DATA COMMUNICATION AND COMPUTER NETWORK

Unit 4

SLOs

- Define the basic terminology of data communication
- Elaborate the terms data rate and baud rate with corresponding formulas and standard units
- Differentiate between analog and digital signals
- Distinguish between data rate and baud rate

4.1 BASICS OF DATA COMMUNICATION

Communication is the process of sharing a message. A conversation between two people is an example of communication. Data communications refers to the sharing of a virtual message. Electronic communications, like emails and instant messages and phone calls are examples of data communications. Data communication is the exchange of digital messages between two devices. It involves a sender and a receiver which communicate via some form of transmission medium such as a cable.

4.1.1 Basic Terminologies of Data Communication

In order to understand the data communication, it is good to know some basic terms related to it.

(i) Data

Collection of raw facts and figures is called data. The word data is derived from Latin language and it is plural of Datum. The text, numbers, symbols, images, voice and video which are processed by computers and digital devices are called data. Data can be considered as unprocessed information.

(ii) Data Communication

Data Communication is the process of transferring data electrically from one place to another. It is the process of exchange of data and information between two parties such as human and electronic or computing device.

(iii) Data Transmission

The data transmission means emission of data in any direction via wireless or wired medium. Transmission may occur between source and destination.

(iv) Analog Signals

Analog signals are a continuously varying signals or waves that change with time period and used to represent data. An analog signal can be used to measure changes in some physical quantities such as light, sound, pressure or temperature.

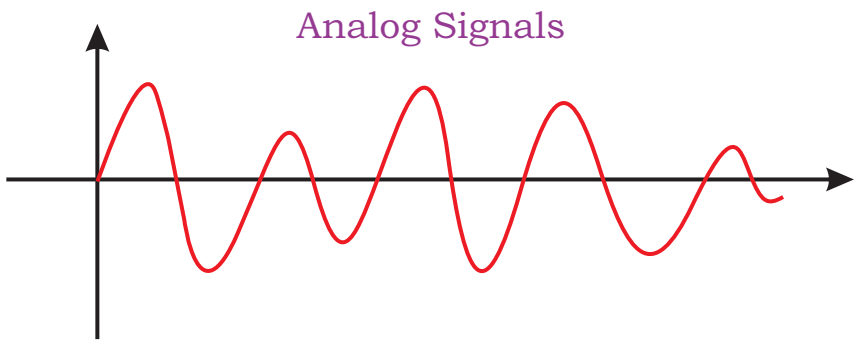

Fig: 4.1 Analog Signals

(v) Digital Signals

A digital signal is an electrical signal that is converted into a pattern of bits to represent a sequence of discrete values, at any given time. It can only be one of the finite numbers represented as 0 or 1.

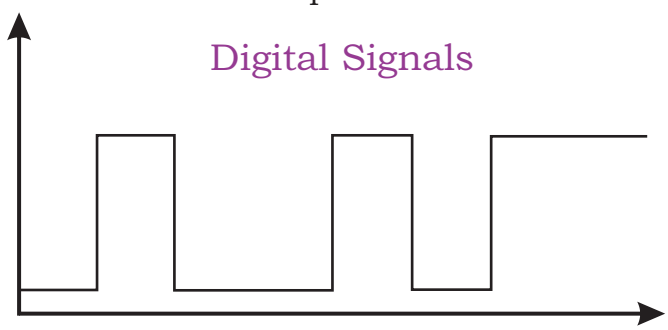

Fig: 4.2 Digital Signals

Difference between Analog and Digital Signals:

Analog Signal	Digital Signal
1 An analog signal is a continuous wave that changes by time period.	1 A digital signal is a discrete wave that carries information in binary form.
2 Analog signal has no fixed range.	2 Digital signal has a finite number i.e. 0 and 1.
3 An analog signal can easily be disturbed by other signals or waves.	3 A digital signal is less prone to other signals disturbance.
4 The human voice is example of an analog signal.	4 Signals used by computer are the digital signal.
5 An analog signal is represented by a sine wave.	5 A digital signal is represented by square waves.
6 Analog signals are long term waves need to be boosting.	6 Digital signals are short term signals remain within digital devices / electronic.

(vi) Data Rate / Bit Rate

Data rate is the rate at which data is transferred. It is normally measured in bits per second. Bit is the actual binary digit which is the basic unit of data transmission. Bit can hold either 0 or 1. Data rate can be ranging from bps (bits per second) for smaller values to kbps (kilo bits per second) and mbps (megabits per second). It is also called bit rate. Data rate becomes faster when more bits are transferred in one second.

Teacher Note

There are many abstract concepts in this chapter. It is good idea that teachers explain this chapter with the help of videos available on internet.

(vii) Baud Rate

The baud rate is the number of signals transmitted per second and one signal can represent one or more bits. It is used to describe the maximum change in an electronic signal. For example, if a signal changes 1200 times in one second, it would be measured at 1200 baud.

Difference between Data Rate and Baud Rate:

Data Rate or Bit Rate	Baud Rate
1 Bit rate tells the number of bits transmitted per unit of time (Second).	1 Baud rate is used when we want to know the number of signal units transmitted per unit of time (Second).
2 Bit rate is the number bits (0's and 1's) transmitted per second.	2 Baud rate is the number of times a signal is traveling comprised of bits. One signal can represent more than one bit.
3 Bit rate = baud rate x the number of bits per signal unit	3 Baud rate = bit rate / the number of bits per signal unit

(viii) Signal to Noise Ratio

Signal-to-noise ratio (abbreviated SNR or S/N) is a measure used in engineering that compares the level of a desired signal and the level of background noise. It is defined as the ratio of signal power to the noise power, often expressed in decibels.

