Chapter – 4

Library Networking

4.1 Introduction:

Library and Information Centre is the light house for information dissemination, which is an important component of any educational institution and hub of the teaching and learning activities where students, researchers and teachers can explore the vast resources of information. The present age is regarded as the age of information. Information has become the commodity in the present day context of information explosion. We are living in the information society. Now information has become an essential for our day-to-day activities. Library and information centre has been playing an important role in extending requisite services to its users. Library and information centre is a social institution and it takes up the society with the world of enormous information. The Library and Information Centres are associated with colleges, universities, research and development organizations that have to provide quick and up to date information to the user community. In the traditional libraries users have to spend more time for searching a small piece of information and for that they have to depend mainly on the library professionals or library staff. But in the age of information communication technology, computers are being used for the day-to-day housekeeping activity in the library. It saves time of the users and library professionals as well as at the same time avoid duplication of work and make the library service smooth and effective.

Due to rapid information explosion and escalation in cost of printing technology, ink and newsprint, it has become impossible for every library to acquire all the documents required by their users. At the same time due to acute financial crisis, adequate grant is not provided by the funding agencies like UGC, AICTE, CSIR, ICMR, ICAR, DST, DOE etc. College libraries are compelled to move towards automation of libraries and resource sharing among the libraries.
The library and information centres are not behind in the race of computerization of the housekeeping activities and computer-based library and information services. Due to enormous capacity of data storage, processing and retrieval of information, the Indian library and information centres are attracted towards the use of information technology for library activities and services under broader term of library automation and networking in order to extend computer-based library and information services to end users and make documents available through resource sharing by introducing the new concept of library networking.

(Manisha 2003)

4.2 Concept and Definition:

Network is the term that is widely used to connect computers that share resources and information with each other through some type of medium. The main objective of networking is optimum utilisation of available information resources through sharing. A computer network allows user of one computer to use resources of another computer, which may be space, database, programme or printer. Communication between computers exists under the control as a series of networking protocol or rules responsible for ensuring the safe delivery of data to its destination. Protocols govern the format of the data, how it is sent and how it is received. It allows each node on the network to receive data in a proper format so that it is understandable.

(Sehgal 2004)

The exponential growth of information in all fields of knowledge, heavy demand of information, accuracy of information and the need for newest information has become the erroneous task to the library. The individual library cannot meet these challenges with its own resources.

A Network is a group of interconnected computer systems by means of a shared communication link.

(Jani & Kumbharana 2001)

Networking of libraries a co-operative endeavor of libraries, improves other areas such as cataloguing process, database creation and staff development too. In addition to that, it reduces the financial burden by the sharing of common resources.
“A formal organisation among libraries for co-operation and sharing of resources, in which the group as a whole is organised in to sub groups with the exception that most of the need of a library will be satisfied within the sub groups of which it is a member. 

Alphonse F. Frezza

(ALA 1986)

According to Miler, it is a library networking system established by libraries and information centers which are brought together by common subject, geographic proximity to share informational resources, human resources and all other elements essential for providing effective information service.

Library Networking, Library Resource Sharing, Library Co-operation, Library Consortium are various term given to the same activity which mean that a group of libraries have come together and entered into some kind of formal understanding for the purpose of sharing the resources of each other’s materials, functions, services and the staff to their mutual benefit realising that only through library networking the greatest amount of the best information can be provided to most of the users at the most reasonable cost. 

(Sujatha 2000)

Various definitions and explanations have been given for the concept of networking. In a broad sense a library network is a distribution system composed of two or more libraries and / or other organizations engaged in a common pattern of information exchange through communication channel for some punctual purpose. In a library networking the aim is to achieve sharing of resources to provide better service to customers. i.e. library network is established for exchange of data, information or resources. Modern networks are intelligent carriers that provide information interchange among attached centres.

4.3 Need of Library Networking:

The following needs and objectives of library networking are currently in vague.

1. Tremendous growth of literature.
2. Increasing cost of documents.
3. Declining library budget.
4. Technological advancement

(Bavakuty 2002)

Above phenomena has compiled for resources sharing through network. Library networking is necessary,

1. To satisfy information needs of users.
2. To increase the availability and accessibility of resources: clientele of each participating library can access to resources available in all the libraries. Resources can be moved from one library to another manually or through modern means. This provides an easy access to and free flow of information.
3. To diminish cost: resource sharing helps in building specialized collection and all participating libraries need not duplicate the procurement of similar material.
4. To exploit resources: resource sharing advocated that the reading material of one library should make available to the client of other libraries, thus exposing the reading materials to a wider group of users. Similarly, the services of a library can be exploited by the users of other libraries or a wider community.
5. To promote co-operative activities like acquisition, exchange, storage binding, training, reference and documentation services, library loans, etc.
6. To eliminate record duplication.
7. To promote the exchange of information with other co-operative networks.

These objectives can be achieved need can be satisfied without harm to the mission of participating libraries.

4.4 Brief History:

The term ‘Resource Sharing’ has been used in the library profession since 1960 however, the practice is as old as librarianship itself. In the olden days, it was called library co-operation and mainly existed in the form of inter-library loan. As Kraus puts it, “the idea that libraries should in some way, find means to work co-
operatively to provide people with access to books unavailable in nearby libraries is a deeply rooted concept in librarianship.”

Some evidence of inter-library loan was found in the period around 200 B.C., with material borrowed by the library of Pergamum from the great Alexandria Library of that time.

In the words of Kraus, “Well before the beginning of the 20th century, the basic method of library co-operation had been suggested and in some cases, attempted with some success.” According to Joe W. Kraus, library co-operation can be traced to the monastic libraries in the first half of the thirteenth century. Specifically, The Registrum Librorum Angeliae indicated the Location of Manuscripts in 138 English and Scottish monasteries. Later, in 1410, the monk John Boston deBury, in his Catalog Scriptorum Ecclesiae, attempted a Union Catalogue.

A number of years later, in 1627, a form of library co-operation was mentioned by Gabriel Naude in his Advice on Establishing a Library, when he stated that catalogues might well serve to “please a friend, when one cannot provide him the book he requires, by directing him to a place where he may find a copy as may be easily done with the assistance of these catalogues.”

Nicolas Claude de Peiresc, a Frenchman, attempted to begin an Inter-Library Loan System in the year 1634. The Royal Library in Paris, The Vatican and Barberini Libraries in Rome were involved in this venture. Though de Peiresc was a very resourceful individual, his plan never materialized.

Around the year 1770, Germany saw the beginnings of planned library co-operation activity. G.E. Lessing, librarian in Wolfenbuttel from 1770 to 1781, formulated a plan for exchange of duplicate materials between libraries. He also suggested the development of a plan for joint acquisitions between Wolfenbuttel and Göttingen.

The nineteenth century saw inter-library co-operation begin in America. The formative years of the American Library Association were characterized by the notion of co-operation.
The American Library Association was organized in Philadelphia, in the year 1876. The first Inter-Library Loan Code became operative from 1917.

More recently, within a period of two decades, the library trends devoted two issues to library co-operation/resource sharing. This fact shows how the subject has gained importance in recent times. It is true that library co-operation had its beginnings during the 1950’s and 60’s but the interest in resource sharing rose in the 1970’s and 80’s and more so, in the 90’s.

The present decade has seen a greatly renewed interest in library co-operation and mutual benefits, prominently both at the international and national levels.

4.4.1 International Scenario:

The quantum of information available on resource sharing and networking is indeed very vast. Though the practice of resource sharing is as old as librarianship itself, it came to light due to the introduction of information technology in libraries. The concepts of inter-library loan, union catalogues, co-operative acquisition, co-operative cataloguing, etc. are based on resource sharing and lead to library economy. Library networking as a means of resource sharing has its beginning in late 1970’s and developed during 1980’s. It is no wonder that libraries in all countries of the world have adopted one form or the other of resource sharing and networking.

Foreign writers explained the situation existing in the developed world. A few foreign writers also demonstrated the relevance of a resource sharing program in the Third World countries. Indian writers served to provide an insight into the working of a resource sharing programme in our country. A brief review of the global an Indian scenario of networks has been presented here country-wide.

