
UNIT 6: TELECOMMUNICATION

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6.0 AIMS AND OBJECTIVES

After studying this unit, you will be able to explain,

- To describe the basic components of a telecommunication
- To describe the three basic network topologies
- The functions of telecommunication
- The types of communication channel, e.t.c.

6.1 INTRODUCTION

Telecommunication can be defined as communication of information by electronic means, usually over some distance.

We are currently in the middle of a telecommunication revolution that has two components: rapid changes in the technology of communications and equally important changes in the ownership, control, and marketing of telecommunications services. Today managers need to understand the capabilities, costs, and benefits of alternative communications technologies and how to maximize their benefits for their organizations.

Change in the telecommunication industry was accompanied by changes in telecommunication technology. Previously, telecommunications meant voice transmission over telephone lines. Today, much telecommunications transmission is digital data

transmission, using computers to transmit data from one location to another. Online information system and remote access to information would be impossible without telecommunications.

Deregulation and the marriage of computers and communications has also made it possible for the telephone companies to expand from traditional voice communications into new information services, such as providing transmission of news reports, stock reports, television programs, and movies.

6.2 COMPONENTS AND FUNCTIONS OF A TELECOMMUNICATIONS SYSTEM

A telecommunications system is a collection of compatible hardware and software arranged to communicate information from one location to another. Figure 6.1: illustrates the components of a typical telecommunications system. Telecommunications systems can transmit text, graphic images, voice, or video information. This section describes the major components of telecommunications systems. Subsequent sections describe how the components can be arranged into various types of network.

A) Components of a Telecommunications System

The essential components of a telecommunications system are these:

1. Computers to process information.
2. Terminals or any input/output devices that send or receive data.
3. Communications channels, the links by which data or voice are transmitted between sending and receiving devices in a network. Communications channels use various communications media, such as telephone lines, fiber optic cables, coaxial cables, and wireless transmission.
4. Communications processors, such as modems, multiplexer, controllers, and front-end processors, which provide support functions for data transmission and reception.
5. Communications software that controls input and output activities and manages other functions of the communications network.

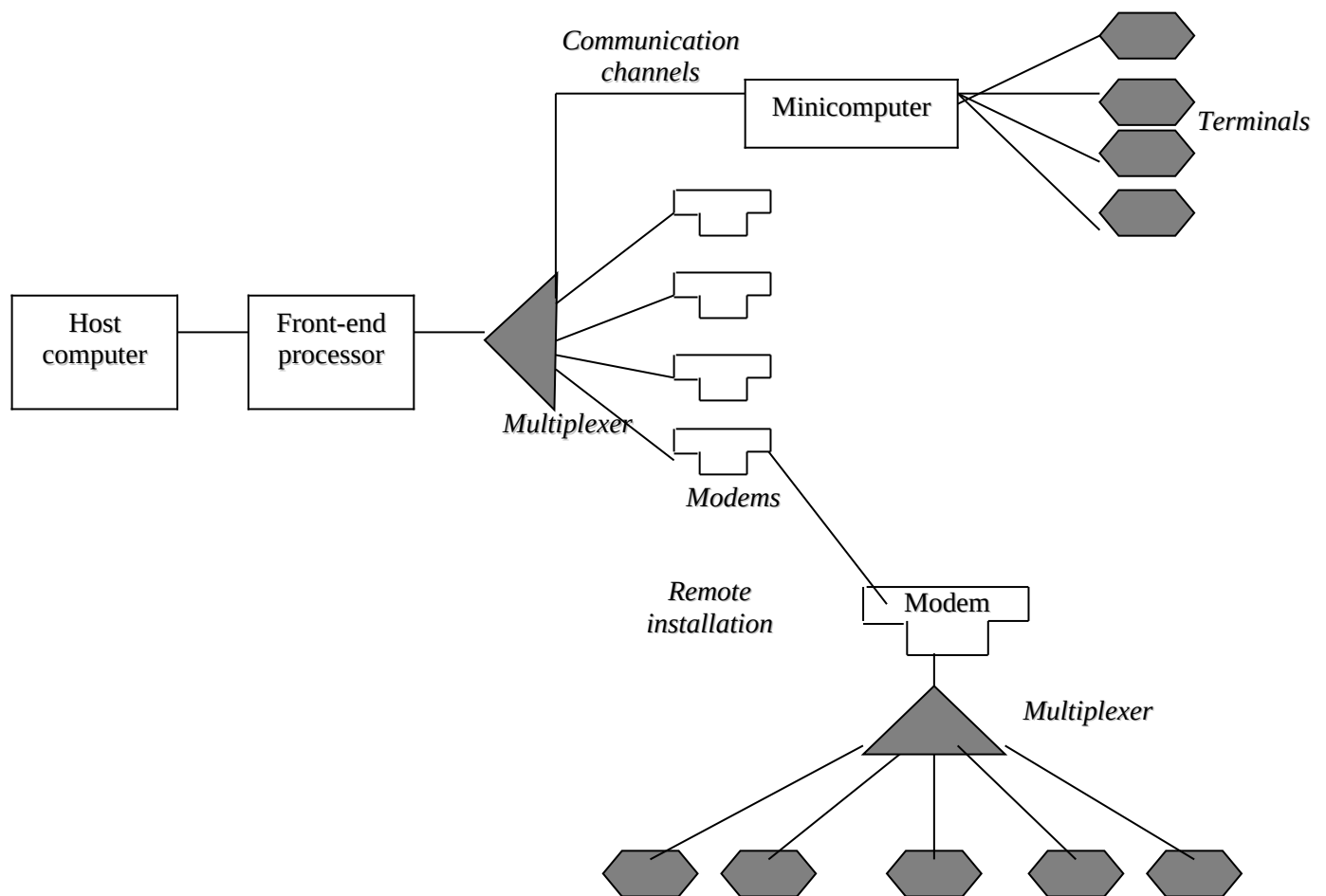


Figure 6.1: Components of a telecommunication system

B) Functions of a Telecommunications System

In order to send and receive information from one place to another, a telecommunications system must perform a number of separate functions. These functions are largely invisible to the people using the system. As outlined in table 6.1: a telecommunications system transmits information, establishes the interface between the sender and the receiver, routes messages along the most efficient paths, performs elementary processing of the information to ensure that the right message gets to the right receiver, performs editorial tasks on the data (such as checking for errors and rearranging the format), and converts messages from one format to another. Lastly, the telecommunications system controls the flow of information. Many of these tasks are accomplished by computer.

