Information and Communication Technology in Academic Libraries

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Abstract

Information technology refers to mosaic of technologies, products and techniques combined to provide new electronic dimensions to information and retrieval activities. The term information technology represents convergence of three strands of technologies, namely computer, microelectronics and communications. It is used to describe products and services that came-up with rapid changes in computer and communication technologies and their fusion. The libraries and information centres have always been quick to find applications of new information technologies in their libraries. Today's modern libraries perform most of their functions using software packages that are now available off-the-shelf. It has their catalogues available on the Internet with a web-based search interface along with links to resources either acquired through external agencies or created in-house. Most such libraries are on the Campus network with CD ROM networks put-in place to serve the information requirement of their academic community. Several libraries have taken-up small-scale digitisation projects for part of their collection. The librarians and information professionals are required to develop skills that are required to use, develop and maintain IT-based services and products used by today's libraries. Rapid changes in information technologies and their adoption in libraries during past three decades have drastically changed the functions and activities of information professionals in libraries. The article deals with new information technologies, their applications in libraries and their products and services. It describes web-based library services that are modified versions of existing services and technology-driven new web-based library services.

1. Introduction

Past three decade has witnessed unprecedented developments in computer and communication technology. Computers are being used increasingly to automate various activities in libraries with a suitable off-the-shelf general or specific-purpose software

package that are now available in a wide range. Tremendous storage and processing potential of computers are being fully realized through existing communication and networking technologies. The two technologies are interdependent, inseparable and share a symbiotic relationship. The computer's ability to store and process vast amount of information and communication technology with its ability to transmit this information from one location to another converged to form "information technology" or "informatics" or "Information and Communication Technology". The information technology refers to mosaic of technologies, products and techniques combined to provide new electronic dimensions to information and retrieval activities. The term information technology represents convergence of three strands of technologies, namely computer, microelectronics and communications. Information technology is used to describe products and services that came-up with rapid changes in computer and communication technologies and their fusion. Thus, technologies which improve the efficiency and effectiveness of an information system or service fall under the purview of information technology. Some of these technologies are available to the libraries for many years, while a few are now emerging as important tools for overcoming the barriers in the access and dissemination of information.

The emergence of Internet, particularly the World Wide Web (WWW) as a new media of information delivery, coupled with availability of powerful hardware, software and networking technology has further triggered large-scale commercial and non-commercial digitisation programmes the world over. Increasing number of publishers are using the Internet as a global way to offer their publications to the international community of scientists and technologists resulting in large-scale appearance of STM electronic journals on the web. The Internet and web technology provides an unparalleled media for delivery of information with greater speed and economy. Moreover, the web-based electronic information products not only eliminated paper, physical storage and transportation costs, it also offers a hosts of other possibilities for incorporating multimedia and hyper-link features to electronic documents hitherto impossible on paper media. The web-based electronic information products are exerting ever-increasing pressure on the traditional libraries, which, in turn, are committing larger portions of their budgetary

allocation for either procuring or accessing web-based online or full-text search services, CD ROM products, online databases, multi-media products, etc. The libraries and information centres, as consumers of electronic journals and online databases, are benefiting greatly from this technology-driven revolution. The information products of technological revolution, in turn, triggered major shifts in the traditional practices and policies of buying, storing and accessing journals.

Rapid changes in information technologies during past three decades have drastically changed the functions and activities of information professionals in libraries. Most functions in modern libraries are being performed using software packages that are now available off-the-shelf. Several libraries have their catalogues available on the Internet with a web-based search interface along with links to resources either acquired through external agencies or created in-house. Most libraries are connected to the Campus network and subscribe to electronic resources to serve the information requirement of their academic community. Several libraries have taken-up small-scale digitisation projects for part of their collection. The librarians and information professionals are required to develop skills that are required to use, develop and maintain IT-based services and products used by today's libraries. The article deals with new information technologies, their products, services and applications in libraries. It describes web-based library services.

2. Need and Purpose of Information Technology in Libraries

The application of information technology in libraries results in increased operational efficiency. The IT increases productivity of library staff. It relieves professional staff from mundane jobs that involves a lot of duplication so that they can be fruitfully used for user-oriented library services. It improves quality of services rendered by the library. Use of information technology ensures ease of functioning, accuracy and economy in human labour with greater speed. The exponential growth of information has made manual system redundant giving way to computerized information storage and retrieval tools. Effective and efficient handling of huge quantum of information is only possible by using computers, which have the added advantage of being highly accurate and efficient that adds value to information.

Moreover, the technology also helps in rendering services that were hitherto not possible using traditional means. The new information technology facilitates improved management of physical and financial resources. The advances in technology and its availability at lower cost, has also raised expectations of users from librarians and libraries. The new information technology, on one hand, facilitate wider access to information for the library users, on other hand, it facilitates wider dissemination of information products and services generated by the library. The availability of networks facilitates resource sharing and high-speed communication with other libraries.

3. Developments in Computer and Microprocessor Technology

Dramatic reductions in the size and cost of computer components and equally impressive gains in the speed, storage capacity and reliability of hardware components have expanded their use rapidly in all activities and functions of a library and information centre. Notable reductions in the size of microprocessors combined with dramatically enhanced capacity have added new dimensions to the computer new hardware technology. Initially, small silicon chips contained only few components and circuits, but the average number of components has doubled each year since 1965. Early small-scale integration efforts first gave way to large-scale integration (LSI) chips that contained thousands of components, very large-scale integration (VLSI) chips that contained hundreds of thousands of components and circuits, and now ultra large-scale integration (ULSI) chips come with millions of components and circuits.

A microprocessor, also known as Central Processing Unit (CPU) of a computer, is a complete computation engine that is fabricated on a single chip. Microprocessors are manufactured by different companies like Intel, Advanced Micro Divices (AMD), Motorola, etc. However, most widely-used microprocessors are manufactured by Intel. The first microprocessor used in a PC was Intel 8080. Introduced in 1974, it was a complete 8-bit microprocessor on a single chip. Intel 8088 used in the IBM PC in 1979, was the first microprocessor that made its presence felt in the market. The PC market moved from the 8088, 80286, 80386, 80486, Pentium, Pentium-II, III, IV and now to Intel Dual Core and Quad Core. The new Intel Dual Core can execute any piece of code that ran on the original 8088, but the Dual Core runs about 3,000 times faster.

The capacity of a microprocessor is measured in terms of the number of bits it can send or receive and the number of bits it can process internally. The 8088 was an 8/16 bit processor, indicating that it can send or receive 8 bits of data and internally process 16 bits of data at a time. The 80286 was a 16/16 bit processor and 80386 chip had a 32-bit processor with a 32-bit data path and, as a result, was much faster than either the 8088 or the 80286 chip. The 80486 chip, introduced by Intel in late 1989, had a 32-bit processor. It has architectural enhancements, hence it performed better than the 80386 chip. The Pentium is a 32-bit processor with a 32-bit data path. It is three times faster than the 80486. The Pentium II and III had a 32-bit processor with a 64-bit data path. It was three times faster than the Pentium. The Pentium IV is a 32-bit processor with a 64-bit data path, and was introduced in 2000. It is four times faster than the Pentium. Currently, PCs and laptops are equipped with Dual Core which is a 64-bit processor with 64-bit data path and processing speed of 3.0 Ghz.

