

LOCAL AREA NETWORKS

The Emergence of Local Area Networks: The advent of IBM PCs in the early 1980s set a whole new standard in both business and personal computing. Along with PCs came a new operating system called DOS. DOS provided an easy programming environment for software vendors developing and publishing software. The significance of the DOS standard is that it stimulates growth of new products by providing software and hardware vendors with an open development platform to build both accessories and software products. Since this brought in an abundance of software, the use of personal computers increased. As more and more people began to use computers, it became obvious that a way of connecting them together would provide many useful benefits, such as printer and hard disk sharing, especially when budgets became a constraint. This gave birth to the Local Area Network (LAN) concept.

The Concept: While personal computers were becoming more powerful through the use of advanced processors and more sophisticated software, users of mainframes and minicomputers began to break with the tradition of having a centralized information systems division. PCs were easy to use and provided a better and more effective way of maintaining data on a departmental level. In the mainframe and mini environment, the data required by individual departments was often controlled by the management information system department or some such similar department. Each user was connected to the main system through a dumb terminal that was unable to perform any of its own processing tasks. In the mainframe and minicomputer environment, processing and memory are centralized.

The host computer became the center of the computing environment, and was managed by a team of data processing DP professionals whose sole task was to operate the system and provide reports to the various departments in the organization. While this method of computerization had its merits, the major minus point was that the system could get easily overloaded as the number of users and consequently, terminals, increased. Secondly, most of the information was centralized to one pool of people, the systems professionals, rather than the end users.

This type of centralized processing systems differs from the distributed processing systems used in LANs. In distributed processing systems, most of the processing is done in the memory of the individual PCs, or workstations. The file server or host system becomes the central point for storing files, connecting and sharing printers or other network resources and for managing the network.

A local area network is best defined in terms of the purpose it is meant to serve rather than in terms of how it does it. *A local area network is primarily a data transmission system intended to link computers and associated devices within a restricted geographical area*; however, many suppliers propose to include speech in their systems. The linked computers and related equipments may be anything from full-scale mainframe computing systems to small desk-top office workstations, terminals, peripherals, etc. The key characteristic of a local area network is the fact that the whole of the network, confined to one site, is completely under the control of one organization. This does not prevent communications taking place between users of the local area network on one site and others elsewhere. This would be achieved using wide area networks with special bridging equipment common to both the local and wide area network to perform the function of taking messages from one network and putting them on the other. Local area networks could conceivably be used as device concentrators for a wide area network.

Having decided to restrict the range of the network to within one site, various options are open to the designer.

The network can have one shape (topology) among several, and many methods of transmitting the information can be used. It is unrealistic to attempt to define local area networks in terms of the topology or transmission technology as these can have much wider applicability. Local area networks can be used in the manner suited to the organization which owns them, and can be completely independent of the constraints imposed by public telephone authorities, or other public services.

Since a local area network is confined to a small area, it is possible to employ vastly different transmission methods from those commonly used on other telecommunication systems. Inexpensive line-driving equipment can be employed instead of the relatively complex modems needed for public analogue network. High data transmission speed can be achieved by utilizing the advantages of short distances and the latest electronic circuits. Thus, local area networks are typified by short distances (up to 10 km. although 1 km. is more usual), by a high transmission rate (0.1 to 30 Mbps), and by a low error rate. It is equally important to stress that local area networks are cheap to install and run, and provide a convenient method for interconnecting a large number of computer based devices on a single site (e.g. word processors, personal computers, as well as ordinary computers).

The main attributes of present-day local area networks can be summarized:

- inexpensive transmission media;
- inexpensive devices (modems, repeaters and transceiver) to interface to the media;
- easy physical connection of devices to the media;
- high data transmission rates;
- network data transmissions are independent of the rates used by the attached devices, making it easier for devices of one speed to send information to devices of another speed;
- a high degree of inter-connection between devices;
- every attached device having the potential to communicate with every other device on the network;
- there is seldom a central controlling processor which polls the attached devices on the network;
- in the majority of cases, each attached device hears (but does not process) messages intended for other devices as well as for itself.

It is important to note that neither the actual data transmission rate used, the access method nor the topology of the network are essential characteristics.

Why LANS? - One of the original reasons for users going in for LANs was that such a distributed environment gave them the ability to have their own independent processing stations while sharing expensive computer resources like disk files, printers and plotters. Today, however, more critical reasons have emerged for users to increasingly move towards LAN solutions. These include:

(i) Security - Security for programs and data can be achieved using servers that are locked through both software and by physical means. Diskless nodes also offer security by not allowing users to download important data on floppies or upload unwanted software or virus.

(ii) Expanded PC usage through inexpensive workstation - Once a LAN has been set up, it actually costs less to automate additional employees through diskless PCs. Existing PCs can be easily converted into nodes by adding network interface cards.

(iii) Distributed processing - Many companies operate as if they had distributed system in place. If numerous PCs are installed around the office, these machines represent the basic platform for a LAN with inter-user communication and information exchange.

(iv) Electronic mail and Message Broadcasting - Electronic mail allows users to communicate more easily among themselves. Each user can be assigned a mail-box on the server. Messages to other users can then be dropped into the mail-box and read by them when they log into the network.