4.4.1.1 UNITED STATES OF AMERICA (USA)

According to Swartz, “Shared library resources and jurisdiction have prospered in the US based on the assumption that more is good and that a well co-ordinated and well-financed more is even better.”
Farmington Plan and the Latin American Co-operative Acquisitions Project were successful in the post-war era; but both were terminated at the end of 1972. The noteworthy arrangement of 1970’s was formed by Harvard, Yale and Columbia Universities and the New York Public Library, under the banner of Research Libraries Group (RLG). As early as in April 1976, Library of Congress’ Network Advisory Committee (NAC) attempted to explore ways in which a more cohesive nationwide system might be developed for sharing of bibliographic information.

OCLC (originally Ohio College Library Centre) is the largest library network in USA, established in 1967, and has a staff of 812 persons (as on 1987) is a non-profit organization and supports resource sharing among more than 6,700 libraries in USA, besides countries in Europe, Saudi Arabia and Australia. Its union catalogue database contains 13 million records; some 30,000 records are added every week. With the steady growth of OCLC, there had been a progressive decline in the amount of original cataloguing to be done by the participating libraries. The system hit rate has increased from 66% in 1971 to 94% in 1983. It caters to several regional networks. The chief among these are Bibliographic Council, Dallas (AMIGOS), Illinois Library and Information Network (ILLINET), New England Library Information Network (NELINET), Midwestern Regional Library Network (MIDLNET), Wisconsin Library Consortium (WLC) and Michigan Library Consortium (MLC).

In addition to these networks, there are certain other networks prevailing in USA to promote resource-sharing activities in USA, namely The South Eastern Library Network (SOLINET), Washington Library Network (WLN), Research Library Group (RLG), Research Libraries and Information Network (RLIN) and California Library Authority for Systems and Services (CLASS).

WLN was established in 1972 and has a staff of 51 persons. It provides more than 250 libraries in seven states of USA, online computerized services to promote resource sharing and automated library functions. Its bibliographic file contains more than 3.5 million catalogue records.

RLIN, established in 1987 and which has a staff of 81 persons, supports the cooperative programmes of Research Libraries Group, comprising 36 major libraries.
and other research institutions. It maintains 6 databases online. The catalogue database holds more than 20 millions records.

RLG was established in 1974 by four major American Research Libraries, namely, Harvard, Yale, Columbia Universities and New York Public Library to share collection resources, to avoid unnecessary duplication of acquisitions, and to establish a single computerized bibliographic processing system.

In 1987, RLG chose BALLOTS (Bibliographic Automation of Large Library Operation Using a Time Sharing System), a system developed in 1967 for the Stanford University Libraries, as its bibliographic processing system.

Lewis B. Mayhew described use of computers in colleges and universities for sharing the instructional resources. He considered sharing system are necessary for handling of bibliographic information from TOXLINE, OCLC and Stanford University’s BALLOTS. He isolated the problem and concluded the real problems are political, organizational and economic.

James G. Williams reported at the 39th ASIS Annual Meeting on the use of simulation methods in designing a computer based library network at Pittsburg University to facilitate the resource sharing. The procedure can also be used to obtain data for determining hardware, software, communications and database storage requirements over a range of conditions.

Allen Kent carried out a study in the university of Pittsburgh library system to determine the extent and full cost of use of library materials. The aim was to develop a foundation for improving the acquisitions, determine weeding policy and low-cost storage facilities for local library holdings.

At the 40th ASIS Annual Meeting James G. Williams reported that Pittsburgh University has designed and implemented the Western Pennsylvania Buhl Network (WEBNET), an experimental library resource sharing network comprised of six academic institutions. The objective of network is to facilitate resource sharing by incorporating the major library functions such as acquisitions, cataloguing, public
service, ILL and management reporting system. A simulation model was developed to aid in the design of the regional network.

The study on library networks involving OCLC, Ohio State University Library, University of Chicago Library, North-west university Library, Stanford university Library and Biomedical Library of the University of California revealed that the libraries automated their routines in the order of loans first, then cataloguing and finally accessions. The Libraries had co-operation on unified cataloguing rules and MARC data formats.

Bernard J. Hurely studied the automated resource sharing in Illinois. The library computer system (LCS) network in Illinois comprised of the three campuses of the University of Illinois and 14 other academic libraries in the state. The collective LCS database containing over 10 million volumes and the member libraries are allowed to search and borrow items from the collections of the other member libraries.

Darrel M. Meinke described how three US college libraries are participating in a Tri-College University Library Consortium by Concordia College, Moorhead State University and North Dakota State University. He concluded co-operation on a large scale has saved money and provide a rapid access to libraries with more knowledge than ever before.

Nancy C. McKeehan described the development of a state-wide computer based integrated library management system. The South Carolina Health Information Network (SCHIN) involving the libraries of the Medical University of South Carolina and the University of South Carolina School of Medicine developed circulation, cataloguing, acquisitions, serials control and online catalogue.

Christine M. Roysdon reported that a campus-wide network was initiated in the Lehigh University, Bethlehem, Pennsylvania, to create an integrated electronic work place for users. A broader range of library services are available to the university community through the network which include electronic question negotiation and online search. Such campus network facilities are also available at the University of California, University of Kentucky, University of Maryland at
Baltimore Health Sciences Library, Massachusetts Institute of Technology, Carnegie Mellon University as reported by Russel Shank and others.

M.J. McCallister and R.F. Gregory described the setting up of the western North Carolina Library Network to Facilitate library co-operation between three university library located in mountainous regions of North Carolina; Appalachian State University, North Carolina University at Asheville and Western Carolina University. The co-operative projects that were taken up by the networking group are a common database, union list of periodicals, Government documents union List, Co-operative Collection Development, etc.

From the above review, it is clear that the university libraries in USA have been a part of the resource sharing networks. Those libraries have been benefited from the larger network like OCLC or from the smaller regional networks.

Survey of literature shows tremendous work has been done in other countries also on resource sharing network. The libraries in the United Kingdom, France, Germany, Thailand, Canada, Japan, the Netherlands, Brazil, Pakistan and other countries have also shown interest in the field.

**4.4.1.2 CANADA**

Though co-operation among academic libraries started in 1960’s, it was only at the provisional level and not at the national level. Tri-University Libraries (TRIUL), Ontario Universities Library Co-Operative System (OULCS), College Bibliocentre (CB) and University of Toronto Library Automation system (UTLAS) are the prominent networks among academic libraries in Canada.

Simon Fraser University, the University of British Columbia and the University of Victoria together established TRIUL in 1970. Collection development, Processing and Public Service were the highlights of the TRIUL consortium. Though the Council of Ontario Universities established OULCS in 1973, an informal arrangement was already working from 1965 itself. Shared automated library system and the development of union files are among the objectives of OULCS. The College Bibliocentre (CB) was established in 1967. The centre functions as a central agency
for purchasing, processing and cataloguing for twenty two colleges of Applied Arts and Technology in Ontario. UTLAS (International Canada) was developed in 1967 as a computerized bibliographic system of the university of Toronto library.

The studies on resource sharing in Canadian Universities reveal that they are using mainly two networks namely Netnoth/Bitnet and CDNet. The office of the Educational Communications of the Associations of Atlantic universities studied the reaction of academic users of these two networks. Another study by L.Fritz and M.Baldock on Canadian Resource Sharing reveals that Saskatchewan University libraries used resources sharing methods in support of distance education.

4.4.1.3 UNITED KINGDOM (UK)

Resource sharing in university libraries in the UK has been studied by Burkett. He points out, “The universities have been acting co-operatively for quite a number of years, both in lending to each other and latterly through regional and local networking, including participation in the British Union Catalogue of periodicals and in permitting use of their collections by external scholars.” As an example, he points out that the Universities of Bath, Bristol, Exeter and Southampton are active members of the South Western Regional Network and they make substantial loans to other libraries both within and outside the region. The university libraries created regional data banks based on the MARC records generated by the British Library Bibliographical Services Division. Several university libraries are involved in Birmingham Libraries Co-operative Mechanization Project. Burkett further points out the contributions made by the Standing Conference of National and University Libraries (SCONUL) in stimulating the exchange of information and collaborative efforts of all the university libraries and major national libraries in the UK.

Three major networks in UK are – 1) The VISCOUNT Project; 2) LIBERTAS Project of SWALCAP; and 3) JANET. VISCOUNT is an initiative of The London and south Eastern Library (LASER). LIBERTAS is the acronym for “Integrated Library System” developed by The South Western Academic Libraries Co-operative Automation Project (SWALCAP). The United Kingdom Joint Academic Network (JANET) is a Wide Area Network (WAN), linking universities, polytechnics and research institutions. It was established in 1983 by the Universities’ Joint
Computer Board. JANET, an integrated, private, academic network linking all UK universities was developed in UK superseding all earlier regional networks.