Like microprocessor technology, digital storage devices have also witnessed notable reductions in its size and cost with dramatically enhancement in capacity of storage. There are two types of data storage devices, i.e. removable data storage devices and non-removable data storage devices. The data storage devices come in many sizes and shapes. The storage devices can also be categorized based on media used for storage, for example magnetic storage media, optical storage media, metal-oxide semiconductors or flash memory devices (popularly known as Pen drives or USB drives).

Magnetic storage media are commonly used for large volumes of data (e.g., video, image, or remote sensing data). Large amounts of data are stored through tape drives because the capacity on the drives is huge - three billion (or three gigabits) of data per square inch can fit on a single magnetic disk. Hard discs, floppies, tapes, cartridges, etc. are example of magnetic media.

CD-ROMs and DVD ROMs are example of optical storage media which can again be of two types, i.e. i) write-once, read-many: data once written cannot be erased; and ii) Rewritable: the data that is once written can be erased completely and the same storage device can be used again for storing different data. A typical disc used in a computer-based CD drive stores 650 MB. Digital Versatile Disk or DVD, initially stood for

Digital Video Disc. Like a CD, DVD is an optical storage system for read-only, recordable and rewritable applications. The DVD format provides several configurations of data layers, moving from 2D storage to 3D storage. Each configuration is designed to provide additional storage capacity. The similarity between the DVD and the CD gets smaller with each upgraded configuration, however, DVDs in contrast to CDs has storage capacity of 4.7 GB.

Metal-oxide semiconductors-based storage devices, popularly known as pen drives or USB drives or flash memory devices, is non-volatile computer memory that can be electrically erased and reprogrammed. It is a technology that is primarily used in memory cards and USB flash drives for general storage and transfer of data between computers and other digital products. Flash memory stores information in an array of memory cells made from floating-gate transistors. In traditional single-level cell (SLC) devices, each cell stores only one bit of information. Some newer flash memory, known as multi-level cell (MLC) devices, can store more than one bit per cell by choosing between multiple levels of electrical charge to apply to the floating gates of its cells. Flash drives are now available with 8 GB storage capacity.

Digital collections that are too large to store entirely on a disk use hierarchical storage mechanisms (HSM). In an HSM, the most frequently used data is kept on fast disks while less frequently used data is kept in nearline such as an automated (robotic) tape library. An HSM can automatically migrate data from tape to disk and vice-versa as required. Intelligent storage networks and snap-servers are now available in which the physical storage devices are intelligently controlled and made available to a number of servers. A number of RAID (Redundant Array of Inexpensive Disks) models are also available for greater security and performance. The RAID technology distributes the data across a number of disks in a way that even if one or more disks fail, the system would still function while the failed component is replaced.

4. Developments in Communication and Network Technology

Communication technology, with its ability to transmit data and information from one location to another, serve as a tool to exploit potentials and ability of computer to store

and process vast amount of information. A computer communication network is an interconnection of a collection of several computers from which the user can select the service required and communicate with any computer as a local user. A computer communication networks can be viewed as a collection of nodes with computing resources and nodal-switching computers that facilitate communication through a set of transmission links. Developments in communication technology have made it possible to interconnect geographically dispersed computing resources of different kinds and makes. Users can access the network through PCs and terminals attached to a node and messages traverse these networks through the switching nodes. Since computer communicates using digitized signals instead of electric signals, it requires different transmission facilities than those used for transmitting analogue electrical signals. It is, however, a common practice to use conventional telecommunication links for data transmission by converting digital signals into analogue signals using a process called “Modulation” and the device that performs the conversion is called the MODEM (MOdulator - DEModulator). Currently, terrestrial, satellite-based data networks, Integrated Service Digital Network (ISDN) and wireless networks are available that can handle all kinds of communication requirements (i.e. voice, data, telemetry, facsimile and video) without discrimination.

The computer networks can be grouped into four categories based on geographical locations of its computer terminals, i.e.

i) Local Area Network (LAN): interconnection of many computers within a given local area, more often premises of a single organization building. A very high speed of data transmission can be attained within a limited geographic area. LANs are typically configured in a star, bus or ring. Low speed LANs use telephone wires or copper cables, optical fibre cables are used to achieve high-speed transmission of data.

ii) Wide Area Network (WAN): WAN is used to interconnect a number of widely dispersed computers in various cities of a country or different countries. WANs use communication media maintained by telegraph or telephone companies. These networks usually have land telephone lines, underground coaxial cables, microwave communication and satellite communications.

iii) Metropolitan Area Network (MAN): MAN refers to inter- connection within geographical limits of a city or town.

iv) Gateways: Gateways consist of software and hardware that are required to interconnect networks amongst themselves. Gateways contend with any differences in packet sizes, protocols and addressing methods between the two networks it connect. Gateways are also used to connect LANs to WANs and WANs, in turn, can be linked through gateways to create national and international data communication networks.

The communications networks can be grouped into the following three categories based on the technology and communication media used by them:

i) Public Switched Telephone Network: PSTN are managed by common carriers usually telephone companies / departments the world over. The PSTN generally provide two basic services, the normal dial-up connections to the subscribers and permanent leased connection between two subscriber's points. The permanent leased connections provide single traceable line between two subscriber points. The leased lines are generally less prone to noise than dial-up lines.

ii) Public Data Network: Analogous to the public telephone network, many domestic common carriers provide data communications services via a specialized network called a Public Data Network (PDN). Most Internet Service Providers (ISPs) use combination of PDN and PSTN for providing Internet connectivity.

iii) Integrated Services Digital Networks (ISDN): An ISDN is a network that provides end-to-end digital connectivity to support a wide range of services, including voice and non-voice services.

Computer networks use physical channels through which information is transmitted between computers in a network. Media may be classified as bounded i.e., wires (twisted pair telephone wires or UTP CAT 5), cables (co-axial) and optical fibres; or unbounded i.e., radio waves or microwaves.

Data communication is an integral part of the modern information storage and retrieval systems in terms of their online access. Today, network technology works on client-

server architecture with middleware used for connecting software components or applications on clients and servers. Technique of packet switching, evolved in 1960s, is used for transferring data between computer systems with an objective to facilitate networked computers to communicate seamlessly across multiple, geographically dispersed locations. The Transmission Control Protocol (TCP) and Internet Protocol (IP), called TCP / IP suite, is the backbone of Internet and other TCP /IP based networks. With developments in communication technology, institutions have options to set-up fibre optic-based gigabit LAN or wireless LAN. Depending on the geographical location, institutions have options to buy terrestrial or satellite-based Internet bandwidth its combinations from a number of Internet Service Providers (ISPs).

5. Library Automation

The library automation refers to computerization or mechanization of all library activities. It deals with the design and development of process and system that minimize the necessity of human intervention in their operations. The library automation is defined as "integrated systems" that computerize an array of traditional library functions such as acquisition, cataloguing, circulation and serials control, etc. using an integrated library software. A computerized library and information system is a set of functional system encompassing:

- In-house Operations of the Library; and
- Other applications of the information technologies in Libraries including information storage and retrieval.

