C H A P T E R 1

Overview

The Cisco Aironet 1520 Series Outdoor Mesh Access Point (hereafter called the *access point*) is a modularized wireless outdoor access point designed for use in a mesh network. The access point also supports wireless client access, point-to-point bridging, point-to-multipoint bridging, and point-to-multipoint mesh wireless connectivity. The access point is a standalone unit that can be

The LAP1522 model supports two radios (2.4-GHz and 5-GHz) and the LAP1524 model supports up to 4 radios (2.4-GHz, 5.8-GHz, and 4.9-GHz public safety band). Both models provide client access without the need for a license. The 5-GHz radios are dedicated to backhaul operations to reach a wired network and the 2.4-GHz radio is used for wireless clients. The 4.9-GHz public safety band radio is used for backhaul and access. The access point can support 6 to 54 Mb/s data rates.

The access point is manufactured in three configurations: cable, pole mount, and mesh. The cable configuration has three antenna connectors on the top of the unit, can be mounted to a cable strand, and supports power-over-cable (POC). The pole mount configuration supports two antennas on the top and bottom of the unit. It can be mounted to a pole or building wall and supports fiber-optic networks and several power options. The Mesh configuration has two antennas on the top and bottom of the unit. It can be powered by AC and only supports wireless backhaul communications to reach the wired network. It does not support hard-wired communications (cable, fiber-optic, or Ethernet) to a wired network.

The access point is also available as a hazardous location option. When configured, the access point complies with safety standards for Class I, Division 2, Zone 2 hazardous locations in which ignitable concentrations of flammable gases, vapors, or liquids are not likely to exist under normal operation conditions). When you select the hazardous location option as part of the ordering process, Cisco configures the system to contain the new components. Two conduit adaptors and assembly instructions placed in the shipping box provide information and assembly procedures.

The access point can also operate as a relay node for other access points not directly connected to a wired network. Intelligent wireless routing is provided by the patented Adaptive Wireless Path Protocol (AWPP). This enables each access point to identify its neighbors and intelligently choose the optimal path to the wired network by calculating the cost of each path in terms of signal strength and the number of hops required to get to a controller.

The access point is configured, monitored, and operated through a Cisco wireless LAN controller (hereafter called a *controller*) as described in the *Cisco Wireless LAN Controller Configuration Guide.* The *Deployment Guide: Cisco Mesh Networking Solution* describes how to plan and initially configure the Cisco mesh network, which supports wireless point-to-point, point-to-multipoint, and mesh deployments. The controllers use a browser-based management system, a command-line interface (CLI), or the Cisco Wireless Control System (WCS) network management system to manage the controller and the associated access points. The access point supports hardware-based advanced encryption standard (AES) encryption between wireless nodes to provide end-to-end security.

This chapter provides information on the following topics:

Hardware Features

This section describes the hardware features of the access point. Figure 1-1, Figure 1-2, and Figure 1-3 show the access point connectors.

Note   The illustrations in this document show all available connections for the access point. Unused connections are capped with a connector plug to ensure the access point's watertight integrity. Liquid tight adapters are provided for connector openings, which can be installed before or after deploying the access point.

Figure 1-1   Access Point Bottom Connectors
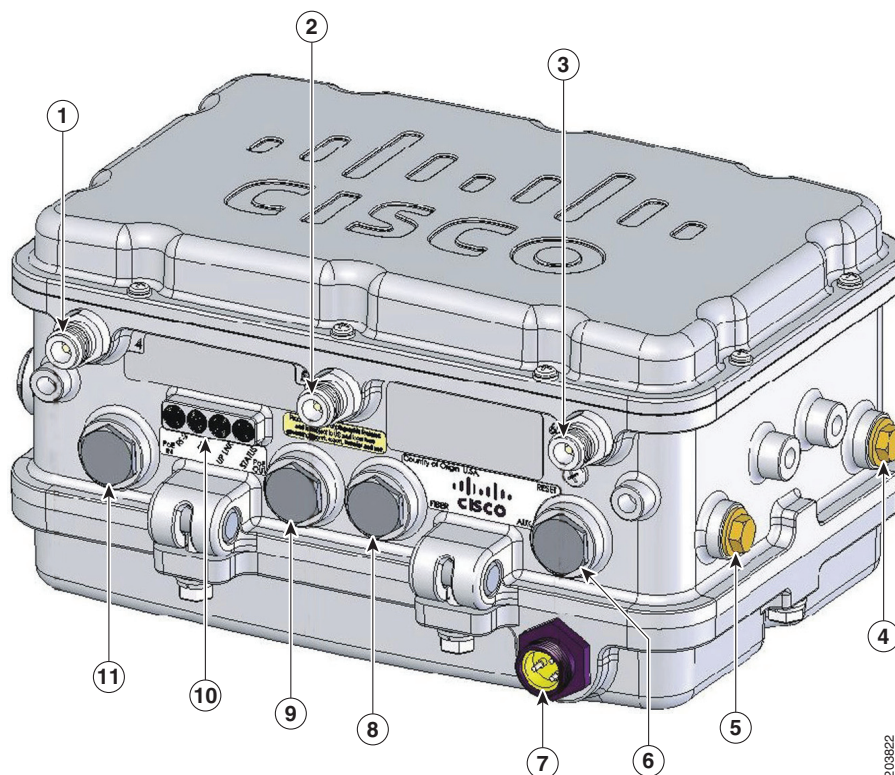
1	Antenna port 4	**7**	AC input connector
2	Antenna port 5	**8**	Fiber port
3	Antenna port 6	**9**	PoE out port
4	Fiber port (optional)	**10**	LEDs
5	Cable POC port (optional)	**11**	PoE in port
6	Aux/console port		