Peter Stone made another survey on JANET respondents were asked if and how they used the network both to access other Online Public Access Catalogue (OPAC) to send E-mail. The OPAC of 15 universities were connected to JANET. There was little use of the network to send mail.

Marie Parkes described the installation of a New Integrated Information Network with fibre optic data and telephone lines at Oxford University. The data network allows easy inter-connection to a large number of asynchronous terminals, micros and host computer ports scattered among the university buildings. The data network is used by university library automation programme. May Katzen report that the University of Leicester organised an information service on humanities through online bulletin board available on the JANET.

The studies on library networks in UK indicate that JANET is the major network connecting the libraries of Universities and polytechnics. Its services include ILL, OPACs, E-Mail, electronic bulletin boards, etc.

4.4.1.4 NETHERLANDS

Alex Klugist reports the decision of several Netherlands’ university libraries including Groningen and the Royal Library in the Hague decided to work together in the Project for Integrated Catalogue Automation (PICA). The Project developed library management system for purchasing, loans and online cataloguing, on PDP 11/44 computer system.

4.4.1.5 AUSTRALIA

The Australian Government patronises a modest Australian program of resource sharing by approving a special provision within the National Library's budget of resources. The National Library of Australia (NLA) has promoted and maintained a wide range of resource sharing networks covering science and technology, industry, the social sciences, etc., offering traditional computer-based and referral services. Australian databases are available on-line through the Australian Information
Network (AUSINET). NLA also participates in the international exchange of MARC data. NLA is the national agency for Cataloguing-in-Publication (CIP), International Standard Book Number (ISBN) and ISSN’s; and is the designated focal point for the Australian Library-Based Information System (ASLIB) and also for UNISIST, NATIS and GIP of UNESCO. College Libraries Activities Network of New South Wales (CLANN) and Co-operative Action by Victorian Academic Libraries (CALVAL) are the outstanding network ventures in Australia.

A communication and resource sharing network known as the Australian National University's Communications Network (ANUNET) was developed in Australia using distributed database management system with heterogeneous remote nodes. There are two major networks in Australia, namely AUSINET and ANUNET, besides the regional networks. AUSINET is general library and information network developed by National Library, whereas ANUNET is a resource sharing network of Australian National University.

4.4.1.6 BRAZIL

Janet Frederik described the national plan for university libraries in Brazil and recommended a Centre for co-operative cataloguing a standard format for computerised cataloguing and development of an on-line network, but at present in 2011 at national level among libraries already connected with the electronic consortium library whether public libraries or university libraries.

(www.bn.br.)

4.4.1.7 AFRICA

The resource sharing in East African countries was described by B.M.Kawesa. Greatest amount of inter-university resource sharing was found among university libraries of Kenya, Tangenia and Uganda. It was found that gifts and exchanges were greater in number than purchases. The reasons were identified and attributed primarily to finance. The landscape of the South African library and information services sector was transformed with the establishment of the first formal library consortium, Cape Library Cooperative (CALICO) in 1992. Thomas and Fourier (2006) explained that
apart from the government pressure to streamline library and education efforts, grant makers like the Andrew W Mellon foundation insisted that it world only work with consortia rather than individual libraries in the funding of library systems project.

Gauteng and Environs Library Consortium (GAELIC) also the largest south African academic library consortium was founded in April 1996, South Eastern Alliance of Library Systems (SEALS) started in the Eastern Cape Province of South Africa was established in 1987. (Glory & Blessing 2008)

4.4.1.8 THE ARAB WORLD

A. Sharif authored an article on “The Factors Which Effect the Development of Librarianship and Library Education in the Arab Countries”. He observed that despite the fact that Arab countries have many things in common to share (language, religion, culture, history, etc.) but cooperation among Arab libraries is totally unknown.

The UNESCO Regional Seminar on Library Development in Arab Speaking States held in 1960 recommended the establishment of a regional scheme for the cooperative acquisition of foreign publications and a union catalogue of such publications. However, nothing concrete has emerged.

4.4.1.9 SOUTH-EAST ASIAN COUNTRIES

The International Federation of Library Associations (IFLA) United Nations Educational, Scientific and Cultural Organizations (UNESCO) seminar on Resource Sharing of Libraries in developing countries in 1977 at Antwerp University made some proposals for the South-East Asian University Libraries Network (SAULNET). The Association of South East Asian Nations (ASEAN) University Librarians favoured for regional co-operation in the creation of a union list of serials and Inter Library (IL) lending, periodical network models are also outlined for SAULNET by Lim Huck Tee. The national libraries of South-East Asian countries, namely, Japan, China, Indonesia, Malaysia, the Philippines, Singapore and Thailand have shown great initiation to develop a co-operative resource sharing networks in the region. The Congress of South-East Asian Libraries (CONSAL) has suggested two important co-
operative programmes, namely the National Libraries and Documentation Centres - South East Asia (NLDC-SEA) and International Serials Data System - South East Asia (ISDS-SEA).

4.4.1.10 JAPAN

The National Library of Japan (NLJ), through a by law, holds an advisory role in co-ordinating libraries in Japan nevertheless, it did not promote or maintain nation wide resource-sharing networks. However, it planned to co-ordinate the distribution of machine-readable data as part of a national shared cataloguing system. The NLJ was found to have been providing computer-based current awareness bulletins for general science and technology, social sciences, humanities and the arts.

The Ministry of Education, Science and Culture also established a central Inter-University Science Information Centre which aimed to provide bibliographic database information and database services including MARC and others. The university libraries assume a vital role in this Inter University Science Information Network. Inter University Science Information Network (IUSIN) was developed by Kazuhiko Nayakama. He studied the use of network and concluded that the burden of computer use has shifted to online systems. Another study was made by E. Naito, A. Miyazawa and H. Inoue on Centre for Bibliographic Information (CBI). The services of CBI include online cataloguing for union catalogue databases, online ILL, batch searching, etc. Kenji Oyagi and Hideho Oikana described an investigation into the desirability of creating a co-operative network between different types of Hokkaido libraries and usefulness of Japanese Machine-Readable Catalogue (MARC) records. Morita observed, “Japan’s information networks are characterized by their overall long-range planning and nationally coordinated development.”

Inspite of technological development, especially in the field of electronics, it appears that Japan has not shown much interest in library networking. It is astonishing that national library has not promoted any newtork. Inter-University Science Information Network plays a vital role in sharing of bibliographic information among university libraries.
Wang and Seng described the programmes at the 45th Annual Meeting of ASIS in Columbus in 1982. They indicated that some plans have been “actively carried out to the effect that national bibliographic data-bases have been established with both Chinese and Western language materials” and that the present Chinese network "consisting of seven academic libraries has made available to libraries at all levels.”

The National Library of China has an advisory role in co-ordinating all libraries in China. Thus, it is the focal point for resource-sharing networks and it is authorised to contract with other organizations in the development and maintenance of resource sharing networks.

The NLC also acts as the national centre responsible for meeting requests for foreign material from other countries, and therefore, it processed more than 90% of inter-library lending requests sent to, or received from abroad.

The Chinese experiences in networking was revealed by Lian Huang at the International Symposium on New Techniques and Application in Libraries in 1988. The Chong Qing University Library in co-operation with the National Science and Technology Information Retrieval system (NSTIRS) developed a technique of long distance online information retrieval system. The objective of the NSTIRS was to set up three main sub-networks at Beijing, Shanghai and Chong Qing, connect the three sub-networks into a national network and build up a range of English and Chinese database and data-banks, but at present library consortia in china have been formed to fulfill the expectation of their users most consortia are identified by academic, public or special library proximity 1. Type such as, 2. Geographical and 3. Administrative division. In term of constituting library consortium, technological feasibility, geographical convenience and administrative affiliation with the state or a local government are major considerations. 

(Elaine and Tim 2009)
4.4.12 THAILAND

Minaikit Nonglak surveyed the university libraries in Thailand for Ph.D. dissertation and proposed a plan for University Library Network in Thailand, but at present most of universities has joined networking either to share resource among the different units and faculties within their university by setting up local area networks or among several universities, such as the academic network called PULINET, THAILNET and ATUNET.


