Configuring Radio Settings

This chapter describes how to configure radio settings for your access point/bridge. This chapter includes these sections:

- Enabling the Radio Interface, page 6-2
- Configuring the Role in Radio Network, page 6-2
- Configuring Radio Data Rates, page 6-5
- Configuring Radio Transmit Power, page 6-7
- Configuring Radio Channel Settings, page 6-9
- Enabling and Disabling World Mode, page 6-11
- Disabling and Enabling Short Radio Preambles, page 6-12
- Configuring Transmit and Receive Antennas, page 6-13
- Aironet Extensions, page 6-14
- Configuring the Ethernet Encapsulation Transformation Method, page 6-15
- Enabling and Disabling Concatenation, page 6-15
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- Enabling and Disabling Reliable Multicast to Workgroup Bridges, page 6-16
- Enabling and Disabling Public Secure Packet Forwarding, page 6-17
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- Performing a Carrier Busy Test, page 6-22

Enabling the Radio Interface

The radio interface is disabled by default.

Note In Cisco IOS Release 12.3(7)JA there is no default SSID. You must create an SSID before you can enable the radio interface.

Beginning in privileged EXEC mode, follow these steps to enable the access point/bridge radio:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**ssid** *string*	Enter the Radio Service Set Identifier. The SSID can consist of up to 32 alphanumeric characters. SSIDs are case sensitive.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

The radio is enabled when you set the SSID.

Configuring the Role in Radio Network

You can configure your access point/bridge as a root bridge, non-root bridge, access point, or workgroup bridge. Figure 6-1 shows a root bridge communicating with a non-root bridge in a point-to-point configuration.

Figure 6-1 Point-to-Point Bridge Configuration

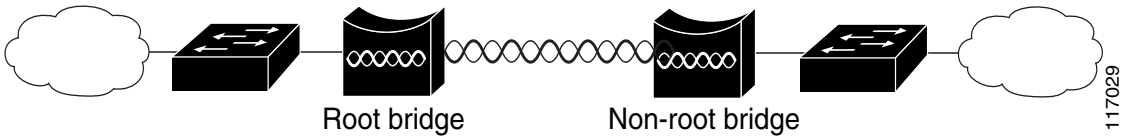


Figure 6-2 shows a typical configuration where the bridge functions as an access point.

Figure 6-2 Access Point Configuration

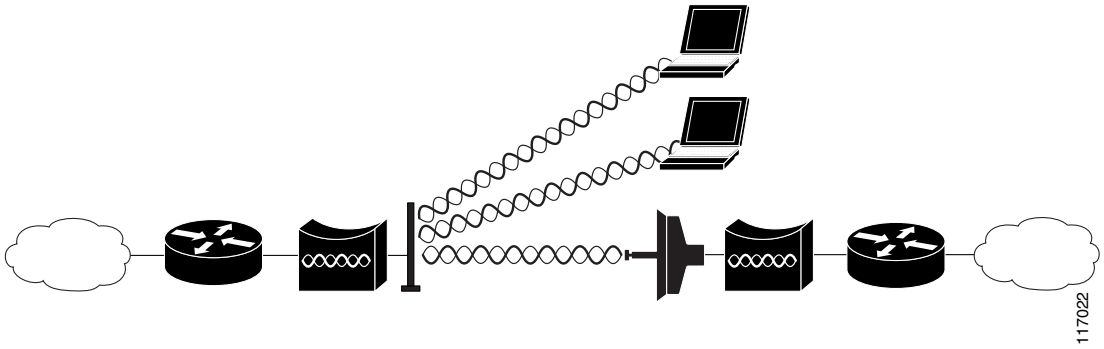
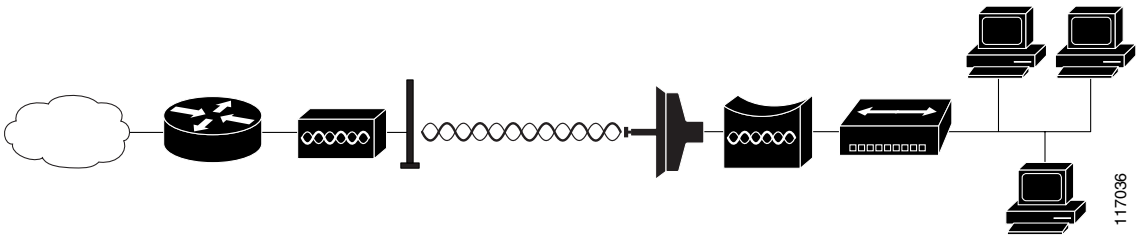


Figure 6-3 shows how the bridge performs when configured as a workgroup bridge.

