IBM

The wireless school

Introduction

Today's students and educators face many challenges. For students, there is peer pressure, educational advancement and personal demands. Educators, in addition to their own personal and professional needs, must try to meet student and community expectations relative to preparing students for the workplace. The days when the public school was the sole provider of education are over. As a result, schools today need to establish and keep a competitive edge and focus on improving student performance. Many studies point to technology as the greatest change agent in educational improvement and growth. Advancements in wireless technology, in particular, now enable improved student services by providing mobile access to data, anywhere at anytime, as well as providing an ever-increasing variety of instructional technology options (e.g., distance learning). That's why now is the ideal time for schools to consider wireless technology, which can enable greater educational opportunities for students and teachers alike.

Trends and directions

Technology adoption by schools

Technology has moved from a luxury, affordable by only the wealthiest school districts, to an educational necessity – a necessity that can finally be afforded by many school districts throughout the country. Many educational institutions already provide technology in computer laboratories and/or individual classrooms. These setups offer standalone connectivity with some network connection between workstations. Although this structure generally works well, it provides only limited access to all users. The computer lab is often available for only a few periods daily, while individual classroom systems may not be accessed by all students on a daily or even weekly basis.

Because neither the computer-laboratory nor individual-classroom approach fully provides the most widespread availability, many schools are looking to enhance computer access. Greater access enables them to move beyond simply using computers to teach computer classes. Learning can now be facilitated through total integration of the computer into the curriculum, and into everyday teaching. And wireless technologies can cost effectively enable such integration.

The Internet impetus

The Internet is a phenomenon of unparalleled proportions. As Chart 1 shows, when compared with other society- and culture-altering technologies, it is the fastest growing technology in the history of mankind. While it took radio 30 years to reach 50 million users, the Internet reached the same level of usage in only five years.

Furthermore, as stated by *The Internet Economy Indicators*, September 2, 1999 (www.internetindicators.com/features.html), "With 1.203 million Internet/IP-based jobs, the Internet Economy is reshaping the job market. Many of these jobs (e.g., Web design and development, Internet consulting) did not exist prior to 1994/1995, and companies have also redesigned existing jobs to meet the challenges and opportunities of the Internet Economy. As pure Internet players flourish and as traditional businesses become more dependent on Internet related technologies for their daily business operations, new jobs will continue to be created and existing jobs will continue to be reshaped in the new economy." This change will require that more and more students be prepared to understand, utilize and incorporate technology into their professional and personal lives. The right time to begin this incorporation is now, while they are fully engaged in the learning process.
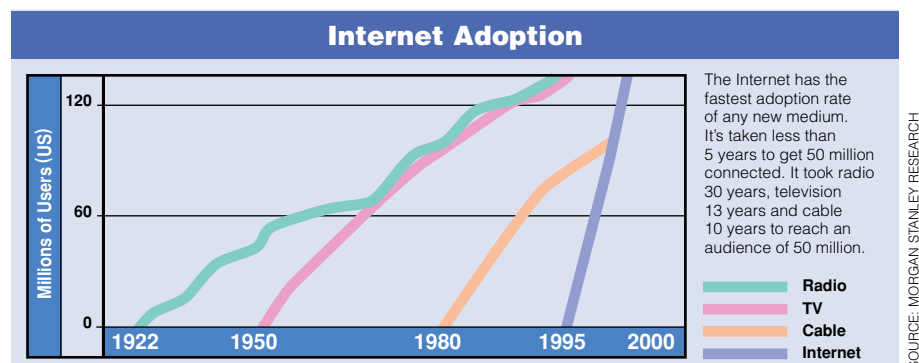

Chart 1: Internet adoption

Recognizing the need for Web access to achieve education excellence, the U.S. Congress passed the Telecommunications Act of 1996, establishing the Universal Service Fund (USF). USF, now better know as E-Rate, was designed to help individual schools purchase technology that provides quantifiable access to the World Wide Web. This Act enables schools to take advantage of the Web's ability to introduce students and educators to a global neighborhood without them ever leaving the classroom. Students can access information from a variety of sources found in different cities, states, countries and continents. Students in central Los Angeles can research and collect data that is assembled in Chicago, Mexico City, Rome or Tokyo. They have immediate access to information as it is published. No longer do they have to rely solely on printed encyclopedias and other "paper-driven" sources; rather, they can use electronic versions that are updated constantly. Or they can go directly to the source listed in reference books. The Web allows them to engage in "collaborative learning" and "collaborative teaching" – across the seven seas and from the four corners of the Earth.