Protocols

A telecommunications network typically contains diverse hardware and software components that need to work together to transmit information. Different components in a network can communicate by adhering to a common set of rules that enable them to "talk" to each other. This set of rules and procedures governing transmission between two points in a network is called a **protocol**. Each device in a network must be able to interpret the other device's protocol.

The principal functions of protocols in a telecommunications network are to identify each device in the communication path, to secure the attention of the other device, to verify correct receipt of the transmitted message, to verify that a message requires retransmission because it cannot be correctly interpreted, and to perform recovery when errors occur. Although business, government, and the computer industry recognize the need for common communications standards, the industry has yet to put a universal standard into effect.

Table 6.1: Functions of Telecommunications

Function	Definition
Transmission	Media, networks, and path
Interface	Path – sender – receiver
Routing	Choosing the most efficient path
Processing	Getting the right message to the right receiver
Editorial	Checking for errors, formats, and editing
Conversion	Changing speeds and codes from one device to another
Control	Routing messages, polling receivers providing network structure maintenance

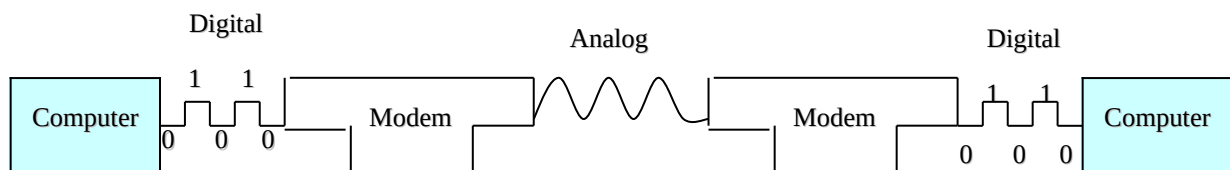
Types of Signals: Analog and Digital

Information travels through a telecommunications system in the form of electromagnetic signals. Signals are represented in two ways: there are analog and digital signals. An **analog signal** is represented by a continuous waveform that passes through a communications medium. Analog signals are used to handle voice communications and to reflect variations in pitch.

A **digital signal** is a discrete rather than a continuous waveform. It transmits data coded into two discrete states: 1-bits and 0-bits, which are represented on-off electrical pulses. Most

computers communicate with digital signals, as do many local telephone companies and some larger networks. But if a telecommunications system, such as traditional telephone network, is set up to process analog signals – the receivers, transmitters, amplifiers, and so forth – a digital signal cannot be processed without some alternations. All digital signals must be translated into analog signals before they can be transmitted in an analog system. The device that performs this translation is called a **modem**. (Modem is an abbreviation for MOdulation/DEModulation.) A modem translates the digital signals of a computer into analog form for transmission over ordinary telephone lines, or it translates analog signals back into digital form for reception by a computer (See figure below).

Figure 6.2 Functions of a Modem



C) Types of Communications Channel

Communications channels are the means by which data are transmitted from one device in a network to another. A channel can utilize different kinds of telecommunications transmission media: twisted wire, coaxial cable, fiber optics, terrestrial microwave, satellite, and wireless transmission. Each has certain advantages and limitations. High speed transmission media are more expensive in general, but they can handle higher volumes (which reduces the cost per bit). For instance, the cost per bit of data can be lower via satellite link than via leased telephone line if a firm uses that satellite link 100 percent of the time. There is also a wide range of speeds possible for any given medium depending on the software and hardware configuration.

1) Twisted Wire

Twisted wire consists of strands of copper wire twisted in pairs and is the oldest transmission medium. Most of the telephone system in a building relies on twisted wires installed for analog communication. Most buildings have additional cables installed for future expansion,

and so there are usually a number of twisted-pair cables unused in every office of every building. These unused cables can be used for digital communications. Although it is low in cost and is already in place, **twisted wire** is relatively slow for transmitting data, and high-speed transmission causes interference called cross talk. On the other hand, new software and hardware have raised the capacity of existing twisted-wire cables up to 10 megabits per second, which is often adequate for connecting microcomputers and other office devices.

2) Coaxial Cable

Coaxial cable, like that used for cable television, consists of thickly insulated copper wire, which can transmit a larger volume of data than twisted wire can. It is often used in place of twisted wire for important links in a telecommunications network because it is a faster, more interference-free transmission medium, with speeds of up to 200 megabits per second. However, coaxial cable is thick, is hard to wire in many buildings, and cannot support analog phone conversations. It must be moved when computers and other devices are moved.

3) Fiber Optics

Fiber optic cable consists of thousands of strands of clear glass fiber, the thickness of a human hair, which are bound into cables. Data are transformed into pulses of light, which are sent through the fiber optic cable by a laser device at a rate of 500 kilobits to several billion bits per second. On the one hand, fiber optic cable is considerably faster, lighter, and more durable than wire media and is well suited to systems requiring transfers of large volumes of data. On the other hand, fiber optic is more difficult to work with, more expensive, and harder to install. It is best used as the backbone of a network and not for connecting isolated devices to a backbone. In most networks, fiber optic cable is used as the high speed trunk line, while twisted wire and coaxial cable are used to connect the trunk line to individual devices.

4) Wireless Transmission

Wireless transmission that sends signals through air or space without any physical tether has emerged as an important alternative to tethered transmission channels such as twisted wire, coaxial cable, and fiber optics. Today, common uses of wireless data transmission include pagers, cellular telephones, microwave transmissions, communication satellites, mobile data

networks, personal communications services, personal digital assistants, and even television remote controls.

