CURRENT TECHNOLOGY IN THE LIBRARY - LOCAL AREA NETWORKS (LANS)

Over the past few years, the development of Local Area Networks (LANs) has been rapidly advancing and is expected to remain so in the future also. The purpose of this article is to define LAN, state briefly its characteristics, position and classification. The four main technological aspects essential for LANs, viz. transmission medium, topology, transmission technology and access control method are dealt with in detail. Finally, the importance of application of LANs in libraries is described.

INTRODUCTION

While making a systematic transition into the Information Age, libraries have to adopt special techniques to superimpose modern information service upon the traditional functions. The technological revolution has already brought about many drastic changes in the libraries and it will continue to change the nature of the libraries. The President of EDUCOM stated that “one of the grand challenges for technology in the coming decades is to create an electronic network linking every scholar in the world to every other scholar and so establish a knowledge management system in this world ----. The network will eliminate the isolation of scholars at small and remote institutions, encourage collaboration, speed up technology transfer, and enhance research productivity by reducing the time needed to obtain and exchange information” [1].

Recent developments in networking, and the integration of word processing and facsimile lead to the discussions on promoting Local Area Networks (LANs) to meet the needs of scholars, researchers and information seekers.

The British Library has installed LANs and the first step towards its implementation was taken in Autumn 1988. Norman Moir, the British Library’s telecommunications manager observes that he is fairly impressed with the LANs and says “We’ve had little trouble, they’re easy to install and easy to maintain. The main thing is that the users are happy” [2].

The computer industry has grown rapidly in a very short span of time. With the advent of personal computers (PCs), a large number of organisations have adopted the use of computers.

The estimated growth in worldwide PC usage is increasing constantly (Fig.1).

When a large number of computers are used. It is natural that the users like to interconnect with each other in order to exchange data and share the resources avoiding duplication of expertise and effort. Local Area Networking is basically a transmission system for linking computers over a restricted geographical area. It is a combination of cables/connectors, computers, processors and interface software which interconnects computers and related devices. It regulates the flow of information traffic among these devices.

DEFINITION

R.M. Metcalfe [3] defines the term ‘Local Area Network’ as “a digital communication facility carrying data at high speed among a large number of

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The Institution of Electrical and Electronic Engineers 802 Local Area Network draft standard [4] describes LAN as "A Local Network is distinguished from other types of data networks in that the communications is usually confined to a moderate size geographic area such as a single office building, a warehouse or a campus. The network can depend on a communication channel of moderate to high data rate which has a consistently low error rate. The network is owned and used by a single organisation. This is in contrast to long distance networks which interconnect facilities in different parts of the country or are used as a public utility. The Local Network is also different from the networks which interconnect devices on a desktop or components within a single piece of equipment".

Looking more towards the user end, Kenyon [5] says that a Local Area Network is "an organised collection of users and services".

**CHARACTERISTICS OF LOCAL AREA NETWORKS**

a) It links different types of computers - micro, mini and mainframe.
b) It maximises local control. The area covered ranges from a few metres to a few kilometres.
c) It avoids degradation of performance.
d) It facilitates distributed processing. In practice, many of the smaller LANs operate on a master and slave basis, with slave PCs clustered round a master shared file store.
e) It avoids problems arising out of network traffic.
f) It helps to share resources like mass storage devices, printers, plotters, etc.
g) It reduces dependence on a central system.
h) It has low error rates.
i) It has a high potential of hardware resilience which reduces the effects of system failure. Failure of one CPU will not affect the other.
Fig. 2: Position of Lans

Fig. 3: Twisted Pair Cable
j) It integrates specialised work stations for activities like CAD, CAM, CIM and word processing etc.
k) It helps to implement online applications including library services. Speed is very high.
l) Relatively inexpensive methods are used to get connected to the network.

Not each and every Local Area Network would have all these characteristics, but fundamentally these are the major characteristics found in any implementation.

POSITION OF LANs

The raw data transmission rate of LANs is high as compared to the ordinary telecommunication circuits. Figure 2 indicates the position of LANs relative to other forms of data networking.

CLASSIFICATION OF LOCAL AREA NETWORKS

The basic concept of all computer networks is the switching of information from one station to another. A station is any system which can communicate, and the nodes are the devices which enable communication to occur. The four main technological aspects, namely Transmission medium, Topology, Transmission technology and Access control method serve as a convenient classification of LANs.