As Chart 2 indicates, there is little doubt that the Web will continue to grow as the need for data expands. If students are to get the education they need to succeed in business and in life, they will need ready access to Web resources. To provide such access, schools will need to understand and implement network access solutions, whether that access is gained through mobile devices or via wired or wireless connectivity.

Global Revenue for Wireless Web Access

Billions

SOURCE: KILLEN & ASSOC., IN WIRELESS WEEK, DEC. 1997
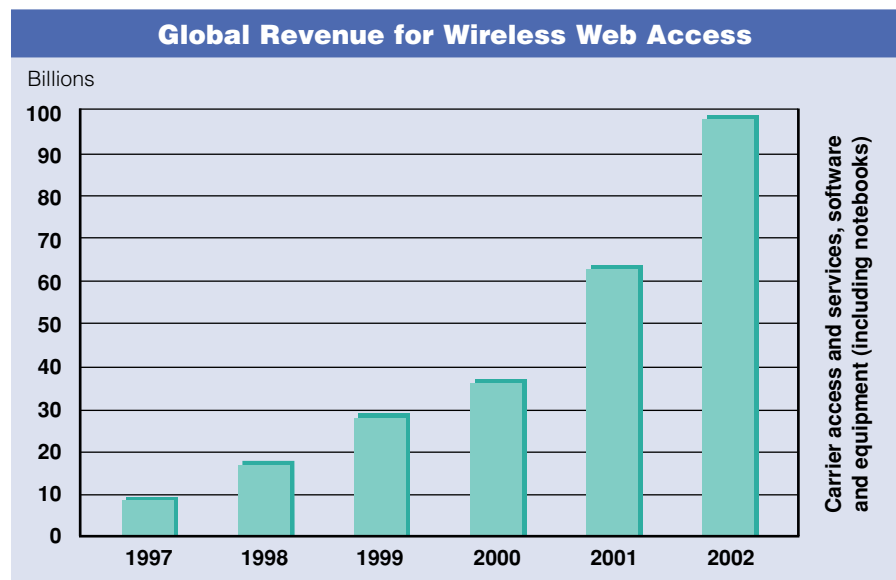
Chart 2: Global revenue for wireless web access. When tied to the intranet/Internet, the global opportunity for mobile and wireless increases five-fold and supports the needs of education.

Wireless approaches

Getting started

When is the right time for schools or districts to consider wireless? They should do so when they are looking at developing or upgrading network infrastructure. Why at this point? School network requirements will vary significantly depending on the type of hardware platforms they run and the variety of software programs and applications they utilize. Adding mobile and wireless technologies brings a further level of complexity and planning that most schools will not necessarily understand. This lack of understanding may keep them from gaining the benefits offered by a wireless solution. Without the vision of what wireless solutions can do to enhance the implementation of a network infrastructure solution, schools may only consider wired solutions. That is why wireless solutions should be considered at the assessment or planning stages of the process.

Often new technologies are deployed in educational institutions to make educational software available to both teachers and students. Because off-the-shelf software and custom applications each have unique installation requirements, schools must gather as much information as possible regarding factors that can impact successful implementation. It is recommended that during the consideration and planning stages, a vision consensus meeting between IT infrastructure specialists, key school decision makers and critical end users (such as faculty, administrators, parents and students) take place. At this meeting, alternative methods for delivering instructional software to students can be explored. The result? The possible incorporation of mobile and wireless technologies into the solution, which may provide both short- and long-term value to the school.