4.4.13 PAKISTAN

Anis Khurshid traces the status of library services in 15 universities in Pakistan and found no library co-operation existing. He stressed the need for resource sharing under the Central Government and suggested creation and maintenance of an updated union list of serials. University Libraries need to be connected with a telex system facilitating bibliographic uses, photocopying and loan of library resources. Establishment of a central agency for acquisition of foreign periodicals and specialization of subjects in universities, etc. are also suggested.

4.4.2 National (Indian) Scenario:

After independence the Union Government took interest in the development of library and information services. Several committees and commissions were appointed to look into the various issues relating to the library development. The committee of Sinha (1959) and S. R. Ranganathan (1965) has made pioneering studies on Indian libraries.

The Report of the Library Committee of the UGC under the Chairmanship of Dr. S. R. Ranganathan submitted in 1957 and published in 1965 recommended:

a. Local, Regional and National co-ordination of book selection, subscription to learned periodicals, and acquisition of back volumes of periodicals, among the libraries;
b. Co-operation in the fullest use of the holdings in the several libraries through a scheme of liberal inter library loan; and

c. Production and continued maintenance of Union Catalogues of learned periodicals, select treatises in foreign languages other than English, and rare books of research value for the holdings of the libraries, in the field of social sciences and humanities by a public agency like the INSDOC for natural sciences.

The Sinha Committee Report of 1959, which was mainly concerned with the public library system in the country, touched on the issue by recommending that “the University Library should co-operate with the Public Library system by

a. issuing book lists on subjects of interest to certain groups in the public;
b. admitting as regular members the more serious minded readers among the public
c. Perform reference functions of the State Central Library where these libraries are not yet established”.

Bombay Science Librarians’ Association (BOSLA), established by V.A.Kamath in 1975, is the fore runner of information networks in India. The main objectives of BOSLA were to provide document delivery through regular courier service and to render cooperation in the acquisition of books and periodicals, reprographic services, compilation of computerised catalogue, manpower exchange, etc. The BOSLA experiment has proved to be a very successful venture and is still continuing. It has become a source of inspiration for the establishment of several such networks across the length and breadth of the country.

National Information System for Science and Technology (NISSAT) is a national information network. UNESCO experts have assisted in the establishment of NISSAT. It is an on-line remote data-base search system. In tune with the changing global scenario and in pursuance of the national efforts in liberalization and globalization of the economy, NISSAT reoriented its programme activities continually in order to be useful to a wider base of clientele in diverse subjects. Besides establishing the internal linkages between the information industry, its promoter and users, NISSAT also made efforts to establish a bridge between
information resource development and users in India and other countries. UNESCO experts have assisted in the establishment of NISSAT. It is an on-line remote database search system.

During the 7th Five Year Plan (1985-90), the Planning Commission of the Government of India appointed a working group under the chairmanship of N. Seshagiri to study the aspect of modernisation of library services and informatics. The report of the working group was submitted in July, 1984, in which it recommended the inter-linking of the library systems.

The Government of India appointed another Committee in November 1986 under the Chairmanship of D. P. Chattopadhyaya to evolve a programme of action for implementing the national policy on library and information systems. The Committee submitted its report in May 1988 which has emphasised the need for resource sharing of universities, colleges and research organizations in a region/State by linking all such organizations and networking. It has further recommended to set up a committee to identify the institutions and disciplines which can be brought under a national network for sharing resources.

In India, there are several states of the art communication and information/library networks in operation. They are Information and Library Network (INFLIBNET), Health Literature Library and Information Services (HELLIS), Pocket-Switched-Public Data Network (PSDN), Education and Research Network (ERNET), National Informatics Centre Network (NICNET), DELNET, CALIBNET, MALIBNET, HYLIBNET, etc.

4.4.2.1. Networks connecting Educational and Research Institutions all over the country

a. ERNET – Education and Research Network

It was launched by the Department of Education (DOE), Govt. of India in late 1986 with financial assistance from UNDP (United Nationals Development Programme) to provide academic and research
institutions with electronic mail facilities. It is currently used by DSIR Labs, research centres and academic institutions. ([www.ernet.in](http://www.ernet.in))

b. SIRNET – Scientific and Industrial Research Network

It was established by INSDOC (Now NISCAIRE) in late 1989 to interconnect all the CSIR laboratories and other Research and Development institutions in India. Its main objective is to harness the vast Science and Technology information resources available with national laboratories and inculcate the habit of resource sharing among them. Its ultimate aim is to link the entire scientific community of the nation with the national library system and the international links to achieve efficient scientific communication.

c. OPNET – Open Education Network

Open University Network – Many institutions are venturing into the field of education and are offering professional and technological courses by using communication technologies. They are using television, computer communication, email and network to reach the students. Indira Gandhi National Open University (IGNOU), which is an apex body for open and distance education, is engaged in the task of developing a network of open universities in India called OPNET. This is a network of physical, intellectual and academic resource organized under the aegis of the Distance Education Council (DEC), an independent arm of IGNOU and distance education in India. All the open universities are partners of OPNET. The resources that are pooled together include academic programmes, norms and sharing programmes, delivery mechanisms and interactive software for student services. The OPNET has an umbrella network with the subnet of every partner university for delivery of their own courses.
4.4.2.2. Networks connecting the libraries in the country

**4.4.2.2.1 INFLIBNET**

Prof. Yash Pal, former Chairman of University Grants Commission, mooted the proposal of networking of libraries in the Universities, Colleges and in the Research and Development Institutions in India. The outcome is a detailed report on automation and networking of libraries in India. He has named this network as Information and Library Network (INFLIBNET).

INFLIBNET, the brain child of UGC, was launched in May 1991, to establish a national computer - communication network to link libraries and information centres in universities, colleges, deemed universities, UGC Information Centres, institutions of national importance, Research and Development institutions, etc.

On April 2, 1993, Prof. G. Ram Reddy, Chairman of the University Grants Commission formally declared commencement of the First Phase of INFLIBNET Programme.

The National Centre of INFLIBNET is located in Gujarat University Campus at Ahmedabad.

INFLIBNET is a major national effort to improve information transfer and access, as a support to scholarship, learning, research and academic pursuits.

It linked up institutions of higher learning, covering all disciplines, Research and Development institutions and national organizations like Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), Defence Research and Development Organisation (DRDO), Indian Council of Medical Research (ICMR), Indian Council of Social Science Research (ICSSR), etc.

There is a National Centre for managing, overseeing and co-ordinating the network administration and four regional centres which are maintained regional union catalogues apart from databases on projects, institutions and specialists.
At the sectoral level, IUC’s (Inter University Centre) Information centres and NISSAT Sectoral Centres or those performing national level functions/services in specific subjects/disciplines/missions has included. The end-users have served locally through the information centres of the respective colleges, departments, universities or Research and Development institutions.

INFLIBNET is providing the following services and activities:

1. Bibliographic Union Database Management
2. Document Delivery through JCC
3. Software Development
4. Publication
5. Human Resources Development and consultancy
6. UGC-INFONET Internet connectivity programme
7. UGC- INFONET Digital
   a. Full-text E-Resources
   b. Bibliographic Database
8. Information Resources@INFLIBNET.

(http://www.inflibnet.ac.in/ (Accessed may 5, 2010)

4.4.2.2 CALIBNET

Established on the lines of the successful BOSLA in Bombay, CALIBNET is a metropolitan network linking 38 libraries in Calcutta metropolitan area. E-Mail, file transfer, remote log-on and database and documents access are in the applications package within individual libraries, the functions to be automated are cataloguing, serials control, acquisition and fund accounting, circulation and local user services. The networking provides for global user’, services of current awareness, SDI, Union catalogues, partial databases, and access to national and international networks.

CALIBNET was inaugurated on 21st September, 1993.

(Rana 2011)
4.4.2.2.3 DELNET

DELNET was inspired by the concept of CALIBNET. DELNET links 42 libraries in the metropolitan area of Delhi. The entire applications package available in CALIBNET is available with DELNET also.

DELNET was started at the India international centre library in January 1988 and was registered as a society in 1992. It was initially supported by the National Information System for Science and Technology (NISSAT) department of scientific and industrial research, Government of India. It was subsequently supported by the national Information Centre, Department of Information Technology, Ministry of Communication and Information technology, Government of India and the ministry of culture, Government of India.

