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COMMUNICATION NETWORKS

Communication systems have achieved a metamorphosis owing to the onset of information revolution and the speedy growth of the service sector. Low-cost phones give way to smart phones offering memory dial, pulse changes, hands-free dialling, wake up calls, etc. The mechanical exchange process are replaced by the analog electronic exchanges and also by digital exchanges, providing facilities like conferencing, call forward, etc. with the advent of sophistication of exchanges and computer technology, standardized data communication channels and process are available In the modern society, which makes it a knowledge based society.

Communication is the process of transmission of data and information from one point to another through a communication network designed to facilitate such exchanges. Almost all communication systems use computer technology. This kind of computer based data communication is called telecommunication-offering advantages like mass data transmission, speedy data transmission, economy, lower rate of errors, etc. The elements of a communication system are:

1. Sender (source) who creates and sends the message.
2. Medium, which transmits the message to the receiver.
3. Receiver (sink) who receives the message.

Working of the Communication System

In a communication system, the transmitter (sender) sends coded messages (messages in the form of symbols) through the channel of communication to the receiver who, in turn, receives it in the form of decoded message. The message to be sent by the sender (source) is encoded by the transmitter (Modem) to facilitate the channel to handle the message easily, and then it is sent to the channel, where it is subject to various noise and distortions, and reaches the decoder (Modem) where it is converted into the original message and then reaches the receiver (destination). The channel of communication carries electrical signals or waves corresponding to the message to be sent and they are converted into the original message when they reach the destination. A typical communication system and its elements can be represented as:

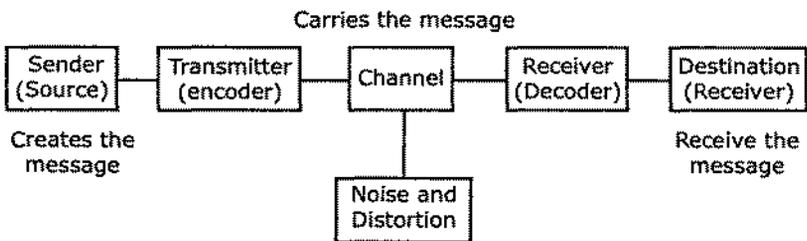


Fig. 8.1: Communication system

Modes of Data Transmission

The electronic systems that transmit data from one point to another are called data transmission systems. Mainly, there are three ways of data transmission. They are:

1. Simplex: In simplex transmission, communication takes place only in one direction. Simplex devices are either send-only or receive - only in nature. Examples are line printers and data collection terminals in factories.

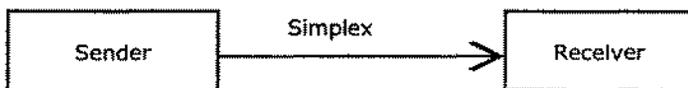


Fig. 8.2: Simplex

2. Half-Duplex: This can transmit data in both directions, but in one direction at a time. It sends and receives data alternatively and is popularly used for voice communication.

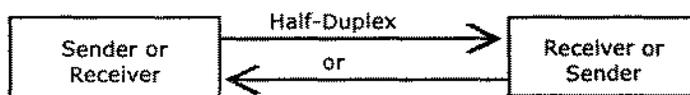


Fig. 8.3: Half-Duplex

3. Full-Duplex: This system facilitates simultaneous transmission of data in both directions of the transmission path.

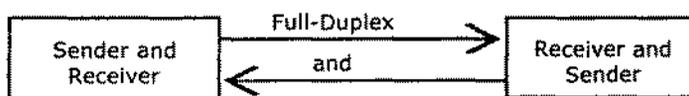


Fig. 8.4: Full-Duplex

Data Transmission Media

Data transmission media or systems mean the physical channels through which data can be transmitted from one point to another. Important such media are divided into two categories, such as: Physical connection lines and Microwave lines. Physical connection lines include:

1. Wire pairs (twisted pairs of copper wires): These are used in local communication devices like telephone, covering short distances (up to 1k.m). These twisted copper wires are used to connect the terminals to the main computer. The transmission speed of this medium is up to 9600 bits per second within a distance of 100 meters.

