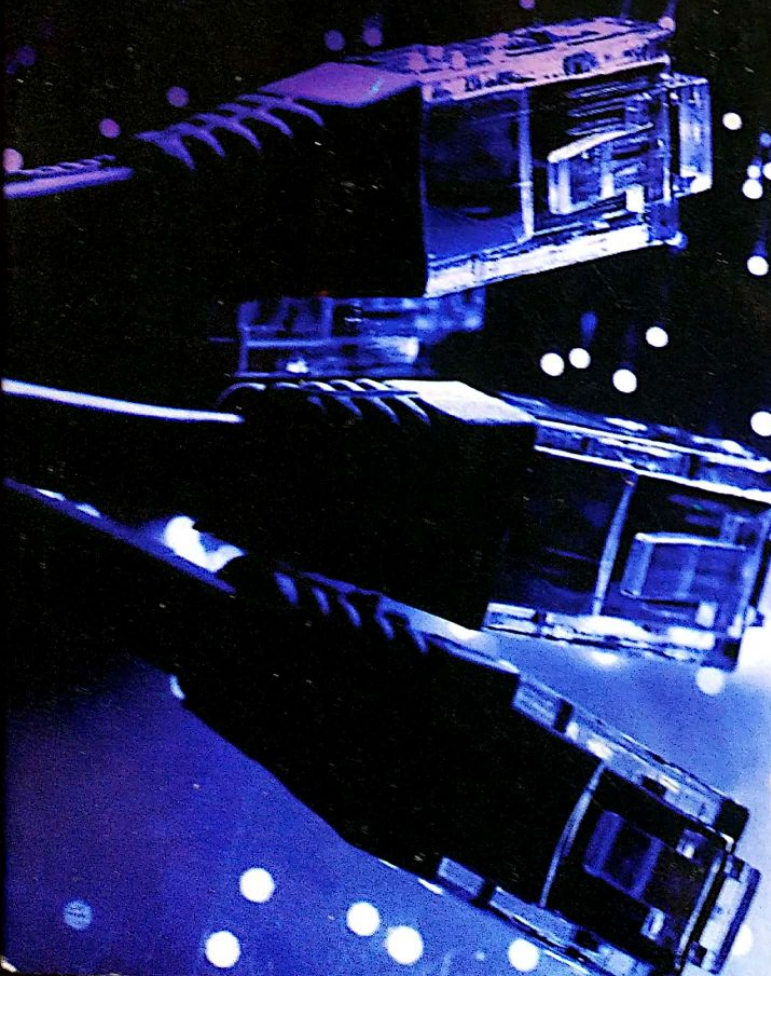
CC-303
Semester-5

Computer Networks

Data communications and Networking
Multiplexing and Demultiplexing and Transmission errors
Transmission Media, Network topologies and Switching
Network protocols, OSI, TCP/IP model

Including Self-Test Examination



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INDEX

Unit -1 Introduction to Data communications and Networking

05 to 29

1.1 Introduction
1.2 Data Communications
1.3 Protocol
1.4 Signal Propagation
1.5 Analog and Digital Signals
1.6 Bandwidth, Amplitude, Frequency and Period of Signals
1.7 Introduction Analog and Digital Transmission
1.8 Analog Signal to Analog Transmission
1.9 Digital to Digital Transmission
1.10 Digital to Analog Transmission:
1.11 Bit Rate and Baud Rate
1.12 Analog to Digital Transmission or Pulse Code Modulation (PCM)
1.13 Modes of data transmission
1.14 Parallel Transmission
1.15 Asynchronous Transmission

Unit - 2 Multiplexing & De-multiplexing 30 to 45

2.1 Multiplexing and Demultiplexing
2.2 Types of Multiplexing
2.3 WDM (Wavelength Division Multiplexing):
2.4 Transmission Errors: detections & correction
2.5 Error Classification
2.6 Types of Error
2.7 Error detection
2.8 Recovery from error

Unit - 3 Transmission Media 46 to 67

3.1 Guided Media
3.1.1 Twisted pair cable
3.1.2 Coaxial Cable

3.1.3 Optical fiber
3.2 Unguided Media
3.2.1 Microwave
3.2.2 Satellite Communication
3.2.3 Cellular Telephone Communications
3.3 Network topology
3.3.1 Bus Topology
3.3.2 Ring Topology
3.3.3 Star Topology
3.3.4 Mesh Topology
3.3.5 Tree Topology
3.3.6 Hybrid Topology
3.4 Switching
3.4.1 Circuit Switching
3.4.2 Packet switching method
3.4.3 Message Switching

Unit - 4 Network Protocols, OSI, TCP/IP Model 68 to 93

4.1 Protocols in computer communications
4.2 OSI model and layer functions
4.3 TCP/IP MODEL
4.4 Types of area networks – LAN, MAN and WAN
4.5 Ethernet
4.6 Introduction to VLAN, Fast and Gigabit Ethernet
4.7 Token Ring
4.8 FDDI
4.9 Introducing Wide-Area Networks (WANs)
4.10 Integrated Services Digital Network (ISDN)
4.11 Bluetooth
4.12 Infrared communication
4.13 Introduction to Wireless LAN
4.14 Internetworking Device

❖ **Self Test Examination** 94 to 100
❖ **Paper 2019** 101 to 102

Unit-1 Introduction to Data communications and Networking

1.1 Introduction:

This chapter provides an introduction to Computer networks and covers fundamental topics like data, information to the definition of communication and computer networks. The main objective of data communication and networking is to enable seamless exchange of data between any two points in the world. This exchange of data takes place over a computer network. It begins by describing why it is important to study data communications and how the invention of the telephone, the computer, and the Internet has transformed the way we communicate. Next, the basic types and components of a data communication network are discussed. Data refers to the raw facts that are collected while information refers to processed data that enables us to take decisions. Ex. When result of a particular test is declared it contains data of all students, when you find the marks you have scored you have the information that lets you know whether you have passed or failed. The word data refers to any information which is presented in a form that is agreed and accepted upon by is creators and users. We also cover different technics to convert signals in different communication medium. Also provide different way to communications.

1.2 Data Communications:

When we communicate, we are sharing information. This sharing can be local or remote. between individuals, local communication usually occurs face to face, while remote communication takes place over distance. Term Tele Communication which includes communication by Telephone, Television, and Telegraphy etc. are used for long distance Communication. But in Terms of Computer Data Communication means exchange information or data between two computers or source and destination. In Computer data are in binary format so it is transferring data in 1 and 0 formats. Source transmits the data and receivers receive the data. Data Communication is interested in the transfer of data, the method of transfer and the preservation of the data during the transfer process.

The purpose of Data Communications is to provide the rules and regulations that allow computers with different disk operating systems, languages, cabling and locations to share resources. The rules and regulations are called protocols and standards in Data Communications. Data communication is performing through some hardware and software they are the part of communication system.

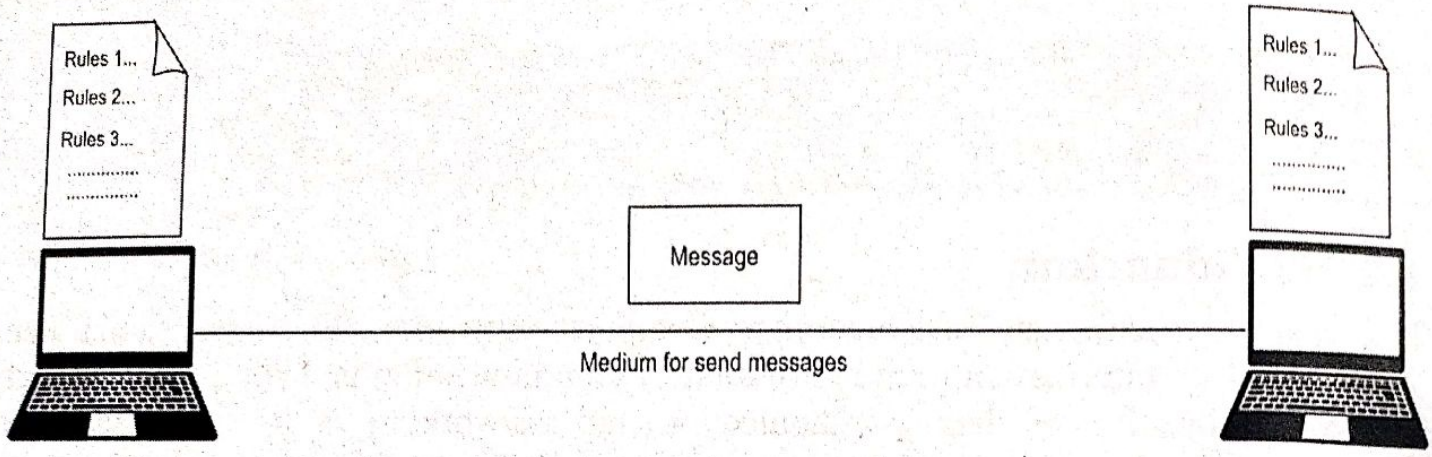


Figure 1.1 Data communication.

The effectiveness of a data communication system depends on the three fundamental characteristics:

Delivery: The System must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user

Accuracy: The system must deliver data accurately. Data that have been altered in transmission and left uncorrected are rustles

Timeliness: The system must deliver data in a timely manner. Data delivered late are useless. In the case of video, audio, and voice data, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery id called real-time transmission.

1.3 Protocol:

Protocol means "set of rules". In Communication there must be some rules that rules are define in protocols. For different types of communication there are different types of protocols are design. These protocols are implementing on same types of communication medium, hardware and software which are used in network. For example if one person can speak only French language then he cannot communicate with other persons in Other Language. Same as, two devices must communicate with each other if it can follow and understand same protocols. It is also compulsory sending device and receiving device both understand same protocols and ready to conversations. Then and only then sender and receiver device communicate.

Otherwise sender is ready to send but receiver is not under stood the protocol so it will not full fill complete communication and there must be error occur in communication. There are many protocols are design in Data Communications. Each Protocol is start their own task based on Communication and Data which is send and receive. Some protocols are very popular but some are use very less. Protocols are work on three basic characteristic.

Syntax: It is focused on Data. What kind of Data is send, the structure of Data also define in syntax. Same structure of Data Sender and Receiver machine can understand, It is a role of protocol to convert data in same syntax so communication can take place.

Semantics: IT Focused on Interpretation of Data which is sent. How data is understand and how it is interpreted by receiver, IT is also defined how it is communicated.

Timing: IT is focused on Agreement between Sender and receiver, when to start a communication and when communication is end. It defines the duration of Communication. In duration the communication must complete, it is role of protocol to set a time as much as data with sender. It also defines the transmission rate, what speed sender will send and what speed receiver will receive data. Speed management between sender and receiver also done by protocol.

1.4 Signal Propagation:

Signals are one kind of waves. We all know that waves are travel on any medium. Waves are generated by giving force from one side and pass up to the end as force is apply. Same Signals are generated by giving force are traverse up to the end as force is apply. For example we all seat in one Air Conditioner hole, While Air Conditioner is started hole is not cool as much after some time some area of hole will cool , after some more time half area of hole is cool and after some more time complete hole will cool. Means cool air is transfer in form of waves in air and hole is cool on T time.one more example there is pool of water if you throw a stone in pool it will generate wrinkles it is called waves. Number of wrinkles is depending on force given by you while you throw stone in pool. The electric signals also behave exactly same way. In Electric signals we apply voltage in one side of wire and the signal will traverse from one end to another end.

1.5 Analog and Digital Signals:

Data can be in two different formate it can be Analog or Digital. Analog Data are always transmit in continuous formate. Digital Signals are discrete formate.

1.5.1 Analog Signals:

Analog waves are in continuous so it is transmit in wave form. Example of Analog signal is Human voice, or any other voice. Analog signals are visualize as a simple curve. It is call oscillations. This signals are transmit on medium by generating smooth cycles in rolling flow.An analog signal can be defined by using amplitude frequency, & phase. This can be captured by microphone. An analog signal is not resistant toward the noise, therefore; it faces distortion as well as reduces the transmission quality. Anlaog signal passes from one destination to another with infinite waves. For long distance transmission Analog signals are regenerated by Amplifier. Analog signal is not encrypted, Analog signals bandwidth is low.

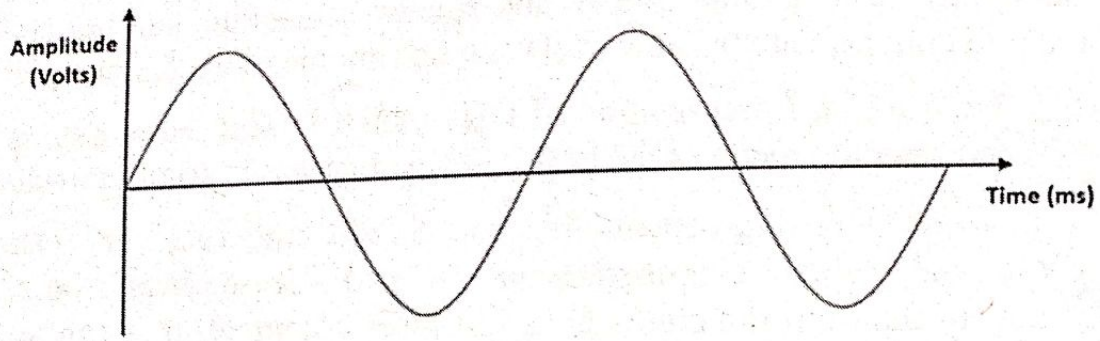


Figure 1.2 Analog Signals.

1.5.2 Digital Signals:

Digital data transmit in form of value like on and off or 1 and 0 so it is represented with square waves. Digital Signals are generated through voltage so it is store in memory and transmit in form of 1 and 0. Digital signal can be defined by bit interval as well as bit rate. It is in binary forate .Digital signals are more resistant toward the noise; therefore, it barely faces some distortion. Digital Signals transmit in limited value so there is fixed number of digits is transmit and that number of waves are generate in this signal. For long distance transmission Digital signals are regenerated by Repeater. Digital signal is encrypted. Digital signals bandwidth is high.

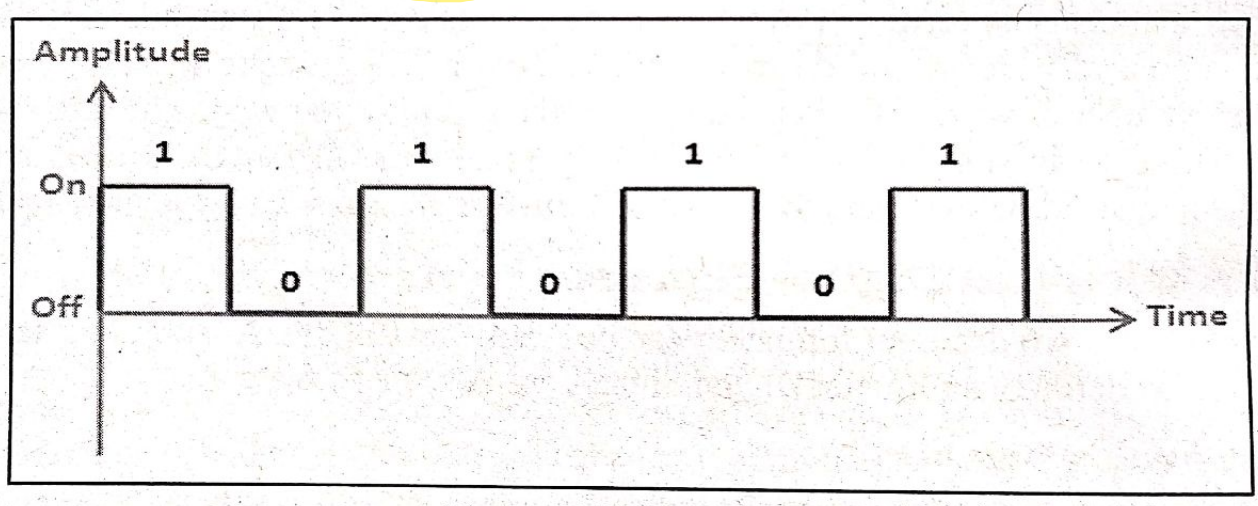


Figure 1.3 Digital Signals.

1.6 Bandwidth, Amplitude, Frequency and Period of Signals:

1.6.1 Bandwidth of Signals:

As we know any data can transmit in medium, we major the capacity of medium to transfer data. To major Capacity of medium is consider as major bandwidth .For example There is one Tank in Tenement and there is one Water pipe is passing from Tank to each house that pipe is large enough to flow a water to each house but at the end each house has smaller pipe then main tank pipe so each house can get enough water in equal quantity. In above example main pipe is large so its capacity to transmit water is high flow. But each house has smaller pipe so the capacity of water flow will decrees.

Bandwidth means maximum capacity to transmit data thorough medium. We are using different bandwidth to pass data in different types of transmission. Analog signal are transmit different types of voice in different bandwidth, same digital signals are transmit different data on different bandwidth.

1.6.2 Amplitude of Signals:

Each signals are traverse in horizontal line, it traverse with some value this value is called its voltage .Voltages are measure in vertical line on T time period as the signal traverse. To measure a voltage on vertical line is also called amplitude of signals in other word it is called signals amplitude. It refers Height of the signals. The maximum amplitude of signal means highest value signal reaches on vertical axis. Amplitude is measured in volts or watts.

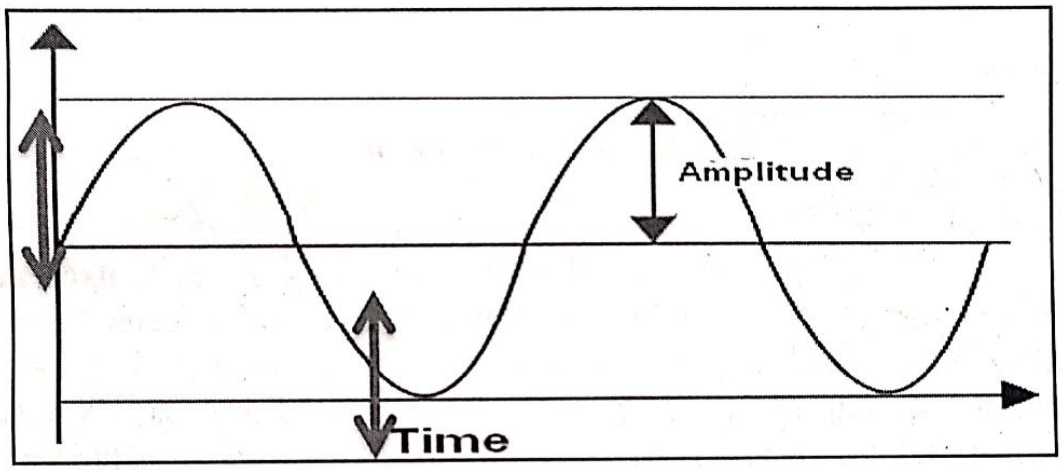


Figure 1.4 Amplitude of Signal.

1.6.3 Wavelength:

We know that signals are traverse in wave format but there are two possibility in waves up-waves an down-waves ,we measure the two consecutive location of in phase is called wave length of signals. We can also say that measure a distance between two same in phase points is called wavelength.

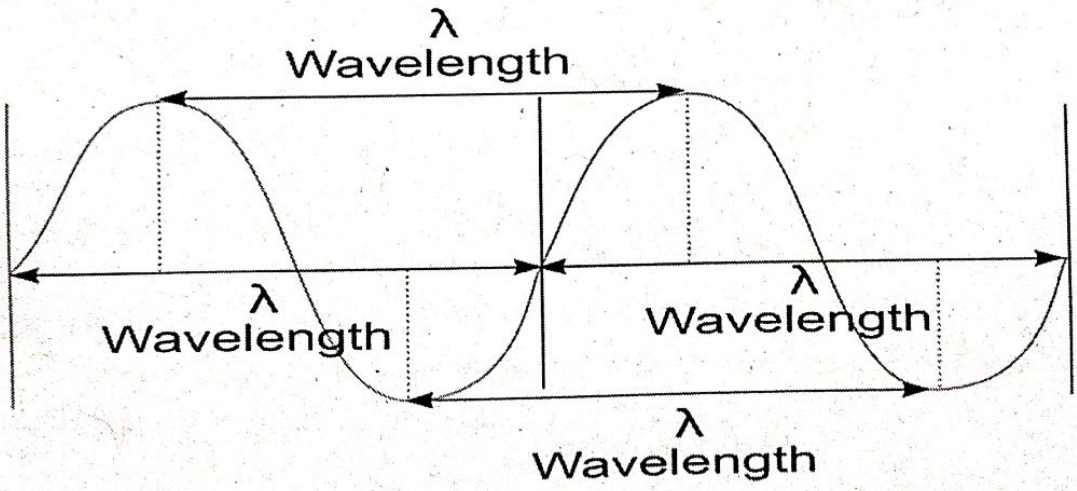


Figure 1.5 Wavelength of Signal.

1.6.4 Period of Signals:

Signals are traverse in form of waves this waves are complete its cycle from starting point to end point. Period is defined the time in seconds to complete one cycle of signal.in communication period is measure in five different unit seconds(S), millisecond (ms=10^{-3} s), microsecond (μs=10^{-6} s), nanosecond (ns=10^{-9} s) and picosecond (ps=10^{-12} s).

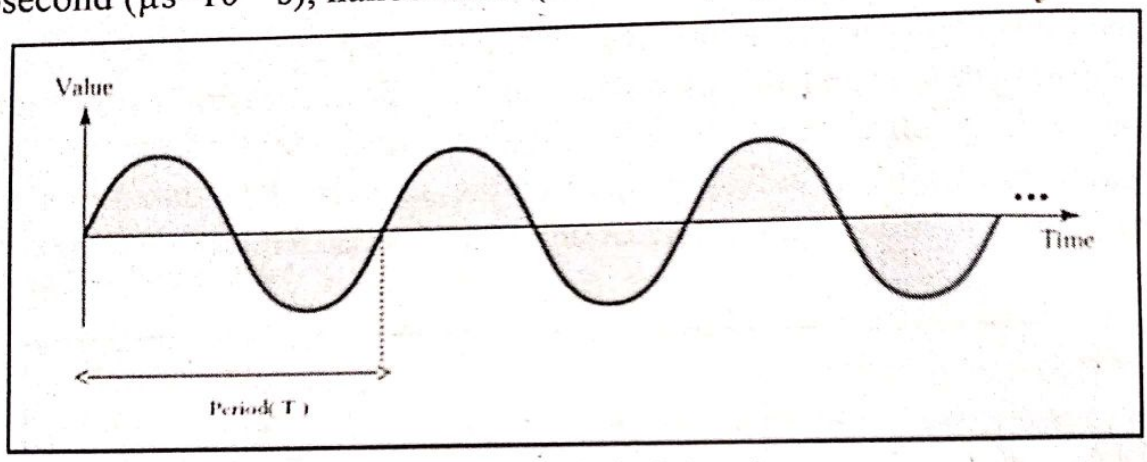


Figure 1.6 Period of signal.

1.6.5 Frequency of Signals:

Signals traverse in form of waves are called its cycle. **Frequency is used measure how many cycles (oscillations) of signal is completed in 1 second.** Means if there is only one cycle complete in one second then the frequency of signal is 1, if there are 3 cycles completed in one second then the frequency of signal is 3.Frequancy is measured in Hz. We can say that 3Hz frequency. Frequency and Force are work to gather, as the Force is increase number of Frequency also increase. If the force is decrease number of Frequency also decreases.

T time number of Cycles completed
T= 1 second
Hz is a measurement unit of Frequancy.
1 Hz means one cycle complete in 1 second

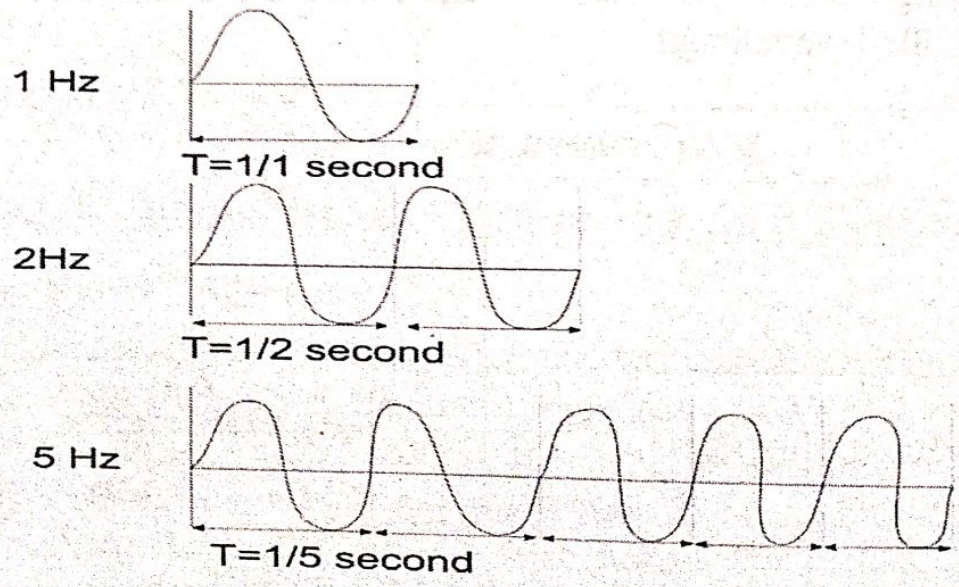


Figure 1.7 Frequency of Signal.

1.6.6 Phase of Signals:

Phase of Signal is used to describe location within a signal wavelength. Phase are change relative to time zero. Phase define the degree of changes in waves on time axis either it is shifted forward or backward. Phase is measured in degree or radians. It is between 0 to 360 degree. Majority phase change on some comman angle or degree like 90,180,135,215 etc. Here I define 4 different phases of signal on time axis, it is also define change of angle.

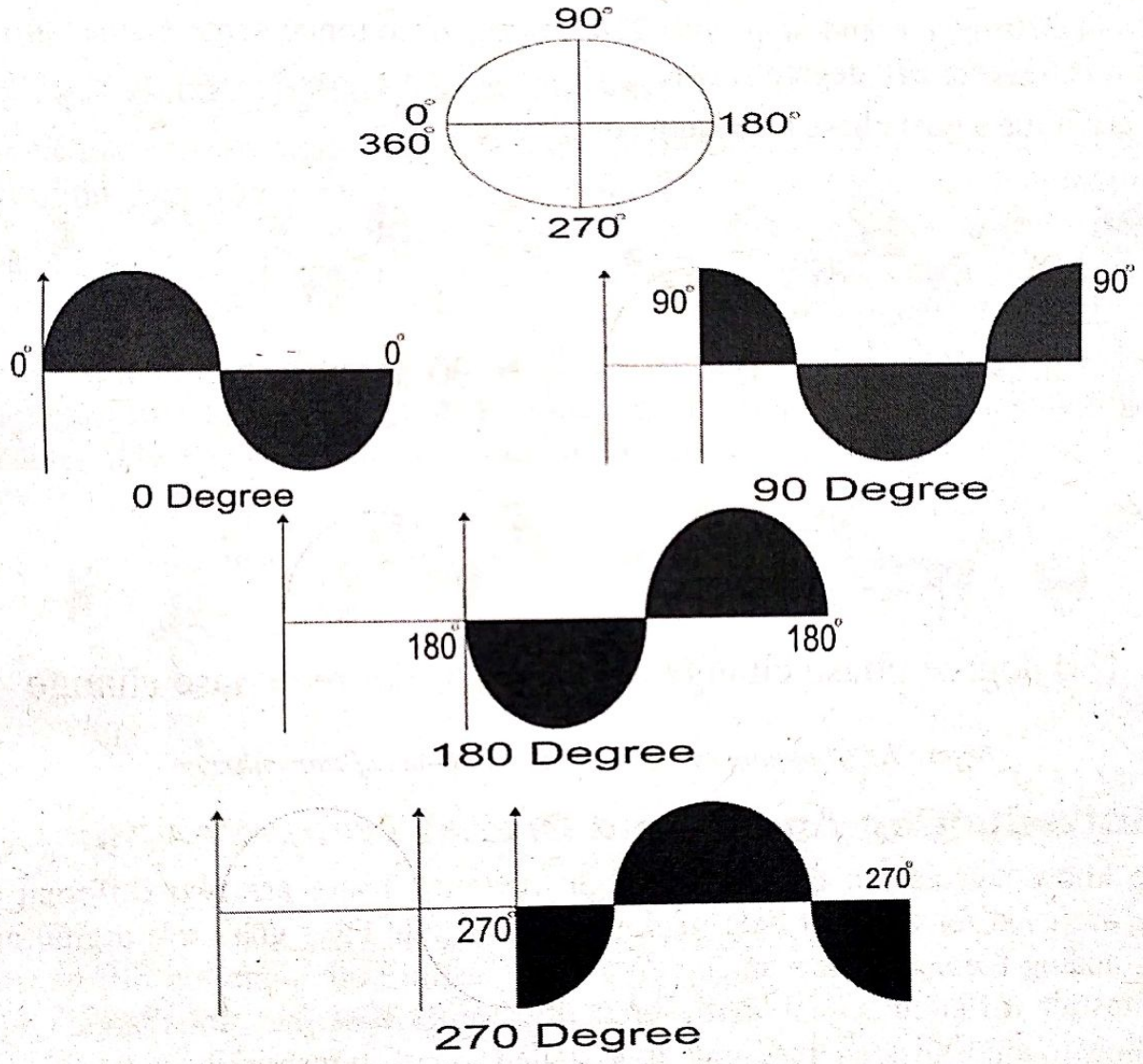


Figure 1.8 Phase of Signal.

First figure define a round with 0 to 360 degree which is only for understand how the signal will traverse and generate different angles.

Second figure define 0 degree angle signals on time axis in that figure the signals curve start from 0 degree and stop with 0 degree, if continue same signals are generate means it is traverse 0 degree angle.

Third figure define 90 degree angle signals on time axis in that figure the signals curve start from 90 degree and stop with 90 degree, if continue same signals are generate means it is traverse 90 degree angle.

Fourth figure define 1800 degree angle signals on time axis in that figure the signals curve start from 180 degree and stop with 180 degree, if continue same signals are generate means it is traverse 180 degree angle.

Fifth figure define 270 degree angle signals on time axis in that figure the signals curve start from 270 degree and stop with 270 degree, if continue same signals are generate means it is traverse 270 degree angle.

There are some signal phase are change on T time.

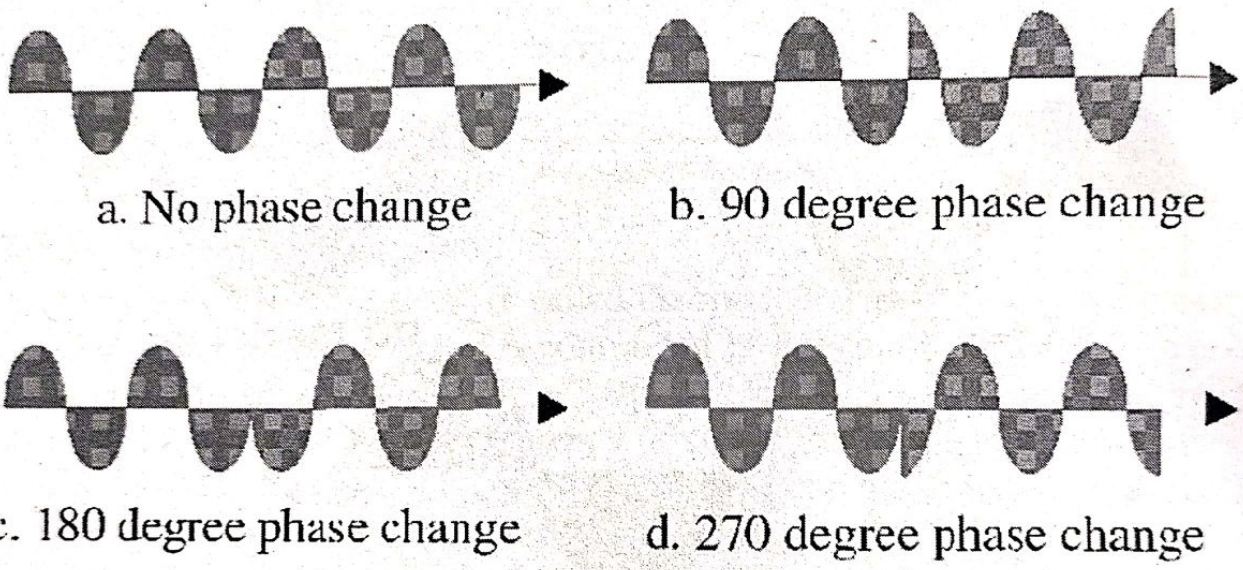


Figure 1.9 Changing in phase of Signal at time of transmission.

1.7 Introduction Analog and Digital Transmission:

As we know signals are transmit through medium. There are two different types of signals are used for transmit data. If the data is Digital the signals are digital and if the data is analog the signals are analog. We can transmit both signal on different medium. For transmit different signal to different medium we require to change signal type according to transmission medium. It is called signal transmission. But if signal and medium both are same then no need to change the signal.

There are 4 different types to transmit signal.

1) Analog signal Analog transmission medium
2) Digital signal Digital transmission medium
3) Digital Signal Analog Transmission medium
4) Analog Signal Digital Transmission medium

1.8 Analog Signal to Analog Transmission:

Analog to analog conversation is used to represent anlog information analog signals.This modulation is used when signal is bandpass or bandpass medium / channel is available. A bandpass signal is passing through bandpass filter. For example Radio signals are such kind of signal which is using this conversion technic.Analog to analog conversion is used three different ways to transmit signals. Telephone Communication is also use this technic.Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM)

1.9 Digital to Digital Transmission:

In this technic we use digital data and transmission medium is use digital signals. When you transmit data from your computer to your Phone both devices are communicate on digital signals. In this type of encoding binary data are transmitted on wire by applying voltage. It is use line coding technic. There are some encoding and decoding hardware is used for encode digital to digital data. In our computer there are different types of data like text,number,image,audio,video etc. line coding technic convert sequence of bits of digital signal at sender side and then digital signals are pass through medium to receiver ,at receiver side data is decoded and store in to receive memory.

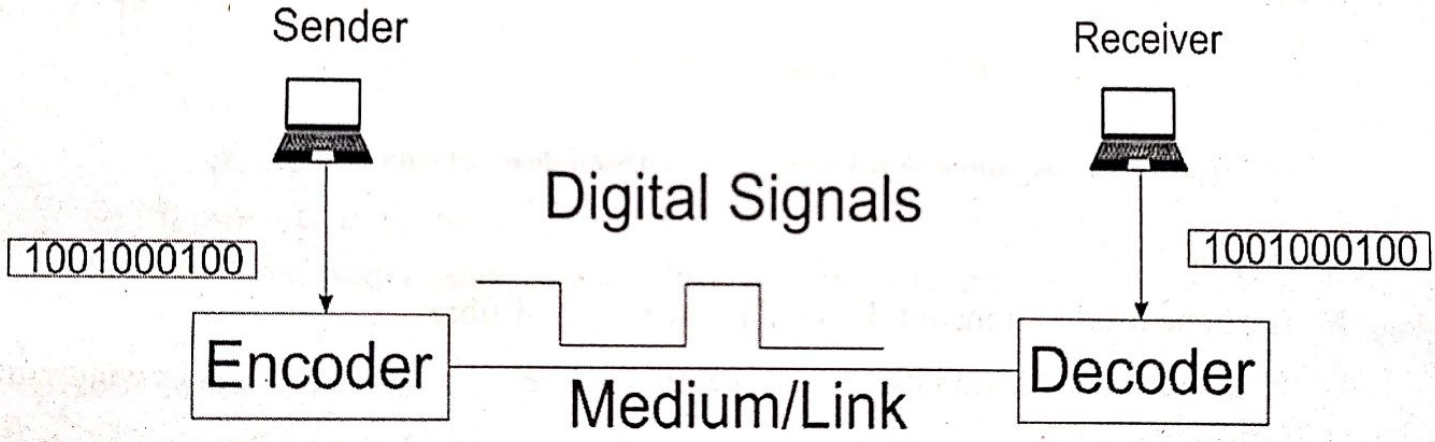


Figure 1.10 digital to digital transmissions.

1.10 Digital to Analog Transmission:

In such kind of conversion our data is in Digital format and we pass such data on analog medium/ link. For passing digital signals on analog medium we need to encode digital data into analog signal and then only analog medium will pass this signal to the receiver. Same at receiver side there one device which demodulate analog signals and convert into actual digital data which computer or any digital device can easily read and store in memory. For encoding and Decoding the hardware which is used is modem .Modem is responsible to modulate and demodulate signals before transmission at both sides. For modulation and demodulation modem use some different technics, that are the ASK, FSK and PSK. These three technic is used only for Digital to Analog Conversation. There is another forth method is also implement which use both amplitude and Phase is known as

QAM.The hardware use one of the technic to modulate and demodulate the signals. We will discuss one by one in this topic.

1.10.1 Amplitude Shift Keying (ASK):

In amplitude shift keying only signal amplitude is observe frequency and phase is not observe. Only amplitude is change Frequency and Phase remains constant. In this technic Amplitude is measure by 1 and 0 of digital bits. There are two different lines to measure 1 and 0 in this technic. If signal is touch to the 0 or below the 0 line then the signal is low or off bit. If signal is touch to the 1 or above the 0 and 1 line the signal is high or on bit.

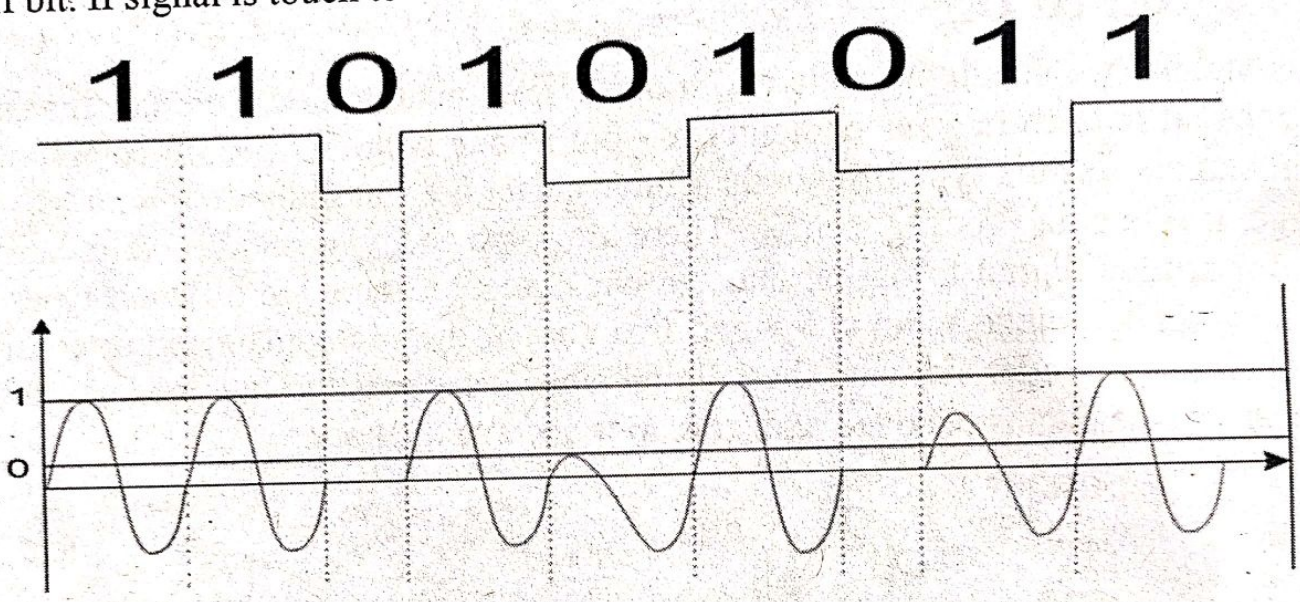


Figure 1.11 Amplitude shift keying convert digital data in to analog signals.

