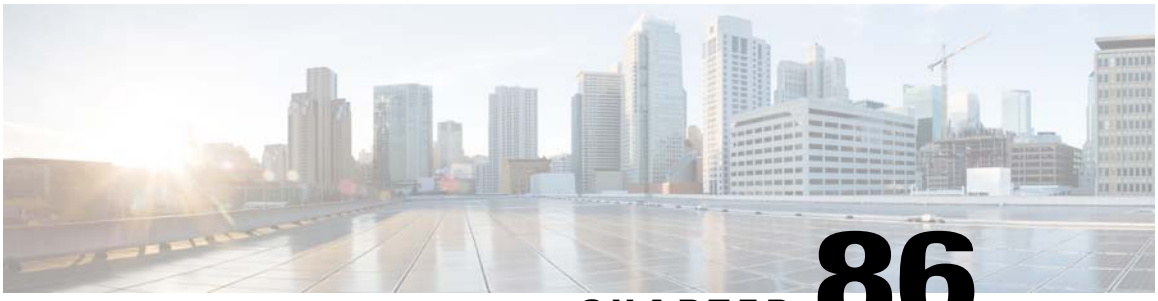
Note You cannot enable both WMM mode and client-controlled CAC mode on the same WLAN.

Step 5 Enable or disable 7920 support mode for phones that require access point-controlled CAC by entering this command:
config wlan 7920-support ap-cac-limit {**enable** | **disable**} *wlan_id*

Step 6 Reenable the WLAN by entering this command:
config wlan enable *wlan_id*

Step 7 Save your changes by entering this command:
save config

Step 8 Verify that the WLAN is enabled and the Dot11-Phone Mode (7920) text box is configured for compact mode by entering this command:
show wlan *wlan_id*



CHAPTER 86

Configuring Media Session Snooping and Reporting

Restrictions for Media Session Snooping and Reporting

Controller software release 6.0 or later releases support Voice over IP (VoIP) Media Session Aware (MSA) snooping and reporting.

Information About Media Session Snooping and Reporting

This feature enables access points to detect the establishment, termination, and failure of Session Initiation Protocol (SIP) voice calls and then report them to the controller and Cisco Prime Infrastructure. You can enable or disable Voice over IP (VoIP) snooping and reporting for each WLAN.

When you enable VoIP Media Session Aware (MSA) snooping, the access point radios that advertise this WLAN look for SIP voice packets that comply with SIP RFC 3261. They do not look for non-RFC 3261-compliant SIP voice packets or Skinny Call Control Protocol (SCCP) voice packets. Any SIP packets destined to or originating from port number 5060 (the standard SIP signaling port) are considered for further inspection. The access points track when Wi-Fi Multimedia (WMM) and non-WMM clients are establishing a call, are already on an active call, or are in the process of ending a call. Upstream packet classification for both client types occurs at the access point. Downstream packet classification occurs at the controller for WMM clients and at the access point for non-WMM clients. The access points notify the controller and Cisco Prime Infrastructure of any major call events, such as call establishment, termination, and failure.

The controller provides detailed information for VoIP MSA calls. For failed calls, the controller generates a trap log with a timestamp and the reason for failure (in the GUI) and an error code (in the CLI) to aid in troubleshooting. For successful calls, the controller shows the number and duration of calls for usage tracking purposes. Cisco Prime Infrastructure displays failed VoIP call information in the Events page.

Configuring Media Session Snooping (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure media session snooping.

Step 3 On the **WLANs > Edit** page, click the **Advanced** tab.

Step 4 Under Voice, select the **Media Session Snooping** check box to enable media session snooping or unselect it to disable this feature. The default value is unselected.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Step 7 See the VoIP statistics for your access point radios as follows:

a) Choose **Monitor** > **Access Points** > **Radios** > **802.11a/n** or **802.11b/g/n** to open the 802.11a/n (or 802.11b/g/n) Radios page.

b) Scroll to the right and click the **Detail** link for the access point for which you want to view VoIP statistics. The **Radio > Statistics** page appears.
The VoIP Stats section shows the cumulative number and length of voice calls for this access point radio. Entries are added automatically when voice calls are successfully placed and deleted when the access point disassociates from the controller.

Step 8 Choose **Management** > **SNMP** > **Trap Logs** to see the traps generated for failed calls. The Trap Logs page appears. For example, log 0 in the figure shows that a call failed. The log provides the date and time of the call, a description of the failure, and the reason why the failure occurred.

Configuring Media Session Snooping (CLI)

Step 1 Enable or disable VoIP snooping for a particular WLAN by entering this command:
config wlan call-snoop {**enable** | **disable**} *wlan_id*

Step 2 Save your changes by entering this command:
save config

Step 3 See the status of media session snooping on a particular WLAN by entering this command:
show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... wpa2-psk
Network Name (SSID).............................. wpa2-psk
Status........................................... Enabled
...
 FlexConnect Local Switching...................... Disabled
```

```
    FlexConnect Learn IP Address..................... Enabled
    Infrastructure MFP protection.............. Enabled (Global Infrastructure MFP
Disabled)
 Client MFP................................... Optional
    Tkip MIC Countermeasure Hold-down Timer....... 60
Call Snooping................................ Enabled
```

Step 4 See the call information for an MSA client when media session snooping is enabled and the call is active by entering this command:
show call-control client callInfo *client_MAC_address*

Information similar to the following appears:

```
Uplink IP/port..................................... 192.11.1.71 / 23870
Downlonk IP/port................................... 192.12.1.47 / 2070
UP................................................. 6
Calling Party...................................... sip:1054
Called Party....................................... sip:1000
Call ID............................................ 58635b00-850161b7-14853-1501a8
Number of calls for given client is.............. 1
```

Step 5 See the metrics for successful calls or the traps generated for failed calls by entering this command:
show call-control ap {**802.11a** | **802.11b**} *Cisco_AP* {**metrics** | **traps**}

Information similar to the following appears when you enter **show call-control ap** {**802.11a** | **802.11b**} *Cisco_AP* **metrics**:

```
Total Call Duration in Seconds................... 120
Number of Calls.............................. 10
```

Information similar to the following appears when you enter **show call-control ap** {**802.11a** | **802.11b**} *Cisco_AP* **traps**:

```
Number of traps sent in one min.................. 2
Last SIP error code.............................. 404
Last sent trap timestamp..................... Jun 20 10:05:06
```

To aid in troubleshooting, the output of this command shows an error code for any failed calls. This table explains the possible error codes for failed calls.

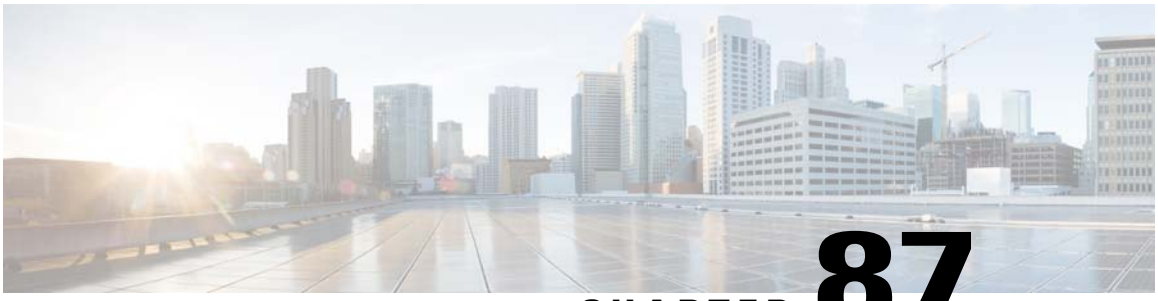
Table 19: Error Codes for Failed VoIP Calls

Error Code	Integer	Description
1	unknown	Unknown error.
400	badRequest	The request could not be understood because of malformed syntax.
401	unauthorized	The request requires user authentication.
402	paymentRequired	Reserved for future use.
403	forbidden	The server understood the request but refuses to fulfill it.

Error Code	Integer	Description
404	notFound	The server has information that the user does not exist at the domain specified in the Request-URI.
405	methodNotallowed	The method specified in the Request-Line is understood but not allowed for the address identified by the Request-URI.
406	notAcceptabl	The resource identified by the request is only capable of generating response entities with content characteristics that are not acceptable according to the Accept header text box sent in the request.
407	proxyAuthenticationRequired	The client must first authenticate with the proxy.
408	requestTimeout	The server could not produce a response within a suitable amount of time, if it could not determine the location of the user in time.
409	conflict	The request could not be completed due to a conflict with the current state of the resource.
410	gone	The requested resource is no longer available at the server, and no forwarding address is known.
411	lengthRequired	The server is refusing to process a request because the request entity-body is larger than the server is willing or able to process.
413	requestEntityTooLarge	The server is refusing to process a request because the request entity-body is larger than the server is willing or able to process.
414	requestURITooLarge	The server is refusing to service the request because the Request-URI is longer than the server is willing to interpret.
415	unsupportedMediaType	The server is refusing to service the request because the message body of the request is in a format not supported by the server for the requested method.
420	badExtension	The server did not understand the protocol extension specified in a Proxy-Require or Require header text box.
480	temporarilyNotAvailable	The callee's end system was contacted successfully, but the callee is currently unavailable.
481	callLegDoesNotExist	The UAS received a request that does not match any existing dialog or transaction.
482	loopDetected	The server has detected a loop.
483	tooManyHops	The server received a request that contains a Max-Forwards header text box with the value zero.

Error Code	Integer	Description
484	addressIncomplete	The server received a request with a Request-URI that was incomplete.
485	ambiguous	The Request-URI was ambiguous.
486	busy	The callee's end system was contacted successfully, but the callee is currently not willing or able to take additional calls at this end system.
500	internalServerError	The server encountered an unexpected condition that prevented it from fulfilling the request.
501	notImplemented	The server does not support the functionality required to fulfill the request.
502	badGateway	The server, while acting as a gateway or proxy, received an invalid response from the downstream server it accessed in attempting to fulfill the request.
503	serviceUnavailable	The server is temporarily unable to process the request because of a temporary overloading or maintenance of the server.
504	serverTimeout	The server did not receive a timely response from an external server it accessed in attempting to process the request.
505	versionNotSupported	The server does not support or refuses to support the SIP protocol version that was used in the request.
600	busyEverywhere	The callee's end system was contacted successfully, but the callee is busy or does not want to take the call at this time.
603	decline	The callee's machine was contacted successfully, but the user does not want to or cannot participate.
604	doesNotExistAnywhere	The server has information that the user indicated in the Request-URI does not exist anywhere.
606	notAcceptable	The user's agent was contacted successfully, but some aspects of the session description (such as the requested media, bandwidth, or addressing style) were not acceptable.

Note If you experience any problems with media session snooping, enter the **debug call-control** {**all** | **event**} {**enable** | **disable**} command to debug all media session snooping messages or events.



CHAPTER 87

Configuring Key Telephone System-Based CAC

Restrictions for Key Telephone System-Based CAC

- The controller ignores the SSID Capability Check Request message from the clients.
- Preferred call is not supported for KTS CAC clients.
- Reason code 17 is not supported in intercontroller roaming scenarios.
- To make the KTS-based CAC feature functional, ensure that you do the following:
  - Enable WMM on the WLAN
  - Enable ACM at the radio level
  - Enable processing of TSPEC inactivity timeout at the radio level

Information About Key Telephone System-Based CAC

Key Telephone System-based CAC is a protocol that is used in NEC MH240 wireless IP telephones. You can configure the controller to support CAC on KTS-based SIP clients, to process bandwidth request message from such clients, to allocate the required bandwidth on the AP radio, and to handle other messages that are part of the protocol.

When a call is initiated, the KTS-based CAC client sends a Bandwidth Request message to which the controller responds with a Bandwidth Confirm message indicating whether the bandwidth is allocated or not. The call is allowed only if the bandwidth is available. If the client roams from one AP to another, the client sends another Bandwidth Request message to the controller.

Bandwidth allocation depends on the median time calculated using the data rate from the Bandwidth Request message and the packetization interval. For KTS-based CAC clients, the G.711 codec with 20 milliseconds as the packetization interval is used to compute the medium time.

The controller releases the bandwidth after it receives the bandwidth release message from the client. When the client roams to another AP, the controller releases the bandwidth on the previous AP and allocates bandwidth on the new AP, in both intracontroller and intercontroller roaming scenarios. The controller releases the bandwidth if the client is dissociated or if there is inactivity for 120 seconds. The controller does not inform the client when the bandwidth is released for the client due to inactivity or dissociation of the client.

Configuring KTS-based CAC (GUI)

Before You Begin

To enable KTS-based CAC for a WLAN, ensure that you do the following:

- Set the QoS profile for the WLAN to Platinum.
- Set the WLAN in disabled state.
- Set the FlexConnect Local Switching in disabled state for the WLAN (On the WLANs > Edit page, click the **Advanced** tab and unselect the **FlexConnect Local Switching** check box).

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure the KTS-based CAC policy.

Step 3 On the **WLANs > Edit** page, click the **Advanced** tab.

Step 4 Under Voice, select or unselect the **KTS based CAC Policy** check box to enable or disable KTS-based CAC for the WLAN.

Step 5 Click **Apply** to commit your changes.

Configuring KTS-based CAC (CLI)

Before You Begin

To enable KTS-based CAC for a WLAN, ensure that you do the following:

- Configure the QoS profile for the WLAN to Platinum by entering the following command:

  config wlan qos *wlan-id* **platinum**

- Disable the WLAN by entering the following command:

  config wlan disable *wlan-id*

- Disable FlexConnect Local Switching for the WLAN by entering the following command:

config wlan flexconnect local-switching *wlan-id* **disable**

Step 1 To enable KTS-based CAC for a WLAN, enter the following command:
config wlan kts-cac enable *wlan-id*

Step 2 To enable the functioning of the KTS-based CAC feature, ensure you do the following:

a) Enable WMM on the WLAN by entering the following command:
config wlan wmm allow *wlan-id*

b) Enable ACM at the radio level by entering the following command:
config 802.11a cac voice acm enable

c) Enable the processing of the TSPEC inactivity timeout at the radio level by entering the following command:
config 802.11a cac voice tspec-inactivity-timeout enable

Related Commands

- To see whether the client supports KTS-based CAC, enter the following command:

  show client detail *client-mac-address*

  Information similar to the following appears:

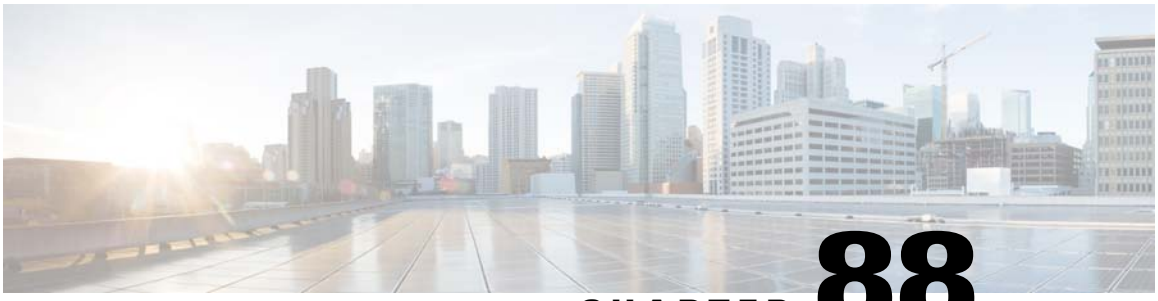
```
Client MAC Address.............................. 00:60:b9:0d:ef:26
Client Username ................................ N/A
AP MAC Address.................................. 58:bc:27:93:79:90

QoS Level....................................... Platinum
802.1P Priority Tag............................. disabled
KTS CAC Capability.............................. Yes
WMM Support..................................... Enabled
Power Save...................................... ON
```

- To troubleshoot issues with KTS-based CAC, enter the following command:

  debug cac kts enable

- To troubleshoot other issues related to CAC, enter the following commands:

  - **debug cac event enable**
  - **debug call-control all enable**



CHAPTER 88

Configuring Reanchoring of Roaming Voice Clients

Restrictions for Configuring Reanchoring of Roaming Voice Clients

- The ongoing data session might be affected due to disassociation and then reassociation.
- This feature is supported for TSPEC-based calls and non-TSPEC SIP-based calls only when you enable the admission control.
- This feature is not recommended for use on Cisco 792x phones.

Information About Reanchoring of Roaming Voice Clients

You can allow voice clients to get anchored on the best suited and nearest available controller, which is useful when intercontroller roaming occurs. By using this feature, you can avoid the use of tunnels to carry traffic between the foreign controller and the anchor controller and remove unnecessary traffic from the network.

The ongoing call during roaming is not affected and can continue without any problem. The traffic passes through proper tunnels that are established between the foreign controller and the anchor controller. Disassociation occurs only after the call ends, and then the client then gets reassociated to a new controller.

Note You can reanchor roaming of voice clients for each WLAN.

Configuring Reanchoring of Roaming Voice Clients (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure reanchoring of roaming voice clients.

Step 3 When the WLANs > Edit page appears, choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

Step 4 In the Voice area select the **Re-anchor Roamed Clients** check box.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Configuring Reanchoring of Roaming Voice Clients (CLI)

Step 1 Enable or disable reanchoring of roaming voice clients for a particular WLAN by entering this command:
config wlan roamed-voice-client re-anchor {enable | disable} *wlan id*

Step 2 Save your changes by entering this command:
save config

Step 3 See the status of reanchoring roaming voice client on a particular WLAN by entering this command:
show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... wpa2-psk
Network Name (SSID).............................. wpa2-psk
Status........................................... Enabled
...
Call Snooping.................................... Enabled
Roamed Call Re-Anchor Policy..................... Enabled
Band Select...................................... Disabled
Load Balancing................................... Disabled
```

Step 4 Save your changes by entering this command:
save config

CHAPTER 89

Configuring Seamless IPv6 Mobility

Prerequisites for Configuring IPv6 Mobility

- Up to eight client addresses can be tracked per client.
- To allow stateful DHCPv6 IP addressing to operate properly, you must have a switch or router that supports the DHCP for IPv6 feature that is configured to act like a DHCPv6 server, or you need a dedicated server such as a Windows 2008 server with a built-in DHCPv6 server.

