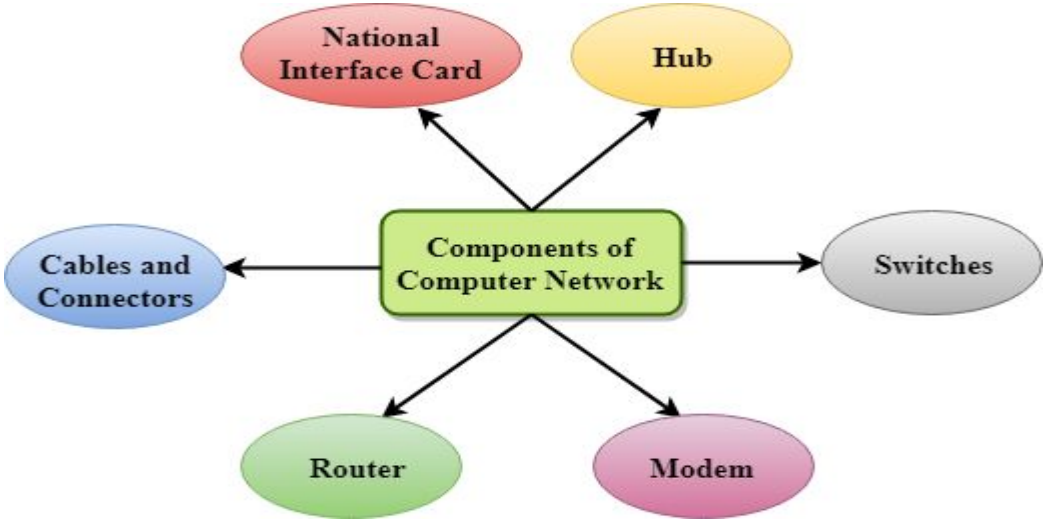
Data Communication and Computer Network

What is Computer Network?

A computer network is a set of devices connected through links. A node can be computer, printer, or any other device capable of sending or receiving the data. The links connecting the nodes are known as communication channels.

Computer Network uses distributed processing in which task is divided among several computers. Instead, a single computer handles an entire task, each separate computer handles a subset.



Different Connecting devices used in computer network

1) **Hub:-** It is also known as multiport repeater.It is normally used for connecting stations in a physical star topology.

   It is the broadcasting device.It sends packets to all nodes in the network.

2) **Repeater :-** It is used to take the distorted,weak and corrupt input signal and regenerate this signal at its output.

   It ensures that the signal are not distorted or weak before it reaches the destination.

   It recreates the bit pattern of the signal, and puts this regenerated signal back on the transmission medium.

   It work in the physical layer with no intelligent function.

Different Connecting devices used in computer network

3) Switch :- It is used to connect multiple computers in which it can direct a transmission to its specific destination.

It is uncasting device. It avoids unnecessary network traffic. It operates in both the physical and the data link layer.

4)**Router:-** It is a device that helps in determining the best and shortest path out of the available paths, for a particular transmission.

Routers use logical and physical addressing to connect two or more logically separate networks.

It works at physical, Data link and network layer of OSI model

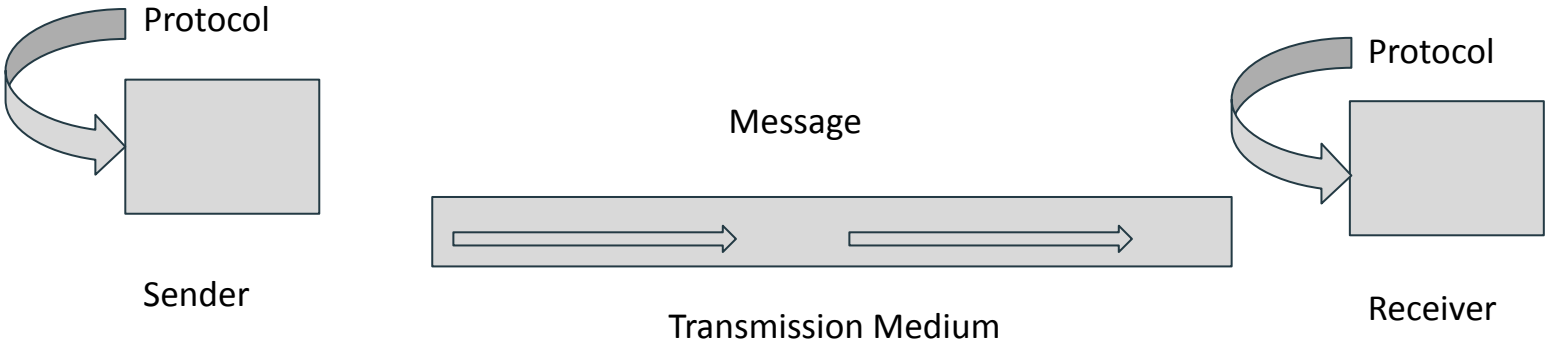
Router read complex network address in packet and efficiently direct packets from one network to another, reducing excessive traffic.

Definition of Data Communication ?

Data Communication is defined as the exchange of information (in the form of 0's and 1's) between two digital devices via some form of transmission medium.

The transfer or exchange of information from one computer to another is known as data communication.

The data communication process is made up of five components namely message sender,receiver,transmission medium and protocol.



Function of each component in data communication

1. The **message** is the information in the form of data to be communicated .It can consist of text,numbers,pictures,sound,video or any combination of these.
2. The **sender** is the device that sends the data message.It can be computer,workstations,telephone and so on.
3. The **receiver** is the device that receive the message.It can be computer,workstations,telephone and so on.
4. The **transmission medium** is the physical path by which a message travel from sender to receiver.It can consist of twisted pair wire,coaxial cable,fibre-optic cable ,laser or radio waves.
5. A **protocol** is refers to a set of rules that coordinate the exchange of information.without the protocol the sender and receiver cannot communicate. Both sender and receiver should follow the same protocol to communicate with each other.

Component of Data Communication

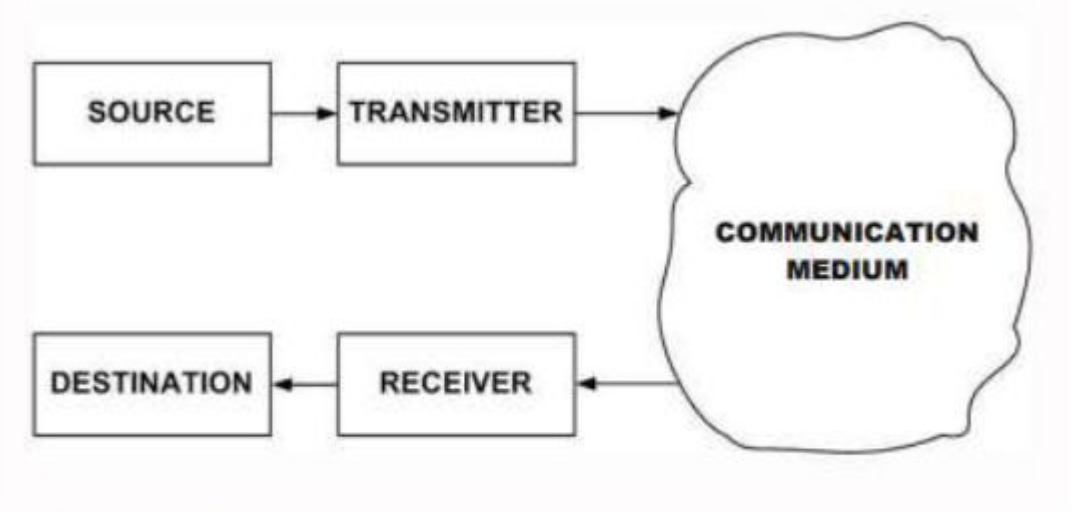


Figure 2.1.1 *Simplified model of a data communication system*

Component of data communication systems are as follows:

1.**Source**:- source generates the data which is to be transmitted. Example of source include telephone terminal, personal computer etc.

2.**Transmitter**:-The transmitter also known as the sender is the device that originates the information transfer. Data from the source are not transmitted in the same from which are generated by source, transmitter converts and encode the data so as to produce electromagnetic signals. Modem is used to convert incoming data stream into analog signals that can be handled by telephone network.

3.**Transmission System**:- It is a single transmission line or network connecting source and destination . Example includes cabling, microwave,fibre optics ,radio waves and so on.

4.**Receiver** :- The Receiver also known as the sink that receives the information transfer. The receiver is to accept the information from transmission line or network and converting it into digital data in the form of stream so that destination can handle the data.

5.**Destination**:-Destination is a device like computer that receives the data.

The efficiency of data communication systems depend on following basic characteristics

1. **Delivery**- the system must deliver data to the correct intended destination.

