RF Site Survey and Antenna Selection For Optimum Wireless LAN Performance

Introduction

Businesses and institutions investing in wireless local area network (LAN) solutions are realizing rapid and significant results in return. A 1998 ROI cost/benefit study conducted by the Wireless Local Area Network Association found that the average payback time for the initial cost of wireless LAN installations was 8.9 months across all industries. In the same study, 97% of respondents said that wireless LANs met or exceeded their expectations to provide their company with a competitive advantage, while 92% reported definite economic and business benefits found after installation.

As companies extend into wireless networking, they need to carefully define the purpose and goals of their new technology. For almost any organization, WLANs must provide large coverage areas, handle extensive traffic, and support a continuously clear, reliable signal. Increasing numbers of companies want their new wireless network to manage converged voice and data communications, or accommodate high data rate transmissions.

To assure needs are met, companies should perform a radio frequency (RF) site survey prior to the wireless installation. A site survey provides a detailed specification addressing coverage, equipment placement, power considerations, and wiring requirements. It also serves as a guide for the network design and for installing and verifying the wireless communication infrastructure.

The Importance of A Site Survey

The site survey's primary objective is to ensure mobile workers – the wireless LAN's "clients"– will not find that the radio frequency signal drops out as they move around the facility, thus becoming disconnected from the host device or other mobile computing devices and their work -- and potentially causing data loss.

The survey also helps customers to clearly understand the impact of the addition of wireless local area networking on their overall networking and system requirements. Important questions it will answer include: Does the existing backbone have adequate bandwidth to handle the overlaid wire-less network? In a cellular architecture, are there sufficient resources to include wireless capabilities?

Performing a site survey therefore provides a realistic understanding of the wireless installation. It determines whether a site has unusually high interference issues to resolve, or capacity is greater than anticipated. And an accurate site survey enables accurate quotes to guide financial decision-making.

For a company's first installation, it is usually wiser to bring in professional assistance to conduct the site survey. This is available from wireless vendors and value-added resellers (VARs). Vendors also offer courses in RF Site Analysis that can help in-house personnel understand the surveying process, enabling the same in-house personnel to have the experience to perform wireless system expansions.

Site Survey Considerations

There are four major areas to be considered when developing a wireless installation design. These should all be considered in terms of future expansion as well as current needs.

1. Range and Coverage

The physical area and characteristics of the space where wireless coverage is needed must first be defined. Is it inside or outside? Does the site need coverage to be isolated to certain spaces? A wireless access point's coverage area is spherical in shape. The size of the total area to be covered— its shape, use and the nature of construction materials used, (see Interference Immunity below) — will determine the number of access points needed. Coverage is generally mapped with cells overlapping by 30% to support continuous communications as mobile users move around the facility. Access point and antenna ranges differ by vendor specification.

Corporate Headquarters
PO Box 1209
Mt. Gilead, NC 27306

Compsee

International Sales Office
2500 Port Malabar Blvd.
Palm Bay, FL 32905

(800) 628-3888 • (321) 724-4321 – V • (321) 723-2895 – F • sales@compsee.com • www.compsee.com

2. Data Rate and Capacity

Determining the required data rate and capacity are essential to assessing the number of access points needed for the site. Requirements to be under-stood include: How many users is the organization planning for? What sort of applications will they be running? What types of equipment do they plan to use? How is this expected to change over the next 1-3 years? As site capacity can be scaled up by adding more access points, it is wise to plan the initial installation to allow for future growth.

Today's wireless LANs generally operate at 1-2 Mbps, which enables both robust data transmission and wireless voice/data communication. Some users need to transmit at higher data rates, and may wish to evaluate today's new 11 Mbps wireless LAN products. For example, hospitals transmitting high resolution images such X-rays or MRIs; retailers using wireless multimedia applications such as video streaming for kiosks; and companies looking for rapid reconfiguration infrastructures, more collaborative work environments, or more flexible training options. All these may make effective use of higher data rate wireless LANs.

High-speed technology comes with built-in limitations, however. Because the wider bandwidth automatically shortens range, high data rate wireless LANs almost always require more access points. The most effective installations, therefore, will mix 11 Mbps and 2 Mbps access points on their network, supporting applications that take advantage of zones with higher speed coverage to meet business requirements, while optimizing longer range coverage elsewhere. High data rate sites, therefore, require a very thorough survey.

3. Interference Immunity

It is important to assess potential sources of interference, both now and in the future. These can include sensitive hospital equipment, previously installed RF systems, and the upcoming Bluetooth initiative for very short-range wireless communications, supporting consumer devices such as personal data assistants.

In outdoor installations, moving vehicles such as trucks, planes, or other equipment may also be large enough to temporarily block RF signals. For example, for good vertical signal penetration in a busy transportation yard, it may be decided to place access points at very high locations. Or, access points may be placed at opposite ends of the yard, ensuring transmission if one signal is shad-owed.

The site survey will also be used to examine potential antenna performance patterns to decide on an omni-directional or directional antenna. Designing a network to avoid interference requires the right combination of signal strength, technology and intelligent access point and antenna placement. (See "Choosing the Right Antenna," on pg.4)

4. Connectivity and Power Requirements

Networking constraints within the environment are among the most commonly overlooked issues covered by the site survey. All of a site's networks – wired or wireless – need to be based on the same standards, usually Ethernet or Token Ring.

