CHAPTER – 5

NETWORK TOPOLOGY AND CONNECTIVITY LINKS
5.1 Selection of topology for library network

Topology refers to the pattern of interlinking the different nodes in a network environment. According to Encyclopaedic Dictionary of Library and Information Science, "Network Topology refers to the arrangements of nodes in communications". There are several network common topologies such as: Bus, Ring, Tree (or Hierarchical) and Star on which a network operates and they are implemented in several places. As we discussed in detail in para 4.2 that as most of these libraries in Gujarat are partially or fully computerised, a local database is not feasible in an environment where communication facilities do not have adequate bandwidth, the selection of a network topology for information and library network plays an important role. DELNET, CALIBNET and INFLIBENT favour centralised database approach/star topology for its own network. In a Star topology, all nodes are connected to a special node or Hub/Central Node. The central node provides switching of information from one node to another. Star topology depends very much on the processing power of central host as it is required to handle traffic from all other nodes. Nodes other than central host/node have very little processing overhead from channels. This makes such a topology economical for terminal (computer) intensive requirements. Star topology/Centralised/Dedicated must be evolved also for this library network for specific reasons which we would like to mention below, however, there are factors like funds, trained personnel, hardware, software and communication facilities which should be borne in mind, since they have an impact on its growth and working:

a) there is no major bibliographical database available in these libraries except ATIRA, Ahmedabad, CSMCRI, Bhavnagar, IPR, Ahmedabad, NIOH, Ahmedabad, PRL, Ahmedabad and SAC, Ahmedabad. Therefore, an union catalogue should be preferred and developed. The editorial supervision in database creation is not possible at individual sites but it is possible when the data is merged in the union catalogue form a central hub/host and therefore the incidence of mistakes are...
likely to be much less than it could otherwise be when the data is left entirely at individual sites,

b) a central database could grow faster as all these participating libraries will be contributing to it and information can be accessed directly, available as it is in the library through each node from the Central Host without any lose of time,

c) check on maintaining standards will also be easier,

d) library network will become effective soon enough,

e) after assessing the Star network topology in an environment in these libraries in Gujarat where the number of high grade catalogues are few, the creation of a central data base was considered to be more appropriate for this information and library network.

5.2 Library network model as proposed

Network models may be Cyclic Decentralised/Non-dedicated, Centralised/Dedicated, and Hierarchical. One model may be more effective and efficient than another for a given purpose. Since most of these libraries are scattered all over Gujarat, a wide area network (WAN), environment is the only answer. It is clear that the Star topology/ Centralised/Dedicated which we discussed above will be the most suitable topology for this network as has been shown in Figure 5.1. A central host/hub can be developed and established with the help of electronic devices such as modem, router and dedicated telephone lines—which will connect the nodes of all these fourteen participating libraries.

The total number of links that can be derived in this information and library network will be :

\[ C = n(n-1/2) = 14. \]

(Where \( C = \text{Links} \); \( n = \text{Number of centres/nodes} \).)
Network Model for Information and Library Network (INFLIBNET)

Central Host 'A'

Star Topology/Centralised/Dedicated

A=Central Host /Hub

m,n,o,p,q,r,s,t,u,v,w,x,y,z-Centres/Nodes

Fig. 5.1
Since, in this network all 14 links will have to be developed at one time, it will range between 1-14.

The operating situation of the network will be determined by one of the following two conditions:

(i) \( m=n=o=p \ldots \equiv \text{equivalent} \)

(ii) \( mVnVoVp \ldots \text{either} \).

Here all these centres/nodes are denoted by \( m,n,o,p,q,r,s,t,u,v, w,x,y,z \). In the first case when the order is received at centre ‘A’ if the resource is available there, it is executed and sent to the requester hence the condition

\[
m=n=o=p\ldots\quad (i).
\]

In the second situation the source is available either at ‘p or q’ or in any one of these fourteen library nodes. The order is then executed by the Centre ‘A’ being a central host/hub and then sent to the requester in the network

\[
(hence\ mVnVoVp)\quad (ii).
\]

The conditions are illustrated in Figures 5.1(a) and 5.1(b). Further, in handling a large scale document supply service, the whole procedure can be computerised processing the orders (requests) quickly. The feasibility of such a proposal can be further explored.

