# Deployment

The Cisco WLAN Solution wireless network provides features and tools that simplify wireless network deployment, allowing IT departments to deploy wireless networks with existing resources, and system integrators to design and deploy wireless networks with greater predictability.

The Radio Resource Management (RRM), which is part of the Cisco WLAN Solution detects coverage holes and interference and automatically determines transmit power level and transmit channels for each Cisco 1000 series lightweight access point, which allows the Cisco WLAN Solution to be deployed without a site survey when the building RF characteristics are well known.

The Cisco WLAN Solution features that simplify the deployment process include:

- Internal dual-band antennas that provide the performance of external antennas without requiring external antennas and RF cables.
- Standards-based 802.3af Power over Ethernet (PoE) that allows the Cisco 1000 series lightweight access points to be powered over unused pairs in the Ethernet cable.
- The Cisco Wireless LAN Controller, which is optimized for the Cisco WLAN Solution infrastructure.
- External power supply option allows the Cisco 1000 series lightweight access points to be easily moved during the site survey to verify RF building characteristics.
- The Dynamic Transmit Power algorithm automatically lowers Cisco 1000 series lightweight access point transmit power to minimize overlap between adjacent 802.11a or 802.11b/g Cisco Radio coverage areas, and automatically increases power to fill coverage holes if a nearby Cisco 1000 series lightweight access point fails.
- Real-time coverage hole detection and client performance monitoring provides the IT manager with real-time visibility into coverage holes based on client traffic.
- Automatic interference detection detects interference from microwave ovens, bluetooth devices, and other access points, and automatically changes the assigned Cisco 1000 series lightweight access point channel to avoid the interference.

# Determining Deployment Requirements

There are a few important deployment criteria to consider when deploying a wireless network:

- Assumptions
- Protocol Requirements
- Coverage Area Requirements
- Building Type
- Building Homogeneity
- Average Client Throughput
- Voice over IP Requirements

**Note** Most enterprise installations are initially designed and deployed for coverage. If there is a large installed base of wireless clients, capacity must also be considered.

## Assumptions

The guidelines in this document are written based on the following conditions and assumptions:

- Client Data Terminal Transmit (Tx) Power: >=15 dBm.
- Client Data Terminal Antenna Gain: >=0 dBi.
- Capacity: up to 15 Data client Terminals or up to 14 VoIP clients per Cisco 1000 series lightweight access point.
- Handover Times: 37 milliseconds or less for Layer 2 (same- Cisco 4100 Series Wireless LAN Controller) handovers, 48 milliseconds or less for Layer 3 (inter-Cisco 4100 Series Wireless LAN Controller and inter-subnet) handovers.
- Quality of Service: Assigned on a per-WLAN basis. VoIP clients with Platinum QoS take precedence (up to 90+% of bandwidth) over clients with Gold, Silver or Bronze QoS.

**Note** These assumptions are typical for available 802.11 client data terminals and typical cubicle density.

# Protocol Requirements

One of the critical decisions in deploying a wireless LAN is deciding which protocols and bands it will support. The following table shows the options and the advantages/disadvantages of each.

*Table 1 Protocol Requirements*

| Protocol/Band | Advantage | Disadvantage |
|---|---|---|
| 802.11a/b/g | Highest capacity option (three 802.11b/g channels and thirteen 802.11a channels)<br>Highest performance option (54 Mbps for both 802.11g and 802.11a)<br>Rogue access point detection for both 2.4 GHz 802.11b/g and 5.0 GHz 802.11a bands | Small increase in the Cisco 1000 Series IEEE 802.11a/b/g lightweight access point cost |
| 802.11 b/g only | Supports legacy clients<br>Lowest cost Cisco 1000 Series IEEE 802.11a/b/g lightweight access point | 802.11g performance is limited in the presence of 802.11b users<br>Limited capacity<br>Does not support 802.11a clients |
| 802.11a only | High performance<br>High Capacity | Does not support 802.11b/g clients |

# Coverage Area Requirements

Customers typically want seamless full RF coverage or partial RF coverage in conference rooms, lunch rooms, etc.

Coverage holes are areas where clients cannot receive a signal from the wireless network. When deploying wireless networks, there is a trade-off between the cost of the initial network deployment and the percentage of coverage hole areas. A reasonable coverage hole criterion for launch is between 2 and 10 percent. This means that between two and ten test locations out of 100 random test locations may receive marginal service. After launch, the Cisco WLAN Solution Radio Resource Management (RRM) will identify these coverage areas and report them to the IT manager, allowing the IT manager to fill holes based on user demand.

# Building Type

Identifying the building type and its RF characteristics is critical in determining how many Cisco Radios will be needed. The following table shows three basic building types that are common in the enterprise market. If the building does not fall into one of these categories then some amount of professional service may be needed.

*Table 2 Building Type*

| Building Type | Description |
|---|---|
| Typical Office Space | This is the most common enterprise building. This type of building consists of large open cubicle areas with walled offices and conference rooms. |
| Drywall Office Space | This type of building consists of mostly offices with dry wall characteristics. |
| Brick/Concrete Walled Office Space | This type of building consists of concrete or brick walls for both exterior and for interior office space. Old buildings found on college campuses are good examples of this type of building. |
| Other | There are some buildings such as sports arenas and stock exchanges that do not fit into one of the typical categories. These buildings typically require some special consideration or professional service. |

# Building Homogeneity

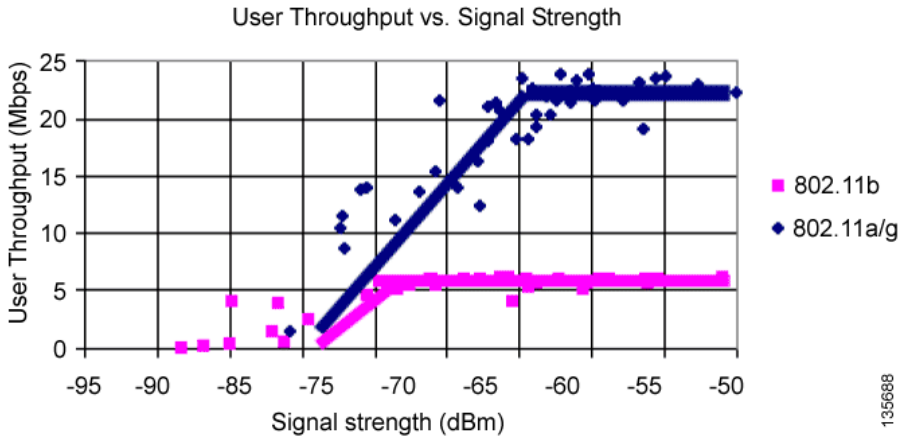
If the building does not have similar RF characteristics throughout the coverage area, the coverage area needs to be divided into areas with similar characteristics and the design process repeated for each area.

