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Networking



## Networking

A computer network is a process of connecting two or more than two electronic devices. (Like computers, mobiles) with the purpose of share data, provide technical support and to communicate especially for the business purpose.

### # Advantage of Networking :-

- 1.) Facility to technical support - Because of having computer networking, a person sitting in USA provides technical support to a person sitting in a remote part of India.
- 2.) Easy sharing of Data - with the help of networking, it is very simple to share all formats of digital data from one computer system to another. (irrespective of their geographic location).
- 3.) Easy sharing of Hardware Resource - with the help of networking, it has now become very simple to share the expensive resources including storage space, processor, fax, etc.

4.) Easy sharing software - Through the networking system, it is easy to share and install the software from one computer system to another computer system.

5.) Easy to Decentralize Data Processing -

Through the networking system, it is very simple to decentralize the data processing system. It ultimately helps to control, secure and manage the important data.

6. Easy to communicate - with the help of networking, the communication system has now become highly efficient, frugal and fast. The different modes of communication are text chatting, video chatting, emails, etc.

## # Types of Network :-

1. Local Area Network (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN)

1.) LAN - It is the technique of interconnecting a few computers located in a given premise. It is normally used for a single business office or a resident apartment.

Date: / /

2) MAN - It is a system of network that normally covers a large metropolitan area (city part). eg: Telephone wiring networking.

3) WAN - It is a system of network that covers a large geographical area across the world. eg: Internet.

## # Types of Network architecture :-

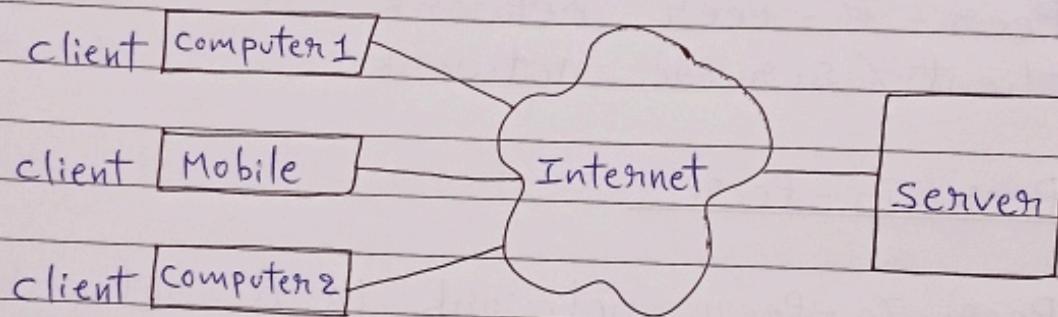
1. Peer - To - Peer network
2. Client / Server network

### 1) Peer - To - Peer -

- \* Peer - To - Peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- \* Peer - To - Peer network is useful for small environments, usually up to 10 computers.
- \* Peer - To - Peer network has no dedicated server.
- \* It is less costly as it does not contain any dedicated server.
- \* There will be a problem can arise if all the computer with the resources is failed due to any reason.

## 2) client / server -

- \* It is a network model designed for the end users called clients, to access the resources such as songs, video, etc, from a central computer known as Server.
- \* The central controller is known as a server while all other computers in the network are called clients.



# communication system - A communication system is a system model that describes the communication exchange between two stations, transmitter and receiver. Signal or information is processed from source to destination through a channel.

# Types of communication system based on physical infrastructure -

There are two types of communication system based on the physical infrastructure:

- ① Line communication system
- ② Radio communication system

\* There is a physical line called hard wire channel between the transmitter and receiver in a line communication system.