2. **Accuracy**- the communication system should be delivered data accurately ie without any error.

3.**Timeless**-the communication system must deliver data on time as required. Delay in data delivery my trended data useless for the receiver.

4. **Jitter** - It is the variation in the packet arrival time. Uneven jitter may affect the timeliness of data being transmitted

5.**Transmission system utilization**- it is a measure of use of Transmission facilities that are shared among the number of communicating device various multiplexing techniques are used to share total capacity of transmission medium with number of users

The efficiency of data communication systems depend on following basic characteristics

6.Synchronization- receiver must be able to detect when transmission begins and When It Ends. Synchronization between receiver and transmission should be achieved using handshaking signals

7. Error detection and correction- transmitted signal May get distorted when it travels long distance through medium. For example a file from one computer can be transmitted to other should be accompanied by error detection code.

8.Message formatting- two party should have same agreement about format of data to exchange a transmitted. By the record for characters is to be adopted in universally.

Protocol standards and standard organizations

Protocol :- A protocol is a set of rules and conventions. In other words a protocol is a set of rules that governs data communication.

A protocol is one of the components of data communication system.Without protocol communication cannot occur. For successful communication to occur the sender and receiver must agree upon certain rules in relation with the data such rules called as protocol

Element of protocols

1 syntax-The syntax of protocol defines the structure or format of data.This mean that the order in which it is to be sent is decided. A protocol could define that the first 16 bit of a data transmission must always contain the receiver's address

2.**Semantics**-Protocol semantics defines the interpretation of the data that is being sent. For example the semantics could define that if the last two bits of the receiver's address field contain a 00, it means that the sender and the receiver are on the same network.

3.**Timing**- Timing refers to an agreement the sender and the receiver about the transmission rate and duration.

Function of Protocols

- Protocol defines data Sequencing rule.
- Protocols define data routing rules which the most efficient path between the source and the destination .
- Protocols define data formatting rules which group of bits or characters within packet constitute data, control,addressing,or other information.
- Protocols define flow control of information or data.
- It defines error control rules are designed to detect error in message and to ensure transmission of correct message.
- Protocols defines connection establishment and termination rules that define how connections are established, maintain and terminated when two nodes of a network want to communicate with each other.

Common Protocols

- Ethernet- The protocol is by far the most widely used.Ethernet uses an access method called CSMA / CD(Carrier sense multiple access/Collision Detection.)The Ethernet protocol allow for linear bus,star or tree topologies.
- ATM- Asynchronous transfer mode (ATM) is a network protocol that transmits data at a speed of 155 mbps and higher.
- TCP(Transmission Control Protocol) - It is a connection-oriented transport protocol. Connection -oriented protocol provide reliable transport, in that if a segment is dropped,the sender can detect that drop and retransmit that dropped segment.
- FTP(File transfer protocol)- It provides the uploading and downloading of file from a remote host running ftp server software.
- SMTP(Simple Mail Transfer Protocol)-It defines how mail message are sent between hosts.
- HTTp(Hypertext Transfer Protocol)- It enables text,graphics,multimedia and other material to be downloaded from an http server.

- **Protocol Standard**
- **International Standard Organization(ISO)**-Iso is well known multi-national standard body.Open Systems Interconnection (OSI) model as a networking protocol is a major contribution of the ISO to the data communication World.ISO created in 1947,the iso is a non-profitable standard creation organization. Members from over eight developed nations actively represent the ISO
- **Institute of Electrical and Electronics Engineers(IEEE)-** IEEE is the biggest professional engineering body in the world. IEEE focus area are development in the areas of electric and electronic engineering and radio sciences. IEEE also covers the development and adoption of international computer and communication standards.
- **American National standards Institute(ANSI):-** ANSI is a private non-profit organization that does not have any direct ties with the us federal government.
- **Telecommunications Industry Association:-**TIA is the leading trade association in the communications and information technology industry. It facilitates business development opportunities through market development, trade promotion, trade shows, and standard development.

Bandwidth, Data Transmission Rate, Baud Rate and BIts per second

Bandwidth is a range within a band of frequencies or wavelengths.Bandwidth is also the amount of data that can be transmitted in a fixed amount of time.

For Digital devices the bandwidth is usually expressed in bits per second (bps) or bytes per second.

For analog devices, the bandwidth is expressed in cycle per second, or hertz(Hz).

Bit Rate :- Bit Rate is simply the number of bits (ie 0’s and1’s) transmitted per unit time.

Bit rate is the number of bits transmitted in one second. It is expressed as bits per second bps.

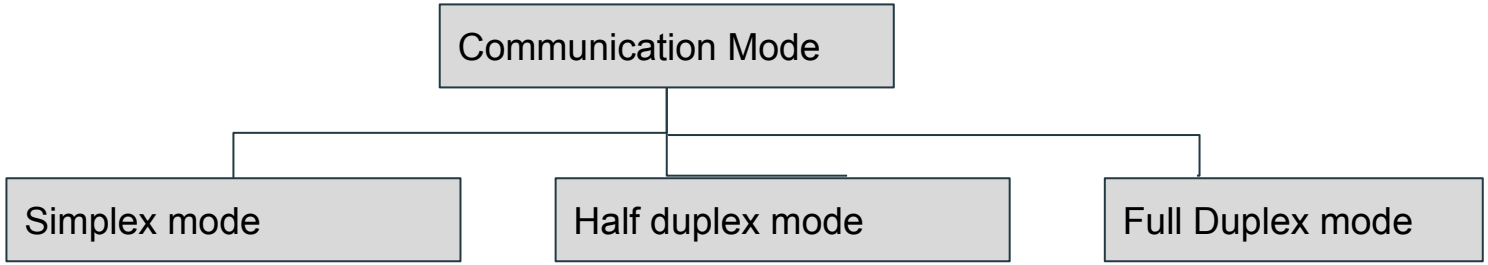
Baud Rate:- Baud rate is the number of signals units transmitted per unit time that is needed to represent those bits.

Modes of Communication.

The direction of data flow between two linked devices is called mode of communication.

There are three types of direction of data flow namely simplex mode , half-duplex mode and full duplex mode.

There are 3 types of transmission modes which are given below: Simplex mode, Half duplex mode, and Full-duplex mode. These are explained below.



Modes of Communication.

Simplex mode: In simplex mode, Sender can send the data but the sender can't receive the data. It is a unidirectional communication

In simplex mode communication mode, the communication can take place in only one direction ie data can be sent only in one direction.

Example of simplex mode are radio and TV transmissions. In computer system, the keyboard, monitor and printer are examples of simplex devices.

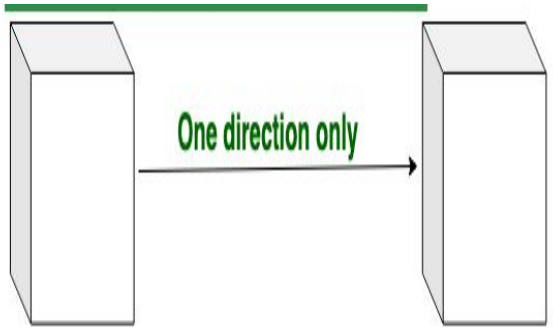
Advantages:- 1) Very Simple and easy communication

Method. 2)Cheaper in cost.

Disadvantages:-1)Only allow for communication in one

Direction. 2) Simplex transmission are not often used

Because it is not possible to send back error to the transmit end



Simplex mode

Modes of Communication.

Half-duplex mode: In half-duplex mode, Sender can send the data and also can receive the data one at a time. It is two-way directional communication but one at a time

-In half duplex communication mode, the communication can take

place in both the directions ,but only in one direction at a time .

-In this mode data is send and received alternatively.

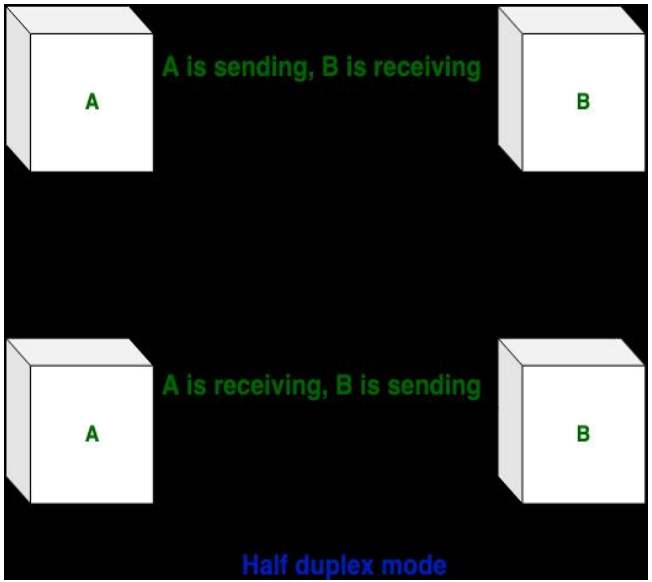
Example -Walkie -talkie.

