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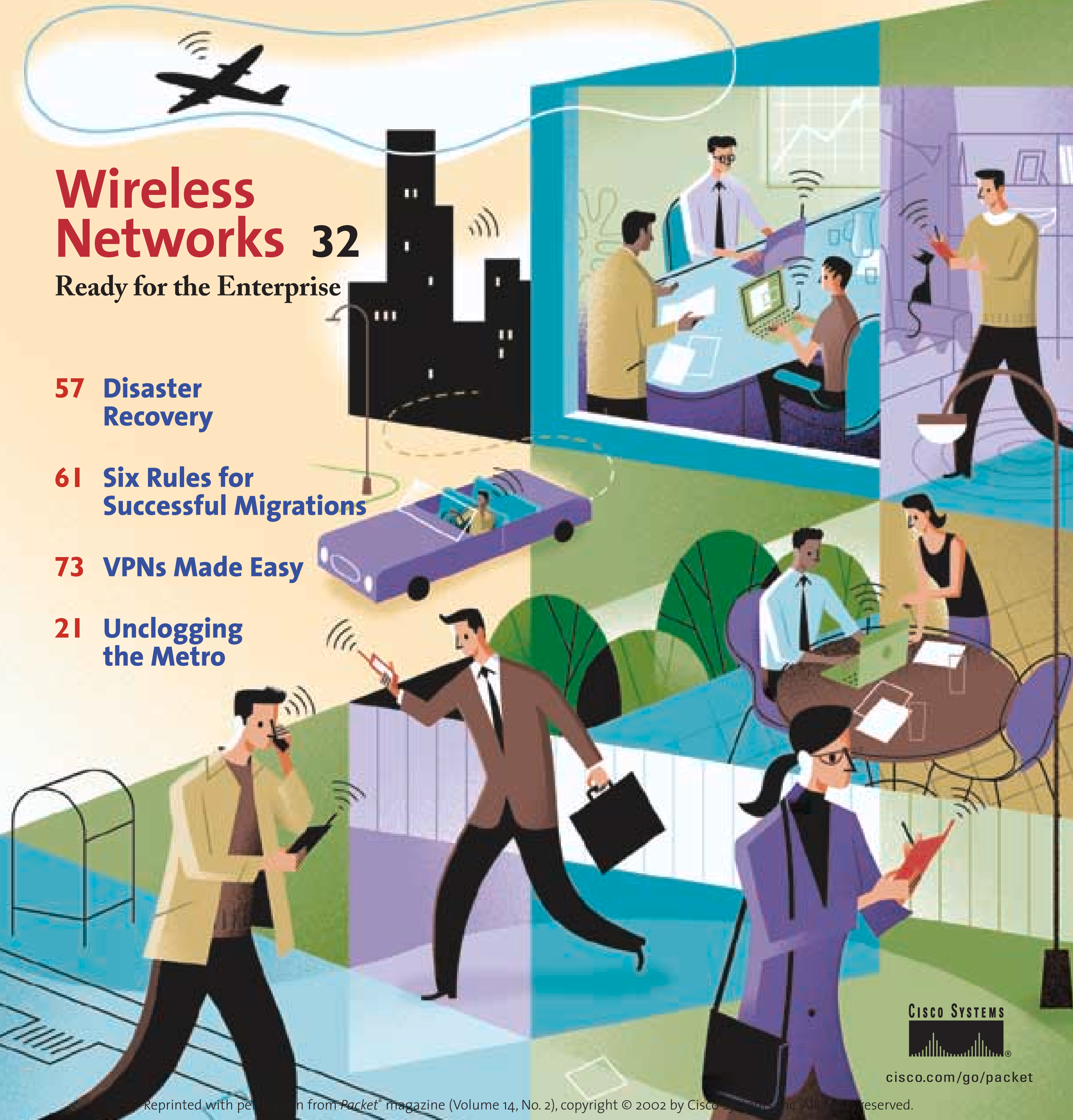

Wireless Networks 32

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Preparing for Wireless LANs

By **BRUCE ALEXANDER AND STEPHEN SNOW**

WIRELESS LOCAL AREA NETWORK (WLAN) technology is more secure, robust, and affordable than ever before. That's why more enterprises are taking advantage of the mobility and productivity benefits that WLANs provide.

Secrets to Successful Wireless Deployment

However, WLAN success is not as simple as plugging in an access point (a wireless "hub") and handing out wireless cards. It requires careful consideration of your network and user requirements, preparation, and a sound deployment and security strategy.