Figure 1-2   Cable, Fiber-Optic, and Antenna Connector Locations
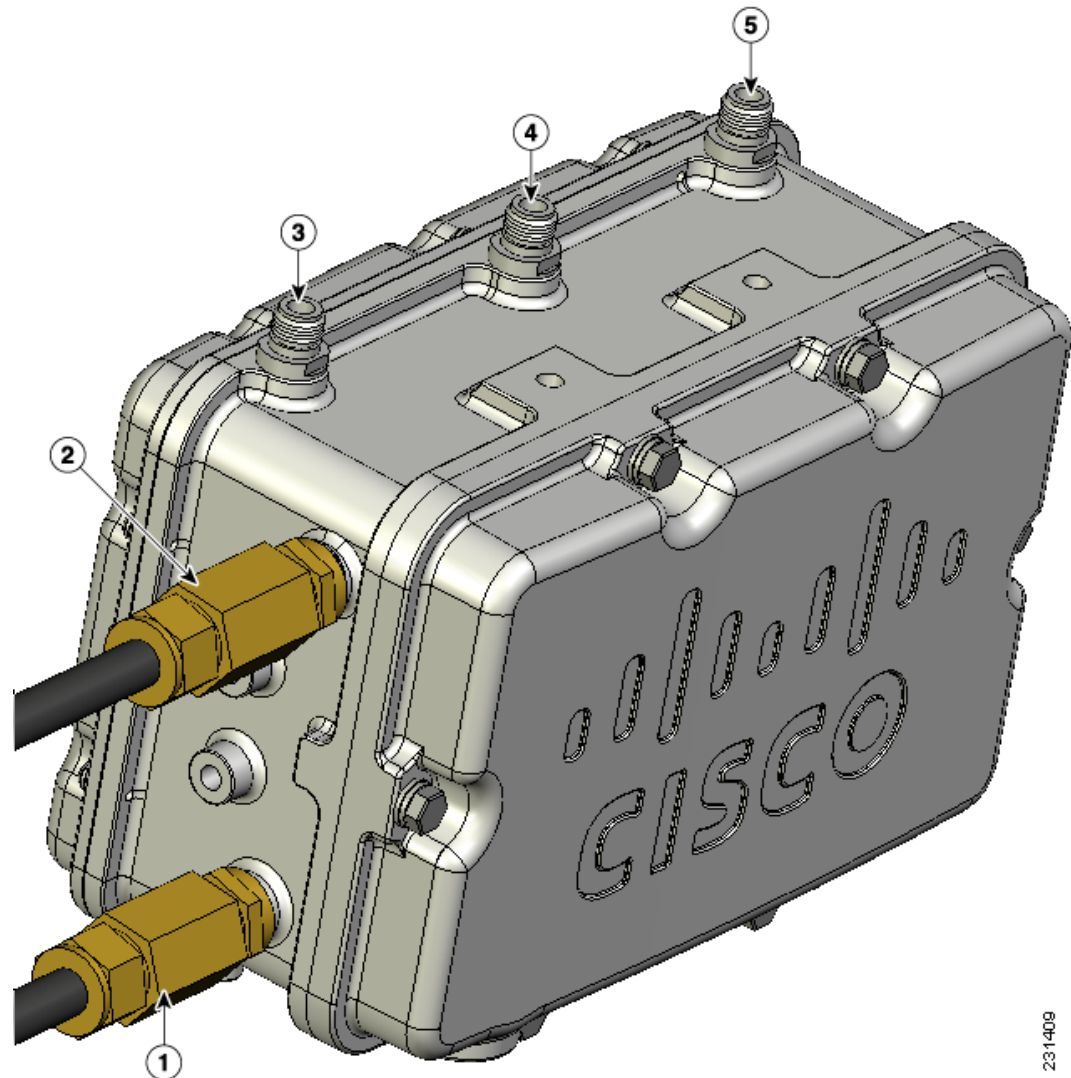
1	Cable POC connector (optional)[1]	**4**	Antenna port 2^2 (Type N)
2	Fiber-optic connector[3] (optional)	**5**	Antenna port 1^2 (Type N)
3	Antenna port 3^2 (Type N)		

