Chapter 3

Information Technology and New Technologies — Their Influence on Library Automation and Networking
In order to identify the importance of information technology and its new
technologies relevant to library automation and networking is discussed in this
chapter. This chapter describes in nutshell the importance of all technologies useful
for library automation and networking especially to the level of college library. This
chapter is divided into six sections. They are: A. Information technology, B.
Communication technology, C. Telecommunication technology, D. Multimedia
technology, E. Computer hardware, and F. Software technology. This chapter will
help the college libraries to choose relevant technologies to go for library automation
and networking based on the size of the library.

3.A. Information Technology

3.A.1. Concept

Information technology is now a pervasive term, often used synonymously
for 'new technology' or 'new information technology' and implied by both expert
and layman as referring to a wide range of systems.

Information technology offers a new way of achieving existing tasks or
fulfilling existing functions in library and information activities. Today people need
only use and indeed are certainly only likely to pay for, a specific piece of
information in any one given medium.¹

Developments in computers, electronic equipment and telecommunications
are bringing information technology close to all aspects of work and leisure. These
developments focus on the storage, retrieval and use of information, on the way we
communicate with others, with ourselves, and with the world. Information
technology helps knowledge workers not only to accomplish their tasks more
efficiently and with greater power, but also in giving depth to the purpose of those
tasks, and enabling those involved in the communication of information to promote
the part they play in it, and in society at large.

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May Katzen argues that electronic modes of communication will complement rather than supersede paper. She notes the features of information technology and its specific advantages thus: (1) That the information so contained and communicated is infinitely malleable; (2) That it can be stored in great quantity; (3) That it can be communicated instantly over distance; and has radically new features; (4) That it can allow response and interaction.²

M.D. Baby has rightly said: “The convenient marriage of computers and communication technology has greatly contributed to the field of education. The child conceived by this marriage is the information technology which has been utilized to enrich the resources required for teaching, sharing of resources globally.”³

The computer and communication technology have made spectacular progress and their convergence has been making an impact on the communication of information as well as the information industry. Convergences of these technologies have resulted in Information Technology (I.T.).

3.4.2. Definitions

The term ‘Information Technology’ is relatively recent in its origin and perhaps not a particularly well-chosen addition to the English language. It has its counterparts in the French ‘informatique’ and the Russian ‘informatika’. However it seems to serve the purpose for which it is intended. For many people, ‘information technology’ is synonymous with ‘the new technology’, that is the use of microprocessor-based machines: microcomputers, automated equipment, word processors and the like.

The British Advisory Council for Applied Research and Development defines information technology as “the scientific, technological and engineering disciplines and the management techniques used in information handling and processing, their applications, computers and their interaction with men and machines, and associated
According to Rowley, information technology means “the collection, storage, processing, dissemination and use of information. It is not confined to hardware and software, but acknowledges the importance of man and goals he sets for this technology, the values employed in making these choices, the assessment criteria used to decide whether he is controlling and being enriched by it.”

The Department of Trade and Industry of Great Britain defines information technology as “the acquisition processing, storage, dissemination and use of vocal, pictorial, textual and numerical information by a microelectronics - based combination of computing and telecommunications.”

Peter Zorkoczky says regarding the advantages of information technology that “a common feature of the current range of tools offered by information technology is that they represent an alternative to established media and to existing facilitate for handling information. By converting the form in which information is expressed to the digital form used by computers, they make it possible to combine a range of tasks hitherto done as separate operations. For example, text translated to this form does not have to be typed out or duplicated when it passes from one person, or section, in an organization to another. Rather, it is the electronic signals representing that text which are transmitted, filed, modified or displayed, using the new tools and products developed for those purposes.”

3.A.3. Information technology in libraries

By information technology it is generally meant a technology used for information dissemination, which includes systems like telex, fax, teleprinter, e-mail and so on. For a librarian, it has a much wider connotation, which includes the technologies and systems like microfilms, microfiche, CD-ROMs, computers,
information networks, etc. In information technology, all those technologies are discussed which libraries and information centres use for collection, processing, storage, retrieval and dissemination of recorded information.

3.A.4. **Information technology as relevant to libraries**

The information technology that is relevant to libraries mainly cover the following:

1. Computer technology,
2. Telecommunication technologies,
3. Reprographic technologies,
4. Library technologies,
5. Technical communication.

The activation and services in libraries in which these technologies are used are indicated in the figure 3.1.8

3.A.5. **Information technology in academic libraries**

The first and foremost information technology component which can be adopted in an academic library is the computer for library automation and have an in-house database of library holding in electronic form. As many primary journals are being published in CD form, it becomes necessary to equip academic libraries to optimize the use of information. E-mail, online retrieval networking, multimedia and internet are the other important technologies, which can be used for faster access to information.

Information technology enables: To capture, store, manipulate, and distribute information, to introduce and provide new services, revitalize the existing services by providing faster access to the resources, by overcoming the space and time barriers, to provide need-based, browsing and retrospective search service to the users, to have a large number of databases in CDs, to avoid routine and redundant activities, to utilize the staff for providing better information services, to develop /
Figure 3.1: Areas of information technology as relevant to libraries:

- Library Technologies
  - Classification
  - Cataloging / indexing
  - Database creation
  - CAS
  - SDI
- Communication Technologies
  - Library Networks
  - Information Networks
  - Internet
  - Telecommunication services
- Technical Communication Technologies
  - Technical Writing
  - Editing
  - Publishing
- Reprographic Technologies
  - Photography
  - Microfilms
  - Optical / Digital
  - Audio / Video
- Computer Technologies
  - Database Organization and Management
  - Library Management Operations
  - Multimedia
- Information Technology

upgrade the abilities of professionals, to encourage networking and resource sharing at local level, to have access to a number of national and international journals which are published only in machine-readable form, to digitize documents for preservation and for space saving, to support library functions such as circulation, serials control, acquisition control, stock maintenance and other routine office works and developing in-house database, to retrieve and disseminate information in user-defined format, to access library catalogues databases of other libraries through library networks, to
improve the efficiency of library functions, and to improve the cost-effectiveness of library operations.

Though information technology has potential for moderating library activities, there is a wide gap between what is told and is what has been achieved. In the academic environment, it is only at the university level that automation has been initiated. In some private professional colleges, the adoption of information technology is being encouraged. Otherwise, at the level of undergraduate college, the state of affairs, to say the least, is pathetic. It is estimated that a large percent of library professionals are not aware of the use of information technology in college libraries. The main problems faced by the college library professionals are:

Lack of support from the higher authorities, lack of economic support and the high cost involved especially for accessing remote databases, lack of long-term approach towards automation, lack of own resources and dependence on other resources, lack of opportunities to explore the available technology and under utilization of information technology, and psychological barriers of the library personnel.

3.B. Communication Technology

Communication technology is one of the components of information technology. This technology is essential to go for networking. Networking requires the following important communication technologies: 1. Standards, 2. Network layers, 3. Protocols and standards, 4. Transmission media, 5. Network architecture.

3.B.1. Standards:

In the mid 1970s, as different types of distributed systems (based on both public and private data networks) started to proliferate, the potential advantages of open systems were acknowledged by the computer industry. As a result, a range of standards started to be introduced. The first was concerned with the overall structure
of the complete communication subsystem within each computer. This was produced by the International Standards Organization (ISO) and is known as the ISO Reference Model for Open System Interconnection (OSI).

3.B.1.a. ISO reference model:

A communication subsystem is a complex piece of hardware and software. Early attempts at implementing the software for such subsystems were often based on a single, complex, unstructured program with many interacting components. The resulting software was difficult to test and often very difficult to modify. To overcome this problem, the ISO has adopted a layered approach for the reference model. The complete communication subsystem is broken down into a number of layers each of which performs a well-defined function.

3.B.1.b. Open system standards:

The ISO Reference Model has been formulated simply as a template for the structure of a communication subsystem on which standards activities associated with each layer may be based. It is not intended that there should be a single standard protocol associated with each layer. Rather, a set of standards is associated with each layer, each offering different levels of functionality. Then, for a specific open systems interconnection environment, such as that linking numerous computer-based systems in a fully-automated manufacturing plant, a selected set of standards is defined for use by all systems in that environment.

The three major international bodies actively producing standards for computer communications are the ISO, the American Institute of Electrical and Electronic Engineers (IEEE) and the International Telegraph and Telephone Consultative Committee (CCITT). Essentially, the ISO and the IEEE produce standards for use by computer manufacturers while the CCITT defines standards for computing equipment to the different types of national and international public
network. As the degree of overlap between the computer and telecommunications industries increases, however, there is an increasing level of cooperation and commonality between the standards produced by these organizations.

In addition, prior to and concurrently with the ISO standards activity, the United States Department of Defence has for many years funded research into computer communications and networking through its Defense Advanced Research Projects Agency (DARPA). As part of this research, the computer networks associated with a large number of universities and other research known as ARPANET, have been extended to incorporate Internets developed by other government agencies. The combined Internet is now known simply as the Internet.

Figure 3.2: Overall structure of the ISO reference model

![Diagram of OSI Reference Model](image)
3.B.2. Network Layers

Conceptually, layers can be considered as performing one of two generic functions: network-dependent functions and application-oriented functions. They in turn give rise to three distinct operational environments.

(a). Network environment: It is concerned with the protocols and standards relating to the different types of underlying data communication networks.

(b). OSI environment: It embraces the network environment and adds additional application-oriented protocols and standards to allow end systems (computers) to communicate with one another in an open way.

(c). Real system environment: It builds on the OSI environment and is concerned with the manufacture's own proprietary software and services, which have been developed to perform a particular distributed information-processing task.

The OSI model is an architecture that divides network communication into seven layers. Each layer covers different network activities, equipment, or protocols.

The Network-dependent layers,

1. Physical Layer: Concerned with the transmission of unstructured bit stream over physical link; involves such parameters as signal voltage swing and bit duration; deals with the mechanical, electrical and procedural characteristics to establish, maintain and deactivate the physical link.

2. Data link layer: Provides for the reliable transfer of data across the physical link; sends blocks of data (frames) with the necessary synchronization, error control and flow control.

3. Network layer: Provides upper layers with independence from the data transmission and switching technologies used to connect systems, responsible for routing of data units, accounting etc.
The Application-oriented layers,

4. Transport layer: Provides the control structure for communication between application; establishes, manages and terminates connections (sessions) between cooperating applications.

5. Session layer: Provides the control structure for communication between application; establishes, manages and terminates connections (sessions) between cooperating applications.

6. Presentation layer: Performs generally useful transformations on data to provide a standardized application interface and to provide common communications services; for example, encryption, text compression, reformatting code, conversion etc.

7. Application layer: Provides services to the users of the OSI environment, for example transaction server, file transfer protocol, network management.

3.B.3. Protocols and standards

3.B.3.a. Introduction:

The exchange of information between computers for the purpose of resource sharing is generally referred to as computer communication. In order to communicate effectively there must be a high degree of cooperation between the two computer systems. Thus, in discussing computer communication the concept of protocols is of utmost significance since computer communication involves heterogeneity of hardware and software platforms, and it is also important to adopt standards for implementing protocols.

When computers, terminals and other data processing devices exchange data, the procedures involved can be quite complex consider, for example, the transfer of a file between two computers. There must be a data path between the two computers, either directly via a point-to-point, or indirectly via a communication network.
A protocol is used for communication between entities in different systems. The terms 'entity' and 'system' are used in a very general sense. Examples of entities are user application programs, file transfer packages, database management systems, computers, terminals and remote sensors. In general, an entity is anything capable of sending or receiving information and a system is a physically distinct object that contains one or more entities. A protocol performs the following functions: establishment of necessary connection, of standard communication path, and of a standard data element.

For two entities to communicate successfully, they must speak the same language. What is communicated, how it is communicated, and when it is communicated must conform to some conventions mutually acceptable to the entities involved. The conventions are referred to as protocol, which may be defined as a set of rules governing the exchange of data between two entities. The key elements of protocols are syntax, semantics, and timing.

Syntax includes things such as data format and signal levels; Semantics includes control information for coordination and error handling; Timing includes speed matching and sequencing.

Protocols are rules and procedures for communication. They are the agreed upon ways in which computers exchange information. Computers need to communicate at many levels and in many different ways. So, there are many corresponding network protocols. There are protocols at various levels in the OSI model. In fact, it is the protocols at a particular level in the OSI model that provides the functionality of that level. Protocols that work together to provide a layer or layers of the OSI model are known as 'protocol stack', or suit.
3.B.3.b. How protocols work:

A protocol is a set of basic steps that both computers must perform in the right order. For instance, for one computer to send a message to another computer, the first computer must perform the following steps.

1. It has to break the data into small sections called packets. 2. It must add addressing information to the packets identifying the destination computers. 3. Then it has to deliver the data to the network card for transmission over the network. 4. The receiving computer must perform the same steps, but in the reverse order. 5. It has to accept the data from the network adapter card; 6. It has to remove the transmitting information that is added by the transmitting computer. 7. Then it has to reassemble the packets of data into the original message.

Each computer needs to perform the same steps the same way so that the data will arrive and reassemble properly. If one computer uses a protocol with different steps or even the same steps with different parameters (such as different sequencing, timing, or error correction) the two computers will not be able to communicate with each other.

3.B.3.c. Protocol stacks:

Each layer provided by protocol stacks or suit handles a different part of the communication process and has its own rules and requirements.

3.B.4. Transmission media

3.B.4.a. Two-wire open lines:

A two-wire open line is the simplest transmission medium. Each wire is insulated from the other and both are open to free space. This type of line is adequate for connecting equipment that is up to 50m apart using moderate bit rates (less than, say, 19.2kbps). The signal, which is typically a voltage or current level relative to ground reference, is applied to one wire and the ground reference is applied to the other.
Although a 2-wire open line can be used to connect two computers (DTEs (Data terminal equipment)), it is used mainly for connecting a DTE to local data circuit terminating equipment (DCE) - a modem, for example.

3.B.4.b. Twisted-pair cable:

A twisted pair generally consists of a pair of insulated copper wires, typically 1 mm thick, twisted together in a helical form as in a DNA molecule. The wire pair is twisted to reduce the electrical interference from and to the adjacent copper pairs. The twisted pair is the oldest and still the most common transmission medium. There are two types of twisted pair cables, unshielded twisted pairs (UTP), and shielded twisted pair (STP).

The wires that connect our telephones are twisted pairs. Twisted pairs can be used for analog as well as digital transmission. In long-distance links, twisted pairs can support speeds up to a few hundred Kbps. This medium is cheap, very easy to handle and provides adequate performance. Owing to these qualities, twisted pairs are widely used and are likely to remain so for years to come.

3.B.4.c. Co-axial cable:

A coaxial cable consists of a stiff copper wire as the core, surrounded by an insulation material. This is also a common transmission medium like the twisted pair. The two kinds of co-axial cables are, baseband and broadband. The baseband coaxial cable can carry only one signal at a time, but it is fast (up to 10 million bits per second). The broadband coaxial cable can carry more than one signal at a time. It can transmit signals with a speed of 5 mbps. Cable TV companies use broadband.

3.B.4.d. Fibre-optic cable:

While the geometry of coaxial cable significantly reduces the various limiting effects, the maximum signal frequency, and hence the information rate that can be transmitted using a solid (normally copper) conductor, although very high, is limited.
This is also the case for twisted pair lines. The optical fibre cable differs from both these transmission media in that it carries the transmitted information in the form of a fluctuating beam of light in a glass fibre, rather than as an electrical signal on a wire. Light waves have a much wider bandwidth than electrical waves enabling optical fibre cable to achieve transmission rates of hundreds of megabits per second.