Advantages:-1) Enables to two way communication.

2) Low cost than full duplex communication mode.

Disadvantages:- 1) Only one device can transmit at a time.

2) high cost than simplex mode.



Modes of Communication.

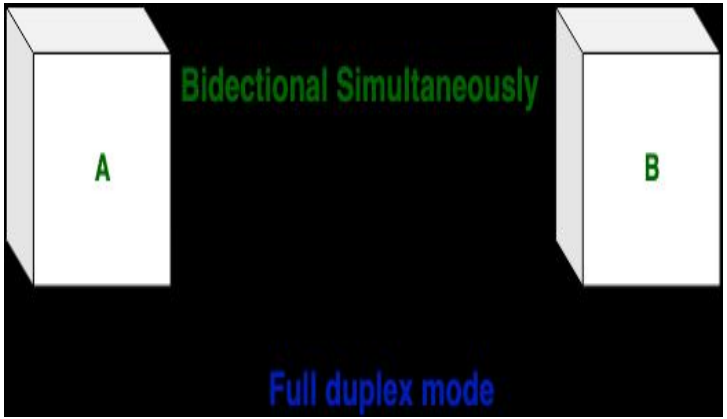
Full duplex mode: In full-duplex mode, Sender can send the data and also can receive the data simultaneously. It is two-way directional communication simultaneously.

Full duplex mode is the fastest directional mode of

Communication.

The Telephone communication system is an example of

Full duplex mode.



Advantages:- 1) Enables two-way communication

Simultaneously

2)Fastest method of data communication

Disadvantages:- 1)More Expensive and complex method.2) the bandwidth channels is required for data transmission.

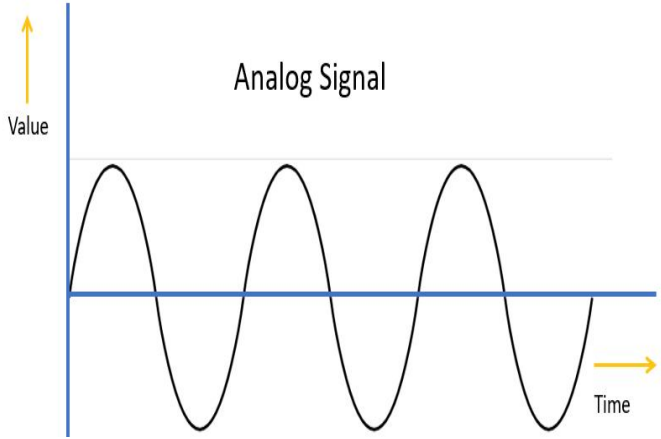
Analog Signal

An analog signal is a continuous wave from that changes smoothly over time. Analog signal is usually represented by sine wave.

A simple example is alternating current ac, which

Continuously varies between about +110 volt to -110volt

In a sine wave fashion 60 times per second.



Advantage of Analog Signal

1)Analog signal are best suited for the transmission of audio

And video

2)They consume less bandwidth than digital signals to carry same

Information.

3) Compared to digital signals,analog signals are of higher density.

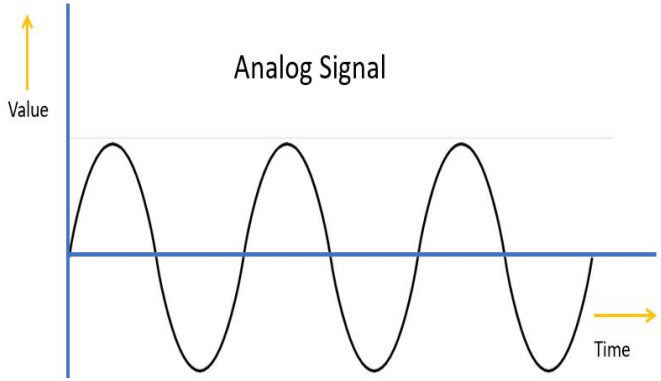
Analog Signal.

Disadvantage of Analog Signal

1)The primary disadvantage of analog signaling is that any stream has noise -ie random unwanted variation.

2)The effect of noise create signal loss and distortion.

3) Most of the analog system also suffer from generation loss.



Digital Signal

A digital signal is discrete in nature.Digital signal can have only a limited number of definite values, often as simple as 1 and 0.

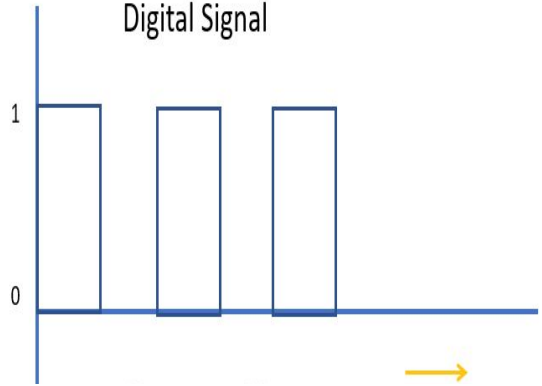
On a serial transmission line a digital signal is transmitted 1-bit at a time. A ‘1’ is represented by a positive voltage and a ‘0’ is Represented by zero voltage.

Advantage of Digital Signal

1)Digital signal are more secure.

2)Digital signal suffer less noise because any errors can be

Detected and corrected using regenerators.

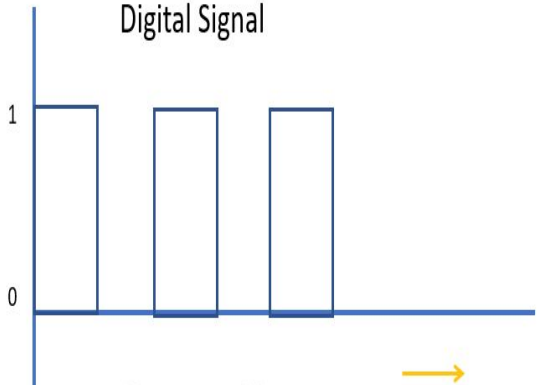


Digital Signal.

Disadvantage of Digital Signal

1)Digital signal need more bandwidth to transmit the same information.

2)The transmitter and receiver have to synchronize very Carefully so that the information makes sense.



Analog Transmission.

To send the digital data over an analog media,it need to be converted into analog signal.

This can be by following two cases.

1)Band pass filter

2) Low pass filter

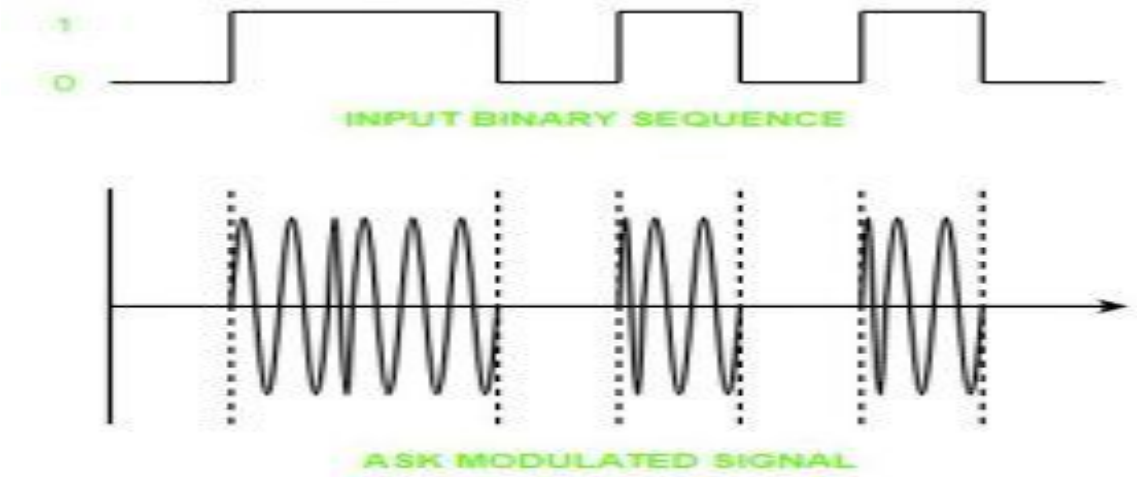
Digital-to-Analog Conversion.

The digital to analog conversion is done by modem.Modem stands for modulator and demodulator.

The following techniques can be used for Digital to Analog Conversion:

1. Amplitude Shift keying – Amplitude Shift Keying is a technique in which carrier signal is analog and data to be modulated is digital. The amplitude of analog carrier signal is modified to reflect binary data.

The binary signal when modulated gives a zero value when the binary data represents 0 while gives the carrier output when data is 1. The frequency and phase of the carrier signal remain constant.