The wireless transmission medium is the electromagnetic spectrum. Some types of wireless transmission, such as microwave or infrared, by nature occupy specific spectrum frequency ranges (measured in megahertz). Other types of wireless transmissions are actually functional uses, such as cellular telephones and paging devices that have been assigned a specific range of frequencies by national regulatory agencies and international agreements. Each frequency range has its own strengths and limitations, and these have helped determine the specific function or data communications niche assigned to it.

5) Microwave systems, both terrestrial and celestial, transmit high frequency radio signals through the atmosphere and are widely used for high volume, long distance, point to point communication. Because microwave signals follow a straight line and do not bend with the curvature of the earth, long distance terrestrial transmission systems require that transmissions be positioned 25 to 30 miles apart, adding to the expense of microwave.

This problem can be solved by bouncing microwave signals off satellites, enabling them to serve as relay stations for microwave signals transmitted from terrestrial stations. Communication satellites are cost effective for transmitting large quantities of data over long distances. Satellites are typically used for communications in large, geographically dispersed organizations that would be difficult to tie together through cabling media or terrestrial microwave.

Conventional communication satellites move in stationary orbits approximately 22,000 miles above the earth. A newer satellite medium, the low orbit satellite, is beginning to be deployed. These satellites travel much closer to the earth and so are able to pick up signals from weak transmitters. They also consume less power and cost less to launch than conventional satellites.

Other wireless transmission technologies have recently been developed and are being used in situations requiring mobile computing power. **Paging systems** have been in common use for several decades, originally just beeping when the user receives a message and requiring the user to telephone an office to learn what the message is. By the mid 1980s, however, paging

devices have been able to receive short alphanumeric messages that the user reads on the pager's screen. Paging is useful for communicating with mobile workers such as repair crews; one way paging can also provide an inexpensive way of communicating with workers in offices.

Cellular telephones (sometimes called mobile telephones) work by using radio waves to communicate with radio antennas (towers) placed within adjacent geographic areas called *cells*. A telephone message is transmitted to the local cell by the cellular telephone and then is handed off from antenna to antenna – cell to cell – until it reaches the cell of its destination, where it is transmitted to the receiving telephone. As a cellular signal travels from one cell into another, a computer that monitors signals from the cells switches the conversation to a radio channel assigned to the next cell. The radio antenna cells normally cover eight-mile hexagonal cells, although their radius is smaller in densely populated localities. While the cellular telephone infrastructure has primarily been used for voice transmission, recent developments have made it capable of two-way digital data transmission.

Wireless network explicitly designed for two way transmission of data files are called mobile data networks. These radio based networks transmit data to and from hand held computers. Another type of mobile data network is based upon a series of radio towers constructed specifically to transmit text and data. Ram Mobile Data (jointly owned by Ram Broadcasting and Bell South) and Ardis (jointly owned by IBM and Motorola) are two publicly available networks that use such media for national two-way data transmission.

One new wireless cellular technology that should begin to be available for both voice and data in 1996 is called personal communication services (PCS). PCS uses lower power, higher frequency radio waves than does cellular technology. Because of the lower power, PCS cells are much smaller and so must be more numerous and closer together. The higher frequency signals enable PCS devices to be used in many places where cellular telephones are not effective, such as in tunnels and inside office buildings. Moreover, because PCS telephones need less power, they can be much smaller (shirt pocket size) and less expensive than cellular telephones.

Personal digital assistants (PDA) are small, pen-based, hand-held computer capable of entirely digital communications transmission. They have build in wireless telecommunications capabilities as well as work organization software. A well-known example is the one pound Apple Newton Message Pad. It can be equipped with a special card that allows it to function as a pager, and when hooked to a cigarette package sized modem, it will transmit E-mail, faxes, documents for printing, and data to other computers. The Newton also includes an electronic scheduler, calendar and notepad software, and is able to accept handwriting input entered through its special stylus.

D) Characteristics of Communications Channel

The characteristics of the communications channel help determine the efficiency and capabilities of a telecommunications system. These characteristics include the speed of transmission, the direction in which signals may travel, and the mode of transmission.

1) Transmission Speed

The total amount of information that can be transmitted through any telecommunications channel is measured in bits per second (BPS). Sometimes this is referred to as the baud rate. A baud is a binary event representing a signal change from positive to negative or vice versa. The baud rate is not always the same as the bit rate. At higher speeds, a single signal change can transmit more than one bit at a time so the bit rate will generally surpass the baud rate.

Since one signal change, or cycle, is required to transmit one or several bits per second, the transmission capacity of each type of telecommunications medium is a function of its frequency, the number of cycles per second that can be sent through that medium measured in hertz. The range of frequencies that can be accommodated on a particular telecommunications channel is called its bandwidth. The bandwidth is the difference between the highest and lowest frequencies that can be accommodated on a single channel.

Table 6.2 compares the transmission speed and relative costs of the major types of transmission media

Table 6.2 : Typical Speeds and Cost of Telecommunications Transmission Media

Medium	Speed	Cost
Twisted wire	300 BPS – 10 MBPS	Low

Microwave	236 KBPS – 100MBPS	High
Satellite	256 KBPS – 100 MBPS	
Coaxial cable	56 KBPS – 200 MBPS	
Fiber optic cable	500 KBPS – 10 GBPS	

BPS = bits per second KBPS = Kilobits per second
MBPS = megabits per second GBPS = gigabits per second

2) Transmission Modes

There are several conventions for transmitting signals; these methods are necessary for devices to communicate when a character begins or ends. **Asynchronous transmission** (often referred to as start-stop transmission) transmits one character at a time over a line, each character framed by control bits – a start bit, one or two stop bits, and a parity bit. Asynchronous transmission is used for transmitting large volumes of data at high speed transmission.

Synchronous transmission transmits groups of characters simultaneously, with the beginning and ending of a block of characters determined by the timing circuitry of the sending and receiving devices. Synchronous transmission is used for transmitting large volumes of data at high speeds.

