Configuring Wireless Devices

This chapter describes the procedures for initial configuration of the wireless device, radio settings, WLAN, and administration of the wireless devices. This chapter contains the following sub-sections:

Wireless Device Overview

Wireless devices (commonly configured as access points) provide a secure, affordable, and easy-to-use wireless LAN solution that combines mobility and flexibility with the enterprise-class features required by networking professionals. When configured as an access point, the wireless device serves as the connection point between wireless and wired networks or as the center point of a stand-alone wireless network. In large installations, wireless users within radio range of an access point can roam throughout a facility while maintaining seamless, uninterrupted access to the network.

With a management system based on Cisco IOS software, wireless devices are Wi-Fi CERTIFIED™, 802.11a-compliant, 802.11b-compliant, 802.11g-compliant, and 802.11n-compliant wireless LAN transceivers.

Software Modes for Wireless Devices

The access point is shipped with an autonomous image and recovery image on the access point's flash. The default mode is autonomous; however, the access point can be upgraded to operate in Cisco Unified Wireless mode.

Each mode is described below:

- Autonomous mode—supports standalone network configurations, where all configuration settings are maintained locally on the wireless device. Each autonomous device can load its starting configuration independently, and still operate in a cohesive fashion on the network.

- Cisco Unified Wireless mode—operates in conjunction with a Cisco Unified Wireless LAN controller, where all configuration information is maintained within the controller. In the Cisco Unified Wireless LAN architecture, wireless devices operate in the lightweight mode using Leightweight Access Point Protocol (LWAPP), (as opposed to autonomous mode). The lightweight access point, or wireless device, has no configuration until it associates to a controller. The configuration on the wireless device can be modified by the controller only when the networking is up and running. The controller manages the wireless device configuration, firmware, and control transactions such as 802.1x authentication. All wireless traffic is tunneled through the controller.

For more information about Cisco Unified Wireless mode, see http://www.cisco.com/en/US/prod/collateral/wireless/ps5679/ps6548/prod_white_paper0900aecd804f19e3_ps6305_Products_White_Paper.html .

Management Options for Wirelss Device

The wireless device runs its own version of Cisco IOS software that is separate from the Cisco IOS software operating on the router. You can configure and monitor the access point with several different tools:

- Cisco IOS software CLI
- Simple Network Management Protocol (SNMP)
- Web-browser Interface

Note Avoid using the CLI and the web-browser tools concurrently. If you configure the wireless device using the CLI, the web-browser interface may display an inaccurate interpretation of the configuration.

Use the **interface dot11radio** command from **global** configuration mode to place the wireless device into the radio configuration mode. Network Configuration Examples

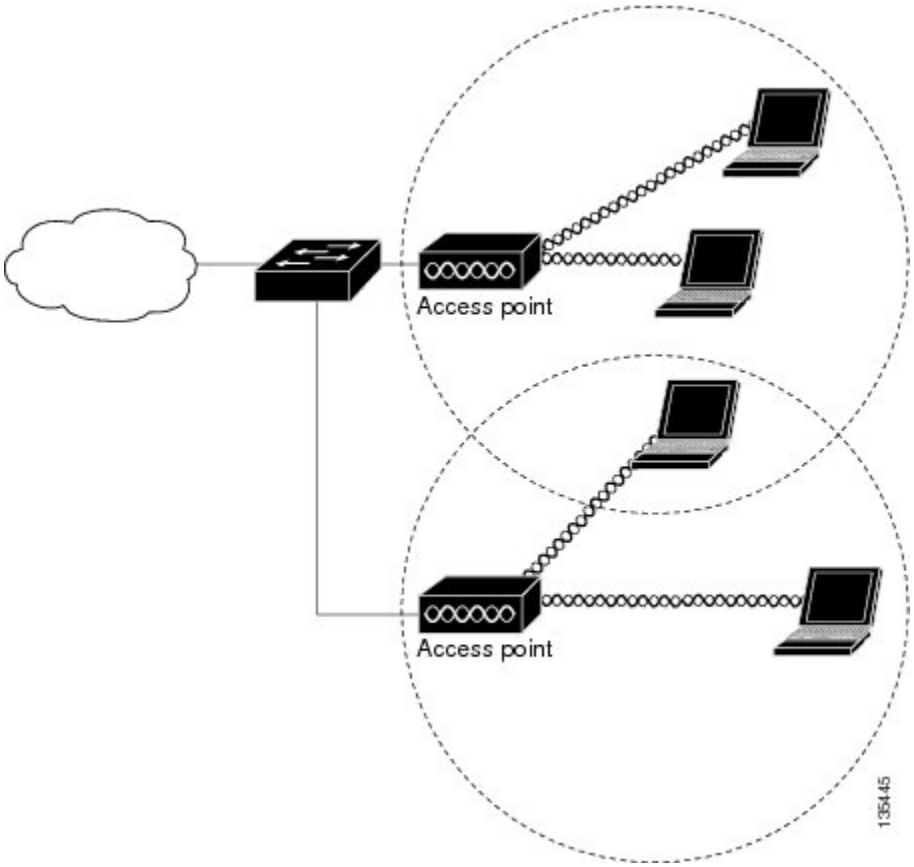
Set up the access point role in any of these common wireless network configurations. The access point default configuration is as a root unit connected to a wired LAN or as the central unit in an all-wireless network. Access points can also be configured as bridges and workgroup bridges. These roles require specific configurations, as defined in the following examples.

Root Access Point

An access point connected directly to a wired LAN provides a connection point for wireless users. If more than one access point is connected to the LAN, users can roam from one area of a facility to another without losing their connection to the network. As users move out of range of one access point, they automatically connect to the network (associate) through another access point. The roaming process is seamless and transparent

to the user. Figure 1: Access Points as Root Units on a Wired LAN, on page 3 shows access points acting as root units on a wired LAN.

Figure 1: Access Points as Root Units on a Wired LAN

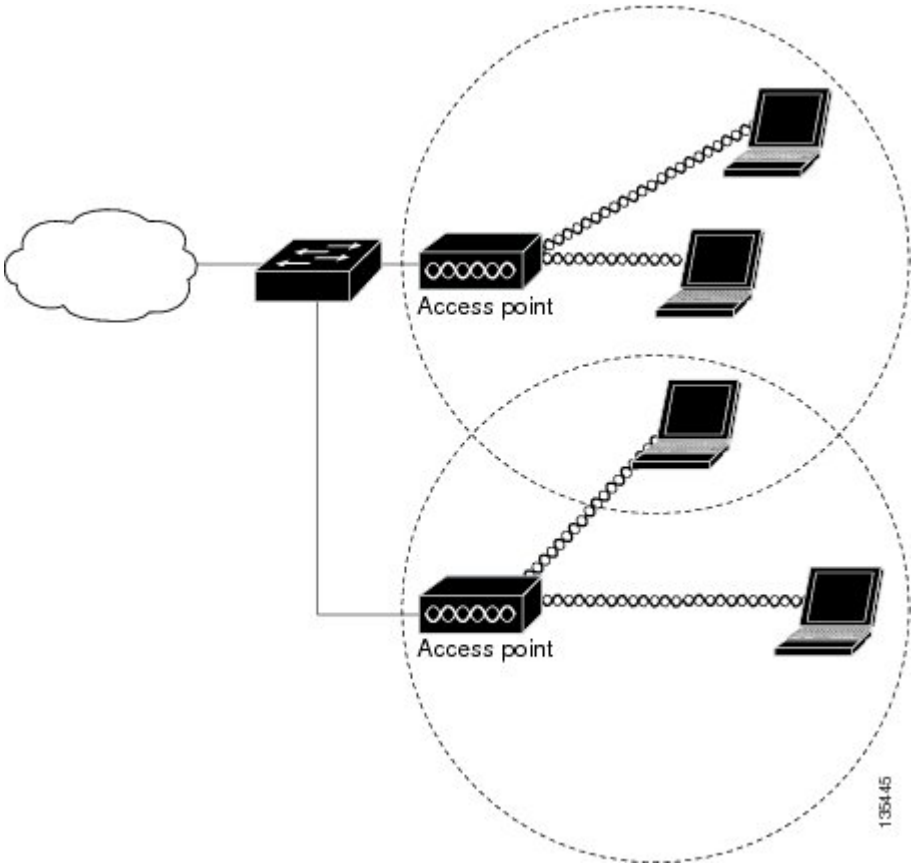


Central Unit in an All-Wireless Network

In an all-wireless network, an access point acts as a stand-alone root unit. The access point is not attached to a wired LAN; it functions as a hub linking all stations together. The access point serves as the focal point for

communications, increasing the communication range of wireless users. Figure 2: Access Point as Central Unit in All-Wireless Network, on page 4 shows an access point in an all-wireless network.

Figure 2: Access Point as Central Unit in All-Wireless Network



Cisco ScanSafe

The Cisco Integrated Services Router G2 (ISR G2) family delivers numerous security services, including firewall, intrusion prevention, and VPN. These security capabilities have been extended with Cisco ISR Web Security with Cisco ScanSafe for a web security and web filtering solution that requires no additional hardware or client software.

Cisco ISR Web Security with Cisco ScanSafe enables branch offices to intelligently redirect web traffic to the cloud to enforce granular security and acceptable use policies over user web traffic. With this solution, you can deploy market-leading web security quickly and can easily protect branch office users from web-based threats, such as viruses, while saving bandwidth, money, and resources.

For more information, see Cisco ISR Web Security with Cisco ScanSafe Solution Guide.

TFTP support with Ethernet WAN interface

Trivial File Transfer Protocol (TFTP) is a file transfer protocol notable for its simplicity. It is generally used for automated transfer of configuration or boot files between machines in a local environment.

The Cisco 819H ISR supports TFTP with Ethernet WAN interface that supports data transfer rate of 10 Mbps.

For more information, see "Using the TFTP Download Command" section .

Note This feature is supported in all Cisco 819 ISRs that have ROMMON version 15.2(2r)T and above.

Note TFTP download using switch port is supported in Cisco 819HGW SKUs only.

LEDs for Cisco 819 Series ISRs

The LED is located on the front panel of the router. Table 1: 3G LED Descriptions for Cisco 819 Series ISRs, on page 5 describes the 3G LED for the Cisco 819 ISR.

Table 1: 3G LED Descriptions for Cisco 819 Series ISRs

LED	Color	Description
SYS	Yellow	FPGA download is complete.
	Green (blinking)	ROMMON is operational.
	Green (solid)	IOS is operational.
	Green (four blinks during bootup)	Reset button has been pushed during the bootup.
	Off	After powering up, when FPGA is being downloaded (in ROMMON).
ACT	Green	Network activity on FE Switch ports, GE WAN port, 3G cellular interface, and serial interfaces.
	Off	No network activity.

LED	Color	Description
WWAN	Green	Module is powered on and connected but not transmitting or receiving.
	Green (slow blinking)	Module is powered on and searching for connection.
	Green (fast blinking)	Module is transmitting or receiving.
	Off	Module is not powered.
GPS	Green (solid)	Standalone GPS.
	Green (slow blinking)	GPS is acquiring.
	Yellow (solid)	Assisted GPS.
	Yellow (slow blinking)	Assisted GPS is acquiring.
	Off	GPS is not configured.
RSSI	Green (solid)	Signal > –60 Very strong signal
	Green (four blinks and then a long pause)	Signal <= –60 to 74 Strong signal
	Green (two blinks and then a long pause)	Signal <= –75 to –89 Fair signal
	Green (one blink and then a long pause)	Signal <= –90 to –109 Marginal signal
	Off	Signal <= –110 Unusable signal

LED	Color	Description
SIM[1],[2]	Green / Yellow (one green blink followed by two yellow blinks)	SIM in slot 0 active, SIM in slot 1 is not.
	Yellow / Green (one yellow blink followed by two greenblinks)	SIM in slot 1 active, SIM in slot 0 is not.
	Off / Green (two green blinks and then pause)	No SIM in slot 0, SIM present in slot 1.
	Green / Off (Slow single green blink and then pause)	SIM present in slot0, no SIM in slot 1.
	Off / Off	No SIM present in either slots.
3G	One blink green and then pause	For 1xRTT, EGPRS, GPRS service.
	Two blink green and then pause	For EVDO, EVDO/1xRTT, UMTS.
	Three blink green and then pause	For EVDO/1xRTT RevA, HSPA, HSUPA/HSDPA.
	Green (solid)	For HSPA PLUS.

1 Not applicable to Verizon and Sprint EVDO modems.

2 There is only one LED to indicate the status two SIMs. A one-blink pattern represents the status of the SIM in slot 0, followed by a two-blink pattern for the SIM in slot 1.

Use the following show commands to check the LED status for your router:

- **show platform led** (for all LEDs)
- **show controller cellular 0** (for 3G LEDs)

The following is a sample output from the show platform led command and shows the LED status:

```
Router# show platform led
LED STATUS:
==========
LEDS  :  SYSTEM   WWAN           RSSI            GPS
STATUS:  GREEN    GREEN          GREEN(2 BLINK)  OFF
LEDS  :  ACTIVITY   SIM(slot0  / slot1)          3G
STATUS:  OFF            GREEN  / YELLOW          GREEN
LAN PORTS       :  FE0      FE1      FE2      FE3
LINK/ENABLE LED :  OFF      OFF      OFF      OFF
SPEED LED       :  Unknown  Unknown  Unknown  Unknown
PORT            :  GE-WAN0
LINK/ENABLE LED :  OFF
SPEED LED       :  Unknown
```

The following is a sample output from the show controllers cellular command showing the 3G LED status:

```
Router# show controllers cellular 0
Interface Cellular0
```

```
3G Modem-QuadBand HSPA+R7/HSPA/UMTS QuadBand EDGE/GPRS Global and GPS,
Cellular modem configuration:
----------------------------
GSM-Carrier Type  : Cellular GSM Global.
SKU (PRI) Value: 9900198    .
Modem is recognized as valid
manufacture id:  0x00001199     product id: 0x000068A3
Sierra Wireless Mini Card MC8705 HSPA+R7 modem.
Cellular Dual SIM details:
----------------------------
SIM 0 is present
SIM 0 is active SIM
Modem Management Statistics
----------------------------
Modem resets = 2
Last known modem state = 'application' mode
Packets sent = 2508, Packets received = 44621, Packets pending = 0
DIP MDM link status retry count = 0 pdp context = 0
DIP MDM link up pending = 0 pdp context = 0
IDB Cellular0: DIP profile id = 255
RSSI LED    : 3-blink Green      <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
Service LED : 3-blink Green      <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
SIM LED     : Slot0 - Green;    Slot1 - Off    <<<<<<<<<<<<<<<<<<<<<<<<
GPS LED     : Off                <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
GPS NMEA port = Disabled   (Stream OFF)
DM port = Disabled
    :
    :
    :
B
```

Basic Wireless Configuration for Cisco 800 Series ISR

This module describes how to configure the autonomous wireless device on the following Cisco Integrated Services Routers (ISRs):

- Cisco 860 Series
- Cisco 880 Series
- Cisco 890 Series
- Cisco 810 Series

Note To upgrade the autonomous software to Cisco Unified software on the embedded wireless device, see the Upgrading to Cisco Unified Software, on page 16 for instructions.

The wireless device is embedded and does not have an external console port for connections. To configure the wireless device, use a console cable to connect a personal computer to the host router's console port, and perform these procedures to establish connectivity and configure the wireless settings.

Starting a Wireless Configuration Session

Note Before you configure the wireless settings in the router's **setup,** you must follow these steps to open a session between the router and the access point.

Enter the following commands in global configuration mode on the router's Cisco IOS command-line interface (CLI).

SUMMARY STEPS

1. **interface wlan-ap0**
2. **ip address** *subnet mask*
3. **no shut**
4. **interface vlan1**
5. **ip address** *subnet mask*
6. **exit**
7. **exit**
8. **service-module wlan-ap 0 session**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface wlan-ap0** **Example:** `Router(config)# interface wlan-ap0`	Defines the router's console interface to the wireless device. • The interface is used for communication between the router's console and the wireless device. **Note** Always use port 0. • The following message appears: `The wlan-ap 0 interface is used for managing the embedded AP. Please use the service-module wlan-ap 0 session command to console into the embedded AP.`
Step 2	**ip address** *subnet mask* **Example:** `Router(config-if)# ip address 10.21.0.20 255.255.255.0`	Specifies the interface IP address and subnet mask. **Note** The IP address can be shared with the IP address assigned to the Cisco Integrated Services Router by using the ip unnumbered vlan1 command.
Step 3	**no shut** **Example:** `Router(config-if)# no shut`	Specifies that the internal interface connection will remain open.
Step 4	**interface vlan1** **Example:** `Router(config-if)# interface vlan1`	Specifies the virtual LAN interface for data communication on the internal Gigabit Ethernet 0 (GE0) port to other interfaces. • All the switch ports inherit the default vlan1 interface on the Cisco 860 Series, Cisco 880 Series, and Cisco 890 Series ISRs.

	Command or Action	Purpose
Step 5	**ip address** *subnet mask* **Example:** `Router(config-if)# ip address 10.10.0.30 255.255.255.0`	Specifies the interface IP address and subnet mask.

Step 6	**exit**
	
	Example:
	`Router(config-if)# exit`
	
	Example:
	`Router(config)#`
		Exits interface configuration mode and returns to global configuration mode.

Step 7	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode.

Step 8	**service-module wlan-ap 0 session**
	
	Example:
	`Router# service-module wlan-ap0 session`
	`Trying 10.21.0.20, 2002 ... Open`
	`ap>`
		Opens the connection between the wireless device and the router's console.

What to Do Next

Tip To create a Cisco IOS software alias for the console to session into the wireless device, enter the **alias exec dot11radio service-module wlan-ap 0 session** command at the EXEC prompt. After entering this command, you utomatically skip to the **dot11 radio** level in the Cisco IOS software.

Closing the Session

To close the session between the wireless device and the router's console, use control+shift+6 and x on the wireless device and enter **disconnect** command on the router and then press enter two times on the router.

Configuring Wireless Settings

Note If you are configuring the wireless device for the first time, you must start a configuration session between the access point and the router before you attempt to configure the basic wireless settings. See the Starting a Wireless Configuration Session , on page 8.

Configure the wireless device with either of the following tools, depending on the software you are using:

- Cisco IOS Command Line Interface, on page 11—Autonomous software
- Cisco Express Setup—Unified Software

Note To upgrade to Unified mode from the Autonomous mode, see Upgrading to Cisco Unified Software, on page 16 for upgrade instructions. After upgrading to Cisco Unified Wireless software, use the web-browser tool to configure the device:

http://cisco.com/en/US/docs/wireless/access_point/12.4_10b_JA/configuration/guide/scg12410b-chap2-gui.html

Cisco Express Setup

To configure the Unified wireless device, use the web-browser tool and perform these steps

1. Establish a console connection to the wireless device and get the Bridge-Group Virtual Interface (BVI) IP address by entering the **show interface bvi1 Cisco IOS** command.
2. Open a browser window, and enter the BVI IP address in the browser-window address line. Press Enter. An Enter Network Password window appears.
3. Enter your username. *Cisco* is the default user name.
4. Enter the wireless device password. *Cisco* is the default password. The Summary Status page appears. For details about using the web-browser configuration page, see the following URL:

   http://cisco.com/en/US/docs/wireless/access_point/12.4_10b_JA/configuration/guide/scg12410b-chap4-first.html#wp1103336

Cisco IOS Command Line Interface

To configure the Autonomous wireless device, use the Cisco IOS CLI tool and perform these tasks:

Configuring the Radio

Configure the radio parameters on the wireless device to transmit signals in autonomous or Cisco Unified mode. For specific configuration procedures, see Configuring Radio Settings, on page 20.

Configuring Wireless Security Settings

This section includes the following configuration tasks:

Configuring Authentication

Authentication types are tied to the Service Set Identifiers (SSIDs) that are configured for the access point. To serve different types of client devices with the same access point, configure multiple SSIDs.

Before a wireless client device can communicate on your network through the access point, the client device must authenticate to the access point by using open or shared-key authentication. For maximum security, client devices should also authenticate to your network using MAC address or Extensible Authentication Protocol (EAP) authentication. Both authentication types rely on an authentication server on your network.

To select an authentication type, see *Authentication Types for Wireless Devices* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityAuthentication Types.html.

To set up a maximum security environment, see *RADIUS and TACACS+ Servers in a Wireless Environment* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityRadiusTacacs_1.html

To provide local authentication service or backup authentication service for a WAN link failure or a server failure, you can configure an access point to act as a local authentication server. The access point can authenticate up to 50 wireless client devices using Lightweight Extensible Authentication Protocol (LEAP), Extensible Authentication Protocol-Flexible Authentication via Secure Tunneling (EAP-FAST), or MAC-based authentication. The access point performs up to five authentications per second.

Configure the local authenticator access point manually with client usernames and passwords because it does not synchronize its database with RADIUS servers. You can specify a VLAN and a list of SSIDs that a client is allowed to use.

For details about setting up the wireless device in this role, see *Using the Access Point as a Local Authenticator* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityLocalAuthent.html

Configuring WEP and Cipher Suites

Wired Equivalent Privacy (WEP) encryption scrambles the data transmitted between wireless devices to keep the communication private. Wireless devices and their wireless client devices use the same WEP key to encrypt and decrypt data. WEP keys encrypt both unicast and multicast messages. Unicast messages are addressed to one device on the network. Multicast messages are addressed to multiple devices on the network.

Cipher suites are sets of encryption and integrity algorithms designed to protect radio communication on your wireless LAN. You must use a cipher suite to enable Wi-Fi Protected Access (WPA) or Cisco Centralized Key Management (CCKM).

Cipher suites that contain Temporal Key Integrity Protocol (TKIP) provide the greatest security for your wireless LAN. Cipher suites that contain only WEP are the least secure.

For encryption procedures, see *Configuring WEP and Cipher Suites* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityCipherSuitesWEP.html

Configuring Wireless VLANs and Assigning SSIDs

If you use VLANs on your wireless LAN and assign SSIDs to VLANs, you can create multiple SSIDs by using any of the four security settings defined in the Table 2: Types of SSID Security , on page 13. A VLAN can be thought of as a broadcast domain that exists within a defined set of switches. A VLAN consists of a number of end systems, either hosts or network equipment (such as bridges and routers), that are connected by a single bridging domain. The bridging domain is supported on various pieces of network equipment, such as LAN switches that operate bridging protocols between them with a separate group of protocols for each VLAN.

For more information about wireless VLAN architecture, see *Configuring Wireless VLANs* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/wireless_vlans.html

Note If you do not use VLANs on your wireless LAN, the security options that you can assign to SSIDs are limited because the encryption settings and authentication types are linked on the Express Security page.

You can configure up to 16 SSIDs on a wireless device in the role of an access point, and you can configure a unique set of parameters for each SSID. For example, you might use one SSID to allow guests limited access to the network and another SSID to allow authorized users access to secure data.

For more about creating multiple SSIDs, see *Service Set Identifiers* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/ServiceSetID.html .