SLOs

- Recognize different components of a communication system
- Tell the various properties of a good communication system

4.1.2 Components of a Communication System

A Communication system has following five components as shown in figure 4.3.

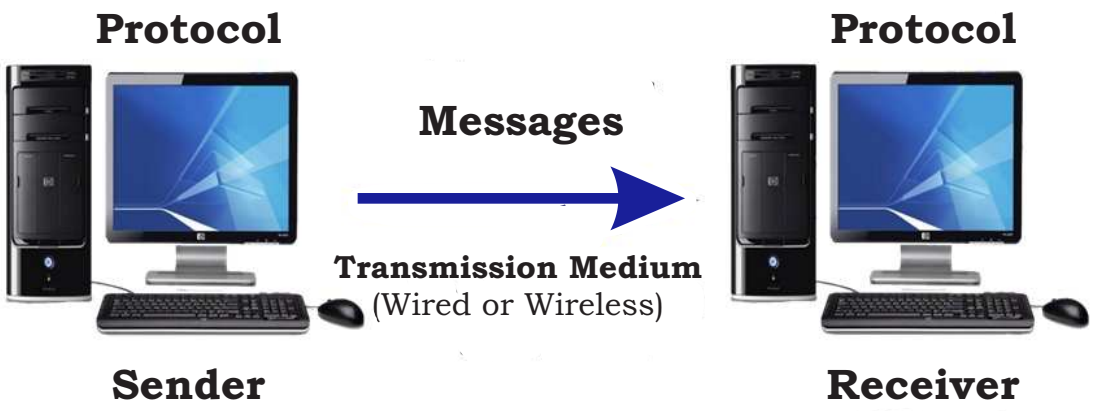

Fig: 4.3 Components of Communication System

(i) Message

It is the information or data to be communicated. Common forms of information include text, numbers, pictures, audio and video.

(ii) Sender

It is the device that generates and sends a message. It can be a computer, telephone handset, etc.

(iii) Receiver

Any particular digital electronic device which has capability to recieve data in form of message. The location of receiving computer is generally different from the sending computer. Like sender, it can also be a computer, telephone handset, etc.

(iv) Medium

It is the channel or path through which the message is carried from sender to the receiver. Some examples include twisted-pair cable, coaxial cable, radio waves, etc.

(v) Protocol

Protocols are the rules and procedures on which computers exchange data on network. Sender and receiver follow same protocols to communicate with each other. In other words, a protocol is an agreement between two parties or venders, using communication devices.

4.1.3 Properties of a Good Communication System

The effectiveness of a data communications system depends on the fundamental characteristics which include delivery, accuracy and timeliness.

Characteristic	Description
1. Delivery	Making sure that the data is delivered is the first fundamental characteristic of any communication network. The system must be able to deliver data in correct order to the correct destination.
2. Accuracy	The system must deliver the data accurately. Data that has been altered during transmission and left uncorrected is not useful.
3. Timeliness	The data must be delivered in a timely manner. Late delivered data is useless.

SLOs

- Develop understanding about the transmission medium
- Recognize and describe different types of guided and unguided media
- Differentiate between guided and unguided media

4.2 TRANSMISSION MEDIUM

Transmission Medium or Communication Channel is a wireless or physical path between the sender and receiver through which data is sent and received from one place to another. Data is transmitted normally by electromagnetic or electrical signals through different types of wires,

atmosphere or vacuum. Transmission media is broadly classified into two groups; guided and unguided as shown in figure 4.4.

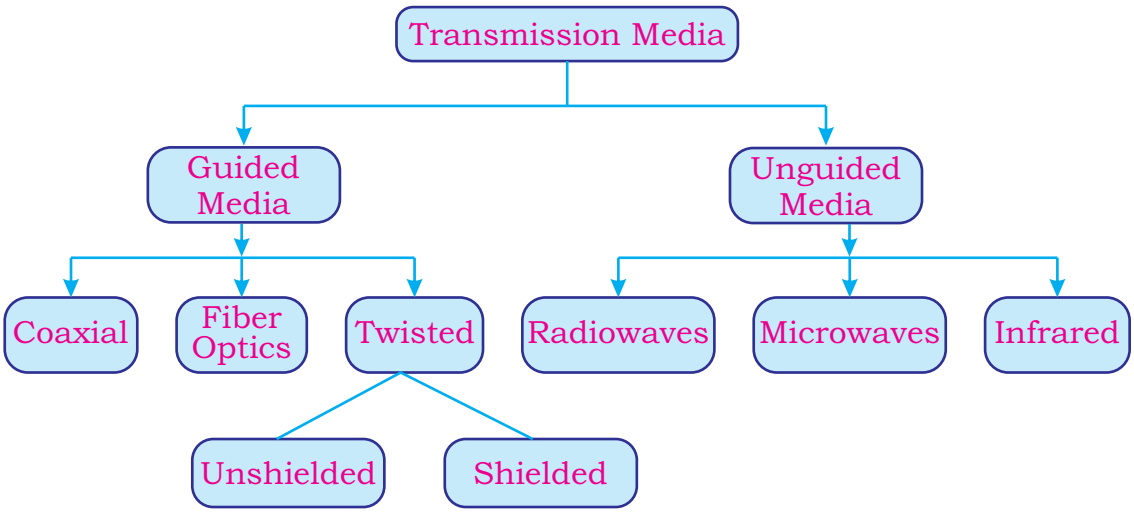

Fig: 4.4 Transmission Medium

4.2.1 Guided Media

In guided media signals are transmitted in a narrow pathway by using physical links. It is also called Wired or Bounded transmission media. The physical links are the cables that are tangible or have physical existence. There are three common types of guided media used for the networks. Each of them has its own characteristics like transmission speed, effect of noise, physical appearance, cost, etc.