3) Transmission Direction

Transmission must also consider the direction of data flow over a telecommunications network. In **simplex transmission**, data can travel only in one direction at all times. In **half duplex transmission**, data can flow two ways but can travel in only one direction at a time. In **full duplex transmission**, data can be sent in both directions simultaneously.

4) Communications Processors

Communications processors, such as front end processors, concentrators, controllers, multiplexers, and modems, support data transmission and reception in a telecommunications network.

The **front-end processor** is a small computer (often a programmable minicomputer) dedicated to communications management and is attached to the main, or host, computer in a

computer system. The front-end processor performs special processing related to communications such as error control, formatting, editing, controlling, routing, and speed and signal conversion. It takes some of the load off the host computer. The front end processor is largely responsible for collecting and processing input and output data to and from terminals and grouping characters into complete messages for submission on the CPU of the host computer.

A **concentrator** is a programmable telecommunications computer that collects and temporarily stores messages from terminals until enough messages are ready to be sent economically. The concentrator then "bursts" signals to the host computer.

A **controller**, which is often a specialized minicomputer, supervises communications traffic between the CPU and peripheral devices such as terminals and printers. The controller manages messages from these devices and communicates them to the CPU. It also routes output from the CPU to the appropriate peripheral device.

A multiplexer is a device that enables a single communications channel to carry data transmissions from multiple sources simultaneously. The multiplexer divides the communications channel so that it can be shared by multiple transmission devices. The multiplexer may divide a high-speed channel into multiple channels of slower speed or may assign each transmission source a very small slice of time for using the high-speed channel.

6.3 TYPES OF TELECOMMUNICATIONS NETWORKS

A number of different ways exist to organize telecommunications components to form a network and hence provide multiple ways of classifying networks. Networks can be classified by their **shape** or **topology**. Networks can also be classified by their geographic scope and the type of services provided. Wide area networks, for example, encompass a relatively wide geographic area, from several miles to thousands of miles, whereas local networks link local resources such as computers and terminals in the same department or building of a firm. This section will describe the various ways of looking at networks.

A) Network Topologies

1) Star Network

The **star network** (see figure 6.3) consists of a central host computer connected to a number of smaller computers or terminals. This topology is useful for applications where some processing must be centralized and some can be performed locally. One problem with the star network is its vulnerability. All communication between points in the network must pass through the central computer. Because the central computer is the traffic controller for the other computers and terminals in the network, communication in the network will come to a standstill if the host computer stops functioning.

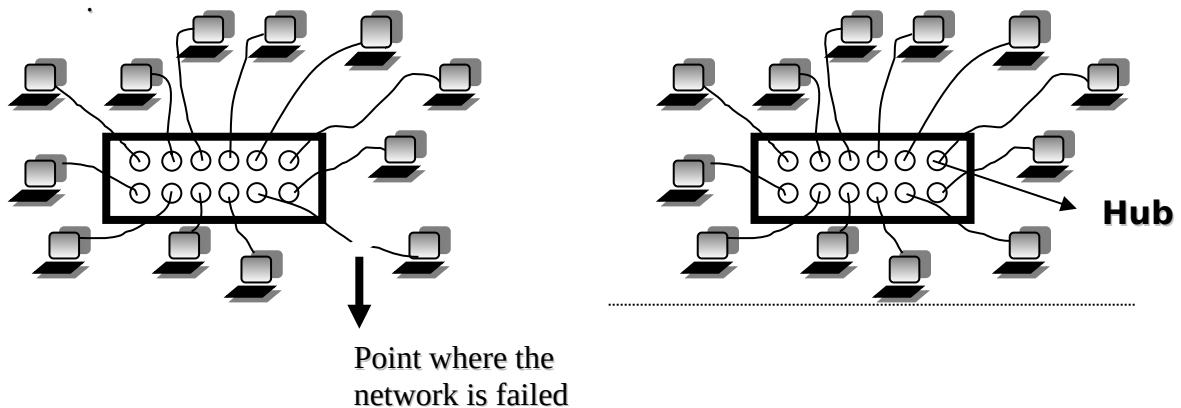


Figure 6.3 Star Net Work

Topology

All computers will be attached to a central controller called a hub forming a star like structure. The hub (sometimes called the *concentrator*) is a central device and it is a connector.

Usually, the hub in its end will be attached to a server and all the computers that are connected with the hub are clients. So any request from the clients will pass through the hub and reaches to the server. Generally, the hub will act as a traffic controlling the requests from the clients this topology is advantageous if you specially consider the network failure and collision of data. If there is any interruption between one of the clients and the hub, then the other clients will normally work. Second, since there is a dedicated controller, the hub, collision is much reduced. The disadvantage of this topology is we need to use more cable and if the hub fails, then the whole network will fail. So the entire network is dependent on the hub.

2) The Bus Network

The bus network links (see figure 6.4) links a number of computers by a single circuit made of twisted wire, coaxial cable, or fiber optic cable. All of the signals are broadcast in both directions to the entire network, with special software to identify which components receive each message (there is not central host computer to control the network). If one of the computers in the network fails, non of the other components in the network is affected. This topology is commonly used for local are networks (LANs), discussed in the following section.

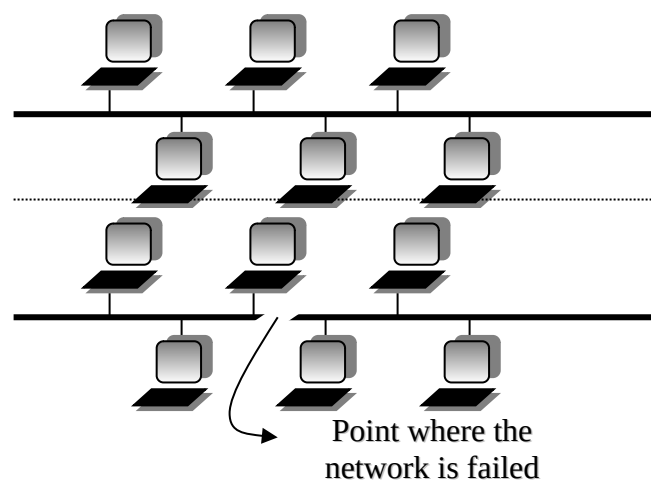


Figure 6.4 The Bus Net Work Topology

The Ring Network

Like the bus network, the ring network (see figure 6.5) does not rely on a central host computer and will not necessarily break down if one of the component computers malfunctions. Each computer in the network can communicate directly with any other computer, and each processes its own applications independently. However, in ring topology, the connecting wire, cable, or optical fiber forms a closed loop. Data are passed along the ring from one computer to another and always flow in one direction.