# Average Client Throughput

The desired average user throughput is 1 Mbps to 18 Mbps.

Average client throughput is related to 802.11 protocol and signal strength, and thus Cisco 1000 series lightweight access point density. In terms of protocol, 802.11b can support an average user throughput of up to 6 Mbps and 802.11a and 802.11g can support a typical average user throughput of up to 20 Mbps with reasonable Cisco 1000 series lightweight access point densities. Generally, the stronger the signal, the higher the client throughput. However, as shown in the figure below, there is a point above which a stronger signal does not increase client throughput. For 802.11b networks, this point is typically -75 dBm, above which average client throughput is 5 to 6.5 Mbps regardless of increase in signal strength. For 802.11a networks, this point is typically between -50 dBm and -60 dBm, above which average client throughput is 24 to 30 Mbps regardless of increase in signal strength. Note that for 802.11a, the range over which the average client throughput improves is between -80 dBm and -50 dBm.

*Figure 1 Average Client Throughput versus Signal Strength*




The following figures show the relationship between average client performance and Cisco 1000 series lightweight access point density for 802.11a and 802.11b clients. The typical Cisco 1000 series lightweight access point density for most enterprise buildings deployed for full coverage is between 2500 and 7000 square feet per Cisco 1000 series lightweight access point.

*Figure 2 Average 802.11a Client Throughput versus Cisco 1000 Series Lightweight Access Point Density for Typical Office Spaces*

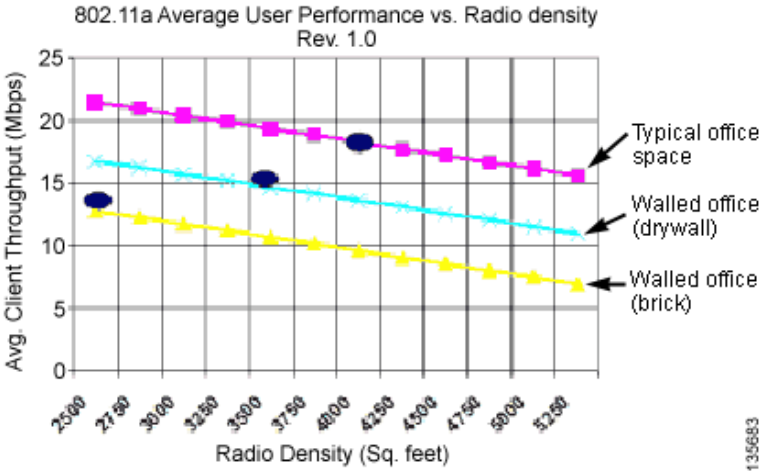
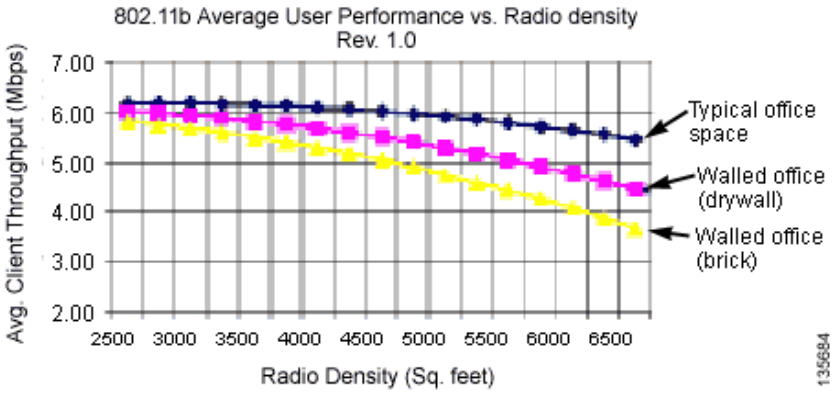


*Figure 3 Average 802.11b Client Throughput versus Cisco 1000 Series Lightweight Access Point Density for Typical Office Spaces*




The following table provides a summary of Cisco Radio coverage as a function of building type and average user performance requirements:

*Table 3 Coverage Area*

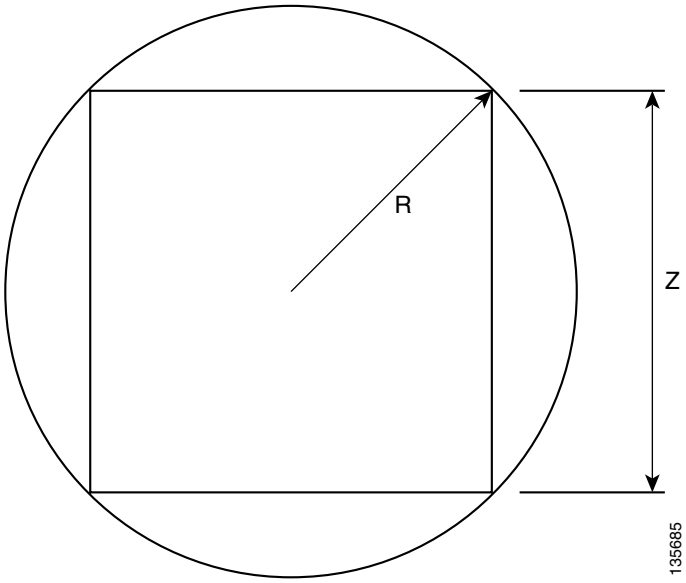
| Coverage Area | Area = $Z^2$ (square ft.) | R (ft.) | Z (ft.) |
|---|---|---|---|
|  | 2500 | 35 | 50 |
| | 3000 | 39 | 55 |
| | 3500 | 42 | 59 |
| | 4000 | 45 | 63 |
| | 4500 | 47 | 67 |
| | 5000 | 50 | 71 |
| | 5500 | 52 | 72 |
| | 6000 | 55 | 57 |
| | 6500 | 57 | 81 |
| | 7000 | 59 | 84 |
| | 7500 | 61 | 87 |
| | 8000 | 63 | 89 |

