Cisco Wireless LAN Controller Configuration Guide, Release 7.0

Chapter 4 - Configuring Controller Settings

Downloads: This chapter (PDF - 3.23MB) The complete book (PDF - 34.93MB) | Feedback

Table of Contents

Configuring Controller Settings

This chapter describes how to configure settings on the controller. It contains these sections:

- Installing and Configuring Licenses
- Configuring 802.11 Bands
- Configuring 802.11n Parameters
- Configuring 802.11h Parameters

Installing and Configuring Licenses

You can order Cisco 5500 Series Controllers with support for 12, 25, 50, 100, 250 or 500 access points as the controller's base capacity. You can add additional access point capacity through capacity adder licenses available at 25, 50, 100 and 250 access point capacities. You can add the capacity adder licenses to any base license in any combination to arrive at the maximum capacity of 500 access points. The base and adder licenses are supported through both rehosting and RMAs.

Note These controller platforms do not require licenses: Cisco 2100 and Cisco 4400 Series Controllers, Cisco WiSMs, Controller Network Modules, and Catalyst 3750G Integrated Wireless LAN Controller Switches.

The base license supports the standard base software set and, for releases 6.0196.0 and later, the premium software set is included as part of the base feature set, which includes this functionality:

- Datagram Transport Layer Security (DTLS) data encryption for added security across remote WAN and LAN links

  Note See the "Configuring Data Encryption" section for more information on data encryption.

- Support for OfficeExtend access points, which are used for secure mobile teleworking

  Note See the "OfficeExtend Access Points" section for more information on OfficeExtend access points.

- Support for the 1130AG and 1240AG series indoor mesh access points, which dynamically establish wireless connections in locations where it might be difficult to connect to the wired network

  Note See "Controlling Mesh Access Points," for more information on mesh access points.

All features included in a Wireless LAN Controller WPLUS license are now included in the base license; this change is introduced in release 6.0.196.0. These WPlus license features are included in the base license:

- OfficeExtend AP
- Enterprise Mesh
- CAPWAP Data Encryption

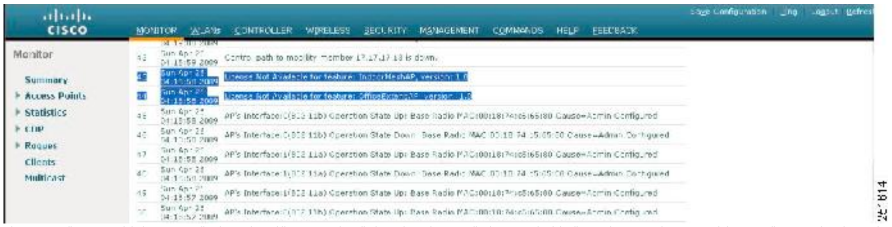
The licensing change can affect features on your wireless LAN when you upgrade or downgrade software releases, so you should be aware of these guidelines:

- If you have a WPlus license and you upgrade from 6.0.x.x to 7.0.98.0, your license file contains both Basic and WPlus license features. You won't see any disruption in feature availability and operation.
- If you have a WPlus license and you downgrade from 7.0.98.0 to 6.0.196.0 or 6.0.188 or 6.0.182, your license file contains only base license, and you will lose all WPLUS features.
- If you have a base license and you downgrade from 6.0.196.0 to 6.0.188 or 6.0.182, when you downgrade, you lose all WPlus features.

To view the controller trap log, choose **Monitor** and click **View All** under "Most Recent Traps" on the controller GUI (see Figure 4-1).

Note You can also view traps by using SNMP-based management tools.

Figure 4-1 Trap Logs Page



```
43  Sun Apr 27 04:15:59 2009  Control path to mobility member 17.17.17.18 is down.
49  Sun Apr 27 04:15:58 2009  License Not Available for feature: IndoorMeshAP, version: 1.0
50  Sun Apr 27 04:15:58 2009  License Not Available for feature: OfficeExtendAP, version: 1.0
48  Sun Apr 27 04:15:58 2009  AP's Interface:0(802.11b) Operation State Up: Base Radio MAC:00:18:74:e5:65:80 Cause=Admin Configured
46  Sun Apr 27 04:15:58 2009  AP's Interface:0(802.11b) Operation State Down: Base Radio MAC:00:18:74:e5:65:80 Cause=Admin Configured
47  Sun Apr 27 04:15:58 2009  AP's Interface:1(802.11a) Operation State Up: Base Radio MAC:00:18:74:e5:65:80 Cause=Admin Configured
46  Sun Apr 27 04:15:58 2009  AP's Interface:1(802.11a) Operation State Down: Base Radio MAC:00:18:74:e5:65:80 Cause=Admin Configured
45  Sun Apr 27 04:15:57 2009  AP's Interface:1(802.11a) Operation State Up: Base Radio MAC:00:18:74:e5:65:80 Cause=Admin Configured
    Sun Apr 27 04:15:52 2009  AP's Interface:0(802.11b) Operation State Up: Base Radio MAC:00:18:74:e5:65:80 Cause=Admin Configured
```

The ap-count licenses and their corresponding image-based licenses are installed together. The controller keeps track of the licensed access point count and does not allow more than the number of access points to associate to it.

The Cisco 5500 Series Controller is shipped with both permanent and evaluation base and base-ap-count licenses. If desired, you can activate the evaluation licenses, which are designed for temporary use and set to expire after 60 days.

Note See the "Choosing the Licensed Feature Set" section for instructions on activating an image-based evaluation license and the "Activating an AP-Count Evaluation License" section for instructions on activating an ap-count evaluation license.

No licensing steps are required after you receive your Cisco 5500 Series Controller because the licenses you ordered are installed at the factory. In addition, licenses and product authorization keys (PAKs) are preregistered to serial numbers. However, as your wireless network evolves, you might want to add support for additional access points or upgrade from the standard software set to the base software set. To do so, you need to obtain and install an upgrade license.

Obtaining an Upgrade or Capacity Adder License

A certificate with a product authorization key (PAK) is required before you can obtain an upgrade license.

You can use the capacity adder licenses to increase the number of access points supported by the controller up to a maximum of 500 access points. The capacity adder licenses are available in access point capacities of 10, 25, 50, 100 and 250 access points. You can add these licenses to any of the base capacity licenses of 12, 25, 50, 100 and 250 access points.

For example, if your controller was initially ordered with support for 100 access points (base license AIR-CT5508-100-K9), you could increase the capacity to 500 access points by purchasing a 250 access point, 100 access point, and a 50 access point additive capacity license (LIC-CT5508-250A, LIC-CT5508-100A, and LIC-CT5508-50A).

You can find more information on ordering capacity adder licenses at this URL: http://www.cisco.com/en/US/products/ps10315/products_data_sheets_list.html

Note If you skip any tiers when upgrading (for example, if you do not install the -25U and -50U licenses along with the -100U), the license registration for the upgraded capacity fails.

For a single controller, you can order different upgrade licenses in one transaction (for example, -25U, -50U, -100U, and -250U), for which you receive one PAK with one license. Then you have only one license (instead of four) to install on your controller.

If you have multiple controllers and want to upgrade all of them, you can order multiple quantities of each upgrade license in one transaction (for example, you can order 10 each of the -25U, -50U, -100U, and -250 upgrade licenses), for which you receive one PAK with one license. You can continue to register the PAK for multiple controllers until it is exhausted.

Base license SKUs for the Cisco 5500 Series Controllers are as follows:

- AIR-CT5508-12-K9
- AIR-CT5508-25-K9
- AIR-CT5508-50-K9
- AIR-CT5508-100-K9
- AIR-CT5508-250-K9
- AIR-CT5508-500-K9

The capacity adder SKUs are as follows:

- LIC-CT5508-25A
- LIC-CT5508-50A
- LIC-CT5508-100A
- LIC-CT5508-250A

To obtain and register a PAK certificate, follow these steps:

Step 1 Order the PAK certificate for an upgrade license through your Cisco channel partner or your Cisco sales representative, or order it online at this URL:

http://www.cisco.com/go/ordering

Step 2 If you are ordering online, begin by choosing the primary upgrade SKU **L-LIC-CT5508-UPG or LIC CT5508-UPG** . Then, choose any number of the following options to upgrade one or more controllers under one PAK. Table 4-1 lists the capacity adder licenses available through email or on paper:

Table 4-1 Available Capacity Adder Licenses

Type	Part Number	Description
email	L-LIC-CT5508-UPG	Primary upgrade SKU: Pick any number or combination of the following options under this SKU to upgrade one or many controllers under one product authorization key
	L-LIC-CT5508-25A	25 AP Adder License for the 5508 Controller (eDelivery)
	L-LIC-CT5508-50A	50 AP Adder License for the 5508 Controller (eDelivery)
	L-LIC-CT5508-100A	100 AP Adder License for the 5508 Controller (eDelivery)
	L-LIC-CT5508-250A	250 AP Adder License for the 5508 Controller (eDelivery)
paper	LIC-CT5508-UPG	Primary upgrade SKU: Pick any number or combination of the following options under this SKU, to upgrade one or many controllers under one product authorization key
	LIC-CT5508-25A	25 AP Adder License for the 5508 Controller
	LIC-CT5508-50A	50 AP Adder License for the 5508 Controller
	LIC-CT5508-100A	100 AP Adder License for the 5508 Controller
	LIC-CT5508-250A	250 AP Adder License for the 5508 Controller

Note If you require a paper certificate for Customs, order it without the "L-" in the SKU (for example, LIC-CT5508-250A) and choose to ship it using U.S. mail.

Step 3 After you receive the certificate, use one of two methods to register the PAK:

- **Cisco License Manager (CLM)** —This method automates the process of obtaining licenses and deploying them on Cisco devices. For deployments with more than five controllers, we recommend using CLM to register PAKs and install licenses. You can also use CLM to rehost or RMA a license.

  Note You cannot use CLM to change the licensed feature set or activate an ap-count evaluation license. To perform these operations, you must follow the instructions in the "Choosing the Licensed Feature Set" section and the "Activating an AP-Count Evaluation License" section. Because you can use CLM to perform all other license operations, you can disregard the remaining licensing information in this chapter except these two sections and the "Configuring the License Agent" section if you want your controller to use HTTP to communicate with CLM.

  Note You can download the CLM software and access user documentation at this URL:

  http://www.cisco.com/go/clm

- **Licensing portal** —This alternative method enables you to manually obtain and install licenses on your controller. If you want to use the licensing portal to register the PAK, follow the instructions in Use the licensing portal to register the PAK as follows:.

Step 4 Use the licensing portal to register the PAK as follows:

a. Go to http://tools.cisco.com/SWIFT/Licensing/PrivateRegistrationServlet

b. On the main Product License Registration page, enter the PAK mailed with the certificate in the Product Authorization Key (PAK) text box and click **Submit** .

c. On the Validate Features page, enter the number of licenses that you want to register in the Qty text box and click **Update** .

d. To determine the controller's product ID and serial number, choose **Controller** > **Inventory** on the controller GUI or enter the **show license udi** command on the controller CLI.

Information similar to the following appears on the controller CLI:

```
Device# PID SN UDI
------- -------------------- ---------------------- --------------------------------
*0 AIR-CT5508-K9 FCW1308L030 AIR-CT5508-K9:FCW1308L030
```

e. On the Designate Licensee page, enter the product ID and serial number of the controller on which you plan to install the license, read and accept the conditions of the end-user license agreement (EULA), complete the rest of the text boxes on this page, and click **Submit** .

f. On the Finish and Submit page, verify that all information is correct and click **Submit** .

g. When a message appears indicating that the registration is complete, click **Download License** . The license is emailed within 1 hour to the address that you specified.

h. When the email arrives, follow the instructions provided.

i. Copy the license file to your TFTP server.

j. Follow the instructions in the "Installing a License" section below to install the license on your controller.

Installing a License

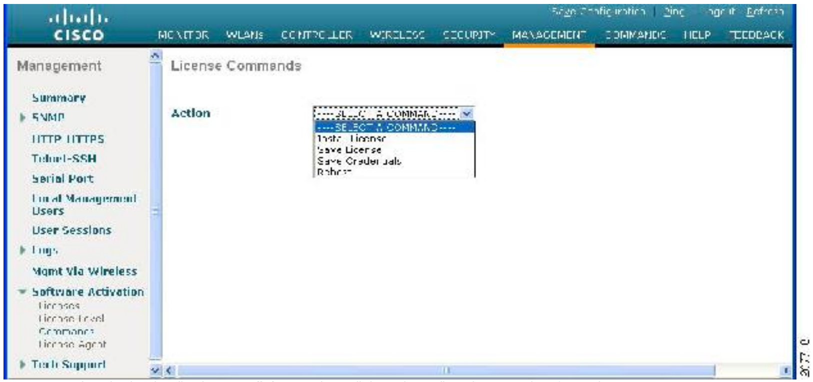
You can use the controller GUI or CLI to install a license on a Cisco 5500 Series Controller.

Using the GUI to Install a License

To install a license on the controller using the controller GUI, follow these steps:

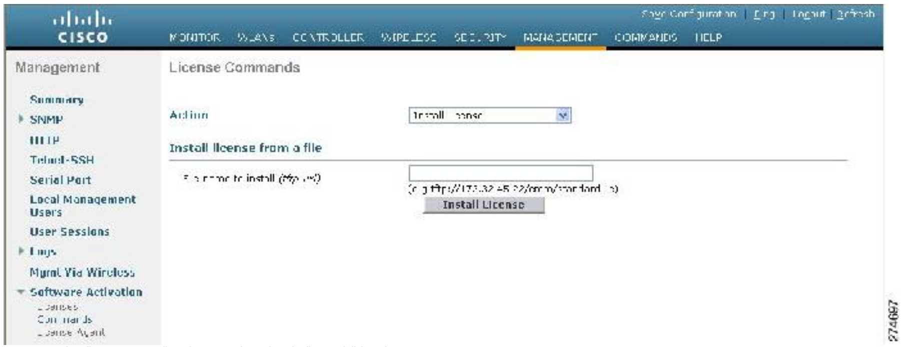
Step 1 Choose **Management** > **Software Activation** > **Commands** to open the License Commands page (see Figure 4-2).

Figure 4-2 License Commands Page



Step 2 From the Action drop-down list, choose **Install License** . The Install License from a File section appears (see Figure 4-3).

Figure 4-3 License Commands (Install License) Page



License Commands

Action: Install License

Install license from a file

File name to install (tftp://...)

(e.g. tftp://172.32.45.22/dom/standard.lic)

Step 3 In the File Name to Install text box, enter the path to the license (*.lic) on the TFTP server.

Step 4 Click **Install License** . A message appears to show whether the license was installed successfully. If the installation fails, the message provides the reason for the failure, such as the license is an existing license, the path was not found, the license does not belong to this device, you do not have correct permissions for the license, and so on.

Step 5 If the end-user license agreement (EULA) acceptance dialog box appears, read the agreement and click **Accept** to accept the terms of the agreement.

Note Typically, you are prompted to accept the EULA for evaluation, extension, and rehost licenses. The EULA is also required for permanent licenses, but it is accepted during license generation.

Step 6 Save a backup copy of all installed licenses as follows:

a. From the Action drop-down list, choose **Save License** .

b. In the File Name to Save text box, enter the path on the TFTP server where you want the licenses to be saved.

Note You cannot save evaluation licenses.

c. Click **Save Licenses** .

Step 7 Reboot the controller.

Step 8 Follow the instructions in the "Viewing Licenses" section to see the status of the license that you installed.

Step 9 If the desired license is not being used by the controller, follow the instructions in the "Choosing the Licensed Feature Set" section or the "Activating an AP-Count Evaluation License" section to change the license that is used by the controller.

Using the CLI to Install a License

To install a license on the controller using the controller CLI, follow these steps:

Step 1 Install a license on the controller by entering this command:

license install *url*

where *url* is tftp:// *server_ip* / *path* / *filename* .

Note To remove a license from the controller, enter the **license clear** *license_name command. For example, you might want to delete an expired evaluation license or any unused license. You* cannot delete unexpired evaluation licenses, the permanent base image license, or licenses that are in use by the controller.

Step 2 If you are prompted to accept the end-user license agreement (EULA), read and accept the terms of the agreement.

Note Typically, you are prompted to accept the EULA for evaluation, extension, and rehost licenses. The EULA is also required for permanent licenses, but it is accepted during license generation.

Step 3 Add comments to a license or delete comments from a license by entering this command:

license comment { **add** | **delete** } *license_name comment_string*

Step 4 Save a backup copy of all installed licenses by entering this command:

license save *url*

where *url* is tftp:// *server_ip* / *path* / *filename* .

Step 5 Reboot the controller by entering this command:

reset system

Step 6 Follow the instructions in the "Viewing Licenses" section to see the status of the license you installed.

Step 7 If the desired license is not being used by the controller, follow the instructions in the "Choosing the Licensed Feature Set" section or the "Activating an AP-Count Evaluation License" section to change the license that is used by the controller.

Viewing Licenses

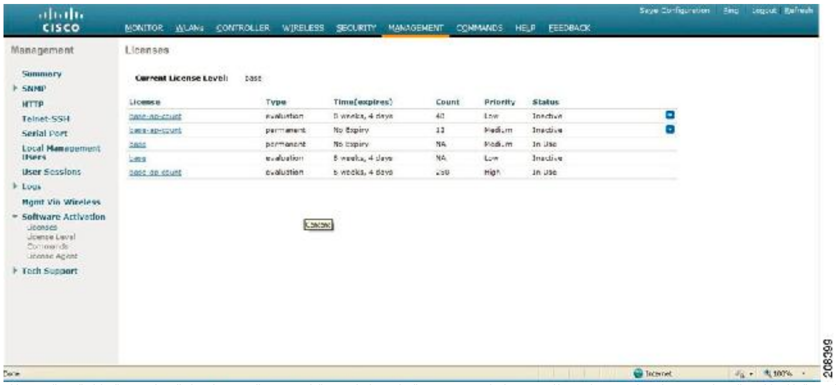
This section describes how to view the licenses on the controller.

Using the GUI to View Licenses

To view licenses on the controller using the controller GUI, follow these steps:

Step 1 Choose **Management** > **Software Activation** > **Licenses** to open the Licenses page (see Figure 4-4).

Figure 4-4 Licenses Page



Licenses

Current License Level: base

License	Type	Time(expires)	Count	Priority	Status
base-ap-count	evaluation	8 weeks, 4 days	40	Low	Inactive
base-ap-count	permanent	No Expiry	12	Medium	Inactive
base	permanent	No Expiry	NA	Medium	In Use
base	evaluation	8 weeks, 4 days	NA	Low	Inactive
base-ap-count	evaluation	8 weeks, 4 days	250	High	In Use

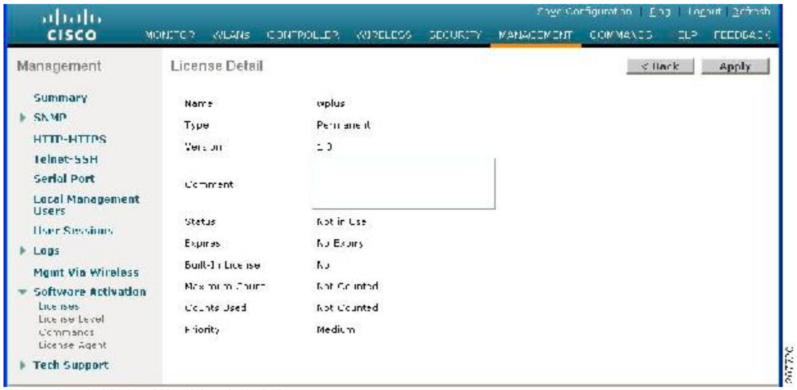
This page lists all of the licenses installed on the controller. For each license, it shows the license type, expiration, count (the maximum number of access points allowed for this license), priority (low, medium, or high), and status (in use, not in use, inactive, or EULA not accepted).

Note Controller platforms do not support the status of 'grace period' or 'extension' as a license type. The license status will always show 'evaluation' even if a grace period or an extension evaluation license is installed.

Note If you ever want to remove a license from the controller, hover your cursor over the blue drop-down arrow for the license and click **Remove**. *For example, you might want to delete an expired evaluation license or any unused* *license. You* cannot delete unexpired evaluation licenses, the permanent base image license, or licenses that are in use by the controller.

Step 2 Click the link for the desired license to view more details for a particular license. The License Detail page appears (see Figure 4-5).

Figure 4-5 License Detail Page



License Detail

Name	wplus
Type	Permanent
Version	1.0
Comment	
Status	Not in Use
Expires	No Expiry
Built-In License	No
Maximum Count	Not Counted
Counts Used	Not Counted
Priority	Medium

This page shows the following additional information for the license:

- The license type (permanent, evaluation, or extension)
- The license version
- The status of the license (in use, not in use, inactive, or EULA not accepted)
- The length of time before the license expires

Note Permanent licenses never expire.

- Whether the license is a built-in license
- The maximum number of access points allowed for this license
- The number of access points currently using this license

Step 3 If you want to enter a comment for this license, type it in the Comment text box and click **Apply.**

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

Using the CLI to View Licenses

To view licenses on the controller, use these commands:

- See the license level, license type, and number of access points licensed on the controller by entering this command:

  show sysinfo

  Information similar to the following appears:

```
Manufacturer's Name.............................. Cisco Systems Inc.
Product Name..................................... Cisco Controller
Product Version.................................. 7.0
RTOS Version..................................... 7.0
Bootloader Version............................... 5.2
Emergency Image Version.......................... N/A
Build Type....................................... DATA + WPS
System Name...................................... Cisco 69
System Location.................................. na
System Contact................................... abc@cisco.com
System ObjectID.................................. 1.3.6.1.4.1.14179.1.1.4.3
IP Address....................................... 10.10.10.10
System Up Time................................... 3 days 1 hrs 12 mins 42 secs
System Timezone Location.........................
CurrentBoot License Level..........................base
CurrentBoot License Type...........................Permanent
NextBoot License Level............................base
NextBoot License Type............................Permanent
Operating Environment............................ Commercial (0 to 40 C)
Internal Temp Alarm Limits....................... 0 to 65 C
Internal Temperature............................. +40 C
State of 802.11b Network......................... Enabled
State of 802.11a Network......................... Enabled
Number of WLANs.................................. 4
Number of Active Clients......................... 0
Burned-in MAC Address............................ 00:1A:6D:DD:1E:40
Crypto Accelerator 1............................. Absent
Crypto Accelerator 2............................. Absent
Power Supply 1................................... Absent
Power Supply 2................................... Present, OK
Maximum number of APs supported.................. 12
```

- See a brief summary of all active licenses installed on the controller by entering this command:

  show license summary

  Information similar to the following appears:

```
Index 1 Feature: base
Period left: 0 minute 0 second
Index 2 Feature: base-ap-count
Period left: 0 minute 0 second
Index3 Feature: base
Period left: Life time
License Type: Permanent
License State: Active, In Use
License Count: Non-Counted
License Priority: Medium
Index 4 Feature: base-ap-count
Period left: 6 weeks, 4 days
License Type: Evaluation
License State: Active, In Use
License Count: 250/250/0
License Priority: High
```

- See all of the licenses installed on the controller by entering this command:

  show license all

  Information similar to the following appears:

```
License Store: Primary License Storage
StoreIndex: 1 Feature: base Version: 1.0
License Type: Permanent
License State: Active, Not in Use
License Count: Non-Counted
License Priority: Medium

StoreIndex: 3 Feature: base-ap-count Version: 1.0
License Type: Evaluation
```

```
   License State: Active, In Use
   Evaluation total period: 8 weeks 4 days
   Evaluation period left: 8 weeks 3 days
   License Count: 250/0/0
   License Priority: High
```

- See the details for a particular license by entering this command:

  show license detail *license_name*

  Information similar to the following appears:

```
   Index: 1 Feature: base-ap-count Version: 1.0
   License Type: Permanent
   License State: Active, Not in Use
   License Count: 12/0/0
   License Priority: Medium
   Store Index: 0
   Store Name: Primary License Storage

   Index: 2 Feature: base-ap-count Version: 1.0
   License Type: Evaluation
   License State: Inactive
   Evaluation total period: 8 weeks 4 days
   Evaluation period left: 8 weeks 4 days
   License Count: 250/0/0
   License Priority: Low
   Store Index: 3
Store Name: Evaluation License Storage
```

- See all expiring, evaluation, permanent, or in-use licenses by entering this command:

  show license {expiring | evaluation | permanent | in-use}

  Information similar to the following appears for the show license in-use command:

```
StoreIndex: 2 Feature: base-ap-count Version: 1.0
License Type: Permanent
License State: Active, In Use
License Count: 12/12/0
License Priority: Medium
StoreIndex: 3 Feature: base Version: 1.0
License Type: Permanent
License State: Active, In Use
License Count: Non-Counted
License Priority: Medium
```

Note Controller platforms do not support the status of 'grace period' or 'extension' as a license type. The license status will always show 'evaluation' even if a grace period or an extension evaluation license is installed.

- See the maximum number of access points allowed for this license on the controller, the number of access points currently joined to the controller, and the number of access points that can still join the controller by entering this command:

  show license capacity

  Information similar to the following appears:

```
Licensed Feature Max Count Current Count Remaining Count
----------------- -------------- ------------------ --------------------
AP Count 250 4 246
```

- See statistics for all licenses on the controller by entering this command:

  show license statistics

  Information similar to the following appears:

```
Administrative statistics
Install success count: 2
Install failure count: 0
Install duplicate count: 0
Comment add count: 0
Comment delete count: 0
Clear count: 0
Save count: 2
Save cred count: 0
Client status
Request success count 2
Request failure count 0
Release count 0
Global Notify count 6
```

- See a summary of license-enabled features by entering this command:

  show license feature

  Information similar to the following appears:

```
Feature name Enforcement Evaluation Clear Allowed Enabled
base yes yes yes yes
base-ap-count yes yes yes no
```

Choosing the Licensed Feature Set

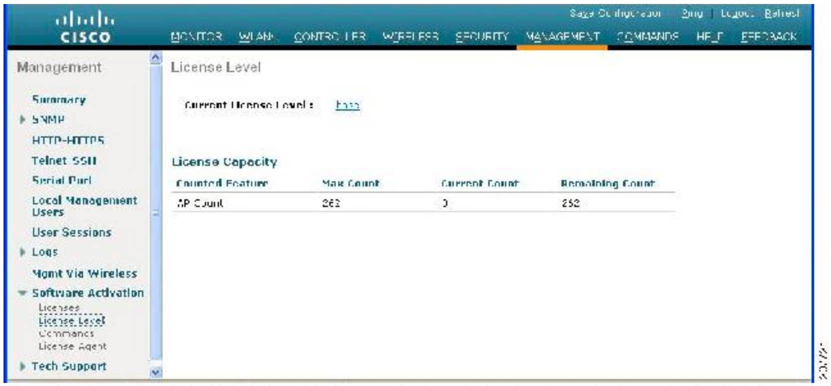
You can configure the controller to specify which feature set it uses. The currently active license determines the feature set and number of access points supported on the controller.

Using the GUI to Choose the Licensed Feature Set

To specify the feature set for the controller using the controller GUI, follow these steps:

Step 1 Choose **Management** > **Software Activation** > **License Level** to open the License Level page (see Figure 4-6).

Figure 4-6 License Level Page



License Level

Current License Level : base

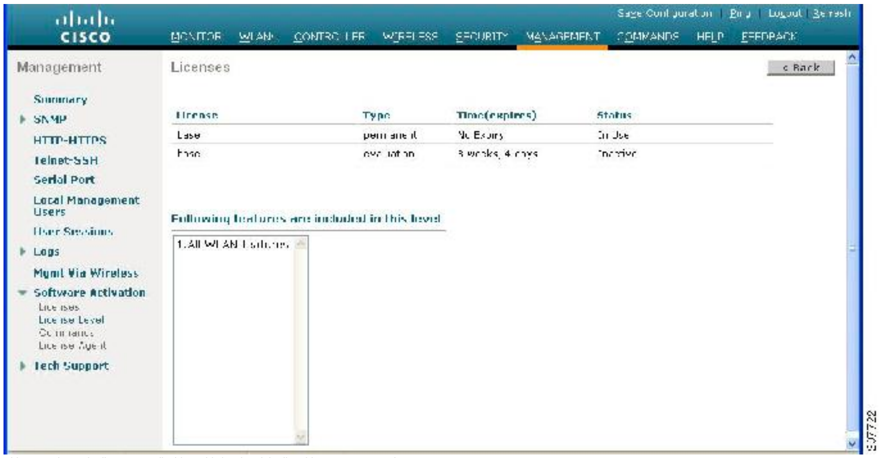
License Capacity

Counted Feature	Max Count	Current Count	Remaining Count
AP Count	262	0	252

This page shows the current license level and the level to be used after the next controller reboot. It also shows the maximum number of access points allowed by the license on the controller, the number of access points currently joined to the controller, and the number of access points that can still join the controller.

Step 2 Click the **base** license level link to open the Licenses page (see Figure 4-7) to learn more about the available license levels.

Figure 4-7 Licenses Page



Licenses

License	Type	Time(expires)	Status
base	permanent	No Expiry	In Use
base	evaluation	8 weeks, 4 days	Inactive

Following features are included in this level

1. All WLAN Features

This page shows the licenses applicable to this level and the list of features supported.

Step 3 Click **Back** to return to the License Level page.

Step 4 If you want to change the license level, follow these steps:

a. Choose the license level to be used on the next reboot: **base** , or **auto** . If you choose **auto** , the licensing software automatically chooses the license level to use on the next reboot. It chooses permanent licenses over evaluation licenses.

Note To prevent disruptions in operation, the controller does not switch licenses when an evaluation license expires. You must reboot the controller in order to return to a permanent license. Following a reboot, the controller defaults to the same feature set level as the expired evaluation license. If no permanent license at the same feature set level is installed, the controller uses a permanent license at another level or an unexpired evaluation license. If no valid licenses are installed, the controller can always operate in base level.

b. Click **Activate** .

c. Click **OK** when prompted to confirm your decision to change the license level on the next reboot.

d. If you are prompted to accept the end-user license agreement (EULA), read and accept the terms of the agreement and then click **Accept** . The Next Boot Level text box now shows the license level that you specified as the level to be used after the next controller reboot.

e. Reboot the controller so that the specified license level takes effect.

Using the CLI to Choose the Licensed Feature Set

To specify the feature set for the controller using the controller CLI, follow these steps:

Step 1 See the current license level and the level to be used after the next controller reboot by entering this command:

show sysinfo

Information similar to the following appears:

```
Product Name..................................... Cisco Controller
Product Version.................................. 6.0.118.0
...
Current Boot License Level....................... base
Current Boot License Type........................ Permanent
Next Boot License Level.......................... auto
Next Boot License Type........................... Permanent
...
```

Step 2 Specify the license level to be used on the next reboot by entering this command:

config license boot *{* **base** | **auto** *}*

If you choose **auto** , the licensing software automatically chooses the license level to use on the next reboot. It chooses permanent licenses over evaluation licenses.

Note To prevent disruptions in operation, the controller does not switch licenses when an evaluation license expires. You must reboot the controller in order to return to a permanent license. Following a reboot, the controller defaults to the same feature set level as the expired evaluation license. If no permanent license at the same feature set level is installed, the controller uses a permanent license at another level or an unexpired evaluation license.

Step 3 If you are prompted to accept the end-user license agreement (EULA), read and accept the terms of the agreement. The EULA appears if no permanent licenses are installed at the specified boot level and the evaluation license has not yet been activated. In this case, the **config license boot** command changes the license level and activates the evaluation license following a reboot.

Step 4 See the license level to be used after the next controller reboot by entering this command:

show sysinfo

Step 5 Reboot the controller in order to have your changes take effect by entering this command:

reset system

Activating an AP-Count Evaluation License

If you are considering upgrading to a license with a higher access point count, you can try an evaluation license before upgrading to a permanent version of the license. For example, if you are using a permanent license with a 50-access-point count and want to try an evaluation license with a 100-access-point count, you can try out the evaluation license for 60 days.

AP-count evaluation licenses are set to low priority by default so that the controller uses the ap-count permanent license. If you want to try an evaluation license with an increased access point count, you must change its priority to high. If you no longer want to have this higher capacity, you can lower the priority of the ap-count evaluation license, which forces the controller to use the permanent license.

Note To prevent disruptions in operation, the controller does not switch licenses when an evaluation license expires. You must reboot the controller in order to return to a permanent license. Following a reboot, the controller defaults to the same feature set level as the expired evaluation license. If no permanent license at the same feature set level is installed, the controller uses a permanent license at another level or an unexpired evaluation license.

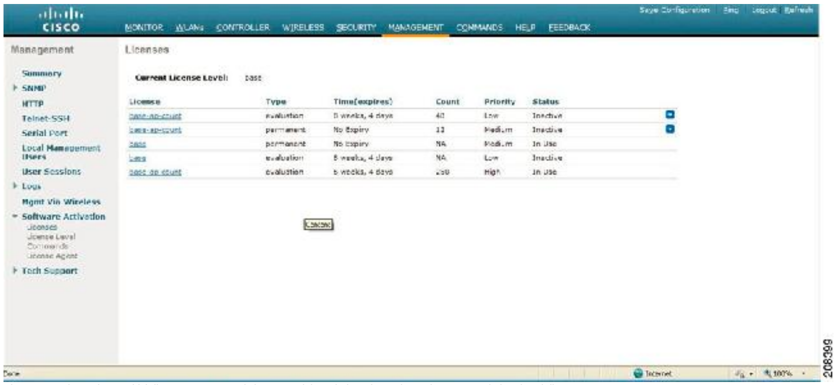
You can activate ap-count evaluation licenses using the controller GUI or CLI.