Advantages of amplitude shift Keying –

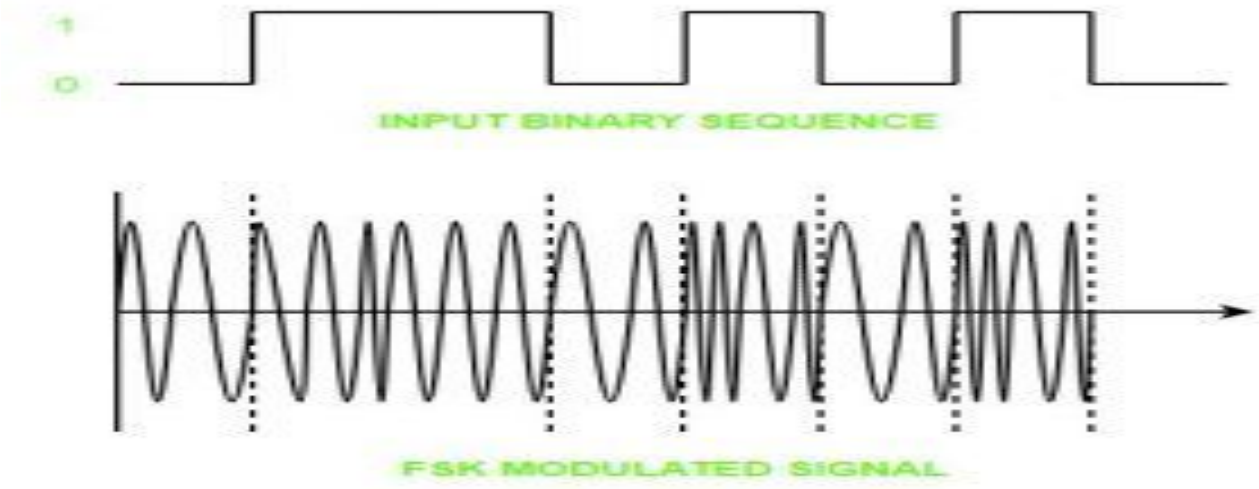
- It can be used to transmit digital data over optical fiber.
- The receiver and transmitter have a simple design which also makes it comparatively inexpensive.
- It uses lesser bandwidth as compared to FSK thus it offers high bandwidth efficiency.

Disadvantages of amplitude shift Keying –

- It is susceptible to noise interference and entire transmissions could be lost due to this.
- It has lower power efficiency.

2. Frequency Shift keying – In this modulation the frequency of analog carrier signal is modified to reflect binary data.

The output of a frequency shift keying modulated wave is high in frequency for a binary high input and is low in frequency for a binary low input. The amplitude and phase of the carrier signal remain constant.



Advantages of frequency shift Keying –

- Frequency shift keying modulated signal can help avoid the noise problems beset by ASK.
- It has lower chances of an error.
- It provides high signal to noise ratio.
- The transmitter and receiver implementations are simple for low data rate application.

Disadvantages of frequency shift Keying –

- It uses larger bandwidth as compared to ASK thus it offers less bandwidth efficiency.
- It has lower power efficiency.

3. Phase Shift keying – In this modulation the phase of the analog carrier signal is modified to reflect binary data.The amplitude and frequency of the carrier signal remains constant.

Advantages of phase shift Keying –

- It is a more power efficient modulation technique as compared to ASK and FSK.
- It has lower chances of an error.
- It allows data to be carried along a communication signal much more efficiently as compared to FSK.

Disadvantages of phase shift Keying –

- It offers low bandwidth efficiency.
- The detection and recovery algorithms of binary data is very complex.
- It is a non coherent reference signal.

Phase Shift Keying (PSY)

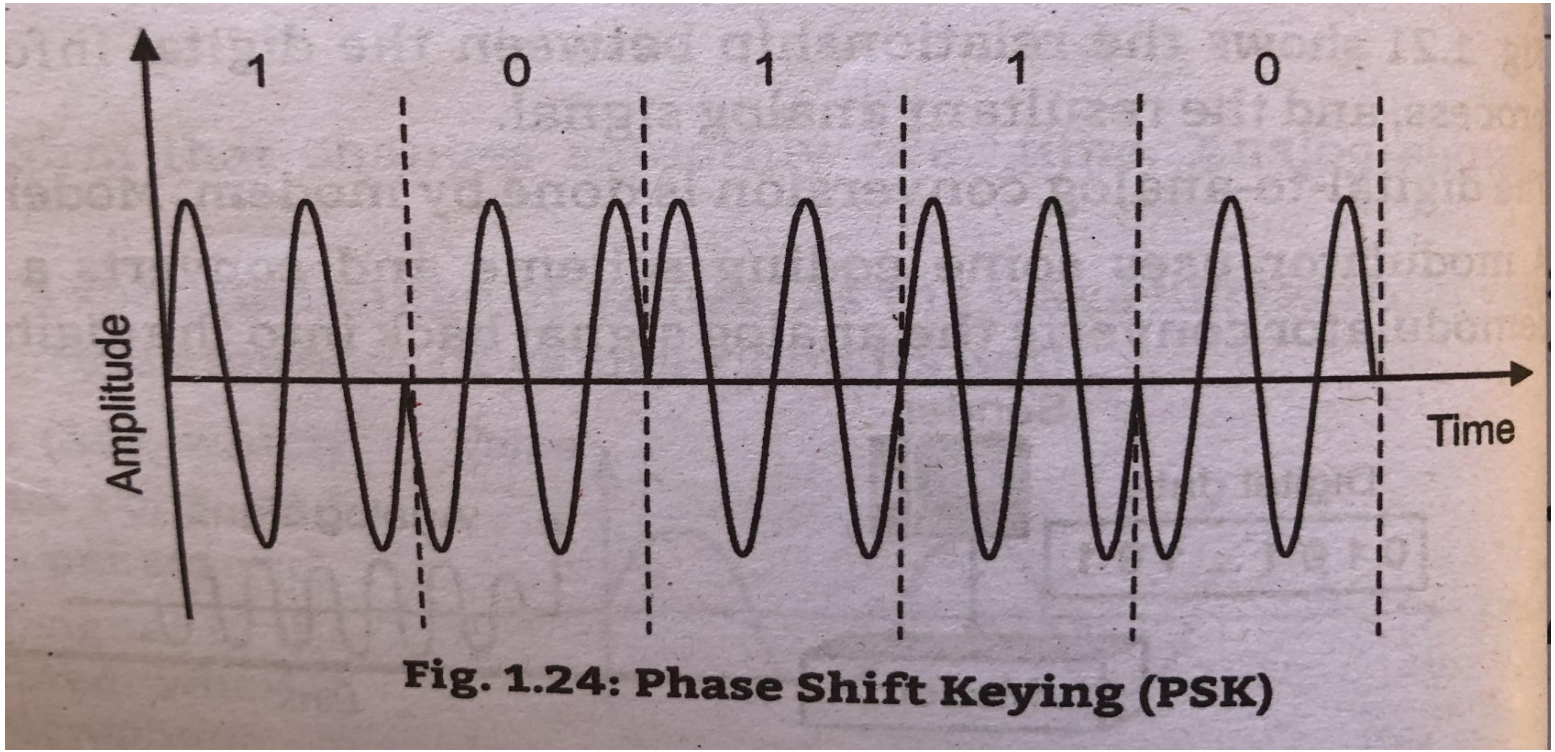


Fig. 1.24: Phase Shift Keying (PSK)

Analog-to-Digital conversion

Microphones create analog voice and camera create analog videos, which are treated is analog data to transmit this analog data over digital over digital signals, we need analog-to-digital conversion.

Analog data is a continuous stream of data in the wave form whereas digital data is discrete To convert analog wave into digital data we use **Pulse code Modulation.**

Pulse is one of the most commonly method used to convert analog data into digital form.

