WLAN: Application Towards M-library

Kamalendu Majumdar U N Singh

Abstract

Two technologies have changed people's attitude to communication and information access in the last decade: the Internet and mobile communication. In one hand the classical internet architecture is visible. On the other hand organizations across the country are embracing wireless campus networks. The appeal is obvious- seamless, ubiquitous connectivity for users wherever they are locate. The emergence of 802.11 wireless standards have brought costs down and increased compatibility. Setting up a wireless network is trivial –most equipment works out of the box with little or no configuration. In this article the authors intend to describe a guide line of achieving an m-library with WML (Wireless Mark-up Language) in WAP (Wireless Application Protocol) in WLAN environment.

Keywords : Wireless Technology, Wireless Networking, Wireless LAN, Applications

0. Introduction

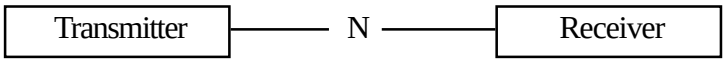
Any body involved in information technology will tell you that the rate of change is increasing rapidly. This only the beginning as technology opens up the internet to intelligent appliances in the home and in the organization. The vending machine orders its own stock, the utility meter that provide up-to-date figures to the central monitoring station and the washing machine that email an engineer with a fault warning who before you know it turns up at your door with the correct part for replacement[12].

People will look at their mobile phone as much as they hold it to their ear[1]. We presume that mobile will fixed communications, such that many people will only have a mobile phone. The mobile phone will be used as an integral part of the majority of people's life, it will not be an added accessory but a core part of how they conduct their daily lives. The mobile phone will become akin to remote control or magic want that lets people do what they want when they want.

An important property of systems is their ability to respond to changes, to adapt themselves to their environments, and to maintain sufficient stability to survive[9]. The characteristics of library services in this regard seem contradictory. Library services are generally regarded as being weak on the features needed for adaptation and stability—feedback on what is happening in library use is generally weak, incomplete, or lacking; the goals of library services are usually vague; library services are often criticized for being rather unresponsive; and librarians have little or no control over the environment. On the other hand, library services do exhibit some of the characteristics of systems that are adaptable: library services may have serious problems but rarely dramatic crises; and the popular stereotypic image of libraries is as safe, suitable places for timid persons to work rather than adventurous, action-oriented "change agents." Even more significantly, library services do, in fact, *survive.* In other words, there is a paradox: library services do not appear to have the usual characteristics of adaptability, but they do share the crucial feature of adaptive systems—survival. So in this stage the library professional should tried to provide the service in a new form. So to cope up with the latest change in the scenario the authors intend to highlight the ambiguity of library as m-library with wireless connectivity. .

1. Networking

A communication system in its simplest form consists of a *transmitter, a channel and a receiver.*



Data communication between transmitter and receiver involves a number of functions such as physical transmission of bits, error control, and routing and session establishment. In order to efficiently implement these functions vendors of computer systems evolved their own architecture. (E.g.System Network Architecture (SNA) of IBM and Digital Network Architecture (DNA) of Digital equipment Corporation (DEC). Such architectures permit interconnection of computers from the same vendor but not from the different vendors. In order to achieve a heterogeneous computer system in network system an architecture which is used a standard by all the vendors is required. OSI (Open Systems Interconnection) is a standard description or "reference model" for how messages should be transmitted between any two points in a telecommunication network proposed by CCITI (International Consultative Committee for Telegraph and Telephones). Its purpose is to guide product implementers so that their products will consistently work with other products. The reference model defines seven layers of functions that take place at each end of a communication.

