Application of Wireless Technologies in Libraries

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Abstract

The paper deals with the application of wireless technologies in libraries, its benefits and issues to consider for installing such a network; wireless Internet access and Short Messaging Service in libraries. The paper describes various wireless technologies like Bluetooth, Infrared, HiPeRLAN and Wireless LAN. The benefits of Wireless LAN like mobility, simplicity, installation speed, flexibility, reduced cost and scalability have been explained and highlights the various Wireless LAN technologies like Narrowband Technology, Spread Spectrum Technology, Frequency Hopping Spread Spectrum Technology, Direct Sequence Spread Spectrum Technology and Infrared Technology. The paper also discusses the working of a Wireless LAN, its range and coverage, compatibility with existing networks, security, safety and cost of Wireless LAN. It further highlights various mobile technologies like Wireless Application Protocol, General Packet Radio Service and Universal Mobile Telecommunications System. The paper concludes with the hope that in the near future the wireless technologies will play an important role in the storage, retrieval and dissemination of information in libraries.

Keywords : Wireless Technology, Wireless Networking, Wireless LAN, Library Networking, Bluetooth, Infrared, HiPeRLAN, SMS, WAP, GPRS, UMTS, Mobile Technology

0. Introduction

Over the last several years, wireless technologies have progressed and achieved success in various fields like healthcare, education, manufacturing, etc. Wireless technology has been around libraries for some years. But now only the libraries have realised its benefits for information services and library management activities. A number of libraries in western countries are using this technology. Wireless technology is very fast, reliable and highly flexible. Its major benefit is the immediate access to digital resources. It enables users to simply and easily connect a wide range of computing and telecommunications devices without the need to buy, carry, or connect cables. It uses a variety of devices such as laptop and notebook computers, tablets, personal digital assistants (PDAs), email-only devices, handheld computers, etc. Wireless networks contribute flexible and instantaneous access to digital information. It eliminates the direct cost of physical networking and reduces the indirect cost of network administration. Wireless LANs offer new solutions for providing cost-effective access to digital information. Wireless technology allows users to access the Internet without the constraints of cables, data lines, phone jacks, or even walls. Wireless data-translation protocols allow disparate devices to use the information from all sources effectively.

1. Wireless Networking in Libraries

Wireless networking help users to access digital information without connecting physically, and system administrators can set up or extend networks without installing wires. Mobility is the most attractive feature of wireless networking. It is more flexible than wired networking. It provides all the functionality of wired networking, without the physical constraints of the wire. In the 1980's the Federal Communications Commission (FCC) proposed the 802.11 as the IEEE standard for wireless networks [1].

Wireless networking can be used to access the library network, library resources and Internet without plug in by wires and cables. Wireless networking will allow users with devices like laptops, notebooks, simputers, PDAs, tablet PCs, etc. to move freely in the library while remaining connected to the library network. Wireless networking is an excellent solution for libraries with historic buildings or older buildings where the installation of wired networking is either impossible or very expensive. Libraries can be saved from the constant wiring and rewiring by installing wireless networks. Libraries can get lot of space by wireless networking. Installation of wireless network is very easy because there are no wires. Wireless network components can be set up anywhere in the library. Wireless networking makes it easy to move computers and other devices without the need to reconfigure the network.

1.1 The Benefits of Wireless Networking in Libraries

Here are some of the benefits of wireless networking in libraries [1].

- A library wireless network provides access to multiple computers, databases, the Internet and library OPAC throughout the library or outside the library.
- It provides faster access to information for library users, resulting in better service and improved user satisfaction, location independent access for network administrators for easier on-site-trouble-shooting and support.
- Using laptop computers library users can access electronic media and also be physically near whatever printed material they want.
- Sharing of peripherals, files, multimedia resources and databases are easier.
- Improved database access.
- Simplified network configuration.
- Wireless networking permit quick connectivity to the network.
- Wireless networking is an excellent solution for libraries with historic buildings or older buildings, which make the installation of wired networking either impossible or very expensive.

1.2 Issues to Consider for Installing Wireless Networks in Libraries

There are some issues to be considered while installing wireless networks in libraries [1].