Figure 6-3 Workgroup Bridge Configuration



Beginning in privileged EXEC mode, follow these steps to set the access point/bridge's radio network role:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**station role** **install {automatic | non-root | root}** **non-root {bridge | wireless clients}** **repeater** **root {access-point | ap-only | [bridge | wireless-clients] | [fallback | repeater | shutdown]}** **scanner** **workgroup-bridge**	Set the access point/bridge role. • **install**—Places the access point/bridge in a bridge link setup mode for antenna alignment purposes. The automatic option configures teh access point/bridge to automatically search for a link to another access point/bridge or an access point in bridge mode. The root and non-root options allow you to manually configure the access point/bridge. • **non-root**—Places the access point/bridge in non-root bridge mode. The wireless clients option allows clients to associate to the non-root access point/bridge while it is in the non-root bridge mode. • **root**—Places the access point/bridge in root bridge mode. The **ap-only** option makes the access point act as a root access point (the default station role). • **scanner**—Causes the access point/bridge to operate as as scanner only and does not accept associations from client devices. As a scanner, the access point/bridge collects radio data and sends it to the WDS server on your network. **Note** The scanner mode is supported only when used with a WLSE device on your network. • **workgroup-bridge**—Places the access point/bridge in the workgroup bridge mode. As a workgroup bridge, the access point/bridge associates to an access point or bridge as a client and provides a wireless LAN connection for devices connected to its Ethernet port.
Step 4	**mobile station**	(Optional) Use this command to configure a non-root bridge as a mobile station. When this feature is enabled the non-root bridge scans for a new parent association when it encounters a poor Received Signal Strength Indicator (RSSI), excessive radio interference, or a high frame-loss percentage. Using these criteria, the access point/bridge searches for a new root association and roams to a new root bridge before it loses its current association. When the mobile station setting is disabled (the default setting) the bridge does not search for a new association until it loses its current association.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Note See Chapter 20, "Configuring Repeater and Standby Access Points and Workgroup Bridge Mode," for more information about configuring the access point/bridge as an access point or workgroup bridge.

Configuring Radio Data Rates

You use the data rate settings to choose the data rates the access point/bridge uses for data transmission. The rates are expressed in megabits per second. The access point/bridge always attempts to transmit at the highest data rate set to **Basic**, also called **Require** on the browser-based interface. If there are obstacles or interference, the access point/bridge steps down to the highest rate that allows data transmission. You can set each data rate to one of three states:

- Basic (this is the default state for all data rates)—Allows transmission at this rate for all packets, both unicast and multicast. At least one of the access point/bridge's data rates must be set to Basic.
- Enabled—The access point/bridge transmits only unicast packets at this rate; multicast packets are sent at one of the data rates set to Basic.
- Disabled—The access point/bridge 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 the access point/bridge to serve client devices operating at specific data rates. For example, to set the 2.4-GHz radio for 11 megabits per second (Mbps) service only, set the 11-Mbps 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 Mbps, 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**.

You can also configure the access point/bridge to set the data rates automatically to optimize either range or throughput. When you enter **range** for the data rate setting, the access point/bridge sets the 6-Mbps rate to **basic** and the other rates to **enabled**. When you enter **throughput** for the data rate setting, the access point/bridge sets all data rates to **basic**. Enter **default** to set the data rates to factory defaults

Beginning in privileged EXEC mode, follow these steps to configure the radio data rates:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**speed** {[**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** }	Set each data rate to **basic** or **enabled**, or enter **range** to optimize range or **throughput** to optimize throughput. • 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 **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** The client must support the basic rate that you select or it cannot associate to the wireless device. If you select 12 Mbps 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. • (Optional) Enter **range** or **throughput** or **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 the other rates to **enabled**. When you enter **throughput**, the wireless device sets all data rates to **basic**. (Optional) Enter **speed throughput ofdm** to set all OFDM rates (6, 9, 12, 18, 24, 36, and 48) to basic (required) and 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 rates 6, 9, 12, 18, 24, 36, 48, and 54 to enabled. These rate settings allow both 802.11b and 802.11g client devices to associate to the wireless device 802.11g radio.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the **speed** command to disable data rates. When you use the **no** form of the command, all data rates are disabled except the rates you name in the command. This example shows how to disable data rate 6.0:

```
ap# configure terminal
ap(config)# interface dot11radio 0
ap(config-if)# no speed basic-9.0 basic-12.0 basic-18.0 basic-24.0 basic-36.0 basic-48.0
basic-54.0
ap(config-if)# end
```

Data rate 6 is disabled, and the rest of the rates are set to basic.