2. Coaxial cables: They are group of wrapped and insulated wire lines capable of transmitting data at high rates. They offer higher bandwidths and the transmission speed is 10 megabits per second. Coaxial cables are used only in long distance telephone lines and closed circuit T.V.

3. Fiber optics lines (Optical Fibers): In Optical fibers, semiconductor lasers are used to transmit information in the form of light along optical (hair-thin glass) fibers, which have a transmission speed of 1,86,000 miles per second, without losing the intensity.

Microwave Lines of Data Transmission include

1. Microwave system (Line-of sight earth microwave): This system uses high frequency radio waves (signals) to transmit the data through air. Since microwave system uses electromagnetic waves, which cannot pass obstacles like hill, it is essential that this type of transmission is in a line-of-sight. The data transmission speed is about 16 gigabits per second.

2. Communication satellites: A communication satellite is a microwave relay station placed in outer space. Launched by space shuttles or rockets, it is positioned approximately 36000 kms above the equator, to move in a geo-synchronous orbit. The satellite accepts microwave signals at 6 giga hertz and transmits them to the earth at speed of 4 giga hertz. INSAT – 1B of India is an example of a communication satellite.

3. Lasers: These are low-powered beams of light invisible to the naked eye. They are used for short distance transmission of data and can have the capacity to carry tens of thousands of times the data, which a microwave signal can carry.

Microwave data transmission, satellite data transmission, and laser technology together, in communication systems, are referred to as high-speed data transmission systems.

The Concept of Communication Networks

Network is a telecommunication and data transfer system, which permits a number of independent computers to communicate over a variety of media. It refers to the logical extension of a data communication system. The process by which two or more computers are interconnected to facilitate the end-users to communicate with each other, to share the resources, and to overcome the limitations of other communication systems, is referred to as computer networking. The way in which the end points or stations of a network are interconnected is called the topology, which determines the path used between a pair of stations in the network. The important network configurations are:

1. Star Network: It is an arrangement of networking, in such a way that various local computers are attached to a host computer through multiple communication lines. The

local computers are not linked to each other and it is possible for them to communicate with each other through the host computer. Star network configuration can be illustrated as follows:

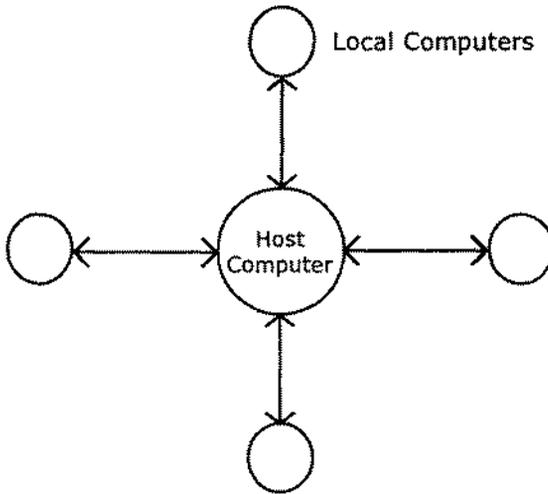


Fig. 8.5: Star Network

2. Ring Network: It is a ring-like arrangement of local computers, with out having a host computer to control the entire communication processes. Each computer receives data from one of its two adjacent computers and has a circular arrangement where there is no master computer in the ring to control the other computer. The typical ring configuration is shown below:

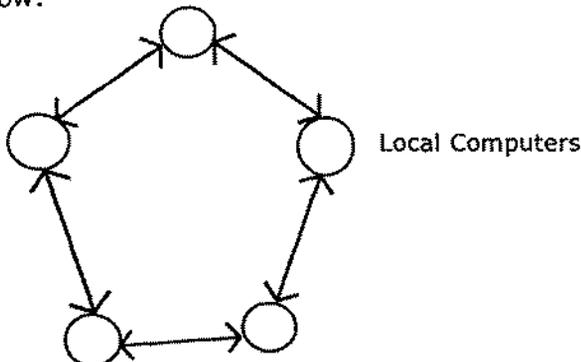


Fig. 8.6: Ring Network

3. Completely Connected Network (Irregular Network): In this type of network, multiple access paths are available between any two computers. It has a separate physical link for connecting each node to any other node; which is referred to as point-to-point link. Control is distributed with each computer in the network. Irregular network can be represented as:

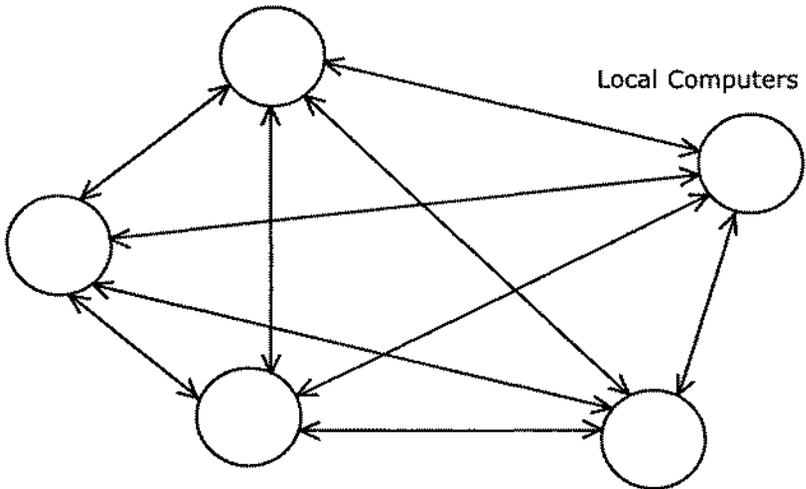


Fig. 8.7: Irregular Network

4. Hybrid Network. (Combination Network): It is a computer network combining the star, ring, and irregular networks, to get the advantage of all the three networks and to overcome their limitations.

A hybrid network takes the following form:

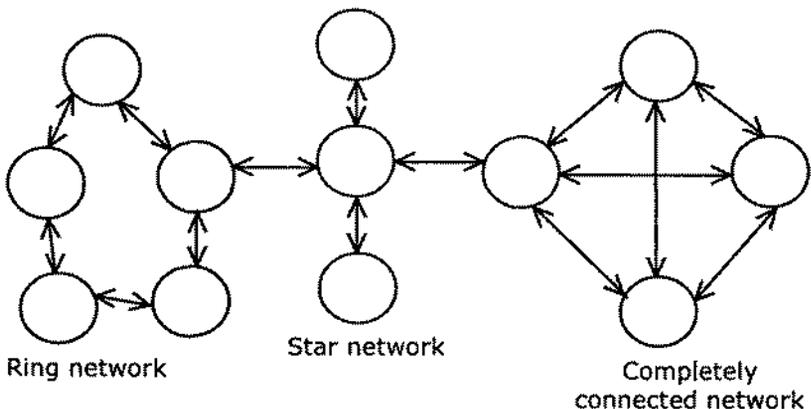


Fig. 8.8: Hybrid Network

5. Multipoint-Network: Connection is established between various local computers through a common, single communication line. Each computer has to wait to transmit its message to the other computers until the communication line is free. When a message travels through the line, each computer checks whether it is addressed to it and the addressee computer picks it up. The network is also called multi drop or broadcasting network. A typical multipoint network is illustrated below:

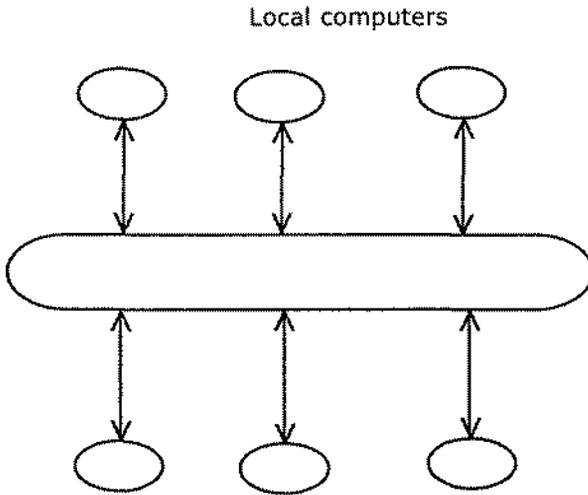


Fig. 8.9: Multipoint-Network

Local Area Network (LAN)

Local Area Network is a digital communication system in which a series of computers in a local area are connected together, and share the peripherals, files, programs and computer capabilities, normally under 1 km across. It is a system of interconnected computers sharing common resources like disks, printers, etc., and allowing many people to use the same software and data files. It is a network operating within a limited area, like an office building or a campus, and is owned by the user organization. Local Area Networks were developed in 1974 by the IBM. They can interconnect micro computers and mainframes as well as peripherals like disks and printers, which can exchange information with one another, and can make use of peripherals.