The Open Systems Interconnection (OSI) reference model is the standard network architecture established by the International Organization for Standardization (ISO) to promote the compatibility of modern packet switch network designs. It is a layered architecture as follow:

- Layer 1: The physical layer...This layer conveys the bit stream through the network at the electrical and mechanical level. It provides the hardware means of sending and receiving data on a carrier.
- Layer 2: The data-link layer...This layer provides synchronization for the physical level and does bit-stuffing for strings of 1's in excess of 5. It furnishes transmission protocol knowledge and management.
- Layer 3: The network layer...This layer handles the routing of the data (sending it in the right direction to the right destination on outgoing transmissions and receiving incoming transmissions at the packet level). The network layer does routing and forwarding.
- Layer 4: The transport layer...This layer manages the end-to-end control (for example, determining whether all packets have arrived) and error-checking. It ensures complete data transfer.
- Layer 5: The session layer...This layer sets up, coordinates, and terminates conversations, exchanges, and dialogs between the applications at each end. It deals with session and connection coordination.
- Layer 6: The presentation layer...This is a layer, usually part of an operating system, that converts incoming and outgoing data from one presentation format to another (for example, from a text stream into a popup window with the newly arrived text). Sometimes called the syntax layer.
- Layer 7: The application layer...This is the layer at which communication partners are identified, quality of service is identified, user authentication and privacy are considered, and any constraints on data syntax are identified. (This layer is *not* the application itself, although some applications may perform application layer functions.)

1.1 Digital Leased line

Organizations with sufficient traffic to justify dedicated communication links among distant locations can set up a private network using digital leased lines offered by telephone companies. A leased line is a permanently dedicated, point-to-point circuit connecting two sites Leased lines are a synchronous service

based on the Circuit-switched network of PSTN. Leased lines are available at many discrete levels of bandwidth. Digital Data Service(DDS) have rates between 2.4 to 56kbps, capable to supporting data communications. Voice and video applications require a leased line with a speed of at least 64kbps. Fractional T1 lines provide speeds at multiples of 64 Kbps, uses is the T1 circuit. T3 is coming into great use[4].

The cost of connection two sites by a leased line include(1) the access charge for connecting the customer premise equipment (CPE) at each site to its nearest Central Office (CO),(2) the port charge for each site, and (3) the interoffice channel(IOC) charge, as can see in Fig-1

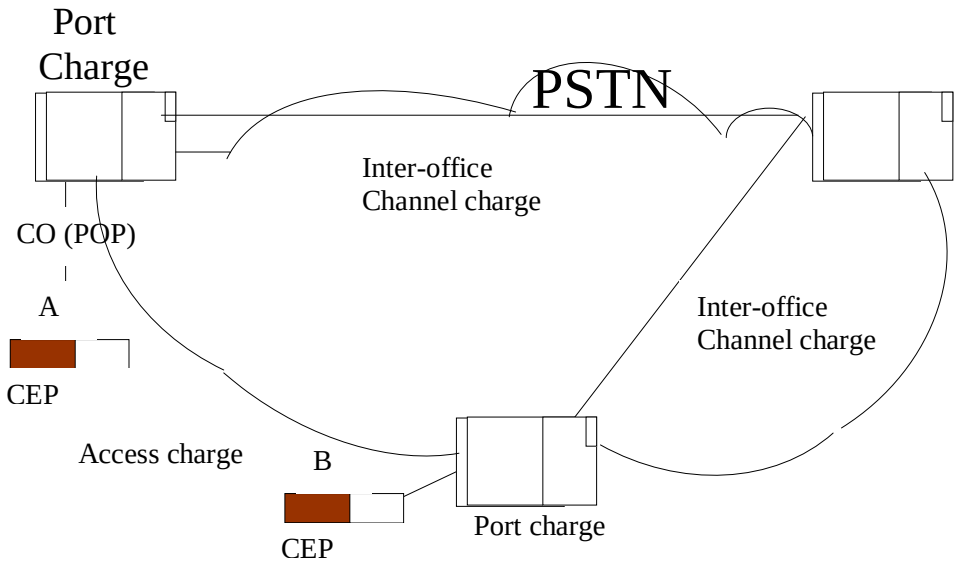


Fig1. Private Network using leased lines

1.2 Switched Multimegabit Data Service

Switched Multimegabit Data Service (SMDS) is high speed, connectionless datagram service designed for LAN interconnection over a wide area. It offer speeds up to 45 Mbps. Bellcore developed the SMDS standard in late 1980s to fill the gap for broadband service until BISDN becomes widely available. SMDS service was first lunch in 1991. It presently offered by most RBOCs, MCI WorldCom, GTE and other value-added network (VAN) service providers.