(v) Organizational Benefits : Benefits of LANs are numerous. These include reduced costs in computer hardware, software and peripherals, and a drastic reduction in the time and cost of training or re-training manpower to use the systems. In addition, the fact that you are networked helps managers and executive to communicate with each other more easily and faster, without any logistical constraints. Information flow too becomes a lot smoother with various departments having the ability to access or request for information and data pertinent to them.

(vi) Data management benefits - Since data is located centrally on the server, it becomes much easier to manage it, as well as back it up. No file is transferred between users through floppies.

(vii) Software cost and upgradation - If the organization is concerned about using licensed software purchasing a network version can save a lot of money, since there would be no need to buy multiple copies of the same software for every machine in the organization. Therefore, software upgrades are much easier as any given package is stored centrally on the server.

LAN Requirements - There are certain features that every LAN should have and users would do well to keep note of these when they decide to implement their own network. These features essentially involve hardware and software components. Broadly, these are :

(i) Compatibility - A local area network operating system must provide a layer of compatibility at the software level so that software can be easily written and widely distributed. A LAN operating system must be flexible, which means that it must support a large variety of hardware. Novell Net Ware is a network operating system that can provide these features, and has today, become an industry standard.

(ii) Internetworking - Bridging of different LANs together is one of the most important requirements of any LAN. Users should be able to access resources from all workstations on the bridge network in a transparent way; no special commands should be required to cross the bridge. A network operating system must be hardware independent, providing the same user interface irrespective of the hardware.

(iii) Growth Path and Modularity. - One of the most important requirements of a LAN is its modularity. A set of PCs should get easily converted into a LAN which can grow in size simply by adding additional workstations. If more storage is required, one should be able to add another hard disk drive, or another server. If you need to connect with a user on another LAN, you should be able to install a bridge.

(iv) System Reliability and Maintenance. - All computers are prone to system lockups, power failures and other catastrophes. If a centralized processing system goes down, all users connected to it are left without a machine to work on. Such a situation can arise even in a distributed or local area network system. However, a LAN operating system should be powerful enough to withstand accidents. In fact, Novells SFT Level I and Level II include fault-tolerance as a feature.

Components of a LAN - A typical local area network running under Novell NetWare has five basic components that make up the network. These are :

- File Servers
- Network operating system
- Personal Computers, Workstations or Nodes
- Network Interface Cards
- Cabling

(i) File Server - A network file server is a computer system used for the purpose of managing the file system, servicing the network printers, handling network communications, and other functions. A server may be dedicated in which case all of its processing power is allocated to network functions, or it may be non-dedicated which means that a part of the servers functions may be allocated as a workstation or DOS-based system.

(ii) The network operating system - It is loaded into the server's hard disk along with the system management tools and user utilities. When the system is restarted, NetWare boots and the server comes under its control. At this point, DOS or Windows is no longer valid on the network drive, since it is running the network operating system or NetWare; however most DOS/Windows programs can be run as normal. No processing is done on the server, and hence it is called a Passive Device. The choice of a dedicated or non-dedicated network server is basically a trade-off between the cost and performance, and operation of a network.

The larger the network, the more important it becomes to have a high performance server. Larger amounts of RAM are required to support disk caches and printer queues (which are created due to sharing of same hard disk and printers by number of nodes on the network) The server should be matched with anticipated throughput as closely as possible. While most IBM systems are satisfactory for NetWare, a Pentium system is preferable for better overall performance of the network.

(iii) Workstations - Workstations are attached to the server through the network interface card and the cabling. The dumb terminals used on mainframes and minicomputer systems are not supported on networks because they are not capable of processing on their own. Workstations are normally intelligent systems, such as the IBM PC. The concept of distributed processing relies on the fact that personal computers attached to the networks perform their own processing after loading programs and data from the server. Hence, a workstation is called an Active Device on the network. After processing, files are stored back on the server where they can be used by other workstations.

The workstation can also be a diskless PC, wherein loading of operating system takes place from the file server. In short, a PC + a LAN card = a Workstation.

(iv) Network interface card: As discussed earlier, every device connected to a LAN needs a Network interface card (NIC) to plug into the LAN. For example, a PC may have an Ethernet card installed in it to connect to an Ethernet LAN.

(v) Network Cabling - Once the server, workstations and network interface cards are in place, network cabling is used to connect everything together. The most popular type of network cable is the shielded twisted-pair, co-axial and fibre optic cabling as discussed below. Please note that cables and cards chosen should match each other.

(a) Twisted-Pair wiring - Twisted-pair wiring or cabling is the same type of cabling system which is used for home and office telephone system. It is inexpensive and easy to install. Technological improvements over the last few years have increased the capacity of twisted-pair wires so that they can now handle data communications with speeds up to 10 mbps (million of bits per second) over limited distances.

(b) Coaxial cable - It is a well established and long-used cabling system for terminals and computers. This cabling comes in a variety of sizes to suit different purposes. Coaxial cable is commonly used to connect computers and terminals in a local area such as an office, floor, building or campus.

(c) Fiber Optic Cables - Many organizations are replacing the older, copper wire cables in their networks with fiber Optic cables. Fiber optic cables use light as the communications medium. To create the on-and-off bit code needed by computers, the light is rapidly turned on and off on the channel. Fiber optic channels are light weight, can handle many times the telephone conversation or volumes of data handled by copper wire cabling, and can be installed in environments hostile to copper wire, such as wet areas or areas subject to a great deal of electromagnetic interference. Data is more secure in fiber optic networks.