Using the GUI to Activate an AP-Count Evaluation License

To activate an ap-count evaluation license using the controller GUI, follow these steps:

Step 1 Choose **Management** > **Software Activation** > **Licenses** to open the Licenses page (see Figure 4-8).

Figure 4-8 Licenses Page



Licenses

Current License Level: base

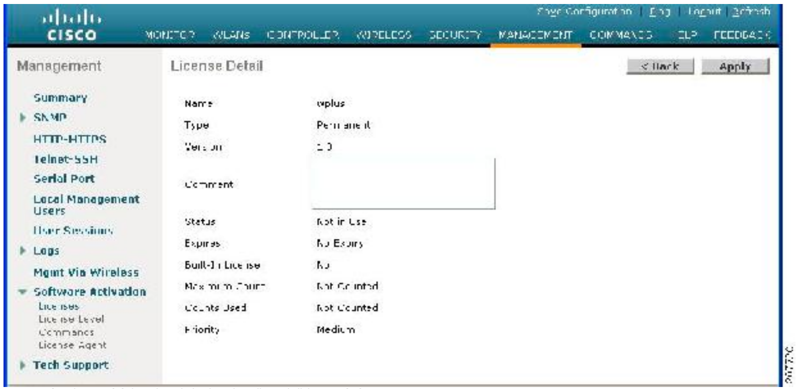
License	Type	Time(expires)	Count	Priority	Status
base-ap-count	evaluation	8 weeks, 4 days	40	Low	Inactive
base-ap-count	permanent	No Expiry	12	Medium	Inactive
base	permanent	No Expiry	NA	Medium	In Use
base	evaluation	8 weeks, 4 days	NA	Low	Inactive
base-ap-count	evaluation	8 weeks, 4 days	250	High	In Use

The Status column shows which licenses are currently in use, and the Priority column shows the current priority of each license.

Step 2 Activate an ap-count evaluation license as follows:

a. Click the link for the ap-count evaluation license that you want to activate. The License Detail page appears (see Figure 4-9).

Figure 4-9 License Detail Page



License Detail

Name	wplus
Type	Permanent
Version	1.0
Comment	
Status	Not in Use
Expires	No Expiry
Built-In License	No
Maximum Count	Not Counted
Counts Used	Not Counted
Priority	Medium

b. Choose **High** from the Priority drop-down list and click **Set Priority** .

Note You can set the priority only for ap-count evaluation licenses. AP-count permanent licenses always have a medium priority, which cannot be configured.

c. Click **OK** when prompted to confirm your decision about changing the priority of the license.

d. When the EULA appears, read the terms of the agreement and then click **Accept** .

e. When prompted to reboot the controller, click **OK** .

f. Reboot the controller in order for the priority change to take effect.

g. Click **Licenses** to open the Licenses page and verify that the ap-count evaluation license now has a high priority and is in use. You can use the evaluation license until it expires.

Step 3 If you decide to stop using the ap-count evaluation license and want to revert to using an ap-count permanent license, follow these steps:

a. On the Licenses page, click the link for the ap-count evaluation license that is in use.

b. Choose **Low** from the Priority drop-down list and click **Set Priority** .

Note You can set the priority only for ap-count evaluation licenses. AP-count permanent licenses always have a medium priority, which cannot be configured.

c. Click **OK** when prompted to confirm your decision about changing the priority of the license.

d. When the EULA appears, read the terms of the agreement and then click **Accept** .

e. When prompted to reboot the controller, click **OK** .

f. Reboot the controller in order for the priority change to take effect.

g. Click **Licenses** to open the Licenses page and verify that the ap-count evaluation license now has a low priority and is not in use. Instead, the ap-count permanent license should be in use.

Using the CLI to Activate an AP-Count Evaluation License

To activate an ap-count evaluation license using the controller CLI, follow these steps:

Step 1 See the current status of all the licenses on your controller by entering this command:

show license all

Information similar to the following appears:

```
   License Store: Primary License Storage
   StoreIndex: 0 Feature: base-ap-count Version: 1.0
   License Type: Permanent
   License State: Active, In Use
   License Count: 12/0/0
   License Priority: Medium
   StoreIndex: 1 Feature: base Version: 1.0
   License Type: Permanent
   License State: Active, In Use
   License Count: Non-Counted
   License Priority: Medium
   StoreIndex: 2 Feature: base Version: 1.0
   License Type: Evaluation
   License State: Inactive
   Evaluation total period: 8 weeks 4 days
   Evaluation period left: 8 weeks 4 days
   License Count: Non-Counted
   License Priority: Low
   StoreIndex: 3 Feature: base-ap-count Version: 1.0
   License Type: Evaluation
   License State: Inactive
   Evaluation total period: 8 weeks 4 days
   Evaluation period left: 8 weeks 4 days
   License Count: 250/0/0
License Priority: Low
```

The License State text box shows the licenses that are in use, and the License Priority text box shows the current priority of each license.

Step 2 Activate an ap-count evaluation license as follows:

a. To raise the priority of the base-ap-count evaluation license, enter this command:

license modify priority *license_name* high

Note You can set the priority only for ap-count evaluation licenses. AP-count permanent licenses always have a medium priority, which cannot be configured.

b. To reboot the controller in order for the priority change to take effect, enter this command:

reset system

c. To verify that the ap-count evaluation license now has a high priority and is in use, enter this command:

show license all

You can use the evaluation license until it expires.

Step 3 If you decide to stop using the ap-count evaluation license and want to revert to using an ap-count permanent license, follow these steps:

a. To lower the priority of the ap-count evaluation license, enter this command:

license modify priority *license_name* low

b. To reboot the controller in order for the priority change to take effect, enter this command:

reset system

c. To verify that the ap-count evaluation license now has a low priority and is not in use, enter this command:

show license all

Instead, the ap-count permanent license should be in use.

Rehosting a License

Revoking a license from one controller and installing it on another is called rehosting. You might want to rehost a license in order to change the purpose of a controller. For example, if you want to move your OfficeExtend or indoor mesh access points to a different controller, you could transfer the adder license from one controller to another controller of the same model, say from one 5500 series controller to another 5500 series controller (intramodel transfer). This can be done in the case of RMA or a network rearchitecture that requires you to transfer licenses from one appliance to another. It is not possible to rehost base licenses in normal scenarios of network rearchitecture. The only exception where the transfer of base licenses is allowed is for RMA when you get a replacement hardware when your existing appliance has a failure.

Evaluation licenses cannot be rehosted.

In order to rehost a license, you must generate credential information from the controller and use it to obtain a permission ticket to revoke the license from the Cisco licensing site. Next, you must obtain a rehost ticket and use it to obtain a license installation file for the controller on which you want to install the license.

Note A revoked license cannot be reinstalled on the same controller

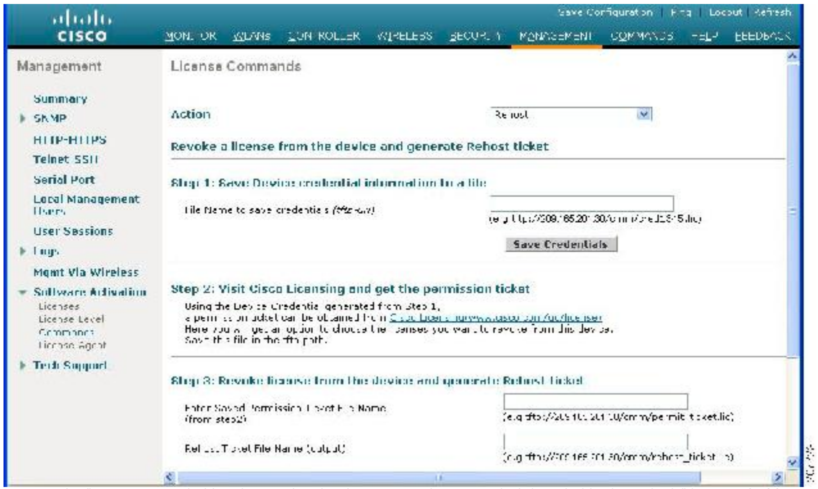
Using the GUI to Rehost a License

To rehost a license using the controller GUI, follow these steps:

Step 1 Choose **Management** > **Software Activation** > **Commands** to open the License Commands page.

Step 2 From the Action drop-down list, choose **Rehost** . The Revoke a License from the Device and Generate Rehost Ticket area appears (see Figure 4-10).

Figure 4-10 License Commands (Rehost) Page



License Commands

Action: Rehost

Revoke a license from the device and generate Rehost ticket

Step 1: Save Device credential information to a file

File Name to save credentials (tftp only) (e.g. tftp://209.165.201.30/cmn/cred1.lic)

Step 2: Visit Cisco Licensing and get the permission ticket

Using the Device Credentials generated from Step 1,
a permission ticket can be obtained from Cisco Licensing (www.cisco.com/go/license)
Here you will get an option to choose the licenses you want to revoke from this device.
Save this file in the tftp path.

Step 3: Revoke license from the device and generate Rehost ticket

Enter Saved Permission Ticket File Name (from step2) (e.g. tftp://209.165.201.30/cmn/permit_ticket.lic)

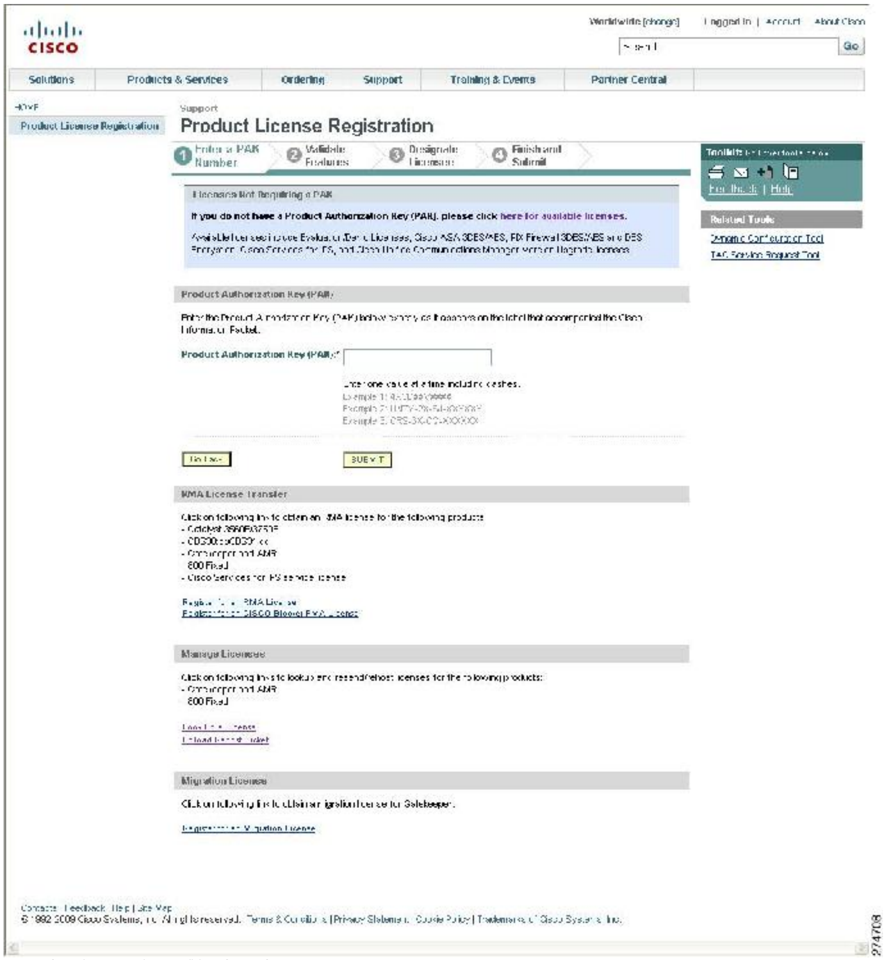
Rehost Ticket File Name (output) (e.g. tftp://209.165.201.30/cmn/rehost_ticket.lic)

Step 3 In the File Name to Save Credentials text box, enter the path on the TFTP server where you want the device credentials to be saved and click **Save Credentials.**

Step 4 To obtain a permission ticket to revoke the license, follow these steps:

a. Click **Cisco Licensing (** https://tools.cisco.com/SWIFT/Licensing/PrivateRegistrationServlet **)** . The Product License Registration page appears (see Figure 4-11).

Figure 4-11 Product License Registration Page



Support

Product License Registration

1 Enter a PAK Number 2 Validate Features 3 Designate Licensee 4 Finish and Submit

Licenses Not Requiring a PAK

If you do not have a Product Authorization Key (PAK), please click here for available licenses.

Available licenses include Evaluation/Demo Licenses, Cisco ASA 3DES/AES, PIX Firewall 3DES/AES and DES Encryption, Cisco Services for IPS, and Cisco Unified Communications Manager Version Upgrade licenses.

Product Authorization Key (PAK)

Enter the Product Authorization Key (PAK) below exactly as it appears on the label that accompanied the Cisco Information Packet.

Product Authorization Key (PAK):*

Enter one value at a time including dashes.
Example 1: [illegible]
Example 2: [illegible]
Example 3: CRS-3X-[illegible]

Go Back SUBMIT

RMA License Transfer

Click on following links to obtain an RMA license for the following products:
- Catalyst 3560E/3750E
- CDS300 [illegible]
- [illegible] AMR 800 Fixed
- Cisco Services for IPS service license

Register for an RMA License
Register for an CISCO [illegible] RMA License

Manage Licenses

Click on following links to lookup and resend/rehost licenses for the following products:
- [illegible] AMR 800 Fixed

Look Up a License
Upload Rehost Ticket

Migration License

Click on following link to obtain migration license for Gatekeeper.

Register for an Migration License

Contacts | Feedback | Help | Site Map
© 1992-2009 Cisco Systems, Inc. All rights reserved. Terms & Conditions | Privacy Statement | Cookie Policy | Trademarks of Cisco Systems, Inc.

274708

b. Under Manage Licenses, click **Look Up a License** .

c. Enter the product ID and serial number for your controller.

Note To find the controller's product ID and serial number, choose **Controller** > **Inventory** on the controller GUI.

d. Open the device credential information file that you saved in In the File Name to Save Credentials text box, enter the path on the TFTP server where you want the device credentials to be saved and click Save Credentials. and copy and paste the contents of the file into the Device Credentials text box.

e. Enter the security code in the blank box and click **Continue** .

f. Choose the licenses that you want to revoke from this controller and click **Start License Transfer** .

g. On the Rehost Quantities page, enter the number of licenses that you want to revoke in the To Rehost text box and click **Continue** .

h. On the Designate Licensee page, enter the product ID and serial number of the controller for which you plan to revoke the license, read and accept the conditions of the end-user license agreement (EULA), complete the rest of the text boxes on this page, and click **Continue** .

i. On the Review and Submit page, verify that all information is correct and click **Submit** .

j. When a message appears indicating that the registration is complete, click **Download Permission Ticket** . The rehost permission ticket is e-mailed within 1 hour to the address that you specified.

k. After the email arrives, copy the rehost permission ticket to your TFTP server.

Step 5 Use the rehost permission ticket to revoke the license from this controller and generate a rehost ticket as follows:

a. In the Enter Saved Permission Ticket File Name text box, enter the TFTP path and filename (*.lic) for the rehost permission ticket that you generated in To obtain a permission ticket to revoke the license, follow these steps:.

b. In the Rehost Ticket File Name text box, enter the TFTP path and filename (*.lic) for the ticket that will be used to rehost this license on another controller.

c. Click **Generate Rehost Ticket** .

d. When the end-user license agreement (EULA) acceptance dialog box appears, read the agreement and click **Accept** to accept the terms of the agreement.

Step 6 Use the rehost ticket generated in Use the rehost permission ticket to revoke the license from this controller and generate a rehost ticket as follows: to obtain a license installation file, which can then be installed on another controller as follows:

a. Click **Cisco Licensing.**

b. On the Product License Registration page, click **Upload Rehost Ticket** under Manage Licenses.

c. On the Upload Ticket page, enter the rehost ticket that you generated in Use the rehost permission ticket to revoke the license from this controller and generate a rehost ticket as follows: in the Enter Rehost Ticket text box and click **Continue** .

d. On the Validate Features page, verify that the license information for your controller is correct, enter the rehost quantity, and click **Continue** .

e. On the Designate Licensee page, enter the product ID and serial number of the controller on which you plan to use the license, read and accept the conditions of the end-user license agreement (EULA), complete the rest of the text boxes on this page, and click **Continue** .

f. On the Review and Submit page, verify that all information is correct and click **Submit** .

g. When a message appears indicating that the registration is complete, click **Download License** . The rehost license key is e-mailed within 1 hour to the address that you specified.

h. After the email arrives, copy the rehost license key to your TFTP server.

i. Follow the instructions in the "Installing a License" section to install this license on another controller.

Using the CLI to Rehost a License

To rehost a license using the controller CLI, follow these steps:

Step 1 Save device credential information to a file by entering this command:

license save credential *url*

where *url* is tftp:// *server_ip* / *path* / *filename* .

Step 2 Obtain a permission ticket to revoke the license as follows:

a. Go to https://tools.cisco.com/SWIFT/Licensing/PrivateRegistrationServlet . The Product License Registration page appears (see Figure 4-11).

b. Under Manage Licenses, click **Look Up a License** .

c. Enter the product ID and serial number for your controller.

Note To find the controller's product ID and serial number, enter the **show license udi** command on the controller CLI.

d. Open the device credential information file that you saved in Save device credential information to a file by entering this command: and copy and paste the contents of the file into the Device Credentials text box.

e. Enter the security code in the blank box and click **Continue** .

f. Choose the licenses that you want to revoke from this controller and click **Start License Transfer** .

g. On the Rehost Quantities page, enter the number of licenses that you want to revoke in the To Rehost text box and click **Continue** .

h. On the Designate Licensee page, enter the product ID and serial number of the controller for which you plan to revoke the license, read and accept the conditions of the end-user license agreement (EULA), complete the rest of the text boxes on this page, and click **Continue** .

i. On the Review and Submit page, verify that all information is correct and click **Submit** .

j. When a message appears indicating that the registration is complete, click **Download Permission Ticket** . The rehost permission ticket is e-mailed within 1 hour to the address that you specified.

k. After the email arrives, copy the rehost permission ticket to your TFTP server.

Step 3 Use the rehost permission ticket to revoke the license from this controller and generate a rehost ticket as follows:

a. To revoke the license from the controller, enter this command:

license revoke *permission_ticket_url*

where *permission_ticket_url* is tftp:// *server_ip* / *path* / *filename* .

b. To generate the rehost ticket, enter this command:

license revoke rehost *rehost_ticket_url*

where *rehost_ticket_url* is tftp:// *server_ip* / *path* / *filename* .

c. If prompted, read and accept the terms of the end-user license agreement (EULA).

Step 4 Use the rehost ticket generated in Use the rehost permission ticket to revoke the license from this controller and generate a rehost ticket as follows: to obtain a license installation file, which can then be installed on another controller as follows:

a. Go to https://tools.cisco.com/SWIFT/Licensing/PrivateRegistrationServlet **.**

b. On the Product License Registration page, click **Upload Rehost Ticket** under Manage Licenses.

c. On the Upload Ticket page, enter the rehost ticket that you generated in Use the rehost permission ticket to revoke the license from this controller and generate a rehost ticket as follows: in the Enter Rehost Ticket text box and click **Continue** .

d. On the Validate Features page, verify that the license information for your controller is correct, enter the rehost quantity, and click **Continue** .

e. On the Designate Licensee page, enter the product ID and serial number of the controller on which you plan to use the license, read and accept the conditions of the end-user license agreement (EULA), complete the rest of the text boxes on this page, and click **Continue** .

f. On the Review and Submit page, verify that all information is correct and click **Submit** .

g. When a message appears indicating that the registration is complete, click **Download License** . The rehost license key is e-mailed within 1 hour to the address that you specified.

h. After the email arrives, copy the rehost license key to your TFTP server.

i. Follow the instructions in the "Installing a License" section to install this license on another controller.

Transferring Licenses to a Replacement Controller after an RMA

If you return a Cisco 5500 Series Controller to Cisco as part of the Return Material Authorization (RMA) process, you must transfer that controller's licenses within 60 days to a replacement controller that you receive from Cisco.

Replacement controllers come preinstalled with the following licenses: permanent base and evaluation base, base-ap-count. No other permanent licenses are installed. The SKU for replacement controllers is AIR-CT5508-CA-K9.

Because licenses are registered to the serial number of a controller, you can use the licensing portal on Cisco.com to request that the license from your returned controller be revoked and authorized for use on the replacement controller. After your request is approved, you can install the old license on the replacement controller. Before you begin, you need the product ID and serial number of both the returned controller and the replacement controller. This information is included in your purchase records.

Note The evaluation licenses on the replacement controller are designed for temporary use and expire after 60 days. To prevent disruptions in operation, the controller does not switch licenses when an evaluation license expires. You must reboot the controller in order to return to a permanent license. If the evaluation licenses expire before you transfer the permanent licenses from your defective controller to your replacement controller, the replacement controller remains up and running using the permanent base license, but access points are no longer able to join the controller.

To transfer a license to a replacement controller after an RMA, follow these steps:

Step 1 Go to https://tools.cisco.com/SWIFT/Licensing/PrivateRegistrationServlet .

Step 2 On the main Product License Registration page, click **Register for an RMA License** under RMA License Transfer.

Step 3 In the Select a Product drop-down list, choose **Cisco 5500 Series Wireless Controllers** .

Step 4 Enter the security code in the blank box and click **Go to RMA Portal** .

Step 5 On the RMA License Transfer page, enter the product ID and serial number of the controller that you returned and your RMA service contract number, and click **Continue** .

Step 6 On the Validate Features page, verify that the license information for your controller is correct, and click **Continue** .

Step 7 On the Designate Licensee page, enter the product ID and serial number of the replacement controller.

Step 8 Read and accept the conditions of the end-user license agreement (EULA), complete the rest of the text boxes on this page, and click **Submit** .

Step 9 On the Review and Submit page, verify that all information is correct and click **Submit** . A message appears indicating that your registration request has been submitted, and you will receive an e-mail that contains your RMA request ID.

Step 10 Select the status of your RMA registration request by following the instructions in the e-mail.

Step 11 After you receive another e-mail notifying you that your RMA registration request is approved (usually within 1 hour), follow the instructions in the "Installing a License" section to install the license on the replacement controller.

Configuring the License Agent

If your network contains various Cisco-licensed devices, you might want to consider using the Cisco License Manager (CLM) to manage all of the licenses using a single application. CLM is a secure client/server application that manages Cisco software licenses network wide.

The license agent is an interface module that runs on the controller and mediates between CLM and the controller's licensing infrastructure. CLM can communicate with the controller using various channels, such as HTTP, Telnet, and so on. If you want to use HTTP as the communication method, you must enable the license agent on the controller.

The license agent receives requests from CLM and translates them into license commands. It also sends notifications to CLM. It uses XML messages over HTTP or HTTPS to receive the requests and send the notifications. For example, CLM sends a **license install** command, and the agent notifies CLM after the license expires.

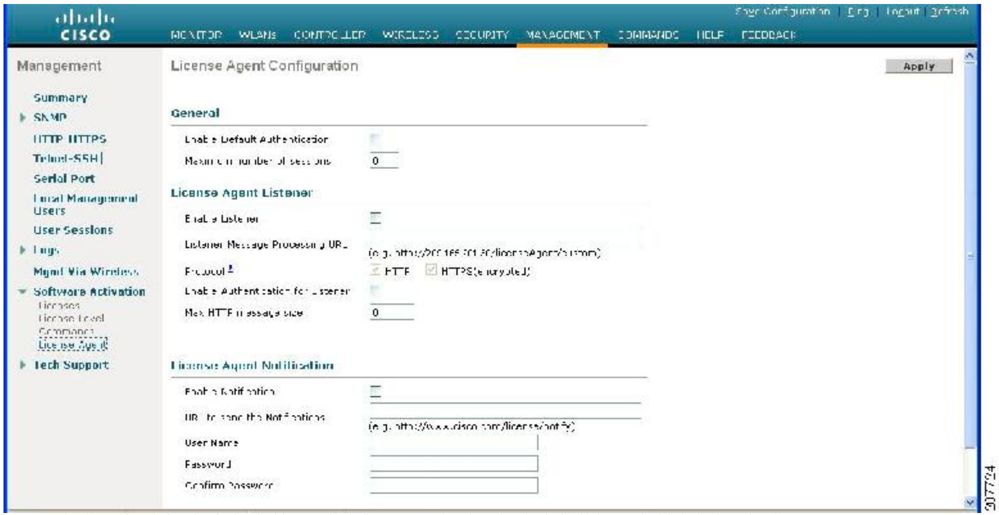
Note You can download the CLM software and access user documentation at this URL:
http://www.cisco.com/go/clm

Using the GUI to Configure the License Agent

To configure the license agent on the controller using the controller GUI, follow these steps:

Step 1 Choose **Management** > **Software Activation** > **License Agent** to open the License Agent Configuration page (see Figure 4-12).

Figure 4-12 License Agent Configuration Page



License Agent Configuration

General

Enable Default Authentication □

Maximum number of sessions 0

License Agent Listener

Enable Listener □

Listener Message Processing URL (e.g. http://209.165.201.30/licenseAgent/custom)

Protocol ☑ HTTP ☑ HTTPS(encrypted)

Enable Authentication for Listener □

Max HTTP message size 0

License Agent Notification

Enable Notification □

URL to send the Notifications (e.g. http://www.cisco.com/license/notify)

User Name

Password

Confirm Password

Step 2 Select the **Enable Default Authentication** check box to enable the license agent, or leave it unselected to disable this feature. The default value is unselected.

Step 3 In the Maximum Number of Sessions text box, enter the maximum number of sessions for the license agent. The valid range is 1 to 25 sessions (inclusive).

Step 4 Configure the license agent to listen for requests from the CLM as follows:

a. Select the **Enable Listener** check box to enable the license agent to receive license requests from the CLM, or unselect this check box to disable this feature. The default value is unselected.

b. In the Listener Message Processing URL text box, enter the URL where the license agent receives license requests (for example, http://209.165.201.30/licenseAgent/custom). The Protocol parameter indicates whether the URL requires HTTP or HTTPS.

Note You can specify the protocol to use on the HTTP Configuration page. See the "Enabling Web and Secure Web Modes" section for more information.

c. Select the **Enable Authentication for Listener** check box to enable authentication for the license agent when it is receiving license requests, or unselect this check box to disable this feature. The default value is unselected.

d. In the Max HTTP Message Size text box, enter the maximum size for license requests. The valid range is 0 to 9999 bytes, and the default value is 0.

Step 5 Configure the license agent to send license notifications to the CLM as follows:

a. Select the **Enable Notification** check box to enable the license agent to send license notifications to the CLM, or unselect this check box to disable this feature. The default value is unselected.

b. In the URL to Send the Notifications text box, enter the URL where the license agent sends the notifications (for example, http://www.cisco.com/license/notify).

c. In the User Name text box, enter the username required in order to view the notification messages at this URL.

d. In the Password and Confirm Password text boxes, enter the password required in order to view the notification messages at this URL.

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

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

Using the CLI to Configure the License Agent

To configure the license agent on the controller using the controller CLI, follow these steps:

Step 1 Enable the license agent by entering one of these commands:

- **config license agent default authenticate** —Enables the license agent default listener with authentication.
- **config license agent default authenticate none** —Enables the license agent default listener without authentication.

Note To disable the license agent default listener, enter the **config license agent default disable command. The** default value is disabled.

Step 2 Specify the maximum number of sessions for the license agent by entering this command:

config license agent max-sessions *sessions*

The valid range for the *sessions* parameter is 1 to 25 (inclusive), and the default value is 9.

Step 3 Enable the license agent to receive license requests from the CLM and to specify the URL where the license agent receives the requests by entering this command:

config license agent listener http { **plaintext** | **encrypt** } *url* **authenticate** [**none**] [**max-message** *size*] [**acl** *acl*]

The valid range for the *size* parameter is 0 to 65535 bytes, and the default value is 0.

Note To prevent the license agent from receiving license requests from the CLM, enter the **config license agent listener http disable command. The** default value is disabled.

Step 4 Configure the license agent to send license notifications to the CLM and to specify the URL where the license agent sends the notifications by entering this command:

config license agent notify *url username password*

Note To prevent the license agent from sending license notifications to the CLM, enter the **config license agent notify disable** *username password command.* **The** default value is disabled.

Step 5 Save your changes by entering this command:

save config

Step 6 See statistics for the license agent's counters or sessions by entering this command:

show license agent {counters | sessions}

Information similar to the following appears for the show license agent counters command:

```
License Agent Counters
Request Messages Received:10: Messages with Errors:1
Request Operations Received:9: Operations with Errors:0
Notification Messages Sent:12: Transmission Errors:0: Soap Errors:0
```

Information similar to the following appears for the show license agent sessions command:

```
License Agent Sessions: 1 open, maximum is 9
```

Note To clear the license agent's counter or session statistics, enter the **clear license agent** {counters | sessions} command.

Configuring 802.11 Bands

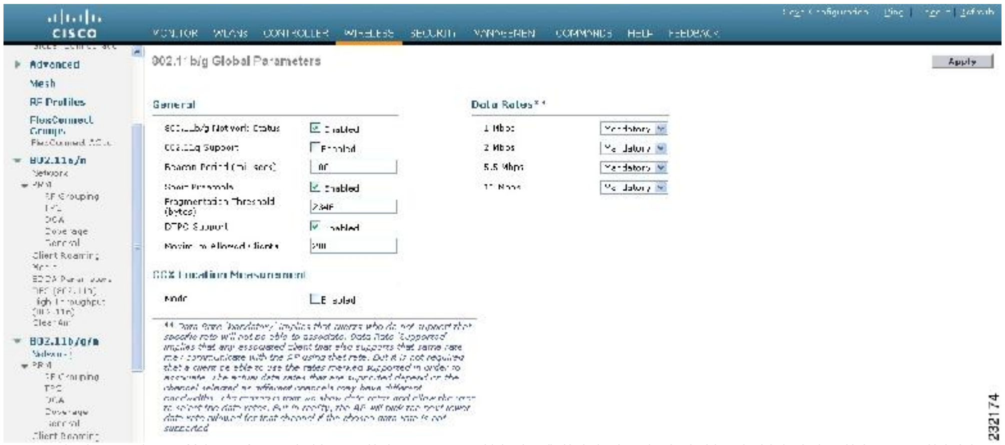
You can configure the 802.11b/g/n (2.4-GHz) and 802.11a/n (5-GHz) bands for the controller to comply with the regulatory requirements in your country. By default, both 802.11b/g/n and 802.11a/n are enabled.

Using the GUI to Configure 802.11 Bands

To configure 802.11 bands using the controller GUI, follow these steps:

Step 1 Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **Network** to open the 802.11a (or 802.11b/g) Global Parameters page (see Figure 4-13).

Figure 4-13 802.11a Global Parameters Page



802.11b/g Global Parameters

General

802.11b/g Network Status ☑ Enabled
802.11g Support ☐ Enabled
Beacon Period (millisecs) 100
Short Preamble ☑ Enabled
Fragmentation Threshold (bytes) 2346
DTPC Support ☑ Enabled
Maximum Allowed Clients 200

CCX Location Measurement

Mode ☐ Enabled

Data Rates**

1 Mbps	Mandatory
2 Mbps	Mandatory
5.5 Mbps	Mandatory
11 Mbps	Mandatory

** Data Rate 'Mandatory' implies that clients who do not support that specific rate will not be able to associate. Data Rate 'Supported' implies that any associated client that also supports that same rate may communicate with the AP using that rate. But it is not required that a client be able to use the rates marked supported in order to associate. The actual data rates that are supported depend on the channel selected as different channels may have different bandwidths. The controller allows you to select the data rates, but in reality, the AP will pick the next lower data rate allowed for that channel if the chosen data rate is not supported

Step 2 Select the **802.11a** (or **802.11b/g**) **Network Status** check box to enable the 802.11a or 802.11b/g band. To disable the band, unselect the check box. The default value is enabled. You can enable both the 802.11a and 802.11b/g bands.

Step 3 If you enabled the 802.11b/g band in Select the 802.11a (or 802.11b/g) Network Status check box to enable the 802.11a or 802.11b/g band. To disable the band, unselect the check box. The default value is enabled. You can enable both the 802.11a and 802.11b/g bands., select the **802.11g Support** check box if you want to enable 802.11g network support. The default value is enabled. If you disable this feature, the 802.11b band is enabled without 802.11g support.

Step 4 Specify the rate at which the SSID is broadcast by the access point by entering a value between 100 and 600 milliseconds (inclusive) in the Beacon Period text box. The default value is 100 milliseconds.

Note The beacon period in Controllers is listed in terms of milliseconds. The beacon period can also be measured in Time Units, where one Time Unit equals 1024 microseconds or 102.4 milliseconds. If a beacon interval is listed as 100 milliseconds in a Controller, it is only a rounded off value for 102.4 milliseconds.

Due to hardware limitation in certain radios, even though the beacon interval is, say 100 Time Units, it is adjusted to 102 Time Units, which roughly equals 104.448 milliseconds. Thus, when the beacon period is to be represented in terms of Time Units, the value is adjusted to the nearest multiple of 17.

Step 5 Specify the size at which packets are fragmented by entering a value between 256 and 2346 bytes (inclusive) in the Fragmentation Threshold text box. Enter a low number for areas where communication is poor or where there is a great deal of radio interference.