Furthermore, light waves are immune to electromagnetic interference and cross talk. Consequently, the optical fibre cable is also extremely useful for the transmission of lower bit rate signals in electrically noisy environments — steel plants. An optic fibre is a piece of very thin, pure glass, with an outside cladding of glass that is similar, but of slightly different chemical composition, and which has a different refractive index. These cables made of plastic or glass and are as thin as human hair. They are highly durable and offers excellent performance. They can carry massive amounts of data (up to billions of bits per second). These cables are unaffected by magnetic or electrical interference; but are expensive and hard to install.

3.B.4.f. Satellites:

All the transmission media mentioned so far have used a physical line to carry the transmitted information. However, data can also be transmitted using electromagnetic (radio) waves through free space as in satellite systems. A collimated microwave beam, onto which the data is modulated, is transmitted to the satellite from the ground. This beam is received and retransmitted (relayed) to the predetermined destination(s) using a directional antenna and an on-board circuit known as a transponder. A single satellite has many such transponders each covering a particular band of frequencies. A typical satellite channel has an extremely high bandwidth (500MHz) and can provide many hundreds of high bit rate data links using a technique known as multiplexing. Essentially, the total available capacity of the
channel is divided into a number of sub-channels, each of which can support a high bit rate link.

Satellites used for communication are normally geostationary, which means that the satellite orbits the earth once every 24 hours in synchronism with the earth's rotation and hence appears stationary from the ground. The orbit of the satellite is chosen so that it provides a line-of-sight communication path to the transmitting station(s). The degree of the collimation of the microwave beam retransmitted by the satellite can be either coarse, so that the signal can be picked up over a wide geographical area, or finely focused, so that it can only be picked up over a limited area. In the second case the signal power is higher allowing smaller diameter receivers known as antennas or dishes (known as very small aperture terminals or VSATs) to be used. Satellites are widely used for data transmission applications ranging from interconnecting different national computer communication networks to providing higher bit rate paths to link communication networks in different parts of the same country.

3.B.4.g. Terrestrial microwave:

Terrestrial microwave links are widely used to provide communication links when it is impractical or too expensive to install physical transmission media; for example, across a river or perhaps a swamp or desert. As the collimated microwave beam travels through the earth's atmosphere, it can be disturbed by such factors as man-made structures and adverse weather conditions. With a satellite link, on the other hand, the beam travels mainly through free space and is therefore less prone to such effects. Nevertheless the line-of-sight microwave communication through the earth's atmosphere can be used reliably over distances in excess of 50 km.
3.B.4.b. Radio:

Lower frequency radio transmission is also used in place of fixed wire links over more modest distances using ground-based transmitters and receivers, for example, to connect a large number of data gathering computers distributed throughout a rural area to a remote data logging / monitoring computer, or for connecting computers (or computer-based terminals) within a town or city to a local or remote computer. Clearly, it would be expensive to install fixed-wire cables for such applications. Hence the radio is often used to provide a cordless (wireless) link between a fixed-wire termination point and distributed computers. A radio transmitter (known as the base station) is placed at the fixed-wire termination point, providing a cordless (wireless) link between each computer and the central site.

3.B.5. Network architecture

Computer networks are concerned with linking together various pieces of computer equipment and systems. One important aim of a network is to provide end-to-end compatibility so that any terminal or system can be linked to any other. In order to consider network further it is useful to examine network architecture. Network architecture consists of the following:

1. The protocols and standards for data encoding and transmission (protocols, hardware and cabling). 2. The topology of the way in which units are distributed through the network. (Topology). 3. The control and flow of information through the network (Network Operating System).

The following are the components and features that all networks have in common: 1. Servers - Computers that provide shared resources to network users; 2. Clients - Computers that access shared network resources provided by a server; 3. Media - The way in which the computers are connected; 4. Resources - Files, Printers or other items to be used by network users.
Typically, two main types of network expansions are possible

a. Expansion within a single network and also homogeneous networks, called network connectivity (LAN).

b. Expansion that involves and joins two separate networks, called Internetwork connectivity (WAN).

3.B.5.a. Network (LAN):

A group of connected computers in the same location is called LAN (Local Area Networks). Local area networks, normally referred to simply as LANs, are used to interconnect distributed communities of computer-based DTEs located within a single building or localized group of buildings. For example, a LAN may be used to interconnect workstations distributed around offices within a single building or a group of buildings such as a university campus. Alternatively, it may be used to interconnect computer-based equipment distributed around a factory or hospital complex. Since all the equipment is located within a single establishment, however, the LANs are normally installed and maintained by the organization. Hence they are also referred to as private data networks.

The main difference between a communication path established using a LAN and a connection made through a public data network is that a LAN normally offers much higher data transmission rates because of the ISO Reference Model for the OSI. However, this difference manifests itself only at the lower network dependent layers. In many instances the higher protocol layers in the reference model are the same for both types of network.

3.B.5.a.1. Selection issues:

Before describing the structure and operation of the different types of LAN, it is perhaps helpful to first identify some of the selection issues that must be considered. A summary of some of these issues is given in Figure 3.3.
3.8.5.2. Network Models:

Network Models can be divided broadly into two categories, (i) server based networks and (ii) peer-to-peer networks.

(i). Server based network:

Most networks have a dedicated server. A dedicated server is a computer on a network that functions as a server and is not used as a client or a workstation. A dedicated server is optimized to service request from network clients. The server
performs a wide variety of tasks. Usually, large networks have specialized servers for different tasks, e.g. file and print servers, application servers, mail servers, communication servers.

(ii). Peer-to-peer networks:

In a peer-to-peer network, there are no dedicated servers. All the computers are equal and, therefore, termed as peers. Normally each computer functions both as client and server. A peer-to-peer network has the advantage of simplicity in design and maintenance. It is usually less expensive to set up, when compared to server-based networks. Peer-to-peer networks are also called workgroups. The term workgroup implies a small group of users. Peer-to-peer networks are suitable for environments where, (1) there are limited user (usually 10 or less); (2) the users are located in the same area; (3) security is not an important issue; (4) the organization and the network have limited growth; (5) users need to freely access data and programs that reside on other computers across the network.

3.B.5.a.3. Topology:

Most wide area networks, such as the PSTN (Public-Switched Data Network), use a mesh (sometimes referred to as a network) topology. With the LANs, however, the limited physical separation of the subscriber DTEs allows simpler topologies to be used. The four topologies in common use are star, bus, ring and hub.

'Network topology' refers to the arrangement or physical layout of computers, cables and other components on the network. A network topology affects its capabilities. Choosing one topology over the other can have impact on the type of equipment the network needs, capabilities of the equipments, networks growth, and the way a network is managed.
A network topology implies a number of conditions. For example, a particular topology can determine not only the type of cable used but how the cable is run through floors, ceiling and walls. Topology can also determine how computers communicate on the network. Different topologies require different communication methods and these methods have a great influence on the network.

The types of network installed will depend on a number of factors. Such as, network budget, network size, level of security required, physical layout, type of business, and amount of network traffic.

Standard topologies: Networks can be configured in the following basic topologies:
(a) Bus, (b) Star, (c) Ring.

a. Bus topology: The bus topology is also known as linear bus. It consists of several computers, which are attached to a common cable called the truck line. The performance on a bus network can be affected by, the number of computers on the network, hardware capabilities of the computer, frequency of data transmission, types of cable used on the network, distance between the computers on the network. Some of the limitations are: only one computer at a time can send messages; it is a passive topology in which the computer on the bus is not responsible for moving the data.

Figure 3.4: Bus topology
b. Star topology: In the star topology, the computers are connected by cable segments to a centralized device known as the 'hub'. Signals are transmitted from the sending computers through the controller on the central hub to the receiving computer. As each computer is connected to a central point, this topology requires a great deal of cabling. Also, if the central controller fails, the entire network is disabled. However, if one computer or the cable that connects it to the hub fails, the rest of the network continues to function normally. The hub is a device used to centralize the network traffic through a single connection point. Hubs can be of two types, active and passive. An active hub regenerates and transmits the signals. It requires electrical power to run. A passive hub acts as a connection point and does not amplify or regenerate the signals. Passive hubs do not require electrical power to run. Because of this the signals after traveling some distance, become weak. Regeneration is the process by which the signals are given more power to travel further.

**Figure 3.5: Star topology**

![Star topology diagram]

c. Ring topology: In this topology, the computers are connected through a single circle of cable. There are no terminated ends. The signals travel around the loop in one direction and pass through each computer. The ring is an active topology where each computer acts like a repeater to boost the signal, and sends it from one to
the next computer. Failure of one computer in a ring network can affect the entire network.

Figure 3.6: Ring topology

Table 3.1: Advantages and disadvantage of topologies.

<table>
<thead>
<tr>
<th>Topology</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>1- Bus</td>
<td>Use the least amount of cable. Media is expensive, simple and reliable. New workstations can be connected without disrupting other.</td>
<td>Hardware bugs are difficult to isolate. Does not adequately support large number of I/O request from users. Cable break can affect many users in the network.</td>
</tr>
<tr>
<td>2- Ring</td>
<td>Network can cover greater distances. Performance is even despite many users. As only one node on the ring can transmit at any given time, there is no chance that frequently occurs with a bus topology.</td>
<td>Expanding the system can be costly. Network configuration disrupts operations.</td>
</tr>
<tr>
<td>3- Star</td>
<td>New computers can be easily added. Cable layouts are easy to modify. Failure of one computer does not affect the rest of the network.</td>
<td>Uses a large amount of cable. If the centralized points fail, the network fails.</td>
</tr>
</tbody>
</table>

In addition to these there are other network topologies such as, fully interconnected, mesh and tree. They are briefly as follows,
A network is said to have fully interconnected topology if every network node is directly connected to every other node. It is often an expensive and clumsy proposition with any but the smallest networks. A mesh, or grid-like, topology has some nodes connected to many others, providing alternative paths across the network. In a tree topology, multiple branching connections are formed in a hierarchical arrangement.

3.5.4. Transmission media used in LAN:

Twisted pair, coaxial cable and optical fibre are the three main types of transmission media used for the LANs.

Figure 3.7: Hub/Tree topology

3.5.5. IEEE standards for LAN:

The various protocol standards for the LANs, which deal with the physical and link layers in the context of the ISO Reference Model, are those defined in the IEEE Standard 802. The IEEE is a professional organization that defines network standards. The IEEE LAN standards are the predominant LAN standards today,
including protocols similar or virtually equivalent to Ethernet and Token Ring. This standard defines a family of protocols, each relating to a particular type of medium access control method. The three medium access control (MAC) standards together with their associated physical media specifications are contained in the following IEEE standards documents:

**IEEE 802.3:** The CSMA/CD bus (Ethernet), IEEE LAN protocol that specifies an implementation of the physical layer and the MAC sub layer of the link layer. The IEEE 802.3 uses the CSMA/CD access at a variety of speeds over a variety of physical media. One physical variation of the IEEE 802.3 (10 Base 5) is very similar to Ethernet.

**IEEE 802.4:** The IEEE LAN protocol specifies an implementation of the physical layer and the MAC sub layer of the link layer. It uses the token-passing access over the bus topology.

**IEEE 802.5:** Token ring: The IEEE LAN protocol that specifies an implementation of the physical layer and the MAC sub layer of the link layer. The IEEE 802.5 uses the token passing access at 4 or 16 Mbps over shielded twisted pair wiring and is very similar to the IBM Token ring.

Apart from this there are some of other IEEE standards,

**IEEE 802.2:** The IEEE LAN protocol that specifies and implementation of the logical link control sub-layer of the link layer. The IEEE 802.2 handles errors, framing, flow control, and the Layer 3 service interface and is used in LAN such as the IEEE 802.3 and IEEE 802.5.

**IEEE 802.6:** The IEEE metropolitan area network (MAN) specification based on the DQDB technology. The IEEE 802.6 supports data rates of 1.5 Mbps to 155 Mbps and support data packets and circuits.
LAN Protocols:

1. Net BEUI: Net BEUI stands for Net BIOS Extended User Interface (Net BIOS stands for the Network Basic input/output system.)

2. NW Link: The NW Link is Microsoft implementation of Novell's IPX/SPX protocol stack, used in Novell Netware

3. TCP/IP: TCP/IP is the Transmission Control Protocol and the Internet Protocol, as well as a suite of related protocols developed by the Department of Defense's Advanced projects Research Agency, under its project on network interconnection, started in 1969.

Each network transport has different strengths and weaknesses. In general, Net BEUI is intended for small, single server network. The NW Link is intended for medium-sized networks (or) for networks that require access to Novell Netware file servers. The TCP/IP is a complex transport sufficient for globe-spanning networks such as the Internet.

Wide Area Network (Telecommunications):

All telecommunications systems have some essential components, a transmitter to send information and a receiver to accept it, a transmission medium through which the message travels; signals and codes which represent the message; network controls to ensure that the message gets to its destination. Computer networks have a variety of transmitters, receivers, transmission media, signal, codes, and network controls.

Data is sent in the form of changing electrical signals over the transmission medium. There are two types of signals available in nature—analog and digital. Analog signals are signals, which are continuous in nature. They are prone to noise and distortion errors. Digital signals are signals with well-defined, discrete amplitude levels. The number of these discrete levels depends upon the definition of a specific signal. It is easier to eliminate noise from digital signals than from analog signals.
The use of PSTN (Public-Switched Data Network) for the transmission of data was considered. Indeed, prior to the advent of public data networks, this was the only method available for transmitting data between user equipments located at different establishments. As indicated earlier, however, a switched connection made through the PSTN currently supports only a modest user data rate, typically less than 9600bps. Furthermore, as telephone calls are charged on a time and distance basis, a typical transaction can be very expensive owing to the often long distances and times involved, especially when a human user is involved.

Figure 3.8: World-wide Internetwork (WWW)

3.B.5.b.1 Characteristics of public data networks:

The standards pertaining to the WANs (Wide Area Networks) are in the main those that have been developed for use by the PTT (Postal, Telegraph and Telephone) and public-carrier data networks. A public data network (PDN) is a network established and operated by a national network administration authority.
specifically for the transmission of data. A primary requirement of the PDN is that it should facilitate the interworking of equipment from different manufacturers, which in turn requires agreed standards for access to and use of these networks. After much discussion and experimentation at national and later at international level, a set of standards internationally, agreed upon, have been accepted by the CCITT for use with a range of PDNs. These X-series and I-series recommendations include standards for user data signaling rates and user interfaces with such networks.

There are two main types of PDNs: packet-switched (PSPDNs) and circuit switched (CSPDNs). Different standards have been defined for each type. Since the PSTN is still widely used for data transmission, standards have also been established for interfacing to this type of network. In general, the standards for each of these networks refer to the lowest three layers of the ISO Reference Model and the functions of each of these layers are as shown figure. It should be remembered that the characteristics of network-dependent layers in the ISO Reference Model are made transparent to the higher protocol layers by the transport layer, which offers the higher layers a network-independent message transport service.

(i). Packet-switched data networks (PSPDNs):

This is a network on which nodes share bandwidth with each other by intermittently sending logical information units (packets). In contrast, a circuit-switching network dedicates one circuit at a time to data transmission.

(ii). Circuit-switched data networks (CSPDNs):

In the case of a circuit-switched service, a circuit is set up in the same way as with the PSTN. The set-up circuit then provides a transparent 64kbps transmission path. It is a switching system in which a dedicated physical circuit path exists between sender and receiver for the duration of the "call". Used heavily in the phone company network, circuit switching is often contrasted with contention and token

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passing as a channel-access method, and with message switching and packet switching as a switching technique.

