Working with WLANs

This chapter contains the following sections:

- Information About WLANs, page 8-1
- Guidelines and Limitations, page 8-1
- Creating WLANs, page 8-3
- Searching WLANs, page 8-6
- Configuring WLANs, page 8-8

Information About WLANs

The Cisco UWN solution can control up to 512 WLANs for lightweight access points. Each WLAN has a separate WLAN ID (1 through 512), 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 512 WLANs 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 Service Set Identifiers (SSIDs) or with the same SSID. An SSID identifies the specific wireless network that you want the controller to access.

Guidelines and Limitations

- 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.
- 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 does not advertise disabled WLANs in its access point group or WLANs that belong to another group. See the "Creating Access Point Groups (GUI)" section on page 8-60 for more information on access point groups.
- 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 SSID.

- WLANS with the same SSID and same L2 Policy cannot be created if the WLAN ID < 17.

- Two WLANs with ids greater than 17 having the same SSID and same L2 policy is allowed provided WLANS are added in different AP groups.

Note This requirement ensures that clients never detect the SSID present on the same access point radio.

When creating a WLAN with the same SSID, follow these guidelines and requirements:

- You must create a unique profile name for each WLAN.
- 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.

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 WPA (Wi-Fi Protected Access) /TKIP (Temporal Key Integrity Protocol) with 802.1X, respectively, or with WPA/TKIP with 802.1X or WPA/AES with 802.1X, respectively.

- 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).

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.

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.

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.

Creating WLANs

This section contains the following topics:

- Creating and Removing WLANs (GUI), page 8-3
- Enabling and Disabling WLANs (GUI), page 8-4
- Creating and Deleting WLANs (CLI), page 8-4
- Viewing WLANs (CLI), page 8-5
- Enabling and Disabling WLANs (CLI), page 8-5

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** and follow the instructions in the "Configuring Wired Guest Access" section on page 12-28.

Step 4 In the Profile Name text box, enter up to 32 alphanumeric 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 alphanumeric 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.

Note If you want to create a guest LAN for wired guest users, follow the instructions in the "Configuring Wired Guest Access" section on page 12-28.

- 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.

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

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.

Searching WLANs

This section contains the following topics:

- Searching WLANs (GUI), page 8-6
- Setting the Client Count per WLAN, page 8-6

Searching WLANs (GUI)

Step 1 To search for WLANs using the controller GUI, follow these steps:

Step 2 On the WLANs page, click **Change Filter**. The Search WLANs dialog box appears.

Step 3 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 4 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**.

Setting the Client Count per WLAN

This section contains the following topics:

- Information About Setting Client Count per WLAN, page 8-7
- Guidelines and Limitations, page 8-7
- Configuring Client Count per WLAN (GUI), page 8-7
- Configuring Maximum Number of Clients per WLAN (CLI), page 8-7

Information About Setting 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 per WLAN depends on the platform that you are using.

Guidelines and Limitations

- The maximum number of clients per WLAN feature is not supported when you use FlexConnect local authentication.
- The maximum number of clients per WLAN feature is supported only for access points that are in connected mode.

Configuring 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 On the Advanced tab, enter the Maximum Allowed Clients text box.

See Table 8-1 for the maximum number of clients supported per platform.

Step 4 Click **Apply** to commit your changes.

Configuring 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

Obtain the WLAN ID from the list.

Step 2 Configure the maximum number of clients per WLAN by entering this command:

config wlan max-associated-clients *max-clients wlanid*

See Table 8-1 for the maximum number of clients supported per platform.

Configuring Maximum Number of Clients per 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 On the Advanced tab, enter the maximum allowed clients per access point radio in the **Maximum Allowed Clients Per AP Radio** text box. You can configure up to 200 clients.

Step 4 Click **Apply** to commit your changes.

Configuring Maximum Number of Clients per AP Radio Per WLAN (CLI)

Step 1 Determine the WLAN ID for which you want to configure the maximum clients per radio by entering this command:

show wlan summary

Obtain the WLAN ID from the list.

Step 2 Configure the maximum number of clients per WLAN by entering this command:

config wlan max-radio-clients *client_count*

You can configure up to 200 clients.

Step 3 To view the configured maximum associated clients, use the **show 802.11a** command.

Configuring WLANs

This section contains the following topics:

- Configuring DHCP, page 8-9
- Configuring MAC Filtering for WLANs, page 8-16
- Configuring Local MAC Filters, page 8-16
- Configuring a Timeout for Disabled Clients, page 8-17
- Assigning WLANs to Interfaces, page 8-18
- Configuring the DTIM Period, page 8-18
- Configuring Peer-to-Peer Blocking, page 8-20
- Configuring Layer 2 Security, page 8-23
- Configuring a WLAN for Both Static and Dynamic WEP, page 8-24
- Configuring WPA1 +WPA2, page 8-26
- Configuring CKIP, page 8-29
- Configuring Session Timeouts, page 8-32
- Configuring Layer 3 Security Using Web Authentication, page 8-33
- Configuring Layer 3 Security Using Web Authentication, page 8-33
- Configuring a Fallback Policy with MAC Filtering and Web Authentication, page 8-36
- Assigning a QoS Profile to a WLAN, page 8-38
- Configuring QoS Enhanced BSS, page 8-40
- Configuring Media Session Snooping and Reporting, page 8-43

- Configuring Key Telephone System-Based CAC, page 8-47
- Configuring Reanchoring of Roaming Voice Clients, page 8-50
- Configuring Seamless IPv6 Mobility, page 8-51
- Configuring RA Guard for IPv6 Clients, page 8-53
- Configuring RA Throttling for IPv6 Clients, page 8-53
- Configuring IPv6 Neighbor Discovery Caching, page 8-55
- Configuring Cisco Client Extensions, page 8-57
- Configuring AP Groups, page 8-58
- Configuring RF Profiles, page 8-64
- Configuring Web Redirect with 802.1X Authentication, page 8-66
- Configuring NAC Out-of-Band Integration, page 8-70
- Configuring Passive Clients, page 8-74
- Configuring Per-WLAN RADIUS Source Support, page 8-79
- Configuring Remote LANs, page 8-81

Configuring DHCP

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.

This section contains the following topics:

- Internal DHCP Server, page 8-9
- External DHCP Servers, page 8-10
- DHCP Assignment, page 8-10
- Configuring DHCP, page 8-11
- Configuring DHCP Scopes, page 8-13

Internal DHCP Server

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 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, DNS, or priming.

Note See Chapter 9, "Controlling Lightweight Access Points," or the *Controller Deployment Guide* at this URL for more information on how access points find controllers:

http://www.cisco.com/en/US/products/ps6366/prod_technical_reference_list.html

An internal DHCP server pool only serves the wireless clients of that controller, not clients of other controllers. Also, internal DHCP server can only serve wireless clients and not wired clients. Wired guest clients are always on a Layer 2 network connected to a local or foreign controller.

Note The DHCP required state can cause traffic to not be forwarded properly if a client is deauthenticated or removed. To overcome this problem, ensure that the DHCP required state is always disabled.

Note The controller does not support internal DHCPv6 servers. However, clients can learn the IP addresses that are assigned by an external DHCPv6 server.

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 obtained from a DHCP server, it maintains the same IP address for that client during intra-controller, inter-controller, and inter-subnet client roaming.

DHCP Assignment

You can configure DHCP on a per-interface or per-WLAN basis. The preferred method is to use the primary DHCP server address assigned to a particular interface.

You can assign DHCP servers for individual interfaces. The management interface, AP-manager interface, and dynamic interfaces can be configured for a primary and secondary DHCP server, and the service-port interface can be configured to enable or disable DHCP servers.

Note See Chapter 11, "Managing Controller Software and Configurations," for information on configuring the controller's interfaces.

You can also define a DHCP server on a WLAN. This server will override 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, all WLANs can be configured 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. See the "Using Management Over Wireless" section on page 7-51 for instructions on configuring management over wireless.

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 are also allowed to create separate WLANs with DHCP Addr. Assignment Required being disabled. This is applicable only if DHCP proxy is enabled for the controller. It is not necessary to define the primary/secondary DHCP server. These WLANs drop all DHCP requests and force clients to use a static IP address. These WLANs do not support management over wireless connections.

Note See Chapter 7, "Configuring Security Solutions," for instructions on globally configuring DHCP proxy.

Note If you want to specify a static IP address for an access point rather than having one assigned automatically by a DHCP server, see the "Configuring a Static IP Address on a Lightweight Access Point" section on page 9-48 for more information.

Guidelines and Limitations

The controller internal DHCP server does not support Cisco Aironet 600 Series OfficeExtend Access Point.

