Select the Right Antennas for Cisco Aironet Wi-Fi Access Points

BENEFITS

- Boost wireless data throughput
- Get the most out of your 802.11n and 802.11ac access point investments
- Match radio signal strength to coverage patterns and building layouts
- Manage performance of dual-band implementations (5 GHz and 2.4 GHz) with full MIMO support

Access point type, building design and materials, and client location affect how your Wi-Fi network performs. Get the highest data rates from your Wi-Fi access points by selecting the right Cisco antenna for each situation.

Antennas are a key component of a Wi-Fi access point, and they have a big impact on network performance. Cisco® Aironet® 802.11n and 802.11ac access points come with either built-in antennas or with RF ports that you can use to connect external antennas. You'll want to consider the external antenna option if your indoor or outdoor network environment has special requirements and you want to improve your wireless coverage and data rates. For example, building materials, floor layouts, distances, and usage patterns sometime require concentrating radio signals in particular directions or at certain angles to get the fastest data throughput. So you might want to use specialized antennas that transmit the radio signal in different shapes.

Choose from an extensive family of single- and dual-band antennas and mounting options for use with Cisco Aironet 802.11n and 802.11ac access points that address each unique situation (Table 1). Indoors. Outdoors. Around corners. In open areas. Down hallways and mine shafts. And in places where aesthetics are important.

Environmental Decision Factors

Every wireless LAN deployment is different. The type and quality of antenna you use with your access points can make a huge difference in Wi-Fi data throughput and, in turn, the quality of the experiences your users enjoy. What might affect transmissions? Some examples are the size of a facility, the construction materials from which it's made, interior walls and cubicles, and outdoor terrestrial objects and bodies of water. These create transmission and multipath considerations that can create interference and impair performance.

For example, consider the following in your indoor environment:

- Paper and vinyl walls have very little effect on signal penetration.
- Precast concrete walls can limit signal penetration to one or two walls before degradation occurs. This limitation might vary widely based on the presence of steel reinforcement within the concrete.
- Concrete and concrete block walls could limit signal penetration to three or four walls.
- Wood or drywall typically allow for adequate penetration through five or six walls.
- A thick metal wall reflects signals, resulting in poor penetration.
- Steel-reinforced concrete flooring will restrict coverage between floors to perhaps one or two floors.

To get the best performance from a Cisco wireless LAN, it is important to understand how to maximize radio coverage and distance with appropriate antenna selection and placement that accounts for these and other environmental variables. With directional and omnidirectional antennas, low-loss cable, mounting hardware, and other accessories, you can customize your wireless solution to meet the requirements of even the most challenging applications.

Antenna Features and Components

What You Buy

An antenna system comprises numerous components, including the antenna, mounting hardware, connectors, antenna cabling, and, in some cases, a lightning arrestor. Table 1 shows the primary categories of Wi-Fi antennas and describes their primary traits and use cases.

Table 1. Types of Available Antennas* and Typical Uses

Antenna Type	Description	Recommended Deployment(s)
Omnidirectional 	Creates a 360-degree coverage pattern. Circular pattern covers wide areas. Ceiling or mast pole mounted.	Open office areas, conference rooms, warehouses, manufacturing floors, outdoor seating areas, indoor/outdoor retail environments.
Dipole 	Creates a 360-degree coverage pattern. Can be bent at different angles to modify the coverage for wall and ceiling mounting as needed. Available in colors for aesthetic preferences.	Office areas, classrooms, hallways, conference rooms, shared (multitenant) environments.
Directional (including patch and Yagi) 	Focuses the radio signal to direct energy in certain directions. Patch and Yagi antennas are typically mounted to a wall or a mast and provide coverage in a limited-angle pattern.	Down a hallway in a hospital or office corridor. In a warehouse or manufacturing facility with high steel shelving. In mining shafts and drifts.

* Indoor access points require RP-TNC connectors; outdoor APs require N-Type connectors.

Key Capabilities

Cisco antenna patterns are integrated into Cisco Prime™ Infrastructure and Mobility Services Engine (MSE) to ensure accurate heat maps. Heat maps help you identify potential coverage holes or areas where more coverage is needed. Figure 1 shows a typical heat map reflecting coverage on a particular floor; red areas indicate the strongest coverage and signal strength, and yellow also shows strong coverage. Green indicates coverage that could be improved. Blue indicates little or no coverage. Heat maps also locate interferers or rogue devices.