*Figure 4 Average Client Throughput versus Signal Strength*

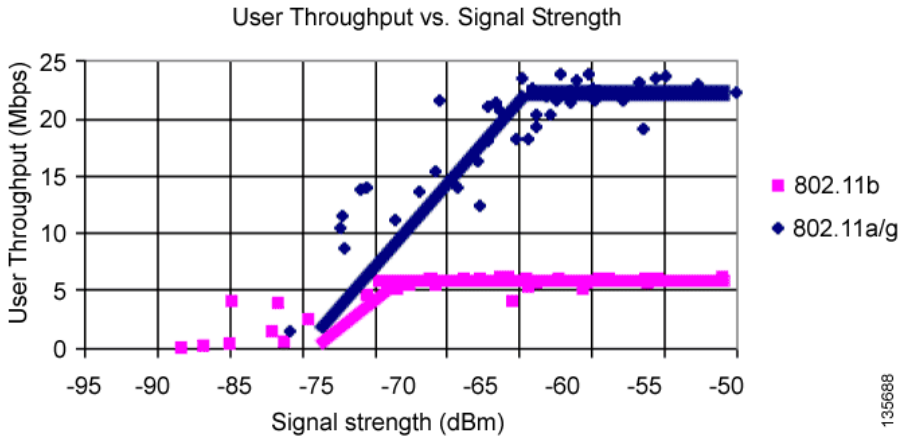



*Table 4 Building Type and Average User Throughput*

| Building Type | Measurement (See Note 1) | Average User Throughput | | | |
|---|---|---|---|---|---|
| | | 1 Mbps | 5 Mbps | 12 Mbps (See Note 2) | 18 Mbps (See Note 2) |
| Typical Office | A (ft.$^2$) | 7000 | 6000 | 5000 | 4000 |
| | R (ft.) | 59 | 55 | 50 | 45 |
| | Z (ft.) | 84 | 77 | 71 | 63 |
| | S (dBm) | -85 | -75 | -70 | -65 |
| Drywall Office Space | A (ft.$^2$) | 5000 | 4000 | 3500 | 3000 |
| | R (ft.) | 50 | 45 | 42 | 39 |
| | Z (ft.) | 71 | 63 | 59 | 55 |
| | S (dBm) | -85 | -75 | -70 | -65 |
| Brick Wall Office Space | A (ft.$^2$) | 4000 | 3500 | 3000 | N/A |
| | R (ft.) | 45 | 42 | 39 | - |
| | Z (ft.) | 63 | 59 | 55 | - |
| | S (dBm) | -85 | -75 | -70 | - |
| Hospital | A (ft.$^2$) | 5000 | 4000 | 3500 | 3000 |
| | R (ft.) | 50 | 45 | 42 | 39 |
| | Z (ft.) | 71 | 63 | 59 | 55 |
| | S (dBm) | -85 | -75 | -70 | -65 |
| Warehouse/Manufacturing | A (ft.$^2$) | 7000 | 6000 | 5000 | 4000 |
| | R (ft.) | 59 | 55 | 50 | 45 |
| | Z (ft.) | 84 | 77 | 71 | 63 |
| | S (dBm) | -85 | -75 | -70 | -65 |

Note1: S is the minimum signal strength over 95% of the coverage area.

Note2: Requires 802.11a.

## Voice over IP Requirements

When deploying 802.11 wireless LANs to support Voice over IP (VoIP) telephones, such as SpectraLink NetLink Telephones, a few special considerations are needed in the deployment process. When deploying an 802.11b voice system, seamless full coverage with an average user throughput of 5 Mbps or more should be used. Areas such as stairways, bathrooms, cafeterias and outside areas may require special consideration and additional access points. These are areas that are not typically critical for data users but are critical coverage areas for voice users who want seamless coverage.

# Determining Deployment Strategy

Depending on the customer and the deployment requirements determined in "Determining Deployment Requirements," there are three strategies for designing and deploying an Cisco WLAN Solution wireless network. The following table provides guidelines for which one is appropriate.

***Table 5 Deployment Strategy***

| Deployment Option | Deployment Requirements |
|---|---|
| Professional Site Survey | This option should be considered when:<br>• Deployments require full coverage with 0% coverage holes.<br>• The RF characteristics of the building vary throughout the coverage area.<br>• The building type is not typical or does not fit into one of the standard configurations (e.g. Arena, Convention Center, Stock Exchange).<br>• The cost or logistics of running Ethernet cables is prohibitive. |
| RF Prediction with Optional Site Survey | This option should be considered when:<br>• The RF characteristics of the building vary throughout the coverage area.<br>• The building type is not typical (e.g. Arena, Convention Center, Stock Exchange).<br>• A Professional Site Survey is too costly, and a graphical coverage plot is desired before deployment. |
| Basic Guidelines with Optional Site Survey | This option is adequate for 80% to 90% of deployments, and is suitable when:<br>• The RF Characteristics are homogenous throughout the coverage area.<br>• The building type can be easily classified. |

# Professional Site Survey

Generally, the professional site survey involves temporarily placing one or more Cisco 1000 series lightweight access points and then measuring the resulting coverage(s). Based on the results of these measurements, Cisco 1000 series lightweight access points are relocated and/or reoriented to achieve complete coverage of the target space without unnecessary coverage overlap or coverage holes between Cisco 1000 series lightweight access points. This approach is appropriate given the following deployment requirements:

- Full Coverage with 0% coverage holes
- The RF characteristics of the building vary throughout the coverage area
- The building type is not typical (Arena, Convention Center, Stock Exchange)

During the Professional Site Survey, one or two access points are placed at or near one end of a building. Their coverage is measured and the access points are relocated and reoriented as necessary to ensure that this end of the building is completely covered. When measurements confirm that this is true, a second or third access point is added so its coverage area somewhat overlaps the coverage area of the first access point(s). (Generally, 10 to 15 percent coverage overlap is considered appropriate.) Its coverage is measured to ensure that its overlap with the first access point(s) is appropriate and to determine the coverage in the rest of the building. This process continues, adding a third or fourth access point and so on. This process continues until all areas of the building are covered.

The professional site survey allows the designer to provide full seamless coverage; however, the Radio Resource Management (RRM) ensures that the channel assignments and transmit power levels are optimized for the Cisco WLAN Solution coverage area, freeing the site survey professional from having to fine-tune these variables.

Other variables designers may include static transmit power level, geometric pattern used for access point placement, and the antenna type (omnidirectional, wide beam directional, or narrow-beam directional). Some designers like to have the flexibility to select antenna types most suited to specific buildings.

Designers may differ in the criteria they use to determine coverage area. Some prefer to use signal strength (RSSI), some prefer signal-to-noise ratio (SNR), and others prefer to use some indication of throughput, such as packet retry rate. These measurements are normally made using site survey software provided by a wireless LAN manufacturer, running on a PC or PDA. They may also be made using one of the handheld measurement tools currently available, such as Air Magnet or Berkeley Varitronics. The measurement tools are usually selected based on their ability to measure the desired variable, RSSI, SNR, or packet retry rates.