Configuring DHCP

This section contains the following topics:

- Configuring DHCP (GUI), page 8-11
- Configuring DHCP (CLI), page 8-12
- Debugging DHCP (CLI), page 8-13

Configuring DHCP (GUI)

To configure a primary DHCP server for a management, AP-manager, or dynamic interface, see Chapter 4, "Configuring Ports and Interfaces."

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 Click 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** to commit your changes.

Step 10 On the General tab, select the **Status** check box and click **Apply** to reenable the WLAN.

Step 11 Click **Save Configuration** to save your changes.

Configuring DHCP (CLI)

To configure a primary DHCP server for a management, AP-manager, or dynamic interface, see Chapter 4, “Configuring Ports and Interfaces.”

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)

- **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.

Configuring 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.

You can configure up to 16 DHCP scopes using the controller GUI or CLI.

This section contains the following topics:

- Configuring DHCP Scopes (GUI), page 8-14
- Configuring DHCP Scopes (CLI), page 8-15

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
```

Configuring MAC Filtering for 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.

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.

Configuring Local MAC Filters

This section contains the following topics:

- Information About Local MAC Filters, page 8-17
- Guidelines and Limitations, page 8-17
- Configuring Local MAC Filters (CLI), page 8-17
- Configuring a Timeout for Disabled Clients, page 8-17
- Configuring a Timeout for Disabled Clients (CLI), page 8-17

Information About Local MAC Filters

Controllers have built-in MAC filtering capability, similar to that provided by a RADIUS authorization server. You can configure a MAC filter using the GUI or CLI.

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.

Guidelines and Limitations

You must have AAA enabled on the WLAN to override the interface name.

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 a Timeout for Disabled Clients (CLI)

- Configure the timeout for disabled clients by entering the **config wlan exclusionlist** *wlan_id timeout* command. Enter a timeout from **1** to **65535** seconds, or enter **0** to permanently disable the client.
- Verify the current timeout by entering the **show wlan** command.

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 the DTIM Period

This section contains the following topics:

- Information About the DTIM Period, page 8-18
- Guidelines and Limitations, page 8-19
- Configuring the DTIM Period, page 8-19

Information About the DTIM Period

In 802.11a/n and 802.11b/g/n 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 (transmit broadcast and multicast frames after every beacon) or 2 (transmit after every other beacon). For instance, if the beacon period of the 802.11a/n or 802.11b/g/n 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 may be suitable for applications, including VoIP, that expect frequent broadcast and multicast frames.

However, the DTIM value can be set as high as 255 (transmit broadcast and multicast frames after every 255th beacon) if all 802.11a/n or 802.11b/g/n 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, resulting in a longer battery life. For instance, if the beacon period is 100 ms and the DTIM value is set to 100, the access point transmits buffered broadcast and multicast frames once every 10 seconds, allowing the power-saving clients to sleep longer before they have to wake up and listen for broadcasts and multicasts, resulting 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. Because of this, a configured beacon period of 100 ms, for example, will result 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 a low DTIM value for 802.11a/n and 802.11b/g/n networks that support such clients.

In controller software release 5.0 or later releases, you can configure the DTIM period for the 802.11a/n and 802.11b/g/n radio networks on specific WLANs. In previous software releases, the DTIM period was configured per radio network only, not per WLAN. The benefit of this change is that now you can configure a different DTIM period for each WLAN. For example, you might want to set different DTIM values for voice and data WLANs.

Guidelines and Limitations

When you upgrade the controller software to release 5.0 or later releases, the DTIM period that was configured for a radio network is copied to all of the existing WLANs on the controller.

Configuring the DTIM Period

This section contains the following topics:

- Configuring the DTIM Period (GUI), page 8-19
- Configuring the DTIM Period (CLI), page 8-19

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** to commit your changes.

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** to commit your changes.

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** to save your changes.

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 either the 802.11a/n or 802.11b/g/n 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*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... employee1
Network Name (SSID).............................. employee
Status........................................... Enabled
...
DTIM period for 802.11a radio.................... 1
DTIM period for 802.11b radio.................... 1
Local EAP Authentication..................... Disabled
...
```

Configuring Peer-to-Peer Blocking

This section contains the following topics:

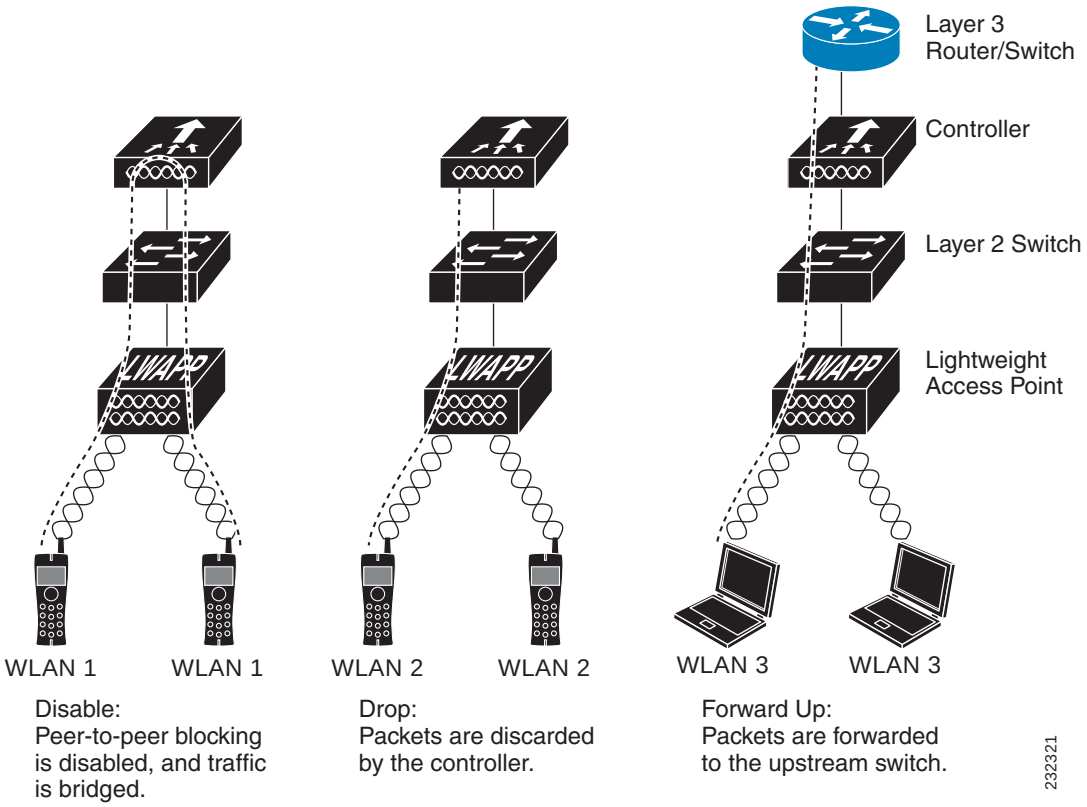
- Information About Peer-to-Peer Blocking, page 8-20
- Guidelines and Limitations, page 8-21
- Configuring Peer-to-Peer Blocking, page 8-22

Information About Peer-to-Peer Blocking

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.

In controller software release 4.2 or later releases, 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. In software release 4.2 or later releases, you also 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. Figure 8-1 shows each option.

Figure 8-1 Peer-to-Peer Blocking Examples



In controller release 7.2 and later releases, peer-to-peer blocking is supported for clients associated with local switching WLAN. Per WLAN, peer-to-peer configuration is pushed by the controller to FlexConnect AP.

Guidelines and Limitations

- 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.

Configuring Peer-to-Peer Blocking

This section contains the following topics:

- Configuring Peer-to-Peer Blocking (GUI), page 8-22
- Configuring Peer-to-Peer Blocking (CLI), page 8-22

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*

Note See the description of each parameter in the "Configuring Peer-to-Peer Blocking (GUI)" section above.