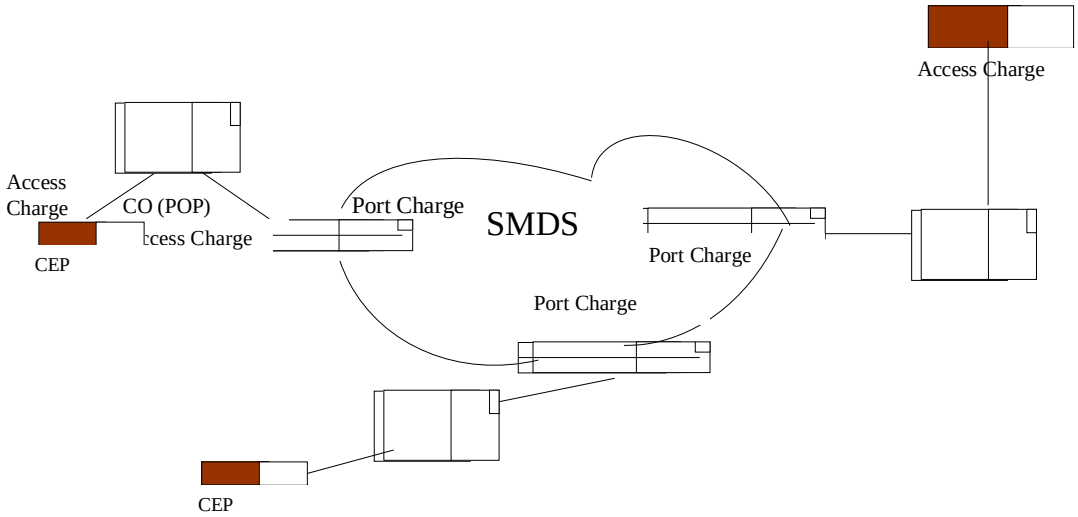


Fig 2– Virtual Private network using SMDS service

There are several network depending on the bandwidth some (Integrated Service s Digital Network, Digital Subscriber line and Cable Modem Technology, x.25 and Frame Relay, Asynchronous Mode and Broadband ISDN) , but in this paper beyond the scope of discussion.

2. What is a wireless LAN ?

It's a networking technology allowing the connection of computers without any wires and cables apart from the mains, mostly using radio technology (and sometime infrared. It's called LAN Local Area Network) because the range targeted is small (within an office, a building, a store, a small campus, a house [15].

WLAN can be configured in a variety of ways, ranging from the deployment of a wireless access point that lets employees connect to a large, corporate network to wireless Internet access from a coffee shop hotspot around the corner. Find out how the flexibility of WLAN enables you to set up a wireless configuration that suits your library needs.

- Ad-Hoc
- Infrastructure
- Hotspots
- Point-to-Point Bridge
- Point-to- Multipoint Bridge
- Ethernet to Wireless Bridge

2.1 Ad Hoc Network

An ad hoc (peer-to-peer) network is an independent local area network not connected to a wired infrastructure and where all stations are connected directly to one another (called a mesh topology). A simple network where communication is established between multiple stations in a given coverage area without the use of an access point or server is refereed to as an ad-hoc network. In order for all stations to have fair access to the wireless media, the standard specifies the rules that each station must observe so that they all have fair access to the wireless media. To ensure that throughput is maximized for all of the users, it also provides methods for arbitrating requests to use the media.

2.2 Infrastructure

In an infrastructure network, WLAN clients connect to the corporate network through a wireless access point, and then operate like a wired client. The infrastructure network uses an access point that controls the allocation of transmits time for all stations and allows mobile stations to roam from cell to cell. The access point is used to handle traffic from the mobile radio to the wired or wireless backbone of the infrastructure network. This arrangement ensures proper handling of the data traffic. The access point routes data between the stations and other wireless stations or to and from the network server.

2.3 Hotspots

To use hotspots, your notebook must be configured with Wi-Fi CERTIFIED technology so you can connect with other products. Wi-Fi CERTIFIED notebooks can send and receive data any where within the range of a wireless LAN base station.