DELNET provides an array of facilities DELNETS relentless efforts in resource sharing have proxed extremely effective. It has contributed a lot towards the modernization of libraries in India

(http://delnet.nic.in (Accessed January 19, 2011))

4.4.2.2.4 MYLIBNET

It is the first library network established in a small city. The launching of MYLIBNET in association with Mysore city library consortium (MCLC) took place on 12th June 1995. There are 16 institutional members. The holding list of Mysore city libraries has been computerised and software has been developed to enable users to access the catalogue and information on-line. MYLIBNET provides e-mail facilities to its members and new facility created on-line updating of databases by the participating libraries through web. Also acting as a one stop centre by providing useful information about Mysore city.

4.4.2.2.5 BONET

The Bombay Library Network (BONET) was setup at the National Centre for Software Technology (NCST), Bombay, on 6 November 1992. The Network is sponsored by NISSAT. The aim of BONET is to build a low cost library information
system which can possibly be used as a model for future expansion of this service even outside Bombay.

BONET also benefits significantly from the experience gained, and facilities created, by the Education and Research Networking (ERNET) project of the Department of Electronics, Govt. of India, assisted by the United Nations Development Programme (UNDP). BONET is aimed at promoting cooperation between libraries in Bombay. The focus is on inter-library activities, rather than on computerizing individual libraries, which is no doubt computerize their own operations and are likely to share their experiences with each other. BONET offers training related to library computerization and networking, and speed up computerization of Bombay libraries. BONET membership provides for access to its centralised catalogues and for E-mail among BONET members. However, access to library related services outside Bombay in India and abroad would require use of ERNET.

The following services offered through BONET include:

- Consultation on standards
- Organized training for selected staff of participating libraries
- On-line catalogue of periodicals for the region
- On-line catalogue of books for the region
- On-line catalogue of preprints/reprints
- Inter-library lending of books and periodicals
- Inter-library request for photocopying
- Computer network support for book ordering
- Information retrieval services
- On-line document delivery of items (such as technical reports) made available by participating libraries in machine readable form
- On-line access to foreign databases, subject to the user’s willingness to pay the costs incurred
- E-mail interface for inter-library queries
- E-mail facilities to order reprints from abroad, when necessary
- Dissemination of information, on new books etc, using E-mail, Bulletin boards, and SDI techniques
- Courier service for inter–library exchange of materials
Under BONET the following databases were created:

i. 25,000 items in a bibliographic database on computers and software technology
ii. Union catalogue of journals and other periodicals in libraries in the region
iii. Tables of contents of 250 Indian periodicals created by the national centre for information
iv. A number of CDROM databases have been mounted on a Novell Server for use to members

(Rana 2011)

4.4.2.6 PUNENET

PUNNET was started in 1992. Presently, 30 libraries and 15 professionals from Pune city are accessing the PUNENET through modem. The users not only access PUNENET data, but also use the e-mail and internet facilities. Following databases are available on PUNENET for its members:

- Catalogues of holding of all member libraries
- Union catalogue of current periodicals in Pune libraries and information centres
- Publishers and book sellers database
- Database on international grants and fellowships in the health sciences
- Hard databanks in biotechnology
- Access to NICNET and databases available on NICNET e.g., MEDLANS, AIDS database, US patent database
- Access to internet and various databases available on internet
- Patent information
- Union catalogue of books available in British libraries in India

4.4.2.7 ADINET

Ahmedabad Library Network (ADINET) is a network of library and information centres in and around Ahmedabad. The process of covering of whole of Gujarat has been started. It was established in 1994 with an initial grant for a few years from National Information System for Science and Technology (NISSAT), Department of
Science and Industrial Research, Government of India. It caters to all types of libraries, school, college, universities, institutional libraries and even public libraries. Hence access is provided to hundred of libraries, librarians and organizations through the ADINET Network.

The main vision of ADINET is to join libraries, to enable them to achieve what cannot be done by one library alone. This is helping them to harness their limited resources and collective strengths so that libraries can continue to play their historical role as society’s portal to information ADINET therefore promotes sharing of resources and disseminates information among libraries by networking them.

(www.alibnet.org/(Accessed September 15, 2011)

4.4.2.8 MALIBNET

The need for inter connecting libraries and information centre in Madras was visualized in the Indian national scientific documentation centre (INSDOC now NISCARE) in 1991. Initially six major academic institutions were directly linked to the MALIBNET host system. A novel and unique feature has permitted to offer their own innovative information service on the network. MALIBNET presently offers the following information services:

a. Current serials acquire in about 60 libraries.
b. Full journal holding about 60 libraries.
c. Contents information of about 500 important journals.
d. Electronic mail including internet connectivity.
e. Door delivery system for document photocopies.
f. It also offers access to about 1000 international databases.

4.4.2.9 HYLIBNET

HYLIBNET is an ambitious plan for interlinking the various libraries in the twin cities of Hyderabad and Secunderabad - a total of 46 Academic and Special Libraries. The Union Catalogue of Journals has already been prepared. Major steps are yet to be taken.
Present situation of Indian college libraries resource sharing networks became an inevitable part of the library development plans. While United States and Canada are at the leading position, developing countries are also eager to follow them due to the several advantages in information exchange and transfer. The launching of communication satellites and the accessability to advanced hardware and software technology of computer systems made the task easy to develop on-line networks. Starting with the BOSLA experiments India now witnesses the progress of nation-wide Library and Information Network on OCLC model namely INFLIBNET, on one side and city based library networks in Delhi, Calcutta, Madras, Pune and at several other cities on the other hand playing a major role in the information exchange. The networking of libraries is expected to bring in rapid changes and a better future for library and information services in the country.

4.4.2.2.10 Others

(a) NICNET

It was established by National Information Centre (NIC) in 1977 and started in the late 1987’s. It was launched basically for getting and providing information from and to district levels to facilitate planning process. It links for regional nodes at Delhi, Pune, Bhubneswar and Hyderabad and has established 32 nodes at state and union territory levels and 439 nodes at district headquarters. By 1991, NICNET has achieved success in the creation of databases and networking. It also provides E-mail and other facilities to users using its already existing infrastructure. The NICNET has expand as a dedicated network having more than 500 nodes geographically distributed over the country, to address the rapidly growing awareness to computerization in different sectors of the government. Each district information centre consolidates information for monitoring the socio-economic development of the district. Each district is connected to its state’s information centre for flow of information from district level to state level. The state centre in turn sends processed information to the regional and the national centre and is also connected to other states. Hence any user connected to a remote or master earth station can link to any other remote micro earth stations. The national centre at the New Delhi is repository of all information systems and conduct research and development of relevant software and hardware tools.
(b) INDONET

India’s first data communication and computer network was started in March 1986 by CMC Ltd. It was launched as a solution to the growing need for providing timely well processed data to various institutions. In the First phase, they have mainly networked Mumbai, Calcutta and Chennai. Later, Delhi and Hyderabad were also linked as additional stations. INDONET presently has an international gateway which provides access to world wide pocket switched networks like USA’s Global Networks Systems (GNS) and Internet.

4.5 Network Architecture and Process / Method

After knowing requirement of networking we should know what type of network is required. Mainly there are two types of network. The type of Network is based on the kinds of data utilized, number of computer and requirements of the users. Following aspects should be considered.

(A) Expense of Network
(B) Number of Computers to be connected with Network
(C) Use of data
(D) Automation level for data safety
(E) Selected speed of network
(F) Facilities etc.

This all elements determine the types of library network. Networking is basically a system. It utilizes a technique to work in sequence and good manner. To know networking one should known the hierarchy of it. The Networking is classified in to two groups on the basis of working system.

(i) Distributed Information Access Network
(ii) Centralized Information Access Network.

In these both networking data input is possible.

1. Distributed Information Access Network :-
In this system data can not be stored centrally. In this networking library documents and data can be receiving independently and it can be utilized as per requirement. Peer to peer is the illustration of this networking. The size of this network is small and geographical span of this network is limited. A user can exchange the data or documents from anyone and store it any computer by independent use.

2. **Centralised Information Access Network :-**

There is a central system of documents resources and data in this networking. The size of the networking is larger and geographical space is not limited. Data and documents resources are stored centrally. It can be available for other libraries / computers as per requirement. A client server network is an example of this typed network SITRIKS had also utilized such central storing system. It is known as Remote Location Storage. Any users can demand data from server and after fulfilling safety norms one can get data and document resources.