To support the seamless IPv6 Mobility, you might need to configure the following:

- Configuring RA Guard for IPv6 Clients
- Configuring RA Throttling for IPv6 Clients
- Configuring IPv6 Neighbor Discovery Caching

Restrictions for Configuring IPv6 Mobility

- Clients must support IPv6 with either static stateless auto configuration (such as Windows XP clients) or stateful DHCPv6 IP addressing (such as Windows Vista clients).

Note Currently, DHCPv6 is supported for use only with Windows Vista clients. For these clients, you must manually renew the DHCPv6 IP address after the client changes VLANs.

Note The Dynamic VLAN function for IPv6 is not supported.

- Roaming of IPv6 clients that are associated with a WLAN that is mapped to an untagged interface to another WLAN that is mapped to a tagged interface is not supported.

Information About IPv6 Mobility

Internet Protocol version 6 (IPv6) is the next-generation network layer Internet protocol intended to replace version 4 (IPv4) in the TCP/IP suite of protocols. This new version increases the Internet global address space to accommodate users and applications that require unique global IP addresses. IPv6 incorporates 128-bit source and destination addresses, which provide significantly more addresses than the 32-bit IPv4 addresses.

To support IPv6 clients across controllers, ICMPv6 messages must be dealt with specially to ensure the IPv6 client remains on the same Layer 3 network. The controllers keep track of IPv6 clients by intercepting the ICMPv6 messages to provide seamless mobility and protect the network from network attacks. The ICMPv6 packets are converted from multicast to unicast and delivered individually per client. This process allows more control. Specific clients can receive specific Neighbor Discovery and Router Advertisement packets, which ensures correct IPv6 addressing and avoids unnecessary multicast traffic.

The configuration for IPv6 mobility is the same as IPv4 mobility and requires no separate software on the client side to achieve seamless roaming. The controllers must be part of the same mobility group. Both IPv4 and IPv6 client mobility are enabled by default.

Configuring IPv6 Globally

Configuring IPv6 Globally (GUI)

Step 1 Choose **Controller** > **General**.

Step 2 From the Global IPv6 Config drop-down list, choose **Enabled** or **Disabled**.

Step 3 Click **Apply**.

Step 4 Click **Save Configuration**.

Configuring IPv6 Globally (CLI)

Use this command to configure IPv6 globally:

- Enable or disable IPv6 globally by entering this command:
  config ipv6 {**enable** | **disable**}

Configuring RA Gaurd for IPv6 Clients

Information About RA Guard

IPv6 clients configure IPv6 addresses and populate their router tables based on IPv6 Router Advertisement (RA) packets. The RA Guard feature is similar to the RA guard feature of wired networks. RA Guard increases the security of the IPv6 network by dropping the unwanted or rogue RA packets that come from wireless clients. If this feature is not configured, malicious IPv6 clients could announce themselves as the router for the network, which would take higher precedence over legitimate IPv6 routers.

RA Guard occurs at the controller. You can configure the controller to drop RA messages at the access point or at the controller. By default, RA Guard is configured at the access point and also enabled in the controller. All IPv6 RA messages are dropped, which protects other wireless clients and upstream wired network from malicious IPv6 clients.

Configuring RA Guard (GUI)

Step 1 Choose **Controller > IPv6 > RA Guard** to open the IPv6 RA Guard page. By default the IPv6 RA Guard on AP is enabled.

Step 2 From the drop-down list, choose **Disable** to disable RA Guard. The controller also displays the clients that have been identified as sending RA packets.

Step 3 Click **Apply** to commit your changes.

Step 4 Click **Save Configuration** to save your changes.

Configuring RA Guard (CLI)

Use this command to configure RA Guard:

config ipv6 ra-guard ap {**enable** | **disable**}

Configuring RA Throttling for IPv6 Clients

Information about RA Throttling

RA throttling allows the controller to enforce limits to RA packets headed toward the wireless network. By enabling RA throttling, routers that send many RA packets can be trimmed to a minimum frequency that will still maintain an IPv6 client connectivity. If a client sends an RS packet, then an RA is sent back to the client. This is allowed through the controller and unicasted to the client. This process ensures that the new clients or roaming clients are not affected by the RA throttling.

Configuring RA Throttling (GUI)

Step 1 Choose **Controller > IPv6 > RA Throttle Policy** page. By default the IPv6 RA Throttle Policy is disabled. Unselect the check box to disable RA throttle policy.

Step 2 Configure the following parameters:

- **Throttle period—**The period of time for throttling. RA throttling takes place only after the Max Through limit is reached for the VLAN or the Allow At-Most value is reached for a particular router. The range is from 10 seconds to 86400 seconds. The default is 600 seconds.
- **Max Through—**The maximum number of RA packets on a VLAN that can be sent before throttling takes place. The No Limit option allows an unlimited number of RA packets through with no throttling. The range is from 0 to 256 RA packets. The default is 10 RA packets.
- **Interval Option—**This option allows the controller to act differently based on the RFC 3775 value set in IPv6 RA packets.
  - **Passthrough—** Allows any RA messages with the RFC 3775 interval option to go through without throttling.
  - **Ignore—**Causes the RA throttle to treat packets with the interval option as a regular RA and subject to throttling if in effect.
  - **Throttle—**Causes the RA packets with the interval option to always be subject to rate limiting.
- **Allow At-least—**The minimum number of RA packets per router that can be sent as multicast before throttling takes place. The range is from 0 to 32 RA packets.
- **Allow At-most—**The maximum number of RA packets per router that can be sent as multicast before throttling takes place. The No Limit option allows an unlimited number of RA packets through the router. The range is from 0 to 256 RA packets.

  Note When RA throttling occurs, only the first IPv6 capable router is allowed through. For networks that have multiple IPv6 prefixes being served by different routers, you should disable RA throttling.

Step 3 Click **Apply** to commit your changes.

Step 4 Click **Save Configuration** to save your changes.

Configuring the RA Throttle Policy (CLI)

Use this command to configure the RA throttle policy:

config ipv6 neigbhor-binding ra-throttle {**allow at-least** *at-least-value* | **enable** | **disable** | **interval-option** { **ignore** | **passthrough** | **throttle**} | **max-through** {**max-through-value** | **no-limit**}

Configuring IPv6 Neighbor Discovery Caching

Information About IPv6 Neighbor Discovery

IPv6 Neighbor Discovery is a set of messages and processes that determine relationships between neighboring nodes. Neighbor Discovery replaces ARP, ICMP Router Discovery, and ICMP Redirect used in IPv4.

IPv6 Neighbor Discovery inspection analyzes neighbor discovery messages in order to build a trusted binding table database, and IPv6 neighbor discovery packets that do not comply are dropped. The neighbor binding table in the controller track each IPv6 address and its associated MAC address. Clients are expired from the table according to Neighbor Binding timers.

Configuring Neighbor Binding (GUI)

Step 1 Choose **Controller > IPv6 > Neighbor Binding** page.

Step 2 Configure the following:

- Down–Lifetime—Specifies how long IPv6 cache entries are kept if the interface goes down. The range is from 0 to 86400 seconds.
- Reachable–Lifetime—Specifies how long IPv6 addresses are active. The range is from 0 to 86400 seconds.
- Stale–Lifetime—Specifies how long to keep IPv6 addresses in the cache. The range is from 0 to 86400 seconds.