(i) Twisted Pair Cable

As name suggests, this cable is made by two separate wires twisted together. A twisted pair cable is made up of insulated copper wires. The insulation and twisting of wires prevent external interference. Each pair of wires has unique color code. This type of cable is widely used in different kinds of data and voice infrastructures. There are two types of twisted pair cables:

(a) Unshielded Twisted Pair (UTP)

(b) Shielded Twisted Pair (STP)

(a) Unshielded Twisted Pair (UTP)

This type of cable can block interference but it is vulnerable to external interference. It is mostly used for telephonic applications. It is less expensive and easy to install.

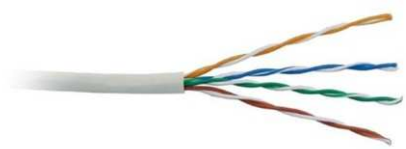

Fig: 4.5 Unshielded Twisted Pair (UTP)

(b) Shielded Twisted Pair (STP)

This type of cable consists of a special coating to block external interference. It is used in fast-data-rate ethernet and also in voice and data channels of telephone lines.

Fig: 4.6 Shielded Twisted Pair (STP)

(ii) Coaxial Cable

Coaxial cable is also known as coax. It has an outer plastic covering containing two parallel conductors each having a separate insulated protection cover. Cable TVs and analog television networks widely use coaxial cables.

Fig: 4.7 Coaxial Cable

(iii) Fiber-Optic Cable

In optical fiber or fiber-optic cable data is transferred in the form of light. It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for transmission of large volumes of data at very high speed.

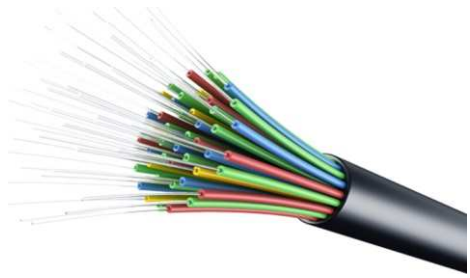

Fig: 4.8 Fiber-Optic Cable

4.2.2 Unguided Media

Unguided media is also termed as wireless or unbounded transmission media. As the name implies, it does not require physical

medium such as wire for the transmission of electromagnetic signals. There are three major types of Unguided Media.

(i) Radio Waves

Radio waves are also called electromagnetic waves. These are easy to generate and can penetrate through buildings. Radio waves are omnidirectional and propagated in all directions. It means that sending and receiving antennas do not need to be aligned. FM, AM radios, television and cordless phones use radio waves for transmission.

Fig: 4.9 Radio Waves

(ii) Microwaves

Microwave transmission is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. These are mostly used for mobile phone communications tower and television broadcast. Terrestrial and Satellite are two types of microwave transmissions.

Terrestrial: Terrestrial microwaves have both stations having antennas on earth.

Satellite: In satellite system (Figure 4.10), some antenna are on satellite in orbit and others are on stations on earth. They work at remote places so it can be used in mobile devices.

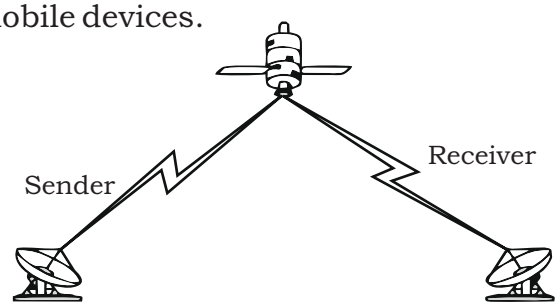

Fig: 4.10 Microwaves Transmission

(iii) Infrared

It uses infrared light to transmit signals. LED is used to transmit signals and light-receivers (photodiodes) to receive signals. They use terahertz frequency. It cannot penetrate walls or other objects. Infrared light is transmitted generally line of sight (point to point). Wireless infrared communications can be used to establish short range wireless links or wireless Local Area Network.

Fig:4.11 Infrared

SLO

- Describe the different types of flaws and faults in transmission signals.

4.2.3 Transmission Impairments

Sometimes, signals traveling through transmission media lose their quality. This means that received signal is not same as the signal that was sent. This phenomenon is called transmission impairments. Transmission impairments are those defects that occur when data is transmitted. There are three causes of impairment i.e. attenuation, distortion and noise.

(i) Attenuation

Attenuation means loss of energy. A signal loses its energy due to the resistance of medium while it is transmitted. Its strength decreases with increase in distance. Amplifiers are used to overcome attenuation and make signal stronger again. It is measured in decibels.

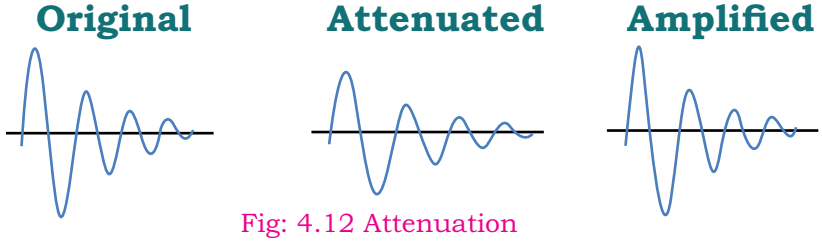

Fig: 4.12 Attenuation

(ii) Distortion

Distortion means change in the shape of the signal. A composite signal has several frequencies. When it travels through a medium different component of signal may reach at different time at destination because each component has different speed in that medium. This is called distortion. They have different phases at sender and receiver ends.