The token ring network is a variant of the ring network. In the token ring network, all of the devices on the network communicate using a signal or "token." The token is a predefined packet of data, which includes data indicating the sender, receiver, and whether the packet is in use. The tokens may contain a message or be empty.

A token moves from device to device in the network, and each device examines the token as it passes by. If the token contains data and is meant for the device, the device accepts the data and marks the packet as empty. If a computer wants to send a message, it finds an available token; supplies sender, receiver, and message data; loads the message onto the token; and marks it as used. If no message is pending, the token passes unchanged. The token ring configuration is most useful for transmitting large volumes of data between micros and a larger computer.

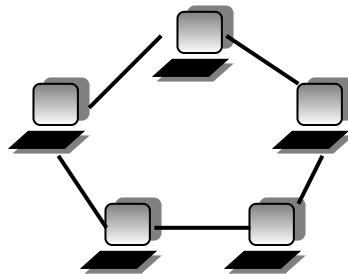


Figure 6.5 The Ring Network Topology

All the nodes are connected in a loop forming a circular structure, just like a ring. This is very similar with bus topology, but except the first and the last nodes is connected to each other. The advantage of the ring topology is we use here again less amount of cable and collision is reduced than bus since the data flow only in one direction. The disadvantage of this topology is whenever there is an interruption at some point; the whole network will go down.

B) Private Branch Exchanges and Local Area Networks

Networks may be classified by geographic scope into local networks and wide area networks. Local networks consist of private branch exchanges and local area networks.

1) Private Branch Exchange

A private branch exchange (PBX) is a special purpose computer designed for handling and switching office telephone calls at a company site. Today's PBXs can carry both voice and data to create local networks.

While the first PBXs performed limited switching functions, they can now store, transfer, hold, and redial telephone calls. PBXs can also be used to switch digital information among computers and office devices. For instance, you can write a letter on a microcomputer in your office, send it to the printer, then dial up the local copying machine and have multiple copies of your letter created. All of this activity is possible with digital PBX connecting “smart” machines in the advanced office. Figure 6.6 illustrates a PBX system.

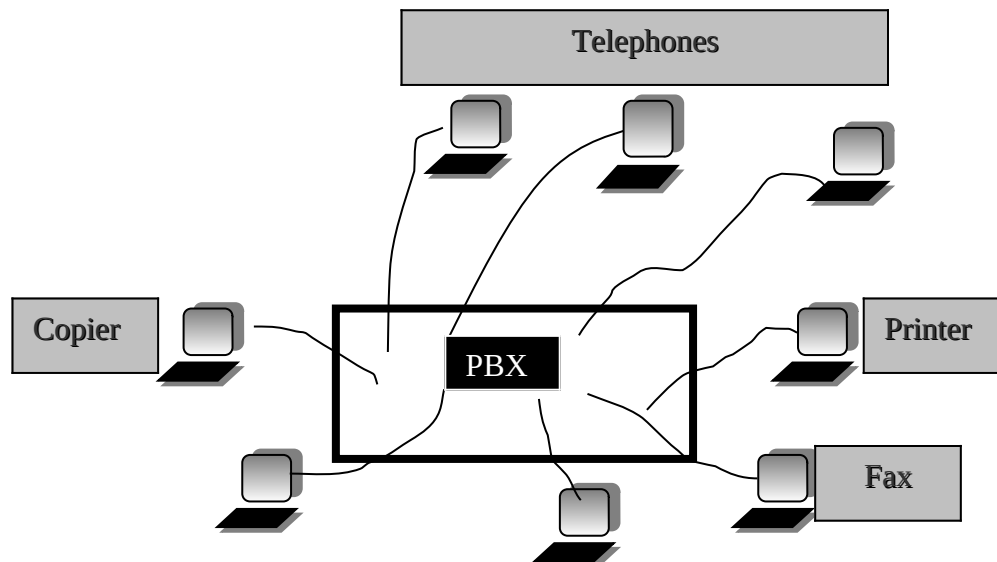


Figure 6.6 PBX System

The advantage of digital PBXs over other local networking options is that they utilize existing telephone lines and do not require special wiring. A phone jack can be found almost anywhere in the office building. Equipment can therefore be moved when necessary with little worry about having to rewire the building. A hard-wired computer terminal or microcomputer connected to a mainframe with coaxial cable must be rewired at considerable cost each time it is moved. A microcomputer connected to a network by telephone can simply be plugged or unplugged anywhere in the building, utilizing the existing telephone lines. PBXs are also supported by commercial vendors such as the local telephone company, so that the organization does not need special expertise to manage them.

2) Local Area Networks

A **local area network (LAN)** encompasses a limited distance, usually one building or several buildings in close proximity. Most LANs connect devices located within a 2000 foot radius and have been widely used to link microcomputers. LANs require their own communications channels.

LANs generally have higher transmission capacities than PBXs, using bus or ring topologies and a high bandwidth. A very fast PBX can have a maximum transmission capacity of over 2 megabits per second. LANs typically transmit at a rate of 256 kilobits per second to over 100 megabits per second. They are recommended for applications requiring high volumes of data and high transmission speeds. For instance, because a picture consumes so many bits of information, an organization might require a LAN for video transmissions and graphics. LANs are totally controlled, maintained, and operated by end users. This produces the advantage of allowing user control, but it also means that the user must know a great deal about telecommunications applications and networking.

