WIRELESS LANS

By Richard W. Boss

Interest in wireless local area networks (wireless LANs or WLANs) has been growing exponentially since late 2001, the year that first saw the deployment of wireless LANs in a number of public libraries. By mid-2008 nearly two-thirds of public libraries had a wireless LAN. The widespread acceptance of the technology appears to be attributable to the fact that standards are now in place that address many of the shortcomings of earlier wireless technology.

Definition

A wireless LAN makes it possible for a desktop, notebook, or laptop PC, or any other type of mobile computer device, to access a local area network without being physically connected to it. It is still rare for a wireless LAN to be deployed throughout an entire building; typically it is installed in an area that is difficult to wire or where a large number of mobile users may be working. Concern about the lesser security of wireless LANs also leads most organizations to create "hybrid" LANs, networks that are part wired and part wireless, with the former connecting devices that need to access records that are only available to authorized users.

The typical wireless LAN involves the installation of access points on the interior walls and/or in the ceilings of a building. Each access point, typically the size of a book, houses a transmitter, a receiver, an antenna, and a piece of equipment that acts as a bridge to an organization's wire-based network. A single access point can serve a number of users, but as more people connect, each person gets a smaller share of the bandwidth--which translates into a slower network connection for each.

A user who has a "wireless network interface card" (also known as a "wireless adapter") in

his or her device that is compatible with the access points in a building can be anywhere up 100 to 300 or more feet from an access point and remain connected to the network because the wireless radio signal carries through most walls, floors, and ceilings.

The major vendors of wireless LAN components for the commercial market, including libraries, are Cisco (www.cisco.com), Intersil (www.intersil.com) , Nokia (www.nokia.com), Symbol Technologies (www.intersil.com) , and 3Com (www.3com.com).

Standards

Many of wireless LANs installed in public libraries are based on the IEEE (Institute of Electrical and Electronics Engineers) ***802.11b*** standard of 1999, a standard which specifies use of the 2.4 GHz band at 11 Mbps. The 802.11b standard replaced the now outdated 802.11 standard.

While a commercial success, products conforming to the IEEE 802.11b standard have been subject to interference from other applications using the 2.4 GHz band, and performance well below 11 Mbps. Among the products which interfere with 802.11b products are cordless telephones, cellular radios, wireless audio speakers, microwave ovens, wireless karaoke machines, and many remote controls--all common, especially in cities. In tests conducted in 2000 by Schneider National Labs in Green Bay, WI for Network Computing, a major networking journal, most wireless LANs based on the 802.11b standard performed at around 3.2 Mbps. Only one product topped out at more than 4.0 Mbps. Several major users have reported that 2.0 Mbps is a more realistic figure because of building obstructions.

Interoperability among products was a problem with the early versions of products based on the 802.11b standard. It was two years after the standard was adopted that several major vendors of wireless LAN products formed a group called the Wireless Ethernet Compatibility Alliance (WECA). WECA applied the "Wi-Fi" label to all 802.11 products that conform to its interoperability requirements. The group, which has been renamed the Wi-Fi Alliance (www.wi-fi.org) aims to give customers cast-iron guarantees that products from the participating vendors will

work together perfectly.

Security has also been an issue. Because radio frequencies are shared among users of the network, any information sent or received can be intercepted. Radio frequencies frequently "leak" out of buildings onto adjacent streets and parking lots, therefore, making it possible for those not affiliated with an organization to "listen in." However, there is now a solution if security is a concern: encryption and/or patron authentication can be used. It is also possible to limit access to network cards that have been registered. Anecdotal evidence suggests that most libraries do not use encryption or other security measures; they merely warn users that it is possible that the information sent and received may be intercepted by others.

Newer products based on the ***802.11a*** standard, which was adopted in November 2001, operate in the 5 GHz band at up to 54 Mbps. However, products based on the standard rarely perform at more than 25 Mbps. While that makes products that conform to this standard far better than those that conform to 802.11b, it is not enough for video and large-image applications. The use of the 5 GHz band dramatically reduces interference because the band is little used by other applications. The range at which 802.11a products operate is relatively short: 100 feet as against 300 feet for 802.11b products. It is, therefore, necessary to install a larger number of access points to cover a given area. That increases cost and the amount of time required for network maintenance.