1. Stinger connector shown is user supplied.

2. Antenna locations depend upon access point configuration (see the "Antenna Connector Locations" section on page 1-5).
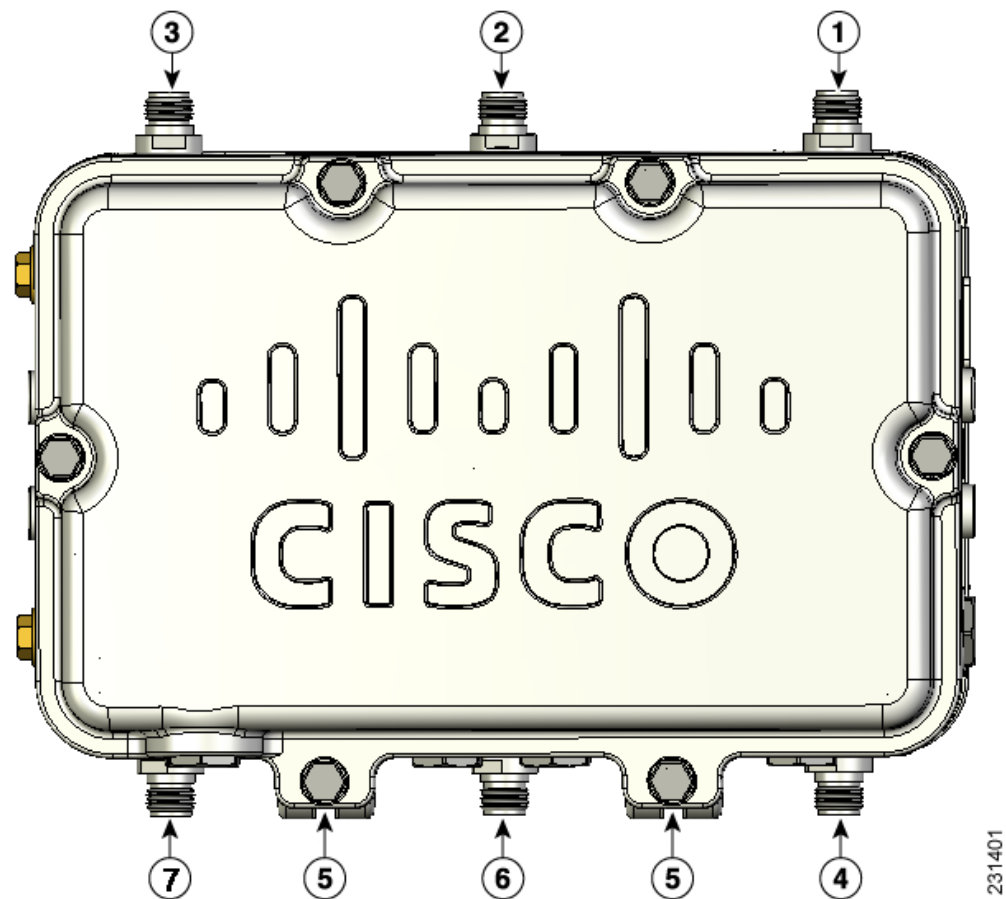
3. Liquid tight adapter not shown.