Note Without VLANs, encryption settings (WEP and ciphers) apply to an interface, such as the 2.4-GHz radio, and you cannot use more than one encryption setting on an interface. For example, when you create an SSID with static WEP with VLANs disabled, you cannot create additional SSIDs with WPA authentication because the SSIDs use different encryption settings. If the security setting for an SSID conflicts with the settings for another SSID, delete one or more SSIDs to eliminate the conflict.

Security Types

Table 2: Types of SSID Security , on page 13 describes the four security types that you can assign to an SSID.

Table 2: Types of SSID Security

Security Type	Description	Security Features Enabled
No security	This is the least secure option. You should use this option only for SSIDs in a public space, and you should assign it to a VLAN that restricts access to your network.	None.

Security Type	Description	Security Features Enabled
Static WEP key	This option is more secure than no security. However, static WEP keys are vulnerable to attack. If you configure this setting, you should consider limiting association to the wireless device based on MAC address, see *Cipher Suites and WEP* at: http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityCipherSuitesWEP.html. Or If your network does not have a RADIUS server, consider using an access point as a local authentication server. See *Using the Access Point as a Local Authenticator* for instructions: http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityLocalAuthent.html.	Mandatory WEP. Client devices cannot associate using this SSID without a WEP key that matches the wireless device key.
EAP[3] authentication	This option enables 802.1X authentication (such as LEAP[4], PEAP[5], EAP-TLS[6], EAP-FAST[7], EAP-TTLS[8], EAP-GTC[9], EAP-SIM[10], and other 802.1X/EAP-based products) This setting uses mandatory encryption, WEP, open authentication plus EAP, network EAP authentication, no key management, and RADIUS server authentication port 1645. You are required to enter the IP address and shared secret for an authentication server on your network (server authentication port 1645). Because 802.1X authentication provides dynamic encryption keys, you do not need to enter a WEP key.	Mandatory 802.1X authentication. Client devices that associate using this SSID must perform 802.1X authentication. If radio clients are configured to authenticate using EAP-FAST, open authentication with EAP should also be configured. If you do not configure open authentication with EAP, the following warning message appears: `SSID CONFIG WARNING: [SSID]: If radio clients are using EAP-FAST, AUTH OPEN with EAP should also be configured.`

Security Type	Description	Security Features Enabled
WPA[11]	This option permits wireless access to users who are authenticated against a database. Access is through the services of an authentication server. User IP traffic is then encrypted with stronger algorithms than those used in WEP. This setting uses encryption ciphers, TKIP[12], open authentication plus EAP, network EAP authentication, key management WPA mandatory, and RADIUS server authentication port 1645. As with EAP authentication, you must enter the IP address and shared secret for an authentication server on your network (server authentication port 1645).	Mandatory WPA authentication. Client devices that associate using this SSID must be WPA capable. If radio clients are configured to authenticate using EAP-FAST, open authentication with EAP should also be configured. If you do not configure open authentication with EAP, the following warning message appears: `SSID CONFIG WARNING: [SSID]: If radio clients are using EAP-FAST, AUTH OPEN with EAP should also be configured.`

3 EAP = Extensible Authentication Protocol.
4 LEAP = Lightweight Extensible Authentication Protocol.
5 PEAP = Protected Extensible Authentication Protocol.
6 EAP-TLS = Extensible Authentication Protocol—Transport Layer Security.
7 EAP-FAST = Extensible Authentication Protocol—Flexible Authentication via Secure Tunneling.
8 EAP-TTLS = Extensible Authentication Protocol—Tunneled Transport Layer Security.
9 EAP-GTC = Extensible Authentication Protocol—Generic Token Card.
10 EAP-SIM = Extensible Authentication Protocol—Subscriber Identity Module.
11 WPA = Wi-Fi Protected Access.
12 TKIP = Temporal Key Integrity Protocol.

Configuring Wireless Quality of Service

Configuring Quality of Service (QoS) can provide preferential treatment to certain traffic at the expense of other traffic. Without QoS, the device offers best-effort service to each packet, regardless of the packet contents or size. It sends the packets without any assurance of reliability, delay bounds, or throughput. To configure QoS for your wireless device, see *Quality of Service in a Wireless Environment* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/QualityOfService.html.

Configuring the Access Point in Hot Standby Mode

In hot standby mode, an access point is designated as a backup for another access point. The standby access point is placed near the access point that it monitors and is configured exactly like the monitored access point. The standby access point associates with the monitored access point as a client and sends Internet Access Point Protocol (IAPP) queries to the monitored access point through the Ethernet and radio ports. If the monitored access point fails to respond, the standby access point comes online and takes the monitored access point's place in the network.

Except for the IP address, the standby access point's settings should be identical to the settings on the monitored access point. If the monitored access point goes off line and the standby access point takes its place in the

network, matching settings ensure that client devices can switch easily to the standby access point. For more information, see *Hot Standby Access Points* at:

http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/RolesHotStandby.html.

Upgrading to Cisco Unified Software

To run the access point in Cisco Unified mode, upgrade the software by performing the following procedures:

Software Prerequisites

- Cisco 890 Series ISRs with embedded access points can be upgraded from autonomous software to Cisco Unified software, if the router is running the IP Base feature set and Cisco IOS 12.4(22)YB software.
- Cisco 880 Series ISRs with embedded access points can be upgraded from autonomous software to Cisco Unified software, if the router is running the advipservices feature set and Cisco IOS 12.4(20)T software.
- To use the embedded access point in a Cisco Unified Architecture, the Cisco Wireless LAN Configuration (WLC) must be running version 5.1 or later.

Preparing for the Upgrade

Perform the tasks in the following sections to prepare for the upgrade:

Secure an IP Address on the Access Point

Secure an IP address on the access point so it that can communicate with the WLC and download the Unified image upon boot up. The host router provides the access point DHCP server functionality through the DHCP pool. The access point then communicates with the WLC and setup option 43 for the controller IP address in the DHCP pool configuration.

Example Configuration: Secure an IP Address on the Access Point

The following example shows a sample configuration:

```
ip dhcp pool embedded-ap-pool
network 60.0.0.0 255.255.255.0
dns-server 171.70.168.183
default-router 60.0.0.1
option 43 hex  f104.0a0a.0a0f   (single WLC IP address(10.10.10.15) in hex format)
int vlan1
ip address 60.0.0.1 255.255.255.0
```

For more information about the WLC discovery process, see Cisco Wireless LAN Configuration Guide at:
http://www.cisco.com/en/US/docs/wireless/controller/4.0/configuration/guide/ccfig40.html

Confirm that the Mode Setting is Enabled

To confirm that the mode setting is enabled, perform the following steps.

1. Ping the WLC from the router to confirm IP connectivity.
2. Enter the **service-module wlan-ap 0 session** command to establish a session into the access point.
3. Confirm that the access point is running an autonomous boot image.
4. Enter the show boot command on the access point to confirm that the mode setting is enabled.

```
Autonomous-AP# show boot
BOOT path-list:      flash:ap801-k9w7-mx.124-10b.JA3/ap801-k9w7-mx.124-10b.JA3
Config file:         flash:/config.txt
Private Config file: flash:/private-config
Enable Break:        yes
Manual Boot:         yes
HELPER path-list:
NVRAM/Config file
buffer size:   32768
Mode Button:    on
```

Performing the Upgrade

To upgrade the autonomous software to Cisco Unified software, follow these steps:

1. To change the access point boot image to a Cisco Unified upgrade image (also known as a *recovery image*), use the **service-module wlan-ap 0 bootimage unified** command, in global configuration mode.

```
Router# conf terminal
Router(config)# service-module wlan-ap 0 bootimage unified
Router(config)# end
```

Note If the **service-module wlan-ap 0 bootimage unified** command does not work successfully, check whether the software license is still eligible.

Note To identify the access point's boot image path, use the **show boot** command in privileged EXEC mode on the access point console.

2. To perform a graceful shutdown and reboot of the access point to complete the upgrade process, use the **service-module wlan-ap 0 reload** command in global configuration mode. Establish a session into the access point, and monitor the upgrade process.

Note See the Cisco Express Setup for details about using the GUI configuration page to set up the wireless device settings.

Troubleshooting an Upgrade or Reverting the AP to Autonomous Mode

If the access point fails to upgrade from autonomous to Unified software, perform the following actions:

- Check to ensure the autonomous access point does not have the static IP address configured on the BVI interface before you boot the recovery image.
- Ping between the router/access point and the WLC to confirm communication.
- Check that the access point and WLC clock (time and date) are set correctly.

The access point may attempt to boot and fail or may become stuck in the recovery mode and fail to upgrade to the Unified software. If either one of this occurs, use the **service-module wlan-ap0 reset bootloader** command to return the access point to the bootloader for manual image recovery.

Downgrading the Software on the Access Point

To reset the access point boot to the last autonomous image, use the **service-module wlan-ap0 bootimage autonomous** command in global configuration mode. To reload the access point with the autonomous software image, use the **service-module wlan-ap 0 reload** command.

Recovering Software on the Access Point

To recover the image on the access point, use the **service-module wlan-ap0 reset bootloader** command in global configuration mode. This command returns the access point to the bootloader for manual image recovery.

Caution Use this command with caution. It does not provide an orderly shutdown and consequently may impact file operations that are in progress. Use this command only to recover from a shutdown or a failed state.

Related Documentation

See the following documentation for additional autonomous and unified configuration procedures:

Table 3: Autonomous Cisco Documentation

Topic	Links
Wireless Overview	Wireless Device Overview, on page 1
Configuring the Radio	Configuring Radio Settings, on page 20
Authentication Types for Wireless Devices	This document describes the authentication types that are configured on the access point. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityAuthenticationTypes.html
RADIUS and TACACS+ Servers in a Wireless Environment	This document describes how to enable and configure the RADIUS and TACACS+ and provides detailed accounting information and flexible administrative control over authentication and authorization processes. RADIUS and TACACS+ are facilitated through AAA[13] and can be enabled only through AAA commands. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityRadiusTacacs_1.html

Topic	Links
Using the Access Point as a Local Authenticator	This document describes how to use a wireless device in the role of an access point as a local authenticator, serving as a standalone authenticator for a small wireless LAN, or providing backup authentication service. As a local authenticator, the access point performs LEAP, EAP-FAST, and MAC-based authentication for up to 50 client devices. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityLocalAuthent.html
Cipher Suites and WEP	This document describes how to configure the cipher suites required for using WPA and CCKM[14]; WEP; and WEP features including AES[15], MIC[16], TKIP, and broadcast key rotation. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityCipherSuitesWEP.html
Hot Standby Access Points	This document describes how to configure your wireless device as a hot standby unit. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/RolesHotStandby.html
Configuring Wireless VLANs	This document describes how to configure an access point to operate with the VLANs set up on a wired LAN. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/wireless_vlans.html
Service Set Identifiers	In the role of an access point, a wireless device can support up to 16 SSIDs. This document describes how to configure and manage SSIDs on the wireless device. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/ServiceSetID.html
Administering the Access Point	Administering the Wireless Device, on page 93
Quality of Service	This document describes how to configure QoS on your Cisco wireless interface. With this feature, you can provide preferential treatment to certain traffic at the expense of other traffic. Without QoS, the device offers best-effort service to each packet, regardless of the packet contents or size. It sends the packets without any assurance of reliability, delay bounds, or throughput. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/QualityOfService.html

Topic	Links
Regulatory Domains and Channels	This document lists the radio channels supported by Cisco access products in the regulatory domains of the world. http://www.cisco.com/en/US/customer/docs/routers/access/wireless/software/guide/RadioChannelFrequencies.html
System Message Logging	This document describes how to configure system message logging on your wireless device. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SysMsgLogging.html

13 AAA = Authentication, Authorization, and Accounting.
14 CCKM = Cisco Centralized Key Management.
15 AES = Advanced Encryption Standard.
16 MIC = Message Integrity Check.

Table 4: Cisco Unified Documentation

Network Design	Links
Why Migrate to the Cisco Unified Wireless Network?	http://www.cisco.com/en/US/solutions/ns175/networking_solutions_products_genericcontent0900aecd805299ff.html
Wireless LAN Controller (WLC) FAQ	http://www.cisco.com/en/US/products/ps6366/products_qanda_item09186a008064a991.shtml
Cisco IOS Command Reference for Cisco Aironet Access Points and Bridges, versions 12.4(10b) JA and 12.3(8) JEC	http://www.cisco.com/en/US/docs/wireless/access_point/12.4_10b_JA/command/reference/cr2410b.html
Cisco Aironet 1240AG Access Point Support Documentation	http://www.cisco.com/en/US/docs/wireless/access_point/1240/quick/guide/ap1240qs.html
Cisco 4400 Series Wireless LAN Controllers Support Documentation	http://www.cisco.com/en/US/products/ps6366/tsd_products_support_series_home.html

Configuring Radio Settings

This section describes how to configure radio settings for the wireless device and includes the following sub sections:

Enabling the Radio Interface

The wireless device radios are disabled by default.

Note You must create a service set identifier (SSID) before you can enable the radio interface.

To enable the access point radio, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **dot11 ssid** *ssid*
3. **interface dot11radio {0}**
4. **ssid** *ssid*
5. **no shutdown**
6. **end**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**dot11 ssid** *ssid*	Enters the SSID. **Note** The SSID consists of up to 32 alphanumeric characters. SSIDs are case sensitive.
Step 3	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 2.4-GHz and 802.11g/n 2.4-GHz radios are radio 0.
Step 4	**ssid** *ssid*	Assigns the SSID that you created in Step 2 to the appropriate radio interface.
Step 5	**no shutdown**	Enables the radio port. **Note** Use the shutdown command to disable the radio port.
Step 6	**end**	Returns to privileged EXEC mode.
Step 7	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Wireless Device Roles in a Radio Network

The wirless device radio performs the following roles in the wireless network:

- Access point
- Access point (fallback to radioP shutdown)
- Root bridge

- Non-root bridge
- Root bridge with wireless clients
- Non-root bridge without wireless clients

You can also configure a fallback role for root access points. The wireless device automatically assumes the fallback role when its Ethernet port is disabled or disconnected from the wired LAN. The default fallback role for Cisco ISR wireless devices is shutdown, that is the wireless device shuts down its radio and disassociates all client devices.

Configuring the Wireless Device Roles in a Radio Network

To set the wireless device's radio network role and fallback role, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **station-role non-root {bridge | wireless-clients} root {access-point | ap-only | [bridge | wireless-clients] | [fallback | repeater | shutdown]} workgroup-bridge {multicast | mode { client | infrastructure} | universal** *Ethernet-client-MAC-address* **}**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 2.4-GHz and 802.11g/n 2.4-GHz radios are radio 0
Step 3	**station-role non-root {bridge | wireless-clients} root {access-point | ap-only | [bridge | wireless-clients] | [fallback | repeater | shutdown]} workgroup-bridge {multicast | mode { client | infrastructure} | universal** *Ethernet-client-MAC-address* **}**	Sets the wireless device role. • Sets the role to non-root bridge with or without wireless clients, to root access point or bridge, or to workgroup bridge. **Note** The bridge mode radio supports point-to-point configuration only. **Note** The repeater and wireless-clients commands are not supported on Cisco 860 Series , Cisco 880 Series Integrated Services Routers. **Note** The scanner command is not supported on Cisco 860 SeriesCisco 880 Series Integrated Services Routers. • The Ethernet port is shut down when any one of the radios is configured as a repeater. Only one radio per access point may be configured as a workgroup bridge or repeater. A workgroup bridge can have a maximum of 25 clients, presuming that no other wireless clients are associated to the root bridge or access point.

	Command or Action	Purpose
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Note When you enable the role of a device in the radio network as a bridge or workgroup bridge and enable the interface using the no shut command, the physical status and the software status of the interface will be up (ready) only if the device on the other end (access point or bridge) is up. Otherwise, only the physical status of the device will be up. The software status will be up when the device on the other end is configured and ready.

Configuring Dual-Radio Fallback

The dual-radio fallback features allows you to configure access points so that if the non-root bridge link connecting the access point to the network infrastructure goes down, the root access point link through which a client connects to the access point shut down. Shutting down the root access point link causes the client to roam to another access point. Without this feature, the client remains connected to the access point, but won't be able to send or receive data from the network.

You can configure dual-radio fallback in three ways:

Radio Tracking

You can configure the access point to track or monitor the status of one of its radios. If the tracked radio goes down or is disabled, the access point shuts down the other radio. If the tracked radio comes up, the access point enables the other radio.

To track radio 0, enter the following command:

```
# station-role root access-point fallback track d0 shutdown
```

Fast Ethernet Tracking

You can configure the access point for fallback when its Ethernet port is disabled or disconnected from the wired LAN. For guidance on configuring the access point for Fast Ethernet tracking, see the Wireless Device Roles in a Radio Network, on page 21.

Note Fast Ethernet tracking does not support the repeater mode.

To configure the access point for Fast Ethernet tracking, enter the following command:

```
# station-role root access-point fallback track fa 0
```

MAC-Address Tracking

You can configure the radio whose role is root access point to come up or go down by tracking a client access point, using its MAC address, on another radio. If the client disassociates from the access point, the root access point radio goes down. If the client reassociates to the access point, the root access point radio comes back up.

MAC-address tracking is most useful when the client is a non-root bridge access point connected to an upstream wired network.

For example, to track a client whose MAC address is 12:12:12:12:12:12, enter the following command:

```
# station-role root access-point fallback track mac-address 12:12:12:12:12:12 shutdown
```

Overview of Radio Data Rates

You use the data rate settings to choose the data rates that the wireless device uses for data transmission. The rates are expressed in megabits per second (Mb/s). The wireless device always attempts to transmit at the highest data rate set to **basic**, also known as **required** on the browser-based interface. If there are obstacles or interference, the wireless device steps down to the highest rate that allows data transmission. You can set each data rate to one of three states:

- Basic (the GUI labels Basic rates as Required)—Allows transmission at this rate for all packets, both unicast and multicast. At least one of the data rates of the wireless device must be set to basic.
- Enabled—The wireless device transmits only unicast packets at this rate; multicast packets are sent at one of the data rates set to basic.
- Disabled—The wireless device does not transmit data at this rate.

Note At least one data rate must be set to **basic**.

You can use the data rate settings to set an access point to serve client devices operating at specific data rates. For example, to set the 2.4-GHz radio for 11 Mb/s service only, set the 11-Mb/s rate to **basic,** and set the other data rates to **disabled**. To set the wireless device to serve only client devices operating at 1 and 2 Mb/s, set 1 and 2 to **basic,** and set the rest of the data rates to **disabled**. To set the 2.4-GHz, 802.11g radio to serve only 802.11g client devices, set any orthogonal frequency division multiplexing (OFDM) data rate (6, 9, 12, 18, 24, 36, 48, 54) to **basic**. To set the 5-GHz radio for 54-Mb/s service only, set the 54-Mb/s rate to **basic,** and set the other data rates to **disabled**.

You can configure the wireless device to set the data rates automatically to optimize either the range or the throughput. When you enter **range** for the data rate setting, the wireless device sets the 1-Mb/s rate to **basic** and sets the other rates to **enabled**. The range setting allows the access point to extend the coverage area by compromising on the data rate. Therefore, if you have a client that cannot connect to the access point although other clients can, the client might not be within the coverage area of the access point. In such a case, using the range option will help extend the coverage area, and the client may be able to connect to the access point.

Typically, the trade-off is between throughput and range. When the signal degrades (possibly due to distance from the access point), the rates renegotiate in order to maintain the link (but at a lower data rate). A link that is configured for a higher throughput simply drops when the signal degrades enough that it no longer sustains a configured high data rate, or the link roams to another access point with sufficient coverage, if one is available. The balance between the two (throughput vs. range) is a design decision that must be made based on resources available to the wireless project, the type of traffic the users will be passing, the service level desired, and as always, the quality of the RF environment. When you enter **throughput** for the data rate setting, the wireless device sets all four data rates to **basic**.

Note When a wireless network has a mixed environment of 802.11b clients and 802.11g clients, make sure that data rates 1, 2, 5.5, and 11 Mb/s are set to **required** (**basic**) and that all other data rates are set to **enable**. The 802.11b adapters do not recognize the 54 Mb/s data rate and do not operate if data rates higher than 11 Mb/s are set to **required** on the connecting access point.