(Maulik 2005)

4.6 **Network organization:-**

To understand network organization is as important as to work on it. We should know the base on which the network is working. Let us understand the hierarchy of network and functions of various series.
1. Peer to peer network :-

Peer to Peer Network

Generally in P2P computer network client or server is not specific each peer (computer connected to network) it self work as client / server on network. It differs by client server model. Any node is capable to start / end any process on the network. Peer node local configuration processing speed, network bandwidth and storage capacity may be different.

In this Library Network / computers are inter connected. Normally 10 (ten) computers are inter connected in this system. For more than 10 computer connection it is not useful. File or print server development is not required. P2P is useful for file showing. No FLOPPY or CD-ROM is required for data exchanging in small office or library. It saves money and secures data exchange. During data exchanging there is no risk regarding data loss due to fault of FLOPPY or CD. It can exchange data speedily. It is not expensive. In limited budget one can establish P2P network and facilitate document resources and data on all computers of library.

File, Image, Music, Movies etc. can be shared in the form of document resources data etc. In this network data are available on all peers and all node work as data server for each others.
2. **Client Server Network** :-

In this network, a library / computer is configured to work as a server. A library / computer having more (rich) data are made responsible to provide data to other connected computer and library. In this network a client users is connected to application. This server can meet any type of request by reading and understanding it.

In this network a central server is developed with many computers / nodes and data centralization is done normally there is only one computer server and client on the base of configuration but in independent position the central server can share the file. Application provides printer, data backup and storage space. Normally a server is a computer with high configuration. It has a large Hard disk. It is made to provide files and applications. It works for 24 hrs. So all client server can accessed. It need not other tools for resource and no sharing for accessing.

Client server network is very useful. It fulfills many requirements. Its working is based on message so its use is expanded. It can adjust with many other applications. The main of this network are as follows:
These both Networks are utilized in all major institutes national safety institutes and related fields of data security. “Thin Client” is a different type of client which can be found in client server architecture. They are such computers which depend on network server for resource sharing and having no hard drive or storage space. This ‘Thin Client’ receives Booting information, selected files through all applications server for users. It is less useful now a day. A setup and running is too easy for such client. It can be modified easily so that time can be saved. The giant work place or libraries having no complex work utilize this client. In this system maintenance cost is also lower.

(Sybex 2009)

4.7 Types of Network:-

The problems like number of libraries / computers to be connected and span / area of it are determined while establishing networking. The main network can be classified as follows:

1. LAN [Local Areas Network]
2. MAN [Metropolitan Area Network]
3. WAN [Wide Area Network]
4. Wireless Network
5. Home Network
6. Global Area Network
7. Inter Network

1. LAN [Local area Network] :-

A Local Area Network (LAN) is a network, which is specially designed to inter connected data communicating devices within a limited geographical area. LAN allows high speed and accurate transmission on dedicated network. Thus devices such as computer, storage devices, terminals, sensor, light pens and printers can be connected into a local area network. Most local area network within a small geographical area, LANs may be
confined to one building a college campus or a local neighborhood with range of up to 10 kilometers. Most LAN is privately owned. A single organization will own the network as part of its computer installation. Because the distances covered are short local area network are characterized by high speeds and low error rate. The main advantages of LAN are the ability to share equipment, such as host computers, printer etc. and to share data and allow it to be centrally controlled and located but made available to many users. LAN is used different type of organizations. Academic libraries for example often operate with split buildings of disc storage and other expensive central facilities such as printer etc. Also LAN may be a means of making a workstation for OPAC (Online Public Access Catalogue) available in different locations. LAN e.g. IPR, PRL, SAC library.

(Tanenbaum 2010)

(A) Topology, (b) Protocol and (c) Media are various components of LAN.

A. **Topology :-**

Topology is a physical construction of network. It is a system of computer connections. Here computers are connected to other devices. So that they can share data. It is a system where workstation is linked to network by cables. It can share document resources and data. The physical size of the network is known as ‘Topology”. Logical Topology is a system of sharing
through signal network media. Logical topology is a data sharing technique but physical construction is the most important in this system.

Topology is the way networks are physically connected together. Topology determines the complexity and therefore the cost of network cable installation. Cable installation can often be a major cost factor for network system. Topology also determines the strategy for physically expanding the network.

Topology may be of following kinds:-

(1) Bus Topology
(2) Star Topology
(3) Ring Topology
(4) Mesh Topology
(5) Hybrid Topology

(1) **Bus Topology :-**

Bus topology itself is known as Linear Topology. There is only single cable. Computers are connected through inter face point. Any in coming signal flows both way in this cable and seen in whole network. How a signal is transmitted in the network is an important particularly signals flows terms one end to another in whole construction. If Node ‘B’ signals Node ‘D’ it affects the whole network and the other node ‘A’ and ‘C’ also can observe it. It requires an addressing system. It suggests the receipt and non receipt of tinguals. 50 Aums terminators are attached at both ends on the cable. It helps in understanding the starting and ending point of ‘Bus’. The length of cable is generally predetermined but it depends on the cable utilized in the network. Now a day’s Fiber optic cable is utilized in ‘Bus’ topology and it be a backbone of it. A coaxial cable was utilized in past. It was more effective than twisted pair cable and T-Connector was utilized in it.

A simple construction and connectivity is a specialty of Bus Topology. It is preferred for small network because it requires only cable and connector.
A slow speed is a main limitation of it. In case of large number of computers
bus Network is very slow. A data flowing through whole network makes
traffic complex. In case of fault of any Node the whole network becomes
useless. To repair the problem is too difficult in it because there is no central
Distribution Point.

Bus Topology

10 Bus – 2 networks is a well-known illustration of it.

(2) Star Topology :-

Star Topology is the most preferred networking. Many pieces of cables
are utilized in it. Here a cable runs to various Nodes from central spot. A
central spot is known as ‘Hub’. The other nodes are workstation or printer. It
is point to point [P2P] connected network. Here one point is Hub and other is
Node.

In this topology A ‘Hub’ is a central point.

It can be replaced by multipart repeaters or multi access unit. Data can
be shared in both ways in star topology. A speed is higher. A cluster can be
developed by grouping many star networks. 10 Bus –T is an illustration of it.
Any fault does not create a major problem in it because each node is
independently linked to HUB. So it helps in being the whole network
worthless. It is more dependable. LED or same other system is used to show
connection status in multi Hubs. It simplifies to remove problems. The whole network is useless when there is a fault in Hub.

The twisted pair cable in place of coaxial cable is utilized in this network and it is less expensive for library or institute. It is easy to connect twisted pair cable. This network is speedy and helps users to have more speed.

This network possessed some limitations also. It needs more cables more over ‘Hub’ itself is a costly device.

(3) **Ring Topology** :-

There is a circle of P2P connection in Ring Topology. Data sharing in Ring Topology is differed by Star and Bus Topology. Data is shared unidirectional. Token Ring Network is an illustration of this topology. Due to
unidirectional sharing network speed is affected negatively and user gets slow speed. Each node signal or data pocket amplify the data before forward pushing it. So each node has to work as repeater.

There is no major difference between Ring and Bus Topology and they are similar in cable lay out. Only single cable is utilized in it. It creates a ring which connects server work station or printer. The signal or data pocket reach to all work station and node delivers it to receivers. If data are taken from it, it is accepted otherwise it is forwarded to next node. Node boosts signal and real speed is given to network. Thus there is token ring system in this topology.

Ring Topology based LAN activates token ring system due to share sharing control system among node to node is named Ring topology. Data packet creates a ring way during data sharing from node to node. FDDI works as token ring and speed is better in it. A special junction box known as multi access unit is utilized in ring topology. It works just like HUB. The only defected node is closed and made remaining network safe.

The shielded and twisted pair cable is utilized in this topology. The ‘D’ connector is utilized in it. ‘D’ connector is very costly. The length of the cable is limited. It has minor problems. A special types HUB is connected as a star network and it performed as logical ring.

Signal in ring network never lose speed as in bus network. Here each node amplify data pocket as repeater so data pocket is hardly spoiled. Thus ring topology is for topology is for better.

A connection break down in ring may cause network shut down. It is a limitation of Ring Topology.
Mesh Topology:

Mesh Topology is a unique solution to solve connection problem in network. In this network each computer is connected with separate cable. It results better in role and speed of network. More over network is more dependable. It become complex by an increase in number of computers. Three computers need three cables but it requires light cable to connect four computers.

