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.

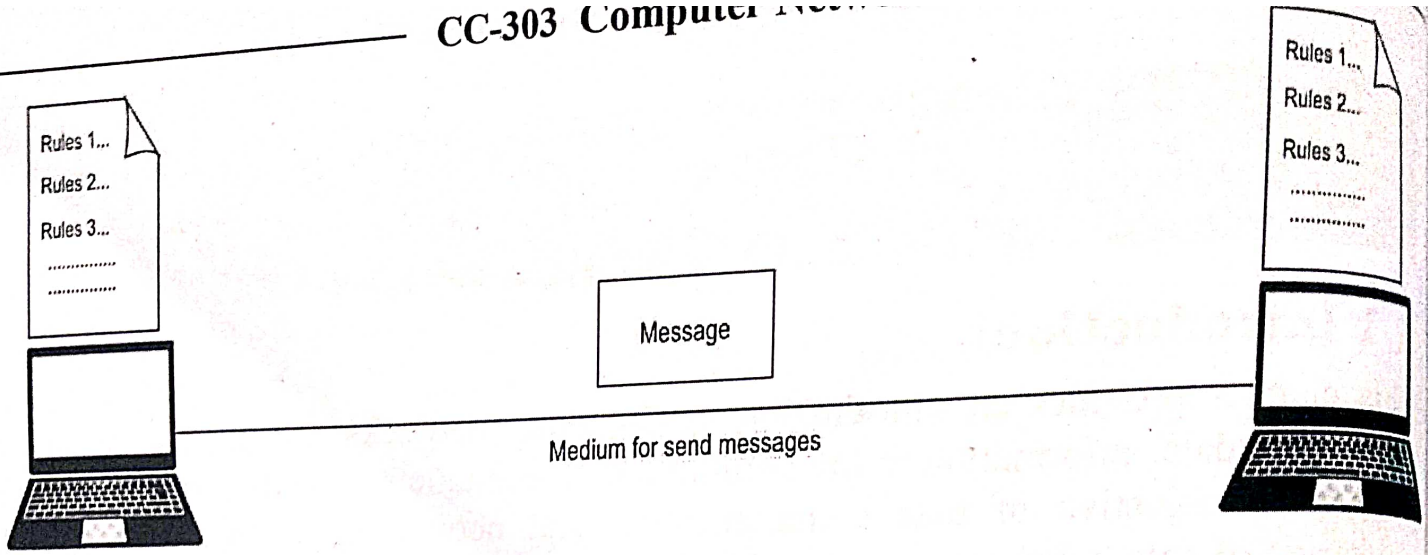


Figure 1.1 Data communication.

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

Delivery: The System must deliver data to the correct destination. Data must be receiv 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 i transmission and left uncorrected are rustles

Timeliness: The system must deliver data in a timely manner. Data delivered late a useless. In the case of video, audio, and voice data, timely delivery means delivering da as they are produced, in the same order that they are produced, and without significa 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 a define in protocols. For different types of communication there are different types protocols are design. These protocols are implementing on same types of communicatio medium, hardware and software which are used in network. For example if one perso can speak only French language then he cannot communicate with other persons in Othe Language. Same as, two devices must communicate with each other if it can follow an understand same protocols. It is also compulsory sending device and receiving devic both understand same protocols and ready to conversations. Then and only then sende 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.

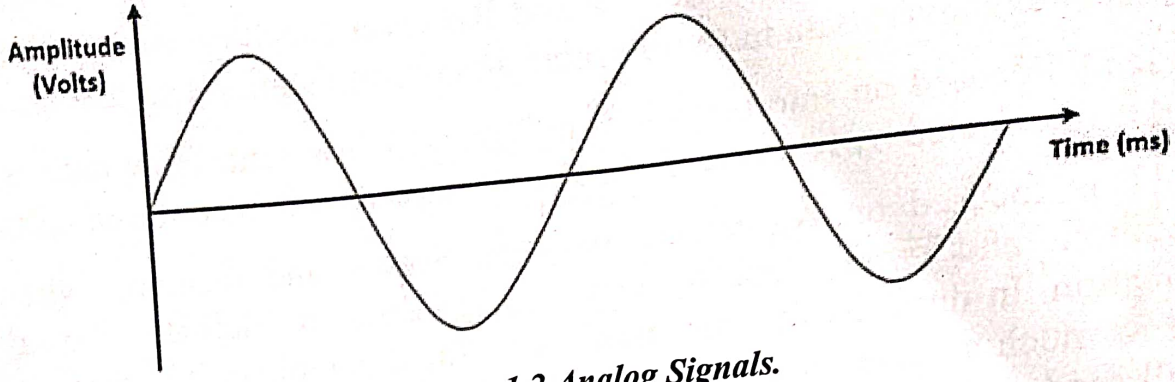


Figure 1.2 Analog Signals.

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.

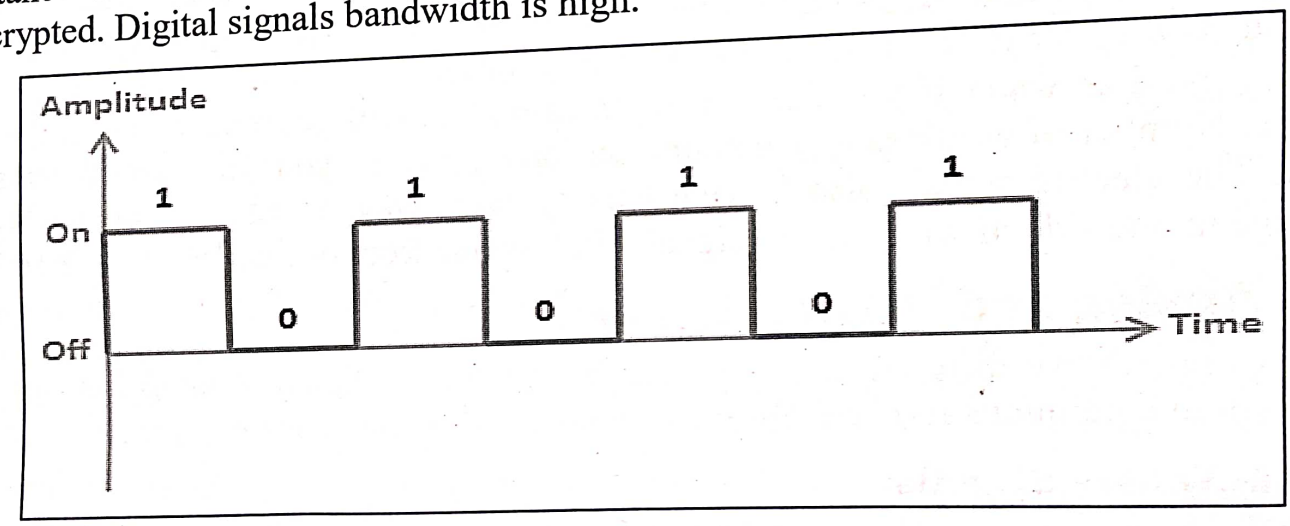


Figure 1.3 Digital Signals.

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.

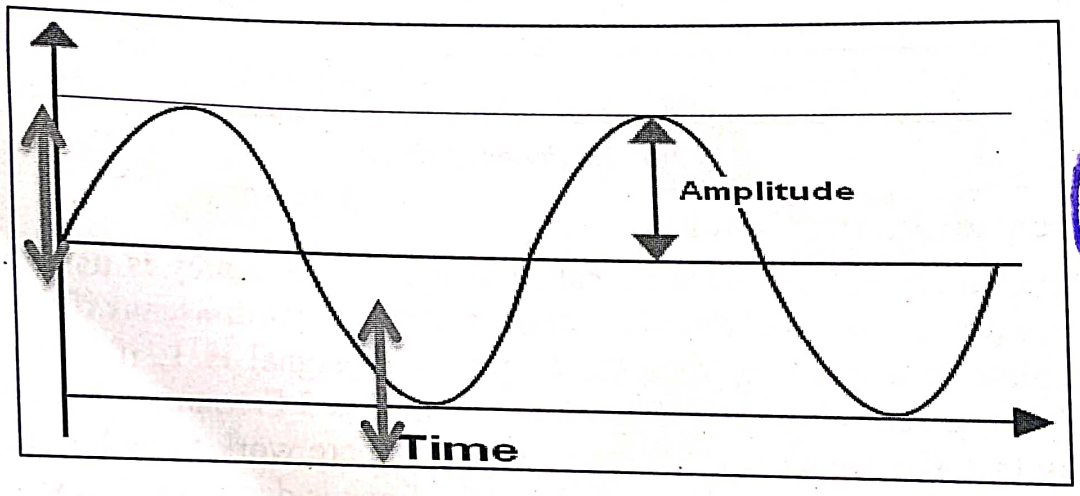


Figure 1.4 Amplitude of Signal.

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.