Figure 1-3   *DC Power Connector and Ground Screw Holes*
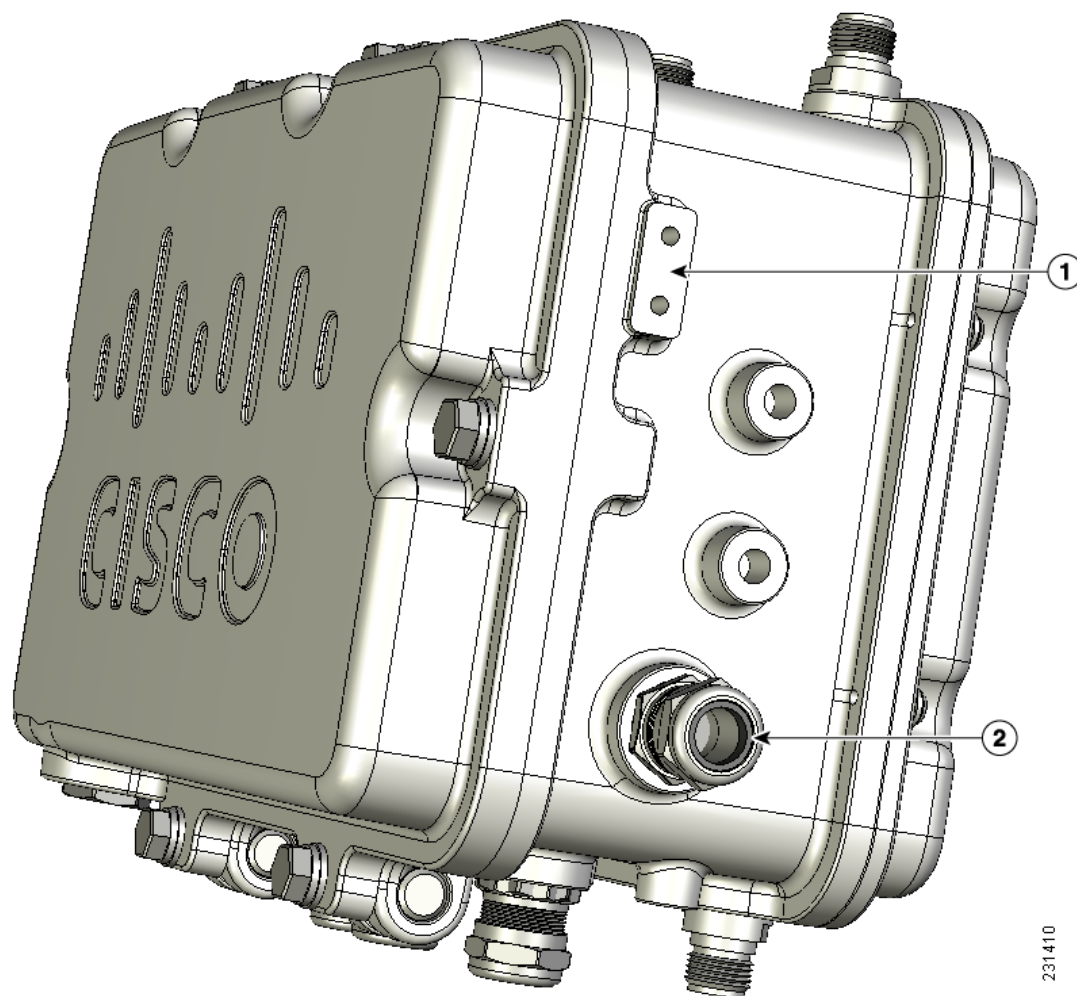
1	Ground screw holes	2	DC power connector

Figure 1-4 shows the antenna port locations for all models. The ports used depend on the model ordered.

Figure 1-4   Antenna Port Locations

1	Antenna port 1	**5**	Hinge
2	Antenna port 2	**6**	Antenna port 5
3	Antenna port 3	**7**	Antenna port 6
4	Antenna port 4		

Antenna Connector Locations

The access point is manufactured in three configurations, cable, mesh, and pole mount. These configurations support specific locations for the access point antennas, as shown in Table 1-1.

Table 1-1   Antenna Locations per Access Point Configuration

Antenna Port	Access Point Configurations	
	Cable	**Mesh and Pole Mount**
1	2.4-GHz antenna connector (RX)	5-GHz antenna connector (TX/RX)
2	5-GHz antenna connector (TX/RX)	–[1]

Table 1-1   Antenna Locations per Access Point Configuration (continued)

Antenna Port	Access Point Configurations	
	Cable	Mesh and Pole Mount
3	2.4-GHz antenna connector (TX/RX)	2.4-GHz antenna connector (RX)
4	—[1]	2.4-GHz antenna connector (RX)
5	—[1]	—[1]
6	—[1]	2.4-GHz antenna connector (TX/RX)

1. Reserved for future use.

Some of the access point's hardware features are listed below:

- Multiple radios (2.4-GHz, 5-GHz, and 4.9-GHz)—see the "Multiple Radio Operation" section on page 1-6

- External radio antennas—see the "External Antennas" section on page 1-7

- Multiple power sources—see the "Multiple Power Sources" section on page 1-8

- Ethernet ports—see the "Ethernet Ports" section on page 1-9

- Rugged metal enclosure—see the "Metal Enclosure" section on page 1-10

- Optional cable modem—see the "Cable Modem" section on page 1-10

- Optional hardware—see the "Optional Hardware" section on page 1-10

Connectors

The optional features of the access point support these connectors (see Figure 1-1):

- PoE-in connector—internal RJ-45 with liquid tight adapter for waterproofing

- PoE-out connector—internal RJ-45 with liquid tight adapter for waterproofing

- Three, four, or six antenna connectors (Type N)—depends on access point configuration

- Fiber-optic connector—internal small form-factor pluggable (SFP) transceiver with LC connector

- Power-over-cable (POC) stinger connector—customer provided

- AC power connector (3-pin Remke Mini-Link 50908)

- DC power connector—internal 2-pin connector

Multiple Radio Operation

The access point supports 2.4-GHz and 5-GHz radios using external antennas (see "External Antennas").