# RF Prediction with Optional Site Survey

RF prediction consists of importing the floor plans of the coverage area into a Computer Aided Design system in which a user can place access points, draw in the walls of the building and assign RF characteristics to the walls. Depending on the confidence level of the estimates made for the building RF characteristics and the cost of filling in potential coverage holes after deployment, an optional site survey may be appropriate to verify assumptions. This approach is appropriate given the following deployment requirements:

- Full Coverage with 2 to 10% coverage holes
- The RF characteristics of the building vary throughout the coverage area
- The building type is not typical (Arena, Convention Center, Stock Exchange)

## Basic Guidelines with Optional Site Survey

The Basic Guideline approach is based on empirical data from existing wireless deployments and is adequate for most deployments. This approach is based on most enterprise buildings having common RF characteristics, and that only a part of the building needs to be characterized to verify the access point coverage for the entire building. This approach leverages the algorithms built into the Cisco WLAN Solution Radio Resource Management (RRM) that ensure that the overlap between access points is minimized and that coverage holes are detected and eliminated before clients find them.

When deploying 802.11 wireless LANs to support Voice over IP (VoIP) telephones, such as SpectraLink NetLink Telephones, a few special considerations are needed in the deployment process. When deploying an 802.11 voice system, full coverage with an average user throughput of 5 Mbps or more should be used. Areas such as stairways, bathrooms, cafeterias and outside areas may require special consideration and access points. These are areas that are not typically critical for data users but are critical coverage areas for voice users who want seamless coverage.

# Example Basic Guidelines Process

This section describes the basic factors that you need to consider before deploying access points.

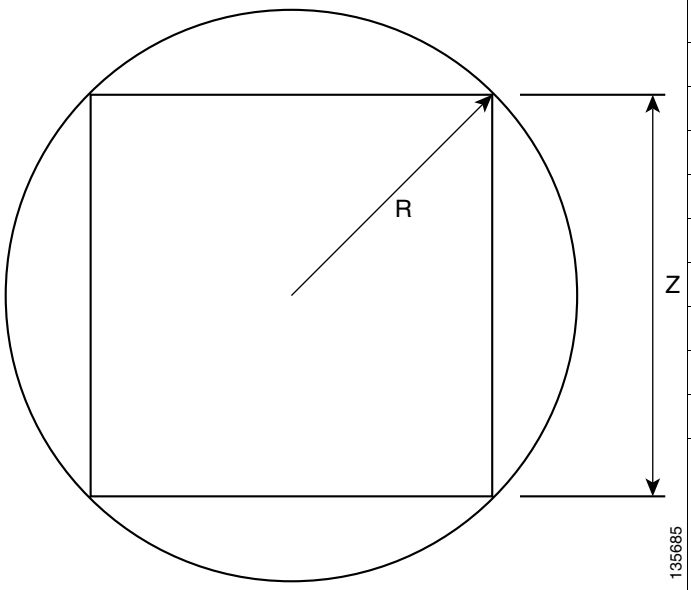
Refer to each of the sections below for a detailed explanation:



## Determining the Radius and Z Factor

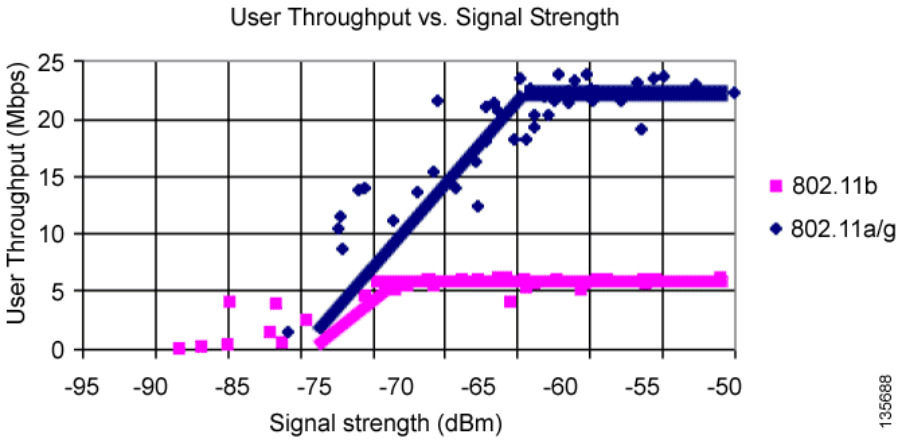
This section helps you to determine the coverage area of a Cisco Radio based on the building type and desired average user performance using the table below. The Z factor represents the length of a square that corresponds to the coverage area of the access point.

*Table 6 Radius and Z Factor Table*

| Coverage Area | Area = $Z^2$ (square ft.) | R (ft.) | Z (ft.) |
|---|---|---|---|
|  | 2500 | 35 | 50 |
| | 3000 | 39 | 55 |
| | 3500 | 42 | 59 |
| | 4000 | 45 | 63 |
| | 4500 | 47 | 67 |
| | 5000 | 50 | 71 |
| | 5500 | 52 | 72 |
| | 6000 | 55 | 57 |
| | 6500 | 57 | 81 |
| | 7000 | 59 | 84 |
| | 7500 | 61 | 87 |
| | 8000 | 63 | 89 |



The following graph displays actual measurements, and shows the relationship between actual user throughput and corresponding signal strength.



The following table includes building types, and shows the coverage area measurements for various average user throughputs.

*Table 7 Building Type and Average User Throughput*

| Building Type | Measurement (Note 1) | Average User Throughput | | | |
|---|---|---|---|---|---|
| | | 1 Mbps | 5 Mbps | 12 Mbps (See Note 2) | 18 Mbps (See Note 2) |
| Typical Office | A (ft.$^2$) | 7000 | 6000 | 5000 | 4000 |
| | R (ft.) | 59 | 55 | 50 | 45 |
| | Z (ft.) | 84 | 77 | 71 | 63 |
| | S (dBm) | -85 | -75 | -70 | -65 |
| Drywall Office Space | A (ft.$^2$) | 5000 | 4000 | 3500 | 3000 |
| | R (ft.) | 50 | 45 | 42 | 39 |
| | Z (ft.) | 71 | 63 | 59 | 55 |
| | S (dBm) | -85 | -75 | -70 | -65 |
| Brick Wall Office Space | A (ft.$^2$) | 4000 | 3500 | 3000 | N/A |
| | R (ft.) | 45 | 42 | 39 | - |
| | Z (ft.) | 63 | 59 | 55 | - |
| | S (dBm) | -85 | -75 | -70 | - |
| Hospital | A (ft.$^2$) | 5000 | 4000 | 3500 | 3000 |
| | R (ft.) | 50 | 45 | 42 | 39 |
| | Z (ft.) | 71 | 63 | 59 | 55 |
| | S (dBm) | -85 | -75 | -70 | -65 |
| Warehouse/Manufacturing | A (ft.$^2$) | 7000 | 6000 | 5000 | 4000 |
| | R (ft.) | 59 | 55 | 50 | 45 |
| | Z (ft.) | 84 | 77 | 71 | 63 |
| | S (dBm) | -85 | -75 | -70 | -65 |

Note1: S is the minimum signal strength over 95% of the coverage area.