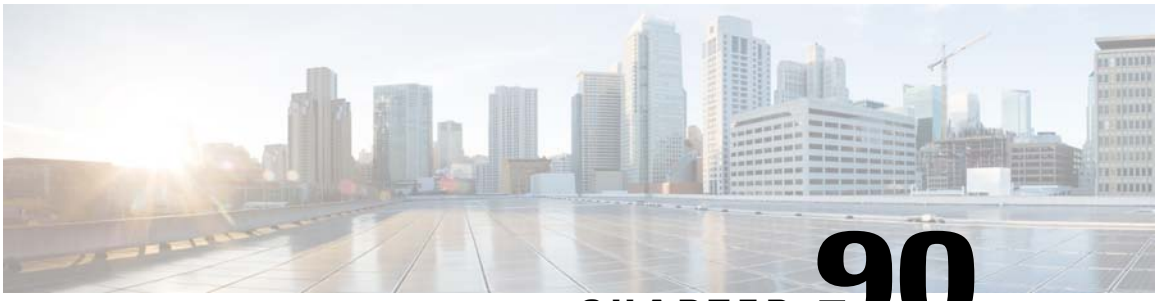
Step 3 Enable or disable the Unknown Address Multicast NS Forwarding.

Step 4 Click **Apply**.

Step 5 Click **Save Configuration**.

Configuring Neighbor Binding (CLI)

- Configure the neighbor binding parameters by entering this command:
  config ipv6 neighbor-binding timers {**down-lifetime** | **reachable-lifetime** | **stale-lifetime**} {**enable** | **disable**}
- Configure the Unknown Address Multicast NS Forwarding by entering this command:
  config ipv6 ns-mcast-fwd {**enable** | **disable**}



CHAPTER 90

Configuring Cisco Client Extensions

Prerequisites for Configuring Cisco Client Extensions

- The software supports CCX versions 1 through 5, which enables controllers and their access points to communicate wirelessly with third-party client devices that support CCX. CCX support is enabled automatically for every WLAN on the controller and cannot be disabled. However, you can configure Aironet information elements (IEs).
- If Aironet IE support is enabled, the access point sends an Aironet IE 0x85 (which contains the access point name, load, number of associated clients, and so on) in the beacon and probe responses of this WLAN, and the controller sends Aironet IEs 0x85 and 0x95 (which contains the management IP address of the controller and the IP address of the access point) in the reassociation response if it receives Aironet IE 0x85 in the reassociation request.

Restrictions for Configuring Cisco Client Extensions

- CCX is not supported on Cisco OEAP 600 access points and all elements related to CCX are not supported.
- Cisco OEAP 600 do not support Cisco Aeronet IEs.
- With the 7.2 release, a new version of CCX, which is called CCX Lite, is available. For more information about CCX Lite, see http://www.cisco.com/web/partners/pr46/pr147/program_additional_information_new_release_features.html

Information About Cisco Client Extensions

The Cisco Client Extensions (CCX) software is licensed to manufacturers and vendors of third-party client devices. The CCX code resident on these clients enables them to communicate wirelessly with Cisco access points and to support Cisco features that other client devices do not, including those features that are related to increased security, enhanced performance, fast roaming, and power management.

Configuring CCX Aironet IEs (GUI)

Step 1 Choose **WLANs** to open the **WLANs** page.

Step 2 Click the ID number of the desired WLAN to open the **WLANs > Edit** page.

Step 3 Choose the **Advanced** tab to open the **WLANs > Edit (Advanced tab)** page.

Step 4 Select the Aironet IE check box if you want to enable support for Aironet IEs for this WLAN. Otherwise, unselect this check box. The default value is enabled (or selected).

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Viewing a Client's CCX Version (GUI)

A client device sends its CCX version in association request packets to the access point. The controller then stores the client's CCX version in its database and uses it to limit the features for this client. For example, if a client supports CCX version 2, the controller does not allow the client to use CCX version 4 features.

Step 1 Choose **Monitor** > **Clients** to open the Clients page.

Step 2 Click the MAC address of the desired client device to open the Clients > Detail page.
The CCX Version text box shows the CCX version supported by this client device. *Not Supported* appears if the client does not support CCX.

Step 3 Click **Back** to return to the previous screen.

Step 4 Repeat this procedure to view the CCX version supported by any other client devices.

Configuring CCX Aironet IEs (CLI)

Use this command to configure CCX Aironet IEs:

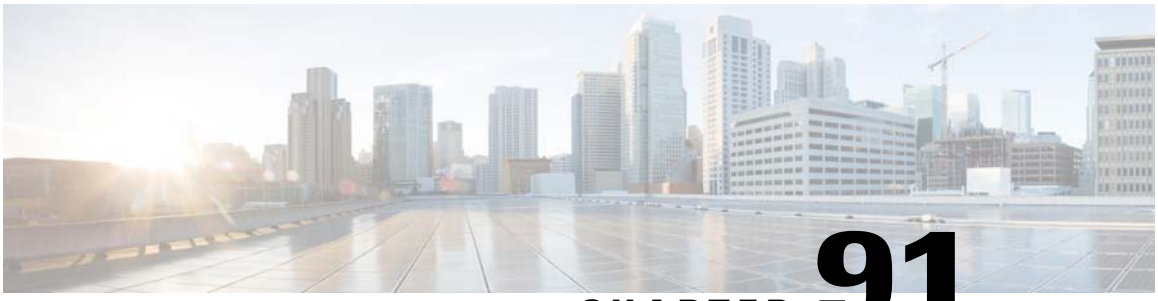
config wlan ccx aironet-ie {**enable** | **disable**} *wlan_id*

The default value is enabled.

Viewing a Client's CCX Version (CLI)

See the CCX version supported by a particular client device using the controller CLI by entering this command:

show client detail *client_mac*



CHAPTER 91

Configuring Remote LANs

Prerequisites for Configuring Remote LANs

- You must remove all remote LANs from a controller's configuration before moving to a release that does not support the remote LAN functionality. The remote LAN changes to a WLAN in earlier releases, which could cause an undesirable or unsecured WLAN being broadcast on the wireless network. Remote LAN is only supported in release 7.0.116.0 and later.
- Remote LAN can be applied on a dedicated LAN port on an OEAP 600 series access point.

Restrictions for Configuring Remote LANs

- Only four clients can connect to an OEAP 600 series access point through a remote LAN port. This number does not affect the fifteen WLAN limit imposed for the controller WLANs. The remote LAN client limit supports connecting a switch or hub to the remote LAN port for multiple devices or connecting directly to a Cisco IP phone that is connected to that port. Only the first four devices can connect until one of the devices is idle for more than one minute.
- It is not possible to configure 802.1X on remote LANs through the controller GUI; configuration only through CLI is supported.

Information About Remote LANs

This section describes how to configure remote LANs.

Configuring a Remote LAN (GUI)

Step 1 Choose **WLANs** to open the WLANs page.
This page lists all of the WLANs and remote LANs currently configured on the controller. For each WLAN, you can see its WLAN/remote LAN ID, profile name, type, SSID, status, and security policies.

The total number of WLANs/Remote LANs appears in the upper right-hand corner of the page. If the list of WLANs/Remote LANs spans multiple pages, you can access these pages by clicking the page number links.

Note If you want to delete a Remote LAN, hover your cursor over the blue drop-down arrow for that WLAN and choose **Remove**, or select the check box to the left of the row, choose **Remove Selected** from the drop-down list, and click **Go**. A message appears asking you to confirm your decision. If you proceed, the remote LAN is removed from any access point group to which it is assigned and from the access point's radio.

Step 2 Create a new Remote-LAN by choosing **Create New** from the drop-down list and clicking **Go**. The WLANs > New page appears.

Step 3 From the Type drop-down list, choose **Remote LAN** to create a remote LAN.

Step 4 In the Profile Name text box, enter up to 32 alphanumeric characters for the profile name to be assigned to this Remote WLAN. The profile name must be unique.

Step 5 From the WLAN ID drop-down list, choose the ID number for this WLAN.

Step 6 Click **Apply** to commit your changes. The **WLANs > Edit** page appears.

Note You can also open the WLANs > Edit page from the WLANs page by clicking the ID number of the WLAN that you want to edit.

Step 7 Use the parameters on the General, Security, and Advanced tabs to configure this remote LAN. See the sections in the rest of this chapter for instructions on configuring specific features.

Step 8 On the General tab, select the **Status** check box to enable this remote LAN. Be sure to leave it unselected until you have finished making configuration changes to the remote LAN.

Note You can also enable or disable remote LANs from the WLANs page by selecting the check boxes to the left of the IDs that you want to enable or disable, choosing **Enable Selected** or **Disable Selected** from the drop-down list, and clicking **Go**.

Step 9 Click **Apply** to commit your changes.

Step 10 Click **Save Configuration** to save your changes.