This example shows how to set up the access point/bridge for 54-Mbps service only:

```
ap# configure terminal
ap(config)# interface dot11radio 0
ap(config-if)# speed basic-54.0
ap(config-if)# end
```

Data rate 54 is set to basic, and the rest of the data rates are set to enabled.

Configuring Radio Transmit Power

Radio transmit power is based on the radio installed in your access point/ and the regulatory domain in which it operates. Rather than listing all transmit power variations for every regulatory domain, an example that shows how to configure radio transmit power is provided.

To determine what transmit power is available for a your access point and regulatory domain operate it in, refer to the hardware installation guide for that device. Hardware installation guides are available at cisco.com. Follow these steps to view and download them:

Step 1 Browse to http://www.cisco.com.

Step 2 Click **Technical Support & Documentation**. A small window appears containing a list of technical support links.

Step 3 Click **Technical Support & Documentation**. The Technical Support and Documentation page appears.

Step 4 In the Documentation & Tools section, choose **Wireless**. The Wireless Support Resources page appears.

Step 5 In the Wireless LAN Access section, choose the device you are working with. An introduction page for the device appears.

Step 6 In the Install and Upgrade section, choose **Install and Upgrade Guides**. The Install and Upgrade Guides page for the device appears.

Step 7 Choose the Hardware Installation Guide for the device. The home page for the guide appears.

Step 8 In the left frame, click **Channels and Antenna Settings**.

Table 6-1 shows the relationship between mW and dBm.

Table 6-1 Translation between mW and dBm

dBm	-1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
mW	1	2	3	4	5	6	8	10	12	15	20	25	30	40	50	60	80	100	125	150	200	250

Beginning in privileged EXEC mode, follow these steps to set the transmit power on your access point/bridge radio:

	Command	**Purpose**
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**power local cck** {**1** | **5** | **10** | **20** | **30** | **50** | **100** | **maximum** }	Set the transmit power for the 802.11g radio to one of the power levels allowed in your regulatory domain. All settings are in mW.
Step 4	**power local ofdm** {**1** | **5** | **10** | **20** | **30** | **maximum**}	You can set Orthogonal Frequency Division Multiplexing (OFDM) power levels and Complementary Code Keying (CCK) power levels. CCK modulation is supported by 802.11b and 802.11g devices. OFDM modulation is supported by 802.11g devices. **Note** The settings allowed in your regulatory domain might differ from the settings listed here. **Note** The 802.11g radio transmits at up to 100 mW for the 1, 2, 5.5, and 11Mbps data rates. However, for the 6, 9, 12, 18, 24, 36, 48, and 54Mbps data rates, the maximum transmit power for the 802.11g radio is 30 mW.
Step 5	**power client** {**1** | **5** | **10** | **20** | **30** | **50** | **100** | **maximum** }	Set the maximum power level allowed on client devices that associate to the access point/bridge in access point mode. All settings are in mW. **Note** The settings allowed in your regulatory domain might differ from the settings listed here.
Step 6	**end**	Return to privileged EXEC mode.
Step 7	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the power command to return the power setting to **maximum**, the default setting.

Limiting the Power Level for Associated Client Devices

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

Beginning in privileged EXEC mode, follow these steps to specify a maximum allowed power setting on all client devices that associate to the access point/bridge:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio** { *slot*/*port* }	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**power client** These options are available for 802.11g, 2.4-GHz clients (in mW): **[1 | 5 | 10 | 20 | 30 | 50 | 100 | maximum] |** **local [cck | ofdm** These cck power level options are available (in mW): **[1 | 5 | 10 | 20 | 30 | 50 | 100 | maximum] |** These ofdm power level options are available (in mW): **[1 | 5 | 10 | 20 | 30 | maximum]**	Set the maximum power level allowed on client devices that associate to the wireless device. **Note** The settings allowed in your regulatory domain might differ from the settings listed here. Use the **power local** command to configure the access point/bridge radio power level You can set Complementary Code Keying (CCK) or Orthogonal Frequency Division Multiplexing power levels.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

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 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 *Cisco Aironet 1300 Series Outdoor Access Point/Bridge Hardware Installation Guide* for the frequencies allowed in your domain.