The LAP1522 model supports simultaneous dual-radio operation using a 2.4-GHz 802.11b/g radio and a 5-GHz 802.11a radio.The 5-GHz radio can operate in either the upper industrial, scientific and medical (ISM) 5.8-GHz band or the public safety 4.9-GHz band. The 5-GHz radio supports one antenna and is used for backhaul operations to the controller.

> ✎
> **Note**   The 4.9-GHz band requires a license and can only be used by qualified public safety operators as defined in section 90.20 of the FCC rules.

The 2.4-GHz radio supports two or three antennas for single-input, multiple-output (SIMO) operation. The access point uses two or three receivers to support maximum ratio combining (MRC) to enhance receiver performance.   MRC is a technique that combines the signals from multiple receivers in a manner to optimize the received signal strength. MRC can provide up to 3 dB of increased receive signal strength with two receive antennas or up to 5 dB with three antennas.

External Antennas

The access point supports up to three N-type radio frequency (RF) antenna connectors on the top of the unit and two on the bottom of the unit. The number of active antenna connectors depends upon the access point configuration (see Antenna Connector Locations, page 1-5). All access point configurations supports multiple 2.4-GHz antennas for MISO operation, but only one 5-GHz antenna.

When using the optional Cisco compact omnidirectional antennas, the 2.4- and 5-GHz antennas connect directly to the access point. The Cisco omnidirectional antennas use vertical polarization.

> ⚠
> **Warning**   **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.** Statement 1030

The access point has been designed to operate with the antennas listed below and with a maximum gain of 8 dBi for 2.4 GHz and 17 dBi for 5 GHz. Antennas not in this list or with a higher gain are strictly prohibited for use with the access point. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (E.I.R.P.) is not more than required for successful communication.

> ⚠
> **Caution**   For directly mounted antennas, you must not add weatherproofing around the antenna connectors because the antenna drain holes might be blocked and damage the antenna.

Table 1-2 and Table 1-3 list the supported external antennas for the access point.

Table 1-2   External 5-GHz Antennas

Part Number	Model[1]	Gain (dBi)
AIR-ANT5180V-N	5-GHz compact omnidirectional	8
AIR-ANT58G10SSA-N	5-GHz sector	9.5
AIR-ANT5114P-N	5-GHz patch	14
AIR-ANT5117S-N	5-GHz 90-degree sector	17

1. Operation in the 4.9-GHz band requires a license and may be used only by qualified Public Safety operators as defined in section 90.20 of the FCC rules.

Table 1-3   External 2.4-GHz Antennas

Part Number	Model	Gain (dBi)
AIR-ANT2450V-N	2.4-GHz compact omnidirectional	5.5
AIR-ANT2480V-N	2.4 GHz omnidirectional	8

Multiple Power Sources

The access point supports these power sources:

- PoE—power injector (AIR-PWRINJ1500-2=)
- AC power—100 to 480 VAC (standard power source for the pole mount configuration)
- POC—40 to 90 VAC (quasi-square wave AC), (standard power source for the cable configuration)
- External 12 VDC

Warning   **Connect the unit only to DC power source that complies with the safety extra-low voltage (SELV) requirements in IEC 60950 based safety standards.** Statement 1033

- Internal battery

The access point can be connected to more than one power source. The access point detects the available power sources and switches to the preferred power source using the following default prioritization:

- AC power or POC power
- External 12-VDC power
- Power injector PoE power
- Internal battery power

Warning   **This unit might have more than one power supply connection. All connections must be removed to de-energize the unit.** Statement 1028

Caution   To provide inline PoE, you must use the 1520 power injector (AIR-PWRINJ1500-2=). Other power injectors, PoE switches, and 802.3af power sources cannot provide adequate power, which can cause the access point to malfunction and cause over-current conditions at the power source.

Caution   The 1520 power injector (AIR-PWRINJ1500-2=) must be used in an indoor environment only.

Note   In the cable configuration, the cable modem is activated only when the access point is powered by POC or external 12 VDC power. When using only PoE power, the cable modem is deactivated.

⚠ **Caution**   When the access point is installed outdoors or in a wet or damp location, the AC branch circuit that is powering the access point should be provided with ground fault protection (GFCI), as required by Article 210 of the National Electrical Code (NEC).