2.4 Point-to-Point Bridge

A bridge connects two networks. A point-to-point bridge would interconnect two buildings. Access points connect a network to multiple users, and bridges connect networks. For example, a wireless LAN bridge can interface with an Ethernet network directly to a particular access point.

2.5 Point-to- Multipoint Bridge

The multipoint wireless bridge configuration is similar to a point-to-point bridge in many ways.

When connecting three or more LANs that may be located on different floors in a building or across buildings, the point to multipoint wireless bridge is utilized.

2.6. Ethernet to Wireless Bridge

An Ethernet to wireless bridge connects a single device that has an Ethernet port but not an 802.11 network interface card (NIC), such as a network printer.

3. What is IEEE 802.11?

IEEE 802.11 specifies a wireless LAN standard developed by the IEEE (Institute of Electrical and Electronic Engineering) committee. The 802.11 working group took on the task of developing a global standard for radio equipment and networks operating in the 2.4GHz unlicensed frequency band for data rates of 1 and 2Mbps. The standard does not specify technology or implementation but simply specifications for the

physical layer and Media Access Control (MAC) layer [14]. The standard allows for manufacturers of wireless LAN radio equipment to build interoperable network equipment. The IEEE 802.11 standard defines the protocol for two types of networks: (1) ad-hoc and (2) infrastructure networks.

There are two modes of interest to most users: WLAN mode and Ethernet conversion mode.

The WLAN mode defines the topology and some of the protocol characteristics of a WLAN node. There are three basic modes for any 802.11 WLAN station. Unfortunately, not everyone uses the same name for the same mode; the following table gives some of the mode names in common usage:

802.11 Official	Common Usage	Vendor
Independent BSS (IBSS)	Ad-Hoc	Peer to Peer
BSS or ESS Station	Infrastructure	Structure net
BSS Access Point	Infrastructure AP	n/a

An IBSS (Independent Basic Service Set) is a collection of stations that are able to communicate with each other directly. There is no central collection point for packets. IBSS networks can be created at any time and by any station. Once one station creates an IBSS, other stations may join that IBSS. The IBSS will exist as long as one of the stations that created or joined the IBSS is still running. If one of the IBSS peer stations is a router and the other peers have the router as their default gateway [5], then wireless packets have the means to enter and leave a wired network (and hence reach the internet).

An ESS (Extend Service Set) station is considered by some to be a ‘client’ on an Infrastructure network. An infrastructure network is created by a centrally coordinating station that has additional functionality. That central station is called an Access Point or AP. Once the AP has created the network, ‘client’ stations may join that network, authenticate with the access point and associate with the ESS network that the AP represents. According to the standard, all traffic within an infrastructure network passes through the AP. When one ‘client’ station wishes to send a packet to another ‘client’ station, the packet first goes to the AP and the AP forwards it to its destination. APs also commonly provide an ‘Integration’ function, that is, the AP provides the means for wireless packets to be forwarded to a wired network. Since all traffic in the infrastructure network passes through the AP, APs are commonly implemented as bridges.

BSS (Basic Service Set) Access Point mode is available in some driver sets (and is the target functionality for Linux WLAN). According to 802.11 an AP is a wireless station with all the same functionality of an ESS station, but it also includes additional functions.

Ethernet conversion modes are NOT specified as part of 802.11 but are necessary in bridges and in station drivers that make the host OS think the WLAN card is an ethernet card (just about every driver, including linux-wlan, does this). The ethernet conversion specifies how ethernet frames will be converted to 802.11 frames and vice-versa. The most common modes are:

Encapsulation :	(simplest) The allowed length of 802.11 data frames is 2340 (data field is 2312). Therefore a maximum length ethernet frame can be tucked into the data field of an 802.11 frame, and that’s precisely what this mode does.
RFC1042:	In its simplest terms, RFC1042 moves the protocol number in a DIXII ethernet frame into an LLC+SNAP header. [*the Logical Link Control layer is one of two sub layers of the Data-Link layer and is concerned with managing traffic (flow and error control) over the physical medium. The Logical Link Control layer identifies a line protocol]*
IEEE 802.1h:	An addendum to a bridging standard. Allows for a receiving station to be able to tell if a frame with an LLC header was originally a DIXII frame.