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

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

Beginning in privileged EXEC mode, follow these steps to set the wireless device radio channel:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio** { *slot/port* }	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**channel** *frequency* | **least-congested**	Set the default channel for the wireless device radio. Table 6-2 show the channels and frequencies. To search for the least-congested channel on startup, enter **least-congested**.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Table 6-2 shows the available frequencies for the IEEE 802.11g 2.4-GHz radio.

Table 6-2 Channels and Available Frequencies for IEEE 802.11g 2.4 GHz Radio

Channel Identifier	Center Frequency (MHz)	Regulatory Domains							
		Americas (–A)		EMEA (–E)		Israel (–I)		Japan (–J)	
		CCK	OFDM	CCK	OFDM	CCK	OFDM	CCK	OFDM
1	2412	X	X	X	X	–	–	X	X
2	2417	X	X	X	X	–	–	X	X
3	2422	X	X	X	X	–	–	X	X
4	2427	X	X	X	X	–	–	X	X
5	2432	X	X	X	X	X	X	X	X
6	2437	X	X	X	X	X	X	X	X
7	2442	X	X	X	X	X	X	X	X
8	2447	X	X	X	X	X	X	X	X
9	2452	X	X	X	X	X	–	X	X
10	2457	X	X	X	X	X	–	X	X
11	2462	X	X	X	X	X	–	X	X
12	2467	–	–	X	X	X	–	X	X
13	2472	–	–	X	X	X	–	X	X
14	2484	–	–	–	–	–	–	–	–

Configuring LBS on Access Points

Use the CLI to configure LBS on your access point/bridge. Beginning in privileged EXEC mode, follow these steps to configure LBS:

Command	Purpose
configure terminal	**Enter global configuration mode.**
dot11 lbs *profile-name*	**Create an LBS profile for the access point and enter LBS configuration mode.**
server-address *ip-address* **port** *port*	**Enter the IP address of the location server and the port on the server to which the access point sends UDP packets that contain location information.**

Command	Purpose
method {**rssi**}	**(Optional) Select the location method that the access point uses when reporting location information to the location server. In this release, rssi (in which the access point measures the location packet's RSSI) is the only option and is also the default.**
packet-type {**short** | **extended**}	**(Optional) Select the packet type that the access point accepts from the LBS tag.** **short—The access point accepts short location packets from the tag. In short packets, the LBS information is missing from the tag packet's frame body and the packet indicates the tag's transmit channel.** **extended—This is the default setting. The access point accepts extended packets from the tag. An extended packet contains two bytes of LBS information in the frame body. If the packet does not contain those two bytes in the frame body, the access point drops the packet.**
channel-match	**(Optional) Specifies that the LBS packet sent by the tag must match the radio channel on which the access point receives the packet. If the channel used by the tag and the channel used by the access point do not match, the access point drops the packet. Channel match is enabled by default.**
multicast-address *mac-address*	**(Optional) Specifies the multicast address that the tag uses when it sends LBS packets. The default multicast address is 01:40:96:00:00:10.**
interface dot11 { **0** | **1** }	**Specify the radio interface on which this LBS profile is enabled. The 2.4-GHz radio is radio 0, and the 5-GHz radio is radio 1. The profile remains inactive until you enter this command.**
exit	**Return to global configuration mode.**

In this example, the profile *southside* is enabled on the access point's 802.11g radio:

```
ap# configure terminal
ap(config)# dot11 lbs southside
ap(dot11-lbs)# server-address 10.91.105.90 port 1066
ap(dot11-lbs)# interface dot11 0
ap(dot11-lbs)# exit
```

Enabling and Disabling World Mode

You can configure the access point/bridge to support 802.11d world mode or Cisco legacy world mode. When you enable world mode, the access point/bridge 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 running firmware version 5.30.17 or later detect whether the access point/bridge is using 802.11d or Cisco legacy world mode and automatically use world mode that matches the mode used by the access point/bridge. World mode is disabled by default.

