



Antenna Basics

The radio coverage of the wireless LAN supported by the bridge can be maximized with the selection of an appropriate antenna. Antennas are available with omnidirectional or directional radiation patterns and with various gain ratings. This appendix provides basic antenna information.

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Antenna System

Deciding which antenna to use involves many factors such as coverage area, maximum distance, indoor location, outdoor location, and antenna height.


Note

In most situations, a detailed site survey along with an antenna calculation are recommended before purchasing a bridge antenna system.

Table 1 provides typical maximum communication distances between a pair of the same style antennas.

Table 1 *Maximum Antenna Distances*

Antenna Type	Distance
Omnidirectional 2.2 dBi antenna	Indoor—350 ft at 1 Mbps Outdoor—2000 ft at 1 Mbps
Omnidirectional 5.2 dBi antenna	5000 ft at 2 Mbps data rate
Directional high-gain Yagi antenna	6.5 miles at 2 Mbps data rate
Directional parabolic dish antenna	25 miles at 2 Mbps data rate

When antennas are used indoors, the building construction, ceiling height, and internal obstructions must be considered. In outdoor environments, obstructions such as trees, vehicles, buildings, and hills must be considered. Distance is a primary factor when using bridge-to-bridge communications; however, coverage area also becomes important when you are using wireless client devices to communicate with the bridge.

General Antenna and Safety Tips

When installing an antenna, follow these general tips:

- For most elevated antenna installations, it is recommended that you use professional installers for proper installation and safety.
- For safety reasons, never touch a high-gain antenna when it is transmitting or point it at any part of your body.
- Carefully follow the instructions provided with your antenna.
- Keep antennas away from metal obstructions (heating and air-conditioning ducts, large ceiling trusses, building superstructures, and major power cabling runs).
- Use a directional antenna when connecting a link between two buildings. A directional antenna must be properly aligned to directly point at the other antenna.
- Mount an omnidirectional antenna in the middle of the desired coverage area when possible.
- Place the antenna as high as possible to increase the coverage area.
- Outdoor antennas should be mounted above obstructions such as trees and buildings.
- Antenna towers should be a safe distance from overhead power lines. The recommended safe distance is twice the tower height.
- Use special ground rods and follow the National Electrical Code for proper outdoor antenna and tower grounding.
- To prevent moisture entry into the antenna cable, seal all external cable connectors using commercial products such as coax compatible electrical tape and Coax-Seal.

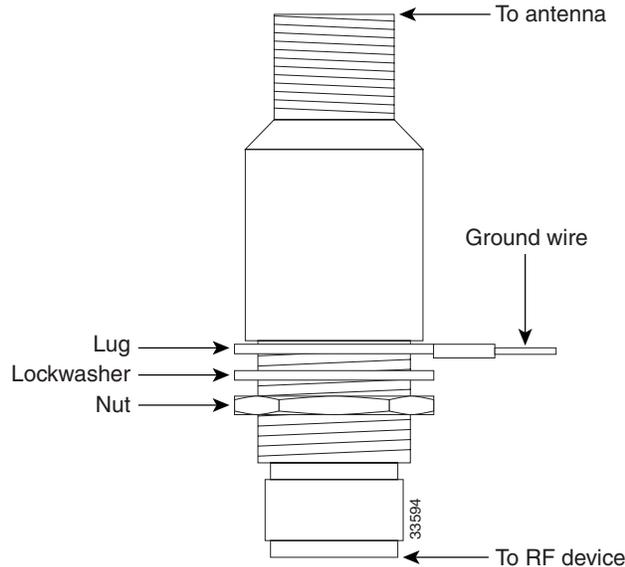
Lightning Arrestors

When you use outdoor antennas, you should use a lightning arrestor to protect radio equipment from static electricity and lightning-induced surges that travel on coaxial transmission lines. However, a lightning arrestor will not prevent damage from direct lightning strikes.

You can install the lightning arrestor indoors or outdoors. Follow the regulations or best practices applicable to lightning arrestors in your local area.

If you install the arrestor outdoors, ground the arrestor by using a ground lug attached to the arrestor and a heavy wire (#6 solid copper) and connect the lug to a good earth ground. If you install the arrestor indoors, place the wireless LAN device near a good source of ground, such as structural steel or the ground on an electrical panel, and ground the arrestor using one of those grounds. [Figure 1](#) shows the connectors on the arrestor and the proper placement of the ground lug.

Figure 1 *Lightning Arrestor Installation*



The part number for the lightning arrestor is AIR-ACC3354. The lightning arrestor kit contains a lightning arrestor, an EMP grounding ring, and an instruction sheet. You can order the arrestor kit through your Cisco Aironet distributor.