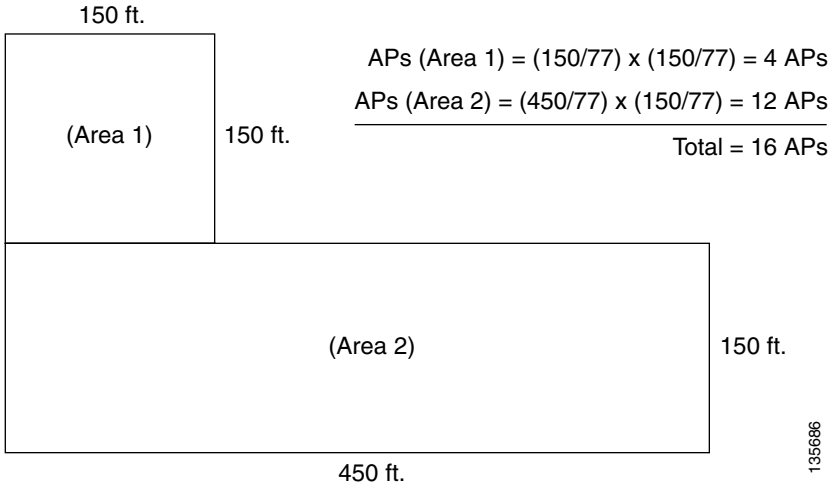
Note2: Requires 802.11a.

# Determining How Many Access Points are Needed

In this section you define the coverage area for each floor in the building and divide it into rectangles and calculate how many access points are needed by dividing the area of each rectangle by the Z factor squared.

The example shown below is for a typical office building with a desired average user throughput of 5 Mbps.

***Figure 5 Determining the Number of access points***



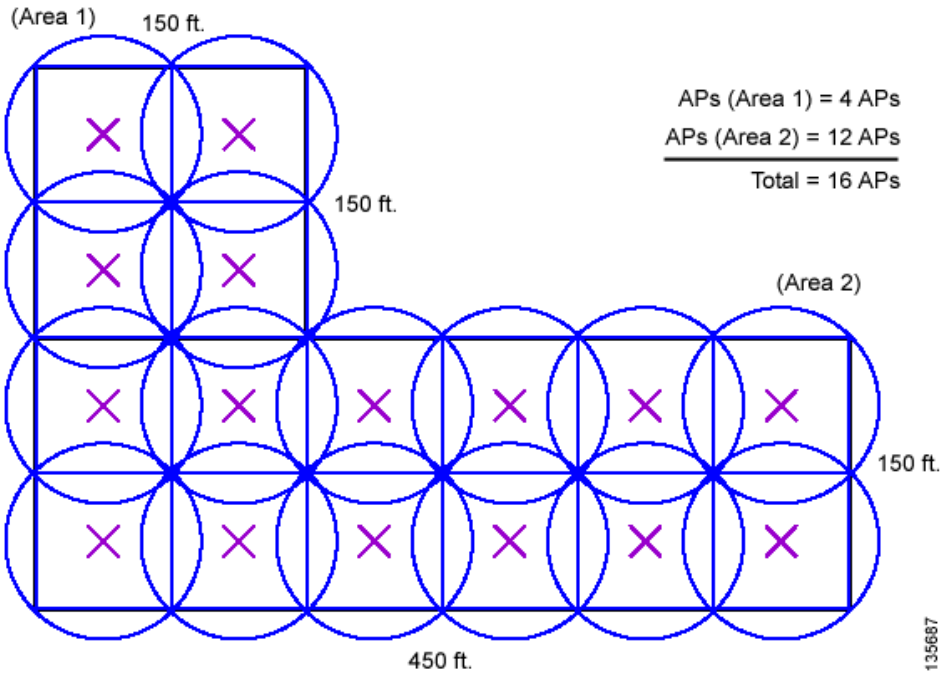

# Optional Minimal Site Survey

If the building type estimate needs to be verified, a quick minimal site survey can be done to verify the signal strength of the access point for the coverage radius. For example, for a typical office building with a desired average user performance of 12 Mbps a signal strength of -75 dBm or better is needed and the site survey will be used to verify that the -75 dBm coverage radius of a Cisco 1000 Series lightweight access point is 50 feet. Review the "Optional Minimal Site Survey" section of this document for how to perform a site survey using a Cisco 1000 Series lightweight access point.

## Placing Access Points

The final step is to determine the installation location of the access point. First, using the radius or Z factor found in Step A, distribute the circles or squares evenly across the rectangles found in Step B. Note that the large "X" in the middle of each coverage area indicates the approximate location of the Cisco 1000 series lightweight access points. Also notice that the Z factor between the centers of each Cisco 1000 series lightweight access point location is the same as the Cisco 1000 series lightweight access point squares when the squares are directly adjacent to each other, as shown in this figure.

***Figure 6 Access Points Location***




# Optional Minimal Site Survey

If the "Building Type" or RF characteristics assumptions are in doubt, complete this step to verify those assumptions.