- It should be simple to install, set up, use and manage.
- It should be reliable and easy to expand as the library network grows.
- It should be compatible with other network devices.
- It should be built by reputable, experienced companies that know the complexities of wireless networking.
- It should be backed by easily accessible, sound technical support.
- Interference in wireless environment should be avoided.
- Wireless technologies should meet the prescribed standards for safety.

2. Wireless Internet Access in Libraries

Wireless technology allows users to access the Internet without the constraints of cables, data lines, phone jacks, or even walls. When connected to library wireless network, users can use their laptops, notebooks, simputers, handheld devices, or web-enabled pagers or phones to check e-mail or to surf

the web without a physical connection. Each device connected to a wireless library network allows users to e-mail, or surf the Internet. Notebook computers and simputers are becoming more affordable and portable. Users can use this facility for reading E-mails and newsgroups, accessing online library catalogues, searching information through web, and live online reference.

3. SMS in Libraries

Short Messaging Service or SMS can be applied in libraries for sending information to library users. Messages like the status of a loaned item, reservation information, overdue notice, reminders and major events can send through this service. SMS is convenient and cost effective for a number of reasons. Messages can be received while making voice calls. A single message can be up to 160 characters of text in length. It is not sent directly from sender to recipient, but always via an SMS Centre. The sender of the message can receive a return message back notifying that the message has been delivered or not. To use SMS, users need a subscription to a mobile telephone network that supports SMS and a mobile phone that supports SMS·Users should have the Knowledge of how to send or read a short message using mobile phone. The most common devices used with SMS are digital cell phones equipped with one-way receive capability.

4. Wireless Technologies

Wireless networks use high-frequency electromagnetic waves, either infrared (IR) or radio frequency (RF) to transmit information from one point to another without replying on any physical connections. RF is expected to be of more practical use in library networking than IR, because it is not limited by line-of-sight transmission; radio waves travel through wall and windows. Data and voice traffic is superimposed or modulated, onto the radio waves or carriers, and extracted at the receiving end. Multiple radio carriers can exist in the same space at the same time without interfering with each other by transmitting at different frequencies. There are a large number of different technologies that can be used in wireless library network applications. Following are some of the technologies for wireless networking.

4.1 Bluetooth

Bluetooth is a global de facto standard for wireless connectivity and is based on a low-cost, low-power, short-range radio link for mobile devices and for Wide Area Network/Local Area Network access points. It offers fast and reliable transmissions of both voice and data over the globally available 2.4 GHz ISM (Industrial, Scientific and Medical) band [1]. Bluetooth will enable users to connect to a wide range of computing and telecommunication devices without the need to buy, carry, or connect cables. And because Bluetooth utilizes a radio-based link, it doesn't require a line-of-sight connection in order to communicate. When two Bluetooth equipped devices come within 10 metres of each other, they can establish a connection.

Bluetooth uses a radio link to connect devices instead of a cable and it can handle raw data of 1 Mbps with a peak asymmetric asynchronous throughput of 721 Kbps or three symmetric voice channels of 64 Kbps [1]. Bluetooth has sufficient in built encryption and authentication. In addition, a frequency-hopping scheme with 1600 hops per second is also employed. Bluetooth eliminates the need for numerous cable attachments for connecting practically any kind of communication devices. The range of each radio is approximately 10 metres, but it can be extended to around 100 metres with an optional amplifier. Up to eight devices can be connected together wirelessly in a network called a 'piconet'. A master unit is the device in a piconet whose clock and frequency hopping sequence are used to synchronise all other devices in the piconet. There is one master unit per piconet. Slaveunits are all devices in a piconet that are not the master. The slaves receive frequency-hopping sequences from the master and rely on the master's clock for the timing of the piconet. Up to 10 piconets can come together to form a 'scatternet' resulting in a total of 80 devices that are able to communicate through the network.

4.2 Infrared

IrDA is a wireless technology that uses infrared, a faster wave frequency that is closer to visible light. It is a cable replacement technology similar to Bluetooth wireless technology. It has a short transmission range, 15 feet to 5 metres. Two devices must have an almost direct line-of-sight to connect. It transmits data in a point-to-point configuration. IrDA technologies did not develop with interoperability and industry standardization as a primary goal, as did Bluetooth.