3.B.5.b.2. User interface protocols for WAN:

A key feature of the ISDB is the logical separation of the signaling channel from the normal voice and/or data channels. The signaling channel, because it is used for call set-up, is said to be part of the control or C plane, while the user channels are said to belong to the user or U plane. As has been indicated, the ISDN supports both circuit-switched and packet-switched services. Two new frame level services, known as frame relay and frame switching, are also supported.

In the case of the two frame-based services, a virtual circuit - known as a virtual path is set up in an analogous way to a virtual circuit through a PSPDN. Additional routing information is retained at each intermediate exchange that allows the subsequent frames of user data to be routed (relayed) across the set-up virtual path. In the case of frame relay, a simple best-try service is supported. With frame switching, on the other hand, error and flow control are performed on each frame. In comparison with packet switching, the routing of frames is much simpler and hence can be carried out at much higher bit rates. A user may have a number of virtual paths to different destinations set up at the same time and the network will route frames to their intended destination using addressing information contained within each frame. Semi-permanent virtual paths can also be requested.

The same signaling procedures are used for both frame relay and frame switching services. The major difference is that the network performs error and flow control procedures with frame switching. Services are defined in the CCITT recommendation I.122/Q.922. In practice, frame relay is by far the dominant service, owing to its minimal overheads.
3.B.5.b.2.i. *Internet protocol standards* (WAN):

Multiple x.25 WANs can be interconnected by X.75-based gateways. Also the introduction of a standard specifying the operation of the X.25 packet-layer protocol for use with the LANs means that one approach to internetworking is to adopt X.25 as an internet-wide protocol. The latter can be operated in either a connection-oriented mode or in a pseudo-connectionless mode by using fast select.

Such a solution has the appeal that the various internetworking functions are much reduced. The disadvantage is that the overheads associated with X.25 packet switching are high and hence the packet throughput of these networks is relatively low. This is also true with fast select, since the same virtual-circuit / error control functions are still used. Moreover, the much improved bit error rate performance of the next generation of wide area networks, such as the ISDN, means that frame relay and cell (fast packet) switching will be the preferred optional modes rather than conventional packet switching.

1. Internet protocol (IP): The Internet protocol is only one of the protocols associated with the complete protocol suite (stack) used with the Internet. The complete suite, known as the TCP/IP, includes transport and application protocols, which are now used as the basis of many other commercial and research networks. All the TCP/IP protocols specifications are publicly available, as a result of which the Internet is by far the largest currently operational Internet based on open standards. The two protocols associated with Internet are known as the Internet IP or simply IP and the ISO Internet protocol known as ISO-IP, which is intended for use with the OSI stacks.

The IP is an internet-wide protocol that enables two transport protocol entities resident in different end systems / hosts to exchange message units in a transparent way. This means that the presence of multiple, possibly different,
networks/subnets and intermediate systems/gateways is completely transparent to both communicating transport entities. As the IP is a connectionless protocol, message units are transferred using an unacknowledged nest-try approach.

Although the operational features associated with the ISO-IP are based on experience gained from the evolution and the use of IP, there are differences both in terms of terminology and operational detail. Hence each protocol is discussed separately.

2. Transmission Control Protocol (TCP): The TCP provides a reliable mechanism for the exchange of data between processes in different computers. The protocol ensures that data are delivered error-free, in sequence, with no loss or duplication. The transport service relieves higher-level software of the burden of managing the intervening communications facility. Because the transport protocol provides high quality service, and because it may need to deal with range of communications services, it is one of the most complex of all communications protocols.

The basic service provided by the TCP is transfer of data between two transport users, such as a File Transfer Protocol (FTP) or a Simple Mail Transfer protocol (SMTP). Data are passed from a transport user to the TCP, which encapsulates the data into a segment, which contains the user data plus control information such as the destination address.

Beyond this basic service, there are a number of other services offered by the TCP. Quality of services, the TCP allows the transport user to specify the quality of transmission service to be provided. It attempts to optimize the use of the underlying IP and network resources to the best of its ability to provide the collective requested services. Urgent delivery: Some data submitted to the TCP may have special urgency. It will attempt to have the transmission facility transfer the data as rapidly
as possible. At the receiving end, the TCP will notify of an interrupt mechanism. This is used to transfer occasional urgent data, such as a break character from a terminal or an alarm condition; Range: A class or range may be used to label data provided to the TCP. This may influence the route taken by the data; security: Data being transmitted may be encrypted to prevent intruder attacks.

Figure 3.9: TCP/IP protocol suite

End-user/Application process

Files transfer protocol, FTP
Remote terminal protocol, TELNET
Simple mail transfer protocol, SMTP
Name server protocol, NSP
Simple network management protocol, SNMP

Layer 4
TCP
UDP
IP
IEEE 802.XX 25

TCP = Transmission control protocol
UDP = User datagram protocol
IP = Internet protocol
LAN / WAN

The protocol suite used with the Internet is known as Transmission Control Protocol/Internet Protocol (TCP/IP). It includes both network-oriented protocols and application support protocols, because the TCP/IP is in widespread use with the existing Internet, many of the TCP/IP protocols have been used as the basis for the ISO standards.
In practice, there are two major open system (vendor-independent) standards: the TCP/IP protocol suite and those on the evolving ISO standards. As can be seen, since the TCP/IP has developed concurrently with the ISO initiative, it does not contain specific protocols relating to all the ISO layers. Moreover, the specification methodology used for the TCP/IP protocols differs from that used for the ISO standards. Nevertheless, most of the functionality associated with the ISO layers is embedded in the TCP/IP suite.

3. File Transfer Protocol (FTP): The purpose of the FTP is to transfer a file or a portion of a file from one system to another, under command of an FTP user. Typically, an online user uses FTP interactively. The user’s communication with the FTP is mediated by the operating system, which contains input/output (I/O) devices. The user connects to the local FTP transfer all or part of a file. The FTP provides mechanism for controlling user access – to access files on a given system, a user may be required to have an authorized password/identify for that system.

4. Simple Mail Transfer Protocol (SMTP): The SMTP provides the basis for a network electronic mail facility. Typically, an electronic mail facility runs on a single system. The SMTP provides a mechanism for transferring messages among separate systems. With it, a user can send mail not only to other users on the same system, but also to any user on the network or on the Internet.

It SMTP accepts messages prepared by the native mail facility and delivers messages to that facility. It makes use of the TCP to send and receive messages across the network. The SMTP standard does not specify the user interface. Thus, the user sees the same interface whether he is sending local mail (native) or remote mail (SMTP).

5. TELNET: Telnet is a protocol used to link terminals to applications. It can be characterized as follows:
It specifies a network standard terminal. Thus, the characteristics of specified terminals are mapped into the standard. This allows terminals from a variety of vendors to be connected to a variety of hosts.

It specifies the protocol between terminal and host. This allows certain terminal characteristics to be negotiated.

It provides reliable data exchange by means of the TCP.

It allows a user at the terminal to control an application in a remote host as if the user were a local user of that host.

Telnet is actually, implemented in two modules, ‘User Telnet’ and ‘Server Telnet’. The user telnet interacts with the terminal I/O module on the system. It converts the characteristics of real terminals to the network standard and vice versa. The server telnet interacts with processes and applications. It acts as a surrogate terminal handler so that remote terminals appear as local to the process or application.

3.5.2.2. Other Protocols:

Sometimes it seems that every computer company in the history of computer has created a protocol or two. Many of these protocols are no longer in widespread use, or they only apply to a certain brand of mini or mainframe computers.

1. DLC: The IBM uses this protocol to link computers together in its SNA (System Network Architecture) mainframe networks. This protocol is connected to IBM equipment that does not support a more common network protocol such as the TCP/IP.

2. X Windows: This is the networked windows protocol of most UNIX workstations.
3. X.25: This protocol is commonly used in wide area communications with multiple communicating devices. The TCP/IP has grown much more popular as a wide area networking standard.

4. NFS: Many UNIX computers use the NFS (Network File System) to share file storage over a TCP/IP network.

5. SNMP: The simple Network Management Protocol (SNMP) is widely used to control network communications using the TCP/IP. Most network analyzer software can interface to the SNMP, and a SNMP monitor is a very useful tool in a network of more than moderate complexity.

3.C. TELECOMMUNICATIONS TECHNOLOGY

3.C.1. Introduction

The main purpose of telecommunications is to transmit representations of information (signals) between remote locations. Most telecommunication systems generally use electrical or electromagnetic media (including light works) to carry signals (representations of information). Phase media are harnessed to provide worldwide telecommunication networks. Today computers are taking their place as controllers of telecommunication systems as well as generators and transformers of information to be delivered via these systems.

3.C.2. Definitions

Communication is the process of exchanging information. telecommunication is the science of communicating over distances where the basic modes of communication, such as speech and vision, are no longer feasible. Telecommunication may be defined as “the transmission of representations of information between remote locations by electronic means.” The most widely used method of communicating over such distances is by the use of electrical signals, either over cables or through free space using radio waves. Recently, however, the
use of light signals carried over optical fibers has become a practical alternative, with considerable implications for the future of telecommunications.

Telecommunication, as an area of information technology, is currently undergoing a radical change.

By way of wire, radio waves or satellite, a wide variety of information is transformed by such systems including sound, visual images, computer processed data, telegraph and teletypewriter signals. In the words of T.II.Choudary, telecommunication means “transforming the telecom network into an information transport system, which in turn, would help in evolving an information intensive society that would use this infrastructure for Tele-banking, Tele-librarying, Tele-shopping, Tele-working, etc., substituting communication for communication.”

3.C.3. Telecommunication services to libraries

Telecommunicating is an exciting management prospect, which has unique opportunities to the Libraries and library users looking for ways to better their working lives and to ‘do more with less’.

In the library for providing services like the SDI, interlibrary loan, referral, online information retrieval services etc., telecommunication network can be effectively used. Moreover, it satisfies that fourth Law of Library Science: “Save the time of the reader as well as the staff”.

Intercom is a system of communication with an organization by means of microphones and loudspeakers. It is very useful in large libraries like the university library. It facilitates quick verbal communications between different sections of a library or of Information centre.

The Very Small Aperture Terminal (VSAT) networks facilitate either “one way applications like information dissemination, training and advertising or two-way communications like facsimile and document transfer, digital voice, compressed
video, reservation system, file transfer etc. There is a tremendous potential for the VSAT in networking Library services throughout the country. Library networks like the INFLIBNET can profitably make use of them.\textsuperscript{13}

- **E-mail**: Electronic mail is primarily an alternative to the conventional postal mail service. Additionally, it offers a range of new features based on the storing and processing abilities of computers. The concept of electronic mail covers a broad spectrum of systems and services whose main common feature is that messages are converted to electronic signals for purposes of transmission.

- **Telex**: Telex (short for tele printer exchange) is a text-orientated service. It is in many ways similar to the public telephone service, except that it carries tele-printer signals instead of speech signals. It is also highly automated, standardized, and is under continuous development.

- **Facsimile services**: Whereas telex caters for text only, facsimile treats a document as a picture. Facsimile services can utilize either the telephone or the telex network for transmission of a faithful copy of an original document. The signal for transmission is generated by automatically scanning the page to be sent. The main advantage of facsimile is that it transmits text and graphics, diagrams, handwriting etc.

- **Videotex**: Videotex or view data, as generic terms, apply to interactive (two-way) systems for transmitting text or graphics stored in computer databases, via the telephone network, for display on a television screen. This description, however, can equally well apply to the use of a timesharing computer or of a specialist information system via a data network, or indeed to some forms of electronic mail.
Teletext: Teletext is a non-interactive (one-way) form of videotele, that is, a method of transmitting text or graphics stored in a computer database, as part of broadcast transmission, for display on a television screen. Again, it is intended for wide public use, carrying information of broad public interest.

Video conferencing: Video Conferencing is a method of holding conferences by transmitting and data communication networks, so that participants can both see and hear each other. It allows people in different locations within India and overseas to meet face to face while being physically thousands of kilometers apart.

Internet service: People from all walks of life in different countries use the Internet for exchanging messages, carry on real time chatting, play games, sell goods and services, advertise products, download software, search for useful and usable information and do many more things. Work groups can now conduct interactive conferences with each other, regardless of physical location – the possibilities are endless.

Bulletin Board Systems (BBS): There are thousands of bulletin boards on various subjects. Normally they are of local interest to some geographical area. Subscribers reach bulletin boards via telephone lines. Nowadays several BBSs are reachable via Internet.


An important landmark in India’s telecommunication development was the announcement of the National Telecom Policy (NTP) in May 1994. Its major objectives were as follows.

- The endeavor to extend telecommunication to all and bring it within the reach of all;
- Provision of certain basic telecom services to all villages as early as possible;
The quality of telecom services to be of world standard; the objective also being to provide the widest permissible range of services to meet the customers demand at reasonable prices; and

Protection of the defence and security interests of the country.¹⁴


The objectives of the NTP 1999 are the following:

Providing access to telecommunication is of utmost importance for achieving the country's social and economic goals. Making available affordable and effective communication for all citizens is to be at the core of the vision and goal of the telecom policy;

It aims to encourage development of telecommunications infrastructure in rural and remote areas of the country;

To create a modern and efficient telecommunication infrastructure taking into account the convergence of information technology, media telecom and consumer electronics and thereby enabling India to become an information technology super-power;

To convert the PCOs into public teleinfocentres having multimedia capability, especially the ISDN server remote database access, Government and community information system etc;

To strengthen research and development effort in the country and provide an impetus to build world class manufacturing capabilities and achieve Hardware; and

To accomplish efficiency and transparency in spectrum management.
3.C.6. Private networks

As an alternative to using the PTT (public-carrier networks) many large corporations have installed their own enterprise-wide private integrated voice and data network, and been managing them.

Telephone (voice) calls made through a public switched telephone network (PSTN) or public ISDN are charged on a time and distance basis. If the networks are used for transmission of data – using a modem with the PSTN, such calls are charged on the same basis. Similarly, calls made using a public data network are normally charged either on the same basis or on the basis of the quantity of data transferred.

In most establishments (companies, universities, hospitals etc.) the majority of communications (voice and data) are local to the establishment with only a small percentage of the calls from outside the establishment. Hence, to avoid public network charges, all establishments install their own private automatic branch exchange (PABX) for telephony and a (private) local area network (LAN) for data communication.

For many large enterprises, however, the level of inter-site traffic, both voice and data, can be considerable. Consequently, many such enterprises install and manage their own private integrated voice and data networks. An added benefit is that more sophisticated services can be more readily offered and, since the network is private apart from the transmission lines, and of course more secure. Such networks are known simply as private networks or enterprise-wide networks. If they span multiple countries, they are known as global networks.

Generally a private network consists of a linked set of intelligent multiplexers (IMUX)-one per site-interconnected by leased lines, which form an enterprise-wide backbone transmission network. Typically, the network uses high-speed digital
leased lines. These operate at multiples of 64kbps; 1.544Mbps (DS1/T1) and 2.048 Mbps (E1) are common.

Each IMUX has a range of voice and data interfaces to meet the requirements at the site. In the case of voice, it can involve direct links with telephone handsets, more usually, a high bit rate link to a PABX. Normally 64kbps is used for each voice circuit but some multiplexer manufacturers incorporate sophisticated compression algorithms to provide good-quality voice communication using 32, 16 or even 8kbps. This means that two, four or eight voice circuits can then be multiplexed onto a single 64kbps time slot giving a substantial saving in the number of circuits required between sites. This technique is known as subrate multiplexing.