Step 6 Make access points advertise their channel and transmit power level in beacons and probe responses. Select the **DTPC Support** check box. Otherwise, unselect this check box. The default value is enabled.

Client devices using dynamic transmit power control (DTPC) receive the channel and power level information from the access points and adjust their settings automatically. For example, a client device used primarily in Japan could rely on DTPC to adjust its channel and power settings automatically when it travels to Italy and joins a network there.

Note On access points that run Cisco IOS software, this feature is called *world mode*.

Note DTPC and 801.11h power constraint cannot be enabled simultaneously.

Step 7 Use the Data Rates options to specify the rates at which data can be transmitted between the access point and the client. These data rates are available:

- 802.11a—6, 9, 12, 18, 24, 36, 48, and 54 Mbps
- 802.11b/g—1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, or 54 Mbps

For each data rate, choose one of these options:

- **Mandatory** —Clients must support this data rate in order to associate to an access point on the controller.
- **Supported** —Any associated clients that support this data rate may communicate with the access point using that rate. However, the clients are not required to be able to use this rate in order to associate.
- **Disabled** —The clients specify the data rates used for communication.

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

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

Using the CLI to Configure 802.11 Bands

To configure 802.11 bands using the controller CLI, follow these steps:

Step 1 Disable the 802.11a band by entering this command:

```
config 802.11a disable network
```

Note The 802.11a band must be disabled before you can configure the 802.11a network parameters in this section.

Step 2 Disable the 802.11b/g band by entering this command:

```
config 802.11b disable network
```

Note The 802.11b band must be disabled before you can configure the 802.11b network parameters in this section.

Step 3 Specify the rate at which the SSID is broadcast by the access point by entering this command:

config {802.11a | 802.11b} **beaconperiod** *time_unit*

where *time_unit* is the beacon interval in time units (TUs). One TU is 1024 microseconds. You can configure the access point to send a beacon every 20 to 1000 milliseconds.

Step 4 Specify the size at which packets are fragmented by entering this command:

config {802.11a | 802.11b} **fragmentation** *threshold*

where *threshold* is a value between 256 and 2346 bytes (inclusive). Specify a low number for areas where communication is poor or where there is a great deal of radio interference.

Step 5 Make access points advertise their channel and transmit power level in beacons and probe responses by entering this command:

```
config {802.11a | 802.11b} dtpc {enable | disable}
```

The default value is enabled. Client devices using dynamic transmit power control (DTPC) receive the channel and power level information from the access points and adjust their settings automatically. For example, a client device used primarily in Japan could rely on DTPC to adjust its channel and power settings automatically when it travels to Italy and joins a network there.

Note On access points that run Cisco IOS software, this feature is called *world mode*.

Step 6 Specify the rates at which data can be transmitted between the controller and the client by entering this command:

config {802.11a | 802.11b} **rate** { **disabled** | **mandatory** | **supported** } *rate*

where

- **disabled** —Clients specify the data rates used for communication.
- **mandatory—C** lients support this data rate in order to associate to an access point on the controller.
- supported **—** Any associated clients that support this data rate may communicate with the access point using that rate. However, the clients are not required to be able to use this rate in order to associate.
- *rate* —The rate at which data is transmitted:
  - 6, 9, 12, 18, 24, 36, 48, and 54 Mbps (802.11a)
  - 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, or 54 Mbps (802.11b/g)

Step 7 Enable the 802.11a band by entering this command:

```
config 802.11a enable network
```

The default value is enabled.

Step 8 Enable the 802.11b band by entering this command:

```
config 802.11b enable network
```

The default value is enabled.

Step 9 Enable or disable 802.11g network support by entering this command:

config 802.11b 11gSupport {enable | disable}

The default value is enabled. You can use this command only if the 802.11b band is enabled. If you disable this feature, the 802.11b band is enabled without 802.11g support.

Step 10 Save your changes by entering this command:

save config

Step 11 View the configuration settings for the 802.11a or 802.11b/g band by entering this command:

show {802.11a | 802.11b}

Information similar to the following appears:

```
802.11a Network............................... Enabled
11nSupport.................................... Enabled
802.11a Low Band........................... Enabled
802.11a Mid Band........................... Enabled
802.11a High Band.......................... Enabled
802.11a Operational Rates
802.11a 6M Rate............................. Mandatory
802.11a 9M Rate............................. Supported
802.11a 12M Rate............................ Mandatory
802.11a 18M Rate............................ Supported
802.11a 24M Rate............................ Mandatory
802.11a 36M Rate............................ Supported
802.11a 48M Rate............................ Supported
802.11a 54M Rate............................ Supported
...
Beacon Interval................................. 100
...
Default Channel............................... 36
Default Tx Power Level........................ 1
DTPC Status................................... Enabled
Fragmentation Threshold....................... 2346
...
```

Configuring 802.11n Parameters

This section provides instructions for managing 802.11n devices such as the Cisco Aironet 1140 and 1250 Series Access Points on your network. The 802.11n devices support the 2.4- and 5-GHz bands and offer high-throughput data rates.

Note The 802.11n high-throughput rates are available only on 1140 and 1250 series access points for WLANs using WMM with no Layer 2 encryption or with WPA2/AES encryption enabled.

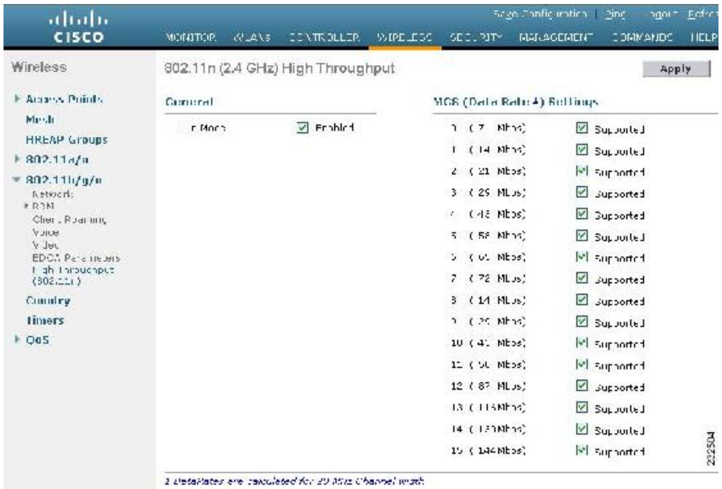
Note For information on configuring radio resource management (RRM) parameters or statically assigning radio parameters for 802.11n access points, see Chapter12, "Configuring Radio Resource ManagementWireless Device Access"

Using the GUI to Configure 802.11n Parameters

To configure 802.11n parameters using the controller GUI, follow these steps:

Step 1 Choose **Wireless** > **802.11a/n** or **802.11b/g/n** > **High Throughput (802.11n)** to open the 802.11n (5 GHz or 2.4 GHz) High Throughput page (see Figure 4-14).

Figure 4-14 802.11n (2.4 GHz) High Throughput Page



802.11n (2.4 GHz) High Throughput

General

11n Mode ☑ Enabled

MCS (Data Rate¹) Settings

0 (7 Mbps) ☑ Supported
1 (14 Mbps) ☑ Supported
2 (21 Mbps) ☑ Supported
3 (29 Mbps) ☑ Supported
4 (43 Mbps) ☑ Supported
5 (58 Mbps) ☑ Supported
6 (65 Mbps) ☑ Supported
7 (72 Mbps) ☑ Supported
8 (14 Mbps) ☑ Supported
9 (29 Mbps) ☑ Supported
10 (43 Mbps) ☑ Supported
11 (58 Mbps) ☑ Supported
12 (87 Mbps) ☑ Supported
13 (116Mbps) ☑ Supported
14 (130Mbps) ☑ Supported
15 (144Mbps) ☑ Supported

1 DataRates are calculated for 20 MHz Channel width

Step 2 Select the **11n Mode** check box to enable 802.11n support on the network. The default value is enabled.

Step 3 Select the check boxes of the desired rates to specify the modulation and coding scheme (MCS) rates at which data can be transmitted between the access point and the client. These data rates, which are calculated for a 20-MHz channel width using a short guard interval, are available:

- 0 (7 Mbps)
- 1 (14 Mbps)
- 2 (21 Mbps)
- 3 (29 Mbps)
- 4 (43 Mbps)
- 5 (58 Mbps)
- 6 (65 Mbps)
- 7 (72 Mbps)
- 8 (14 Mbps)
- 9 (29 Mbps)
- 10 (43 Mbps)
- 11 (58 Mbps)
- 12 (87 Mbps)
- 13 (116 Mbps)
- 14 (130 Mbps)
- 15 (144 Mbps)

Any associated clients that support the selected rates may communicate with the access point using those rates. However, the clients are not required to be able to use this rate in order to associate. The MCS settings determine the number of spatial streams, the modulation, the coding rate, and the data rate values that are used.

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

Step 5 Use the 802.11n data rates that you configured by enabling WMM on the WLAN as follows:

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

b. Click the ID number of the WLAN for which you want to configure WMM mode.

c. When the WLANs > Edit page appears, choose the **QoS** tab to open the WLANs > Edit (Qos) page.

d. From the WMM Policy drop-down list, choose **Required** or **Allowed** to require or allow client devices to use WMM. Devices that do not support WMM cannot join the WLAN.

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

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

Note To determine if an access point supports 802.11n, look at the 11n Supported text box on either the 802.11a/n (or 802.11b/g/n) Cisco APs > Configure page or the 802.11a/n (or 802.11b/g/n) AP Interfaces > Details page.

Using the CLI to Configure 802.11n Parameters

To configure 802.11n parameters using the controller CLI, follow these steps:

Step 1 Enable 802.11n support on the network by entering this command:

config { **802.11a** | **802.11b** } **11nsupport** { **enable** | **disable** }

Step 2 Specify the modulation and coding scheme (MCS) rates at which data can be transmitted between the access point and the client by entering this command:

config { **802.11a** | **802.11b** } **11nsupport mcs tx** { **0-15** } { **enable** | **disable** }

See the descriptions of the 0 through 15 MCS data rates in the "Using the GUI to Configure 802.11n Parameters" section.

Step 3 Use the 802.11n data rates that you configured by enabling WMM on the WLAN as follows:

config wlan wmm required wlan_id

The required parameter requires client devices to use WMM. Devices that do not support WMM cannot join the WLAN.

Step 4 Specify the aggregation method used for 802.11n packets as follows:

a. Disable the network by entering this command:

config { **802.11a** | **802.11b** } **disable network**

b. Specify the aggregation method entering this command:

config { **802.11a** | **802.11b** } **11nsupport a-mpdu tx priority {0-7 | all} {enable** | **disable** }

Aggregation is the process of grouping packet data frames together rather than transmitting them separately. Two aggregation methods are available: Aggregated MAC Protocol Data Unit (A-MPDU) and Aggregated MAC Service Data Unit (A-MSDU). Both A-MPDU and A-MSDU are performed in the software.

You can specify the aggregation method for various types of traffic from the access point to the clients. Table 4-2 defines the priority levels (0-7) assigned per traffic type.

Table 4-2 Traffic Type Priority Levels

User Priority	Traffic Type
0	Best effort
1	Background
2	Spare
3	Excellent effort
4	Controlled load
5	Video, less than 100-ms latency and jitter
6	Voice, less than 10-ms latency and jitter
7	Network control

You can configure each priority level independently, or you can use the **all** parameter to configure all of the priority levels at once. When you use the **enable** command, the traffic associated with that priority level uses A-MPDU transmission. When you use the **disable** command, the traffic associated with that priority level uses A-MSDU transmission. Configure the priority levels to match the aggregation method used by the clients. By default, A-MPDU is enabled for priority level 0, 4 and 5 and the rest are disabled.

c. R **eenable the network by entering this command:**

config {802.11a | 802.11b} enable network

Step 5 Save your changes by entering this command:

save config

Step 6 View the configuration settings for the 802.11a/n or 802.11b/g/n band by entering this command:

show {802.11a | 802.11b}

Information similar to the following appears:

```
802.11a Network............................... Enabled
11nSupport.................................... Enabled
802.11a Low Band........................... Enabled
802.11a Mid Band........................... Enabled
802.11a High Band.......................... Enabled
802.11a Operational Rates
802.11a 6M Rate.............................. Mandatory
802.11a 9M Rate.............................. Supported
802.11a 12M Rate............................. Mandatory
802.11a 18M Rate............................. Supported
802.11a 24M Rate............................. Mandatory
802.11a 36M Rate............................. Supported
802.11a 48M Rate............................. Supported
802.11a 54M Rate............................. Supported
802.11n MCS Settings:
MCS 0........................................ Supported
MCS 1...................................... Supported
MCS 2...................................... Supported
MCS 3...................................... Supported
MCS 4...................................... Supported
MCS 5...................................... Supported
MCS 6...................................... Supported
MCS 7...................................... Supported
MCS 8...................................... Supported
MCS 9...................................... Supported
MCS 10..................................... Supported
MCS 11..................................... Supported
MCS 12..................................... Supported
MCS 13..................................... Supported
MCS 14..................................... Supported
MCS 15........................................ Supported
802.11n Status:
A-MPDU Tx .................................. Enabled
Priority 0............................... Enabled
Priority 1............................... Disabled
Priority 2............................... Disabled
Priority 3............................... Disabled
Priority 4............................... Enabled
Priority 5............................... Enabled
Priority 6............................... Disabled
Priority 7............................... Disabled

A-MSDU Tx .................................. Enabled
Rifs Tx ..................................... Enabled
Guard Interval ............................. Short
Beacon Interval................................ 100
CF Pollable mandatory.......................... Disabled
CF Poll Request mandatory...................... Disabled
CFP Period......................................... 4
CFP Maximum Duration............................. 60
Default Channel.................................. 36
Default Tx Power Level........................... 1
DTPC Status...................................Enabled
Fragmentation Threshold....................... 2346
Long Retry Limit.................................. 4
Maximum Rx Life Time........................... 512
Max Tx MSDU Life Time............................ 512
Medium Occupancy Limit........................... 100
RTS Threshold.................................... 2347
Short Retry Limit................................ 7
TI Threshold..................................... -50
Traffic Stream Metrics Status.................... Enabled
Expedited BW Request Status...................... Disabled
EDCA profile type................................ default-wmm
Voice MAC optimization status.................... Disabled
Call Admission Control (CAC) configuration
Voice AC - Admission control (ACM)............ Enabled
Voice max RF bandwidth........................ 75
Voice reserved roaming bandwidth............. 6
Voice load-based CAC mode.................... Disabled
Voice tspec inactivity timeout............... Disabled
Video AC - Admission control (ACM)........... Enabled
Voice Stream-Size............................ 84000
Voice Max-Streams............................ 2
Video max RF bandwidth....................... Infinite
Video reserved roaming bandwidth........... 0
```

Configuring 802.11h Parameters

802.11h informs client devices about channel changes and can limit the transmit power of those client devices. You can configure the 802.11h parameters using the controller GUI or CLI.

Using the GUI to Configure 802.11h Parameters

To configure 802.11h parameters using the controller GUI, follow these steps:

Step 1 Disable the 802.11a band as follows:

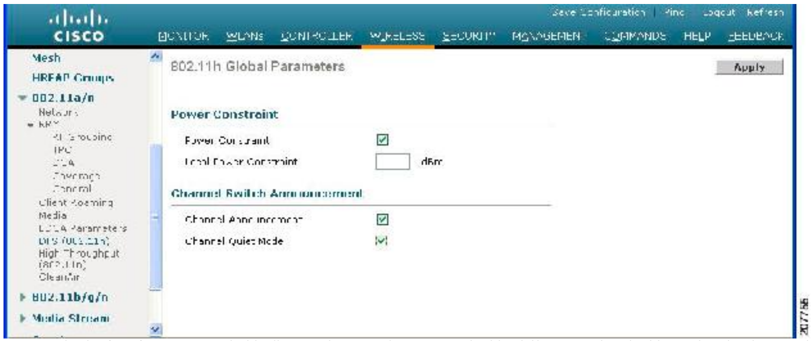
a. Choose **Wireless** > **802.11a/n** > **Network** to open the 802.11a Global Parameters page.

b. Unselect the **802.11a Network Status** check box.

c. Click **Apply** to commit your change.

Step 2 Choose **Wireless** > **802.11a/n** > **DFS (802.11h)** to open the 802.11h Global Parameters page (see Figure 4-15).

Figure 4-15 802.11h Global Parameters Page



802.11h Global Parameters

Power Constraint

Power Constraint ☑

Local Power Constraint ☐ dBm

Channel Switch Announcement

Channel Announcement ☑

Channel Quiet Mode ☑

Step 3 Select the **Channel Announcement** check box if you want the access point to announce when it is switching to a new channel and the new channel number, or unselect this check box to disable the channel announcement. The default value is disabled.

Step 4 If you enabled the channel announcement in Select the Channel Announcement check box if you want the access point to announce when it is switching to a new channel and the new channel number, or unselect this check box to disable the channel announcement. The default value is disabled., the Channel Quiet Mode check box appears. Select this check box if you want the access point to stop transmitting on the current channel, or unselect this check box to disable quiet mode. The default value is disabled.

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

Step 6 Reenable the 802.11a band as follows:

a. Choose **Wireless** > **802.11a/n** > **Network** to open the 802.11a Global Parameters page.

b. Select the **802.11a Network Status** check box.

c. Click **Apply** to commit your change.

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

Using the CLI to Configure 802.11h Parameters

To configure 802.11h parameters using the controller CLI, follow these steps:

Step 1 Disable the 802.11a network by entering this command:

config 802.11a disable network

Step 2 Enable or disable the access point to announce when it is switching to a new channel and the new channel number by entering this command:

config 802.11h channelswitch { **enable** | **disable** } *switch_mode*

You can enter a 0 or 1 for the *switch_mode parameter to* specify whether transmissions are restricted until the actual channel switch (0) or are not restricted (1). The default value is disabled.

Step 3 Configure a new channel using the 802.11h channel announcement by entering this command:

config 802.11h setchannel channel *channel*

Step 4 Configure the 802.11h power constraint value by entering this command:

config 802.11h powerconstraint *value*

The default value for the *value* parameter is 3 dB.

Step 5 Reenable the 802.11a network by entering this command:

config 802.11a enable network

Step 6 See the status of 802.11h parameters by entering this command:

show 802.11h

Information similar to the following appears:

```
Power Constraint................................ 0
Channel Switch.................................. Disabled
Channel Switch Mode............................. 0
```

Configuring DHCP Proxy

When DHCP proxy is enabled on the controller, the controller unicasts DHCP requests from the client to the configured servers. Consequently, at least one DHCP server must be configured on either the interface associated with the WLAN or the WLAN itself.

When DHCP proxy is disabled on the controller, those DHCP packets transmitted to and from the clients are bridged by the controller without any modification to the IP portion of the packet. Packets received from the client are removed from the CAPWAP tunnel and transmitted on the upstream VLAN. DHCP packets directed to the client are received on the upstream VLAN, converted to 802.11, and transmitted through a CAPWAP tunnel toward the client. As a result, the internal DHCP server cannot be used when DHCP proxy is disabled. The ability to disable DHCP proxy allows organizations to use DHCP servers that do not support Cisco's native proxy mode of operation. It should be disabled only when required by the existing infrastructure.

You can use the controller GUI or CLI to enable or disable DHCP proxy on a global basis, rather than on a WLAN basis. DHCP proxy is enabled by default.

Note DHCP proxy must be enabled in order for DHCP option 82 to operate correctly. See the "Configuring DHCP Option 82" section for information on DHCP option 82.

Note All controllers that will communicate must have the same DHCP proxy setting.

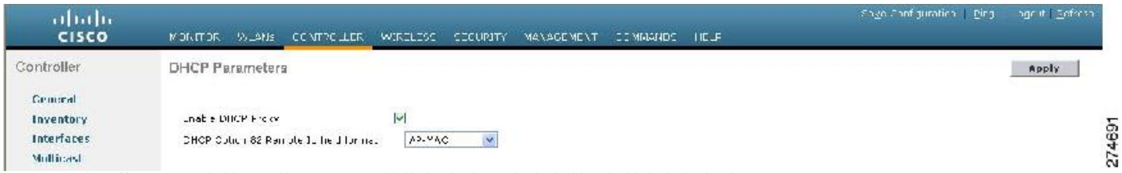
Note See "Configuring WLANs," for information on configuring DHCP servers.

Using the GUI to Configure DHCP Proxy

To configure DHCP proxy using the controller GUI, follow these steps:

Step 1 Choose **Controller** > **Advanced** > **DHCP** to open the DHCP Parameters page (see Figure 4-16).

Figure 4-16 DHCP Parameters Page



Enable DHCP Proxy ☑

DHCP Option 82 Remote Id field format AP-MAC

Step 2 Select the **Enable DHCP Proxy** check box to enable DHCP proxy on a global basis. Otherwise, unselect the check box. The default value is selected.

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

Step 4 Click **Save Configuratio** n to save your changes.

Using the CLI to Configure DHCP Proxy

To configure DHCP proxy using the controller CLI, follow these steps:

Step 1 Enable or disable DHCP proxy by entering this command:

config dhcp proxy { **enable** | **disable** }

Step 2 View the DHCP proxy configuration by entering this command:

show dhcp proxy

Information similar to the following appears:

```
DHCP Proxy Behavior: enabled
```

Configuring Administrator Usernames and Passwords

You can configure administrator usernames and passwords to prevent unauthorized users from reconfiguring the controller and viewing configuration information. This section provides instructions for initial configuration and for password recovery.

Configuring Usernames and Passwords

To configure administrator usernames and passwords using the controller CLI, follow these steps:

Step 1 Configure a username and password by entering one of these commands:

- config mgmtuser add username password read-write—Creates a username-password pair with read-write privileges.
- config mgmtuser add username password read-only—Creates a username-password pair with read-only privileges.

Usernames and passwords are case-sensitive and can contain up to 24 ASCII characters. Usernames and passwords cannot contain spaces.

Note If you ever need to change the password for an existing username, enter the config mgmtuser password username new_password command.

Step 2 List the configured users by entering this command:

show mgmtuser

Restoring Passwords

To configure a new username and password at boot-up using the controller CLI, follow these steps:

Step 1 After the controller boots up, enter **Restore-Password** at the User prompt.

Note For security reasons, the text that you enter does not appear on the controller console.

Step 2 At the Enter User Name prompt, enter a new username.

Step 3 At the Enter Password prompt, enter a new password.

Step 4 At the Re-enter Password prompt, reenter the new password. The controller validates and stores your entries in the database.

Step 5 When the User prompt reappears, enter your new username.

Step 6 When the Password prompt appears, enter your new password. The controller logs you in with your new username and password.

Configuring SNMP

To configure SNMP using the controller CLI, follow these steps:

Step 1 Enter the config snmp community create name command to create an SNMP community name.

Step 2 Enter the config snmp community delete name command to delete an SNMP community name.

Step 3 Enter the config snmp community accessmode ro name command to configure an SNMP community name with read-only privileges. Enter config snmp community accessmode rw name to configure an SNMP community name with read-write privileges.

Step 4 Enter the config snmp community ipaddr ip-address ip-mask name command to configure an IP address and subnet mask for an SNMP community.

Note This command behaves like an SNMP access list. It specifies the IP address from which the device accepts SNMP packets with the associated community. The requesting entity's IP address is ANDed with the subnet mask before being compared to the IP address. If the subnet mask is set to 0.0.0.0, an IP address of 0.0.0.0 matches to all IP addresses. The default value is 0.0.0.0.

Note The controller can use only one IP address range to manage an SNMP community.

Step 5 Enter the config snmp community mode enable command to enable a community name. Enter the config snmp community mode disable command to disable a community name.

Step 6 Enter the config snmp trapreceiver create name ip-address command to configure a destination for a trap.

Step 7 Enter the config snmp trapreceiver delete name command to delete a trap.

Step 8 Enter the config snmp trapreceiver ipaddr old-ip-address name new-ip-address command to change the destination for a trap.

Step 9 Enter the config snmp trapreceiver mode enable command to enable traps. Enter the config snmp trapreceiver mode disable command to disable traps.

Step 10 Enter config snmp syscontact syscontact-name to configure the name of the SNMP contact. Enter up to 31 alphanumeric characters for the contact name.

Step 11 Enter the config snmp syslocation syslocation-name command to configure the SNMP system location. Enter up to 31 alphanumeric characters for the location.

Step 12 Use the show snmpcommunity and the show snmptrap commands to verify that the SNMP traps and communities are correctly configured.

Step 13 Use the show trapflags command to see the enabled and disabled trapflags. If necessary, use the config trapflags command to enable or disable trapflags.

Changing the Default Values of SNMP Community Strings

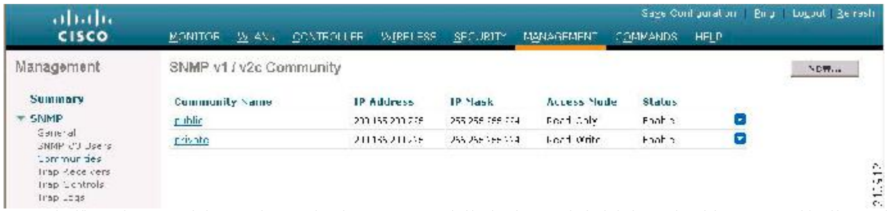
The controller has commonly known default values of "public" and "private" for the read-only and read-write SNMP community strings. Using these standard values presents a security risk. If you use the default community names, and since these are known, the community names could be used to communicate to the controller using the SNMP protocol. Therefore, Cisco strongly advises that you change these values.

Using the GUI to Change the SNMP Community String Default Values

To change the SNMP community string default values using the controller GUI, follow these steps:

Step 1 Choose Management and then Communities under SNMP. The SNMP v1 / v2c Community page appears (see Figure 4-17).

Figure 4-17 SNMP v1 / v2c Community Page



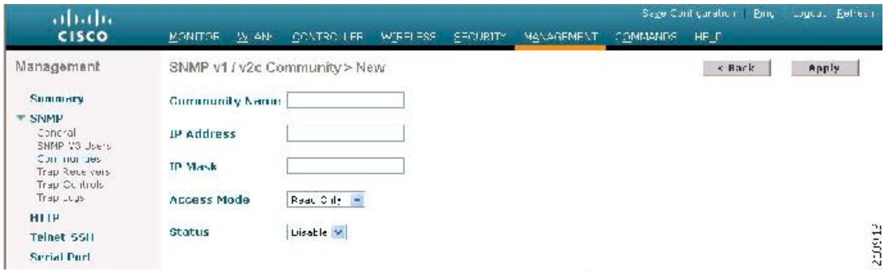
SNMP v1 / v2c Community

Community Name	IP Address	IP Mask	Access Mode	Status
public	209.165.200.225	255.255.255.224	Read Only	Enable
private	209.165.200.225	255.255.255.224	Read Write	Enable

Step 2 If "public" or "private" appears in the Community Name column, hover your cursor over the blue drop-down arrow for the desired community and choose Remove to delete this community.

Step 3 Click New to create a new community. The SNMP v1 / v2c Community > New page appears (see Figure 4-18).

Figure 4-18 SNMP v1 / v2c Community > New Page



SNMP v1 / v2c Community > New

Community Name:

IP Address

IP Mask

Access Mode Read Only

Status Disable

Step 4 In the Community Name text box, enter a unique name containing up to 16 alphanumeric characters. Do not enter "public" or "private."

Step 5 In the next two text boxes, enter the IP address from which this device accepts SNMP packets with the associated community and the IP mask.

Step 6 Choose Read Only or Read/Write from the Access Mode drop-down list to specify the access level for this community.

Step 7 Choose Enable or Disable from the Status drop-down list to specify the status of this community.

Step 8 Click Apply to commit your changes.

Step 9 Click Save Configuration to save your settings.

Step 10 Repeat this procedure if a "public" or "private" community still appears on the SNMP v1 / v2c Community page.

Using the CLI to Change the SNMP Community String Default Values

To change the SNMP community string default values using the controller CLI, follow these steps:

Step 1 See the current list of SNMP communities for this controller by entering this command:

show snmp community

Step 2 If "public" or "private" appears in the SNMP Community Name column, enter this command to delete this community:

config snmp community delete name

The name parameter is the community name (in this case, "public" or "private").

Step 3 Create a new community by entering this command:

config snmp community create name

Enter up to 16 alphanumeric characters for the name parameter. Do not enter "public" or "private."

Step 4 Enter the IP address from which this device accepts SNMP packets with the associated community by entering this command:

config snmp community **ipaddr** *ip_address ip_mask name*

Step 5 Specify the access level for this community by entering this command, where ro is read-only mode and rw is read/write mode:

config snmp community accessmode { **ro** | **rw** } *name*

Step 6 Enable or disable this SNMP community by entering this command:

config snmp community mode { **enable** | **disable** } *name*

Step 7 Save your changes by entering save config.

Step 8 Repeat this procedure if you still need to change the default values for a "public" or "private" community string.

Changing the Default Values for SNMP v3 Users

The controller uses a default value of "default" for the username, authentication password, and privacy password for SNMP v3 users. Using these standard values presents a security risk. Therefore, Cisco strongly advises that you change these values.

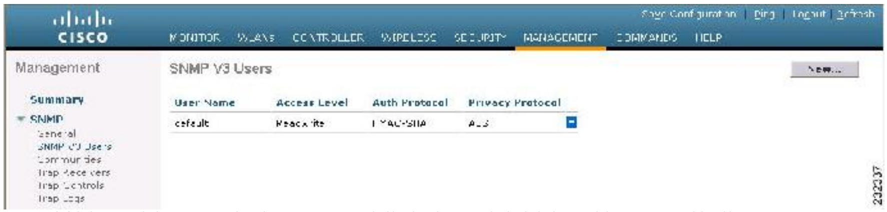
Note SNMP v3 is time sensitive. Make sure that you have configured the correct time and time zone on your controller.

Using the GUI to Change the SNMP v3 User Default Values

To change the SNMP v3 user default values using the controller GUI, follow these steps:

Step 1 Choose Management > **SNMP** > SNMP V3 Users to open the SNMP V3 Users page (see Figure 4-19).

Figure 4-19 SNMP V3 Users Page



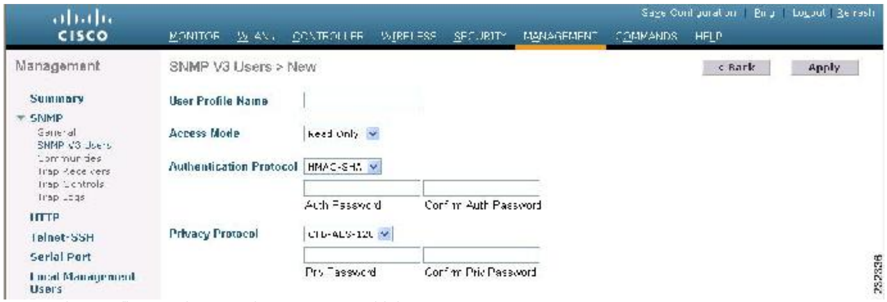
SNMP V3 Users

User Name	Access Level	Auth Protocol	Privacy Protocol
default	ReadWrite	HMAC-SHA	AES

Step 2 If "default" appears in the User Name column, hover your cursor over the blue drop-down arrow for the desired user and choose Remove to delete this SNMP v3 user.

Step 3 Click New to add a new SNMP v3 user. The SNMP V3 Users > New page appears (see Figure 4-20).

Figure 4-20 SNMP V3 Users > New Page



SNMP V3 Users > New

User Profile Name

Access Mode: Read Only

Authentication Protocol: HMAC-SHA

Auth Password / Confirm Auth Password

Privacy Protocol: CFB-AES-128

Priv Password / Confirm Priv Password

Step 4 In the User Profile Name text box, enter a unique name. Do not enter “default.”

Step 5 Choose Read Only or Read Write from the Access Mode drop-down list to specify the access level for this user. The default value is Read Only.

Step 6 From the Authentication Protocol drop-down list, choose the desired authentication method: **None** , **HMAC-MD5** (Hashed Message Authentication Coding-Message Digest 5), or **HMAC-SHA** (Hashed Message Authentication Coding-Secure Hashing Algorithm). The default value is HMAC-SHA.

Step 7 In the Auth Password and Confirm Auth Password text boxes, enter the shared secret key to be used for authentication. You must enter at least 12 characters.

Step 8 From the Privacy Protocol drop-down list, choose the desired encryption method: **None** , **CBC-DES** (Cipher Block Chaining-Digital Encryption Standard), or **CFB-AES-128** (Cipher Feedback Mode-Advanced Encryption Standard-128). The default value is CFB-AES-128.

Note In order to configure CBC-DES or CFB-AES-128 encryption, you must have selected either HMAC-MD5 or HMAC-SHA as the authentication protocol in From the Authentication Protocol drop-down list, choose the desired authentication method: None, HMAC-MD5 (Hashed Message Authentication Coding-Message Digest 5), or HMAC-SHA (Hashed Message Authentication Coding-Secure Hashing Algorithm). The default value is HMAC-SHA..

Step 9 In the Priv Password and Confirm Priv Password text boxes, enter the shared secret key to be used for encryption. You must enter at least 12 characters.

Step 10 Click Apply to commit your changes.

Step 11 Click Save Configuration to save your settings.

Step 12 Reboot the controller so that the SNMP v3 user that you added takes effect.

Using the CLI to Change the SNMP v3 User Default Values

To change the SNMP v3 user default values using the controller CLI, follow these steps:

Step 1 See the current list of SNMP v3 users for this controller by entering this command:

show snmpv3user

Step 2 If “default” appears in the SNMP v3 User Name column, enter this command to delete this user:

config snmp v3user delete *username*

The username parameter is the SNMP v3 username (in this case, “default”).