An automated library is one where a computer system is used to manage one or several of the key functions of a library such as acquisitions, serials control, cataloguing, circulation and the public access catalogue. An integrated library system or an integrated online library system is used for computerization of in-house activities of a library. Such application packages use a single bibliographic database and a set of interrelated application programs to support multiple library operations. Most integrated library software are modular in design consisting of a number of optional and basic modules. Most library packages typically incorporate modules for: Acquisition, Cataloguing, Circulation Control,

Serials Control and Online Public Access Catalogue. Online Public Access Catalogue is often a principal motive for the implementation of integrated library software. Several off-the-shelf packages are available in the market that can be used for computerization of in-house activities of the Library. These software packages are available for single user in a workstation mode (Windows 95/98/2000) as well in simultaneous multi-user environment on Windows and its variant / Unix / Linux / Sun Solaris Operating Systems. LibSys, SOUL, Alice for Windows, Slim +, Virtua, Librarians Suit, etc. are some of the important software packages available in India.

Libraries, besides using integrated library software, also use office automation software like word processing (MS Word), spread-sheet (MS Excel), database management systems (MS Access), presentation packages (MS Powerpoint) and graphic applications (Photoshop or Paint). Librarians and information professionals, therefore, require basic training in use of such general-purpose packages.

6. Automatic Identification and Data Collection Technology

There are three important identification and data collection technologies that are used in libraries, namely, bar code technology, RFID and Smart card. These technologies are described below briefly.

6.1. Bar Code Technology

Bar code technology is being used in library and businesses for the past 30 years to minimize data entry errors, speed processes and reduce costs. Most books, journals as well as other consumer products in the market carry black and white thin and thick strips called barcodes. Barcode technology offers a mechanism that can be used for identification, location and tracking of items that are bar coded.

Barcode is not a new technology, it was introduced in 1940 although it was first applied commercially in 1960's as a method for tracking rail road cars. Since then, it has been used extensively in consumer industry, material handling, industries and libraries. A bar code is a machine readable code consisting of a series of bars and spaces printed in defined ratios. Bar code symbologies are essentially alphabets in which different widths of bars and spaces are combined to form characters and ultimately, forms a message.

Because there are many ways to arrange these bars and spaces, numerous symbologies are possible. Common linear symbologies include UPC/EAN, Interleaved 2 of 5 (I of 5), Codabar, Code 39 and Code 128. While each symbology is in some way unique, the composition of a complete message (bar code) is regardless of the symbology used.

Barcode by itself, is not a system but is an identification tool that enables accurate reading of data for sophisticated management systems. Use of barcode increasing accuracy in data collection, saves time and brings about the efficiency in library activities.

Bar code technology is being used in libraries all over the world especially for circulation of books as well as for several other functions including location control or book tracking, stock verification, receipt of issues of journals, cross checking of documents issued from the library, etc.

6.2. Radio Frequency Identification (RFID)

RFID (Radio Frequency Identification) is a term used for a radio-enabled device that communicates with or interrogates a tag or smart label, which is embedded with a single microchip processor and an antenna. The origin of the term lies in the invention of "tags" that reflects back or re-transmit a radio frequency signal. The two components of RFID are tags and readers. The tags or label is equipped with a single microchip processor, an antenna and an ID code that can be embedded in almost any object. RFID readers are radio-enabled devices that communicate with or interrogate RFID tags or labels wirelessly and obtain the ID code on the tags from a distance of several inches. The RFID readers can be fixed or made portable just like barcode scanners. RFID can also be referred as a high-tech version of the barcode.

In the past few years, the cost of RFID tags have come down drastically. Low cost RFID tags, typically costs less than Rs. 30.00 each for up to 1 metre range making the technology affordable as an alternative to the barcode, magnetic strip or printed label. RFID has advantages that include tolerance of mis-orientation and obscuration, lower cost over life and ability to "read". Most importantly, RFID tags are cheap enough to be disposable and thin enough to go even inside the sheets of paper in some cases.

An RFID tag is a means of storing and retrieving data through a radio frequency transmission to the chip inside the tag. An RFID tag is simply an integrated circuit (chip), which includes memory for data storage and a substrate backing material with an antenna pattern. The chip can typically hold up to 1,024 bits (128 bytes) of information. In a typical library implementation, each book is equipped with smart labels and library patrons are given library cards imbedded with smart labels. Tags or smart labels can be programmed to store i) unique accession number of documents; ii) class number of a document; and iii) a unique security code for EAS.

While accession number is used for carrying out functions of circulation, stock verification and other library applications, class number can be deployed for sorting documents according to class numbers and segregating then into bins for different shelving areas. As mentioned earlier, the RFID tags can also be used as antitheft devices in libraries. Such applications of RFID are called Electronic Article Surveillance (EAS). New forms of RFID perform EAS functions as well, obviating the need for a separate device.

An interrogator, or reader, is a radio frequency device used to write data to and read data from the chip. Smart tags used in a library are passive, having no internal power source such as a battery. The interrogator provides enough RF energy to power and activate the tag to reflect or to present information stored on them. RFID tags transmit data, antennas receive or transmit the RF signal through the air and readers decode the RF information received from the RFID tag through the antenna. The data is then transmitted to the host application for necessary processing.

6.3. Smart Cards

A smart card, chip card, or integrated circuit card (ICC), is a pocket-sized card with embedded integrated circuits which can process data. Effectively, a smart card can receive input, process it and deliver the processed data as an output. There are two broad categories of smart cards, memory cards contain only non-volatile memory storage components and specific security logic. Microprocessor cards contain volatile memory and microprocessor components. The card is made of plastic, generally PVC. The card may embed a hologram to avoid counterfeiting. Smartcards are generally used as security authentication mechanism for single sign-on within large companies and

organizations. A quickly growing application of smart card is as digital identification cards. In this application, the cards are used for authentication of identity. When combined with biometrics, smart cards can provide two- or three-factor authentication. The libraries generally use smart cards to identify and authenticate its patrons.

7. Internet Technology and its Services

The Internet has revolutionised our society, our economy and our technological systems. Over the past century, important technological developments have created a global environment that is drawing people of the world closer and closer together. About fifteen years ago, most of the world knew little or nothing about the Internet. The Internet was then a private network accessible only to computer scientists and researchers who used it to interact with colleagues in their respective disciplines. It is estimated that about 60 million host computers on the Internet today serve about 200 million users in over 200 countries and territories. Also, the total numbers of host computers and users have been growing at about 33% every six months since 1988 – or roughly 80% per year.

The Internet has revolutionised the computer and communications world like nothing before. The invention of the telegraph, telephone, radio, and computer set the stage for this unprecedented integration of capabilities. The Internet is at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without barriers of geographic location. The Internet represents one of the most successful examples of the benefits of sustained investment and commitment to research and development of information infrastructure. Beginning with the early research in packet switching, the government, industry and academia have been partners in evolving and deploying this exciting new technology. Today, terms like “Yahoo” and “Google” are common part of our vocabulary. Internet-based communication services, content creation and delivery tools applicable in libraries are given below.

7. 1. Internet-based Communication Services

Libraries use Internet-based communication system while attending their day-to-day routine works. An Internet-based communication system allows communication between

computer users hooked into a network. Internet-based communication system is used for communication between person-to-person, person-to-group and group-to-group. A document or message sent through electronic system may contain text, graphics, image, speech as well as other types of information. Major Internet-based communication services are described below.

7.1.1. Electronic Mail (E-mail)

Electronic Mail, or e-mail, is a fast, easy and inexpensive way to communicate with other Internet users around the world. It is the most popular and widely used services of the Internet. E-mail is the term given to an electronic message, usually a form of simple text message that a user types at a computer system and is transmitted over some form of computer network to another user, who can read it. Email offers speedy and economical transfer of messages anywhere in the world. Sending e-mail messages are virtually free even to long-distance destinations. Most integrated library system support e-mail-based communication to library users (for circulation and acquisition-related activities) and to the vendors / publishers (for placing orders, reminders, cancellation, etc).