Configuring a Remote LAN (CLI)

- See the current configuration of the remote LAN by entering this command:

  show remote-lan *remote-lan-id*

- Enable or disable remote LAN by entering this command:

  config remote-lan {enable | disable} *remote-lan-id*

- Enable or disable 802.1X authentication for remote LAN by entering this command:

  config remote-lan security 802.1X {enable | disable} *remote-lan-id*

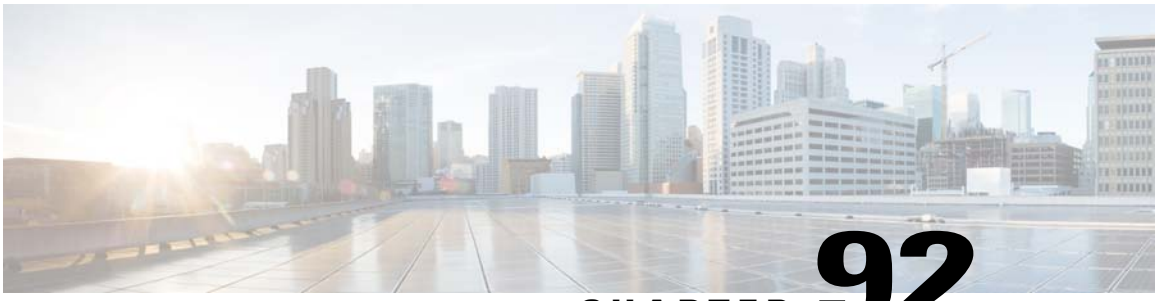
Note The encryption on a remote LAN is always “none.”

- Enable or disable local EAP with the controller as an authentication server, by entering this command:

  config remote-lan local-auth enable *profile-name remote-lan-id*
- If you are using an external AAA authentication server, use the following command:

  config remote-lan radius_server auth {add | delete} *remote-lan-id server id*

  config remote-lan radius_server auth {enable | disable} *remote-lan-id*



CHAPTER 92

Configuring AP Groups

Prerequisites for Configuring AP Groups

The following are the prerequisites for creating access point groups on a controller:

- The required access control list (ACL) must be defined on the router that serves the VLAN or subnet.
- Multicast traffic is supported with access point group VLANs. However, if the client roams from one access point to another, the client might stop receiving multicast traffic, unless IGMP snooping is enabled.

AP Groups Supported on Controller Platforms

This table lists the AP groups supported on various controller platforms:

Controller Platform	AP Groups Supported
Cisco 2500 Series Wireless Controller	50
Cisco 5500 Series Wireless Controller	500
Cisco Virtual Wireless Controller	200
Cisco 7500 Series Wireless Controller	6000
Cisco 8500 Series Wireless Controller	6000

Controller Platform	AP Groups Supported
Cisco Wireless Services Module 2	1000

Restrictions for Configuring Access Point Groups

- Suppose that the interface mapping for a WLAN in the AP group table is the same as the WLAN interface. If the WLAN interface is changed, the interface mapping for the WLAN in the AP group table also changes to the new WLAN interface.

  Suppose that the interface mapping for a WLAN in the AP group table is different from the one defined for the WLAN. If the WLAN interface is changed, then the interface mapping for the WLAN in the AP group table does not change to the new WLAN interface.

- If you clear the configuration on the controller, all of the access point groups disappear except for the default access point group “default-group,” which is created automatically.
- The default access point group can have up to 16 WLANs associated with it. The WLAN IDs for the default access point group must be less than or equal to 16. If a WLAN with an ID greater than 16 is created in the default access point group, the WLAN SSID will not be broadcasted. All WLAN IDs in the default access point group must have an ID that is less than or equal to 16. WLANs with IDs greater than 16 can be assigned to custom access point groups.
- The OEAP 600 Series access point supports a maximum of two WLANs and one remote LAN. If you have configured more than two WLANs and one remote LAN, you can assign the 600 Series access point to an AP group. The support for two WLANs and one remote LAN still applies to the AP group If the 600 Series OEAP is in the default group, the WLAN/remote LAN ids must be lower than 8.
- All OfficeExtend access points should be in the same access point group, and that group should contain no more than 15 WLANs. A controller with OfficeExtend access points in an access point group publishes only up to 15 WLANs to each connected OfficeExtend access point because it reserves one WLAN for the personal SSID.

Note A controller with OfficeExtend access points in an access point group publishes up to 15 WLANs to each connected OfficeExtend access point because it reserves one WLAN for the personal SSID.

Information About Access Point Groups

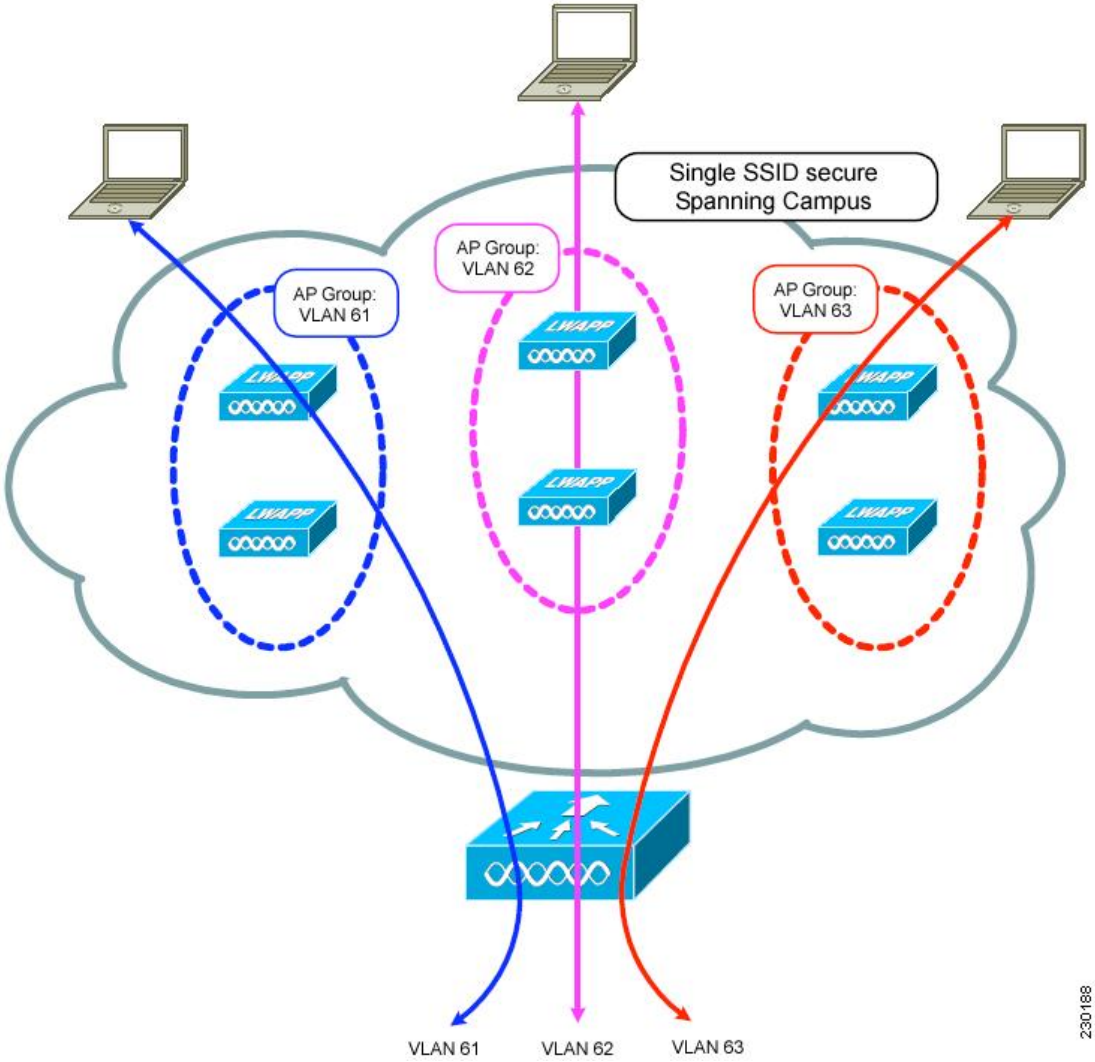
After you create up to 512 WLANs on the controller, you can selectively publish them (using access point groups) to different access points to better manage your wireless network. In a typical deployment, all users on a WLAN are mapped to a single interface on the controller. Therefore, all users that are associated with that WLAN are on the same subnet or VLAN. However, you can choose to distribute the load among several interfaces or to a group of users based on specific criteria such as individual departments (such as Marketing) by creating access point groups. Additionally, these access point groups can be configured in separate VLANs to simplify network administration.