4.3 HIPERLAN Technology

High Performance Radio Local Area Network type 2 (HIPERLAN/2) provides high-speed multimedia communications between different broadband core networks and mobile terminals. HIPERLAN/2 relies on cellular networking topology combined with and ad hoc networking capability. It supports two basic modes of operation: centralised mode and direct mode. The centralised mode is used in the cellular networking topology where each radio cell is controlled by an access point covering a certain geographical area. In this mode, a mobile terminal communicates with other mobile terminals or with the core network via an access point. The direct mode is used in the ad hoc networking topology, where a radio cell covers the whole serving area.

4.4 Wireless LAN

A Wireless Local Area Network (WLAN) is a flexible data communication system implemented as an extension to, or as an alternative for, a wired LAN. It uses a high speed, radio-frequency (RF) network access technology to transmit data. It links computers to each other or to networks for shared access and Internet based information. The Institute of Electrical and Electronic Engineers (IEEE) established the 802.11b standard for wireless networks, and the Wireless Compatibility Ethernet Alliance (WECA), assures that Wireless LAN products are interoperable from manufacturer to manufacturer [2].

4.4.1 Benefits of Wireless LAN

Following are some of the benefits of Wireless LAN.

4.4.1.1 Mobility

Wireless LAN systems can provide LAN users with access to real-time information anywhere in their organization. This mobility supports productivity and service opportunities not possible with wired networks.

4.4.1.2 Simplicity

Users need very little information to take advantage of wireless LANs. Because the wireless nature of a wireless LAN is transparent to a user's NOS, applications work the same as they do on wired LANs.

4.4.1.3 Installation Speed

Installing a wireless LAN system can be fast and easy. Therefore it can eliminate the need to pull cable through walls and ceilings. Since only the access points of wireless LANs require cabling, network managers are saved from pulling cables for wireless LAN end users. Lack of cabling also makes moves, adds, and changes trivial operations on wireless LANs. The portable nature of wireless LANs lets network managers pre-configure and troubleshoot entire networks before installing them at remote locations.

4.4.1.4 Installation Flexibility

Wireless technology allows the network to go where wire cannot go.

4.4.1.5 Reduced Cost

While the initial investment required for wireless LAN hardware can be higher than the cost of wired LAN hardware, overall installation expenses and life-cycle costs can be significantly lower. Long-term cost benefits are greatest in dynamic environments requiring frequent moves and changes.

4.4.1.6 Scalability

Wireless networks can be designed to be extremely simple or quite complex. Wireless networks can support large numbers of nodes and/or large physical areas by adding access points to extend coverage.

4.4.2 Wireless LAN Technologies

Wireless LANs have a range of technologies and each technology comes with its own set of advantages and limitations.

4.4.2.1 Narrowband Technology

A narrowband radio system transmits and receives information on a specific radio frequency. Narrowband radio keeps the radio signal frequency as narrow as possible just to pass the information. Undesirable cross talk between communication channels is avoided by carefully coordinating different users on different channel frequencies.

4.4.2.2 Spread Spectrum Technology

Spread Spectrum Technology is a wideband radio frequency technique developed to use in reliable, secure, mission-critical communications systems. It is designed to trade off bandwidth efficiency for reliability, integrity and security. There are two types of spread spectrum radio: Frequency Hopping Spread Spectrum Technology and Direct Sequence Spread Spectrum Technology. Frequency Hopping Spread Spectrum (FHSS) uses a narrowband carrier that changes frequency in a pattern known to both transmitter and receiver. Properly synchronized, the net effect is to maintain a single logical channel. To an unintended receiver, FHSS appears to be short duration impulse noise. Direct Sequence Spread Spectrum (DSSS) generates a redundant bit pattern for each bit to be transmitted. This bit pattern is called a chip (or chipping code). The longer the chip, the greater the probability the original data can be recovered. Even if one of more bits in the chip are damaged during transmission, statistical techniques embedded in the radio can recover the original data without the need for retransmission.