Transmission Medium

Transmission medium denotes the nature of the physical path along which the data must travel. The three main media used in LANs are; twisted pair cable, coaxial cable and fibre optic cable.

Twisted Pair Cable: This is the most common transmission medium used for the telephone network to link each hand set to its local exchange. It is suitable for limited distances and it is the cheapest of the three media. It is easy to install and is being used very successfully in LANs especially in Cambridge Ring networks which is a Local Area Network project at the University of Cambridge. IBM has also standardised on twisted pair cabling system. It has the capacity to carry data upto 16 Mbits/
Fig. 5: Fibre Optic Cable

Fig. 6: Star Topology
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Each circuit requires two insulated wires usually made of copper and twisted in a helical pattern as in Figure 3.

Coaxial Cable: This is the most versatile and popular medium of LANs, since it offers high speeds over moderate distances at moderate prices. Like twisted pairs, coaxial cable comprises two wires but its design of a single inner conductor and a hollow outer conductor as shown in Figure 4 with insulating material in-between enables it to have higher bandwidth and work at higher data rates than twisted pair. Bandwidth is the width of the frequency band that can be handled efficiently by the system and it is also a measure of the transmission speed.

Fibre optic cable: It consists of a very thin, flexible, glass or plastic strand, through which light can be transmitted by reflection off the tube's internal walls as shown in Figure 5.

Fibre optic cable can operate with much greater speeds and distances than coaxial cable and has the lowest error rate. It requires the conversion of electrical signals from a station into light signals which is done by a light source namely Light Emitting Diode (LED) and Injection Lazer Diode (ILD). LEDs are much cheaper than lazer devices.

Topology

The topology of a network is the shape of the communication link between the stations, i.e. how the stations on the network are arranged in relation to each other. The four basic topologies used in LANs are star, ring, bus and tree.

Star topology: In this topology, as in figure 6 each station is connected to a central switch on a central node by a dedicated physical link. The access to the network or a station in the network is under the control of central node.

Ring topology: A ring network as shown in Figure 7 is one where the stations are connected by a loop of cable, and each connection point, called a repeater, is responsible for passing on fragments of the data. The data is sent in packets, and within each station there is a controller board responsible for recognising packets addressed to a station and for deciding to start transmitting the data when it is clear.

IBM has chosen the token passing ring as their preferred LAN product.

Ring can overcome some of the distance limitations between stations.

Bus topology: Bus networks are the most common LANs, because about 50% of them are based on this topology. It does not have switches and repeaters, but simply share a common linear communication medium as shown in Figure 8.

Each station must have a tap, i.e. a hardware for attachment to the medium which must be capable of delivering the signal to all the stations on the bus. The most significant bus network is Ethernet, invented by Xerox Palo Alto Research Centre in 1975. It is now adopted as an international standard with readily available interfaces. It is attractive because it is available either as a baseband or a broadband LAN which is explained in detail under the heading “Transmission Technology”.

Tree topology: The tree network is a generalisation of the bus topology where the cable is made to branch down many side shoots by the use of a cable splitting device as shown in Figure 9. Each transmission propagates down each branch of the tree to all stations.

Transmission Technology

Transmission of the data means how the bits themselves are sent across whatever medium has been chosen. There are two types of transmission, namely Baseband networks and Broadband networks.

Baseband networks: Baseband means that the original signal is transmitted without modulation, i.e. at its original frequency. For LANs, baseband means that digital signalling is used where the whole bandwidth of the medium is used to carry one single transmission. In this, only one information channel can be handled on the medium at any one time. This network has simple topology and it is relatively cheaper to use for linking a moderate number of stations.

Broadband networks: Broadband networks use modulated analogue signals called carrier signals to transmit data over a wide range of frequencies.
Fig. 7: Ring Topology

Fig. 8: Bus Topology
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normally up to 300 or 400 MHz. The total frequency of the medium is divided into a number of narrower bands or channels and each channel is used independently to provide a range of services. Thus this network can support many thousands of terminals and host computers. Another advantage of broadband network is that channels can also be assigned for analogue data, including television, voice, facsimile and security systems. Modems are essential at each station to modulate and demodulate the digital signal into the carrier signals. Broadband network normally use a tree topology as shown in Figure 10.

This network is ideal for campus networks and large factory complexes.

Access Control Method

This is a method to control the flow of data between the stations in a LAN. It is related to the topology of the LAN, and some techniques like Polling, Carrier Sense Multiple Access (CSMA), Token Passing and Slotted ring can be imposed on different topologies.