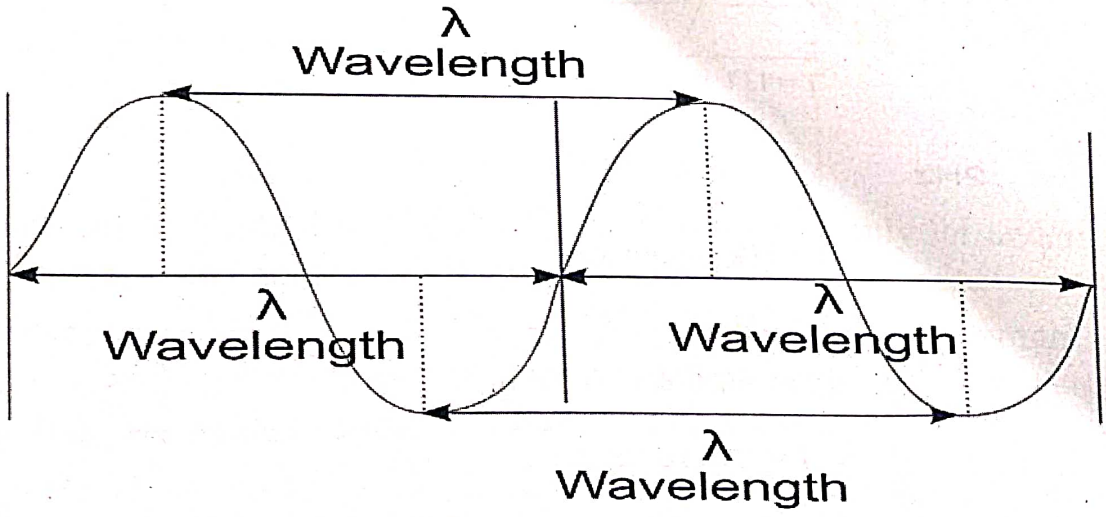


Figure 1.5 Wavelength of Signal.

1.6.4 Period of Signals:

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

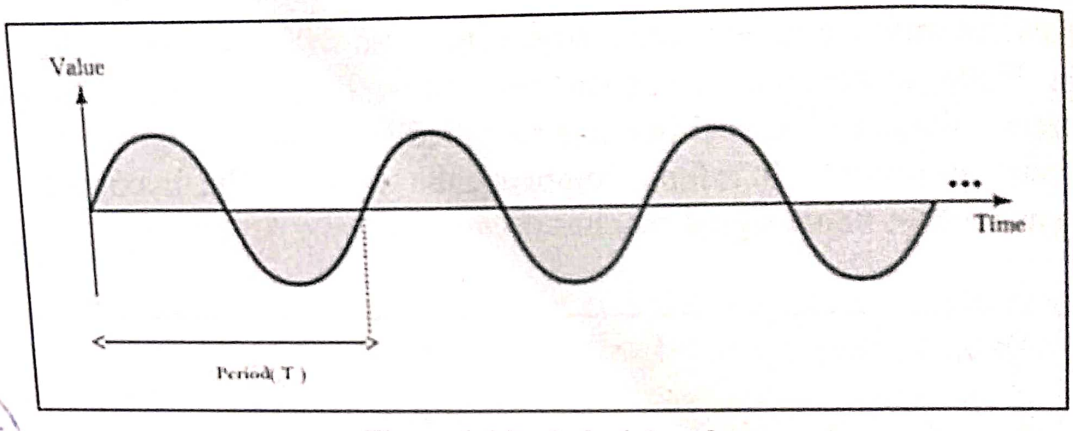


Figure 1.6 Period of signal.

1.6.5 Frequency of Signals:

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

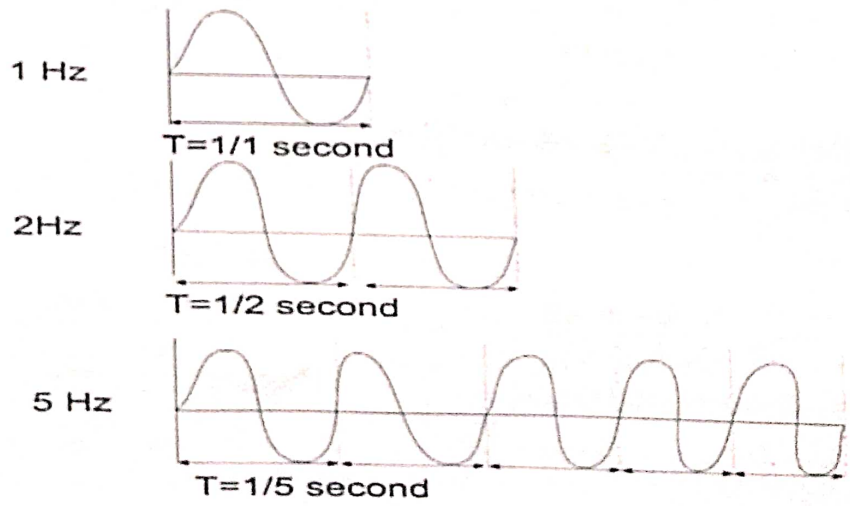


Figure 1.7 Frequency of Signal.

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.

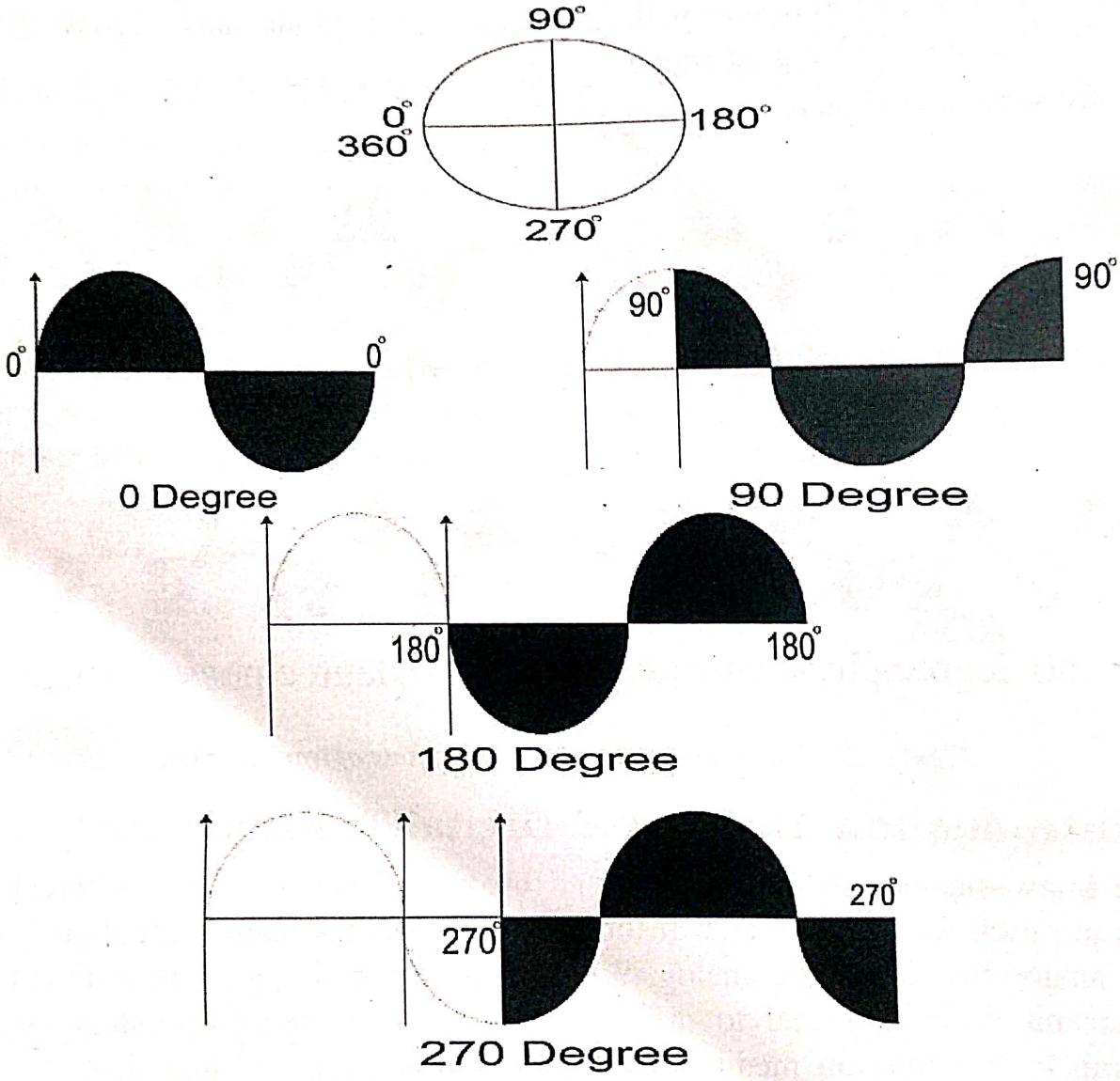


Figure 1.8 Phase of Signal.

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.