Upon completion of this meeting, IT specialists, whether employed by the school, the school district or a third-party solutions provider, should create a plan of action that addresses key objectives as well as identifies the technology requirements necessary to achieve those objectives. The plan will indicate not only the ideal hardware solution, but also the integration services necessary for effective deployment. At the school's or district's request, a financial analysis or return on investment study can be included. Chart 3 shows the elements that go into planning for a wireless system design proposal.
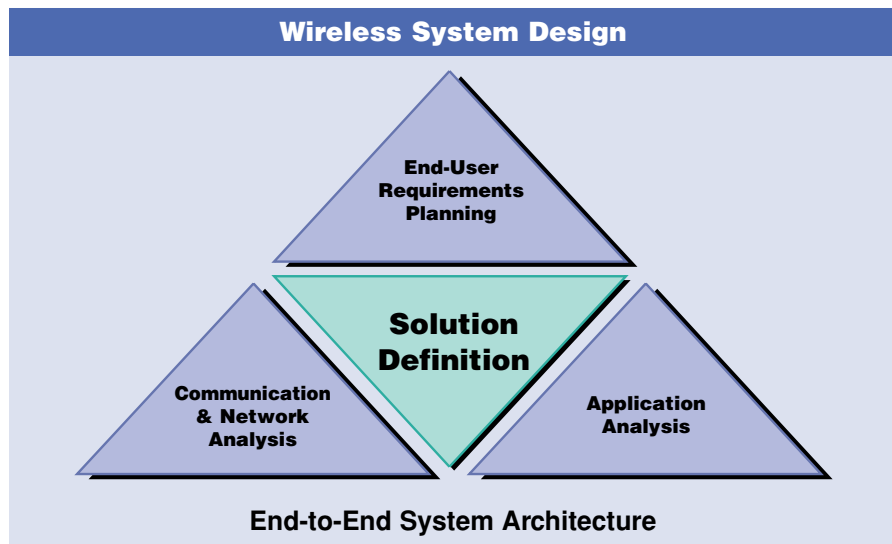
Wireless System Design

End-User
Requirements
Planning

Solution
Definition

Communication
& Network
Analysis

Application
Analysis

End-to-End System Architecture

Chart 3: Wireless system design

Enabling mobile education through wireless LANs

Wireless networks are based on Radio Frequency (RF). Advances in RF
technology have altered the computer industry's approaches to networking.
These advances now enable a radio-based local area network (LAN) to
function in virtually any environment. Early wireless LAN networks were
based on either RF or infrared (IR) technologies, often with many inhibitors
to successful implementation. These early RF LANs were slow and prone
to interference from everyday devices.

The primary challenges for IR technologies were related to speed and
interference; these challenges still exist today. Because IR is a light-based
technology, whenever any object comes between the transmitter and
receiver, communications cease. The interference factor is but one limitation
of IR. IR-based LANs are still slower and less reliable than RF LANs and,
unlike RF, there is no standard that governs IR-based LAN technology. With
RF, there are three standards currently announced. It is for these reasons
that the number of RF-based LANs is in the tens of thousands while
IR-based LANs have yet to receive widespread adoption.

Today's wireless LANs address many of these concerns. With speeds that
exceed the average T1 line, wireless LANs with speeds of 2, 5, 11 and 24
Mbps have been developed and work as reliably as traditional wired LANs.

As Chart 4 demonstrates, there are many benefits to wireless LANs as they pertain to schools:

- A wireless LAN enables students to realize technology-based anytime/ anyplace learning.

- A wireless LAN-based notebook computer can be moved anywhere in a building with no loss of connection, enabling the school to optimize the ratio of computers to students.

- For schools using computer-based testing (CBT) and training, a wireless LAN computer enables access to both testing and remediation whenever and wherever it is needed, without students having to wait hours or days for scheduled computer time.