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
```

Configuring Layer 2 Security

This section contains the following topics:

- Configuring Static WEP Keys (CLI), page 8-23
- Configuring Dynamic 802.1X Keys and Authorization (CLI), page 8-23

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.

- 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 a WLAN for Both Static and Dynamic WEP

This section contains the following topics:

- Information About WLAN for Both Static and Dynamic WEP, page 8-24
- WPA1 and WPA2, page 8-24
- Guidelines and Limitations, page 8-25

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.

Note WLAN should be enabled only after WPA1 and WPA2 ciphers are enabled. You can enable WPA1 and WPA2 using the **`config wlan security wpa {wpa1/wpa2} enable`** command. You can not enable ciphers from the GUI unless WPA1 and WPA 2 are enabled.

Guidelines and Limitations

- 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 4.2 or later release of 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. See the "Configuring Cisco Client Extensions" section on page 8-57 for more information on CCX.

Configuring WPA1 +WPA2

This section contains the following topics:

- Configuring WPA1+WPA2 (GUI), page 8-26
- Configuring WPA1+WPA2 (CLI), page 8-27

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.

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 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

Information similar to the following appears:

```
PMK-CCKM Cache
                          Entry
Type        Station       Lifetime   VLAN Override        IP Override
------  ------------------ --------   ------------------   ---------------
```

```
CCKM    00:07:0e:b9:3a:1b   150                          0.0.0.0
```

If you enabled WPA2 with 802.1X authenticated key management, the controller supports opportunistic PMKID caching but not sticky (or non-opportunistic) PMKID caching. In sticky PMKID caching, the client stores multiple PMKIDs. This approach is not practical because it requires full authentication for each new access point and is not guaranteed to work in all conditions. In contrast, opportunistic PMKID caching stores only one PMKID per client and is not subject to the limitations of sticky PMK caching.

Step 9 Enable the WLAN by entering this command:

config wlan enable *wlan_id*

Step 10 Save your settings by entering this command:

save config

Configuring Sticky PMKID Caching

This section contains:

- Information About Sticky PMKID Caching
- Guidelines and Limitations
- Configuring Sticky PMKID Caching (CLI)

Information About Sticky PMKID Caching

Beginning in Release 7.2 and later releases, the controller supports Sticky PMKID Caching (SKC). With sticky PMKID 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 (PMK) identifier (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.

Guidelines and Limitations

- 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 does not work across controllers in a mobility group.
- SKC works only on WPA2-enabled WLANs.
- SKC works only on local mode APs.

Configuring Sticky PMKID Caching (CLI)

Step 1 Disable the WLAN by entering this command:

config wlan disable *wlan_id*

Step 2 Enable Sticky PMKIDCaching by entering this command:

config wlan security wpa wpa2 cache sticky enable *wlan_id*

By default, Sticky PMKID Caching (SKC) is disabled and Opportunistic PMKID 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

Configuring CKIP

This section contains the following topics:

- Information About CKIP, page 8-30
- Configuring CKIP, page 8-30

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.

Configuring CKIP

This section contains the following topics:

- Configuring CKIP (GUI), page 8-30
- Configuring CKIP (CLI), page 8-31

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.

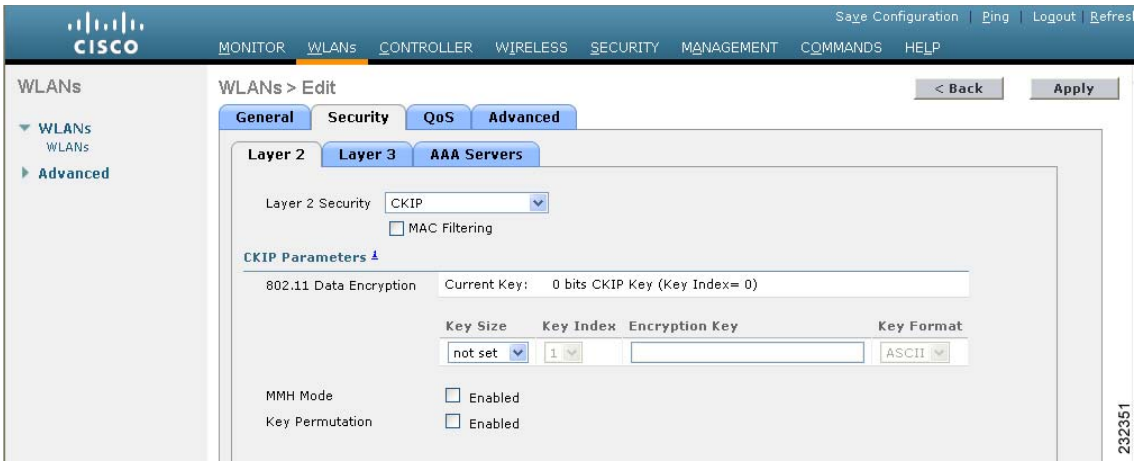
Step 4 Select the **Aironet IE** check box to enable Aironet IEs for this WLAN and click **Apply**.

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.

Figure 8-2 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

Configuring Session Timeouts

The session timeout is the maximum time for a client session to remain active before requiring reauthorization. This section contains the following topics:

- Configuring a Session Timeout (GUI), page 8-32
- Configuring a Session Timeout (CLI), page 8-32

Configuring a Session Timeout (GUI)

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. Otherwise, unselect the check box. The default value is selected.

In the Session Timeout text box, enter a value between 300 and 86400 seconds to specify the duration of the client session. 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 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 Layer 3 Security Using Web Authentication

This section contains the following topics:

- Information About Web Authentication, page 8-33
- Guidelines and Limitations, page 8-33
- Configuring Web Authentication, page 8-34

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.

Guidelines and Limitations

- Web authentication is supported only with these Layer 2 security policies: open authentication, open authentication+WEP, and WPA-PSK. It is not supported for use with 802.1X.
- 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.
- 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.
- Special charecters are not supported in the username field for web-authentication.
- 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.

For more information on using web authentication, see Chapter 12, "Managing User Accounts."

Configuring Web Authentication

This section contains the following topics:

- Configuring the Web Authentication (GUI), page 8-34
- Configuring the Web Authentication (CLI), page 8-35

Configuring the 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 the 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*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... cj
Network Name (SSID).............................. cj
Status........................................... Disabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Network Admission Control

  NAC-State...................................... Disabled
  Quarantine VLAN................................ 0
Number of Active Clients......................... 0
Exclusionlist Timeout............................ 60 seconds
Session Timeout.................................. 1800 seconds
CHD per WLAN..................................... Enabled
Webauth DHCP exclusion........................... Disabled
Interface........................................ management
WLAN ACL......................................... unconfigured
DHCP Server...................................... Default
DHCP Address Assignment Required................. Disabled
...
Web Based Authentication......................... Disabled
Web-Passthrough.................................. Disabled
...
```

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 to allow users to launch the web browser if they need to provide credentials to access Internet, and the actual authentication is done in the background every time the device connects to a new SSID.

This HTTP request triggers a webauth interception in the controller as any other page requests are performed by a wireless client. This interception leads to a webauth process, which will be completed normally. If the webauth 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 a 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 canceled, 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 captive portal by sending a web request upon connecting to a wireless network, and directs the request to http://www.apple.com/library/test/success.html.

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 captive portal and Apples'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.

Cisco Wireless Lan Controller 7.2 prevents this pseudo browser from popping up. You can now configure the controller to bypass WISPr detection process, so the webauth interception is only done when a user requests a webpage leading to splash page load in user context, without the WISPr detection being performed in the background.

Configuring Captive Bypassing

Configuring Captive Bypassing (CLI)

- **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.

Configuring a Fallback Policy with MAC Filtering and Web Authentication

This section contains the following topics:

- Information About Fallback Policy with MAC Filtering and Web Authentication, page 8-37
- Configuring a Fallback Policy with MAC Filtering and Web Authentication, page 8-37

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

This section contains the following topics:

- Configuring a Fallback Policy with MAC Filtering and Web Authentication (GUI), page 8-37
- Configuring a Fallback Policy with MAC Filtering and Web Authentication (CLI), page 8-38

Configuring a Fallback Policy with MAC Filtering and Web Authentication (GUI)

Note Before configuring a fallback policy, you must have MAC filtering enabled. To know more about how to enable MAC filtering, see the "Configuring MAC Filtering for WLANs" section on page 8-16.

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 "Configuring MAC Filtering for WLANs" section on page 8-16

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
```

Assigning a QoS Profile to a WLAN

This section contains the following topics:

- Information About QoS Profiles, page 8-38
- Assigning QoS Profiles, page 8-39

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 access point uses this QoS-profile-specific UP in accordance with the values in Table 8-1 to derive the IP DSCP value that is visible on the wired LAN.

Table 8-1 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

Table 8-1 Access Point QoS Translation Values (continued)

AVVID Traffic Type	AVVID IP DSCP	QoS Profile	AVVID 802.1p	IEEE 802.11e UP
Voice	46 (EF)	Platinum	5	6
Interactive video	34 (AF41)	Gold	4	5
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 converted value of the MSB (100) which is 4. The 802.11e UP value of DSCP 32 is 4.

Assigning QoS Profiles

This section contains the following topics:

- Assigning a QoS Profile to a WLAN (GUI), page 8-39
- Assigning a QoS Profile to a WLAN (CLI), page 8-40

Assigning a QoS Profile to a WLAN (GUI)

If you have not already done so, configure one or more QoS profiles using the instructions in the "Configuring QoS Profiles (GUI)" section on page 4-66.

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 Click **Apply** to commit your changes.

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

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 on page 4-68.

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 Save your changes by entering this command:

save config

Step 3 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
...
```

Configuring QoS Enhanced BSS

This section contains the following topics:

- Information About QoS Enhanced BSS, page 8-40
- Guidelines and Limitations, page 8-41
- Configuring QBSS, page 8-42

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.