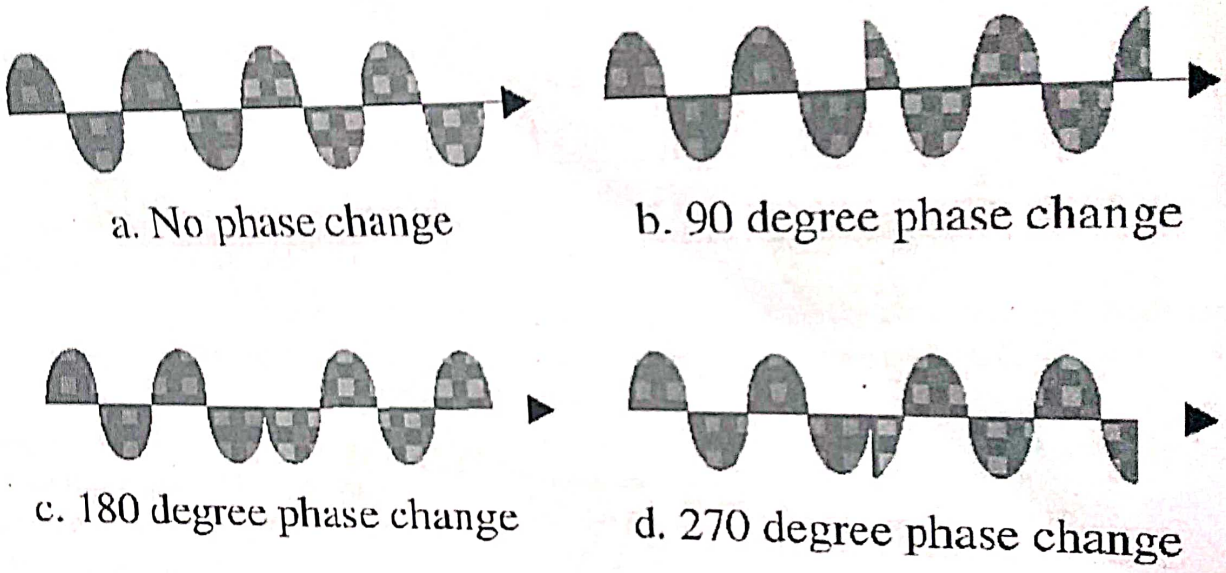


Figure 1.9 Changing in phase of Signal at time of transmission.

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.

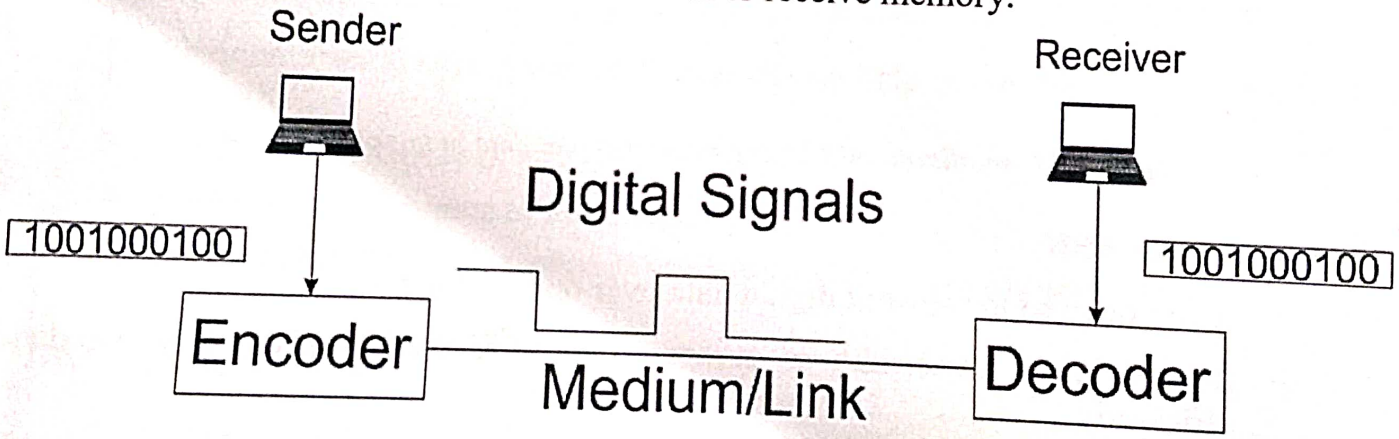


Figure 1.10 digital to digital transmissions.

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 signal 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 observe. Only amplitude is change Frequency and Phase remains constant. In this Amplitude is measure by 1 and 0 of digital bits. There are two different lines to mea and 0 in this technic. If signal is touch to the 0 or below the 0 line then the signal or off bit. If signal is touch to the 1 or above the 0 and 1 line the signal is high or on

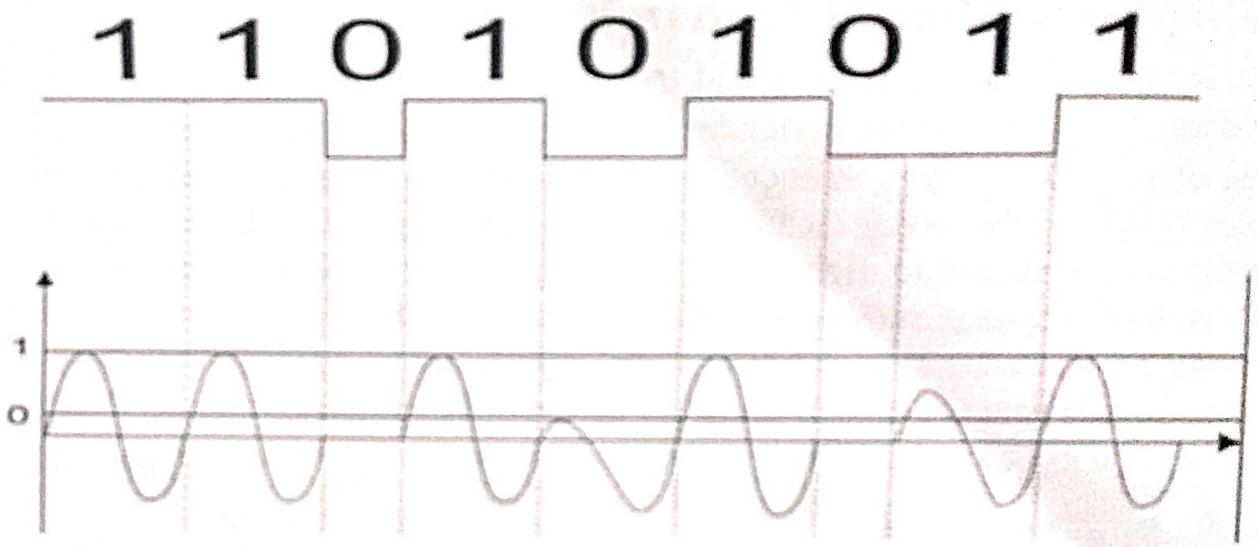


Figure 1.11 Amplitude shift keying convert digital data in to analog signals.

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 bandwi efficiency.

Disadvantages of ASK

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

1.10.2 Frequency Shift Keying (FSK):

In this technic Frequency only observe Amplitude and Phase remain Constant. Frequenc is varied to represent 1 and 0.There is two frequencies are used to f1 and f2.Frequancy 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.

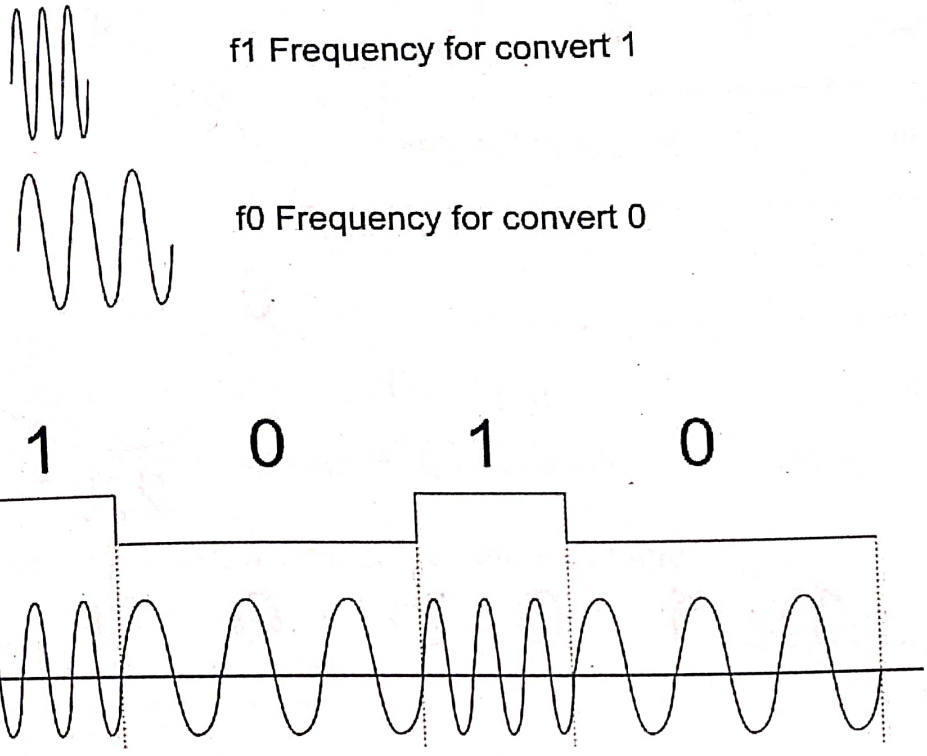


Figure 1.12 Frequency shift keying convert digital data in to analog signals.