Beginning in privileged EXEC mode, follow these steps to specify a maximum allowed power setting on all client devices that associate to the access point/bridge:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**power client** These options are available for 802.11b, 2.4-GHz clients (in mW): { **1** | **5** | **20** | **30** | **50** | **100** | **maximum**} These options are available for 802.11g, 2.4-GHz clients (in mW): { **1** | **5** | **10** | **20** | **30** | **50** | **100** | **maximum**} **world-mode dot11d country_code** *code* { **both** | **indoor** | **outdoor** } | **legacy**	Set the maximum power level allowed on client devices that associate to the access point/bridge. **Note** The settings allowed in your regulatory domain might differ from the settings listed here. Enable 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 access point/bridge. • Enter the **legacy** option to enable Cisco legacy world mode.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

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

Aironet extensions must be enabled for world mode operation. Aironet extensions are enabled by default.

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 access point 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. Cisco Aironet Wireless LAN Client Adapters support short preambles. Early models of Cisco Aironet's Wireless LAN Adapter (PC4800 and PC4800A) require long preambles.
- Long—A long preamble ensures compatibility between the access point/bridge and all early models of Cisco Aironet Wireless LAN Adapters (PC4800 and PC4800A). If these client devices do not associate to your access point/bridge, you should use short preambles.

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

Beginning in privileged EXEC mode, follow these steps to disable short radio preambles:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**no preamble-short**	Disable short preambles and enable long preambles.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Short preambles are enabled by default. Use the **preamble-short** command to enable short preambles if they are disabled.

Configuring Transmit and Receive Antennas

You can select the antenna the access point/bridge uses to receive and transmit data. There are three options for both the receive and the transmit antenna:

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

Note The **antenna** commands are not available for access point/bridges equipped with a captive (internal) antenna.

Beginning in privileged EXEC mode, follow these steps to select the antennas the access point uses to receive and transmit data:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**antenna gain** {<–128 - 128>	Specifies the antenna gain in dB of the connected antennas. Enter the gain in whole numbers (-128 –128 dBi) of the antenna(s) connected to your access point/bridge. **Note** This setting does not change the antenna gain, it is used to identify the gain of the installed antenna(s). **Note** The antenna gain value is listed on the user document that shipped with your antenna.
Step 4	**antenna receive** {**diversity** | **left** | **right**}	Set 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**. With one antenna, connect the antenna to the right connector and set the diversity to **right**.
Step 5	**antenna transmit** {**diversity** | **left** | **right**}	Set the transmit antenna to diversity, left, or right. **Note** For best performance with two antennas, leave the transmit antenna setting at the default setting, **diversity**. With one antenna, connect the antenna to the right connector and set the diversity to **right**.
Step 6	**end**	Return to privileged EXEC mode.
Step 7	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Aironet Extensions

Note Aironet extensions are required by the access point/bridge. They cannot be disabled.

By default, the access point/bridge 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 access point/bridge and associated client devices. Aironet extensions must be enabled to support these features:

- Load balancing—The access point/bridge uses Aironet extensions to direct client devices to an access point that provides the best connection to the network based on factors such 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 both the access point/bridge and all associated client devices, adds a few bytes to each packet to make the packets tamper-proof.
- Temporal Key Integrity Protocol (TKIP)—TKIP, also known as WEP key hashing, is an additional WEP security feature that defends against an attack on WEP in which the intruder uses an unencrypted segment called the initialization vector (IV) in encrypted packets to calculate the WEP key.
- Repeater mode—Aironet extensions must be enabled on repeater access points and on the root access points to which they associate.
- World mode—Client devices with world mode enabled receive carrier set information from the access point and adjust their settings automatically.

- Limiting the power level on associated client devices—When a client device associates to the access point/bridge, the access point/bridge sends the maximum allowed power level setting to the client.

Configuring the Ethernet Encapsulation Transformation Method

When the access point/bridge receives data packets that are not 802.3 packets, the access point/bridge must format the packets to 802.3 using an encapsulation transformation method. These are the two transformation methods:

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

Beginning in privileged EXEC mode, follow these steps to configure the encapsulation transformation method:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**payload-encapsulation dot1h | rfc1042**	Set the encapsulation transformation method to RFC1042 (**rfc1042**) or 802.1h (**dot1h**, the default setting).
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Note For best performance over your access point/bridge links, adjust the CW-min and CW-max contention window settings to depending on the number of non-root access point/bridges associated to each root access point/bridge. Refer to the "CW-min and CW-max Settings for Point-to-Point and Point-to-Multipoint Bridge Links" section on page 14-11 for instructions on adjusting these settings.