Step 3 Create a new SNMP v3 user by entering this command:

config snmp v3user create *username* { **ro** | **rw** } { **none** | **hmacmd5** | **hmacsha** } { **none** | **des | aescfb128** } *auth_key encrypt_key*

where

- username is the SNMP v3 username.
- ro is read-only mode and rw is read-write mode.
- **none** , **hmacmd5** , and **hmacsha** are the authentication protocol options.
- none, des, and **aescfb128** are the privacy protocol options.
- *auth_key is the authentication shared secret key.*
- *encrypt_key is the encryption shared secret key.*

Do not enter “default” for the username, auth_key, and encrypt_key parameters.

Step 4 Save your changes by entering the save config command.

Step 5 Reboot the controller so that the SNMP v3 user that you added takes effect by entering **reset sy**`stem` command.

Configuring Aggressive Load Balancing

Enabling aggressive load balancing on the controller allows lightweight access points to load balance wireless clients across access points. You can enable aggressive load balancing using the controller GUI or CLI.

Note Clients are load balanced between access points on the same controller. Load balancing does not occur between access points on different controllers.

When a wireless client attempts to associate to a lightweight access point, association response packets are sent to the client with an 802.11 response packet including status code 17. This code indicates whether the access point can accept any more associations. If the access point is too busy, the client attempts to associate to a different access point in the area. The system determines if an access point is relatively more busy than its neighbor access points that are also accessible to the client.

For example, if the number of clients on AP1 is more than the number of clients on AP2 plus the load-balancing window, then AP1 is considered to be busier than AP2. When a client attempts to associate to AP1, it receives an 802.11 response packet with status code 17, indicating that the access point is busy, and the client attempts to associate to a different access point.

You can configure the controller to deny client associations up to 10 times (if a client attempted to associate 11 times, it would be allowed to associate on the 11th try). You can also enable or disable load balancing on a particular WLAN, which is useful if you want to disable load balancing for a select group of clients (such as time-sensitive voice clients).

Client Association Limits

The maximum number of client associations that the access points can support is dependent upon the following factors:

- The maximum number of client associations differs for lightweight and Autonmous IOS access points.
- There may be a limit per radio, and an overall limit per AP.
- AP hardware (the 16-MB APs have a lower limit than the 32-MB and higher APs).

Client Association Limits for Lightweight Access Points

Per AP Limits

- For 16-MB APs, the limit is 128 clients per AP. This is applicable to 1100 and 1200 series APs.
- For 32-MB and higher APs, there is no per-AP limit.

Per-radio limits

- For all IOS APs, the limit is 200 associations per radio
- For all 1000 and 1500 series APs, which are not supported beyond the 4.2 release, the limit is 250 associations per radio.

Thus, with 32-MB and higher lightweight IOS APs, with two radios, up to 200+200=400 associations are supported.

Client Association Limits for Autonomous IOS Access Points

Per-AP limits

Practically, the limit is around 80 to 127 clients per AP. This varies depending on the following factors:

- AP model (whether it is 16 MB or 32 MB or higher).
- IOS version.
- Hardware configuration (two radios use more memory than one).
- Enabled features (WDS functionality in particular).

Per-radio limits

The practical per-radio limit is about 200 associations. One will likely hit the per-AP limit first.

Per-SSID limits

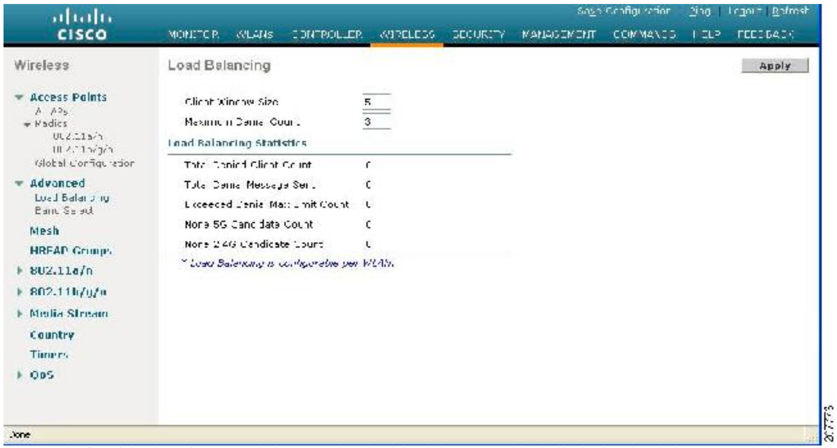
Unlike Cisco Unified Wireless Network, Autonomous IOS supports per-SSID/per-AP association limits. This is configured using the max-associations CLI, under dot11 SSID. The maximum and default is 255 associations.

Using the GUI to Configure Aggressive Load Balancing

To configure aggressive load balancing using the controller GUI, follow these steps:

Step 1 Choose Wireless > Advanced > **Load Balancing** to open the Load Balancing page (see Figure 4-21).

Figure 4-21 Wireless > Advanced > Load Balancing Page



Load Balancing

Client Window Size	5
Maximum Denial Count	3

Load Balancing Statistics

Total Denied Client Count	0
Total Denial Message Sent	0
Exceeded Denial Max Limit Count	0
None 5G Candidate Count	0
None 2.4G Candidate Count	0

* Load Balancing is configurable per WLAN.

Step 2 In the Client Window Size text box, enter a value between 1 and 20. The window size becomes part of the algorithm that determines whether an access point is too heavily loaded to accept more client associations:

load-balancing window + client associations on AP with the lightest load = load-balancing threshold

In the group of access points accessible to a client device, each access point has a different number of client associations. The access point with the lowest number of clients has the lightest load. The client window size plus the number of clients on the access point with the lightest load forms the threshold. Access points with more client associations than this threshold is considered busy, and clients can associate only to access points with client counts lower than the threshold.

Step 3 In the Maximum Denial Count text box, enter a value between 0 and 10. The denial count sets the maximum number of association denials during load balancing.

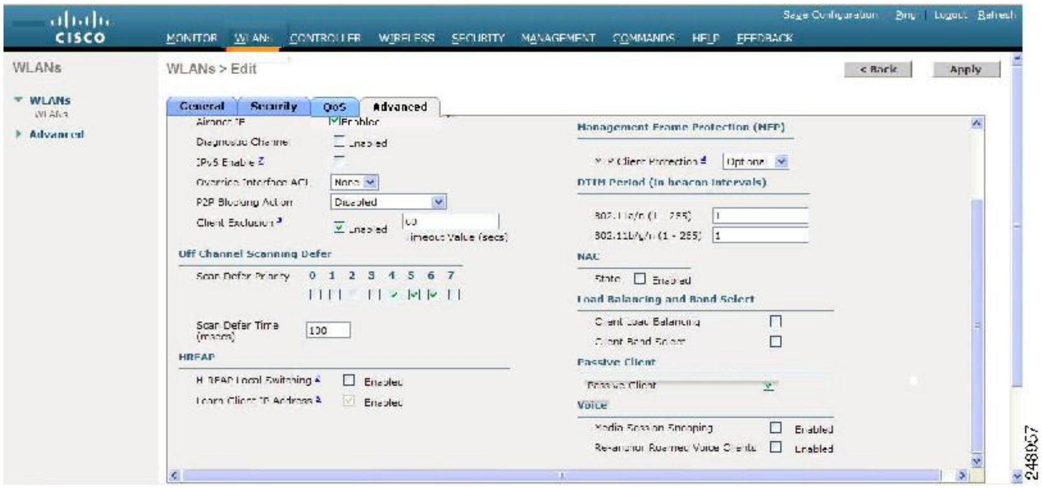
Step 4 Click **Apply** to commit your changes.

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

Step 6 To enable or disable aggressive load balancing on specific WLANs, choose WLANs > WLAN ID. The WLANs > Edit page appears.

Step 7 Click the Advanced tab (see Figure 4-22).

Figure 4-22 WLANs > Advanced Page


CISCO
Save Configuration | Ping | Logout | Refresh
MONITOR WLANs CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP FEEDBACK
WLANs
WLANs
WLANs
Advanced
< Back
Apply
General
Security
QoS
Advanced
248957

WLANs > Edit

Aironet IE ☑ Enabled
Diagnostic Channel □ Enabled
IPv6 Enable
Override Interface ACL None
P2P Blocking Action Disabled
Client Exclusion ☑ Enabled 60 Timeout Value (secs)

Off Channel Scanning Defer

Scan Defer Priority 0 1 2 3 4 5 6 7

Scan Defer Time (msecs) 100

HREAP

H-REAP Local Switching □ Enabled
Learn Client IP Address ☑ Enabled

Management Frame Protection (MFP)

MFP Client Protection Optional

DTIM Period (in beacon intervals)

802.11a/n (1 - 255) 1
802.11b/g/n (1 - 255) 1

NAC

State □ Enabled

Load Balancing and Band Select

Client Load Balancing □
Client Band Select □

Passive Client

Passive Client

Voice

Media Session Snooping □ Enabled
Re-anchor Roamed Voice Clients □ Enabled

Step 8 Click Apply to commit your changes.

Step 9 Click Save Configuration to save your settings

Using the CLI to Configure Aggressive Load Balancing

To configure aggressive load balancing using the controller CLI, follow these steps:

Step 1 Set the client window for aggressive load balancing by entering this command:

config load-balancing window *client_count*

You can enter a value between 0 and 20 for the *client_count* parameter.

Step 2 Set the denial count for load balancing by entering this command:

config load-balancing denial denial_count

You can enter a value between 1 and 10 for the denial_count parameter.

Step 3 Save your changes by entering this command:

save config

Step 4 Enable or disable aggressive load balancing on specific WLANs by entering this command:

config wlan load-balance allow {enable | disable} wlan_ID

You can enter a value between 1 and 512 for wlan_ID parameter.

Step 5 Verify your settings by entering this command:

show load-balancing

Information similar to the following appears:

```
Aggressive Load Balancing........................ Enabled
Aggressive Load Balancing Window................. 1 clients
Aggressive Load Balancing Denial Count........... 3

Statistics
Total Denied Count............................... 5 clients
Total Denial Sent................................ 10 messages
Exceeded Denial Max Limit Count.................. 0 times
None 5G Candidate Count.......................... 0 times
None 2.4G Candidate Count........................ 0 times
```

Step 6 Save your changes by entering this command:

save config

Configuring Band Selection

Band selection enables client radios that are capable of dual-band (2.4- and 5-GHz) operation to move to a less congested 5-GHz access point. The 2.4-GHz band is often congested. Clients on this band typically experience interference from Bluetooth devices, microwave ovens, and cordless phones as well as co-channel interference from other access points because of the 802.11b/g limit of three nonoverlapping channels. To combat these sources of interference and improve overall network performance, you can configure band selection on the controller.

Band selection works by regulating probe responses to clients. It makes 5-GHz channels more attractive to clients by delaying probe responses to clients on 2.4-GHz channels.

Band selection is enabled globally by default.

Note Band-selection enabled WLANs do not support time-sensitive applications like voice and video because of roaming delays.

Guidelines for Using the Band Selection

Follow these guidelines when using band selection:

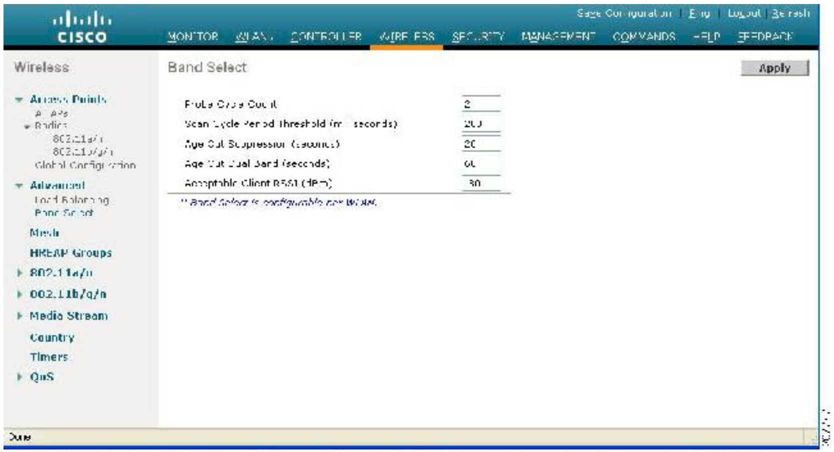
- Band selection can be used only with Cisco Aironet 1140 and 1250, 1260, and 3500 Series access points.
- Band selection operates only on access points that are connected to a controller. A hybrid-REAP access point without a controller connection does not perform band selection after a reboot.
- The band-selection algorithm directs dual-band clients only from the 2.4-GHz radio to the 5-GHz radio of the same access point, and it only runs on an access point when both the 2.4-GHz and 5-GHz radios are up and running.
- You can enable both band selection and aggressive load balancing on the controller. They run independently and do not impact one another.

Using the GUI to Configure Band Selection

To configure band selection using the controller GUI, follow these steps:

Step 1 Choose Wireless > Advanced > **Band Select** to open the Band Select page (see Figure 4-23).

Figure 4-23 Wireless > Advanced > Band Select Page



Band Select

Probe Cycle Count 2
Scan Cycle Period Threshold (milliseconds) 200
Age Out Suppression (seconds) 20
Age Out Dual Band (seconds) 60
Acceptable Client RSSI (dBm) -80

* Band Select is configurable per WLAN.

Step 2 In the Probe Cycle Count text box, enter a value between 1 and 10. The cycle count sets the number of suppression cycles for a new client. The default cycle count is 2.

Step 3 In the Scan Cycle Period Threshold (milliseconds) text box, enter a value between 1 and 1000 milliseconds for the scan cycle period threshold. This setting determines the time threshold during which new probe requests from a client come from a new scanning cycle. The default cycle threshold is 200 milliseconds.

Step 4 In the Age Out Suppression (seconds) text box, enter a value between 10 and 200 seconds. Age-out suppression sets the expiration time for pruning previously known 802.11b/g clients. The default value is 20 seconds. After this time elapses, clients become new and are subject to probe response suppression.

Step 5 In the Age Out Dual Band (seconds) text box, enter a value between 10 and 300 seconds. The age-out period sets the expiration time for pruning previously known dual-band clients. The default value is 60 seconds. After this time elapses, clients become new and are subject to probe response suppression.

Step 6 In the Acceptable Client RSSI (dBm) text box, enter a value between –20 and –90 dBm. This parameter sets the minimum RSSI for a client to respond to a probe. The default value is –80 dBm.

Step 7 Click **Apply** to commit your changes.

Step 8 Click **Save Configuration** to save your changes.

Step 9 To enable or disable aggressive load balancing on specific WLANs, choose WLANs > WLAN ID. The WLANs > Edit page appears.

Step 10 Click the Advanced tab (see Figure 4-22).

Step 11 Click Save Configuration to save your changes.

Using the CLI to Configure Band Selection

To configure band selection using the controller CLI, follow these steps:

Step 1 Set the probe cycle count for band select by entering this command:

```
config band-select cycle-count cycle_count
```

You can enter a value between 1 and 10 for the *cycle_count* parameter.

Step 2 Set the time threshold for a new scanning cycle period by entering this command:

```
config band-select cycle-threshold milliseconds
```

You can enter a value for threshold between 1 and 1000 for the milliseconds parameter.

Step 3 Set the suppression expire to the band select by entering this command:

```
config band-select expire suppression seconds
```

You can enter a value for suppression between 10 to 200 for the seconds parameter.

Step 4 Set the dual band expire by entering this command:

```
config band-select expire dual-band seconds
```

You can enter a value for dual band between 10 and 300 for the seconds parameter.

Step 5 Set the client RSSI threshold by entering this command:

```
config band-select client-rssi client_rssi
```

You can enter a value for minimum dBm of a client RSSI to respond to a probe between 20 and 90 for the client_rssi parameter.

Step 6 Save your changes by entering this command:

```
save config
```

Step 7 Enable or disable band selection on specific WLANs by entering this command:

```
config wlan band-select allow {enable | disable} wlan_ID
```

You can enter a value between 1 and 512 for wlan_ID parameter.

Step 8 Verify your settings by entering this command:

```
show band-select
```

Information similar to the following appears:

```
Band Select Probe Response....................... Enabled
Cycle Count.................................. 3 cycles
Cycle Threshold.............................. 300 milliseconds
Age Out Suppression.......................... 20 seconds
Age Out Dual Band............................ 20 seconds
Client RSSI.................................. -30 dBm
```

Step 9 Save your changes by entering this command:

```
save config
```

Configuring Fast SSID Changing

When fast SSID changing is enabled, the controller allows clients to move between SSIDs. When the client sends a new association for a different SSID, the client entry in the controller connection table is cleared before the client is added to the new SSID. When fast SSID changing is disabled, the controller enforces a delay before clients are allowed to move to a new SSID.

Using the GUI to Configure Fast SSID Changing

To configure fast SSID changing for mobile clients using the controller GUI, follow these steps:

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

Step 2 From the Fast SSID Change drop-down list, choose **Enabled** to enable this feature or **Disabled** to disable it. The default value is disabled.

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

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

Using the CLI to Configure Fast SSID Changing

To configure fast SSID changing for mobile clients using the controller CLI, follow these steps:

Step 1 Enable or disable fast SSID changing by entering this command:

```
config network fast-ssid-change { enable | disable }
```

Step 2 Save your changes by entering this command:

```
save config
```

Enabling 802.3X Flow Control

802.3X Flow Control is disabled by default. To enable it, enter the config switchconfig flowcontrol enable command.

Configuring 802.3 Bridging

The controller supports 802.3 frames and the applications that use them, such as those typically used for cash registers and cash register servers. However, to make these applications work with the controller, the 802.3 frames must be bridged on the controller.

Support for raw 802.3 frames allows the controller to bridge non-IP frames for applications not running over IP. Only this raw 802.3 frame format is currently supported:

```
+-------------------+---------------------+-----------------+------------------------+
| Destination | Source | Total packet | Payload .....
| MAC address | MAC address | length |
+-------------------+---------------------+-----------------+------------------------
```

You can configure 802.3 bridging through the controller GUI in software release 4.1 or later releases and through the controller CLI in software release 4.0 or later releases.

Note In controller software release 5.2 or later releases, the software-based forwarding architecture for 2100-series-based controllers is being replaced with a new forwarding plane architecture. As a result, Cisco 2100 Series Controller and the Cisco Wireless LAN Controller Network Module for Cisco Integrated Services Routers (as well as Cisco 5500 Series Controllers) bridge 802.3 packets by default. Therefore, 802.3 bridging can now be disabled only on 4400 series controllers, the Cisco WiSM, and the Catalyst 3750G Wireless LAN Controller Switch.

Note By default, Cisco 2100 Series Controllers that run software release 5.2 or later releases and Cisco 5500 Series Controllers bridge all non-IPv4 packets (such as AppleTalk, IPv6, and so on). If desired, you can use ACLs to block the bridging of these protocols.

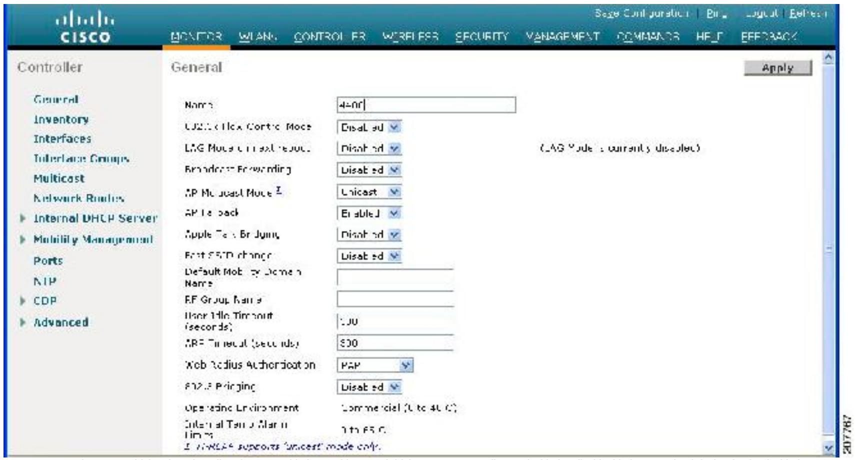
Note You can also configure 802.3 bridging using the Cisco Wireless Control System (WCS). See the Cisco Wireless Control System Configuration Guide for instructions.

Using the GUI to Configure 802.3 Bridging

To configure 802.3 bridging using the controller GUI, follow these steps:

Step 1 Choose Controller > General to open the General page (see Figure 4-24).

Figure 4-24 General Page



General

Name: 4400

802.3x Flow Control Mode: Disabled

LAG Mode on next reboot: Disabled (LAG Mode is currently disabled)

Broadcast Forwarding: Disabled

AP Multicast Mode 1: Unicast

AP Fallback: Enabled

Apple Talk Bridging: Disabled

Fast SSID change: Disabled

Default Mobility Domain Name:

RF Group Name:

User Idle Timeout (seconds): 300

ARP Timeout (seconds): 300

Web Radius Authentication: PAP

802.3 Bridging: Disabled

Operating Environment: Commercial (0 to 40 C)

Internal Temp Alarm Limits: 0 to 65 C

1. WLC4404 supports 'unicast' mode only.

Step 2 From the 802.3 Bridging drop-down list, choose Enabled to enable 802.3 bridging on your controller or Disabled to disable this feature. The default value is Disabled.

Note In controller software release 5.2 or later releases, you can disable 802.3 bridging only for 4400 series controllers, the Cisco WiSM, and the Catalyst 3750G Wireless LAN Controller Switch.

Step 3 Click Apply to commit your changes.

Step 4 Click Save Configuration to save your changes.

Using the CLI to Configure 802.3 Bridging

To configure 802.3 bridging using the controller CLI, follow these steps:

Step 1 See the current status of 802.3 bridging for all WLANs by entering this command:

```
show network
```

Step 2 Enable or disable 802.3 bridging globally on all WLANs by entering this command:

```
config network 802.3-bridging {enable | disable}
```

The default value is disabled.

Note In controller software release 5.2 or later releases, you can disable 802.3 bridging only for 4400 series controllers, the Cisco WiSM, and the Catalyst 3750G Wireless LAN Controller Switch.

Step 3 Save your settings by entering this command:

```
save config
```

Configuring Multicast Mode

If your network supports packet multicasting, you can configure the multicast method that the controller uses. The controller performs multicasting in two modes:

- **Unicast mode** —In this mode, the controller unicasts every multicast packet to every access point associated to the controller. This mode is inefficient but might be required on networks that do not support multicasting.
- **Multicast mode** —In this mode, the controller sends multicast packets to a CAPWAP multicast group. This method reduces overhead on the controller processor and shifts the work of packet replication to your network, which is much more efficient than the unicast method.

You can enable multicast mode using the controller GUI or CLI.

Understanding Multicast Mode

When you enable multicast mode and the controller receives a multicast packet from the wired LAN, the controller encapsulates the packet using CAPWAP and forwards the packet to the CAPWAP multicast group address. The controller always uses the management interface for sending multicast packets. Access points in the multicast group receive the packet and forward it to all the BSSIDs mapped to the interface on which clients receive multicast traffic. From the access point perspective, the multicast appears to be a broadcast to all SSIDs.

In controller software release 4.2 or later releases, Internet Group Management Protocol (IGMP) snooping is introduced to better direct multicast packets. When this feature is enabled, the controller gathers IGMP reports from the clients, processes them, creates unique multicast group IDs (MGIDs) from the IGMP reports after selecting the Layer 3 multicast address and the VLAN number, and sends the IGMP reports to the infrastructure switch. The controller sends these reports with the source address as the interface address on which it received the reports from the clients. The controller then updates the access point MGID table on the access point with the client MAC address. When the controller receives multicast traffic for a particular multicast group, it forwards it to all the access points, but only those access points that have active clients listening or subscribed to that multicast group send multicast traffic on that particular WLAN. IP packets are forwarded with an MGID that is unique for an ingress VLAN and the destination multicast group. Layer 2 multicast packets are forwarded with an MGID that is unique for the ingress interface.

When IGMP snooping is disabled, the following is true:

- The controller always uses Layer 2 MGID when it sends multicast data to the access point. Every interface created is assigned one Layer 2 MGID. For example, the management interface has an MGID of 0, and the first dynamic interface created is assigned an MGID of 8, which increments as each dynamic interface is created.

- The IGMP packets from clients are forwarded to the router. As a result, the router IGMP table is updated with the IP address of the clients as the last reporter.

When IGMP snooping is enabled, the following is true:

- The controller always uses Layer 3 MGID for all Layer 3 multicast traffic sent to the access point. For all Layer 2 multicast traffic, it continues to use Layer 2 MGID.
- IGMP report packets from wireless clients are consumed or absorbed by the controller, which generates a query for the clients. After the router sends the IGMP query, the controller sends the IGMP reports with its interface IP address as the listener IP address for the multicast group. As a result, the router IGMP table is updated with the controller IP address as the multicast listener.
- When the client that is listening to the multicast groups roams from one controller to another, the first controller transmits all the multicast group information for the listening client to the second controller. As a result, the second controller can immediately create the multicast group information for the client. The second controller sends the IGMP reports to the network for all multicast groups to which the client was listening. This process aids in the seamless transfer of multicast data to the client.
- If the listening client roams to a controller in a different subnet, the multicast packets are tunneled to the anchor controller of the client to avoid the reverse path filtering (RPF) check. The anchor then forwards the multicast packets to the infrastructure switch.

Note If a 4400 series WLC has LAG and IGMP snooping enabled, WLC port 1 must be active. WLC sourced IGMP queries (only applicable if WLC IGMP snooping is enabled) are sent out of only WLC port 1 when LAG is enabled. This restriction is not applicable if LAG is disabled and the Management and AP Manager interfaces are mapped to ports other than 1. This restriction is not applicable to other WLC platforms.

Note The MGIDs are controller specific. The same multicast group packets coming from the same VLAN in two different controllers may be mapped to two different MGIDs.

Note If Layer 2 multicast is enabled, a single MGID is assigned to all the multicast addresses coming from an interface (see Figure 4-26).

Guidelines for Using Multicast Mode

Follow these guidelines when you enable multicast mode on your network:

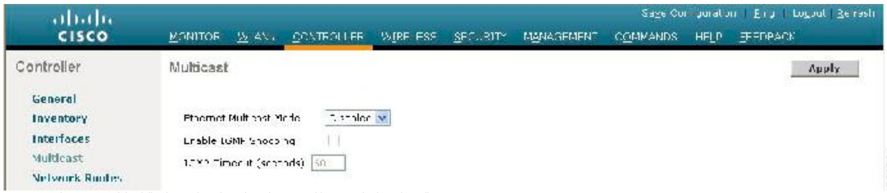
- The Cisco Unified Wireless Network solution uses some IP address ranges for specific purposes, and you should keep these ranges in mind when configuring a multicast group:
  - 224.0.0.0 through 224.0.0.255—Reserved link local addresses
  - 224.0.1.0 through 238.255.255.255—Globally scoped addresses
  - 239.0.0.0 through 239.255.x.y /16—Limited scope addresses
- When you enable multicast mode on the controller, you also must configure a CAPWAP multicast group address. Access points subscribe to the CAPWAP multicast group using IGMP.
- Cisco 1100, 1130, 1200, 1230, and 1240 access points use IGMP versions 1, 2, and 3.
- Access points in monitor mode, sniffer mode, or rogue detector mode do not join the CAPWAP multicast group address.
- The CAPWAP multicast group configured on the controllers should be different for different controllers.
- Multicast mode does not operate across intersubnet mobility events such as guest tunneling. It does, however, operate with interface overrides using RADIUS (but only when IGMP snooping is enabled) and with site-specific VLANs (access point group VLANs).
- For LWAPP, the controller drops multicast packets sent to UDP control port 12223. For CAPWAP, the controller drops multicast packets sent to UDP control and data ports 5246 and 5247, respectively. Therefore, you may want to consider not using these port numbers with the multicast applications on your network.
- We recommend that any multicast applications on your network not use the multicast address configured as the CAPWAP multicast group address on the controller.
- Cisco 2100 Series Controllers do not support multicast-unicast mode. They do, however, support multicast-multicast mode, except when access points are connected directly to the local port of a 2100 series controller.

Using the GUI to Enable Multicast Mode

To enable multicast mode using the controller GUI, follow these steps:

Step 1 Choose **Controller** > **Multicast** to open the Multicast page (see Figure 4-25).

Figure 4-25 Multicast Page



Multicast

Ethernet Multicast Mode: Disabled

Enable IGMP Snooping: □

IGMP Timeout (seconds): 60

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

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

Note Hybrid REAP supports unicast mode only.

Step 3 If you chose Multicast in Choose one of the following options from the Ethernet Multicast Mode drop-down list:, enter the IP address of the multicast group in the Multicast Group Address text box.

Step 4 If you want to enable IGMP snooping, select the **Enable IGMP Snooping** check box. If you want to disable IGMP snooping, leave the check box unselected. The default value is disabled.

Step 5 To set the IGMP timeout, enter a value between 30 and 7200 seconds in the **IGMP Timeout** text box. The controller sends three queries in one timeout value at an interval of *timeout* /3 to see if any clients exist for a particular multicast group. If the controller does not receive a response through an IGMP report from the client, the controller times out the client entry from the MGID table. When no clients are left for a particular multicast group, the controller waits for the IGMP timeout value to expire and then deletes the MGID entry from the controller. The controller always generates a general IGMP query (that is, to destination address 224.0.0.1) and sends it on all WLANs with an MGID value of 1.

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

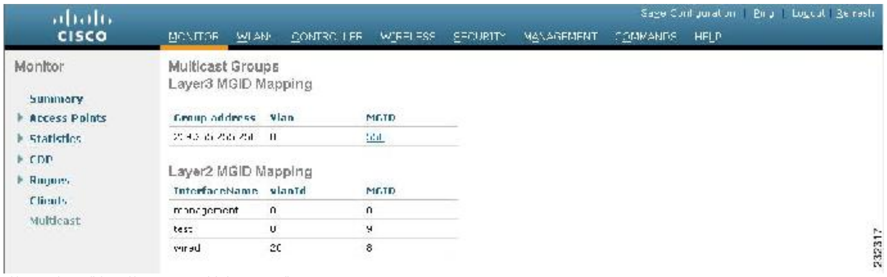
Step 7 Click **Save Configuration** to save your changes.

Using the GUI to View Multicast Groups

To view multicast groups using the controller GUI, follow these steps:

Step 1 Choose **Monitor > Multicast. The** Multicast Groups page appears (see Figure 4-26).

Figure 4-26 Multicast Groups Page



Multicast Groups

Layer3 MGID Mapping

Group address	Vlan	MGID
[illegible]	0	550

Layer2 MGID Mapping

InterfaceName	vlanId	MGID
management	0	0
test	0	9
wired	20	8

This page shows all the multicast groups and their corresponding MGIDs.

Step 2 Click the link for a specific MGID (such as MGID 550) to see a list of all the clients joined to the multicast group in that particular MGID.

Using the CLI to Enable Multicast Mode

To enable multicast mode using the controller CLI, follow these steps:

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

```
config network multicast global {enable | disable}
```

The default value is disabled.

Note The **config network broadcast** {**enable** | **disable**} command allows you to enable or disable broadcasting without enabling or disabling multicasting as well. This command uses the multicast mode currently on the controller to operate.

Step 2 Perform one of the following:

a. Configure the controller to use the unicast method to send multicast packets by entering this command:

config network multicast mode unicast

b. Configure the controller to use the multicast method to send multicast packets to a CAPWAP multicast group by entering this command:

config network multicast mode multicast *multicast_group_ip_address*

Step 3 Enable or disable IGMP snooping by entering this command:

config network multicast igmp snooping { **enable** | **disable** }

The default value is disabled.

Step 4 Set the IGMP timeout value by entering this command:

config network multicast igmp timeout *timeout*

You can enter a *timeout* value between 30 and 300 seconds. The controller sends three queries in one timeout value at an interval of *timeout* /3 to see if any clients exist for a particular multicast group. If the controller does not receive a response through an IGMP report from the client, the controller times out the client entry from the MGID table. When no clients are left for a particular multicast group, the controller waits for the IGMP timeout value to expire and then deletes the MGID entry from the controller. The controller always generates a general IGMP query (that is, to destination address 224.0.0.1) and sends it on all WLANs with an MGID value of 1.

Step 5 Save your changes by entering this command:

save config

Using the CLI to View Multicast Groups

To view multicast groups using the controller CLI, use these commands:

- See all the multicast groups and their corresponding MGIDs by entering this command:

  show network multicast mgid summary

  Information similar to the following appears:

```
Layer2 MGID Mapping:
-------------------
InterfaceName vlanId MGID
-------------------------------- ------ ----
management 0 0
test 0 9
wired 20 8

Layer3 MGID Mapping:
-------------------
Number of Layer3 MGIDs........................... 1

Group address Vlan MGID
--------------- ---- ----
239.255.255.250 0 550
```

- See all the clients joined to the multicast group in a specific MGID by entering this command:

  show network multicast mgid detail *mgid_value*

  where the *mgid_value* parameter is a number between 550 and 4095.

  Information similar to the following appears:

```
Mgid........................................ 550
Multicast Group Address..................... 239.255.255.250
Vlan........................................ 0
Rx Packet Count............................. 807399588
No of clients............................... 1
Client List.................................
Client MAC Expire Time (mm:ss)
00:13:02:23:82:ad 0:20
```

Using the CLI to View an Access Point's Multicast Client Table

To help troubleshoot roaming events, you can view an access point's multicast client table from the controller by performing a remote debug of the access point.