A particular technique known as rate adaption is used for connecting asynchronous or synchronous terminals, such as the PCs. In this case a 64kbps channel can be used to support multiple terminals, examples include 20 X 2.4 kbps and 5 X 9.6kbps. Such links are often used to connect a distributed community of data terminals to a central computer holding, such as, for example, an enterprise-wide electronic mail server or database.

The increasing use of LANs in many establishments means that it is now common practice to provide a means of linking such LANs. As described in the last chapter, this is normally done using remote bridges. Private X.25 packet switching exchanges are also sometimes incorporated. Alternatively, private frame relay adapters (FRAs) are now being incorporated to achieve added levels of (statistical) multiplexing. Since in private networks circuits are normally set up throughout the network on a semi-permanent basis, using network management, each FRA needs only to packetize data. This is done only when data is to be transmitted, thus eliminating the need to allocate permanent channels.
Although many private networks are run and managed by the enterprises to which they belong, a number of PTTs and public-carrier operators are now cooperating to provide a facility that enables an equivalent private network to be set up within the public network. Known as virtual private networks or VPNs, they offer similar services to a private network but are managed and operated by the PTT or public carrier.

**3.C.7. Advanced WAN technologies (High speed)**

The network administrator should consider several advanced WAN environments, which are becoming more popular as their technology matures. These include: Fax vs the Modem, Leased Lines, DSL (Digital Subscriber Line), ADSL (Asymmetric DSL), CDSL (Consumer DSL), DSL Lite or G.Lite, HDSL (High bit-rate DSL), IDSL (ISDN DSL), RADSL (Rate-Adaptive DSL), SDSL (Single-line DSL), UDSL (Unidirectional DSL), VDSL (Very high data rate DSL), x2/DSL, ISDN (Integrated Service Digital Network), ATM (Asynchronous Transfer Mode), WAP (Wireless Application Protocol), WT (Wireless Telephopy), SONET (Synchronous Optical Network), WDM (Wavelength Division Multiplexing), DWDM (Dense WDM), Optical Layer, VoIP (Voice over Internet Protocol), Video Conferencing, Cable Network, Bluetooth, JetSend (Hewlett-Packard), HAVi (Home Audio-Video interoperability), T Spaces (IBM).

**3.C.8. Internet Service Providers**

The Internet is a worldwide network of computers connected to each other. To get on to the Internet, you need to connect to someone who is already connected. That someone for you is your ISP. When he says that he now has a direct gateway to the Net, he means that he now is bypassing his previous connection provider. As cable providers do, for pay-channels, the ISPs maintain expensive links with the internet, and then distribute the cost among their users.
a. MTNL: It is an ISP which provides Internet access to users. Services of the MTNL are as follows: Internet Services, Integrated Services Digital Network (ISDN), Inet, Data Communication Services, Intelligent Network Services (IN Services), Voice Mail Service, Radio Paging Service, Multimedia Services.

b. VSNL: Videsh Sanchar Nigam Limited (VSNL) is India's International telecommunication service provider. The company operates a network of earth stations, switches, submarine cable systems, and value added service nodes to provide a range of basic and value added services.

The VSNL's main gateway centres are located at Mumbai, New Delhi, Kolkata and Chennai. International telecommunication circuits are derived via Intelsat and Inmarsat satellites and wide band submarine cable systems e.g. FLAG, SEA-ME-WE-2 and SEA-ME-WE-3.

Incorporation: The VSNL was incorporated on April 1, 1986 under the Indian Companies Act, 1956 to take over the activities of the erstwhile Overseas Communication Services (OCS).

The VSNL's mission is to create a global and seamless network of information superhighways; to connect people and computers cost-effectively and efficiently anytime, anywhere.

The VSNL's objectives are as follows:

- To plan and provide a full range of international telecommunications services from the VSNL Gateways in India to users worldwide - at sea, on land and in the air;
- To achieve and maintain a high degree of customer confidence by continuously upgrading technology, service performance and attending promptly to customer needs;
- To develop a sound marketing strategy with cost effective solutions;
To generate adequate internal resources to finance the corporation's investment plans, working capital needs and to build its reserves, besides payment of dividends to the VSNL shareholders.

To enlarge the availability of International Telecommunications Services and to strive to attain global standards;

To seek, promote and foster excellence amongst the workforce, improve productivity, update human and machine capabilities;

To allocate resources to different services and strive to reduce their cost per unit;

To represent and participate in the activities of INTELSAT, INMARSAT, ICO, Global Communications Council, Asia Pacific Telecommunity and other telecommunications bodies to cater to the interests of the VSNL, BSNL and the country;

To actively seek expansion of the company's operations through joint ventures in new areas of service;

To continuously enhance the quality of service.

The VSNL has planned an expenditure of over Rs. 59 Billion (revised) over a five-year period for enhancement of its infrastructural facilities and services. The VSNL's 9th Five Year Plan (1997-98 to 2001-02) has been formulated with an objective of providing for the core business of international telephony as well as for diversification into other areas i.e. National Long Distance, Internet and Value Added Services, etc. Plans also include positioning the VSNL as a global and regional player through the creation of regional hub in India.
3.D. Multimedia Technology

3.D.1. Concept

Multimedia in computer systems means, from the user's point of view, using many input media (i.e. text, speech, gestures, direct manipulation) and output media (text, sound, graphics, video) in the same application.

3.D.2. Definitions

Multimedia means more than one type of medium, any combination of two or more of animation, audio, graphics, text and video.15

According to Bill Gates (Microsoft) and others, multimedia is the integration of audio, video, text and graphics within an electronic interface that is ultimately delivered to the user via CD-ROM or network.16

Harry Newton (1991) defined that multimedia is the combination of different types of media users and communication of information between two users and their computers. The format in which the information for communication exists differs but it usually includes voice communication (voice encoding, voice verification and the convergence of text to voice) sound processing (music synthesis, CD-ROMs), data communication, telecommunication, and image procession.


(a) Text: Information about an object / event, etc; notes, caption, subtitles, contents, indexes, dictionaries, and help facilities.

(b) Data: Tables, charts, graphs, spreadsheets, statistics, and raw data.

(c) Graphics: Both traditional and computer generated (vector form) such as drawings, prints, maps, etc.

(d) Photographic images: (raster form): negatives, slides, prints (both from digital still and video cameras and scanned photographs).

(e) Animation: including both computers-generated, video, etc.
(f) Audio: including speech and music digitized from cassettes, tapes, CDs, etc.

(g) Video: (digital): either converted from analogue film or entirely created within a computer.


The general applications of multimedia are as follows: Instruction/training and technical presentations; Multimedia communications such as multimedia, e-mail, personal conferencing, videophones, video conferencing, etc.; Public information points/kiosks for libraries, museums, hospitals, tourists sites, monuments, etc.; Medical information systems; Multimedia databases, multimedia information banks; Multimedia newsletters, multimedia books, other information resources; References tools, e.g. encyclopedias, directories etc.; Archival systems; Geographical information systems; Electronic publishing and book selling; Point-of-sale displays; Product information catalogues; Technical documentation, including engineering drawings, specifications, etc.; Architectural information displays. For example, Walk-through programmes for new buildings or constructions/already constructed buildings/monuments; Entertainment, leisure, home; Exhibitions such as conferences, trade shows, new product, facilities, museums, libraries etc.; Interactive displays in museums, hospitals, libraries etc.


Multimedia applications in libraries can achieve the following:

> They can help satisfying different information needs such as reference, enrichment, entertainment, leisure, etc.

> They can help meeting various types of information preferences of the users such as scholarly, scientific, vocational, artistic, recreational, etc.
> Being in digital format, information can also be accessed by remote users on a network. They also help in overcoming the barriers of boundaries, proximity and physical capacity of a library to accommodate users.

> They are interesting and easy to use over the existing form such as print, microforms, online, etc.

> Their control and interactivity helps the users and provides the benefits of books (information) and human beings (interactivity). 17

3.E. Computer hardware

The following pages focus on Hardware technology in relation to computers networking and telecommunications.

3.E.1. Peripheral devices

Any device used for input / output operations with the CPU is called a peripheral devices. These devices are of four kinds. (a) Processing device, (b) Input devices (c) Output devices (d) Storage devices.

(a). Processing device:

It is a device that can process any command and give an appropriate result. Some of the common processing devices are briefly described below:

Processor: Processors are designed to interpret a specified number of instruction codes. Each instruction code is a string of binary digits. All processors have input / output instructions, arithmetic instructions, logic instructions, branch instructions and instructions to manipulate characters. The number and type of instructions available differ from processor to processor.

RAM (Random Access Memory): It's commonplace for all the devices in a PC to store their data for processing. RAM is volatile in nature.
Figure 3.10: Multimedia applications in libraries

- Speech
- Video
- Audio
- Group discussion
- Sound
- Slides
- Scanner
- Text
- Data
- Recording & Editing
- Multimedia CD-ROM
- Other Libraries
(b). Input devices:

An input device can only input data to the computer. It allows commands, programs, and data to enter the computer that is how the user ‘talks’ to the computer. Some of the common input devices are briefly described below.

Keyboard: The keyboard is the primary input device. It is used for entering commands and data into system. Its sole purpose is to effect a convenient and natural method of transferring data and instructions from the external world to the rest of the components inside the computer, in a language that it can understand. The variations in the keyboards are a result of the types of switches that are used; these are mechanical switch keyboards, membrane switch keyboards, capacitive switch keyboards, and conductive switch keyboards.

Examples: (i). PC/XT keyboard (83/84-key}; (ii).PC/AT keyboard (84-key); (iii). AT and T keyboard (84-key); (iv). Enhanced keyboard (101/102-key) (v). Enhanced windows keyboard (104-key) (vi). PS/2 Multimedia keyboard (110+ -key) (vii). USB keyboard (Universal Serial Bus).

Mouse: The Mouse is a position indicator Input Device. It is a hand-held device that controls the movement of a pointer on the screen. It is used to perform tasks on the computer. Some models of the Mouse are:

Examples: (i). Standard Serial mouse (2/3 button) (ii). Standard PS/2 port mouse (2/ Scroll button) (iii). USB mouse (2 button with scroll)

Joystick: A manual device connected to a terminal with a control that can be moved or titled in various directions for moving the cursor to any position on the CRT screen; this device is commonly used in computer graphics and many types of computer games. Joystick is a Gaming controller.
Examples: Microsoft FF Pro (joystick), Hitech 3D joystick, Halberd knight (joystick), etc.

Scanner: Scanning an image is like a copier copying an image. The major difference is that the output of scanning is an electronic file, which can be edited by software and stored in disk.

Examples: (i). UMAX 2200 this can scan photographs, films, and transparencies, and comes with a rich bundle of software. (ii). Acer Scan 620U is also a USB Scanner from Acer.

Web Camera: The webcam is an image-capturing device. It allows connecting face to face with any one online. It enables one to send video (used for video conferencing) and static images through the net.

Examples: 3Com Home connect from 3Com, Quik Cam PRO / HOME / VC from Logitech, Webcam DUC 300 from D-Link.

Floppy Drive: Floppies have become the default media for data storage for not just IBM-based machines but also in Macintosh, though their file formats are completely different.

Examples: Sony floppy drives, Samsung floppy drives, Fujitsu floppy drivers, etc.

CD-Drives: The CD-ROM (Compact Disc Read Only Memory) drives can read compact discs that generally have a capacity of around 650 MB and more. They include software CDs, audio CDs as well as video CDs.

Examples: Sony 52x CD-ROM Drives, Creative 52x CD-ROM drives, Acer 50x CD-ROM drives, Samsung 52x CD-ROM drives.

(c). Output devices:

There are devices that can provide for only the output of data. The computer communicates with our environment and us through an output device. Printers and monitors are two of the most common output devices used with the computer.
Some of the common output devices are briefly described below:

Monitors: These are also called Visual Display Units (VDU). Monochrome and Colour display units are there. Nowadays monitors in different standard settings are available. Apart from the old standard settings of horizontal and vertical sizing and position, today monitors feature a host of other parameters such as Raster rotation, Parallelogram distortion, Trapezoidal distortion, Pincushion distortion and Upper and Lower edge correction, which are effected through the on screen display (OSD) (Normally these settings are known as Raster distortions,). And sive really monitors support resolutions up to 1280x1024 pixels but some monitors go up to 2048x1536 pixels. And most people are using monitors of 14-inches, 15-inches, 17-inches, and 19-inches, but 21-inch monitors are also available.

Examples: Sony CPD-E100 14-inches Aperture Grille (CRT type), Samsung 55V 15" Shadow Mask (CRT Type), etc.

Printers: A printer is an output device that converts electronic signals from the computer into human-readable form, or HARD COPY: Printers are often categorized based on the printing mechanism as Impact and Non-impact printers.

Figure 3.11: Different types of printers based on printing mechanism

But today most people are using 3 types of printers (a), Dot Matrix Printers (b), Inkjet Printers, (c) Laser Printers.
a. Dot Matrix Printers: Dot Matrix Technology (DMP) refers to the way the DMPs form characters or images on paper. This is done by several tiny pins aligned in a column striking an ink ribbon positioned between the pins and the paper. The impact creates the final dots on the paper. Characters are formed by the pattern these closely spaced dots make when the print head moves laterally across the page in very small increments. The pins contained in the print head are about an inch long and are driven by several hammers, which force each pin into contact with the ink ribbon (and paper) at a certain time. Laser printers and inkjet printers, on the other hand, can print without actually striking the paper and are therefore referred to as non-impact printers. It is also due to the impact factor that the DMPs are notorious for the noise they create.  

Examples: LX 240, LQ 1050_DX from wipro.

(b). Inkjet Printers: In inkjet printing, ink is emitted from nozzles as they pass over the media. A print head scans the page in horizontal strips, using a motor assembly to move it back and forth, as another motor assembly rolls the paper in vertical steps. When strip of image is printed, then the paper moves on, ready for the next strip. To speed things up, the print head does *not* print just a single row of pixels in each pass, but a vertical row of pixels at a time. Inkjet manufacturers use two major technologies, thermal technology (Hewlett Packard and Canon), and Piezoelectric technology (Epson). Inkjet printers offer a low-cost method to add color-printing capabilities to your home or office computer system.

Examples: HP DeskJet 640C, Epson Stylus color 480, Canon BJC3000, Lexmark Z31 color Jet printer, etc.

(c). Laser Printers: To deliver excellent quality output, a laser printer controls five different operations at the same time interpret signals from a computer, translate those signals into instructions that control the firing and movement of a laser beam,
control the movement of the paper, sensitize the paper so that it will accept the black toner that makes up the image, fuse that image to the paper. Laser printers use a technology similar to the one used in photocopiers. The Laser beam is focused on a photoelectric belt or drum, creating an electrical charge.

Examples: HP LaserJet 2100, Lexmark Optra B310, Samsung ML-5000A, Xerox Docuprint P8e, etc.