Guidelines and Limitations

- 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.

Additional Guidelines for Using 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.

See Chapter 4, "Configuring Controller Settings," for more information and configuration instructions for load-based CAC.

Configuring QBSS

This section contains the following topics:

- Configuring QBSS (GUI), page 8-42
- Configuring QBSS (CLI), page 8-42

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*

Configuring Media Session Snooping and Reporting

This section contains the following topics:

- Information About Media Session Snooping and Reporting, page 8-43
- Guidelines and Limitations, page 8-44
- Configuring Media Session Snooping, page 8-44

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 WCS. VoIP snooping and reporting can be enabled or disabled for each WLAN.

When VoIP MSA snooping is enabled, 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 WCS 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. WCS displays failed VoIP call information in the Events page.

Guidelines and Limitations

Controller software release 6.0 or later releases support Voice over IP (VoIP) Media Session Aware (MSA) snooping and reporting.

Configuring Media Session Snooping

This section contains the following topics;

- Configuring Media Session Snooping (GUI), page 8-44
- Configuring Media Session Snooping (CLI), page 8-44

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** to commit your changes.

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

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 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. Table 8-2 explains the possible error codes for failed calls.

Table 8-2 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.

Table 8-2 Error Codes for Failed VoIP Calls (continued)

Error Code	Integer	Description
402	paymentRequired	Reserved for future use.
403	forbidden	The server understood the request but refuses to fulfill it.
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.

Table 8-2 Error Codes for Failed VoIP Calls (continued)

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 end system of the callee 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.

Configuring Key Telephone System-Based CAC

This section contains the following topics:

- Information About Key Telephone System-Based CAC, page 8-48
- Guidelines and Limitations, page 8-48
- Configuring KTS-based CAC, page 8-48

Information About Key Telephone System-Based CAC

Key Telephone System (KTS) 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.

Guidelines and Limitations

- 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

Configuring KTS-based CAC

This section contains the following topics:

- Configuring KTS-based CAC (GUI), page 8-48
- Configuring KTS-based CAC (CLI), page 8-49

Configuring KTS-based CAC (GUI)

Prerequisites

To enable KTS-based CAC for a WLAN, ensure that you do the following:

- Set the QoS profile for the WLAN to Platinum (see the "Assigning QoS Profiles" section on page 8-39).
- Set the WLAN in disabled state (see the "Enabling and Disabling WLANs (GUI)" section on page 8-4).
- 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)

Prerequisites

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 Enable KTS-based CAC for a WLAN by entering this command:

config wlan kts-cac enable *wlan-id*

Step 2 Enable the KTS-based CAC feature by doing the following:

a. Enable WMM on the WLAN by entering this command:

config wlan wmm allow *wlan-id*

b. Enable ACM at the radio level by entering this command:

config 802.11a cac voice acm enable

c. Enable processing of the TSPEC inactivity timeout at the radio level by entering this command:

config 802.11a cac voice tspec-inactivity-timeout enable

Related Commands

- See whether the client supports KTS-based CAC by entering 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
```

- Troubleshoot issues with KTS-based CAC by entering the following command:

  debug cac kts enable

- Troubleshoot other issues related to CAC, by entering the following commands:
  - **debug cac event enable**
  - **debug call-control all enable**

Configuring Reanchoring of Roaming Voice Clients

This section contains the following topics;

- Information About Reanchoring of Roaming Voice Clients, page 8-50
- Guidelines and Limitations, page 8-50
- Configuring Reanchoring of Roaming Voice Clients, page 8-50

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.

Guidelines and Limitations

- 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.
- You can reanchor roaming of voice clients for each WLAN.
- This feature is not recommended for use on Cisco 792x phones.

Configuring Reanchoring of Roaming Voice Clients

This section conatins the following topics;

- Configuring Reanchoring of Roaming Voice Clients (GUI), page 8-51
- Configuring Reanchoring of Roaming Voice Clients (CLI), page 8-51

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

Configuring Seamless IPv6 Mobility

This section contains the following topics:

- Information About IPv6 Mobility, page 8-52
- Guidelines and Limitations, page 8-52

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 NDP (Neighbor Discovery Packets) packets are converted from multicast to unicast and delivered individually per client. This unique solution ensures that Neighbor Discovery and Router Advertisement packets are not leaked across VLANs. Clients can receive specific Neighbor Discovery and Router Advertisement packets ensuring 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.

Guidelines and Limitations

- Up to 16 client addresses can be tracked per client.
- 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 on the controller software releases 6.0 and 7.0.

- To allow stateful DHCPv6 IP addressing to operate properly, you must have a switch or router that supports the DHCP for IPv6 feature (such as the Catalyst 3750 switch) 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.

Note To load the SDM IPv6 template in the Catalyst 3750 switch, enter the **sdm prefer dual-ipv4-and-v6 default** command and then reset the switch. For more information, see *Catalyst 3750 Switch Configuration Guide for Cisco IOS Release 12.2(46)SE*.

To support the seamless IPv6 Mobility, you might need to configure the following:

- Configuring RA Guard for IPv6 Clients, page 8-53
- Configuring RA Throttling for IPv6 Clients, page 8-53
- Configuring IPv6 Neighbor Discovery Caching, page 8-55

Configuring RA Guard for IPv6 Clients

This section contains the following topics:

- Information About RA Guard, page 8-53
- Configuring RA Guard (GUI), page 8-53
- Configuring RA Guard (CLI), page 8-53

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 often with high priority, 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, select **Disable** if you want 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)

- **config ipv6 ra-guard ap** {**enable** | **disable**}

Configuring RA Throttling for IPv6 Clients

This section contains the following topics;

- Information about RA Throttling, page 8-54
- Configuring RA Throttling (GUI), page 8-54
- Configuring RA Throttle Policy (CLI), page 8-54

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, an RA is sent back to the client. This RA 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 enabled.

Step 2 Unselect the check box to disable RA throttle policy.

Step 3 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**—Allows the controller to act differently based on the RFC 3775 value set in IPv6 RA packets.
  - **Passthrough**—Allows any RA messages with the RFC3775 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 4 Click **Apply** to commit your changes.

Step 5 Click **Save Configuration** to save your changes.

Configuring RA Throttle Policy (CLI)

- **config ipv6 neigbhor-binding ra-throttle** {**allow at-least** *at-least-value* | **enable** | **disable** | **interval-option** {**ignore** | **passthrough** | **throttle**} | **max-through** {*mzx-through-value* | **no-limit**}

Configuring IPv6 Neighbor Discovery Caching

This section contains the following topics;

- Information About IPv6 Neighbor Discovery, page 8-55
- Configuring Neighbor Binding Timers (GUI), page 8-55
- Configure Neighbor Binding Timers (CLI), page 8-55

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 tracks each IPv6 address and its associated MAC address. Clients are expired from the table according to Neighbor Binding timers.

Configuring Neighbor Binding Timers (GUI)

Step 1 Choose **Controller > IPv6 > Neighbor Binding Timers** page.

Step 2 Configure the following Timers:

- **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.

Note It is recommended that you configure Reachable-lifetime as 3600 sec and Stale-Lifetime as 300 sec for optimal performance.

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

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

Configure Neighbor Binding Timers (CLI)

- **config ipv6 neighbor-binding timers** {**down-lifetime** | **reachable-lifetime** | **stale-lifetime**} {**enable** | **disable**}

Configuring Unknown Address NS Multicast Forwarding

The IPv6 addresses of wireless clients are cached by the controller. If the controller receives an NS multicast looking for an IPv6 address, which belongs to any of the wireless clients of the controller, the controller acts as the proxy and replies with the NA. If the controller does not have the IPv6 address of a wireless client, the controller would not respond with NA and would drop the NS packet. To resolve this issue, an NS Multicast Forwarding knob is provided. If this knob is enabled, the controller gets the NS packet for the IPv6 address that it does not have (cache miss), forwards the NS packet to the wireless side. This packet reaches the intended wireless client and the client replies with NA.

This cache miss scenario occurs rarely, and only very few clients which do not implement complete IPv6 stack may not advertise their IPv6 address during NDP.

Configuring NS Multicast Forwarding (CLI)

- Enter the following command to enable or disable NS multicast forwarding:

  config ipv6 ns-mcast-fwd {**enable** | **disable**}

  By default, NS multicast forwarding is disabled.

  When the NS multicast forwarding is enabled, the controller sends an NS multicast packet to all the wireless and wired clients. When the NS multicast forwarding is disabled, the controller sends an NS multicast packet to the wired side.

- Enter the following command to view the status of the NS multicast forwarding:

  show ipv6 summary

  Information similar to the following appears:

```
Reachable-lifetime value..................... 86400
Stale-lifetime value......................... 86400
Down-lifetime value.......................... 86400
RA Throttling................................ Enabled
RA Throttling allow at-least................. 2
RA Throttling allow at-most.................. no-limit
RA Throttling max-through.................... 10
RA Throttling throttle-period................ 12
RA Throttling interval-option................ ignore
NS Mulitcast CacheMiss Forwarding........... Disabled
```

- Enter the following command to view the NS multicast forwarding statistics:

  show ipv6 neighbor-binding counters

  Information similar to the following appears:

```
..............
Cache Miss Statistics:

Multicast NS Forward[1]
Multicast NS Dropped[3]
```

Note The Multicast NS Forward parameter is incremented when the knob is enabled. The Multicast NS Dropped parameter is incremented when the knob is diabled.

Configuring Cisco Client Extensions

This section contains the following topics;

- Information About Cisco Client Extensions, page 8-57
- Guidelines and Limitations, page 8-57
- Configuring CCX Aironet IEs, page 8-57

Information About Cisco Client Extensions

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 related to increased security, enhanced performance, fast roaming, and superior power management.

Guidelines and Limitations

- The 4.2 or later releases of controller software support 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 a specific CCX feature per WLAN. This feature is 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.
- 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.

Configuring CCX Aironet IEs

This section contains the following topics;

- Configuring CCX Aironet IEs (GUI), page 8-57
- Viewing a Client's CCX Version (GUI), page 8-58
- Configure CCX Aironet IEs (CLI), page 8-58
- Viewing a Client's CCX Version (CLI), page 8-58

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.

Configure CCX Aironet IEs (CLI)

- **config wlan ccx aironet-ie** {**enable** | **disable**} *wlan_id*

Note 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*

Configuring AP Groups

This section contains the following topics:

- Information About Access Point Groups, page 8-59
- Guidelines and Limitations, page 8-59
- Configuring Access Point Groups, page 8-60

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 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 example, 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 example, 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.

Guidelines and Limitations

- 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.
- 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.
- 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.

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.

- You can create up to 300 access point groups for Cisco 4400 Series Controllers, Cisco WiSM, and 3750G wireless LAN controller switch; and up to 500 access point groups for Cisco 5500 Series Controllers.

- 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.
- 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.

Configuring Access Point Groups

Step 1 Configure the appropriate dynamic interfaces and map them to the desired VLANs.

For example, to implement the network in Figure 7-23, create dynamic interfaces for VLANs 61, 62, and 63 on the controller. See Chapter 4, "Configuring Ports and Interfaces," for information on how to configure dynamic interfaces.

Step 2 Create the access point groups. See the "Creating Access Point Groups (GUI)" section on page 8-60.

Step 3 Create a RF profile. See the "Creating an RF Profile (GUI)" section on page 8-65.

Step 4 Assign access points to the appropriate access point groups. See the "Creating Access Point Groups (GUI)" section on page 8-60.

Step 5 Apply the RF profile on the AP Groups. See the "Applying RF Profile to AP Groups (GUI)" section on page 8-65.

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 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 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 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 6 Click the name of the group to edit this new group. The AP Groups > Edit (General) page appears.

Step 7 Change the description of this access point group by entering the new text in the AP Group Description text box and click **Apply**.

Step 8 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 9 Click **Add New** to assign a WLAN to this access point group. The Add New section appears at the top of the page.

Step 10 From the WLAN SSID drop-down list, choose the SSID of the WLAN.

Step 11 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 12 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. See the "Configuring NAC Out-of-Band Integration" section on page 8-70 for more information on NAC.

Step 13 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 14 Repeat Step 9 through Step 13 to add any additional WLANs to this access point group.

Step 15 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 16 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 17 Click **Save Configuration** to save your changes.

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 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

  Information similar to the following appears:

```
Site Name..................................... AP2
Site Description.............................. Access Point 2

WLAN ID          Interface          Network Admission Control
-------         -----------        --------------------------
 1              management           Disabled
 2              management           Disabled
 3              management           Disabled
 4              management           Disabled
 9              management           Disabled
 10             management           Disabled
 11             management           Disabled
 12             management           Disabled
 13             management           Disabled
 14             management           Disabled
 15             management           Disabled
 16             management           Disabled
 18             management           Disabled

AP Name Slots AP Model     Ethernet MAC   Location Port Country Priority GroupName
------- ---- ------------- ----------------- ------- ---- ------- -------- ---------
AP1242   2   AP1242AG-A-K9 00:14:1c:ed:23:9a default  1    US       1       AP2
...
```

- 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*

  Information similar to the following appears:

```
Site Name..................................... AP3
Site Description.............................. Access Point 3

WLAN ID          Interface          BSSID
-------         ------------  -------------------
 10             management     00:14:1b:58:14:df
```

- See the number of WLANs enabled for an access point group by entering this command:

  show ap config {**802.11a** | **802.11b**} *Cisco_AP*

  Information similar to the following appears:

```
Cisco AP Identifier........................... 166
```

```
Cisco AP Name.................................. AP2
...
Station Configuration
      Configuration ............................ AUTOMATIC
      Number Of WLANs .......................... 2
...
```

- Enable or disable debugging of access point groups by entering this command:

  debug group {**enable** | **disable**}

Configuring RF Profiles

This section contains the following topics:

- Information About RF Profiles, page 8-64
- Guidelines and Limitations, page 8-64
- Configuring RF Profiles, page 8-65

Information About RF Profiles

RF profiles allow you to tune groups of APs that share a common coverage zone together and selectively change how RRM operates the APs within that coverage zone.

For example, a university might deploy a high density of APs, in an area with a high number of users. 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 allow you to optimize the RF settings for AP groups that operate in different environments or coverage zones. RF profiles are created for 802.11b/g/n or 802.11a/n 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 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.

Note An AP that has a custom power setting applied for AP power is not in global configuration mode, 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.

Guidelines and Limitations

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 apply:

- The same RF profile must be applied and present on every controller of the AP group or the action will fail for that controller.

- 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 can assign the same RF profile to more than one AP group.
- Within the AP group, changing the assignment of an RF profile on either band causes the AP to reboot.
- You cannot delete an RF profile that is applied to an AP group.
- You cannot delete an AP group that has APs assigned to it.

Configuring RF Profiles

This section contains the following topics:

- Creating an RF Profile (GUI), page 8-65
- Applying RF Profile to AP Groups (GUI), page 8-65

Creating an RF Profile (GUI)

Step 1 Choose **Wireless > RF Profiles** to open the RF profiles page.

Step 2 Click **New** to create a new RF profile.

Step 3 Enter the **RF Profile Name** and choose the radio band.

Step 4 Click **Apply** to configure the customizations of power and data rate parameters.

Step 5 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. The range is from -10 dBm to 30 dBm.

Step 6 Configure a custom TPC power threshold for either Version1 or Version 2 of TPC. The range is from –80 dBm to –50 dBm.

Note Only one TPC version can be operable for RRM on a 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.

Step 7 Configure the data rates to be applied to the APs of this RF profile.

Step 8 Click **Apply** to commit your changes.

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

Applying RF Profile to AP Groups (GUI)

Step 1 Choose **WLAN > Advanced > AP Groups** to open the AP Groups page.

Step 2 Click **AP Group Name** to open a configuration dialog box.

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 **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 have chose the APs in to the AP group, the process of moving the APs into the new group reboots the APs and the configurations for the RF profiles will be applied to the APs of the AP group.

Step 4 Click the **APs** tab and choose the APs to add to the AP group.

Step 5 Click the **Add APs** to add the selected APs to the AP group. A warning message is displayed indicating that the AP group reboot and the APs rejoin the controller.

Note The APs cannot belong to two AP groups at once.

Step 6 Click **OK**. The APs are added to the AP group.

Configuring Web Redirect with 802.1X Authentication

This section contains the following sections:

- Information About Web Redirect with 802.1X Authentication, page 8-66
- Configuring Web Redirect, page 8-67

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.

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 Thi s procedure is specific to the CiscoSecure ACS; however, this procedure 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*

Configuring Web Redirect

This section contains the following topics:

- Configuring Web Redirect (GUI), page 8-68
- Configuring Web Redirect (CLI), page 8-68
- Disabling Accounting Servers per WLAN (GUI), page 8-69
- Disabling Coverage Hole Detection per WLAN, page 8-69
- Disabling Coverage Hole Detection on a WLAN (GUI), page 8-69
- Disabling Coverage Hole Detection on a WLAN (CLI), page 8-69

Configuring Web Redirect (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **Layer 2** tabs to open the WLANs > Edit (Security > Layer 2) page.

Step 4 From the Layer 2 Security drop-down list, choose **802.1X** or **WPA+WPA2**.

Step 5 Set any additional parameters for 802.1X or WPA+WPA2.

Step 6 Choose the **Layer 3** tab to open the WLANs > Edit (Security > Layer 3) page.

Step 7 From the Layer 3 Security drop-down list, choose **None**.

Step 8 Check the **Web Policy** check box.

Step 9 Choose one of the following options to enable conditional or splash page web redirect: **Conditional Web Redirect** or **Splash Page Web Redirect**. The default value is disabled for both parameters.

Step 10 If the user is to be redirected to a site external to the controller, choose the ACL that was configured on your RADIUS server from the Preauthentication ACL drop-down list.

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

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

Configuring Web Redirect (CLI)

Step 1 Enable or disable conditional web redirect by entering this command:

config wlan security cond-web-redir {**enable** | **disable**} *wlan_id*

Step 2 Enable or disable splash page web redirect by entering this command:

config wlan security splash-page-web-redir {**enable** | **disable**} *wlan_id*

Step 3 Save your settings by entering this command:

save config

See the status of the web redirect features for a particular 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
...
Web Based Authentication..................... Disabled
Web-Passthrough.............................. Disabled
Conditional Web Redirect..................... Disabled
Splash-Page Web Redirect..................... Enabled
...
```

Disabling Accounting Servers per WLAN (GUI)

Note Disabling accounting servers disables all accounting operations and prevents the controller from falling back to the default RADIUS server for the WLAN.