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.

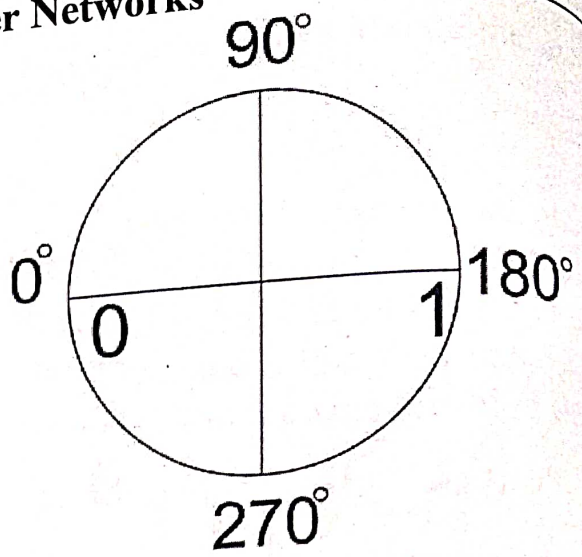
Disadvantages of FSK

- 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



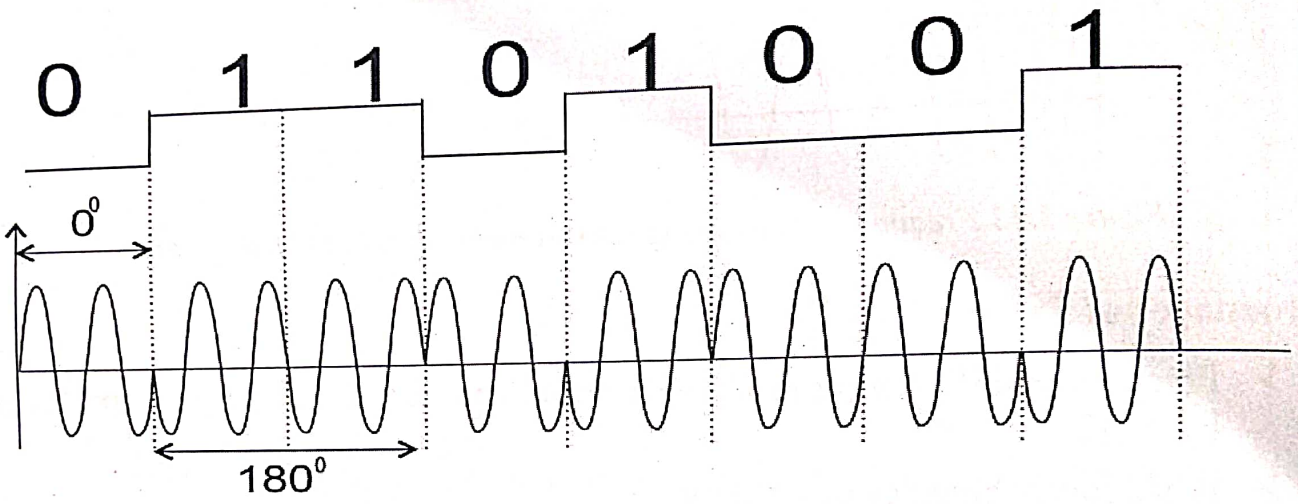
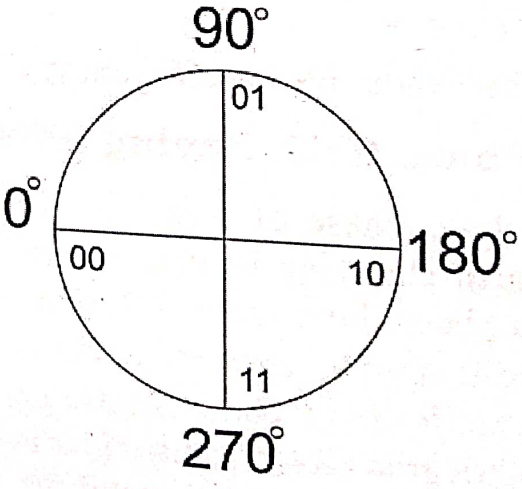


Figure 1.13 Phase shift keying convert digital data in to analog signals.

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



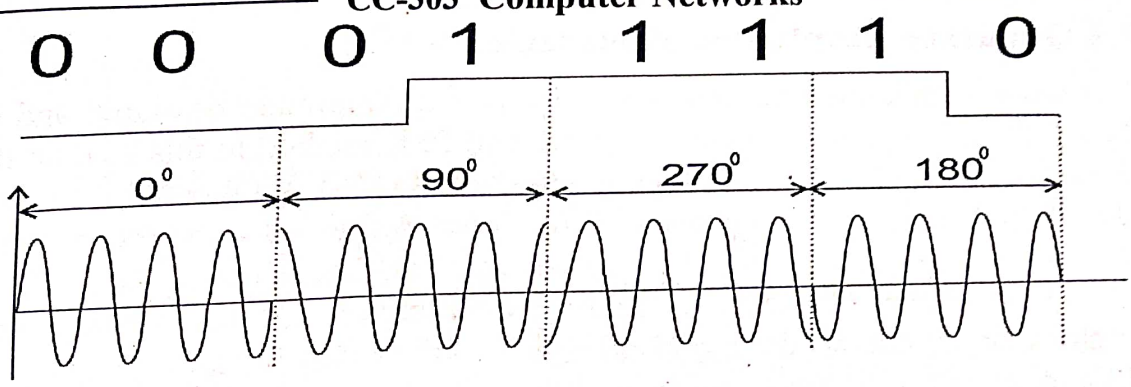


Figure 1.14 4-PSK convert digital data in to analog signals.

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

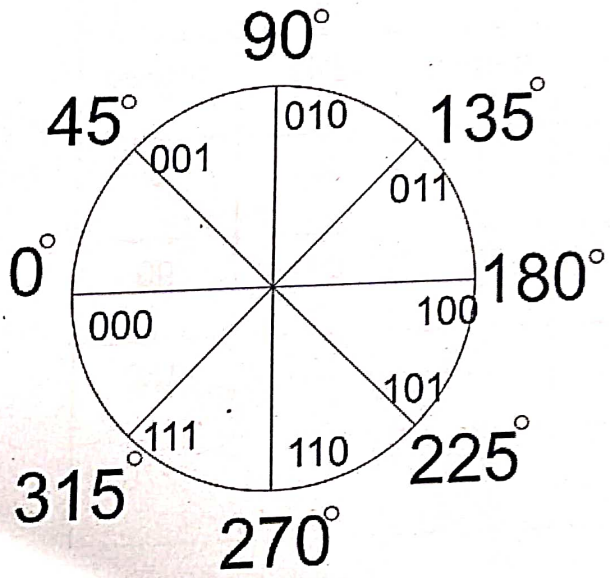


Figure 1.15 8-PSK table with angles of phase.

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.

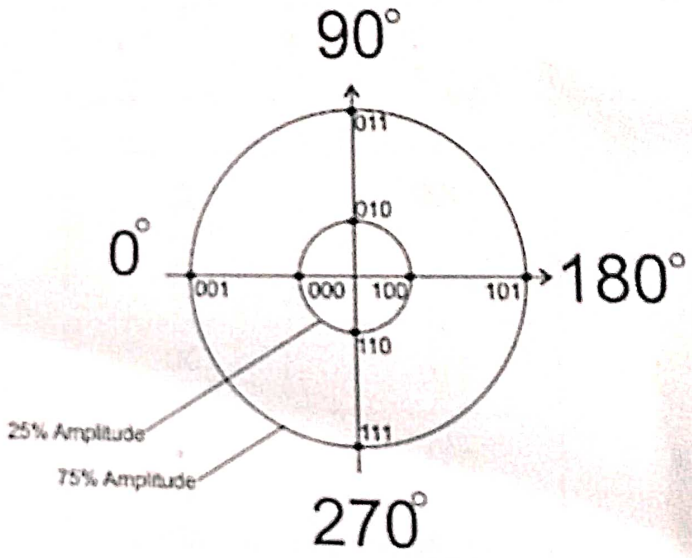
Disadvantage of PSK

- 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.