<table>
<thead>
<tr>
<th>Details</th>
<th>Dot Matrix Printers</th>
<th>Inkjets</th>
<th>Lasers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Rs 8,000-Rs 15,000</td>
<td>Rs 6,000-Rs. 15,000</td>
<td>Rs 15,000-Rs 25,000</td>
</tr>
<tr>
<td>Cost of replacement Cartridge</td>
<td>Rs 80-Rs 100</td>
<td>Rs 600-Rs.1,500</td>
<td>Rs 4,000 approx</td>
</tr>
<tr>
<td>Pages per Cartridge</td>
<td>1000</td>
<td>500</td>
<td>4,000</td>
</tr>
<tr>
<td>Life</td>
<td>100 million characters</td>
<td>25,000 Pages</td>
<td>60,000 pages</td>
</tr>
<tr>
<td>Speed</td>
<td>300 cps</td>
<td>300 or 360 dpi (up to 1440 dpi in certain models)</td>
<td>300 or 600 dpi</td>
</tr>
<tr>
<td>Print quality</td>
<td>Dotted lines</td>
<td>Average to good quality</td>
<td>Good quality</td>
</tr>
<tr>
<td>Color capability</td>
<td>Only by changing ink ribbon</td>
<td>With color inkjets</td>
<td>Only in high-end color lasers</td>
</tr>
<tr>
<td>Noise factor</td>
<td>Makes a lot of noise</td>
<td>Bearable noise in some models</td>
<td>Quite smooth</td>
</tr>
<tr>
<td>Paper size support</td>
<td>Up to 132-column</td>
<td>A4 size</td>
<td>A4 size</td>
</tr>
</tbody>
</table>

Speakers: Speakers are used to listen to audio output from the computer system. The traditional two-piece speakers system makes listening to game play or music an enjoyable experience. Volume control, bass control, Treble control, Microphone in, Headphone out, 3D surround effect, subwoofer are some of the different options we usually see in most of the speakers. And also we are getting different models like amplified speakers, flat panel speakers.
(d). Storage devices:

Storage devices can be divided into (i) tape drives and (ii) disk drives.

(i). Tape drives:

One of the oldest methods of archiving data, used in telecommunication and later adopted in the PCs, is the Tape drive technology. Tape drives are basically used for archiving and backing up data. Some of these are described briefly below,

Magnetic tape: It is a sequential access storage medium. It is the slowest mass storage technology currently in use and is one of the cheapest storage media.

Cartridge tape: After the CD-ROM drives; cassette and cartridge tapes are the most frequently used devices with minicomputers and the PCs. The 0.25 inch cartridge tapes are widely used with workstations, usually to take back-up of large databases/files. These can store up to 5 GB of data. Of late, 4 mm and 8 mm videotapes are also being used. These are low-cost and have longer access time than floppy discs.

Digital Audio Tape (DAT): It is the most common device used for archival storage and retrieval of large volumes of data. Digital recording on magnetic tape was developed for use in sound recordings in the 1970s and for the consumer market by the late 1980s. Digital Audio Tape (DAT) drives are primarily used where space is a major concern. Similar to the working of a video tape it works on a principle called helical scan recording, where the tape is wound in a cylindrical drum containing a pair of read and write heads.

(ii). Disk drives:

Disk drives can be divided into fixed disks and flexible disks devices. Some of Fixed disks are: Hard disk: Hard disk drives were originally called ‘fixed disks’ or ‘Wincheaters’, which was a code name used by the IBM. Hard disks are heavy devices up to 20 inches in diameter.
Two types of interfaces are used in the manufacturing of hard disks. (i), IDE (Integrated Drive Electronics) also known as ATA (AT Attachment Interface) and (ii), SCSI (Small Computer System Interface). The former is cheaper than all other drives.

Some of Hard disk drive manufacturers are Fujitsu, IBM, Samsung, Seagate, Quantum, etc. The capacities available in to day’s market are as follows: 4.3 GB, 4.5 GB, 6.4 GB, 8.4 GB, 8.6 GB, 9.1 GB, 10 GB, 15 GB, 16.8 GB, 18.2 GB, 20 GB, 30 GB, 36 GB, 40 GB, and 60 GB, etc (GB- Giga Bytes)

Flexible disks are: Removable drives are quickly becoming the standard at the small office level and are popular add-ons for the home-user. The mobile storage market has many options. Apart from the older tape drives and Magneto optical (MO) drives, there are new models of Zip drives from Iomega. Also available are Jaz drives and ORB drives. Removable storage media are divided into magnetic media and optical media.

Floppy disks, Zip disks, Jaz disks and other storage devices are come under magnetic media.

Optical discs are non-magnetic, removable devices. Broadly, the Optical media can be grouped into three categories viz., (i). Read-only, (ii). Write once-read many (WORM), and (iii). Erasable / re-writable. Most of these are being used in libraries, publishing, multimedia products, and software/database distribution.

(i). Read-only media include analogue and digital video discs, CD-audio, CD-ROM, hydride discs, LV-ROM, CD-Interactive (CD-I), CD-Interactive Video (CD-IV), CD-Video (CD-V), Digital Video Interactive (CVI), Digital Video / Versatile Disc (DVD), Photo-CD, Data and Optical ROM (DROM and OROM), optical card, optional film and optical tape; the WORM media include write once-read many discs, CD-Recordable (CD-R), CD-PROM recordable videodiscs, digital
optical discs (with diameters of 5.25, 8, 12 and 14 inches), optical card, and optical paper; and the erasable/re-writable media include Erasable Programmable Memory (EPROM) discs, CD-Erasable (CD-E, also known as CD-Re-writable, (CD-RW) discs, phase change and magneto-optic devices (1,9), Videodisc (Video High Density, (VHD)), Capacitance Electronic Disc (CED), Optical Memory Disc Recorded (OMDR) and Direct-Read-After-Write (DRAW)), Compact Disc-Read Only Memory: CD-ROM C, DVD: (DVD-Video or simply DVD, DVD-ROM, DVD-R, DVD-RAM and DVD+RW. Among these DVD-R, DVD-RAM and DVD-Audio are in the pipeline. Ultimately, DVD is expected to replace CD-ROM in near future.), Optical Tape (200GB data on optical tapes in the near future) Fluorescent Disk Technology (Future):

Write Once-Read Many Media include, CD-Recordable and DVD-R are the two important ones in WORM technology, having potential applications in libraries.

Erasable/Re-writable Media, include, CD-Re-writable (CD-RW, also known as CD-Erasable or CD-E) and DVD-RAM/DVD+RW, which are amenable for writing, erasing and rewriting data any number of times.

3.E.2 Physical devices used in LAN

a. Network Interface Card (NIC):

A microprocessor can communicate with the RAM at the rate of at least 16 million characters of information per second, or even two to three times faster. But the LAN cables available today can support data flow only of a fraction of that speed. Hence there arises a need for special add-on boards or adapters called network interface cards (NICs) or LAN cards or network cards. Depending on their features and the manufacturer, these cards may vary in cost. While a ‘dumb’ card is relatively inexpensive and works fine with 486 or Pentium-based machines, a ‘smart’ network
card has its own microprocessor, and is often a good choice for older, slower computers or bigger, high-demand networks.

b. Repeaters:

As signals travel along a cable, they degrade and become distorted in a process that is called attenuation. If a cable is long enough, the attenuation of a signal becomes unrecognizable. A repeater enables signals to travel further. A repeater takes a weak signal from one segment, regenerates it, and passes it on to the next segment. Repeaters can move packets from one physical medium to another. Repeaters are the least expensive way of expanding a network. While they are a good initial solution, they are at the low end of network expansion components. Repeaters will also pass a broadcast storm along from one segment to the next, back and forth along the network. A broadcast storm occurs when there are so many broadcast messages on the network that the number is approaching the network bandwidth. If a device is responding to a packet that is continuously circulating on the network, or a packet is continuously attempting to contact a system that never replies, network performance will be degraded.

c. Hubs:

The hub is a device that provides a central connection point for various terminal computers or communication devices. The LAN hubs range from simple write-management facilities to various switching devices, and can serve a variety of purposes. An active hub strengthens and retransmits incoming signals and is recommended for larger networks. A passive hub, on the other hand, acts just as a connecting point without any amplification facility. Passive hubs do not require electrical power to run. Advanced hubs that accommodate several different types of cables are called hybrid hubs. Connecting more than one hub can expand a hub-based network.
Active hubs, most hubs are active in that they regenerate and retransmit the incoming signals in the same way as a repeater does. In fact, because hubs usually have eight to twelve ports for network computers to connect to, they are sometimes called multiport repeaters. Active hubs are recommended for larger networks. Active hubs require electrical power to run. Passive hubs, on the other hand, act just as a connecting point without any amplification facility. They do not require electrical power to run. Intelligent hubs or Hybrid hubs are advanced hubs that can accommodate several different types of cables.

d. Data Switches:

A data switch is a device linking terminals, computers, etc. to the host computer. Switches are basically concentrating devices that have between 8 to 64 ports. Until recently, routers were used in the LANs but now higher layer switches are replacing them.

e. Bridges:

Bridges are used to connect two or more networks or to divide an overloaded network into separate network segments, thus reducing the traffic on each segment and making the network more efficient. Bridges work best in networks that are highly segregated.

Cascaded bridges: The simplest method of expanding a LAN is to cascade segments in the form of a daisy chain through a series of 2-port bridges. If a LAN is allowed to evolve in this way, however, then the overall improvement in total load will ultimately decrease as the number of segments increases. This is because any remote traffic from or to a workgroup may have to be forwarded over several intermediate segments thus increasing the load on them.

Multiport bridges: A multiport bridge, as its name implies, supports multiple ports and hence segments. The maximum number of ports supported ranges from
five to ten, so they provide a convenient means of linking segments that are physically distributed around a single office complex.

Backbones: An alternative way to link multiple segments within a building is to introduce what is known as a building backbone solely for relaying inter-segment traffic. Typically, this operates at the same bit rate as the other segments.

Remote bridges: As has been indicated, many large organizations need to provide links between the LANs installed in geographically distributed establishments. In such cases, a common solution is to use leased lines to link the various sites and remote bridges. Often the latter are connected directly to each establishment-wide backbone. The bit rate of the leased lines selected must now be determined by considering the level of inter-establishment traffic. Delays associated with this traffic will be made up of the transmission and propagation delays of the leased lines and the buffer delays (the time a frame waits before it is relayed) at each side of the link.

3.E.3. Physical devices used in WAN

a. Modems:

The term ‘modem’ is a contraction of modulator/demodulator. A modem contains a modulator as well as a demodulator. Most modems are designed for utilizing the analog voice band service offered by the telecommunication network.

Types of Modems:

Modems can be of several types and they can be categorized in a number of ways. Categorization is usually based on the following basic modem features:

1. Directional capability - half duplex modem and full duplex modem.

2. Connection to the line - 2 wire modem and 4-wire modem.

3. Transmission mode - Asynchronous modem and synchronous modem
1. Half Duplex and Full Duplex Modems: A half duplex modem permits transmission in one direction at a time. If a carrier is detected on the line by the modem, it gives an indication of the incoming carrier to the DTE through a control signal of its digital interface (Figure 3.12.1). So long as the carrier is being received, the modem does not give clearance to the DTE to transmit.

A full duplex modem allows simultaneous transmission in both directions. Thus, there are two carriers on the line, one outgoing and the other incoming (Figure 3.12.2).

A 2-wire connection is cheaper than a 4-wire connection because only one pair of wires is extended to the subscriber's premises. The data connection established through telephone exchanges is also a 2-wire connection. For the 2-wire connections, modems with a 2-wire line interface are required. Such modems use the same pair of wires for outgoing and incoming carriers. Half duplex mode of transmission using the same frequency for the incoming and outgoing carriers can be easily implemented. This transmit and receive carrier frequencies can be the same because only one of them is present on the line at a time.

Asynchronous and synchronous modems:

Figure 3.12.1: Half duplex modem.
Figure 3.12.2: Full duplex modem.

<table>
<thead>
<tr>
<th>Request to Transmit Data</th>
<th>Yes</th>
<th>Data</th>
<th>Outgoing carrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td></td>
<td></td>
<td>Incoming carrier</td>
</tr>
<tr>
<td>Incoming carrier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.12.3: 4-wire Modem

Modems for asynchronous and synchronous transmission are of different types. An asynchronous modem can only handle data bytes with start and stop bits. There are no separate timing signal or clock between the modem and the DTE (Figure 3.13.1). The internal timing pulses are synchronized repeatedly with the leading edge of the start pulse.

A synchronous modem can handle a continuous stream of data bits but requires a clock signal (Figure 3.13.2). The data bits are always synchronized with the clock signal. There are separate clocks for the data bits being transmitted and received.

For synchronous transmission of data bits, the DTE can use its internal clock and supply the same to the modem. Else, it can take the clock from the modem and send data bits on each occurrence of the clock pulse. At the receiving end, the modem recovers the clock signal from the received data signal and supplies it to the DTE. It is, however, necessary that the received data signal contain enough
transitions to ensure that the timing extraction circuit remains in synchronization.

High speed modems are provided with scramblers and descramblers for this purpose.

Figure 3.13.1: Asynchronous modem

Data
Start Bit Stop Bit

Figure 3.13.2: Synchronous modem

Data
Clock
Received Clock
Received Data

*Transmit clock is supplied either by the modem or by the DTE

b. Multiplexers:

A network which allows a number of sample, low cost terminals to share communication lines, introduces almost no delay and requires no special computer software, can be constructed by the use of multiplexers.

c. Routers:

In an environment consisting of several network segments with differing protocols and architectures, a bridge may not be adequate for ensuring fast communication among all of the segments. Routers work at the Network layer of the OSI model. This means they can switch and route packets across multiple networks. Routers read complex network addressing information in the packet and, because they function at a higher layer in the OSI model than bridges, they have access to additional information. Routers have access to more information in packets than bridges, and use this information to improve packet deliveries. They are used in
complex network situations because they provide better traffic management than bridges and do not pass broadcast traffic. They can share status and routing information with one another and use this information to bypass slow or manufacturing connections.

There are two major types of routers and they are static router and dynamic router.

Static router: Static routers require an administrator to manually set up and configure the routing table and to specify each route.

Dynamic router: Dynamic routers do an automatic discovery of routes and therefore have a minimal amount of set up and configuration. They are more sophisticated in that they examine information from other routers and make packet-by-packet decisions about how to send data across network.

d. Brouters:

A brouter, as the name implies, combines the best qualities of both a bridge and a router. It can act like a router for one protocol and bridge all of the others. Brouters can, route selected routable protocols; bridge non-routable protocols; deliver more cost-effective and more manageable internetworking than separate bridges and routers.

e. Gateways:

Gateways make communication possible between different architectures and environments. They repack and convert data going from one environment to another, so that each environment can understand the other environments data. A gateway repackages information to match the requirements of the destination system. It can change the format of a message so that it will conform to the application program at the receiving end of the transfer. A gateway links two systems that do not use the same, communication protocols; data formatting structures; languages; and architecture.
f. WebRamp:

WebRamp series consist of an integrated analog/ISDN router and ethernet hub, designed to increase your productivity on the Internet and provide telecommuter dial-in access. The latest WebRamps are the most affordable way to give everyone internet access because you can share up to 3 modems or ISDN simultaneously with regular phone lines, let remote users securely access your LAN and use e-mail, the Internet and the shared files, control each user’s access to different internet applications, connect remote networks using IP/IPX routing or bridging, easily create a virtual private network connecting geographically distant branches over the Internet.

3.F. Software technology

Computer software, which includes programs, language, and/or routines that control the operations of a computer in solving a given problem, may be classified into two broad categories: (a). system software and (b). application software. System software is constituted by general programs written for the system, which provide the environment to facilitate the writing of application software. Programming language translators are examples of system software. On the other hand, application software is the set of programs necessary to carry out operations for a specified application. For example, programs to solve a set of equations, process examination results, etc. constitute application software. 21

2. System software:

'System software' is a program that directs the overall operation of the computer, facilitates its use and interacts with the users. In other words 'system software' is a collection of programs that manages the resources of a computer system. One of the important systems software is the Operating System.
Operating System: An Operating system may be defined as a set of system programs that control and coordinate the operation of a computer system. Some of the major facilities provided by modern operating systems are:

- Easy interaction between humans and computers,
- Starting computer operation automatically when power is turned on,
- Loading and scheduling users' programs along with necessary compilers,
- Controlling input and output,
- Controlling program execution,
- Managing use of main memory,
- Managing and manipulating (e.g. editing) files,
- Providing security to users' jobs and files,
- Accounting resource usage.