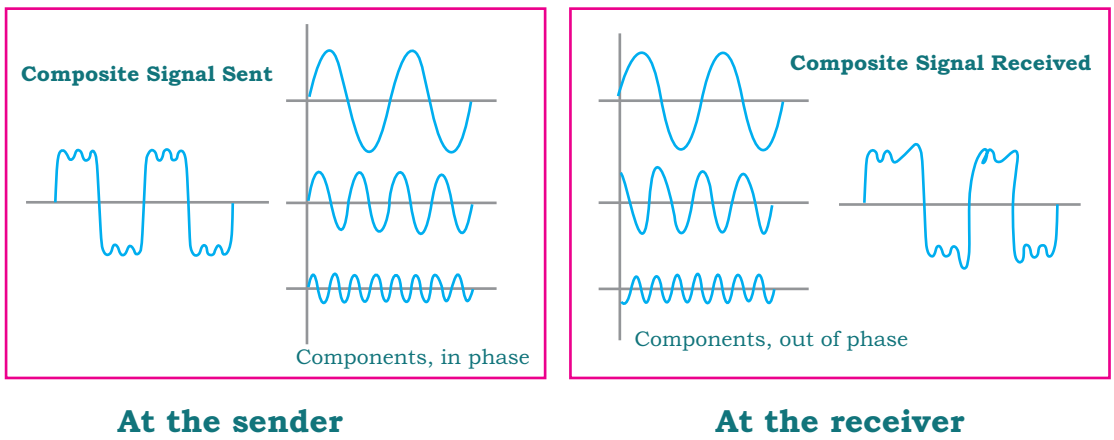

Fig: 4.13 Distortion

(iii) Noise

Unwanted signal that mixes up with the original signal during the transmission of data is called noise. It can be induced noise, crosstalk noise, thermal noise and impulse noise which may damage the signal.

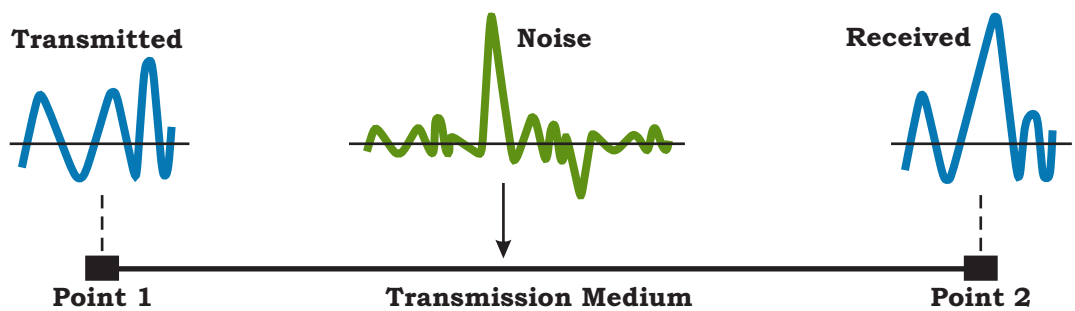

Fig: 4.14 Noise

SLOs

- Define different communication devices
- Explain the function of router
- Differentiate among different types of modems
- Describe the function of switch/router
- Elaborate the functions of different communication devices

4.3 COMMUNICATION DEVICES

A communication device is any type of hardware capable of transmitting and receiving data, instructions and information.

4.3.1 Switch

A switch or network switch (Figure 4.15) is a networking device that connects computers and other devices like printers, scanners and cameras on a network. Data cables from all computers and other devices of network are plugged into the switch to enable communication between them.

Fig: 4.15 Switch

4.3.2 Router

A Router (Figure 4.16) is a device that connects two or more networks. Routers are a combination of hardware and software. The main function of a router is to determine the optimal data path and transfer the information through that path, also known as network traffic controller.

Fig: 4.16 Router

4.3.3 Modem

Modem is short for Modulator and Demodulator. Modulation is the process of converting digital signals into analog signals. Demodulation is

quite opposite; it converts analog signals into digital signals. Modem has the ability of sending and receiving signals that allows computers to share information with each other. This sharing of information is possible over phone lines, cables or satellite connections.

(i) Dial-up Modem

Dialup modems (Figure 4.17) use standard telephone lines to transmit and receive information. A dialup modem can be internal or external. It is important to remember that telephone lines carry only analog signals, whereas data packets sent by the computer are in digital form. In order to send these packets across a telephone line, modem converts digital signals into analog.

Fig: 4.17 Dial-up Modem

(ii) DSL Modem

DSL stands for Digital Subscriber Line (Figure 4.18). Like dial-up modem DSL modem also uses telephone lines to transfer digital signals. DSL modem has a built-in network switch which enables use of twisted pair wires to deliver data and voice at high speed as compare to dial-up modem. Some DSL modems also have wireless communication functionality.

Fig: 4.18 DSL Modem

(iii) ISDN Modem

Integrated Services Digital Network (ISDN: Figure 4.19) is a digital phone connection that can transmit data, voice and video over a normal telephone line at the same time which was not done before. It is faster and expensive technology. Since ISDN work on digital transmission it converts analog voice to digital signals before transmission.