It involves three step namely,

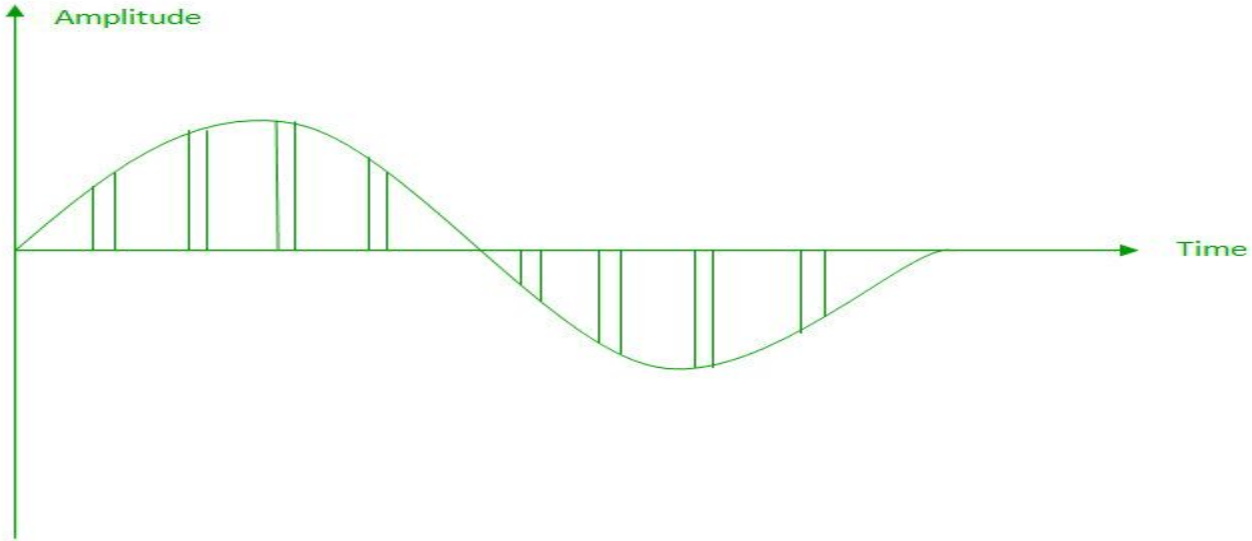
1)Sampling

2)Quantization

3)Encoding

Analog-to-Digital conversion

1)Sampling:- The analog signal is sampled every T interval.According to the Nyquist theorem, the sampling rate must be at least 2 times the highest frequency contained in the signal



Analog-to-Digital conversion

2)Quantization:- The quantization is done between the maximum amplitude value and the minimum amplitude value. Quantization is approximation of the instantaneous analog value.

3)Encoding:- In Encoding, each approximated value is then converted into binary format.

Definition of Computer Network

A computer network is defined as a set of electronically connected computers which can share information and resources among themselves.

Need of Computer Network

1) Sharing of information and data over the geographical wide areas.
2) Communication from one computer to the other computer
3) Sharing the resources such as printers among the network users.
4) Exchange of data and information amongst the data and users,via the network.
5) Sharing of Expensive software and database.

Characteristics of Computer Network

The following characteristics should be considered in computer network design and ongoing maintenance:

1. Availability: Availability is typically measured in a percentage based on the number of minutes that exist in a year. Therefore, uptime would be the number of minutes the network is available divided by the number of minutes in a year.

2. Cost: Includes the cost of the network components, their installation, and their ongoing maintenance.

3. Reliability: Defines the reliability of the network components and the connectivity between them. Mean Time Between Failures (MTBF) is commonly used to measure reliability.

4. Security: Includes the protection of the network components and the data they contain and/or the data transmitted between them.

5. Speed: Includes how fast data is transmitted between network end points, (the data rate).

Characteristics of Computer Network

6. Scalability: Defines how well the network can adapt to new growth, including new users, applications, and network components.

7. Topology: Describes the physical cabling layout and the logical way data moves between components.

8. Integration: All the components of the network work in a coordinated manner for a seamless user experience.

9. Sharing: Computer networks enable sharing of files, software, hardware resources and computing capabilities.

Advantages of Computer network

1. **File Sharing:** The major advantages of a computer network is that allows file sharing and remote file access. A person sitting at one workstation that is connected to a network can easily see files present on another workstation, provided he/she is authorized to do so.

2. **Resource Sharing:** A computer network provides a cheaper alternative by the provision of resource sharing. All the computers can be interconnected using a network, and just one modem and printer can efficiently provide the services to all users.

3. **Inexpensive Set-up:** Shared resources mean reduction in hardware costs. Shared files mean reduction in memory requirement, which indirectly means reduction in file storage expenses.

4. **Flexible Handling:** A user can log on to a computer anywhere on the network and access his/her files. This offers flexibility to the user as to where he/she should be during the course of his/her routine.

5. **Increased Storage Capacity:** Since, there is more than one computer on a network which can easily share files, the issue of storage capacity gets resolved to a great extent.

6. Easy Communication: It is very easy to communicate through a network. People can communicate efficiently using a network with a group of people. They can enjoy the benefit of emails, instant messaging, telephony, video conferencing, chat rooms, etc.

7. Speed: Sharing and transferring files within networks is very rapid (fast), depending on the type of network. This will save time while maintaining the integrity of files

8**. Flexible Access:** Access of files from computers throughout the world, and 24 x 7 environment.

Disadvantages of Computer Network:

1. Security Concerns: One of the major drawbacks of computer networks is the security issues that are involved.

2. Expensive to Build: Building a network is a complex and time consuming for large scale organizations.

3. Virus and Malware: Viruses can spread on a network easily, because of the inter-connectivity of workstations.

4. Lack of Robustness: If the main file server of a computer network breaks down, the entire, system or network becomes useless.

5. Needs an Efficient Handler: The technical skills and knowledge required to operate ant administer a computer network.

6. Lack of Independence: Since most networks have a centralized server and dependent clients, the client users lack any freedom whatsoever. Centralized decision making can sometimes hinder how a client user wants to use his own computer.

Application of Computer Network

1**) Marketing and Sales:** Computer networks are used extensively in both marketing and sales organizations. Marketing professionals use them to collect, exchange, and analyze data related to customer needs and product development cycles. Sales application includes tele-shopping, which uses order-entry computers or telephones connected to order processing network, and online-reservation services for hotels, airlines and so on.

2. Financial Services: Today's financial services are totally depended on computer networks. Application includes credit history searches, foreign exchange and investment services, and electronic fund transfer, which allow user to transfer money without going into a bank (An Automated Teller Machine (ATM) is an example of electronic fund transfer automatic pay-check is another).

3. Manufacturing: Computer networks are used in many aspects of manufacturing including manufacturing process itself. Two of them that use network to provide essential services are Computer-Added Design (CAD) and Computer-Assisted Manufacturing (CAM), both of which allow multiple users to work on a project simultaneously.

Application of Computer Network

4. Directory Services: Directory services allow list of files to be stored in central location to speed worldwide search operations.

5. Electronic Data Interchange (EDI): EDI allows business information, including document such as purchase orders and invoices, to be transferred without using paper.

7. Electronic Mail: Probably it's the most widely used computer network application.

8. Teleconferencing: Teleconferencing allows conference to occur without the participants being in the same place. Applications include simple text conferencing (where participants communicate through their normal keyboards and monitor) and video conferencing Where-participants can even see as well as talk to other fellow participants.

9. E-Commerce: Computer networks have paved way for a variety of business and commercial transactions online, popularly called e-commerce. Users and organizations can pool funds, bua, or sell items, pay bills, manage bank accounts, pay taxes, transfer funds and handle investment electronically.

Network Benefits:-

Most of the benefits of networking can be divided into generic categories ie connectivity and sharing.

1.File Sharing -

Network file sharing is the process of copying files from one computer to another using a live network connection. Any file can be centrally stored and can be used by more than one user by sharing it.

File sharing requires a shared directory or disk drive to which many users can access over a network

But in fact, more than one person cannot make changes to the file at a same time which is called as file locking. Only database program allow multiple users to access database simultaneously.

Network operating system that performs file sharing administrator the security of these shared files i.e. it control the kind of permissions and the users who has access to the file.

For example, some users may have permission to view a shared file where other user may have permission to edit that shared file.

• File server provides different file services which are used by network application to share, store,

retrieve and move data

Advantages of File Sharing:

1. Easily and simply share data and information on network.
2. Easy access of information data.

Disadvantages of File Sharing:

1. Less secure.
2. Conflicting problem arises.

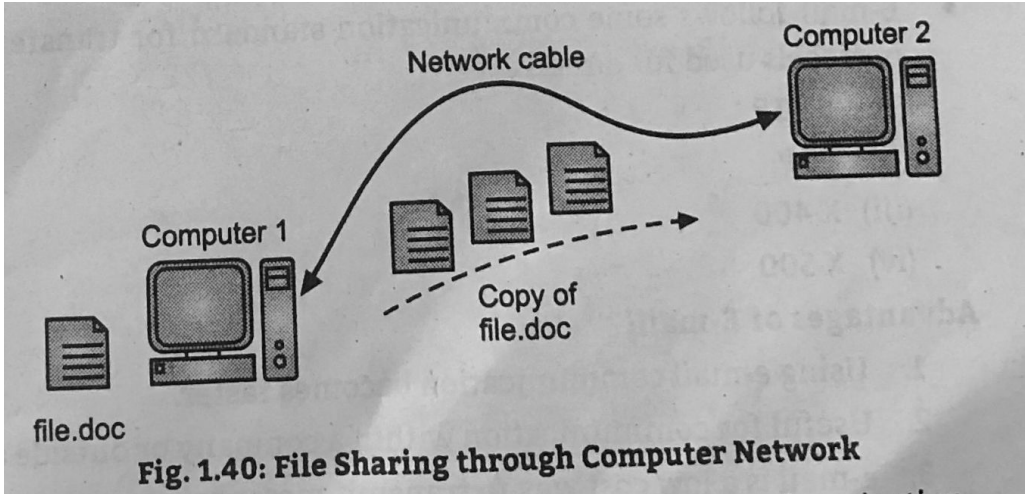
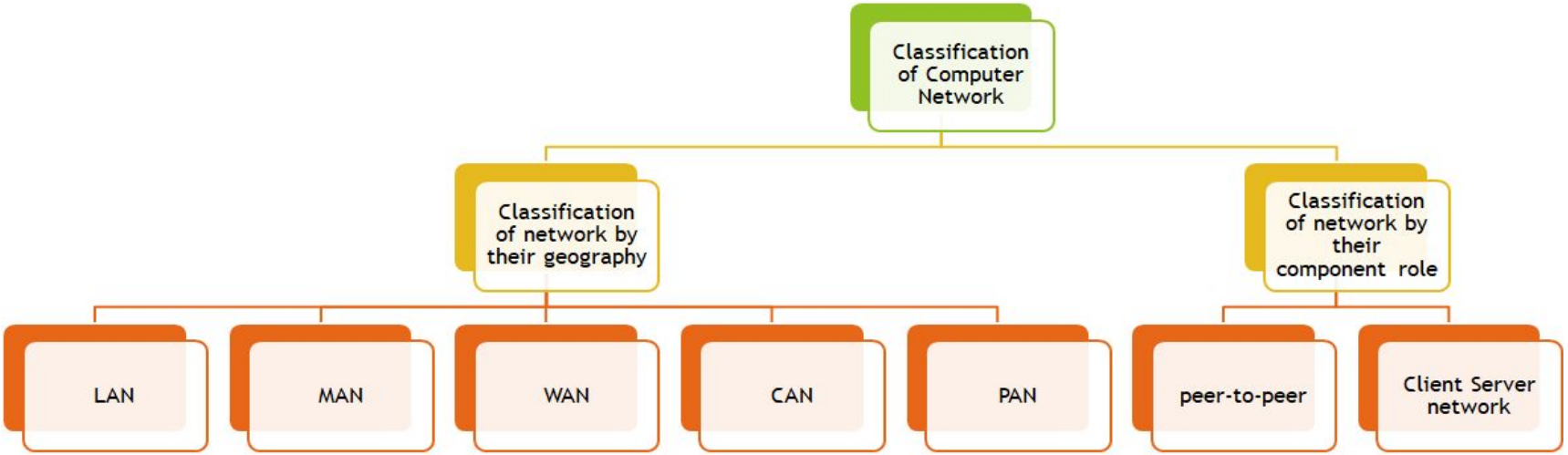


Fig. 1.40: File Sharing through Computer Network


Classification of Computer Network
Classification of network by their geography
Classification of network by their component role
LAN
MAN
WAN
CAN
PAN
peer-to-peer
Client Server network

Computer networks can be classified based on several factors. The most known classification is based on the physical size of the network that is the inter processor distance.

PAN (Personal Area Network): PAN is a type of computer network that revolves around an individual or personal area. It covers an area within 10 meters (about 30 feet). This kind of computer network includes mobile computers, tablets, PDAs, printers, scanners etc. PAN is used for a personal purpose like data sharing. This type of network can be wired or wireless.

Personal area networks may be wired with computer buses such as USB and FireWire. A Wireless Personal Area Network (WPAN) can also be made possible with network technologies such as IrDA and Bluetooth.

Advantages of PAN:
(i) PAN network is easy to use. No advanced setup is required.
(ii) PAN network is secured because all the devices are authorized before data sharing.
(iii) Many devices can be connected to one device at the same time in a PAN.
(iv) PAN is an inexpensive way of communication.
(v) A person can move devices as it is a wireless network and data exchange is not affected. That means PAN is portable as well.

Disadvantage of the PAN: (I) PAN has slow data transfer rate.
(ii) PAN is used in digital devices such as smart phones, PDA, laptops, tablets etc. which are costly.
(iii) Signal range is maximum 10 meters which makes limitation for long distance sharing.

2. CAN (Campus Area Network)

A Campus Area Network (CAN) is used to connect buildings across campuses of colleges or universities.

A CAN is actually a type of Local Area Network (LAN). It is larger than a LAN but smaller than a Metropolitan Area Network (MAN).

An example of the CAN is the networking between school, library and hostel. School management can access to library and hostel data through the network. Any student with login access can search the book by connecting its computer with the library. Similarly, school staff can check hostel data through their computers

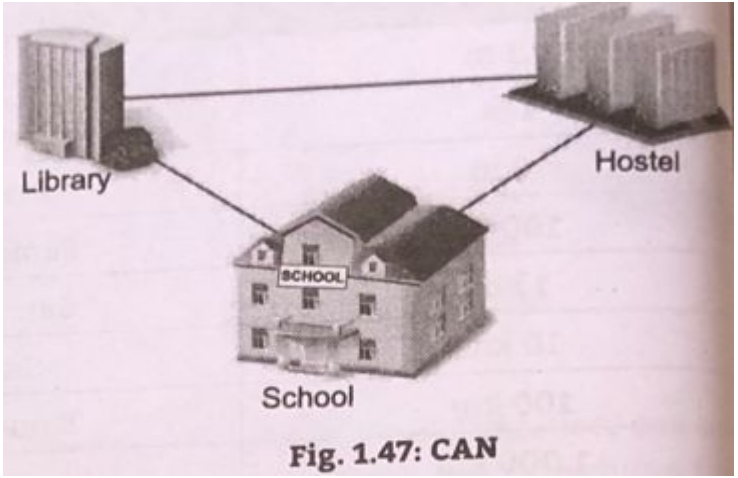


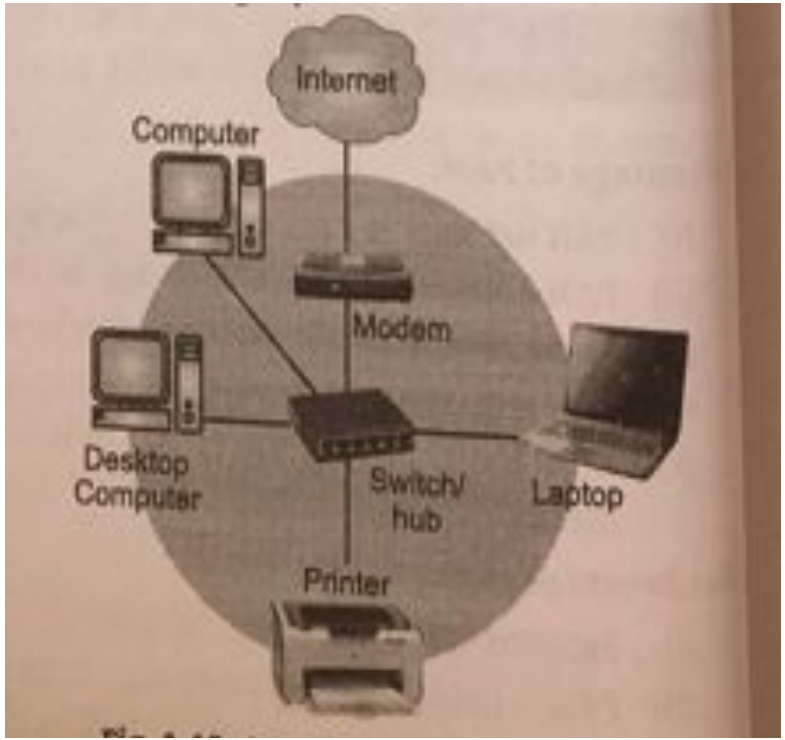
Fig. 1.47: CAN

Advantages of CAN: (i) CAN are economical and Cost effective way for data transmission. (ii) CAN is simple and easy to implement. (iii) Helpful for universities and corporate organization to work from any block and receive the same speed of data transfer.

Disadvantages of CAN: (i) CAN covers small geographical area 1 km to 5 km.