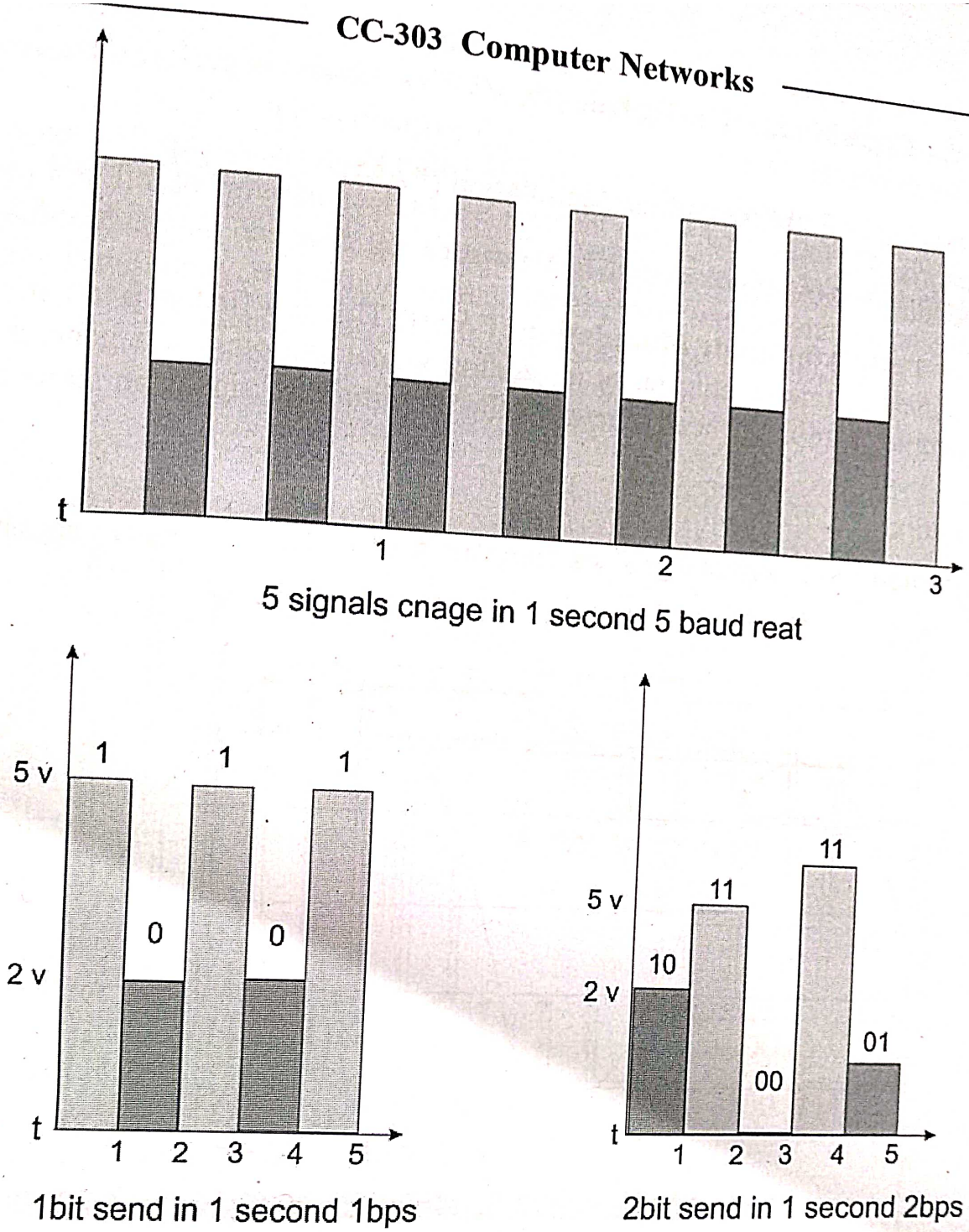


Figure 1.17 Baud Rate and Bit Rate.

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

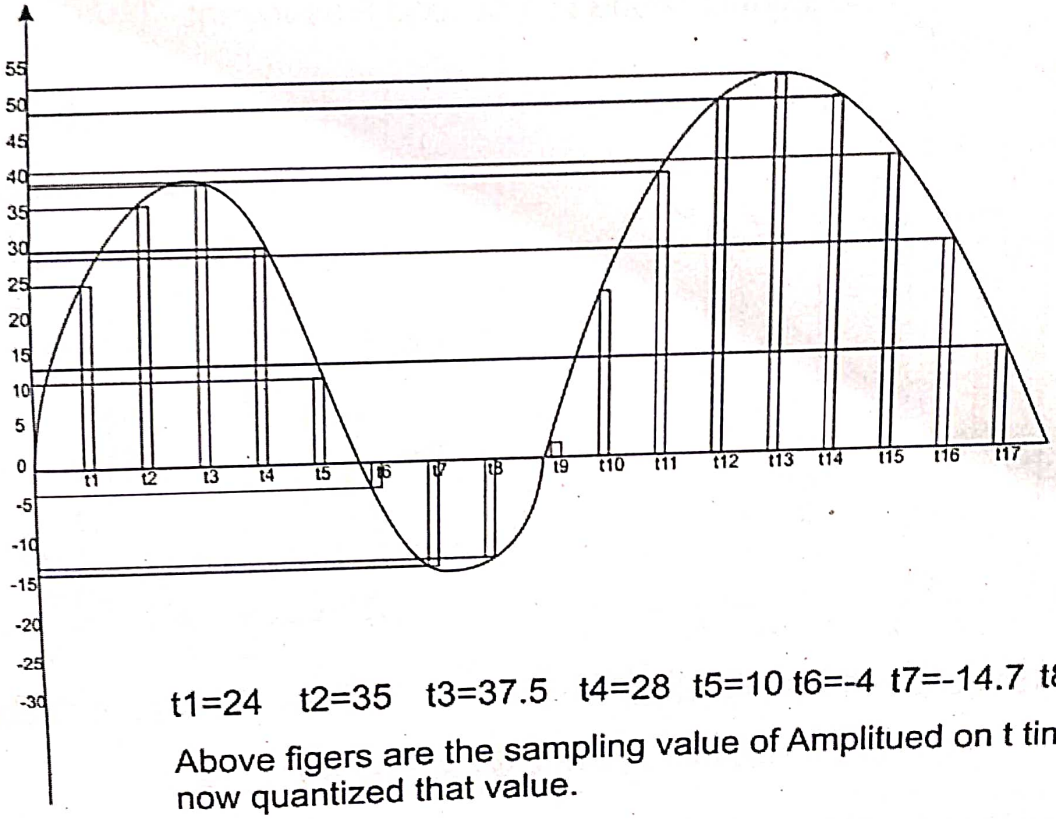
and it is Pulse Code Modulation Technic (PCM).This technic is perform major 3 steps convert anlog to digital signals.

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.