In terms of IP segmentation, it is advantageous to keep all networks, wired and wireless, as flat as possible for the best performance. Switched environments add a layer, and wireless performance will depend partly on the quality of the switches and how quickly they update the MAC tables.

Connecting to the wired infrastructure may require different cabling approaches than those used with the site's wired network. Wireless access points are typically installed in ceilings for better coverage, which means that AC power and data cabling will need to be run through some non-conventional areas.

Corporate Headquarters
PO Box 1209
Mt. Gilead, NC 27306

Compsee

International Sales Office
2500 Port Malabar Blvd.
Palm Bay, FL 32905

(800) 628-3888 • (321) 724-4321 – V • (321) 723-2895 – F • sales@compsee.com • www.compsee.com

Site Survey Tools

The measurement step of a site survey consists of setting up temporary antennas and access points. The consultant measures every part of the site with a software survey tool – installed on a handheld computer or laptop – that monitors the signal strength and identifies failure zones. Such site survey tools measure performance between access points, identify sources of interference, and help determine access point placement.

Compsee uses both a handheld survey system and notebook-based tools. For high data rate site surveys, a site survey tool is used consisting of 32-bit Windows application that uses both a notebook containing a PC Card and an access point to collect WLAN transmission statistics in the environment where the network is to be installed. It helps customers to both determine the location and, even more essential for high data rate communications, to calculate the number of access points needed for good cover-age and adequate bandwidth.

Site Survey Check List for Wireless LAN Installation Success

- Identify area of wireless/mobile activity
- Measure radio characteristics of site
- Survey and identify power options
- Verify host connectivity required
- Survey existing network connections and existing equipment
- Analyze results
- Design network for coverage
- Design network as “legal” Ethernet segment
- Plan integration into existing network
- Document equipment placement, power considerations, and wiring

Choosing the Right Antenna

The role of a wireless antenna is to direct radio frequency (RF) power from a radio into the coverage area. Different antennas produce different coverage patterns, however, and need to be selected and placed according to site coverage requirements. There are two types of antennas:

Omni-directional antennas: These have a 360° coverage pattern on a horizontal plane. The coverage pattern is torus-shaped (doughnut-shaped), making them ideal for square or fairly square areas. Omni-directional antennas include:

- Plane antenna
- Ceiling mount dipole antenna
- Rubber duck dipole antenna
- Short rubber duck dipole antenna
- Spectrum24 Sandra "D" antenna
- Magnetic mount dipole antenna

Directional antennas: These concentrate the coverage pattern in one direction. This produces an almost conical-shaped coverage pattern, similar to that of a flashlight. The antenna directionality is specified by the angle of the beam width. Typical beam width angles are from 90° (somewhat directional) to as little as 20° (very directional). The directed beam allows for a longer but narrower coverage pattern, which is ideal for elongated areas, corners and outdoor point-to-point applications. Directional antennas include:

- Yagi antenna (30° beam)
- Patch antenna (70° beam)
- Panel antenna (22° beam)

Corporate Headquarters
PO Box 1209
Mt. Gilead, NC 27306

Compsee

International Sales Office
2500 Port Malabar Blvd.
Palm Bay, FL 32905

(800) 628-3888 • (321) 724-4321 – V • (321) 723-2895 – F • sales@compsee.com • www.compsee.com

Calculating Antenna Site Coverage

An increase in coverage within the beam width is called "antenna gain" and is measured in decibels (dB). Gain improves the range of the signal for better communication. Each 1dB increase in antenna gain results in a range increase of approximately 2.5%. For an unobstructed outdoor site, each 1dB increase in gain results in a range increase of approximately 5%. Actual results vary depending on the amount and type of obstructions at the site.

Optimizing Performance with Antenna Diversity

For sites with many obstructions, performance and signal reception may be improved by placing two antennas at the site. Compsee offers access point with dual antenna ports, creating”diversity” that allows devices to actively switch during reception to the antenna with the best signal.

Positioning Antennas for Best Results

The proper positioning (orientation) of antennas at the site helps to ensure maximum coverage area. Antennas should generally be mounted as high and as clear of obstructions as is practically possible. Best performance is attained when the transmitting and receiving antennas are both located at the same height and within direct line of sight of each other. Access point antennas should be positioned on or close to the ceiling. Omni-directional antennas should be placed in the center of the coverage area whenever possible. If mounted below the coverage area (on a table, desk, etc.), point the top of the antenna up. If mounted above the coverage area (from a ceiling), the top of the antenna must be pointing down. Directional antennas should be pointed in the direction of the coverage area.

Do You Need to Do a Site Survey?

Site surveys differ in their complexity and level of effort, based on the technology and space being surveyed. Small facilities probably do not require one at all; customers can rely on wireless vendor specifications and a good look at the office blueprint. However, for larger installations, the site survey offers a level of security in an arena in which – unlike wired networks – there are many variables to consider. A thoughtful, accurate, and effective assessment of coverage and system requirements will ease the wireless LAN installation process, while laying the groundwork for ongoing expansion.

For further information contact:

Compsee, Inc.
International Sales Office
2500 Port Malabar Blvd. NE
Palm Bay, FL 32905

(800) 628-3888 (V)
(321) 724-4321 (V)
(321) 723-2895 (F)
sales@compsee.com