LANs allow organizations to share expensive hardware and software. For instance, several microcomputers can share a single printer by being tied together in a LAN. LANs can promote productivity because users are no longer dependent upon a centralized computer system (which can fail) or upon the availability of a single peripheral device such as a printer. Finally, there are many new applications – such as electronic mail, graphics, video teleconferencing, and on line applications – requiring high capacity networks.

The file server acts as a librarian, storing various programs and data files of network users. The server determines who gets access to what and in what sequence. Servers may be powerful microcomputers with large hard disk capacity, workstations, microcomputers, or mainframes, although specialized computers with large hard disk capacity, workstations, minicomputers, or mainframes, however specialized computers are now available for this purpose. The server typically contains the LAN's network operating system, which manages the server and routes and manages communications on the network.

The network gateway connects the LAN to public networks, such as the telephone network, or to other corporate networks so that the LAN can exchange information with networks external to it. A gateway is generally a communications processor that can connect dissimilar networks by translating from one set of protocols to another. (A bridge connects two networks of the same type. A route is used to route messages through several connected LANs or to a wide area network).

There are four principal LAN technologies for physically connecting devices Ethernet, developed by Xerox, Digital Equipment Corporation, and Intel; AppleTalk from Apple Computer Incorporated; token ring, developed by IBM and Texas Instruments; and ARCnet, developed by Data point. They employ either a Base band or a broadband channel technology. Base band products provide a single path for transmitting text, graphics, voice, or video data, and only one type of data at a time can be transmitted. **Broadband** products provide several paths so that different types of data can be transmitted simultaneously.

LAN capabilities are also defined by the network operating system. The network operating system can reside on every computer in the network, or it can reside on a single designated file server for all the applications on the network. Some of the leading network operating systems include Novell's Netware, Microsoft's LAN Manager, and IBM's PC LAN (AppleTalk for networks of Macintosh computers combines' technology for physically connecting devices with network operating system functions).

The primary disadvantages of LANs are that they are more expensive to install than PBXs and are more inflexible, requiring new wiring each time the LAN is moved. LANs require

specialized trained staff to manage and run them. There are four important criteria for evaluating LANs:

1. How flexible is the system (can new users be added, and how many)?
2. What is the actual performance (as opposed to advertising claims)?
3. What is the true cost of the network, including software, implementation, rewiring, training, network management, and opportunity cost of use?
4. How reliable will the system be in the face of various sorts of disturbances?

The computers in these networks are usually near to each other. LAN covers a confined area, usually an office, a building or groups of near-by buildings. Since the *nodes* (devices attached to the network) are near to each other, they are connected using cabling system. As a result, the following two types of networking is generally referred as models of LANs. These two models are:

a) Client/Server Model

In this model, some nodes are dedicated to serve the others. The dedicated ones are called *servers* and the others are referred as *clients*. Each server here usually is a powerful computer with a very high speed containing the data and resources needed by the client. So, clients will send requests asking server to provide data and resources and the servers will fulfill their request.

Take each computer connected to a client/server model network: it can be a client or a server, not both. A client computer cannot communicate with another client computer directly, rather if there is any data to be sent to another client, then it will send the data to the server and the server is the one who sends actually the data to the mentioned client computer. Therefore data flow and communication is only between clients and servers. If a client/server model network has one server and three clients, then the data flow and communication can be indicated as shown below:

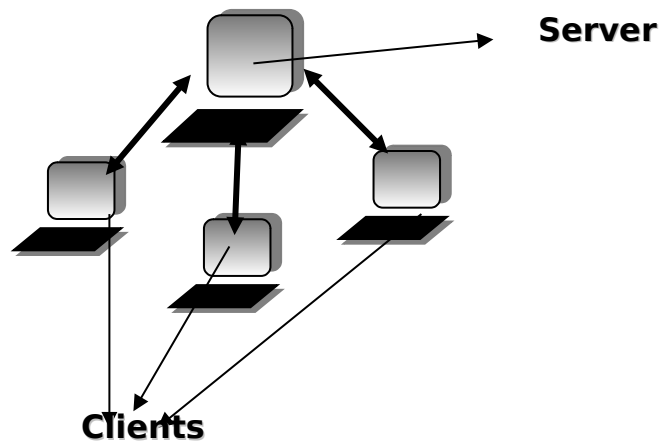


Figure 6.7 Client/Server Model

b) Peer-to-peer Model

In this case, the situation is different from the client/server model because here every computer has equal responsibility. There is no any dedicated server or dependent clients. Each computer can be a client and another time a server. Because computer asks data and resource from another computer the first computer is acting as a client and the second one as a server.

In another time the same computer that is asked in the previous case can ask in its turn, the computer that asks it or any other computer in the network for service. And by now this computer is acting as a client, and the other one as a server. In conclusion, data flow and communication will be between each computer. If there are three computers in this network, then the data flow will be like the following:

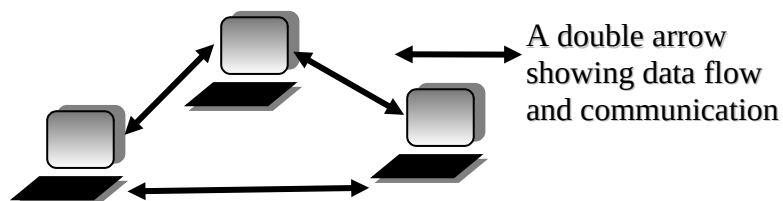


Figure 6.8 Peer-to-peer Model

3) Wide Area Networks (WANs)

Wide area networks (WANs) span broad geographical distances, ranging from several miles to across entire continents. Common carriers (companies licensed by the government to provide communications services to the public, such as AT&T or MCI) typically determine transmission rates or interconnections between lines, but the customer is responsible for

telecommunications contents and management. It is up to the individual firm to establish the most efficient routing of messages, and to handle error checking, editing, protocols, and telecommunications management.