A fault in one computer doesn’t affect the whole system so it is advantageous. It is too expensive and complex as the length of cable is longer.

Hybrid Topology:

To harvest the benefits of all above topology and to eliminate the demerits of all a new topology is developed and it is known as Hybrid topology.
It is made of more dependable WAN is applier. Hybrid topology is an integrated form of ‘Bus’, ‘Star’, ‘Ring’ and ‘Mesh’ Topology.

Many networks utilize any two topologies. Many institutes harvest merits of multi topology. A linear topology is established to connect with group star technology. A library has many sections such as book collection section, journals section, circulation (Issue/Return) section, technical section etc. In all these sections computer works as work station. All sectional computers connected with star topology are linked with bus topology. It is known as Hybrid topology.

The Hybrid topology is star ring topology which is utilized through token ring network. It has star topology based wiring but HUB is connected with ring topology. Thus star-ring topology or star-bus topology earns benefit of both.

A limitation of hybrid topology is that the devices used in one topology may be useful in others or not. It requires changing same devices to share data among two. A better network can be developed by utilizing. Ethernet Technique, IEEE standards and topology. We can select suitable network as the basis of it and earn the best efficiency at the lowest cost.

**Hybrid Topology**

**B. Protocol :-**

Protocol is the rule of sharing data and encoding system of Network. Protocol is helpful in knowing whether the network is based on P2P or client server. Network Protocol is a language of computers. It differs by normal
language. For example, Computers, connected with internet TCP / IP protocol. It means they understand TCP / IP language.

C. Media :-

Media is a link to join hooker devices and drive or storage in network. Twisted pair wire, coaxial wire and fiber optic wire are main media. At present two types of wiring are utilized in LAN. They are named as ethernet and token ring. Some networks utilize only radio waves to communicate data which is helpful to mobile computer users. It is also known as wireless technique switch or HUB which is required to wiring system while access point device is used in wireless Networking.

Data sharing done through telephone rings in LAN is more over speedy. But there is a limit of distance. More over number of computers to be connected in LAN are predetermined.

2. **MAN [Metropolitan Area Network] :-**

A Metropolitan Area Network or MAN (plural: MANs) is basically a bigger version of a LAN and normally users similar technology. It might cover a group of nearby corporate office or city and might be either private or public. A MAN can support both data and voice and might even be related to the local cable television network. A MAN just has one or two cables and does not contain switching elements, which shunt packets over one of several potential output lines. Not having to switch simplifies the design. A key aspect of a MAN is that there is broadcast medium to which all the computers are attached. This greatly simplifies the design compared to other kind of network for example CALIBNET (Calcutta Library Network) DELNET (Delhi Library Network) ADINET (Ahmedabad Library Network)
3. **WAN [Wide Area Network] :-**

Wide Area Network (WAN) is those networks that cover a large geographical area spanning cities, countries or even continents. Typical a WAN consists of a number of interconnected switching nodes. A transmission from any one device is routed through these internal nodes to the specified destination device. These nodes are not concerned with the content of the data. Their purpose is to provide a switching faculty that will move data from node to node until they each their destination. Traditionally, WANs have been implemented using one of the two technologies, circuit switching and packet switching. More recently, frame relay and ATM technologies have assumed major roles. Some of the relay and ATM technologies have assumed major roles. Some of the important WAN technology is given bellow

9. Leased Lines
10. Asymmetric Digital Subscribers Line (ADSL)
11. Integrated Service Digital Network (ISDN)
12. Frame Relay
13. Asynchronous Transfer Mode (ATM)
Wide Area Network

(Arunima 2002)

4. Wireless Networking :-

Wireless network utilize only radio waves to communicate data. It does not use Ethernet and token ring system. A short range radio is utilized to connect components of various computers through inter connection. All these computers are connected with cable of main unit. A short range wireless network is known as blue-tooth also. Various components of computers are limited with no cable in this system. Bluetooth, digital camera, handset, scanner and other devices are linked to computer writhing particular range. They have no cable.

A computer having radio modem and antenna share data with another system. P2P is also wireless network.

5. **Home Network :-**

Home network links various devices such as CD-ROM, Scanner, and Speaker Camera etc. to computers of the same home. Home network is a system where music system, T.V., computers of other home and other devices are connected through intranet.

(Tanenbaum 2010)

6. **Global Area Networks**

Global Area Networks (GAN) specifications are in development by several groups, and there is no common definition. In general, however, a GAN is a model for supporting mobile communications across an arbitrary number of
wireless LANs, satellite coverage areas, etc. The key challenges in mobile communications is "handling off" the user communications from one local coverage area to the next. In IEEE Project 802, this involves a succession of terrestrial Wireless local area networks (WLAN).

7. **Internetwork**

Two or more networks or network segments connected using devices that operate at layer 3 (the 'network' layer) of the OSI Basic Reference Model, such as a router. Any interconnection, industrial, or governmental networks mall also is defined as an internetwork. In modern practice, the interconnected networks use the Internet Protocol. There are at least three variants of interwork, depending on who administers and who participates in them:

- Intranet
- Extranet
- Internet

Intranets and extranets may or may not have connections to the Internet. If connected from being accessed from the Internet without proper authorization. The internet is not it may serve as a portal for access to portions of an extranet.

(A) **Intranet**

An Intranet is a set of interconnected networks, using the Internet Protocol and uses IP-based tools such as web browsers and FTP, tools, that is under the control of a single administrative entity. That administrative entity closes the intranet to the rest of the world, and allows only specific users. Most commonly, an intranet is the internal network of a library or other library.

(B) **Extranet**

An extranet is network or internetwork that is limited in scope to single organization or entity which also has limited connections to the networks
of one or more other usually, but not necessarily, trusted organizations or entities (e.g. a library user may be given access to some part of its intranet creating in this way an extranet, while at the same time the user may not considered 'trusted' from a security standpoint). Technically, an extranet may also be categorized as a CAN, MAN, WAN or other type of network, although, by definition, an extranet cannot consist of a single LAN; it must have at least one connection with an external network.

(C) Internet

A specific inter network, consisting of a worldwide interconnection of governmental, academic, public and private networks based upon the Advanced Research Projects Agency Network (ARPANET) developed by ARPA of the U.S. Department of Defense - also home to the World Wide Web (WWW) and referred to as the 'Internet' with a capital 'I' to distinguish it from other generic internetworks. Participants in the Internet, or their service providers, use IP Addresses obtained from address registries that control assignments. Service providers and large libraries also exchange information on the reach ability of their address ranges through him Border Gateway Protocol (BGP).

4.8 Network Component :-

Network is a system which links many computers. It helps to fulfill the objectives. Many elements are utilized in proper way in network. Network is just like a building. The devices such as Ethernet card cable expansion device connector HUB router etc. are utilized in network. Network has its settings which depend upon the rest components used. To develop network its various components are useful for us. So it is not useless to know about it. The main components of network are as follows:
1. **Server :-**

A server is a device of network which regulates resources. Server is a computer having high configuration on network. It has a large space for Hard Disk. It is built to present application and files.

The server may be of two kinds:

(a) **File server**

(b) **Application server**

File server allows the user to input and access data on computer. An application server is useful to run any programme in computer. Moreover it can use for NET surfing in user web, mail and data based server. This server indicates the hardware or HTTP server.

A special and predetermined components are required to make a computer a server some operating system perform predetermined functions. ‘Windows NT’ or 2000 operating system’ is utilized to develop network by installing service pocket network server can run effectively. There are also some services in control panel.
2. **Work station :-**

A work station is a computer linked with server network. It used as a network server resource to get information. Generally it is personal computer in which operating system, Hard Disk and Software are installed. It can process independently.

There is no limit of operating system in work station. We can use Windows 98, Windows 95, Linux and other operating systems in it. The cost of workstation depends on the resources utilized in it. A workstation builder tries to control the cost of computer. Moreover he tries to provide such configuration which flows constant data in network.

3. **Network Interface Card (NIC) :-**

Network Interface Card is known as NIC or network card. NIC is a circuit or chip. It is useful to establish communication between two computers on network. After installing the board resource, data and computer hardware are shared on network. It is used for LAN, WAN or other networks. NIC is differed by connectors and process from Modem.

NIC is attached with PCI [Peripheral Component Interface] expansion slot on mother board in computer. In past, it was attached in ISA [Industry Standards Architecture] slot. At present also some computers use ISA compatible NIC. But now all NIC slot in PCI. Because ISA standard slot are not used on mother board.