This article, and the one that follows, compose a two-part "WLAN How To" series designed to help you get the most out of your wireless network investment. — Eds.

The Essential Questions

Knowing the answer to the following question is the first step to a successful deployment: Why is the organization considering wireless? If you can clearly define the requirements of your wireless network, you can develop a deployment plan that will not only save networking dollars, but increase both productivity and user satisfaction.

How many of your users require mobility, and where do they need to go? What user applications will run over the WLAN? Listing the applications required by users will help to determine minimum bandwidth requirements and identify WLAN candidates. Keep in mind, however, that wireless is a shared medium, not a switched medium.

While most mainstream networked applications can be migrated to a shared WLAN, it's not necessarily appropriate for all applications.

Knowing your users and their application requirements will help you to define coverage areas that don't waste money—or compromise security—by sending signals beyond the intended areas.

Choosing the Right Technology

After you define the requirements of your users, you will need to choose a wireless technology. For most enterprises, the choice is between IEEE standards 802.11b and 802.11a. The 802.11b standard has been widely adopted by vendors and customers who find its 11-Mbps data rate more than adequate for their applications. Interoperability between many of the products on the market is ensured through the Wireless Ethernet Compatibility Alliance (WECA) Wi-Fi certification program. Therefore, if your network requirements include supporting a wide variety of devices from different vendors, 802.11b is probably your best choice.

The higher data rate of the 802.11a standard (up to 54 Mbps) provides higher per-user throughput when the shared medium is properly provisioned. However, as of this writing, WECA testing for interoperability of 802.11a devices has not yet begun. Only a handful of companies are currently manufacturing 802.11a products (mainly access points and CardBus client adapters). Therefore, 802.11a systems should be targeted for end users whose applications require the higher bandwidth that the new standard affords. For more information on wireless standards, and to determine which one is right for your deployment, see "Welcome to the Wireless Enterprise," page 32.

JOHN BLECK

Data Rates

Because data rates affect range, selecting data rates during the design stage is extremely important. Access points offer clients multiple data rates for the wireless link. For 802.11b, the range is from 1 to 11 Mbps in four increments, while for 802.11a the range is 6 to 54 Mbps in seven increments. The client cards will automatically switch to the fastest possible rate of the access point; how this is done varies from vendor to vendor. Because each data rate has a unique cell of coverage (the higher the data rate, the smaller the cell), the minimum data rate for any given cell must be determined at the design stage. Cell sizes at given data rates can be thought of as being concentric circles with higher data rate circles nested within the coverage area of the immediately higher data rate. Selecting only the highest data rate will require a greater number of access points to cover a given area; therefore, care must be taken to develop a compromise between required aggregate data rate and overall system cost.

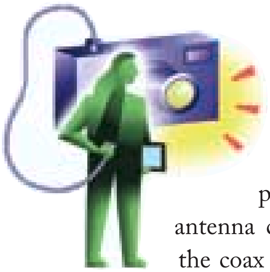
Access Point Placement and Power

For a typical office, education, or health-care environment, access points can be mounted at ceiling height. For warehouses and other facilities with high ceilings, they should be mounted between 15 and 25 feet. Mounting access points at this height can create the additional problem of getting power to the unit. In these cases, you may want to consider a device that allows you to provide power over the Category 5 Ethernet cable—such as the Cisco Aironet® 1200 Series, which can be powered by all Cisco line-power-enabled devices such as Catalyst® switches, line-power patch panels. or a power injector that ships with the product. Powering access points in this manner can drastically reduce the cost and complication of installations.

In public areas such as retail stores, trying to keep the access point out of sight can create challenges as well. If it has to be placed above ceiling panels, you will typically want to place the antenna below the ceiling, where it will distribute the signal properly. This means you will need an access point with a remote antenna capability. Also, many regions legally require that devices installed above a ceiling be plenum rated, so be certain that the access point you choose has a metal casing that meets the specific fire code requirements of your area.

Antenna Selection and Placement

Each access point has a type of antenna system. Some, such as those designed for the 802.11a U-NII 1 indoor band, require an antenna



that is permanently attached. Others have antennas that can be placed remotely via an antenna cable. However, because the coax cable used for RF has a very high signal loss, the antenna should not be mounted more than a few feet from the access point. The correct antenna can make the difference between a system that simply works and a system that works well. Proper antenna selection and placement also can drastically reduce the number of access points required, lowering overall system costs. For example, larger networks will benefit greatly if their design incorporates a 2.4-GHz external antenna.