Cahners In-Stat Group, a market research firm, estimated in 2002 that the WLAN market would grow to $4.6 billion by 2005 as the result of the 802.11a standard's adoption. It also predicted that the 802.11a standard would represent more than 60 percent of the market. While the revenue estimate was correct, the older 802.11b products outsold 802.11a products by four to one in 2005 because prices for 802.11b products came down to half those for 802.11a. That, and

the fact that the greater range of 802.11b access points means that fewer of them are required to cover an area, made the older standard far more cost effective.

While 802.11a products that conform to the requirements of the Wi-Fi Alliance are interoperable with other products which conform to the same standard, they are not compatible with products which conform to the 802.11b standard. However, there are access points that are dual-mode, supporting both standards. That is important for libraries that provide wireless access to patrons because some will have 802.11b network cards and some will have 802.11a network cards in their devices.

There is yet another option, IEEE ***802.11g***, a standard adopted n 2003. It uses the 2.4 GHz band, but bumps bandwidth up to a potential 54 Mbps. However, the actual is closer to 25 Mbps. It is compatible with 802.11b, but performance will drop lower when 802.11b is also present. The main drawback of 801.11g is that like 802.11b, it does not address the problem of interference. It has particular appeal for small organizations because of its relatively low implementation cost. While 802.11g has been quite successful, libraries that want to provide access to patrons regardless of the network card used have had to purchase multi-mode access points that support all three standards. These have been at least 30 to percent more expensive than dual-mode access points that support only 802.11b and 802.11a.

The problem with all three of the foregoing standards is that none can accommodate the increasing demand for streaming video, whether a feature-length movie or a video conference. A fourth standard that overcomes these limitations, **802.11n,** is in development. The main benefit of this standard is that it will support bandwidths of 200 Mbps or more, with actual performance likely to be at least 100 Mbps. The standard will support streaming video; and it will be backward compatible, with interoperability with 802.11a and 802.11g and coexistence with 802.11b.

The 802.11n standard uses several new technologies, the most important of which is MIMO (Multiple Input, Multiple Output) technology, a technology that uses several antennae to move multiple data streams from one place to another instead of sending and receiving a single stream of data. It can simultaneously transmit three streams of data and receive two. This not only allows more data to be transmitted in a period of time, but also increases the range to as much as 600 feet if there are no barriers that could block the signal.

The first draft of the 802.11n standard was adopted in March of 2006 and distributed for trial use, and the second draft was distributed in mid-2007. While the final version was scheduled to be published in mid-2009. Some products that conform to the 802.11n draft standard had already reached the market in late 2007. Unless a manufacturer guarantees that it will bring its product into conformity with the standard when ratified at no additional cost, it is unwise to purchase 802.11n products.

802.11n is the first wireless standard that may have a significant impact on wired LANs because the 100 Mbps realizable bandwidth is equal to that of most wired LANs currently installed in libraries. However, to get the most out of the standard, it is necessary to implement a pure 801.11n network, thereby sidestepping lower performance as a result of the presence of older, slower clients on the wireless LAN. While that is possible in corporations that standardize the clients used by their employees and universities that issue laptops to faculty, staff, and students; it is unrealistic for public libraries that serve a diverse group of users with mobile computer devices that range from new to nearly a decade old. For them, multi-mode access points that support all four standards are the best solution for the time being. Pricing for these four-mode access points was volatile in mid-2008, but they were at least 50 percent higher than for three-mode access points.

All of the foregoing standards use the Ethernet protocol and CSMA/CA (carrier sense multiple access with collision avoidance) for path sharing.

For a technical article on the 802.11n standard, see the following:
http://www.deviceforge.com/articles/AT5096801417.html

Applications

Some libraries use wireless LANs solely in locations where pulling cable is difficult and expensive. Examples include single-story buildings on concrete slabs and multi-story buildings with no plenums (space between the floor and the ceiling of the floor below it. Another application is

where the installation is intended to be temporary--thus making it possible to remove and relocate the wireless LAN at modest cost.

The vast majority of libraries use wireless LANs to accommodate network users who move around a facility with mobile computer devices. Now that airports, malls, coffee shops, and many other public places have wireless LANs, users expect to have that convenience in libraries.