Configuring Radio Data Rates

To configure the radio data rates, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **speed**
   - 802.11b, 2.4-GHz radio:

     {[1.0] [11.0] [2.0] [5.5] [basic-1.0] [basic-11.0] [basic-2.0] [basic-5.5] | range | throughput}
   - 802.11g, 2.4-GHz radio:

     {[1.0] [2.0] [5.5] [6.0] [9.0] [11.0] [12.0] [18.0] [24.0] [36.0] [48.0] [54.0] [basic-1.0] [basic-2.0] [basic-5.5] [basic-6.0] [basic-9.0] [basic-11.0] [basic-12.0] [basic-18.0] [basic-24.0] [basic-36.0] [basic-48.0] [basic-54.0] | range | throughput [ofdm] | default}
   - 802.11a 5-GHz radio:

     {[6.0] [9.0] [12.0] [18.0] [24.0] [36.0] [48.0] [54.0] [basic-6.0] [basic-9.0] [basic-12.0] [basic-18.0] [basic-24.0] [basic-36.0] [basic-48.0] [basic-54.0] | range | throughput | ofdm-throughput | default}
   - 802.11n 2.4-GHz radio:

     {[1.0] [11.0] [12.0] [18.0] [2.0] [24.0] [36.0] [48.0] [5.5] [54.0] [6.0] [9.0] [basic-1.0] [basic-11.0] [basic-12.0] [basic-18.0] [basic-24.0] [basic-36.0] [basic-48.0] [basic-5.5] [basic-54.0] [basic-6.0] [basic-9.0] [default] [m0-7] [m0.] [m1.] [m10.] [m11.] [m12.] [m13.] [m14.] [m15.] [m2.] [m3.] [m4.] [m5.] [m6.] [m7.] [m8-15] [m8.] [m9.] [ofdm] [only-ofdm] | range | throughput}
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 2.4-GHz and the 802.11g/n 2.4-GHz radios are radio 0.
Step 3	**speed** • 802.11b, 2.4-GHz radio: **{[1.0] [11.0] [2.0] [5.5] [basic-1.0] [basic-11.0] [basic-2.0] [basic-5.5] | range | throughput}** • 802.11g, 2.4-GHz radio: **{[1.0] [2.0] [5.5] [6.0] [9.0] [11.0] [12.0] [18.0] [24.0] [36.0] [48.0] [54.0] [basic-1.0] [basic-2.0] [basic-5.5] [basic-6.0] [basic-9.0] [basic-11.0] [basic-12.0] [basic-18.0] [basic-24.0] [basic-36.0] [basic-48.0] [basic-54.0] | range | throughput [ofdm] | default}** • 802.11a 5-GHz radio: **{[6.0] [9.0] [12.0] [18.0] [24.0] [36.0] [48.0] [54.0] [basic-6.0] [basic-9.0] [basic-12.0] [basic-18.0] [basic-24.0] [basic-36.0] [basic-48.0] [basic-54.0] | range | throughput | ofdm-throughput | default}** • 802.11n 2.4-GHz radio: **{[1.0] [11.0] [12.0] [18.0] [2.0] [24.0] [36.0] [48.0] [5.5] [54.0] [6.0] [9.0] [basic-1.0] [basic-11.0] [basic-12.0] [basic-18.0] [basic-24.0] [basic-36.0] [basic-48.0] [basic-5.5] [basic-54.0] [basic-6.0] | basic-9.0] [default] [m0-7] [m0.] [m1.] [m10.] [m11.] [m12.] [m13.] [m14.] [m15.] [m2.] [m3.] [m4.] [m5.] [m6.] [m7.] [m8-15] [m8.] [m9.] [ofdm] [only-ofdm] | range | throughput}**	Sets each data rate to basic or enabled, or enters range to optimize range or enters throughput to optimize throughput. • (Optional) Enter 1.0, 2.0, 5.5, and 11.0 to set these data rates to enabled on the 802.11b, 2.4-GHz radio. Enter 1.0, 2.0, 5.5, 6.0, 9.0, 11.0, 12.0, 18.0, 24.0, 36.0, 48.0, and 54.0 to set these data rates to enabled on the 802.11g, 2.4-GHz radio. Enter 6.0, 9.0, 12.0, 18.0, 24.0, 36.0, 48.0, and 54.0 to set these data rates to enabled on the 5-GHz radio. • (Optional) Enter basic-1.0, basic-2.0, basic-5.5, and basic-11.0 to set these data rates to basic on the 802.11b, 2.4-GHz radio. Enter basic-1.0, basic-2.0, basic-5.5, basic-6.0, basic-9.0, basic-11.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0, basic-48.0, and basic-54.0 to set these data rates to basic on the 802.11g, 2.4-GHz radio. **Note** If the client must support the basic rate that you select, it cannot associate to the wireless device. If you select 12-Mb/s or higher for the basic data rate on the 802.11g radio, 802.11b client devices cannot associate to the wireless device 802.11g radio. Enter basic-6.0, basic-9.0, basic-12.0, basic-18.0, basic-24.0, basic-36.0, basic-48.0, and basic-54.0 to set these data rates to basic on the 5-GHz radio. • (Optional) Enter range or throughput or **{[1.0] [11.0] [2.0] [5.5] [basic-1.0] [basic-11.0] [basic-2.0] [basic-5.5] | range | throughput}ofdm-throughput** (no ERP protection) to automatically optimize radio range or throughput. When you enter range, the wireless device sets the lowest data rate to **basic** and sets the other rates to enabled. When you enter throughput, the wireless device sets all data rates to basic. (Optional) On the 802.11g radio, enter speed throughput ofdm to set all OFDM rates (6, 9, 12, 18, 24, 36, and 48) to **basic** (**required**) and to set all the CCK rates (1, 2, 5.5, and 11) to **disabled**. This setting disables 802.11b protection mechanisms and provides maximum throughput for 802.11g clients. However, it prevents 802.11b clients from associating to the access point. • (Optional) Enter default to set the data rates to factory default settings (not supported on 802.11b radios). On the 802.11g radio, the default option sets rates 1, 2, 5.5, and 11 to **basic**, and stes rates 6, 9, 12, 18, 24, 36, 48, and 54 to **enabled**. These rate settings

	Command or Action	Purpose
		allow both 802.11b and 802.11g client devices to associate to the wireless device 802.11g radio. On the 5-GHz radio, the default option sets rates 6.0, 12.0, and 24.0 to **basic**, and stes rates 9.0, 18.0, 36.0, 48.0, and 54.0 to **enabled**. On the 802.11g/n 2.4-GHz radio, the default option sets rates 1.0, 2.0, 5.5, and 11.0 to **enabled**. On the 802.11g/n 5-GHz radio, the default option sets rates to 6.0, 12.0, and 24.0 to **enabled**. The modulation coding scheme (MCS) index range for both 802.11g/n radios is 0 to 15.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Configuration Example: Configuring Radio Data Rates

This example shows how to configure data rates **basic-2.0** and **basic-5.5** from the configuration:

```
ap1200# configure terminal
ap1200(config)# interface dot11radio 0
ap1200(config-if)# speed basic-2.0 basic-5.5
ap1200(config-if)# end
```

Configuring MCS Rates

Modulation coding scheme (MCS) is a specification of PHY parameters consisting of modulation order (binary phase shift keying [BPSK], quaternary phase shift keying [QPSK], 16-quadrature amplitude modulation [16-QAM], 64-QAM) and forward error correction (FEC) code rate (1/2, 2/3, 3/4, 5/6). MCS is used in the wireless device 802.11n radios, which define 32 symmetrical settings (8 per spatial stream):

- MCS 0–7
- MCS 8–15
- MCS 16–23
- MCS 24–31

The wireless device supports MCS 0–15. High-throughput clients support at least MCS 0–7.

MCS is an important setting because it provides for potentially greater throughput. High-throughput data rates are a function of MCS, bandwidth, and guard interval. The 802.11a, b, and g radios use 20-MHz channel widths. Table 5: Data Rates Based on MCS Settings, Guard Interval, and Channel Width , on page 28 shows potential data rated based on MCS, guard interval, and channel width.

Table 5: Data Rates Based on MCS Settings, Guard Interval, and Channel Width

MCS Index	Guard Interval = 800 ns	Guard Interval = 400 ns		
	20-MHz Channel Width Data Rate (Mb/s)	40-MHz Channel Width Data Rate (Mb/s)	20-MHz Channel Width Data Rate (Mb/s)	40-MHz Channel Width Data Rate (Mb/s)
0	6.5	13.5	7 2/9	15
1	13	27	14 4/9	30
2	19.5	40.5	21 2/3	45
3	26	54	28 8/9	60
4	39	81	43 1/3	90
5	52	109	57 5/9	120
6	58.5	121.5	65	135
7	65	135	72 2/9	152.5
8	13	27	14 4/9	30
9	26	54	28 8/9	60
10	39	81	43 1/3	90
11	52	108	57 7/9	120
12	78	162	86 2/3	180
13	104	216	115 5/9	240
14	117	243	130	270
15	130	270	144 4/9	300
The legacy rates are as follows: 5 GHz: 6, 9, 12, 18, 24, 36, 48, and 54 Mb/s 2.4 GHz: 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, and 54 Mb/s				

Configuration Example: MCS Rates

MCS rates are configured using the speed command.

The following example shows configuring speed setting for an 802.11g/n 2.4-GHz radio:

```
interface Dot11Radio0
no ip address
no ip route-cache
!
ssid 800test
!
speed basic-1.0 2.0 5.5 11.0 6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0 m0. m1. m2. m3. m4. m8.
 m9. m10. m11. m12. m13. m14. m15.
```

Configuring Radio Transmit Power

Radio transmit power is based on the type of radio or radios installed in your access point and the regulatory domain in which it operates.

To set the transmit power on access point radios, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **power local**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 2.4-GHz and the 802.11g/n 2.4-GHz radios are radio 0.

Step 3	**power local**
	
	Example:
	
	`These options are available for the 2.4-GHz 802.11n radio (in dBm):`
	
	Example:
	
	`{8 | 9| 11 | 14 | 15 | 17 | maximum}`
		Sets the transmit power for the 2.4-GHz radioso that the power level is allowed in your regulatory domain.
		Note Use the no form of the **power local** command to return the power setting to maximum, the default setting.

	Command or Action	Purpose
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Limiting the Power Level for Associated Client Devices

You can also limit the power level on client devices that associate to the wireless device. When a client device associates to the wireless device, the wireless device sends the maximum power level setting to the client.

Note Cisco AVVID documentation uses the term Dynamic Power Control (DPC) to refer to limiting the power level on associated client devices.

To specify a maximum allowed power setting on all client devices that associate to the wireless device, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **power client**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 2.4-GHz and 802.11g/n 2.4-GHz radios are radio 0.
Step 3	**power client** **Example:** `These options are available for 802.11n 2.4-GHz clients (in dBm): {local | 8 | 9 | 11 | 14 | 15 | 17 | maximum}`	Sets the maximum power level allowed on client devices that associate to the wireless device. • Setting the power level to local sets the client power level to that of the access point. • Setting the power level to maximum sets the client power to the allowed maximum. **Note** The settings allowed in your regulatory domain might differ from the settings listed here.

	Command or Action	Purpose
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Use the no form of the **power client** command to disable the maximum power level for associated clients.

Note Aironet extensions must be enabled to limit the power level on associated client devices. Aironet extensions are enabled by default.

Configuring Radio Channel Settings

The default channel setting for the wireless device radios is least congested. At startup, the wireless device scans for and selects the least-congested channel. For the most consistent performance after a site survey, however, we recommend that you assign a static channel setting for each access point. The channel settings on the wireless device correspond to the frequencies available in your regulatory domain. See the access point hardware installation guide for the frequencies allowed in your domain.

Each 2.4-GHz channel covers 22 MHz. Because the bands for channels 1, 6, and 11 do not overlap, you can set up multiple access points in the same vicinity without causing interference. The 802.11b and 802.11g 2.4-GHz radios use the same channels and frequencies.

The 5-GHz radio operates on 8 channels from 5180 to 5320 MHz, up to 27 channels from 5170 to 5850 MHz depending on regulatory domain. Each channel covers 20 MHz, and the bands for the channels overlap slightly. For best performance, use channels that are not adjacent (use channels 44 and 46, for example) for radios that are close to each other.

Note The presence of too many access points in the same vicinity can create radio congestion that can reduce throughput. A careful site survey can determine the best placement of access points for maximum radio coverage and throughput.

The 802.11n standard allows both 20-MHz and 40-Mhz channel widths consisting of two contiguous non-overlapping channels (for example, 2.4-GHz channels 1 and 6)

One of the 20-MHz channels is called the control channel. Legacy clients and 20-MHz high-throughput clients use the control channel. Only beacons can be sent on this channel. The other 20-MHz channel is called the extension channel. The 40-MHz stations may use this channel and the control channel simultaneously.

A 40-MHz channel is specified as a channel and extension, such as 1,1. In this example, the control channel is channel 1 and the extension channel is above it.

Configuring Wireless Channel Width

To set the wireless device channel width, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0 }**
3. **channel {frequency | least-congested | width [20 | 40-above | 40-below] | dfs}**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0 }**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0
Step 3	**channel {frequency | least-congested | width [20 | 40-above | 40-below] | dfs}**	Sets the default channel for the wireless device radio.To search for the least-congested channel on startup, enter least-congested. • Use the width option to specify a bandwidth to use. This option is available for the Cisco 800 series ISR wireless devices and consists of three available settings: **20**, **40-above**, and **40-below:** ◦ Choosing **20** sets the channel width to 20 MHz. ◦ Choosing **40-above** sets the channel width to 40 MHz with the extension channel above the control channel. ◦ Choosing **40-below** sets the channel width to 40 MHz with the extension channel below the control channel. **Note** The channel command is disabled for 5-GHz radios that comply with European Union regulations on dynamic frequency selection (DFS). See the Enabling and Disabling World Mode, on page 33 for more information.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Enabling and Disabling World Mode

You can configure the wireless device to support 802.11d world mode, Cisco legacy world mode, or world mode roaming. When you enable world mode, the wireless device adds channel carrier set information to its beacon. Client devices with world mode enabled receive the carrier set information and adjust their settings automatically. For example, a client device used primarily in Japan could rely on world mode to adjust its channel and power settings automatically when it travels to Italy and joins a network there. Cisco client devices detect whether the wireless device is using 802.11d or Cisco legacy world mode and automatically use the world mode that matches the mode used by the wireless device.

You can also configure world mode to be always on. In this configuration, the access point essentially roams between countries and changes its settings as required. World mode is disabled by default.

Enabling World Mode

To enable world mode, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0 }**
3. **world-mode {dot11d country_code code {both | indoor | outdoor} | world-mode roaming | legacy}**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0 }**	Enters interface configuration mode for the radio interface.
Step 3	**world-mode {dot11d country_code code {both | indoor | outdoor} | world-mode roaming | legacy}**	Enables world mode. • Enter the dot11d option to enable 802.11d world mode. ◦ When you enter the dot11d option, you must enter a two-character ISO country code (for example, the ISO country code for the United States is US). You can find a list of ISO country codes at the ISO website. ◦ After the country code, you must enter indoor, outdoor, or both to indicate the placement of the wireless device. • Enter the legacy option to enable Cisco legacy world mode. • Enter the world-mode roaming option to place the access point in a continuous world mode configuration.

	Command or Action	Purpose
		Note Aironet extensions must be enabled for legacy world mode operation, but Aironet extensions are not required for 802.11d world mode. Aironet extensions are enabled by default.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Use the no form of the **world-mode** command to disable world mode.

Disabling and Enabling Short Radio Preambles

The radio preamble (sometimes called a header) is a section of data at the head of a packet that contains information that the wireless device and client devices need when sending and receiving packets. You can set the radio preamble to long or short:

- Short—A short preamble improves throughput performance.
- Long—A long preamble ensures compatibility between the wireless device and all early models of Cisco Aironet Wireless LAN Adapters. If these client devices do not associate to the wireless devices, you should use short preambles.

You cannot configure short or long radio preambles on the 5-GHz radio.

Disabling Short Radio Preambles

To disable short radio preambles, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0 }**
3. **no preamble-short**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**interface dot11radio {0 }**	Enters interface configuration mode for the 2.4-GHz radio interface.
Step 3	**no preamble-short**	Disables short preambles and enables long preambles. **Note** Short preambles are enabled by default. Use the preamble-short command to enable short preambles if they are disabled.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Transmit and Receive Antennas

You can select the antenna that the wireless device uses to receive and transmit data. There are four options for both the receive antenna and the transmit antenna:

- Gain—Sets the resultant antenna gain in decibels (dB).
- Diversity—This default setting tells the wireless device to use the antenna that receives the best signal. If the wireless device has two fixed (non-removable) antennas, you should use this setting for both receive and transmit.
- Right—If the wireless device has removable antennas and you install a high-gain antenna on the wireless device's right connector, you should use this setting for both receive and transmit. When you look at the wireless device's back panel, the right antenna is on the right.
- Left—If the wireless device has removable antennas and you install a high-gain antenna on the wireless device's left connector, you should use this setting for both receive and transmit. When you look at the wireless device's back panel, the left antenna is on the left.

See the following section for information on configuring transmit and receive antennas:

Configuring Transmit and Recieve Antennas

To select the antennas that the wireless device uses to receive and transmit data, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0 }**
3. **gain dB**
4. **antenna receive {diversity | left | right}**
5. **end**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0 }**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0
Step 3	**gain dB**	Specifies the resultant gain of the antenna attached to the device. • Enter a value from –128 to 128 dB. If necessary, you can use a decimal in the value, such as 1.5. **Note** The Cisco 860 and Cisco 880 ISRs are shipped with a fixed antenna that cannot be removed. The antenna gain cannot be configured on these models
Step 4	**antenna receive {diversity | left | right}**	Sets the receive antenna to diversity, left, or right. **Note** For best performance with two antennas, leave the receive antenna setting at the default setting, diversity. For one antenna, attach the antenna on the right and set the antenna for right.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Disabling and Enabling Aironet Extensions

By default, the wireless device uses Cisco Aironet 802.11 extensions to detect the capabilities of Cisco Aironet client devices and to support features that require specific interaction between the wireless device and associated client devices. Aironet extensions must be enabled to support these features:

- Load balancing—The wireless device uses Aironet extensions to direct client devices to an access point that provides the best connection to the network on the basis of such factors as number of users, bit error rates, and signal strength.

- Message Integrity Check (MIC)—MIC is an additional WEP security feature that prevents attacks on encrypted packets called bit-flip attacks. The MIC, implemented on the wireless device and all associated client devices, adds a few bytes to each packet to make the packets tamper-proof.
- Load balancing—The wireless device uses Aironet extensions to direct client devices to an access point that provides the best connection to the network on the basis of such factors as number of users, bit error rates, and signal strength.
- Cisco Key Integrity Protocol (CKIP)—Cisco's WEP key permutation technique is based on an early algorithm presented by the IEEE 802.11i security task group. The standards-based algorithm, Temporal Key Integrity Protocol (TKIP), does not require Aironet extensions to be enabled.
- World mode (legacy only)—Client devices with legacy world mode enabled receive carrier set information from the wireless device and adjust their settings automatically. Aironet extensions are not required for 802.11d world mode operation.
- Limiting the power level on associated client devices—When a client device associates to the wireless device, the wireless device sends the maximum allowed power level setting to the client.

Disabling Aironet extensions disables the features listed above, but it sometimes improves the ability of non-Cisco client devices to associate to the wireless device.

Disabling Aironet Extensions

Aironet extensions are enabled by default. To disable Aironet extensions, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0 }**
3. **no dot11 extension aironet**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0 }**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0.
Step 3	**no dot11 extension aironet**	Disables Aironet extensions.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Use the dot11 extension aironet command to enable Aironet extensions if they are disabled.

Ethernet Encapsulation Transformation Method

When the wireless device receives data packets that are not 802.3 packets, the wireless device must format the packets to 802.3 by using an encapsulation transformation method. These are the two transformation methods:

- 802.1H—This method provides optimum performance for Cisco wireless products.
- RFC 1042—Use this setting to ensure interoperability with non-Cisco wireless equipment. RFC1042 does not provide the interoperability advantages of 802.1H but is used by other manufacturers of wireless equipment.

For information on how to configure the ethernet encapsulation transformation method, see the following section:

Configuring the Ethernet Encapsulation Transformation Method

To configure the encapsulation transformation method, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0 }**
3. **payload-encapsulation {snap | dot1h}**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0 }**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0.
Step 3	**payload-encapsulation {snap | dot1h}**	Sets the encapsulation transformation method to RFC 1042 (snap) or 802.1h (dot1h, the default setting).
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Enabling and Disabling Public Secure Packet Forwarding

Public Secure Packet Forwarding (PSPF) prevents client devices that are associated to an access point from inadvertently sharing files or communicating with other client devices that are associated to the access point. PSPF provides Internet access to client devices without providing other capabilities of a LAN. This feature is useful for public wireless networks like those installed in airports or on college campuses.

Note To prevent communication between clients associated to different access points, you must set up protected ports on the switch to which the wireless devices are connected. See the Related Documentation, on page 18 for instructions on setting up protected ports.

To enable and disable PSPF using CLI commands on the wireless device, you use bridge groups. For a detailed explanation of bridge groups and instructions for implementing them, see the following link:

http://www.cisco.com/en/US/docs/ios/12_2/ibm/configuration/guide/bcftb_ps1835_TSD_Products_Configuration_Guide_Chapter.html

Configuring Public Secure Packet Forwarding

PSPF is disabled by default. To enable PSPF, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **bridge-group group port-protected**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0.
Step 3	**bridge-group group port-protected**	Enables PSPF.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Use the no form of the **bridge group** command to disable PSPF.

Configuring Protected Ports

To prevent communication between client devices that are associated to different access points on your wireless LAN, you must set up protected ports on the switch to which the wireless devices are connected.

To define a port on your switch as a protected port, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport protected**
4. **end**
5. **show interfaces** *interface-id* **switchport**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface** *interface-id*	Enters interface configuration mode. • Enter the type and number of the switch port interface to configure, such as *wlan-gigabitethernet0*.
Step 3	**switchport protected**	Configures the interface to be a protected port.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**show interfaces** *interface-id* **switchport**	Verifies your entries.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

To disable protected port, use the **no switchport protected** command.

For detailed information on protected ports and port blocking, see the “Configuring Port-Based Traffic Control” chapter in Catalyst 3550 Multilayer Switch Software Configuration Guide, 12.1(12c)EA1. Click this link to browse to that guide:

http://www.cisco.com/en/US/docs/switches/lan/catalyst3550/software/release/12.1_12c_ea1/ configuration/ guide/3550scg.html

Beacon Period and the DTIM

The beacon period is the amount of time between access point beacons in kilomicroseconds (Kmicrosecs). One Kmicrosec equals 1,024 microseconds. The data beacon rate, always a multiple of the beacon period, determines how often the beacon contains a delivery traffic indication message (DTIM). The DTIM tells power-save client devices that a packet is waiting for them.

For example, if the beacon period is set at 100, its default setting, and if the data beacon rate is set at 2, its default setting, then the wireless device sends a beacon containing a DTIM every 200 Kmicrosecs.

The default beacon period is 100, and the default DTIM is 2.

See the following section for information on configuring beacon period and DTIM:

Configuring the Beacon Period and the DTIM

To configure the beacon period and the DTIM, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **beacon period** *value*
4. **beacon dtim-period** *value*
5. **end**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0
Step 3	**beacon period** *value*	Sets the beacon period. • Enter a value in kilomicroseconds.
Step 4	**beacon dtim-period** *value*	Sets the DTIM. • Enter a value in kilomicroseconds.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

RTS Threshold and Retries

The request to send (RTS) threshold determines the packet size at which the wireless device issues an RTS before sending the packet. A low RTS threshold setting can be useful in areas where many client devices are associating with the wireless device, or in areas where the clients are far apart and can detect only the wireless device and not detect each other. You can enter a setting ranging from 0 to 2347 bytes.

The maximum RTS retries is the maximum number of times the wireless device issues an RTS before stopping the attempt to send the packet over the radio. Enter a value from 1 to 128.

The default RTS threshold is 2347 for all access points and bridges, and the default maximum RTS retries setting is 32.

Configuring RTS Threshold and Retries

To configure the RTS threshold and maximum RTS retries, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **rts threshold** *value*
4. **rts retries** *value*
5. **end**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 2.4-GHz and the 802.11g/n 2.4-GHz radios are radio 0
Step 3	**rts threshold** *value*	Sets the RTS threshold. • Enter an RTS threshold from 0 to 2347.
Step 4	**rts retries** *value*	Sets the maximum RTS retries. • Enter a setting from 1 to 128.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Use the no form of the **rts** command to reset the RTS settings to defaults.

Maximum Data Retries

The maximum data retries setting determines the number of attempts that the wireless device makes to send a packet before it drops the packet. The default setting is 32.

Configuring the Maximum Data Retries

To configure the maximum data retries, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **packet retries** *value*
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz radio is radio 0.
Step 3	**packet retries** *value*	Sets the maximum data retries. • Enter a setting from 1 to 128. **Note** Use the no form of the **packet retries** command to reset the setting to the default.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Configuring the Fragmentation Threshold

The fragmentation threshold determines the size at which packets are fragmented (sent as several pieces instead of as one block). Use a low setting in areas where communication is poor or where there is a great deal of radio interference. The default setting is 2346 bytes.

Configuring the Fragment Threshold

To configure the fragmentation threshold, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **interface dot11radio {0}**
3. **fragment-threshold** *value*
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface dot11radio {0}**	Enters interface configuration mode for the radio interface. The 802.11g/n 2.4-GHz and 5-GHz radios are radio 0.
Step 3	**fragment-threshold** *value*	Sets the fragmentation threshold. • Enter a setting from 256 to 2346 bytes for the 2.4-GHz radio. • Enter a setting from 256 to 2346 bytes for the 5-GHz radio. **Note** Use the no form of the **fragment-threshold** command to reset the setting to the default.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Enabling Short Slot Time for 802.11g Radios

You can increase throughput on the 802.11g 2.4-GHz radio by enabling short slot time. Reducing the slot time from the standard 20 microseconds to the 9-microsecond short slot time decreases the overall backoff, which increases throughput. Backoff, which is a multiple of the slot time, is the random length of time that a station waits before sending a packet on the LAN.