To view an access point's multicast client table using the controller CLI, follow these steps:

Step 1 Initiate a remote debug of the access point by entering this command:

debug ap enable *Cisco_AP*

Step 2 See all of the MGIDs on the access point and the number of clients per WLAN by entering this command:

debug ap command "show capwap mcast mgid all " *Cisco_AP*

Step 3 See all of the clients per MGID on the access point and the number of clients per WLAN by entering this command:

debug ap command "show capwap mcast mgid id *mgid_value* " *Cisco_AP*

Configuring Client Roaming

The Cisco UWN Solution supports seamless client roaming across lightweight access points managed by the same controller, between controllers in the same mobility group on the same subnet, and across controllers in the same mobility group on different subnets. Also, in controller software release 4.1 or later releases, client roaming with multicast packets is supported.

You can adjust the default RF settings (RSSI, hysteresis, scan threshold, and transition time) to fine-tune the operation of client roaming using the controller GUI or CLI.

Intra-Controller Roaming

Each controller supports same-controller client roaming across access points managed by the same controller. This roaming is transparent to the client as the session is sustained, and the client continues using the same DHCP-assigned or client-assigned IP address. The controller provides DHCP functionality with a relay function. Same-controller roaming is supported in single-controller deployments and in multiple-controller deployments.

Inter-Controller Roaming

Multiple-controller deployments support client roaming across access points managed by controllers in the same mobility group and on the same subnet. This roaming is also transparent to the client because the session is sustained and a tunnel between controllers allows the client to continue using the same DHCP- or client-assigned IP address as long as the session remains active. The tunnel is torn down, and the client must reauthenticate when the client sends a DHCP Discover with a 0.0.0.0 client IP address or a 169.254.*.* client auto-IP address or when the operator-set session timeout is exceeded.

Inter-Subnet Roaming

Multiple-controller deployments support client roaming across access points managed by controllers in the same mobility group on different subnets. This roaming is transparent to the client because the session is sustained and a tunnel between the controllers allows the client to continue using the same DHCP-assigned or client-assigned IP address as long as the session remains active. The tunnel is torn down, and the client must reauthenticate when the client sends a DHCP Discover with a 0.0.0.0 client IP address or a 169.254.*.* client auto-IP address or when the operator-set user timeout is exceeded.

Voice-over-IP Telephone Roaming

802.11 voice-over-IP (VoIP) telephones actively seek out associations with the strongest RF signal to ensure the best quality of service (QoS) and the maximum throughput. The minimum VoIP telephone requirement of 20-millisecond or shorter latency time for the roaming handover is easily met by the Cisco UWN Solution, which has an average handover latency of 5 or fewer milliseconds when open authentication is used. This short latency period is controlled by controllers rather than allowing independent access points to negotiate roaming handovers.

The Cisco UWN Solution supports 802.11 VoIP telephone roaming across lightweight access points managed by controllers on different subnets, as long as the controllers are in the same mobility group. This roaming is transparent to the VoIP telephone because the session is sustained and a tunnel between controllers allows the VoIP telephone to continue using the same DHCP-assigned IP address as long as the session remains active. The tunnel is torn down, and the VoIP client must reauthenticate when the VoIP telephone sends a DHCP Discover with a 0.0.0.0 VoIP telephone IP address or a 169.254.*.* VoIP telephone auto-IP address or when the operator-set user timeout is exceeded.

CCX Layer 2 Client Roaming

The controller supports five CCX Layer 2 client roaming enhancements:

- Access point assisted roaming—This feature helps clients save scanning time. When a CCXv2 client associates to an access point, it sends an information packet to the new access point listing the characteristics of its previous access point. Roaming time decreases when the client recognizes and uses an access point list built by compiling all previous access points to which each client was associated and sent (unicast) to the client immediately after association. The access point list contains the channels, BSSIDs of neighbor access points that support the client's current SSID(s), and time elapsed since disassociation.
- Enhanced neighbor list—This feature focuses on improving a CCXv4 client's roam experience and network edge performance, especially when servicing voice applications. The access point provides its associated client information about its neighbors using a neighbor-list update unicast message.
- Enhanced neighbor list request (E2E)—The End-2-End specification is a Cisco and Intel joint program that defines new protocols and interfaces to improve the overall voice and roaming experience. It applies only to Intel clients in a CCX environment. Specifically, it enables Intel clients to request a neighbor list at will. When this occurs, the access point forwards the request to the controller. The controller receives the request and replies with the current CCX roaming sublist of neighbors for the access point to which the client is associated.

  Note To see whether a particular client supports E2E, choose Wireless > Clients on the controller GUI, click the Detail link for the desired client, and look at the E2E Version text box under Client Properties.

- Roam reason report—This feature enables CCXv4 clients to report the reason why they roamed to a new access point. It also allows network administrators to build and monitor a roam history.
- Directed roam request—This feature enables the controller to send directed roam requests to the client in situations when the controller can better service the client on an access point different from the one to which it is associated. In this case, the controller sends the client a list of the best access points that it can join. The client can either honor or ignore the directed roam request. Non-CCX clients and clients running CCXv3 or below must not take any action. No configuration is required for this feature.

Controller software release 4.2 or later releases support 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 generate and respond to CCX frames appropriately. Clients must support CCXv4 or v5 (or CCXv2 for access point assisted roaming) in order to utilize these roaming enhancements. See the "Configuring Cisco Client Extensions" section for more information on CCX.

The roaming enhancements mentioned above are enabled automatically, with the appropriate CCX support.

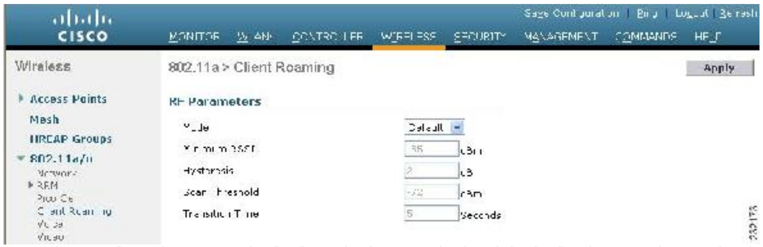
Note Hybrid-REAP access points in standalone mode do not support CCX Layer 2 roaming.

Using the GUI to Configure CCX Client Roaming Parameters

To configure CCX client roaming parameters using the controller GUI, follow these steps:

Step 1 Choose Wireless > **802.11a/n** (or **802.11b/g/n)** > Client Roaming. The 802.11a (or 802.11b) > Client Roaming page appears (see Figure 4-27).

Figure 4-27 802.11a > Client Roaming Page



802.11a > Client Roaming

RF Parameters

Mode: Default
Minimum RSSI: -85 dBm
Hysteresis: 2 dB
Scan Threshold: -72 dBm
Transition Time: 5 Seconds

Step 2 If you want to fine-tune the RF parameters that affect client roaming, choose Custom from the Mode drop-down list and go to Step 3. If you want to leave the RF parameters at their default values, choose Default and go to Step 8.

Step 3 In the Minimum RSSI text box, enter a value for the minimum received signal strength indicator (RSSI) required for the client to associate to an access point. If the client's average received signal power dips below this threshold, reliable communication is usually impossible. Therefore, clients must already have found and roamed to another access point with a stronger signal before the minimum RSSI value is reached.

The range is -80 to -90 dBm.

The default is -85 dBm.

Step 4 In the Hysteresis text box, enter a value to indicate how much greater the signal strength of a neighboring access point must be in order for the client to roam to it. This parameter is intended to reduce the amount of roaming between access points if the client is physically located on or near the border between two access points.

The range is 3 to 20dB.

The default is 3 dB.

Step 5 In the Scan Threshold text box, enter the minimum RSSI that is allowed before the client should roam to a better access point. When the RSSI drops below the specified value, the client must be able to roam to a better access point within the specified transition time. This parameter also provides a power-save method to minimize the time that the client spends in active or passive scanning. For example, the client can scan slowly when the RSSI is above the threshold and scan more rapidly when the RSSI is below the threshold.

The range is -70 to -77 dBm.

The default is -72 dBm.

Step 6 In the Transition Time text box, enter the maximum time allowed for the client to detect a suitable neighboring access point to roam to and to complete the roam, whenever the RSSI from the client's associated access point is below the scan threshold.

The Scan Threshold and Transition Time parameters guarantee a minimum level of client roaming performance. Together with the highest expected client speed and roaming hysteresis, these parameters make it possible to design a wireless LAN network that supports roaming simply by ensuring a certain minimum overlap distance between access points.

The range is 1 to 10 seconds.

The default is 5 seconds.

Step 7 Click Apply to commit your changes.

Step 8 Click Save Configuration to save your changes.

Step 9 Repeat this procedure if you want to configure client roaming for another radio band (802.11a or 802.11b/g).

Using the CLI to Configure CCX Client Roaming Parameters

Configure CCX Layer 2 client roaming parameters by entering this command:

config {802.11a | 802.11b} l2roam rf-params { **default** | **custom** *min_rssi roam_hyst scan_thresh trans_time}*

Note See the description, range, and default value of each RF parameter in the "Using the GUI to Configure CCX Client Roaming Parameters" section.

Using the CLI to Obtain CCX Client Roaming Information

To view information about CCX Layer 2 client roaming using the controller CLI, follow these steps:

Step 1 View the current RF parameters configured for client roaming for the 802.11a or 802.11b/g network by entering this command:

show {802.11a | 802.11b} l2roam rf-param

Step 2 View the CCX Layer 2 client roaming statistics for a particular access point by entering this command:

show {802.11a | 802.11b} l2roam statistics ap_mac

This command provides the following information:

- The number of roam reason reports received
- The number of neighbor list requests received
- The number of neighbor list reports sent
- The number of broadcast neighbor updates sent

Step 3 View the roaming history for a particular client by entering this command:

show client roam-history client_mac

This command provides the following information:

- The time when the report was received
- The MAC address of the access point to which the client is currently associated
- The MAC address of the access point to which the client was previously associated
- The channel of the access point to which the client was previously associated
- The SSID of the access point to which the client was previously associated
- The time when the client disassociated from the previous access point
- The reason for the client roam

Using the CLI to Debug CCX Client Roaming Issues

If you experience any problems with CCX Layer 2 client roaming, enter this command:

debug l2roam [detail | error | packet | all] { **enable** | **disable** }

Configuring IP-MAC Address Binding

In controller software release 5.2 or later releases, the controller enforces strict IP address-to-MAC address binding in client packets. The controller checks the IP address and MAC address in a packet, compares them to the addresses that are registered with the controller, and forwards the packet only if they both match. In previous releases, the controller checks only the MAC address of the client and ignores the IP address.

Note If the IP address or MAC address of the packet has been spoofed, the check does not pass, and the controller discards the packet. Spoofed packets can pass through the controller only if both the IP and MAC addresses are spoofed together and changed to that of another valid client on the same controller.

To configure IP-MAC address binding using the controller CLI, follow these steps:

Step 1 Enable or disable IP-MAC address binding by entering this command:

config network ip-mac-binding { **enable** | **disable** }

The default value is enabled.

Note You might want to disable this binding check if you have a routed network behind a workgroup bridge (WGB).

Note You must disable this binding check in order to use an access point in sniffer mode if the access point is joined to a Cisco 5500 Series Controller, a Cisco 2100 Series Controller, or a controller network module that runs software release 6.0 or later releases.

Step 2 Save your changes by entering this command:

save config

Step 3 View the status of IP-MAC address binding by entering this command:

show network summary

Information similar to the following appears:

```
RF-Network Name............................. ctrl4404
Web Mode.................................... Disable
Secure Web Mode............................. Enable
Secure Web Mode Cipher-Option High.......... Disable
Secure Web Mode Cipher-Option SSLv2......... Enable
...
IP/MAC Addr Binding Check ............... Enabled
...
```

Configuring Quality of Service

Quality of service (QoS) refers to the capability of a network to provide better service to selected network traffic over various technologies. The primary goal of QoS is to provide priority including dedicated bandwidth, controlled jitter and latency (required by some real-time and interactive traffic), and improved loss characteristics.

The controller supports four QoS levels:

- Platinum/Voice—Ensures a high quality of service for voice over wireless.
- Gold/Video—Supports high-quality video applications.
- Silver/Best Effort—Supports normal bandwidth for clients. This is the default setting.
- Bronze/Background—Provides the lowest bandwidth for guest services.

Note VoIP clients should be set to Platinum.

You can configure the bandwidth of each QoS level using QoS profiles and then apply the profiles to WLANs. The profile settings are pushed to the clients associated to that WLAN. In addition, you can create QoS roles to specify different bandwidth levels for regular and guest users. Follow the instructions in this section to configure QoS profiles and QoS roles.

Configuring Quality of Service Profiles

You can use the controller GUI or CLI to configure the Platinum, Gold, Silver, and Bronze QoS profiles.

Using the GUI to Configure QoS Profiles

To configure QoS profiles using the controller GUI, follow these steps:

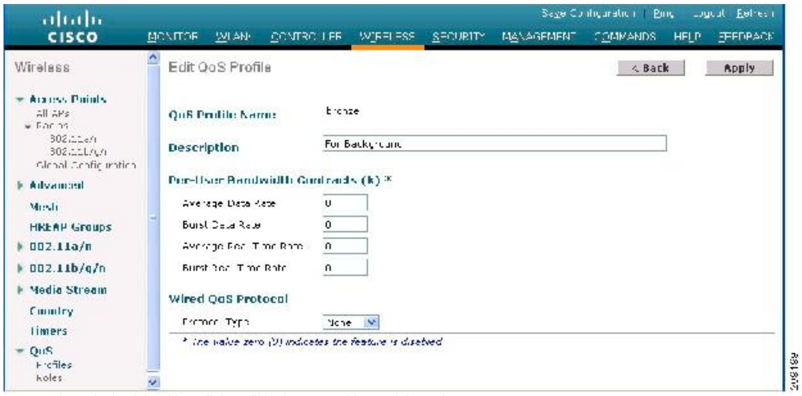
Step 1 Disable the 802.11a and 802.11b/g networks so that you can configure the QoS profiles.

To disable the radio networks, choose **Wireless > 802.11a/n** or **802.11b/g/n > Network** , unselect the 802.11a (or 802.11b/g) Network Status check box, and click Apply.

Step 2 Choose **Wireless** > **QoS > Profiles** to open the QoS Profiles page.

Step 3 Click the name of the profile that you want to configure to open the Edit QoS Profile page (see Figure 4-28).

Figure 4-28 Edit QoS Profile Page



Edit QoS Profile

QoS Profile Name: Bronze

Description: For Background

Per-User Bandwidth Contracts (k) *

Average Data Rate: 0

Burst Data Rate: 0

Average Real-Time Rate: 0

Burst Real-Time Rate: 0

Wired QoS Protocol

Protocol Type: None

* The value zero (0) indicates the feature is disabled

Step 4 Change the description of the profile by modifying the contents of the Description text box.

Step 5 Define the average data rate for TCP traffic per user by entering the rate in Kbps in the Average Data Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the profile.

Step 6 Define the peak data rate for TCP traffic per user by entering the rate in Kbps in the Burst Data Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the profile.

Note The Burst Data Rate should be greater than or equal to the Average Data Rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Step 7 Define the average real-time rate for UDP traffic on a per-user basis by entering the rate in Kbps in the Average Real-Time Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the profile.

Step 8 Define the peak real-time rate for UDP traffic on a per-user basis by entering the rate in Kbps in the Burst Real-Time Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the profile.

Note The Burst Real-Time Rate should be greater than or equal to the Average Real-Time Rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Step 9 In the Queue Depth text box, enter the maximum number of packets that access points keep in their queues. Any additional packets are dropped.

Step 10 Choose **802.1p** from the Protocol Type drop-down list and enter the maximum priority value in the 802.1p Tag text box to define the maximum value (0–7) for the priority tag associated with packets that fall within the profile.

The tagged packets include CAPWAP data packets (between access points and the controller) and packets sent toward the core network.

Note If a QoS profile has 802.1p tagging configured and if this QoS profile is assigned to a WLAN that uses an untagged interface on the controller, the client traffic will be blocked.

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

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

Step 13 Reenable the 802.11a and 802.11b/g networks.

To enable the radio networks, choose **Wireless > 802.11a/n** or **802.11b/g/n > Network** , select the 802.11a (or 802.11b/g) Network Status check box, and click Apply.

Step 14 Follow the instructions in the "Assigning a QoS Profile to a WLAN" section to assign a QoS profile to a WLAN.

Using the CLI to Configure QoS Profiles

To configure the Platinum, Gold, Silver, and Bronze QoS profiles using the controller CLI, follow these steps:

Step 1 Disable the 802.11a and 802.11b/g networks so that you can configure the QoS profiles by entering these commands:

config 802.11a disable network

config 802.11b disable network

Step 2 Change the profile description by entering this command:

config qos description {bronze | **silver** | **gold** | **platinum}** *description*

Step 3 Define the average data rate in Kbps for TCP traffic per user by entering this command:

config qos average-data-rate {bronze | **silver** | **gold** | **platinum}** *rate*

Note For the *rate* parameter, you can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the QoS profile.

Step 4 Define the peak data rate in Kbps for TCP traffic per user by entering this command:

config qos burst-data-rate {bronze | **silver** | **gold** | **platinum}** *rate*

Step 5 Define the average real-time rate in Kbps for UDP traffic per user by entering this command:

```
config qos average-realtime-rate {bronze | silver | gold | platinum} rate
```

Step 6 Define the peak real-time rate in Kbps for UDP traffic per user by entering this command:

```
config qos burst-realtime-rate {bronze | silver | gold | platinum} rate
```

Step 7 Specify the maximum percentage of RF usage per access point by entering this command:

```
config qos max-rf-usage {bronze | silver | gold | platinum} usage_percentage
```

Step 8 Define the maximum value (0–7) for the priority tag associated with packets that fall within the profile, by entering these commands:

```
config qos protocol-type {bronze | silver | gold | platinum} dot1p
config qos dot1p-tag {bronze | silver | gold | platinum} tag
```

The tagged packets include CAPWAP data packets (between access points and the controller) and packets sent toward the core network.

Note If a QoS profile has 802.1p tagging configured and if this QoS profile is assigned to a WLAN that uses an untagged interface on the controller, the client traffic will be blocked.

Step 9 Reenable the 802.11a and 802.11b/g networks so that you can configure the QoS profiles by entering these commands:

```
config 802.11a enable network
config 802.11b enable network
```

Step 10 Follow the instructions in the "Assigning a QoS Profile to a WLAN" section to assign a QoS profile to a WLAN.

Configuring Quality of Service Roles

After you configure a QoS profile and apply it to a WLAN, it limits the bandwidth level of clients associated to that WLAN. Multiple WLANs can be mapped to the same QoS profile, which can result in bandwidth contention between regular users (such as employees) and guest users. In order to prevent guest users from using the same level of bandwidth as regular users, you can create QoS roles with different (and presumably lower) bandwidth contracts and assign them to guest users.

You can use the controller GUI or CLI to configure up to ten QoS roles for guest users.

Note If you choose to create an entry on the RADIUS server for a guest user and enable RADIUS authentication for the WLAN on which web authentication is performed rather than adding a guest user to the local user database from the controller, you need to assign the QoS role on the RADIUS server itself. To do so, a "guest-role" Airespace attribute needs to be added on the RADIUS server with a datatype of "string" and a return value of "11." This attribute is sent to the controller when authentication occurs. If a role with the name returned from the RADIUS server is found configured on the controller, the bandwidth associated to that role is enforced for the guest user after authentication completes successfully.

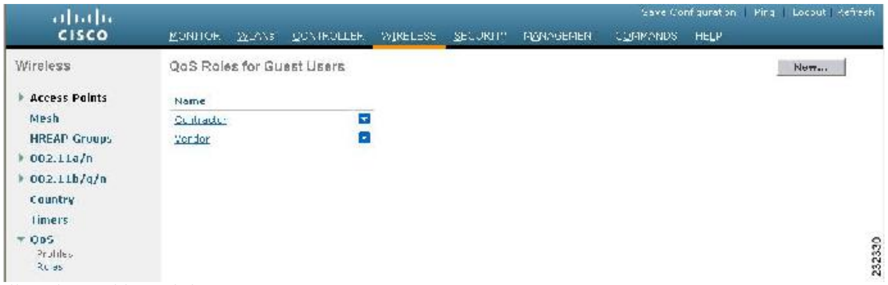
Using the GUI to Configure QoS Roles

To configure QoS roles using the controller GUI, follow these steps:

Note Guest User role is not supported on Cisco 2106 Controller.

Step 1 Choose **Wireless** > **QoS > Roles** to open the QoS Roles for Guest Users page (see Figure 4-29).

Figure 4-29 QoS Roles for Guest Users Page


CISCO
Save Configuration | Ping | Logout | Refresh
MONITOR WLANs CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP
Wireless
Access Points
Mesh
HREAP Groups
802.11a/n
802.11b/g/n
Country
Timers
QoS
Profiles
Roles
New...
232330

QoS Roles for Guest Users

Name
Contractor
Vendor

This page shows any existing QoS roles for guest users.

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

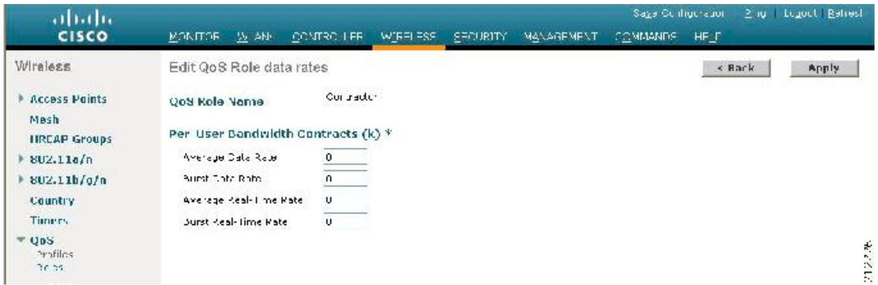
Step 2 Click **New** to create a new QoS role. The QoS Role Name > New page appears.

Step 3 In the Role Name text box, enter a name for the new QoS role. The name should uniquely identify the role of the QoS user (such as Contractor, Vendor, and so on).

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

Step 5 Click the name of the QoS role to edit the bandwidth of a QoS role. The Edit QoS Role Data Rates page appears (see Figure 4-30).

Figure 4-30 Edit QoS Role Data Rates Page


CISCO
Save Configuration | Ping | Logout | Refresh
MONITOR WLANs CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP
Wireless
Access Points
Mesh
HREAP Groups
802.11a/n
802.11b/g/n
Country
Timers
QoS
Profiles
Roles
< Back
Apply

Edit QoS Role data rates

QoS Role Name Contractor

Per User Bandwidth Contracts (k) *

Average Data Rate 0
Burst Data Rate 0
Average Real-Time Rate 0
Burst Real-Time Rate 0

Note The values that you configure for the per-user bandwidth contracts affect only the amount of bandwidth going downstream (from the access point to the wireless client). They do not affect the bandwidth for upstream traffic (from the client to the access point).

Step 6 Define the average data rate for TCP traffic on a per-user basis by entering the rate in Kbps in the Average Data Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the QoS role.

Step 7 Define the peak data rate for TCP traffic on a per-user basis by entering the rate in Kbps in the Burst Data Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the QoS role.

Note The Burst Data Rate should be greater than or equal to the Average Data Rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Step 8 Define the average real-time rate for UDP traffic on a per-user basis by entering the rate in Kbps in the Average Real-Time Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the QoS role.

Step 9 Define the peak real-time rate for UDP traffic on a per-user basis by entering the rate in Kbps in the Burst Real-Time Rate text box. You can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the QoS role.

Note The Burst Real-Time Rate should be greater than or equal to the Average Real-Time Rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Step 10 Click **Apply** to commit your changes.

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

Step 12 Apply a QoS role to a guest user, by following the steps in the "Using the GUI to Configure Local Network Users" section.

Using the CLI to Configure QoS Roles

To configure QoS roles using the controller CLI, follow these steps:

Step 1 Create a QoS role for a guest user by entering this command:

config netuser guest-role create *role_name*

Note If you want to delete a QoS role, enter this command:
config netuser guest-role delete *role_name*

Step 2 Configure the bandwidth contracts for a QoS role by entering these commands:

- **config netuser guest-role qos data-rate average-data-rate** *role_name rate*— Configures the average data rate for TCP traffic on a per-user basis.
- **config netuser guest-role qos data-rate burst-data-rate** *role_name rate*— Configures the peak data rate for TCP traffic on a per-user basis.

Note The Burst Data Rate should be greater than or equal to the Average Data Rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

- **config netuser guest-role qos data-rate average-realtime-rate** *role_name rate*— Configures the average real-time rate for UDP traffic on a per-user basis.
- **config netuser guest-role qos data-rate burst-realtime-rate** *role_name rate*— Configures the peak real-time rate for UDP traffic on a per-user basis.

Note The Burst Real-Time Rate should be greater than or equal to the Average Real-Time Rate. Otherwise, the QoS policy may block traffic to and from the wireless client.

Note For the *role_name* parameter in each of these commands, enter a name for the new QoS role. The name should uniquely identify the role of the QoS user (such as Contractor, Vendor, and so on). For the *rate* parameter, you can enter a value between 0 and 60,000 Kbps (inclusive). A value of 0 imposes no bandwidth restriction on the QoS role.

Step 3 Apply a QoS role to a guest user by entering this command:

config netuser guest-role apply *username role_name*

For example, the role of *Contractor* could be applied to guest user *jsmith* .

Note If you do not assign a QoS role to a guest user, the Role text box in the User Details shows the role as "default." The bandwidth contracts for this user are defined in the QoS profile for the WLAN.

Note If you want to unassign a QoS role from a guest user, enter the **config netuser guest-role apply** *username* **default command**. This user now uses the bandwidth contracts defined in the QoS profile for the WLAN.

Step 4 Save your changes by entering this command:

save config

Step 5 See a list of the current QoS roles and their bandwidth parameters by entering this command:

show netuser guest-roles

Information similar to the following appears:

```
Role Name....................................... Contractor
Average Data Rate........................... 10
Burst Data Rate............................. 10
Average Realtime Rate....................... 100
Burst Realtime Rate......................... 100

Role Name....................................... Vendor
Average Data Rate........................... unconfigured
Burst Data Rate............................. unconfigured
Average Realtime Rate....................... unconfigured
Burst Realtime Rate...................... unconfigured
```

Configuring Voice and Video Parameters

Three parameters on the controller affect voice and/or video quality:

- Call admission control
- Expedited bandwidth requests
- Unscheduled automatic power save delivery

Each of these parameters is supported in Cisco Compatible Extensions (CCX) v4 and v5. See the "Configuring Cisco Client Extensions" section for more information on CCX.

Note CCX is not supported on the AP1030.

Traffic stream metrics (TSM) can be used to monitor and report issues with voice quality.

Call Admission Control

Call admission control (CAC) enables an access point to maintain controlled quality of service (QoS) when the wireless LAN is experiencing congestion. The Wi-Fi Multimedia (WMM) protocol deployed in CCXv3 ensures sufficient QoS as long as the wireless LAN is not congested. However, in order to maintain QoS under differing network loads, CAC in CCXv4 is required. Two types of CAC are available: bandwidth-based CAC and load-based CAC.

Bandwidth-Based CAC

Bandwidth-based, or static, CAC enables the client to specify how much bandwidth or shared medium time is required to accept a new call and in turn enables the access point to determine whether it is capable of accommodating this particular call. The access point rejects the call if necessary in order to maintain the maximum allowed number of calls with acceptable quality.

The QoS setting for a WLAN determines the level of bandwidth-based CAC support. To use bandwidth-based CAC with voice applications, the WLAN must be configured for Platinum QoS. To use bandwidth-based CAC with video applications, the WLAN must be configured for Gold QoS. Also, make sure that WMM is enabled for the WLAN. See the "Configuring 802.3 Bridging" section for QoS and WMM configuration instructions.

Note You must enable admission control (ACM) for CCXv4 clients that have WMM enabled. Otherwise, bandwidth-based CAC does not operate properly.

Load-Based CAC

Load-based CAC incorporates a measurement scheme that takes into account the bandwidth consumed by all traffic types (including that from clients), co-channel access point loads, and collocated channel interference, for voice applications. Load-based CAC also covers the additional bandwidth consumption resulting from PHY and channel impairment.

In load-based CAC, the access point continuously measures and updates the utilization of the RF channel (that is, the percentage of bandwidth that has been exhausted), channel interference, and the additional calls that the access point can admit. The access point admits a new call only if the channel has enough unused bandwidth to support that call. By doing so, load-based CAC prevents oversubscription of the channel and maintains QoS under all conditions of WLAN loading and interference.

Note Load-based CAC is supported only on lightweight access points. If you disable load-based CAC, the access points start using bandwidth-based CAC.

Expedited Bandwidth Requests

The expedited bandwidth request feature enables CCXv5 clients to indicate the urgency of a WMM traffic specifications (TSPEC) request (for example, an e911 call) to the WLAN. When the controller receives this request, it attempts to facilitate the urgency of the call in any way possible without potentially altering the quality of other TSPEC calls that are in progress.

You can apply expedited bandwidth requests to both bandwidth-based and load-based CAC. Expedited bandwidth requests are disabled by default. When this feature is disabled, the controller ignores all expedited requests and processes TSPEC requests as normal TSPEC requests.

See Table 4-3 for examples of TSPEC request handling for normal TSPEC requests and expedited bandwidth requests.

Table 4-3 TSPEC Request Handling Examples

CAC Mode	Reserved bandwidth for voice calls [1]	Usage [2]	Normal TSPEC Request	TSPEC with Expedited Bandwidth Request
Bandwidth-based CAC	75% (default setting)	Less than 75%	Admitted	Admitted
		Between 75% and 90% (reserved bandwidth for voice calls exhausted)	Rejected	Admitted
		More than 90%	Rejected	Rejected
Load-based CAC		Less than 75%	Admitted	Admitted
		Between 75% and 85% (reserved bandwidth for voice calls exhausted)	Rejected	Admitted
		More than 85%	Rejected	Rejected

[1] For bandwidth-based CAC, the voice call bandwidth usage is per access point and does not take into account co-channel access points. For load-based CAC, the voice call bandwidth usage is measured for the entire channel.

[2] Bandwidth-based CAC (consumed voice and video bandwidth) or load-based CAC (channel utilization [Pb]).

Note Controller software release 6.0 or later releases support admission control for TSPEC g711-40ms codec type.

Note When video ACM is enabled, the controller rejects a video TSPEC if the Non-MSDU size in the TSPEC is greater than 149 or the mean data rate is greater than 1 Kbps.

U-APSD

Unscheduled automatic power save delivery (U-APSD) is a QoS facility defined in IEEE 802.11e that extends the battery life of mobile clients. In addition to extending battery life, this feature reduces the latency of traffic flow delivered over the wireless media. Because U-APSD does not require the client to poll each individual packet buffered at the access point, it allows delivery of multiple downlink packets by sending a single uplink trigger packet. U-APSD is enabled automatically when WMM is enabled.

Traffic Stream Metrics

In a voice-over-wireless LAN (VoWLAN) deployment, traffic stream metrics (TSM) can be used to monitor voice-related metrics on the client-access point air interface. It reports both packet latency and packet loss. You can isolate poor voice quality issues by studying these reports.

The metrics consist of a collection of uplink (client side) and downlink (access point side) statistics between an access point and a client device that supports CCX v4 or later releases. If the client is not CCX v4 or CCXv5 compliant, only downlink statistics are captured. The client and access point measure these metrics. The access point also collects the measurements every 5 seconds, prepares 90-second reports, and then sends the reports to the controller. The controller organizes the uplink measurements on a client basis and the downlink measurements on an access point basis and maintains an hour's worth of historical data. To store this data, the controller requires 32 MB of additional memory for uplink metrics and 4.8 MB for downlink metrics.

TSM can be configured through either the GUI or the CLI on a per radio-band basis (for example, all 802.11a radios). The controller saves the configuration in flash memory so that it persists across reboots. After an access point receives the configuration from the controller, it enables TSM on the specified radio band.

Note Access points support TSM in both local and hybrid-REAP modes.

Using the GUI to Configure Voice Parameters

To configure voice parameters using the controller GUI, follow these steps:

Note SIPs are available only on the Cisco 4400 Series and Cisco 5500 Series Controllers, and on the 1240, 1130, and 11n access points.

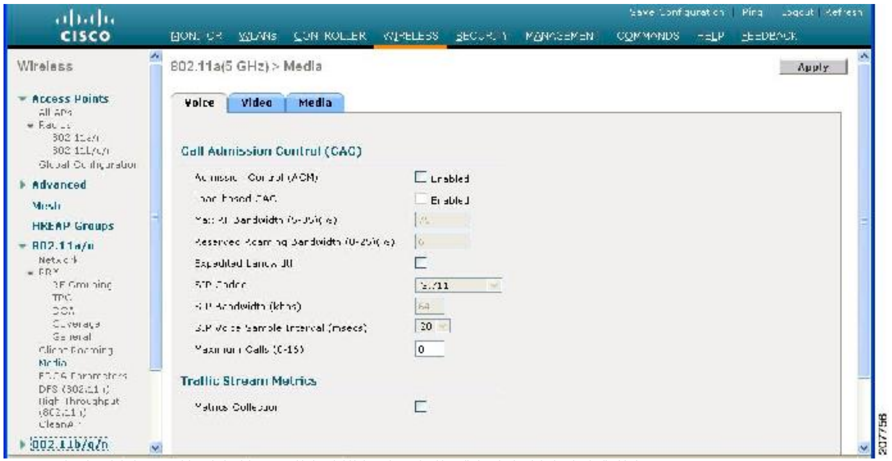
Step 1 Make sure that the WLAN is configured for WMM and the Platinum QoS level.