Figure 1. Heat Map Showing Wi-Fi Coverage and Relative Signal Strength

Models and Options Available

Tables 2 through 7 show the 802.11n and 802.11ac Wi-Fi antenna options and respective part numbers available for Cisco indoor access points. Tables 8 through 11 show the 802.11n and 802.11ac Wi-Fi antenna options and their respective part numbers available for Cisco outdoor access points.

Table 2. Indoor Omnidirectional Antennas, Single Band

2.4-GHz Omnidirectional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT1728	1	Ceiling mount: indoor/outdoor	5.2 dBi
AIR-ANT2506	1	Mast mount: indoor/outdoor	5.2 dBi
AIR-ANT2430V-R=	3	Ceiling-mount: indoor	3 dBi
AIR-ANT2440NV-R=	3	Wall mount indoor/outdoor	4 dBi
5-GHz Omnidirectional Antenna Part Number	**Ports per Antenna**	**Description**	**Gain**
AIR-ANT5160V-R	1	Ceiling mount: indoor/outdoor	6 dBi
AIR-ANT5140V-R=	3	Ceiling mount: indoor	4 dBi
AIR-ANT5140NV-R=	3	Wall mount: indoor/outdoor	4 dBi
2.4-/5-GHz Omnidirectional Antenna Part Number	**Ports per Antenna**	**Description**	**Gain**
AIR-ANT2451NV-R=	6	Ceiling mount: indoor	2.5 dBi (2.4 GHz) 3.5 dBi (5 GHz)

Table 3. Indoor Dipole Antennas, Single Band

2.4-GHz Dipole Antenna Part Number	Ports per Antenna	Color	Gain
AIR-ANT4941 **AIR-ANT2422DB-R***	1	Black	2.2 dBi
AIR-ANT2422DW-R= **AIR-ANT2422DW-R***	1	White	2.2 dBi
AIR-ANT2422DG-R= **AIR-ANT2422DG-R***	1	Gray	2.2 dBi
AIR-ANT2422SDW-R **AIR-ANT2422SDW-R***	1	White (short)	2.2 dBi
5-GHz Dipole Antenna Part Number	**Ports per Antenna**	**Color**	**Gain**
AIR-ANT5135D-R **AIR-ANT5135DB-R***	1	Black	3.5 dBi
AIR-ANT5135DW-R= **AIR-ANT5135DW-R***	1	White	3.5 dBi
AIR-ANT5135DG-R= **AIR-ANT5135DG-R***	1	Gray	3.5 dBi
AIR-ANT5135SDW-R **AIR-ANT5135SDW-R***	1	White (short)	3.5 dBi

* Part number when ordered as an option

Table 4. Indoor Directional Antennas, Single Band

2.4-GHz Directional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2460NP-R	3	Patch, wall mount, indoor/outdoor	6 dBi
AIR-ANT2485P-R**	1	Patch, wall mount, indoor/outdoor	8.5 dBi
AIR-ANT2410Y-R**	1	Yagi, mast mount, indoor/outdoor	10 dBi
5-GHz Dipole Antenna Part Number	**Ports per Antenna**	**Description**	**Gain**
AIR-ANT5160NP-R=	1	Patch, wall mount, indoor/outdoor	6 dBi
2.4/5-GHz Dipole Antenna Part Number	**Ports per Antenna**	**Description**	**Gain**
AIR-ANT25137NP-R=** **AIR-ANT25137NP-R4=**** **(qty=4)**	6	Patch, wall mount, indoor/outdoor	13 dBi (2.4 GHz) 7 dBi (5 GHz)

** Approved only for AP3502P

Table 5. Indoor Dipole Antennas, Dual Band

Dual-Band Dipole Antenna Part Number	Ports per Antenna	Color	Gain
AIR-ANT2524DB-R= **AIR-ANT2524DB-R***	1	Black	2 dBi (2.4 GHz) 4 dBi (5 GHz)
AIR-ANT2524DGR= **AIR-ANT2524DG-R***	1	Gray	2 dBi (2.4 GHz) 4 dBi (5 GHz)
AIR-ANT2524DW-R= **AIR-ANT2524DWR***	1	White	2 dBi (2.4 GHz) 4 dBi (5 GHz)
AIR-ANT2535SDW-R **AIR-ANT2535SDW-R***	1	White (short)	3 dBi (2.4 GHz) 5 dBi (5 GHz)