Many 802.11g radios support short slot time, but some do not. When you enable short slot time, the wireless device uses the short slot time only when all clients associated to the 802.11g 2.4-GHz radio support short slot time.

Short slot time is supported only on the 802.11g 2.4-GHz radio. Short slot time is disabled by default.

In radio interface mode, enter the short-slot-time command to enable short slot time:

```
ap(config-if)# short-slot-time
```

Use the no form of the short-slot-time command to disable short slot time.

Performing a Carrier Busy Test

You can perform a carrier busy test to check the radio activity on wireless channels. During the carrier busy test, the wireless device drops all associations with wireless networking devices for 4 seconds while it conducts the carrier test and then displays the test results.

In privileged EXEC mode, enter this command to perform a carrier busy test:

```
dot11 interface-number carrier busy
```

For interface-number, enter dot11radio 0 to run the test on the 2.4-GHz radio

Use the **show dot11 carrier busy** command to redisplay the carrier busy test results.

Configuring VoIP Packet Handling

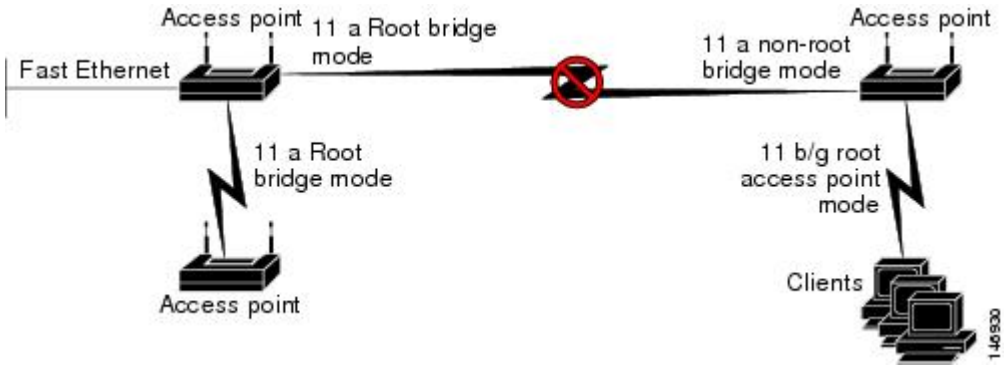
You can improve the quality of VoIP packet handling per radio on access points by enhancing 802.11 MAC behavior for lower latency for the class of service (CoS) 5 (Video) and CoS 6 (Voice) user priorities.

To configure VoIP packet handling on an access point, follow these steps:

1. Using a browser, log in to the access point.
2. Click **Services** in the task menu on the left side of the web-browser interface.
3. When the list of Services expands, click **Stream**.
   The Stream page appears.
4. Click the tab for the radio to configure.
5. For both CoS 5 (Video) and CoS 6 (Voice) user priorities, choose Low Latency from the Packet Handling drop-down menu, and enter a value for maximum retries for packet discard in the corresponding field.

The default value for maximum retries is 3 for the Low Latency setting. This value indicates how many times the access point will try to retrieve a lost packet before discarding it.

Figure 3: Packet Handling Configuration



Note You may also configure the CoS 4 (Controlled Load) user priority and its maximum retries value.

6 Click **Apply**.

Configuring WLAN

This section describes the Wireless LAN (WLAN) configuration tasks for Cisco 810, 860, 880 and 890 series routers and contains the following sections:

Configuring WLAN Using the Web-based Interface

Use the web-based interface to display wireless LAN (WLAN) information and configure settings. For information about the CLI-based WLAN interface, see Configuring WLAN Using the CLI-based Interface, on page 53.

Connecting to the Web-based WLAN Interface

To connect to the web-based WLAN interface, open the following address in a web browser: http://10.10.10.2

Log in using the default credentials:

User name: **admin**

Password: **admin**

Note When using the default WLAN credentials, the user is prompted to change the password when logging in for the first time.

Address for Accessing Web-based Interface

You can change the address for accessing the web-based interface. See Configuring Access to the Web-based Interface, on page 47.

DHCP Server Configuration

By default, the DHCP server is not configured. Configure DHCP parameters using the Cisco IOS CLI on VLAN 1.

Subnet

Connect to the interface from a device within the LAN containing the router. The device must be within the subnet configured for accessing the router. The default subnet mask is 255.255.255.0.

Displaying Device Information

In the left pane, click **Device Info -> Summary** to open the Device Info page, displaying the following device information:

- Hardware and driver information for upgrading drivers or troubleshooting

Displaying Connection Statistics

In the left pane, click **Device Info -> Statistics** to open the Statistics - WLAN page, displaying statistics on packets received and packets transmitted. The page is automatically refreshed.

Configuring Access to the Web-based Interface

In the left pane, click **Device Info -> Network Interface** to open the Network Interface Setup page for configuring access to the web-based interface.

The page shows the IP address and subnet mask used to access the web-based interface. You can enter a new IP address and subnet mask for accessing the web-based interface. The default values are:

IP: **10.10.10.2**

Subnet Mask: **255.255.255.248**

Note Enter IPv4 values only. IPv6 is not supported.

Note Changing the IP address to a different subnet requires changing VLAN 1 to be in the same subnet also.

Note You can access the web-based interface only from a device within the same subnet.

Configuring Basic Wireless Settings

In the left pane, click **Wireless -> Basic** to open the Wireless - Basic page, providing configuration options for the wireless LAN (WLAN).

Main SSID

The options in the top portion of the Wireless - Basic page apply to the main service set identification (SSID):

- Enable Wireless—Enables/disables the WLAN feature.
- Hide Access Point—Hiding the SSID provides a small measure of security in helping to prevent unauthorized users from accessing the network. When this feature is enabled, the WLAN access point SSID is not broadcast, making wireless snooping more difficult.
- Clients Isolation—Prevents a wireless client connected to a specific SSID from communicating with other wireless clients connected to the same SSID.
- Disable WMM Advertise—Disables the WiFi Multimedia (WMM) feature. The WMM feature prioritizes media traffic to improve media transmission.
- Enable Wireless Multicast Forwarding (WMF)—Enables the Wireless Multicast Forwarding (WMF) feature.
- SSID—Main SSID used for accessing the WLAN. Devices connected to the WLAN using the same SSID operate within the same domain. The main SSID can be disabled only by disabling WLAN completely.
- BSSID—MAC address for the main SSID. Each enabled SSID has a separate BSSID.
- Max Clients—Configures the maximum number of clients that can connect to the main SSID. Default value: 16 Recommended maximum: 16 Theoretical maximum: 128

Guest SSIDs

A table at the bottom of the Wireless - Basic page shows the guest SSIDs for connecting guest devices to the WLAN. For each guest SSID, you can configure options similar to those for the main SSID.

Default SSID Values

The following are the default SSID values:

- Main SSID: Cisco860
- Guest SSID 1: Cisco860_Guest1
- Guest SSID 2: Cisco860_Guest2
- Guest SSID 3: Cisco860_Guest3

Note By default, the main SSID is enabled and guest SSIDs are disabled.

Configuring Security

In the left pane, click **Wireless -> Security** to open the Wireless - Security page, providing security settings for each access point.

Complete the following steps to configure security settings for an access point:

1. In the Select SSID drop-down list, select the SSID to configure.
2. Using the drop-down lists, select network authentication options for the SSID. Selecting an authentication type displays additional options specific to the authentication type.

Note By default, the network authentication is open and WEP encryption is disabled for each SSID.

3. Click **Apply/Save**.

Configuring MAC Filtering

In the left pane, click **Wireless -> MAC Filter** to open the Wireless - MAC Filter page, enabling you to restrict access to specific SSIDs according to device MAC addresses.

For each SSID, you can specify MAC addresses to allow or MAC addresses to deny. By default, the MAC restriction feature is disabled for all SSIDs.

Complete the following steps to configure MAC filtering for an SSID:

1. In the Select SSID drop-down list, select the SSID to configure.
2. To add a MAC address to the list, click **Add** and enter the address.
3. To remove a MAC address from the list, select the “Remove” check box for the address and click **Remove**.
4. Select a MAC restriction mode from these options:
   - Disabled—The feature is disabled.
   - Allow—Allow devices with the specified MAC addresses to connect.
   - Deny—Do not allow devices with the specified MAC addresses to connect.

Configuring Advanced Wireless Settings

In the left pane, click **Wireless > Advanced** to open the Wireless - Advanced page for configuring the advanced wireless LAN (WLAN) features described in Table 6: Advanced WLAN, on page 49.

Table 6: Advanced WLAN

Option	Description
Band	Frequency band. This is preset to 2.4 GHz.
Channel	Radio channels. By default, the router sets the channel automatically. You can select a specific channel. The channel options depend on the geographic region.

Option	Description
Auto Channel Timer (min)	(Enabled when Channel is set to Auto) Minutes to wait before scanning again to determine the best channel. Range: 1 to 35791394 minutes.
802.11n/EWC	Enables/disables 802.11n support.
802.11n Rate	(802.11n/EWC must be set to Auto) Configures the rate for 802.11n.
802.11n Protection	(802.11n/EWC must be set to Auto) Configures RTS/CTS protection.
Support 802.11n Client Only	(802.11n/EWC must be set to Auto) Restricts support to 802.11n only.
RIFS Advertisement	(802.11n/EWC must be set to Auto) Enables/disables Reduced Inter-Frame Space (RIFS) Advertisement.
RX Chain Power Save	(802.11n/EWC must be set to Auto) Enables/disables the power save mode.
RX Chain Power Save Quiet Time	(802.11n/EWC must be set to Auto and RX Chain Power Save must be set to Enable) Time interval (seconds) to wait before going into the power save mode. Range: 0 to 2147483647 seconds.
RX Chain Power Save PPS	(802.11n/EWC must be set to Auto and RX Chain Power Save must be set to Enable) Packets per second (PPS) threshold. When the PPS is below the threshold, the router enters power save mode after the number of seconds configured in the “RX Chain Power Save Quiet Time” field. Range: 0 to 2147483647 packets per second.
54g Rate	(802.11n/EWC must be set to Disabled or 802.11n Rate must be set to “Use 54g Rate”) Configures the 54g rate.

Option	Description
Multicast Rate	Transmit/Receive rate for multicast packets. **Note** If 802.11n/EWC is Disabled and "54g Mode" is set to "802.11b Only," then the options will change.
Basic Rate	Data rate that wireless clients should support.
Fragmentation Threshold	Maximum packet size (bytes) before data is fragmented. Range: 256 to 2346 bytes.
RTS Threshold	RTS threshold value that will trigger the CTS protection mechanism. If an access point transmits a packet larger than the threshold, this will trigger the CTS protection mode. Range: 0 to 2347 bytes.
DTIM Interval	Delivery Traffic Indication Message (DTIM) interval information is included in beacon frames to inform clients of when next to expect buffered data from AP. The interval is specified as number of beacons. For example, if DTIM interval is set to 2, the client will wake-up/check for buffered data on AP at every second beacon. Range: 1 to 255 beacons.
Beacon Interval	Length of time between beacon transmissions. Range: 1 to 65535 milliseconds.
Global Max Clients	Upper limit for the maximum number of clients that can connect to an AP. The "Max Clients" setting for each SSID cannot exceed this limit. Range: 1 to 128 Default value: 16 Recommended maximum: 16 Theoretical maximum: 128
Transmit Power	Configures the transmit power level.
WMM (Wi-Fi Multimedia)	Enables/disables the WMM feature, a quality of service (QoS) feature of 802.11.
WMM No Acknowledgement	(WMM (Wi-Fi Multimedia) must be set to Enabled or Auto) Enables/disables the WMM No Acknowledgement feature.

Option	Description
WMM APSD	(WMM (Wi-Fi Multimedia) must be set to Enabled or Auto) Enables/disables the WMM Automatic Power Save Delivery feature. **Note** When WMM is in Auto mode, WMM APSD must be set to Enabled to enable a client to use Power Save Mode. When WMM is in Enabled mode, the client can use Power Save Mode regardless of whether WMM APSD is Enabled or Disabled.
54g Mode	(802.11n/EWC must be set to Disabled) Configures 54g mode.
54g Protection	(802.11n/EWC must be set to Disabled) Setting this field to Auto enables the RTS/CTS Protection mechanism.
Preamble Type	(802.11n/EWC must be set to Disabled. 54g Mode must be set to either “54g Auto” or “802.11b only”.) Defines the length of the cyclic redundancy code (CRC) block used for AP-to-WLAN client communication.

Station Information

In the left pane, click **Wireless -> Station Info** to open the Wireless - Authenticated Stations page, displaying clients that have been authenticated for wireless LAN (WLAN) and the status of each client.

Configuring the Password for Connecting to the Web-based Interface

In the left pane, click **Management** to open the Access Control - Passwords page for configuring the administrative password.

The user name must be **admin**. You can follow the instructions on this page to change the password. The default password is **admin**.

Note The administrative account has unrestricted permission to configure the router.

Note To restore WLAN config to the default, delete the wlconfig.txt file from the flash memory, using the Cisco IOS CLI.

Saving the Wireless LAN Configuration to a File

In the left pane, click **Configuration -> Backup** to save a configuration file for the wireless configuration. The file is saved locally on the workstation being used to access the GUI. For information about loading the saved configuration from the local file, see Loading a Wireless LAN Configuration File, on page 53.

Loading a Wireless LAN Configuration File

In the left pane, click **Configuration -> Update** to load a configuration file for the wireless LAN configuration from the workstation being used to access the GUI.

Caution Loading a configuration file restarts the router, interrupting any current connections.

For information about saving a configuration file locally, see Saving the Wireless LAN Configuration to a File, on page 53.

Note A configuration file can be used to load a specific configuration onto several different routers.

Restoring the Default Configuration

In the left pane, click **Configuration -> Restore Default** to restore the wireless LAN configuration to default.

Caution Restoring the default configuration restarts the router, interrupting any current connections.

Configuring WLAN Using the CLI-based Interface

Use the CLI-based interface to display wireless LAN (WLAN) information and configure settings. For information about the web-based WLAN interface, see Configuring WLAN Using the Web-based Interface, on page 46.

See the following sections:

WLAN CLI Interface

The WLAN CLI interface is similar to the CLI interface for IOS.

When you enter the CLI interface, the prompt appears as follows:

ap#

Similarly to Cisco IOS, the prompt indicates the command mode. For example, using the **configure terminal** command to enter global configuration mode changes the prompt to:

ap(config)#

To exit from a specific mode, use the **exit** command.

For example:

ap(config)# **exit**

ap#

Displaying Command Information for WLAN CLI

Entering a question mark (**?**) displays information about available command options. This feature provides a simple access to information about commands and relevant command options.

Example : Displaying Command Information for WLAN CLI

In interface configuration mode, entering **?** at the prompt displays the commands available in that mode:

```
ap(config-if)# ?
        exit                    Exit from config-if mode
        ip                      Interface Internet Protocol config commands
        no                      Negate a command or set its defaults
        shutdown                Shutdown the interface
```

In SSID configuration mode, entering **encryption mode wep ?** displays the options available for configuring WEP encryption mode with the **encryption mode wep** command, as follows:

```
ap(config-ssid)# encryption mode wep ?
        current-key             Network Key to use
        encryption-strength     Encryption strength
        key                     Set encryption keys
        <cr>
```

Three arguments (*current-key* , *encryption-strength* , and *key*) may be entered for the command. The <cr> option indicates that **encryption mode wep** is valid by itself without additional options. In this example, entering the command without additional arguments enables WEP encryption.

Connecting to the WLAN CLI Interface

To connect to the WLAN CLI interface, complete the following steps.

1. From the Cisco IOS command line, create a loopback interface, specifying any desired IP address. For information about creating a loopback interface in Cisco IOS, see the *Cisco IOS Master Commands List* : http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html
2. Connect by Telnet to the IP address specified for the loopback interface and port 2002.
3. Log in when prompted.
   The router displays the WLAN CLI interface prompt.

Note The default login credentials are: User name: **admin** Password: **admin** When logging in for the first time, the router prompts you to change the default password.

Example: Configuring a Loopback Interface

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface loopback 0
Router(config-if)# ip address 1.1.1.1 255.255.255.0
Router(config-if)# end
```

Example: Accessing WLAN CLI Using Telnet Through the Loopback Interface