4.4.2.3 Infrared Technology

Infrared (IR) systems use very high frequencies, just below visible light in the electromagnetic spectrum to carry data. Like light, IR cannot penetrate opaque objects; it is either directed (line-of-sight) or diffuse technology. Inexpensive directed systems provide very limited range and typically used for personal area networks but occasionally used in specific wireless LAN applications.

4.4.3 How Wireless LANs Work

Wireless LANs use electromagnetic airwaves (radio or infrared) to communicate information from one point to another without relying on any physical connection. Radio waves are often referred to as radio carriers because they simply perform the function of delivering energy to a remote receiver. The data being transmitted is superimposed on the radio carrier so that it can be accurately extracted at the receiving end. This is generally referred to as modulation of the carrier by the information being transmitted. Once data is superimposed (modulated) onto the radio carrier, the radio signals occupy more than a single frequency, since the frequency or bit rate of the modulating information adds to the carrier. Multiple radio carriers can exist in the same space at the same time without interfering with each other if the radio waves are transmitted on different radio frequencies. To extract data, a radio receiver tunes in one radio frequency while rejecting all other frequencies.

In a wireless LAN configuration, a transmitter/receiver, call an access point, connects to the wired network from a fixed location using standard cabling. At a minimum, the access point receives, buffers, and transmits data between the wireless LAN and the wired network infrastructure. A single access point can support a small group of users and can function within a range of less than one hundred to several hundred feet. Adding access points allows a network to grow by extending its wireless coverage. The access point is usually mounted high but may be mounted essentially anywhere that is practical as long as the desired radio coverage is obtained. End users access the wireless LAN through wireless LAN adapters, which are implemented as PC cards in notebook or palmtop computers, as cards in desktop computers, or integrated within hand-held computers. Wireless LAN adapters provide an interface between the client network operating system (NOS) and the airwaves via an antenna. The nature of the wireless connection is transparent to the NOS.

4.4.4 Range and Coverage

Most wireless LAN systems use RF because radio waves can penetrate most indoor walls and obstacles. The range for typical wireless LAN systems varies from under 100 feet to more than 300 feet [2]. Solid objects block infrared signals, which imposes additional limitations. Coverage can be extended via roaming.

4.4.5 Compatibility with Existing Network

Most wireless LANs provide for industry-standard interconnection with wired networks such as Ethernet or Token Ring. Wireless LAN nodes are supported by network operating systems in the same fashion as any other LAN node. Once installed, the network treats wireless nodes like any other network component.

4.4.6 Security

Security provisions are typically built into wireless LANs, making them more secure than most wired LANs. It is extremely difficult for unintended receivers to listen in on wireless LAN traffic. Complex encryption techniques make it impossible to gain unauthorized access to network traffic. In general, individual nodes must be security-enabled before they are allowed to participate in network traffic. The WEP (Wired Equivalent Privacy) 40-bit encryption built into 802.11b Wireless LANs should be sufficient for most applications. However, Wireless LAN security needs to be integrated into an overall network security strategy.

4.4.7 Safety

The output power of wireless LAN systems is very low, much less than that of a hand-held cellular phone. Since radio waves fade rapidly over distance, very little exposure to RF energy is provided to those in the area of a wireless LAN system. Wireless LANs must meet government and industry regulations for safety.

4.4.8 Cost

The cost of installing and maintaining a wireless LAN is lower than the cost of installing and maintaining a traditional wired LAN. A Wireless LAN eliminates the direct costs of cabling and the labour associated with installing and repairing it. It simplify moves, adds, and changes that reduce the indirect costs of network administration. Hardware costs include adding APs to the network infrastructure and Wireless LAN adapter cards to all wireless devices and computers. Hardware costs will depend on such factors as performance requirements, coverage requirements, and vendor product range at different data rates. Infrastructure costs depend primarily on the number of access points deployed. The number of access points typically depends on the required coverage region and/or the number and type of users to be serviced. The coverage area is proportional to the square of the product range.