LAN is constructed of high capacity lines such as coaxial cables. Messages are assembled by the sending device in the form of small packets to indicate the destination. The attached computers can perform a variety of functions, such as word processing and electronic mail. Examples of LAN are Ethernet and Omnet.

LAN Topology

Topology means the structure or layout of the cable used to interconnect workstations on the network. It can also be referred to as the architecture of the network. It signifies the way in which physical connection is established among computers within the network. The most important topologies in LAN are:

1. Loop topology: In Loop topology, terminal devices connected to the loop requires minimum intelligence and the controller uses a poll and select method of access. Loop topology exercises centralized placement of network control in the controller, with the result that the failure of the controller may cause the failure of the entire network.

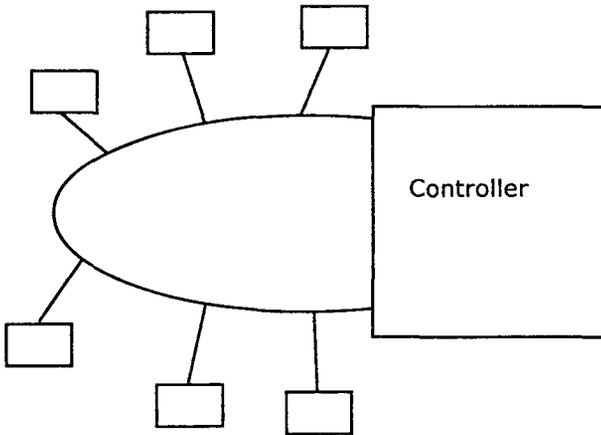


Fig. 8.10: Loop topology

2. Bus topology: Bus topology involves the use of a cable as a long branch into which other branches are interconnected, so that each station on the network is linked to the data highway.

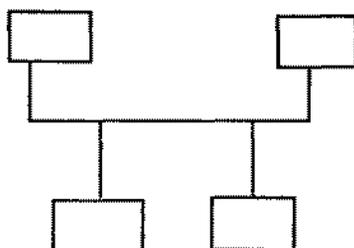


Fig. 8.11: Bus topology

3. Ring topology: Various workstations are connected to form a circle. It is also referred to as a looped bus. Data is circulated around the ring and transmitted to the required point or workstation in the network.

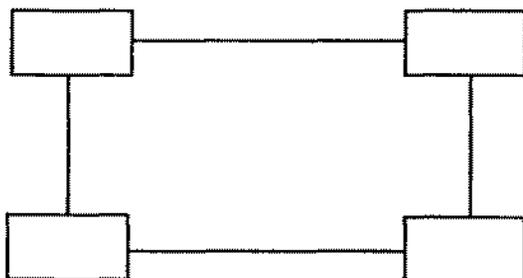


Fig. 8.12: Ring topology

4. Star topology: Each workstation is connected to a common controller in the network, and access to and from each station is controlled by the controller. Access from one node to another can occur only through the central device.

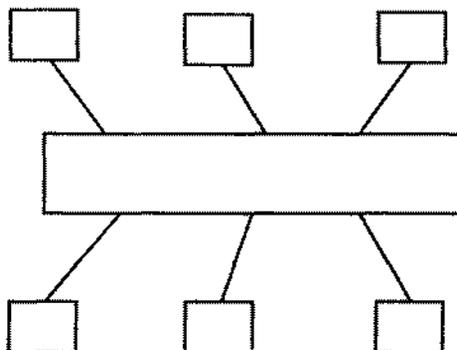


Fig. 8.13: Star topology

5. Tree topology: It is in the nature of a complex bus. The networks has a common point at the top of the structure, which is known as 'headend and cables radiate from there to various nodes, which in turn provide access to the workstations in the network.