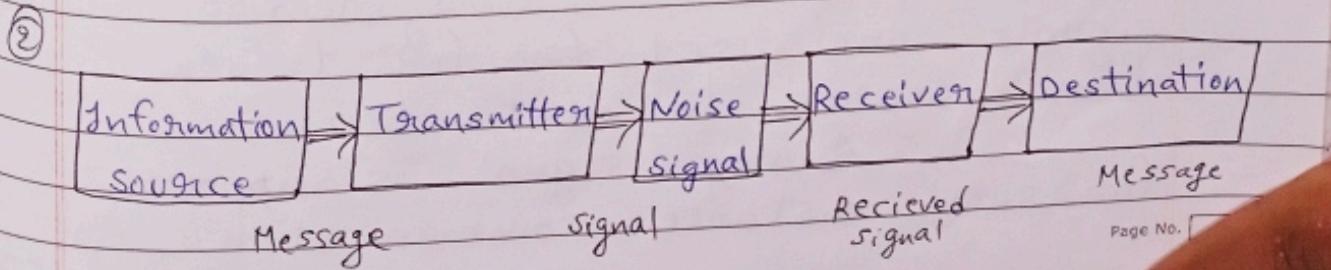
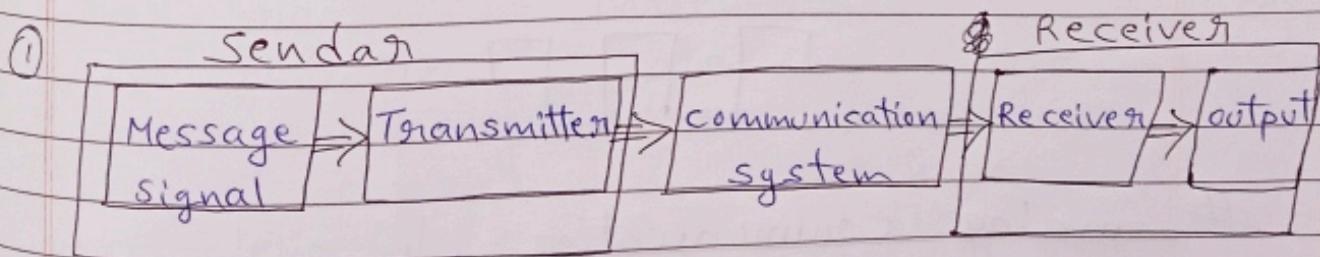
Whereas in radio communication system, there is no dedicated physical path between the transmitter and receiver. (Wireless communication)

 Note:- Signal specification that are used to decide the type of communication system are -

- ① Nature of the baseband (Information signal)
- ② Information signal
- ③ Nature of the Transmitted signal

# A/c to the nature of the baseband signal, the communication system are -

- ① Analog communication system
- ② Digital communication system

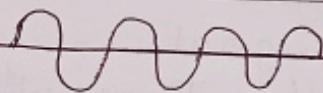


# Signal - when data is send over a physical medium, it need to first converted into electromagnetical signal.

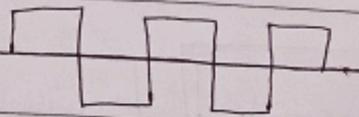
→ signal can be divided into two types :-

- ① Analog signal
- ② Digital signal

1) Analog signal - Analog signal are continuous wave form in nature and representing by continuous electromagnetic wave. eg: Human voice



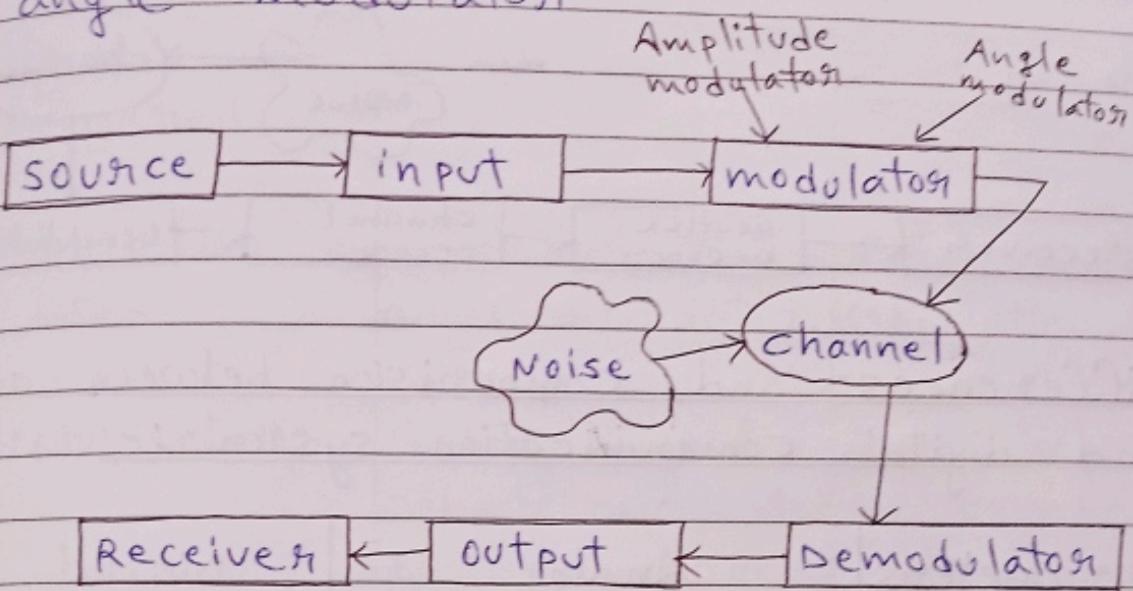
2) Digital signal - Digital signal are discrete in nature and represent sequence of voltage pulse. These are used within circuits of digital computer system. eg: Files on a computer disk.