* Part number when ordered as an option

Table 6. Indoor Omnidirectional Antennas, Dual Band

Dual-Band Omnidirectional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2524V4C-R=	4	Ceiling mount, indoor/outdoor	2 dBi (2.4 GHz) 4 dBi (5 GHz)
AIR-ANT2544V4M-R=	4	Mast/wall mount, indoor/outdoor	4 dBi (2.4 GHz) 4 dBi (5 GHz)

Table 7. Indoor Directional Antennas, Dual Band

Dual-Band Directional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2566P4W-R=	4	Wall mount, indoor/outdoor	6 dBi (2.4 GHz) 6 dBi (5 GHz)
AIR-ANT2566D4M-R=	4	Mast/wall mount, IP67	6 dBi (2.4 GHz) 6 dBi (5 GHz)
AIR-ANT2513P4M-N=**	4	Mast/wall mount, indoor/outdoor	13 dBi (2.4 GHz) 13 dBi (5 GHz)

** Approved only for AP3702P

Table 8. Outdoor Omnidirectional Antennas, Single Band

2.4-GHz Omnidirectional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2440V-N= **AIR-ANT2440V-N***	1	N-male connector, white, right angle	2 dBi
AIR-ANT2450V-N= **AIR-ANT2450V-N***	1	N-male connector, white	5 dBi
AIR-ANT2480V-N=	1	N-male connector, white	8 dBi
5-GHz Omnidirectional Antenna Part Number	**Ports per Antenna**	**Description**	**Gain**
AIR-ANT5140V-N= **AIR-ANT5140V-N***	1	N-male connector, white, right angle	4 dBi
AIR-ANT5180V-N= **AIR-ANT5180V-N***	1	N-male connector, white	8 dBi

* Part number when ordered as an option

Table 9. Outdoor Directional Antennas, Single Band

2.4-GHz Directional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2413P2M-N=	2	N-male connector, gray, right angle	13 dBi
5-GHz Directional Antenna Part Number	**Ports per Antenna**	**Description**	**Gain**
AIR-ANT5114P-N=	1	N-male connector, white	14 dBi
AIR-ANT5114P2M-N=	2	N-male connector, gray, right angle	14 dBi

Table 10. Outdoor Omnidirectional Antennas, Dual Band

Dual-Band Omnidirectional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2547V-N= **AIR-ANT2547V-N**	1	N-male connector, white	4 dBi (2.4 GHz) 7 dBi (5 GHz)
AIR-ANT2547VG-N= **AIR-ANT2547VG-N**	1	N-male connector, gray	4 dBi (2.4 GHz) 7 dBi (5 GHz)
AIR-ANT2568VG-N= **AIR-ANT2568VG-N**	1	N-male connector, gray	6 dBi (2.4 GHz) 8 dBi (5 GHz)

Table 11. Outdoor Directional Antennas, Dual Band

Dual-Band Directional Antenna Part Number	Ports per Antenna	Description	Gain
AIR-ANT2588P3M-N=	3	Mast/wall mount, indoor/outdoor	8 dBi (2.4 GHz) 8 dBi (5 GHz)
AIR-ANT2513P4M-N=	4	Mast/wall mount, indoor/outdoor	13 dBi (2.4 GHz) 13 dBi (5 GHz)

After selecting the appropriate antenna, refer to the relevant access point ordering guide for any other accessories you might needs to complete your access point deployment. These include mounting brackets, antenna cables (if not included with the antenna), and lightning arrestors.

Use Cases and Considerations

Table 12 lists guidelines for deploying antennas in different environments.