- Wireless LANs can provide access to distant or difficult-to-reach areas.
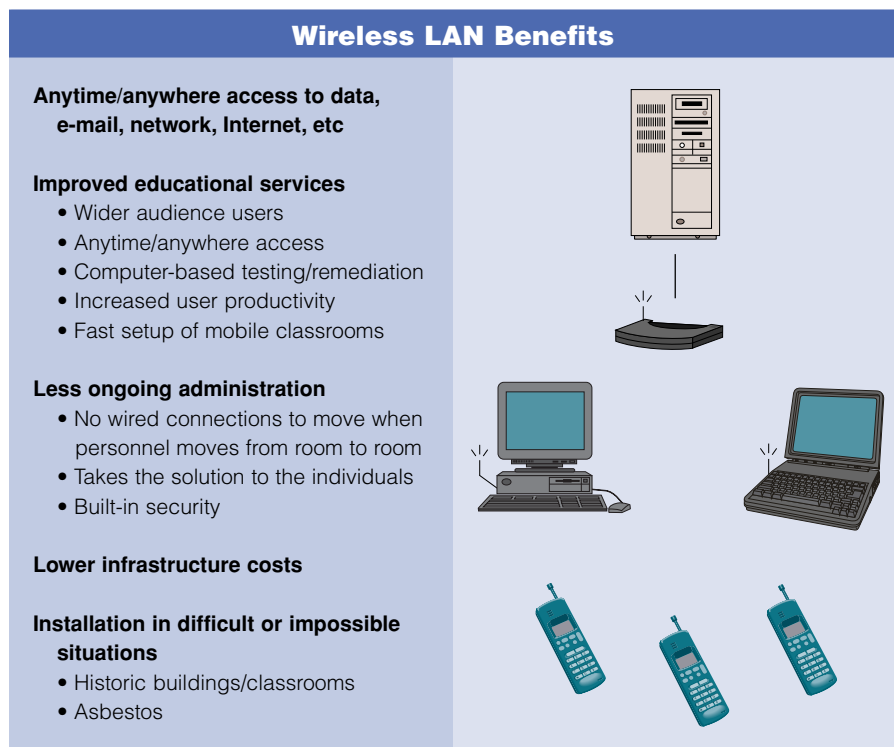
- Wireless LANs can increase the reach of a wired network.

Wireless LAN Benefits

Anytime/anywhere access to data, e-mail, network, Internet, etc

Improved educational services
- Wider audience users
- Anytime/anywhere access
- Computer-based testing/remediation
- Increased user productivity
- Fast setup of mobile classrooms

Less ongoing administration
- No wired connections to move when personnel moves from room to room
- Takes the solution to the individuals
- Built-in security

Lower infrastructure costs

Installation in difficult or impossible situations
- Historic buildings/classrooms
- Asbestos

Chart 4: Wireless LAN benefits

In terms of facility infrastructure costs, the wireless LAN's expense is comparable to providing a network connection to every student in the building. IT specialists can determine ways to make wireless LANs less costly than wireline LANs. Through detailed site surveys and consultative assessments, these alternatives can be explored in detail with educators and administrators.

Questions regarding security often arise when wireless LANs are being considered. However, that's less of an issue than most realize. That's because wireless LANs have the same network security as traditional wired LANs and, in fact, have the added security provided via encryption of the RF signal. To 'hack' into a wireless LAN successfully, an individual would need the encryption key, identical hardware, access to the building, a valid IP address and a network ID and password. That's not to say that it's impossible for a hacker to gain unauthorized access, but it's extremely difficult.

How wireless LANs add value

There are many different ways a wireless RF-based LAN can be utilized by educational institutions:

- Mobile labs

- Total laptop campus environment

- Limited laptop campus environment

- Extension of connectivity to distant or hard to reach location

- Mobile/temporary classrooms

Mobile computer labs

A mobile computer lab environment is a vital paradigm shift from the traditional standalone lab. It involves the use of a cart provisioned with laptop computers and wireless LAN equipment. This cart can be wheeled from room to room; it contains all necessary wireless LAN components – the network cards, access points, laptop computers and printers. In short, it integrates all components in one place.

Generally, this cart solution is less expensive because fewer computers and network adapters are required to provide the necessary coverage for the school. However, for the most effective use of the cart, administrators need to decide whether or not to build wireless LAN transmitters into it or place transmitters throughout the school. If the transmitters are included as part of the cart, each room will need a network port. When the cart is moved into the room, it is plugged into the port, resulting in the room becoming "networked."

The number of wireless LAN transmitters is thus reduced to the number required to support the cart, usually two. The disadvantage to this solution is the need to run cable to each room. If there is hazardous material present, such as asbestos, this may be a difficult and expensive undertaking. There may also be additional setup time required, although minimal, while the transmitter is connected and powered up.

The critical benefit a cart solution brings to schools is that there's no longer a need for a standalone lab that may sit idle at various times throughout the day. It also enables schools to convert existing computer labs into much-needed classroom space. There's no longer a need to dedicate learning space for storage of computers. When not in use, the cart can be locked and then secured in a locked storage closet or office.