7.1.2. Listserv

Listservs are electronic groups that typically centre around broad topics such as Digital Libraries or Reference Service, etc. Listservers of IFLA with the name IFLA-I, Digilib-I, LIBJOBS-I are good example of this. Every e-mail message sent to the listserv is distributed to all members of that listserv, which is potentially hundreds or thousands of people. It does not cost anything to subscribe to a listserv, but simply requires that the user sends an e-mail message to the appropriate address with the message: subscribe (listserv) Firstname Lastname. Each Listserver has one address where a user sends requests to subscribe, un-subscribe, search the archives, etc., and another address to send actual questions or responses to the readers of the list. Apart from organising discussions, job announcements and conference announcements are popular usage of Listservs.

7.1.3. Chat or Instant Messengers

Chat refers to any live discussions conducted using the Internet, usually between more than two persons using their keyboard to communicate. Chat programs allow users on

the Internet to communicate with each other by typing in real time. It is a feature offered by many online services or Web sites that allows users to “chat” by typing messages which are displayed almost instantly on the screens of other users who are using the chat room at a given time. After entering a chat room, any user can type a message that will appear on the monitors of all the other users. Chatting is one of the most popular uses of the Internet. Generally the users remain anonymous by using nicknames or pseudonyms to identify themselves online.

A variation of chat is the phenomenon of the instant messenger. Instant messaging can be used to communicate privately with friends, relatives or co-workers. To send and receive instant messages, a user needs a connection to the Internet and instant messaging software such as Gmail Messenger, Yahoo Messenger and MSN Messenger. The instant messaging software enables a user to set up a list of contacts who also use the same program. Once this list is set up, one can see each contact as they come online. A chat session can be started with them quickly and easily. Most conversations are typed text messages that are sent back and forth, though more advanced users can exchange voice, video, files and more.

7.1.4. Conferencing

One of the most exciting features of Internet is to communicate, talk, and see groups of people in different locations around the world, without the expense of travel. Conferencing can take many forms, such as web chat, audio conferencing, video conferencing, multimedia conferencing, screen-sharing, etc. The conferencing programs, such as the popular CU-SeeMe, allow workgroups to use the Internet to see each others’ faces in small windows on the computer screen and to hear their voices through computer speakers. One can use desktop video and audio simultaneously or audio can be used alone, or just use the screen-sharing capability without either audio or video.

7.1.4.1. Audio Conferencing or Internet Telephony

Internet telephony also called IP telephony is a combination of hardware and software that allows the Internet to be used as a telephone carrier. Internet telephony is the conversion of analogue speech signals used on current telephone systems into digital data, allowing calls to be sent over the Internet, bypassing long distance charges. While

the Internet was first devised as a way of transmitting data, it is now being used to make voice calls. Internet telephony is projected to explode as the costs plummet. After the costs of initial set-up and access to an Internet Service Provider, long-distance voice calls can be made via the Internet free of charge, but current quality of voice transmission over the Internet is not always as good as direct telephone service. There are also PSTN / Internet gateways that allow regular telephone callers to make Phone-to-Internet-to-Phone connections. There are PC-to-Phone connections and Phone-to-PC connections.

7.1.4.2. Video Conferencing

Video conferencing is one of the most exciting areas of development in telecommunications, with applications ranging from business to government to education to home and family. Video conferencing involves sending video signals as well as audio and computer data signals. Conferencing can be done one-to-one, one-to-many (called multicast), and many-to-many (called multipoint). While video conferencing, one can talk as well as see the people sitting miles away as if all are discussing in one room facing each other. One of the most popular applications is transmission on news from various locations by the TV news channels. It also has enormous potential for enhancing communications for small and mid-sized companies, as well as distance learning. However, video conferencing requires sufficient bandwidth to transfer video files of acceptable quality. Desktop conferencing, therefore, is not yet widely implemented for business and educational use. As bandwidth increases, desktop video conferencing is expected to blossom. The PictureTel and Vtel are two of the largest companies that sell video conferencing equipment.

7.1.4.2. 1. NetMeeting

Microsoft NetMeeting facilitates a new way of talking, meeting, working and sharing over the Internet. It uses Internet phone voice communications and conferencing standards to provide multi-user applications and data sharing over Intranets or the Internet. Two or more users can work together and collaborate in reach time using application sharing, whiteboard, and chat functionality.

NetMeeting can be used for common collaborative activities such as virtual meetings. It can also be used for customer service applications, telecommuting, distance learning, and technical support. The product is based on ITU (International Telecommunication Union) standards, so it is compatible with other products based on the same standards.

NetMeeting supports text chat, video shared whiteboard, transferring of files, directory of connected users. Files, such as documents or pictures, can be exchanged. One of the problems with net meeting is the break-up in audio that sometimes becomes inaudible when using it on the Internet, though it works fine over a high-speed company network. Net meeting is normally installed with Internet Explorer, or it can be download from http://www.microsoft.com/windows/netmeeting/. There is a web site dedicated to Netmeeting at http://www.netmeet.net/.

7.1.5. News Groups

Another Internet service similar to listservs is a newsgroup. News Groups are like an International bulletin board. Each group is a forum for a different subject, where a subscriber can post his / her questions or answers. There are thousands of groups covering just about every area of interest. The difference between listserv and news group is that when a user joins a group, the mail is no longer automatically deposited into his mailbox. Instead a user is expected to go to the newsgroup himself to read it. Some listservs can also be accessed as a newsgroup. A good analogy to a newsgroup is a bulletin board, i.e. one can go to it, as opposed to having mail delivered to his / her desk. The mails from newsgroup does not get cluttered and it can be easily regulate how often messages are read. A drawback of a newsgroup lies in the fact that a user must remember to go out to the newsgroup to look for the information. There are hundreds of newsgroup communities. They centre around topics such as computing, news, recreation, social, and “alternative” topics. There are newsgroups dealing with virtually every topic under the sun and new newsgroups appear every day.

7.2. Internet-based Content Publishing and Delivery Services

The World Wide Web- know as WWW, W3 or simply, the Web help people to publish, organize and provide access to information on the Internet. The WWW can be defined

as a hypertext, multimedia, distributed information system that provides links to hypertext documents, as well as to many other Internet tools and databases. The Web serves as a platform for several specialised content publishing and delivery services. Some of the important tools for content publishing and delivery services applicable to libraries and information centres are described below.

7.2.1. Blogs

A blog (an abridged form of term web log) is a website, usually maintained by an individual, with regular entries of commentary, descriptions of events, or other material such as graphics or video. Entries are commonly displayed in reverse chronological order (Wikipedia, 2008). Blogs are considered as lightweight publishing tools. Blogs provide control to an individual or group of individuals for publishing contents or making commentary on it. Technologically, blogs are easier to use, platform-independent, and accessible online over the Internet. Broadly, blogs can be said to be online dairies, however, thousands of blogs are maintained by experts in different subject areas who are willing to share their knowledge, understanding and opinions with other people. Michael Casey, who coined the term “Library 2.0”, for example maintains a blog on Library 2.0 called LibraryCrunch.