Advantage of ASK

- It can be used to transmit digital data over optical fibre.
- It uses lesser bandwidth as compared to FSK thus it offers high bandwidth efficiency.

Disadvantages of ASK

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

1.10.2 Frequency Shift Keying (FSK):

In this technic Frequency only observe Amplitude and Phase remain Constant. Frequency is varied to represent 1 and 0.There is two frequencies are used to f1 and f2.Frequancy of bit signal is measured by their constant wave form. If frequency is rapid and near to each other, match with f1 type of frequency means its high bit or on bit 1. If frequency is slow and far to each other, match with f2 type of frequency means it is low and 0 bit.

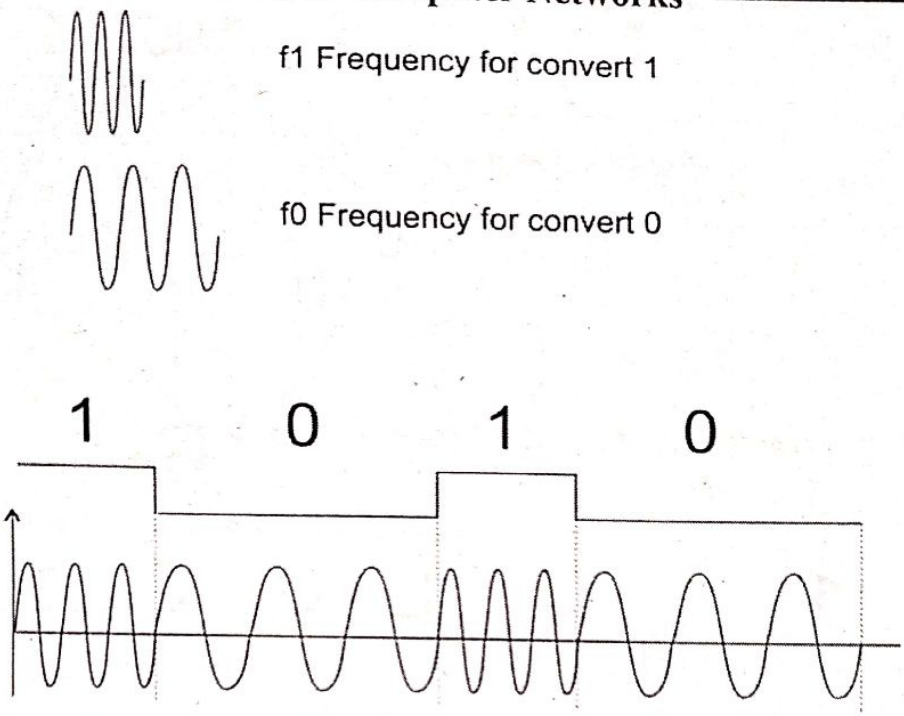


Figure 1.12 Frequency shift keying convert digital data in to analog signals.

Advantages of FSK

- 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.

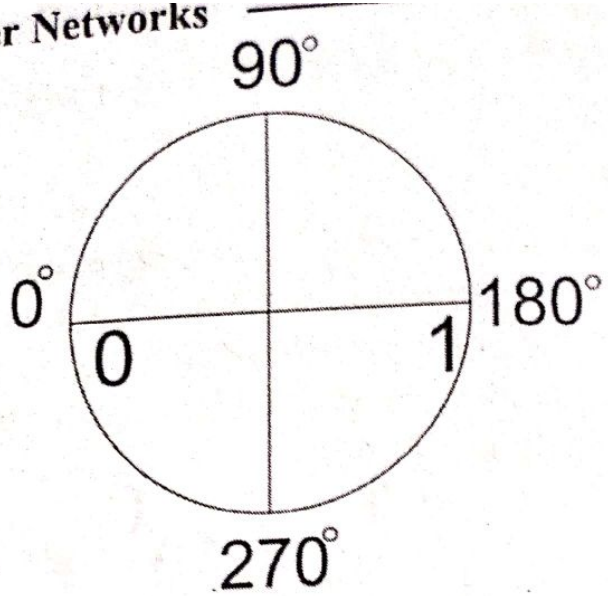
Disadvantages of FSK

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

1.10.3 Phase Shift Keying (PSK):

In this technic Phase of signal is observe .Amplitude and Frequency remain constant. According to changing in Phase 0 and 1 of binary bit convert in to analog signal. For measure a phase there are 3 different technics are used.2-PSK,4-PSK and 8-PSK one of the technic is used to convert digital to analog signals. Here we define 2-PSK or binary-PSK technic. In this technic 2 different phase are define 0 degree phase and 180 degree phase. In 0 degree phase value of bit is consider 0 and in 180 degree phase value of bit is consider as1. While 0 (off) is send the signal start with 0 degree phase, if 1 (on) is send then signal start with 180 degree phase.

Bit	Phase in Degree
0	0
1	180



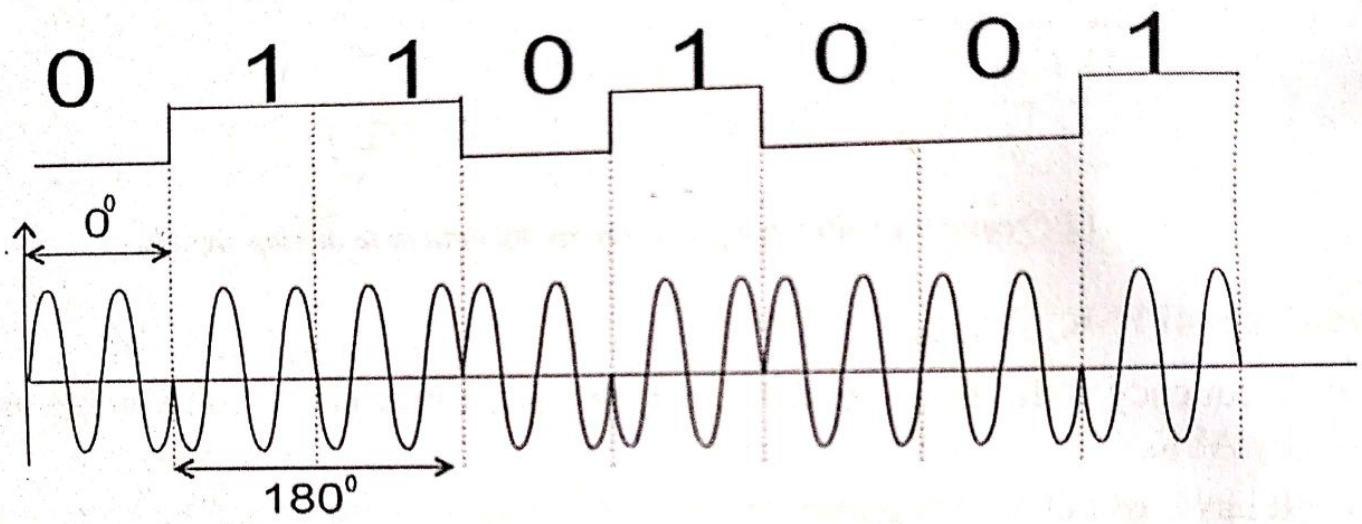
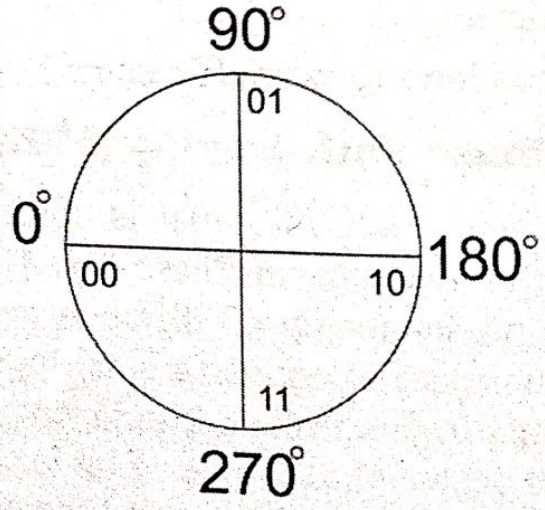


Figure 1.13 Phase shift keying convert digital data in to analog signals.

There is also one method here we explain 4-PSK.In this technic we use pair of bits with 4 different combination. Four (4) different combinations use 4 different angles to convert digital data into analog signals. In this technic 2 bits send same time so it send fast data compare to 2-PSK. Following are 4 different pair of bits with 4 different angles.

Bit	Phase in Degree
00	0
01	90
10	180
11	270



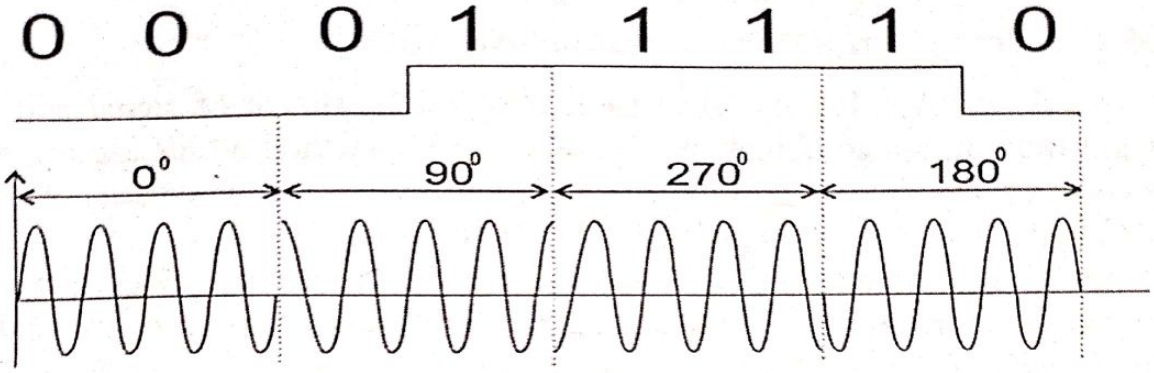


Figure 1.14 4-PSK convert digital data in to analog signals.

For information we define here 8-PSK angle and bits table.

Bit	Phase in Degree
000	0
001	45
010	90
011	135
100	180
101	225
110	270
111	315

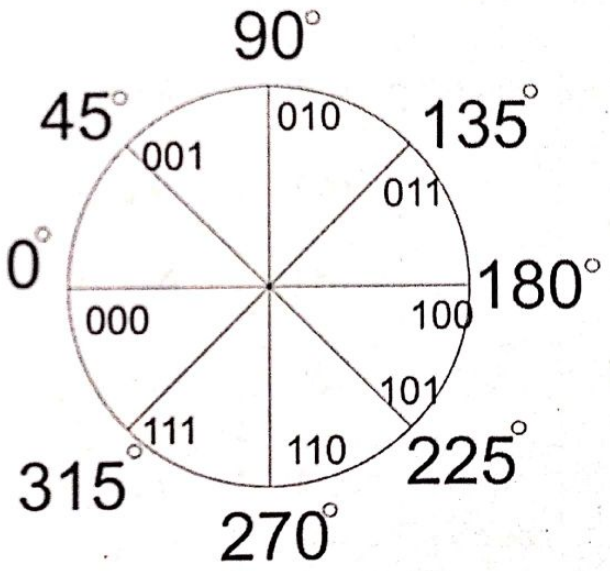


Figure 1.15 8-PSK table with angles of phase.

Advantage of PSK

- 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.

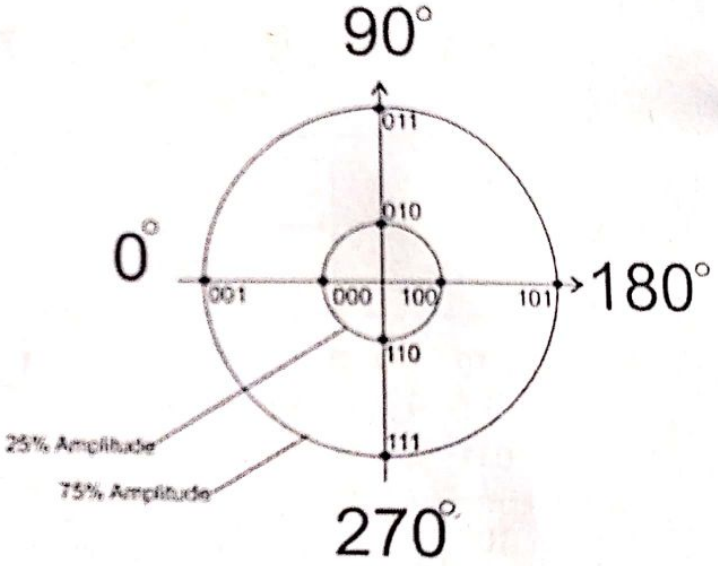
Disadvantage of PSK

- It is a non coherent reference signal.

1.10.4 Quadrate Amplitude Modulation (QAM):

QAM is work withAmplitude and phase.It observe Amplitude of signal and phase of signals at t time. It is a combination of ASK and PSK method.In this technic frequency remain constant. Quadrature amplitude modulation (QAM) is a modulation scheme used for both digital and analog signals.In QAM also define different technics to conver Digital to anlaog signals.4-QAM,8-QAM and 16-QAM.There are two different Amplitudes are define 25% and 75% on that two amplitude different angles are define, on that angles pair of the 4 bits digital number is define to generate analog signals. In 8-QAM there are two different amplitudes 25% and 75% and 4 different angles are define on 25% amplitude and 75% amplitude so there are total 8 permutations for convert digital data to analog signals.

25% Amplitude		75% Amplitude	
Bits	degree	Bits	degree
000	0	001	0
010	90	011	90
100	180	101	180
110	270	111	270



8 - QAM

Figure 1.16 QAM table of Signals angle and amplitude.

1.11 Bit Rate and Baud Rate:

Bit Rate means number of bits pass per seconds. Baud rate means number of signal change per second. baud rate equal the bit rate divided by the number of bits represented by each signal. If n=number of bits/signals. Baud rate id lower then bit rate. Unit of Baud rate is (Bd) and it is used to measure speed of changing signal. If only one signal is change in one second then baud rate is 1Bd, if 5 signals are change in one second then baud rate is 5Bd.Unit of Bit Rate is (bps) it is also used to measure speed. If only one bit is send in one second then bit rate is 1bps, If 2 bits are send in one second then bit rate is 2bps. There are more number of bits are used in baud reate.

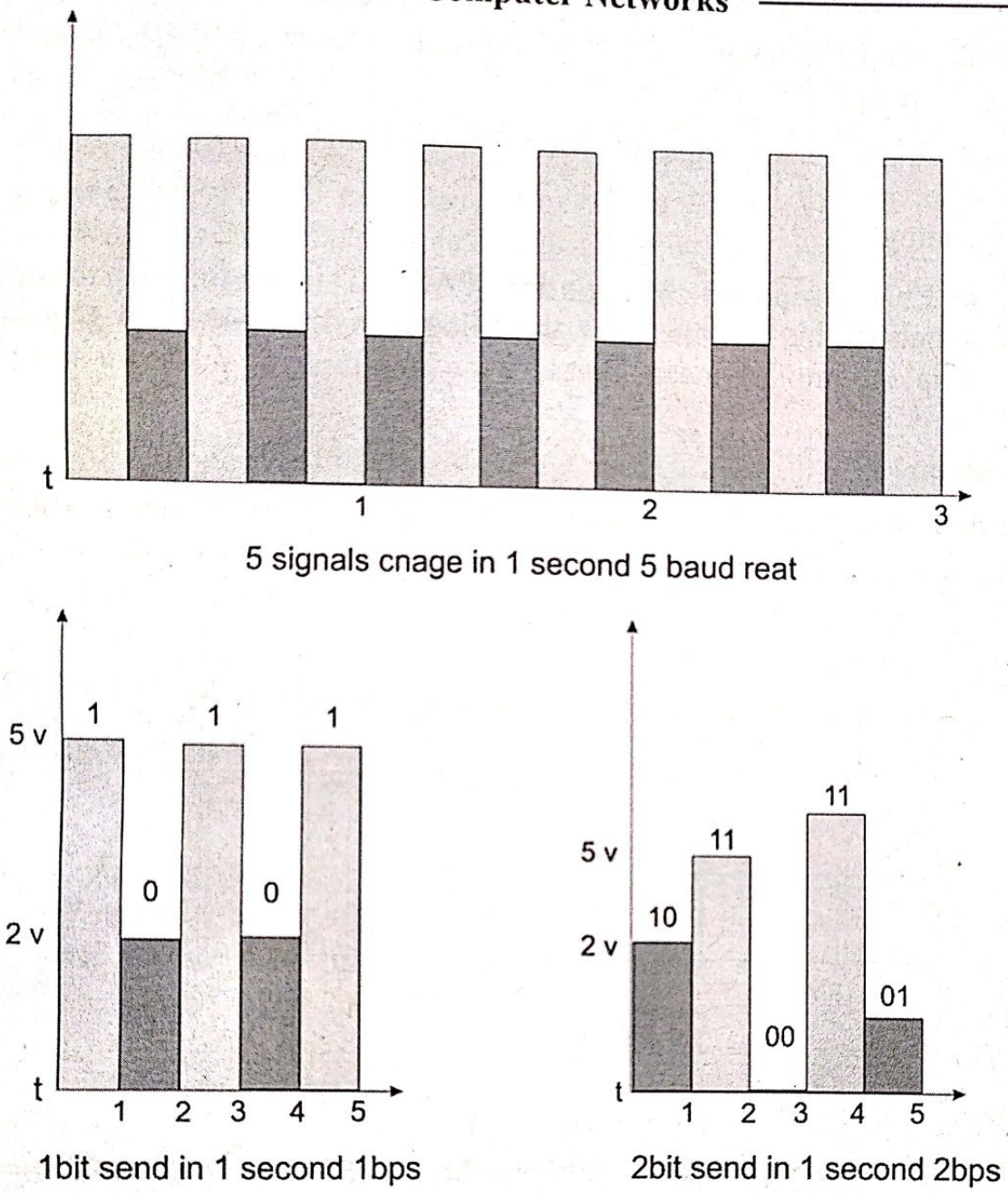


Figure 1.17 Baud Rate and Bit Rate.

1.12 Analog to Digital Transmission or Pulse Code Modulation (PCM):

This technic is used to convert analog data into Digital Signals. While your data is analog and transmission medium is digital at that time according to digital medium your analog data is convert in to digital signals. While you want to transmit analog signal at very long distance at that time it is compulsory to transmit your data in digital signals. Also while you send your voice recording to another device like computer, mobile etc. at that time your voice recording signals are converted into digital form and send it to other device. For converting Analog data into digital signals there is only one popular method is used

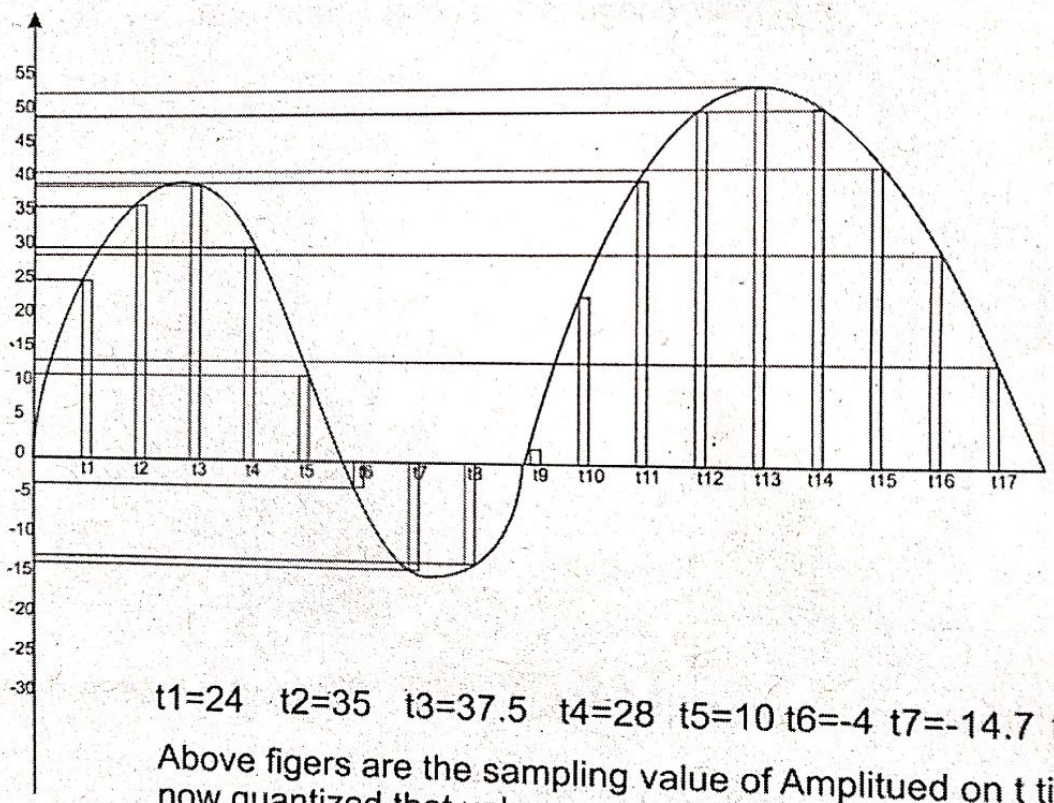
and it is Pulse Code Modulation Technic (PCM).This technic is perform major 3 steps to convert anlog to digital signals.

1) Sampling or Pulse Amplitude Modulation (PAM)
2) Quantization
3) Encoding

Sampling or Pulse Amplitude Modulation (PAM): This is a first step to convert analog to digital signals.In this technic takes an analog signal samples, and generates a pulse based on sample. Sampling means measure the amplitude of signal on some equal time interval.

t = 1 second

left side show the height of signal we sampling the amplitude in every t second.



t1=24 t2=35 t3=37.5 t4=28 t5=10 t6=-4 t7=-14.7 t8=-13

Above figers are the sampling value of Amplitued on t time. now quantized that value.

Figure 1.18 PCM sampling the analog signal amplitude.

In above figure we have sampling the signal and measure the amplitude of signal on every t seconds. For sampling height we have taken a range 5. There are some digits in positive and negative value, also they are in some fraction part also. If some value is in fraction part then convert it in to non-fractional for that if number is grater then 5 then convert it in to nearest heights value of it amplitude height. If number is less than 5 then convert it into nearest lowest value of it amplitude height. For example t3 is 37.5 then convert it into 38 same t7 is -14.7 then convert it into -15. After this conversion we will get all non-fractional value and pass it for quantization.

Quantization: In this step we will convert all sign decimal value of amplitude in to binary sign value. If value is positive then we will set 0 an if value is negative set as 1 for sign bit.we will quantization all value in order of t time not in order of height range. We have get amplitude value in each t time interval so we will follow the order according to t time. After this step we will get sequence of binary digits. We will pass this digit for encoding, it will convert this into digital signals. And transfer that signals in bit order.

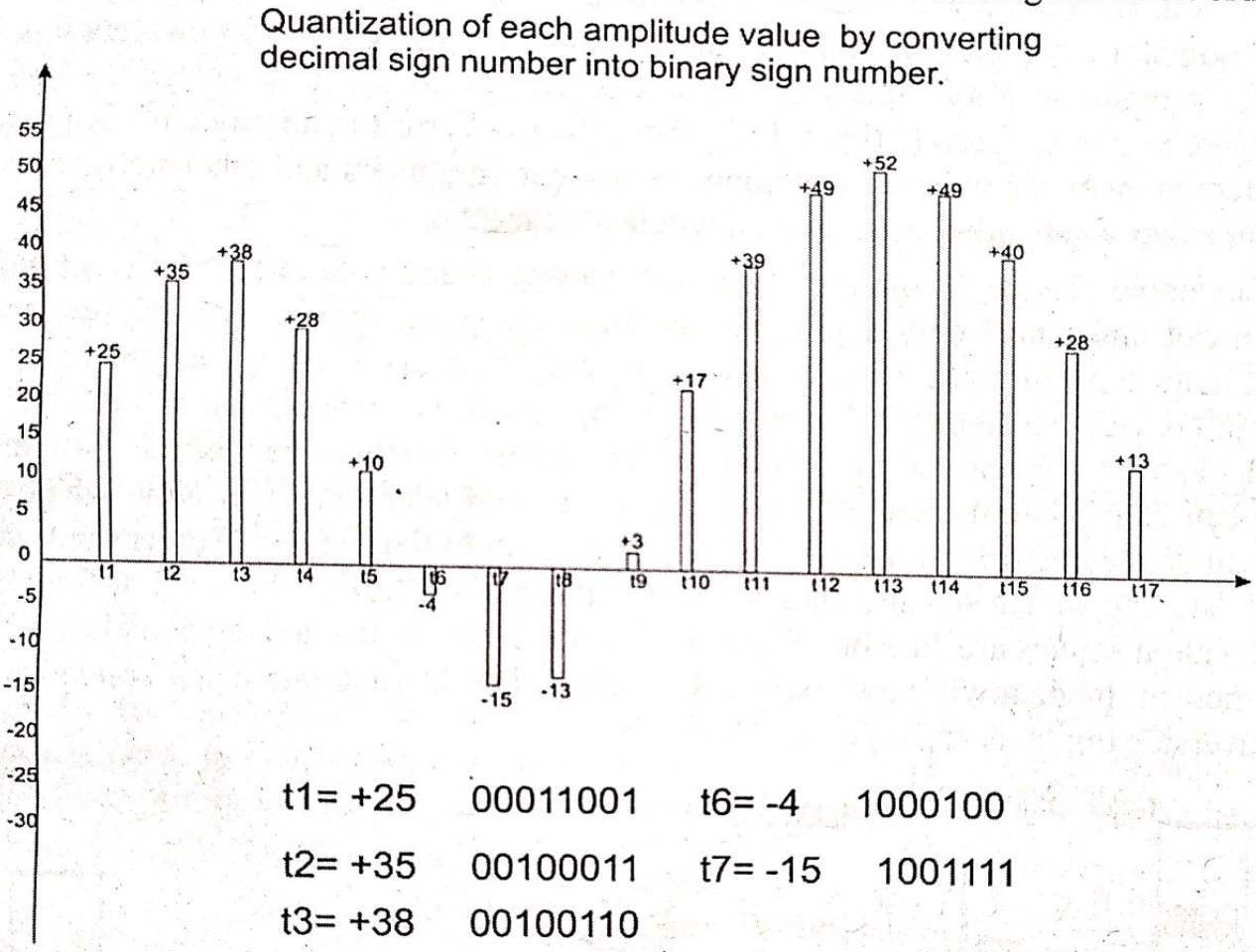


Figure 1.19 PCM quantization of amplitude value.

In above figure t1 to t17 amplitude values are quantized. And pass it for encoding.

Encoding: In this step we get all quantized value in order of t time interval, now it will convert in to signals. If bit is found 0 then no signal is generate and if bit is found 1 then signal is generated. After this all signals are transfer on digital medium to receiver.

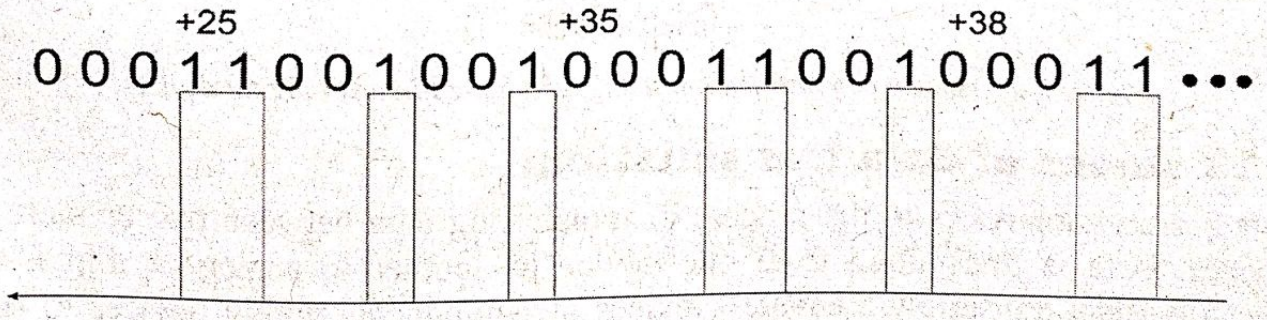


Figure 1.20 Digital Signal converted using PCM.

Modem:

Modem is an Inter-networking Device. It Facilitates connection to the Internet by transmitting and receiving data over telephone line. Main task of Modem is Modulation and De-Modulation means it convert Digital signal to Analog signal using Modulation technique and convert Analog Signal to Digital signal using De-Modulation technique. Modulator converts digital signals in to analog using ASK, FSK, PSK and QAM technic. Demodulator resembles an analog to digital converter. Modem works on Data link layer. It not provide security. Speed of modem is depend on speed of telephone line. It is measure in bits per second (bps). IT is also called as "broad band modem". A broadband modem is an external device that connects to your computers and other network devices using either a network cable or over a wireless connection.

For example, device A communicates with Device B and both are on different network. Both can understand only digital signals. Both are communicate with each other using telephone line. Our telephone line is working only with analog signals so it is compulsory to both device transfer digital data in to analog signal. For modulation and demodulation both device is connected with modem. Telephone line also connected with modem. Modem is and intermediate of Computer device and telephone line. Now whatever the digital data come from device A first it will enter in to the Modem. Modem will convert that data into anlaog signals using any one of the method ASK, FSK, PSK or QAM. After conversion signals are pass on telephone line. On receiver side anlaog signals are receive by modem, modem will now convert that signals into Digital data using converter. After Conversion digital data pass to the Device B.

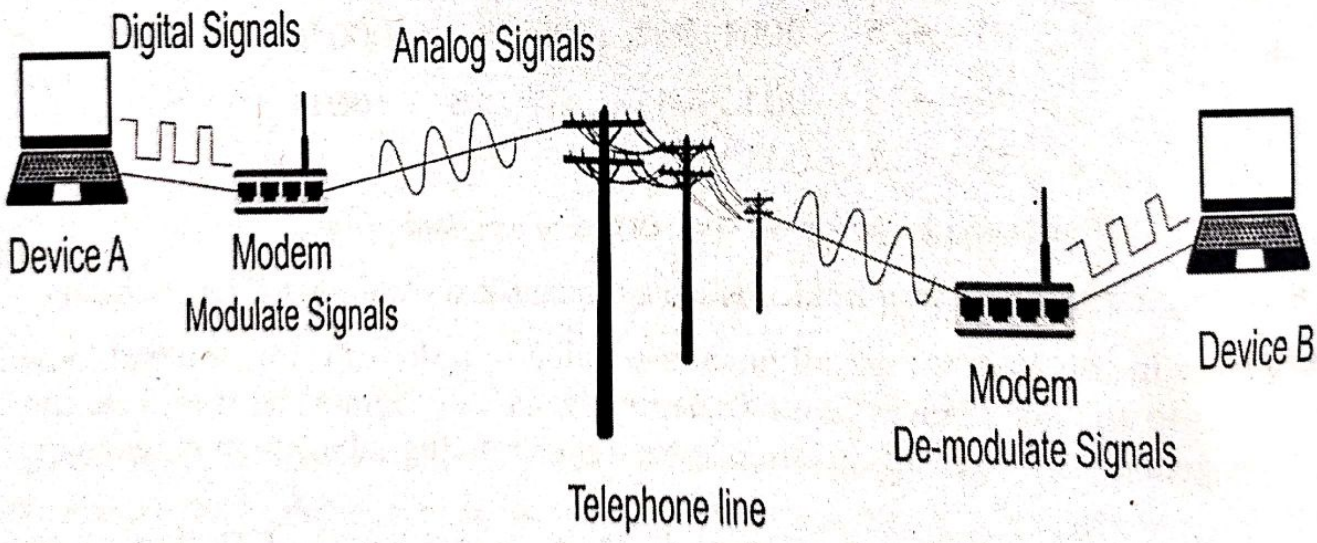
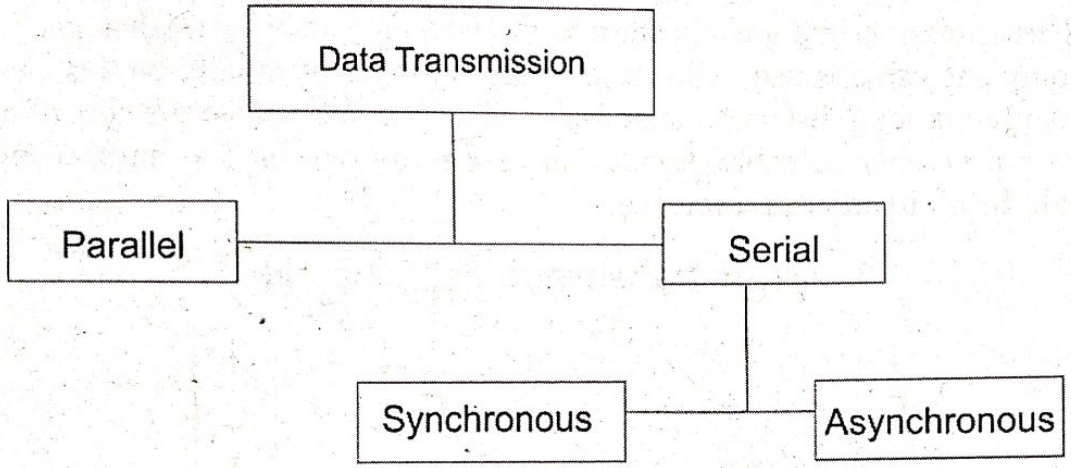


Figure 1.21 Modem communication using telephone line with digital devices.

1.13 Modes of data transmission:

Data transmission refers to the process of transferring data between two or more digital devices. Data is transmitted from one device to another in analog or digital format. Basically, data transmission enables devices or components within devices to speak to each other.

Basic two types of Data transmission:



1.14 Parallel Transmission:

In such kind of transmission computer produce bunch of bits and send that bunch at a time to the receiver. Compute create bunch depend on medium or cable which use parallel transmission. If cable has capacity to send 4 bits at a time so computer will produce bunch of 4 bits and send it on cable. If cable capacity to send 8 bits at a time then computer will produce 8 bits bunch. In Parallel transmission group of n bits send at a time. In parallel transmission n number of wires are send n bits. Each bit has its own wire, bunch of all data transmit one after another in same way. This technic is used for only short distance communication. It is very difficult to manage bunch of wires on long distance communication so it is quite impossible for long distance communication. Advantage of this technic is speed. In such kind of communication cost is high because n number of wires you have to manage.

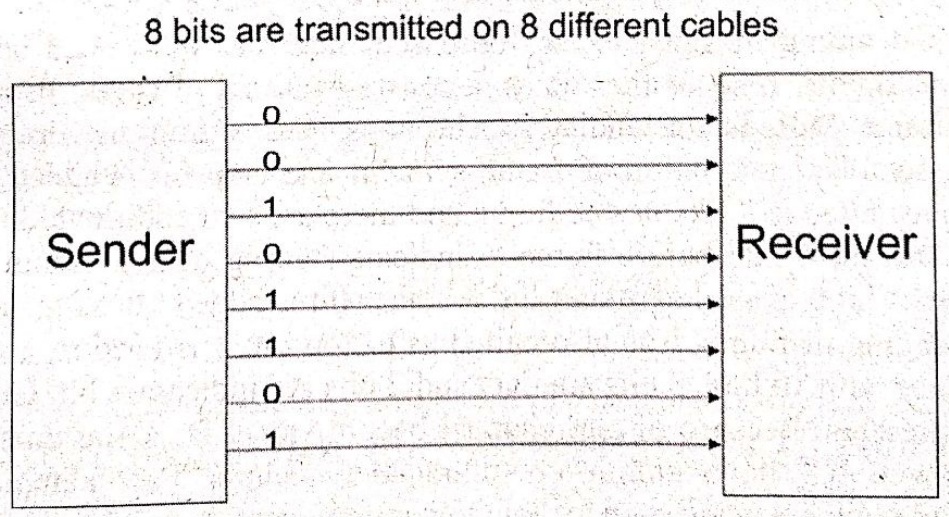


Figure 1.22 Parallel Communication of 8 bits data.

Serial Transmission:

In serial transmission bits are transmitted in sequential order one after another. In this technic only one cable is use. All bits are transmitting sequentially on this channel. This technic is used in long distance transmission. This technic reduce the cost of cables, it is not require n number of cable. Sender sends one by one bits, at another end receiver arrange all the bit in order as it receive.