The Ethernet cable from the power injector to the access point (PoE-in port) must be not less than 10 ft (3.1 m).

The AC power cord options are listed below:

- 40-ft (15.2-m) power cord for light pole installations in the US and Canada. One end of the power cord is terminated with an access point AC power connector, and the other end is terminated with an AC plug (AIR-CORD-R3P-40NA=).

- 40-ft (15.2-m) power cord for light pole installations in the European Union. One end of the power cord is terminated with an access point AC power connector, and the other end is unterminated. Users must install a plug that is certified for outdoor use and that it has a minimum IP67 rating, such as Interpower 84131251 or Hubbell HBL316P6W (IEC/EN60309) pin-and-sleeve type connectors (AIR-CORD-R3P-40UE=).

- 4-ft (1.2-m) streetlight power tap adapter for light pole installations in the US and Canada (AIR-PWR-ST-LT-R3P=).

Ethernet Ports

The access point supports a PoE-in port and a PoE-out port. The access point's PoE-in port uses an RJ-45 connector (with a liquid tight adapter) to link the access point to the 10/100/1000BASE-T network. The Ethernet cable is used to send and receive Ethernet data and to optionally supply inline 56-VDC power from the power injector.

The access point's PoE-out (10/100/1000BASE-T) port uses an RJ-45 connector (with a liquid tight adapter) to provide LAN connectivity and IEEE 802.3af power to a single peripheral customer device, such as a camera or sensor gateway. The PoE-out port should not be connected to a switch or hub.

✎ **Note**   The PoE-out port is disabled when the access point is powered by the power injector.

The Ethernet MAC addresses is printed on the bottom of the access point under the LEDs (refer to the "Finding the Product Serial Number" section on page XIV).

⚠ **Warning**   **To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.** Statement 1023

The Ethernet cable must be a shielded outdoor rated Category 5e (CAT5e) or better cable. The access point senses the Ethernet and power signals and automatically switches internal circuitry to match the cable connections.

⚠ **Caution**   To provide inline PoE, you must use the 1520 power injector (AIR-PWRINJ1500-2=). Other power injectors, PoE switches, and 802.3af power sources cannot provide adequate power, which may cause the access point to malfunction and cause possible over-current conditions at the power source.

Cable Modem

The access point cable configuration contains an internal cable modem for connection to the cable network from the pole-mounted cable lines. The access point can be powered using the 40-to 90-VAC (quasi-square wave AC) power provided by the cable network.

✎
Note The access point uses a Scientific Atlanta DPC2100 cable modem board and 4015821 RF splitter.

The cable modem supports these main features:

- Data Over Cable Service Interface Specifications (DOCSIS) 2.0
- Backward compatibility with existing DOCSIS 1.1 and 1.0 networks

Metal Enclosure

The access point uses a metal enclosure that can accommodate both indoor or outdoor operating environments and an industrial temperature operating range of –40 to 131°F (–40 to 55°C). The access point complies with NEMA 4 and IP67 requirements.

Optional Hardware

Some of the access point hardware options are listed below:

- Fiber-optic module and take-up reel kit (GLC-FE-100BX-URGD=)—Small form-factor pluggable (SFP) module for connection to fiber-optic lines. The take-up reels are used to store excess fiber-optic cable by wrapping the cable around the reels.
    - Single strand fiber bidirectional optical transceiver
    - 1.3 (transmit) /1.5 (receive) micrometer wavelength division multiplexing (WDM) function
    - 100 Mb/s data rates
    - LC receptacle
    - Supports up to 15.5 mi (25 km) of fiber-optic cable.
- Pole mount kit (AIR-ACCPMK1520=)—provides hardware for mounting the access point to a metal or wood pole, such as a streetlight pole.
- Strand mount kit (AIR-ACCSMK1520=)—provides hardware for mounting the access point to a cable strand.
- Streetlight power tap adapter (AIR-PWR-ST-LT-R3P=)—connects to the light control connector on a streetlight pole and provides AC power to the access point.
- 1520 power injector (AIR-PWRINJ1500-2=)—provides PoE to the access point.
- 40-ft (12.2-m) power cord for light pole installations in the US and Canada (AIR-CORD-R3P-40NA=)—provides AC power to the access point. One end of the power cord is terminated with an access point AC power connector, and the other end is terminated with an AC plug.
- Battery backup module (AIR-1520-BATT-6AH). The integrated battery can be used for temporary backup power during external power interruptions.
    - 3- hour access point operation using two radios at 77°F (25°C)—with PoE output port off

- 2-hour access point operation using two radios at 77°F (25°C)— with PoE output port on
- banding strap tool (BAND IT) (AIR-BAND-INST-TL=)—used to install the metal straps used in pole mounting.