The first process of conversion involves mobilising the resources that have been accumulated in the previous years. Thus the process of integrating the Interim System into a Centralised System is the mode of converting the Non-Directed network into a Centralised/Dedicated model. It can be achieved by establishing all these links at a single central host (viz. operating centres). It would also be necessary to establish links between other nodes.
Star Topology/Centralised/Dedicated

Fig. 5.1(a)

Star Topology/Centralised/Dedicated

Fig. 5.1(b)
5.3 Connectivity of the participating libraries

Today in India, networks permit far flung community of users to share computer resources and the wide range of facilities accessible through networks are in-fact becoming more interesting. So far as interlinking of all these libraries is concerned, most of the participating libraries in this network being scattered and located at a distance all over Gujarat can be covered under the wide area network (WAN) category. As has been discussed in para 5.2 that there will be fourteen nodes in the network, their operating situation in the network will be determined by one of the two conditions as discussed in para 5.2 and shown in Figures 5.1, 5.1(a) and 5.1(b). Hence, the connectivity in all these participating libraries can be established through a mix of satellite and dedicated telecommunication systems. The use of communication satellite for data communication is picking up in India, with its high bandwidths and used in a wide variety of configurations is a much more viable, effective, comprehensive and economical method of point-to-point linked up communication network. Availability of open system interconnection (OSI) series and other developments in information technology have relieved us many procedural and connectivity problems arising out of different brands and protocols. How the satellite communication will operate the data transfer in an information network system can be gauged from Figure 5.2. This connectivity is possible with the help of communication hardware such as Modems at both the ends using dedicated telephone lines. The dedicated telephone lines (as has been shown in Figure 5.3) can be leased for service network connections which give a perfect model for interlinking of university libraries and information centres in Gujarat. Leased lines avoid the connection delays and other problems found in dial-up telephone lines arrangements. Dial-up telephone lines, are relatively inexpensive, no doubt, but they are relatively very slow, operating at not more than 2500 character per second. This delay can be avoided if the participating libraries operate leased line of DOT on a Microsoft SQL Windows NT Operating System, through NIC VSAT or ERNET VSAT, as illustrated and shown in Figure 5.3.
1. Inflibnet service centre will send data/information to a satellite operator's ground station.

2. The data/information will be encoded into a radio wave and beamed to satellite overhead.

3. Satellite will receive the transmission, amplify the signal and send it directly back to the ground.

4. A library top antenna will receive satellite transmission.

5. The signal will be carried to a personal computer, return transmission will be beamed back up to the satellite and relayed to the Inflibnet service provider.

Figure 5.2
Interlinking of University Libraries and Information Centres Through Information and Library Network in Gujarat (A Model)

Figure 5.3
The computers at all nodes can be linked by Very Small Aperture Satellite terminals (VSATs), installed on the building through communication controllers. The VSATs will have antennas of about 2 to 2.5 diameter. The satellite nodes will communicate with each other through a centrally located host/hub “A” which has been shown in Figure 5.2. The Central Hub or Host or Earth Station will have a large antenna of 7.5 m. to 11 m. diameter. This station will act as a switch for connecting various nodes in the network. It will also act as network control and monitoring centre (NCMC). The success of the network of WAN in this network type depends on standardised practices for information organisation, indexing and other intricate library operations.

Some of the networks which can be used for data communication are NICNET, I-NET, ERNET, INDONET, etc. more details of which are given in annexure 5. It is possible to access national databases directly on their PCs through this library network and logon.