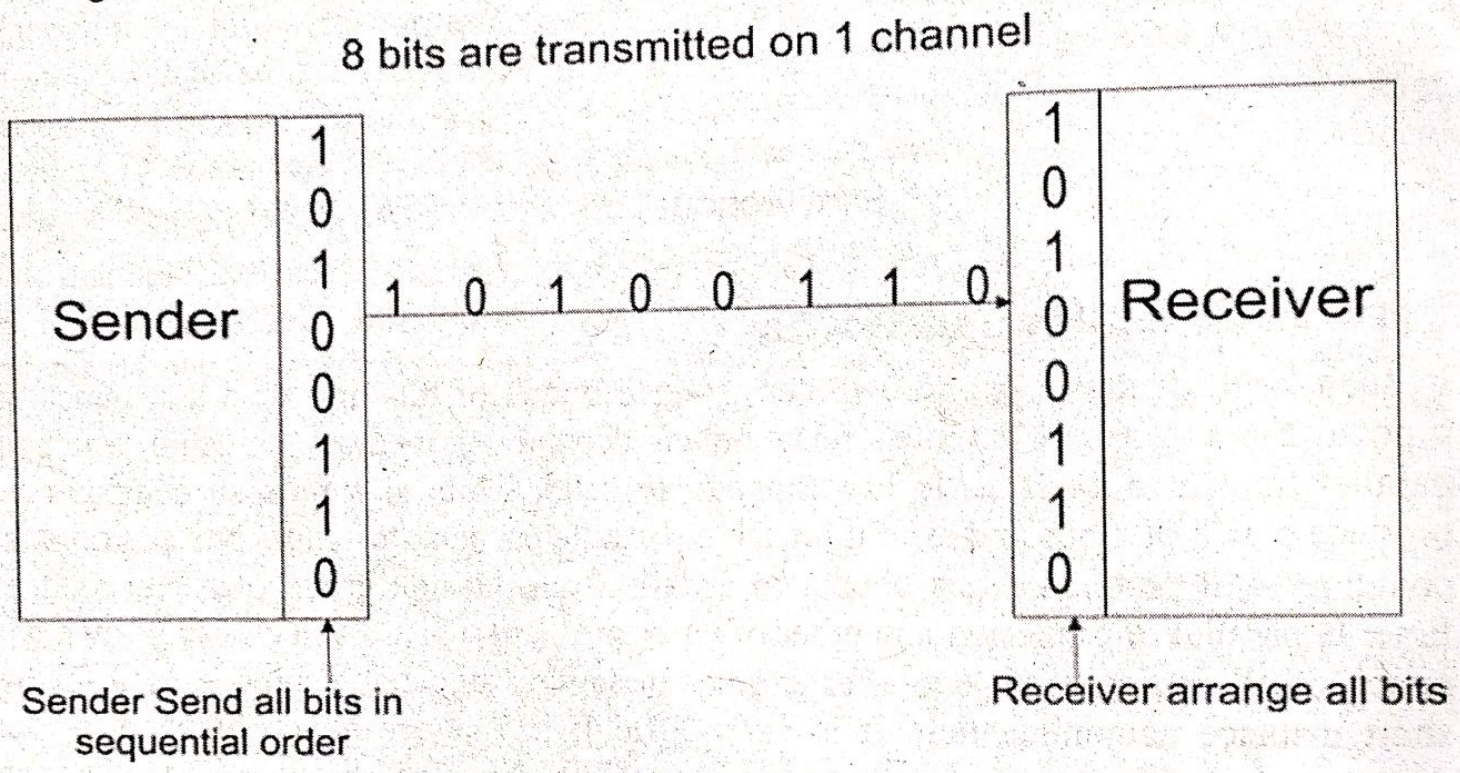


Figure 1.23 Serial Communication of 8 bits data.

1.15 Asynchronous Transmission:

In this technic timing of signal is not observed. Information is send and received by agreed upon patterns. It sends the data in a constant current of bytes. In this technic bits are send in frame. Pulse is not sending synchronous. Receiver not use timing to predict of next frame, so for identification of frame start bit and stop bit is added. The size of a character transmitted is 8 bits in one frame and there are two additional bits are added in this frame. One bit is add before frame to indicate starting of new frame data, it is also called as a start bit.0 is used as a start bit. Another bit is added after the end of the frame to indicate ending of frame, it is also called as a stop bit. 1 is used as a stop bit. Frame size is increase with 10 bits, 8 bits are data and 2 bits are indication bit. Gap between two frames are presents. Because of gap channel become ideal for some time. Transmission speed is slower. If follows simple communication technic. For example letter, email, television and radio are using such technic to communicate.

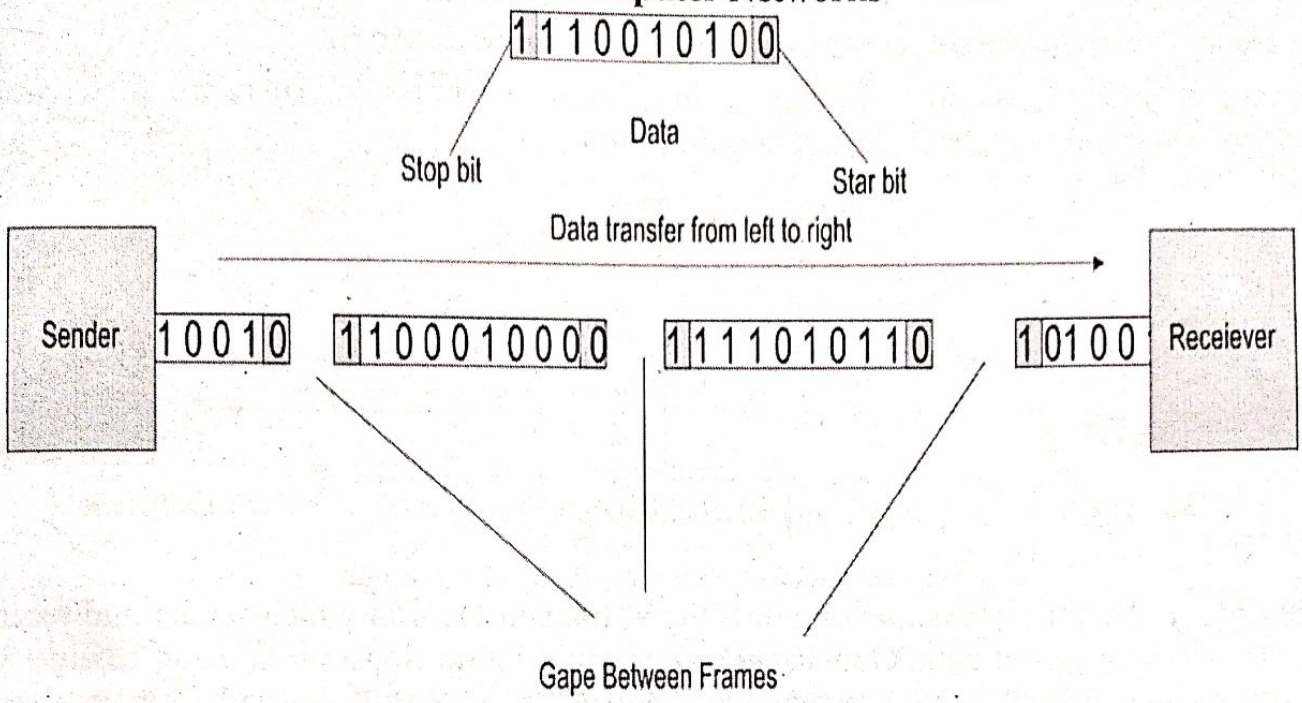


Figure 1.24 Asynchronous transmission.

1.15.1 Synchronous Transmission:

The term synchronous is used to describe a continuous and consistent timed transfer of data blocks. Synchronous data transmission is a data transfer method in which a continuous stream of data signals is accompanied by timing signals (generated by an electronic clock) to ensure that the sender and the receiver are in synchronized with one another. The data is sent in frames or packets spaced by fixed time intervals. Sender and receiver both use a clock at the same rate, it is used as a reference point for data transmission. In this technic no extra bits are added in frame also there is no gape between two frames. Synchronous transmission modes are used when large amounts of data must be transferred very quickly from one location to the other. It is faster than asynchronous transmission. It is reliable transmission technic. It provide real time communication between connected device, Video call, chat room, internet call etc. are using this transmission technic.

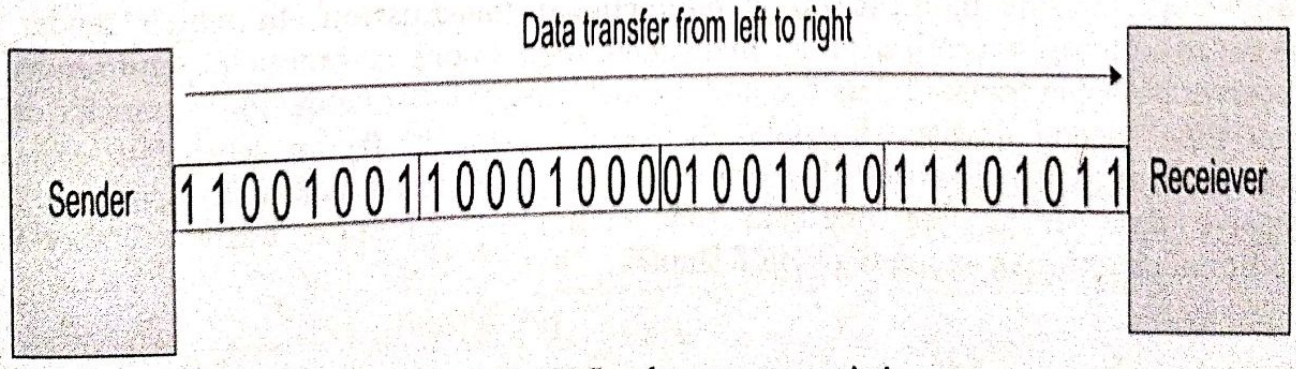
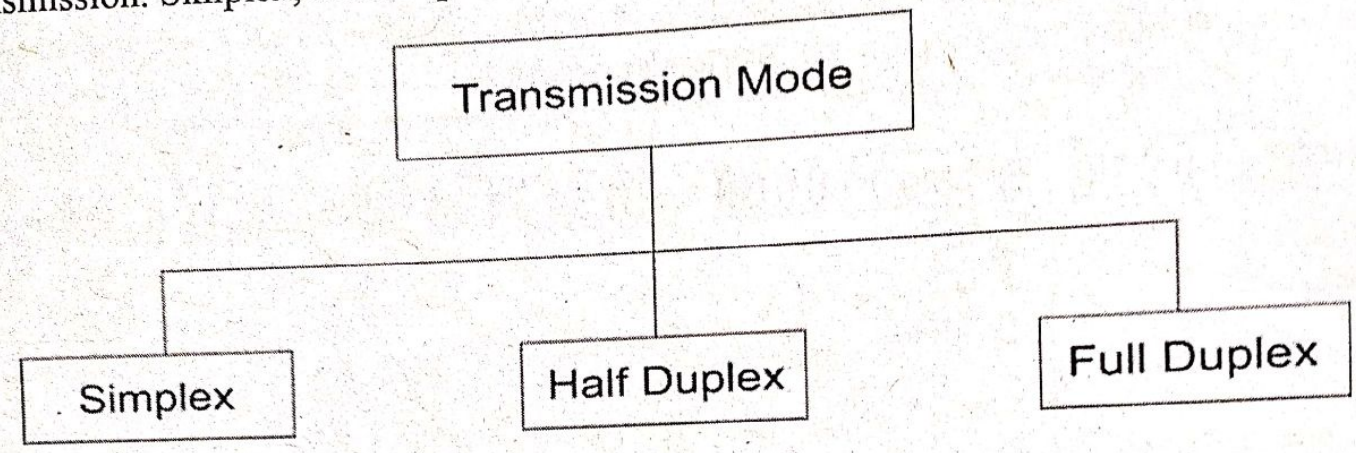


Figure 1.25 of 8 Synchronous transmissions.

1.15.2 Transmission Mode or way of Transmission:

Transmission mode is define the way or direction of transmission. There are three types of transmission. Simplex, Half-duplex and Full-duplex.



Simplex: This transmission is unidirectional transmission, in which sender and receiver both are not transmit data. Only sender has permission to transmit data and receiver will only receive data. There is no request or any ACK or NACK is send from receiver to sender. It is also called one-way transmission. Radio communication is an example of Simplex communication.

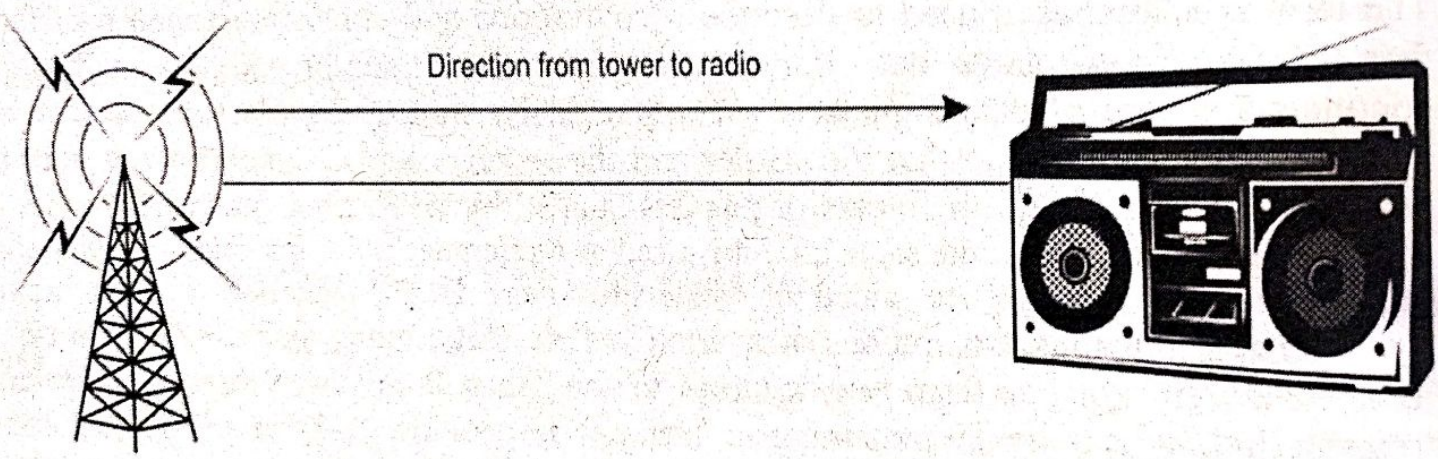


Figure 1.26 Simplex way of Communication.

Half-Duplex: This transmission is bidirectional transmission. In which sender and receiver both can transmit data. In this technic there is one commitment with sender and receiver both can transmit data but not at same time, while one device is transfer data at that time second device who only receive the data not try to send data otherwise communication will interrupt. Same if second device transfer data first device will only receive data. It is like one-lane road with two direction traffic. Walky-Talky communication is an example of Half-Duplex.

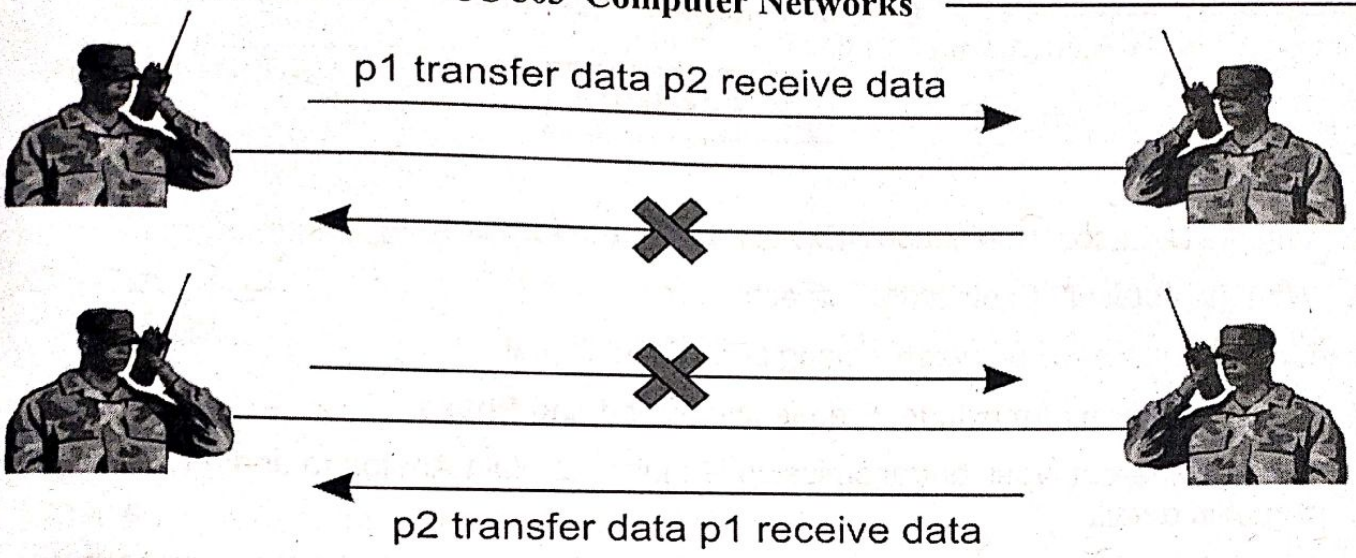


Figure 1.27 Half-Duplex way of Communication.

Full-Duplex: This transmission is bidirectional transmission. In which sender and receiver both can transmit data. Sender and receiver both can transmit data at same time, while one device is transfer data at that time second device who can receive data also send data. Means both device can send and receive request, ACK and NACK.It is also called as duplex communication. It is like two-way road with both direction traffic. Telephone network, Data passing on computer is an example of full-duplex communication.

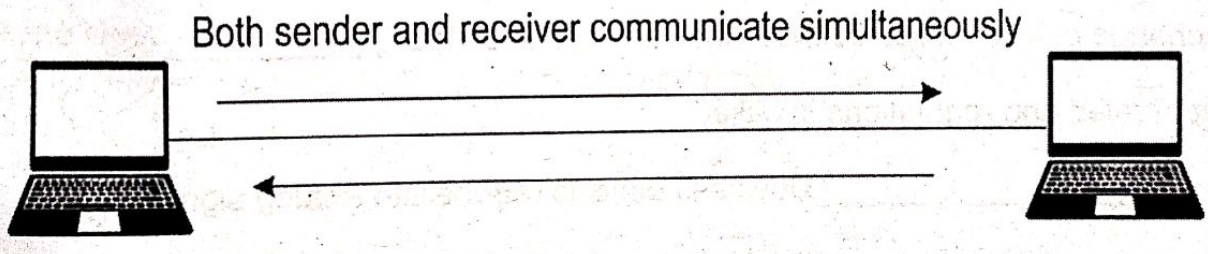


Figure 1.28 Full-Duplex way of Communication.

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Exercises

1. What is Data communication? Explain it's Characteristics.
2. What is protocol? Explain its Characteristics.
3. Explain Difference between Anlaog and Digital signal.
4. Define the terms Amplitude, Frequency, Period and Phase.
5. List the different types of transmission technics. Explain Analog to analog and digital to digital in detail.
6. List the Digital to Analog transmission technics. Explain Phase Shift keying technic.
7. Explain Difference between ASK and FSK.
8. Explain Analog to Digital transmission technic.
9. Which are the two different modes of communication explain in detail.
10. Explain Difference between Synchronous and Asynchronous communication.
11. Explain Different way of Communications in detail.

Fill in the blanks:

1. Exchange of information between two devices is called _____.
2. Set of rules and regulations is called _____.
3. _____ Device is used to regenerate analog signals.
4. _____ Device is used to regenerate digital signals.
5. Frequency measured in _____.
6. _____ is highly affected by noise.
7. _____ is measured in t time period.
8. _____ is more powerful and reliable modulation technic.
9. _____ Transmission technic send bunch of data at a time.
10. In _____ transmission gape between frames produce.
11. _____ Transmission technic is used for long distance communication.

12. In _____ communication way both sender and receiver not transfer data at same time.

Answer:

1) Data Communication	2) Protocol	3) Amplifier	4) repeater
5) hz	6) ASK	7) Phase	8) PSK
9) parallel	10) Asynchronous	11) Synchronous	12) Full-duplex

True False:

1. The Bit Rate is number of interval per seconds.
2. Amplitude measured in Hz.
3. For completion of Communication both device must understand protocols.
4. In protocol what kind of Data is send, understand by semantics.
5. Digital Signals are transmit in cyclic rolling from.
6. Bandwidth is used to measured capacity of medium/channel.
7. 5Hz means 4 signals in one second.
8. Analog to Analog modulation is used in band pass signals.
9. Digital to digital modulation use line coding technic for modulation.
10. In 8-PSK 2 bits are transmit at a time.
11. Pulse Code modulation convert Digital to analog signals.
12. In half-duplex mode both party can transmit data at same time.

Answer:

1. True	2. False	3. True	4. False	5. False	6. True
7. False	8. True	9. True	10.False	11.False	12. False

Unit-2 Multiplexing & De-multiplexing

2.1 Multiplexing and Demultiplexing:

Multiplexing devides the physical line or medium into logical segments called channel

- In multiplexing different channels carry data simultaneously over the same physical medium.
- H.w is used to multiplexing is called multiplexer or mux in short.
- Mux is combine the inputs of different sources and lads them on different channel at medium.
- These data are traverse over the medium simultaneously.
- At the end of another side (destination) Demultiplexer or mux is used to separates the signals means for different destination.
- Demultiplexer sends that separate signals to different destinations.
- Multiplexer is responsible or both multiplexing and Demultiplexing.

Multiplexing allows adding new channels in the same line without having to install a new line.

As the increasing the channel the total load at signals are divided in to different channel and capacity at each channel will reduce

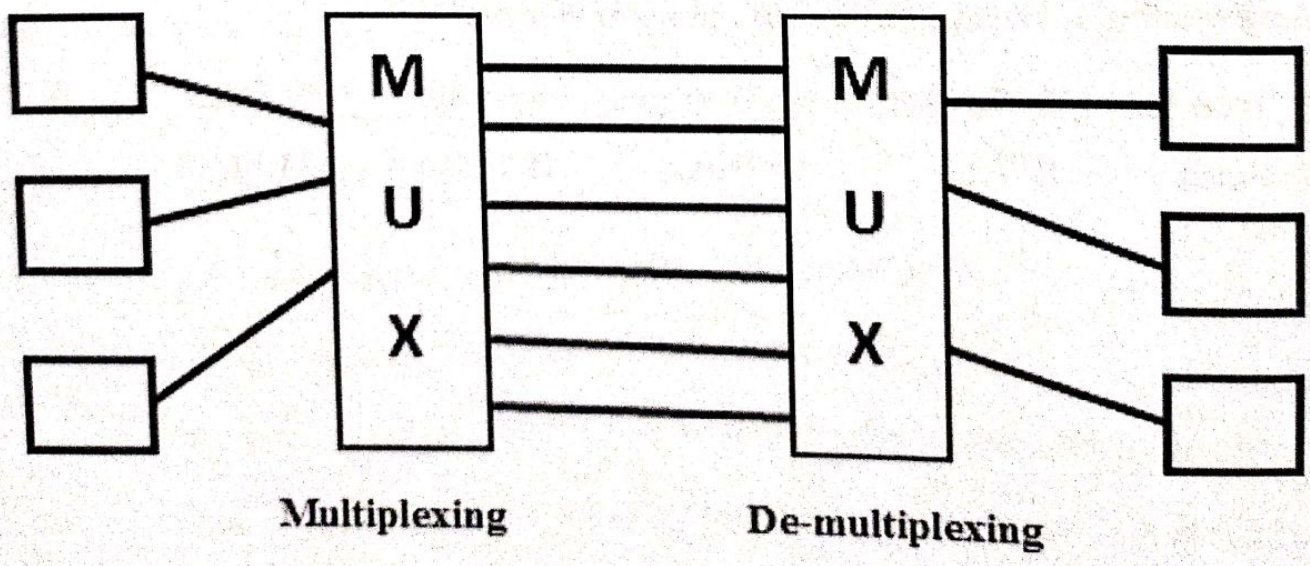


Figure 2.1 Multiplexing using Multiplexer.

2.2 Types of Multiplexing:

2.2.1 FDM (Frequency Division Multiplexing):

- FDM is an analog technique that can be applied when bandwidth at link is greater than the combined bandwidth of signals to be transmitted.
- In FDM signals generated by each signals generated by each sending device modulate different carrier frequencies.
- These modulated signals are then combined in t a single composite signal.
- This technique used unpublic telephones it is also used in TV channels.
- The carrier frequencies are separated by enough bandwidth to accommodate the modulation signal.
- Channels must be separated by strips at unused bandwidth (guard bands) to prevent signals from overlapping.

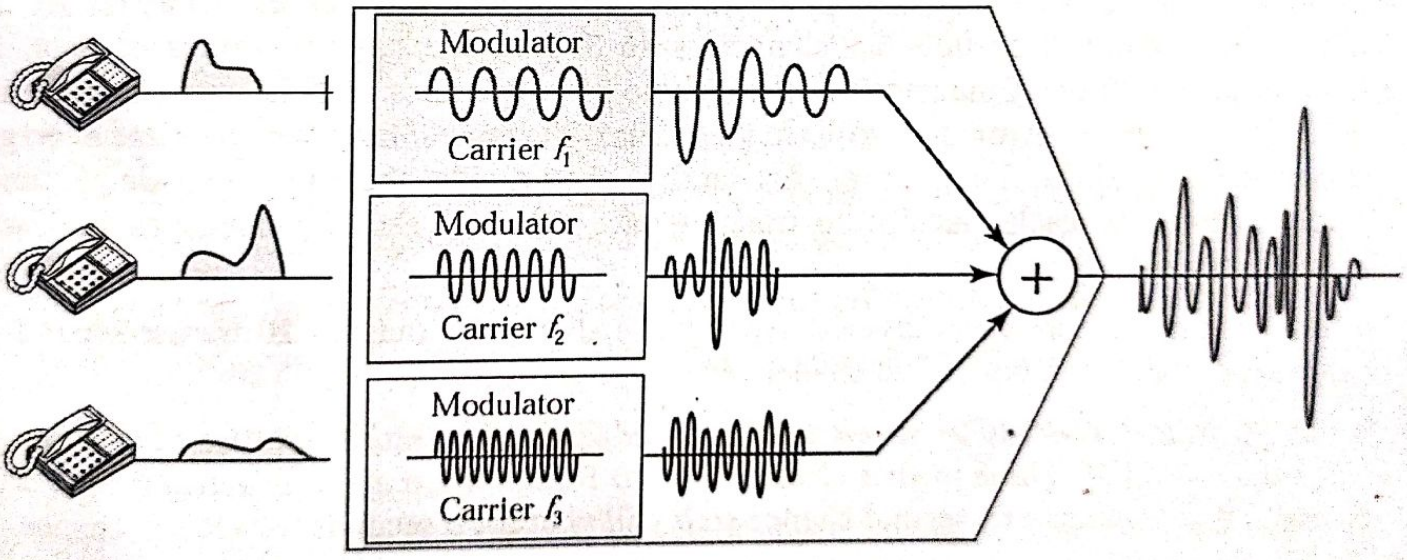


Figure 2.2 Frequency Division Multiplexing.

2.2.2 TDM (Time Division Multiplexing):

- TDM divides the available spectrum such that each user gates a specific time slot to transmit its data.
- Each sender gets it turn once in a cycle.
- When specific user's turn comes the entire bandwidth is given to him.
- The bandwidth of the multiplexed signal is usually more than the total signals are input to them.
- It is a digital process.

- TDM implemented in two ways:
  1) Synchronous TDM
  2) Asynchronous TDM

1) Synchronous TDM:

The **Synchronous** means that exactly the same time slot to each device at all time. Whether or not a device has anything to transmit. Means in such technic each device has allocate same timeslots to communicate in medium. If device has more number of data it will give as much time as the device has less number of data. In this technic each connected device has given average time slot. For calculate average time slot each device give the detail of total number of bits to transfer/send in network. After getting detail of all device total number of bits are find and that total bits are divided by number of connected computers that amount of time is consider as an average time and assign that timeslot to each machine. For example 3 machines are connected each has n number of bits for transmission. Medium can transmit 20 frames per seconds. Each frame has 100 character capacity Now we consider n number of bits/character of each device are as bellow, A machine has 1000 bits/characters so A machine has 10 frames of data, B machine has 3000 bits/Characters so B machine has 30 frames of data and C machine has 2000 bits/character of data so C machine has 20 frames, now we calculate average time so we add all the frames from A B and C then divide them by 20 so we get time which is given to each machine to transfer data. 10+30+20=60/20=3seconds for each device to transmit data.

A has 10 frames now A has given 3 seconds, Medium can transmit 20 frames/second A will transmit all 10 frame in first chance.

B has 30 frames now B has given 3 seconds, Medium can transmit 20 frames/second B will transmit all 20 frame in first chance. But 10 frames are remain to transmit so B will transmit this frames in its second chance so b will wait for 6 seconds for second chance.

C has 20 frames now C has given 3 seconds, Medium can transmit 20 frames/second C will transmit all 10 frame in first chance.

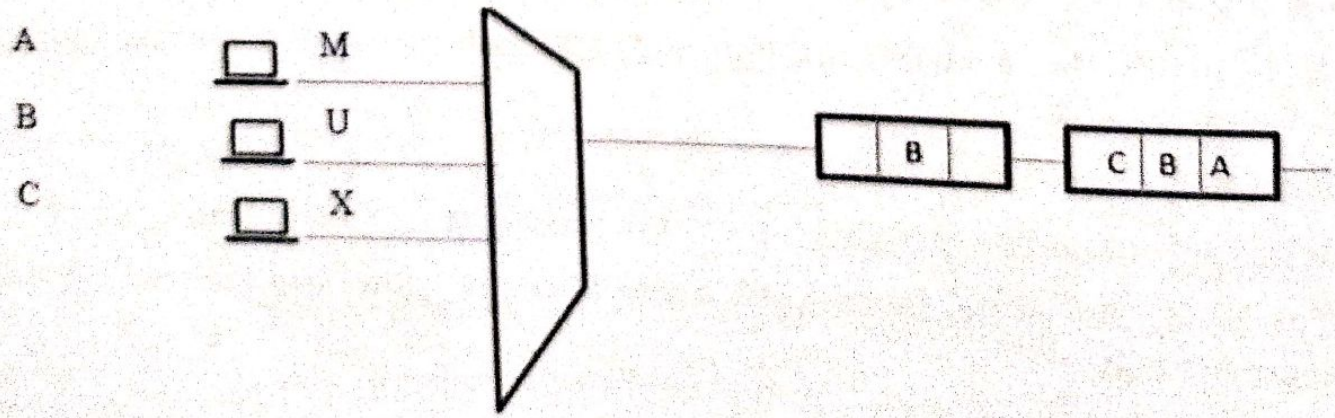


Figure 2.3 Time Division Multiplexing.

In above case in first chance A B and C all send 20 frames ,A has only 10 frame,it will send all the frames also C has 20 frames so C also send all frames,B has 30 frames so it will send 20 frames in first chance but 10 frames are remain it will take second chance. According to rules A and C also give second chance but they have no frames to send so A will west 3 second. Same C also west time of 3 second, in this technic west of time is possible.

2) Asynchronous TDM or Statistical TDM:

Asynchronous time division multiplexing or statistical TDM. This technique is more intelligent. It monitors which machine or terminal is sending the data more quantity, allocates the time slices more attend to that node. Relatively inactive or less quantity data computers/terminals get the time slice less. While completely inactive/ideal computers may note gate any time slice.

2.3 WDM (Wavelength Division Multiplexing):

- when transmission medium is not copper wire but it is optical fibber/fibrotic this method is implemented
- WDM is same like FDM.
- Compare to FDM, WDM working on very high frequencies.
- In WDM multiplexing & de-multiplexing is perform on very narrow bands of light from different sources are combine to make a very wide band of light.
- Here transmission is combining on the basis of difference between the wavelengths.
- Combining & splitting of light sources are easily handled by prism.

2.4 Transmission Errors: detections & correction:

Introduction:

It is impossible to sound any signals analog or digital at long distance without any distortion. This distortion occur duo to various impairments. Such impairments are imperfect mediums/environment.

Three Error are classified

1. Delay Distortion
2. Attenuation
3. Noise

2.5 Error Classification:

(1) Delay Distortion:

- Distortion is occurring because signals at different frequencies travel at different speed along the medium.

- Distortion means that signals changes its form or shape.
- Distortion cause in composite signals made at different frequencies
- each signal component has its own propagation speed through a medium and its own delay in arriving on destination

(2) Attenuation:

- Attenuation means loss at energy
- In these case signals travels through any medium it losses some at its energy
- Just like our voice becomes weak over a long distance and loses its contents beyond a certain distance.
- Attenuation is very small at short distance while it is increases at long distance.
- the loss of energy causes due to some at signals absorbed by the medium.
- To reduce the attenuation amplifier is use.

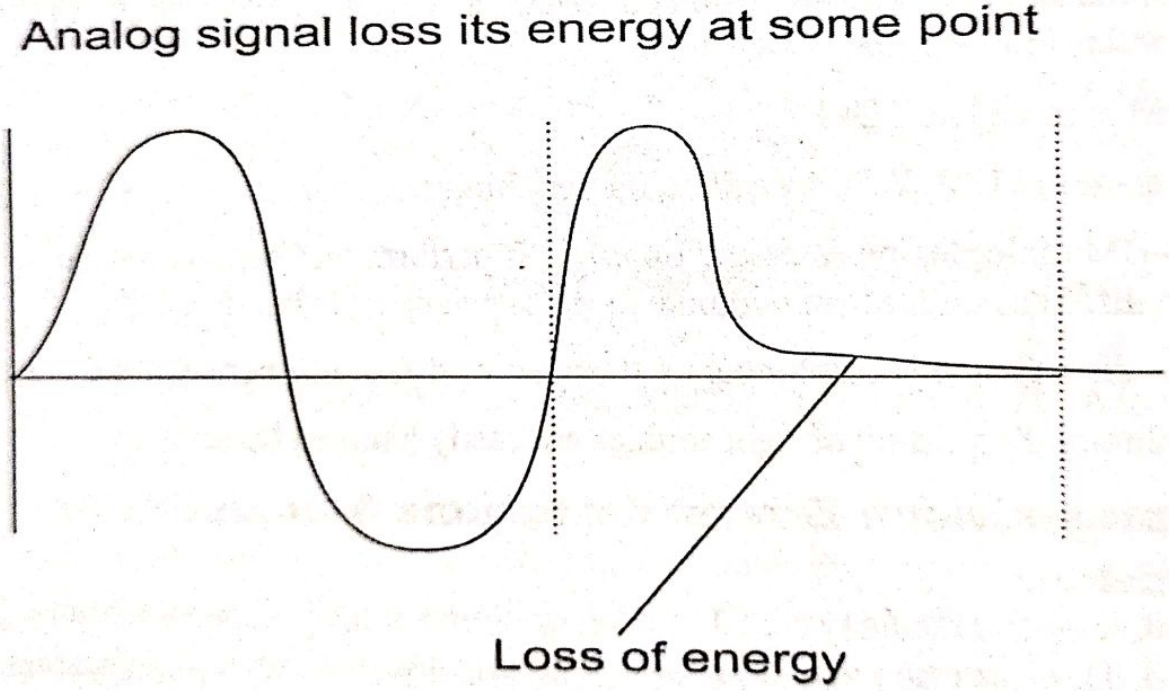


Figure 2.4 Attenuation.

(3) Noise:

- Noise is corrupt the signal.
- Which poses the problem in receiving a signal accurately at receiver.
- Noise is kind of external interference which changes the shape at the signal.
- Noise can be different type

Thermal Noise & Non-thermal noise

- Thermal Noise is the disturbance caused due to the electrons present in medium.
- These noise is depends on temperature more temperature more noise.

- Non-thermal noise caused due to other external reason like cross-talking, multifunction device.

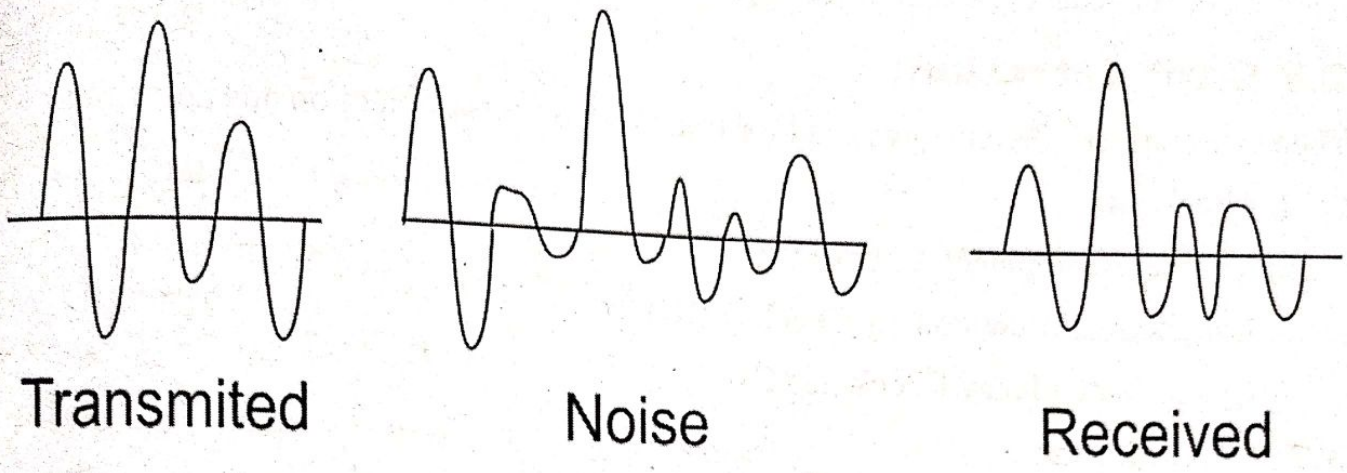


Figure 2.5 Noise.

2.6 Types of Error:

Due to above errors we can classify error in two different categories Single-bit Errors & Burst Errors

1. Single-Bit Error:

This error only one bit at a given data unit is changed from 0 to 1 or 1 to 0

- This error causes in the case of parallel or serial transmission.
- Suppose sender send following frame

0	0	0	0	1	0	1	0

- Receiver receive following frame in this frame bit no 4 is change with 1 to 0 means there is single bit error occur in frame

0	0	0	0	0	0	1	0

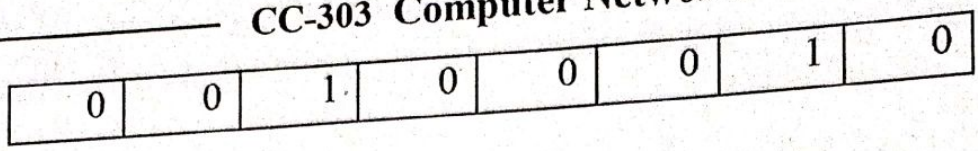
For example parallel transmission in CPU and memory inside a computer.

2. Burst Error:

The burst error means two or more bits in the data unit change from 1 to 0 or 0 to 1.These bits need not necessarily be adjacent bits. Length of burst error is measured from the first corrupted bit to last corrupted bit. This error mostly happens in a serial transmission. For example sender sends following frame.

0	0	0	0	1	0	1	0

Receiver receive following frame in this frame two bits are 4 number bit is change with 1 to 0 and 6 number bit is change with 0 to 1so it is called burst error



2.7 Error detection:

There are number of techniques used for transmission error detection and correction.

1. Checksum
2. Vertical Redundancy Check (VRC)
3. Longitudinal Redundancy Check (LRC)
4. Cyclic Redundancy Check (CRC)

2.7.1 Checksum:

- A checksum is fixed length data that is result of performing certain operations on the data to send from sender to receiver.
- Sender runs the appropriate checksum algorithm to compute the checksum of data.
- Now it will append the checksum into the data packet which is to be sending.
- When receiver receives the data the receiver runs the same checksum algorithm.
- Receiver compare that freshly calculate checksum to received checksum from sender.
- If the two checksums match, the receiver of that data is assure that the data has no change during transmission.

Steps to calculate Checksum

Assume there are some bits to send data ->11001000111111100110.

Step 1 Now we will make a bunch of data, You can create bunch of n bits. Here we use n=4 bits bunch our bunch is 1100 1000 1111 1110 0110

Step 2 Now add the all bunch, for addition use binary addition rules.

Step 3 After addition make the One's complement of addition Answer. You can send one's complement value as a Checksum bits. You can also use two's complement value for checksum.

Step 4 for two's complement add 1 in one's complement value.