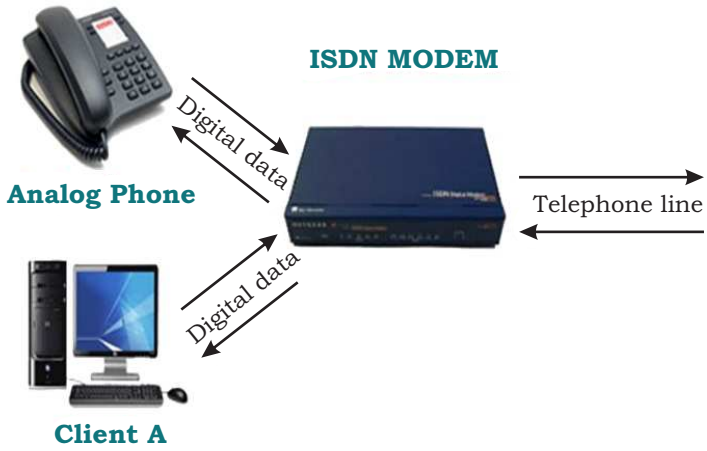

Fig: 4.19 ISDN Modem

4.3.4 Network Interface Card (NIC)

Network cards also known as Network Interface Cards (NICs: Figure 4.20) are hardware devices that connect a computer with the network. They are installed on the mother board. They are responsible for establishing a physical connection between the network and the computer. Computer data is translated into electrical signals and sent to the network via Network Interface Cards. Modern motherboards have built-in NICs.

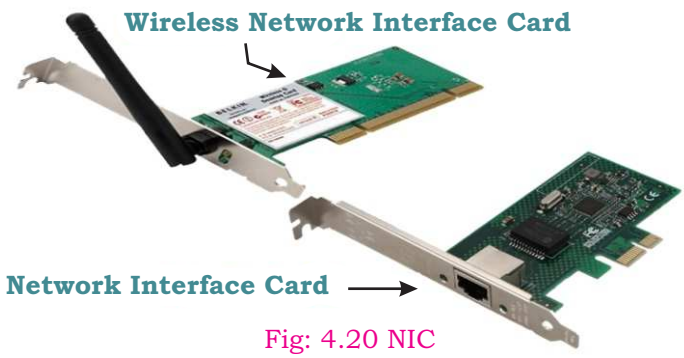

Fig: 4.20 NIC

SLOs

- Define the term computer network and networking
- Classify the network types on the basis of their characteristics

4.4 BASICS OF COMPUTER NETWORKS

Computer networks are just like a highway on which data can travel. A computer network connects parts of distributed system including hardware and software. It shares common functions and features like data and devices which is very important nowadays.

4.4.1 Computer Network and Networking

(i) Computer Network

A computer network is a group of computers and related equipment connected by a communication links to share data and other resources. The related equipment may be printer, scanners, fax machines, server, etc. The resources may include a file server, internet connection, etc.

(ii) Networking

Networking is the act of joining computers and its accessories so that exchange of information and sharing of resources take place. In today's world, networking plays a vital role in computers and telecommunication fields. Modern organizations create a networking environment and device connectivity for fast, inexpensive and reliable communication.

Teacher Note

Teachers are expected to show network physically. They are also supposed to show how we can access other computers and printers attached with a network.

4.4.2 Types of Computer Networks

Computer networks can be categorized by their size as well as their purpose. The size of a network can be expressed by the geographical area they occupy and the number of computers that are part of the network. Networks can cover anything from a handful of devices within a single room to millions of devices spread across the entire globe. There are three types of computer networks:

- Local Area Network (LAN)
- Metropolitan Area Network (MAN)
- Wide Area Network (WAN)

(i) Local Area Network (LAN)

LAN is a group of computer and peripheral devices which are connected in a limited area such as school, laboratory, home and office building. Useful resources like internet access, storage space and printers can be shared through LAN. It can be built with inexpensive hardware such as hubs, switches, network adapters and network cables. Data and software are also shared through LAN.

(ii) Metropolitan Area Network (MAN)

In MAN, computer network can spread across an entire city, college campus, or a small region. It can cover the area of several miles and may include multiple small networks or LANs. MANs offer very fast communication but they are expensive to establish. Therefore, only large business organization or universities set up MAN. It also requires security measures to prevent unauthorized access.

(iii) Wide Area Network (WAN)

A Wide Area Network is used for long distance transmission of data. WAN helps to cover a larger geographical area and connect cities, provinces or even countries. Using WAN technology, computers may be linked together in different countries using satellites, microwaves or telecommunication links. Therefore, large business, research and

educational organizations situated at longer distances use WAN. A WAN may include multiple MANs and LANS. WANs are set up with expensive devices and need some dedicated connections

SLOs

- Define the term network topology
- Develop understanding about physical layout of bus, ring and star topologies
- Differentiate the network topologies according to their design and physical layout

4.5 Fundamental of Topologies

The physical layout in which computers are connected is called topology. The topology of network describes the way computers are connected. Topology is a major design consideration for computer networking.

4.5.1 Bus Topology

As name suggests, in Bus Topology computers and other devices are connected with a single cable. The central cable is the backbone of the network and every device communicates with the other device through this bus. The advantages of Bus Topology are simplicity, low cost and easy expansion of the network. The disadvantage of the Bus Topology is that a breakdown in the bus cable brings the entire network down.