From a user's perspective, the details of each mode don't matter that much. You just need to make sure that all of your stations and APs use a matching mode. Unfortunately, some vendors use their own naming conventions for the various modes.

4. The device

The Wavelan has been around for quite a while now, and this product is now discontinued (and replaced by the Wavelan IEEE/ Orinoco- see section 3.1. The Wavelan is a radio LAN, using the 900 MHz or 2.4 GHz ISM band (Direct Sequence. It is built by Lucent, formerly AT& T, formerly NCR, and there is a few OEM(original equipment manufacturer) version (for example the DEC RoamAbout DS. The Wavelan comes in two flavors, an ISA card and a PCMCIA card (plus the access point).

The Wavelan appears to the PC as a standard network card and interfaces naturally with the networking stack. The configuration includes setting the frequency (10 different channels, Network ID (16 bits. Hardware encryption is optional (DES or AES- 64 bits key).

This product is built around a standard Ethernet controller (that may be found in some 3Com and Intel Ethernet cards, and the Ethernet physical layer is replaced by a radio modem. The ISA and Pcmcia cards share the same basic architecture, have the same modem, but have different Ethernet Controllers and bus interfaces (the pcmcia has only one transmit buffer). Because the Wavelan doesn't use a specific radio MAC (no MAC level retransmissions for example, it uses very efficiently the bandwidth, but is more sensitive to packet loss and collisions).

4.1 Low power Wireless Card for windows: Specifications

- Interface Standards [13]
- Compact Flash Interface-CompactFlash I/O, Type I
- Physical Characteristics
- CF I/O Card Size-88 x 42.8 x 3.3mm
- Power Consumption-11 Mbps with Dynamic Rate scaling to 5.5, 2, and 1 Mbps to optimize range and throughput
- Data Rate-Up to 33.6 Kbps
- Frequency Range-2.4-2.5 GHz band
- Range-Approx. 300 feet (typical office environment)
- International Roaming-802.11d compliant with automatic adjustment to country specifications when supported by infrastructure.
- Access Protocol-Carrier Sense Multiple Access with Collision Avoidance Protocol (CSMA/CA)
- Operating System Support-Windows CE (v2.11 or greater)

5. Protocols

In information technology, a protocol (pronounced PROH-tuh-cahl, from the Greek *protocollon*, which was a leaf of paper glued to a manuscript volume, describing its contents) is the special set of rules that end points in a telecommunication connection use when they communicate. Protocols exist at several levels in a telecommunication connection. There are hardware telephone protocols. There are protocols between each of several functional layers and each corresponding layer at the other end of a

communication. Both end points must recognize and observe a protocol. Protocols are often described in an industry or international standard.

On the Internet, there are the TCP/IP protocols, consisting of:

- Transmission Control Protocol (TCP), which uses a set of rules to exchange messages with other Internet points at the information packet level [11]
- Internet Protocol (IP), which uses a set of rules to send and receive messages at the Internet address level
- Hypertext Transfer Protocol (HTTP) and File Transfer Protocol (FTP), each with defined sets of rules to use with corresponding programs elsewhere on the Internet
- There are many other Internet protocols, such as the Border Gateway Protocol (BGP) and the Dynamic Host Configuration Protocol (DHCP).WAP, SIP, RTP, RTF and so on.

5.1 The Wireless Application Protocol (WAP)

It is a set of open, global protocols for developing applications and services that use wireless networks. The WAP protocols are mainly based on already existing Internet Protocols, but are optimized for mobile with wireless devices. It's a global standard developed to make Internet services available for mobile users. Even though WAP is based on Internet technology; WAP and the Internet live side by side. A library that has an Internet site can make the information available for mobile users by transforming the pages in WAP pages.