“Communication media is required to communicate between two computers through network interface card. In absence of wireless network for networking linking of two NIC is necessary and it requires cable”.

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**Network Interface Card (NIC)**

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4. **Cable for Network :-**

Different types of cables are available as transmission lines. The backbone of the network, come in two basic varieties, Base-band and broad band. Base-band communication link is twisted pair wire and base-band coaxial cable. Broadband media are broadband coaxial and fiber optic cable.

**(A) Twisted Pair Wire:-**

It is the cable used for telephone. The twisting standardizes the electrical properties throughout the length of the cable, and minimizes the interference created by adjacent wires in multi pair cable.

![Twisted Pair Wire](image)

**(B) Base Band Coaxial Cable:-**

It is the cable used for CAT-5 (Community Antenna Television) systems. The cable is approximates 3/8 diameter, a central carrier is surrounded by a fine woven mesh or copper which forms an outer shell. This cable carries a single digital signal at high data rate up to 10 to 12 Mbps.
Base Band Coaxial Cable

(C) Broadband Coaxial Cable:-

It comes in different diameters with wiring amounts of insulation. The cable may have the same construction as baseband coaxial. It can carry 50 to 100 television channels or thousands of voice and low speed data channels at rates 9.2 to 50 Kbps.

Broadband Coaxial Cable

(D) Fiber Optic Cable:

Fiber optics cable is also used as network media. In fiber optic system data are shared in the form of glass/plastic wire or fiber. More data can be transmitted in this system. The most of the telephone companies use it. In India also this system is progressive. Reliance use optic fiber in place of copper wire.

The bandwidth of network is faster in optic fiber based communication. Repeaters can be minimized and networking distance can be increased in this technique. Total expenditure is also lower. Repeaters are devices which refresh and boost signals after some distance. Fiber optics may be classified into two:
(i) Single mode fiber  
(ii) Multi mode fiber

Single mode fiber is used for far distance network. While multi mode fiber is used for short distance network.

Thus we can use cables as network media. Network speed varies in different cable only. Cable is not the component of network. When only two computers are connected in P2P it creates no problems. Two computers can be liked directly with NIC or other system. More devices are required to connect three or more computers in network. In short one should know what devices are required to enlarge network.

Fiber Optics Cable

5. **Modem:**

A device which converts the digital signal to analog signal and vice-versa capable of being transmitted over a conventional telephone line.
6. **Network Extension Device :-**

Network extension device is useful to enlarge network. It is also a part of our need. Single NIC is used in single computer. A specific device is useful to extend the existing computer network. Network extension device is useful to extend network system.

NIC is used on the base of cable used in computers cables are not connected directly in NIC. In the same way cable wire is not used in electric socket. A special connector is required to set cable in NIC. We use connector named plug to set wire in socket BNC connector UTP (RJ-45) connector etc. are known as cable connector.

7. **Hub :-**

A cable of NIC of network connected computers is attached to other point from where data are shared. It is known as Hub.

Hub is a common connection point for data and device in Network. Data or request pocket Hub, Hub makes copy all other connection port. Thus one computer resource make suitable to connect others and thus data sharing is done.

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![Switch Buttons to select each USB device for 2 users](image)

Connecting to 4 USB devices
Hub is of three types:-

1. **Passive Hub / Active Hub**
2. **Intelligent Hub**
3. **Switching Hub**

1. **Passive Hub / Active Hub** :-

   Passive Hub is used as media or path of data. Data flows from data pocket to another part / computer through it. This Hub sends all incoming signals to outgoing wires but it doesn’t amplify it. Active Hub amplify the signals and send forward.

2. **Intelligent Hub** :-

   It is also known as ‘Manageable Hub’. If provides service of controlling and data sharing and administration.

3. **Switching Hub** :-

   It does not a copy the data pocket to all part but send data to only target computers. It can control the useless data send to computers.
8. **Switch :-**

Hub is unable to manage the increasing load and traffic of Network. To simplify working of Hub switch is used. Switch manages Network traffic and functions of Hub. Switch is set between some Hubs and useless data are minimized. It can boost speed of Network.

The similar persecutions are required in Hub and switch because there is no major difference between them. If connections linked with Hub are of 10 MBPS and it has 8 port connection received to each port will be of 12.5 MBPS according to 100/8. Each port works as Hub in switch. Thus each port active connection of 100 MBPS. Slow input can be identified and functions according to them. Switch can be configured through software. A Software is joined with switch and it can watch all functions.

![Switch Diagram](Maulik 2005)

9. **Bridge :-**

Bridge is used to connect two or more LAN. It made possible data sharing between two connections. It is faster than router but not so effective.

It is interconnect two networks that use identical protocol. The bridge act as an address filter, picking up packets from one LAN that are intended for a destination on another LAN and passing those packets on. The bridge
operates at data link layer. Bridges do not forward local traffic, thus reduce overall traffic in a multi-LAN inter network.

There are two types of bridges, transparent bridges keeps routing tables of physical address of network devices and forward traffic. They use a spanning tree algorithm scheme for routing. Source routing bridge does not keep track of the route by which packets are sent. To establish a route, the station initiating communication broadcasts a discovery packet, which makes its way through the networks source routing bridges. The discovery packet keeps track of the bridges at crosses on the way to the destination.

Bridge

10. **Router** :-

Router provides a reliable cost effective solution for interconnecting two networks of different protocol. The router operates at network layer of the OSI model. Different routers support different set protocols. Local routers interconnect small to medium sized network. Remote routers link joining geographically separate networks into a large, complex wide area networks.
11. **Bouter :-**

Bouter is a modified system of Router. Bouter is a Hybrid from of Bridge and Router. It can perform the functions of both Bridge and Router. Bouter knows the kind and packet to be routed. It flows other packets safe in network. It functions as Bridge. Bouter is capable to understand protocol of local and outside network.

12. **Repeater :-**

Repeater is a network device which flow incoming data / signal forward by amplifying it Analog or Digital both signals can be reproduced through repeaters. It can boost the speed of Network.

The repeater can only connect identical LANs, such as Ethernet/ 802.3 to Ethernet / 802.3 or Token Ring to Token Ring for different cables, different repeaters are available, viz twisted pair repeater, thin coaxial repeaters etc.

Signal incoming in network are in the form of electric or charge. It is made slow due to process / working. Repeaters recharge them to be speedy.
13. **Gateway :-**

If the complexity or sophistication required increases, as between network from different vendors or between LANS and public nets, gateways are used to make physical and higher level protocol, transformations. Gateways connect all seven layers of the OSI models. (32)

![Gateway Diagram]

4.9 **Advantage of the library network:**

In light of the goal and targets the benefits of libraries and information network are as under:

1. Reduce redundancy and duplication but apprehensions and needed, in many books and periodicals, audio-visual materials and other materials required especially costly material and high prices.

2. The economy in the competencies and human capacities, especially the specialized and trained them, through centralized, procedures and technical operations, cataloguing cooperative and classification and tags and the work of abstract and Indexing.
3. Source provides adequate information and may of the beneficiaries of library services participation in the network and can provide more than one library.

4. Standards specifications and method of week in the participating libraries, where they are building the foundations of specific standard adopted by all participating libraries.

5. The results economy in expenditure, which will result in their libraries in the network, can be invested in additional events and other activities for such libraries.

6. Provide more convictions when users and beneficiaries of computing.

(Abdul 2007)

4.10 Problems to establish library network:

There are some common problems to establish library network are as follow:

i. Lack of legal documents.

ii. Lack of information.

iii. Lack of money

iv. Lack of qualified staff.

v. Lack of Government policy on importance of computers and peripherals forces to change network design. Rental structures of telecom charges may also make the network unviable.

vi. Financial crunch creates delay in project implementation which affects users and raises project cost.

vii. Time lag between planning and implementation creates many technical and financial problems.

viii. Decentralized decision making in the organization delays the planning and implementation of the networks.

ix. Outdated indigenous technology create problems in inter network integration due to mismatching of technology with the imported equipment.
x. Lack of measurement and evaluation creates problem in convincing the top management for networking approval.

(Antony 2005)

4.11 Conclusion:-

Indian libraries are not sufficient developed for library networking. But we can get benefit of developing countries in this field. Principles and practice both are important. So library networking is progressive to meet user’s demand at lower cost.
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