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN to be modified. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **AAA Servers** tabs to open the WLANs > Edit (Security > AAA Servers) page.

Step 4 Unselect the **Enabled** check box for the Accounting Servers.

Step 5 Click **Apply** to commit your changes.

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

Disabling Coverage Hole Detection per WLAN

Note Coverage hole detection is enabled globally on the controller. See the "Configuring Coverage Hole Detection (GUI)" section on page 13-14 for more information.

Note In software release 5.2 or later releases, you can disable coverage hole detection on a per-WLAN basis. When you disable coverage hole detection on a WLAN, a coverage hole alert is still sent to the controller, but no other processing is done to mitigate the coverage hole. This feature is useful for guest WLANs where guests are connected to your network for short periods of time and are likely to be highly mobile.

Disabling Coverage Hole Detection on a WLAN (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the profile name of the WLAN to be modified. The WLANs > Edit page appears.

Step 3 Choose the **Advanced** tab to display the WLANs > Edit (Advanced) page.

Step 4 Unselect the **Coverage Hole Detection Enabled** check box.

Note OEAP 600 Series Access Points do not support coverage hole detection.

Step 5 Click **Apply** to commit your changes.

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

Disabling Coverage Hole Detection on a WLAN (CLI)

Step 1 Disable coverage hole detection by entering this command:

config wlan chd wlan_id disable

Note OEAP 600 Series Access Points do not support Coverage Hole detection.

Step 2 Save your settings by entering this command:

save config

Step 3 See the coverage hole detection status for a particular WLAN by entering this command:

show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 2
Profile Name..................................... wlan2
Network Name (SSID).............................. 2
. . .
CHD per WLAN..................................... Disabled
```

Configuring NAC Out-of-Band Integration

This section contains the following topics;

- Information About NAC Out-of-Band Integration, page 8-70
- Guidelines and Limitations, page 8-71
- Configuring NAC Out-of-Band Integration, page 8-72

Information About NAC Out-of-Band Integration

The Cisco NAC Appliance, also known as Cisco Clean Access (CCA), is a network admission control (NAC) product that allows network administrators to authenticate, authorize, evaluate, and remediate wired, wireless, and remote users and their machines prior to allowing users onto the network. It identifies whether machines are compliant with security policies and repairs vulnerabilities before permitting access to the network. The NAC appliance is available in two modes: in-band and out-of-band. Customers can deploy both modes if desired, each geared toward certain types of access (in-band for supporting wireless users and out-of-band for supporting wired users, for example).

To implement the NAC out-of-band feature on the controller, you must enable NAC support on the WLAN or guest LAN and then map this WLAN or guest LAN to an interface that is configured with a quarantine VLAN (untrusted VLAN) and an access VLAN (trusted VLAN). When a client associates and completes Layer 2 authentication, the client obtains an IP address from the access VLAN subnet, but the client state is Quarantine. While deploying the NAC out-of-band feature, be sure that the quarantine VLAN is allowed only between the Layer 2 switch on which the controller is connected and the NAC appliance and that the NAC appliance is configured with a unique quarantine-to-access VLAN mapping. Client traffic passes into the quarantine VLAN, which is trunked to the NAC appliance. After posture validation is completed, the client is prompted to take action for remediation. After cleaning is completed, the NAC appliance updates the controller to change the client state from Quarantine to Access.

the link between the controller and the switch is configured as a trunk, enabling the quarantine VLAN (110) and the access VLAN (10). On the Layer 2 switch, the quarantine traffic is trunked to the NAC appliance while the access VLAN traffic goes directly to the Layer 3 switch. Traffic that reaches the quarantine VLAN on the NAC appliance is mapped to the access VLAN based on a static mapping configuration.

Guidelines and Limitations

- In controller software releases prior to 5.1, the controller integrates with the NAC appliance only in in-band mode, where the NAC appliance must remain in the data path. For in-band mode, a NAC appliance is required at each authentication location (such as at each branch or for each controller), and all traffic must traverse the NAC enforcement point. In controller software release 5.1 or later releases, the controller can integrate with the NAC appliance in out-of-band mode, where the NAC appliance remains in the data path only until clients have been analyzed and cleaned. Out-of-band mode reduces the traffic load on the NAC appliance and enables centralized NAC processing.
- The NAC appliance supports up to 3500 users, and the controller supports up to 5000 users. Multiple NAC appliances might need to be deployed.
- CCA software release 4.5 or later releases is required for NAC out-of-band integration.
- Because the NAC appliance supports static VLAN mapping, you must configure a unique quarantine VLAN for each interface configured on the controller. For example, you might configure a quarantine VLAN of 110 on controller 1 and a quarantine VLAN of 120 on controller 2. However, if two WLANs or guest LANs use the same distribution system interface, they must use the same quarantine VLAN, provided they have one NAC appliance deployed in the network. The NAC appliance supports unique quarantine-to-access VLAN mapping.
- For posture reassessment based on session expiry, you must configure the session timeout on both the NAC appliance and the WLAN, making sure that the session expiry on the WLAN is greater than that on the NAC appliance.
- When a session timeout is configured on an open WLAN, the timing out of clients in the Quarantine state is determined by the timer on the NAC appliance. Once the session timeout expires for WLANs using web authentication, clients deauthenticate from the controller and must perform posture validation again.
- NAC out-of-band integration is supported only on WLANs configured for FlexConnect central switching. It is not supported for use on WLANs configured for FlexConnect local switching.

Note See Chapter 16, "Configuring FlexConnect," for more information on FlexConnect.

- If you want to enable NAC on an access point group VLAN, you must first enable NAC on the WLAN. Then you can enable or disable NAC on the access point group VLAN. If you ever decide to disable NAC on the WLAN, be sure to disable it on the access point group VLAN as well.
- NAC out-of-band integration is not supported for use with the WLAN AAA override feature.
- All Layer 2 and Layer 3 authentication occurs in the quarantine VLAN. To use external web authentication, you must configure the NAC appliance to allow HTTP traffic to and from external web servers and to allow the redirect URL in the quarantine VLAN.

Note See the Cisco NAC appliance configuration guides for configuration instructions: http://www.cisco.com/en/US/products/ps6128/products_installation_and_configuration_guides_list.html

Configuring NAC Out-of-Band Integration

This section contains the following topics:

- Configuring NAC Out-of-Band Integration (GUI), page 8-72
- Configure NAC Out-of-Band Integration (CLI), page 8-73

Configuring NAC Out-of-Band Integration (GUI)

Step 1 Configure the quarantine VLAN for a dynamic interface as follows:

a. Choose **Controller** > **Interfaces** to open the Interfaces page.

b. Click **New** to create a new dynamic interface.

c. In the Interface Name text box, enter a name for this interface, such as "quarantine."

d. In the VLAN ID text box, enter a nonzero value for the access VLAN ID, such as "10."

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

f. Select the **Quarantine** check box and enter a nonzero value for the quarantine VLAN ID, such as "110."

Note We recommend that you configure unique quarantine VLANs throughout your network. If multiple controllers are configured in the same mobility group and access interfaces on all controllers are in the same subnet, it is mandatory to have the same quarantine VLAN if there is only one NAC appliance in the network. If multiple controllers are configured in the same mobility group and access interfaces on all controllers are in different subnets, it is mandatory to have different quarantine VLANs if there is only one NAC appliance in the network.

g. Configure any remaining text boxes for this interface, such as the IP address, netmask, and default gateway.

h. Click **Apply** to save your changes.

Step 2 Configure NAC out-of-band support on a WLAN or guest LAN as follows:

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

b. Click the ID number of the desired WLAN or guest LAN. The WLANs > Edit page appears.

c. Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

d. Configure NAC out-of-band support for this WLAN or guest LAN by selecting the **NAC State** check box. To disable NAC out-of-band support, leave the check box unselected, which is the default value.

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

Step 3 Configure NAC out-of-band support for a specific access point group as follows:

a. Choose **WLANs** > **Advanced** > **AP Groups** to open the AP Groups page.

b. Click the name of the desired access point group.

c. Choose the **WLANs** tab to open the AP Groups > Edit (WLANs) page.

d. Click **Add New** to assign a WLAN to this access point group. The Add New section appears at the top of the page.

e. From the WLAN SSID drop-down list, choose the SSID of the WLAN.

f. 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 NAC out-of-band support.

g. To enable NAC out-of-band support for this access point group, select the **NAC State** check box. To disable NAC out-of-band support, leave the check box unselected, which is the default value.

h. Click **Add** to add this WLAN to the access point group. This WLAN appears in the list of WLANs 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 4 Click **Save Configuration** to save your changes.

Step 5 See the current state of the client (Quarantine or Access) as follows:

a. Choose **Monitor > Clients** to open the Clients page.

b. Click the MAC address of the desired client to open the Clients > Detail page. The NAC state appears under the Security Information section.

Note The client state appears as "Invalid" if the client is probing, has not yet associated to a WLAN, or cannot complete Layer 2 authentication.

Configure NAC Out-of-Band Integration (CLI)

Step 1 Configure the quarantine VLAN for a dynamic interface by entering this command:

config interface quarantine vlan *interface_name vlan_id*

Note You must configure a unique quarantine VLAN for each interface on the controller.

Note To disable the quarantine VLAN on an interface, enter *0* for the VLAN ID.

Step 2 Enable or disable NAC out-of-band support for a WLAN or guest LAN by entering this command:

config {**wlan** | **guest-lan**} **nac** {**enable** | **disable**} {*wlan_id* | *guest_lan_id*}

Step 3 Enable or disable NAC out-of-band support for a specific access point group by entering this command:

config wlan apgroup nac {**enable** | **disable**} *group_name wlan_id*

Step 4 Save your changes by entering this command:

save config

Step 5 See the configuration of a WLAN or guest LAN, including the NAC state by entering this command:

show {**wlan** *wlan_ id* | **guest-lan** *guest_lan_id*}

Information similar to the following appears:

```
WLAN Identifier.............................. 1
```

```
Profile Name..................................... wlan
Network Name (SSID).............................. wlan
Status........................................... Disabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Network Admission Control

  NAC-State...................................... Enabled
  Quarantine VLAN............................ 110
...
```

Step 6 See the current state of the client (either Quarantine or Access) by entering this command:

show client detailed *client_mac*

Information similar to the following appears:

```
Client's NAC state.............................. QUARANTINE
```

Note The client state appears as "Invalid" if the client is probing, has not yet associated to a WLAN, or cannot complete Layer 2 authentication.

Configuring Passive Clients

This section contains the following topics:

- Information About Passive Clients, page 8-74
- Guidelines and Limitations, page 8-75
- Configuring Passive Clients, page 8-75

Information About Passive Clients

Passive clients are wireless devices, such as scales and printers that are configured with a static IP address. These clients do not transmit any IP information such as IP address, subnet mask, and gateway information when they associate with an access point. As a result, when passive clients are used, the controller never knows the IP address unless they use the DHCP.

Wireless LAN controllers currently act as a proxy for ARP requests. Upon receiving an ARP request, the controller responds with an ARP response instead of passing the request directly to the client. This scenario has two advantages:

- The upstream device that sends out the ARP request to the client will not know where the client is located.
- Power for battery-operated devices such as mobile phones and printers is preserved because they do not have to respond to every ARP requests.

Since the wireless controller does not have any IP related information about passive clients, it cannot respond to any ARP requests. The current behavior does not allow the transfer of ARP requests to passive clients. Any application that tries to access a passive client will fail.

The passive client feature enables the ARP requests and responses to be exchanged between wired and wireless clients. This feature when enabled, allows the controller to pass ARP requests from wired to wireless clients until the desired wireless client gets to the RUN state.

Guidelines and Limitations

- The passive client feature is not supported with the AP groups and FlexConnect centrally switched WLANs.

Configuring Passive Clients

This section contains the following topics:

- Enabling the Passive Client Feature on the Controller (GUI), page 8-76
- Configuring Passive Clients (CLI), page 8-76

Enabling the Multicast-Multicast Mode (GUI)

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

Step 2 Choose one of the following options from the AP Multicast Mode drop-down list:

- **Unicast**—Configures the controller to use the unicast method to send multicast packets. This is the default value.
- **Multicast**—Configures the controller to use the multicast method to send multicast packets to a CAPWAP multicast group.

Step 3 Select Multicast from the **AP Multicast Mode** drop-down list. The Multicast Group Address text box is displayed.

Step 4 In the Multicast Group Address text box, enter the IP address of the multicast group.

Step 5 Click **Apply** to commit your changes.

Step 6 Click Multicast to enable the global multicast mode.

Enabling the Global Multicast Mode on Controllers (GUI)

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

Note The Enable IGMP Snooping text box is highlighted only when you enable the Enable Global Multicast mode. The IGMP Timeout (seconds) text box is highlighted only when you enable the Enable IGMP Snooping text box.

Step 2 Select the **Enable Global Multicast Mode** check box to enable the multicast mode. This step configures the controller to use the multicast method to send multicast packets to a CAPWAP multicast group.

Step 3 Select the **Enable IGMP Snooping** check box to enable the IGMP snooping. The default value is disabled.

Step 4 In the IGMP Timeout text box to set the IGMP timeout, enter a value between 30 and 7200 seconds.

Step 5 Click **Apply** to commit your changes.

Enabling the Passive Client Feature on the Controller (GUI)

Step 1 Choose **WLANs > WLANs > WLAN ID** to open the WLANs > Edit page. By default, the General tab is displayed.

Step 2 Choose the **Advanced** tab.

Step 3 Select the **Passive Client** check box to enable the passive client feature.

Step 4 Click **Apply** to commit your changes.

Configuring Passive Clients (CLI)

Step 1 Enable multicasting on the controller by entering this command:

config network multicast global enable

The default value is disabled.

Step 2 Configure the controller to use multicast to send multicast to an access point by entering this command:

config network multicast mode multicast *multicast_group_IP_address*

Step 3 Configure passive client on a wireless LAN by entering this command:

config wlan passive-client {**enable** | **disable**} *wlan_id*

Step 4 Configure a WLAN by entering this command:

config wlan

Step 5 Save your changes by entering this command:

save config

Step 6 Display the passive client information on a particular WLAN by entering this command:

show wlan *2*

Information similar to the following appears:

```
WLAN Identifier.................................. 2
Profile Name..................................... passive
Network Name (SSID).............................. passive
Status........................................... Enabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Network Admission Control
  NAC-State.............................Disabled
  Quarantine VLAN.......................0
Number of Active Clients.................1
Exclusionlist Timeout...................60 seconds
Session Timeout.........................1800 seconds
CHD per WLAN............................Enabled
Webauth DHCP exclusion..................Disabled
Interface...............................management
WLAN ACL................................unconfigured
DHCP Server.............................Default
DHCP Address Assignment Required......Disabled
--More-- or (q)uit
Quality of Service............................... Silver (best effort)
WMM.............................................. Allowed
CCX - AironetIe Support.......................... Enabled
```

```
CCX - Gratuitous ProbeResponse (GPR)..... Disabled
CCX - Diagnostics Channel Capability..... Disabled
Dot11-Phone Mode (7920)..................... Disabled
Wired Protocol.............................. None
Passive Client Feature...................... Enabled
Peer-to-Peer Blocking Action................ Disabled
Radio Policy................................ All
DTIM period for 802.11a radio............... 1
DTIM period for 802.11b radio............... 1
Radius Servers
   Authentication........................... Global Servers
   Accounting............................... Global Servers
Local EAP Authentication.................... Disabled
Security
   802.11 Authentication:................... Open System
   Static WEP Keys.......................... Disabled
   802.1X................................... Disabled
   Wi-Fi Protected Access (WPA/WPA2)........ Disabled
--More-- or (q)uit
   CKIP ..................................... Disabled
   Web Based Authentication................. Disabled
   Web-Passthrough.......................... Disabled
   Conditional Web Redirect................. Disabled
   Splash-Page Web Redirect................. Disabled
   Auto Anchor.............................. Disabled
   FlexConnect Local Switching.................... Disabled
   FlexConnect Learn IP Address................... Enabled
   Infrastructure MFP protection............... Enabled (Global Infrastructure MFP
Disabled)
   Client MFP............................... Optional but inactive (WPA2 not
configured)
   Tkip MIC Countermeasure Hold-down Timer..... 60
Call Snooping............................... Disabled
Band Select................................. Enabled
Load Balancing.............................. Enabled
```

Step 7 Verify if the passive client is associated correctly with the AP and if the passive client has moved into the DHCP required state at the controller by entering this command:

debug client *mac_address*

Step 8 Display the detailed information for a client by entering this command:

show client detail *mac_address*

Information similar to the following appears:

```
Client MAC Address.......................... 00:0d:28:f4:c0:45
Client Username ............................ N/A
AP MAC Address.............................. 00:14:1b:58:19:00
Client State................................ Associated
Client NAC OOB State........................ Access
Wireless LAN Id............................. 1
BSSID....................................... 00:14:1b:58:19:00
Connected For .............................. 8 secs
Channel..................................... 11
IP Address.................................. Unknown
.........................