The most obvious application of blogs for libraries is to use it as a tool for promotion, publicity and for outreach services. Libraries can disseminate information to their users, make announcements for its new resources and events through its blogs. Blogs can be used to initiate debates and interaction amongst users and staff. Moreover, library staff and user can be encouraged to use Library blogs to get to know each other and interact at personal level.

7.2.2. Wikis

A wiki is a collection of web pages designed to enable anyone who accesses it to contribute or modify content, using a simplified markup language. Wikis are often used to create collaborative websites and to power community websites (Wikipedia, 2008). For example, the collaborative encyclopaedia, Wikipedia is one of the best-known wikis, that has broken down one the golden rules of librarianship, i.e. content validation and

authenticity of information. Wikis are also used in businesses to provide affordable and effective Intranets and for knowledge management. Ward Cunningham, developer of the first wiki software, WikiWikiWeb, originally described it as “the simplest online database that could possibly work” (Wikipedia, 2008).

Wikis can essentially be equated to open web-pages, where anyone registered with it can publish on to it, add to it, amend it and change it. As in case of blogs, Wikis do not have reliability as traditional resources. Inspite of this, their value as information resource cannot be undermined. Wikis are not only popular but de-facto source of information for people inspite of the fact that it is not validated or authenticated. The lack of peer review and editorship in case of Wikis is a challenge to librarians. Wikis as items in a collection, and the associated instruction of users in their evaluation, is certainly an important task for libraries.

Libraries can use wiki as a communication tool to enable social interaction among librarians and patrons. Users can share information, ask and answer questions, and librarians can do the same within a wiki. Moreover, a record of these transactions can be archived for perpetuity. Transcripts of such question-answer sessions would serve as a resource for the library to provide as reference. Furthermore, wikis (as well as blogs) will ultimately evolve into a multi-media environment, where both synchronous and asynchronous audio and video collaborations will take place.

7.2.3. Podcasting

The word “podcasting” is derived from two words, namely “broadcasting” and “iPod” (popular MP3 player from Apple Computer). Podcasting is defined as “process of capturing audio digital-media files that can be distributed over the Internet using RSS feeds for playing-back on portable media players as well as computers. Users can subscribe to such feeds and automatically download these files directly into an audio management program (such as iTunes, Windows Media Player or MusicMatch) on their PCs. When a user synchronizes their portable audio device with their personal computer the podcasts are automatically transferred to that device to be listened to at the time and location most convenient for the user (Wikipedia, 2008).

Podcasts can be used with a variety of digital audio formats and play on almost any MP3 player or portable digital audio device - as well as any brand of desktop computer or laptop. Though podcasters' web sites may also offer direct download or streaming of their content, a podcast is distinguished from other digital media formats by its ability to be syndicated, subscribed to, and downloaded automatically when new content is added, using an aggregator or feed reader capable of reading feed formats such as RSS or Atom. Several libraries use podcasts to support library orientations programmes.

Taking advantage of podcasting and other consumer technologies (e.g., PDAs, iPods and other MP3 players) as a deliver media of Library's content and services is a great leap forward for library profession.

7.2.4. Vodcasting

The "VOD" in Vodcasting stands for "video-on-demand". It is identical to podcasting. While podcasting is used for delivering audio files, vodcasting is used for delivering video content. Like podcast content, vodcasts content can be played either on a laptop or on personal media assistant (PMA).

7.2.5. RSS Feeds

RSS stands for Real Simple Syndication or Rich Site Summary. The technology, on one hand allows a web site (or e-publisher) to list the newest published updates (like table of contents of journals, new articles) through a technology called XML, on the other hand, it facilitates a web user to keep track new updates on chosen website (s). Like a personal search assistant, RSS feed readers visit pre-defined web sites, look for updated information and fetch it automatically on to the user's desktop. It provides users a way to syndicate and republish content on the Web. Users republish content from other sites or blogs on their sites or blogs, aggregate content on other sites in a single place, and ostensibly distil the Web for their personal use.

Libraries are already creating RSS feeds for users to subscribe to, including updates on new items in a collection, new services, and new content in subscription databases. They can also republishing content from other scholarly web sites on their sites.

8. Digitization

Digitisation is the process of converting the content of physical media (e.g., periodical articles, books, manuscripts, cards, photographs, vinyl disks, etc.) into digital format. A digital image, in turn, is composed of a set of pixels (picture elements), arranged according to a pre-defined ratio of columns and rows. An images document file can be managed as a regular computer file and can be retrieved, printed and modified using appropriate software. In most library applications, digitisation normally results in documents that are accessible from the web site of a library and thus, on the Internet. Optical scanners and digital cameras are used to digitise images by translating them into bit maps. It is also possible to digitise sound, video, graphics, animations, etc. Further, textual images can be OCRed so as to make its contents searchable.

Digitisation is not an end in itself. It is the process that creates a digital image from an analogue image. Selection criteria, particularly those which reflect user needs are of paramount importance. Therefore, the principles that are applicable in traditional collections development are applicable when materials are being selected for digitisation. However, there are several other considerations related to technical, legal, policy, and resources that become important in a digitisation project.

Several digital library projects are concerned with providing digital access to materials that already exists with traditional libraries in printed media. Digitization of printed material is practically the only reasonable solution for institutions such as libraries for converting existing paper collection (legacy documents) without having access to the original data in computer processible formats. Digitization is the natural choice for large-scale conversions for major digital library initiatives. Printed text, pictures and figures are transformed into computer-accessible forms using a digital scanner or a digital camera in a process called document imaging or scanning. The digitally scanned images are stored in a file as a bit-mapped page image, irrespective of the fact that a scanned page contains a photograph, a line drawing or text. A bit-mapped page image is a type of computer graphic, literally an electronic picture of the page which can most easily be equated to a facsimile image of the page and as such they can be read by humans, but not by the computers, understably “text” in a page image is not searchable on a computer using

the present-day technology. An image-based implementation require a large space for data storage and transmission. There are several large projects using page images as their primary storage format, including project JSTOR (**www.jstor.org**) at Princeton University funded by the Melon Foundation. The project Jstor has a complete set of more than 1000+ journals scanned and hosted on web servers that resides at the University of Michigan and is mirrored at Princeton University. Using technology developed at Michigan, high resolution (600 dpi) bit-mapped images of each page are linked to a text file generated with optical character recognition (OCR) software. Linking a searchable text file to the page images of the entire published record of a journal along with newly constructed table of contents, indexes, permits high level of access, search and retrieval of the journal material previously unimaginable (Guthrie, 1997).

Capturing page image format is comparatively easy and inexpensive, it is a faithful reproduction of its original maintaining page integrity and originality. The scanned textual images, however, are not searchable unless it is OCRed, which in itself, is highly error prone process specially when it involves scientific texts.

9. Electronic Resources

Electronic resources can be defined as resources in electronic format or computer-processible format that provide information or an indicator to the information and are generally accessible over the Internet or stored on media like CD ROM / DVD ROM or other storage devices. The emergence of Internet and the World Wide Web (WWW) in early 1990s, as a new media of information storage and delivery, came as a real boon for evolution of electronic resources. While searching bibliographic databases became popular, it created demand for actual content in full-text that became difficult for libraries to obtain. Coincided with evolution of World Wide Web (WWW), display technology evolved, cost of storage came down drastically and networks became faster. It became possible for publishers to deliver content, either as a bitmap page images or other structured formats such as HTML, PDF or RTF. Increasingly larger number of publishers started using the Internet as a global way to offer their publications to the international community of scientists and technologists given the fact that technology is in a position to deliver more content to more users at a significantly lower cost per user.