In the figure, three configured dynamic interfaces are mapped to three different VLANs (VLAN 61, VLAN 62, and VLAN 63). Three access point groups are defined, and each is a member of a different VLAN, but all are members of the same SSID. A client within the wireless SSID is assigned an IP address from the VLAN subnet on which its access point is a member. For example, any user that associates with an access point that is a member of access point group VLAN 61 is assigned an IP address from that subnet.

In the figure, the controller internally treats roaming between access points as a Layer 3 roaming event. In this way, WLAN clients maintain their original IP addresses.

After all access points have joined the controller, you can create access point groups and assign up to 16 WLANs to each group. Each access point advertises only the enabled WLANs that belong to its access point group. The access point does not advertise disabled WLANs in its access point group or WLANs that belong to another group.

Figure 46: Access Point Groups



Configuring Access Point Groups

Step 1 Configure the appropriate dynamic interfaces and map them to the desired VLANs.
For example, to implement the network described in the Information About Access Point Groups section, create dynamic interfaces for VLANs 61, 62, and 63 on the controller. See the Configuring Dynamic Interfaces section for information about how to configure dynamic interfaces.

Step 2 Create the access point groups. See the Creating Access Point Groups section.

Step 3 Create a RF profile. See the Creating an RF Profile section.

Step 4 Assign access points to the appropriate access point groups. See the Creating Access Point Groups section.

Step 5 Apply the RF profile on the AP groups. See the Applying RF Profile to AP Groups section.

Creating Access Point Groups (GUI)

Step 1 Choose **WLANs** > **Advanced** > **AP Groups** to open the AP Groups page.
This page lists all the access point groups currently created on the controller. By default, all access points belong to the default access point group "default-group," unless you assign them to other access point groups.

Note The controller creates a default access point group and automatically populates it with the first 16 WLANs (WLANs with IDs 1 through 16, or fewer if 16 WLANs are not configured). This default group cannot be modified (you cannot add WLANs to it nor delete WLANs from it). It is dynamically updated whenever the first 16 WLANs are added or deleted. If an access point does not belong to an access point group, it is assigned to the default group and uses the WLANs in that group. If an access point joins the controller with an undefined access point group name, the access point keeps its group name but uses the WLANs in the default-group access point group.

Step 2 Click **Add Group** to create a new access point group. The Add New AP Group section appears at the top of the page.

Step 3 In the **AP Group Name** text box, enter the group's name.

Step 4 In the **Description** text box, enter the group's description.

Step 5 In the **NAS-ID** text box, enter the network access server identifier for the AP group.

Step 6 Click **Add**. The newly created access point group appears in the list of access point groups on the AP Groups page.

Note If you ever want to delete this group, hover your cursor over the blue drop-down arrow for the group and choose **Remove**. An error message appears if you try to delete an access point group that is used by at least one access point. Before deleting an access point group in controller software release 6.0 or later releases, move all access points in the group to another group. The access points are not moved to the default-group access point group as in previous releases.

Step 7 Click the name of the group to edit this new group. The **AP Groups > Edit (General)** page appears.

Step 8 Change the description of this access point group by entering the new text in the AP Group Description text box and click **Apply**.

Step 9 Choose the **WLANs** tab to open the AP Groups > Edit (WLANs) page. This page lists the WLANs that are currently assigned to this access point group.

Step 10 Click **Add New** to assign a WLAN to this access point group. The Add New section appears at the top of the page.

Step 11 From the WLAN SSID drop-down list, choose the SSID of the WLAN.

Step 12 From the **Interface Name** drop-down list, choose the interface to which you want to map the access point group. Choose the quarantine VLAN if you plan to enable network admission control (NAC) out-of-band support.

Note The interface name in the default-group access point group matches the WLAN interface.

Step 13 Select the **NAC State** check box to enable NAC out-of-band support for this access point group. To disable NAC out-of-band support, leave the check box unselected, which is the default value.

Step 14 Click **Add** to add this WLAN to the access point group. This WLAN appears in the list of WLANs that are assigned to this access point group.

Note If you ever want to remove this WLAN from the access point group, hover your cursor over the blue drop-down arrow for the WLAN and choose **Remove**.

Step 15 Repeat *Step 9* through *Step 13* to add any additional WLANs to this access point group.

Step 16 Choose the **APs** tab to assign access points to this access point group. The AP Groups > Edit (APs) page lists the access points that are currently assigned to this group as well as any access points that are available to be added to the group. If an access point is not currently assigned to a group, its group name appears as “default-group”.

Step 17 Select the check box to the left of the access point name and click **Add APs** to add an access point to this access point group. The access point now appears in the list of access points currently in this access point group.

Note To select all of the available access points at once, select the **AP Name** check box. All of the access points are then selected.

Note If you ever want to remove an access point from the group, select the check box to the left of the access point name and click **Remove APs**. To select all of the access points at once, select the **AP Name** check box. All of the access points are then removed from this group.

Note If you ever want to change the access point group to which an access point belongs, choose **Wireless** > **Access Points** > **All APs** > *ap_name* > **Advanced** tab, choose the name of another access point group from the **AP Group Name** drop-down list, and click **Apply**.

Step 18 In the **802.11u** tab, do the following:

a) Choose a HotSpot group that groups similar HotSpot venues.

b) Choose a venue type that is based on the HotSpot venue group that you choose.

c) To add a new venue, click Add New Venue and enter the language name that is used at the venue and the venue name that is associated with the basic service set (BSS). This name is used in cases where the SSID does not provide enough information about the venue.

d) Select the operating class(es) for the AP group.

e) Click **Apply**.

Step 19 Click **Save Configuration**.

Creating Access Point Groups (CLI)

Step 1 Create an access point group by entering this command:
config wlan apgroup add *group_name*

Note To delete an access point group, enter the **config wlan apgroup delete** *group_name command*. An error message appears if you try to delete an access point group that is used by at least one access point. Before deleting an access point group in controller software release 6.0 or later releases, move all access points in the group to another group. The access points are not moved to the default-group access point group as in previous releases. To see the access points in a group, enter the **show wlan apgroups** command. To move the access points to another group, enter the **config ap group-name** *group_name Cisco_AP* command.

Step 2 Add a description to an access point group by entering this command:
config wlan apgroup description *group_name description*

Step 3 Assign a WLAN to an access point group by entering this command:
config wlan apgroup interface-mapping add *group_name wlan_id interface_name*

Note To remove a WLAN from an access point group, enter the **config wlan apgroup interface-mapping delete** *group_name wlan_id* command.

Step 4 Enable or disable NAC out-of-band support for this access point group by entering this command:
config wlan apgroup nac {**enable** | **disable**}*group_name wlan_id*

Step 5 Configure a WLAN radio policy on the access point group by entering this command:
config wlan apgroup wlan-radio-policy *apgroup_name wlan_id* {**802.11a-only** | **802.11bg** | **802.11g-only** | **all**}

Step 6 Assign an access point to an access point group by entering this command:
config ap group-name *group_name Cisco_AP*

Note To remove an access point from an access point group, reenter this command and assign the access point to another group.

Step 7 To configure HotSpot for the AP group, enter this command:
config wlan apgroup hotspot {**venue** | **operating-class**}

Step 8 Save your changes by entering this command:
save config

Viewing Access Point Groups (CLI)

To view information about or to troubleshoot access point groups, use these commands:

- See a list of all access point groups on the controller by entering this command:

  show wlan apgroups

- See the BSSIDs for each WLAN assigned to an access point group by entering this command:

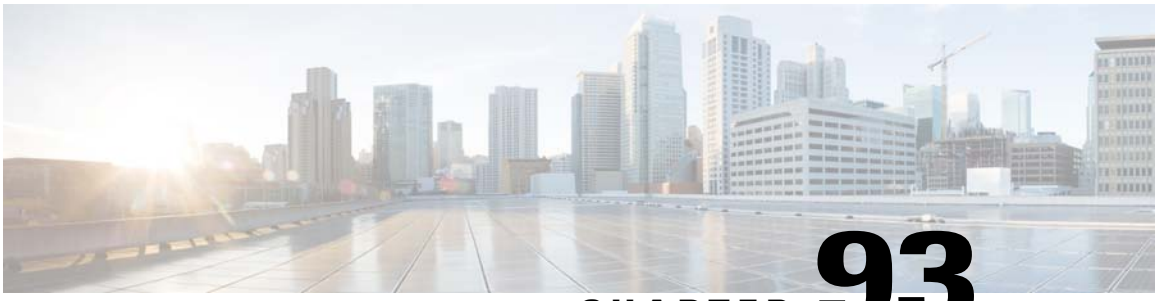
  show ap wlan {**802.11a** | **802.11b**} *Cisco_AP*

- See the number of WLANs enabled for an access point group by entering this command:

show ap config {**802.11a** | **802.11b**} *Cisco_AP*

- Enable or disable debugging of access point groups by entering this command:

  debug group {**enable** | **disable**}



CHAPTER 93

Configuring RF Profiles

Prerequisites for Configuring RF Profiles

Once you create an AP group and apply RF profiles or modify an existing AP group, the new settings are in effect and the following rules become effective:

- The same RF profile must be applied and present on every controller of the AP group or the action will fail for that controller.
- You can assign the same RF profile to more than one AP group.