A popular application of wireless LANs in libraries has been the lending of laptops to patrons for their use throughout the building. That is not only an excellent way to increase the number of available PCs during busy periods without installing a large number of data jacks, but also gives the library the opportunity to configure the machines to best work with its integrated library system and other electronic products and services. One library has learned that students studying as a group like to take several laptops into a group study room that has only one data jack so they can work collaboratively. Another--one with extensive book stacks-- has observed students using laptops on the floor in the classifications of interest to them. They can then search and retrieve very quickly.

Patrons, especially students, often bring their own 3.5 -inch diskettes so they can download information, therefore, most libraries which make laptops available do not disable the “a” drives. They do limit access to the hard drives, however.

Costs and Headaches

Each access point costs up to $500 in equipment ($180 to $250 for a single mode; $300 to $400 for a dual mode, and $450 or more for a multi-mode access point), plus another $1,500 for design and installation--a figure which includes connection to the electrical supply and to the organization’s wired network. The network cards or adapters are under $100 each; however, almost all notebook and laptop PCs, and other mobile computing devices, now come with a built-in wireless

LAN card.

Libraries that require 50 or more access points in a facility should consider installing a wireless LAN switch. That obviates the need to have relatively expensive "intelligent" access points—access points that include considerable data communication and security software. The simpler access points costs at least 60 percent less to purchase and require less maintenance. The leading vendors of wireless LAN switches are Aruba (www.arubanetworks.com) and Trapeze (www.trapezenetworks.com).

Wireless LANs take more time and expertise to design and tune than wired networks. Very thick concrete floors, a large number of metal desks and filing cabinets, densely filled book stacks, and a large number of people can all weaken the radio signal.

When planning a wireless LAN, a library should measure the building to get the spacing of access points right, computing bandwidth needs based on the potential number of users, and identifying potential obstructions to the radio signal before beginning the installation of the access points. When a consulting firm is retained to conduct the survey, the cost can be as much as $1,000 per access point.

Security Concerns

There has been increasing concern expressed about the security of wireless LANs. They are much less secure than wired LANs, but the level of security can be increased by using encryption and/or authentication. The Wi-Fi Alliance has developed a standard for encryption and authentication in a wireless environment known as WPA (Wi-Fi Protected Access). It is participating in the development of an IEEE standard based on its work. The standard will be officially known as 802.11i, but is already being referred to as WPA2. A library can choose to use

encryption on all of its own equipment, including not just PCs, but other devices including RFID readers and sensors; but it should not expect patrons to utilize encryption on the devices they bring into the library.

A library can protect its staff applications by having all staff devices on its wired LAN and by requiring authentication of users. It can protect databases available only to authorized patrons by requiring authentication of users for everything except the patron access catalog. The patron access catalog can be protected by using a proxy server so that the back-end database is not accessed directly.

What a library cannot do is to protect the devices patrons bring into the library. It should advise patrons of that fact.

Prospects

Despite the enthusiasm about wireless LANs, they do not appear to pose an immediate threat to conventional wired LANs. While 30 to 54 Mbps may seem like a great deal of bandwidth, a significant number of libraries have been upgrading their wired Ethernet LANs to 100 Mbps because they have found that the increasing use of graphics, audio, and motion video on LANs means that it must be possible to provide each user with up to 1 Mbps of bandwidth. A few are now moving to 1.0 Gbps wired LANs. A cluster of desktop machines or laptops in a small area can overwhelm a wireless LAN offering 54 Mbps or less of bandwidth.

Finally, the users will be the ones to determine whether they will use wireless LANs exclusively. Rensselaer Polytechnic Institute, which for several years has required each student to own a notebook computer, expected that requirement to reduce the demand for student computer labs, but it has found that students often don't want to add a notebook or laptop computer to an already heavy book bag, or don't want to risk theft of the device. Students are also less inclined to upgrade memory and software on a regular basis than the institution. That is probably true of non-students as well.

More Information

Libraries interested in pursuing wireless LANs should search online reference services under headings such as wireless LANs, WLANs, wireless local area networks, wireless communication systems, and 802.11.

When surfing the net, it is best to look for that which is dated 2007 or later because earlier information does not reflect the current state of wireless LAN technology.

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