Electronic resources on the Internet manifest themselves in numerous flavours and categories, although most of them emulate the traditional publishing while others are revolutionary in their design and approach. While the present trend to imitate and emulate the traditional models of scholarly communication may continue for some time, eventually the capabilities added by the new media would be used in more innovative ways. Some of the important types of e-resources are described below.

9.1. Electronic Databases

An electronic database consists of electronic resources integrated in highly organized fashion so as to provide controlled access to it by their commercial providers. The first databases were bibliographic in nature and were online version of existing indexing and abstracting services such as Biological Abstracts, Index Medicus, Chemical Abstracts, etc. By the year 1988, only half of all databases were bibliographic in nature. With introduction of a number of online databases containing textual information, news, statistics, commodity prices, etc., a third type of databases holding text of full-length documents started appearing. Several full-text of encyclopaedia, directories and articles from journals are now available online. Most of the publishers now provide access to their full-text journals through their web site or through other electronic publishing platforms. While there are a number of public-domain databases, most online databases require annual subscription for accessing them. Thousands of databases are now available on compact discs (CD-ROM) as well as on the Web.

9.2. Electronic Journals

Electronic journals, or “e-journals”, are used for those journals and newsletters that are prepared and distributed electronically. Electronic journals may be defined very broadly as any journal, magazine, e-zine, webzine, newsletter or type of electronic serial publication which is available over the Internet and can be accessed using different technologies such as WWW, Gopher, ftp, telnet, e-mail or listserv. Several traditional journals are now being published both on the Web and in print. Content lists for most of the journals are available on the Web or distributed to subscribers as an e-mail text messages or through technologies like RSS and Atom.

Internet-based electronic journals started to appear in the beginning of 1990. These journals were mostly delivered as an attachment to e-mail while their back issues were mounted on anonymous ftp sites and users were required to download them from these ftp sites. The libraries and information centres made them accessible through their gopher site. 1995 witnessed peak of Gopher technology which then dropped suddenly and dramatically by 1997. With advent of WWW technology in 1993, electronic publishing became more than a novelty, the web as a means of delivery of electronic information has grown steadily since then. As publishers experiment with different publication modes and models, the very definition of a journal is undergoing change in the electronic environment. New journals have evolved based on the graphic capabilities of the Internet that are available only in electronic form.

Like print journals, current and archival issues of electronic journals can be browsed through their content pages. Moreover, e-journals can also be searched not only on their metadata but also in full-text through sophisticated search interface. Currently, there are more than 50,000 peer-reviewed, scholarly electronic journals that are available on the Internet.

9.3. Electronic Books

An electronic book is digital reading material that a user can view on a desktop or Personal Digital Assistant (PDA), laptop or on a dedicated, portable device with a large storage capacity and the ability to download new titles via a network connection. More and more traditional book publishers, as well as those catering to the professional and business communities, are launching their e-book collections.

The electronic books market consists of two distinct components i.e. i) electronic books consisting of digital material or contents; and ii) electronic book hardware including e-book reading appliance, PCs, laptop or PDA. The digital material or content that make an electronic book are simply textual and graphical files consisting of bits that can be transported any digital storage media or delivered over a network connection. It is designed to be viewed on some combination of hardware and software ranging from dumb terminals to web browsers, on personal computers to the new reading appliances.

More and more books are now being released on the web through enhanced interfaces that offer features such as increased search capacity within a book or entire collection of books, ability to highlight and flag a page, ability to make notes on text without damaging the book, ability to e-mail quotes from the books to other colleagues, etc. Most publishers like Springer, Wiley InterScience, Taylor and Francis, Cambridge University Press, Oxford University Press, etc. offer their e-book collections on subscription / one-time purchase basis. Besides, there are a number of e-books aggregators that make thousands of books available online for libraries and individuals at relatively lower cost. Three major e-books aggregators are Questia (http://www.questia.com/), Ebrary (http://www.ebrary.com/) and NetLibrary (http://www.netlibrary.com/). However, just like other e-resources, e-books come with restrictions such as limit on downloads, in terms of number of pages, i.e. one page at a time or one chapter at a time or no download at all.

9.4. Electronic Theses and Dissertations

Theses submitted to the universities as requirement for the award of Ph.D. degree constitute a useful source of information for the new and ongoing research. Doctoral dissertations submitted to universities and academic institutions are originally created in digital format using one of the word processing software packages like MSWord, LaTex, Word Perfect, Word Pro, etc. or one of the desktop publishing packages like Page Maker, Ventura, etc. These documents are undisputedly highly valuable collection especially in digital format that qualify to be an important component of a digital library. The documents composed on word processing packages / desktop publishing packages can be easily converted into PDF, Post Script or XML using appropriate software tools so as to host them on the web. Several universities and institutions have already implemented electronic submission of doctoral dissertations under the overall umbrella of an international digital library initiative called “Networked Digital Library of Theses and Dissertations” (NDLTD).

9.5. Digitized Print Material

Several digital library projects are concerned with providing digital access to materials that already exists with traditional libraries in printed media. Scanned page images are

practically the only reasonable solution for institutions such as libraries for converting existing paper collection (legacy documents) without having access to the original data in computer processible formats convertible into HTML / XML or in any other structured or unstructured text. Scanned page images are natural choice for large-scale conversions for major digital library initiatives. Printed text, pictures and figures are transformed into computer-accessible forms using a digital scanner or a digital camera in a process called document imaging or scanning. The digitally scanned images are stored in a file as a bit-mapped page image, irrespective of the fact that a scanned page contains a photograph, a line drawing or text. A bit-mapped page image can most easily be equated to a facsimile image of the page and as such they can be read by humans, but not by the computers, understably "text" in a page image is not searchable on a computer using the present-day technology. An image-based implementation require a large space for data storage and transmission. There are several large projects using page images as their primary storage format, including project JSTOR (www.jstor.org) at Princeton University funded by the Melon Foundation.

Capturing page image format is comparatively easy and inexpensive, it is a faithful reproduction of its original maintaining page integrity and originality. The scanned textual images, however, are not searchable unless it is OCRed, which in itself, is highly error prone process specially when it involves scientific texts. Options and technology for converting print to digital and the process of Optical Character Recognition (OCR) are elaborated in section on "digitisation".

There are several other types of electronic resources such as e-prints, post-prints, technical reports, library catalogues, online courseware, educational materials, career sources, information on organizations, associations and so forth. Examples of various types of e-resources can be viewed on the web.

9.6. Audio, Video and Streaming Media

Streaming multimedia is sequential delivery of multimedia content, including video, audio or some other learning objects, over a computer network that is displayed (or played back) to the end-user as it is being delivered by the provider. The advent of the MP3

players and the iPod resulted in a greater effort to deliver downloadable media. Moreover, web documents are now coming with greater integration of text with media. Encyclopaedia now have articles with audio files, video clips and animation to illustrate a given topic.

Media can broadly be categorized into three category, namely i) commercial movies that have greater copyright restrictions, ii) educational media typically are lesser controlled and many a time are made available free-of-cost; and iii) media targeted for individual users, such as movies and songs, that comes with restrictions in terms of copying and distributions.