5. Mobile Technologies

Mobile technologies provide wide coverage to access information from networks. There are several mobile technologies. Here are some of the most used mobile technologies.

5.1 WAP

Wireless Application Protocol (WAP) is a protocol for wireless access to information resources and services from mobile devices. It is the de-facto-standard for the presentation and delivery of wireless information on mobile devices. WAP can be used to access Internet without a PC or modem. Mobile devices contain specifically designed WAP enabled microbrowser to display the information from Internet. Microbrowser is software built into a wireless device that allows users to access and display specially formatted Internet content. But in order to display the information on the screen of mobile devices, websites should be written in specifically designed Wireless Markup Language (WML). WML is a markup language developed for mobile devices. It is based on Extensible Markup Language (XML) and created to address the display, bandwidth and memory limitations of mobile and wireless devices. WML supports text and images and manages navigation and command execution. Websites written in Hypertext Markup Language (HTML) should be transferred to WML. The WAP gateway facilitates the delivery of WML contents to wireless devices. WAP technology can be used to send information to users' mobile devices. It can be used to provide reference services for specific information.

5.2 GPRS

The General Packet Radio Service (GPRS) is a service that allows mobile phones to be used for sending and receiving data over an Internet Protocol based network. GPRS enables wireless access to Internet, enabling users to access E-mail and other Internet applications using mobile phones. As in Internet, GPRS data is also handled as a series of "packets" that can be routed over several paths through the network. GPRS enables any service that is used over the Internet like File Transfer Protocol (FTP), web browsing, chat, E-mail, and telnet. It allows information to be transmitted more quickly and efficiently and facilitates instant connections whereby information can be sent or received immediately as the need arises. To use GPRS, users need a mobile phone or terminal that supports GPRS and a subscription to a mobile telephone network that supports GPRS. Users should know how to send and receive GPRS information using the mobile devices.

5.3 UMTS

Universal Mobile Telecommunications System (UMTS) uses ATM based switching network architecture. UMTS aims to provide services for mobile and fixed subscribers by common call processing procedures. It will provide at least 144 kbps for full mobility, 384 kbps for limited mobility and 2048 mbps for low mobility applications [3]. It can deliver low-cost, high-capacity mobile communications offering data rates up to 2Mbit/sec with global roaming and other advanced capabilities. UMTS can deliver pictures, graphics, video communications and other wide-band information as well as voice and data. It will extend the capability of mobile technologies by providing increased capacity, data capability and a far greater range of services using an innovative radio access scheme and an enhanced network.

6. Conclusion

Wireless technologies offer cost-effective access to digital information and provide connection to a wide range of computing and telecommunications devices without the need to buy, carry, or connect cables. In the future it will be the major technology for digital exchange of information. The application of wireless technologies in libraries like Wireless networking, Wireless Internet, Wireless OPAC, SMS, etc. will provide easy access to databases, Internet, online catalogue, and other digital information. It will provide faster access to digital information, resulting in better service and improved user satisfaction. It will make sharing of peripherals, files, multimedia resources and databases easier. Library users can access digital resources while physically near the printed materials. Libraries can reduce installation and maintenance costs of their network and they can move, add and change the network very quickly. Wireless networking will be an excellent solution for libraries with historic buildings or older buildings where installation is impossible or very expensive. But such a network should be simple, reliable and easy to expand whenever needed and should be compatible with other network devices. It should be built by reputable, experienced companies backed by easily accessible, sound technical support.

7. References

1. Mohamed Haneefa, K and Bavakutty, M. “Wireless Networking in Libraries: A Conceptual Introduction”, In Library Co-operation in a Networked World: Papers presented in the National Seminar held at the University of Calicut, 25-26 May 2001, edited by M. Bavakutty 132-145. New Delhi : Ess Ess Publications, 2001.
2. Bhartiya, Chandra Shekhar. “Wireless LANs a Cost Benefit Analysis”, Information Technology, 10 (7), (May 2001), pp-80.
3. Kush, Ashwani and Chauhan, R.K. “Wirelss Media: A New Paradigm”, DESIDOC Bulletin of Information Technology, 23 (3), (May 2003), pp-4.

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