Total laptop campus environment

This wireless network option looks at the entire school facility and provides wireless network coverage every place learning will take place. Educators can now vary the locations where computers will be used. This is in direct contrast to the standard cabling approach, which only allows notebooks to be used in the exact location where the network connection has been installed. This new approach allows the computer to work anywhere in the building. It also facilitates upgrading to another option in deploying wireless LAN technology, a wireless LAN/laptop campus. In many respects, this coverage is similar to that of a cellular telephone network. Users can roam from class to class without ever losing their connection.

One example of this is IBM's ThinkPad® Campus where each student and educator has a computer assigned to them for the duration of the school year. At the end of the day, the computers go home with the student or faculty member instead of being secured in the building. Generally funded by both the school and parents, these computers are leased from a financial institution offering a technology refresh program. Refresh is important as it enables the school to continuously upgrade the technology. Older equipment can be offered to faculty, staff and students at a lower price than a new computer, increasing the likelihood of after-school use. The ThinkPad Campus provides "information on demand" and is gaining popularity in many schools. Higher education institutions refer to this approach as *ThinkPad University™*.

Limited laptop campus environment

This use of wireless technology is a scaled-down version of the ThinkPad Campus scenario as there is a smaller than 1:1 ratio of computers to students and faculty. The advantage is reduced total capital outlay and total cost of ownership because of the smaller number of computers being deployed. Educators can select areas within the school where technology would be most beneficial. If this need changes throughout the year, the computers can be redeployed with no additional investment required. The principal disadvantage to this alternative is that technology remains a limited resource.

Extension of connectivity to distant or hard-to-reach locations

Historically, locations within a building that are difficult to reach or expensive to cable have had no access to the Web. In many buildings, special-use areas such as sports or performing arts have little or no access to electronic learning. These underserved areas can now have equal access through the use of mobile and wireless technologies.

Hard-to-reach locations may also include remote buildings that don't have connection to their school's network. There is no physical link between the buildings such as a bridge or tunnel. In these instances, it is often necessary to install completely separate networks in each building. Wireless technology can enable a bridge to link the buildings so that a single network covers a single campus. The advantage to this approach is in reduced server hardware and licensing costs as well as reduced management activity to build, monitor and maintain multiple networks.

Mobile/temporary classrooms

There is a national shortage of learning space. This shortage is often addressed through the use of trailers configured as mobile or temporary classrooms. While these trailers have heat and light, they often don't have access to the school's network or to the Web. Schools that make the investment to provide access often do so via a fiber-optic network link. This link can be expensive (often costing $5000 or more) and it has to be run each time a trailer is moved. Because trailers are modular, they are often moved annually, thereby resulting in recurring recabling costs. A wireless antenna mounted on the primary school building can provide a link to these mobile classrooms without requiring costly cabling. A wireless solution is reusable and there are no repeated charges to move the data connection. In this way, a single access point can provide a network link to one or more mobile classrooms. When compared with the cost of cabling, this approach often pays for itself.

Selecting the right alternative

Issues centering on configuration, installation and support of computers are common to both the ThinkPad Campus and wireless cart approaches. Appendix A serves as a starting point in understanding the issues and requirements of the individual school as they plan wireless projects.

When considering a wireless LAN, a site survey will allow for the optimal configuration. This survey provides a picture of the RF environment into which the wireless LAN equipment will be placed. The site survey makes recommendations on the placement and quantity of the access points and the type of antenna needed, and it identifies exactly where in the building wireless LAN coverage should be made available.

Without this survey, there can be no guarantee or assurance that the right type and quantity of wireless LAN equipment will be selected or that it will be placed in the correct locations to ensure coverage everywhere a network connection is needed. Failure to conduct this survey may result in the wireless LAN failing to work as expected. Since each access point needs both alternating current (AC) power and a network connection, problems may also exist with the installation if these two factors are not taken into consideration in the planning phase of the wireless LAN.

A significant advantage to selecting wireless LAN technologies is that they are simply an add-on to the existing wired LAN infrastructure. Every wireless LAN requires cabling so it can interface to any standard network cabling architecture (Ethernet or Token Ring). Technology is only limited with respect to interoperability between different wireless LAN technologies. This may change in time, but currently once a type of wireless LAN is selected, that should be the single direction selected by the school. This also makes support and service easier to set up and maintain.