1100 1000 1111 1110 0110
1100

+ 1000
+ 1111
+ 1110
+ 0110
10111
01000 1's compliment
+ 1 2's compliment
01001 Checksum

Final Bits to send **0 1 0 0 1** 0 1 1 0 1 1 1 0 1 1 1 1 1 0 0 0 1 1 0 0

Checksum

Checksum is also called as **hash sum.**

10101001

00111001

00011101

11111111 1's compliment

2.7.2 VRC (Vertical Redundancy Check) or Parity check method:

- It is least expensive technique.
- In this method, sender appends a single additional bit, called parity bit to the message before transmitting it.
- There are two schemes in this odd parity and even parity.
- In odd parity scheme given some bits, an additional parity bit is added in such a way that number of 1's in the bits inclusive of the parity bit is odd.
- In even parity bit the parity bit is added such that the number of 1's inclusive of the parity bit is even.
- Parity checking can detect only **single bit - errors**.
- In burst error or multiple bits change error this technique would not work.

For example following bits are send using VRC error detection method.

11101110 10011110 11100100 11011000 1100100

We can use either even parity or odd parity bit checking, here we use Even parity bit of all data .First of arrange all bunch in vertical .Now calculate number of 1 in all bunch if it is even then add 0 in parity bit but if it is odd then add 1 in parity bit.

Data	Parity/VRC Bits
11101110	0
10011110	1
11100100	0
11011000	0
11001000	1

Our parity data is 01001 it is called VRC matching bits. Now append that bits with your actual data so receiver will receive the data and calculate VRC again and match that bits with our VRC bits if both are same then no error in data.

2.7.3 LRC (Longitudinal Redundancy Check):

- In LRC a block of bits is organized in a table.
- LRC is used to detect burst errors.
- For example: we want to send a block of 32 bits .we organizes them in a table made of four rows and eight columns.
- Then we calculate parity bit for each column and create a new row of eight bits which are the parity bits for whole blocks.
- We then attach the eight parity bits to the original data and send them to the receiver.

For example following bits are send 11100111 11011101 00111001 10101001

Now arrange all bits in vertical and then check parity bit same like VRC but in LRC we check parity bits in vertical format. Here we use even parity bit.

```
11100111  ┐
11011101  ├  calculate parity bits for all columns
00111001  ┤
10101001  ┘
----------
10101010     LRC
```

Our final data with attaching LRC is as follow:

11100111 11011101 00111001 10101001 **10101010**

↑

LRC

2.7.4 CRC (Cyclic Redundancy Check):

- Most powerful redundancy checks technique.
- LRC and VCR is addition base while CRC is based on division.
- In CRC reminder is consider as a CRC bits and appended at the end of data.
- The sender appends this CRC to the end of data unit such that the resulting data unit becomes exactly divisible by predetermined divisor *i.e.* remainder becomes zero.
- And receiver side same data use for division and if there is no remainder in division that data are accepted as exact data.
- If the remainder after division is zero then there is no error in the data unit & receiver accepts it.
- If remainder after division is not zero, it indicates that the data unit has been damaged in transit and therefore it is rejected.
- For example, if data to be transmitted is 1001 and predetermined divisor is 1011. The procedure given below is used:
- String of 3 zeroes is appended to 1011 as divisor is of 4 bits. Now newly formed data is 1011000.
- Data unit 1011000 is divided by 1011.
- During this process of division, whenever the leftmost bit of dividend or remainder is 0, we use a string of Os of same length as divisor. Thus in this case divisor 1011 is replaced by 0000.
- At the receiver side, data received is 1001110.
- This data is again divided by a divisor 1011.
- The remainder obtained is 000; it means there is no error.

```
1011 ) 1001110
       1011
       ----
        0101
        0000
        ----
```

```
1011
1011
----
0000
0000
----
 000   Reminder is ZERO so no Error in data.
```

2.8 Recovery from error:

If we send some data and receiver will check the data if it is error free then receiver will send positive acknowledgement (ACK) if any error to be found it will send negative acknowledgement (NAK) to sender. Sender will wait for ACK or NAK would then decide whether to transmit the same frame of data or new frame of data.

There are three Technics are used for Error recovery:

1 Stop and Wait

2 Go-Back-n

3 Sliding Window

2.8.1 Stop and wait protocol:

- This is a very simple method. This method is used for flow control.
- Sender sends one frame of data and necessarily waits for an acknowledgement (ACK) from receiver.
- Only when an ACK has been received the next frame sends.
- This method is advantages for each frame. Each frame is checked and acknowledge. It has also disadvantage is slow in communication.
- The sender set timer for whole communication.
- If the sender send first frame timer will start and upto end of the time frame must be reach at receiver side.
- If sender does not receive ACK in time sender will retransmit the frame with new timer. However also one possibility is it receiver does not receive correct message receiver will send NAK to sender and sender will send the frame which one is define in NAK resend that frame.
- If receiver duplicate frame receiver will discard that frame.

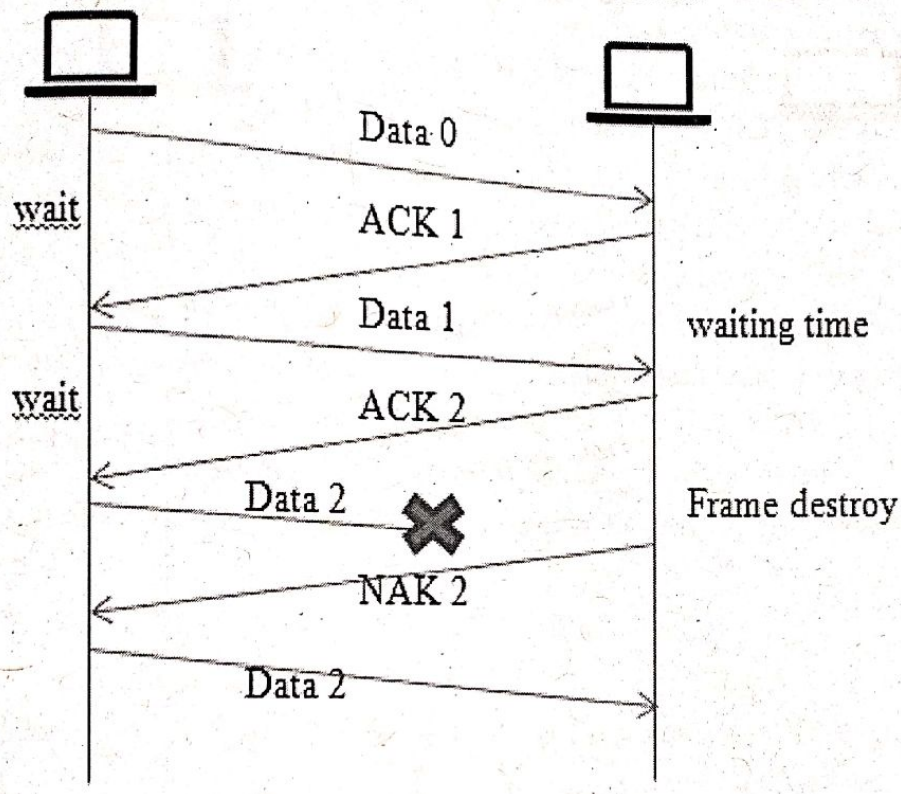


Figure 2.6 Stop and wait error recovery method.

2.8.2 Go-back-N:

- This scheme is used when more than one frame is sent at a time.
- For example:- suppose sender send [5] frames to receiver.
- 0, 1, 2 frames are arrive correctly at the receiver. But frame 3 is an error so it is not receive. Therefore receiver sends NAK for frame 3.
- Sender will retransmit the frames from frame no 3 to 5.
- If there is a possibility if sender has sent five frames 4 and 5 number's frame reach correctly.
- But due to NAK sender resend frames 3 to 5 so 4 & 5 numbr's frames are duplicate so receiver identify that frames and discard the duplicate frames only 3rd no frame will accept.
- There is also possibility that if receiver's ACK is on the way and it is not reach at sender side on time. So in this condition sender will re-send the all frames if receiver will receive this frame discard the frames and send ACK again.

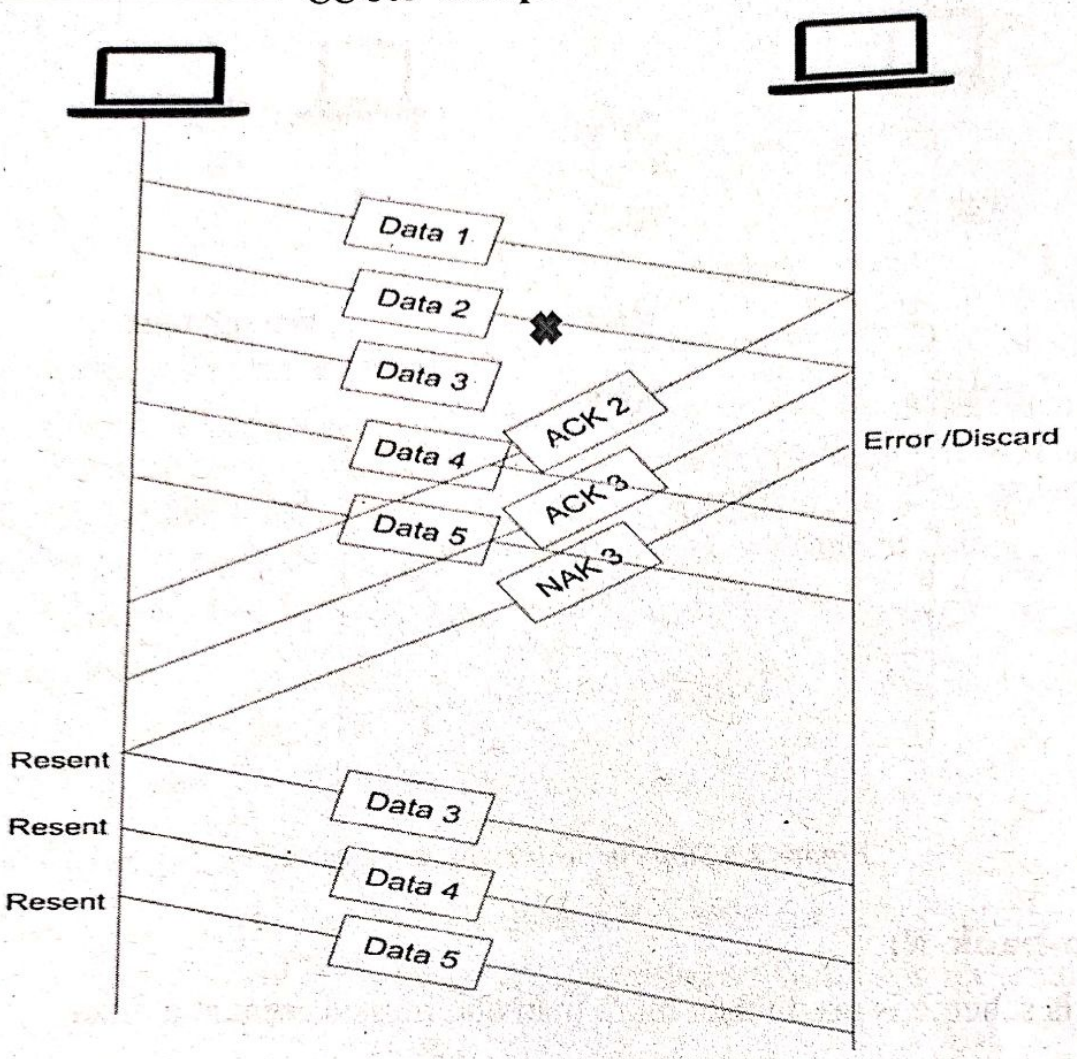
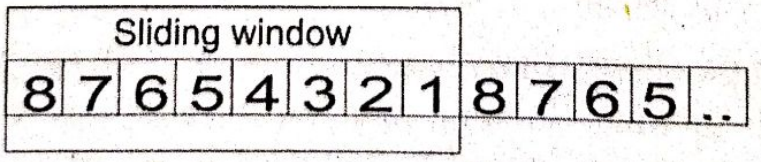


Figure 2.7 Go-back-n error recovery method.

2.8.3 Sliding window:

- Sliding window technique is based on two provisions technique.
- In this technique transmission mechanism is working under imaginary window.
- This window holds n numbers at maximum frames to be sent at a time.
- Transmission mechanism allows the data to be transmitted at a time only up to the size at window.
- Window defines how much the sender can send it must wait the receiver.



- In figure show sliding window at size 8 frames, that is sender can send eight frames. After completion of sending all frames from window [1] second [2] window has started.

- Both sender and receiver will maintain their own sliding windows.
- After completion of sending 1 frame sender will wait for ack.
- When sender has received ack it has also append next expected frame number from sender side.For ex:- if sender receive 1 to 3 frame and ack come then in ack there is next frame number-4 also appended as a next expected frame no.
- There are two butters work as storing frame data and one for controlling the window.For ex:- suppose sender has sent 8 frames in one window
- Now suppose 1 to 4 frames receive correctly then ack will come.So sender will move the left window counter to next frame.
- Right counter will move for next new frames hold in window.Thus, at the end of all frame receive new window of 8 frames will generate automatically.

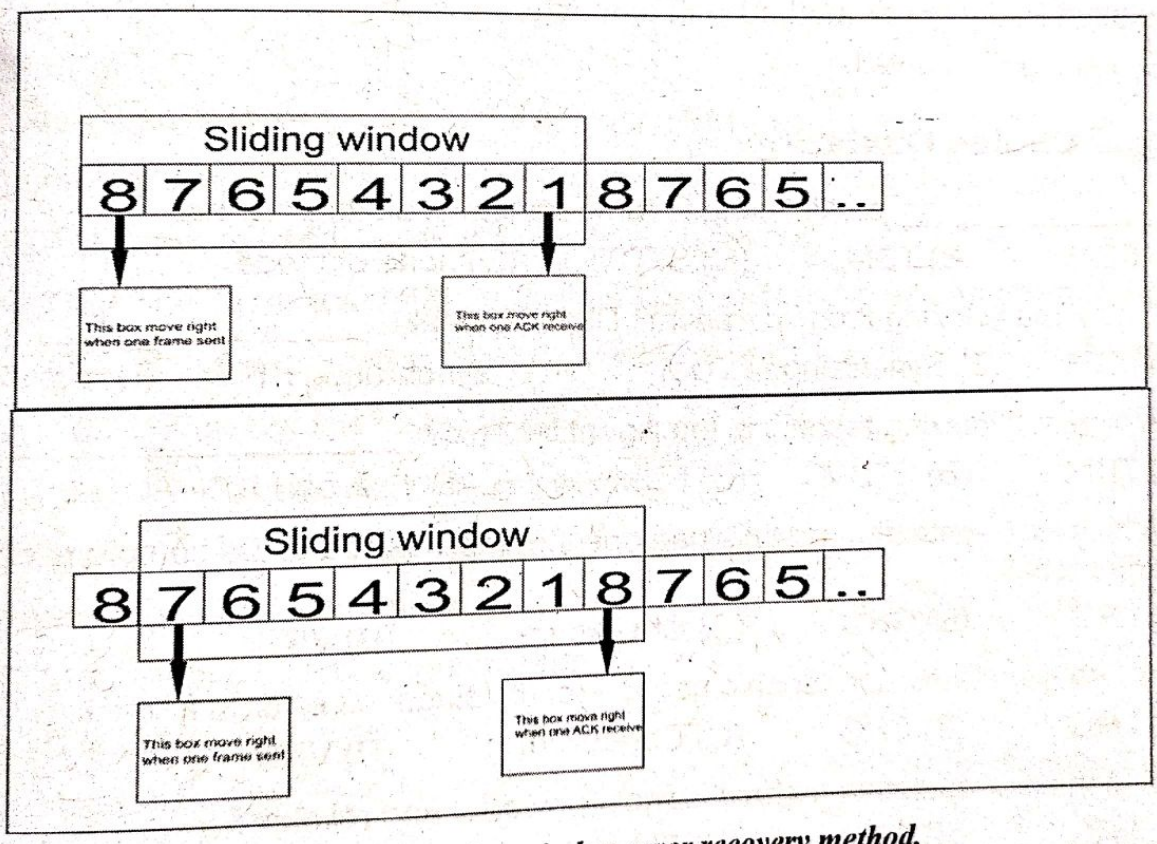


Figure 2.8 Sliding window error recovery method.

Exercises

1. What is Multiplexing explain with example.
2. Explain FDM in detail.
3. Explain STDM in Detail
4. Explain Classification of error in detail.
5. Explain Different types of Error.
6. List the Error recovery Method. Explain Stop-and-wait.
7. Which error recovery method is used while window size is fixed, explain in detail.
8. List the Error Detection Technics. Explain Checksum with example.
9. Explain Parity check method with example.
10. Explain LRC in detail.

Multipal Choice Qustation:

1. _____multiplexing technic transmits analog signals
   (A) FDM (B) TDM (C) STDM (D) none of these.
2. Which multiplexing technic transmit Digital Signals? _____
   (A) FDM (B) Synchronous TDM (C) Asynchronous TDM (D) both B and C
3. Which multiplexing technic is Intelligent technic? _____
   (A) TDM (B) STDM (C) FDM (D) Both A and B
4. Which Error detection technic use one's complement and 2's complement arithmetic?
   (A) LRC (B) CRC (C) Checksum (D) VRC
5. Which error detection technic use to identify single bit error in frame?
   (A) LRC (B) CRC (C) Checksum (D) VRC
6. Which error detection technic is most powerful and reliable?
   (A) LRC (B) CRC (C) Checksum (D) VRC
7. _____ error is corrupt the signals.
   (A) Attenuation (B) Noise (C) Singlebit (D) burst
8. _____ error detection method send frames after acknowledgment receive.
   (A) Go-back-n (B) Stop-and –wait (C) LRC (D) none of these.

Answers:

1- A 2-D 3-B 4-C 5-D 6-B 7-B 8-B

Answer the Questions:

1. Which error detection technic is used one's complement arithmetic?
2. Which Multiplexing is used Fiber cable?
3. Extra bits are added in actual data frame is called _____.
4. VRC is also called as _____ method.
5. Which error detection technics are used to check burst error?

Answers:

1. VRC & LRC
2. WDM
3. Redundant bit
4. Parity Check
5. LRC and CRC.

True False:

1. Guard bands increase the bandwidth for FDM
2. In multiplexing different channels transmit data on different medium.
3. FDM technic is used in Telephone communication.
4. In TDM each user will get specific time slot to access medium turn by turn.
5. STDM calculate quantity of data from sender machine, then allocate time slot.
6. WDM work on low frequency band.
7. FDM and WDM are using same technic.
8. Delay Distortion occurs while signal lost it's energy.
9. Attenuation is a type of error.
10. CRC is used to check single bit error.
11. LRC is based on Division Technic.
12. Go-back-n is used for error correction when more than 1 frame is send at a time to.

Answers:

1. True
2. False
3. True
4. True
5. True
6. False
7. True
8. False
9. False
10. False
11. False
12. True

Unit-3 Transmission Media

Introduction:

As we discuss previous chapter computer and other telecommunication devices transmit data in form of signals, and signals are transmitted through one medium that medium is called transmission medium. Transmission media is used to transfer data from one place to another place. Communication medium is called transmission media. It is a physical path between transmitter and receiver. There are Two types of Transmission media **Guided and unguided.**

3.1 Guided Media:

Guided media are the Physical path to communicate from one device to another device. It includes cables or wires, wired media. The data transmits on this media is directed and it has one physical limit to transfer data. There are three different types of cables are used in guided media. Twisted pair, Coaxial and Fiber optic. Twisted pain and Coaxial both are copper based Metallic cables. Fiber optic is glass or plastic cable. We will discuss all cable in detail later.

3.1.1 Twisted pair cable:

It consists of two identical wires wrapped together in double helix. It is also called helical form twisted cable. Twisting of wires reduces cross talk. Also prevent external signal interference. Prevents noise. Two types of Twisted pair, Unshielded Twisted Pair (UTP) Cable and Shielded Twisted Pair (STP) Cable

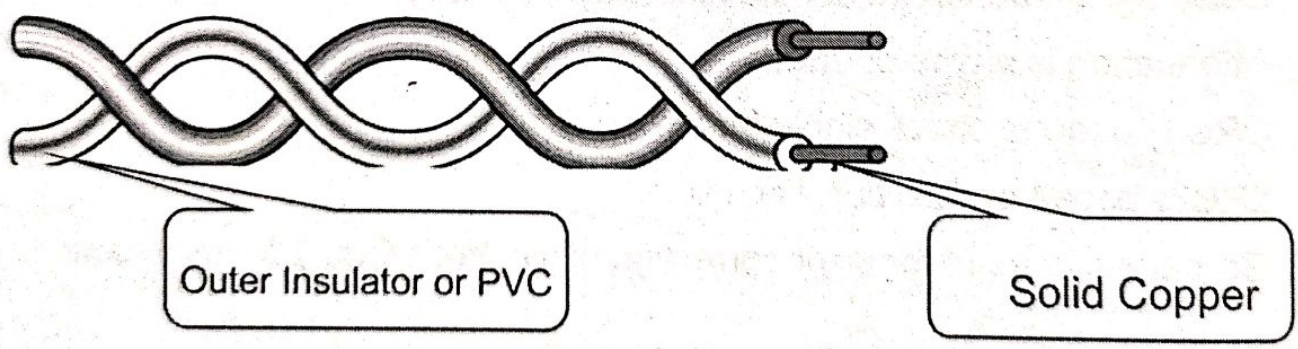


Figure 3.1 Twisted Pair

Unshielded Twisted pair Cable (UTP):

The unshielded twisted pair cable has 4 pairs of copper wires that are present inside a plastic sheath. These wires are twisted to protect them from interference. The only protection available for a UTP cable is a plastic sheath that is thin in size. These types of cable are most common type of cable used in telecommunication. UTP outer insulator is colored so it is identify specific conductor. Also identify which cable belongs with other in pair. UTP is low cost cable and easy to used and install. There are different categories of UTP are available.

Category-1: this cable is used in telephone communication. It is more effective and efficient for telephone line but due to low speed this cable is not used for internet communication.

Category-2: this cable is higher than category-1 it is used both telephone line also we can use it for send data up to 4mbps.

Category-3: this cable capacity is increase with 10mbps.This cable also used for Data transmission. Now days this cables are more used in telephone line.

Category-4: This cable capacity is increase with 16mbps.

Category-5: this cable capacity is increase with 100mbps. It is used for broadband connection.

UTP cable connect with connector this connecters are based on the twist in cable, if cable has 2 pair of twist then 4 line conductor is use, if cable has 4 pair of twist then 8 line conductor is use.

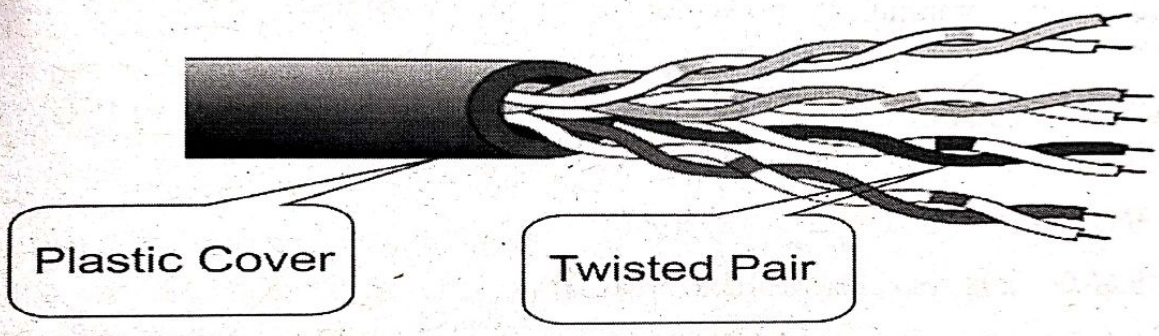


Figure 3.2 Unshielded Twisted Pair

Shielded Twisted pair Cable (STP):

Both contain PVC, Foil/Metal shield, Copper wire. Main difference in STP and UTP is that STP contains extra shield on copper wire. Shield prevents signal interference and noise. So signal interference protection is more in STP than UTP.IT is prevent the crosstalk.IT is also used same color code like UTP, also use same conductors. This cable is more expensive then UTP.

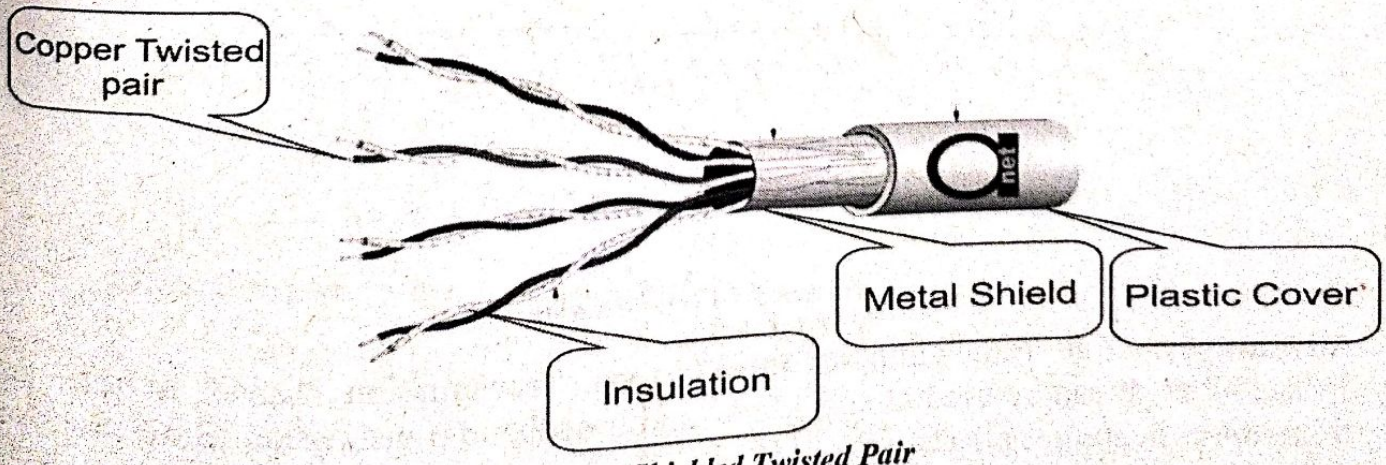


Figure 3.3 Shielded Twisted Pair

Advantages:-

It is very simple, flexible, easy to install and maintain, low weight and cheap.

Disadvantages:-

High attenuation:-- attenuation means loss in signal over a large distance. So carrying signal for large distance without repeater is problem in UTP.

Bandwidth is less, 1Mbps to 10 Mbps speed.

3.1.2 Coaxial Cable:

This cable is divided in to 4 different parts. Most inner part is copper wire which is used to transmit data using electrons. Second part is insulating material which is manufacture with PVC is protect the copper wire by outer conductor. Outer metallic wrapping is used as a shield against noise and as the second conductor which completes the circuit. The outermost part is the plastic cover which protects the whole cable. This cable is Suitable for wide speed communication. Widely used in TV Signals. Also used in computer network.

The designs of **coaxial cable** are categorized by their radio government (RG) ratings. A unique set of physical specifications defines by each RG number.

1. **RG-8** – It is used in thick Ethernet
2. **RG-9** – It is also used in thick Ethernet
3. **RG-11** – It is used in thick Ethernet
4. **RG-58** – It is used in thin Ethernet
5. **RG-59** – Used for Television

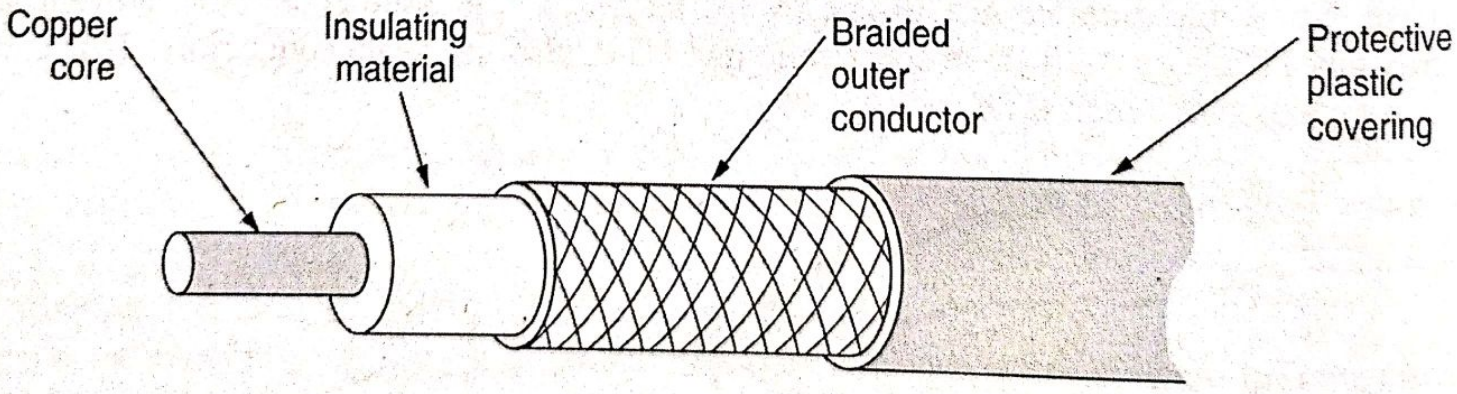


Figure 3.4 Coaxial Cable

Advantages: High Bandwidth up to 400Mbps, Transmission channel is better than Twisted Pair. It can be used as shared n/w and broadband transmission. Better protection from noise. Scaling is also better.

Disadvantages: It is Expensive than Twisted Pair Cable. Compare with fiber optic cables it covers less distance. If a single cable is failed then the entire network can be interrupted.

3.1.3 Optical fiber:

Consists of inner glass core surrounded by a glass like material which has lower refractive index. New transmission medium used for long distance communication. This cable is divided in three parts.

Core: Glass/Plastic through which light travels. It use led or lesser light for transmit data.This core is thick as our hair.

Cladding: Reflects light back to the core, Protective coating.

Secondary buffer: This is used to protect hole cable.

Refraction: As a light ray passes from one transparent medium to another, it changes direction; this phenomenon is called refraction of light.in other words how light bends when it passes from one material to another.

Critical Angle: Light propagating from denser medium to rarer medium, if the angle of reflection 90 degree corresponding angle is called critical angle.

Reflection: If a light ray is an incident at the interface of two media with an angle greater than the critical angle, it is completely reflected back to the denser medium. This phenomenon is called total internal reflection.

Optical fibers use total internal reflection to transmit light. It has a solid core of dense glass surrounded by a less dense cladding. The light ray passing through the inner core is reflected back instead of being refracted to the rarer cladding.

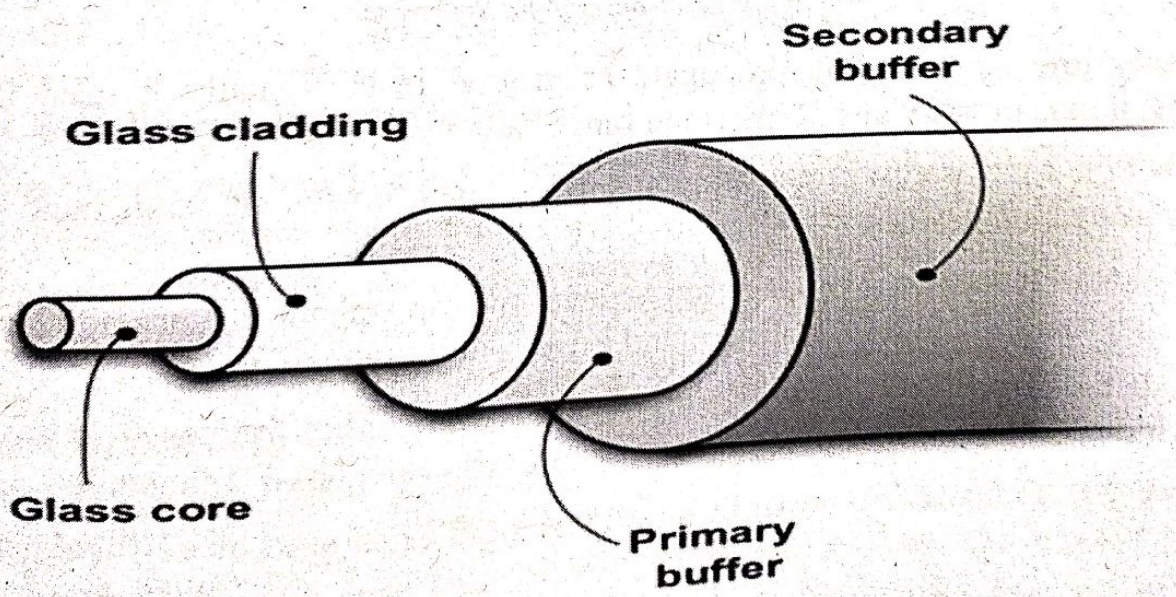


Figure 3.5 Fiber Optic Cable

Advantages: Secure transmission. It is noise resistance; it is not affected by noise because it is used light source. It has less signal attenuation. It passes data with higher bandwidth.

Disadvantage: Installation, connecting to fiber is difficult, Most expensive

3.2 Unguided Media:

Used to transmit data without using cables for ex. Air, water, vacuum, wireless media. This is also called wireless communication. It transports electromagnetic waves without using physical line.IT uses different types of antenna and disk to communicate. It divided into different frequency. It is called electromagnetic spectrum, it has range of frequency starting from VLF to EHF. We will discuss one by one in shortly.

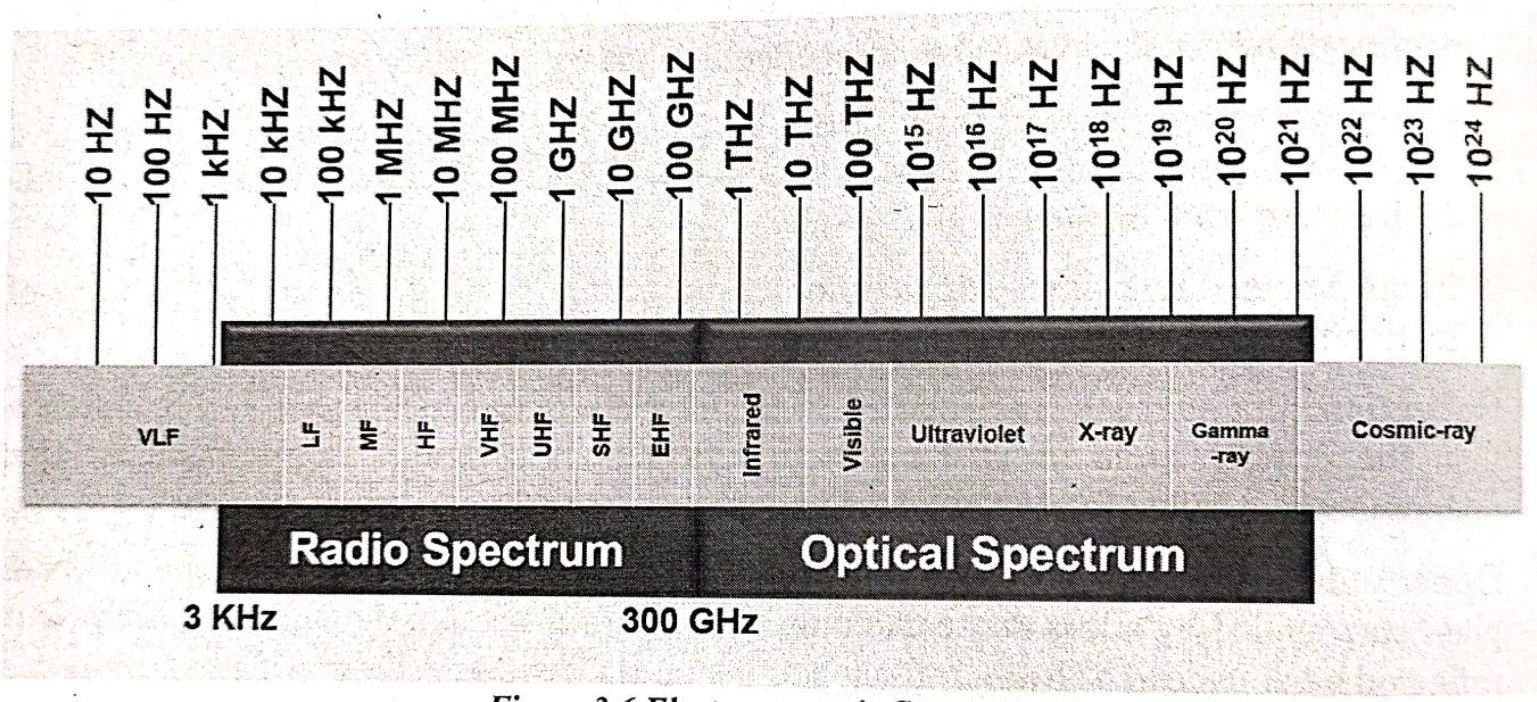


Figure 3.6 Electromagnetic Spectrum

VLF: vary low Frequency is propagate at ground level. Usually it used in air but sometime it pass in water also. It use long range radio.

LF: Low Frequency is also propagating at surface level. It use long range radio signals. It used for navigation devices.

MF: Medium Frequency is propagating at level of troposphere. It transmit signal at line of sight antenna. It includes AM Radio and Emergency Frequency.

HF: High Frequency is propagating in the ionosphere. This frequency is used in ham radio, Military communication, long distance aircraft, Telephone, Telegraph.

VHF: Very High Frequency is work on line of sight.IT is used in VHF Television, FM radio.

UHF: Ultra High Frequency is also work on line of sight. It uses UHF Television. Mobile communication, paging and microwave link.

SHF: Super High Frequency it is also work on line of sight. It uses in terrestrial microwave and radar communication.

EHF: Extremely High Frequency uses space propagation. It is used in Satellite communication.

3.2.1 Microwave:

Microwave is Radio waves that are used to provide high speed transmission. Both Voice and Data can be transmitted. Data is transmitted through the air from one microwave station to other. Microwave uses line of sight transmission. It means that signals travel in a straight path and cannot blend. These signals are VHF frequency band. IT transmits signals one way at a time. For two way communication two different frequencies are required. It use transceiver which allow single antenna to serve both frequency and function. It uses two types of antennas parabolic dish and horn. Microwaves communication antennas are fixed on tall building or tall mountain hill. Taller the antenna longer the ways transmit signals in this communication.