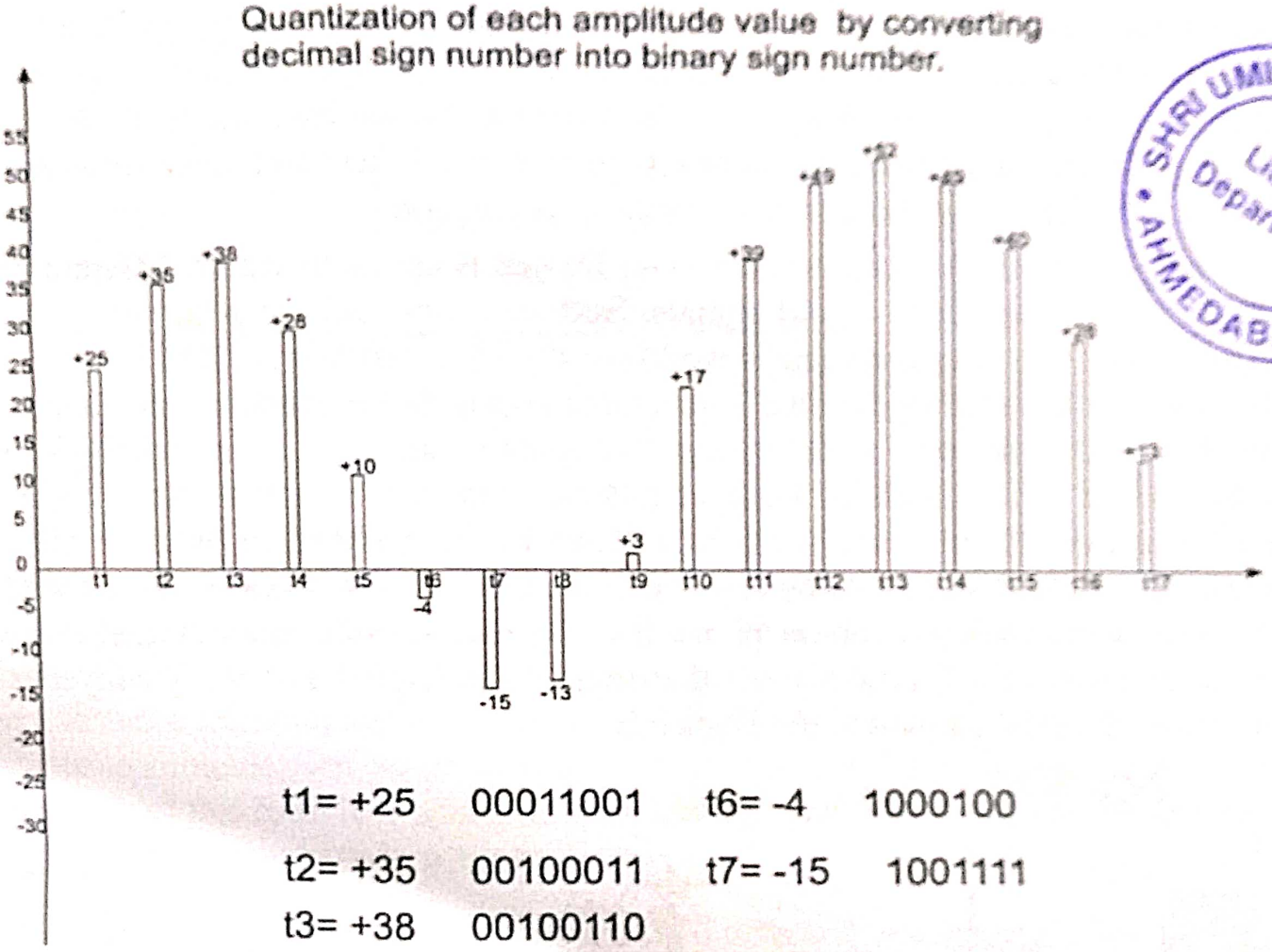


Figure 1.19 PCM quantization of amplitude value.

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.

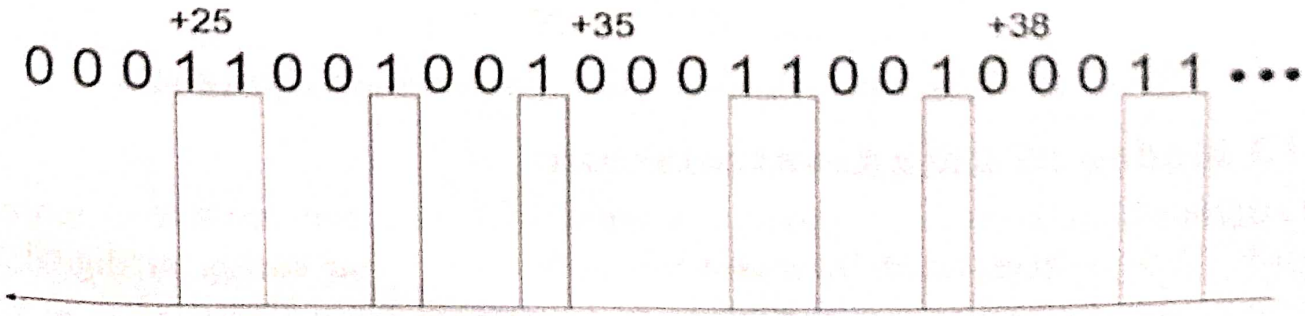


Figure 1.20 Digital Signal converted using PCM.

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.

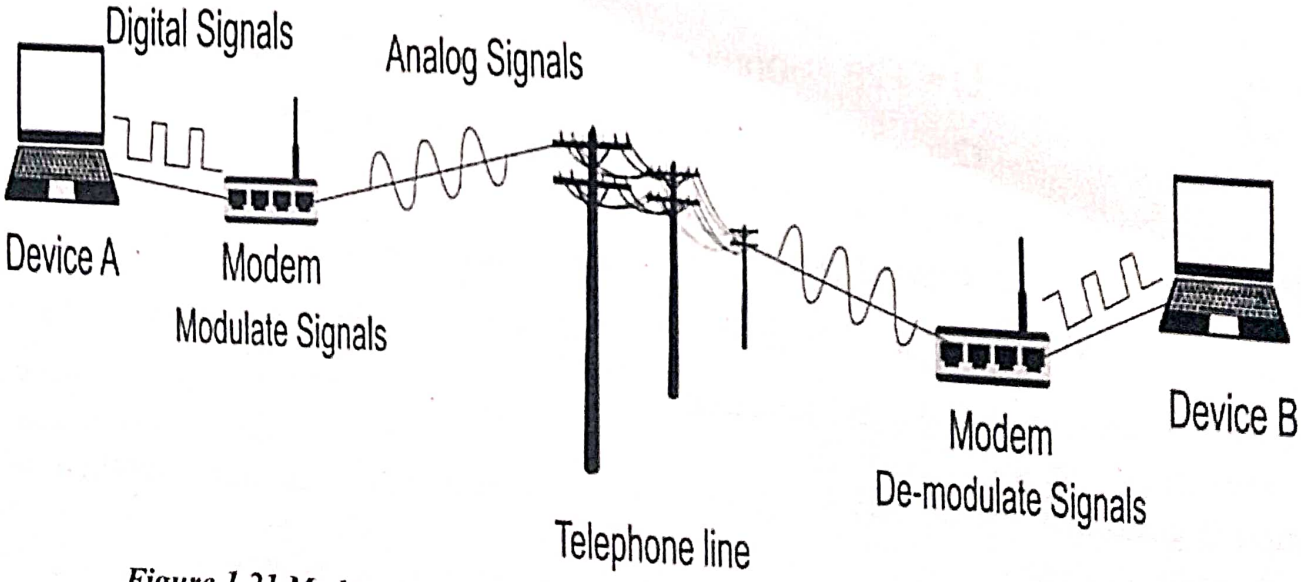
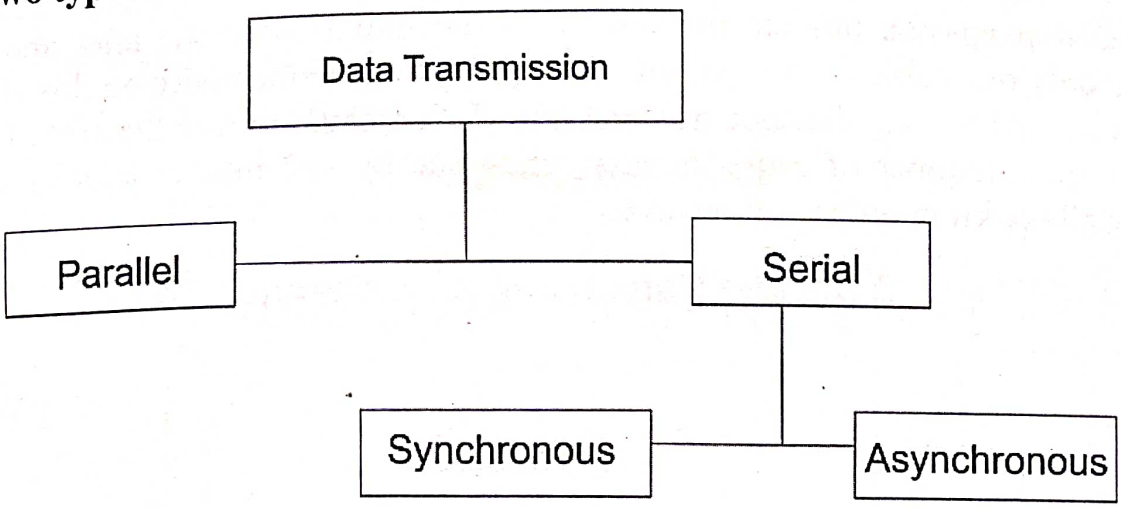


Figure 1.21 Modem communication using telephone line with digital devices.

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.

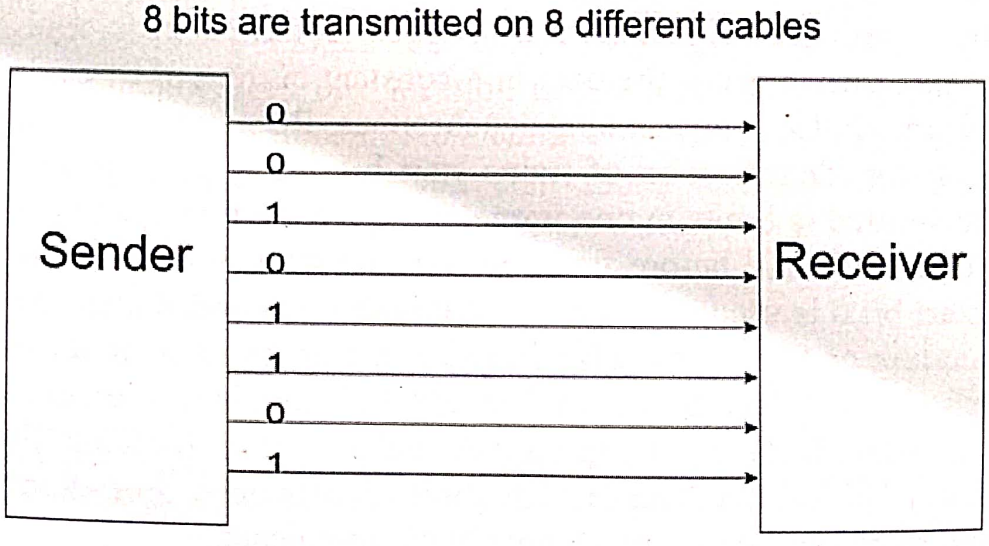


Figure 1.22 Parallel Communication of 8 bits data.