Network Deployment Examples

The access point is a wireless device designed for wireless client access and point-to-point bridging, point-to-multipoint bridging, and point-to-multipoint mesh wireless connectivity. The access point provides 5-GHz backhaul capability to link with another access point to reach a wired network connection or to provide repeater operations for other access points.

The access point plays one of two primary radio roles: a root access point (hereafter called a *RAP*) or the access points that relay their wireless connections to the controller are called *mesh access points (MAPs)*. When the access point has a wired Ethernet, fiber-optic, or cable connection to the controller (through a switch), the radio role is called a RAP. A RAP is a parent node to any bridging or mesh network. A controller can support one or more RAPs, each one parenting the same or different wireless networks. There can be more than one RAP for the same mesh network for redundancy. Both RAP and MAP access points can support wireless clients using the 2.4-GHz radio.

> **Note**   The access point must be configured as a RAP in the controller, whereas the MAP role is a default setting.

When the access point does not have a wired Ethernet, fiber-optic, or cable connection to the controller, the radio role is called a MAP. The MAPs have a wireless connection (through the backhaul interface) to other MAPs and finally to a RAP with an Ethernet or cable connection through a switch to the controller. MAPs can also have a wired Ethernet connection to a local LAN and serve as a bridge endpoint for that LAN (using a point-to-point or point-to-multipoint bridge connection).

Wireless Backhaul

The access point supports wireless backhaul capability using the 5-GHz radio to bridge to another access point to reach a wired network connection to a controller (see Figure 1-5). The access point connected to the wired network is considered a RAP in this configuration. The remote access point is considered a MAP and transfers wireless client traffic to the RAP for transfer to the wired network. Lightweight access point protocol (LWAPP) control traffic is also transferred over this bridged link.
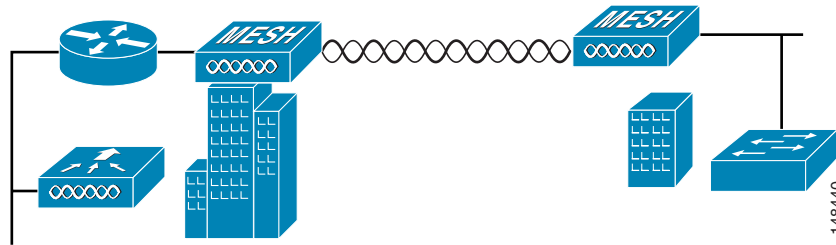
Figure 1-5   Access Point Backhaul Example
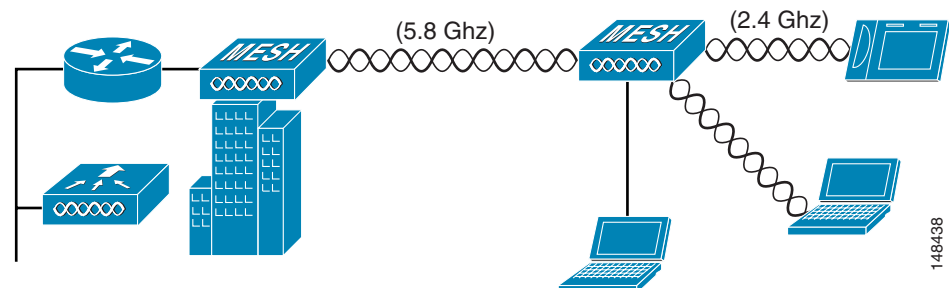
Point-to-Point Bridging

The access points can be used to extend a remote network by using the 5-GHz backhaul radio to bridge the two network segments as shown in Figure 1-6. To support Ethernet bridging, you must enable bridging on the controller for each access point.

*Figure 1-6*   *Access Point Point-to-Point Bridging Example*

Point-to-Multipoint Bridging

The access points can be used as a RAP to connect multiple remote MAPs with their associated wired networks (see Figure 1-7). By default, this capability is turned-off for all access points. To support Ethernet bridging, you must enable bridging on the controller for each access point.

Wireless client access can be provided over the bridging link; however, if bridging between tall buildings, the 2.4-GHz wireless coverage area might be limited and possibly not suitable for direct wireless client access.