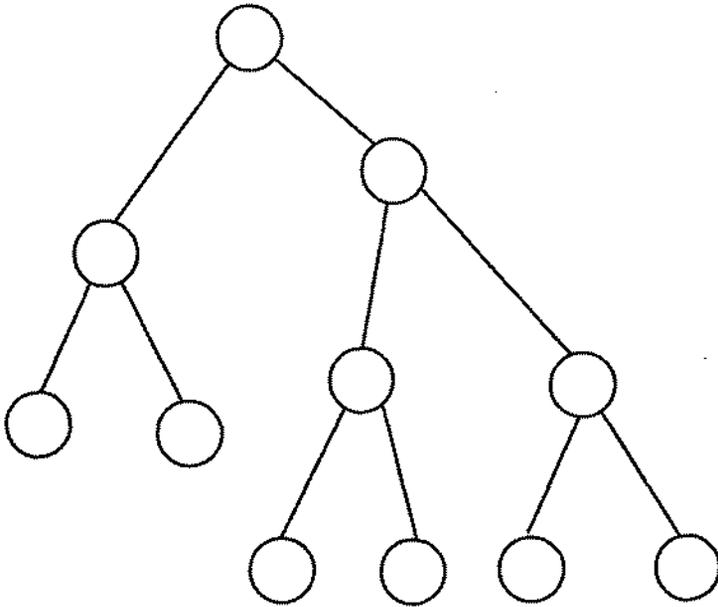


Fig. 8.14: Tree topology

6. Mixed topology: It is a combination of various topologies. An example is the IBM Token-Ring Network in which eight PCs connected to a common device called Multi Station Access Unit (MSAU), which in turn connected in a ring topology to other MSAUs.

The important characteristics of LAN are:

1. Limited geographical coverage.
2. Communication link for sharing information and other resources like, peripherals, software, etc.
3. High transmission speed with in the limited area.
4. Low error rates.
5. Ownership by the user (private ownership).
6. Absence of regulations applicable to the LAN.

The components of a LAN are:

1. Workstation: It refers to a single user microcomputer with high transmission speed and abilities. Workstations are of two types: User workstation and server workstation.

2. File Server: It is a special computer to serve files to other workstations on the network.

3. Gateway: It facilitates communication between LAN's when two networks with different technologies have to communicate with each other, and is also used to connect LAN with a mainframe computer.

4. Network Interface Unit: It is a printed circuit-board installed in the microcomputer to connect the workstations functionally and physically with the network. It is also called network card.

5. Active Hub: It is a distribution point with powerful, active devices to drive distant nodes up to 1 km away.

6. Passive Hub: It is also a distribution point, which does not use power or active devices in the network to connect four nodes within a short distance.

7. LAN Cable: Cable used to transfer data at high speed, e.g., coaxial and fiber optic cables.

8. Network Operating System (NOS): It facilitates the file and print server along with other functions such as e-mail between workstations.

9. Application Software.

10. Protocols.

These are technical guidelines for communication in the network, specifying the order in which signals are transmitted.

Wide Area Network (WAN)

WAN is a digital communication system, which provides communication over long distance. It is capable of interconnecting different sites of computer installations and user terminals, and can facilitate LANs to communicate with each other. It was developed in the 1960s to enable communication between computer centers and sharing hardware, software and other communication facilities. It is also called long haul network. It can be implemented with the help of private or public networks. In private network,

organizations adopt telephone lines on lease to connect the workstations to the network, whereas in public networks, Government-owned telecommunication companies undertake the responsibility. Some of the examples of private networks are INDONET, NICNET, SBINET, WELCOME NET, etc. Advanced communication services of US AT&T, Prestel of British Post Office, Telnnet of the US, DATAPAC of Bell Canada, TRANSPAC of France, etc. are examples of public networks which facilitate transmission of data and provision of value-added services to users.

WAN, is a group of computer covering a large geographical area, which are interconnected and share peripherals, files, programs, and computer capabilities. Remote access is obtained by the installation of a batch terminal at a remote location which is connected through a telephone line and a pair of modems to the computer. WAN can be divided into three categories. They are:

1. Circuit switched network: It is the most popular network where the switching equipment establishes a connection within each pair of devices, which wants to communicate. Telephone network is an example where connection is established between the two telephones, when dialing a particular number.