Some of the operating systems are as follow:

The DOS (Disk Operating System) is a single user Operating system. There are several versions of it, of which MS-DOS 6.22 (Microsoft DOS) is a popular version. After that, Microsoft released the Windows based operating systems (i.e. Graphical user interface). The important ones are Windows 95, Windows 97, Windows 98, Windows Me. One of the famous operating systems from the IBM is OS2. Mostly the above-mentioned operating systems are used for desktop-based computers. Among the network-based computers having network operating system, the important ones are UNIX designed by AT and T, Windows NT server/client, Windows 2000 Server/Advanced server/Professional, Windows XP from Microsoft, Netware from Novell, Solaris from Sun Microsystems. But, in India most people use Windows based operating systems, because they are user-friendly.
b. Application software:

It is a program designed to solve a particular problem for an application, such as payroll program. In other words ‘application softwares’ are a collection of programs, which perform specific tasks for the computer user.

3.F.1. Library software packages: Indian library software packages

There are a number of library software packages, developed during the 1980s and 90s, which are being used in libraries for purpose of library automation.

3.F.1.a. LIBRIS:

The LIBRIS is a comprehensive, user friendly and menu driven library software package developed by frontier information technologies pvt. ltd., Secunderabad. It is a library management system optimizing the utilization of library facilities by the members and the management of library functions by the library staff.

The LIBRIS covers all the functional areas of a library, viz., acquisition, cataloging, circulation and periodicals. It provides powerful and extensive facilities for on-line enquiries for books, authors, articles, and for efficient distribution of information.

The features of LIBRIS are: Integrated System: The LIBRIS is an integrated system achieving unity inspite of diverse needs of various departments of Library. It is a user friendly system. It is an on-line, menu-driven application, with easy-to-understand prompts and functions to guide the user. Users do not require extensive training to operate it. The existing staff can be taught to use the package. The LIBRIS is a modular package and can be implemented in phases. A library can go in for the required modules initially. The other modules can be added to the existing package according to the library needs. The LIBRIS is a comprehensive package and covers all the areas of a library. It supports all the functional areas such as library
administration, acquisition, cataloguing, union cataloguing, circulation, periodicals, enquiries, the OPACS etc. The LIBRIS is a reliable and dependable system and is capable of 24-hour non-stop operations. The software is tested, tried and proven. It enforces discipline, removes operator errors and improves efficiency of library management. Access to the LIBRIS is restricted by passwords, with a multi-level security it has. Different levels of security are available for different users. It has 'password protection for all modules and screens'. It has in-built backup and recovery features. Backup of data can be taken periodically and it can be used for restoration in case of system failure. It has multi-user access. It has unlimited multi-user license single location. It keeps track of overall budget for materials and expenses (purchases) incurred and maintains it. It keeps track of department-wise budget and expenses incurred. It provides inter-library loan facility and provides list of libraries which can borrow books from the client library and the libraries from whom the client library can borrow, and it tracks records of the books borrowed.

The LIBRIS maintains supplier list, along with details of the material offered with prices, can also be maintained. It enables verifying requests by librarian. Facility is available for the librarian to verify requests of members and suppliers. It provides facilities for online printing of order details / invoice it can print purchase orders, line and record invoices against deliveries. It maintains records of bound journals / periodicals, Maintains records of back volumes of journals / periodicals. It can create a directory and maintain alphabetical list of all materials. Based on category, fields change at runtime depending upon the category of materials, the fields change at run time. It maintains records of other materials in the library like racks, furniture and fittings. It provides current awareness service / selective dissemination of information to inform members about new arrivals or about materials that are of specific interest to specific members; It maintains new arrivals
document and prints out details of new arrivals for library notice board. AACR2 level I cards are automatically generated. Facilities for automatic match with drop downs and automatic important and export from/to standard formats are available. Letterheads can be automatically printed.

The LIBRIS package has the following facilities for book bank management:
book journey; track material from arrival till circulation; cardex for serial control;
full windows compliance on: 32-bits version Windows 95/97/98/NT
server/workstation; gate pass printing; GUI date maintenance; multimedia help;
receipt generation; reminder notice through print (snail) mail or e-mail; union
cataloguing; bar code support for serial control, issue and return. Online help: online help throughout the running of the software; the OPAC facility provides access to bibliographic database and provides features like browse and search, viewing of holding, reservation etc. The OPAC (browser based) on LAN/WAN facility which enables members to access the library by using browsers like the Internet explorer/Netscape navigator this requires internet information server software (which comes as option pack 3 with Windows NT 4.0). Additional printing of catalogue cards for all cards, i.e., for AACR I, AACR II formats; Online management for catalogue complete online management for all catalogues in the software.

Data of CDs/Microform/DVD; Conference Host, etc. can be maintained in the LIBRIS package. At nominal cost FRONTIER makes constant improvements to the LIBRIS, taking into consideration the various technological breakthroughs in the computer industry as well as libraries. New features and improvements, as and when they are delivered, will be made available at nominal cost; Training: training will be provided to the operating staff as well as Librarian on the operation of the package.
Advanced internet web based OPAC features are made available. Here the collection of information can be hosted on the website of the client; WEB uploading cum
updating software facilitates the uploading of the collection information on the website periodically.

There are several other special features in LIBRIS. It is designed for all WIN-32 platforms (Windows-9x, Windows-NT/WS and Windows 2000). It supports all Windows features such as drag/drop, cut, copy, paste, window minimizing resizing etc. It co-exists with other windows applications (outlook, word, excel, power point and any other windows applications). It has minimal data entry and maximum supports like dropdown menus, combo boxes, pull down menus, Lists, Grids, options etc. It has been built around tag-format architecture, so that minimum disk space is used, and conforms to international standards like the AACR. The LIBRIS has the facility for multimedia compatibility, which allows playing multimedia-associated program over the LAN/WAN. It has the facility for member identity card generation with barcode and scanned photograph. It has provision for source and authority file maintenance and output facility through card printing, with embedded pictures on print, magnetic media. It supports export / import of data in the MARC, CCF format.

3.1.1.b. LIBSYS:

The LIBSYS is a comprehensive library software package produced by the LIBSYS corporation, New Delhi. It is a fully integrated multi-user system designed to run on super-micro/mini computers under the UNIX/VMS/LAN platforms. Micro-LIBSYS, a subset of LIBSYS, is also available for PCs under the DOS/XENIX. The LIBSYS is easy to operate and the library staff can use it easily without any prerequisite of programming/computer skill. Minimal data entry requirements, maximum possible integration of functions and powerful search and query facilities of this package can ensure high productivity.

The LIBSYS supports almost all library activities relating to acquisition, cataloguing, circulation, serials control and article alert.
The features of LIBSYS are the following: Acquisition: acquisition, a sub-system of LIBSYS, covers initiation of titles for ordering including duplicate check; approval process; placing order; receiving material against firm order; invoice processing and accessioning; payment requisition; order follow-up; receiving of gift/free items, online queries by titles, orders, invoices, vendors, and budget heads; and generating various reports such as approval request form, purchase order, overdue notices, budget and expenditure analysis, payment requisition report, accession register, bill register, etc.

Cataloguing: cataloguing, a sub-system of the LIBSYS, facilitates maintaining in-process title file; catalogue production either by data import or entering data; catalogue maintenance; thesaurus construction; authority files maintenance; holding updates; holdings summary by ranges of call no; printing 3 X 5 inch catalogue cards, preparing special bibliographies, list of recent arrivals and SDI facility, and import/export of bibliographic data in standard exchange (CCF, MARC, etc.) formats.

OPAC: Online Public Access of Catalogue (OPAC) provides various catalogues / indexes such as author catalogue, title catalogue, subject catalogue, classified catalogue. The KWIC/KWOC indexes words based Boolean searches using logical connectors ‘OR’, ‘AND’, and ‘ANDNOT’; electronic mail facility for online reserves, personalized SDI, notices and messages. Circulation: circulation, a sub-system of the LIBSYS, supports front desk operations such as issues, returns, renewals, reserves/holds; membership records keeping; collection updates including monitoring of items on display and in bindery; overdue follow-up and recall facility; inter-library loans; stock verification; flexibility in operations including option for use of bar codes scanner for borrower and material identification; comprehensive statistics on circulation; reporting capabilities which includes list of highly reserved
titles, statistics on number of issues by title/borrower, list of delinquency cases, non-circulating material list, etc., and keeping log of all the circulation transactions.

Serials control: Serials is an independent sub-system of the LIBSYS providing for new subscription; subscription renewal; subscription extension; invoice processing; budget and expenditure analysis, recording of issues received; claims monitoring which include generating notices for 'not received' overdue and damaged/soiled issues, missing issues, various indexes/list, online queries on various aspects of serials control including serial holdings; and circulation of loose issues and found volumes;

Operating Environment, Developed in the 'C', LIBSYS is currently available on the following range of computer systems and it can be modified to run on any other industry standard micro mini/main-frame system:

- 386/486 based PC/AT under UNIX,
- Motorola 68000/Intel 386/486 based mini under UNIX,
- Microvax under VMS or ULTRIX,
- NOVELL LAN.

Whereas, Micro-LIBSYS is available on the following platforms:

- PC/XT or PC/AT under MS-DOS,
- PC/AT under XENIX (SCO).

Other features:

The LIBSYS supports its own screen handling and index generation procedures. Therefore, it does not require the purchasing of any RDBMS. However, the LIBSYS can be modified to operate on any preferred database such as the ORACLE, INGRES etc. The LIBSYS is user-friendly having features such as: (1) integrated functions, (2) interactive and screen oriented, (3) menu driven, (4) multi-user capabilities, (5) minimum possible data entry, (6) powerful data editing facility
easily installed, (7) user defined security, (8) database recovery procedure, and (9) help facility.

The LIBSYS users include the National Informatics Centre (NIC), TIFR, C-DAC, INSDOC, Indian Oil Corporation’s Library Division, Government of India’s Department of Electronics, library and information service divisions of Ministry of External Affairs, the AIMS, NML, BHEL, IGNOU, DMRL Planning Commission, University of Hyderabad, space application centre and parliament.

3.F.1.c. TLMS (Total library management service):

Total Library Management Service (TLMS) is a masterpiece of technology, which assures the highest levels of satisfaction. The name has a history. Originally the TRANCE library management system was so much appreciated for the services it had been rendering that on popular demand the name was changed to TOTAL instead of TRANCE to show its completeness in what it offers. Library management is obviously the major reason for the existence of the software. The name ‘system’ was changed to SERVICE for it is not a system but a complete service.

The features of TLMS are: AACR2 Level 1 cards for multilingual: The system provides AACR2 level 1 of information when the material has been catalogued in multiple languages or languages other than English. AACR2 Level 2 cards: For material catalogued exclusively in English a higher level of information is shown on the AACR2 card. It can maintain a higher cataloguing level in libraries. Accession register: The system prints an accession register to specifications. Auto cataloguing with our website: This feature is exclusively available to the TLMS users and is currently under trial. This service is free at present. It saves time, money and has accurate information in system. Auto export and import: This package allows automatic import or export in the USMARC, UKMARC, UNIMARC, New Indian UNIMARC, CCF and CDS/ISIS Formats. The TLMS automatically scans key
words. This saves the pain of typing the numbers. Once the material is catalogued, a
g graphical card in the tradition of the AACR2 is automatically generated. It is
supported with active information about the status of the book. Automatically bar
codes are generated from the TLMS itself. This not only ensures that the books are
marked with their names and accession numbers together with the bar code, but also
that in the automatic issue and return processes, the bar codes from other libraries
will not be read. Normally one has to buy the software for bar coding separately;
Automatic letterheads: The Logo and the name of the institutions are in the database
and therefore they do not need preprinted stationary to print out the reports;
Automatic match with drop downs: Drop downs are lists that match what you are
typing. This ensures that you do not have to type the existing data again and that the
data being entered is correct. Bar code support for batch return: We may collect the
material being returned and return it in one go even if it has been issued to various
members. This allows us to process the returns in batches rather than online. Barcode
support for issue and return: The barcode generated by the system can be used to
issue and return the material using the barcode of readers. This increases the
processing speed of library counters, saves time for the members and reduces
manpower as the same counters can handle the increased load. Bar coding for serial
control: Barcodes for books can be generated by some other systems. The TLMS is
the only software that boasts of automatic barcodes even for the material that comes
as serials and is entered into the daily CARDEX and even without accession
numbers. This means that serials can be issued and returned at the barcode issue
return counter from the moment they arrive into the library;

Book bank (SAF) management: All educational institutes need to maintain
the (SAF) book bank separately. Book journey: This traditional feature allows you to
track the progress of the material as it arrives in the acquisition department till it
reaches circulation. Bulletin board: In the internet/intranet module the bulletin board allows to post information on the website so that all members can read notices in one go. This bulletin board will be available from across the net. CARDEX for serial control: The CARDEX allows entries of the serials into the system as they come. Further a simple and foolproof system allows to tackle missing, late or combined issues. Chat Room: The chat room allows conferencing over the internet/intranet. This useful feature allows research groups to talk to each other without necessarily being present in person; Client server technology: The client server technology ensures secure and distributed computing. It also prevents viruses from entering the system from the client side into the server; Complete correspondence kit: The TLMS in version 3.5 onwards has a full-fledged correspondence kit to cater to all the needs of a librarian. Further customization ensures that the kit is personal in all respects.

Digital Camera Support: The digital camera support helps in the creation of identify cards. This allows, together with a lamination machine, to create and identify cards in 3mm flat. The members save money and time on getting their photos taken. Further this activity can be charged higher to subsidize the cost of automation. Email: E-mail is a new medium of communication. The TLMS system delivers a full-fledged email server where all people have their own email address and can email to each other. This energizes information exchange and promotes researchers. The library might also want to catalogue emails as new information material. E-mail cataloguing supported: More and more documents are being emailed instead of being published on the computer. Thus it is time that the emails are also catalogued; Full windows compliance: The TLMS is fully windows-compliant. It is designed for the most modern OS (Operating System) in the world. It supports all the 32-Bit versions of windows, i.e. Windows 95/97/98, windows NT 4.0 sever / workstation. Gatepass: The issue and return counter can print a gatepass
on printer of choice this saves the covers of the material from tedious, messy and
damaging stamping of dates. Further the roll of the printouts can be saved for audit
and security reasons; GOC (Good Offices Committee) date maintenance: The
conversion rates and tables issued by the GOC are entered periodically and can be
used by the system. This ensures smooth and even working in the organization and
removes typographical errors. History: The history feature keeps track of history of
the various materials and members. This encompasses acquisition to circulation. This
information is very useful while deciding on acquisition or renewing material. ID
card with photograph: for various categories: The digital camera produces the ID
cards. Various categories of members should have a different styled ID cards to
differentiate them from one another, e.g. students from the faculty. The TLMS gives
various formats that may be used for different categories. Inform on arrival: The
acquisition process traces the request all the way till the requester is informed. This
helps to keep better relationships with the members. Instant access to all data being
entered: Since this technology is client-server technology, all data entered is updated
on the server. This means that the data is available the moment it is served. This
leads to accurate information.

3.F.1.d. Sanjay:

Sanjay is a library automation software package, which has been designed
and developed by the DESIDOC, Delhi, with the support of NISSAT, by augmenting
the CDS/ISIS (ver2.3) to cater to the needs of library management.