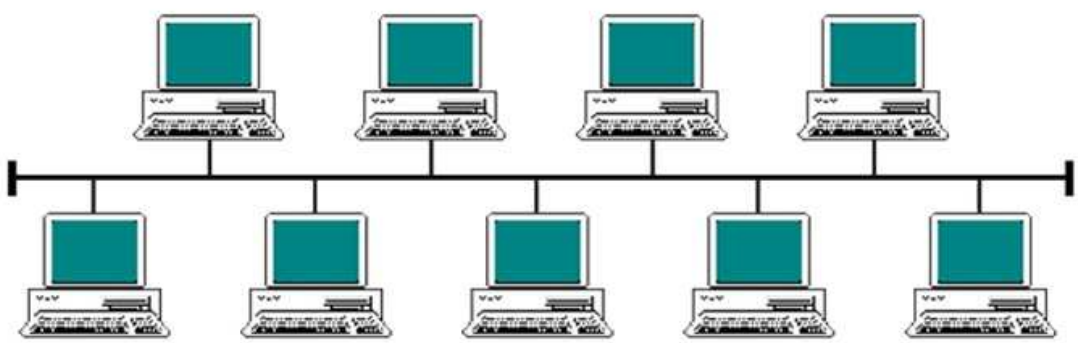

Fig: No. 4.21 Bus Topology

4.5.2 Ring Topology

In Ring Topology, computers are connected in a ring or circle shape. The signal travels around the loop in one direction and passes through each computer. The recipient of the message receives the message while another computer acts like a repeater to send it to the next computer. The failure of a link or a computer can make the entire network non-functional.

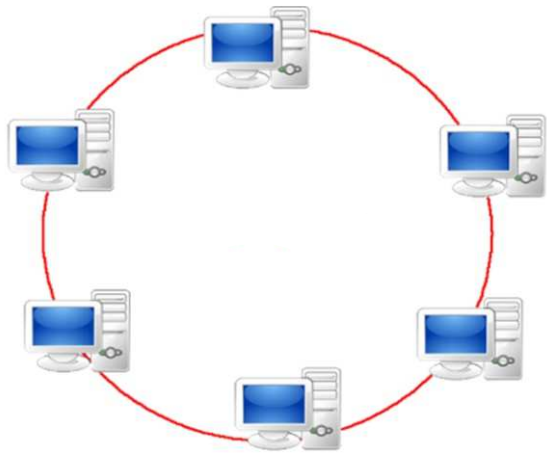

Fig: 4.22 Ring Topology

4.5.3 Star Topology

In a star topology, all the computers are connected to a central device called hub or switch. To communicate with any computer, the sender must send information to the hub. Then the hub transmits that information to the destination. The advantages of star topology are easy to set up and easy expansion of the network. Another feature of Star Topology is that if one link to the hub breaks, only the station using that link is affected not the whole network.

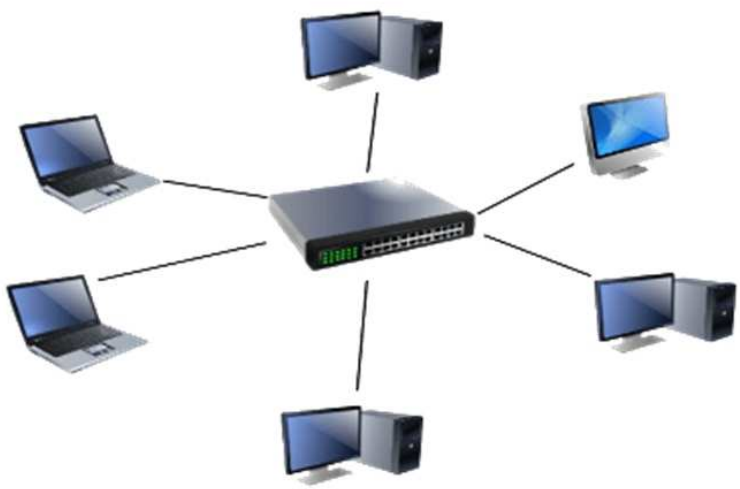

Fig: No. 4.23 Star Topology

SLO

- List out the names of standards organizations: ISO, IEEE, IETF, ITU, ANSI

4.6 STANDARD ORGANIZATIONS

Standards are rules that define the appearance, functionality, or protocols of some equipment. They are essential for network communication. Network standards define rules of communications among computing devices. This ensures that companies (i.e. Cisco and IBM) that manufacture computing and networking products follow these uniform standards. By following standards, all hardware become compatible in the network, allowing efficient networking to take place.

Standard Organization develops, coordinates, revises, amends and reissues technical standards. These standards are intended to address the requirements of a group of concerned devices. There are several organizations working on standardization of computing equipment to enable the interoperability among different devices manufactured by different companies in different regions. IEEE, IETF, ITU and ANSI are the examples of standard organizations.

4.6.1 International Organization for Standardization (ISO)

It covers a wide range of fields. The ISO has members from the standards committees of various governments across the world. It is even responsible for developing models which provides high level of system compatibility, quality enhancement, improved productivity and reduction in costs. The ISO is also responsible for endorsing and coordinating the functions of the other standards organizations.

4.6.2 Institute of Electrical and Electronic Engineering (IEEE)

It is an international professional non-profit organization. Electronics, computer and communication engineers, researchers, scientists and students are the members of IEEE. This organization develops communication and information processing standards for all fields related to electrical and computer engineering.

4.6.3 International Engineering Task Force (IETF)

It is a large international community of network designers, operators, vendors and researchers concerned with the development of internet architecture and smooth operation of the internet.

4.6.4 International Telecommunication Union (ITU)

This organization is a specialized agency that is responsible for resolving the issues that concern with information and communication technologies.

4.6.5 American National Standards Institute (ANSI)

It is the official standards agency for the United States. ANSI is a completely private, non-profit organization comprised of equipment manufacturers and users of data processing equipment and services. It supervises standards for products, services, processes, systems and personnel in the United States. ANSI membership is comprised of people from professional societies, industry associations, governmental and regulatory bodies, and consumer goods.