Security Policy Completed................... No
Policy Manager State........................ DHCP_REQD
Policy Manager Rule Created................. Yes
ACL Name.................................... none
ACL Applied Status.......................... Unavailable
```

Step 9 Check if the client moves into the run state, when a wired client tries to contact the client by entering this command:

debug client *mac_address*

Step 10 Configure and check if the ARP request is forwarded from the wired side to the wireless side by entering this command:

debug arp all enable

Information similar to the following appears:

```
*dtlArpTask: Apr 15 10:54:26.161: Received dtlArpRequest
   sha: 00:19:06:61:b1:c3 spa: 80.4.1.1
   tha: 00:00:00:00:00:00 tpa: 80.4.0.50
   intf: 1, vlan: 71, node type: 1, mscb: not found, isFromSta: 0^M^M
*dtlArpTask: Apr 15 10:54:26.161: dtlArpFindClient:ARP look-up for 80.4.0.50 failed (not a
client).

*dtlArpTask: Apr 15 10:54:26.161: Dropping ARP to DS (mscb (nil), port 65535)
   sha 0019.0661.b1c3 spa: 80.4.1.1
   tha 0000.0000.0000 tpa: 80.4.0.50
*dtlArpTask: Apr 15 10:54:26.161: Arp from Wired side to passive client

*dtlArpTask: Apr 15 10:54:27.465: dtlArpBcastRecv: received packet (rxTunType 1, dataLen
122)
```

Configuring Client Profiling

This section contains the following topics:

- Information About Client Profiling, page 8-78
- Guidelines and Limitations, page 8-78
- Configuring Client Profiling (GUI), page 8-79
- Configuring Client Profiling (CLI), page 8-79

Information About Client Profiling

When a client tries to associate with a WLAN, it is possible to determine the client type from the information received in the process. The controller acts as the collector of the information and sends the ISE with the required data in an optimal form.

Guidelines and Limitations

- By default, client profiling will be disabled on all WLANs.
- Client profiling is supported on access points that are in Local mode and FlexConnect mode.
- Profiling is not supported for clients in the following scenarios:
  - Clients associating with FlexConnect mode APs in Standalone mode.
  - Clients associating with FlexConnect mode APs when local authentication is done with local switching is enabled.
- Both DHCP Proxy and DHCP Bridging mode on the controller are supported.

- Accounting Server configuration on the WLAN must be pointing at an ISE running 1.1 MnR or later releases. Cisco ACS does not support client profiling.
- The type of DHCP server used does not affect client profiling.
- If the DHCP_REQUEST packet contains a string that is found in the Profiled Devices list of the ISE, then the client will be profiled automatically.
- The client is identified based on the MAC address sent in the Accounting request packet.
- Only MAC address should be sent as calling station ID in accounting packets when profiling is enabled.
- To enable client profiling, you must enable DHCP required flag and disable local authentication flag.
- With profiling enabled for local switching FlexConnect mode APs, only VLAN override is supported as an AAA override attribute.

Configuring Client Profiling (GUI)

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the WLAN ID. The WLANs > Edit page appears.

Step 3 Click the **Advanced** tab.

Step 4 In the Client Profiling area, to profile clients based on DHCP, select the **DHCP Profiling** check box.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Configuring Client Profiling (CLI)

- To enable or disable client profiling for a WLAN based on DHCP, enter this command:

  config wlan profiling radius dhcp {**enable** | **disable**} *wlan-id*
- To see the status of client profiling on a WLAN, enter this command:

  show wlan *wlan-id*
- To enable or disable debugging of client profiling, enter this command:

  debug profiling {**enable** | **disable**}

Configuring Per-WLAN RADIUS Source Support

This section contains the following topics:

- Information About Per-WLAN RADIUS Source Support, page 8-80
- Guidelines and Limitations, page 8-80
- Configuring Per-WLAN RADIUS Source Support, page 8-80

Information About Per-WLAN RADIUS Source Support

By default, the controller sources all RADIUS traffic from the IP address on its management interface. This means that even if a WLAN has specific RADIUS servers configured instead of the global list, the identity used is the management interface IP address.

If you want to do a per-user WLAN filtering, you can use the callStationID set by RFC 3580 to be in the APMAC:SSID format. You can also extend the filtering on the authentication server to be on a per-WLAN source interface by using the NAS-IP-Address attribute.

When the per-WLAN RADIUS source support is enabled, the controller sources all RADIUS traffic for a particular WLAN using the dynamic interface that is configured. Also, RADIUS attributes are modified accordingly to match the identity. This feature effectively virtualizes the controller on the per-WLAN RADIUS traffic, where each WLAN can have a separate L3 identity. This feature is useful in ACS Network Access Restrictions, Network Access Profiles, and so on.

This feature can be combined with normal RADIUS traffic source, with some WLANs using the management interface and others using the per-WLAN dynamic interface as the address source.

Guidelines and Limitations

- It is up to the authentication server (RADIUS) to implement a proper rule filtering on the new identity because the controller sources traffic only from the selected interface.
- callStationID is always in the APMAC:SSID format to comply with 802.1x over RADIUS RFC. This is also a legacy behavior. Web-auth can use different formats available in the **config radius callStationIDType** command.

If AP groups or AAA override are used, the source interface remains the WLAN interface, and not what is specified on the new AP group or RADIUS profile configuration.

Configuring Per-WLAN RADIUS Source Support

This section contains the following topics:

- Configuring Per-WLAN RADIUS Source Support (CLI), page 8-80
- Monitoring the Status of Per-WLAN RADIUS Source Support (CLI), page 8-81

Configuring Per-WLAN RADIUS Source Support (CLI)

Step 1 Enter the **config wlan disable** *wlan-id* command to disable the WLAN.

Step 2 Enable or disable the per-WLAN RADIUS source support by entering this command:

config wlan radius_server overwrite-interface {**enable** | **disable**} *wlan-id*

Note When enabled, the controller uses the interface specified on the WLAN configuration as identity and source for all RADIUS related traffic on that WLAN.

When disabled, the controller uses the management interface as the identity in the NAS-IP-Address attribute. If the RADIUS server is on a directly connected dynamic interface, the RADIUS traffic will be sourced from that interface. Otherwise, the management IP address is used. In all cases, the NAS-IP-Address attribute remains the management interface, unless the feature is enabled.

Step 3 Enter the **config wlan enable** *wlan-id* command to enable the WLAN.

Note You can filter requests on the RADIUS server side using CiscoSecure ACS. You can filter (accept or reject) a request depending on the NAS-IP-Address attribute through a Network Access Restrictions rule. The filtering to be used is the CLI/DNIS filtering.

Monitoring the Status of Per-WLAN RADIUS Source Support (CLI)

To see if the feature is enabled or disabled, enter this command:

show wlan *wlan-id*

Example

The following example shows that the per-WLAN RADIUS source support is enabled on WLAN 1.

show wlan *1*

Information similar to the following appears:

```
WLAN Identifier.................................. 4
Profile Name..................................... 4400-wpa2
Network Name (SSID).............................. 4400-wpa2
Status........................................... Enabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Network Admission Control
...
Radius Servers
   Authentication................................ Global Servers
   Accounting.................................... Global Servers
   Overwrite Sending Interface................... Enabled
Local EAP Authentication......................... Disabled
```

Configuring Remote LANs

This section contains the following topics:

- Guidelines and Limitations, page 8-81
- Guidelines and Limitations, page 8-81
- Configuring Remote LANs, page 8-82

Guidelines and Limitations

- 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 releases.

- 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.
- A Remote LAN can be applied on a dedicated LAN port on an OEAP 600 series access point.

Configuring Remote LANs

This section contains the following topics:

- Configuring a Remote LAN (GUI), page 8-82
- Configuring a Remote LAN (CLI), page 8-83

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 From the drop-down list, choose **Create New** and click **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, enter this 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*