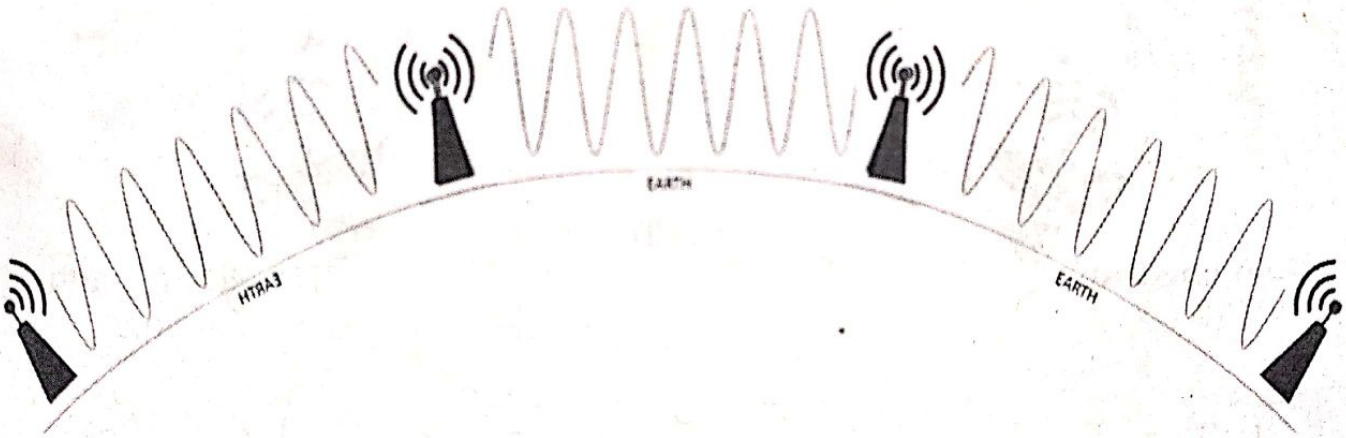


Figure 3.7 Microwave Communication

3.2.2 Satellite Communication:

Satellite Communication is used in wireless communication over long distances. This communication uses the satellite and earth based stations. A satellite receives microwave signals from earth based station. It amplifies the signals and retransmits them back to different earth based stations. Advantage that a large volume of data can be communicated at once. For satellite Communication super tall antenna and repeater are used. Each antenna communicates with satellite with two different links, one is Uplink and another is down link. Uplink is used to communicate from earth to antenna to satellite, and down link is used to communicate from satellite to earth antenna. For constant communication with earth satellite must move same speed as the earth .Such satellite is called as geosynchronous satellite. This types of satellite move on earth orbits. Satellite connects with number of stations on earth with line of sight. Only one satellite is

not enough to cover whole earth so minimum 3 satellites is required to connect whole earth with equidistant from each other in geosynchronous orbit. Satellite communication frequency is in Gigahertz (GHz).

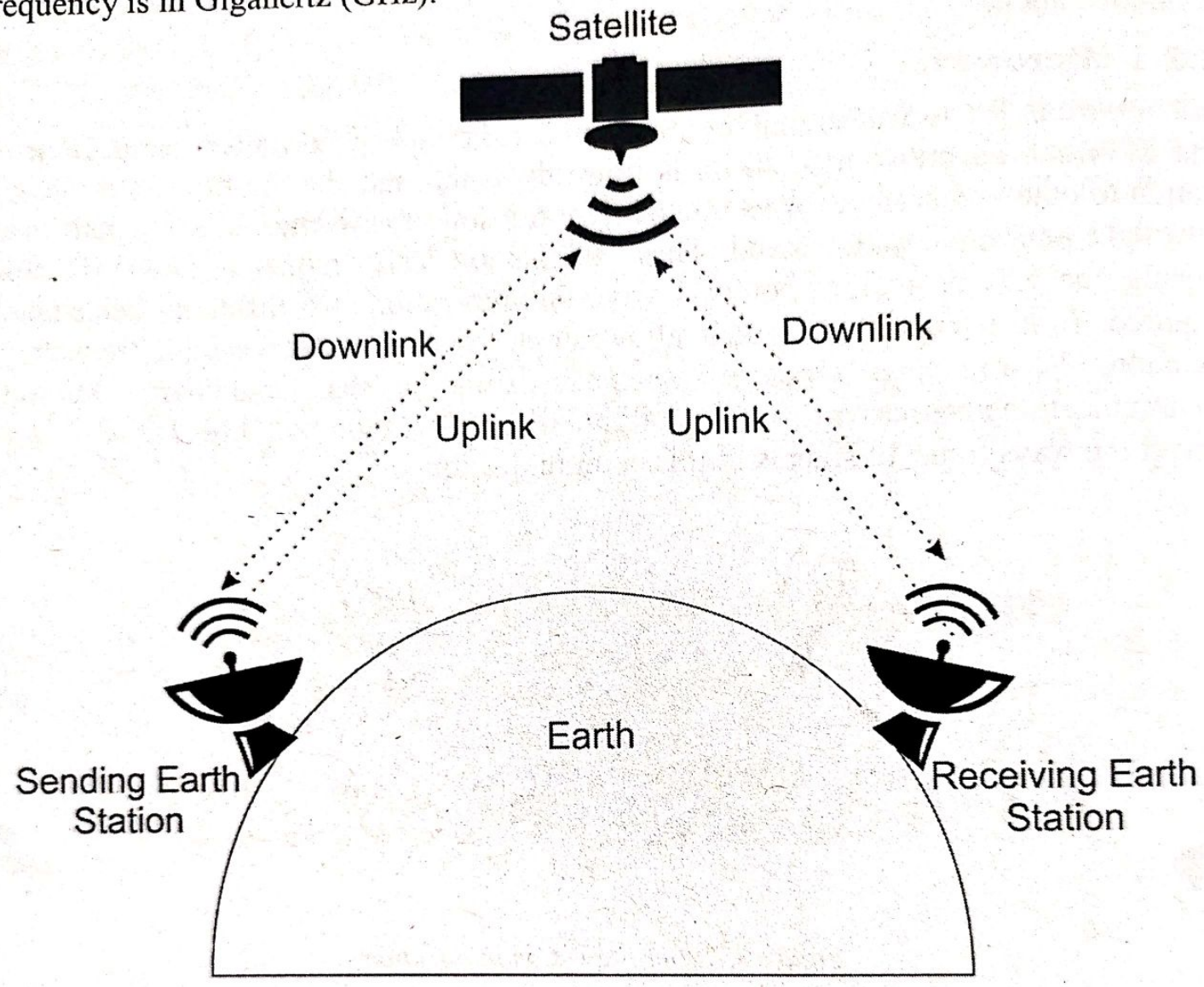


Figure 3.8 Satellite Communication

3.2.3 Cellular Telephone Communications:

This system is provide communication between two moving device both are mobile or cellphone, or one moving device and one stationary (Land) unit. A cellular service is work with different cells, so it is divided into cells. There are different service provider are register for such service. Service provider provide different services like, locate and track a caller, assign a channel to the call and transfer the signal from channel to channel as the caller moves from one cell to another cell. There are some units are connected for such a communication. We will discuss all one by one.

Cell: It is a physical region or a small area .In each cell there is one Antenna is established and small office is develop for control cell. It is also called cell office. Telephone office also defines in cell. Telephone offices are only control land line phones. Cell size is not fixed it is based on population of that cell.

Mobile Telephone Switching Office (MTSO): Each cell office is control by MTSO. It coordinates and communicates with different cell office and telephone office. These centers are technology based so it is a responsibility of MTSO to manage a call time, channel allocation and recording the call data also mange billing system of each call.

Telephone Central office (TCO): It is control telephone system. It also communicates with MTSO. Telephone central office also called as Central office of City or Town.

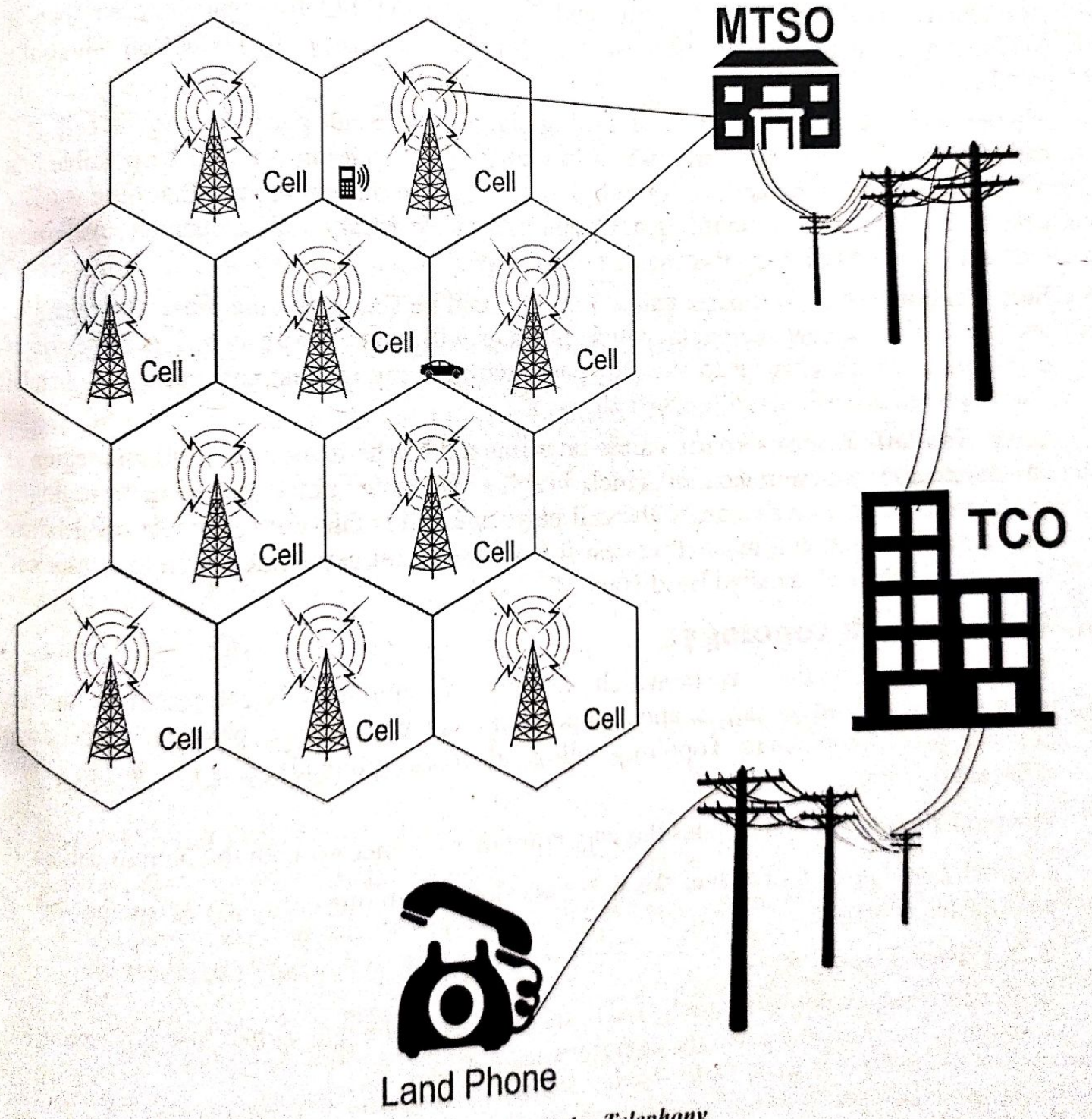


Figure 3.9 Cellular Telephony

How Cellular system is work?

Caller will dial 7 Land line number or 10 digit mobile numbers. Cell office will get this number form cell tower. now cell office will pass this number to MTSO. We know that MTSO is managing call system, now MTSO will pass this number TCO which connected with each other. MTSO broadcast this call. TCO will verify the calling number. IF called party found the by TCO then inform back to the MTSO with Cell or Region. Now MTSO will allocate one channel with Call party, and connection is established. At Receiving side call is transfer to TCO, It will send number to MTSO for match the number, If MTSO found number in It's database then forward the query signals to cell where the number is search.

There are two different condition of getting signals while call party change the cell. It is called Handoff. While two party are calling and call is ongoing it might be possible one of the call party is moving from one region or cell to another region at that time without call fail a person who is moving from region to another region need channel, to allocate channel is called Handoff. Two types of Handoff

Soft Handoff: While call party call is ongoing and he/she is moving from one region to another region, a new region in which he/ she will enter before entering in region if cell/region provide channel to the call party without any request call party get channel from new region easily is called Soft Handoff.

Hard Handoff: While call party call is ongoing and he/she is moving from one region to another region, a new region in which he/ she will enter before entering in region if cell/region not provide channel to the call party and call is fail. For reconnect call he / she who enter in region will make a request for channel from new region then region or cell will provide channel is called Hard Handoff.

3.3 Network topology:

Topology refers to the way in which network of computers is connected. It defines arrangement of nodes, cables and connectivity devices. It is a physical relationship between pair of computers. Topology follows different protocols. It is divided in to two different topology.

Physical Topology:- It describes the way computers connected with the help of cables.

Logical Topology:- It describes the way data flows from one computer to another within a computer network.

3.3.1 Bus Topology:

In Bus topology, computers connected to a shared central cable, called bus. All connected computers use the same cable for data transmission.

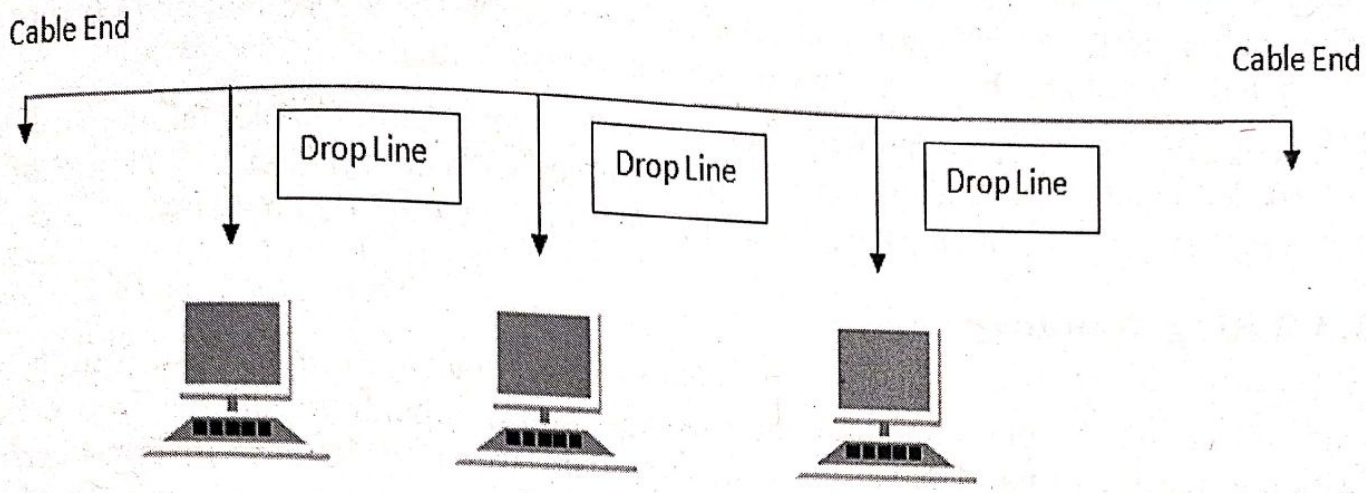


Figure 3.10 Bus Topology

In this topology, if a computer sends data frame to another computer, all other computers connected to the same central cable also receive the frame, i.e. other computers can hear what the first computer is saying. However, only the target computer accepts it; others reject the frame by checking the destination MAC address in the received frame.

Since bus topology requires less cabling, so it is easy to install and less expensive to implement as compared to other topologies. However, with the increase in the length of the central cable and increase in the count of taps, the strength of the signal decreases, so only a limited number of computers can be connected in bus topology. In this topology, all computers depend on the central cable for data transmission. So, if the central cable fails, it paralyzes the whole network, i.e. bus topology has very little fault tolerance. Here, a security risk exists because all computers can hear what other computers are saying on the shared media.

Advantages of Bus Topology:

- It is easy to install.
- Less cabling comparative to mesh and star topology, so it is less expensive to implement compared to other topologies.

Disadvantages of Bus Topology:

- As the strength of signal decreases with the increase in the wire length.
- Failure of central cable can cause failure of the whole network. For this reason, it is considered to have very little fault tolerance.
- Security risk exists because all computers can hear what other computers are saying on the shared media.
- In a bus topology, only one computer can transmit data at a time. So while one computer is sending a file to a printer, other computers have to wait. If other

computers too start sending data at the same time, it will collide and corrupt the whole data. In such a case, data should be re-transmitted.

- Therefore, if more computers connect to the same central cable, the network will become slower and also increase the chances of data collisions. It is one of the reasons why bus topology is rarely used in modern computer networks.

3.3.2 Ring Topology:

In a ring topology, each computer connects to two adjacent computers to form a ring. Data transmitted by one computer moves from one computer to another in a circular fashion to reach its final destination. It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first.

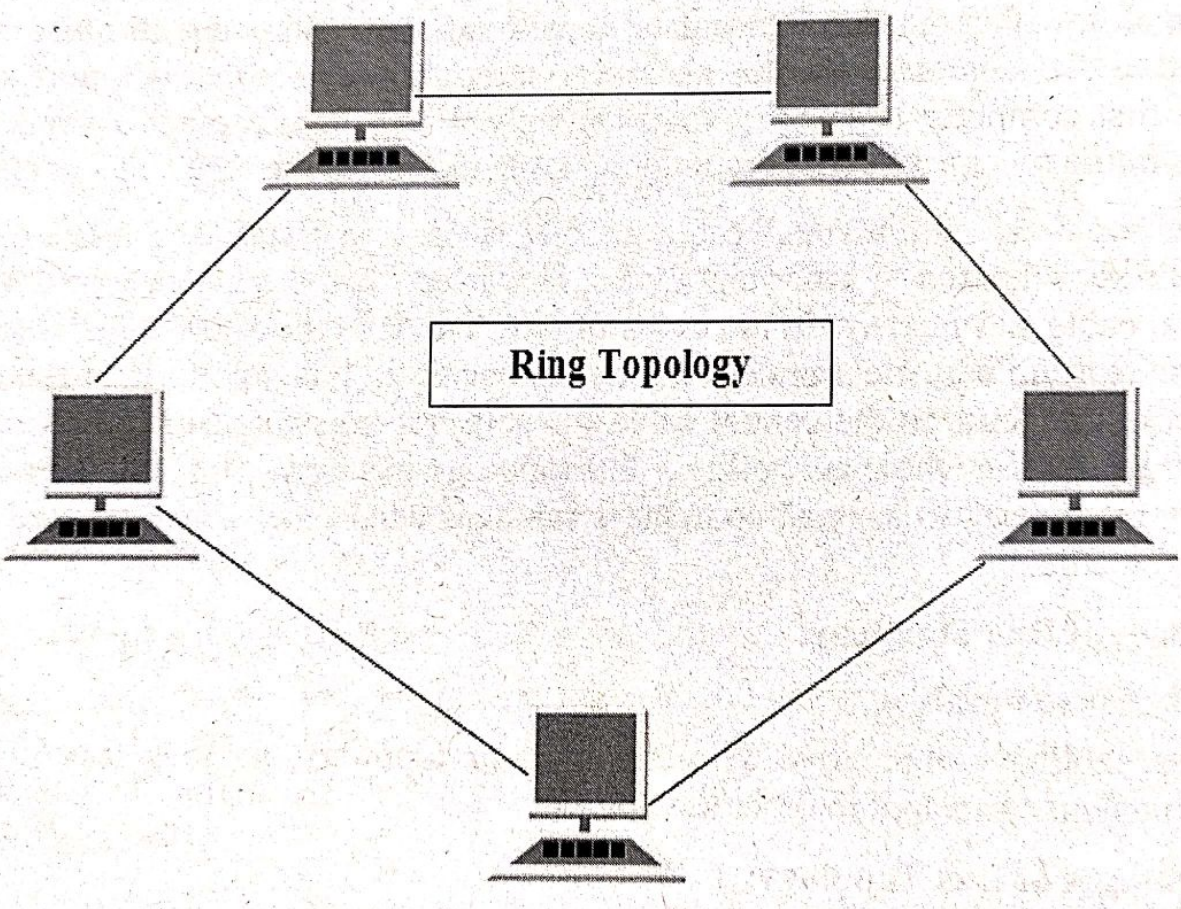


Figure 3.11 Ring Topology

Advantages of Ring Topology:

- Easy installation and less cabling compared to mesh topology.
- Unidirectional data flow reduces the chances of data packet collisions

Disadvantages of Ring Topology:

- As each data frame has to pass all computers between the source and destination, it makes data transmission slower than the star topology.

- As all computers connect to form a closed loop, one fault disturbs the whole network.
- It is difficult to reconfigure because we need to break the ring to add or remove another computer. Due to this reason, the physical ring topology is rarely used.
- Troubleshooting is difficult in ring topology.

3.3.3 Star Topology:

In Star topology, the computers connect to a central device, a switch or a hub, with point-to-point communication links. Point-to-Point connection means that there is a dedicated link/cable between the two devices. Other devices can not use it.

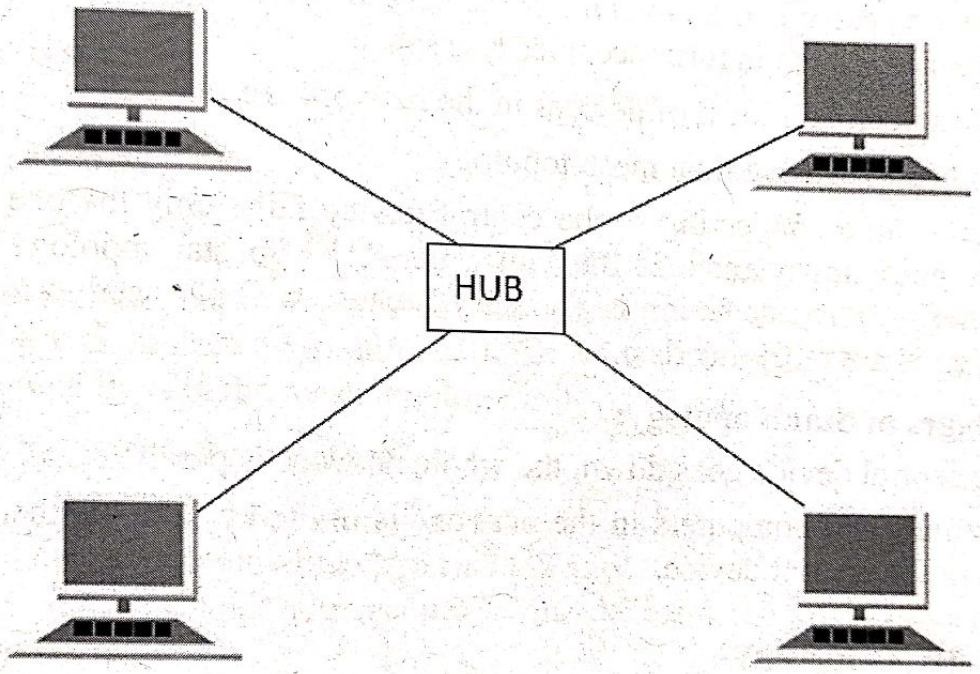


Figure 3.12 Star Topology

In this topology, if one computer wants to send some data frame to another computer, it is first routed to the central device. The central device, then, either broadcast or unicast the received data frame towards the destination computer based on the central device used.

Broadcast means the transmission of data to all connected devices while unicast means transmission of data to the target device only.

If the central device is a hub, it broadcasts the received frame to all of the connected computers, i.e. a hub is a multiport repeater. The frame has a destination MAC address, so only the target computer accepts the frame, others reject it. Since a hub broadcasts the received data, so it increases unnecessary data traffic in the network. To overcome this limitation, a switch is used as a central device.

Suppose your computer is connected to a printer with a star topology network. Now, you click on PRINT on your computer to print a file. If the central device is a hub, the file is

sent to all the connected computers. However, only the printer accepts it. On the other hand, if the central device is a switch, the file is sent to the printer only, i.e. unicast. Moreover, when the computer is busy in sending a file to the printer, computers A and B can also communicate with each other without affecting the computer – printer link, i.e. switched connection allows simultaneous communication. On the other hand, a hub allows only one device to communicate at a time.

Advantages of Star Topology:

- Only one input/output port and one cable are needed for each device to connect to several devices. It makes it less expensive than the mesh topology.
- Only one cable is used to connect the central device to a node. Hence, less cabling is needed, which in turn, occupies less space.
- Addition and removal of devices in the network are easy.
- It is less expensive than mesh topology.
- If one cable connecting to the central device fails, only the one communication link goes down and not the entire network. So star topology has good fault tolerance. Fault detection is also easy because we only need to locate a computer which is not receiving data.

Disadvantages of Star Topology:

- If the central device goes down, the whole network is paralyzed.
- The number of computers in the network is limited by the number of input/output ports in the central device.

3.3.4 Mesh Topology:

In a fully connected mesh topology, each device has a point-to-point link to every device in the network. Therefore,

- If the number of devices in a network = 4
- Then the number of links/cables each device have = 4-1 = 3
- Therefore, the number of links/cables 4 devices have = 4 (4-1) = 12

Note that these are simplex links. In simplex links, data can move in one direction only. So, one link is used for sending data, and the other is used to receive data.

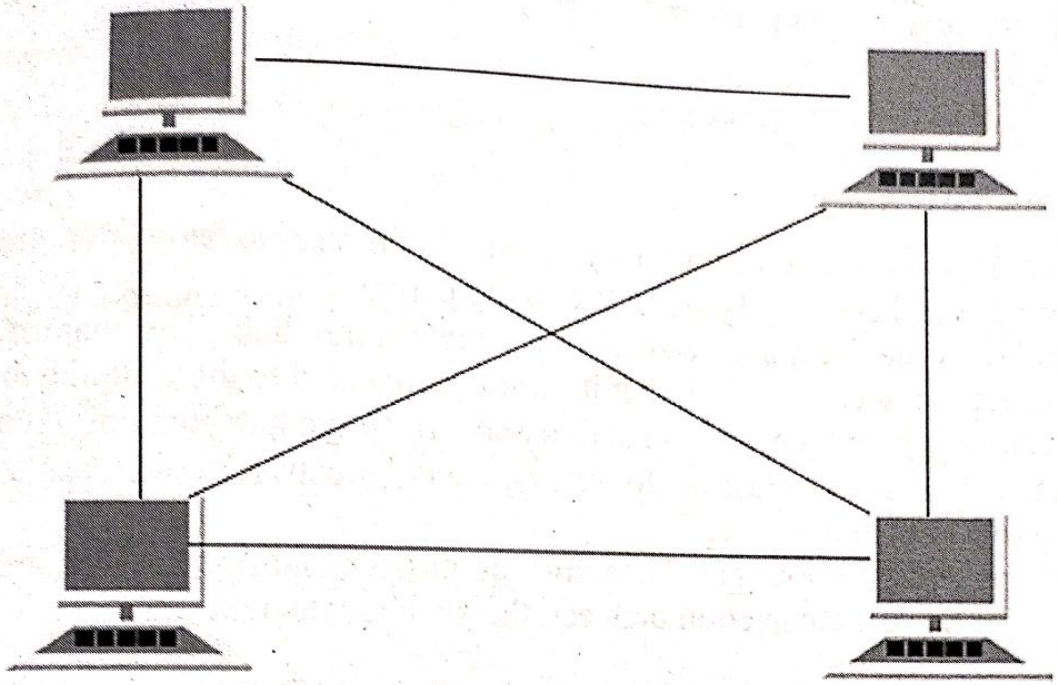


Figure 3.13 Mesh Topology

Duplex links are the ones where data can move in both directions simultaneously. Therefore, we can replace two simplex links with one duplex link. Hence, the total number of duplex links in the mesh topology is 4(4-1)/2 = 6

In general, if there are n devices, then

- ✓ the total number of simplex links = n (n-1),
- ✓ the total number of duplex links = n (n-1)/2, and
- ✓ the total number of input/output ports in one device = the total number of links each device have = n-1

So, if the total number of computers to be connected is 10, then the total number of duplex links to manage is 45, and each node to should have 9 input/output ports, which would be difficult to manage and also increase the cost. Example of mesh topology is connection between regional telephone offices.

Advantages of Mesh Topology:

- The dedicated point-to-point link eliminates traffic problems which are encountered if a link is shared among several devices.
- The dedicated point-to-point link maintains privacy and security of the messages shared between two devices because other computers cannot hear what the other two computers are saying.
- If one link fails, it does not affect the whole network.

Disadvantages of Mesh Topology:

- Since each device is connected to every device, so installation is difficult.

- Multiple input/output ports and a large number of cables increase the cost and make it expensive.
- More cables consume large space.

3.3.5 Tree Topology:

- Tree Topology is a variation of a star. As in star nodes in tree are linked to a central hub that controls the traffic to the network.
- Not every device plugs directly into the central hub. The majority of devices connect to a secondary hub that in turn is connected to the central hub.
- A central hub in the tree is an active hub. An active hub contains a repeater.
- Active hub is responsible to manage whole network and dependent network (passive hub) and devices.
- The secondary hubs may be active or passive hub. A Passive hub provides a simple physical connection between the attached devices.

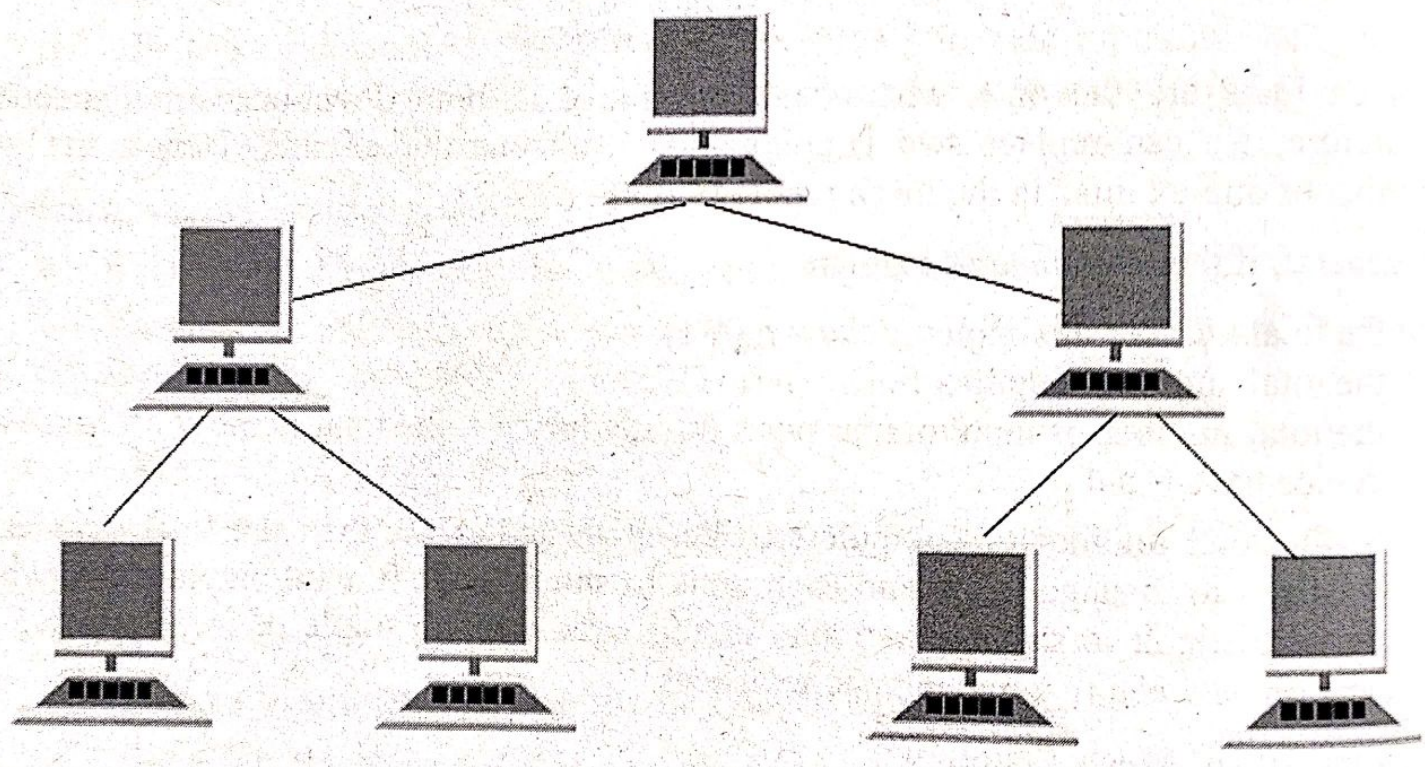


Figure 3.14 Tree Topology

Advantages of Tree Topology:

- Easy to expand nodes.
- Easily manage and error detection is easy.
- Point to point connection with each device to switch.
- It is easy to set-up and extend network.

- If one computer fails it does not affect the other computers.
- It is easy to detect fault in network.
- It is supported by majority hardware and software require to communicate in network.

3.3.6 Hybrid Topology:

All topologies are interconnected to form a hybrid topology. It is mixture of two or more topologies.

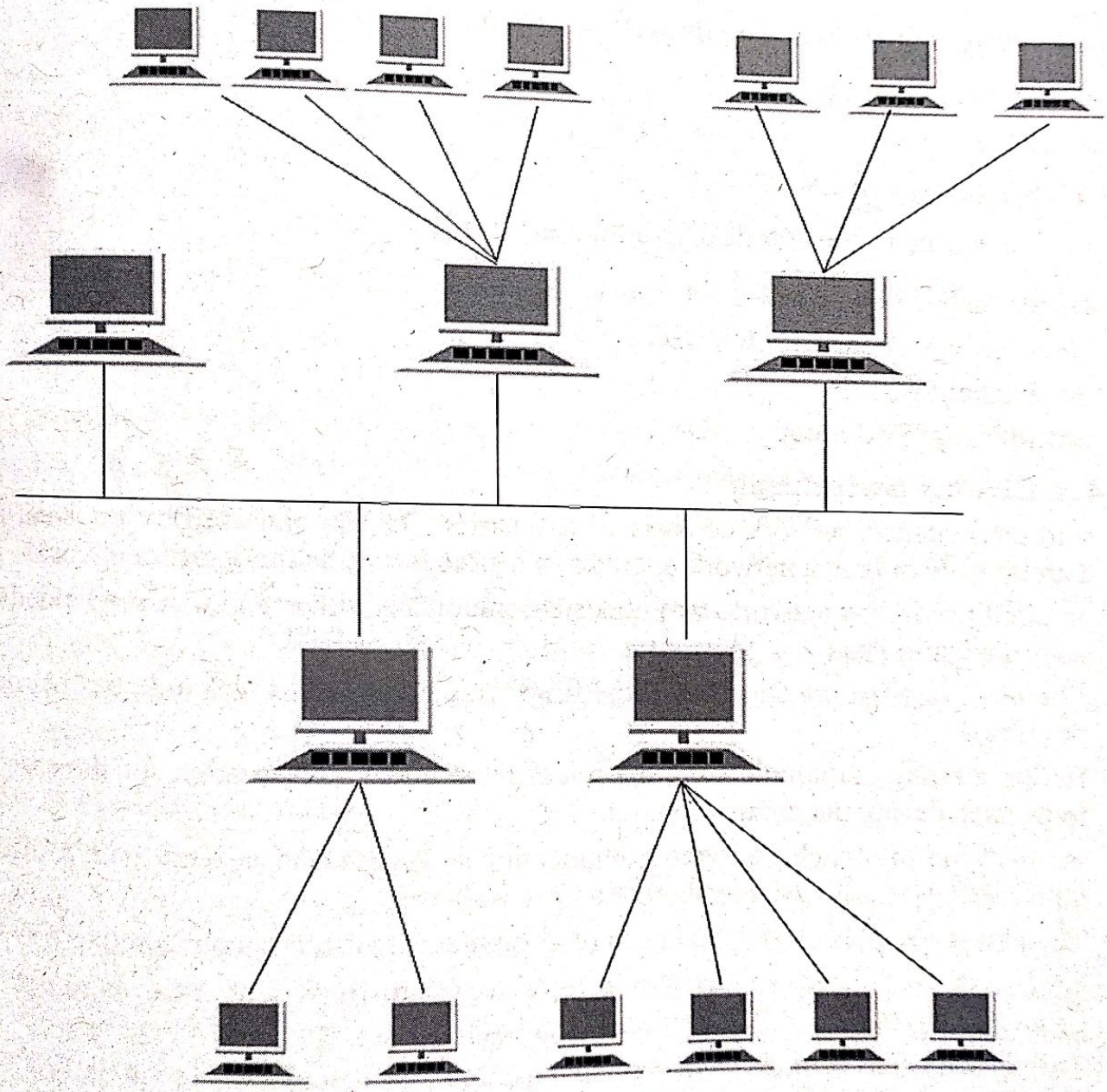


Figure 3.15 Hybrid Topology

Hence, while choosing a physical topology for a network, we should always consider:

- Cost
- Ease of installation
- Ease of maintenance, and
- Cable fault tolerance

Advantages of Hybrid Topology:

- Reliable
- Error detection is easy.

Disadvantages of Hybrid Topology:

- Complex in design
- Costly

3.4 Switching:

Switching is used to transfer data in computer network.

Types of Switching:-

- Circuit Switching
- Packet Switching
- Message Switching

3.4.1 Circuit Switching:

- Circuit switched network consists of a set of switches connected by physical links Circuit switching in a network operates in a similar way as the telephone works.
- In circuit switched network, two nodes communicate with each other over a dedicate communication path.
- There is a need of pre-specified route from which data will travel and no other data is permitted.
- Before starting communication, the nodes must make a reservation for the resource to be used during the communication.
- In this type of switching, once a connection is established, a dedicated path exists between both ends until the connection is terminated.
- The end systems, such as telephones or computers are directly connected to a switch.
- When system A needs to communicate with system B, system A needs to request a connection to system B that must be accepted by all switches as well as by B itself.
- This is called as **setup phase** in which a circuit is reserved on each link, and the combination of circuits or channels defines a dedicated path.