The minimal site survey consists of the following:

- Collecting Tools and Materials
- Selecting Cisco 1000 Series Lightweight Access Point Locations
- Preparing Optional Cisco 1000 Series Lightweight Access Point Tripod Test Assemblies
- Positioning a Cisco 1000 Series Lightweight Access Point at Each Planned Location
- Verifying RF Coverage Using the Site Survey Tool

# Collecting Tools and Materials

Before you start a site survey, you must collect some items:

- Maps or building plans of the areas to be covered, with a feet or meters scale included.
- Duct Tape and Cable Ties.
- T-10 Security Torx screwdriver.
- A PC with a crossover CAT-5 or higher Ethernet cable capable of establishing a telnet session with each Cisco 1000 series lightweight access point.
- A Site Survey Tool, consisting of a computer equipped with 802.11a and 802.11b/g transceivers and the signal strength monitoring and recording software.
- Between one and five Cisco 1000 series lightweight access points with power supplies:
  - Cisco 1000 series lightweight access points.
  - Available Power Sources:
  - * Recommended factory-orderable 110 VAC-to-48 VDC power supplies.
  - * Optional Ethernet Power Injectors: Single RJ-45, 300 mA 48 VDC output, (MILAN Model MIL-L1611, or equivalent). Refer to "Preparing Optional Cisco 1000 Series Lightweight Access Point Tripod Test Assemblies" for more information.
  - Recommended temporary stands, such as photographer's telescoping lighting stands, that can be raised to ceiling height. Refer to "Preparing Optional Cisco 1000 Series Lightweight Access Point Tripod Test Assemblies" for more information.
  - Optionally, you can temporarily position the Cisco 1000 series lightweight access points at or near ceiling height using ladders and/or tall bookcases, but they do not offer the portability of the Cisco 1000 series lightweight access point tripod test assemblies.

# Selecting Cisco 1000 Series Lightweight Access Point Locations

Using the Cisco Radio density estimate from "Determining Deployment Requirements" and the guidelines for placing Cisco 1000 series lightweight access points described in "Cisco 1000 Series Lightweight Access Point Placement Guidelines," determine the location for three to five Cisco 1000 series lightweight access points in a typical test coverage area.

# Preparing Optional Cisco 1000 Series Lightweight Access Point Tripod Test Assemblies

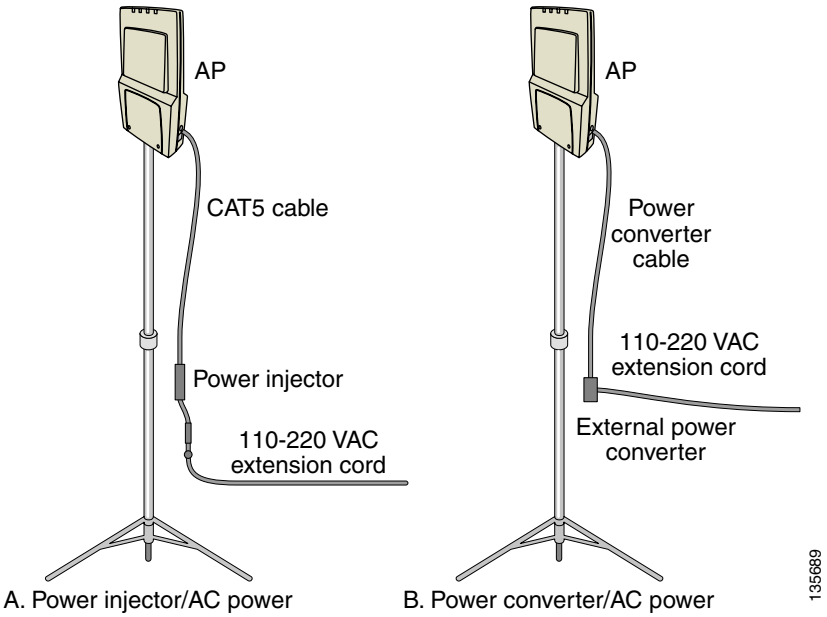
You do not need to use the optional Cisco 1000 series lightweight access point tripod test assemblies described in this section--you can tape or cable tie the Cisco 1000 series lightweight access points to the ceiling, or place them on tall cabinets or ladders. However, if you must move them from their original positions, having them mounted on the tripod test assembly stands makes it easier to relocate them.

**Caution** You only need AC extension cords if you have enough 110 VAC electrical outlets within easy reach of all potential Cisco 1000 series lightweight access point mounting locations. If you do use AC power cords, make sure you use duct tape to avoid creating trip hazards with the extension cords.

- Contact Cisco WLAN Solution for the Cisco 1000 series lightweight access point mounting brackets and recommended telescoping stand screws.
- Use duct tape and/or cable ties to assemble the telescoping stands, Cisco 1000 series lightweight access points, CAT-5 Ethernet cables, Ethernet power injectors, power inverter, external power supply, battery packs, and/or extension cords as shown in the following figure.

**Note** Make sure you support the CAT-5 and power cables to remove harmful stress on the Cisco 1000 series lightweight access point connectors.

***Figure 7 Cisco 1000 Series Lightweight Access Point Tripod Test Assemblies***




- Continue with "Positioning a Cisco 1000 Series Lightweight Access Point at Each Planned Location."

# Positioning a Cisco 1000 Series Lightweight Access Point at Each Planned Location

This section assumes that you have determined the Cisco 1000 series lightweight access point locations as described in "Cisco 1000 Series Lightweight Access Point Placement."

Refer to "Preparing Optional Cisco 1000 Series Lightweight Access Point Tripod Test Assemblies" for instructions on how to power the Cisco 1000 series lightweight access points at each planned location.

**Caution** If you are using AC extension cords, make sure you use duct tape to avoid creating trip hazards.

- Using the floor plans and/or maps from "Cisco 1000 Series Lightweight Access Point Placement Guidelines," place the Cisco 1000 series lightweight access point assemblies at or near the indicated locations.

- If any power is being applied to the Cisco 1000 series lightweight access point, remove the power now.

## Verifying RF Coverage Using the Site Survey Tool

- Follow the manufacturer's instructions supplied with the Site Survey Tool to collect signal strength information from the coverage area being tested.
- If necessary, reposition the Cisco 1000 series lightweight access point(s) in the coverage area and repeat the previous steps until you have verified coverage, and then continue.