5.2 The WAP layers are

- Wireless Application Environment (WAE)
- Wireless Session Layer (WSL)
- Wireless Transport Layer Security (WTLS)
- Wireless Transport Layer (WTP)

Wireless is a term used to describe telecommunications in which electromagnetic waves (rather than some form of wire) carry the signal over part or the entire communication path. Some monitoring devices, such as intrusion alarms, employ acoustic waves at frequencies above the range of human hearing; these are also sometimes classified as wireless. By adopting the wireless LAN network m-library can evolve and will play a role in the library ever –larger numbers of user in their mobility.

5.3 Moving away from the Desktop PC to Information Devices

While computers are now the primary means of accessing the Internet, we have already seeing other internet-enabled devices such as pagers and cell phones, which can send and receive e-mail and access the Web. It works with the help of WAP[3,9,13].

5.4 WAP value chains

- Content
- Technology
- Access

WAP content is not vary different from the Hyper Text Mark up Language (HTML) content one comes across on any Net page. Only, it is in HTML, but in WML(wirelessesmark-up Language) which facilitates mobile (wireless)

device with their small displays and user-interfaces access content resident on Internet or Intranet-pages[6,8,10]. Content providers can choose to WAP-enabled their sites; this will enable mobile-phone users to directly access their sites.

Alternatively, content of m-library may be in HTML format and the user whishes to access the site through a wireless device, the WAP filter on the gateway will convert HTML to WML. The WAP gateway, the technology facilities in a way so that the WAP gateway could reside even at the WAP service provider's site example library.

For security purpose[2] and the network quality, it is preferable that the WAP Gateway be deployed at the operator's site. The reason is all access provider need to have a gateway of their own, then only they will be able the users be taken to the service-provider's default WAP portal when they switch their wireless device.

WML (Wireless Markup Language), formerly called HDML (Handheld Devices Markup Languages), is a language that allows the text portions of Web pages to be presented on cellular telephones and personal digital assistants (PDAs) via wireless access. WML [12] is part of the Wireless Application Protocol (WAP) that is being proposed by several vendors to standards bodies. The Wireless Application Protocol works on top of standard data link protocols, such as Global System for Mobile[14] communication,

code-division multiple access, and time division multiple access, and provides a complete set of network communication programs comparable to and supportive of the Internet set of protocols. WML is a language offered royalty-free. Specifications are available at Phone.com's Web site. According to Phone.com, any programmer with working knowledge of HTML, common gateway interface, and Structured Query Language should be able to write a presentation layer using WML. A filter program can be written or may be available from a vendor that will translate HTML pages into WML pages.

6. Conclusion

The situation of Net access over cell phones, may be still young, is attracting huge amounts of attention. A study from Cap Gemini America optimistically predicted that a full 78 percent of Net subscribers would be tapped into the wireless Internet as soon as next year[7]. Beneath the snowballing success of the wireless Web, a high-stakes game of technology tug-of-war is taking place. But underneath the hood of this giant-in-waiting lies a technology some influential industry players say is short-lived at best, and at worst a mistake Powerful players such as Microsoft, Nokia and Phone.com are lining up to push the technology in different directions, in a fight that will determine what mobile Net access will look like, and which companies will dominate this market. Dubbed "WAP," or the Wireless Access Protocol, the mobile data technology is what makes Web content available on cell phones tiny screens. But because it was developed specifically for these devices, it's not compatible with much of the technology that underlies the current Web. That's creating two versions of the Internet, driving a wedge between the wired and the wireless world—and that doesn't make any sense for cell phone subscribers, critics say. "In essence,

WAP creates a parallel Internet and limits the content end users are able to get," said Jane Zwieg, vice president of wireless research firm Herschel Shosteck Associates. "End users are used to getting whatever content they want."

Whatever the criticisms, the wireless Web is still in its infancy. Only a few companies offer the ability to surf remote Web sites over a cell phone, and the bugs are still being worked out with the technology. But analysts are bullish on the notion. International Data Corp. predicts that close to 1.3 billion people worldwide will be plugged in to Web-capable phones by 2004, compared to just 700 million people with ordinary Net connections. In this situation we the library professional have to play a vital and anticipatory role. We are in the progress off setting up electronic library or digital library; we have to think a step ahead and have to configure a card or equipment in our library server machine to cope up with the change which WAP suppose to make for the mobile user of library.