Enabling and Disabling Concatenation

Use the **concatenation** command to enable packet concatenation on the access point/bridge radio. Using concatenation, the access point/bridge combines multiple packets into one packet to reduce packet overhead and overall latency, which increases transmission efficiency.

Beginning in privileged EXEC mode, follow these steps to enable concatenation and set the maximum length of concatenation.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.

	Command	Purpose
Step 3	**concatenation** *bytes*	(Optional) *Bytes* specifies a maximum size for concatenation packets in bytes. Enter a value from 1600 to 4000.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Configuring the Radio Distance Setting

The **distance** command is active only when the access point/bridge is configured as a root bridge. Use the command to specify the distance from a root access point/bridge to the non-root access point/bridges with which it communicates. The distance setting adjusts the access point/bridge's time out values to account for the time required for radio signals to travel from access point/bridge to access point/bridge. If more than one non-root access point/bridge communicates with the root access point/bridge, enter the distance from the root access point/bridge to the non-root access point/bridge that is farthest away. Enter a value from 0 to 99 km. You do not need to adjust this setting on non-root access point/bridges.

In installation mode, the default distance setting is 99 km. In other modes, the default distance setting is 0 km.

Beginning in privileged EXEC mode, follow these steps to configure the access point/bridge distance setting:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**distance** *kilometers*	Enter a distance setting from 0 to 99 km.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the **distance** command to set the default distance.

Enabling and Disabling Reliable Multicast to Workgroup Bridges

The *Reliable multicast messages from the access point to workgroup bridges* setting limits reliable delivery of multicast messages to approximately 20 Cisco Aironet Workgroup Bridges that are associated to the access point. The default setting, **disabled**, reduces the reliability of multicast delivery to allow more workgroup bridges to associate to the access point.

Access points and bridges normally treat workgroup bridges not as client devices but as infrastructure devices, like access points or bridges. Treating a workgroup bridge as an infrastructure device means that the access point reliably delivers multicast packets, including Address Resolution Protocol (ARP) packets, to the workgroup bridge.

The performance cost of reliable multicast delivery—duplication of each multicast packet sent to each workgroup bridge—limits the number of infrastructure devices, including workgroup bridges, that can associate to the access point. To increase beyond 20 the number of workgroup bridges that can maintain

a radio link to the access point, the access point must reduce the delivery reliability of multicast packets to workgroup bridges. With reduced reliability, the access point cannot confirm whether multicast packets reach the intended workgroup bridge, so workgroup bridges at the edge of the access point's coverage area might lose IP connectivity. When you treat workgroup bridges as client devices, you increase performance but reduce reliability.

Note This feature is best suited for use with stationary workgroup bridges. Mobile workgroup bridges might encounter spots in the access point's coverage area where they do not receive multicast packets and lose communication with the access point even though they are still associated to it.

A Cisco Aironet Workgroup Bridge provides a wireless LAN connection for up to eight Ethernet-enabled devices.

Beginning in privileged EXEC mode, follow these steps to configure the encapsulation transformation method:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**infrastructure-client**	Enable reliable multicast messages to workgroup bridges.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the command to disable reliable multicast messages to workgroup bridges.

Enabling and Disabling Public Secure Packet Forwarding

Public Secure Packet Forwarding (PSPF) prevents client devices associated to an access point from inadvertently sharing files or communicating with other client devices associated to the access point. It 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 your access points are connected. See the Configuring Protected Ports, page 6-18 for instructions on setting up protected ports.

To enable and disable PSPF using CLI commands on your access point, you use bridge groups. You can find a detailed explanation of bridge groups and instructions for implementing them in this document:

- *Cisco IOS Bridging and IBM Networking Configuration Guide, Release 12.2*. Click this link to browse to the Configuring Transparent Bridging chapter:

  http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fibm_c/bcfpart1/bcftb.htm

You can also enable and disable PSPF using the web-browser interface. The PSPF setting is on the Radio Settings pages.

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

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**bridge-group** *group* **port-protected**	Enable PSPF.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

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

Configuring Protected Ports

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

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

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Enter interface configuration mode, and enter the type and number of the switchport interface to configure, such as **gigabitethernet0/1**.
Step 3	**switchport protected**	Configure the interface to be a protected port.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show interfaces** *interface-id* **switchport**	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

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

For detailed information on protected ports and port blocking, refer to the "Configuring Port-Based Traffic Control" chapter in the *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

Enabling Short Slot Time

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.