Speed has always been a problem here. The bigger the network, the slower the speed. ATM (Asynchronous Transfer Mode) is the new network technology coming up which supports high speed networking. These network can also use combined protocol transparency with very high data transfer rates. CCITT (An International Government and Telecommunications body) and ISO have during 1970s jointly developed standard protocols for packet switching. They are:

X.25 specifies details of the interactions between each user packet mode device and the node of the network,

X.75 network-to-network gateway in interfacing,

X.3,X.28,
X.29 connect non-packet switch terminals to a system.
Among these protocols, X.25 protocol is the most widely used in implementing WAN (Wide Area Network)\(^7\). To achieve optimum speed for transferring data, a 9,600 bps modem, for example must be connected to another 9,600 bps modem, because a fast modem slows down in order to communicate with a slower modem.

The library network could be expanded from phase I to II by putting X.25 switches and establishing connection to gateways and stand-alone machine. In the beginning the TCP/IP can be used and then a change over to ISO/OSI is possible when it will be fully operational.

The library network can share the satellite network frequency in the existing framework, but it can be shifted to the extended C-band frequency of the INSAT-2 satellite series, once the later is at the operational stage. This can be linked via satellite and dedicated telephone lines to reach individual nodes. There will be local area networks (LANs) at each node to reach maximum number of users (if necessary in future).

\subsection*{5.3.1 Selection of the central host}

The information and library network of university libraries and information centres in Gujarat is a multiple function/service network. It will offer catalogue-based services, database services, documents supply services, collection development and communication-based services as discussed in para 4.5.

So far as selection of the central host of such a library network programme is concerned, it is a very difficult task for them (participating libraries) to decide, select or establish a central host, where all these participating libraries of the network will function in an integrated manner. Once the central host is selected, the different functions/activities will start operating as outlined hereunder:

i. a central database will grow faster as all participating libraries will be contributing to it, and information available in a given library can be assessed from each node through the central host immediately (instantly),
ii. union catalogue will be developed when the data is merged in the union catalogue form at one place and therefore incidence of mistakes will be much less then it could otherwise be when the data is left entirely in the central host,

iii. check on maintaining standards will be easier,

iv. library network will become active soon enough,

v. central host will act as a switch for connecting of all the other nodes of participating libraries in the network programme,

vi. it will also act as network control and monitoring centre (NCMC).

5.3.2 Devices used to access library network

In order to access the library network the libraries should acquire the following equipment:

- modem, router, computer and a dedicated telephone line.

5.3.2.1 Modem

The modem, is an acronym for MOdulator/DEModulator, which is also known as network technical control system. It is an electronic device enabling a computer to communicate and exchange information with other computers via a dedicated telephone line. The speed at which a modem transmits data is measured in bits per seconds or bps. Modems come in various speeds and use various modulation protocols. Most 2400 bps modems use the V.22 bis protocol, while 9600 bps modems use the V.32 protocol; 14,400 bps modems, the V.32 bps standard, and 28,800 bps modems use the V.34 faster modems which are usually compatible with slower ones. Two common standards for error-correcting protocols eliminate errors attributable to noise and other glitches in the telephone system: MNP-4 and V.42. For data-compression, two standards predominate: V.42 bps and MNP-5. For example, a 58 kbps modem, can download data from the Internet at the rate of 58 kilo-bytes per second (kbps).
5.3.2.2 Router

A router is a somewhat slow-moving device that can screen packets to ensure security. The router works like a switching station in a train yard. The router selects the most economical path, or arranges a data "detour" when an inoperative link prevents the data from being transmitted along the best network route. Sometimes routers will break down a packet into smaller packets to prevent distortion caused by noise on the telephone line.\(^{11}\)

5.3.2.3 Computer

Computers are an electronic device, capable of performing a multitude of repetitive tasks, namely, organising, storing and retrieving vast quantities of information and because of their speed, reliability, accuracy and efficiency, enhance productivity.