LAN (Local Area Network)

- Local Area Network (LAN) is privately-owned networks covering a small geographic area (less than 1 km), like a home, office, building or group of buildings (example, campus).
- LAN is a group of computers and associated peripheral devices connected by a communications channel, capable of sharing files and other resources among several users.
- LAN transmits data with a speed of several megabits per second (106 bits per second). The transmission medium is normally coaxial cables.
- LAN links computers, i.e., software and hardware, in the same area for the purpose of sharing information. Usually LAN links computers within a limited geographical area because they must be connected by a cable, which is quite expensive.
- A network which consist of less than 500 interconnected devices across several building , is still recognized as a lan


Internet
Computer
Modem
Desktop Computer
Switch/ hub
Laptop
Printer

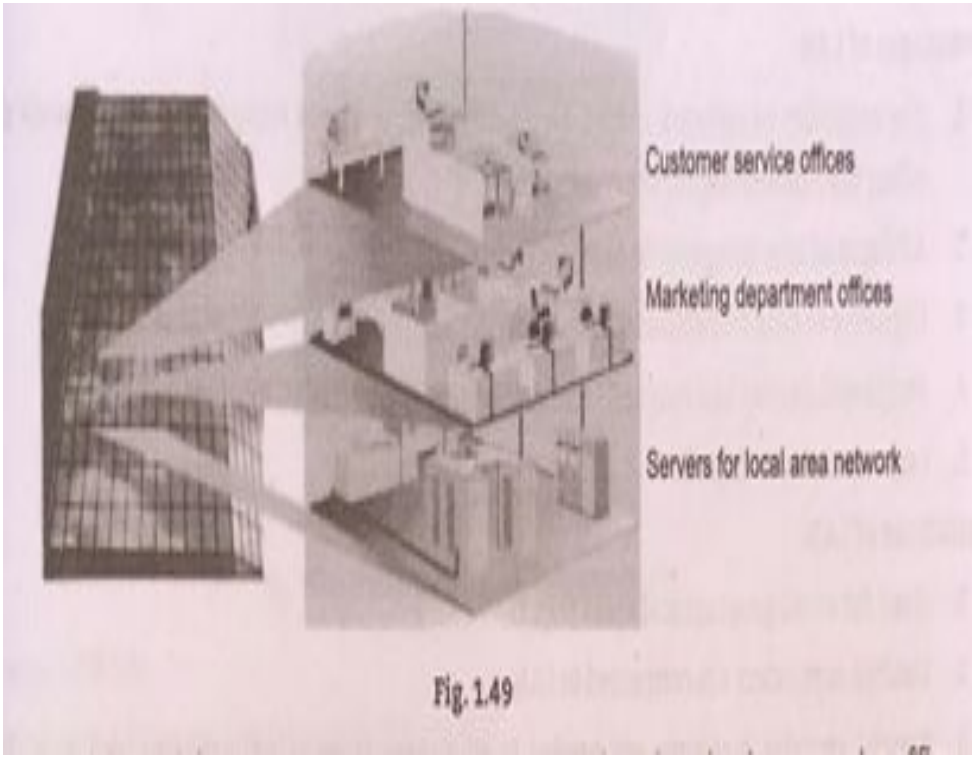

Customer service offices
Marketing department offices
Servers for local area network

Fig. 1.49

Characteristics of LAN:

1. Every computer has the potential to communicate with any other computers of the network.

2. The reliability of network is high because the failure of the computer in the network does not affect the functioning for other computers.

3. High degree of interconnection between computers.

4. Easy physical connection of computers in a network.

5. Inexpensive medium of data transmission.

6. High data transmission rate.

7. Less expensive to install.

8. Peripheral devices can be shared.

Advantages of LAN:

1. The reliability of network is high because the failure of one computer in the network does not effect the functioning for other computers.
2. Addition of new computer to network is easy.
3. High rate of data transmission is possible.
4. Peripheral devices like magnetic disk and printer can be shared by other computers.
5. Less expensive to install.

Limitations of LAN:

1.Used for small geographical areas (less than 1 km).
2. Limited computers are connected in LAN.
3. Special security measures are needed to stop users from using programs and data that they should not have access to network.
4. Networks are difficult to set up and need to be maintained by skilled technicians.
5. If the file server develops a serious fault, all the users are affected, rather than just one user in the case of a stand-alone machine. MAN (Metropolitan Area Network)

MAN (Metropolitan Area Network)

- MAN (Metropolitan Area Network) which is a network covering a larger area than LAN, say a network of all computers within a city.
- A MAN may be owned and operated by a single organization but is used by a larger number of individuals and organizations.
- A MAN can cover a group of corporate offices or a town or city and can be either privately or publicly owned.
- The best example of MAN is cable television. In their early systems a large antenna was placed on top of hill and signal was then piped to subscriber.
- A MAN is smaller than a Wide Area Network(WAN) but larger than a Local Area Network (LAN). MAN is designed to extend over an entire city

Advantages of MAN:

- MAN spans large geographical area than LAN.
- MAN falls in between the LAN and WAN therefore, increases the efficiency of handling data
- MAN time saves the cost attached to establish a wide area network.
- MAN offers centralized management of data.
- MAN enables you to connect many fast LANs together.

Disadvantages of MAN:

- Implementation of MAN requires high cost.
- If MAN becomes bigger then it becomes difficult to manage it. This is due to a security problem and other extra configuration.
- In MAN there are high chances of attacking hackers on the network compared to LAN. So data may be leaked.
- To setup MAN it requires technical people that can correctly setup MAN.

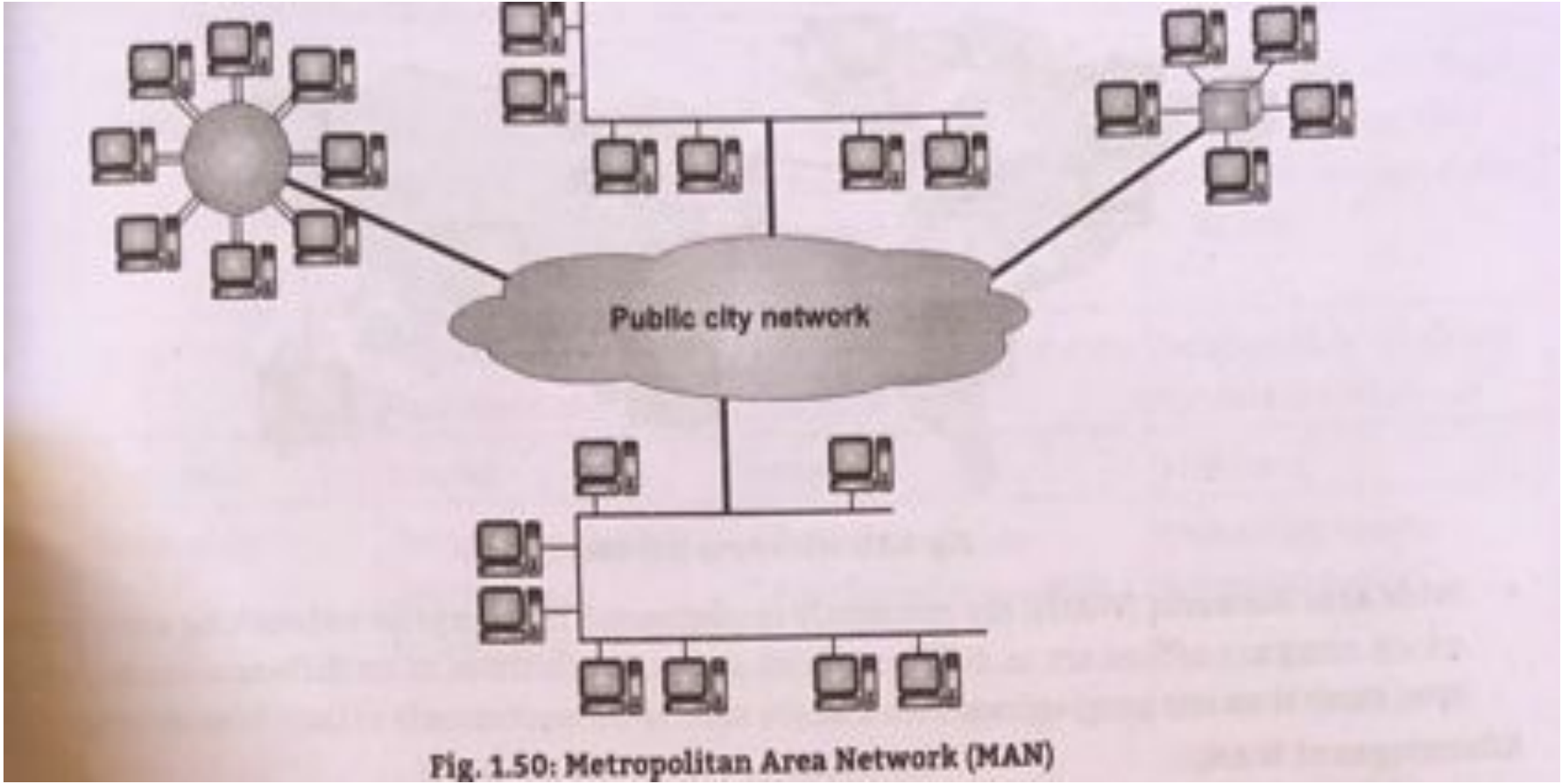
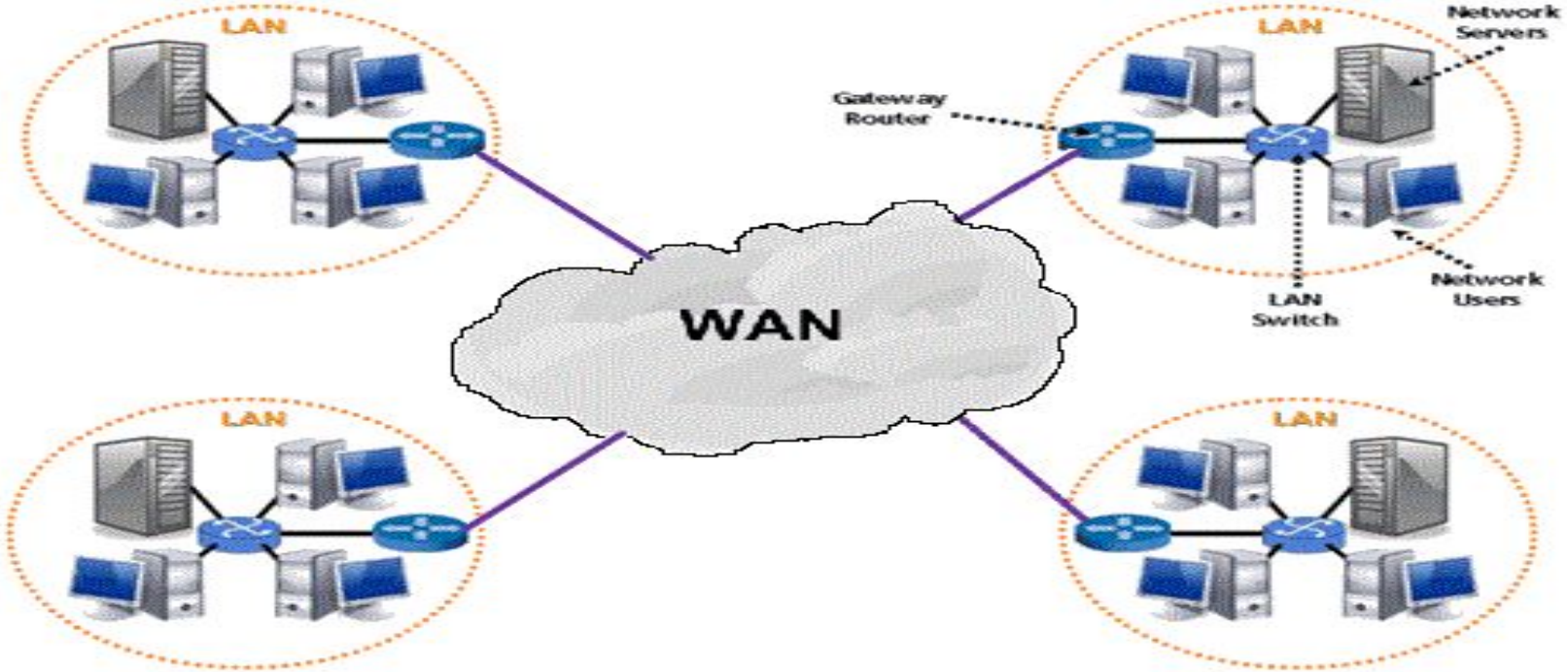