Ongoing support of a wireless LAN environment requires special planning. During the planning and deployment of the solution, project managers should develop a strategy to handle operational support issues such as battery charging, replacement and repair of failing components and technical support for users. Without this planning, schools and technology administrators may have to spend time unnecessarily following up on these details. This may cause LAN downtime as well as less productive equipment use.

Conclusion

Whatever the educational environment, be it primary or secondary grades, private schools or public, mobile and wireless technologies can address a variety of user requirements. A wireless LAN solution can enable schools to deliver technology-based instruction resulting in information on demand. It can free space currently used by computer labs and, at the same time, provide additional security for computer equipment. Wireless technology can optimize the time of students using computers while enabling access to information whenever and wherever learning takes place. With the ThinkPad Campus approach, everyone in the school can have anytime/anywhere access to information within their school. Wireless technology is proven, available and affordable, and the benefits are many. Based on current technology trends, federal funding programs and the explosive use of the Internet, the time to consider wireless solutions for your school is NOW.

For more information

To learn more about mobile and wireless and IBM Global Services, visit www.ibm.com/services/pss/us/mobilew.html or contact your IBM sales representative.

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Appendix A: Going wireless!

The following questions help mobile and wireless specialists in determining an individual school's needs.

Computer

Feature	Question	Response	QTY
Laptop	Do you need a laptop computer? How many?	Yes No	_____
Desktop	Do you need a desktop computer? How many?	Yes No	_____
Memory	Indicate in MB the amount of RAM needed.		_____ MB
HDD	Indicate in MB the size of hard drive needed.		_____ GB
Processor	Indicate in MHz the speed of processor needed.		_____ MHz
CD-ROM	Indicate the speed of CD-ROM Drive.		_____ ms
Display	Indicate the size desired for the display/LCD.		___ inches
Spare parts	What percentage of spare parts will you want on hand?		_____ %

Network

Feature	Question	Response	QTY
Network	What type of network is currently in place?	___ Token Ring ___ Ethernet	
# of Users	How many users are currently on the network?		_____
Capacity	How many users does your network allow?		_____
Server	What type of server do you currently have? Memory HDD	_____ Mfg.	 _____ MB _____ GB
Hubs	Are there any open hubs on the existing network?	Yes No	
TCP/IP	Do you use dynamic IP addressing?	Yes No	
Internet	Do you currently access the Internet? How? (ie., T1/Dial-up,etc)	Yes No _____	
Printers	Do you currently have network printers?	Yes No	

WLAN

Feature	Question	Response		QTY
Site survey	Have you received your presurvey form? Have you returned your presurvey form? Have you scheduled your site survey?	Yes Yes Yes	No No No	
Placement	Have you decided where you want wireless coverage?	Yes	No	
Building	Does your building have historic status, asbestos or any other features that will make cabling difficult?	Yes	No	
Location	How many locations/buildings do you want equipped for wireless?			_____
PCMCIA	Will you need PCMCIA cards?	Yes	No	
ISA	Will you need ISA cards?	Yes	No	
Cabling	Do you have preferred cable installers?	Yes	No	
Power	Do you have a preferred installer for AC power?	Yes	No	
Union	Does your city/town require union labor?	Yes	No	

Solution

Feature	Question	Response		QTY
Cart	Do you want wireless carts? How many?	Yes	No	_____
Cart users	How many students will be using cart(s)?			_____
TPC	Do you want to deploy the ThinkPad Campus methodology?	Yes	No	
TPC users	How many total users will there be?			_____
WLAN	Do you want your entire building enabled for wireless?	Yes	No	
Building	How many floors are there in your building?			_____
Campus	How many buildings are there on your campus?			_____

Services

Feature	Question	Response	QTY
Help desk	Do you require Help Desk support?	Yes No	
Installation	Do you require installation of the WLAN hardware?	Yes No	
Training	Will you require training on the new technology?	Yes No	
Deployment	Will you require assistance with distributing the technology?	Yes No	
Application	Will you require applications to be installed on the computers prior to receiving them?	Yes No	
Maintenance	Will you want information on the IBM Self-Maintainer program?	Yes No	

Financing

Question	Response
Do you require financing?	Yes No
How many months of financing do you require?	_____ months
Do you require technology refresh?	Yes No

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