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

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

Enter **no slot-time-short** to disable short slot time.

Configuring the Beacon Period and the DTIM

The beacon period is the amount of time between access point beacons in Kilomicroseconds. One Kμsec 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 the data beacon rate is set at 2, its default setting, then the wireless device sends a beacon containing a DTIM every 200 Kμsecs.

Beginning in privileged EXEC mode, follow these steps to configure the beacon period:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**beacon period** *value*	Set the beacon period. Enter a value between 20 and 4000 Kusecs.
Step 4	**beacon dtim-period** *value*	Set the DTIM. Enter a value between 1 and 100 Kilomicroseconds.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Configure RTS Threshold and Retries

The RTS threshold determines the packet size at which the access point/bridge issues a request to send (RTS) before sending the packet. A low RTS Threshold setting can be useful in areas where many client devices are associating with the access point/bridge, or in areas where the clients are far apart and can detect only the access point/bridge and not each other. You can enter a setting ranging from 0 to 23472347 bytes.

Note When concatenation is enabled, the RTS and fragment thresholds are set to 4000. Changing them to a lower value may degrade access point/bridge performance.

Maximum RTS Retries is the maximum number of times the access point/bridge 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 2312, and the default maximum RTS retries setting is 32. Beginning in privileged EXEC mode, follow these steps to configure the RTS threshold and maximum RTS retries:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**rts threshold** *value*	Set the RTS threshold. Enter a setting from 0 to 4000.
Step 4	**rts retries** *value*	Set the maximum RTS retries. Enter a setting from 1 to 128.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

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

Configuring the Maximum Data Retries

The maximum data retries setting determines the number of attempts the access point/bridge makes to send a packet before giving up and dropping the packet.

The default setting is 32. Beginning in privileged EXEC mode, follow these steps to configure the maximum data retries:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**packet retries** *value* | **drop-packet**	Set the maximum data retries. Enter a setting from 1 to 128. Use the **drop-packet** command to maintain association and drop the packets when the maximum retry value is reached.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the command to reset the setting to defaults.

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.

Note When concatenation is enabled, the RTS and fragment thresholds are set to 4000. Changing them to a lower value may degrade access point/bridge performance.

The default setting is 2338 bytes. Beginning in privileged EXEC mode, follow these steps to configure the fragmentation threshold:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**fragment-threshold** *value*	Set the fragmentation threshold. Enter a setting from 256 to 2346 bytes for the 2.4-GHz radio.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the command to reset the setting to defaults.

Setting the Root Parent Timeout Value

Use the **parent timeout** command to define the amount of time that a non-root access point/bridge or workgroup bridge tries to associate with a parent access point. The command defines how long the access point/bridge or workgroup bridge attempts to associate with a parent in the parent list. If an association is not made within the timeout value, another acceptable parent is used. You set up the parent list using the **parent** command. With the timeout disabled, the parent must come from the parent list.

Beginning in privileged EXEC mode, follow these steps to configure the root parent timeout value:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**parent timeout** *seconds*	The **seconds** value specifies the amount of time in seconds the non-root access point/bridge or workgroup bridge attempts to associate with a specified parent. Enter a value between 0 and 65535 seconds.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the command to reset the setting to defaults.

Configuring the Root Parent MAC

Use the **parent** command to add a parent to a list of valid parent access points. The command adds a parent to the list of valid parent access points. You can use this command multiple times to define up to four valid parents. A repeater access point operates best when it is configured to associate with specific root access points that are connected to the wired LAN.

Beginning in privileged EXEC mode, follow these steps to configure the fragmentation threshold:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface dot11radio 0**	Enter interface configuration mode for the radio interface.
Step 3	**parent** *1-4 mac-address*	The value 1-4 specifies the parent root access point number. **mac-address** specifies the MAC address of a parent access point (in xxxx.xxxx.xxxx format).
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Use the **no** form of the command to reset the setting to defaults.

Performing a Carrier Busy Test

You can perform a carrier busy test to check the radio activity on access point/bridge channels. During the carrier busy test, the access point/bridge drops all associations with wireless networking devices for around 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, or enter **dot11radio 1** to run the test on the 5-GHz radio.

Use the **show dot11 carrier busy** command to re-display the carrier busy test results.