Fig. 1.50: Metropolitan Area Network (MAN)

(WAN)Wide Area Network

- Wide Area Network is a long-distance communications network that covers a wide geographic area, such as a state or country or even the whole world.
- A wide area network is a network that spans a large geographical area, the most common example being the Internet.
- The Internet is a public WAN, but there are many ways to create a business model or private WAN.A private wan is essentially two or more lans connected to each other.
- A Wan provides long-distance transmission of data, voice, image, and video information over large geographical areas that may comprise a country or even whole world.
- Wide Area Networks (WANs) are commonly implemented in enterprise networking environments in which company offices are in different cities, states, or countries or on different continents.WAN's span more than one geographical area and are used to connect remote offices to each other.



WAN - Wide Area Network

Advantages of WAN:

1. WAN covers a large geographical area so long distance businesses can connect on the one network.

2. WAN shares software and resources with connecting workstations.

3. Messages can be sent very quickly to anyone else on the network. These messages can have pictures, sounds, or data included with them, (called attachments).

4. Expensive things (such as printers or phone lines to the internet) can be shared by all the computers on the network without having to buy a different peripheral for each computer.

5. Everyone on the network can use the same data. This avoids problems where some users may have older information than others.

Disadvantages of WAN:

1. WANs are expensive and generally slow.

2. WANs need a good firewall to restrict outsiders from entering and disrupting the network.

3. Setting up a network can be an expensive and complicated experience. The bigger the network the more expensive it is.

4. Security is a real issue when many different people have the ability to use information from other computers. Protection against hackers and viruses adds more complexity and expense.

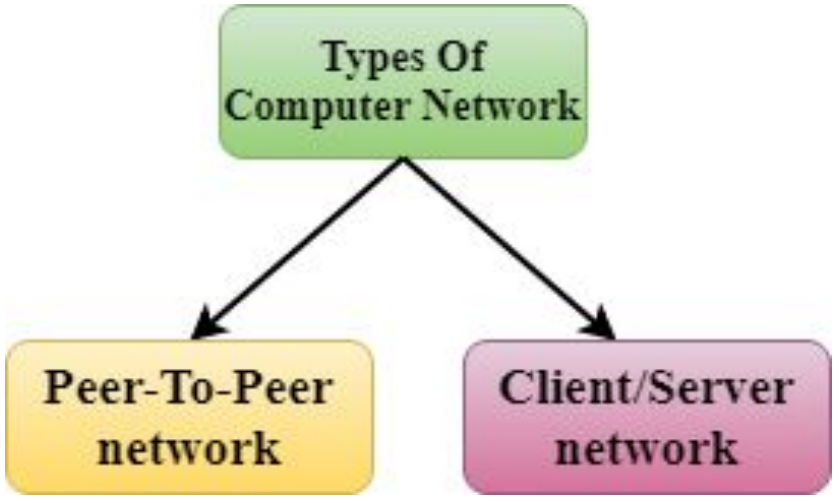
5. Slow speed than LAN and MAN.

Network Architecture:

- The computer network architecture specifies how the physical and logical components of a computer network are assembled and connected with each other to facilitate information exchange and resource sharing.

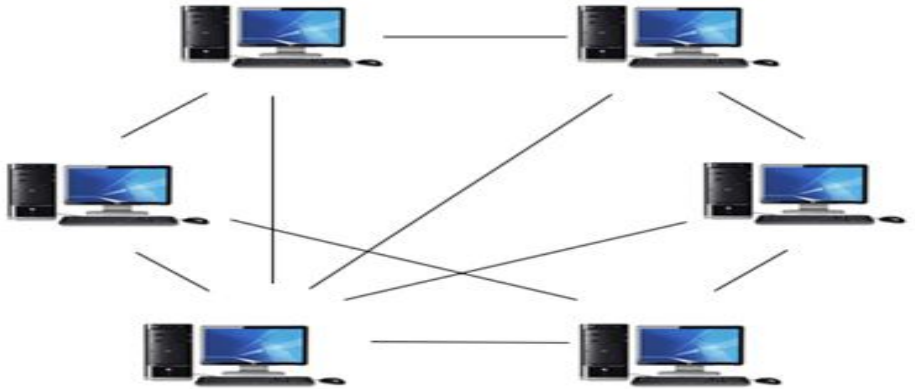
The two types of network architectures are used:

- Peer-To-Peer network
- Client/Server network



Peer-To-Peer network

- Peer-To-Peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- Peer-To-Peer network is useful for small environments, usually up to 10 computers.
- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.



Advantages Of Peer-To-Peer Network:

- It is less costly as it does not contain any dedicated server.
- If one computer stops working but, other computers will not stop working.
- It is easy to set up and maintain as each computer manages itself.

Disadvantages Of Peer-To-Peer Network:

- In the case of Peer-To-Peer network, it does not contain the centralized system . Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.

Client/Server Network

- Client/Server network is a network model designed for the end users called clients, to access the resources such as songs, video, etc. from a central computer known as Server.
- The central controller is known as a **server** while all other computers in the network are called **clients**.
- A server performs all the major operations such as security and network management.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server. For example, if client1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

Advantages Of Client/Server network:

- A Client/Server network contains the centralized system. Therefore we can back up the data easily.
- A Client/Server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in Client/Server network as a single server administers the shared resources.
- It also increases the speed of the sharing resources.

Disadvantages Of Client/Server network:

- Client/Server network is expensive as it requires the server with large memory.
- A server has a Network Operating System(NOS) to provide the resources to the clients, but the cost of NOS is very high.
- It requires a dedicated network administrator to manage all the resources.