The features of Sanjay are: It is user-friendly for library housekeeping
operations; has a set of 70 Pascal programs and 25 special menus. Responds very
quickly and takes 1 minute for a query on 12,000 documents. It has an effective
interlinking of database. It is a package based on the CDS/ISIS version 2.3 with
enhanced capabilities through the interfacing of some Pascal programs; it links two
or more databases for single application. It can handle numeric calculations such as
data specification and house-keeping jobs like acquisition, circulation, budget control
and related functions; and it incorporates the provision of data security and selective
access by introducing maintenance module and user module.

The package is marketed by the NISSAT, New Delhi, at a nominal price. It has already been implemented in 15 libraries including Technology Bhawan Library
and Indian Oil Corporation (R and D) library, New Delhi.

3.F.1.e. \textit{Maitrayee}:

Maitrayee has been developed by the CMC Ltd., primarily for the
CALIBNET with financial assistance from that NISSAT.

The features of Maitrayee are: Database related activities are based on the
INGRES, as a DBMS platform. The package includes the following key features
such as, portability, maintainability, security, flexibility, recovery features, varied
routing capability etc. The networking protocol is developed to suit international
standards and multi-vendor hardware. The applications software incorporates the
following main sub-systems acquisition and fund accounting sub-system,
cataloging sub-system, circulation sub-system, user search services, serials control
sub-system, central host and networking services.

Keeping in view the software requirements of the CALIBNET, DELNET and
INFLIBNET, so far no Indian software has been regarded as ideal for networking. 24

3.F.1.f. \textit{Odyssey}:

This software was developed by the SRA system ltd., imaging division,
Chennai. It is a comprehensive document image management system, which
provides easy methods for storage, sharing and retrieval of documents. It takes
information from various sources such as scanners, faxes, computer created
documents and other ASCII files. It supports various types of storage media like hard disks, optical discs, the CD-ROMs and Juke Boxes.

The features of Odyssey are: It provides multi-level security features and access control for the document images; it supports different types of scanners and provides a flexible scanner control; it uses the CCITT group IV Fax format for compression of B/W documents and the JPDOC format for colour documents; it allows the users to index their document in a flexible manner with user definable index fields, which could be used later for retrieval. Text index can also be built automatically using the OCR facility. It provides document archival facilities including archival management read / write disk cache, batch mode archival, read only and rewritable disk management, auto servicing of requests for retrieval and volume management etc. It provides a comprehensive electronic filing cabinet in a hierarchical fashion. Document can also be filed automatically in multiple folders without duplication; it provides various methods of retrieval by unique system generated ID number, document reference, key words, text search facility, query by form (QBF) for document types etc; it provides notepad facility to annotate document images. It has a built-in mailing system. This enables users to mail documents with messages within the Odyssey networks. It incorporates a work-flow facility, using which any user can initiate an action-oriented document routing process to route documents to other users in the network. The user will also be able to keep track of documents and their flow when they move from one user to another. The OCR can be used for text search, conversion of image text to the ASCII text, content-based text search and automatic indexing; it provides a comprehensive text search facility to give support for context-based search using the OCR facility. Text search can also be performed on the ASCII text and word-processed documents for context-based retrieval; it provides utilities for data export and import through the
The Odyssey is built around client server architecture and supports the NetBIOS, SPX/IPX and TCP/IP communication protocols. It is developed with modular and open-ended design. Therefore it can easily be integrated with other application software systems; the system requirements for Odyssey application are: PC/AT 486 or above, 8MB RAM, VGA display, MS windows 3.0/windows 95/windows NT, industry standard scanner.

3.E.1.g. Suchika (ver 1.0):

Suchika is an integrated software package for library automation, designed and developed during 1996 by the Defense Scientific Information and Documentation Centre (DESIDOC), Delhi for its Defence Science Library and other libraries/Technical Information Centres (TICs) of Defence Research and Development Organization (DRDO), scattered all over India.

The purpose of developing this software is to automate all the DRDO libraries / TICs, to create and maintain a DRDO libraries holdings database and help the libraries to follow uniform standard practices. The package has been developed in C++ language in the MS-DOS and UNIX versions keeping in view the requirements of big and small libraries of the DRDO.

The features of Suchika are: The package is menu-driven and user-friendly, and it conforms to international standards like Common Communication Format (CCF), ISO-2709, AACR2 and allows data conversion from the CSC/ISIS etc. Suchika has powerful search facilities. Search can be conducted on any field by specifying the field(s) or through the various indexes like author, subject, keywords, report no, patent no etc. Query may be typed or selected by using the index concerned. Boolean search operators can also be used. Suchika also provides facility for free text searching. Search results can be displayed according to the desired format, and after selecting the relevant records, printouts can also be taken. Suchika
has inbuilt facility for data validation and data duplication checking. This package has been developed in modular form, such as acquisition, circulation, OPAC, serials control modules. Therefore, its implementation is quite easy.

3.1.1.1. Granthalaya:

It is a complete library automation package designed and developed in FoxPro by the Indian National Scientific Documentation Centre (INSDOC), New Delhi. This package is available in MS-DOS.

The features of Granthalaya are:

Modularity: the package comprises seven modules (data administration, query, circulation, acquisition, serial control, technical processing and library administration) designed to handle all functions of a library and information centre.

Object oriented design: The package has been developed based on object-oriented design, which offers qualitatively superior end product.

CCF compatibility: The package adopts the Common Communication Format (CCF). It incorporates all mandatory fields of the CCF, which facilitates import/export of data form/to Granthalaya to/from various platforms. Export and import of data to and from the ISO-2709 and ASCII format is possible.

Dictionary concept: Dictionary facility is provided in the package for data elements like publishers, keywords, accompanying materials, etc.

Powerful query and search facilities: The package is provided with sophisticated tools for retrieval of information by different search parameters. Search can be conducted by using Boolean logic operators. Search terms can be typed or selected through dictionaries.

Easy to use: The package is easy to learn and use. It provides on-screen messages to help users;

The INSDOC is marketing and promoting this package for library automation in India. It has already been implemented at National Science Library, INSDOC,
New Delhi. Its UNIX version has been implemented at the Nuclear Science Centre Library, New Delhi.

3.F.1.i. WILISYS:

The Wipro Library Information Systems (WILISYS) is a family of comprehensive software for library computerization. It consists of two major software packages: (i) WILIMAX: WIPRO Library Management System for books and journals, and (ii) WILITRAX: WIPRO Library Abstracts System for abstracts.

(i) WILIMAX: This package is aimed at computerization of different library activities such as acquisition, circulation etc. It comprehensively covers the major areas of computerization of books and journals. The activities encompassed by the software are elucidated below:

The features of WILIMAX are:

Books Module: The major activities covered by the modules are acquisition, circulation, binding and maintenance, and search and query. Each of these modules has been discussed here in detail. The acquisition module supports the following: Receiving requests from members, processing received requests, checking the availability of books in the library before order placement, validation of requests against pending orders, order placement based on requests from members, books received on approval basis and review of list sent by publishers, generation of order letter, keeping track of the receipts, and if they are not received in the stipulated time sending appropriate reminders, budget monitoring and associate reports, accessioning of acquired books, and giving intimation to users on the arrival of books. The activities covered by circulation module are the following: Registration of new members, charging books, discharging books, reservation of books, cancellation of reservation, renewals, monitoring overdue books and printing reminders, circulation statistics. The activities covered by the binding and
maintenance module are: Sending books for binding, receipt of books after binding, binding reports, and lost books maintenance. The following catalogue cards can be generated by the cataloging module: Author catalogue, series catalogue, title catalogue, and subject catalogue;

*In the search and Query Module*, a query can be made on a book based on multiple query elements. For instance, if a person knows only the partial title of a particular book, he can phrase a query based on the title information. The selected books are displayed for perusal. Queries can be phrased using a user-friendly query language.

The query elements which are supported by the query language are: author, title, keyword, year of publication, series, subject, and document type. Combination queries are possible using the above query elements. The combination operators 'AND' and 'OR' are supported.

*Periodicals module:* The major activities covered by this module acquisition are monitoring the arrival of journal issues, binding, holdings maintenance, history maintenance and circulation. The activities under the periodicals module are listed briefly. Acquisition: Placing orders for new journals, renewal of journals, budget monitoring, order cancellation; Monitoring and arrival of journal issues; Registration of journal issues, registration at exchange and gratis journals, periodicity amendment, automatic reminder generation for overdue issues, registration of indexes; Binding: Identifying complete volumes of journals to be sent for binding, sending journals for binding, receipt of journal after binding, accessioning of bound journals; Holdings: Registration of existing holdings in the library, consolidated list of holdings, report of gaps in subscriptions; History: Amalgamation of journals, change of journal title, splitting of journals, query on history information; Circulation: Charging issues of journals, discharging issues, fine maintenance.

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(ii). WILITRAX: This package, second of the packing of WILISYS, is meant for storing and retrieving abstracts information.

The features of WILITRAX are: Exchange of information (abstract) with different sources and databases in the ISO-2709 format, maintenance of user profiles, dissemination of information in accordance with the user profiles, retrospective search of abstracts, associate reports. Security features: Security being an important feature of any system, WILISYS provides different levels of security for users and the library staff, which can be configured, based on requirements, operating environment: WILISYS is developed in portable 'C' language. It uses the UNIFY relational database management system for data management. WILISYS is implemented on the UNIX operating system and can be used on any WIPRO minicomputers or higher and microcomputers running UNIX the operating system.

3.1.1. TULIPS:

Tata Unisys Library Information Processing System (TULIPS) is a comprehensive library package aimed at better and faster information dissemination to library users as well as computerization of certain vital housekeeping activities of the library to improve the service quality. American studies research centre, Hyderabad; and Ramakrishna mission institute of culture, Calcutta use TULIPS in their library systems.

The features of TULIPS are: It is flexible to suit most types of libraries and has supporting utilities to aid customization. It is completely menu-driven with context sensitive help. It is developed under ORACLE, RDBMS. Has a modularized design; and extensive security features; and online budget maintenance. It maintains data and systems dictionaries. It has acquisition control which includes the following functions: (a) Master maintenance: This sub-module deals with tables/ files that are relatively permanent in nature and less frequently updated. These master tables are
necessary for consistency and simplicity in the maintenance of details like vendor
details, budget allotments, currency etc., (b) Transaction maintenance: This module
handles transactions of documents or titles that may be categorized into books,
standards, reports, conference proceedings, microfiche, recording etc. They may be
further grouped according to their mode of acquisition i.e. complementary or
purchased on various funds. It also provides an on-line browse facility, which allows
to browse through existing titles, already available in the library and those being
ordered to avoid duplication and unnecessary purchases; (c) Order processing: This
sub-module handles data entry and variation, budget updates and invoicing; (d)
Queries and reports: This sub module provides exhaustive on-line query facilities to
be able to perform any enquiries on the basis of title, order, vendor, budget status etc.

Reports generated include titles in acquisition, requested titles, approval
form, approved titles, reminders, budget status reports, reports on orders and
reminders.

Cataloguing: The main functions of this module are the following: (a) Book
data entry: Any new book that comes to the library has to be given identification
'accession number' which is unique to it. The various details of the book like its title,
author or authors, publishers, edition, series, volume, etc., along with the accession
number are entered. Along with these details, a mark of 5 keywords can be given to
that book. After the names of the authors and the title, are entered, a check is
performed to see if that book is already available in the library. If it does then, the
newly acquired book is entered as a duplicate copy and there is no need to enter
other details of the book other than the edition and year of publication. Further if the
book has been acquired by raising purchase orders the details of that book can be got
by just giving its reference number, thereby reducing the data entry work. (b)
Reports: Include catalogue cards for all new books, a weekly magazine listing new
additions and authorwise/subjectwise lists. (c) Queries: Users can generate their own queries on accession number, author, keyword or title, using AND/OR conditions.
(d) Maintenance: This is used to maintain data like call number, book types, keywords, authors etc., and it has extensive help features.

Circulation: Circulation control captures, organizes and maintains information relating to members, books and loan transactions. It generates:

Circulation details bookwise / memberwise, information such as withdrawal cards, replaced cards, statistics, reminder notices, and availability slip for reserved books,

(a) Member information: Using this the user can maintain data/information on members of the library including member designation/type of member, department/area of interest. (b) Report: This module provides features like available documents lists, reminders for overdue documents, up-to-date member information departmentwise / designationwise, code report, check list of circulation transactions and member updates for a specified period. (c) Queries: Users can query the circulation data under multiple criteria. This section helps to retrieve member, reservation or transaction details for any documents. The query can be memberwise/documentwise. In addition, memberwise information can be obtained for the list of books due on a particular date, department, designation, card numbers etc. (d) Serials control: The serial control and journal article section deals with the procurement and the maintenance of periodicals / journals.

The main functions of TULIPS are:

Master file maintenance: It maintains four types of files namely vendor, periodical list, budget, terms and conditions. Order processing: This section deals with data that is related to the process of acquisition of periodicals. Periodical and member details, approval details, and unique reference numbers are maintained here to facilitate ordering. Queries: The modules provide an on-line query system.
user can use this section to find out details related to any table by making appropriate choices. Reports: such as user query on the orders that are overdue, any vendor or periodical by its code, a periodical or article by if keyword etc., can be generated.

Utilities: This module provides the tools for security privileges, codes, maintenance of different types of periodicals, backups of the database and database integrity check routines.

3.F.1.k. Basisplus and Techlibplus:

Basisplus software, designed and developed by Information Dimensions Inc. (IDI), USA, is being marketed in India by the National Informatics Centre (NIC), New Delhi. This software provides facilities for the storage, retrieval and electronic management of documents. It is based on relational technology and supports client-server architecture.

Its features are: Relational Database Management System (RDBMS), full text capability with free text searching and thesaurus, object management, converter technology for document interchange, library automation.

Techlibplus is built on basisplus and designed to streamline and facilitate all the day-to-day operations of a fully electronic library. Techlibplus provides patron access, catalogue maintenance, circulation, serials management, acquisition, processing and MARC cataloguing.

3.F.1.l. Delsis:

The Delsis, a networking software, is an integrated modular package developed on the BASIS PLUS by the DELNET to undertake complex cataloguing and union cataloguing functions in libraries, library networks and information centres.

The following are its features: Enquiries through the OPAC by author / title / subject / call no / series / keyword, etc., Boolean enquiries, full text search retrieval,
display records in the AACR II format, data import / export, automatic index
generation. Input format, that is Common Communication Format (CCF) developed
by UNESCO, duplicate checking of records, creation of bibliographic records in
Indian languages for 13 languages, interface to the CDS / ISIS;

All DELNET databases and online inter-library loan facility, etc. are
functioning on this software at present.

3.1.1. SOUL (Software for University Libraries):

The INFLIBNET Centre has developed This windows-based library
management software “SOUL”, which provides total solution for library
management. It is designed using client - server architecture, which imparts extra
strength to storage capacity, and has multiple access to single database, various
levels of security, back up and restorage facilities etc. This software was designed
after a comprehensive study of different library related functions practiced in
university libraries. It has the MS-SQL Server 6.5 RDBMS as the back end. This
user-friendly software is quite easy to work with. It comprises following modules,
viz. acquisition, catalogue, circulation, OPAC, serial control and administration.