WANs may consist of a combination of switched and dedicated lines, microwave, and satellite communications. **Switched lines** are telephone lines that a person can access from his or her terminal to transmit data to another computer, the call being routed or switched through paths to the designated destination. **Dedicated lines**, or non-switched lines, are continuously available for transmission and the lessee typically pays a flat rate for total access to the line. The lines can be leased or purchased from common carriers or private communications media vendors. Dedicated lines are often conditioned to transmit data at higher speeds than switched lines and are more appropriate for higher volume transmissions. Switched lines, on the other hand, are less expensive and more appropriate for low volume applications requiring only occasional transmission.

4) Value Added Networks

Value added networks are an alternative to firms designing and managing their own networks. **Value added networks (VANs)** are private, multi-path, data only, third party managed networks that can provide economies in the cost of service and in network management because they are used by multiple organizations. The value added network is set up by a firm that is in charge of managing the network. That firm sells subscriptions to other firms wishing to use the network. Subscribers pay only for the amount of data they transmit plus a subscription fee. The network may utilize twisted pair lines, satellite links, and other communications channels leased by the value added carrier.

The term value added refers to the extra “value” added to communications by the telecommunications and computing services these networks provide to clients. Customers do not have to invest in network equipment and software or perform their own error checking, editing, routing, and protocol conversion. Subscribers may achieve savings in line charges and transmission costs because the cost of using the network is shared among many users. The resulting costs may be lower than if the clients had leased their own lines or satellite services. VANs are attractive for firms such as Continental Grain because they provide special services such as electronic mail and access to foreign telecommunications systems.

The leading international value added networks, in addition to GE information Service Company (GEIS), are Infonet, Telenet, and Tymnet. These networks provide casual or intermittent users international services on a dial up basis and can provide a private network using dedicated circuits for customers requiring a full time network. (Maintaining a private network may be most cost effective for organizations with a high communications volume).

Another way value added networks provide economies is through packet switching. Packet switching breaks up a lengthy block of text into small, fixed bundles of data (often 128 bytes each) called packets. The VAN gathers information from many users, divides it into small packets, and continuously uses various communications channels to send the packets. Each packet travels independently through the network (this contrasts to one firm using a leased line, for example, for one hour and then not using it for three or four hours). Packets of data originating at one source can be routed through different paths in the network, and then may be reassembled into the original message when they reach their destination. Packet switching enables communications facilities to be utilized more fully by more users.

Frame relay is a faster and less expensive variant of packet switching. Frame relay is a shared network service that packages data into “frames” that are similar to packets. Frame relay, however, does not perform error correction. This is because so many of today’s digital lines are cleaner than in the past and networks are more adept at correcting transmission problems. Frame relay can communicate at transmission speeds up to 1.544 megabits per second. Frame relay is essentially used for transmitting data. It is not recommended for any transmissions that are sensitive to varying delay, such as voice or digital video traffic, and it cannot easily control network congestion. Frame relay works successfully only over reliable lines that do not require frequent retransmission because of error.

Most corporations today use separate networks for voice, private-lines services, and data, each of which is supported by a different technology. An emerging networking technology called asynchronous transfer mode (ATM) may overcoming some of these problems because it can seamlessly and dynamically switch voice, data, images and video between users. ATM also promises to tie LANs and wide area networks together more easily (LANs are generally based on lowest stopped protocols, whereas WANs operate at higher speeds). ATM technology

parcels information into uniform "cells," each with 53 groups of eight bytes, eliminating the need for protocol conversion. It can pass data between computers from different vendors and permits data to be transmitted at any speed the network handles. ATM currently requires fiber optic cable, but it can transmit up to 2.5 GBPS.

The Advantages of Computer Network

There are three main advantages of any network. These are:

a) To share hardware equipments

Expensive hardware devices can be shared using network. For example, in an office if there are six computers and if there is always a need to print some documents from the users of those computers, then it is difficult and inefficient to buy a printer for each of them. Instead, the best thing to do is to construct a network between the computers and use only one printer, which is also attached to the network. If there is the network, the users of the network can use the printer, which may be attached to one of the computers.

In the case of LAN, if the model is a client/server model, then the device to be shared will be connected with the server and if it is a peer-to-peer model it can be attached with one of the computers. In WAN, it is not common to share hardware devices between countries. But surprisingly, some very powerful and speedy super or mainframe computers can be shared to some authorized users.

b) To share data and software

Data (user file or software) can be shared between connected computers. In LAN, this capability of sharing data will remove sneaker net (carrying disks to transfer data) and as a result virus protection. If the model is client/server, then we will have one or more file servers dedicated to provide only data to clients, but if we are working with peer-to-peer model, every computer can share data equally with the others in the network. In WAN, the most visible application of networks is sharing data and communication, because data can be sent with in a matter of minutes.

c) Communication

Sending and receiving messages is possible in LANs as well as in WANs. In early times, when people share mainframe computers (at that time there were no PCs), by connecting their terminals to the mainframe computer (network), further than sharing the power of the powerful computers, no one was not in a position to think about the network as a tool for communication.

6.4 USE OF TELECOMMUNICATIONS FOR COMPETITIVE ADVANTAGE

Telecommunications has helped eliminate barriers of geography and time, enabling organizations to accelerate the pace of production, to speed decision making, to forge new products, to move into new markets, and to create new relationships with customers. Many of the strategic applications described in would not be possible without telecommunications in their strategic plans will fall behind.

Some of the leading telecommunications applications for communication, coordination, and speeding the flow of transactions, messages, and information throughout business firms are electronic mail, voice mail, facsimile machines (FAX), digital information services, teleconferencing, and electronic data interchange.

1) Electronic Mail

Electronic mail, or e-mail, is the computer-to-computer exchange of messages. A person can use a microcomputer attached to a modem or a terminal to sent notes and even lengthier documents just by typing in the name of the message's recipient.

E-mail eliminates telephone tag and costly long distance telephone charges, expediting communication between different parts of the organization.

E-mail systems present security problems because without adequate protection, electronic eavesdroppers can read the mail as it moves through a network.

2) Voice Mail

A **voice mail** system digitizes the spoken message of the sender, transmits it over a network, and stores the message on disk for later retrieval. When the recipient is ready to listen, the

messages are reconverted to audio form. Various "store and forward" capabilities notify recipients messages for future use, deleting them, or routing them to other parties.