```
Router# telnet 1.1.1.1 2002
Trying 1.1.1.1, 2002 ... Open
Connecting to AP console, enter Ctrl-^ followed by x,
then "disconnect" to return to router prompt
ap#
```

Exiting from the WLAN CLI Interface

To exit from the WLAN CLI and return to the Cisco IOS CLI prompt, press **CTRL-SHIFT-6**, followed by **x**, then "**disconnect**".

Setting the IP Address for the Web-based Interface

By default, the IP address used to access the web-based WLAN interface is 10.10.10.2.

To change the IP address of the bridge interface used to access the web-based interface, perform these steps.

SUMMARY STEPS

1. **configure terminal**
2. **interface BVI 1**
3. **ip address** *IP-address subnet-mask*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `ap#` **configure terminal** **Example:** `ap(config)#`	Enters configuration mode.
Step 2	**interface BVI 1** **Example:** `ap(config)#` **interface BVI 1**	The interface number.
Step 3	**ip address** *IP-address subnet-mask* **Example:** `ap(config-if)# ip address 10.10.10.2 255.255.255.248`	Configures the new IP address and subnet mask. **Note** Use IPv4 addresses only. **Tip** You can display the configured IP address using the **show interfaces BVI 1** command (see Displaying the BVI 1 Interface Details, on page 88).

	Command or Action	Purpose

Enabling and Disabling WLAN

By default, the WLAN feature is enabled.

To enable or disable WLAN, follow these steps from global configuration mode:

Use **shutdown** to disable WLAN and **no shutdown** to enable WLAN.

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **[no] shutdown**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters interface configuration mode.
Step 2	**[no] shutdown** **Example:** `ap(config-if)#` **no shutdown**	**shutdown—**Disables WLAN. **no shutdown—**Enables WLAN.

Configuring the Main SSID

To change the name of the main SSID, perform these steps.

SUMMARY STEPS

1. **configure terminal**
2. **dot11 ssid** *SSID-name*

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	
	Example:
	`ap# configure terminal`
	
	Example:
	`ap(config)#`
		Enters configuration mode.

Step 2	**dot11 ssid** *SSID-name* **Example:** `ap(config)# dot11 ssid mainssid`	*SSID-name*—The main SSID. The SSID may be up to 32 characters. In the example, the new SSID is called mainssid.

Configuring Guest SSIDs

To change the name of a guest SSID, perform these steps.

SUMMARY STEPS

1. **configure terminal**
2. **dot11 guest-ssid** *guest-SSID-number SSID-name*

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	
	Example:
	`ap# configure terminal`
	
	Example:
	`ap(config)#`
		Enters configuration mode.

Step 2	**dot11 guest-ssid** *guest-SSID-number SSID-name* **Example:** `ap(config)# dot11 guest-ssid 1 guest1`	*guest-SSID-number*—Specify 1, 2, or 3 to identify the guest SSID to configure. *SSID-name*—The new SSID. The SSID may be up to 32 characters.

	Command or Action	Purpose
		The example specifies a new SSID of **guest1** for guest SSID number 1.

Enabling and Disabling Guest SSIDs

To enable or disable a guest SSID, follow these steps from global configuration mode:

Note The main SSID cannot be disabled. However, guest SSIDs can be enabled/disabled. By default, guest SSIDs are disabled.

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **[no] guest-ssid** *guest-SSID-number SSID-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters interface configuration mode.
Step 2	**[no] guest-ssid** *guest-SSID-number SSID-name* **Example:** `ap(config-if)#` **guest-ssid 1 guestssid1**	Enables the guest SSID specified by *guest-SSID-number* and *SSID-name*. • *guest-SSID-number*—Specify 1, 2, or 3 to identify the guest SSID to configure. • *SSID-name*—The name of the guest SSID. Entering the wrong SSID displays an error message. **Note** The **no** form of the command disables the specified guest SSID.

Hiding an Access Point

To hide or unhide an SSID, follow these steps from global configuration mode:

Note Hiding the SSID (access point) provides a small measure of security in helping to prevent unauthorized users from accessing the network. When you hide the SSID, the SSID is not broadcasted, making wireless snooping more difficult.

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **[no] hide-ap**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**[no] hide-ap** **Example:** `ap(config-ssid)#` **hide-ap**	Hides the SSID specified in the previous step. **Note** The **no** form of the command unhides the specified SSID.

Enabling and Disabling Client Isolation

To enable or disable client isolation for a specific SSID, follow these steps from global configuration mode:

Note Client isolation prevents a wireless client connected to a specific SSID from communicating with other wireless clients connected to the same SSID.

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **[no] isolate-clients**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**[no] isolate-clients** **Example:** `ap(config-ssid)#` **isolate-clients**	Enables client isolation for the SSID specified in the previous step. The **no** form of the command disables client isolation for the specified SSID.

Enabling and Disabling WMM Advertise

To enable or disable WiFi Multimedia (WMM) Advertise for a specific SSID, follow these steps from global configuration mode.

Note The WiFi Multimedia (WMM) Advertise feature prioritizes media traffic to improve media transmission. WMM Advertise is enabled by default.

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **[no] disable-wmm**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option.

	Command or Action	Purpose
		• *SSID-name*—The SSID name.
Step 2	**[no] disable-wmm** **Example:** `ap(config-ssid)#` **disable-wmm**	Disables the WMM Advertise feature for the SSID specified in the previous step. The **no** form of the command enables the WMM Advertise feature for the specified SSID. **Note** WMM Advertise is enabled by default.

Enabling and Disabling Wireless Multicast Forwarding (WMF)

To enable or disable Wireless Multicast Forwarding(WMF) for a specific SSID, follow these steps from global configuration mode:

Note The WMF feature improves multicast traffic performance.

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **[no] wmf**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number*—The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name*—The SSID name.
Step 2	**[no] wmf** **Example:** `ap(config-ssid)#` **wmf**	Enables the WMF feature for the SSID specified in the previous step. The **no** form of the command disables the WMF feature for the specified SSID.

Configuring the Global Maximum Number of Clients

To set the global maximum number of clients that can connect to an AP, follow these steps from global configuration mode:

SUMMARY STEPS

1. **configure terminal**
2. **global-max-clients** *number-of-clients*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `ap#` **configure terminal** **Example:** `ap(config)#`	Enters configuration mode. **Note** To exit a configuration mode after completing configuration tasks, use the **exit** command .
Step 2	**global-max-clients** *number-of-clients* **Example:** `ap(config)#` **global-max-clients 32**	Configures the maximum number of clients that can connect to an AP. *number-of-clients* range: 1 to 128 clients

Configuring the Maximum Number of Clients for an SSID

To configure the maximum number of clients, follow these steps from global configuration mode:

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **max-associations** *number-of-clients*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode.

	Command or Action	Purpose
	Example: `ap(config)#` **dot11 guest-ssid 1 guestssid1**	• **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**max-associations** *number-of-clients* **Example:** `ap(config-ssid)#` **max-associations 24**	Configures the maximum number of clients for the SSID specified in the previous step. *number-of-clients***—**Range is from 1 to 128 and the default value is 16.

Configuring Authentication Options

Use the **authentication** command to configure authentication options for a specific SSID. By default, network authentication is Open.

To configure the authentication options, follow these steps from global configuration mode:

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **authentication** *authentication-options*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**authentication** *authentication-options* **Example:** `ap(config-ssid)#` **authentication open**	Configures authentication options for the SSID specified in the previous step. Table 7: Authentication Command Options, on page 64 describes options for the **authentication** command. The default authentication option is **open**.

	Command or Action	Purpose

What to Do Next

Table 7: Authentication Command Options, on page 64 describes options for the **authentication** command:

Table 7: Authentication Command Options

Option	Syntax	Description
Open authentication	**open**	Configures open authentication.
Shared authentication	**shared** `ap(config-ssid)#` **authentication shared**	Configures shared authentication.
802.1x Options		
Authentication server port	**802.1x auth-port** *port-number* `ap(config-ssid)#` **authentication 802.1x auth-port 2000**	Defines the UDP port for the RADIUS authentication server. Range: 0 to 65535 Default: 1812
RADIUS key	**802.1x key** *encryption-key* `ap(config-ssid)#` **authentication 802.1x key ABC123ABC1**	Defines the per-server encryption key. Enter the server key in an unencrypted (cleartext) form.
RADIUS server address	**802.1x server** *server-IP-address* `ap(config-ssid)#` **authentication 802.1x server 10.1.1.1**	Specifies a RADIUS server.
WPA Authentication		
Authentication server port	**WPA auth-port** *port-number* `ap(config-ssid)#` **authentication WPA auth-port 2000**	Defines the UDP port for the RADIUS authentication server. Range: 0 to 65535 Default: 1812
RADIUS key	**WPA key** *encryption-key* `ap(config-ssid)#` **authentication WPA key ABC123ABC1**	Defines the per-server encryption key. Enter the server key in an unencrypted (cleartext) form.

Option	Syntax	Description
WPA Group Rekey Interval	**WPA rekey-interval** *seconds* `ap(config-ssid)#` **authentication WPA rekey-interval 604800**	Defines the authentication rekey interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the rekey interval to one week (604800 seconds).
RADIUS server address	**WPA server** *server-IP-address* `ap(config-ssid)#` **authentication WPA server 10.1.1.1**	Specifies a RADIUS server.
WPA-PSK Authentication		
WPA/WAPI passphrase	**WPA-PSK passphrase** *password* `ap(config-ssid)#` **authentication WPA-PSK passphrase MyPaSsWoRd**	The passphrase for WPA-PSK. Enter a cleartext/unencrypted WPA passphrase. Range: 8 to 63 ASCII characters or 64 hexadecimal digits
WPA Group Rekey Interval	**WPA-PSK rekey-interval** *seconds* `ap(config-ssid)#` **authentication WPA-PSK rekey-interval 604800**	Defines the authentication rekey interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the rekey interval to one week (604800 seconds).
WPA2 Authentication		
Authentication server port	**WPA2 auth-port** *port-number* `ap(config-ssid)#` **authentication WPA2 auth-port 2000**	Defines the UDP port for the RADIUS authentication server. Range: 0 to 65535 Default: 1812
RADIUS key	**WPA2 key** *encryption-key* `ap(config-ssid)#` **authentication WPA2 key ABC123ABC1**	Defines the per-server encryption key. Enter the server key in an unencrypted (cleartext) form.
WPA2 preauthentication	**WPA2 preauth** `ap(config-ssid)#` **authentication WPA2 preauth** `ap(config-ssid)#` **no authentication WPA2 preauth**	Enables WPA2 preauthentication. The **no** form of the command disables preauthentication.

Option	Syntax	Description
Network reauthorization interval	**WPA2 reauth-interval** *seconds* `ap(config-ssid)#` **authentication WPA2 reauth-interval 604800**	Defines the WPA2 reauthorization interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the reauthorization interval to one week (604800 seconds).
WPA Group Rekey Interval	**WPA2 rekey-interval** *seconds* `ap(config-ssid)#` **authentication WPA2 rekey-interval 604800**	Defines the authentication rekey interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the rekey interval to one week (604800 seconds).
RADIUS server address	**WPA2 server** *server-IP-address* `ap(config-ssid)#` **authentication WPA2 server 10.1.1.1**	Specifies a RADIUS server.
WPA2-PSK Authentication		
WPA/WAPI passphrase	**WPA2-PSK passphrase** *password* `ap(config-ssid)#` **authentication WPA2-PSK passphrase MyPaSsWoRd**	The passphrase for WPA2-PSK. Enter a cleartext/unencrypted WPA passphrase. Range: 8 to 63 ASCII characters or 64 hexadecimal digits
WPA-PSK Group Rekey Interval	**WPA2-PSK rekey-interval** *seconds* `ap(config-ssid)#` **authentication WPA2-PSK rekey-interval 604800**	Defines the authentication rekey interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the rekey interval to one week (604800 seconds).
Mixed WPA2/WPA Authentication		
Authentication server port	**Mixed-WPA2-WPA auth-port** *port-number* `ap(config-ssid)#` **authentication Mixed-WPA2-WPA auth-port 2000**	Defines the UDP port for the RADIUS authentication server. Range: 0 to 65535 Default: 1812
RADIUS key	**Mixed-WPA2-WPA key** *encryption-key* ap(config-ssid)# **authentication Mixed-WPA2-WPA key ABC123ABC1**	Defines the per-server encryption key. Enter the server key in an unencrypted (cleartext) form.

Option	Syntax	Description
WPA2 preauthentication	**Mixed-WPA2-WPA preauth** `ap(config-ssid)#` **authentication Mixed-WPA2-WPA preauth** `ap(config-ssid)#` **no authentication Mixed-WPA2-WPA preauth**	Enables WPA2 preauthentication. The **no** form of the command disables preauthentication.
Network reauthorization interval	**Mixed-WPA2-WPA reauth-interval** `ap(config-ssid)#` **authentication Mixed-WPA2-WPA reauth-interval 604800**	Defines the WPA2 reauthorization interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the reauthorization interval to one week (604800 seconds).
WPA Group Rekey Interval	**Mixed-WPA2-WPA rekey-interval** *seconds* `ap(config-ssid)#` **authentication Mixed-WPA2-WPA rekey-interval 604800**	Defines the authentication rekey interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the rekey interval to one week (604800 seconds).
RADIUS server address	**Mixed-WPA2-WPA server** *server-IP-address* `ap(config-ssid)#` **authentication Mixed-WPA2-WPA server 10.1.1.1**	Specifies a RADIUS server.
Mixed WPA2/WPA-PSK Authentication		
Passphrase	**Mixed-WPA2-WPA-PSK passphrase** *password* `ap(config-ssid)#` **authentication Mixed-WPA2-WPA-PSK passphrase MyPaSsWoRd**	The preshared passphrase for WiFi protected access. Enter a clear WPA passphrase. Range: 8 to 63 ASCII characters or 64 hexadecimal digits
WPA Group Rekey Interval	**WPA2-PSK rekey-interval** *seconds* `ap(config-ssid)#` **authentication Mixed-WPA2-WPA-PSK rekey-interval 604800**	Defines the authentication rekey interval in seconds. Range: 0 to 2147483647 (seconds) The example configures the rekey interval to one week (604800 seconds).

Configuring Encryption Options

To configure the encryption options for a specific SSID, follow these steps from global configuration mode:

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **encryption mode** *encryption-options*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**encryption mode** *encryption-options* **Example:** `ap(config-ssid)#` **encryption mode wep**	Configures encryption options for the SSID specified in the previous step. Table 8: Encryption Command Options, on page 68 describes options for the **encryption mode** command.

What to Do Next

Table 8: Encryption Command Options, on page 68 describes options for the **encryption mode** command:

Table 8: Encryption Command Options

Option	Syntax	Description
WEP encryption options		

Option	Syntax	Description
Enable/Disable WEP encryption	**[no] encryption mode wep** `ap(config-ssid)#` **encryption mode wep** `ap(config-ssid)#` **no encryption mode wep**	Enables WEP encryption. The **no** form of the command disables WEP encryption. **Note** The WEP encryption default setting depends on the authentication option selected. Open authentication—Default is disabled. Shared—Default is enabled; cannot disable. 802.1x—Default is enabled; cannot disable. WPA, WPA-PSK, WPA2, WPA2-PSK, Mixed WPA2/WPA, Mixed WPA2/WPA-PSK—Default is disabled; cannot enable.
Encryption strength	**wep encryption-strength [64bit | 128bit]** `ap(config-ssid)#` **encryption mode wep encryption-strength 64bit**	Configures the WEP encryption strength. **64bit—**Specifies a 64-bit key. **128bit—**Specifies a 128-bit key.
Current network key	**wep current-key** *key-number* `ap(config-ssid)#` **encryption mode wep current-key 1**	It is possible to configure four different network keys. This command determines which key to use currently. *key-number* range: 1 to 4
Network key	**wep key** *key-number key* `ap(config-ssid)#` **encryption mode wep key 1 54321**	Configures a network key. *key-number* range: 1 to 4 *key*: • For a 64-bit key: 5 ASCII characters or 10 hexadecimal digits • For a 128-bit key: 13 ASCII characters or 26 hexadecimal digits
WPA/WAPI Encryption Options		
AES	**aes** `ap(config-ssid)#` **encryption mode aes**	Configures the encryption mode to AES. **Note** AES is supported only under WPA, WPA-PSK, WPA2, WPA2-PSK, Mixed WPA2/WPA, or Mixed WPA2/WPA-PSK.

Option	Syntax	Description
TKIP+AES	**tkip+aes** `ap(config-ssid)#` **encryption mode tkip+aes**	Configures the encryption mode to TKIP+AES. **Note** TKIP+AES is supported only under WPA, WPA-PSK, WPA2, WPA2-PSK, Mixed WPA2/WPA, or Mixed WPA2/WPA-PSK.

Configuring the MAC Address Filter Access List

To add a MAC address to the access-list or to remove a MAC address from the access-list, follow these steps from global configuration mode :

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **[no] access-list** *MAC-address*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**[no] access-list** *MAC-address* **Example:** `ap(config-ssid)#` **access-list AB:12:CD:34:EF:56** **Example:** `ap(config-ssid)#` **no access-list AB:12:CD:34:EF:56**	Adds the MAC address to the access list for the SSID specified in the previous step. *MAC-address***—**Hexadecimal characters in the following format: HH:HH:HH:HH:HH:HH **Note** The **no** form of the command removes a MAC address from the access list.

Configuring the MAC Address Filter Mode

To select the MAC address access list mode, follow these steps from global configuration mode:

SUMMARY STEPS

1. **dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name*
2. **[no] mac-filter-mode [allow | deny]**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**dot11 {ssid | guest-ssid}** [*guest-SSID-number*] *SSID-name* **Example:** `ap(config)#` **dot11 guest-ssid 1 guestssid1**	Enters SSID configuration mode for a specific SSID. The ap(config-ssid) prompt indicates SSID configuration mode. • **ssid—**The main SSID. • **guest-ssid—**A guest SSID. • *guest-SSID-number***—**The guest SSID number. Use this only with the **guest-ssid** option. • *SSID-name***—**The SSID name.
Step 2	**[no] mac-filter-mode [allow | deny]** **Example:** `ap(config-ssid)#` **mac-filter-mode allow** **Example:**	Configures the mode for the MAC address filter feature. • **allow—**To allow MAC addresses on the access list to connect: • **deny—**To deny MAC addresses on the access list from connecting:

Configuring Radio Channel

To configure channel options, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **channel** {*channel-number* | **least-congested**} **[timer** *minutes-before-next-scan***]**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**channel** {*channel-number* | **least-congested**} [**timer** *minutes-before-next-scan*] **Example:** `ap(config-if)#` **channel least-congested timer 60**	Configures a specific radio channel manually or selects automatic scanning; and configures the automatic scanning timer. • *channel-number*—Sets a specific channel. The channel-number range is 1 to11 for American models, or 1 to 13 for European models • **least-congested**—Configures automatic scanning for the least congested channel, use the **least-congested** option and specify the number of minutes to wait before scanning again for the best channel. • *minutes-before-next-scan*—Sets the timer for automatic scanning. Range varies from 1 to 35791394.

Configuring 802.11n Options

To configure 802.11n options, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **[no] dot11n**
3. **dot11n rate**
4. **[no] dot11n protection**
5. **[no] dot11n n-client-only**
6. **[no] dot11n rifs**
7. **[no] dot11n [rx-pwr-save | rx-pwr-save quiet-time** *seconds*| **pps** *pps-value*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.

	Command or Action	Purpose
Step 2	**[no] dot11n**	Configures 802.11n radio options.
Step 3	**dot11n rate**	Configures the 802.11n rate: • *rate* range: 0 to 15. Table 9: Rate Options for 802.11n, on page 73 describes the 802.11n rates for each *rate* value. • **54g—**Uses the 54g rate. • **auto—**Selects a rate automatically.
Step 4	**[no] dot11n protection**	Enables 802.11n protection.
Step 5	**[no] dot11n n-client-only**	Enables the 802.11n client-only mode, which limits the WLAN to clients using 802.11n: **Note** When the 802.11n client-only option is enabled, clients are unable to connect to SSIDs with a WEP security setting. To enable the client to connect to the SSID, change the SSID security setting so that WEP is not configured. Alternatively, the client can connect to an SSID with non-WEP security settings.
Step 6	**[no] dot11n rifs**	Enables Reduced Inter-Frame Space (RIFS) advertisement.
Step 7	**[no] dot11n [rx-pwr-save | rx-pwr-save quiet-time** *seconds*| **pps** *pps-value*]	Enables the RX Chain Power Save. • *seconds* —Sets the RX Chain Power Save quiet time (time interval to wait before going into power save mode): The range is from 0 to 2147483647. • *pps-value* — Sets the RX Chain Power Save packets per second (PPS) threshold. The range is from 0 to 2147483647 packets per second.

What to Do Next

Table 9: Rate Options for 802.11n, on page 73 describes the rate options for 802.11n, as specified by rate in the **dot11n** *rate* command:

Table 9: Rate Options for 802.11n

Value	Rate
0	MCS index 0, 6.5 Mbps
1	MCS index 1, 13 Mbps
2	MCS index 2, 19.5 Mbps
3	MCS index 3, 26 Mbps

Value	Rate
4	MCS index 4, 39 Mbps
5	MCS index 5, 52 Mbps
6	MCS index 6, 58.5 Mbps
7	MCS index 7, 65 Mbps
8	MCS index 8, 13 Mbps
9	MCS index 9, 26 Mbps
10	MCS index 10, 39 Mbps
11	MCS index 11, 52 Mbps
12	MCS index 12, 78 Mbps
13	MCS index 13, 104 Mbps
14	MCS index 14, 117 Mbps
15	MCS index 15, 130 Mbps

Configuring the 54g Mode

To set the 54g mode, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **54g-mode [auto | dot11b-only | lrs | performance]**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**54g-mode [auto | dot11b-only | lrs | performance]**	Configures the 54g mode. • **auto—**54g auto mode. Accepts 802.11b, 802.11g, and 54g clients. This option provides the widest compatibility.

	Command or Action	Purpose
	Example: `ap(config-if)#` **54g-mode auto**	• **dot11b-only—**Accepts only 802.11b clients. • **lrs—**54g Limited Rate Support (LRS). Intended for legacy 802.11b client support. • **performance—**54g Performance mode. Accepts only 54g clients, provides the fastest performance with 54g certified equipment.

Configuring the 54g Preamble Type

To set the 54g preamble type, follow these steps from global configuration mode:

Note The preamble type can be set only when 802.11n is disabled (**no dot11n**) and 54g-mode is either **auto** or **dot11b-only**.

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **54g-mode {auto | dot11b-only} preamble {short | long}**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**54g-mode {auto | dot11b-only} preamble {short | long}** **Example:** `ap(config-if)#` **54g-mode auto preamble long** **Example:** `ap(config-if)#` **54g-mode dot11b-only preamble short**	Configures 54g preamble type. • **short—**Short preamble. When there are no 802.11b clients, setting preamble type to **short** improves performance. • **long—**Long preamble. When there are both 802.11g and 802.11b clients, set preamble type to **long**. • **54g-mode** must be either **auto** or **dot11b-only**.

Configuring the 54g Rate

To set the 54g transmission rate, follow these steps from global configuration mode:

Note The 54g rate can be set only when the 802.11n rate is configured to use 54g rate (**dot11n rate 54g**) or when 802.11n is disabled (**no dot11n**).

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **54g-rate** {*Mbps-rate* |**auto**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**54g-rate** {*Mbps-rate* |**auto**} **Example:** `ap(config-if)#` **54g-rate 54** **Example:**	Configures the rate for 54g mode. • *Mbps-rate*—specifies a rate in Mbps. The following values are possible: • 1 • 2 • 5.5 • 6 • 9 • 11 • 12 • 18 • 24 • 36 • 48 • 54 • **auto**—Sets the 54g rate automatically.

Configuring 54g Protection

To set 54g protection, follow these steps from global configuration mode:

Note 54g protection can be set only when 802.11n is disabled.

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **54g-protection**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**54g-protection** **Example:** `ap(config-if)#` **54g-protection**	Enables 54g protection. • **54g-protection—**Enables the RTS/CTS protection mechanism. • **no 54g-protection—**Disables 54g protection.

Configuring the Multicast Rate

To set the multicast transmission rate, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **multicast-rate** {*Mbps-rate* | **auto**}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**multicast-rate** {*Mbps-rate* | **auto**} **Example:** `ap(config-if)#` **multicast-rate 54** **Example:** `ap(config-if)#` **multicast-rate auto**	Configures the multicast rate. *Mbps-rate* specifies a rate in Mbps. The following values are possible: • 1 • 2 • 5.5 • 6 • 9 • 11 • 12 • 18 • 24 • 36 • 48 • 54 **auto—**Sets the multicast rate automatically. **Note** When 802.11n is disabled (**no dot11n**) and 54g-mode is configured to 802.11b only (**54g-mode dot11b-only**), the only accepted rates are auto, 1, 2, 5.5, or 11 Mbps. Attempting to configure any other rate displays a warning message:

Configuring the Basic Rate

To set the basic transmission rate, which is the data rate that wireless clients should support, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **basic-rate {1 | 2 | all | default}**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**basic-rate {1 | 2 | all | default}** **Example:** `ap(config-if)#` **basic-rate 2** **Example:** `ap(config-if)#` **basic-rate all**	Configures the basic rate. • **1—**1 and 2 Mbps • **2—**1, 2, 5.5, 6, 11, 12, and 24 Mbps • **all—**All rates • **default—**1, 2, 5.5, and 11 Mbps

Configuring the Fragmentation Threshold

To set the fragmentation threshold, which is the maximum packet size (bytes) before data is fragmented, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **fragment-threshold** *threshold-in-bytes*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**fragment-threshold** *threshold-in-bytes* **Example:** `ap(config-if)#` **fragment-threshold 2346**	Configures the fragmentation threshold in bytes. *threshold-in-bytes* range: 256 to 2346 bytes Default value is 2346

Configuring the RTS Threshold

To set the request-to-send (RTS) threshold, follow these steps from global configuration mode:

Note If an access point transmits a packet larger than the threshold, it will trigger CTS (clear-to-send) protection mode.

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **rts-threshold** *threshold-in-bytes*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**rts-threshold** *threshold-in-bytes* **Example:** `ap(config-if)#` **rts-threshold 2347**	Configures the RTS threshold in bytes. *threshold-in-bytes*—Range is from 0 to 2347 bytes. Default value is 2347

Configuring the DTIM Interval

To set the Delivery Traffic Indication Message (DTIM) interval, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **dtim-interval** *number-of-beacons*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**dtim-interval** *number-of-beacons* **Example:** `ap(config-if)#` **dtim-interval 255**	Configures the DTIM interval that is included in beacon frames to inform clients of when next to expect buffered data from the AP. *number-of-beacons*—Range is 1 to 255 beacons. Default is 1

Configuring the Beacon Interval

To set the beacon interval, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **beacon-interval** *number-of-milliseconds*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**beacon-interval** *number-of-milliseconds* **Example:** `ap(config-if)#` **beacon-interval 65535**	Configures the beacon interval. *number-of-milliseconds*—range is 1 to 65535 milliseconds (ms) and default value is 100 milliseconds.

Configuring the Radio Transmit Power

To set the radio transmit power for WLAN, follow these steps from global configuration mode:

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **tx-pwr** *power-percentage*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.
Step 2	**tx-pwr** *power-percentage* **Example:** `ap(config-if)#` **tx-pwr 60**	Configures the transmit power, as a percentage of the maximum power. *power-percentage*—specifies the power percentage. The following values are possible: • 20 • 40 • 60 • 80 • 100

Configuring WMM Options

To configure WiFi Multimedia (WMM) options, follow these steps from global configuration mode :

SUMMARY STEPS

1. **interface Dot11Radio 0**
2. **[no] wmm [auto | no-ack | apsd]**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**interface Dot11Radio 0** **Example:** `ap(config)#` **interface Dot11Radio 0**	Enters radio interface mode, indicated by the ap(config-if) prompt.

	Command or Action	Purpose
Step 2	**[no] wmm [auto | no-ack | apsd]** **Example:** `ap(config-if)#` **wmm**	Enable or Disables WMM. • auto—Configures WMM auto mode: • no-ack—Configures no-acknowledgement for WMM • apsd—Enables Automatic Power Save Delivery (APSD) mode for WMM. **Note** When WMM is in "Auto" mode, WMM APSD must be set to "Enabled" to enable a client to use Power Save Mode. When WMM is in "Enabled" mode, the client can use Power Save Mode regardless of whether WMM APSD is "Enabled" or "Disabled".

Displaying Current CLI Values and Keywords

Use the **show ap-config** command to display the current CLI values and keywords.

SUMMARY STEPS

1. **show ap-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ap-config** **Example:** `ap#` **show ap-config**	Displays the current CLI values and keywords.

What to Do Next

Example Configuration: Displaying Current CLI Values and Keywords

This example displays current CLI values and keywords.