Antenna Cable

An antenna cable introduces signal losses in the antenna system for both the transmitter and receiver. To reduce signal loss, you should minimize the cable length and use only low-loss antenna cable to connect your radio device to the antenna.

Antenna Types

Cisco Aironet offers several different styles of antennas in the 2.4 GHz range. Each antenna has been FCC-approved for use with the bridge. The antennas provide omnidirectional, directional, or diversity coverage and support various communication distances. Antennas are available with different gain ratings and coverage areas.

Omnidirectional Antennas

An omnidirectional antenna provides a 360-degree radiation pattern. This type of antenna is used when coverage in all directions is required and when communicating with wireless client devices. Antennas in this category are available in different gain ratings (typically 2.2 to 12 dBi).

Directional Antennas

A directional antenna provides a stronger radiation pattern in a specific direction by focusing the radiation energy to provide a greater coverage distance. Directional antennas include the Yagi antenna, the patch antenna, and the parabolic dish antenna.

Parabolic dishes have very high gain (typically 21 dBi) along with a very narrow radiation angle (typically 12.5 degrees) and must be accurately aimed at the other antenna. Yagi antennas have high gain (typically 13.5 dBi) and a wider radiation angle (typically 25 to 30 degrees). Yagi antennas must also be properly aimed at the other antenna. Patch antennas have high gain (typically 6 dBi) and a relatively broad radiation angle. The patch antenna is more tolerant of orientation, but must still be positioned to face the direction of the other antenna.

Diversity Antennas

A diversity antenna is physically two antennas (sometimes in a single package) that provide diversity antenna operation. In diversity operation, the radio receives signals on both antennas but responds (transmits) on the antenna with the strongest received signal. Diversity operation helps improve system performance when signals are being reflected along different paths to the antenna. Diversity antennas for the bridge are available in 2.2 dBi and 5.2 dBi gain ratings.

Basic Antenna Alignment

When you are using directional antennas to communicate between two bridges, you must manually align the antennas for proper bridge operation. Directional antennas have greatly reduced radiation angles. The radiation angle for yagi antennas is approximately 25 to 30 degrees, and for parabolic dish antennas the radiation angle is approximately 12.5 degrees.

You can use the bridge link test to help measure the alignment of two antennas after the bridges are associated. The association indicates the antennas are pointing in the general vicinity of each other, but does not indicate that the antennas are properly aligned. The link test provides information you can use to gauge the alignment.

Typically, when two antennas are aligned to the edges of their radiation patterns, communication can be marginal as indicated by lost packets, high retry counts, and a low signal strength. However, when two antennas are properly aligned, communication is improved as indicated by all packets being received, lower retry counts, and a higher signal strength.

The following steps provide general guidelines for basis antenna alignment:

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- Step 1** Obtain the initial alignment direction. This may involve a visual line of sight for shorter distances or a Global Positioning System (GPS) receiver, map, and compass for longer distances.



Note The antennas must be located above interfering objects such as trees and buildings.

- Step 2** When the antennas are initially aligned, set the bridge for a 1-Mbps data rate and check for association between the bridges.
- From the bridge Summary Status home screen, click **Setup**.
 - Click Root Radio **Hardware**.
 - In the Data Rates selection boxes for 2.0, 5.5, and 11.0 click each of the pull down arrows and select **no**.
 - Click **OK** on the bottom of the screen, then on the pop-up message click **OK** to update the selections.
 - On the bridge Setup screen, click **Associations** to view the Association Table screen and verify that the destination bridge is listed in the Association Table.

- Step 3** After the bridges are associated, execute a link test with the other bridge and monitor the number of successful packets, number of retries, and average signal strength. Adjust the antenna for the largest number of successful packets, the lowest number of retries, and the highest average signal strength. Refer to [Performing a Link Test](#) for additional information.
- Step 4** Repeat Step 2 and Step 3 for each of the higher data rates until the antennas are adjusted at the 11-Mbps data rate.

Performing a Link Test

The link test is a valuable diagnostic tool used to check radio communication with a remote device. Typically, the link test consists of sending data packets of specified size to a destination radio, receiving the same data packet back from the destination, verifying the data, and providing status information.



Note A link test can be performed only when the two bridges are associated and use the same WEP key when WEP is enabled.

Follow these steps to initiate a bridge link test using a browser interface:

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- Step 1** From the bridge's Summary Status home screen, click **Associations**.
- Step 2** Click the **MAC address** of the remote bridge.
- Step 3** Enter **1000** in the Link Test Count entry box to increase the number of packets used.
- Step 4** Click **Link Test** to begin the link test operation.
- When the link test completes, the results are displayed on a pop-up status screen.
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