3) Facsimile Machines (FAX)

Facsimile (FAX) machines can transmit documents containing both text and graphics over ordinary telephone lines. A sending FAX machine scans and digitizes the document image. The digitized document is then transmitted over a network and reproduced in hard copy form by a receiving FAX machine. The process results in a duplicate, or facsimile, of the original.

4) Digital Information Services

Powerful and far reaching digital electronic services now enable networking micro computer and workstation users to obtain information from outside the firm instantaneously without leaving their desks. Stock prices, historical references to periodicals, industrial supplies catalogs, legal research, news articles, reference works, weather forecasts, and travel information are just some of the electronic databases that can be accessed on line. Many of these services have capabilities for electronic mail, electronic bulletin boards, and for on line discussion groups, shopping, and travel reservations.

5) Teleconferencing, Data conferencing, and Videoconferencing

People can meet electronically – even though they are hundreds or thousands of miles apart – by using teleconferencing, data conferencing, or videoconferencing. Teleconferencing allows a group of people to "confer" simultaneously via telephone or via electronic mail group communication software (see figure). Teleconferencing that includes the ability of two or more people at distant locations to work on the same document or data simultaneously is called **data conferencing**. With data conferencing, two or more users at distant locations are able to edit and directly modify data (text, such as word processing documents, numeric, such as spreadsheets, and graphic) files simultaneously. Teleconferencing that also has the capability to let participants see each other "face-to-face" over video screens is termed *video teleconferencing* or **videoconferencing**.

These various forms of electronic conferencing are growing in popularity because they save travel time and cost. Legal firms might use videoconferencing to take depositions and to convene meetings between lawyers in different branch offices.

Videoconferencing has usually required special video conference rooms and video cameras, microphones, television monitors, and a computer equipped with a codec device that converts video images and analog sound waves into digital signals and compresses them for transfer over communications channels. Another codec on the receiving end reconverts the digital signals back into analog for display on the receiving monitor.

6) Electronic Data Interchange

Electronic data interchange (EDI) is the direct computer-to-computer exchange between two organizations of standard business transaction documents such as invoices, bills of lading, or purchase orders. EDI saves money and time because transactions can be transmitted from one information system to another through a telecommunications network, eliminating the printing and handling of paper at one end and the inputting of data at the other. EDI may also provide strategic benefits by helping firm “lock in” customers, making it easier for customers or distributors to order from them rather than from competitors.

EDI differs from electronic mail in that transmits an actual structured transaction (with distinct fields such as the transaction date, transaction amount, sender's name and recipient's name) as opposed to an unstructured text message such as a letter.

For EDI to work properly, four key requirements must be addressed:

- a) Transaction standardization:** participating companies must agree on the form of the message to be exchanged. Transaction formats and data must be standardized. The American National Standards Institute (ANSI) has developed the X.12 data interchange protocol as a generic, flexible business data interchange standard for EDI, but specific industries have adopted multiple EDI standards. This can raise problems for inter-organizational networking, since manufacturing, retail, and banking standards might collide.
- b) Translation software:** special software must be developed to convert incoming and outgoing messages into a form comprehensible to other companies.
- c) Appropriate "mailbox" facilities:** companies using EDI must select a third party, value added network with mailbox facilities that allows messages to be sent, sorted, and held until they are needed by the receiving computer. For example, the insurance field

generally uses Information Network, and office systems tend to use GE Information Services.

d) Legal restrictions: to comply with legal requirements, certain transactions require "writing," a "signature," or the "original document" in hard copy form. (EDI messages do not, for example, deal with warranties or limitations of liability and other conditions of doing business typically contained in hard copy business documents.) Parties must agree on the means of verifying that messages are authentic and complete according to the agreed-on protocol, the point in the transaction when the contract between the two parties goes into effect, error-checking procedures, and the level of network security to prevent unauthorized access and use of the system.

As intelligent agent technology and commercial networks open new electronic marketplaces, they will lead to more flexible forms of EDI in which exchange of purchase and sale transactions are not limited to the computer systems of two organizations.

Check Your Progress Exercise

1. Discuss in detail the components of a telecommunication?

2. Discuss in detail the Functions of the telecommunication?

3. Discuss in brief the telecommunication network?

4. Bring about the distinction between data conferencing, teleconferencing, and videoconferencing?

6.5 SUMMARY

A telecommunication system is a set of compatible devices that are used to develop a network for communications from one location to another by electronic means. The essential components of a telecommunication system are computers, terminals or other input/output devices, communication channels, communication processors (such as modems, multiplexes, controllers, and front end processors), and telecommunications software.

Different components of a telecommunication network can communicate with each other with a common set of rules termed protocols.

Data are transmitted throughout a telecommunications network using either analog signals or digital signals. A modem is a device that translates from analog to digital and vice versa.

The principal transmission media are twisted copper telephone wire, coaxial copper cable, fiber optic cable, and wireless transmission utilizing microwave, satellite, low frequency radio, or infrared waves.

The three common network topologies are the star network, the bus network, and the ring network. In a star network, all communication must pass through a central computer. The bus network links a number of devices to single channel and broadcasts all of the signals to the entire network, with special software to identify which components receive each message. In a ring network, each computer in the network can communicate directly with any other computer but the channel is a closed loop. Data are passed along the ring from one computer to another.

Networks can be classified by their shape or configuration or by their geographic scope and type of service produced. Local area network (LANs) and private branch exchange (PBXs) are used to link offices and buildings in close proximity. Wide area networks (WANs) span a

broad geographical distance, ranging from several miles to entire continents and are private networks that are independently managed. Value added networks (VANs) also encompass a wide geographic area but are managed by a third party, which sells the services of the network to other companies.

6.6 ANSWER TO CHECK YOUR PROGRESS

1. Refer to Section 6.2
2. Refer to Section 6.2
3. Refer to Section 6.3
4. Refer to Section 6.4