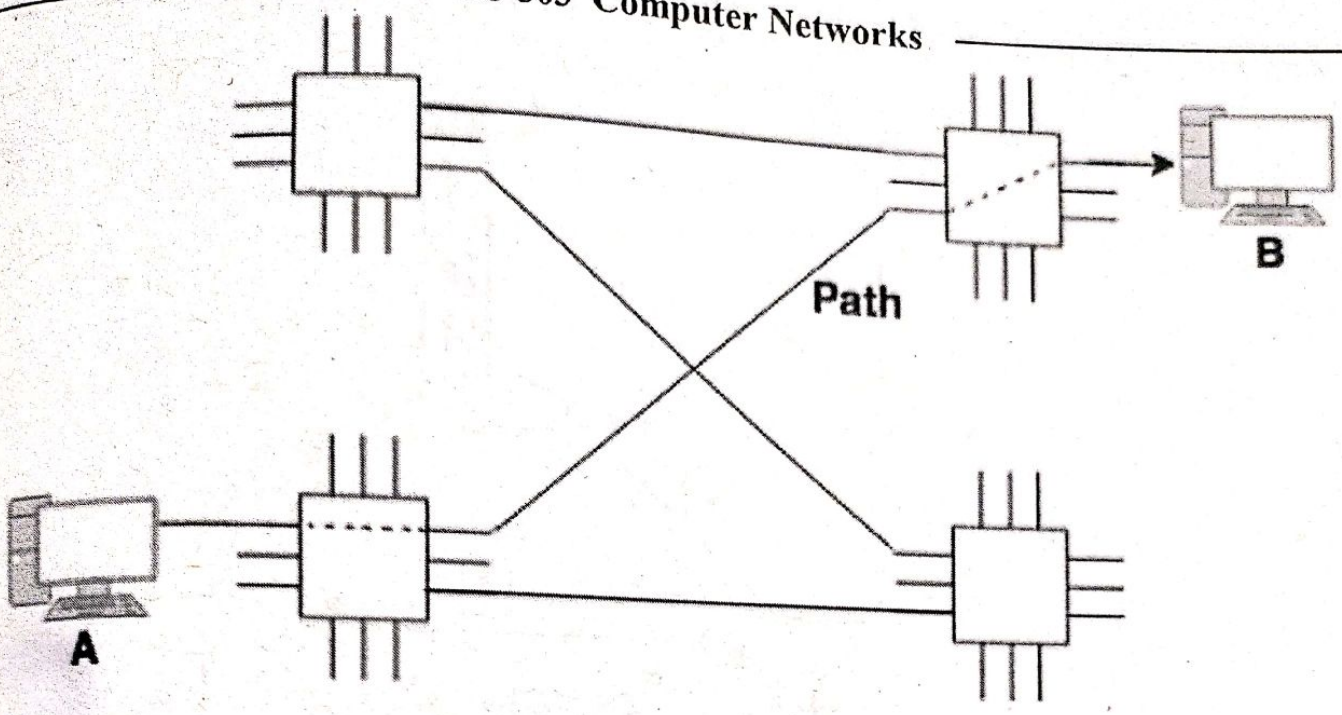


Figure 3.16 Circuit Switching

- After the establishment of the dedicated circuit, the data transfer can take place.
- After all data has been transferred, the circuit is torn down.
- Packet Switching
- In packet switching, messages are divided into packets of fixed or variable size.
- The size of packet is decided by the network and the governing protocol.
- Resource allocation for a packet is not done in packet switching.
- Resources are allocated on demand.
- The resource allocation is done on first-come, first-served basis.
- Each switching node has a small amount of buffer space to hold packets temporarily.
- If the outgoing line is busy, the packet stays in queue until the line becomes available.

3.4.2 Packet switching method:

1. Datagram Packet Switching:

- Datagram packet switching is normally implemented in the network layer.
- In datagram network, each packet is routed independently through the network.
- Each packet carries a header that contains the full information about the destination.
- When the switch receives the packet, the destination address in the header of the packet is examined; the routing table is consulted to find the corresponding port through which the packet should be forwarded.

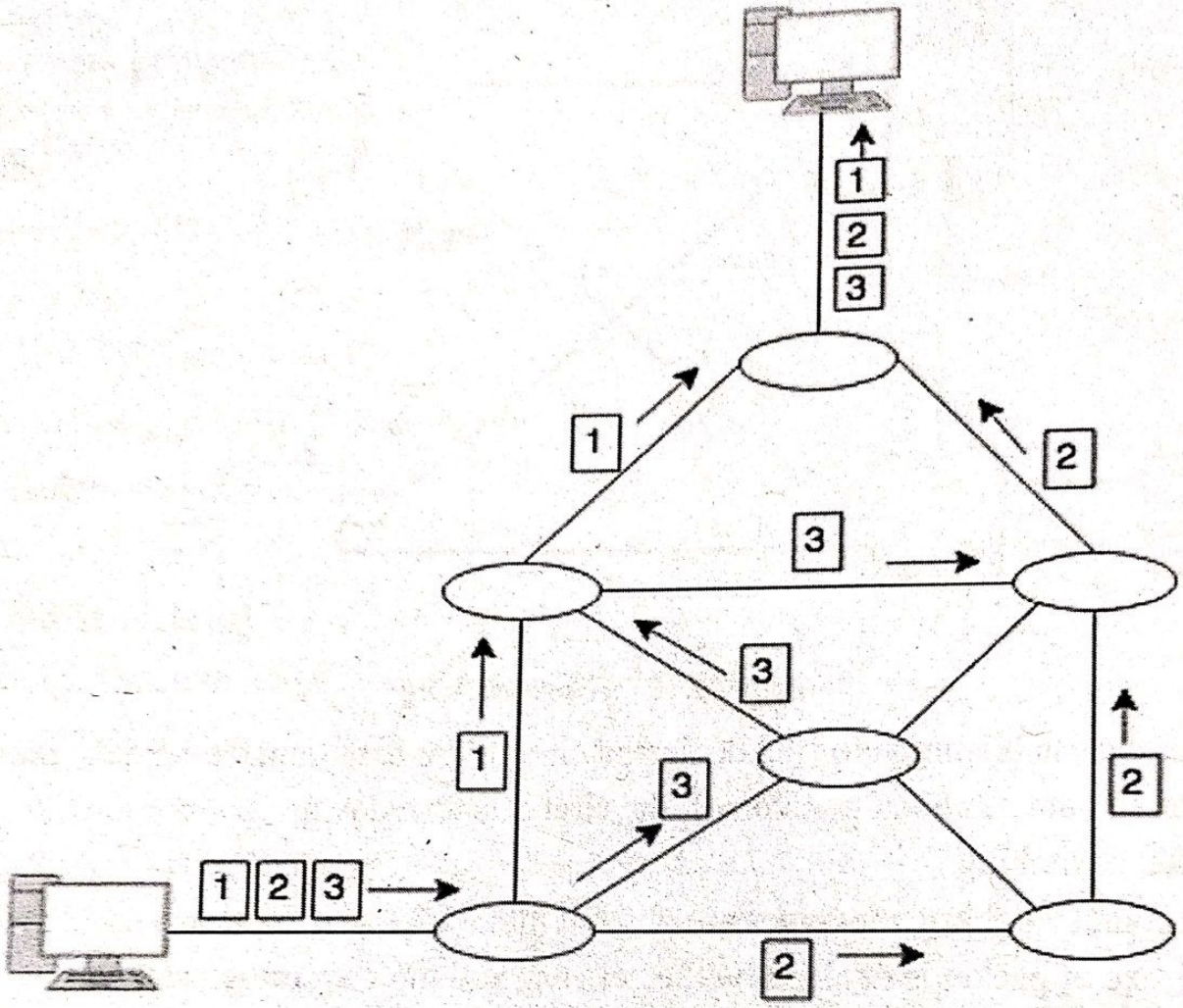


Figure 3.17 Packet Switching

2. Virtual Circuit Packet Switching:

- Virtual circuit packet switching is normally done at the data link layer.
- Virtual circuit packet switching establishes a fixed path between a source and a destination to transfer the packets. It is also called as connection oriented network. A source and destination have to go through three phases in a
- virtual circuit packet switching:
  - i. Setup phase
  - ii. Data transfer phase
  - iii. Connection release phase
- A logical connection is established when a sender sends a setup request to the receiver and the receiver sends back an acknowledgement to the sender if the receiver agree.
- All packets belonging to the same source and destination travel the same path.
- The information is delivered to the receiver in the same order as transmitted by the sender.

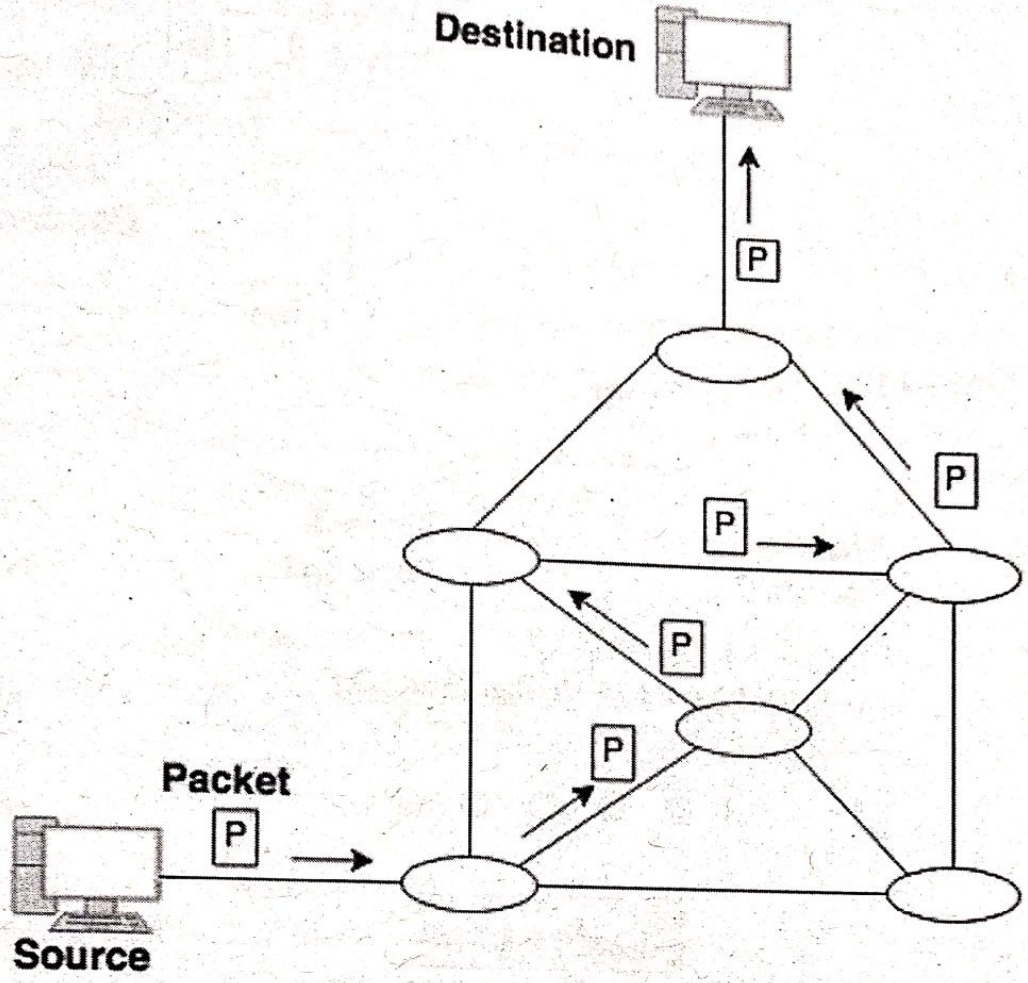


Figure 3.18 Virtual circuit Packet Switching

3.4.3 Message Switching:

- In message switching, it is not necessary to establish a dedicated path between transmitter and receiver.
- In this, each message is routed independently through the network.
- Each message carries a header that contains the full information about the destination.
- Each intermediate device receives the whole message and buffers it until there are resources available to transfer it to the next hop.
- If the next hop does not have enough resources to accommodate large size message, the message is stored and switch waits.
- For this reason a message switching is sometimes called as **Store and Forward Switching**.
- Message switching is very slow because of store-and-forward technique.
- Message switching is not recommended for real time applications like voice and video.

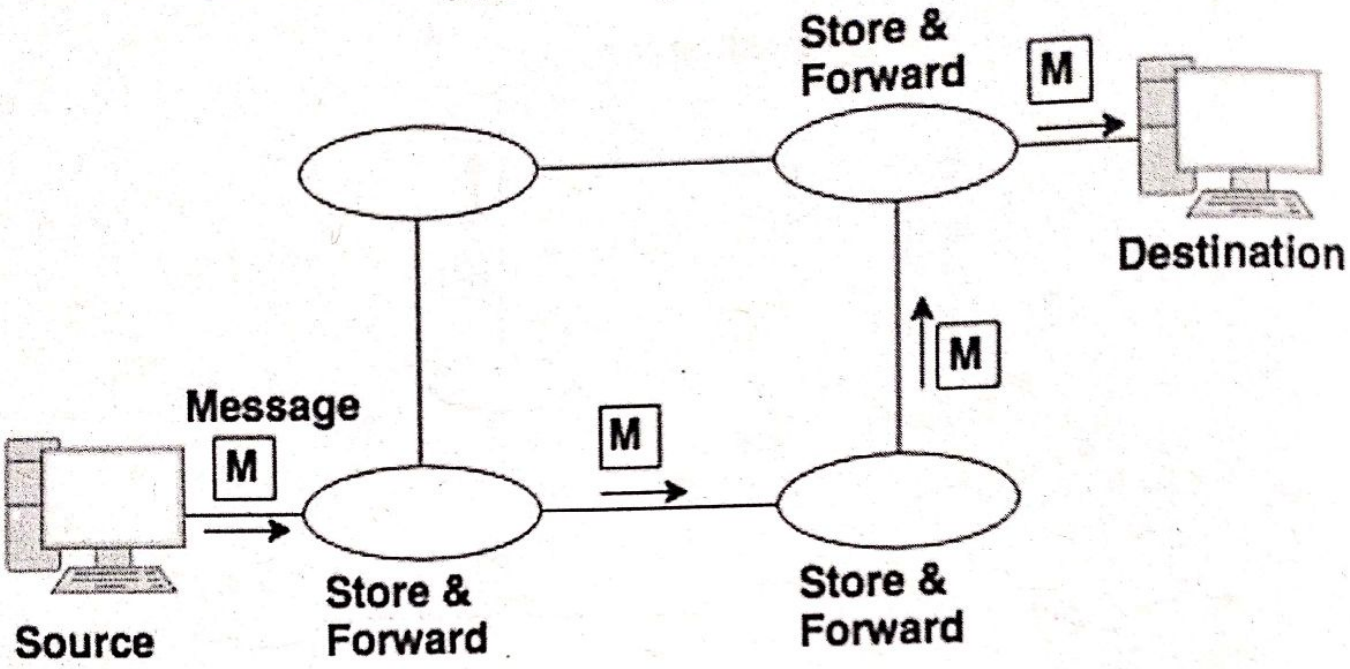


Figure 3.19 Message Switching

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Exercises

1. List the different types of Guided media. Explain Coaxial Cable in detail
2. Explain Fiber optic Cable in detail.
3. Explain Microwave Communication.
4. Explain Satellite communication in detail.
5. Explain Cellular Telephone System in brief.
6. List the different type of topology. Write difference between star and mesh topology.
7. Explain Ring topology.
8. List the different types of Switching Explain Message Switching.
9. Explain Packet Switching.

Fill in the blanks:

1. STP prevents from _____ in communication signal.
2. Fiber optic cable sends light source through _____.
3. Message switching technic also called as _____.
4. _____ switching technic used in Telephone communication.

5. Microwave signal transfer in _____ way.
6. Satellite communication use _____ and _____ links to communicate.
7. In tree topology parent node is known as _____ and child node is known as _____.
8. _____ topology use common cable to connect one or more machine.
9. In _____ topology central device is manage whole network.
10. _____ is connecting with cell office in cellular communication.
11. Full form of TCO_____.
12. _____ topology is fully connected.

Answer:

(1) Noise (2) Reflection (3) Store and forward (4) Circuit
(5) Line of sight (6) uplink, downlink (7) Active Hub, Passive Hub (8) Bus
(9) Star (10) MTSO (11) Telephone Central Office (12) Mesh

True False:

1. Guided media is use wireless communication.
2. Full form of UTP is Universal Twisted Pair Cable.
3. Capacity of Twisted Pair cable is 1 to 1000 Mbps.
4. Outer conductor is used in coaxial cable to protect noise.
5. Fiber cable use glass to transfer data on high speed.
6. Fiber cable transfer data in form of electrons.
7. Fiber cable use refraction technic to transmit signals.
8. UHF Frequency is used for space and satellite communication.
9. Microwaves are VHF frequency band waves.
10. GEO satellites are used for communication on Earth Tower.
11. In cellular telephony, a service is dived in small regions called MTSO.
12. In star topology as many channels as number of device connected.

Answer:

1. False 2. False 3. False 4. True. 5. True 6. False
7. True 8. False 9. True 10. True. 11. False. 12. True

Unit - 4 Network Protocols, OSI, TCP/IP Model

4.1 Protocols in computer communications:

Protocols are set of rules that must be followed by the machines to transfer the data effectively. Let's understand the concept of protocol.

A computer network is a collection of various computing devices. The purpose of computer network is that the devices can share the data. In computer network we are having one sender and receiver. Sender will send some data to the receiver. To send the data sender needs some kind of connection. Connection can be wired or wireless. Let's say Sender sends the data to the Receiver. Receiver receives the data. But what if the receiver is not able to read the data. The data which is sent by the sender it must be understood by the receiver. For that there must be some kind of protocol which must be running at the sender machine and also on the receiver machine. So that the message sent from the sender could be understood by the receiver.

For example I make a call to Bhavna in Mumbai who knows Marathi only. And I know Gujarati only. So whatever I am speaking is hearable to Bhavna but she can't able to understand it. On the same way what Bhavna on receiver side is speaking can't be understood by me. So in this case sender and receiver both are able to send message. But cannot be able to understand. So there must be some protocol in networking language running on both side sender and receiver for proper communication (or in our scenario we must have translator for me and Bhavna..!)

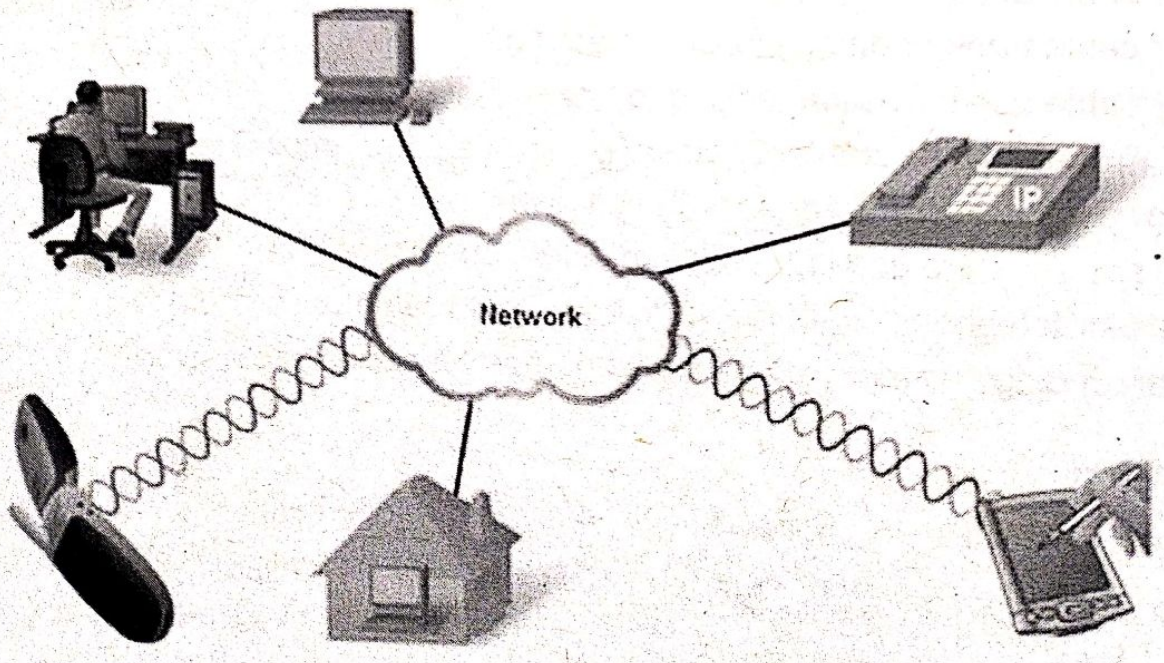

Figure 4.1 COMMUNICATION PROTOCOL.

4.2 OSI model and layer functions:

OSI stands for **Open Systems Interconnection Model** developed by **International Organization of Standardization (ISO)** in 1984. OSI model describes how data is transferred from one computer to another computer in computer network. For example if one computer is having windows 10 Operating system and another computer is having MAC Operating system so how both the computers will communicate can be described by OSI model. OSI model contains 7 layers as shown in figure 4.2. Network Layer, Data Link Layer and Physical Layer are also known as **Lower Layers** or **Hardware Layers**. Application Layer, Presentation Layer and Session Layer are also known as **Software Layers**.

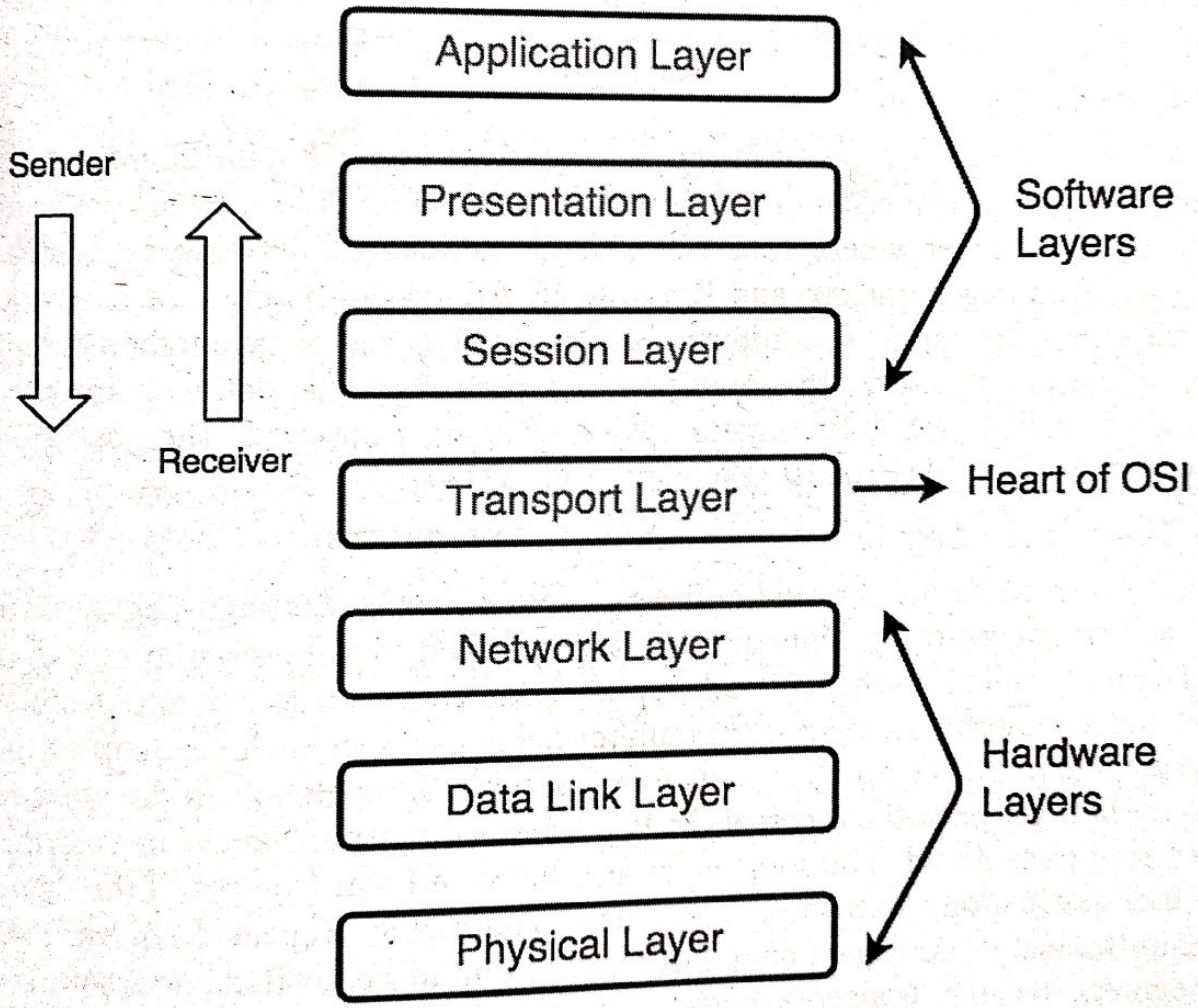

Figure 4.2 Layers of OSI Model

4.2.1 Physical Layer (Layer 1):

Physical layer converts binary sequence into signals and transmit over local media. It can be an electrical signals in case of copper cable, light signal in case of optical fiber and radio signal in case of AIR. At the receiver it converts the received signal into bits and converts into data link layer as a frame.

4.2.2 Data Link Layer (DLL):

Data link layer receives data packets from network layer. Physical addressing is done at Data link layer where Mac address of sender and receiver are assign to each data packets form a frame. MAC address is a 12 digit alphanumeric number embedded in NIC(Network Interface Card) of a computer by your computer manufacturer. Data unit in Data link layer is called a Frame.

Data Link Layer is divided into two sub layers :

1. Logical Link Control (LLC):- This layer is responsible for identity and encapsulating network-layer protocols and allows you to find the error.
2. Media Access Control (MAC):- It is responsible for controlling how device in a network gain access to medium and permits to transmit data.

4.2.3 Network Layer:

Network layer works for the transmission of the received data segments from one computer to another located in different networks. Data units in network layer are called packets. It is the layer where routers reside. Functions of network layer are Logical Addressing, Path determination and Routing. IP Addressing is done in network layer is called Logical Addressing. A computer is connected to server or another computer in a number of ways. Choosing the best possible path for data delivery from source to destination is called path determination. This layer uses protocols such as OSPF (Open Shortest path first), BGP(Broader Gateway Protocol) etc.

4.2.4 Transport Layer:

Transport layer performs the reliability of communication through segmentation, flow control and error control. In segmentation data received from session layer is divided into small data units called segments. Each segment can contain a source and destination port number and a sequence number. Port number helps to direct each segment to the correct application and sequence number helps to reassemble the segments in the correct order to form correct message at the receiver. In flow control transport layer controls the amount of data being transmitted. Transport layer also helps in Error Control, if the data dose not arrive the destination, Transport layer uses Automatic Repeat Request schemes to retransmit the lost or corrupted data. For that a group of bits called checksum is added to each segment by the transport layer to find out received corrupted segment. TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) are Transport layer protocol. Transport layer performs two types of services connection oriented Transmission (done by TCP) and connectionless Transmission (done by UDP).

4.2.5 Session Layer:

This layer is responsible for establishment of connection, maintenance of sessions, authentication and also ensures security. Suppose you are planning for a party. For that you have hired helpers for that all the arrangements can be done smoothly. Session layer

helps setting up and managing connection and terminating the session. Like you have helpers for party, Session layer also has its own helpers called APIs, NETBIOS for Network Basic Input Output System is an example of API which allows applications on different computers which communicate with each other. Session layer helps in session management, authentication and authorization.

4.2.6 Presentation Layer:

It receives data from Application Layer. This data is in the form of characters and numbers. Presentation layer convert this numbers and characters into machine readable format. For ex. Conversion of ASCII to EBCDIC is called translation. Presentation layer reduces the number bits that need to be transmitted on a network. This is called data compression that helps to reduce size of files like video. As the size of file is reduced so it can be transmitted in very less time and data transmission can be done faster. So Data compression is useful for real time video and audio streaming. To maintain the integrity of data, data is encrypted at sender side and decrypted at receiver side. Secure Socket Layer Protocol (SSL) is used for encryption and decryption in Presentation Layer.

4.2.7 Application Layer:

It is used by network applications that uses internet like Browsers, Skype messanger, Outlook etc. It uses application layer protocols like HTTP, HTTPS, FTP, DHCP, TELNET etc. All this protocols are for different web services like File Transfer (FTP Protocol-), Web surfing (HTTP/S Protocol Email (SMTP Protocol), Virtual Terminals (TELNET Protocol) etc. Application layer provide services for network applications with the help of protocols to perform user activities.

4.3 TCP/IP MODEL:

TCP/IP is a network model used in current internet architecture. TCP/IP it was designed and developed by Department of Defense (DoD) in 1960s and is based on standard protocols to connect remote machines. It stands for Transmission Control Protocol / Internet Protocol. The **TCP/IP model** is a concise version of the OSI model. It contains four layers, unlike seven layers in the OSI model.

The layers are:

1. Network Access Layer
2. Internet Layer
3. Transport Layer
4. Application Layer

The diagrammatic comparison of the TCP/IP and OSI model is as follows:

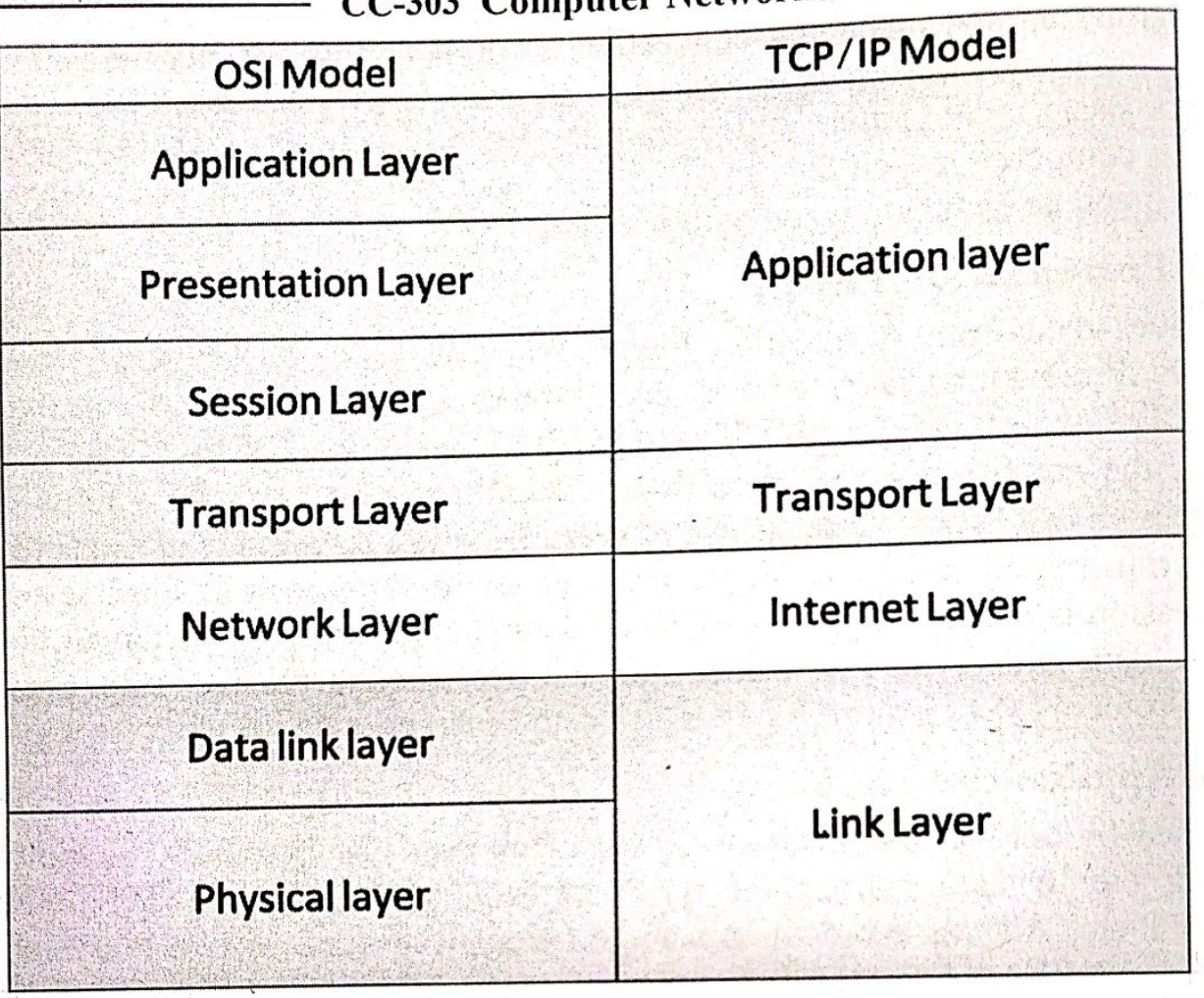

Figure 4.3 OSI Model v/s TCP/IP Model

4.3.1 Network Access Layer:

- A network layer is the lowest layer of the TCP/IP model.
- A network layer is the combination of the Physical layer and Data Link layer defined in the OSI reference model.
- It defines how the data should be sent physically through the network.
- This layer is mainly responsible for the transmission of the data between two devices on the same network.
- The functions carried out by this layer are encapsulating the IP datagram into frames transmitted by the network and mapping of IP addresses into physical addresses.
- The protocols used by this layer are ethernet, token ring, FDDI, X.25, frame relay.

4.3.2 Internet Layer:

- An internet layer is the second layer of the TCP/IP model.
- An internet layer is also known as the network layer.
- The main responsibility of the internet layer is to send the packets from any network, and they arrive at the destination.

- The protocols used by this layer are IP (Internet Protocol), ARP (Address Resolution Protocol), ICMP (Internet Control Message Protocol) etc.

4.3.3 Transport Layer:

- The transport layer is responsible for the reliability, flow control, and correction of data which is being sent over the network.
- The protocols used in the transport layer are **TCP** (Transmission control protocol) and **UDP** (User Datagram protocol User Datagram Protocol)

4.3.4 Application Layer:

- It is responsible for handling high-level protocols.
- This layer allows the user to interact with the application.
- When one application layer protocol wants to communicate with another application layer, it forwards its data to the transport layer.
- The protocols used in this layer are HTTP/S, SMTP, DNS (Domain Name System), TELNET etc.

4.4 Types of area networks – LAN, MAN and WAN:

If two or more devices connected with each other via medium then they form network. The devices can be mobile, laptop, computer etc. The Network allows computers to connect and communicate with different computers via any medium. There are main three types of network LAN (Local Area Network), MAN (Metropolitan Area Network) and WAN (Wide Area Network).

Local Area Network (LAN):

- LAN operates in a small physical area like building, college, bank.
- LAN networks are easy to design and troubleshoot.
- LAN is used to share resources like printer, software application, data.
- LAN is having high security as number of computers are limited and range is limited but lack of privacy because once resources are shared it can be used by all the users of a LAN network.
- BUS, RING Topology are used in LAN.

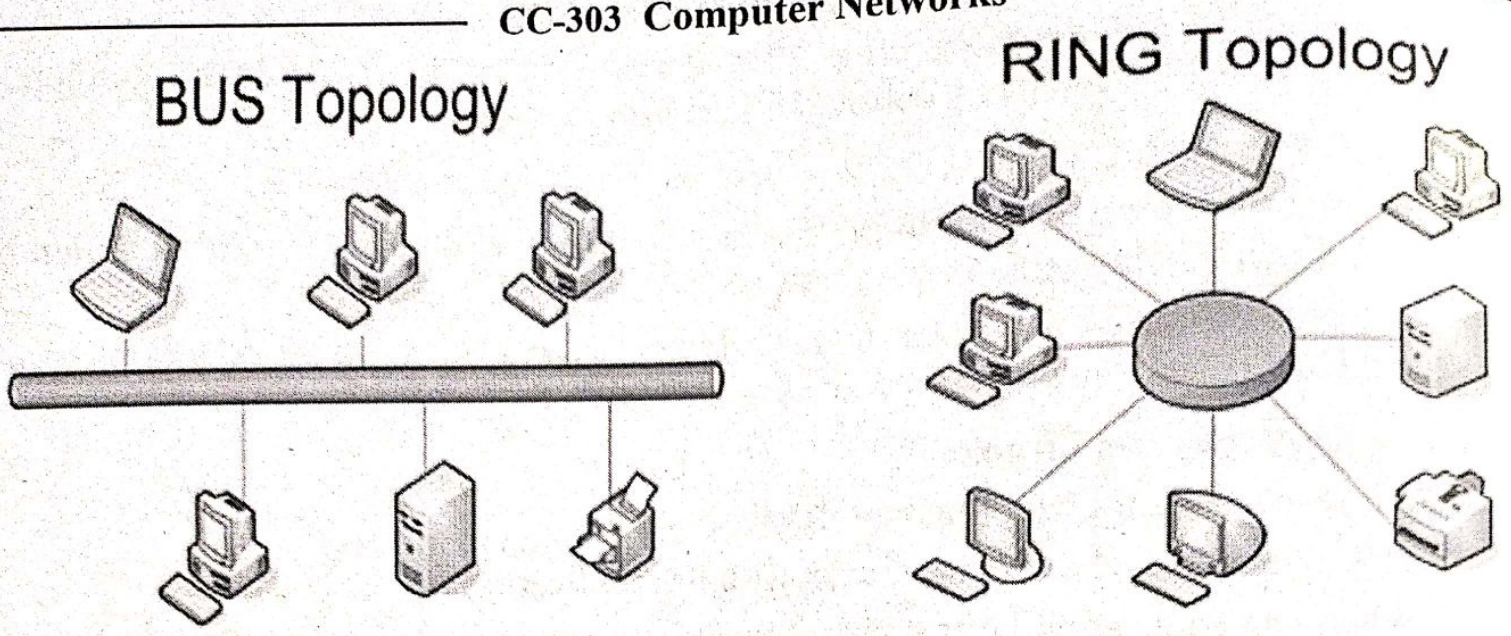

Figure 4.4 Bus and Ring Topology in LAN

Metropolitan Area Network (MAN):

- It is a collection of different LANs.
- It connects two or more computers that are apart but resides in the same or different cities.
- An example of MAN is a cable television networks available in whole city.
- A MAN can be created as a single network such as Cable TV Network, covering the entire city or a group of several Local Area Networks (LANs).
- MAN is having less security.
- It requires more cables.

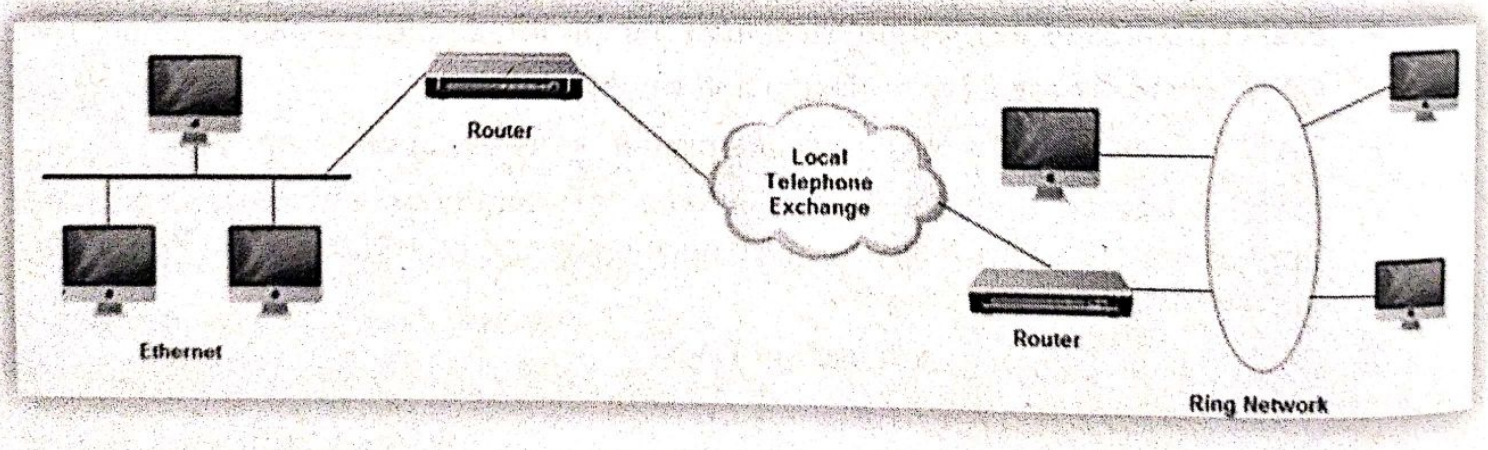

Figure 4.5 MAN

Wide Area Network (WAN):

- It is a collection of LANs and MANs.
- WAN is used to cover a large geographical area, state or country.
- For example satellite system, telephone line uses WAN.