```
ap# show ap-config
global-max-clients 16
dot11 ssid Cisco860
no isolate-clients
no wmf
max-associations 16
no hide-ap
no disable-wmm
no mac-filter-mode
authentication open
no encryption mode wep
exit
```

```
dot11 guest-ssid 1 Cisco860_Guest1
no isolate-clients
no wmf
max-associations 16
no hide-ap
no disable-wmm
no mac-filter-mode
authentication open
no encryption mode wep
exit
dot11 guest-ssid 2 Cisco860_Guest2
no isolate-clients
no wmf
max-associations 16
no hide-ap
no disable-wmm
no mac-filter-mode
authentication open
no encryption mode wep
exit
dot11 guest-ssid 3 Cisco860_Guest3
no isolate-clients
no wmf
max-associations 16
no hide-ap
no disable-wmm
no mac-filter-mode
authentication open
no encryption mode wep
exit
interface Dot11Radio 0
no shutdown
ssid Cisco860
no guest-ssid 1 Cisco860_Guest1
no guest-ssid 2 Cisco860_Guest2
no guest-ssid 3 Cisco860_Guest3
dot11n
channel least-congested timer 15
dot11n rate auto
dot11n protection
no dot11n n-client-only
dot11n rifs
no dot11n rx-pwr-save
dot11n rx-pwr-save quiet-time 10
dot11n rx-pwr-save pps 10
54g-rate auto
multicast-rate auto
basic-rate default
fragment-threshold 2346
rts-threshold 2347
dtim-interval 1
beacon-interval 100
tx-pwr 100
wmm
no wmm no-ack
wmm apsd
exit
interface BVI 1
ip address 10.10.10.2  255.255.255.248
no shutdown
exit
```

Displaying Current Channel and Power Information

Use the **show controllers Dot11Radio 0** command to display the current channel and power information.

SUMMARY STEPS

1. **show controllers Dot11Radio 0**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show controllers Dot11Radio 0** **Example:** `ap#` **show controllers Dot11Radio 0**	Displays the current channel and power information.

What to Do Next

Example

```
ap# show controllers Dot11Radio 0
interface Dot11Radio0
Beacon Interval(ms)                : 100
DTIM Interval(beacon)              :   1
Power Control:          On, HW
Current Channel:        11
BSS Channel:            11
BSS Local Max:          30.0 dBm
BSS Local Constraint:   0.0 dB
Channel Width:          20MHz
User Target:            31.75 dBm
SROM Antgain 2G:        2.0 dB
SROM Antgain 5G:        2.0 dB
SAR:                    -
Current rate:           [MCS15] ht mcs 15 Tx Exp 0 BW 20 sgi
Regulatory Limits:
Rate                   Chains 20MHz
DSSS                    1     19.0
OFDM                    1     13.50
MCS0_7                  1     13.50
VHT8_9SS1               1     -
DSSS_MULTI1             2     -
OFDM_CDD1               2     10.50
MCS0_7_CDD1             2     10.50
VHT8_9SS1_CDD1          2     -
MCS0_7_STBC             2     10.50
VHT8_9SS1_STBC          2     -
MCS8_15                 2     10.50
VHT8_9SS2               2     -
DSSS_MULTI2             3     -
OFDM_CDD2               3     -
MCS0_7_CDD2             3     -
VHT8_9SS1_CDD2          3     -
MCS0_7_STBC_SPEXP1      3     -
VHT8_9SS1_STBC_SPEXP1   3     -
MCS8_15_SPEXP1          3     -
VHT8_9SS2_SPEXP1        3     -
MCS16_23                3     -
VHT8_9SS3               3     -
Core Index:             0
Board Limits:
Rate                   Chains 20MHz
DSSS                    1     17.50
OFDM                    1     17.50
MCS0_7                  1     17.50
VHT8_9SS1               1     -
DSSS_MULTI1             2     17.50
OFDM_CDD1               2     17.50
MCS0_7_CDD1             2     17.50
```

```
VHT8_9SS1_CDD1         2     -
MCS0_7_STBC            2     17.50
VHT8_9SS1_STBC         2     -
MCS8_15                2     17.50
VHT8_9SS2              2     -
DSSS_MULTI2            3     -
OFDM_CDD2              3     -
MCS0_7_CDD2            3     -
VHT8_9SS1_CDD2         3     -
MCS0_7_STBC_SPEXP1     3     -
VHT8_9SS1_STBC_SPEXP1  3     -
MCS8_15_SPEXP1         3     -
VHT8_9SS2_SPEXP1       3     -
MCS16_23               3     -
VHT8_9SS3              3     -
Power Targets:
Rate                  Chains 20MHz
DSSS                   1     16.0
OFDM                   1     12.0
MCS0_7                 1     12.0
VHT8_9SS1              1      8.0
DSSS_MULTI1            2      8.0
OFDM_CDD1              2      9.0
MCS0_7_CDD1            2      9.0
VHT8_9SS1_CDD1         2      8.0
MCS0_7_STBC            2      9.0
VHT8_9SS1_STBC         2      8.0
MCS8_15                2      9.0
VHT8_9SS2              2      8.0
DSSS_MULTI2            3     -
OFDM_CDD2              3     -
MCS0_7_CDD2            3     -
VHT8_9SS1_CDD2         3     -
MCS0_7_STBC_SPEXP1     3     -
VHT8_9SS1_STBC_SPEXP1  3     -
MCS8_15_SPEXP1         3     -
VHT8_9SS2_SPEXP1       3     -
MCS16_23               3     -
VHT8_9SS3              3     -
Maximum Power Target among all rates:   16.0  16.0
Last est. power                     :   0.0  15.75
Power Target for the current rate   :   16.0  16.0
Last adjusted est. power            :   0.0  15.75
Power Percentage                    :   100
Channel Status:
No scan in progress.
current mac channel     11
target channel  11
```

Displaying Current Associated Clients

Use the **show dot11 associations** command to display the current associated clients.

SUMMARY STEPS

1. **show dot11 associations**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show dot11 associations** **Example:** `ap#` **show dot11 associations**	Displays the current associated clients.

What to Do Next

Example: Displaying Current Associated Clients

```
ap# show dot11 associations
Authenticated       Associated      Authorized       Interface
AA:BB:CC:11:22:33   yes             no               Dot11Radio0
```

Displaying the SSID to BSSID Mapping

Each SSID has an associated BSSID. Use the **show dot11 bssid** command to display the SSID to BSSID mapping.

SUMMARY STEPS

1. **show dot11 bssid**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show dot11 bssid** **Example:** `ap#` **show dot11 bssid**	Displays the SSID to BSSID mapping.

What to Do Next

Example: Displaying the SSID to BSSID Mapping

```
ap# show dot11 bssid
Interface       BSSID               Guest           SSID
Dot11Radio0     A4:93:4C:01:7A:9A   No              Cisco860
Dot11Radio0     A4:93:4C:01:7A:9B   Yes             Cisco860_Guest1
Dot11Radio0     A4:93:4C:01:7A:9C   Yes             Cisco860_Guest2
Dot11Radio0     A4:93:4C:01:7A:9D   Yes             Cisco860_Guest3
```

Displaying the Tx/Rx Statistics

Use the **show dot11 statistics** command to display the current transmit/receive (tx/rx) statistics for Dot11Radio 0 interface.

SUMMARY STEPS

1. **show dot11 statistics**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show dot11 statistics** **Example:** `ap#` **show dot11 statistics**	Displays the current tx/rx statistics for Dot11Radio 0 interface.

What to Do Next

Example: Displaying the Tx/Rx Statistics

```
ap# show dot11 statistics
            rx bytes   rx pkts   rx errs  rx drops  tx bytes   tx pkts   tx errs  tx drops
Dot11Radio0        0         0         0         0     12824        94         0         0
```

Displaying the BVI 1 Interface Details

Use the **show interfaces BVI 1** command to display BVI 1 interface details. Details include the IP address of the router.

Tip After changing the IP address used for accessing the router, this command can be used to confirm the change. See Setting the IP Address for the Web-based Interface, on page 55.

SUMMARY STEPS

1. **show interfaces BVI 1**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show interfaces BVI 1** **Example:** `ap#` **show interfaces BVI 1**	Displays the current BVI 1 interface details.

What to Do Next

Example: Displaying the BVI 1 Interface Details

```
This example displays BVI 1 interface details.
ap# show interfaces BVI 1
BVI1
          Link encap:Ethernet  HWaddr AA:11:BB:22:CC:33
          inet addr:10.10.10.2  Bcast:10.10.10.7  Mask:255.255.255.248
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:260 multicast:86 unicast:0 broadcast:174
          RX errors:0 dropped:0 overruns:0 frame:0
          TX packets:21 multicast:0 unicast:21 broadcast:0
          TX errors:0 dropped:0 overruns:0 carrier:0 collisions:0
          txqueuelen:0
          RX bytes:46642 (45.5 KiB) TX bytes:1260 (1.2 KiB)
          RX multicast bytes:32164 (31.4 KiB) TX multicast bytes:0 (0.0 B)
```

Displaying Dot11Radio 0 Interface Information

Use the **show interfaces Dot11Radio 0** command to display Dot11Radio 0 interface information.

SUMMARY STEPS

1. **show interfaces Dot11Radio 0**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show interfaces Dot11Radio 0** **Example:** `ap#` **show interfaces Dot11Radio 0**	Displays the current Dot11Radio 0 interface information.

Example: Displaying Dot11Radio 0 Interface Information

This example displays Dot11Radio 0 interface information.

```
ap# show interfaces Dot11Radio 0
Dot11Radio0
          Link encap:Ethernet  HWaddr AA:11:BB:22:CC:33
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 multicast:0 unicast:0 broadcast:0
          RX errors:0 dropped:0 overruns:0 frame:160876
          TX packets:267 multicast:86 unicast:0 broadcast:181
          TX errors:0 dropped:0 overruns:0 carrier:0 collisions:0
          txqueuelen:1000
          RX bytes:0 (0.0 B) TX bytes:52150 (50.9 KiB)
          RX multicast bytes:0 (0.0 B) TX multicast bytes:0 (0.0 B)
          Interrupt:15 Base address:0x4000
```

Displaying Brief Details for All Interfaces

Use the **show ip interface brief** command to display brief details for all interfaces.

SUMMARY STEPS

1. **show ip interface brief**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ip interface brief** **Example:** `ap#` **show ip interface brief**	Displays brief details for all interfaces.

What to Do Next

Example: Displaying Brief Details for All Interfaces

In the output, the Method column indicates whether the interface was user-configured or configured by DHCP.

```
ap# show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
Dot11Radio0                unassigned      YES NVRAM  up                    up
BVI1                       10.10.10.2      YES NVRAM  up                    up
```

Displaying CPU Statistics

Use the **show processes cpu** command to display CPU utilization statistics.

SUMMARY STEPS

1. **show processes cpu**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show processes cpu** **Example:** `ap#` **show processes cpu**	Displays CPU utilization statistics.

Example: Displaying CPU Statistics

```
ap# show processes cpu
CPU:   0% usr   0% sys   0% nic  90% idle   0% io   0% irq   9% sirq
```

Showing a Summary of Memory Usage

Use the **show memory summary** command to display details of current memory usage.

SUMMARY STEPS

1. **show memory summary**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show memory summary** **Example:** `ap#` **show memory summary**	Displays details of current memory usage.

What to Do Next

Example: Showing a Summary of Memory Usage

ap# **show memory summary**

Total(kB) Used(kB) Free(kB)

Processor 88052 44212 43840

Pinging an Address

Use the **ping** command to test connectivity with a specific address.

SUMMARY STEPS

1. **ping** {*IP-address* | *hostname*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**ping** {*IP-address* | *hostname*} **Example:** `ap#` **ping 10.0.0.0**	Tests connectivity to the specified IP address or host name. Entering the **ping** command with an address specified indicates the round trip time in milliseconds for several transmissions of a small datagram. Entering the **ping** command without specifying an address starts the interactive mode of the command, enabling you to enter the target address, the transmission repeat count, and the datagram size.

Changing the Administrator Password

Use the **password** command to change the administrator password.

Note The default login credentials are: User name: **admin** Password: **admin** When logging in for the first time, the router prompts you to change the default password.

SUMMARY STEPS

1. **password** *old-password new-password confirm-password*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**password** *old-password new-password confirm-password* **Example:** `ap#` **password admin AbCdE123# AbCdE123#**	Changes the administrator password. Note that the command requires entering the new password twice to confirm the exact text of the new password.

Configuring the Number of Lines on Screen

Use the **terminal length** command to configure the number of lines displayed on the screen.

SUMMARY STEPS

1. **terminal length** *number-of-lines*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal length** *number-of-lines* **Example:** `ap#` **terminal length 40**	Sets the number of lines displayed on the screen. *number-of-lines* range: 0 to 512 A value of 0 specifies that the display does not pause for scrolling.

What to Do Next

Administering the Wireless Device

This module describes the following wireless device administration tasks:

Securing Access to the Wireless Device

This section provides information about performing the following tasks to secure access to the wireless device:

Disabling the Mode Button Function

Caution This command disables password recovery. If you lose the privileged EXEC mode password for the access point after entering this command, you must contact the Cisco Technical Assistance Center (TAC) to regain access to the access point CLI.

Note To reboot the wireless device, use the service-module wlan-ap reset command from the router's Cisco IOS CLI. See the Rebooting the Wireless Device, on page 111 for information about this command.

The mode button is enabled by default. To disable the access point's mode button, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **no boot mode-button**
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**no boot mode-button**	Disables the access point's mode button.
Step 3	**end**	Returns to privileged EXEC mode. **Note** It is not necessary to save the configuration.

Dispaying the mode-button status

You can check the status of the mode button by executing the show boot or show boot mode-button command in privileged EXEC mode. The status does not appear in the running configuration. The following example shows typical responses to the show boot and show boot mode-button commands:

```
ap# show boot
BOOT path-list: flash:/c1200-k9w7-mx-v123_7_ja.20050430/c1200-k9w7-mx.v123_7_ja.20050430
Config file: flash:/config.txt
Private Config file: flash:/private-config
Enable Break:  no
Manual boot: no
Mode button: on
Enable IOS break:  no
HELPER path-list:
NVRAM/Config file
 buffer size: 32768
ap# show boot mode-button
on
ap#
```

Note As long as the privileged EXEC password is known, you can use the boot mode-button command to restore the mode button to normal operation.

Preventing Unauthorized Access to Your Access Point

You can prevent unauthorized users from reconfiguring the wireless device and viewing configuration information. Typically, you want the network administrators to have access to the wireless device while restricting access to users who connect through a terminal or workstation from within the local network.

To prevent unauthorized access to the wireless device, configure one of these security features:

Note The characters TAB, ?, $, +, and [are invalid characters for passwords.

Protecting Access to Privileged EXEC Commands

A simple way of providing terminal access control in your network is to use passwords and assign privilege levels. Password protection restricts access to a network or network device. Privilege levels define what commands users can issue after they have logged in to a network device.

Note For complete syntax and usage information for the commands used in this section, see *Cisco IOS Security Command Reference for Release 12.4*

This section describes how to control access to the configuration file and privileged EXEC commands. It contains the following configuration information:

Configuring Default Password and Privilege Level

Table 10: Default Passwords and Privilege Levels , on page 95 shows the default password and privilege level configuration.

Table 10: Default Passwords and Privilege Levels

Privilege Level	Default Setting
Username and password	Default username is Cisco, and the default password is Cisco.
Enable password and privilege level	Default password is Cisco. The default is level 15 (privileged EXEC level). The password is encrypted in the configuration file.
Enable secret password and privilege level	Default enable password is Cisco. The default is level 15 (privileged EXEC level). The password is encrypted before it is written to the configuration file.
Line password	Default password is Cisco. The password is encrypted in the configuration file.

Setting or Changing a Static Enable Password

The enable password controls access to the privileged EXEC mode.

Note The **no enable password** command, in global configuration mode, removes the enable password, but you should use extreme care when using this command. If you remove the enable password, you are locked out of the privileged EXEC mode.

To set or change a static enable password, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **enable password** *password*
3. **end**
4. **show running-config**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**enable password** *password*	Defines a new password or changes an existing password for access to privileged EXEC mode. • The default password is Cisco. • *password* —A string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. The characters TAB, ?, $, +, and [are invalid characters for passwords.
Step 3	**end**	Returns to privileged EXEC mode.
Step 4	**show running-config**	Verifies your entries.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

The enable password is not encrypted and can be read in the wireless device configuration file.

Configuration Example: Changing a Static Enable Password

The following example shows how to change the enable password to *l1u2c3k4y5* . The password is not encrypted and provides access to level 15 (standard privileged EXEC mode access):

```
AP(config)# enable password l1u2c3k4y5
```

Protecting Enable and Enable Secret Passwords with Encryption

To configure encryption for enable and enable secret passwords, follow these steps, beginning in privileged EXEC mode:

Note It is recommend that you use the **enable secret** command because it uses an improved encryption algorithm.If you configure the **enable secret** command, it takes precedence over the **enable password** command; the two commands cannot be in effect simultaneously.

SUMMARY STEPS

1. **configure terminal**
2. • **enable password** [**level** *level*] {*password* | *encryption-type encrypted-password*
   or
   • **enable secret** [**level** *level*] {*password* | *encryption-type encrypted-password*
3. **service password-encryption**
4. **end**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	• **enable password** [**level** *level*] {*password* | *encryption-type encrypted-password* or • **enable secret** [**level** *level*] {*password* | *encryption-type encrypted-password*	Defines a new password or changes an existing password for access to privileged EXEC mode. or Defines a secret password, which is saved using a nonreversible encryption method. • *level* —(Optional) Range is from 0 to 15. Level 1 is normal user EXEC mode privileges. The default level is 15 (privileged EXEC mode privileges). • *password* —A string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. By default, no password is defined. • *encryption-type* —(Optional) Only type 5. Cisco proprietary encryption algorithm, is available. If you specify an encryption type, you must provide an encrypted password—an encrypted password you copy from anotheraccess point wireless device configuration. **Note** If you specify an encryption type and then enter a clear text password, you cannot reenter privileged EXEC mode. You cannot recover a lost encrypted password by any method.
Step 3	**service password-encryption**	(Optional) Encrypts the password when the password is defined or when the configuration is written. Encryption prevents the password from being readable in the configuration file.
Step 4	**end**	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Configuration Example: Enable Secret Passwords

This example shows how to configure the encrypted password *1FaD0$Xyti5Rkls3LoyxzS8* for privilege level 2:

```
AP(config)# enable secret level 2 5 $1$FaD0$Xyti5Rkls3LoyxzS8
```

Configuring Username and Password Pairs

Configure username and password pairs, which are locally stored on the wireless device. These pairs are assigned to lines or interfaces, and they authenticate each user before the user can access the wireless device. If you have defined privilege levels, assign a specific privilege level (with associated rights and privileges) to each username and password pair.

To establish a username-based authentication system that requests a login username and a password, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **username** *name* [**privilege** *level*] {**password** *encryption-type password* }
3. **login local**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**username** *name* [**privilege** *level*] {**password** *encryption-type password* }	Enters the username, privilege level, and password for each user. • *name*—Specifies the user ID as one word. Spaces and quotation marks are not allowed. • *level* —(Optional) Specifies the privilege level the user has after gaining access. The range is 0 to 15. Level 15 gives privileged EXEC mode access. Level 1 gives user EXEC mode access. • *encryption-type* —Enter 0 to specify that an unencrypted password will follow. Enter 7 to specify that a hidden password will follow.

	Command or Action	Purpose
		• *password* —The password the user must enter to gain access to the wireless device. The password must be from 1 to 25 characters, can contain embedded spaces, and must be the last option specified in the **username** command.
Step 3	**login local**	Enables local password checking at login time. Authentication is based on the username specified in Step 2.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**show running-config**	Verifies your entries.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Note You must have at least one username configured and you must have login local set to open a Telnet session to the wireless device. If you enter no username for the only username, you can be locked out of the wireless device.

Configuring Multiple Privilege Levels

By default, Cisco IOS software has two modes of password security: user EXEC and privileged EXEC. You can configure up to 16 hierarchical levels of commands for each mode. By configuring multiple passwords, you can allow different sets of users to have access to specified commands.

For example, for many users to have access to the **clear line** command, you can assign it level 2 security and distribute the level 2 password fairly widely. For more restricted access to the **configure** command, you can assign it level 3 security and distribute that password to a more restricted group of users.

This section includes this configuration information:

Setting the Privilege Level for a Command

To set the privilege level for a command mode, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **privilege** *mode* **level** *level command*
3. **enable password level** *level password*
4. **end**
5. • **show running-config**
   or
   • **show privilege**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**privilege** *mode* **level** *level command*	Sets the privilege level for a command. • *mode* —Enter **configure** for global configuration mode, **exec** for EXEC mode, **interface** for interface configuration mode, or **line** for line configuration mode. • *level* —Range is from 0 to 15. Level 1 is for normal user EXEC mode privileges. Level 15 is the level of access permitted by the **enable** password. • *command* —Specifies the command to which access is restricted.
Step 3	**enable password level** *level password*	Specifies the enable password for the privilege level. • *level* —Range is from 0 to 15. Level 1 is for normal user EXEC mode privileges. • *password* —A string from 1 to 25 alphanumeric characters. The string cannot start with a number, is case sensitive, and allows spaces but ignores leading spaces. By default, no password is defined. **Note** The characters TAB, ?, $, +, and [are invalid characters for passwords.
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	• **show running-config** or • **show privilege**	Verifies your entries. The **show running-config** command displays the password and access level configuration. The **show privilege** command displays the privilege level configuration.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Configuring Multiple Privilege Levels

Note When you set a command to a privilege level, all commands whose syntax is a subset of that command are also set to that level. For example, if you set the **show ip route** command to level 15, the **show** commands and **show ip** commands are automatically set to privilege level 15 unless you set them individually to different levels. To return to the default privilege for a given command, use the **no privilege** *mode* **level** *level command* command in global configuration mode.

Logging Into and Exiting a Privilege Level

To log in to a specified privilege level or to exit to a specified privilege level, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **enable** *level*
2. **disable** *level*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** *level*	Logs in to a specified privilege level. *level* — The privilege range is from 0 to 15.
Step 2	**disable** *level*	Exits to a specified privilege level.

Controlling Access Point Access with RADIUS

This section describes how to control administrator access to the wireless device by using Remote Authentication Dial-In User Service (RADIUS). For complete instructions on configuring the wireless device to support RADIUS, see the Cisco IOS Software Configuration Guide for Cisco Aironet Access Points.

RADIUS provides detailed accounting information and flexible administrative control over authentication and authorization processes. RADIUS is facilitated through authentication, authorization, and accounting (AAA) and can be enabled only through AAA commands.

Note For complete syntax and usage information for the commands used in this section, see "Cisco IOS Security Command Reference" .

RADIUS configuration tasks are described in the following sections:

RADIUS Configuration

RADIUS and AAA are disabled by default. To prevent a lapse in security, you cannot configure RADIUS through a network management application. When enabled, RADIUS can authenticate users who are accessing the wireless device through the CLI.

To configure AAA authentication, define a named list of authentication methods and then apply the list to various interfaces. The method list defines the types of authentication to be performed and the sequence in which they are performed; it must be applied to a specific interface before any defined authentication methods are performed. The only exception is the default method list (which is named default). The default method list is automatically applied to all interfaces except those that have a named method list explicitly defined.

A method list describes the sequence and authentication methods to be used to authenticate a user. You can designate one or more security protocols for authentication, thus ensuring a backup system for authentication in case the initial method fails. The software uses the first method listed to authenticate users. If that method fails to respond, the software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle—that is, the security server or local username database responds by denying the user access—the authentication process stops, and no other authentication methods are attempted.

Configuring RADIUS Login Authentication

To configure login authentication, follow these steps, beginning in privileged EXEC mode. This procedure is required.

SUMMARY STEPS

1. **configure terminal**
2. **aaa new-model**
3. **aaa authentication login {default** |*list-name* } *method1* [*method2...*
4. **line** [**console** | **tty** | **vty**] *line-number* [*ending-line-number*
5. **login authentication** {**default** | *list-name*
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**aaa new-model**	Enables AAA.
Step 3	**aaa authentication login {default** |*list-name* } *method1* [*method2...*	Creates a login authentication method list. • To create a default list that is used when a named list is *not* specified in the **login authentication** command, use the **default** keyword followed by the

	Command or Action	Purpose
		methods that are to be used in default situations. The default method list is automatically applied to all interfaces. • *list-name*—A character string to name the list you are creating. • *method1...* —Specifies the actual method the authentication algorithm tries. The additional methods of authentication are used only if the previous method returns an error, not if it fails. Select one of these methods: • **local**—Use the local username database for authentication. You must enter username information in the database. Use the **username** *password* global configuration command. • **radius**—Use RADIUS authentication. You must configure the RADIUS server before you can use this authentication method. For more information, see the "Identifying the RADIUS Server Host" section of the "Configuring Radius and TACACS+ Servers" chapter in Cisco IOS Software Configuration Guide for Cisco Aironet Access Points.
Step 4	**line** [**console** | **tty** | **vty**] *line-number* [*ending-line-number*	Enters line configuration mode, and configures the lines to which the authentication list applies.
Step 5	**login authentication** {**default** | *list-name*	Applies the authentication list to a line or set of lines. • If you specify **default**, use the default list that you created with the **aaa authentication login** command. • *list-name* —Specifies the list that you created with the **aaa authentication login** command.
Step 6	**end**	Returns to privileged EXEC mode.
Step 7	**show running-config**	Verifies your entries.
Step 8	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Defining AAA Server Groups

You can configure the wireless device to use AAA server groups to group existing server hosts for authentication. Select a subset of the configured server hosts and use them for a particular service. The server group is used with a global server-host list, which lists the IP addresses of the selected server hosts.

Server groups can also include multiple host entries for the same server if each entry has a unique identifier (the combination of the IP address and UDP port number), allowing different ports to be individually defined

as RADIUS hosts providing a specific AAA service. If you configure two different host entries on the same RADIUS server for the same service (such as accounting), the second configured host entry acts as a failover backup to the first one.

You use the **server** group server configuration command to associate a particular server with a defined group server. You can either identify the server by its IP address or identify multiple host instances or entries by using the optional **auth-port** and **acct-port** keywords.

Configuring AAA Server Group

To define the AAA server group and associate a particular RADIUS server with it, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **aaa new-model**
3. **radius-server host** {*hostname* | *ip-address* } [**auth-port** *port-number*] [**acct-port** *port-number*] [**timeout** *seconds*] [**retransmit** *retries*] [**key** *string*]
4. **aaa group server radius** *group-name*
5. **server** *ip-address*
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**aaa new-model**	Enables AAA.
Step 3	**radius-server host** {*hostname* | *ip-address* } [**auth-port** *port-number*] [**acct-port** *port-number*] [**timeout** *seconds*] [**retransmit** *retries*] [**key** *string*]	Specifies the IP address or hostname of the remote RADIUS server host. • **auth-port** *port-number*—(Optional) Specifies the user datagram protocol (UDP) destination port for authentication requests. • **acct-port** *port-number*—(Optional) Specifies the UDP destination port for accounting requests. • **timeout** *seconds* —(Optional) The time interval that the wireless device waits for the RADIUS server to reply before retransmitting. The range is 1 to 1000. This setting overrides the **radius-server timeout** global configuration command setting. If no timeout is set with the **radius-server host** command, the setting of the **radius-server timeout** command is used. • **retransmit** *retries*—(Optional) The number of times that a RADIUS request is resent to a server if that server is not responding or responding slowly. The range is 1 to 1000. If no retransmit value is set with the **radius-server host** command, the setting of the **radius-server retransmit** global configuration command is used.

	Command or Action	Purpose
		• **key** *string* —(Optional) Specifies the authentication and encryption key used between the wireless device and the RADIUS daemon running on the RADIUS server. **Note** The key is a text string that must match the encryption key that is used on the RADIUS server. Always configure the key as the last item in the **radius-server host** command. Leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in your key, do not enclose the key in quotation marks unless the quotation marks are part of the key. To configure the wireless device to recognize more than one host entry that is associated with a single IP address, enter this command as many times as necessary, making sure that each UDP port number is different. The wireless device software searches for hosts in the order in which you specify them. Set the timeout, retransmit, and encryption key values to use with the specific RADIUS host.
Step 4	**aaa group server radius** *group-name*	Defines the AAA server-group with a group name. This command puts the wireless device in a server group configuration mode.
Step 5	**server** *ip-address*	Associates a particular RADIUS server with the defined server group. • Repeat this step for each RADIUS server in the AAA server group. • Each server in the group must be previously defined in Step 2.
Step 6	**end**	Returns to privileged EXEC mode.
Step 7	**show running-config**	Verifies your entries.
Step 8	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Enable RADIUS login authentication: See the "Configuring RADIUS Login Authentication" section of the "Configuring Radius and TACACS+ Servers" chapter in *Cisco IOS Software Configuration Guide for Cisco Aironet Access Points* for information to enable RADIUS login authentication.

Configuration Example: AAA Group

In the following is example, the wireless device is configured to recognize two different RADIUS group servers (group1 and group2). Group1 has two different host entries on the same RADIUS server, which are configured for the same services. The second host entry acts as a failover backup to the first entry.