Step 2 Disable all WLANs with WMM enabled and click **Apply** .

Step 3 Choose Wireless and then Network under 802.11a/n or 802.11b/g/n, unselect the 802.11a (or 802.11b/g) Network Status check box, and click Apply to disable the radio network.

Step 4 Choose Wireless > 802.11a/n or 802.11b/g/n > Media. The 802.11a (or 802.11b) > Media page appears (see Figure 4-31). The Voice tab is displayed by default.

Figure 4-31 802.11a/n > Voice Parameters Page



802.11a(5 GHz) > Media

Call Admission Control (CAC)

Admission Control (ACM) □ Enabled

Load-based CAC □ Enabled

Max RF Bandwidth (5-85)(%) 75

Reserved Roaming Bandwidth (0-25)(%) 6

Expedited Bandwidth □

SIP Codec G.711

SIP Bandwidth (kbps) 64

SIP Voice Sample Interval (msecs) 20

Maximum Calls (0-15) 0

Traffic Stream Metrics

Metrics Collection □

Step 5 Select the Admission Control (ACM) check box to enable bandwidth-based CAC for this radio band. The default value is disabled.

Step 6 Select both the Admission Control (ACM) check box and the Load-based AC check box to enable load-based CAC for this radio band. The default value for both check boxes is disabled.

Step 7 In the Max RF Bandwidth text box, enter the percentage of the maximum bandwidth allocated to clients for voice applications on this radio band. Once the client reaches the value specified, the access point rejects new calls on this radio band.

The range is 5 to 85%. The sum of max bandwidth% of voice and video should not exceed 85%.

The default is 75%.

Step 8 In the Reserved Roaming Bandwidth text box, enter the percentage of maximum allocated bandwidth that is reserved for roaming voice clients. The controller reserves this bandwidth from the maximum allocated bandwidth for roaming voice clients.

The range is 0 to 25%.

The default is 6%.

Step 9 To enable expedited bandwidth requests, select the Expedited Bandwidth check box. By default, this text box is disabled.

Step 10 From the SIP Codec drop-down list, choose one of the following options to set the codec name. The default value is G.711. The options are as follows:

- User Defined
- G.711
- G.729

Step 11 In the SIP Bandwidth (kbps) text box, enter the bandwidth in kilo bits per second.

The possible range is 8 to 64.

The default value is 64.

Note The SIP Bandwidth (kbps) text box is highlighted only when you select the SIP codec as User-Defined. If you choose the SIP codec as G.711, the SIP Bandwidth (kbps) text box is set to 64. If you choose the SIP codec as G.729, the SIP Bandwidth (kbps) text box is set to 8.

Step 12 In the SIP Voice Sample Interval (msecs) text box, enter the value for the sample interval.

Step 13 In the Maximum Calls text box, enter the maximum number of calls that can be made to this radio. The maximum call limit includes both direct and roaming-in calls. If the maximum call limit is reached, new or roaming-in calls will fail.

The possible range is 0 to 25.

The default value is 0, which indicates that there is no check for maximum call limit.

Step 14 Select the Metrics Collection check box to collect Traffic Stream Metrics. By default, the box is unselected. That is, the traffic stream metrics is not collected by default.

Step 15 Click Apply to commit your changes.

Step 16 Reenable all WMM WLANs and click Apply.

Step 17 Choose Network under 802.11a/n or 802.11b/g/n, select the 802.11a (or 802.11b/g) Network Status check box, and click Apply to reenable the radio network.

Step 18 Click Save Configuration to save your changes.

Step 19 Repeat this procedure if you want to configure voice parameters for another radio band (802.11a or 802.11b/g).

Using the GUI to Configure Video Parameters

To configure video parameters using the controller GUI, follow these steps:

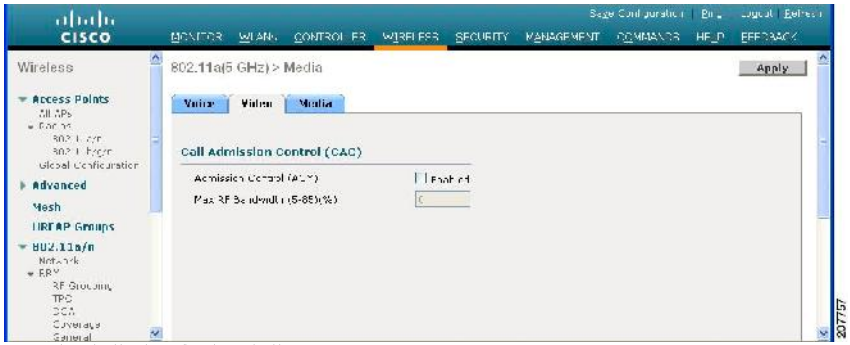
Step 1 Make sure that the WLAN is configured for WMM and the Gold QoS level.

Step 2 Disable all WLANs with WMM enabled and click **Apply** .

Step 3 Choose Wireless and then Network under 802.11a/n or 802.11b/g/n, unselect the 802.11a (or 802.11b/g) Network Status check box, and click Apply to disable the radio network.

Step 4 Choose Wireless > 802.11a/n or 802.11b/g/n > Media. The 802.11a (or 802.11b) > Media page appears (see Figure 4-32).

Figure 4-32 802.11a > Video Parameters Page



802.11a(5 GHz) > Media

Call Admission Control (CAC)

Admission Control (ACM) □ Enabled

Max RF Bandwidth (5-85)(%) 0

Step 5 Choose the Video tab to configure the CAC for Video parameters.

Step 6 Select the Admission Control (ACM) check box to enable video CAC for this radio band. The default value is disabled.

Step 7 In the Max RF Bandwidth text box, enter the percentage of the maximum bandwidth allocated to clients for video applications on this radio band. Once the client reaches the value specified, the access point rejects new requests on this radio band.

The range is 5 to 85%. The sum of maximum bandwidth% of voice and video should not exceed 85%.

The default is 0%.

Step 8 Click Apply to commit your changes.

Step 9 Reenable all WMM WLANs and click Apply.

Step 10 Choose Network under 802.11a/n or 802.11b/g/n, select the 802.11a (or 802.11b/g) Network Status check box, and click Apply to reenable the radio network.

Step 11 Click Save Configuration to save your changes.

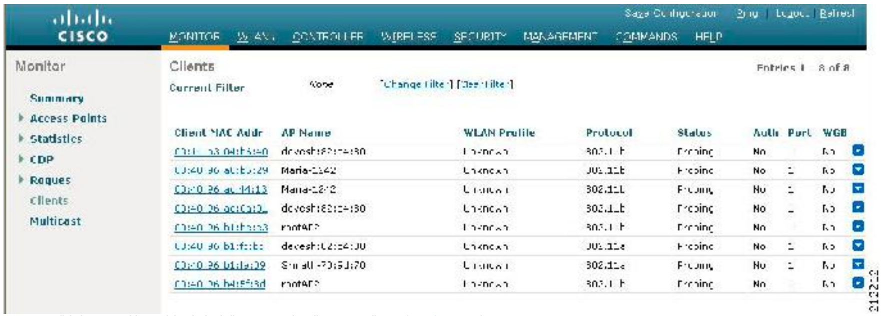
Step 12 Repeat this procedure if you want to configure video parameters for another radio band (802.11a or 802.11b/g).

Using the GUI to View Voice and Video Settings

To view voice and video settings using the controller GUI, follow these steps:

Step 1 Choose Monitor > Clients to open the Clients page (see Figure 4-33).

Figure 4-33 Clients Page



Clients

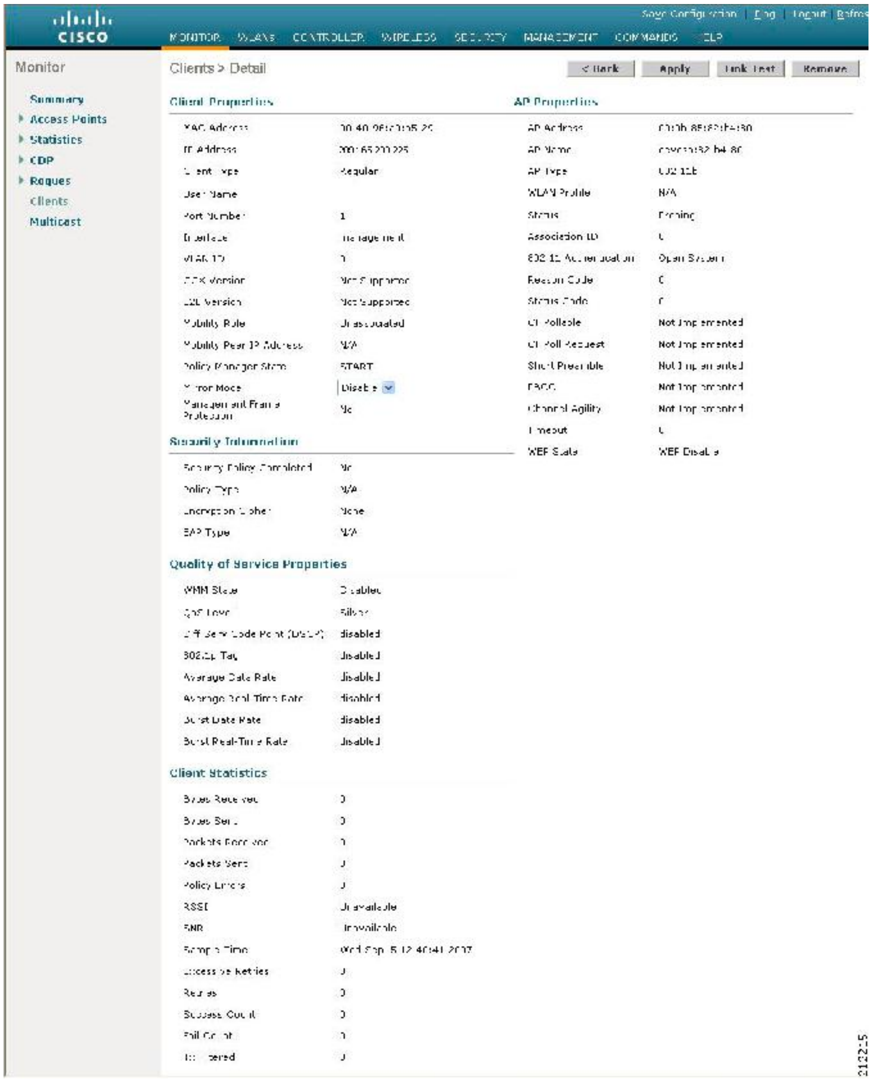
Entries 1 - 8 of 8

Current Filter None [Change Filter] [Clear Filter]

Client MAC Addr	AP Name	WLAN Profile	Protocol	Status	Auth	Port	WGB
[illegible]:04:f5:40	devesh:82:24:30	Unknown	802.11b	Probing	No		No
00:40:96:a6:b5:29	Maria-1142	Unknown	802.11b	Probing	No	1	No
00:40:96:a6:44:13	Maria-1242	Unknown	802.11b	Probing	No	1	No
00:40:96:a6:c0:[illegible]	devesh:82:24:30	Unknown	802.11b	Probing	No	1	No
00:40:96:b1:b5:c3	rootAP2	Unknown	802.11b	Probing	No		No
00:40:96:b1:f[illegible]:b[illegible]	devesh:82:24:30	Unknown	802.11a	Probing	No	1	No
00:40:96:b1:[illegible]:09	Small -70:5[illegible]:70	Unknown	802.11a	Probing	No	1	No
00:40:96:b4:f5:3d	rootAP2	Unknown	802.11b	Probing	No		No

Step 2 Click the MAC address of the desired client to open the Clients > Detail page (see Figure 4-34).

Figure 4-34 Clients > Detail Page



Clients > Detail

Client Properties

MAC Address	00:40:96:a[illegible]:05:26
IP Address	209.165.200.225
Client Type	Regular
User Name	
Port Number	1
Interface	management
VLAN ID	0
CCX Version	Not Supported
E2E Version	Not Supported
Mobility Role	Unassociated
Mobility Peer IP Address	N/A
Policy Manager State	START
Mirror Mode	Disable
Management Frame Protection	No

AP Properties

AP Address	00:0b:85:[illegible]:f4:80
AP Name	[illegible]:32:b4:80
AP Type	802.11b
WLAN Profile	N/A
Status	Probing
Association ID	0
802.11 Authentication	Open System
Reason Code	0
Status Code	0
CF Pollable	Not Implemented
CF Poll Request	Not Implemented
Short Preamble	Not Implemented
PBCC	Not Implemented
Channel Agility	Not Implemented
Timeout	0
WEP State	WEP Disable

Security Information

Security Policy Completed	No
Policy Type	N/A
Encryption Cipher	None
EAP Type	N/A

Quality of Service Properties

WMM State	Disabled
QoS Level	Silver
Diff Serv Code Point (DSCP)	disabled
802.1p Tag	disabled
Average Data Rate	disabled
Average Real-Time Rate	disabled
Burst Data Rate	disabled
Burst Real-Time Rate	disabled

Client Statistics

Bytes Received	0
Bytes Sent	0
Packets Received	0
Packets Sent	0
Policy Errors	0
RSSI	Unavailable
SNR	Unavailable
Sample Time	Wed Sep 5 12:40:41 2007
Excessive Retries	0
Retries	0
Success Count	0
Fail Count	0
Tx Filtered	0

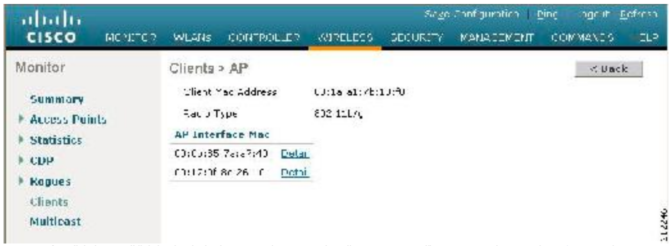
This page shows the U-APSD status (if enabled) for this client under Quality of Service Properties.

Step 3 Click Back to return to the Clients page.

Step 4 See the TSM statistics for a particular client and the access point to which this client is associated as follows:

a. Hover your cursor over the blue drop-down arrow for the desired client and choose 802.11aTSM or 802.11b/g TSM. The Clients > AP page appears (see Figure 4-35).

Figure 4-35 Clients > AP Page



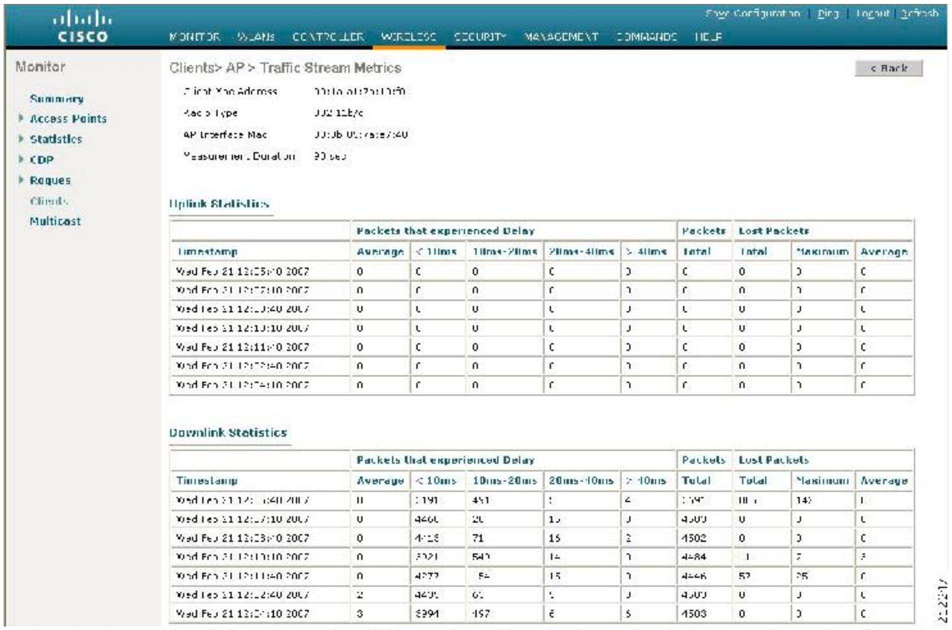
Clients > AP

Client Mac Address	00:1a:a1:7b:10:90
Radio Type	802.11b/g

AP Interface Mac	
00:0b:85:7e:e7:40	Detail
00:17:0f:8c:26:[illegible]0	Detail

b. Click the Detail link for the desired access point to open the Clients > AP > Traffic Stream Metrics page (see Figure 4-36).

Figure 4-36 Clients > AP > Traffic Stream Metrics Page


CISCO
Save Configuration | Ping | Logout | Refresh
MONITOR WLANs CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP
Monitor
Summary
Access Points
Statistics
CDP
Rogues
Clients
Multicast
< Back
212217

Clients> AP > Traffic Stream Metrics

Client Mac Address 00:1a:a1:[illegible]
Radio Type 802.11b/g
AP Interface Mac 00:0b:85:[illegible]:e7:40
Measurement Duration 90 sec

Uplink Statistics

	Packets that experienced Delay					Packets	Lost Packets		
Timestamp	Average	< 10ms	10ms-20ms	20ms-40ms	> 40ms	Total	Total	Maximum	Average
Wed Feb 21 12:25:40 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:27:10 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:[illegible]:40 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:1[illegible]:10 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:11:40 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:[illegible]:40 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:[illegible]:10 2007	0	0	0	0	0	0	0	0	0

Downlink Statistics

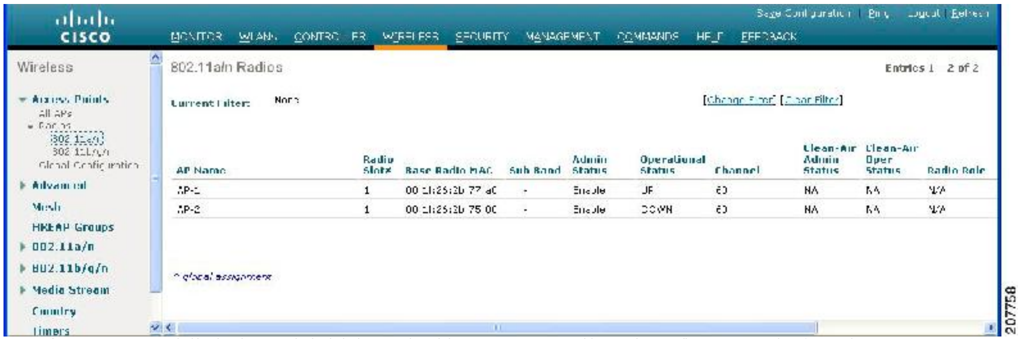
	Packets that experienced Delay					Packets	Lost Packets		
Timestamp	Average	< 10ms	10ms-20ms	20ms-40ms	> 40ms	Total	Total	Maximum	Average
Wed Feb 21 12:[illegible]:40 2007	0	[illegible]191	451	[illegible]	4	[illegible]	[illegible]	14[illegible]	[illegible]
Wed Feb 21 12:27:10 2007	0	4460	20	15	0	4500	0	0	0
Wed Feb 21 12:[illegible]:40 2007	0	4418	71	15	2	4502	0	0	0
Wed Feb 21 12:[illegible]:10 2007	0	3921	540	14	0	4484	1	7	7
Wed Feb 21 12:[illegible]:40 2007	0	4277	[illegible]54	15	0	4446	57	25	0
Wed Feb 21 12:[illegible]:40 2007	2	4435	65	5	0	4500	0	0	0
Wed Feb 21 12:[illegible]:10 2007	3	3994	497	6	5	4503	0	0	0

This page shows the TSM statistics for this client and the access point to which it is associated. The statistics are shown in 90-second intervals. The timestamp text box shows the specific interval when the statistics were collected.

Step 5 See the TSM statistics for a particular access point and a particular client associated to this access point, as follows:

a. Choose Wireless > **Access Points** > **Radios** > 802.11a/n or 802.11b/g/n. The 802.11a/n Radios or 802.11b/g/n Radios page appears (see Figure 4-37).

Figure 4-37 802.11a/n Radios Page



802.11a/n Radios

Entries 1 - 2 of 2

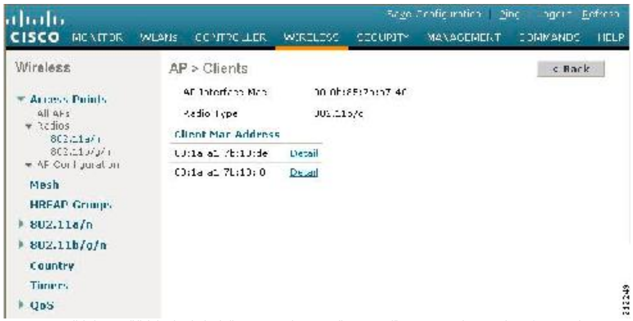
Current Filter: None [Change Filter] [Clear Filter]

AP Name	Radio Slot#	Base Radio MAC	Sub Band	Admin Status	Operational Status	Channel	Clean-Air Admin Status	Clean-Air Oper Status	Radio Role
AP-1	1	00:1b:25:2b:77:a0	-	Enable	UP	60	NA	NA	N/A
AP-2	1	00:1b:25:2b:75:00	-	Enable	DOWN	60	NA	NA	N/A

* global assignment

b. Hover your cursor over the blue drop-down arrow for the desired access point and choose 802.11aTSM or 802.11b/g TSM. The AP > Clients page appears (see Figure 4-38).

Figure 4-38 AP > Clients Page



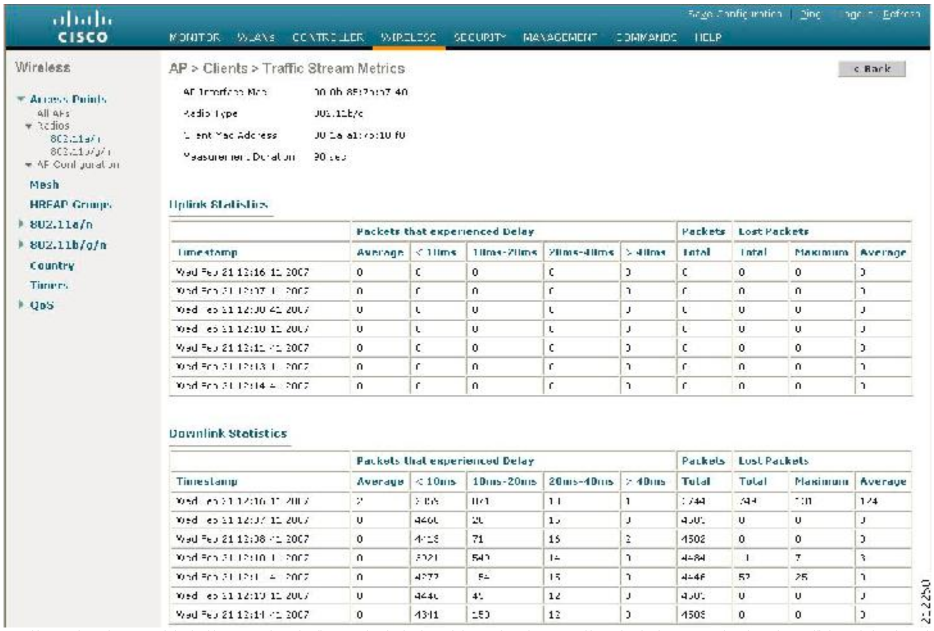
AP > Clients

AP Interface Mac 00:0b:85:[illegible]:7 40
Radio Type 802.11b/g

Client Mac Address	
00:1a:a1:7b:10:de	Detail
00:1a:a1:7b:10:[illegible]0	Detail

c. Click the Detail link for the desired client to open the AP > Clients > Traffic Stream Metrics page (see Figure 4-39).

Figure 4-39 AP > Clients > Traffic Stream Metrics Page



AP > Clients > Traffic Stream Metrics

AP Interface Mac 00:0b:85:[illegible]:40
Radio Type 802.11b/g
Client Mac Address 00:1a:a1:[illegible]:10:f0
Measurement Duration 90 sec

Uplink Statistics

	Packets that experienced Delay					Packets	Lost Packets		
Timestamp	Average	< 10ms	10ms-20ms	20ms-40ms	> 40ms	Total	Total	Maximum	Average
Wed Feb 21 12:16:11 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:07:11 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:08:41 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:10:11 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:11:41 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:13:11 2007	0	0	0	0	0	0	0	0	0
Wed Feb 21 12:14:41 2007	0	0	0	0	0	0	0	0	0

Downlink Statistics

	Packets that experienced Delay					Packets	Lost Packets		
Timestamp	Average	< 10ms	10ms-20ms	20ms-40ms	> 40ms	Total	Total	Maximum	Average
Wed Feb 21 12:16:11 2007	2	[illegible]	1141	11	1	3744	344	301	174
Wed Feb 21 12:07:11 2007	0	4460	26	15	0	4501	0	0	0
Wed Feb 21 12:08:41 2007	0	4418	71	15	2	4502	0	0	0
Wed Feb 21 12:10:11 2007	0	3921	549	14	0	4484	1	7	3
Wed Feb 21 12:11:41 2007	0	4277	154	15	0	4446	57	25	0
Wed Feb 21 12:13:11 2007	0	4446	45	12	0	4501	0	0	0
Wed Feb 21 12:14:41 2007	0	4341	150	12	0	4503	0	0	0

This page shows the TSM statistics for this access point and a client associated to it. The statistics are shown in 90-second intervals. The timestamp text box shows the specific interval when the statistics were collected.

Using the GUI to Configure Media Parameters

To configure Media parameters using the controller GUI, follow these steps:

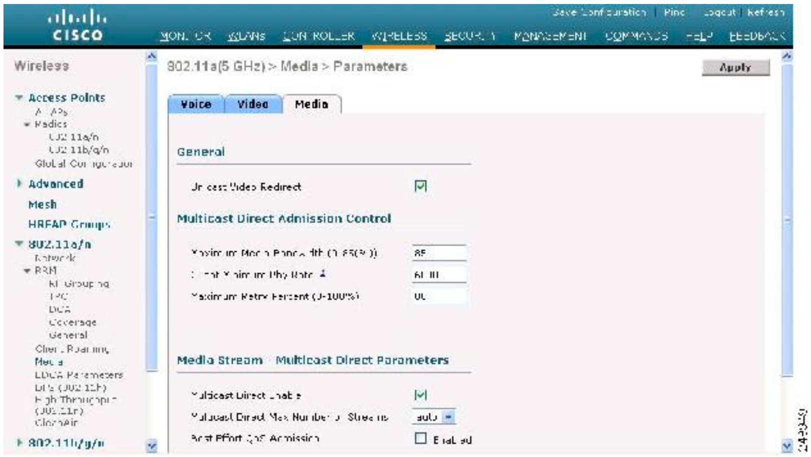
Step 1 Make sure that the WLAN is configured for WMM and the Gold QoS level.

Step 2 Disable all WLANs with WMM enabled and click **Apply** .

Step 3 Choose Wireless and then Network under 802.11a/n or 802.11b/g/n, unselect the 802.11a (or 802.11b/g) Network Status check box, and click Apply to disable the radio network.

Step 4 Choose Wireless > 802.11a/n or 802.11b/g/n > Media. The 802.11a (or 802.11b) > Media > Parameters page appears (see Figure 4-40).

Figure 4-40 802.11a > Media Parameters Page



802.11a(5 GHz) > Media > Parameters

General

Unicast Video Redirect ☑

Multicast Direct Admission Control

Maximum Media Bandwidth (0-85(%)) 85
Client Minimum Phy Rate 6000
Maximum Retry Percent (0-100%) 80

Media Stream - Multicast Direct Parameters

Multicast Direct Enable ☑
Multicast Direct Max Number of Streams auto
Best Effort QoS Admission □ Enabled

Step 5 Choose the Media tab to open the Media page.

Step 6 Select the Unicast Video Redirect check box to enable Unicast Video Redirect. The default value is disabled.

Step 7 In the Maximum Media Bandwidth (0-85%) text box, enter the percentage of the maximum bandwidth to be allocated for media applications on this radio band. Once the client reaches the specified value, the access point rejects new calls on this radio band.

The default value is 85%; valid values are from 0 to 85%.

Step 8 In the Client Phy Rate text box, enter the value for the rate in kilobits per second at which the client operates.

Step 9 In the Maximum Retry Percent (0-100%) text box, enter the percentage of the maximum retry. The default value is 80.

Step 10 Select the Multicast Direct Enable check box to enable the Multicast Direct Enable text box. The default value is enabled.

Step 11 From the Multicast Direct Max Number of Streams drop-down list, choose the maximum number of allowed multicast direct streams per radio. The range is 0 to 20 and auto. The default value is set to auto.

Step 12 If you want to enable the best radio queue for this radio, select the Best Effort QoS Admission check box. The default value is disabled.

Using the CLI to Configure SIP Based CAC

To configure the SIP based CAC using the controller CLI, follow these steps:

Step 1 Set the voice to the platinum QoS level by entering this command:

```
config wlan qos wlan-id Platinum
```

Step 2 Enable the call-snooping feature for a particular WLAN by entering this command:

```
config wlan call-snoop enable wlan-id
```

Step 3 Enable the ACM to this radio by entering this command:

```
config {802.11a | 802.11b} cac {voice | video} acm enable
```

Using the CLI to Configure Voice Parameters

Note Make sure that you perform the Using the CLI to Configure SIP Based CAC before you do this procedure.

To configure voice parameters using the controller CLI, follow these steps:

Step 1 See all of the WLANs configured on the controller by entering this command:

show wlan summary

Step 2 Make sure that the WLAN that you are planning to modify is configured for WMM and the QoS level is set to Platinum by entering this command:

show wlan wlan_id

Step 3 Disable all WLANs with WMM enabled prior to changing the voice parameters by entering command:

config wlan disable wlan_id

Step 4 Disable the radio network by entering this command:

config {802.11a | 802.11b} disable network

Step 5 Save your settings by entering this command:

save config

Step 6 Enable or disable bandwidth-based voice CAC for the 802.11a or 802.11b/g network by entering this command:

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

Step 7 Set the percentage of maximum bandwidth allocated to clients for voice applications on the 802.11a or 802.11b/g network by entering this command:

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

The bandwidth range is 5 to 85%, and the default value is 75%. Once the client reaches the value specified, the access point rejects new calls on this network.

Step 8 Set the percentage of maximum allocated bandwidth reserved for roaming voice clients by entering this command:

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

The bandwidth range is 0 to 25%, and the default value is 6%. The controller reserves this much bandwidth from the maximum allocated bandwidth for roaming voice clients.

Step 9 Configure the codec name and sample interval as parameters and to calculate the required bandwidth per call by entering this command:

config {802.11a | 802.11b} cac voice sip codec {g711 | g729} sample-interval number_msecs

Step 10 Configure the bandwidth that is required per call by entering this command:

config {802.11a | 802.11b} cac voice sip bandwidth bandwidth_kbps sample-interval number_msecs

Step 11 Reenable all WLANs with WMM enabled by entering this command:

config wlan enable wlan_id

Step 12 Reenable the radio network by entering this command:

config {802.11a | 802.11b} enable network

Step 13 Save your changes by entering this command:

save config

Using the CLI to Configure Video Parameters

Note Make sure that the Using the CLI to Configure SIP Based CAC are met.

To configure video parameters using the controller CLI, follow these steps:

Step 1 See all of the WLANs configured on the controller by entering this command:

show wlan summary

Step 2 Make sure that the WLAN that you are planning to modify is configured for WMM and the QoS level is set to Gold by entering this command:

show wlan wlan_id

Step 3 Disable all WLANs with WMM enabled prior to changing the video parameters by entering this command:

config wlan disable wlan_id

Step 4 Disable the radio network by entering this command:

config {802.11a | 802.11b} disable network

Step 5 Save your settings by entering this command:

save config

Step 6 Enable or disable video CAC for the 802.11a or 802.11b/g network by entering this command:

config {802.11a | 802.11b} cac video acm {enable | disable}

Step 7 Set the percentage of maximum bandwidth allocated to clients for video applications on the 802.11a or 802.11b/g network by entering this command:

config {802.11a | 802.11b} cac video max-bandwidth bandwidth

The bandwidth range is 5 to 85%, and the default value is 5%. However, the maximum RF bandwidth cannot exceed 85% for voice and video. Once the client reaches the value specified, the access point rejects new calls on this network.

Note If this parameter is set to zero (0), the controller assumes that you do not want to do any bandwidth allocation and, therefore, allows all bandwidth requests.

Step 8 Process or ignore the TSPEC inactivity timeout received from an access point by entering this command:

config {802.11a | 802.11b} cac video **tspec-inactivity-timeout** {enable | ignore}

Step 9 Reenable all WLANs with WMM enabled by entering this command:

config wlan enable wlan_id

Step 10 Reenable the radio network by entering this command:

config {802.11a | 802.11b} enable network

Step 11 Save your settings by entering this command:

save config

Using the CLI to View Voice and Video Settings

To view voice and video settings using the controller CLI, follow these steps:

Step 1 See the CAC configuration for the 802.11a or 802.11b/g network by entering this command:

show {802.11a | show 802.11b}

Step 2 See the CAC statistics for a particular access point by entering this command:

show ap stats {802.11a | 802.11b} ap_name

Information similar to the following appears:

```
Call Admission Control (CAC) Stats
Voice Bandwidth in use(% of config bw)......... 0
Total channel MT free........................ 0
Total voice MT free.......................... 0
Na Direct.................................... 0
Na Roam...................................... 0
Video Bandwidth in use(% of config bw)......... 0
Total num of voice calls in progress........... 0
Num of roaming voice calls in progress......... 0
Total Num of voice calls since AP joined....... 0
Total Num of roaming calls since AP joined..... 0
Total Num of exp bw requests received.......... 5
Total Num of exp bw requests admitted.......... 2

Num of voice calls rejected since AP joined...... 0
Num of roam calls rejected since AP joined..... 0
Num of calls rejected due to insufficient bw....0
Num of calls rejected due to invalid params.... 0
Num of calls rejected due to PHY rate.......... 0
Num of calls rejected due to QoS policy..... 0
```

In the example above, “MT” is medium time, “Na” is the number of additional calls, and “exp bw” is expedited bandwidth.