Polling: This technique relies on a master-slave relationship between a central server and the other stations on the LAN. It was developed for star topologies, but also used in other topologies. The central server maintains a list of the stations assigned to share its disc space. When there is a transmission to make, the station is permitted to send one or more packets to the central station. The station must then wait until it is polled again before it can send any more. This technique depends heavily on the reliability of the central server and it is very simple to implement. It is, therefore, more used for small scale networks where transactions are expected to be low.

Carrier Sense Multiple Access (CSMA): This technique is commonly used in LANs. It is restricted to bus and tree topologies. There is no polling from a central station, but all the sections have equal priority and has multiple access, i.e. all the stations share the same physical medium, or the same channel in a broadband system. A station must listen to the medium to find out if it is idle or not before starting its own transmission, so the name carrier sensing. The problem with this method is that two stations could decide to transmit simultaneously. To overcome this CSMA with Collision Detection (CSMA/CD) and CSMA with Collision Avoidance (CSMA/CA) are commonly used.

Token passing: This is a form of distributed polling where a single poll or a token permanently circulates around the stations in some sequence. It is applicable to both ring and bus topologies. In a token ring access, the token rotates round the ring. This technique is used in the IBM and IEEE 802.5 token rings. In a token bus access, the token passing is similar in operation to that on a ring but the flow of control from station to station is not automatic, and the stations have to be organised into a logical ring sequence.

Slotted ring: This technique is commonly known as Cambridge ring, since it was developed as a working system in the Computer Laboratory of the University of Cambridge. This is a technique for access to a ring whereby an empty packet, or slot is continuously circulating round the stations. A station may fill the slot when it is received. It is capable of high transmission speeds.

APPLICATION OF LOCAL AREA NETWORKS IN LIBRARIES

In Library and Information Science, the integration of library applications have been the watchword of its development. Special libraries and information centres are heavily committed to information retrieval facilities, whereas academic libraries and public libraries are still getting under way.

Local Area Network is fundamentally involved with the structure of information-based activities. Management benefits of flexibility and expandability characteristics of LAN are very essential for library services. Many library work like data entry, word processing can be economically done under local control at a work station. Local Area Networks help to share resources such as data in hard disks/CD ROMs/ optical disks. The sudden proliferation of microcomputers and microcomputer networks is presenting more and more libraries with the challenge of data-processing management [6]. Large libraries which are in a position to utilize computer facilities, i.e. have a mainframe or minicomputer installation may be networked to other facilities.
Fig. 9: Tree Topology
Fig. 10: Broadband Network
within the organisation. Gateways to remote databases can be provided which allow access from different points outside the physical locality of the library.

Housekeeping applications like cataloguing, circulation, acquisition, periodical control, word processing, management of information and financial control are all feasible. In addition to this, LAN can be used for a more essential and important service, i.e. readers service apart from the technical services mentioned above.

Information services to readers like retrieval of primary and secondary sources, databases, current awareness services (CAS), selective dissemination of information (SDI), computer assisted learning, user education packages are all feasible. Neil Maclean [7] has explained this as “Access is potentially an uncontrollable resource in a Local Area Network”. If a library computer system consists of one large microcomputer for circulation control with its own database, another for catalog maintenance, yet another for on-line patron access catalog, then with the proper LAN software, any terminal can use any computer as required. Thus a group of separate computers and databases can form an integrated system through use of a LAN.

CONCLUSION

Computer networks are expected to play an increasingly important role in the libraries and Local Area Networks will play a major part in the development of networks. Local Area Networks in libraries provide the future prospect of entering into new information technology at lower cost but at a clear development pathway. LAN will have an increasingly important role in producing effective library and Information systems within and between the organisations. The future library system should be a Local Area Network with microcomputer work stations for housekeeping or technical services, reader services, shared file storage, shared printing facilities and shared storage of databases. This results in closely integrated library services leading to greater accessibility for the community it serves. Making full and effective use of LAN requires a new partnership among libraries, computer technology and concerned authorities. Technology is going to remain the driving force by creating new opportunities for the expansion and improvement in library and information services. It would be appropriate to conclude with the words of Mr. Jakob Van Heijst [8],” Director of United Nation’s Dag Hammarskjold Library that in this day and age, having books or other material available on the premises is no longer the primary function of a library. Now-a-days, the ability to locate the needed information, with the aid of the most modern technologies, is considered most important” and it is in this context that LANs come to play their vital role.

REFERENCES