```
AP(config)# aaa new-model
AP(config)# radius-server host 172.20.0.1 auth-port 1000 acct-port 1001
AP(config)# radius-server host 172.10.0.1 auth-port 1645 acct-port 1646
AP(config)# aaa group server radius group1
AP(config-sg-radius)# server 172.20.0.1 auth-port 1000 acct-port 1001
AP(config-sg-radius)# exit
AP(config)# aaa group server radius group2
AP(config-sg-radius)# server 172.20.0.1 auth-port 2000 acct-port 2001
AP(config-sg-radius)# exit
```

Configuring RADIUS Authorization for User Privileged Access and Network Services

AAA authorization limits the services that are available to a user. When AAA authorization is enabled, the wireless device uses information retrieved from the user's profile, which is in the local user database or on the security server, to configure the user session. The user is granted access to a requested service only if the user profile allows it.

You can use the **aaa authorization** command in global configuration mode with the **radius** keyword to set parameters that restrict a user's network access to privileged EXEC mode.

The aaa authorization exec radius command sets these authorization parameters:

- Use RADIUS for privileged EXEC access authorization if authentication was performed by using RADIUS.
- Use the local database if authentication was not performed by using RADIUS.

Note Authorization is bypassed for authenticated users who log in through the CLI, even if authorization has been configured.

Configuring RADIUS Authorization for User Privileged Access and Network Services

To specify RADIUS authorization for privileged EXEC access and network services, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **aaa authorization network radius**
3. **aaa authorization exec radius**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**aaa authorization network radius**	Configures the wireless device for user RADIUS authorization for all network-related service requests.
Step 3	**aaa authorization exec radius**	Configures the wireless device for user RADIUS authorization to determine whether the user has privileged EXEC access. The **exec** keyword might return user profile information (such as **autocommand** information).
Step 4	**end**	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show running-config**	Verifies your entries.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

To disable authorization, use the **no aaa authorization** {**network** | **exec**} *method1* command in global configuration mode.

Displaying the RADIUS Configuration

To display the RADIUS configuration, use the **show running-config** command in privileged EXEC mode.

Controlling Access Point Access with TACACS+

This section describes how to control administrator access to the wireless device using Terminal Access Controller Access Control System Plus (TACACS+). For complete instructions on configuring the wireless device to support TACACS+, see *Cisco IOS Software Configuration Guide for Cisco Aironet Access Points* .

TACACS+ provides detailed accounting information and flexible administrative control over authentication and authorization processes. TACACS+ is facilitated through AAA and can be enabled only through AAA commands.

Note For complete syntax and usage information for the commands used in this section, see Cisco IOS Security Command Reference .

These sections describe TACACS+ configuration information.

Default TACACS+ Configuration

TACACS+ and AAA are disabled by default.

To prevent a lapse in security, you cannot configure TACACS+ through a network management application. When enabled, TACACS+ can authenticate administrators who are accessing the wireless device through the CLI.

To configure AAA authentication, you define a named list of authentication methods and then apply the list to various interfaces. The method list defines the types of authentication to be performed and the sequence in which they are performed; it must be applied to a specific interface before any defined authentication methods are performed. The only exception is the default method list (which is named *default*). The default method list is automatically applied to all interfaces, except those that have a named method list explicitly defined.

A method list describes the sequence and authentication methods to be used to authenticate a user. You can designate one or more security protocols for authentication, thus ensuring a backup system for authentication in case the initial method fails. The software uses the first method listed to authenticate users. If that method fails to respond, the software selects the next authentication method in the method list. This process continues

until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle—that is, the security server or local username database responds by denying the user access—the authentication process stops, and no other authentication methods are attempted.

Configuring TACACS+ Login Authentication

To configure login authentication, follow these steps, beginning in privileged EXEC mode. This procedure is required.

SUMMARY STEPS

1. **configure terminal**
2. **aaa new-model**
3. **aaa authentication login {default |** *list-name* } *method1* [*method2...*
4. **line** [**console** | **tty** | **vty**] *line-number* [*ending-line-number*
5. **login authentication** {**default** | *list-name*
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**aaa new-model**	Enables AAA.
Step 3	**aaa authentication login {default** | *list-name* } *method1* [*method2...*	Creates a login authentication method list. • To create a default list that is used when a named list is *not* specified in the **login authentication** command, use the **default** keyword followed by the methods that are to be used in default situations. The default method list is automatically applied to all interfaces. • *list-name* —A character string to name the list you are creating. • *method1...* —Specifies the actual method the authentication algorithm tries. The additional methods of authentication are used only if the previous method returns an error, not if it fails. Select one of these methods: • **local**—Use the local username database for authentication. You must enter username information into the database. Use the **username** *password* command in global configuration mode. • **tacacs+**—Use TACACS+ authentication. You must configure the TACACS+ server before you can use this authentication method.

	Command or Action	Purpose
Step 4	**line** [**console** | **tty** | **vty**] *line-number* [*ending-line-number*	Enters line configuration mode, and configures the lines to which the authentication list applies.
Step 5	**login authentication** {**default** | *list-name*	Applies the authentication list to a line or set of lines. • If you specify **default**, use the default list created with the **aaa authentication login** command. • *list-name* —Specifies the list created with the **aaa authentication login** command.
Step 6	**end**	Returns to privileged EXEC mode.
Step 7	**show running-config**	Verifies your entries.
Step 8	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

To disable AAA, use the **no aaa new-model** command in global configuration mode. To disable AAA authentication, use the **no aaa authentication login** {default | *list-name* } *method1* [*method2...*] command in global configuration mode. To either disable TACACS+ authentication for logins or to return to the default value, use the **no login authentication** {**default** | *list-name* } command in line configuration mode.

Configuring TACACS+ Authorization for Privileged EXEC Access and Network Services

AAA authorization limits the services available to a user. When AAA authorization is enabled, the wireless device uses information retrieved from the user profile, which is located either in the local user database or on the security server, to configure the user session. The user is granted access to a requested service only if the information in the user profile allows it.

You can use the **aaa authorization** command in global configuration mode with the **tacacs+** keyword to set parameters that restrict a user network access to privileged EXEC mode.

The aaa authorization exec tacacs+ local command sets these authorization parameters:

- Use TACACS+ for privileged EXEC access authorization if authentication was performed by using TACACS+.
- Use the local database if authentication was not performed by using TACACS+.

Note Authorization is bypassed for authenticated users who log in through the CLI even if authorization has been configured.

To specify TACACS+ authorization for privileged EXEC access and network services, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **aaa authorization network tacacs+**
3. **aaa authorization exec tacacs+**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**aaa authorization network tacacs+**	Configures the wireless device for user TACACS+ authorization for all network-related service requests.
Step 3	**aaa authorization exec tacacs+**	Configures the wireless device for user TACACS+ authorization to determine whether the user has privileged EXEC access. The **exec** keyword might return user profile information (such as **autocommand** information).
Step 4	**end**	Returns to privileged EXEC mode.
Step 5	**show running-config**	Verifies your entries.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Displaying the TACACS+ Configuration

To display TACACS+ server statistics, use the **show tacacs** command in privileged EXEC mode.

Administering the Access Point Hardware and Software

This section contains information on performing the following tasks:

Administering the Wireless Hardware and Software

This section provides instructions for performing the following tasks:

Resetting the Wireless Device to the Factory Default Configuration

To reset the wireless device hardware and software to its factory default configuration, use the **service-module wlan-ap0 reset default-config** command in the router's Cisco IOS privileged EXEC mode.

Caution Because you may lose data, use only the **service-module wlan-ap0 reset** command to recover from a shutdown or failed state.

Rebooting the Wireless Device

To perform a graceful shutdown and reboot the wireless device, use the **service-module wlan-ap0 reload** command in the router's Cisco IOS privileged EXEC mode. At the confirmation prompt, press **Enter** to confirm the action, or enter **n** to cancel.

When running in autonomous mode, the reload command saves the configuration before rebooting. If the attempt is unsuccessful, the following message displays:

```
Failed to save service module configuration.
```

When running in Lightweight Access Point Protocol (LWAPP) mode, the reload function is typically handled by the wireless LAN controller (WLC). If you enter the service-module wlan-ap0 reload command, you will be prompted with the following message:

```
The AP is in LWAPP mode. Reload is normally handled by WLC controller.
Still want to proceed? [yes]
```

Monitoring the Wireless Device

This section provides commands for monitoring hardware on the router for displaying wireless device statistics and wireless device status.

Use the **service-module wlan-ap0 statistics** command in privileged EXEC mode to display wireless device statistics. The following is sample output for the command:

```
  CLI reset count = 0

  CLI reload count = 1

  Registration request timeout reset count = 0

  Error recovery timeout reset count = 0

  Module registration count = 10


The last IOS initiated event was a cli reload at *04:27:32.041 UTC Fri Mar 8 2007
```

Use the **service-module wlan-ap0 status** command in privileged EXEC mode to display the status of the wireless device and its configuration information. The following is sample output for the command:

```
Service Module is Cisco wlan-ap0
Service Module supports session via TTY line 2
Service Module is in Steady state
Service Module reset on error is disabled
Getting status from the Service Module, please wait..

Image path = flash:c8xx_19xx_ap-k9w7-mx.acregr/c8xx_19xx_ap-k9w7-mx.acre
```

```
gr
System uptime = 0 days, 4 hours, 28 minutes, 5 seconds

Router#d was introduced for embedded wireless LAN access points on Integrated Services
Routers.
```

Managing the System Time and Date

You can manage the system time and date on the wireless device automatically, by using the Simple Network Time Protocol (SNTP), or manually, by setting the time and date on the wireless device.

Note For complete syntax and usage information for the commands used in this section, see *Cisco IOS Configuration Fundamentals Command Reference for Release 12.4* .

This section provides the following configuration information:

Understanding Simple Network Time Protocol

Simple Network Time Protocol (SNTP) is a simplified, client-only version of NTP. SNTP can only receive the time from NTP servers; it cannot provide time services to other systems. SNTP typically provides time within 100 milliseconds of the accurate time, but it does not provide the complex filtering and statistical mechanisms of NTP.

You can configure SNTP to request and accept packets from configured servers or to accept NTP broadcast packets from any source. When multiple sources are sending NTP packets, the server with the best stratum is selected. Click this URL for more information on NTP and strata:

http://www.cisco.com/en/US/docs/ios/12_1/configfun/configuration/guide/fcd303.html#wp1001075
http://www.cisco.com/en/US/docs/ios/12_1/configfun/configuration/guide/fcd303.html#wp1001075

If multiple servers are at the same stratum, a configured server is preferred over a broadcast server. If multiple servers pass both tests, the first one to send a time packet is selected. SNTP chooses a new server only if the client stops receiving packets from the currently selected server, or if (according to the above criteria) SNTP discovers a better server.

Configuring SNTP

SNTP is disabled by default. To enable SNTP on the access point, use one or both of the commands listed in Table 11: SNTP Commands, on page 112 in global configuration mode.

Table 11: SNTP Commands

Command	Purpose
sntp server {address | hostname} [version number]	Configures SNTP to request NTP packets from an NTP server.
sntp broadcast client	Configures SNTP to accept NTP packets from any NTP broadcast server.

Enter the sntp server command once for each NTP server. The NTP servers must be configured to respond to the SNTP messages from the access point.

If you enter both the sntp server command and the sntp broadcast client command, the access point accepts time from a broadcast server but prefers time from a configured server, if the strata are equal. To display information about SNTP, use the show sntp EXEC command.

Time and Date Manual Configuration

If no other source of time is available, you can manually configure the time and date after restsarting the system. The time remains accurate until the next system restart. We recommend that you use manual configuration only as a last resort. If you have an outside source to which the wireless device can synchronize, you do not need to manually set the system clock.

You have the options to configure the system clock, time zone and summer time.

Conffiguring Time and Date

To set the system clock manually , follow these steps, beginning in privileged EXEC mode:

Note If you have an outside source on the network that provides time services, such as an NTP server, you do not need to manually set the system clock.

SUMMARY STEPS

1. **clock set** *hh*:*mm*:*ss day month year*
2. **clock timezone** *zone hours-offset minutes-offset*
3. **clock summer-time** *zone* **recurring** [*week day month hh*:*mm week day month hh*:*mm* [*offset*]]
4. • **clock summer-time** *zone* **date** [*month date year hh*:*mm month date year hh*:*mm* [*offset*]]
   or
   • **clock summer-time** *zone* **date** [*date month year hh*:*mm date month year hh*:*mm* [*offset*]]
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**clock set** *hh*:*mm*:*ss day month year* **Example:** **clock set** `hh:mm:ss month day year`	Manually sets the system clock by using one of these formats: • *hh*:*mm*:*ss* —Specifies the time in hours (24-hour format), minutes, and seconds. The time specified is relative to the configured time zone. • *day*—Specifies the day by date in the month. • *month*—Specifies the month by its full name. • *year*—Specifies the year in four digits (no abbreviation).

	Command or Action	Purpose
Step 2	**clock timezone** *zone hours-offset minutes-offset*	Sets the time zone. **Note** The wireless device keeps internal time in universal time coordinated (UTC). Use this command only for display purposes and when the time is manually set. • *zone*—Enter the name of the time zone to be displayed when standard time is in effect. The default is UTC. • *hours-offset*—Enter the hours offset from UTC. • *minutes-offset*—(Optional) Enter the minutes offset from UTC. The *minutes-offset* variable in the **clock timezone** command in global configuration mode is available for situations where a local time zone is a percentage of an hour different from UTC.
Step 3	**clock summer-time** *zone* **recurring** [*week day month hh*:*mm week day month hh*:*mm* [*offset*]]	(Optional) Configures summer time to start and end on the specified days every year. The first part of the **clock summer-time** global configuration command specifies when summer time begins, and the second part specifies when it ends. All times are relative to the local time zone. The start time is relative to standard time. The end time is relative to summer time. If the starting month is after the ending month, the system assumes that you are in the southern hemisphere. Summer time is disabled by default. If you specify **clock summer-time** *zone* **recurring** without parameters, the summer time rules default to the United States rules. • *zone* —Specifies the name of the time zone (for example, PDT) to be displayed when summer time is in effect. • *week* —(Optional) Specifies the week of the month (1 to 5 or **last**). • *day* —(Optional) Specifies the day of the week (for example, Sunday). • *month* —(Optional) Specifies the month (for example, January). • *hh*:*mm* —(Optional) Specifies the time (24-hour format) in hours and minutes. • *offset* —(Optional) Specifies the number of minutes to add during summer time. The default is 60.
Step 4	• **clock summer-time** *zone* **date** [*month date year hh*:*mm month date year hh*:*mm* [*offset*]] or • **clock summer-time** *zone* **date** [*date month year hh*:*mm date month year hh*:*mm* [*offset*]]	(Optional) Sets summer time if there is no recurring pattern. Configures summer time to start on the first date and end on the second date. The first part of the **clock summer-time** global configuration command specifies when summer time begins, and the second part specifies when it ends. All times are relative to the local time zone. The start time is relative to standard time. The end time is relative to summer time. If the starting month is after the ending month, the system assumes that you are in the southern hemisphere. Summer time is disabled by default. • *zone*—Specifies the name of the time zone (for example, PDT) to be displayed when summer time is in effect. • *week* —(Optional) Specifies the week of the month (1 to 5 or **last**).

	Command or Action	Purpose
		• *day* —(Optional) Specifies the day of the week (for example, Sunday). • *month* —(Optional) Specifies the month (for example, January). • *hh*:*mm* —(Optional) Specifies the time (24-hour format) in hours and minutes. • *offset* —(Optional) Specifies the number of minutes to add during summer time. The default is 60.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**show running-config**	Verifies your entries.
Step 7	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Note To display the time and date configuration, use the **show clock** [**detail**] command in privileged EXEC mode. The system clock keeps an *authoritative* flag that shows whether the time is authoritative (believed to be accurate). If the system clock has been set by a timing source such as NTP, the flag is set. If the time is not authoritative, it is used only for display purposes. Until the clock is authoritative and the *authoritative* flag is set, the flag prevents peers from synchronizing to the clock when the peers' time is invalid. The symbol that precedes the **show clock** display has this meaning:

Example Configuration : Time and Date

This example shows how to specify that summer time starts on the first Sunday in April at 02:00 and ends on the last Sunday in October at 02:00:

```
AP(config)# clock summer-time PDT recurring 1 Sunday April 2:00 last Sunday October 2:00
```

This example shows how to set summer time to start on October 12, 2000, at 02:00, and end on April 26, 2001, at 02:00:

```
AP(config)# clock summer-time pdt date 12 October 2000 2:00 26 April 2001 2:00
```

Configuring a System Name and Prompt

Configure the system name on the wireless device to identify it. By default, the system name and prompt are *ap* .

If you have not configured a system prompt, the first 20 characters of the system name are used as the system prompt. A greater-than symbol (>) is appended. The prompt is updated whenever the system name changes, unless you manually configure the prompt by using the **prompt** command in global configuration mode.

Note For complete syntax and usage information for the commands used in this section, see Cisco IOS Configuration Fundamentals Command Reference and Cisco IOS IP Addressing Services Command Reference .

This section contains the following configuration information:

Configuring a System Name

To manually configure a system name, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **hostname** *name*
3. **end**
4. **show running-config**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**hostname** *name*	Manually configures a system name. The default setting is *ap* . **Note** When you change the system name, the wireless device radios are reset, and associated client devices disassociate and quickly re-associate. **Note** You can enter up to 63 characters for the system name. However, when the wireless device identifies itself to client devices, it uses only the first 15 characters in the system name. If it is important for client users to distinguish between devices, make sure that a unique portion of the system name appears in the first 15 characters.
Step 3	**end**	Returns to privileged EXEC mode.
Step 4	**show running-config**	Verifies your entries.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Understanding DNS

The DNS protocol controls the Domain Name System (DNS), a distributed database with which you can map hostnames to IP addresses. When you configure DNS on the wireless device, you can substitute the hostname for the IP address with all IP commands, such as **ping**, **telnet**, **connect**, and related Telnet support operations.

IP defines a hierarchical naming scheme that allows a device to be identified by its location or domain. Domain names are pieced together with periods (.) as the delimiting characters. For example, Cisco Systems, Inc. is a commercial organization that IP identifies by a *com* domain name, so its domain name is *cisco.com* . A specific device in this domain, such as the File Transfer Protocol (FTP) system, is identified as *ftp.cisco.com* .

To keep track of domain names, IP has defined the concept of a domain name server, which holds a cache (or database) of names mapped to IP addresses. To map domain names to IP addresses, you must first identify the hostnames, specify the name server that is present on your network, and enable the DNS.

This section contains the following configuration information:

Default DNS Configuration

Table 12: Default DNS Configuration , on page 117 describes the default DNS configuration.

Table 12: Default DNS Configuration

Feature	Default Setting
DNS enable state	Disabled.
DNS default domain name	None configured.
DNS servers	No name server addresses are configured.

Setting Up DNS

To set up the wireless device to use the DNS, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **ip domain-name** *name*
3. **ip name-server** *server-address1* [*server-address2 ... server-address6*
4. **ip domain-lookup**
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**ip domain-name** *name*	Defines a default domain name that the software uses to complete unqualified hostnames (names without a dotted-decimal domain name). Do not include the initial period that separates an unqualified name from the domain name.

	Command or Action	Purpose
		At boot time, no domain name is configured. However, if the wireless device configuration comes from a BOOTP or DHCP server, then the default domain name might be set by the BOOTP or DHCP server (if the servers were configured with this information).
Step 3	**ip name-server** *server-address1* [*server-address2 ... server-address6*	Specifies the address of one or more name servers to use for name and address resolution. You can specify up to six name servers. Separate server addresses with a space. The first server specified is the primary server. The wireless device sends DNS queries to the primary server first. If that query fails, the backup servers are queried.
Step 4	**ip domain-lookup**	(Optional) Enables DNS-based hostname-to-address translation on the wireless device. This feature is enabled by default. If your network devices require connectivity with devices in networks for which you do not control name assignment, you can dynamically assign device names that uniquely identify your devices by using the global Internet naming scheme (DNS).
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**show running-config**	Verifies your entries.
Step 7	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

If you use the wireless device IP address as its hostname, the IP address is used and no DNS query occurs. If you configure a hostname that contains no periods (.), a period followed by the default domain name is appended to the hostname before the DNS query is made to map the name to an IP address. The default domain name is the value set by the **ip domain-name** command in global configuration mode. If there is a period (.) in the hostname, Cisco IOS software looks up the IP address without appending any default domain name to the hostname.

To remove a domain name, use the **no ip domain-name** *name* command in global configuration mode. To remove a name server address, use the **no ip name-server** *server-address* command in global configuration mode. To disable DNS on the wireless device, use the **no ip domain-lookup** command in global configuration mode.

Displaying the DNS Configuration

To display the DNS configuration information, use the **show running-config** command in privileged EXEC mode.

Note When DNS is configured on the wireless device, the show running-config command sometimes displays a server IP address instead of its name.

Creating a Banner

You can configure a message-of-the-day (MOTD) and a login banner. By default the MOTD and login banners are not configured.The MOTD banner appears on all connected terminals at login and is useful for sending messages that affect all network users (such as impending system shutdowns).

The login banner also appears on all connected terminals. It appears after the MOTD banner and appears before the login prompts appear.

Note For complete syntax and usage information for the commands used in this section, see Cisco IOS Configuration Fundamentals Command Reference .

This section contains the following configuration information:

Configuring a Message-of-the-Day Login Banner

You can create a single-line or multiline message banner that appears on the screen when someone logs into the wireless device.

To configure an MOTD login banner, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **banner motd** *c message c*
3. **end**
4. **show running-config**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**banner motd** *c message c*	Specifies the message of the day. • *c* —Enter the delimiting character of your choice, such as a pound sign (#), and press the **Return** key. The delimiting character signifies the beginning and end of the banner text. Characters after the ending delimiter are discarded. • *message* —Enter a banner message up to 255 characters. You cannot use the delimiting character in the message.
Step 3	**end**	Returns to privileged EXEC mode.
Step 4	**show running-config**	Verifies your entries.

	Command or Action	Purpose
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Example: Configuring a MOTD Banner

The following example shows how to configure a MOTD banner for the wireless device. The pound sign (#) is used as the beginning and ending delimiter:

```
AP(config)# banner motd
#
This is a secure site. Only authorized users are allowed.
For access, contact technical support.
#
AP(config)#
```

This example shows the banner that results from the previous configuration:

```
Unix> telnet 172.2.5.4
Trying 172.2.5.4...
Connected to 172.2.5.4.
Escape character is '^]'.
This is a secure site. Only authorized users are allowed.
For access, contact technical support.
User Access Verification
Password:
```

Configuring a Login Banner

You can configure a login banner to appear on all connected terminals. This banner appears after the MOTD banner and appears before the login prompt appears.

To configure a login banner, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **banner login** *c message c*
3. **end**
4. **show running-config**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**banner login** *c message c*	Specifies the login message. • *c* —Enter the delimiting character of your choice, such as a pound sign (#), and press the **Return** key. The delimiting character signifies the

	Command or Action	Purpose
		beginning and end of the banner text. Characters after the ending delimiter are discarded. • *message* —Enter a login message up to 255 characters. You cannot use the delimiting character in the message.
Step 3	**end**	Returns to privileged EXEC mode.
Step 4	**show running-config**	Verifies your entries.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Example Configuration: Login Banner

The following example shows how to configure a login banner for the wireless device using the dollar sign ($) as the beginning and ending delimiter:

```
AP(config)# banner login
$
Access for authorized users only. Please enter your username and password.
$
AP(config)#
```

Administering Wireless Device Communication

This section provides information about performing the following tasks:

Configuring Ethernet Speed and Duplex Settings

The Ethernet speed and duplex are set to auto by default. To configure Ethernet speed and duplex, follow these steps, beginning in privileged EXEC mode:

Note The speed and duplex settings on the wireless device Ethernet port must match the Ethernet settings on the port to which the wireless device is connected. If you change the settings on the port to which the wireless device is connected, change the settings on the wireless device Ethernet port to match.

SUMMARY STEPS

1. **configure terminal**
2. **interface fastethernet0**
3. **speed {10 | 100 | auto}**
4. **duplex {auto | full | half}**
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**interface fastethernet0**	Enters configuration interface mode.
Step 3	**speed {10 | 100 | auto}**	Configures the Ethernet speed. **Note** We recommend that you use auto, the default setting.
Step 4	**duplex {auto | full | half}**	Configures the duplex setting. **Note** We recommend that you use auto, the default setting.
Step 5	**end**	Returns to privileged EXEC mode.
Step 6	**show running-config**	Verifies your entries.
Step 7	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

Configuring the Access Point for Wireless Network Management

You can enable the wireless device for wireless network management. The wireless network manager (WNM) manages the devices on your wireless LAN.

Enter the following command to configure the wireless device to interact with the WNM:

```
AP(config)# wlccp wnm ip address ip-address
```

Enter the following command to check the authentication status between the WDS access point and the WNM:

```
AP# show wlccp wnm status
```

Possible statuses are not authenticated, authentication in progress, authentication fail, authenticated, and security keys setup.

Configuring the Access Point for Local Authentication and Authorization

You can configure AAA to operate without a server by configuring the wireless device to implement AAA in local mode. The wireless device then handles authentication and authorization. No accounting is available in this configuration.

Note You can configure the wireless device as a local authenticator for 802.1x-enabled client devices to provide a backup for your main server or to provide authentication service on a network without a RADIUS server. See the *Using the Access Point as a Local Authenticator* document on Cisco.com for detailed instructions on configuring the wireless device as a local authenticator. http://www.cisco.com/en/US/docs/routers/access/wireless/software/guide/SecurityLocalAuthent.html

To configure the wireless device for local AAA, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **aaa new-model**
3. **aaa authentication login default local**
4. **aaa authorization exec local**
5. **aaa authorization network local**
6. **username** *name* [**privilege** *level*] {**password** *encryption-type password*
7. **end**
8. **show running-config**
9. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**aaa new-model**	Enables AAA.
Step 3	**aaa authentication login default local**	Sets the login authentication to use the local username database. The **default** keyword applies the local user database authentication to all interfaces.
Step 4	**aaa authorization exec local**	Configures user AAA authorization to determine whether the user is allowed to run an EXEC shell by checking the local database.
Step 5	**aaa authorization network local**	Configures user AAA authorization for all network-related service requests.
Step 6	**username** *name* [**privilege** *level*] {**password** *encryption-type password*	Enters the local database, and establishes a username-based authentication system. Repeat this command for each user. • *name*—Specifies the user ID as one word. Spaces and quotation marks are not allowed.

	Command or Action	Purpose
		• *level*—(Optional) Specifies the privilege level that the user has after gaining access. The range is 0 to 15. Level 15 gives privileged EXEC mode access. Level 0 gives user EXEC mode access. • *encryption-type*—Enter 0 to specify that an unencrypted password follows. Enter 7 to specify that a hidden password follows. • *password*—Specifies the password that the user must enter to gain access to the wireless device. The password must be from 1 to 25 characters long, can contain embedded spaces, and must be the last option specified in the **username** command. **Note** The characters TAB, ?, $, +, and [are invalid characters for passwords.
Step 7	**end**	Returns to privileged EXEC mode.
Step 8	**show running-config**	Verifies your entries.
Step 9	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Note To disable AAA, use the **no aaa new-model** command in global configuration mode. To disable authorization, use the **no aaa authorization** {**network** | **exec**} *method1* command in global configuration mode.

Configuring the Authentication Cache and Profile

The authentication cache and profile feature allows the access point to cache the authentication and authorization responses for a user so that subsequent authentication and authorization requests do not need to be sent to the AAA server.

Note On the access point, this feature is supported only for Admin authentication.

The following commands that support this feature are included in Cisco IOS Release 12.3(7):

- **cache expiry**
- **cache authorization profile**
- **cache authentication profile**
- **aaa cache profile**

Note See Cisco IOS Command Reference for Cisco Aironet Access Points and Bridges, Versions 12.4(10b)JA and 12.3(8)JEC for information about these commands.

Example Configuration: Authentication Cache and Profile

The following is a configuration example for an access point configured for Admin authentication using TACACS+ with the authorization cache enabled. Although this example is based on a TACACS server, the access point could be configured for Admin authentication using RADIUS:

```
version 12.3
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
!
hostname ap
!
!
username Cisco password 7 123A0C041104
username admin privilege 15 password 7 01030717481C091D25
ip subnet-zero
!
!
aaa new-model
!
!
aaa group server radius rad_eap
server 192.168.134.229 auth-port 1645 acct-port 1646
!
aaa group server radius rad_mac
server 192.168.134.229 auth-port 1645 acct-port 1646
!
aaa group server radius rad_acct
server 192.168.134.229 auth-port 1645 acct-port 1646
!
aaa group server radius rad_admin
server 192.168.134.229 auth-port 1645 acct-port 1646
cache expiry 1
cache authorization profile admin_cache
cache authentication profile admin_cache
!
aaa group server tacacs+ tac_admin
server 192.168.133.231
cache expiry 1
cache authorization profile admin_cache
cache authentication profile admin_cache
!
aaa group server radius rad_pmip
!
aaa group server radius dummy
!
aaa authentication login default local cache tac_admin group tac_admin
aaa authentication login eap_methods group rad_eap
aaa authentication login mac_methods local
aaa authorization exec default local cache tac_admin group tac_admin
aaa accounting network acct_methods start-stop group rad_acct
aaa cache profile admin_cache
all
!
aaa session-id common
!
!
!
bridge irb
!
```

```
!
interface Dot11Radio0
no ip address
no ip route-cache
shutdown
speed basic-1.0 basic-2.0 basic-5.5 6.0 9.0 basic-11.0 12.0 18.0 24.0 36.0 48.0 54.0
station-role root
bridge-group 1
bridge-group 1 subscriber-loop-control
bridge-group 1 block-unknown-source
no bridge-group 1 source-learning
no bridge-group 1 unicast-flooding
bridge-group 1 spanning-disabled
!
interface Dot11Radio1
no ip address
no ip route-cache
shutdown
speed basic-6.0 9.0 basic-12.0 18.0 basic-24.0 36.0 48.0 54.0
station-role root
bridge-group 1
bridge-group 1 subscriber-loop-control
bridge-group 1 block-unknown-source
no bridge-group 1 source-learning
no bridge-group 1 unicast-flooding
bridge-group 1 spanning-disabled
!
interface FastEthernet0
no ip address
no ip route-cache
duplex auto
speed auto
bridge-group 1
no bridge-group 1 source-learning
bridge-group 1 spanning-disabled
!
interface BVI1
ip address 192.168.133.207 255.255.255.0
no ip route-cache
!
ip http server
ip http authentication aaa
no ip http secure-server
ip http help-path http://www.cisco.com/warp/public/779/smbiz/prodconfig/help/eag
ip radius source-interface BVI1
!
tacacs-server host 192.168.133.231 key 7 105E080A16001D1908
tacacs-server directed-request
radius-server attribute 32 include-in-access-req format %h
radius-server host 192.168.134.229 auth-port 1645 acct-port 1646 key 7 111918160405041E00
radius-server vsa send accounting
!
control-plane
!
bridge 1 route ip
!
!
!
line con 0
transport preferred all
transport output all
line vty 0 4
transport preferred all
transport input all
transport output all
line vty 5 15
transport preferred all
transport input all
transport output all
!
end
```

Configuring the Access Point to Provide DHCP Service

By default, access points are configured to receive IP settings from a DHCP server on your network. You can also configure an access point to act as a DHCP server to assign IP settings to devices on both wired and wireless LANs.

Note When you configure the access point as a DHCP server, it assigns IP addresses to devices on its subnet. The devices communicate with other devices on the subnet but not beyond it. If data needs to be passed beyond the subnet, you must assign a default router. The IP address of the default router should be on the same subnet as the access point configured as the DHCP server.

For detailed information on DHCP-related commands and options, see the DHCP part in Cisco IOS IP Addressing Services Configuration Guide, Release 12.4 at:

http://www.cisco.com/en/US/docs/ios/ipaddr/configuration/guide/iad_dhcp_rdmp_ps6350_TSD_Products_Configuration_Guide_Chapter.html
http://www.cisco.com/en/US/docs/ios/ipaddr/configuration/guide/iad_dhcp_rdmp_ps6350_TSD_Products_Configuration_Guide_Chapter.html

The following sections describe how to configure the wireless device to act as a DHCP server:

Setting up the DHCP Server

To configure an access point to provide DHCP service and to specify a default router, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **ip dhcp excluded-address** *low_address* [*high_address*]
3. **ip dhcp pool** *pool_name*
4. **network** *subnet_number* **[mask |** *prefix-length***]**
5. **lease** {days [hours] [minutes] | **infinite**}
6. **default-router** address [address2 ... address 8]
7. **end**
8. **show running-config**
9. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `AP# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**ip dhcp excluded-address** *low_address* [*high_address*]	Excludes the wireless device IP address from the range of addresses that the wireless device assigns. • Enter the IP address in four groups of characters, such as 10.91.6.158. • The wireless device assumes that all IP addresses in a DHCP address pool subnet are available for assigning to DHCP clients. You must specify the IP addresses that the DHCP server should not assign to clients. • (Optional) To enter a range of excluded addresses, enter the address at the low end of the range, followed by the address at the high end of the range.
Step 3	**ip dhcp pool** *pool_name*	Creates a name for the pool of IP addresses that the wireless device assigns in response to DHCP requests, and enters DHCP configuration mode.
Step 4	**network** *subnet_number* **[mask |** *prefix-length***]**	Assigns the subnet number for the address pool. The wireless device assigns IP addresses within this subnet. (Optional) Assigns a subnet mask for the address pool, or specifies the number of bits that compose the address prefix. The prefix is an alternative way of assigning the network mask. The prefix length must be preceded by a forward slash (/).
Step 5	**lease** {days [hours] [minutes] | **infinite**}	Configures the duration of the lease for IP addresses assigned by the wireless device. • *days* —Lease duration in number of days. • *hours* —(Optional) Lease duration in number of hours. • *minutes* —(Optional) Lease duration in number of minutes. • **infinite**—Sets the lease duration to infinite.
Step 6	**default-router** address [address2 ... address 8]	Specifies the IP address of the default router for DHCP clients on the subnet. **Note** One IP address is required; however, you can specify up to eight addresses in one command line.
Step 7	**end**	Returns to privileged EXEC mode.
Step 8	**show running-config**	Verifies your entries.
Step 9	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Example Configuration: Setting up the DHCP Sever

The following example shows how to configure the wireless device as a DHCP server, how to exclude a range of IP address, and how to assign a default router:

```
AP# configure terminal
AP(config)# ip dhcp excluded-address 172.16.1.1 172.16.1.20
AP(config)# ip dhcp pool wishbone
AP(dhcp-config)# network 172.16.1.0 255.255.255.0
AP(dhcp-config)# lease 10
AP(dhcp-config)# default-router 172.16.1.1
AP(dhcp-config)# end
```

Monitoring and Maintaining the DHCP Server Access Point

The following sections describe commands you can use to monitor and maintain the DHCP server access point:

show Commands

To display information about the wireless device as DHCP server, enter the commands in Table 13: Show Commands for DHCP Server , on page 129, in privileged EXEC mode.

Table 13: Show Commands for DHCP Server

Command	Purpose
show ip dhcp conflict [address]	Displays a list of all address conflicts recorded by a specific DHCP Server. Enter the wireless device IP address to show conflicts recorded by the wireless device.
show ip dhcp database [url]	Displays recent activity on the DHCP database. **Note** Use this command in privileged EXEC mode.
show ip dhcp server statistics	Displays count information about server statistics and messages sent and received.

clear Commands

To clear DHCP server variables, use the commands in Table 14: Clear Commands for DHCP Server, on page 129, in privileged EXEC mode.

Table 14: Clear Commands for DHCP Server

Command	Purpose
clear ip dhcp binding {address | *}	Deletes an automatic address binding from the DHCP database. Specifying the address argument clears the automatic binding for a specific (client) IP address. Specifying an asterisk (*) clears all automatic bindings.

Command	Purpose
clear ip dhcp conflict {address | *}	Clears an address conflict from the DHCP database. Specifying the address argument clears the conflict for a specific IP address. Specifying an asterisk (*) clears conflicts for all addresses.
clear ip dhcp server statistics	Resets all DHCP server counters to 0.

debug Command

To enable DHCP server debugging, use the following command in privileged EXEC mode:

debug ip dhcp server {events | packets | linkage}

Use the no form of the command to disable debugging for the wireless device DHCP server.

Configuring the Access Point for Secure Shell

This section describes how to configure the Secure Shell (SSH) feature.

Note For complete syntax and usage information for the commands used in this section, see the "*Secure Shell Commands*" section in the *Cisco IOS Security Command Reference for Release 12.4.*

Understanding SSH

SSH is a protocol that provides a secure, remote connection to a Layer 2 or Layer 3 device. There are two versions of SSH: SSH version 1 and SSH version 2. This software release supports both SSH versions. If you do not specify the version number, the access point defaults to version 2.

SSH provides more security for remote connections than Telnet by providing strong encryption when a device is authenticated. The SSH feature has an SSH server and an SSH integrated client. The client supports the following user authentication methods:

For more information about SSH, see Part 5, "*Other Security Features*" in the *Cisco IOS Security Configuration Guide for Release 12.4* .

Note The SSH feature in this software release does not support IP Security (IPsec).

Configuring SSH

Before configuring SSH, download the cryptographic software image from Cisco.com. For more information, see release notes for this release.

For information about configuring SSH and displaying SSH settings, see Part 6, "*Other Security Features* " in *Cisco IOS Security Configuration Guide for Release 12.4* , which is available at:

http://www.cisco.com/en/US/docs/ios/security/configuration/guide/12_4/sec_12_4_book.html

Client ARP Caching

You can configure the wireless device to maintain an address resolution protocol (ARP) cache for associated client devices. Maintaining an ARP cache on the wireless device reduces the traffic load on your wireless LAN. ARP caching is disabled by default.

This section contains this information:

Understanding Client ARP Caching

ARP caching on the wireless device reduces the traffic on your wireless LAN by stopping ARP requests for client devices at the wireless device. Instead of forwarding ARP requests to client devices, the wireless device responds to requests on behalf of associated client devices.

When ARP caching is disabled, the wireless device forwards all ARP requests through the radio port to associated clients. The client that receives the ARP request responds. When ARP caching is enabled, the wireless device responds to ARP requests for associated clients and does not forward requests to clients. When the wireless device receives an ARP request for an IP address not in the cache, the wireless device drops the request and does not forward it. In its beacon, the wireless device includes an information element to alert client devices that they can safely ignore broadcast messages to increase battery life.

When a non-Cisco client device is associated to an access point and is not passing data, the wireless device might not know the client IP address. If this situation occurs frequently on your wireless LAN, you can enable optional ARP caching. When ARP caching is optional, the wireless device responds on behalf of clients with IP addresses known to the wireless device but forwards out of its radio port any ARP requests addressed to unknown clients. When the wireless device learns the IP addresses for all associated clients, it drops ARP requests not directed to its associated clients.

Configuring Client ARP Caching

To configure the wireless device to maintain an ARP cache for associated clients, follow these steps, beginning in privileged EXEC mode:

SUMMARY STEPS

1. **configure terminal**
2. **dot11 arp-cache [optional]**
3. **end**
4. **show running-config**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal**	Enters global configuration mode.
Step 2	**dot11 arp-cache [optional]**	Enables ARP caching on the wireless device.

	Command or Action	Purpose
		(Optional) Use the optional keyword to enable ARP caching only for the client devices whose IP addresses are known to the wireless device.
Step 3	**end**	Returns to privileged EXEC mode.
Step 4	**show running-config**	Verifies your entries.
Step 5	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

What to Do Next

Example: Configure ARP Caching

The following example shows how to configure ARP caching on an access point:

```
AP# configure terminal
AP(config)# dot11 arp-cache
AP(config)# end
```

Configuring Multiple VLAN and Rate Limiting for Point-to-Multipoint Bridging

This feature modifies the way that point-to-multipoint bridging can be configured to operate on multiple VLANs with the ability to control traffic rates on each VLAN.

Note A rate-limiting policy can be applied only to Fast Ethernet ingress ports on non-root bridges.

In a typical scenario, multiple-VLAN support permits users to set up point-to-multipoint bridge links with remote sites, with each remote site on a separate VLAN. This configuration provides the capability for separating and controlling traffic to each site. Rate limiting ensures that no remote site consumes more than a specified amount of the entire link bandwidth. Only uplink traffic can be controlled by using the Fast Ethernet ingress ports of non-root bridges.

Using the class-based policing feature, you can specify the rate limit and apply it to the ingress of the Ethernet interface of a non-root bridge. Applying the rate at the ingress of the Ethernet interface ensures that all incoming Ethernet packets conform to the configured rate.