Note Suppose an AP has to be rebooted when a voice client associated with the AP is on an active call. After the AP is rebooted, the client continues to maintain the call, and during the time the AP is down, the database is not refreshed by the controller. Therefore, we recommend that all active calls are ended before the AP is taken down.

Step 3 See the U-APSD status for a particular client by entering this command:

show client detail client_mac

Step 4 See the TSM statistics for a particular client and the access point to which this client is associated by entering this command:

show client tsm {802.11a | 802.11b} client_mac {ap_mac | all}

The optional all command shows all access points to which this client has associated. Information similar to the following appears:

```
Client Interface Mac: 00:01:02:03:04:05
Measurement Duration: 90 seconds

Timestamp 1st Jan 2006, 06:35:80
UpLink Stats
================
Average Delay (5sec intervals)............................35
Delay less than 10 ms.....................................20
Delay bet 10 - 20 ms......................................20
Delay bet 20 - 40 ms......................................20
Delay greater than 40 ms..................................20
Total packet Count.........................................80
Total packet lost count (5sec).............................10
Maximum Lost Packet count(5sec)............................5
Average Lost Packet count(5secs)...........................2
DownLink Stats
================
Average Delay (5sec intervals)............................35
Delay less than 10 ms.....................................20
Delay bet 10 - 20 ms......................................20
Delay bet 20 - 40 ms......................................20
Delay greater than 40 ms..................................20
Total packet Count.........................................80
Total packet lost count (5sec).............................10
Maximum Lost Packet count(5sec)............................5
Average Lost Packet count(5secs)...........................2
```

Note The statistics are shown in 90-second intervals. The timestamp text box shows the specific interval when the statistics were collected.

Note To clear the TSM statistics for a particular access point or all the access points to which this client is associated, enter the **clear** client tsm {802.11a | 802.11b} client_mac {ap_mac | all} command.

Step 5 See the TSM statistics for a particular access point and a particular client associated to this access point by entering this command:

show ap stats {802.11a | 802.11b} ap_name tsm {client_mac | all}

The optional all command shows all clients associated to this access point. Information similar to the following appears:

```
AP Interface Mac: 00:0b:85:01:02:03
Client Interface Mac: 00:01:02:03:04:05
Measurement Duration: 90 seconds

Timestamp 1st Jan 2006, 06:35:80
UpLink Stats
================
Average Delay (5sec intervals)............................35
Delay less than 10 ms.....................................20
Delay bet 10 - 20 ms......................................20
Delay bet 20 - 40 ms......................................20
Delay greater than 40 ms..................................20
Total packet Count.........................................80
Total packet lost count (5sec).............................10
Maximum Lost Packet count(5sec)............................5
Average Lost Packet count(5secs)...........................2
DownLink Stats
================
Average Delay (5sec intervals)............................35
Delay less than 10 ms.....................................20
Delay bet 10 - 20 ms......................................20
Delay bet 20 - 40 ms......................................20
Delay greater than 40 ms..................................20
Total packet Count.........................................80
Total packet lost count (5sec).............................10
Maximum Lost Packet count(5sec)............................5
Average Lost Packet count(5secs)...........................2
```

Note The statistics are shown in 90-second intervals. The timestamp text box shows the specific interval when the statistics were collected.

Step 6 Enable or disable debugging for call admission control (CAC) messages, events, or packets by entering this command:

debug cac { **all** | **event** | **packet** }{ **enable** | **disable** }

where **all** configures debugging for all CAC messages, **event** configures debugging for all CAC events, and **packet** configures debugging for all CAC packets.

Configuring EDCA Parameters

Enhanced distributed channel access (EDCA) parameters are designed to provide preferential wireless channel access for voice, video, and other quality-of-service (QoS) traffic. Follow the instructions in this section to configure EDCA parameters using the controller GUI or CLI.

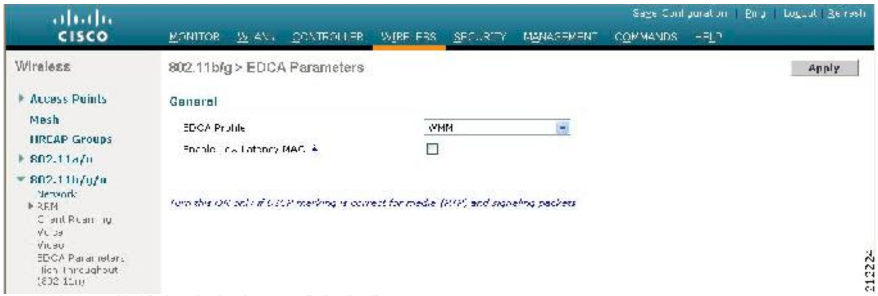
Using the GUI to Configure EDCA Parameters

To configure EDCA parameters using the controller GUI, follow these steps:

Step 1 Choose Wireless and then Network under 802.11a/n or 802.11b/g/n, unselect the 802.11a (or 802.11b/g) Network Status check box, and click Apply to disable the radio network.

Step 2 Choose EDCA Parameters under 802.11a/n or 802.11b/g/n. The 802.11a (or 802.11b/g) > EDCA Parameters page appears (see Figure 4-41).

Figure 4-41 802.11a > EDCA Parameters Page



802.11b/g > EDCA Parameters

General

EDCA Profile: WMM

Enable Low Latency MAC: ☐

Turn this ON only if DSCP marking is correct for media (RTP) and signaling packets

Step 3 Choose one of the following options from the EDCA Profile drop-down list:

- **WMM** —Enables the Wi-Fi Multimedia (WMM) default parameters. This is the default value. Choose this option when voice or video services are not deployed on your network.
- **Spectralink Voice Priority** —Enables SpectraLink voice priority parameters. Choose this option if SpectraLink phones are deployed on your network to improve the quality of calls.
- **Voice Optimized** —Enables EDCA voice-optimized profile parameters. Choose this option when voice services other than SpectraLink are deployed on your network.
- **Voice & Video Optimized** —Enables EDCA voice- and video-optimized profile parameters. Choose this option when both voice and video services are deployed on your network.

Note If you deploy video services, admission control (ACM) must be disabled.

Step 4 If you want to enable MAC optimization for voice, select the **Enable Low Latency MAC** check box. Otherwise, leave this check box unselected, which is the default value. This feature enhances voice performance by controlling packet retransmits and appropriately aging out voice packets on lightweight access points, which improves the number of voice calls serviced per access point.

Note We do not recommend you to enable low latency MAC. You should enable low latency MAC only if the WLAN allows WMM clients. If WMM is enabled, then low latency MAC can be used with any of the EDCA profiles. See the "Configuring QoS Enhanced BSS" section for instructions on enabling WMM.

Step 5 Click Apply to commit your changes.

Step 6 To reenable the radio network, choose Network under 802.11a/n or 802.11b/g/n, select the 802.11a (or 802.11b/g) Network Status check box, and click Apply.

Step 7 Click Save Configuration to save your changes.

Using the CLI to Configure EDCA Parameters

To configure EDCA parameters using the controller CLI, follow these steps:

Step 1 Disable the radio network by entering this command:

config {802.11a | 802.11b} disable network

Step 2 Save your settings by entering this command:

save config

Step 3 Enable a specific EDCA profile by entering this command:

config advanced {802.11a | 802.11b } **edca-parameters** *?*

where *?* is one of the following:

- wmm-default—Enables the Wi-Fi Multimedia (WMM) default parameters. This is the default value. Choose this option when voice or video services are not deployed on your network.
- svp-voice—Enables SpectraLink voice priority parameters. Choose this option if SpectraLink phones are deployed on your network to improve the quality of calls.
- optimized-voice—Enables EDCA voice-optimized profile parameters. Choose this option when voice services other than SpectraLink are deployed on your network.
- optimized-video-voice—Enables EDCA voice- and video-optimized profile parameters. Choose this option when both voice and video services are deployed on your network.

Note If you deploy video services, admission control (ACM) must be disabled.

Step 4 View the current status of MAC optimization for voice by entering this command:

show { **802.11a** | **802.11b** }

Information similar to the following appears:

```
Voice-mac-optimization...................Disabled
```

Step 5 Enable or disable MAC optimization for voice by entering this command:

config advanced { **802.11a** | **802.11b** } **voice-mac-optimization** { **enable** | **disable** }

This feature enhances voice performance by controlling packet retransmits and appropriately aging out voice packets on lightweight access points, which improves the number of voice calls serviced per access point. The default value is disabled.

Step 6 Reenable the radio network by entering this command:

config {802.11a | 802.11b} enable network

Step 7 Save your settings by entering this command:

save config

Configuring Cisco Discovery Protocol

The Cisco Discovery Protocol (CDP) is a device discovery protocol that runs on all Cisco-manufactured equipment. A device enabled with CDP sends out periodic interface updates to a multicast address in order to make itself known to neighboring devices.

The default value for the frequency of periodic transmissions is 60 seconds, and the default advertised time-to-live value is 180 seconds. The second and latest version of the protocol, CDPv2, introduces new time-length-values (TLVs) and provides a reporting mechanism that allows for more rapid error tracking, which reduces downtime.

CDPv1 and CDPv2 are supported on the following devices:

- Cisco 5500, 4400, and 2100 Series Controllers

Note CDP is not supported on the controllers that are integrated into Cisco switches and routers, including those in the Catalyst 3750G Integrated Wireless LAN Controller Switch, the Cisco WiSM, and the Cisco 28/37/38xx Series Integrated Services Router. However, you can use the show ap cdp neighbors detail {Cisco_AP | all} command on these controllers in order to see the list of CDP neighbors for the access points that are connected to the controller.

- CAPWAP-enabled access points
- An access point connected directly to a Cisco 5500, 4400, or 2100 Series Controller

Note For Intelligent Power Management to work as expected, ensure that CDPv2 is enabled on the 2500 series WLCs.

This support enables network management applications to discover Cisco devices.

These TLVs are supported by both the controller and the access point:

- Device-ID TLV: 0x0001—The host name of the controller, the access point, or the CDP neighbor.
- Address TLV: 0x0002—The IP address of the controller, the access point, or the CDP neighbor.
- Port-ID TLV: 0x0003—The name of the interface on which CDP packets are sent out.
- Capabilities TLV: 0x0004—The capabilities of the device. The controller sends out this TLV with a value of Host: 0x10, and the access point sends out this TLV with a value of Transparent Bridge: 0x02.
- Version TLV: 0x0005—The software version of the controller, the access point, or the CDP neighbor.
- Platform TLV: 0x0006—The hardware platform of the controller, the access point, or the CDP neighbor.

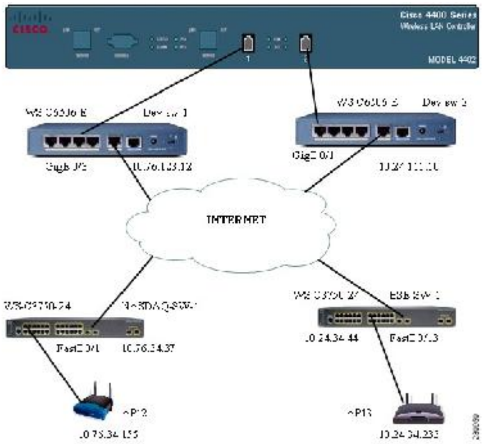
These TLVs are supported only by the access point:

- Full/Half Duplex TLV: 0x000b—The full- or half-duplex mode of the Ethernet link on which CDP packets are sent out. This TLV is not supported on access points that are connected directly to a 5500, 4400, or 2100 series controller.
- Power Consumption TLV: 0x0010—The maximum amount of power consumed by the access point. This TLV is not supported on access points that are connected directly to a 5500, 4400, or 2100 series controller.

You can configure CDP and view CDP information using the GUI in controller software release 4.1 or later or the CLI in controller software release 4.0 or later releases. Figure 4-42 shows a sample network that you can use as a reference when performing the procedures in this section.

Note Changing the CDP configuration on the controller does not change the CDP configuration on the access points that are connected to the controller. You must enable and disable CDP separately for each access point.

Figure 4-42 Sample Network Illustrating CDP

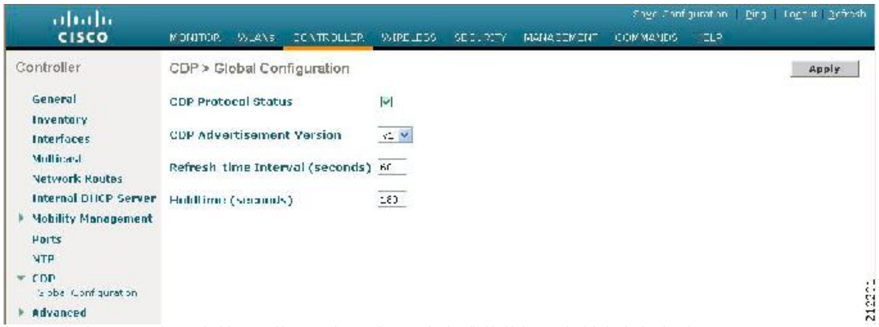


Using the GUI to Configure Cisco Discovery Protocol

To configure CDP using the controller GUI, follow these steps:

Step 1 Choose Controller > CDP > Global Configuration to open the CDP > Global Configuration page (see Figure 4-43).

Figure 4-43 CDP > Global Configuration Page



CDP > Global Configuration

CDP Protocol Status ☑

CDP Advertisement Version v1

Refresh time Interval (seconds) 60

Holdtime (seconds) 180

Step 2 Select the CDP Protocol Status check box to enable CDP on the controller or unselect it to disable this feature. The default value is selected.

Note Enabling or disabling this feature is applicable to all controller ports.

Step 3 From the CDP Advertisement Version drop-down list, choose v1 or v2 to specify the highest CDP version supported on the controller. The default value is v1.

Step 4 In the Refresh-time Interval text box, enter the interval at which CDP messages are to be generated. The range is 5 to 254 seconds, and the default value is 60 seconds.

Step 5 In the Holdtime text box, enter the amount of time to be advertised as the time-to-live value in generated CDP packets. The range is 10 to 255 seconds, and the default value is 180 seconds.

Step 6 Click Apply to commit your changes.

Step 7 Click Save Configuration to save your changes.

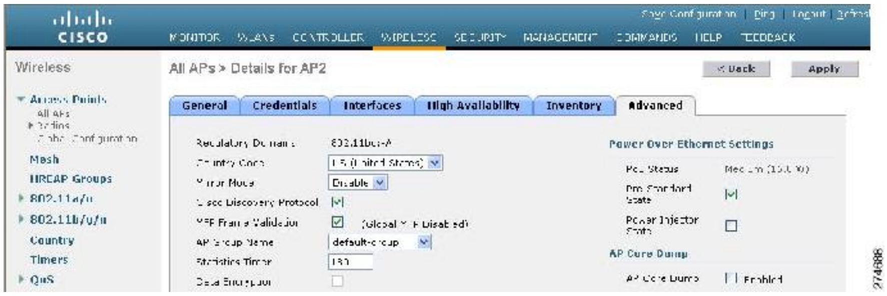
Step 8 Perform one of the following:

- To enable or disable CDP on a specific access point, follow these steps:

Choose Wireless > Access Points > All APs to open the All APs page.

1. Click the link for the desired access point.
2. Choose the **Advanced** tab to open the All APs > Details for (Advanced) page (see Figure 4-44).

Figure 4-44 All APs > Details for (Advanced) Page



All APs > Details for AP2

Regulatory Domains 802.11bg:-A

Country Code US (United States)

Monitor Mode Disable

Cisco Discovery Protocol ☑

MFP Frame Validation ☑ (Global MFP Disabled)

AP Group Name default-group

Statistics Timer 180

Data Encryption □

Power Over Ethernet Settings

PoE Status Medium (15.4 W)

Pre-Standard State ☑

Power Injector State □

AP Core Dump

AP Core Dump □ Enabled

1. Select the Cisco Discovery Protocol check box to enable CDP on this access point or unselect it to disable this feature. The default value is enabled.

Note If CDP is disabled in Step 2, a message indicating that the Controller CDP is disabled appears.

1. Click Apply to commit your changes.

- To enable or disable CDP on all access points currently associated to the controller, follow these steps:

Choose Wireless > Access Points > Global Configuration to open the Global Configuration page.

1. Select the **CDP State** check box to enable CDP on all access points associated to the controller or unselect it to disable CDP on all access points. The default value is selected.
2. Click **Apply** to commit your changes.

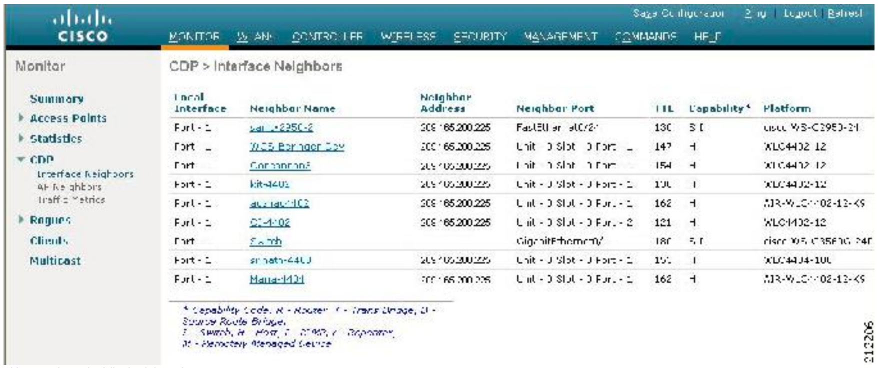
Step 9 Click Save Configuration to save your changes.

Using the GUI to View Cisco Discovery Protocol Information

To view CDP information using the controller GUI, follow these steps:

Step 1 Choose Monitor > CDP > Interface Neighbors to open the CDP > Interface Neighbors page appears (see Figure 4-45).

Figure 4-45 CDP > Interface Neighbors Page



CDP > Interface Neighbors

Local Interface	Neighbor Name	Neighbor Address	Neighbor Port	TTL	Capability*	Platform
Port - 1	[illegible]-2950-2	209.165.200.225	FastEthernet0/2	130	S I	cisco WS-C2950-24
Port - 1	WCS-Bangalore-Dev	209.165.200.225	Unit - 0 Slot - 0 Port - 1	147	H	WLC4402-12
Port - 1	[illegible]	209.165.200.225	Unit - 0 Slot - 0 Port - 1	154	H	WLC4402-12
Port - 1	kit-4401	209.165.200.225	Unit - 0 Slot - 0 Port - 1	130	H	WLC4402-12
Port - 1	[illegible]-4402	209.165.200.225	Unit - 0 Slot - 0 Port - 1	162	H	AIR-WLC4402-12-K9
Port - 1	[illegible]-4402	209.165.200.225	Unit - 0 Slot - 0 Port - 2	121	H	WLC4402-12
Port - 1	Switch		GigabitEthernet0/	180	S I	cisco WS-C3560G-24P
Port - 1	[illegible]-4400	209.165.200.225	Unit - 0 Slot - 0 Port - 1	151	H	WLC4404-100
Port - 1	Mana-4404	209.165.200.225	Unit - 0 Slot - 0 Port - 1	162	H	AIR-WLC4402-12-K9

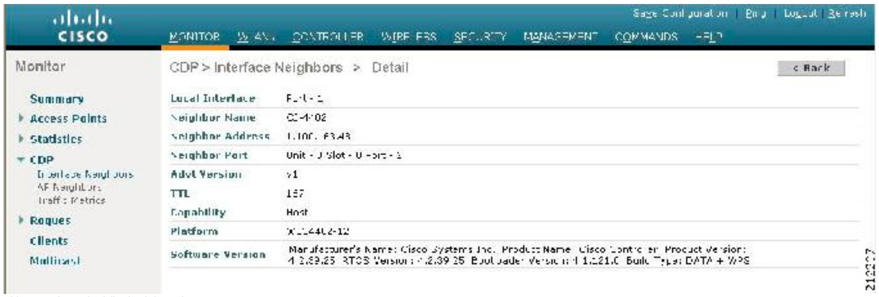
* Capability Code: R - Router, T - Trans Bridge, B - Source Route Bridge, S - Switch, H - Host, I - IGMP, r - Repeater, M - Remotely Managed Device

This page shows the following information:

- The controller port on which the CDP packets were received
- The name of each CDP neighbor
- The IP address of each CDP neighbor
- The port used by each CDP neighbor for transmitting CDP packets
- The time left (in seconds) before each CDP neighbor entry expires
- The functional capability of each CDP neighbor, defined as follows: R - Router, T - Trans Bridge, B - Source Route Bridge, S - Switch, H - Host, I - IGMP, r - Repeater, or M - Remotely Managed Device
- The hardware platform of each CDP neighbor device

Step 2 Click the name of the desired interface neighbor to see more detailed information about each interface's CDP neighbor. The CDP > Interface Neighbors > Detail page appears (see Figure 4-46).

Figure 4-46 CDP > Interface Neighbors > Detail Page



CDP > Interface Neighbors > Detail

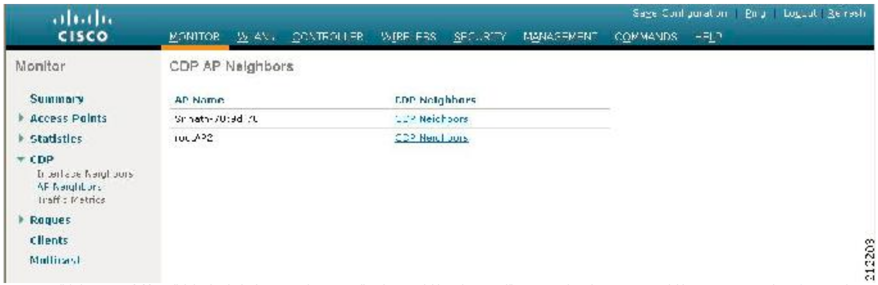
Local Interface	Port - 1
Neighbor Name	C3-4402
Neighbor Address	1.100.63.43
Neighbor Port	Unit - 0 Slot - 0 Port - 1
Advt Version	v1
TTL	157
Capability	Host
Platform	AIR-WLC4402-12
Software Version	Manufacturer's Name: Cisco Systems Inc. Product Name: Cisco Controller Product Version: 4.2.39.25 RTOS Version: 4.2.39.25 Bootloader Version: 1.221.0 Build Type: DATA + WPS

This page shows the following information:

- The controller port on which the CDP packets were received
- The name of the CDP neighbor
- The IP address of the CDP neighbor
- The port used by the CDP neighbor for transmitting CDP packets
- The CDP version being advertised (v1 or v2)
- The time left (in seconds) before the CDP neighbor entry expires
- The functional capability of the CDP neighbor, defined as follows: Router, Trans Bridge, Source Route Bridge, Switch, Host, IGMP, Repeater, or Remotely Managed Device
- The hardware platform of the CDP neighbor device
- The software running on the CDP neighbor

Step 3 Choose AP Neighbors to see a list of CDP neighbors for all access points connected to the controller. The CDP AP Neighbors page appears (see Figure 4-47).

Figure 4-47 CDP AP Neighbors Page

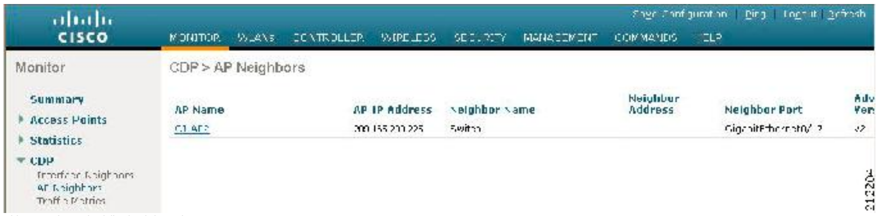


CDP AP Neighbors

AP Name	CDP Neighbors
[illegible]	CDP Neighbors
[illegible]AP2	CDP Neighbors

Step 4 Click the **CDP Neighbors** link for the desired access point to see a list of CDP neighbors for a specific access point. The CDP > AP Neighbors page appears (see Figure 4-48).

Figure 4-48 CDP > AP Neighbors Page


Save Configuration | Ping | Logout | Refresh
MONITOR WLANs CONTROLLER WIRELESS SECURITY MANAGEMENT COMMANDS HELP
Monitor
Summary
Access Points
Statistics
CDP
Interface Neighbors
AP Neighbors
Traffic Metrics
212204

CDP > AP Neighbors

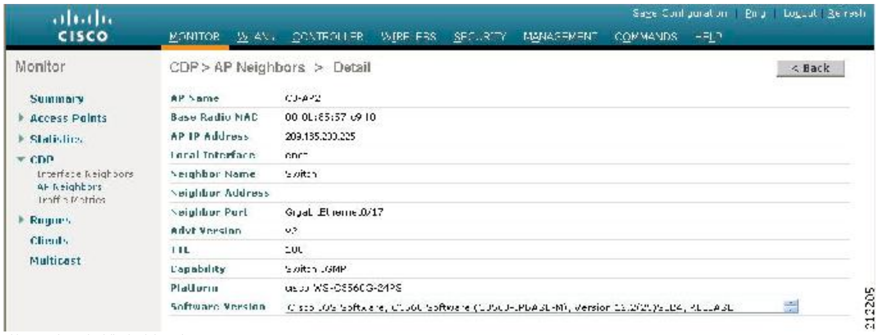
AP Name	AP IP Address	Neighbor Name	Neighbor Address	Neighbor Port	Adv Ver
CJ-AP2	209.135.200.225	Switch		GigabitEthernet0/17	v2

This page shows the following information:

- The name of each access point
- The IP address of each access point
- The name of each CDP neighbor
- The IP address of each CDP neighbor
- The port used by each CDP neighbor
- The CDP version being advertised (v1 or v2)

Step 5 Click the name of the desired access point to see detailed information about an access point's CDP neighbors. The CDP > AP Neighbors > Detail page appears (see Figure 4-49).

Figure 4-49 CDP > AP Neighbors > Detail Page



CDP > AP Neighbors > Detail

AP Name	CJ-AP2
Base Radio MAC	00:0b:85:57:c9:10
AP IP Address	209.135.200.225
Local Interface	[illegible]
Neighbor Name	Switch
Neighbor Address	
Neighbor Port	GigabitEthernet0/17
Advt Version	v2
TTL	[illegible]
Capability	Switch IGMP
Platform	cisco WS-C3560G-24PS
Software Version	Cisco IOS Software, C3560 Software (C3560-IPBASE-M), Version 12.2(25)SEB4, RELEASE

This page shows the following information:

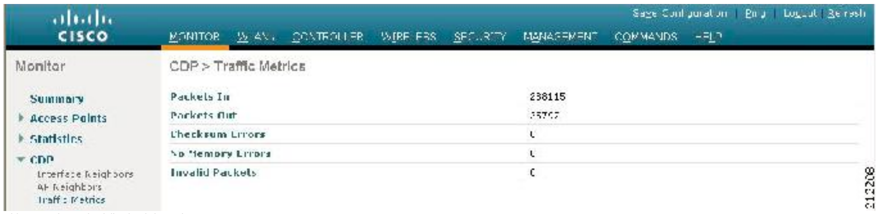
- The name of the access point
- The MAC address of the access point's radio
- The IP address of the access point
- The interface on which the CDP packets were received
- The name of the CDP neighbor
- The IP address of the CDP neighbor
- The port used by the CDP neighbor
- The CDP version being advertised (v1 or v2)
- The time left (in seconds) before the CDP neighbor entry expires
- The functional capability of the CDP neighbor, defined as follows: R - Router, T - Trans Bridge,

B - Source Route Bridge, S - Switch, H - Host, I - IGMP, r - Repeater, or M - Remotely Managed Device

- The hardware platform of the CDP neighbor device
- The software running on the CDP neighbor

Step 6 Choose Traffic Metrics to see CDP traffic information. The CDP > Traffic Metrics page appears (see Figure 4-50).

Figure 4-50 CDP > Traffic Metrics Page



CDP > Traffic Metrics

Packets In 238115

Packets Out 35767

Checksum Errors 0

No Memory Errors 0

Invalid Packets 0

This page shows the following information:

- The number of CDP packets received by the controller
- The number of CDP packets sent from the controller
- The number of packets that experienced a checksum error
- The number of packets dropped due to insufficient memory
- The number of invalid packets

Using the CLI to Configure the Cisco Discovery Protocol

To configure CDP using the controller CLI, follow these steps:

Step 1 Enable or disable CDP on the controller by entering this command:

config cdp {enable | disable}

CDP is enabled by default.

Step 2 Specify the interval at which CDP messages are to be generated by entering this command:

config cdp timer seconds

The range is 5 to 254 seconds, and the default value is 60 seconds.

Step 3 Specify the amount of time to be advertised as the time-to-live value in generated CDP packets by entering this command:

config cdp holdtime seconds

The range is 10 to 255 seconds, and the default value is 180 seconds.

Step 4 Specify the highest CDP version supported on the controller by entering this command:

config cdp advertise {v1 | v2}

The default value is v1.

Step 5 Enable or disable CDP on all access points that are joined to the controller by entering the config ap cdp {enable | disable} all command.

The config ap cdp disable all command disables CDP on all access points that are joined to the controller and all access points that join in the future. CDP remains disabled on both current and future access points even after the controller or access point reboots. To enable CDP, enter the config ap cdp enable all command.

Note After you enable CDP on all access points joined to the controller, you may disable and then reenable CDP on individual access points using the command in Step 6. After you disable CDP on all access points joined to the controller, you may not enable and then disable CDP on individual access points.

Step 6 Enable or disable CDP on a specific access point by entering this command:

config ap cdp {enable | disable} Cisco_AP

Step 7 Save your changes by entering this command:

save config

Using the CLI to View Cisco Discovery Protocol Information

To obtain information about CDP neighbors on the controller using the controller CLI, follow these steps:

Step 1 See the status of CDP and to view CDP protocol information by entering this command:

show cdp

Step 2 See a list of all CDP neighbors on all interfaces by entering this command:

show cdp neighbors [detail]

The optional detail command provides detailed information for the controller's CDP neighbors.

Note This command shows only the CDP neighbors of the controller. It does not show the CDP neighbors of the controller's associated access points. Additional commands are provided below to show the list of CDP neighbors per access point.

Step 3 See all CDP entries in the database by entering this command:

show cdp entry all

Step 4 See CDP traffic information on a given port (for example, packets sent and received, CRC errors, and so on) by entering this command:

show cdp traffic

Step 5 See the CDP status for a specific access point by entering this command:

show ap cdp ap-name Cisco_AP

Step 6 See the CDP status for all access points that are connected to the controller by entering this command:

show ap cdp all

Step 7 See a list of all CDP neighbors for a specific access point by entering these commands:

- show ap cdp neighbors ap-name Cisco_AP
- show ap cdp neighbors detail Cisco_AP

Note The access point sends CDP neighbor information to the controller only when the information changes.

Step 8 See a list of all CDP neighbors for all access points connected to the controller by entering these commands:

- show ap cdp neighbors all
- show ap cdp neighbors detail all

Information similar to the following appears when you enter the show ap cdp neighbors all command:

```
AP Name AP IP Neighbor Name Neighbor IP Neighbor Port
-------- -------- ------------- ----------- -------------
AP0013.601c.0a0 10.76.108.123 6500-1 10.76.108.207 GigabitEthernet1/26
AP0013.601c.0b0 10.76.108.111 6500-1 10.76.108.207 GigabitEthernet1/27
AP0013.601c.0c0 10.76.108.125 6500-1 10.76.108.207 GigabitEthernet1/28
```

Information similar to the following appears when you enter the show ap cdp neighbors detail all command:

```
AP Name: AP0013.601c.0a0
AP IP Address: 10.76.108.125
----------------------------------
Device ID: 6500-1
Entry address(es): 10.76.108.207
Platform: cisco WS-C6506-E, Capabilities: Router Switch IGMP
Interface: Port - 1, Port ID (outgoing port): GigabitEthernet1/26
Holdtime: 157 sec
Version:
Cisco Internetwork Operating System Software IOS (tm) s72033_rp Software (s72033_rp-PSV-M), Version 12.2(18)SXD5, RELEASE SOFTWARE (fc3) Technical Support:
http://www.cisco.com/techsupport Copyright (c) 1986-2005 by cisco Systems, Inc. Compiled Fri 13-Ma
```

Note The access point sends CDP neighbor information to the controller only when the information changes.

To obtain CDP debug information for the controller using the controller CLI, follow these steps:

Step 1 Obtain debug information related to CDP packets by entering by entering this command:

debug cdp packets

Step 2 Obtain debug information related to CDP events by entering this command:

debug cdp events

Configuring RFID Tag Tracking

The controller enables you to configure radio-frequency identification (RFID) tag tracking. RFID tags are small wireless devices that are affixed to assets for real-time location tracking. They operate by advertising their location using special 802.11 packets, which are processed by access points, the controller, and the location appliance.

To know more about the tags supported by controller, see http://www.cisco.com/web/partners/pr46/pr147/ccx_wifi_tags.html . Some of the tags from these vendors comply with Cisco Compatible Extensions for RFID Tags. See Table 4-4 for details. The location appliance receives telemetry and chokepoint information from tags that are compliant with this CCX specification.