Features: (1) The in-built network features of the software will allow multiple
libraries of universities to function together and have access to distributed databases
installed at various university libraries and union catalogue mounted at the
INFLIBNET using the VSAT network. (2) The acquisition module enables the
library staff to handle the following major functions related to acquisition of library
materials: (i) suggestion management, (ii) ordering, cancellation and reminders. (iii)
receiving, (iv). payment including fund control, and (v). master file management
such as currency table, vendors, publisher, uses etc,. Through this module, library
staff can search the entire database of library holdings for the purpose of duplicate
check etc. Using various combinations a number of reports can be generated. (3) The
catalogue module is used for retrospective conversion of books, technical processing of books received from the acquisition section, printing a range of records for verification, searching by title and accession numbers, the authority files for publishers etc. One of the unique feature of SOUL is its access to authority files on screen as well as selection box in various fields of records. Once the proposed VAST Network by the INFLIBNET is commissioned, this module will take care of automatic replication of data into union catalogue. This will avoid exchange of library data on physical media i.e. floppy, tape etc. This module covers functions such as catalogue process, catalogue search, user services, catalogue card generation, authority file maintenance, retro conversion, stock verification report generation, union database maintenance, and export/import of records. (4) The circulation module will take care of all possible functions dealt in a university library set-up. Starting from membership management, maintenance of status of library items can be handled using the SOUL. Circulation transactions viz. issue, return, renewal, reserve, recall, hold can be done successfully. Complex functions like fine management for each category of user and material can also be effectively carried out. Inter-library loan, searching the status of every member or library items are also possible. Reminders for overdue material, generation of various reports have also been covered. (5) The on-line public Access catalogue (OPAC) of SOUL is a window to the library collection. Using the user-friendly menu, the user can search for an item available in the library by author, little, corporate author, conference name, subject descriptor, class number etc. The Boolean search enables the user to conduct the search using all combinations including type of material, language, year etc. Besides, this will serve as first point of information about the library and also gateway for accessing the INTERNET, union databases or any other external sources. (6) The complex job of keeping track of serials can easily and effectively be
handled using the SOUL through its serial control module. This module broadly handles function such as suggestions, subscription, payment including fund control, check of users, issue arrival, reminder generation, finding management, search status of every item, master database management, report generation etc. (7) The user administration module is used for creating new users and giving them right for accessing different modules.

Benefits of using SOUL: It is available free of cost to university libraries. It is software designed and developed exclusively to work under university environment. The network features of the software will allow multiple libraries of university to function together. Exhaustive training at the INFLIBNET is supported by a comprehensive manual. It provides for onsite training, Free updation / modification, and free technical assistance. It follows the INFLIBNET’s recommended standards and formats such as the CCF, AACR2, LCSH.

Its hardware and software requirement are minimum:

**Server:** Pentium @ 233 Mhz with 64 MB RAM ; 1.2 GB HDD ; 32x CDROM Drive; 1.44” Floppy Drive; Color Monitor (SVGA); Windows-NT Operating System; MS-SQL Server 6.5.

**Client:** Pentium @ 233 Mhz with 32 MB RAM; 1.2 GB HDD with 10 MB Free space; 1.44” Floppy Drive; Color Monitor (SVGA); Windows-95 Operating System.

**3.F.1.n. Delmarc and Delplus:**

In order to modernize and network all kinds of libraries in India, the DELNET presents two software viz. Delmarc and Delplus – the library management software packages that conform to international standards. Delmarc is a multi-user software and is ideal for university libraries, public libraries, and research libraries with major collections. It is offered to member-libraries of DELNET at a subsidized
price of Rs. 25,000. Delplus is a stand-alone software and is designed to cater to the needs of various types of small and medium size libraries with a collection of books up to 1,00,000 at a subsidized price of Rs. 15,000.

Common Features: (1) Software are barcode enabled, (2) they are suitable for all kinds of libraries including public libraries, academic libraries and special libraries, (3) have free upgradeation available, (4) provision for backlog entry (Retro-Conversion), (5) there is backup and restore facility, (6) online help available (7) export/import of data into/from standard MARC21 format, (8) cataloguing of multiple copies, (9) overdue charge maintenance.


Special features of DELMARC: The DELMARC manages libraries with extensive collections, complex operations and serves a large clientele. This software is easy to work with and offers the following modules at this stage: (1) Multi-user facility allows different branch libraries/sections/branches of a library to function together. (2) Follows internationally recommended standards and formats such as MARC21, UNIMARC and CCF, (3) A wide range of reports are generated. (4) Can define the member categories, member groups, currencies etc. (5) Provides new arrival's list and online reservation of new arrivals or other titles, (6) Result can be seen/printed in the AACR-II format or any MARC format described above. (7) Issue, return or reserve items are by accession number as well as by title, author, etc. (8) Can print/save most possible Added Entries related to the record.

Special features of Delplus: It is user friendly and can be operated very easily with minimal computer knowledge. It conforms to international standards, viz.,
MARC-21, CCF and AACR-II. It also provides the display facility of a bibliographic record in other standard formats. Further,

1. It is menu driven with Graphical User Interface (GUI).

2. It has an effective administration and security system and provides for password both for System Administrator as well as the user.

3. Has reservation facility for materials,

4. For online monitoring of the status of documents.

5. Interactive facility for maintaining library inventory/database, and

6. Generation of reminders and intimation to vendor/supplier/binder, etc. including members.

7. Makes online listing of country and language information with related codes.

8. It has a separate module for article indexing.

In addition to the above software packages there are other packages developed by individual organizations in India for purpose of library automation:

1. **Illms**: This software was developed by the INFLIBNET centre Ahmedabad. It was developed as a means to automate the documentary resources available in all the university libraries and college libraries in India under the INFLIBNET programme. Because of some problems the package could not be used by librarians satisfactorily. So, this package is not in vogue at present.

2. **Archives**: Archives is an integrated software package developed in multi-user FoxPro based by Minifax Electronics Pvt. Ltd., Bombay. It is a comprehensive package offering acquisition control, serial control, cataloguing, circulation control, information storage and retrieval and SDI.

3. **Libman**: Libman was developed by Datapro Consultancy Services, Pune. Creation of database of books, members, issue and return, interlibrary loan,
generation of overdue lists, computerization of figures etc., are possible with this package.

4. Libra: It is a multi-user, multilingual, user friendly package available from Ivy systems Ltd., New Delhi. It facilitates housekeeping operations such as acquisition control, circulation control, cataloguing, and on-line retrieval.

5. Librarian: This (ver. 3.0) is a codeless library management software package developed by computer professionals in consultation with experienced library professionals. It was developed by Soft-Aid, Pune.

6. Memlib: The Memex Library Manager (Memlib) has been developed by Memex, Pvt. Ltd., Trivandrum. It is Microsoft windows-based, application software, which can run in a single-user or multi-user environment. This software provides facility for almost all-important functions in a library, which include acquisitions processing, circulation, serials control etc. Another important feature of this software is its import facility of CDS/ISIS database. Memlib on-line search facility provides for various options and makes many selected jobs very easy without browsing entire thorough the data.

7. Kryger Library Manager: It is a menu-driven and user-friendly software developed by Blitz Auto Visuals, Pune. It is a complete library management package for on-line information. It runs on the PC XT/AT compatibles. It contains facilities for validation of data entry, circulation control, cataloguing card printing, information services, preparation of cards according to the AACR II, information search etc.

8. Libinfo: Libinfo is a sophisticated software package. It is developed by the DASTURCO, Calcutta for use with the IBM PC-XT/PC-AT and compatibles; and it is specially designed for effective library management.
11. MITALS: MITALS is an acronym, for Madras Institute of Technology, Automated Library Systems. It is a locally developed software package for information retrieval. It has been developed in clipper supported by the FoxBASE plus specifically to suit work with the barcode system under network environment. This indigenously developed software package is highly flexible and user-friendly. The package contains user-oriented integrated applications like circulation control, open public access catalogue, selected article retrieval concept, selective dissemination of information, report generation, periodical control, acquisition system.27

12. SLIM++: SLIM stands for System for Library Information Management. It is developed by Algorhythms, Pune based company, started by a husband-wife computer professional team – Madhusudan and Meera Gaitaiwaris. The latest version, SLIM++. SLIM++, is a true window based version, which has features like “copy/paste”, “drag and drop”, minimizing / maximizing the program window, copying from/to any other windows program such as Word, and Outlook express. In addition, keeping in conformity with international library standardization requirement, SLIM++ can export and import catalogue data into standards like the MARC and CCF. The software is continuously and constantly updated with valuable feedback from its users.

13. LSEase: LSEase is an offshoot of the Libsys, the most popular and widely used library software in the country. It has a mixed blend of functionality and technology that adequately meets the automation requirements of any growing library and knowledge resource centre. As an integrated library management system, it covers the various operations of a library such as acquisition, cataloguing, circulation and serials control (journals subscription) including powerful OPAC. It continues to be outstanding in this market segment because of carrying over international standards such as option for MARC (MARC21/UNIMARC/CCF), client-server implementation, option to run on either Windows NT/2000/XP or Linux, use of preferred back-end RDBMS (Oracle, MS SQL/MySQL), support on
multimedia files and digital contents from its parent system-Libsys. Some of the newly added features in LSEase includes in-built barcode printing, member ID cards making, network downloading / cooperative cataloguing and library map, etc, optional unicode support along with use of GIST / ISM publisher (from C-DAC) allows multilingual data handling in Indian and International scripts / languages.

3.2. International library software packages:

3.2.1. CDS/ISIS:

The acronym CDS/ISIS stands for Computerized Documentation System / Integrated Set of Information System. It is a menu driven generalized information storage and retrieval system, designed specifically for computerized management of databases. It has been designed and developed by the UNESCO's division of Software Development Applications Office of Information programmes and Services and released in 1985. The NISSAT is the national distributor of this package in India.

The features of CDS/ISIS are: The package allows its users to create non-numerical databases; the database can contain over one crore sixty lakh records; the maximum size of display format is of 4,000 characters; there are menus and sub-menus which provide options; it allows the user to create databases on his/her own; it allows the user to enter new records in a database and edit, modify, delete, print, display or browse the existing records; the status of information is displayed as soon as a database is selected; its indexing capabilities are extremely dependable and fast; its search facilities are simple, accurate and rapid; details of search results can be seen immediately on the VDU and also can be printed/copied; it allows the users to make their own menus or sub-menus and their own programmes through advance programming; it prints partial or full catalogues and/or indexes from any given database.
3.F.2.b. Minisis:

The Minisis is a library information management software developed by the International Development Research Centre (IDRC), Canada to run the HP3000 family computers. It is a useful package for library work including networking. In India this software can be had from Hewlett Packard India Ltd., community centre, New Delhi.

The features of Minisis are: A comprehensive system for bibliographic and library automation applications, allowing quick and efficient retrieval of information; interactive terminal-oriented design, allowing concurrent use of software by several users; friendly, easy-to-use interface for the end users like library staff having little or no computer background; conforming to the ISO format, ISO 2709, for interchange of library data with other organizations; SDI capabilities; support of interchange of data in the Minisis, UNIMARC format; modularity of the software, allowing easy additions of the applications which may be specific to each organization; generation of a wide variety of outputs and reports on the terminals or on the printers; a flexible design allowing multilingual, multi-character set capability for databases and user dialogue. Presently, the Minisis supports French, Spanish and Arabic apart from English; a general-enough information system to cater to a wide variety of information application.28

3.F.2.c. Oasis for DOS / Alice for Windows:

These are two important packages developed by the International Group Softlink America and Softlink Australia. They are introduced in India by the Softlink Asia Pvt. Ltd. The Oasis package runs under the DOS platform and the Alice run under the windows platform. These packages are used in more than 7000 major libraries all over the world. Oasis/Alice software packages perform various library
functions like management, acquisition, circulation, Online Public Access Catalogue (OPAC), periodical and journal indexing, stock verification etc.,

The features of Oasis/Alice are: Oasis/Alice are a menu driven package, which facilitate easy use by both library staff and users; they have simple search screen. So the users can carry out simple as well as complex search, print the result and on-line reservation; the search screen has a password. This will protect the system so that the end-user cannot enter into database design area; it takes care of all library functions. This will facilitate a fileless library; it runs on Bar code Technology, which facilitates speedy circulation of books and stock verification; it runs on a multi-user platform. It supports the Novell Netware, Windows NT system on the DOS, Windows 3.1 or 95 or Windows 98; it also runs on single user platform convertible to multi-user platform; it has inbuilt communication and it facilitates online access to other libraries; it has a CD-ROM loader. It facilitates downloading data from the CD-ROM diskettes; it has a multimedia function; it facilitates the scanning of data, videos, graphics, photographs, sound clips in records etc.; it has a 7-digit data capacity. This enables to hold 99 lakh records; it has special data protection; it facilitates the saving of data up to the last record entered in case of power failure; it has in-built tutorial modules. It helps the library staff/students to learn the software by themselves; it has complete documentation. The reference manuals and tutorials manuals help the library staff to understand the software functions and the library automation.

The Alice for windows software has four distinct versions: (i) The public library version; (ii) The special library version; (iii) The academic library version; (iv) The school library version.

The library automation software comprises modules, from which one can select those that meet one's requirements. Alice for Windows also runs on the LAN.
using the Novell Netware or Windows NT Platform. The AI’W is also available for Macintosh users.

Alice supports Z3950 client/Server Architecture also. Its web inquiry module makes your library database accessible from any corner of the globe on the Internet. Softlink gives strong support to the clients by giving literature and training from time to time. All supported clients are provided with access to the technical support team. 30

3.F.2.d. Superdoc:

This package is developed by the THERMO DATA Group in Grenoble, France.

The features of Superdoc are: It is a particularly user-friendly file management and information interval package which possesses a sufficient degree of flexibility to serve many applications of library and documentation centres such as the production of indexes, catalogues and bibliographies; the package can be installed and used in an IBM compatible microcomputer having an ANSI standard monitor controller. 31

3.F.2.e. CAIRS (Computer Assisted Information/Library Retrieval System):

The CAIRS was developed in 1972 by the Leatherhead Food Research Association, Surrey, England.

The features of CAIRS are: The CAIRS Series runs on mainframes, minis and micros providing a total automated system of information retrieval and management; the software is appropriate for entry, indexing, storage and retrieval of text or numerical data; the system permits four different methods of data entry; direct online entry, batch data entry, document data preparation, and data prepared using external systems, word processors, other computer or key to disk systems.
3.1.2.1. Total Library Computerization (TLC) version 2:

This software package has been developed by On Point, Inc., Washington DC for automation of small and medium sized libraries.

The features of TLC are: It runs on single user and multi-user environment; It has basic library management modules for cataloging, circulation, serials control, acquisition etc.\(^32\)

In addition to the above the following library software packages are also used in other countries:

1. Consearch 3.0:

This is an Electronic Research and Utility for windows. It was developed by Management Information Technologies, Inc., Hauppauge, New York. There are about 1000 registered users for Consearch. It runs on Windows platform and it has a good use of the graphical user interface.

2. End Note Plus 2:

This is an enhanced referenced database and bibliography manager. This software is developed by Niles and Associates, Inc, Berkeley. It requires Windows 95/Windows NT as operating system. The End Note plus 2 makes good use of the graphical user interface.

3. Sci-mate:

The Sci-mate developed by institution for scientific information, philadelphia is a software for microcomputers, designed specifically for menu-driven searching of a wide variety of online databases and for the management of textile information.\(^33\)

4. The IV + V System Software Package:

It has been developed by the Institute for Machine Documentation (IMD) Graz, Austria and called IV-V system (Information ver mittlung und-verarbeitung). It is conceived as a generalized databases management system intended for both
bibliographic and factual information management. It is designed as an implementation of the relational database model. The basic system functions are: data entry/data editing, database creation and maintenance, retrieval and output. This system functions only in single use mode and in this context is available for use on the IBM PC-XT, IBM PC-AT. This system is under active consideration of the UNESCO for using as portable software package for information handling and they are preparing a demonstration database on its microcomputer using IVIV and implementing the Common Communication Format (CCF).
References