SLOs

- Define network architecture
- Memorize the names of seven layers of OSI's ISO model
- Define the functions of all layers of OSI's ISO model
- Describe functions of layers in TCP/IP model

4.7 NETWORK ARCHITECTURE

It is the design of a computer network. It is a framework for the specification of a network's physical components, their functional organization and configuration, operational procedures and communication protocols used. Just like OSI / TCP layered architecture.

4.7.1 ISO's OSI Model

The Open Systems Interconnection model is a conceptual model developed by ISO. It characterizes and standardizes the communication functions of a telecommunication and computing network. Its goal is the interoperability of different communication systems with standard

communication protocols. This model divides a communication system into seven abstraction layers.

No.	Layers	Functions
7.	Application	This layer enables users to access the network with applications such as email, file transfer, etc. These applications produce the data, which is transferred over the network.
6.	Presentation	It receives information from the application layer and converts it to uniform network format (ASCII or Unicode) which is acceptable by rest of OSI model and destination. Encryption and decryption are also the responsibility of this layer. This layer also reduces number of transfer bits by compression.
5.	Session	This layer establishes, maintains and ends a session or logical connection between applications on two computers. It manages who can transmit data at a certain time and for how long. This layer adds checkpoints. If session fails only data after the most recent checkpoint need to be transmitted.
4.	Transport	It ensures the reliable transmission of data. Transport layer manages error control, flow control and quality of the service. If the data is not properly transmitted it requests to resend.
3.	Network	The function of this layer is the selection of the shortest and suitable path from source to destination, from the number of routes available. It is also responsible to convert logical address (IP address) to physical address (MAC address).
2.	Data link	This layer is responsible to transmit data using physical addresses. Data Link Layer ensures error free transmission of packets. Packet in this layer is referred as Frame.
1.	Physical	It is responsible for converting electrical signals into bits. It also defines the cable types to be used as transmission media, cards, topology and other physical aspects.

4.7.2 TCP/IP Model

TCP/ IP is a suite of communication protocols used to interconnect network devices on the internet. These are set of rules and procedures. TCP/IP specifies how data is exchanged over the internet by providing end-to-end communications. It also identifies how data should be broken into packets, addressed, transmitted, routed and received at the destination. With reference to OSI layers, we can understand the functions of TCP/IP layers.

OSI Layers	TCP/IP Layers	Function
Application	**Application Layer**	Using protocols like HTTP and FTP, this layer allows interaction with applications. Application layer is also responsible to encode and decode data and establish communication between two devices.
Presentation		
Session		
Transport	**Transport Layer**	Using protocols like UDP and TCP, this layer establishes a logical connection between two devices and makes sure the reliable delivery of data.
Network	**Internet Layer**	It is responsible for packet forwarding by accessing physical path.
Data link	**Network Access Layer**	Using the logical addressing this layer decides how data will be sent across different networks paths.
Physical		

SLOs

- Define network address
- Differentiate between Physical Address and Logical Address
- Describe IPV4 address

4.8 NETWORK ADDRESSING

Network addresses are like our house addresses. They must be unique and distinctive. This avoids confusion for the postman. A network address is any Logical or Physical Address that uniquely identifies it from

others. This address is needed to distinguish a network node or device on a computer network. It is a numeric or symbolic number or address that is assigned to any device that seeks access to network or is the part of a network. Remember, Physical and Logical Address are different.

Difference between Physical Address and Logical Address:

Physical Address	Logical Address
1. Physical address is attached with ROM of the NIC card.	1. Logical address is assigned to a device.
2. Physical Addressing means MAC (Media Access Control) provided by manufacture and attached address of the NIC. The card which is used to connect your machine to the internet.	2. Logical addressing means IP addressing that is provided by your Internet Service Provider (ISP) or set by network administrator.
3. Physical addressing cannot be changed. They are also called hardware address.	3. Logical Address can be changed.
4. Physical address is a 48 bit mac address.	4. Logical address is a 32 bit IP Address.
5. It is globally Unique and permanent.	5. It is unique in one network and temporary.

4.8.1 IPV4 Address

An IP address is a unique number or address used to identify a device on a network. The device could be a computer, printer, smart phone, tablet, etc.

Every device connected to the internet must have an IP address to communicate with other devices. IP address acts as a telephone number or a car registration number. It shows ownership and location. IP address allows a device to communicate and be located by other devices on the internet. IPV4 stands for Internet Protocol version 4.

An IPV4 address is made up of 32 binary bits, which is divided into two parts, network and host. The network portion of the address mentions

the computer network and the host portion identifies the computer or any other computing device. IP version 4 (IPV4) addresses are comprised of four number segments separated by dots. Example of an IP address is 192.168.108.105.

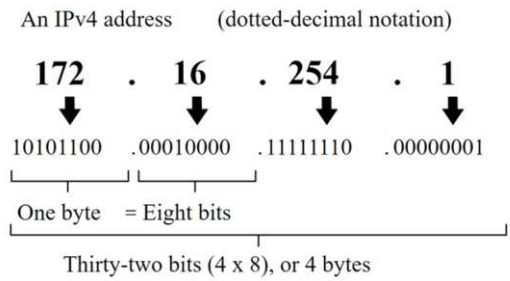

Fig: 4.24 IP Address

SUMMARY

- Communication is the process of sharing a message. Data communication refers to the exchange of digital messages between two devices.
- Analog signals are continuously varying signals or waves that change with time period and used to represent data.
- A digital signal is an electrical signal that is converted into a pattern of bits to represent a sequence of discrete value.
- Data rate refers to the rate at which data is transferred. It is normally measured in bits per second transferred.
- The baud rate is the number of signals transmitted per second and one signal can represent one or more bits.
- A communication system has following five component; message, sender, receiver, medium, protocol.
- The effectiveness of a data communications system depends on the fundamental characteristics which include delivery, accuracy and timeliness.
- Transmission medium or communication channel is a wireless or physical path between the sender and receiver through which data is sent and received from one place to another.
- Transmission media is broadly classified into two groups guided and unguided.