Restrictions for Configuring RF Profiles

- Once you create an AP group and apply RF profiles or modify an existing AP group, the new settings are in effect and the following rules become effective:
  - AP that has a custom power setting applied for AP power is not in global mode configuration, an RF profile has no effect on this AP. For RF profiling to work, all APs must have their channel and power managed by RRM.
  - Within the AP group, changing the assignment of an RF profile on either band causes the AP to reboot.
  - Once you assign an RF profile to an AP group, you cannot make changes to that RF profile. You must change the AP group RF profile settings to none in order to change the RF profile and then

add it back to the AP group. You can also work around this restriction by disabling the network that will be affected by the changes that you will be making either for 802.11a or 802.11b.

- You cannot delete an AP group that has APs assigned to it.
- You cannot delete an RF profile that is applied to an AP group.

- If you enable Out of Box, save the configuration, and then reboot the CIsco WLC, the status of Out of Box is changed to disabled. This behavior is observed in Cisco WiSM2, Cisco 5500 Series WLC, and Cisco 2500 Series WLC. The workaround is to enable Out of Box again after you reboot the Cisco WLC.

Information About RF Profiles

RF Profiles allows you to tune groups of APs that share a common coverage zone together and selectively change how RRM will operates the APs within that coverage zone.

For example, a university might deploy a high density of APs in an area where a high number of users will congregate or meet. This situation requires that you manipulate both data rates and power to address the cell density while managing the co-channel interference. In adjacent areas, normal coverage is provided and such manipulation would result in a loss of coverage.

Using RF profiles and AP groups allows you to optimize the RF settings for AP groups that operate in different environments or coverage zones. RF profiles are created for the 802.11 radios. RF profiles are applied to all APs that belong to an AP group, where all APs in that group will have the same profile settings.

The RF profile gives you the control over the data rates and power (TPC) values.

Note The application of an RF profile does not change the AP's status in RRM. It is still in global configuration mode controlled by RRM.

To address high-density complex RF topologies, the following configurations are available:

- High Density Configurations—The following configurations are available to fine tune RF environments in a dense wireless network:
  - Client limit per WLAN or radio—Maximum number of clients that can communicate with the AP in a high-density environment.
  - Client trap threshold—Threshold value of the number of clients that associate with an access point, after which an SNMP trap is sent to the controller and Cisco Prime Infrastructure.
- Stadium Vision Configurations—You can configure the following parameter:
  - Multicast data rates—Configurable data rate for multicast traffic based on the RF condition of an AP.
- Out-of-Box AP Configurations—To create an Out of Box AP group that consists of newly installed access points that belong to the default AP group. When you enable this feature:
  - Newly installed access points that are part of the default AP group will be part of the Out-of-Box AP group and their radios will be switched off. This eliminates any RF instability caused by the new access points.

- All access points that do not have a group name become part of the Out of Box AP group.
- Special RF profiles are created per 802.11 band. These RF profiles have default settings for all the existing RF parameters and additional new configurations.

Note When you disable this feature after you enable it, only subscription of new APs to the Out of Box AP group stops. All APs that are subscribed to the Out of Box AP Group remain in this AP group. The network administrators can move such APs to the default group or a custom AP group upon network convergence.

- Band Select Configurations— Band Select addresses client distribution between the 2.4-GHz and 5-GHz bands by first understanding the client capabilities to verify whether a client can associate on both 2.4-GHz and 5-GHz spectrum. Enabling band select on a WLAN forces the AP to do probe suppression on the 2.4-GHz band that ultimately moves dual band clients to 5-GHz spectrum. You can configure the following band select parameters per AP Group:
  - Probe response—Probe responses to clients that you can enable or disable.
  - Probe Cycle Count—Probe cycle count for the RF profile. The cycle count sets the number of suppression cycles for a new client.
  - Cycle Threshold—Time threshold for a new scanning RF Profile band select cycle period. This setting determines the time threshold during which new probe requests from a client come in a new scanning cycle.
  - Suppression Expire—Expiration time for pruning previously known 802.11b/g clients. After this time elapses, clients become new and are subject to probe response suppression.
  - Dual Band Expire—Expiration time for pruning previously known dual-band clients. After this time elapses, clients become new and are subject to probe response suppression.
  - Client RSSI—Minimum RSSI for a client to respond to a probe.
- Load Balancing Configurations—Load balancing maintains fair distribution of clients across APs. You can configure the following parameters:
  - Window—Load balancing sets client association limits by enforcing a client window size. For example, if the window size is defined as 3, assuming fair client distribution across the floor area, then an AP should have no more than 3 clients associated with it than the group average.
  - Denial—The denial count sets the maximum number of association denials during load balancing.
- Coverage Hole Mitigation Configurations—You can configure the following parameters:
  - Data RSSI—Minimum receive signal strength indication (RSSI) value for data packets received by the access point. The value that you enter is used to identify coverage holes (or areas of poor coverage) within your network.
  - Voice RSSI—Minimum receive signal strength indication (RSSI) value for voice packets received by the access point.
  - Coverage Exception—Minimum number of clients on an access point with an RSSI value at or below the data or voice RSSI threshold to trigger a coverage hole exception.

- Coverage Level—Percentage of clients on an access point that are experiencing a low signal level but cannot roam to another access point. If an access point has more number of such clients than the configured coverage level it triggers a coverage hole event.

Configuring an RF Profile (GUI)

Step 1 Choose **Wireless** > **RF Profiles** to open the RF profiles page.

Step 2 To configure the out-of-box status for all RF profiles, select or unselect the **Enable Out Of Box** check box.

Step 3 Click **New**.

Step 4 Enter the RF Profile Name and choose the radio band.

Step 5 Click **Apply** to configure the customizations of power and data rate parameters.

Step 6 In the **General** tab, enter the description for the RF profile in the Description text box.

Step 7 In the **802.11** tab, configure the data rates to be applied to the APs of this profile.

Step 8 In the **RRM** tab, do the following:

a) In the TPC area, configure the Maximum and Minimum Power Level Assignment, that is the maximum and minimum power that the APs in this RF profile are allowed to use.

b) In the TPC area, configure a custom TPC power threshold for either Version1 or Version 2 of TPC.

Note Only one version of TPC can be operable for RRM on a given controller Version 1 and Version 2 are not interoperable within the same RF profile. If you select a threshold value for TPCv2 and it is not in the chosen TPC algorithm for the RF profile, this value will be ignored.

c) In the Coverage Hole Detection area, configure the voice and data RSSI.

d) In the Coverage Exception text box, enter the number for clients.

e) In the Coverage Level text box, enter the percentage.

Step 9 In the **High Density** tab, do the following:

a) In the High Density Parameters area, enter the maximum number of clients to be allowed per AP radio and the client trap threshold value.

b) In the Multicast Parameters area, choose the data rates from the Multicast Data Rates drop-down list.

Step 10 In the **Client Distribution** tab, do the following:

a) In the Load Balancing area, enter the client window size and the denial count.
The window size becomes part of the algorithm that determines whether an access point is too heavily loaded to accept more client associations:

load-balancing window + client associations on AP with the lightest load = load-balancing threshold

In the group of access points accessible to a client device, each access point has a different number of client associations. The access point with the lowest number of clients has the lightest load. The client window size plus the number of clients on the access point with the lightest load forms the threshold. Access points with more client associations than this threshold is considered busy, and clients can associate only to access points with client counts lower than the threshold.

The denial count sets the maximum number of association denials during load balancing.

b) In the Band Select area, select or unselect the **Probe Response** check box.

Note The Band Select configurations are available only for the 802.11b/g RF profiles.

c) In the Cycle Count text box, enter a value that sets the number of suppression cycles for a new client. The default count is 2.
d) In the Cycle Threshold text box, enter a time period in milliseconds that determines the time threshold during which new probe requests from a client from a new scanning cycle. The default cycle threshold is 200 milliseconds.
e) In the Suppression Expire text box, enter a time period after which the 802.11 b/g clients become new and are subject to probe response suppression.
f) In the Dual Band Expire text box, enter a time period after which the dual band clients become new and are subject to probe response suppression.
g) In the Client RSSI text box, enter the minimum RSSI for a client to respond to a probe.