Table 12. Guidelines for Deployment

Environment	Common Characteristics and Guidelines
Enterprise/large retail store	These installations often require a large coverage area. Omnidirectional antennas mounted just below the ceiling girders or just below the drop ceiling typically provide the best coverage (this will vary with stocking, type of material, and building construction). The antenna should be placed in the center of the desired coverage cell and in an open area for best performance. In cases where the radio unit will be located in a corner or at one end of the building, a directional antenna such as a patch or Yagi can be used for better signal penetration.
Warehouse and manufacturing floor	These installations often require a large coverage area. Omnidirectional antennas mounted at 20 to 25 feet typically provide the best overall coverage. Mount height also depends upon the height of the racking, material on the rack, and ability to locate the antenna at this height. Mounting the antenna higher will sometimes actually reduce coverage, as the angle of radiation from the antenna is more outward than down. The antenna should be placed in the center of the desired coverage cell and in an open area for best performance. In cases where the radio unit will be located against a wall, a directional antenna such as a patch or Yagi can be used for better signal penetration. The coverage angle of the antenna will affect the coverage area.
Small office/small retail store	The standard dipole antenna might provide adequate coverage, depending on the location of the radio device. However, in a back corner office a patch antenna might provide better coverage. It can be mounted to the wall above most obstructions for best performance. Coverage of this type of antenna depends on the surrounding environment.
Point to point communications	When interconnecting two points, consider the distance, obstructions, and antenna location. Directional antennas are recommended, but omnidirectional antennas can be used if the distances are not too great. These antennas should be installed as high as possible and above obstructions such as trees, buildings, and other objects. Directional antennas must be aligned so that their main radiated power lobes are directed at each other. With the use of directional antennas, fewer interference possibilities exist and there is less possibility of causing interference to anyone else.
Point-to-multipoint communications	In this case, a single point is communicating to several remote points. Consider using an omnidirectional antenna at the main communication point. The remote sites can use a directional antenna directed at the main point antenna.

> “Every wireless LAN deployment is different. The type and quality of antenna you use with your access points can make a huge difference in Wi-Fi data throughput and, in turn, the quality of the experiences your users enjoy.”

Why Cisco?

Cisco has the widest range of antennas, cables, and accessories available from any wireless manufacturer. In addition:

- Cisco antennas go through complete electrical, mechanical, and environmental testing.
- Cisco has long-standing relationships with other antenna suppliers who understand that Cisco customers require world-class antennas.

- All Cisco wireless network features are tested with Cisco antennas to help ensure consistent, repeatable performance. Examples of these wireless features are the Cisco radio resource management (RRM), Cisco CleanAir®, rogue access point detection, and location services.
- You get the full support of the Cisco Technical Assistance Center (TAC) when you use Cisco antennas.

Services

Cisco Advanced Services can help you with a site survey, bill of materials (BOM) creation, network deployment, and other aspects of your Wi-Fi deployment. To learn more, visit http://www.cisco.com/web/services/portfolio/index.html.

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital® can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce capital expenditures. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

Next Steps

To determine the optimal Wi-Fi antenna choice for your RF environments, consider a site survey. To get started, consult your Cisco sales representative or find a Cisco wireless partner at https://tools.cisco.com/WWChannels/LOCATR/openBasicSearch.doc.

For in-depth education about Wi-Fi antennas, cabling, and radio signal patterns, consult the Cisco Aironet Antennas and Accessories Reference Guide.

RF GLOSSARY	
dB; dBd; dBi; dBm	Measure of RF signal gain in decibels (dB); decibels relative to a standard half-wave dipole antenna (dBd); decibels relative to an isotropic (theoretical) antenna (dBi), with a uniform three-dimensional radiation pattern; and decibels relative to a milliwatt (dBm).
Direction	Shape of the RF transmission pattern.
Gain	A measure of increase in the power of an RF signal. Generally, the higher the gain, the longer the distance covered and the narrower the coverage beam.
Lightning arrestor	A device that protects against damage from potential charges developing on the antenna and cable or caused by lightning strikes. The Cisco Aironet lightning arrestor protects 2.4-GHz to 5.8- GHz radio equipment from static electricity and lightning-induced surges that travel on coaxial transmission lines.
Multipath	Phenomenon by which radio signals reach a receiving antenna by two or more paths. This can happen because there are multiple transmitters and receivers (called multiple input, multiple output, or MIMO, in 802.11n and 802.11ac parlance) or because signals bounce off terrestrial objects or reflect from bodies of water. Multipath can have positive and negative effects on performance.
Polarization	The direction of radio wave oscillation.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C22-734002-01 06/15