# Cisco 1000 Series Lightweight Access Point Placement Guidelines

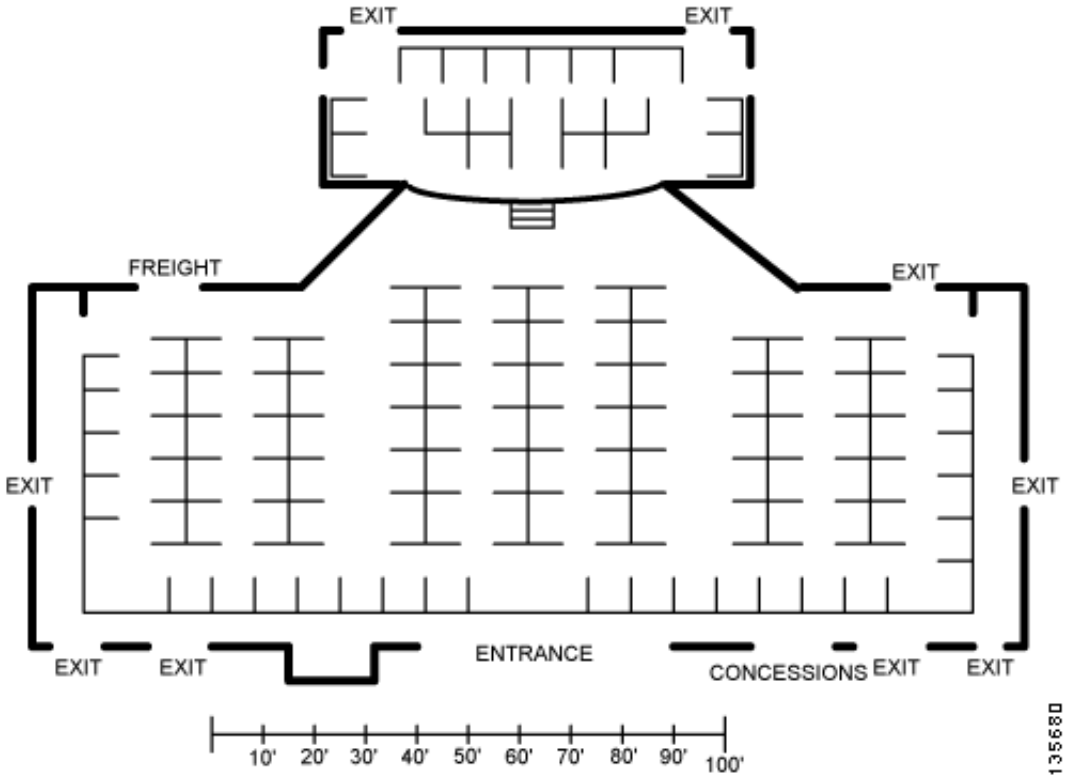
This step describes where and how Cisco 1000 series lightweight access points should be placed. You must know certain information to select Cisco 1000 series lightweight access point locations:

- Collecting Maps or Building Floor Plans
- Noting Deployment Constraints
- Access Point Placement Guidelines
- Cisco 1000 Series Lightweight Access Point Placement

# Collecting Maps or Building Floor Plans

Collect maps or building plans of the areas to be covered, with a feet or meters scale included.

*Figure 8 Typical Floor Plan -- Open Auditorium with Cubicles*




# Noting Deployment Constraints

If the Cisco 1000 series lightweight access points are to use existing wiring, note these locations on the map.

If there are locations where Cisco 1000 series lightweight access points cannot be placed, note these locations on the map.

# Access Point Placement Guidelines

- Position the Cisco 1000 series lightweight access points above obstructions.
- Position the Cisco 1000 series lightweight access points vertically near the ceiling in the center of each coverage area, if possible.
- Position Cisco 1000 series lightweight access points in locations where users are expected to be. For example, large rooms are typically a better location for Cisco 1000 series lightweight access points than a hallway.

# Cisco 1000 Series Lightweight Access Point Placement

- Place Cisco 1000 series lightweight access points on the floor plan using the "Noting Deployment Constraints" and "Access Point Placement Guidelines" sections such that coverage circles are touching or slightly overlapping as illustrated in the following example.

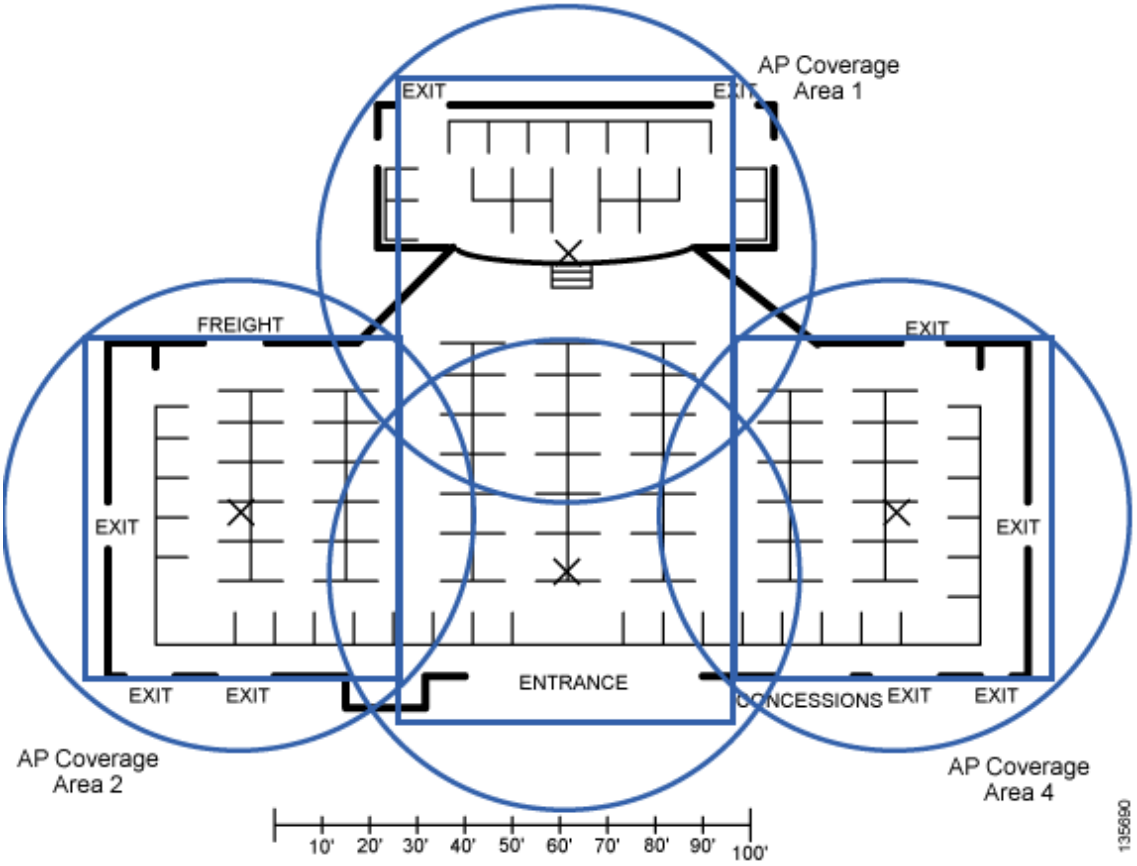
Example

- The open auditorium (a Warehouse/Manufacturing Building Type) shown in the "Collecting Maps or Building Floor Plans" section is approximately 20,000 square feet.
- As described in the "Voice over IP Requirements" section, a typical SpectraLink NetLink Telephone requires approximately 6 Mbps 802.11b throughput, resulting in a minimum A = 5,000 square foot coverage area per Cisco 1000 series lightweight access point for an open area.
- Dividing 20,000 square feet by A = 5,000 square feet per Cisco 1000 series lightweight access point results in at least four Cisco 1000 series lightweight access points required for the auditorium.
- According to the guidelines in "Determining Deployment Requirements," an A = 5,000 square foot coverage area results in an R = 50-foot coverage circle radius, or Z = 71-foot coverage square.
- On your floor plan map, arrange four 50-foot radius coverage circles so they overlap, as shown in the following figure.