2. Leased line networks: Groups of lines are routed between telephone company offices with each line used to carry one conversation at a time, which is switched on to the line. Multiplexing technique can be used to reduce the number of physical lines.

3. Packet switching networks: Here blocks of data packets are routed through a fixed network, shared by all communicating devices. The packets use the network as a highway through which they can reach their destinations.

WAN can be useful in E-mail, communication between personal computers, communication with mainframes, Bulletin Board Systems, etc.

Protocols

Protocols are an agreement between two communication devices about the meaning of control information being sent with the data, and to determine how the control information and data are to be packaged. In simple words, it is a set of rules and procedures established to control transmission

between two workstations, so that the receiver can properly interpret the information transmitted by the sender. It is a method for establishing rules for the proper interpretation of controls and data transmitted. International Rs-232 is a common standard protocol.

Modem

Telephone lines use analog signals for data transmission while computers produce digital signals. In order to facilitate communication among these telephone lines and computers, it is necessary to perform a conversion of these signals. The process of converting digital signals to analog signals is called modulation and the process of converting an analog signal to a digital signal is called demodulation. The device used for conversion of these signals is called Modulator-demodulator (Modem), which serves as an interface between the computer and the telephone line. At one end it converts digital signals into analog signals, and at the other end, it converts the analog signals into digital signals. Modem and its working can be expressed as follows.

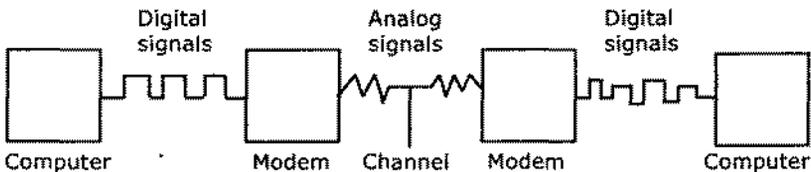


Fig. 8.15: Working of a Modem

Electronic Communication Devices

Electronic Communication Devices transmit and distribute text and image data in electronic form over telecommunication networks. These devices help to reduce the volume of paper communication in the form of memos, letters, circulars, reports and other documents. Important among such communication devices are:

1. E-mail: It is a system of communication which allows the people who are linked together through a network to communicate electronically with another in written form at any time, from anywhere in the world. The user sends an electronic message over the network, which is stored in the

electronic mail box of the receiver. The electronic mail box is a file or server which facilitates the retrieval of messages in it until the recipients are ready to accept them. E-mail facility can be obtained in three ways. In the first way, we have to set up a private network linking the workstations involved in communication. Secondly, we have to subscribe to an e-mail service provider who maintains the network. Finally, we can take the Internet connection. Users can edit, sort, save and classify the messages and forward them to other individuals on the network. If two users are logged on to the network, at the same time, they can converse through E-mail. E-mail systems can have multi media facility, allowing the users to send not only text but also voice and still pictures. The advantages of E-mail are:

1. E-mail allows the organization to be responsive to customer needs.
2. It provides instantaneous access to, and dissemination of, information, thereby eliminating the time lag involved in postal services.
3. E-mail messages do not get lost or reach the wrong party.
4. Messages can be sent at any time.
5. Messages are stored in the mailbox until the receivers are ready to receive them.
6. The recipient can receive the message at any time convenient for him.
7. Copies of messages can be sent to multiple recipients.

The important limitations are:

1. Poor telecommunication facility affects the quality of the message being sent.

2. Recipients must have e-mail access.

2. Voice mail: It transmits digitized voice messages. The sender can dial up the voice mail service organization, and type in identification code. After the identity is checked, the user can send his message in voice form, which is stored in the magnetic disk of the voicemail computer system, and the recipients, when he opens his voice mail box, gets the stored voice message.

3. Teleconferencing: It is a facility allowing people in different places to communicate electronically, without being physically present at one place. It enables people to communicate with each other from their offices, from other countries, etc.