- The internet is the largest WAN.
- WAN is having less security.

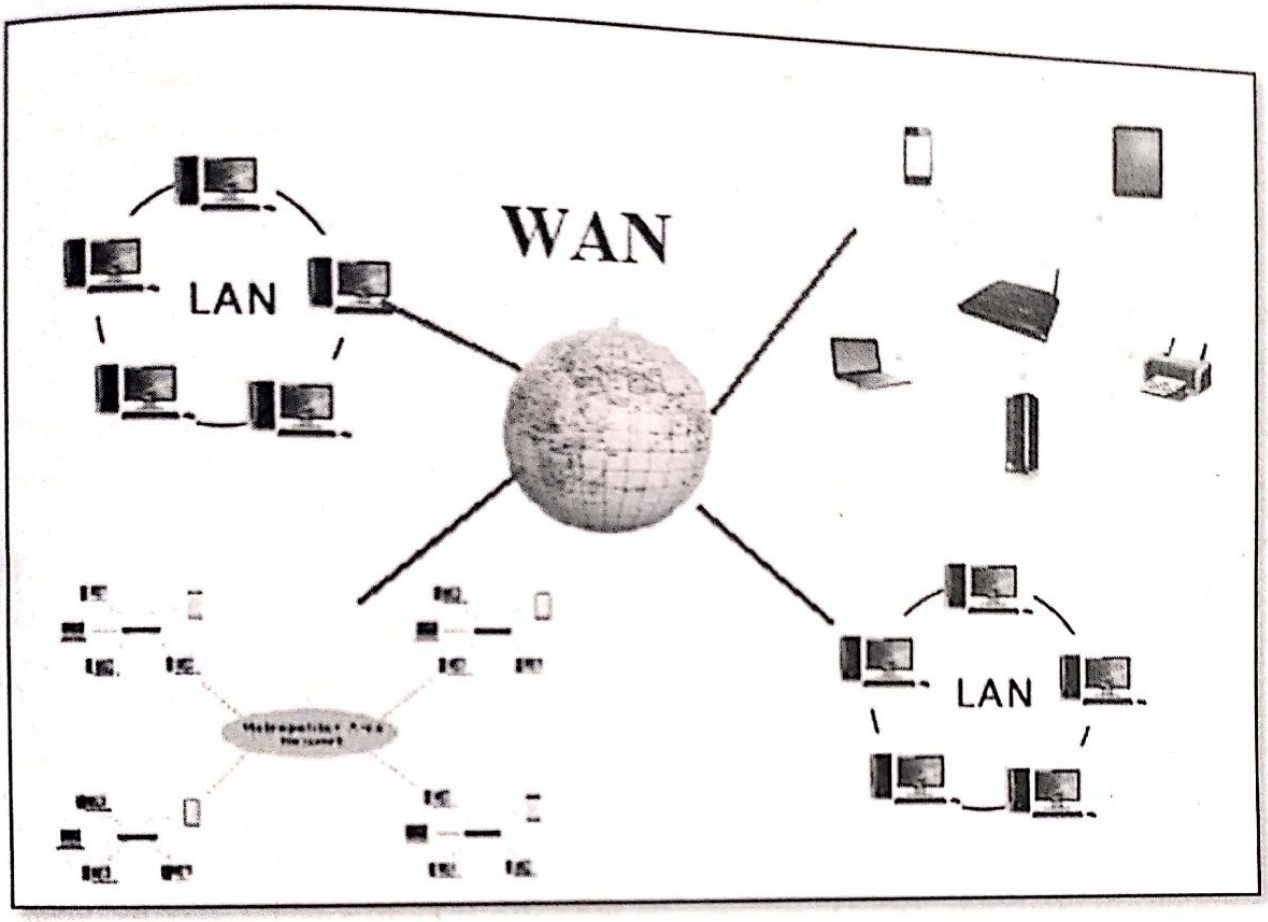

Figure 4.6 WAN

4.4.1 Difference between LAN and WAN:

LAN	WAN
LAN is owned by a person i.e privately owned.	It can be owned by private or public.
LAN Operates over small physical area.	MAN Operates over large physical area covering large distance across countries.
Easy to design and maintain LAN.	It's difficult to design and maintain WAN.
LAN uses coaxial cables for data transmission.	WAN uses satellite links for data transmission.
Propagation delay is low in LAN.	Propagation delay is high in WAN.
Data rate in LAN is high.	Data rate in WAN is low.
In LAN Broadcasting technique is used.	In WAN Switching technique is used.

4.5 Ethernet:

Ethernet is widely used networking technology for LANs. Ethernet is described as IEEE 802.3 standard. Ethernet LAN can be defined as a combination of computers and cables to communicate over network. Ethernet was used on Bus Topology networks in the early days of networking. Ethernet was then later used on Star Topologies. Ethernet operates in two layers of OSI model, the lower half of the data link layer, known as the MAC sublayer and the physical layer. Ethernet uses frames. Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method is used in Ethernet. It supports speeds up to 100 Gbps. Ethernet can use coaxial, twisted pair or fiber optic cables as a transmission medium. Ethernet uses Manchester Encoding Technique for converting data bits into signals. For Normal Ethernet, operational bandwidth is 10 Mbps. For Fast Ethernet, operational bandwidth is 100 Mbps. For Gigabit Ethernet, operational bandwidth is 1 Gbps.

4.5.1 ETHERNET STANDARDS:

- **10Base5:**

  10Base5 ethernet standard is also known as thick net or thick Ethernet. A segment of the original 10Base5 cable can be long up to 500m.

- **10Base2:**

  10Base2 ethernet standard is also known as thin-net, thinwire Ethernet or thin Ethernet. In this standard "10" means the network operates at 10 Mbps, "Base" refers to the fact that the cable is used in a base band system and the "2" means that a given segment can not be longer than 200m.

- **10BaseT:**

  10BaseT is also known as twisted pair Ethernet. In this standard The "T" stands for twisted pair. A 10BaseT segment length is limited to less than 100m.

Advantages of Using Ethernet:

- Ethernet is simple to understand and implement.
- Ethernet is cheap and its Maintenance is easy.

4.5.2 Limitations of Using Ethernet-

- Ethernet can not be used for real time applications. Because Real time applications require the delivery of data within time limit. Also it can not be used for interactive applications. Because Interactive applications like chatting requires the delivery of even very small amount of data.
- Ethernet is not reliable because of high probability of collisions.
- High number of collisions may cause a delay in delivering the data to its destination.

- It can not be used for client server applications. Because this applications require that server must be given higher priority than clients. Ethernet has no facility to set priorities. **Token Ring** overcomes these limitations of Ethernet.

4.5.3 Collision Detection in CSMA/CD:

We all know that in a shared network, multiple nodes are transmitting data. So if all nodes are transmitting data at the same time when the other node is already sending data then the collision may occur. And your data will not transmit. So before transmitting data in a shared network, node first senses the transmission channel. That means node will check the transmission channel if it is free or not. If any other node is transmitting data then it will wait for the channel to get free. Node will not sense the whole transmission channel. For example if your transmission channel is 500m long then node will not check the whole channel. Suppose you want to go to opposite side of your house. So for this you need to check whether any vehicle is passing from your home to opposite side or not. You do not need to check the whole road for that.

So CSMA is useful to minimize the chance of collision. CSMA means "sense before transmit" or we can say that "listen before talk". It the carrier or channel is busy that means transmission is taking place. And node will wait for carrier or channel to get idle. The possibility of collision is still exists because of propagation delay. That means a node may sense the channel and fount as idle only because the first bit sent by another node has not been received.

CSMA/CD is the technique in which different nodes that follow this protocol agree on some terms and collision detection measures for effective transmission. This protocol decides which node will transmit data so that data reaches the destination without corruption.

4.5.4 Working of CSMA/CD:

- First it will check if the sender is ready for transmitting data packets.
- Then it will check if the transmission link is idle or not.
- The sender node has to keep on checking if the transmission link/medium is idle. For this it will continuously senses transmissions from other nodes. Sender will send dummy data on the link. If it does not receive any collision signal, this means the link is idle at the moment. If it senses that the carrier is free and there are no collisions, it sends the data. Otherwise it will not send the data and wait for transmission channel to get free.
- Then node will transmit the data & check for collisions.
- Sender node will transmit its data on the link. CSMA/CD method does not use 'acknowledgement' system. It will check for the successful and unsuccessful transmissions through collision signals. During the data transmission, if collision signal is received by the node, transmission is stopped. The station then transmits a jam signal onto the link and waits for random time interval before it resends the

frame. After some random time, it will again attempt to transfer the data and repeat above process.

- If no collision was detected in propagation, the sender completes its frame transmission and resets the counters once the data is transmitted.

4.6 Introduction to VLAN, Fast and Gigabit Ethernet:

4.6.1 Virtual LANs (VLANs):

Computers in networks are connected in any of network like local area networks (LANs) or wide area networks (WANs). For that various network devices such as switches, hubs, bridges, workstations and servers are connected to each other in the same network at a specific location are generally known as LANs. A LAN network is also considered a broadcast domain. While VLAN allows several networks to work virtually as one LAN. VLAN saves network resources and increases network efficiency. VLANs are also created to provide security, network management and scalability. By using VLAN Traffic patterns can be controlled easily.

The virtual area network is a LAN configured not by physical wiring like conventional LAN but it is configured by software. In VLAN total stations are divided in logical groups instead of physical segments. It is possible to move one station from one group to any other group without changing the physical configuration. Because membership of a group is defined by software not by hardware. VLAN is very useful for a company having two separate buildings. There are various characteristics used to group various stations in a LAN like port number, MAC address and IP address. VLANs help to improve the overall performance of a network by grouping together devices that communicate most frequently. VLANs provide security on larger networks. Because VLANs having a higher degree of control over which devices have access to each other. VLANs are flexible because they are based on logical connections, rather than physical connection.

Advantages of VLAN

- Reduction in cost.
- Saving of time required for rewiring. No need to change physical configuration.
- Provides additional security. The message broadcast in one group can not be listened by members of other group.

Drawbacks of VLAN

- VLAN is having high risk of virus issues because one infected system may spread a virus through the whole logical network.
- VLAN is not used for very large networks because additional routers might be needed to control the workload.

- VLAN is more effective at controlling latency than a WAN, but it is less efficient than a LAN

4.6.2 FAST AND GIGABIT ETHERNET:

Fast Ethernet	Gigabit Ethernet
It is the successor of 10 Base T Ethernet.	It is the successor of Fast Ethernet.
Its configuration is simple.	Its configuration is complicated.
It provides speed up to 100 Mbps speed.	It provides speed up to 1 Gbps.
It can cover up to 10 km range.	It can cover up to 70km.
Delay is more in Fast Ethernet.	Delay is less in Gigabit Ethernet.
It is having 100 to 500 bit times round trip delay.	It is having 4000 bit times round trip delay.

4.7 Token Ring:

Token ring was developed in the early 1980s by IBM for a local area network for LAN. In a Token Ring network all hosts are connected in a ring topology. The token, an empty frame is continuously circulated on the ring. The empty token has only three fields. The token is like a taxi, moving on loop. If a workstation doesn't having anything to transmit, then it passes the token. It workstation is having something to transmit, then it catches the token and attaches data and sends it to the ring.

Let's say suppose workstation A has a message to send to workstation B. It catches the passing token and attaches its data. Now empty token is having data. The token is released to the ring and then examined by each successive workstation. When the data frame reaches the destination, workstation B copies the frame and release token to the network. Frame status provides acknowledgement that the message has been delivered successfully. When the token gets back to the sender workstation A removes the message from token and release empty token to the network. The token becomes available again and ready to take message. In Token Ring network, the media access method is called token passing. When a workstation wants to transmit data, it should hold the token until it is done. If any other hosts want to send data, then they should wait.

In compare to Ethernet, Token ring is having some better features such as Token passing access method won't cause collisions as Ethernet CSMA/CD will cause. Token Ring allows for larger frame size than Ethernet. One drawback of Token ring is that it is more expensive.

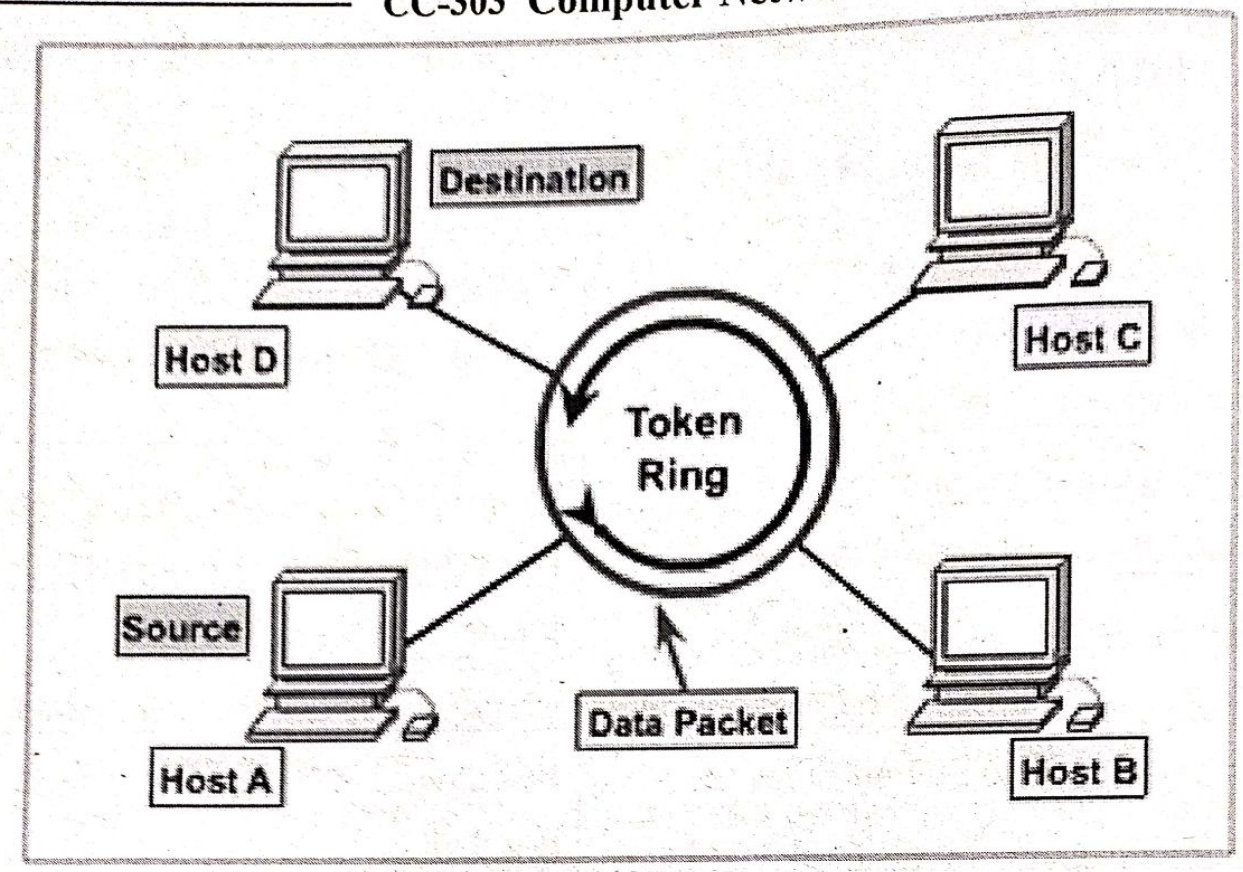

Figure 4.7 Token Ring

4.8 FDDI:

FDDI is a set of ANSI and ISO standards for transmission of data in local area network (LAN) over fiber optic cables. It is applicable in large LANs that can extend up to 200 kilometers in diameter. It uses ring based token passing mechanism and is derived from IEEE 802.4 token bus standard. FDDI contains two token rings, a primary ring for data and token transmission and a secondary ring that provides backup if the primary ring fails.

4.8.1 Features of FDDI:

- Optical fiber is used as physical medium in FDDI.
- It operates in the physical and medium access control (MAC) layer of the OSI model.
- It provides high data rate of 100 Mbps and can support thousands of users.
- It is used in LANs for long distance voice and multimedia communication up to 200 kilometers.
- FDDI technology is also be used as a backbone for a Wide Area Network (WLAN).

4.8.2 FDDI Access Method:

- The FDDI is based on the token ring.
- There are two token rings in FDDI network, one for possible backup in case the primary ring fails.

- In FDDI, any station wants to transmit information holds the token and then transmits the information.
- When it finishes it release the token in the ring.
- The time at which station holds the token is called as Synchronous Allocation Time (SAT).
- SAT time varies for each station.
- The allocation of SAT time to each station is achieved by Station Management (SMT).
- Ring Control, Ring Initialization, Station Insertion and Station Removal are the functions of SMT.

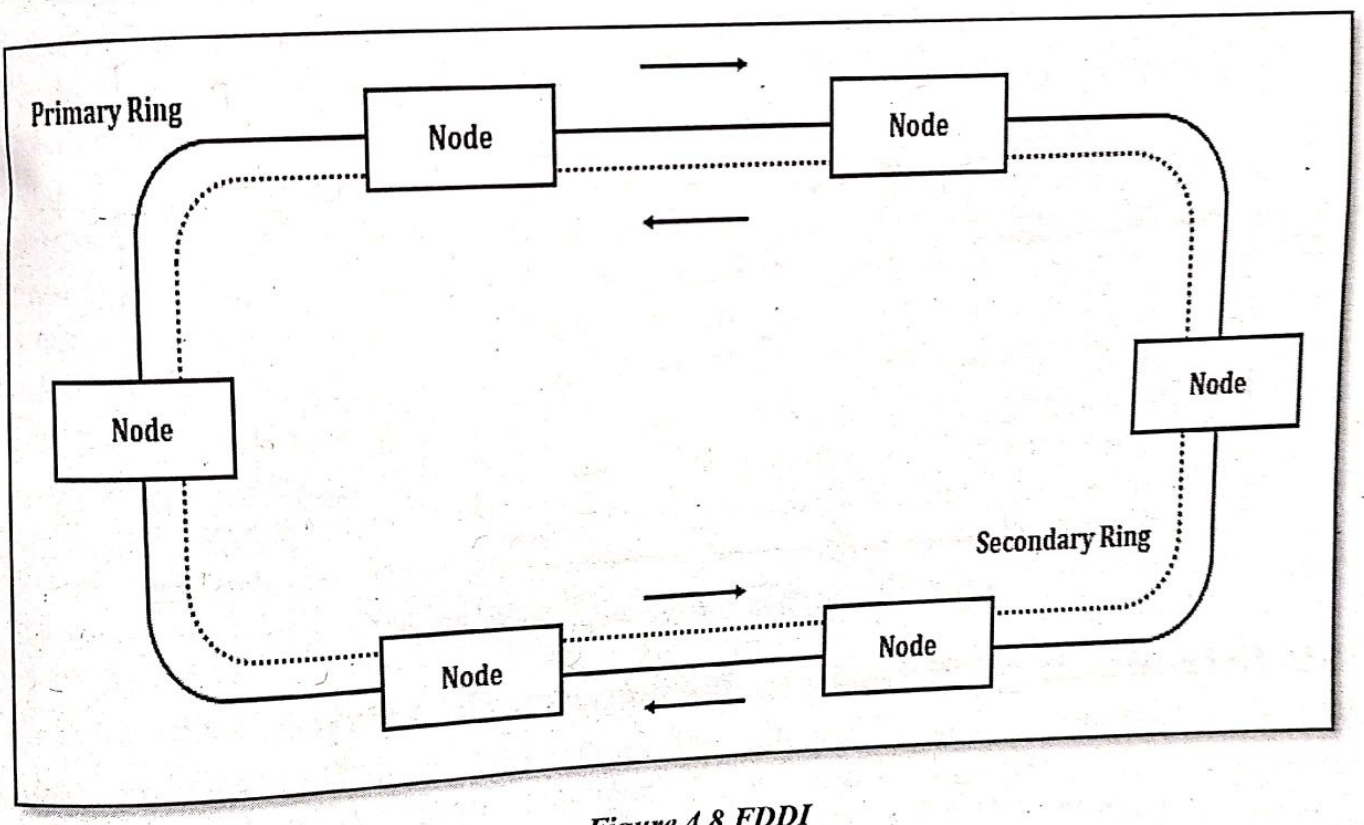

Figure 4.8 FDDI

4.8.3 Self-healing Mechanism:

The second ring of FDDI network is useful for self-healing mechanism. In FDDI when due to host is down or network error occurs then NIC can not communicate with its neighboring hosts. In this situation second ring is useful for NIC as a backup ring. So for failure of host or a network in FDDI network, second ring is used as a back up ring for data transmission. This is called loopback mechanism. So whenever first ring fails in FDDI network, the second ring is used to create a closed loop. This second ring bypasses the failed host to create a new closed loop between all other hosts using loopback mechanism till the fault ring will be repaired

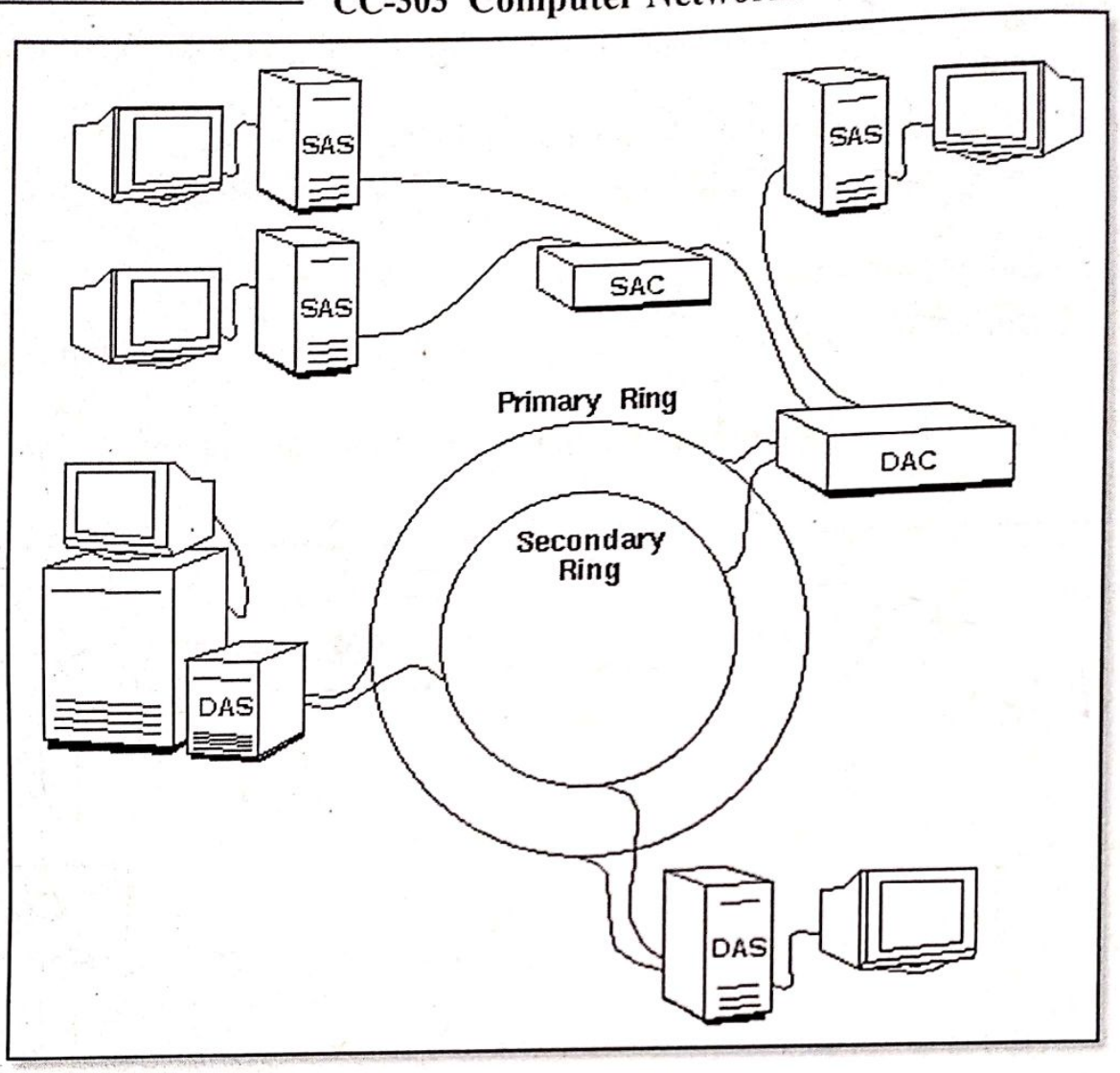

Figure 4.9 Self healing mechanisms in FDDI

4.9 Introducing Wide-Area Networks (WANs):

WANs are the network that provides long distance transmission of data, voice, image and video over large geographical area. WAN connects computers in different cities and countries. Example of WAN is internet, which connects lots of LANs together to make WAN.

On smaller scale may have WAN, because it connects different headquarters to its multiple offices. For connections Routers or multifunction devices are used to connect LANs to make WANs. A WAN is data communication network that operates beyond the geographical scope of LAN.WAN is useful for sharing information or resources to remote site. WAN networks are useful for the services such as telephone companies, cable companies, satellite systems, and network providers.

In WAN we only see path whatever sender and receiver may present at same location. For example sending message through whatsapp. It's not necessary that for a WAN there is internet. For example ATM, GPS.

4.10 Integrated Services Digital Network (ISDN):

Not long time ago, the old plain telephone service i.e traditional PSTN was analog. So in that from customer premises to central office there was a local loop, and from central office/ local exchange to the backbone of the network. PSTN was simply designed for analog telephone calls. With the invention of personal computers, digital data transmission was needed. For voice calls everything remained the same. Modems were developed for computers to allow digital exchange over existing analog PSTN network. Digital signals are modulated to analog signals and transmitted over the PSTN network. Only at the receiving end, analog signals are de-modulated back to original digital signals. But analog signals have many disadvantages compared with digital signals. Over the long distance, analog signals cannot maintain high quality. Analog signals carry less information per second than digital signals. In terms of data rate services and support Analog signals are not as flexible as digital signals. For these reasons ISDN was introduced.

ISDN is a set of international communication standards designed in 1980s and improved in 1990s. It is a digital network to transmit voice, image, video and text over the existing circuit switched PSTN telephone network. A circuit switched telephone network system is called ISDN, but it also uses packet switched networks for digital transmission of voice and data. This provides better quality of data or voice than analog phone.

ISDN was implemented to improve the dial-up connection. ISDN is considered as the evolution of internet that lies between dial-up and DSL/Cable. Now a days, we all are using high speed internet at home, for that ISDN became the standard by which all broadband internet service providers competed. ISDN internet services like the dial-up connection are still exists, and is being replaced by broadband companies that provides faster and cheaper services.

4.10.1 ISDN Architecture and Channel type:

There are three types of channels in ISDN. Bearer (B) channel- that supports 64 Kbps data rates, Data (D) channel- that supports 16 to 64 Kbps data rates and Hybrid (H) channel- that supports 384, 1536 or 1920 Kbps data rates. User can obtain different data rates by combination of these channels.

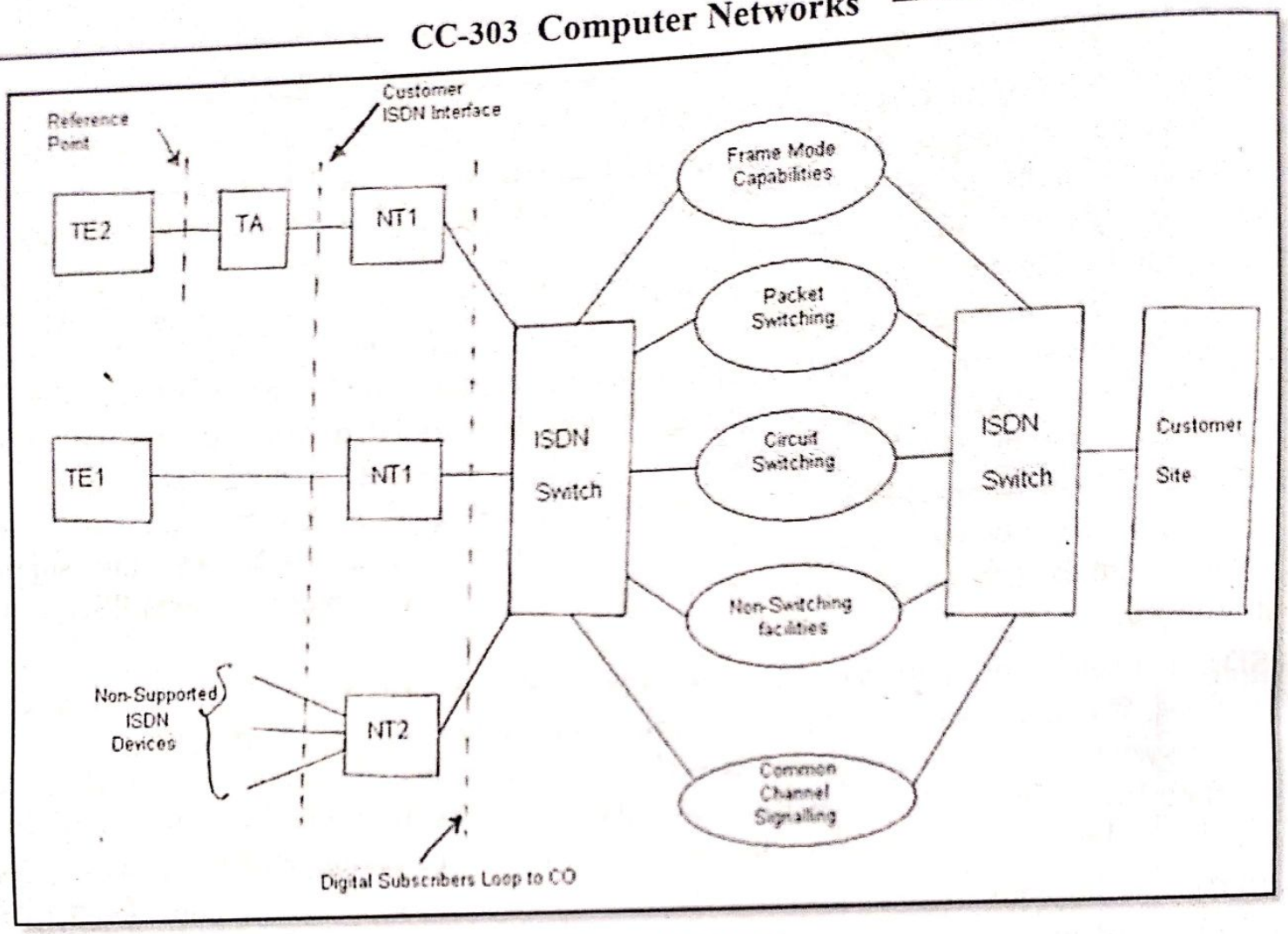

Figure 4.10 ISDN

As shown in figure 4.9 components like TE1, TE2, TA, NT1, NT2 are used in ISDN. TE1 (Terminal Equipment 1) is used as an interface between ISDN terminal and the network. TE2 (Terminal Equipment 2) is used as an interface between Non ISDN terminal and the network like old telephone. TA (Terminal Adapter) which allows interface between non ISDN devices and ISDN network.NT1 (Network Terminal 1) works as physical layer device and separates user premises and Phone Company. And NT2 (Network Terminal 2) will works as functions of OSI layer 2 to 3 works. PBX and LAN are considered as NT 2 device.

4.10.2 ISDN Interface:

ISDN provides single interface for connecting your telephone, fax machine and computers. In ISDN terminal adapter different types of devices such as an analog phone, a fax machine or a computer are connected. This converts different types of data into ISDN format so that they can share the same digital PSTN network.

There are two options for ISDN.BRI (Basic Rate Interface) and PRI (Primary Rate Interface). BRI uses two bearer channels and one 16 Kbps data channel. Bearer channel bears traffic from point to point. It uses circuit switching method to carry data. Each bearer channel can carry data at the rate 64 Kbps. Data channel might be confusing because data/D channel does not carry the real data, instead it carries information about

data and signaling information. Take a phone call as an example. In which data channel may carry information like session initiation and termination signals, caller ID etc. BRI is a common option for home users.PRI is commonly used by business and organization. This type of ISDN uses 23 bearer channels and one 64 Kbps data channel.

4.11 Bluetooth:

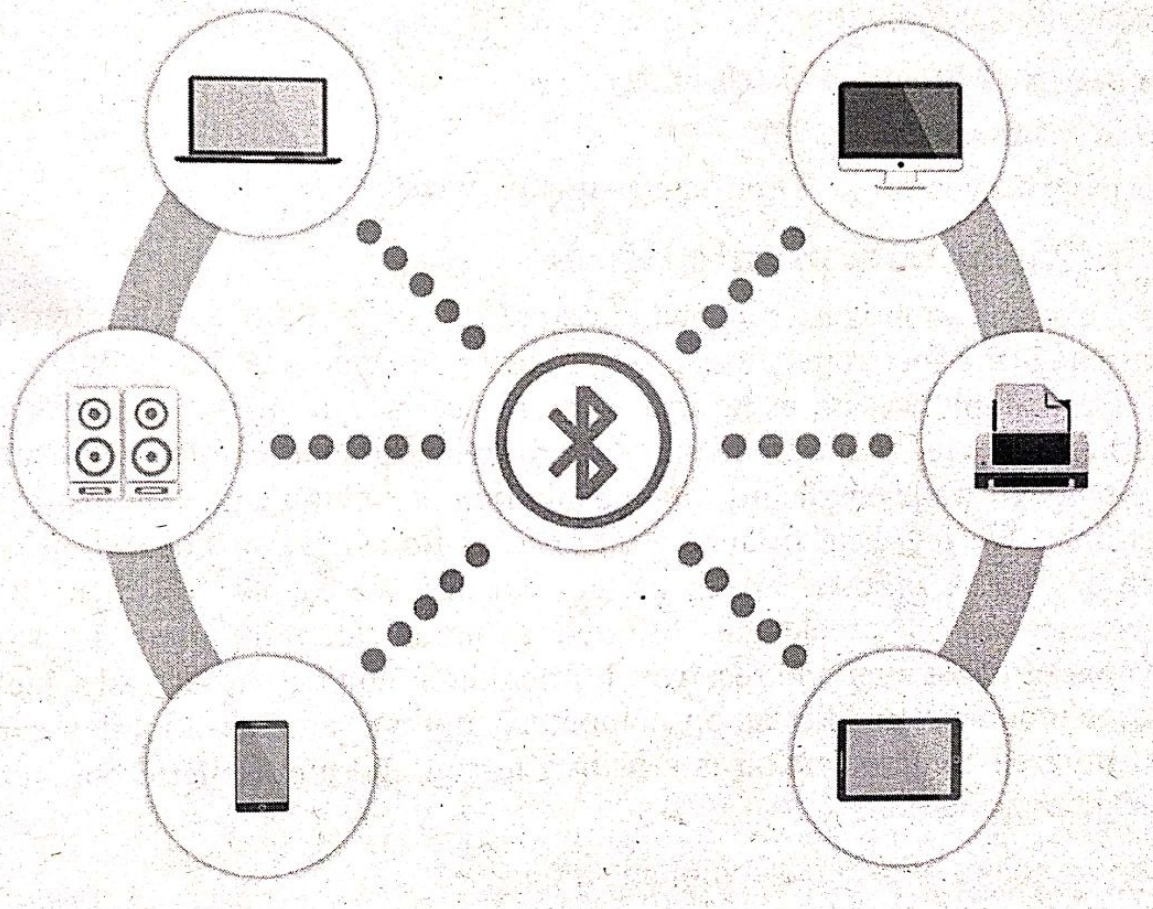

Figure 4.11 Bluetooth

Bluetooth is IEEE 802.15 standard. It is wireless technology based on mobile computing technology used to send or receive data to connected device. The data can be send or receive at a certain distance. It uses bandwidth of 2.4 to 2.485 GHz. The range of Bluetooth technology is less than 10 meter. But latest version of Bluetooth 5.0 can transfer data in a rage of 40-400 meters. Bluetooth can transmit data at 1 Mbps to 3 Mbps speed. We can connect maximum 7 devices through Bluetooth at the same time. Spread spectrum frequency hopping technique is used in Bluetooth. In which if two devices want to connect via Bluetooth, then they pick a channel randomly. If a channel is busy then it will select another channel. Devices shift the frequency continuously to reduce the risk of interference from other appliances. Piconet is formed when a group of two or more Bluetooth devices will share information. Scatternet is formed when two or more separate piconets will share information. Applications of Bluetooth are Bluetooth speakers, Bluetooth headphones, Bluetooth headsets, Wireless mouse and wireless keyboards.

Advantages of Bluetooth Technology

- Wireless technology.
- Very simple to form a piconet.
- Cheap technology.
- Robust.
- Low energy consumption.

Disadvantages of Bluetooth Technology

- Low in Bandwidth.
- Data transmission range is constant as it is very less.

4.12 Infrared communication:

Infrared communication is used for wireless communication. In which infrared waves of the electromagnetic spectrum is used. We are using infrared communication in our day to day life for example we are using it in cars, in audio equipments, in remote control of television etc. Infrared is the frequency of light which is not visible to human eyes. It is having a range of wavelengths just like visible light is having wavelengths from red light to violet light. We feel heat from sunlight, fire or from radiator because infrared waves are thermal. Shorter infrared waves are not hot and we cannot feel them. TV remotes waves are shorter in wavelength. Infrared communication requires a transceiver i.e combination of transmitter and receiver. Infrared communication is most widely used for wireless communication like laptop computers, digital cameras, mobiles and all other devices. Infrared communication is sensitive to fog and atmospheric conditions due to line of sight transmission.

There are two types of infrared communication:-

Point to Point:- In which a line of sight is required between transmitter and receiver. So in this type of infrared communication transmitter and receiver are pointed to each other without any obstacles. For example remote control communication.

Diffuse Point:- In which a line of sight is not required between transmitter and receiver. In thid type of infrared communication transmitter and receiver are maintained by reflecting surfaces such as roof, ceiling etc. For example wireless communication.

Advantages of Infrared communication:

- Since it is having short range of communication it is secure for transmission.
- It is cheap transmission medium.
- Other electric device can not interfered with infrared transmission.

Disadvantages of Infrared communication:

- It is used only for short range communication.
- Infrared waves can not pass through obstacles like walls, buildings etc.

- Direct connection is needed as a Line of sight for good transmission quality and high data rates.