Diversity antenna systems use two separate antennas or, in some cases, two antennas in a single enclosure. The radio then has the capability to choose the best antenna for receiving the signal. Using diversity antennas to overcome multipath interference, which occurs when radio waves bounce off objects and take multiple paths to their destination, can drastically improve the reception and size of your coverage area.

While the size of the coverage area is the most important determining factor for antenna selection and placement, it isn't the sole criterion. Building construction, ceiling height, internal obstructions, available mounting locations, and physical aesthetics all must be considered.

Cement and steel construction have different radio propagation characteristics and are therefore factors when determining antenna strength. Internal obstructions, such as product inventory and racking in warehouse environments, are also factors. For example, any product with high water content will absorb 2.4-GHz RF energy. In a warehouse, shelves stacked with paper or cardboard products can, due to their high water content, create RF "shadows" or dead spots.

External considerations, such as public locations that prohibit the use of larger antennas, may require creative antenna placement so that they are unobtrusive and blend well with the surroundings.

Connecting to the Wired LAN

How will your WLAN connect to the wired network? Remember, the client will be moving from office to office, floor to floor, or maybe even building to building. If users are moving across subnets, you have new challenges to consider. Some operating systems (such as Windows XP and Windows 2000) support automatic Dynamic Host Control Protocol (DHCP) release/renew to obtain the IP address for the new subnet. However, certain IP applications such as virtual private networks (VPNs) will fail when this feature is enabled. This issue can be solved by deploying a flat network design for your WLANs, where all access points in a roaming area are on the same segment.

Many large companies use several flat networks. They determine where users will typically roam and try to segment the wireless network based on coverage areas with a minimum number of users roaming between them. If you don't have coverage outdoors, you'll lose IP connectivity as you move between buildings, so a good segmentation plan is to provide one subnet per building.

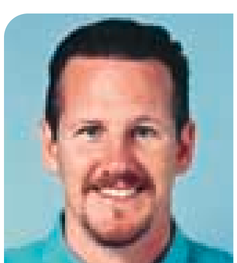
The Site Survey

A comprehensive site survey will help you define your coverage area and data rates, and determine the most precise placement of your access points. A prerequisite to the survey is to obtain as much information about the site as possible. Surveying involves both diagramming the coverage area and measuring the strength of the signal. While signal strength can tell you if the signal is strong enough to be received, signal-to-noise ratio

SITE SURVEY CHECKLIST

Before beginning your site survey, make sure you have the following:

- ✔ Detailed layout of the building (that can be marked up), including where most users will be located.
- ✔ Portable battery pack or other method of powering access points.
- ✔ Description of the desired coverage areas and areas that do not need coverage.
- ✔ Number of users, descriptions of applications, and data rates, for determining how to properly provision your collision domains through access point placement.
- ✔ The same brand and model of WLAN equipment that will eventually be deployed.
- ✔ Antennas. Consider trying out more than one kind of antenna, because performance can vary in different coverage areas.
- ✔ Miscellaneous supplies:
  - Digital camera (to provide pictures for the installation team)
  - Tie wraps (for temporarily mounting access points and antennas)
  - Duct tape (also invaluable for temporarily mounting equipment)
  - Small flashlight (for seeing under ceiling tiles and the like)



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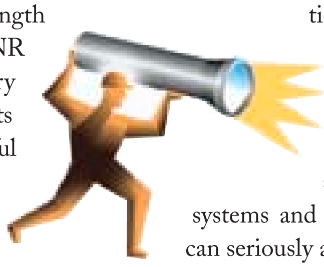
(SNR) measurements help you compare the signal to the noise floor. If noise in the band is high enough, it can cause reception problems, even if there is a strong signal from the access point. Because signal strength alone is not sufficient, using both SNR measurements and packet retry count—the number of times packets had to be retransmitted for successful reception—is the best way to validate your coverage area.



Packet retry count, which should be below 10 percent in all areas, is the ultimate method for determining the edge of RF data reception. You may have areas where the signal is strong, but because of noise floor, or multipath interference, you cannot decode the signal, and the packet retry count will increase. However, without an SNR reading, you will not know whether packet retries are increasing because you are out of range, the noise is too high, or the signal is too low.