4. Fax: It is a communication technology, which uses telephones, modems and scanners to transmit text and graphics to an individual or organization anywhere in the world. The scanner scans the document at one end, and at the other end the modem receives it. It is also known as facsimile transmission. The whole requirements are a fax machine, a telephone connection, a scanner, a modem, and a printer. The scanned documents are printed by the printer and the fax machine sends it to the recipient.

5. Internet: It is a group of networks and millions of computers across the world are involved in communication and sharing information through the network. It was developed in 1969 by the Pentagon of U.S. and, by 1990, it came to be known as Internet. The important Internet protocols are:

a. TCP/IP – Transmission Control Protocol / Internet protocol, which permits any computer to communicate with any other computer.

b. HTML – Hyper Text Markup Language which explains how the text, messages, images and sound are transmitted

c. HTTP – Hyper Text Transport Protocol, which decides HTML documents to be served through Internet.

d. SMTP – Simple Mail Transfer Protocol that enables the text – based communication.

e. Other support protocols like Telnet, File Transfer protocol, Java, Win stock, etc.

VSNL is the most important agency in India, which provides Internet connections. It provides service like E-mail, User net, Telnet, FTP and WWW.

Distributed Data Bases

Distributed data processing system is considered as a configuration in which a number of geographically spread independent computer systems are interconnected through a telephone network, which facilitates transmission of messages, programs, data and other resources between

co-operating terminals. Each CPU has its own processing power; each computer terminal can have its own power to enter and retrieve data; each input device can have its own power to input data; each output can have its own capability to receive output. All these devices can be grouped in one location. When they are dispersed to various locations, so that the power is distributed to different locations, it becomes a distributed database system. There are a number of advantages for distributed databases, such as: greater flexibility, quick and better access, ability to develop their own specialized applications, lower costs, availability of multiple process, availability of better resources, capturing advantages of both centralized and distributed systems, rapid reaction facilities, etc. But it suffers from a lot of limitations also, like lack of proper society controls, lack of adequate communication standards, difficulty in decentralized control, and high cost of telecommunication facilities.

Conclusion

At the heart of information systems of organizations, there is a central repository of information, which is used by various users. Modern information Systems primarily aim at organizing these data resources, so that they can be communicated to the required parties at the required time and at low cost. With the sophistication of communication technologies and computers, they influence each other. Computer communication facilities like LAN, WAN, Internet, etc., gain competitive advantage over the traditional communication systems and are capable of dispersing reliable information at the right time to the right person without causing any delay in transmission. These sophisticated communication technologies can significantly influence day-to-day business practices.

Exercise

Short Answer Questions

1. What is a communication network?
2. What are the components of a communication system?
3. What do you mean by sink in communication system?
4. Explain the functioning of a communication system.
5. Explain various models of data transmission.
6. What is a simplex mode of data transmission?

7. What are the different data transmission media in operation?
8. What is optical fiber?
9. Write short note on coaxial cables and wire pairs.
10. What are the physical connection lines for data transmission?
11. Explain different microwave lines of data transmission.
12. What is a communication satellite?
13. Explain the concept of network.
14. Write short notes on star, ring and completely connected networks.
15. What is a hybrid network?
16. What are the different network configurations?
17. Explain a multipoint network.
18. Describe a Local Area Network (LAN) and its functioning.
19. What do you mean by topology?
20. What are the different LAN topologies?
21. Write short note on Loop, Bus, Ring, Star, Tree and Mixed Topologies.
22. Describe the characteristics of LAN.
23. What are the components of LAN?
24. Distinguish between active and passive hub.
25. Describe the concept of WAN.
26. What are the different categories of WAN?
27. What do you mean by protocol?
28. What is a modem?
29. What is E-mail and how is it significant in present day business world?
30. What is teleconferencing?
31. What is Voice Mail?
32. What is Internet?
33. Distinguish between internet and intranet
34. What are distributed databases?
35. Explain the significance of Internet.

Essay Questions

1. Explain various data transmission media.
2. Explain various communication networks.
3. Describe LAN its features and working.

4. Compare and contrast LAN and WAN.
5. Describe various electronic communication devices.
6. Explain WAN, its features and functioning.
7. Explain the significance and use of Internet and E-mail.
8. Discuss the recent development in the field of communication networks.