5.3.2.4 Telephone lines

Telephone lines are the most popular means of connecting distant networks. In most cases, this method requires the use of a modem to convert the digital signals of the network into analog signals used by telephone lines. Dedicated telephone lines can be leased to service network connections. Leased lines avoid connection delays and other problems found in dial-up telephone line arrangement.

5.3.2.5 Communication satellite

For data transmission, the most appropriate channel is the satellite link. How, communication satellite works into the data communication system in an information network system can be seen as illustrated in Figure 5.2. The on-line search services are usually accessed via national packet switched services (e.g. PSS in the UK, Datex-P in West Germany and BSNL in India, to a telecommunication networks like EURONET, TELNET or TYMENT, ERNET, I-NET, NICNET.
5.3.2.6 Communication software

Communication software, an application program, which is also known as a terminal emulation software is responsible for linking computer-modem-telephone line to make a complete telemetric system. It supports communication between user or participates and file server for accessing required information. It is commonly used in combination with a modem. The software offers us a way to give commands to the modem to dial the other computer’s modem, and then to issue commands and retrieve responses from the remote computers. If modems are translators between computers and telephone lines and telephone lines are the highways across which information is sent, the communication software is the glue that holds it all together.

There are various types of communication software available these days. Some of them are PROCOMM, NFTSCAPE, DIALOG-LINK, Vianet, Telnet, Comet, Ms.net, Netware, Superlan, STNEXPRESS, and X.400. E-Mail, Password. Connectivity with other operating systems are some of the common features of these software.

5.3.2.7 Mode of communication

Mode of communication is a method of operation which is very important in a library network. There are two types of transmission modes in a library network:

   a) asynchronous, and
   b) synchronous.

   a) Asynchronous transmission

   In data communication, asynchronous transmission is one in which one character is sent at a time. Asynchronous transmission is usually used in personal computers when using modems. The best protocol supports for a asynchronous transmission, at the world level, are X.3,X.28,X.29.
ii) Synchronous transmission

In data communication, synchronous transmission is one in which blocks of characters with no gaps between them are sent in a timed sequence. Unlike asynchronous transmission, it is a high-speed transmission and is used in direct computer-to-computer communication of large computer systems. In synchronous transmission sending and receiving devices operate continuously at the same frequency. The best protocol support for synchronous transmission, at the world level, are X.25, X.75, X.32.15.

5.3.2.8 Communication interface or networks protocol support

Network protocols are fundamental to all data communication, being a set of rules that govern the operation of fundamental units to achieve communication. Perhaps the best known, widely used and the world’s most implemented data communication protocol is X.2516,17. In the case of X.25 the DCE provides access to a packet-switched network18.

5.4 Network policy and governance

Plato once said “the beginning is the most important (part) of any work”. And so it is with building a good library network system. Clarity of the functions help to facilitate designing, monitoring and developing the network. This also ensures :-

a) transition from manual to automated system smoothly,

b) that a piece-meal approach be adopted in terms of hardware, software, training and educating library professionals and data in machine readable form,

c) users be kept informed about progress of the network and the services offered,

d) access to other national and international networks be established, and

e) MoUs be created for all types of network activities among the participating libraries19.
The Memorandum of Understanding (MoU) should take into account:

i) copyright and security requirement,

ii) proprietary rights,

iii) licenses granted to the participating libraries by the network,

iv) the modes of acquiring equipment by the participating libraries,

v) preparation of an operating manual,

vi) amount of registration fee and annual fee to be paid by participating libraries,

vii) fee to be fixed for extra-use over and above that basically outlined,

viii) compensation be paid to a big library offering its materials and not receiving much in return,

ix) maintenance and alterations,

x) warranty,

xi) termination of agreements, and

xii) indemnity, settlement of disputes, etc.\[20\]

5.4.1 Monitoring

Once the new system has been implemented, provision should be made to monitor, audit and evaluate it, both at the time of its completion in order to see that it is working satisfactorily, and on a continuous basis to check that the system remains appropriate for the library. The reasons for such a check, according to Clayton (1992) are \[21\]:-
i) show the value gained from capital expenditure as also measure and be able to demonstrate how far the system meets the objectives defined at the planning stage,

ii) show the value gained from current expenditure as also measure and be able to demonstrate the effectiveness of the system's performance on a daily basis,

iii) through a process of measurement, be able to identify areas where objectives are not being met and diagnose the cause as also rectify defects, and

iv) identify areas which should have priority for future development.