- Twisted Pair Cable is made by putting two separate wires together in a twisted pattern.
- Shielded Twisted Pair (STP) is type of cable consists of a special jacket to block external interference.
- Coaxial cable has an outer plastic covering containing two parallel conductors each having a separate insulated protection cover.
- In fiber optic cable data is transferred in the form of light.
- Radio waves are also called electromagnetic waves.
- Radios, television and cordless phones use radio waves for transmission.
- Microwave transmission is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other.
- Infrared light is transmitted generally line of sight (point to point).
- Transmission impairments are those defects that occur when data is transmitted. There are three kinds of impairment as attenuation, distortion and noise.
- Attenuation means loss of energy or a weakened signal.
- Distortion means change in the shape of the signal.
- Influence signal that mixes up with the original signal during the transmission of data is called noise.
- A switch or network switch is a networking device that connects computers and other devices like printers, scanners, and cameras of a computer network.
- A Router is device that connects two or more networks.
- Dialup modems use standard telephone lines to transmit and receive information.
- DSL stands for Digital Subscriber Line. DSL modems are the next step in modem technology.
- Integrated Services Digital Network (ISDN) is a digital phone connection that can transmit data, voice and video over a normal telephone line at the same time.
- Network cards also known as Network Interface Cards (NICs) are hardware devices that connect a computer with the network.
- A computer network is a system of computers and related equipment connected by a communication links to share data and other resources.

- Computer networks can be categorized by their size as well as their purpose.
- There are three types of computer networks Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN).
- A Local Area Network (LAN) is a group of computer and peripheral devices which are connected in a limited area such as school, laboratory, home, and office building.
- A Metropolitan Area Network or MAN consists of a computer network across an entire city, college campus, or a small region.
- A Wide Area Network is used for long distance transmission of data. WAN helps to cover a larger geographical area. It may connect two or more countries.
- Bus topology consists of a single cable by which all the computers and other devices of a network are connected.
- In ring topology, computers are connected in a ring shape.
- In a star topology, all the computers are connected to a central device called hub or switch.
- Network standards define rules of communications among computing devices.
- International Organization for Standardization (ISO) consists of members from the standards committees of various governments across the world.
- IEEE, IETF, ITU and ANSI are examples of standard organizations with different goals and functions.
- Network architecture is the design of a computer network.
- The OSI is a conceptual model that characterizes and standardizes the communication functions of telecommunication and computing.
- A network address is any logical or physical address that uniquely identifies itself from other addresses.
- Physical address is a 48 bit MAC, permanent address.
- Logical address is a 32 bit IP Address. It is temporary.
- An IPV4 address is made up of 32 binary bits, which is divided into two parts, network and host.

EXERCISE

A. Choose the right answer:

1. Wired Media is also called:
   a) targeted media b) directed media
   c) guided media d) unguided media

2. Communication system is made up of
   a) three components b) four components
   c) five components d) six components

3. Both Physical and Logical addresses are:
   a) different b) unique
   c) permanent d) temporary

4. If you are an electrical or electronic engineer, you should join:
   a) IEEE b) IETF
   c) ITU d) ANSI

5. The topology in which all computers are connected to a central device called hub is:
   a) Bus b) Star
   c) Ring d) Tree

6. Change in the shape of signal between sender and receiver is called:
   a) attenuation b) interruption
   c) noise d) distortion

7. Router determines data path to transfer data packets which is the:
   a) shortest b) longest
   c) cheapest d) optimal

8. Converting digital signal to analog is called:

a) modulation b) modification

c) bandwidth d) multiplexing

9. The number of bits used in an IPV 4 address are:

a) 16 b) 32

c) 64 d) 128

10. The loss of energy in transmission signal refers to.

a) Attenuation b) Distortion

c) Noise d) Jitter

B. Respond the following:

1. List the properties of a good communication system. Explain any one.
2. Explain components of communication using single example.
3. Write the function of following network devices.
   Amplifiers, Routers, Switch, Hub
4. List the causes of signal impairments. Explain any one.
5. What is the difference between radio wave and microwave?
6. Why OSI model is broken up in layers?
7. Explain the purpose of Standard Organization.
8. List one merit and one demerit of each topology.
9. Give one example of LAN, WAN and MAN.
10. How can we measure bit rate and baud rate? Give an example of each.

C. Match the columns:

S.NO.	A	S.NO.	B	C
(i)	Parts of an IPV4 address	(a)	WAN	
(ii)	Physical address	(b)	Network and Host	
(iii)	Change in shape of signals	(c)	Transport layer	
(iv)	A networking connecting two continents	(d)	Data link layer	
(v)	TCP and UDP are used at	(e)	Cannot be changed	
(vi)	In OSI model the layer responsible to decide the format of data	(f)	Distortion	

ACTIVITIES

1. APSTNDP are the first characters of OSI Model's Layer. Make sentence of seven words where each word starts with each character.
2. Compare Coaxial Cable, UTP, STP and Fiber Optic cable in terms of cost, data rate, installation, interference and maximum length of segment.
3. Uncover the twisted pair cable, count number of wires and also make list of color scheme.
4. Identify different type of layers of coaxial cable.
5. Identify and write names of different connectors used in telephone landline, coaxial cable and twisted pair cable.
6. Make a list of hardware equipment for each topology.
7. Draw a Hybrid Topology diagram in which bus, ring and star topologies are used.