7. References

1. MOHAN, A.; Voice enabled request and response for mobile devices supporting WAP protocol, Vehicular Technology Conference, 2000. IEEE VTS-Fall VTC 2000. 52nd , Volume: 6, 2000,.p.2736-2743, vol.6
2. EUN-KYEONG KWON; YONG-GU CHO; KI-JOON Chae; Integrated transport layer security: end-to-end security model between WTLS and TLS , Proceedings of 15th International Conference on Information Networking, 2001. 2001., p65 –71.
3. KHAR, R.W* effect considered harmful [Internet WAP]., Internet Computing, IEEE , Vol:3(4)1999.,P. 89 –92
4. KETAMO, M., xTask-adaptable working environment. Proceedings of International Workshop on Wireless and Mobile Technologies in Education, 2002. IEEE, p.55-62
5. ROUHANA, N.; HORLAIT, E.; BWIG: Bluetooth Web Internet Gateway.Proceedingsof ISCC 2002. Seventh International Symposium on Computers and Communications, 2002.,p. 679 –684
6. MOHAN, A.; Voice browsing for handheld mobile devices supporting WAP protocol, International Conference on Personal Wireless Communications, 2000 IEEE, p. 408 –412
7. CHI-WEI LAN; CHUN-CHOU CHIEN; MENG-YEN HSIEH; CHEN, I.; A mobile e-commerce solution. Proceedings of the International Symposium on Multimedia Software Engineering, 2000.,p.215 –222
8. OJANEN, E.; VEIJALAINEN, J.; Compressibility of WML and WMLScript byte code: initial results [Wireless Mark-up Language], Proceedings of the Tenth International Workshop on Research Issues in Data Engineering, 2000. RIDE ,p.55 –62
9. CHI-HSING CHU; CHIEN-HSUAN HUANG; LEE, M.; Building an XML-based unified user interface system under J2EE architecture., Proceedings of the International Symposium on Multimedia Software Engineering, 2000.,p. 208 –214
10. READ, K; MAURER, F.; Developing mobile wireless applications Internet Computing, IEEE , Vol7(1) 2003.,p 81 –86.
11. HUSTON, G.; TCP in a wireless world. Internet Computing, IEEE , v.5(2) 2001., p. 82 –84
12. MEIJS, F.; NIKOLOVA, M.; VOORWINDEN, P.; Remote mobile control of home appliances ICCE. 2002 Digest of Technical Papers. International Conference on Consumer Electronics,100 –101p.
13. PASSANI, L. Abstracting WML with the Open Usability Interface Source: Windows Developer Magazine, v 13 , n 11 , Nov. 2002 , p 8-17
14. SUNGWON LEE; NAH-OAK SONG; Experimental WAP (wireless application protocol) traffic modeling on CDMA based mobile wireless network . 54th Conference on Vehicular Technology . IEEE VTS 54th, Vol 4 , 2001.,p. 2206 -2210.
15. http://www.intel.com/business/bss/infrastructure/wireless/solutions/configuration.htm visited on 04/12/03

About Authors

Mr. Kamalendu Majumdar is Assistant Librarian at Indian Institute of Technology, Kharagpur-721 302, India and holds M.L.I.Sc. His major research areas include multimedia information retrieval , wireless information retrieval, query processing and optimization in multiprocessor and distributed systems, and database management system and specialy interested in computer network . He has published over 30 Conference/ journal papers in international and national conferences and journals and edited IMeL2002 conference proceedings.
E-mail : kamal@library.iitkgp.ernet.in

Prof. U.N. Singh is Head of DLIS&DIT at G G University, Bilaspur, India and holds M.Sc, ADIS and Ph.D. His field of interest includes information science, Information storage and retrieval, and query processing , Computer network, Data and file structure, Bibliometrics, Scientometrics and Library Automation. He has published over 25 Conference/ Journal papers in international and national conferences and journals. He has guided Six Ph.D scholars and member of Board of Studies and Ph.D Committee in several Indian universities.
E-mail : unsingh03@yahoo.com