*Figure 1-7*   *Access Point Point to Multipoint Bridging Example*
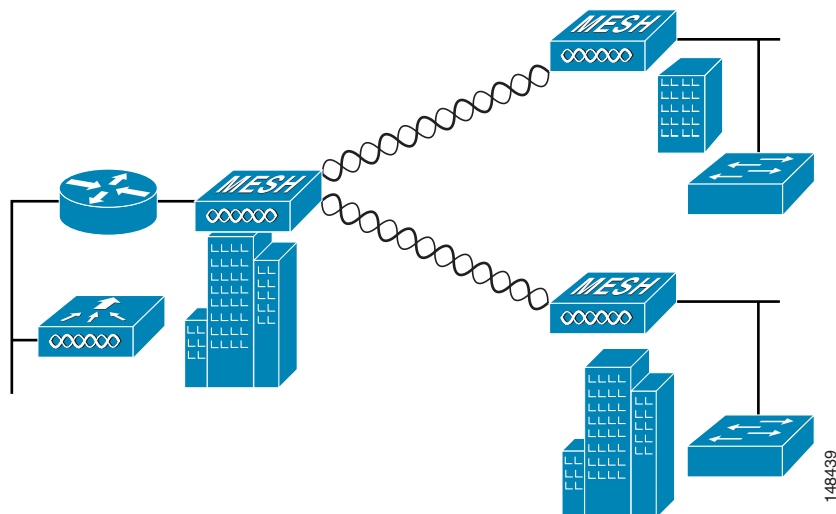
Mesh Network

The access points are typically deployed in a mesh network configuration. In a typical mesh deployment, one or more RAPs have a wired network connection through a switch to a controller. Other remote MAPs without wired network connections use the backhaul feature to optimally link to a RAP that is connected to the wired network. In the mesh network, the links between the access points are referred to as the *backhaul links.*

Intelligent wireless routing is provided by the patented Adaptive Wireless Path Protocol (AWPP). This enables each MAP to identify its neighbors and intelligently choose the optimal path to the RAP with the wired network connection by calculating the cost of each path in terms of signal strength and the number of hops required to get to a controller.

Figure 1-8 illustrates a typical mesh configuration using MAPs and RAPs.

Figure 1-8   Typical Mesh Configuration Using Access Points
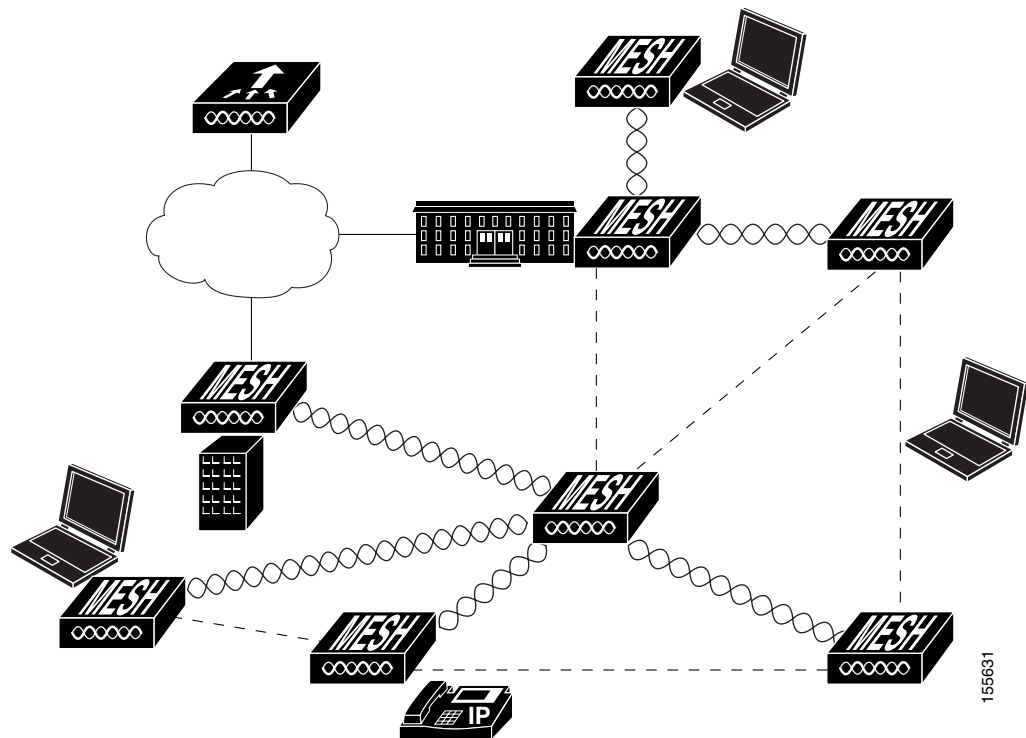
Layer 3 Network Operation

The access points support Layer 3 network operation. Access points and controllers in Layer 3 configurations use IP addresses and UDP packets, which can be routed through large networks. Layer 3 operation is scalable and recommended by Cisco.

Figure 1-9 illustrates a typical Layer-3 wireless network configuration containing access points and a controller.

Figure 1-9   Typical Layer 3 Access Point Network Configuration Example