Table 4-4 Cisco Compatible Extensions for RFID Tags Summary

Partners	AeroScout		WhereNet	Pango (InnerWireless)
Product Name	T2	T3	Wheretag IV	V3
Telemetry				
Temperature	X	X	—	X
Pressure	—	—	—	—
Humidity	—	—	—	—
Status	—	—	—	—
Fuel	—	—	—	—
Quantity	—	—	—	—
Distance	—	—	—	—
Motion Detection	X	X	—	X
Number of Panic Buttons	1	2	0	1
Tampering		X	X	X
Battery Information	X	X	X	X
Multiple-Frequency Tags[3]	X	X	X	

[3] For chokepoint systems, note that the tag can work only with chokepoints coming from the same vendor.

Note The Network Mobility Services Protocol (NMSP) runs on location appliance software release 3.0 or later releases. In order for NMSP to function properly, the TCP port (16113) over which the controller and location appliance communicate must be open (not blocked) on any firewall that exists between these two devices. See the *Cisco Location Appliance Configuration Guide* for additional information on NMSP and RFID tags.

The Cisco-approved tags support these capabilities:

- **Information notifications** —Enable you to view vendor-specific and emergency information.
- **Information polling** —Enables you to monitor battery status and telemetry data. Many telemetry data types provide support for sensory networks and a large range of applications for RFID tags.
- **Measurement notifications** —Enable you to deploy chokepoints at strategic points within your buildings or campuses. Whenever an RFID tag moves to within a defined proximity of a chokepoint, the tag begins transmitting packets that advertise its location in relation to the chokepoint.

The number of tags supported varies depending on controller platform. Table 4-5 lists the number of tags supported per controller.

Table 4-5 RFID Tags Supported per Controller

Controller	Number of RFID Tags Supported
5508	2500
Cisco WiSM	5000
4404	2500
4402	1250
Catalyst 3750G Integrated Wireless LAN Controller Switch	1250
2106	500
Controller Network Module within the Cisco 28/37/38xx Series Integrated Services Routers	500

You can configure and view RFID tag tracking information through the controller CLI.

Using the CLI to Configure RFID Tag Tracking

To configure RFID tag tracking parameters using the controller CLI, follow these steps:

Step 1 Enable or disable RFID tag tracking by entering this command:

config rfid status { **enable** | **disable** }

The default value is enabled.

Step 2 Specify a static timeout value (between 60 and 7200 seconds) by entering this command:

config rfid timeout *seconds*

The static timeout value is the amount of time that the controller maintains tags before expiring them. For example, if a tag is configured to beacon every 30 seconds, we recommend that you set the timeout value to 90 seconds (approximately three times the beacon value). The default value is 1200 seconds.

Step 3 Enable or disable RFID tag mobility for specific tags by entering these commands:

- **config rfid mobility** *vendor_name* **enable** —Enables client mobility for a specific vendor's tags. When you enter this command, tags are unable to obtain a DHCP address for client mode when attempting to select and/or download a configuration.
- **config rfid mobility** *vendor_name* **disable** —Disables client mobility for a specific vendor's tags. When you enter this command, tags can obtain a DHCP address. If a tag roams from one subnet to another, it obtains a new address rather than retaining the anchor state.

Note These commands can be used only for Pango tags. Therefore, the only valid entry for *vendor_name* is "pango" in all lowercase letters.

Using the CLI to View RFID Tag Tracking Information

To view RFID tag tracking information using the controller CLI, follow these steps:

Step 1 See the current configuration for RFID tag tracking by entering this command:

show rfid config

Information similar to the following appears:

```
RFID Tag data Collection.................... Enabled
RFID timeout................................ 1200 seconds
RFID mobility............................ Oui:00:14:7e : Vendor:pango
State:Disabled
```

Step 2 See detailed information for a specific RFID tag by entering this command:

show rfid detail mac_address

where mac_address is the tag's MAC address.

Information similar to the following appears:

```
RFID address................................ 00:12:b8:00:20:52
Vendor...................................... G2
Last Heard.................................. 51 seconds ago
Packets Received............................ 2
Bytes Received.............................. 324
Cisco Type..................................

Content Header
=================
Version......................................... 1
Tx Power........................................ 12 dBm
Channel......................................... 1
Reg Class....................................... 12
Burst Length.................................... 1

CCX Payload
===========
Last Sequence Control........................... 0
Payload length.................................. 127
Payload Data Hex Dump

01 09 00 00 00 00 0b 85 52 52 52 02 07 4b ff ff
7f ff ff ff 03 14 00 12 7b 10 48 53 c1 f7 51 4b
50 ba 5b 97 27 80 00 67 00 01 03 05 01 42 34 00
00 03 05 02 42 5c 00 00 03 05 03 42 82 00 00 03
05 04 42 96 00 00 03 05 05 00 00 00 55 03 05 06
42 be 00 00 03 02 07 05 03 12 08 10 00 01 02 03
04 05 06 07 08 09 0a 0b 0c 0d 0e 0f 03 0d 09 03
08 05 07 a8 02 00 10 00 23 b2 4e 03 02 0a 03

Nearby AP Statistics:
lap1242-2(slot 0, chan 1) 50 seconds ag.... -76 dBm
lap1242(slot 0, chan 1) 50 seconds ago..... -65 dBm
```

Step 3 See a list of all RFID tags currently connected to the controller by entering this command:

show rfid summary

Information similar to the following appears:

```
Total Number of RFID : 24
----------------- -------- ------------------ ------ ---------------------
RFID ID VENDOR Closest AP RSSI Time Since Last Heard
----------------- -------- ------------------ ------ ---------------------
00:04:f1:00:00:03 Wherenet HReap -70 151 seconds ago
00:04:f1:00:00:05 Wherenet HReap -66 251 seconds ago
00:0c:cc:5b:f8:1e Aerosct HReap -40 5 seconds ago
00:0c:cc:5c:05:10 Aerosct HReap -68 25 seconds ago
00:0c:cc:5c:06:69 Aerosct HReap -54 7 seconds ago
00:0c:cc:5c:06:6b Aerosct HReap -68 245 seconds ago
00:0c:cc:5c:06:b5 Aerosct cisco1242 -67 70 seconds ago
00:0c:cc:5c:5a:2b Aerosct cisco1242 -68 31 seconds ago
00:0c:cc:5c:87:34 Aerosct HReap -40 5 seconds ago
00:14:7e:00:05:4d Pango cisco1242 -66 298 seconds ago
```

Step 4 See a list of RFID tags that are associated to the controller as clients by entering this command:

show rfid client

When the RFID tag is in client mode, information similar to the following appears:

```
------------------ -------- --------- ----------------- ------ ----------------
Heard
RFID Mac VENDOR Sec Ago Associated AP Chnl Client State
------------------ -------- --------- ----------------- ------ ----------------

00:14:7e:00:0b:b1 Pango 35 AP0019.e75c.fef4 1 Probing
When the RFID tag is not in client mode, the above text boxes are blank.
```

Using the CLI to Debug RFID Tag Tracking Issues

If you experience any problems with RFID tag tracking, use these debug commands.

- Configure MAC address debugging by entering this command:

  debug mac addr *mac_address*

  Note We recommend that you perform the debugging on a per-tag basis. If you enable debugging for all of the tags, the console or Telnet screen is inundated with messages.

- Enable or disable debugging for the 802.11 RFID tag module by entering this command:

  debug dot11 rfid { **enable** | **disable** }

- Enable or disable RFID debug options by entering this command:

  debug rfid { **all** | **detail** | **error** | **nmsp** | **receive** } { **enable** | **disable** }

  where

  – **all:**configures debugging of all RFID messages.

  – **detail:**configures debugging of RFID detailed messages.

  – **error:**configures debugging of RFID error messages.

  – **nmsp:**configures debugging of RFID NMSP messages.

  – **receive:**configures debugging of incoming RFID tag messages.

Configuring and Viewing Location Settings

This section provides instructions for configuring and viewing location settings from the controller CLI.

Note Access points in monitor mode should not be used for location purposes.

Installing the Location Appliance Certificate

A self-signed certificate (SSC) is required on the location appliance. This certificate, which is comprised of the location appliance MAC address and a 20-byte key hash, must be present on the controller. Otherwise, the controller cannot authenticate the location appliance, and they can never establish a connection. WCS usually pushes the certificate to the controller automatically, but you can install the certificate on the controller using the controller CLI if necessary (for example, if the controller is not connected to WCS or if an error or certificate mismatch occurs on WCS).

Note If an error occurs on WCS and prevents the location appliance certificate from being pushed to the controller, make sure that the time zone has been synchronized on the controller and the location appliance before following this procedure. Follow the instructions in the "Viewing Location Settings" section to do so.

To install the location appliance certificate on the controller using the controller CLI, follow these steps:

Step 1 Obtain the key hash value of the location appliance certificate by entering this command:

debug pm pki enable

Information similar to the following appears:

```
Thu Oct 11 08:52:26 2007: sshpmGetIssuerHandles: Calculate SHA1 hash on Public Key Data
Thu Oct 11 08:52:26 2007: sshpmGetIssuerHandles: Key Data 30820122 300d0609 2a864886 f70d0101
Thu Oct 11 08:52:26 2007: sshpmGetIssuerHandles: Key Data 01050003 82010f00 3082010a 02820101
Thu Oct 11 08:52:26 2007: sshpmGetIssuerHandles: Key Data 009a98b5 d2b7c77b 036cdb87 5bd20e5a
Thu Oct 11 08:52:26 2007: sshpmGetIssuerHandles: Key Data 894c66f4 df1cbcfb fe2fcf01 09b723aa
Thu Oct 11 08:52:26 2007: sshpmGetIssuerHandles: Key Data 5c0917f1 ec1d5061 2d386351 573f2c5e
Thu Oct 11 08:52:30 2007: sshpmGetIssuerHandles: Key Data b9020301 0001
Thu Oct 11 08:52:30 2007: sshpmGetIssuerHandles: SSC Key Hash is 4869b32638c00ffca88abe9b1a8e0525b9344b8b
```

Step 2 Install the location appliance certificate on the controller by entering this command:

config auth-list add lbs-ssc *lbs_mac lbs_key*

where

- *lbs_mac* is the MAC address of the location appliance.
- *lbs_key* is the 20-byte key hash value of the certificate.

Step 3 Save your changes by entering this command:

s ave config

Step 4 Verify that the location appliance certificate is installed on the controller by entering this command:

show auth-list

Information similar to the following appears:

```
Authorize APs against AAA ....................... disabled
Allow APs with Self-Signed Certificate (SSC) .... disabled

Mac Addr Cert Type Key Hash
----------------------- ---------- ------------------------------------------
00:16:36:91:9a:27 LBS-SSC 593f34e7cb151997a28cc7da2a6cac040b329636
```

Synchronizing the Controller and Location Appliance

For controller software release 4.2 or later releases, if a location appliance (release 3.1 or later releases) is installed on your network, the time zone must be set on the controller to ensure proper synchronization between the two systems. Also, the times must be synchronized on the two devices. We recommend that you set the time even for networks that do not have location appliances. See the "Configuring 802.11 Bands" section for instructions on setting the time and date on the controller.

Note The time zone can be different for the controller and the location appliance, but the time zone delta must be configured accordingly, based on GMT.

Configuring Location Settings

The controller determines the location of client devices by gathering received signal strength indication (RSSI) measurements from access points all around the client of interest. The controller can obtain location reports from up to 16 access points for clients, RFID tags, and rogue access points.

Improve location accuracy by configuring the path loss measurement (S60) request for normal clients or calibrating clients by entering this command:

config location plm *?*

where *?* is one of the following:

- **client** {enable | disable} *burst_interval* —Enables or disables the path loss measurement request for normal, noncalibrating clients. The valid range for the *burst_interval* parameter is 1 to 3600 seconds, and the default value is 60 seconds.
- calibrating {enable | disable} {uniband | multiband}—Enables or disables the path loss measurement request for calibrating clients on the associated 802.11a or 802.11b/g radio or on the associated 802.11a/b/g radio.

If a client does not send probes often or sends them only on a few channels, its location cannot be updated or cannot be updated accurately. The **config location plm** command forces clients to send more packets on all channels. When a CCXv4 (or higher) client associates, the controller sends it a path loss measurement request, which instructs the client to transmit on the bands and channels that the access points are on (typically, channels 1, 6, and 11 for 2.4-GHz-only access points) at a configurable interval (such as 60 seconds) indefinitely.

These four additional location CLI commands are available; however, they are set to optimal default values, so we do not recommend that you use or modify them:

- Configure the RSSI timeout value for various devices by entering this command:

  config location expiry *?*

  where *?* is one of the following:

  – **client** *timeout* —Configures the RSSI timeout value for clients. The valid range for the *timeout*parameter is 5 to 3600 seconds, and the default value is 5 seconds.

  – **calibrating-client** *timeout* —Configures the RSSI timeout value for calibrating clients. The valid range for the *timeout*parameter is 0 to 3600 seconds, and the default value is 5 seconds.

  – **tags** *timeout* —Configures the RSSI timeout value for RFID tags. The valid range for the *timeout*parameter is 5 to 300 seconds, and the default value is 5 seconds.

  – **rogue-aps** *timeout* —Configures the RSSI timeout value for rogue access points. The valid range for the *timeout*parameter is 5 to 3600 seconds, and the default value is 5 seconds.

  Ensuring that recent, strong RSSIs are retained by the CPU is critical to location accuracy. The **config location expiry** command enables you to specify the length of time after which old RSSI averages expire.

  Note We recommend that you do not use or modify the **config location expiry** command.

- Configure the RSSI half life for various devices by entering this command:

  config location rssi-half-life *?*

  where *?* is one of the following:

  – **client** *half_life* —Configures the RSSI half life for clients. The valid range for the *half_life*parameter is 0, 1, 2, 5, 10, 20, 30, 60, 90, 120, 180, or 300 seconds, and the default value is 0 seconds.

  – **calibrating-client** *half_life* —Configures the RSSI half life for calibrating clients. The valid range for the *half_life*parameter is 0, 1, 2, 5, 10, 20, 30, 60, 90, 120, 180, or 300 seconds, and the default value is 0 seconds.

  – **tags** *half_life* —Configures the RSSI half life for RFID tags. The valid range for the *half_life*parameter is 0, 1, 2, 5, 10, 20, 30, 60, 90, 120, 180, or 300 seconds, and the default value is 0 seconds.

  – **rogue-aps** *half_life* —Configures the RSSI half life for rogue access points. The valid range for the *half_life*parameter is 0, 1, 2, 5, 10, 20, 30, 60, 90, 120, 180, or 300 seconds, and the default value is 0 seconds.

  Some client devices transmit at reduced power immediately after changing channels, and RF is variable, so RSSI values might vary considerably from packet to packet. The **config location rssi-half-life** command increases accuracy by averaging nonuniformly arriving data using a configurable forget period (or half life).

  Note We recommend that you do not use or modify the **config location rssi-half-life** command.

- Configure the NMSP notification threshold for RSSI measurements by entering this command:

  config location notify-threshold *?*

  where *?* is one of the following:

  – **client** *threshold* —Configures the NMSP notification threshold (in dB) for clients and rogue clients. The valid range for the *threshold*parameter is 0 to 10 dB, and the default value is 0 dB.

  – **tags** *threshold* —Configures the NMSP notification threshold (in dB) for RFID tags. The valid range for the *threshold*parameter is 0 to 10 dB, and the default value is 0 dB.

  – **rogue-aps** *threshold* —Configures the NMSP notification threshold (in dB) for rogue access points. The valid range for the *threshold*parameter is 0 to 10 dB, and the default value is 0 dB.

  Note We recommend that you do not use or modify the **config location notify-threshold** command.

- Configure the algorithm used to average RSSI and signal-to-noise ratio (SNR) values by entering this command:

  config location algorithm *?*

  where *?* is one of the following:

  – **simple**—Specifies a faster algorithm that requires low CPU overhead but provides less accuracy.

  – rssi-average—Specifies a more accurate algorithm but requires more CPU overhead.

  Note We recommend that you do not use or modify the **config location algorithm** command.

Viewing Location Settings

To view location information, use these CLI commands:

- View the current location configuration values by entering this command:

  show location summary

  Information similar to the following appears:

  ```
  Location Summary

  Algorithm used: Average
  Client
  RSSI expiry timeout: 5 sec
  Half life: 0 sec
  Notify Threshold: 0 db
  Calibrating Client
  RSSI expiry timeout: 5 sec
  Half life: 0 sec
  Rogue AP
  RSSI expiry timeout: 5 sec
  Half life: 0 sec
  Notify Threshold: 0 db
  RFID Tag
  RSSI expiry timeout: 5 sec
  Half life: 0 sec
  Notify Threshold: 0 db
  ```

- See the RSSI table for a particular client by entering this command:

  show location detail *client_mac_addr*

  Information similar to the following appears:

  ```
  ...
  [11] AP 00:00:00:00:00:00 : Slot 0 inUse 0, expired 0, Timestamp (antenna-A 0) (antenna-B 0), band 0 rssi (antenna-A 0) (antenna-B 0), snr 0, acceptable 0
  [12] AP 00:00:00:00:00:00 : Slot 0 inUse 0, expired 0, Timestamp (antenna-A 0) (antenna-B 0), band 0 rssi (antenna-A 0) (antenna-B 0), snr 0, acceptable 0
  [13] AP 00:00:00:00:00:00 : Slot 0 inUse 0, expired 0, Timestamp (antenna-A 0) (antenna-B 0), band 0 rssi (antenna-A -1) (antenna-B 0), snr 0, acceptable 0
  [14] AP 00:00:00:00:00:00 : Slot 0 inUse 0, expired 0, Timestamp (antenna-A 0) (antenna-B 0), band 0 rssi (antenna-A 0) (antenna-B 0), snr 0, acceptable 0
  [15] AP 00:00:00:00:00:00 : Slot 0 inUse 0, expired 0, Timestamp (antenna-A 0) (antenna-B 0), band 0 rssi (antenna-A 0) (antenna-B 0), snr 0, acceptable 0
  ```

- See the location-based RFID statistics by entering this command:

  show location statistics rfid

  Information similar to the following appears:

  ```
  RFID Statistics
  ```

```
Database Full : 0 Failed Delete: 0
Null Bufhandle: 0 Bad Packet: 0
Bad LWAPP Data: 0 Bad LWAPP Encap: 0
Off Channel: 0 Bad CCX Version: 0
Bad AP Info : 0
Above Max RSSI: 0 Below Max RSSI: 0
Invalid RSSI: 0 Add RSSI Failed: 0
Oldest Expired RSSI: 0 Smallest Overwrite: 0
```

- Clear the location-based RFID statistics by entering this command:

  clear location statistics rfid

- Clear a specific RFID tag or all of the RFID tags in the entire database by entering this command:

  clear location rfid { *mac_address* | **all** }

- See whether location presence (S69) is supported on a client by entering this command:

  show client detail *client_mac*

  When location presence is supported by a client and enabled on a location appliance, the location appliance can provide the client with its location upon request. Location presence is enabled automatically on CCXv5 clients.

  Information similar to the following appears:

```
Client MAC Address............................. 00:40:96:b2:a3:44
Client Username ............................... N/A
AP MAC Address................................. 00:18:74:c7:c0:90
Client State................................... Associated
Wireless LAN Id................................ 1
BSSID.......................................... 00:18:74:c7:c0:9f
Channel........................................ 56
IP Address..................................... 192.168.10.28
Association Id................................. 1
Authentication Algorithm....................... Open System
Reason Code.................................... 0
Status Code.................................... 0
Session Timeout................................ 0
Client CCX version............................. 5
Client E2E version............................. No E2E support
Diagnostics Capability......................... Supported
S69 Capability................................. Supported
Mirroring...................................... Disabled
QoS Level...................................... Silver
...
```

Note See the *Cisco Wireless Control System Configuration Guide* or the *Cisco Location Appliance Configuration Guide* for instructions on enabling location presence on a location appliance.

Modifying the NMSP Notification Interval for Clients, RFID Tags, and Rogues

The Network Mobility Services Protocol (NMSP) manages communication between the location appliance and the controller for incoming and outgoing traffic. If your application requires more frequent location updates, you can modify the NMSP notification interval (to a value between 1 and 180 seconds) for clients, active RFID tags, and rogue access points and clients.

Note The TCP port (16113) that the controller and location appliance communicate over must be open (not blocked) on any firewall that exists between the controller and the location appliance for NMSP to function.

To modify the NMSP notification interval value on the controller using the controller CLI, follow these steps:

Step 1 Set the NMSP notification interval value for clients, RFID tags, and rogue clients and access points by entering these commands, where *interval* is a value between 1 and 180 seconds:

- **config nmsp notification interval rssi clients** *interval*
- **config nmsp notification interval rssi rfid** *interval*
- **config nmsp notification interval rssi rogues** *interval*

Step 2 See the NMSP notification intervals by entering this command:

show nmsp notification interval

Information similar to the following appears:

```
NMSP Notification Interval Summary

RSSI Interval:
Client......................................... 2 sec
RFID........................................... 0 sec
Rogue AP....................................... 2 sec
Rogue Client................................... 2 sec
```

Viewing NMSP Settings

To view NMSP information, use these CLI commands:

- See the status of active NMSP connections by entering this command:

  show nmsp status

  Information similar to the following appears:

```
MSE IP Address Tx Echo Resp Rx Echo Req Tx Data Rx Data
-------------- ----------- ----------- ------- -------
171.71.132.107 39046 39046 103742 1
```

- See the NMSP capabilities by entering this command:

  show nmsp capability

  Information similar to the following appears:

```
Service Subservice
------- ----------
RSSI Mobile Station, Tags, Rogue,
Info Mobile Station, Rogue,
Statistics Mobile Station, Tags,
IDS Services WIPS
```

- See the NMSP counters by entering this command:

  show nmsp statistics {summary | connection}

  where

  – **summary**shows the common NMSP counters.

  – **connection**shows the connection-specific NMSP counters.

  Information similar to the following appears for the **show nmsp statistics summary** command:

```
NMSP Global Counters

Client Measure Send Fail....................... 0
Send RSSI with no entry........................ 0
APP msg too big................................ 0
Failed Select on Accept Socket................. 0
Failed SSL write............................... 0
Partial SSL write.............................. 0
SSL write returned zero........................ 0
SSL write attempts to want read................ 0
SSL write attempts to want write............... 0
SSL write got default error.................... 0
SSL write max data length sent................. 0
SSL write max attempts to write in loop........ 0
SSL read returned zero......................... 0
SSL read attempts to want read................. 0
SSL read attempts to want write................ 0
SSL read got default error..................... 0
Failed SSL read - Con Rx buf freed............. 0
Failed SSL read - Con/SSL freed................ 0
```

```
Max records read before exiting SSL read......... 0
Normal Prio Tx Q full............................ 0
Highest Prio Tx Q count.......................... 0
Normal Prio Tx Q count........................... 0
Messages sent by APPs to Highest Prio TxQ........ 0
Max Measure Notify Msg........................... 0
Max Info Notify Msg.............................. 0
Max Highest Prio Tx Q Size....................... 0
Max Normal Prio Tx Q Size........................ 0
Max Rx Size...................................... 1
Max Info Notify Q Size........................... 0
Max Client Info Notify Delay..................... 0
Max Rogue AP Info Notify Delay................... 0
Max Rogue Client Info Notify Delay............... 0
Max Client Measure Notify Delay.................. 0
Max Tag Measure Notify Delay..................... 0
Max Rogue AP Measure Notify Delay................ 0
Max Rogue Client Measure Notify Delay............ 0
Max Client Stats Notify Delay.................... 0
Max Client Stats Notify Delay.................... 0
RFID Measurement Periodic........................ 0
RFID Measurement Immediate....................... 0
SSL Handshake failed............................. 0
NMSP Rx detected con failure..................... 0
NMSP Tx detected con failure..................... 0
NMSP Tx buf size exceeded........................ 0
Reconnect Before Conn Timeout................. 0
```

Information similar to the following appears for each active connection when you enter the **show nmsp statistics connection** command:

```
NMSP Connection Counters

MSE IP: 171.71.132.107
Connection status: UP
Tx message count Rx message count
---------------- ---------------
WLC Capability: 1 MSE Capability: 0
Service Subscr Rsp: 1 Service Subscr Req: 1
Measure Rsp: 0 Measure Req: 0
Measure Notify: 0
Info Rsp: 0 Info Req: 0
Info Notify: 0
Stats Rsp: 0 Stats Req: 0
Stats Notify: 0
Loc Req: 0 Loc Rsp: 0
Loc Subscr Req: 0 Loc Subscr Rsp: 0
Loc Notify: 0
Loc Unsubscr Req: 0 Loc Unsubscr Rsp: 0
AP Monitor Rsp: 0 AP Monitor Req: 0
AP Monitor Notify: 64677
IDS Get Rsp: 0 IDS Get Req: 0
IDS Notif: 0
IDS Set Rsp: 0 IDS Set Req: 0
```

- See the mobility services that are active on the controller by entering this command:

  show nmsp subscription {summary | **detail** | detail *ip_addr* }

  where

  – **summary**shows all of the mobility services to which the controller is subscribed.

  – **detail shows details for all of the mobility services to which the controller is subscribed.**

  – **detail** *ip_addr*shows details only for the mobility services subscribed to by a specific IP address.

  Information similar to the following appears for the show nmsp subscription summary command:

  ```
  Mobility Services Subscribed:

  Server IP Services
  --------- --------
  1.4.93.31 RSSI, Info, Statistics
  ```

  Information similar to the following appears for the show nmsp subscription detail *ip_addr* command:

  ```
  Mobility Services Subscribed by 1.4.93.31

  Services Sub-services
  -------- -----------
  RSSI Mobile Station, Tags,
  Info Mobile Station,
  Statistics Mobile Station, Tags,
  ```

- Clear all NMSP statistics by entering this command:

  clear nmsp statistics

Debugging NMSP Issues

Use these CLI commands if you experience any problems with NMSP:

- Configure NMSP debug options by entering this command:

  debug nmsp *?*

  where *?* is one of the following:

  – **all** { **enable** | **disable**}—Enables or disables debugging for all NMSP messages.

  – **connection** { **enable** | **disable**}—Enables or disables debugging for NMSP connection events.

  – **detail** { **enable** | **disable**}—Enables or disables debugging for NMSP detailed events.

  – **error** { **enable** | **disable**}—Enables or disables debugging for NMSP error messages.

  – **event** { **enable** | **disable**}—Enables or disables debugging for NMSP events.

  – **message** { **tx** | **rx** } { **enable** | **disable**}—Enables or disables debugging for NMSP transmit or receive messages.

  – **packet** { **enable** | **disable**}—Enables or disables debugging for NMSP packet events.

- Enable or disable debugging for NMSP interface events by entering this command:

  debug dot11 nmsp { **enable** | **disable** }

- Enable or disable debugging for IAPP NMSP events by entering this command:

  debug iapp nmsp { **enable** | **disable** }

- Enable or disable debugging for RFID NMSP messages by entering this command:

  debug rfid nmsp { **enable** | **disable** }

- Enable or disable debugging for access point monitor NMSP events by entering this command:

  debug service ap-monitor nmsp { **enable** | **disable** }

- Enable or disable debugging for wIPS NMSP events by entering this command:

  debug wips nmsp { **enable** | **disable** }

Configuring the Supervisor 720 to Support the WiSM

When you install a WiSM in a Cisco Catalyst 6500 series switch or a Cisco 7600 series router, you must configure the Supervisor 720 to support the WiSM. When the supervisor detects the WiSM, the supervisor creates ten Gigabit Ethernet interfaces, ranging from Gigslot/1 to Gigslot/8. For example, if the WiSM is in slot 9, the supervisor creates interfaces Gig9/1 through Gig9/8. The first eight Gigabit Ethernet interfaces must be organized into two EtherChannel bundles of four interfaces each. The remaining two Gigabit Ethernet interfaces are used as service-port interfaces, one for each controller on the WiSM. You must manually create VLANs to communicate with the ports on the WiSM.

Note The WiSM is supported on Cisco 7600 series routers running only Cisco IOS Release 12.2(18)SXF5.

General WiSM Guidelines

Follow these guidelines when you add a WiSM to your network:

- The switch or router ports leading to the controller service port are automatically configured and cannot be manually configured.
- The switch or router ports leading to the controller data ports should be configured as edge ports to avoid sending unnecessary BPDUs.
- The switch or router ports leading to the controller data ports should not be configured with any additional settings (such as port channel or SPAN destination) other than settings necessary for carrying data traffic to and from the controllers.

Note See “Configuring Ports and Interfaces,” for information on configuring the WiSM’s ports and interfaces.

Configuring the Supervisor

Note You must log into the switch or router CLI and begin in privileged EXEC mode.

To configure the supervisor to support the WiSM, follow these steps:

	Command	Purpose
Step 1	configure terminal	Enters global configuration mode.
Step 2	interface vlan	Creates a VLAN to communicate with the data ports on the WiSM and enters interface configuration mode.
Step 3	ip address ip-address gateway	Assigns an IP address and gateway to the VLAN.
Step 4	ip helper-address ip-address	Assigns a helper address to the VLAN.
Step 5	end	Returns to global configuration mode.
Step 6	wism module *module_number* controller {1 | 2} allowed-vlan *vlan_number*	Creates Gigabit port-channel interfaces automatically for the specified WiSM controller and configure the port-channel interfaces as trunk ports. Also, specifies the VLAN that you created earlier as the allowed VLAN on the port-channel trunk. VLAN traffic is carried on the trunk between the WiSM controller and the supervisor. **Note** Services might be temporarily interrupted (for approximately two pings) after you enter this command.
Step 7	wism module *module_number* controller {1 | 2} native-vlan *vlan_number*	For the native VLAN on the ports, specifies the VLAN that you created earlier to communicate with the WiSM data ports.
Step 8	**interface** *vlan*	Creates a VLAN to communicate with the service ports on the WiSM.
Step 9	**ip address** *ip_address gateway*	Assigns an IP address and gateway to the VLAN.
Step 10	**end**	Returns to global configuration mode.
Step 11	**wism service-vlan** *vlan*	Configures the VLAN that you created in Steps 8 through Step 10 to communicate with the WiSM service ports.
Step 12	end	Returns to global configuration mode.
Step 13	**show wism status**	Verifies that the WiSM is operational.

Note The commands used for communication between the Cisco WiSM, the Supervisor 720, and the 4404 controllers are documented in *Configuring a Cisco Wireless Services Module and Wireless Control System* at this URL: http://www.cisco.com/en/US/docs/wireless/technology/wism/technical/reference/appnote.html#wp39498

Using the Wireless LAN Controller Network Module

Follow these guidelines when using a wireless LAN controller network module (CNM) installed in a Cisco Integrated Services Router:

- The CNM does not support IPsec. To use IPsec with the CNM, configure IPsec on the router in which the CNM is installed. Click this link to browse to IPsec configuration instructions for routers:

  http://www.cisco.com/en/US/tech/tk583/tk372/tech_configuration_guides_list.html

- The CNM does not have a battery and cannot save a time setting. It must receive a time setting from an external NTP server when it powers up. When you install the module, the configuration wizard prompts you for NTP server information.
- To access the CNM bootloader, we recommend that you reset the CNM from the router. If you reset the CNM from a CNM user interface, the router might reset the CNM while you are using the bootloader.

  When you reset the CNM from a CNM interface, you have 17 minutes to use the bootloader before the router automatically resets the CNM. The CNM bootloader does not run the Router Blade Configuration Protocol (RBCP), so the RBCP heartbeat running on the router times out after 17 minutes, triggering a reset of the CNM.

  If you reset the CNM from the router, the router stops the RBCP heartbeat exchange and does not restart it until the CNM boots up. To reset the CNM from the router, enter one of these commands on the router CLI:

  service-module wlan-controller 1/0 reset (for Fast Ethernet CNM versions)

  service-module integrated-service-engine 1/0 reset (for Gigabit Ethernet CNM versions)

- Gigabit Ethernet versions of the Cont **roller Network Module are supported on** Cisco 28/37/38xx Series Integrated Services Routers running Cisco IOS Release 12.4(11)T2 or later.

Resetting the Controller to Default Settings

If you want to return the controller to its original configuration, you can use the controller GUI or CLI to reset the controller to factory-default settings.

Using the GUI to Reset the Controller to Default Settings

To return the controller to factory-default setting using the controller GUI, follow these steps:

Step 1 Open your Internet browser.

Step 2 Enter the controller IP address in the browser address line and press Enter. An Enter Network Password dialog box appears.

Step 3 Enter your username in the User Name text box. The default username is admin.

Step 4 Enter the wireless device password in the Password text box and press Enter. The default password is admin.

Step 5 Choose **Commands** > **Reset to Factory Default** .

Step 6 Click Reset.

Step 7 When prompted, confirm the reset.

Step 8 Reboot the controller without saving the configuration.

Step 9 Use the configuration wizard to enter configuration settings. See the “Using the Configuration Wizard” section for instructions.

Using the CLI to Reset the Controller to Default Settings

To return the controller to factory default settings using the controller CLI, follow these steps:

Step 1 Enter the reset system command. At the prompt that asks whether you need to save changes to the configuration, enter N. The unit reboots.

Step 2 When you are prompted for a username, enter the recover-config command to restore the factory-default configuration. The controller reboots and displays this message:

```
Welcome to the Cisco WLAN Solution Wizard Configuration Tool
```

Step 3 Use the configuration wizard to enter configuration settings. See the “Using the Configuration Wizard” section for instructions.