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.

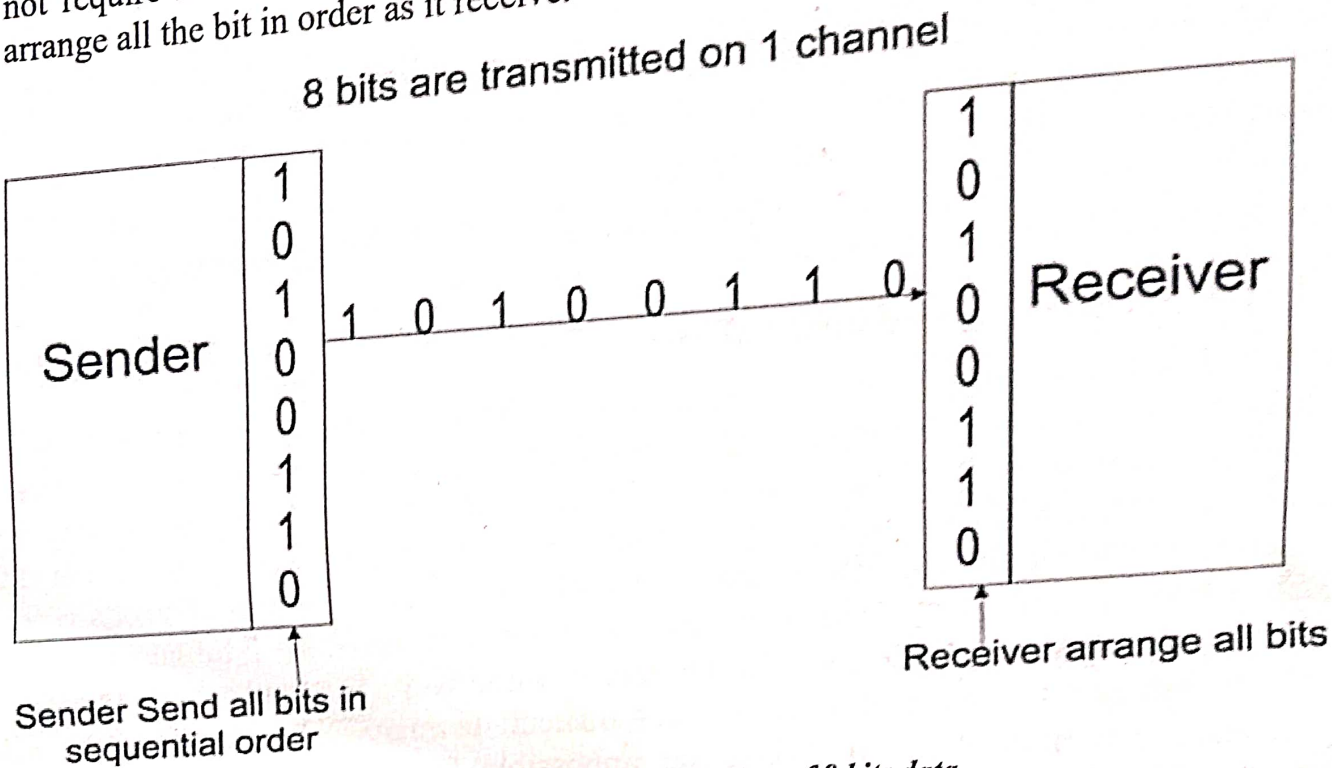


Figure 1.23 Serial Communication of 8 bits data.

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.

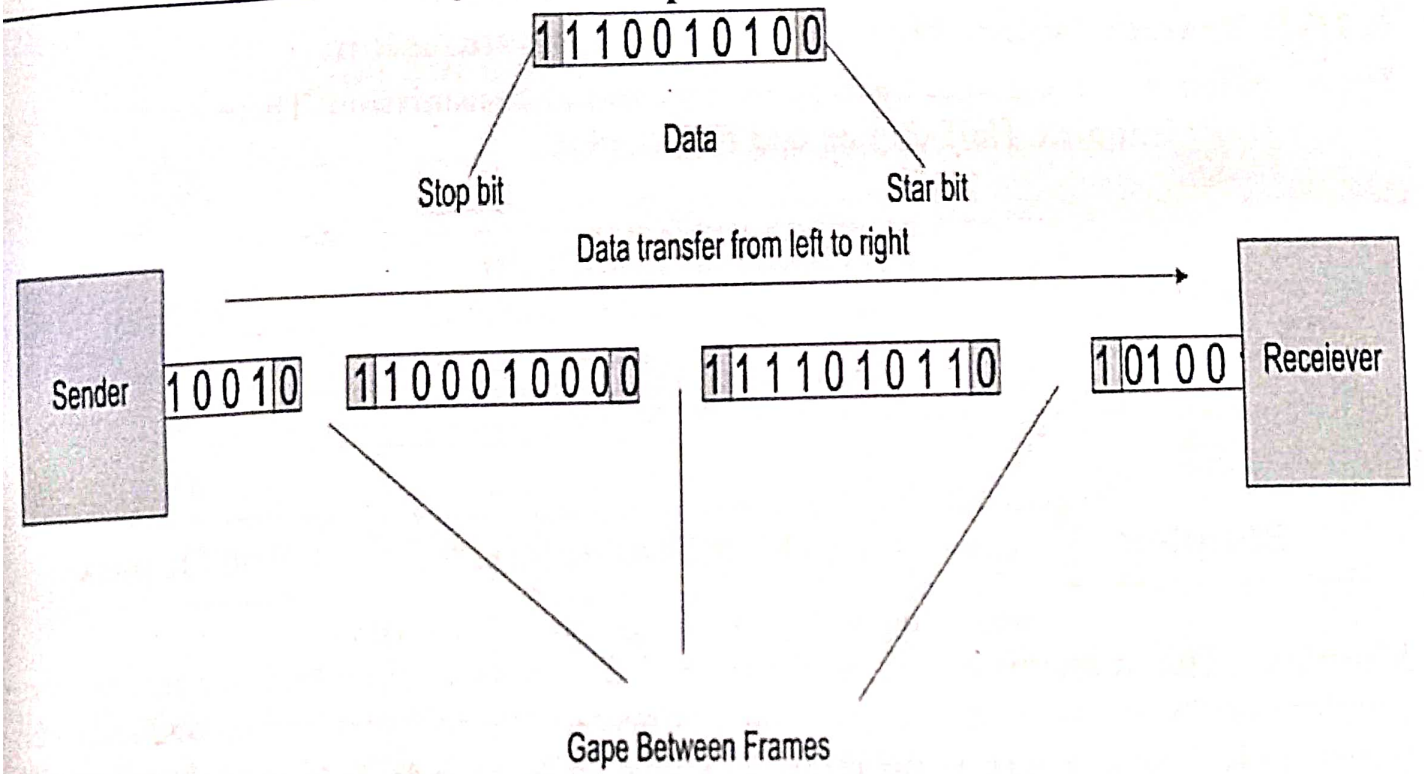


Figure 1.24 Asynchronous transmission.

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.