5.4.2 Upgrading and replacement

Change is the law of nature. What is considered best today may become obsolete tomorrow. This is particularly true of IT, where obsolescence is rather a rule and not an exception. Keeping in view its rapid development, Haseltine says\(^\text{22}\) that it is extremely difficult to select IT these days as one has to choose it in the dark because what is purchased today becomes outdated by tomorrow. But this does not mean that the library network should wait for what will be in the market in the next month or next year. But the best way out for the library network is to select a system with some in-built (networks') upgradation, or in the alternative easily change the supplier, since in the very nature of things, upgradation is indispensable and that too from time to time necessitating sizable money inputs. It is, therefore suggested that the library network should make provision for a definite amount in the budget for upgrading and replacement. Peripherals like terminals should be replaced after every five years of heavy use.

It must, however, be noted that the systems should not be unnecessarily upgraded or replaced merely for the sake of change or simply because the supplier can or has provided for them under an upgrading/maintenance agreement, but only when there is a dire need for it and when it becomes evident that a completely new system offers significant additional benefits. Therefore, the same system should be allowed to continue if it satisfies the needs and fulfils the previously defined aims. If, however, upgrading
amounts to no more than minor improvements and fixing of faults, then it should, of course be implemented as soon as possible.

5.4.3 Maintenance

The main aim of any library network is to serve its member libraries without any disruption in service. In order to achieve this aim, it is suggested that a maintenance agreement should be provided both for the computer hardware and software in which it should be clearly specified that faults must be corrected immediately and if the problems cannot be rectified, there should be provision for the replacement of the system. This is necessary because machines/software are prone to faults. Usually vendors offer guarantee maintenance support for a minimum charge of 10 to 15% per annum of the initial cost; this is not a large amount and such an agreement will ensure that the library network has protection against its critical operations and can save a lot of mental strain.

5.4.4 Security and backup

Computer hardware, software and above all, the library database are the most important assets, and therefore it is necessary that preventive measures are taken to protect them from fire, explosion, theft, corruption, etc. For this purpose, the following steps should be taken:

i) in order to maintain the security of data and continuity of network services, unauthorized access to the computer systems must be strictly prohibited. For this purpose, an individual password should be allocated to each user of the staff,

ii) all floppy discs and tapes should be stored under lock and key in a fire proof safe,

iii) computer systems, particularly the portable micro computers are easy for anyone to pick one up and walk away with. Similarly, software is also easy to steal. Therefore, it is essential to safeguard them adequately. Moreover, preservation of an intact library collection and database may necessitate other security precautions such as computer lock-down devices. Other techniques include engraving or indelibly
marking the library identification and date of purchase, fitting intruder detection devices to guard the area of the library, etc.

iv) the whole computer system should also be insured so that in case of any unexpected calamity, the loss can be borne by the insurance company,

v) it is also suggested that two or more staff members should exclusively be made responsible for security and back-up duties. It should also be ensured that the persons responsible operate effective procedures to back-up systems so that data accidentally deleted can be restored quickly and easily,

vi) back-up of data files should be done in a regular and organised way. For this purpose, it is suggested that

a) programmes' copy be stored in a safe location: if amendments are made, new copies must be made,

b) master file information copy be checked weekly, and

c) transactions copy be checked daily.

In addition, regular, effective checks and rigorous control on computer virus should also be made an essential part of maintenance.

References