Step 11 Click **Apply** to commit your changes.

Step 12 Click **Save Configuration** to save your changes.

Configuring an RF Profile (CLI)

Step 1 To configure the out-of-box status for all RF profiles, enter this command:
config rf-profile out-of-box {**enable** | **disable**}

Step 2 To create or delete an RF profile, enter this command:
config rf-profile {**create** {**802.11a** | **802.11b**} | **delete**} *profile-name*

Step 3 To specify a description for the RF profile, enter this command:
config rf-profile description *text profile-name*

Step 4 To configure the data rates to be applied to the APs of this profile, enter this command:
config rf-profile data-rates {**802.11a** | **802.11b**} {**disabled** | **mandatory** | **supported**} *rate profile-name*

Step 5 To configure the maximum and minimum power level assignment, that is the maximum and minimum power that the APs in this RF profile are allowed to use, enter this command:
config rf-profile {**tx-power-max** | **tx-power-min**} *power-value profile-name*

Step 6 To configure a custom TPC power threshold for either Version1 or Version 2 of TPC, enter this command:
config rf-profile {**tx-power-control-thresh-v1** | **tx-power-control-thresh-v2**} *power-threshold profile-name*

Step 7 To configure the coverage hole detection parameters:

a) To configure the coverage data, enter this command:
config rf-profile coverage data *value-in-dBm profile-name*

b) To configure the minimum client coverage exception level, enter this command:
config rf-profile coverage exception *clients profile-name*

c) To configure the coverage exception level percentage, enter this command:
config rf-profile coverage level *percentage-value profile-name*

d) To configure the coverage of voice, enter this command:
config rf-profile coverage voice *value-in-dBm profile-name*

Step 8 To configure the maximum number of clients to be allowed per AP radio, enter this command:
config rf-profile max-clients *num-of-clients profile-name*

Step 9 To configure the client trap threshold value, enter this command:
config rf-profile client-trap-threshold *threshold-value profile-name*

Step 10 To configure multicast, enter this command:
config rf-profile multicast data-rate *rate profile-name*

Step 11 To configure load balancing, enter this command:
config rf-profile load-balancing {**window** *num-of-clients* | **denial** *value*} *profile-name*

Step 12 To configure band select:

a) To configure the band select cycle count, enter this command:
config rf-profile band-select cycle-count *max-num-of-cycles profile-name*

b) To configure the cycle threshold, enter this command:
config rf-profile band-select cycle-threshold *time-in-milliseconds profile-name*

c) To configure the expiry of the band select, enter this command:
config rf-profile band-select expire {**dual-band** | **suppression**} *time-in-seconds profile-name*

d) To configure the probe response, enter this command:
config rf-profile band-select probe-response {**enable** | **disable**} *profile-name*

e) To configure the minimum RSSI for a client to respond to a probe, enter this command:
config rf-profile band-select client-rssi *value-in-dBm profile-name*

Step 13 Configure the 802.11n only mode for an access point group base by entering this command:
config rf-profile 11n-client-only {**enable** | **disable**} *rf-profile-name*

In the 802.11n only mode, the access point broadcasts support for 802.11n speeds. Only 802.11n clients are allowed to associate with the access point

Applying an RF Profile to AP Groups (GUI)

Step 1 Choose **WLANs** > **Advanced** > **AP Groups** to open the AP Groups page.

Step 2 Click the AP Group Name to open the AP Group > Edit page.

Step 3 Click the **RF Profile** tab to configure the RF profile details. You can choose an RF profile for each band (802.11a/802.11b) or you can choose just one or none to apply to this group.

Note Until you choose the APs and add them to the new group, no configurations are applied. You can save the new configuration as is, but no profiles are applied. Once you choose the APs to move the AP group, the process of moving the APs into the new group reboots the APs and the configurations for the RF profiles are applied to the APs in that AP group.

Step 4 Click the **APs** tab and choose the APs to add to the AP group.

Step 5 Click **Add APs** to add the selected APs to the AP group. A warning message displays that the AP group will reboot the APs will rejoin the controller.

Note APs cannot belong to two AP groups at once.

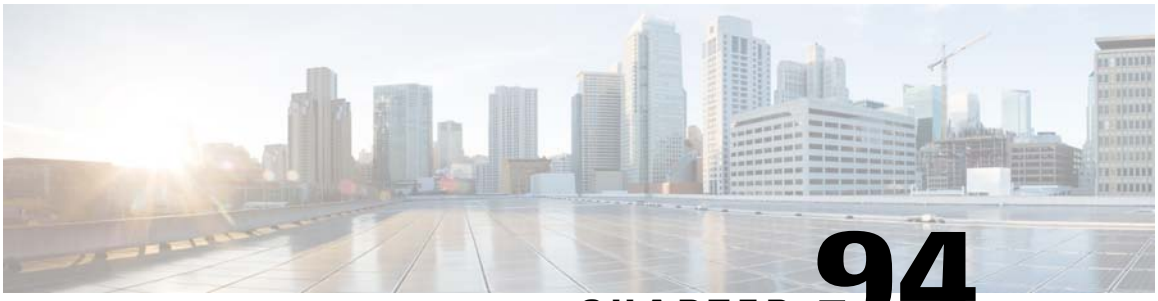
Step 6 Click **Apply**. The APs are added to the AP Group.

Applying RF Profiles to AP Groups (CLI)

What to Do Next

Use this command to apply RF profiles to AP groups:

- **config wlan apgroup profile-mapping** {**add** | **delete**} *ap-group-name rf-profile-name*



CHAPTER 94

Configuring Web Redirect with 8021.X Authentication

Information About Web Redirect with 802.1X Authentication

You can configure a WLAN to redirect a user to a particular web page after 802.1X authentication has completed successfully. You can configure the web redirect to give the user partial or full access to the network.

Conditional Web Redirect

If you enable conditional web redirect, the user can be conditionally redirected to a particular web page after 802.1X authentication has completed successfully. You can specify the redirect page and the conditions under which the redirect occurs on your RADIUS server. Conditions might include the user's password reaching expiration or the user needing to pay his or her bill for continued usage.

If the RADIUS server returns the Cisco AV-pair "url-redirect," then the user is redirected to the specified URL upon opening a browser. If the server also returns the Cisco AV-pair "url-redirect-acl," the specified access control list (ACL) is installed as a preauthentication ACL for this client. The client is not considered fully authorized at this point and can only pass traffic allowed by the preauthentication ACL.

After the client completes a particular operation at the specified URL (for example, changing a password or paying a bill), the client must reauthenticate. When the RADIUS server does not return a "url-redirect," the client is considered fully authorized and allowed to pass traffic.

Note The conditional web redirect feature is available only for WLANs that are configured for 802.1X or WPA+WPA2 Layer 2 security.

After you configure the RADIUS server, you can then configure the conditional web redirect on the controller using either the controller GUI or CLI.

Splash Page Web Redirect

If you enable splash page web redirect, the user is redirected to a particular web page after 802.1X authentication has completed successfully. After the redirect, the user has full access to the network. You can specify the redirect page on your RADIUS server. If the RADIUS server returns the Cisco AV-pair "url-redirect," then the user is redirected to the specified URL upon opening a browser. The client is considered fully authorized at this point and is allowed to pass traffic, even if the RADIUS server does not return a "url-redirect."

Note The splash page web redirect feature is available only for WLANs that are configured for 802.1X or WPA+WPA2 Layer 2 security with 802.1x key management. Preshared key management is not supported with any Layer 2 security method.

Suppose there are backend applications running on the wireless clients and they use HTTP or HTTPS port for their communication. If the applications start communicating before the actual web page is opened, the redirect functionality does not work with web passthrough.

After you configure the RADIUS server, you can then configure the splash page web redirect on the controller using either the controller GUI or CLI.

Configuring the RADIUS Server (GUI)

Note These instructions are specific to the CiscoSecure ACS; however, they should be similar to those for other RADIUS servers.

Step 1 From the CiscoSecure ACS main menu, choose **Group Setup**.

Step 2 Click **Edit Settings**.

Step 3 From the Jump To drop-down list, choose **RADIUS (Cisco IOS/PIX 6.0)**.

Step 4 Select the **[009\001] cisco-av-pair** check box.

Step 5 Enter the following Cisco AV-pairs in the [009\001] cisco-av-pair edit box to specify the URL to which the user is redirected and, if configuring conditional web redirect, the conditions under which the redirect takes place, respectively:
url-redirect=http://url

url-redirect-acl=acl_name