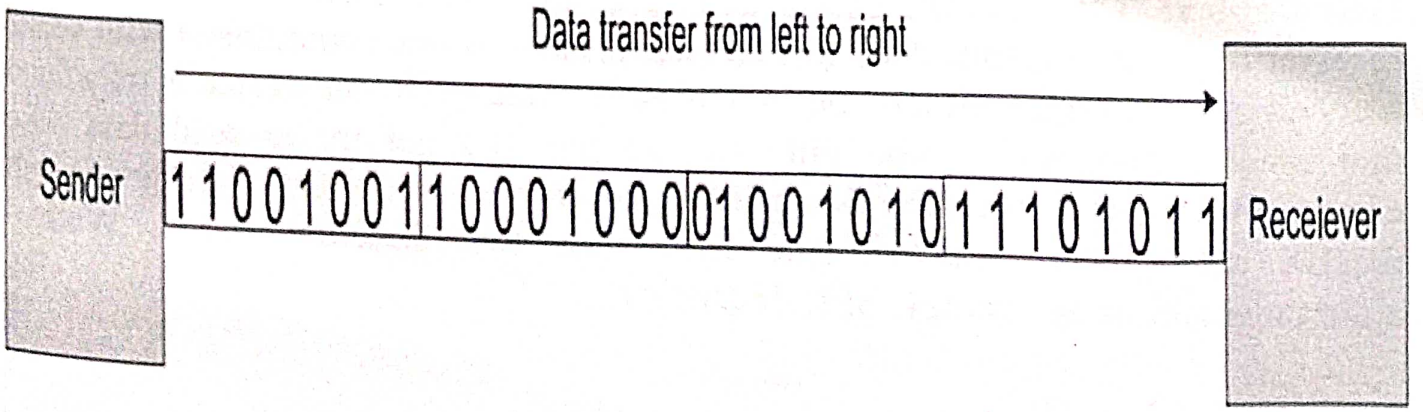
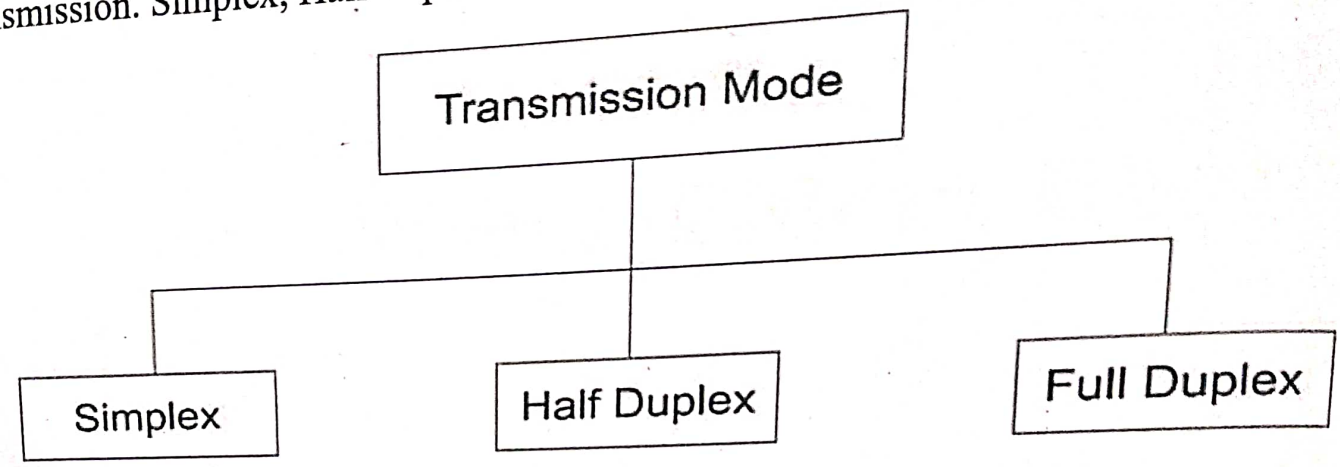


Figure 1.25 of 8 Synchronous transmissions.

1.15.2 Transmission Mode or way of Transmission:

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



Simplex: This transmission is unidirectional transmission, in which sender and receive both are not transmit data. Only sender has permission to transmit data and receiver wil 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.

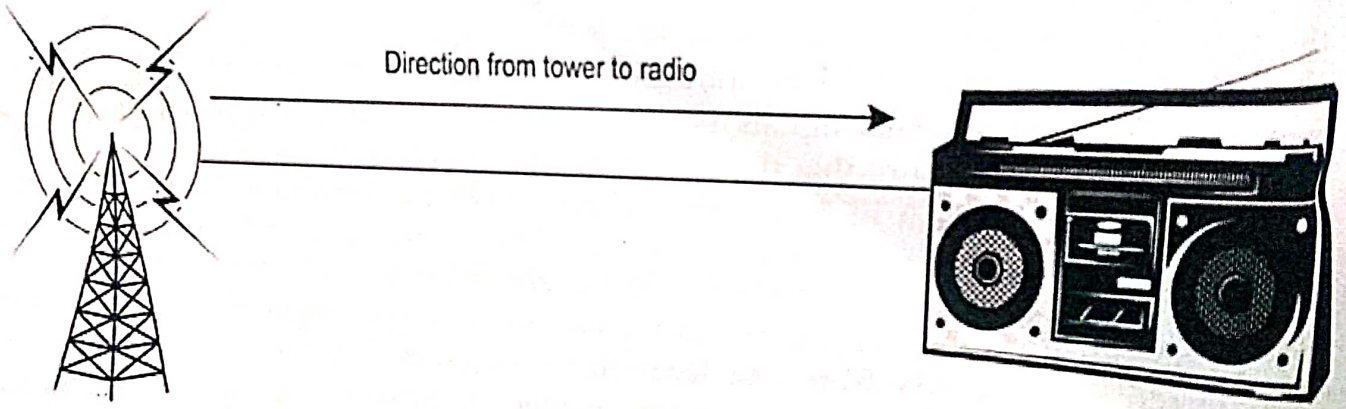


Figure 1.26 Simplex way of Communication.

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

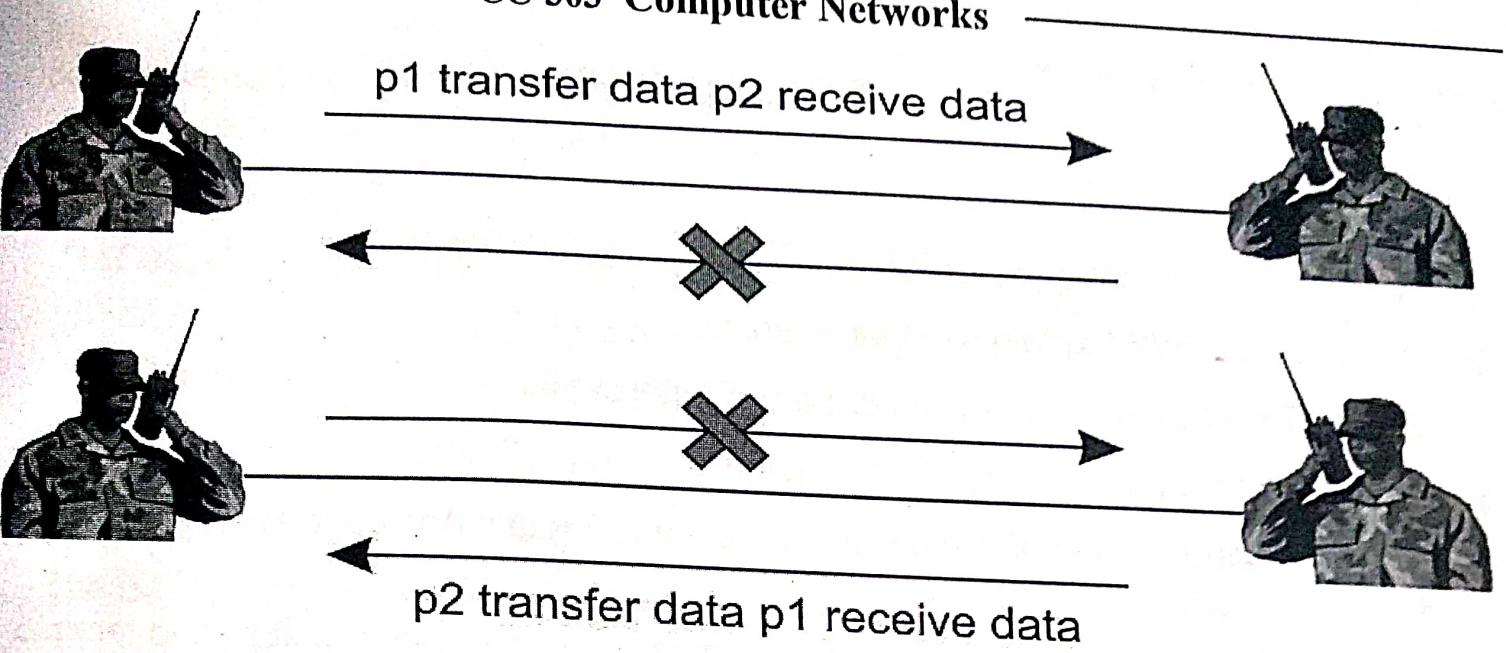


Figure 1.27 Half-Duplex way of Communication.

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.

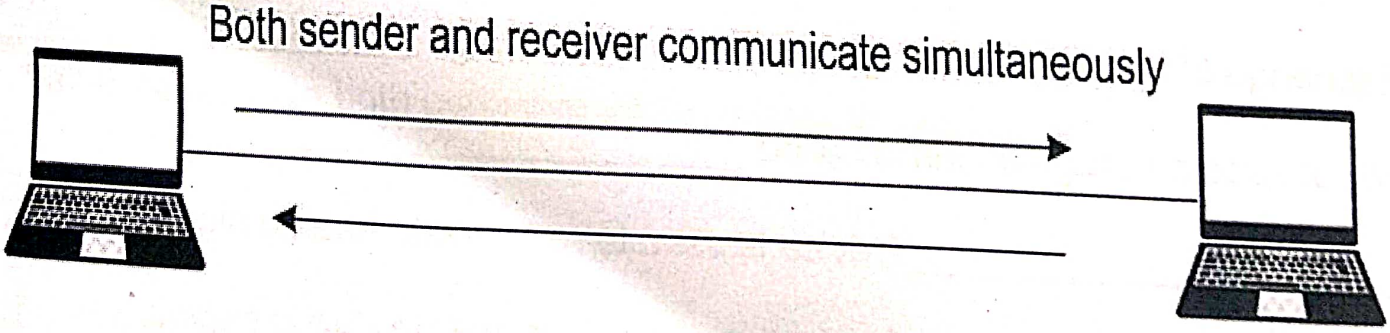


Figure 1.28 Full-Duplex way of Communication.

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