**Note** The Cisco 1000 series lightweight access point coverage areas should overlap approximately 10% to 15% to minimize the number of coverage holes.

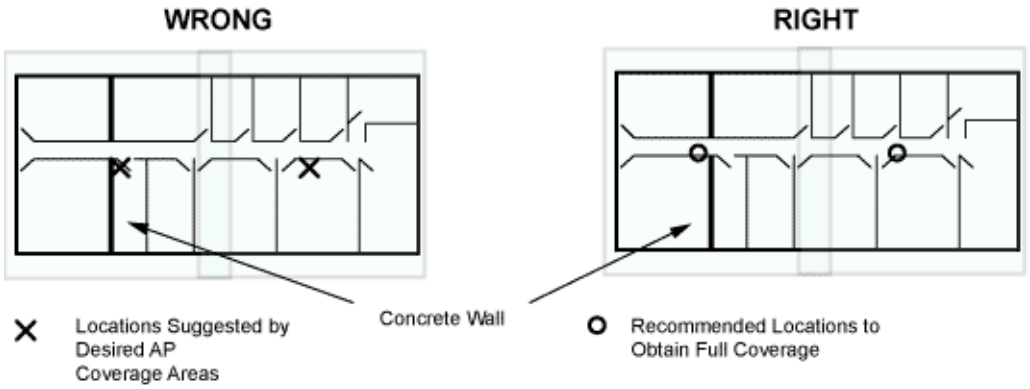
**Note** The large "X" in the middle of each circular Cisco 1000 series lightweight access point coverage area--those are the indicated locations of the associated Cisco 1000 series lightweight access points.

*Figure 9* *802.11a Cisco 1000 Series Lightweight Access Point Coverage Areas Arranged on Typical Warehouse Floor Plan*



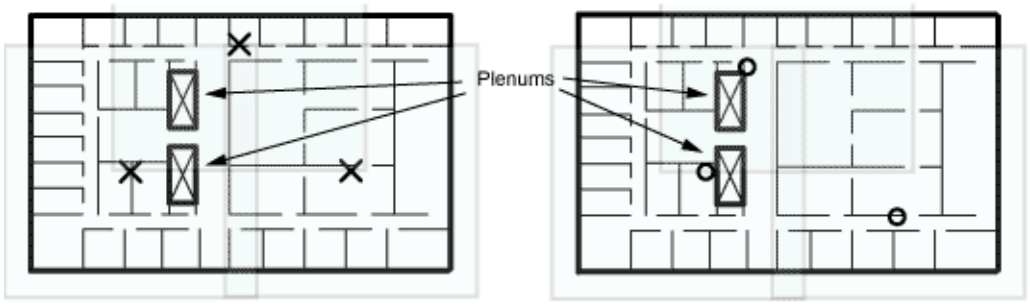
- See the following figure for a description of what to do if there are any large metal obstructions where you plan to install Cisco 1000 series lightweight access points.

***Figure 10 What to do about Metal RF Barriers in a Planned Cisco 1000 Series Lightweight Access Point Location***



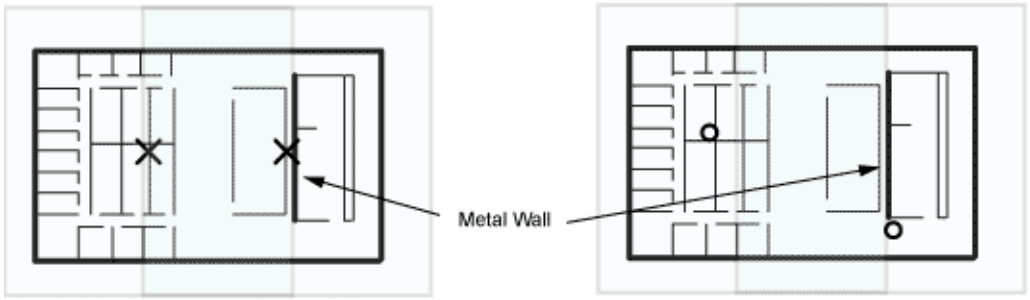

**Notes:** Both Locations moved up to mount in hallways, Left Location moved to other side of wall to provide coverage on left side of wall, and Right Location moved slightly left to provide better coverage to overlap area. Also note that the coverage areas remain where they were for coverage testing.

A. I Have a Large Concrete Wall in the Middle of One Coverage Area




**Notes:** Upper Location moved to hallway at corner of plenum, Left Location moved next to plenum, Right Location moved to hallway, and Left Location moved to hallway to provide better coverage to overlap areas. Also note that the coverage areas remain where they were for coverage testing.

B. I Have Large HVAC Plenums Next to Planned Locations




**Notes:** Right Location moved slightly to the right of one end of the Metal Wall in a hallway, and Left Location moved up and to the left to provide better coverage to overlap area.
Also note that the coverage areas remain where they were for coverage testing.

135691

C. I Have a Large Metal Wall Next to a Planned Location

- When you are installing Cisco 1000 series lightweight access points using the "RF Prediction with Optional Site Survey" or "Basic Guidelines with Optional Site Survey" method:
  - Complete "Optional Minimal Site Survey" for the optional minimal site survey, or
  - Use the *Quick Start Guide: Cisco Aironet 1000 Series Lightweight Access Points with Internal Antennas* or *Quick Start Guide: Cisco Aironet 1000 Series Lightweight Access Points with External Antennas* to install the Cisco 1000 series lightweight access points without a minimal site survey.

# Where to Go from Here

You have successfully planned and tested the Cisco 1000 series lightweight access point RF coverage in your target area, and have determined where the Cisco 1000 series lightweight access points are to be located.

Continue with *Quick Start Guide: Cisco Aironet 1000 Series Lightweight Access Points with Internal Antennas* or *Quick Start Guide: Cisco Aironet 1000 Series Lightweight Access Points with External Antennas* for final installation instructions.