9.7. Subject Gateways or Library Portals

The web, being a hypermedia-based system, allows linking amongst electronic resources stored on servers dispersed geographically on distant locations. The portal sites or gateways redirect a user to the holders of the original digital material. The librarians, being the earliest users of the web, started to gather and organize link to important web-based resources on various subjects.

A subject gateway can be defined as facilities that allow easier access to web-based resources in a defined subject area. The simplest types of subject gateways are sets of web pages containing list of links to resources. Some gateways index their lists of links and provide a simple search facility. More advanced gateways offer a much-enhanced service via a system consisting of a resource database and various indexes, which can be searched and / or browse throughout a web-based interface (O'Leary, M., 2000).

Subject gateways are also known as Subject-based Information Gateways (SBIGs), subject-based gateways, subject index gateways, virtual libraries, clearing houses, subject trees, pathfinders, etc. Subject gateway is an important component of a library web site designed for the library users so as to help them discover high-quality information on the Internet in a quick and effective way.

In the traditional information environment human intermediaries, such as publishers and librarians, filter and process information so that users can search catalogues and indexes of organized knowledge as opposed to raw data and information. Subject gateways

work on the same principle, i.e. they employ subject experts and information professionals to select, classify and catalogue Internet resources to aid search and retrieval for the users. Users are offered access to a database of Internet resources descriptions which they can search by keywords or browse by subject area. A description of each resource is provided to help users assess very quickly its origin, content and nature, enabling them to decide if it is worth investigating further. In the process users get benefited from the expertise of librarians and subject experts with subject gateways rather than having to locate, evaluate, filter and organize the resources themselves. Specialized software are available as freeware or as priced software to create and maintain professionally developed subject gateways.

10. Information Technology-based Library Services

New information technology can potentially support a range of traditional and non-traditional library services. Most of the library services generated using information technology resemble closely to those generated manually with improvements and modifications to suit the requirements of automated services. Examples of some of IT-based library services are given below:

10.1. OPAC and WebPAC

Remote access to the Library catalogues (OPAC) was possible only through a telnet connection before the Web was launched. The web-based interfaces are now available for most of the integrated library software packages including Libsys. Web sites are increasingly providing links to their webPAC instead of telnet links to their Library OPAC. Exploiting the provisions of hyperlinking that the web provides, various searchable elements of a bibliographic record in a webPAC are hyperlinks to other records in the database. For example, an author is a hyperlink to all records in the database for that author, a series is an hyperlink to all serial title under that series; a keyword for a record is a link to all records in database having that keyword, etc. In effect, a web PAC adds software-based functionality to a conventional OPAC. A user has additional incentives to visit the library web page hosting webPAC. With web-based resources and services in place, many libraries are phasing out their dumb terminals. The library web sites are increasingly becoming a more logical gateway to the catalogue and other web-based library resources.

The acceptability of web-based interfaces to the Library OPAC is much greater because web interfaces are familiar to the users with its graphical and navigational interfaces. The users can click complex subjects instead of typing them or remembering complex commands.

10.2. Information Alerting Services

As the name implies, information alerting services or Current Awareness Services (CAS) are produced by the libraries for their users to alert them about new developments in a given field of study. Information alerting services are issues periodically by the libraries either for internal distribution amongst staff and employees or externally to other users. The alerting service may be issued as a newsletter reporting new developments, programmes, forthcoming seminars and conferences, events, training programmes, etc. It may also consist of recent additions of books and other documents in the library for a specified time period. Most library integrated system facilitate generation of such a service organized according to subject category for a given time period. Alerting service may also consist of an indexing service issued by a library or a commercial publisher or a society that regularly indexes the contents of periodicals and some other publications systematically in a specified subject field. Such indexing services are issued at a regular interval. Abstracting services are essentially indexing services wherein an abstract of articles are included in addition to its bibliographic details. Index India and Reader's Guide to Periodical Literature are examples of indexing services. Biological Abstracts, Chemical Abstracts and Index Medicus are example of abstracting services. Most indexing and abstracting services are now available as web-based databases with sophisticated search interface.

Selective dissemination of information (SDI) is a personal form of Current Awareness Service (CAS). It refers to the mechanism of selectively directing new items of information from primary or secondary sources to individuals based on their current interests in a particular subject. SDI is delivered based on a user interest profile which is matched with updates on databases for finding the items of interest for a given user.

Push technology or personalisation are more recent terms that are used in place of SDI.

10.3. Digital Reference Service

Reference service and imparting instructional training to the library users are key areas of activities for any library. The technology now allows reference librarians to reach out to the users using the network instead of waiting at the reference desk for users to come by. Besides, imparting instructions on mechanisms of using a library, a reference librarian is also involved in delivering reference service that require deep intellectual understanding of subject. Although automated libraries are not yet sufficiently advanced to offer interactive reference services, electronically-mediated reference services are increasingly available through libraries and information centres.

Digital reference service, also called “Ask-An-Expert” or “Ask-A-Librarian” services are Internet-based question and answer service that connect users with individuals who possess specialized subject knowledge and skill in conducting precision searches (Davis, 2000). As opposed to static web pages, digital reference services use the Internet to place people in contact with people who can answer specific question and instruct users on developing certain skills. The people who serve as digital reference experts (also called volunteers or mentors) are most of the time information specialists, affiliated to various libraries.

10.4. Real-time Digital Reference Service: Library Chat Rooms

Several libraries have started experimenting with offering real time digital reference service, using chat software, live interactive communication activities, call counter management software, web contact software, bulletin board services, interactive customer assistance system or related technologies.

Many libraries are experimenting with Internet chat technology as an innovative method to extend and enhance traditional and remote reference service. While digital reference service is asynchronous method of information delivery, the Internet chat providing the benefit of synchronous communication between a user and a reference librarian (or mentor). Interactive reference services facilitate a user to talk to a real, live reference librarian at any time of day or night from anywhere in the world. Unlike with email reference, the librarian can perform a reference interview of a sort by seeking clarifications from the user. The librarian can conduct Internet searches and push websites onto the patron’s browser, and can receive immediate feedback from the patron as to whether

his or her question has been answered to his satisfaction. Most libraries currently involved in real-time reference service are part of a collaborative network so that they can share staffing and work around the clock to truly provide reference service any time. Library of Congress Collaborative Digital Reference Service (http://www.loc.gov/rr/digref/cdrshome.html) is one of such services. Several institutions including Cornell University, Internet Public Library, Michigan State University and North Carolina University are offering Internet chat-based services using software like LivePerson, AOL Instant Messenger, Conference Room and Netscape Chat. The librarians have observed that their relatively new chat-based service logged significantly more questions in a relatively short time than their well-established e-mail digital reference service.

LiveRef(sm) (http://www.public.iastate.edu/~CYBERSTACKS/LiveRef.htm) maintains an online registry of real-time digital reference services.

10.5. Electronic Document Delivery Services

The term "electronic document delivery systems" implies delivery of electronic version of a document that might involve reproduction of an electronic copy of a document if it is not available in electronic format. The libraries had been using fax machines for immediate delivery of photocopies of articles via telephone lines. The first use of electronic document delivery was based on scanning technology. With maturity of scanning equipment and technology, document supply services started scanning the documents as bitmap page images. Applications are built in such a way so as to automatically produce a hard copy together with a header page containing the address of the applicant which can again be send by snail mail or facsimile. A software package known as "Ariel" is used in several libraries in developed countries for delivery of scanned articles via Internet. The Ariel software is loaded on an Internet-enabled computer, can receive and send electronic information to other libraries which have installed Ariel.