4.13 Introduction to Wireless LAN:

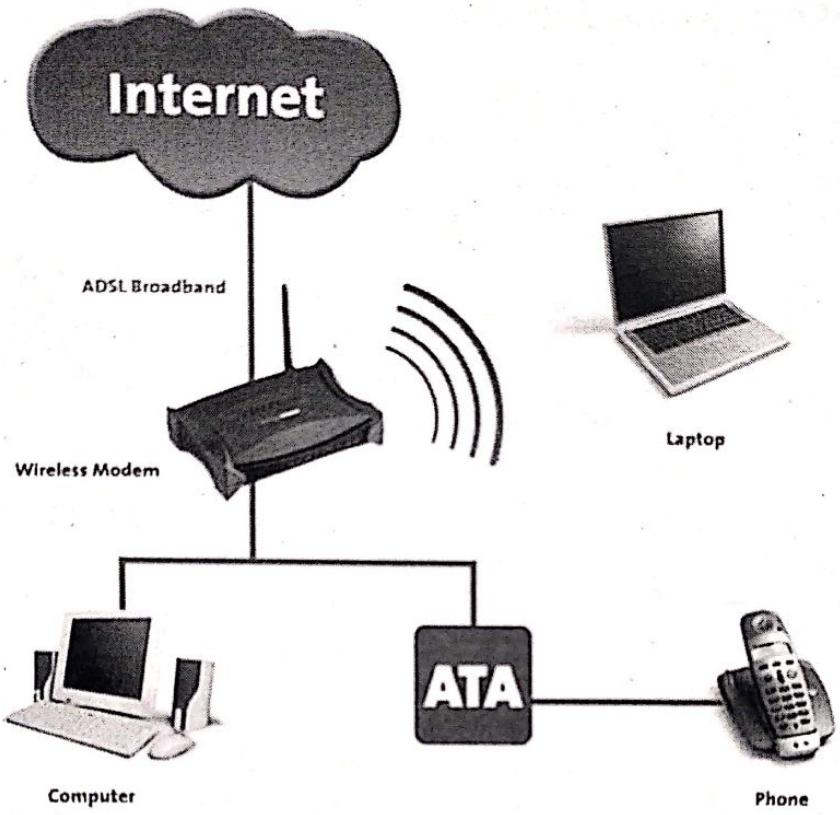

Figure 4.12 WLAN

WLAN is a wireless computer network connecting two or more devices using a wireless distribution method within a limited area such as in school or office building. IEEE 802.11 standard supports WLAN. WLAN provides network connectivity over wireless media. As shown in figure 4.11 Access Point (AP) is installed which act as bridge between wireless and wired network. The AP is connected to wired network with antenna to provide wireless connectivity. In WLAN mobile user is connected to a local area network through wireless connection. In WLAN users can move around in a certain area while connected to a network. There are two types of wireless networks: Ad Hoc networks in which all stations communicate directly; and another is Infrastructure networks in which all stations communicate through access points.

Advantages of Wireless LAN:

- By using WLAN devices can connect wirelessly so cables are not needed.
- Hundreds of devices can connected through WLAN.
- WLAN range can easily be extended by adding one or more repeaters.
- We can easily upgrade WLAN by replacing routers with new versions.

Disadvantages of Wireless LAN:-

- Security is less than Wired networks.
- WLAN networks may suffer from other signals interference

4.14 Internetworking Device:

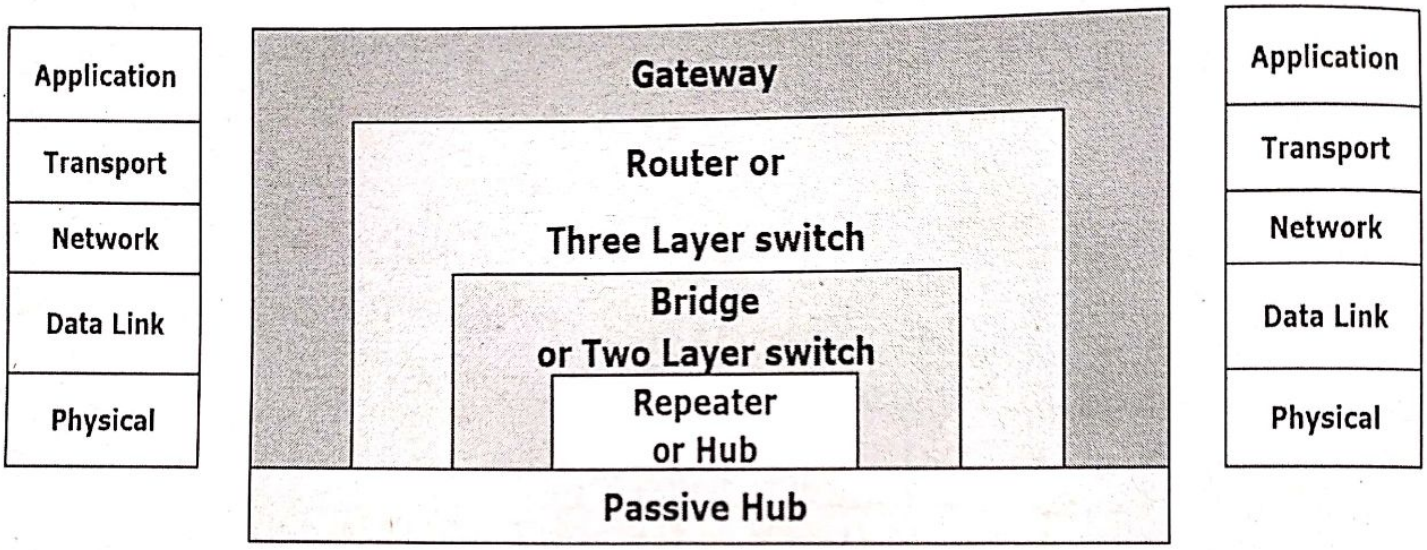

Figure 4.13 Connecting devices

Two or more devices are connected to each other for sharing data or resources from a network. The devices used for connecting different network resources in a network are called internetworking devices. There are many internetworking devices such as repeaters, routers, bridges, gateways etc.

4.14.1 Hub:

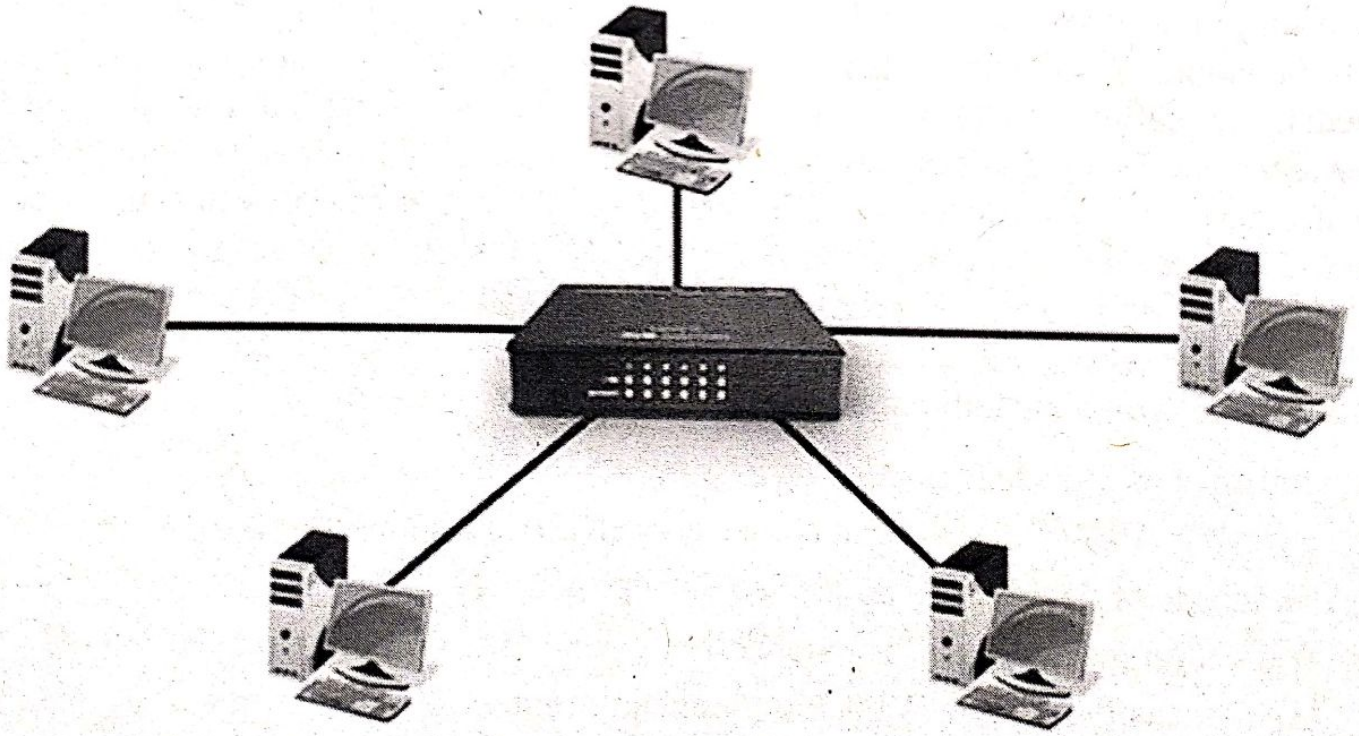

Figure 4.14 Hub

Hub is a repeater with multiport. It receives data from one port andsends the data to all the port. It is multiport repeater, as it connects multiple wires. Hub is not capable to filter data. So Hub will sent all data packets to all devices in a network. Hubs are not intelligent to find the best path for data packets. It operates at physical layer. All the workstations will send the packets of information to hub and hub will send all the information packets to all other workstations. Two types of Hub are Active Hub and Passive Hub. Active hub is also called as multiport repeaters. It will regenerate or amplify the signals before they are retransmitted. Passive hub is just a connecter. It will not amplify the signals, it will pass the signals without regenerating or amplification.

4.14.2 Repeater:

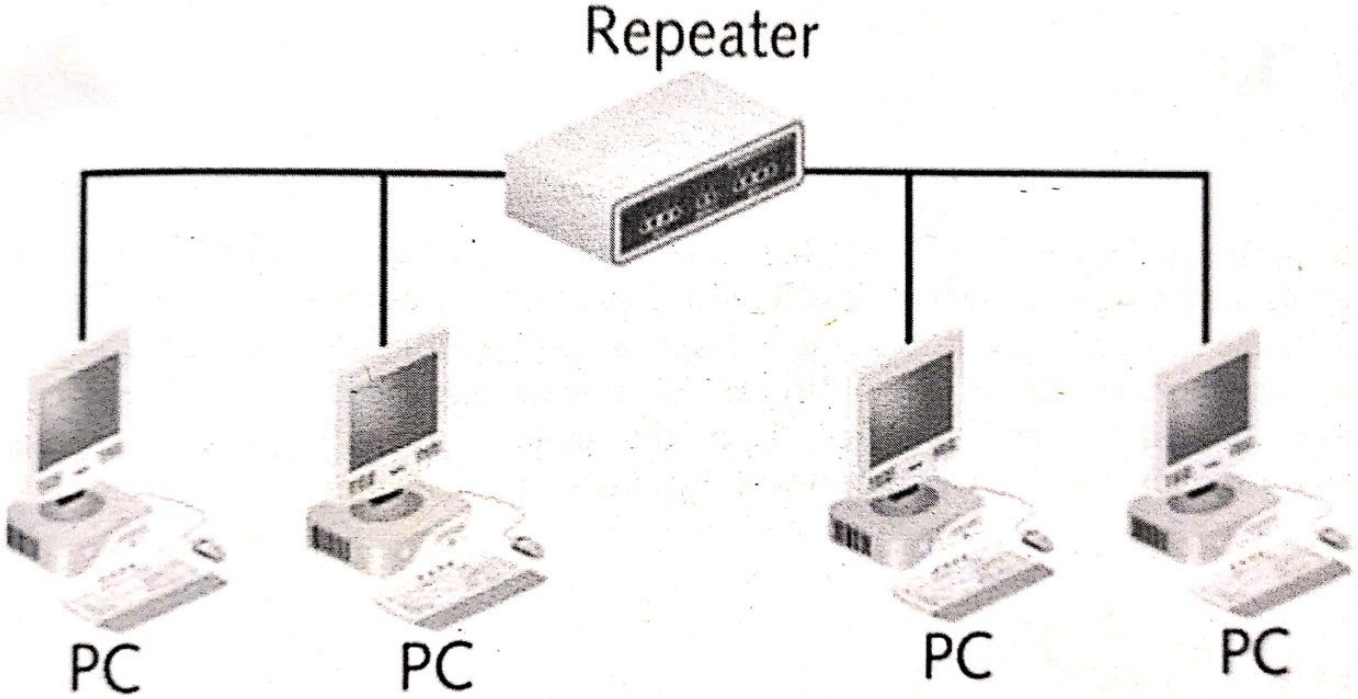

Figure 4.15 Repeater

It can be used to increase the length of the signal. It connects two segment of the same network. A repeater forwards every frame, as it doesn't have any filtering capability. Repeater is also called as generator, it is not an amplifier. It operates at physical layer. Repeater will regenerate the signal when signal becomes weak.

4.14.3 Switch:

Switch is a networking device when it receives data from the one of the connected device, it forwards the data only to the portion at which destination system is connected. It operates at Data Link Layer. It is more advanced than Hub. Switch is full duplex device. Most networks are use switches to connect to computer, printer and servers.

4.14.4 Bridge:

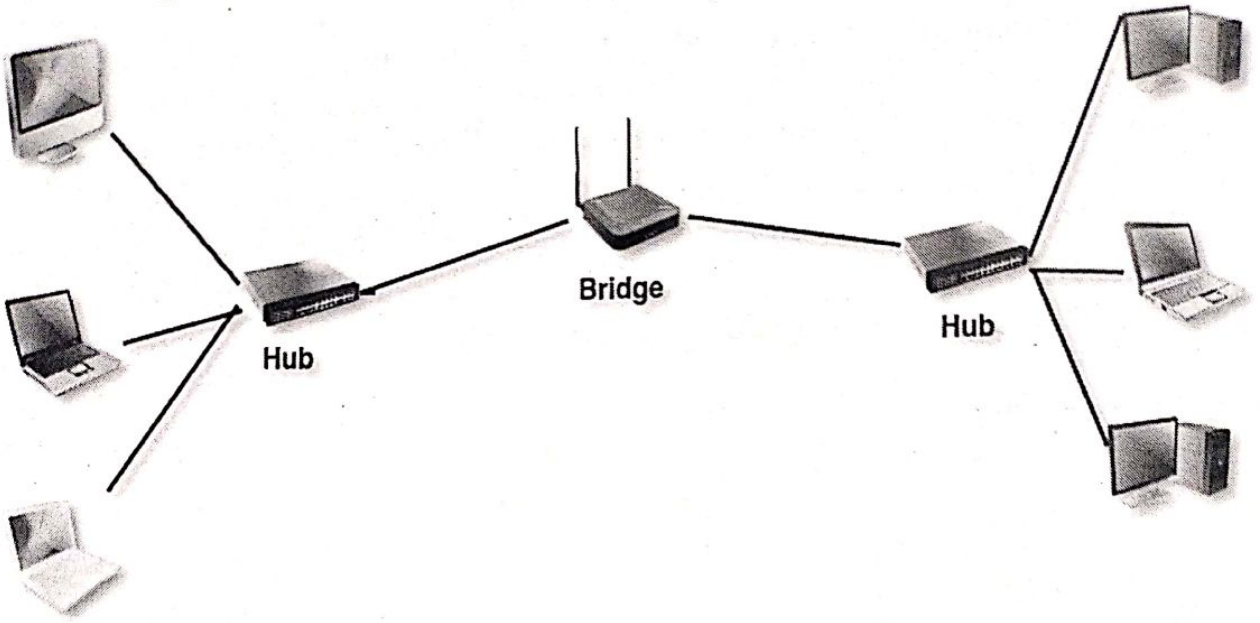

Figure 4.16 Bridge

It operates at Physical and Data link layer. As it operates at physical layer, it will regenerate the signal as soon as it will receive. As a device of data link layer, Bridge will check the MAC address of source and destination. A filtering decision table and a table that maps port address are used in Bridge. Routing table is used to record the segment no of address. If destination address is in the same segment as the source address, transmission is stopped, otherwise it will forwarded to other segment.

4.14.5 Routers:-

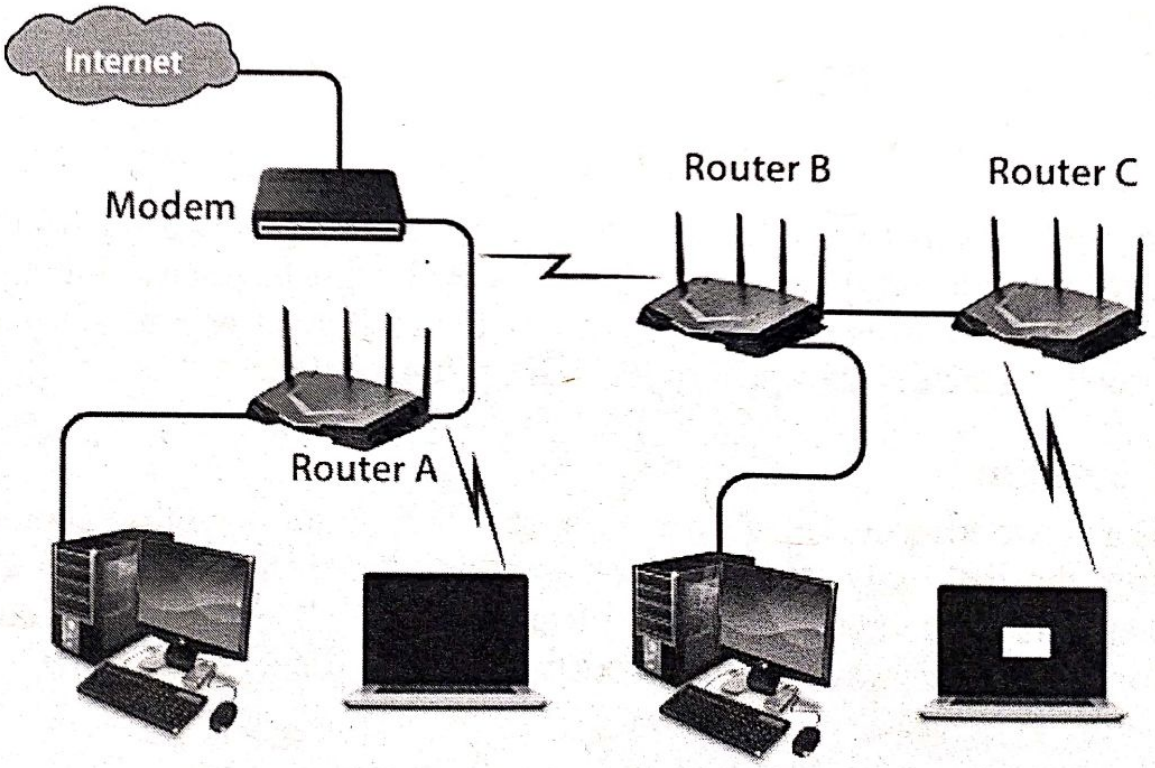

Figure 4.17 Routers

Router is an intelligent device which connects two or more networks. It will routes the packets based on their logical address i.e host to host address. Routers are used to connect LANs and WANs in the internet and having routing table for decision making of route. Routers are having software that allows router to move data from one network to another. Routers are operate at Network Layer. Routers are more expensive than switches and hubs.

4.14.6 Gateways:-

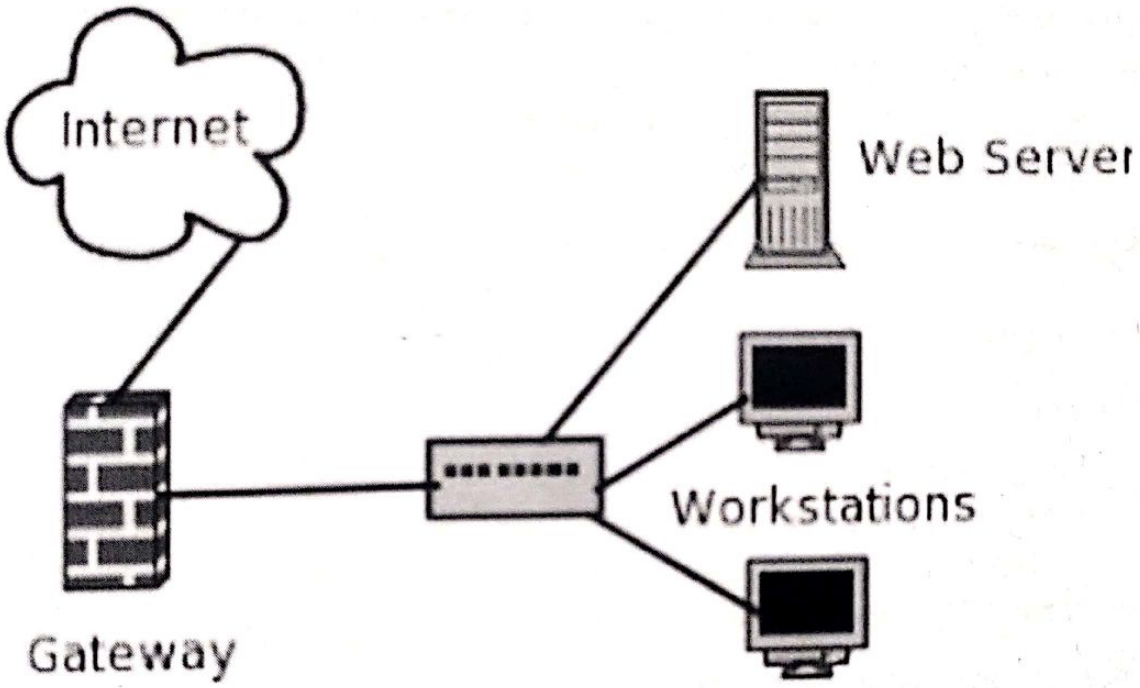

Figure 4.18

A gateway is a networking device that establishes an intelligent connection between a local network and external networks with completely different structures. It acts as a gate between two networks. Communication between two different networks is done using the same protocol in router. On the other hand A gateway is a network node that connects two networks using different protocols together. For example to translate different email protocols and to send email over internet Gateways are used. Gateway is also called protocol converter. Gateway operates at Application Layer.

☺ ☺ ☺ ☺ ☺

Exercises

1. Which of the following condition is used to transmit two packets over a medium at the same time? _____

   A. Contention B. Collision
   C. Synchronous D. Asynchronous

2. Which of the following device is used to connect two systems, especially if the systems use different protocols? _____

   A. hub B. bridge
   C. gateway D. repeater

3. What protocol is used between E-Mail servers? _____

   A. FTP B. SMTP
   C. SNMP D. POP3

4. ISDN stands for _____

   A. Integrated Services Digital Network
   B. Integrated Services Discrete Network
   C. Integrated Services Digital Node
   D. None of Above

5. An interconnected collection of piconet is called _____

   A. Scatternet B. Micronet C. mininet D. multinet

6. Explain OSI model in detail.
7. Explain TCP/IP model in detail.
8. Explain collision detection technique in detail.

Answer:

1) Collision 2) gateway 3) SMTP
4) Integrated Services Digital Network 5) Scatternet

Short quotes and answer:

1. What is the full form of OSI?
2. Which layer is responsible for routing of data?
3. Which layer is responsible for error control?
4. Which protocol is used for run different Application level protocols?
5. Full form of TCP/IP model.
6. Which Network is use for Home network?

7. What is the full form of ISDN?

Answer:

1. Open System Interconnection
2. Network Layer
3. Transport Layer
4. Application Layer
5. Transmission Control Protocol and Internet Protocol
6. LAN
7. Integrated Service Digital Network.

True False:

1. Physical Layer is responsible for transmit binary data on channel.
2. TCP and UDP protocols are access by Transport layer in TCP/IP model.
3. MAN network is used to communicate around the world.
4. 802.3 is stands for Blue tooth connection.
5. CSMA/CD Technic is used for access Ethernet cable.
6. VLAN is used to create virtual networks in single network.
7. Full form of FDDI Fiber Data Destination Interface.
8. In ISDN D channel is used to send Data.
9. PRI is used for conference call.
10. In Blue tooth device that control other devices is called as a passive hub.
11. In wireless network Access point is responsible to manage whole network.
12. Bridge is connecting between two different networks.

Answer:

1. True	2. True	3. False	4. False	5. True	6. True
7. False	8. False	9. True	10. False	11. True	12. True

Self-Test Examination

1. FDDI used which type of physical topology?
   A) Bus B) Ring C) Star D) Tree
2. FTP stands for-
   A) File transfer protocol B) File transmission protocol
   C) Form transfer protocol D) Form transmission protocol
3. Which of the following are the network services?
   A) File service B) Print service
   C) Database service D) All of the above
4. FDDI stands for
   A) Fiber Distributed Data Interface B) Fiber Data Distributed Interface
   C) Fiber Dual Distributed Interface D) Fiber Distributed Data Interface
5. Which is the main function of transport layer?
   A) Node to node delivery B) End to end delivery
   C) Synchronization D) Updating and maintaining routing tables
6. The name of the protocol which provides virtual terminal in TCP/IP model is-
   A) Telnet B) SMTP C) HTTP D) PPP
7. The layer one of the OSI model is _____
   A) Physical layer B) Link layer C) Router layer D) Broadcast layer
8. Which of the following TCP/IP protocols is used for transferring files form one machine to another.
   A) FTP B) SNMP C) SMTP D) RPC
9. The data unit in the TCP/IP layer called a _____
   A) Message B) Segment C) Datagram D) Frame
10. DNS can obtain the _____ of host if its domain name is known and vice versa.
    A) Station address B) IP address C) Port address D) Checksum
11. A communication device that combines transmissions from several I/O devices into one line is a -
    A) Concentrator B) Modifier C) Multiplexer D) Full duplex file
12. Which layers of the OSI determines the interface often system with the user?
    A) Network B) Application C) Data link D) Session

13. In which OSI layers does the FDDI protocol operate?
A) Physical B) Data link C) Network D) A and B

14. In FDDI, data normally travel on _____
A) The primary ring B) The Secondary ring
C) Both rings D) Neither ring

15. Which of the following is the logical topology?
A) Bus B) Tree C) Star D) Both A and B

16. Which of the following is not the layer of TCP/IP protocol?
A) Application Layer B) Session Layer
C) Transport Layer D) Internetwork layer

17. _____ was the first step in the evolution of Ethernet from a coaxial cable bus to hub managed, twisted pair network.
A) Star LAN B) Ring LAN C) Mesh LAN D) All of the above

18. _____ is the predominant form of Fast Ethernet, and runs over two pairs of category 5 or above cable.
A) 100 BASE-T B) 100 BASE-TX
C) 100 BASE-T4 D) 100 BASE-T2

19. _____ is a high performance fiber optic token ring LAN running at 100 Mbps over distances upto 1000 stations connected.
A) FDDI B) FDDT C) FDDR D) FOTR

20. _____ is another kind of fiber optic network with an active star for switching.
A) S/NET B) SW/NET C) NET/SW D) FS/NET

21. Which of the following is not a mechanism that DHCP supports for IP address allocation?
A) Automatic allocation B) Static allocation
C) Dynamic allocation D) Manual allocation

22. Computer Network is
A) Collection of hardware components and computers
B) Interconnected by communication channels
C) Sharing of resources and information
D) All of the Above

23. Protocols are?
A) Agreements on how communication components and DTE's are to communicate
B) Logical communication channels for transferring data
C) Physical communication channels sued for transferring data
D) None of above

24. What is a Firewall in Computer Network?
A) The physical boundary of Network
B) An operating System of Computer Network
C) A system designed to prevent unauthorized access
D) A web browsing Software

25. Each IP packet must contain
A) Only Source address
B) Only Destination address
C) Source and Destination address
D) Source or Destination addres

26. What is the minimum header size of an IP packet?
A) 16 bytes
B) 10 bytes
C) 20 bytes
D) 32 bytes

27. Routing tables of a router keeps track of
A) MAC Address Assignments
B) Port Assignments to network devices
C) Distribute IP address to network devices
D) Routes to use for forwarding data to its destination

28. Which of the following is not the possible ways of data exchange?
A) Simplex
B) Multiplex
C) Half-duplex
D) Full-duplex

29. The management of data flow between computers or devices or between nodes in a network is called
A) Flow control
B) Data Control
C) Data Management
D) Flow Management

30. What does the port number in a TCP connection specify?
A) It specifies the communication process on the two end systems
B) It specifies the quality of the data & connection
C) It specify the size of data
D) All of the above

31. Repeater operates in which layer of the OSI model?
A) Physical layer
B) Data link layer
C) Network layer
D) Transport layer

32. Which of the following layer of OSI model also called end-to-end layer?
A) Presentation layer
B) Network layer
C) Session layer
D) Transport layer

33. Router operates in which layer of OSI Reference Model?
A) Layer 1 (Physical Layer)
B) Layer 3 (Network Layer)
C) Layer 4 (Transport Layer)
D) Layer 7 (Application Layer)

34. Bridge works in which layer of the OSI model?
A) Appliation layer
B) Transport layer
C) Network layer
D) Datalink layer

35. Why IP Protocol is considered as unreliable?
A) A packet may be lost
B) Packets may arrive out of order
C) Duplicate packets may be generated
D) All of the above

36. DHCP Server provides _____ to the client.
A) Protocol
B) IP Address
C) MAC Address
D) Network Address

37. What is the address size of IPv6 ?
A) 32 bit
B) 64 bit
C) 128 bit
D) 256 bit

38. What is the full form of RAID ?
A) Redundant Array of Independent Disks
B) Redundant Array of Important Disks
C) Random Access of Independent Disks
D) Random Access of Important Disks

39. What do you mean by broadcasting in Networking?
A) It means addressing a packet to all machine
B) It means addressing a packet to some machine
C) It means addressing a packet to a particular machine
D) It means addressing a packet to except a particular machine

40. What is the size of Source and Destination IP address in IP header?
A) 4 bits
B) 8 bits
C) 16 bits
D) 32 bits

41. A set of rules that govern all aspects of information communication is called
A) Server
B) Internet
C) Protocol
D) OSI Model

42. Controlling access to a network by analyzing the incoming and outgoing packets is called
A) IP Filtering
B) Data Filtering
C) Packet Filtering
D) Firewall Filtering

43. DHCP is the abbreviation of
A) Dynamic Host Control Protocol
B) Dynamic Host Configuration Protocol
C) Dynamic Hyper Control Protocol
D) Dynamic Hyper Configuration Protocol

44. What is the use of Bridge in Network?
A) to connect LANs
B) to separate LANs
C) to control Network Speed
D) All of the above

45. What is the meaning of Bandwidth in Network?
A) Transmission capacity of a communication channels
B) Connected Computers in the Network
C) Class of IP used in Network
D) None of Above

46. Which of the following is correct regarding Class B Address of IP address
A) Network bit – 14, Host bit – 16
B) Network bit – 16, Host bit – 14
C) Network bit – 18, Host bit – 16
D) Network bit – 12, Host bit – 14

47. _____ provides a connection-oriented reliable service for sending messages
A) TCP
B) IP
C) UDP
D) All of the above

48. What does Router do in a network?
A) Forwards a packet to all outgoing links
B) Forwards a packet to the next free outgoing link
C) Determines on which outing link a packet is to be forwarded
D) Forwards a packet to all outgoing links except the originated link

49. Which of the following is correct in CIDR?
A) Class A includes Class B network
B) There are only two networks
C) There are high & low class network
D) There is no concept of class A, B, C networks

50. Which of the following layer is not network support layer?
A) Transport Layer
B) Network Layers
C) Data link Layer
D) Physical Layer

☺ ☺ ☺ ☺ ☺

BCA Self test OMR Sheet

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Important Instructions

- *Darken one circle deeply for each question in the OMR Answer Sheet, as faintly darkened, half darkened circle might be rejected by the Optical Scanner.*

Wrong Marking	Correct Marking
✓ ✗ ● ◐ ▬	●

- *Use blue/black ball point pen to record the answer.*
- *Rough work must not be done on the answer sheet.*

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Answer of Online Examination Self-Test

1. B) Ring
2. A) File transfer protocol
3. D) All of the above
4. A) Fiber Distributed Data Interface
5. B) End to end delivery
6. A) Telnet
7. A) Physical layer
8. A) FTP
9. D) Frame
10. B) IP address
11. C) Multiplexer
12. B) Application
13. D) A and B
14. A) The primary ring
15. C) Star
16. B) Session Layer
17. A) Star LAN
18. B) 100 BASE-TX
19. A) FDDI
20. A) S/NET
21. B) Static allocation
22. D) All of the Above
23. B) Logical communication channels for transferring data
24. C) A system designed to prevent unauthorized access
25. C) Source and Destination address
26. C) 20 bytes
27. D)Routes to use for forwarding data to its destination
28. B) Multiplex
29. A) Flow control
30. A)It specifies the communication process on the two end systems
31. A) Physical layer
32. D) Transport layer
33. B) Layer 3 (Network Layer)
34. D) Datalink layer
35. D) All of the above
36. B) IP Address
37. C) 128 bit
38. A) Redundant Array of Independent Disks
39. A) It means addressing a packet to all machine
40. D) 32 bits
41. C) Protocol
42. C) Packet Filtering
43. B) Dynamic Host Configuration Protocol
44. A) to connect LANs
45. A) Transmission capacity of a communication channels
46. A) Network bit – 14, Host bit – 16
47. A) TCP
48. C) Determines on which outing link a packet is to be forwarded
49. D) There is no concept of class A, B, C networks
50. A) Transport Layer

Gujarat University

October-2019

B.C.A. Semester - V

CC-303 Computer Networks (NEW COURSE)

Time: 2.5 hrs. Marks: 70

Q1 (A) **Answer the Questions in detail**

a. Explain Data Communication and their Characteristics. 7

b. List the Different Types of Transmissions. Explain ASK and PSK in detail. 7

OR

a. Explain PCM in detail.

b. Explain Simplex, Half Duplex and Full Duplex communication.

Q1 (B) **Answers the following question (any 4)** 4

1. Define Term Frequency.
2. What is Protocol?
3. _____Modulation Technique is ignoring Amplitude and phase of Signal to convert the digital to analog signals.
4. _____Device is use to regenerate Digital signal.
5. FSK is highly affected by noise. (True/False).
6. Full form of QPSK.

Q2 (A) **Answer the Questions in detail**

a. Which protocol is use when window size is fixed for transferring data? Explain brief. 7

b. Explain Different categories of error. 7

OR

a. List the different types of Error Detection Method. Explain Parity Check Method with Example.

b. What is Multiplexing and Demultiplexing? Which are the different methods? Explain FDM in detail.

Q2 (B) **Answers the following question (any 4)** 4

1. _____is an intelligent Multiplexing Technique.
2. _____is a batter error detection method.
3. In single bit error there are more no of bits are changed. (True/False).
4. Full form of LRC. _____

5. _____multiplexing technic is used when transmission medium is Optical Fibre.
6. Attenuation is increases Strength in signal.(True/False)

Q3 (A) Answer the Questions in detail

a. List the Different types of Transmission medium Explain Coaxial and Fibre Optic in detail. 7

b. List the Different Types of Topology. Different Between Star and Mesh topology. 7

OR

a. List the different types of Switching Explain Packet and Message Switching.

b. Explain Cellular Telephone technique in detail.

Q3 (B) Answers the following question (Any 3) 3

1. In _____ communication signal are pass line of sight.
2. In fibre optic cable _____ technique is used to guide light source.
3. In Satellite communication _____ and _____ types of bands are use.
4. The process of handling a signal from one cell to another cell is called _____.
5. Ring Topology is control by central device. (True/False)

Q4 (A) Answer the Questions in detail

a. What is the use of CSMA/CD Explain in detail? 7

b. Difference between Bridge and Gateway. 7

OR

a. Explain IEE 802.15 and also Explain Piconet and Scatternet.

b. What is the full form of ISDN? Explain its Interfaces.

Q4 (B) Answers the following question (any 3) 3

1. Full form of OSI.
2. Full form of CDDI.
3. _____ Layer is responsible for data transfer in OSI and TCP/IP.
4. _____ device is used to connect Ethernet and Computer.
5. _____ Mechanism is used to manage a FDDI network while error occurs.

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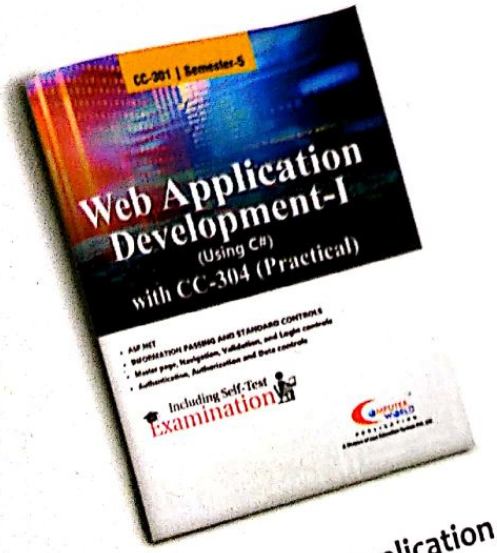

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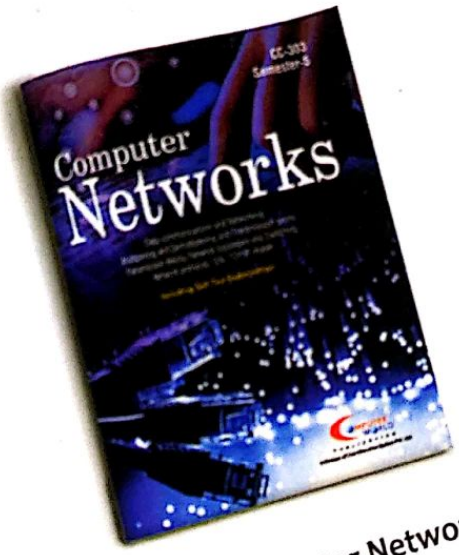
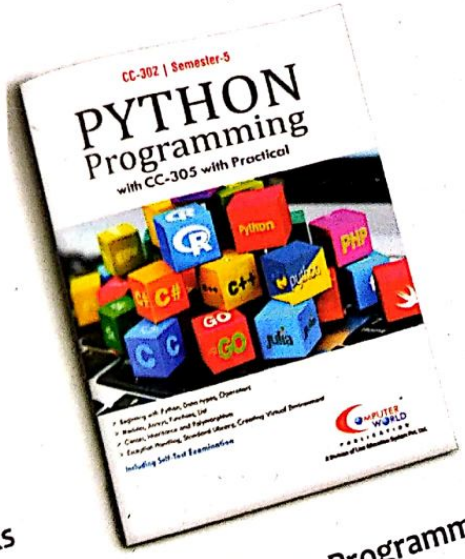


CC-303 Computer Networks



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