Your site survey must also determine if RF interference exists. An 802.11b WLAN uses the 2.4-GHz band, while an 802.11a WLAN uses the U-NII 1 and U-NII 2 5-GHz bands. Both of these are shared, unlicensed bands. Because they use a shared spectrum, neglecting to take into consideration interference created by microwave ovens, cordless phones, satellite systems, and other RF devices such as RF lighting systems and neighboring WLANs, can seriously affect performance.

Conducting the Site Survey

While physically examining your site, mark up the building layout or site map to show all coverage areas. Starting with the building outline, mark the outside areas that need coverage. Identify possible obstructions for RF such as freezers, coolers, X-ray rooms, elevators, and microwaves. Because metal is highly reflective for RF signals, collections of office equipment such as metal bookshelves and cabinets also constitute potential RF problem areas. Mark all possible obstructions.

A successful wireless deployment ensures adequate coverage where needed but minimizes the coverage that extends beyond the physical campus. Failing to limit RF coverage can result in the network extending needlessly beyond the facility, potentially exposing the network to unauthorized access (see "How to Build a Secure WLAN," page 40). Surveying from "the outside in" helps ensure that your coverage area does not extend beyond the facility. To do this, place your access point in the outside corner of your proposed coverage area (position A in Figure 1). Moving inward, locate the edge of your coverage area (position B) using your survey method of choice—the preferred being a combination of SNR and packet retry count.

Now move the access point to position B. Since position B represented the coverage edge when the access point was in position A, with the access point at position B, position A is now the edge, receiving adequate coverage without RF spilling beyond the facility walls. Performing another survey at position B will allow you to determine if your coverage area includes more users than the desired maximum number per access point. If so, you will need to reduce the coverage area by using a smaller antenna or lowering the power level of the access point. After the entire site survey is completed, summarize your findings in a report for the installation team, including your building diagram with access point placement and cell structures, antenna choice, configuration parameters, power requirements, possible interference sources, and photographs of each location.

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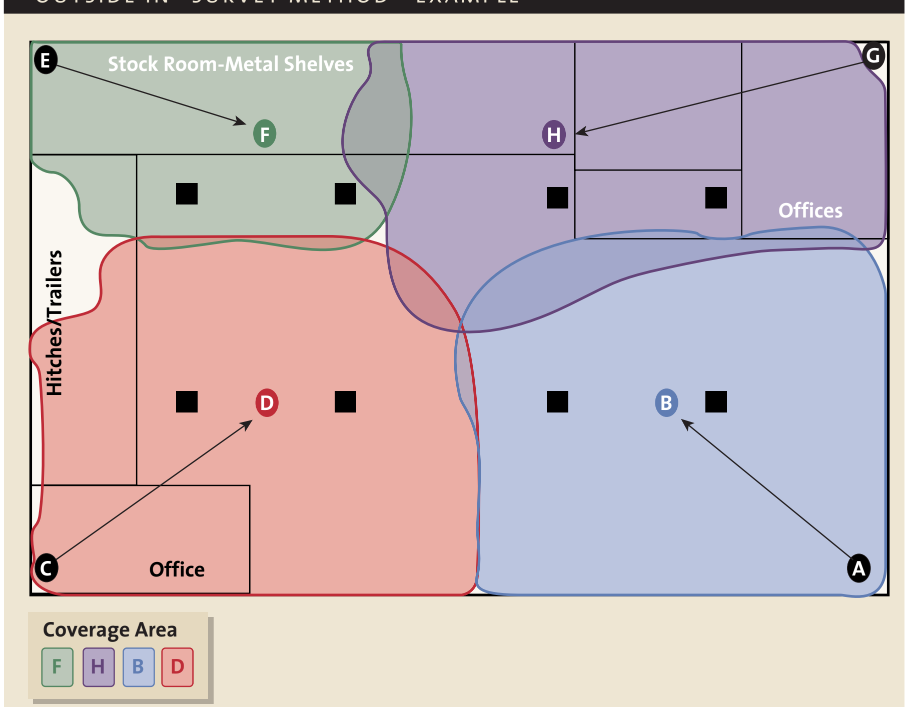
Without proper design and installation, a WLAN can be disappointing. Documenting user application and bandwidth requirements, choosing the appropriate technology and products, and completing a comprehensive site survey prior to installation will help ensure success and deliver a wireless network that meets or exceeds your—and your users'—greatest expectations. ▲▲

"OUTSIDE IN" SURVEY METHOD—EXAMPLE



INS AND OUTS: Surveying from "the outside in" helps ensure that your coverage area does not extend needlessly beyond the facility, creating possible security risks.