Availability of most of the peer reviewed research journals in electronic format, inexpensive technology to scan articles and improved electronic delivery mechanisms are some of the enabling factors that have contributed to well-established electronic document delivery system now available commercially. More recently most of the secondary services that were available on CD ROM or through online search services are now available on the

Internet where the bibliographic references are linked to their full-text on the publisher's site. The technology has now been perfected and there are several electronic document delivery services that allow a user to download an article in full-text from their site or deliver them electronically as attachment to e-mails. Most electronic publishers and aggregators like OCLC, OVID etc. are offering full-text of articles through their web sites. Different vendors have various payment options; some charge each time the journal is used, whereas others provide open access for a set annual fee. A user who wishes to have the item delivered can enter a credit card number and specify a delivery method (postal, UPS, fax, e mail, etc.) and indicate whether it is a rush item (with a rush order fee attached.)

The ADONIS (Article Delivery Over Network information Systems) can be considered as a landmark development in electronic document delivery system. The project was launched by a consortium of five major publishers - Academic Press, Blackwell's Scientific Publications (merged with Wiley InterScience), Elsevier Science Publications, and Springer Verlag. The project uses combination of laser scanning, printing and digital optical storage technology for storage and retrieval of complete pages of over 650 scientific, technical and medical journal articles. The issues of journals are available on CD ROM with weekly updates for distribution to each centre in various countries licensed to use the system for document delivery.

10.6. Library Web Sites

Libraries are using web technology to create home pages as starting points or as gateways for searching information about the library. A home page reflects characteristics of an academic institution. It provides an opportunity to the library to propagate its services and facilities to the academic community worldwide. The home pages of libraries are increasingly used as an integrated interface designed to deliver detailed information about a library as well as to provide access to all computer-based services offered by a library.

Several library web sites facilitate virtual guide to the physical facilities including collections, services and infrastructure available in the library through their web sites. Most library web sites provide library layouts and floor plans to guide users to physical location of facilities and services along with link to relevant information.

Besides offering information, the library web sites of academic institutions invariably hosts subject gateways or subject portals that contains links to web resources for subjects of interest to the institution. Most of the IT-based library services mentioned in this article are offered through the web sites of libraries.

The library web sites can have features like have Frequently Asked Questions (FAQ) along with their answers, library calendar listing events or show information for forthcoming events, Web forms for inviting feedback. Moreover, libraries may also use bulletin boards, threaded discussion forum and listservs to help promote and evolve web-based library services.

10.7. Web-based User Education

The www provides a dynamic environment for distributing information over a large network and web-based instructions is a suitable tool to do so. Web-based guides and teaching tools can be easily updated, accessed, and printed on demand. They may include colour graphics and screenshots. The web-based user education provides a high degree of interactivity and flexibility to the users offering them the benefit of self-pace, graduated to teach from basic to highly advanced levels and designed in a wide range of formats that accommodate diverse learning styles. The proliferation of digital resources will generate greater demands on reference and instructional services. With availability of digital resources that can be used anywhere at any time, requirement for instructional and reference services would also grow. Failure to develop both the technological aspects and required service components would lead to under utilization of digital resources. The library web sites can use web-based user education for imparting training to users in the following areas:

i) Basic library skills along with glossary of library terms;

ii) Using Library OPAC / webPAC, locating books, magazines and other library materials;

iii) Instructions for searching CD ROM and web-based databases and other electronic resources; and

iv) Instructions on subject searching training, using Boolean operators and searching Internet resources through search engines.

The web technology provides for incorporating both synchronous and asynchronous interactivity in the web-based user education.

11. Digital Libraries

The increasing popularity of Internet and developments in web technologies act as catalyst to the concept of digital library. While the Internet serves as the carrier and provides the contents delivery mechanism, the web provides the tools and techniques for content publishing, hosting and accessing. Today's digital libraries are built around Internet and web technologies with electronic journals as their building blocks.

The libraries will not become digital libraries, but will rather acquire access to ever growing digital collections on behalf of their users. Majority of these collections are being made available by external sources like commercial publishers, collections mounted by scholarly societies, resources at other libraries, electronic journal sites, etc. The electronic journals have become the largest and fastest growing segment of digital collections for most libraries. The Internet has long been a favorite media for experimenting with electronic publishing and delivery. The technology allows creation of fully digitized multimedia products and make them accessible through the Internet. Technological changes, especially the Internet and web technology, continue to attract more and more traditional players to adopt it as a global way to offer their publications to the international community of scientists and technologists. Most of the important publishers now have their web-based interfaces to offer full-text of their journals. The current electronic publishing market consists of traditional players offering electronic versions of their print journals as well as several new enterprises offering new products and services that are "borne digital". The market also has several subscription agents in their new role as electronic aggregators.

Besides electronic journals, there are several online databases that are now available through the web including Medline (several versions), AGRICOLA and ERIC. Most online search services like STN and DIALOG also have their web-based interfaces. Reference works like encyclopedia, dictionaries, handbooks, atlases, etc. are also making their electronic appearance on the web. However, amongst electronic resources created

exclusively for the web, imbibing all features and facilities offered by the new technology, include web-based educational tutorials called “online courseware”. The online courseware is proliferating the web as a strong contender for distant education. Telecampus, Canada (www.telecampus.edu/) lists more than 12,000 online courseware available on the web. Moreover, highly specialized web sites are now coming-up in various disciplines which offer information in totality including all kinds of resources in electronic format, EI Engineering Village (http://www.ei.org/), ISI Electronic Library (http://www.isinet.com), IEEE / IEE Electronic Library (http://www.ieee.org/), Engineering Sciences Data Unit (http://www.esdu.com) are some of the important examples.

12. Conclusion

Rapid growth of information technology, particularly, the Internet and associated technologies, has opened up an entirely new medium for providing improved information services and resources for the users. As information professionals, we have the opportunity not only to play a leading role in the organization and navigation using new tools and technologies, but also in the development and maintenance of IT-based services and resources for our users and organizations. With availability of web-based resources and services, the local collection of a library is not the only source of information for a user. The users are interacting virtually with the library collections and resources as well as with host of resources that the librarian did not select or may not even know about them. The librarians can no longer stay behind the desk to wait for the users to come, assuming that the users would approach at the right time and for the right things. The role of library as a primary aggregator of content for its user is less and less unique. In an environment of self-service databases, electronic forms, web information and the growth of distance education, a user is likely to approach the librarian after he has already begun his search, but was not satisfied with the results.

The future will require the librarians to reorient themselves, think creatively and adopt new technology to generate services and resources where their skills of structuring and organizing resources are put to its best use. With myriad of disorganized and unverified information, the web is in need of librarians who are trained in the structuring and organizing information, have the ability to locate and evaluate information resources, and have in-depth subject expertise. If the librarians are committed to sustain their

roles as providers and facilitator of information in the emerging and competitive space of higher education, they would need to adopt new technology, interact with users to learn about their requirements and expectations. The librarians have to join the academic community as facilitators and collaborators, guide the students through the complex maze of print and digital resources, teaching them how to search effectively and helping them judge the quality and usefulness of the information that they encounter. The opportunities are limitless especially in the chaotic scenario of Internet.

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