# Analog communication - In analog communication system, analog signals are used for transmitting from source to destination.

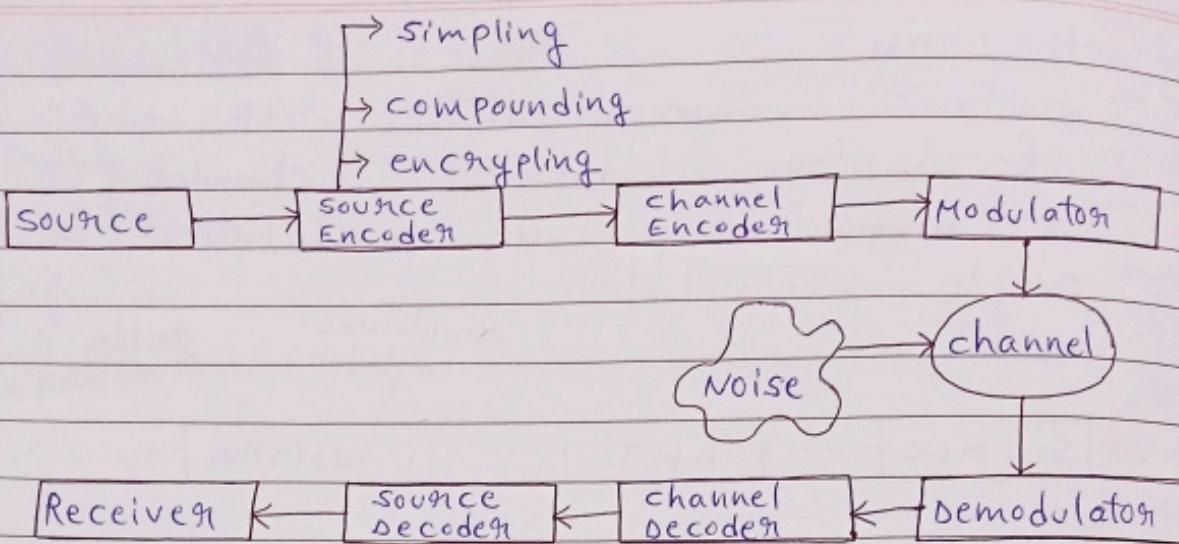
Analog signal is appropriate for short distance communication. All

through we can use it for long distance communication with the help of Analog modulator technology, such as ~~ampt~~ amplitude modulator and angle modulators.



\* Modulator - Modulation is the process of multiplying the low frequency information signal with the high frequency carrier signal.

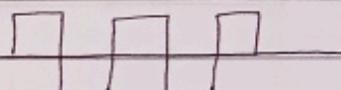
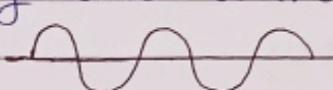
# Digital communication - It is one which uses digital signal for transmitting information from source to destination. Digital signals are represented by square waves. This signal consist of discrete values rather than continuous values like analog signal.



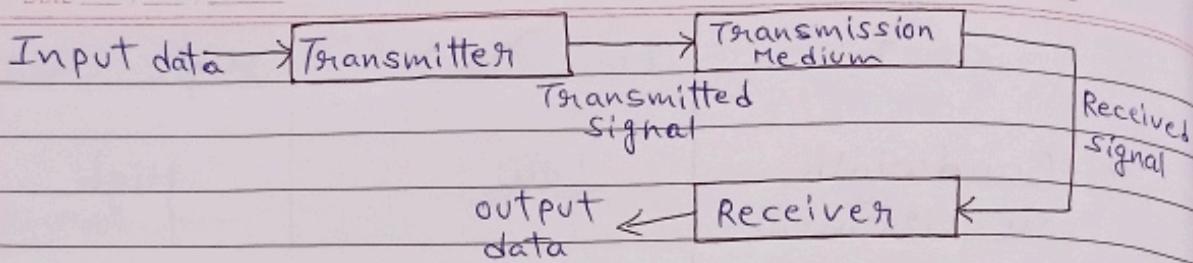
# Differences and comparison between analog and digital communication system :-

Parameters	Analog c.s	Digital c.s
① Definition	Analog communication is the technology which used analog signal for transmission of information.	Digital communication is the technology which used digital signal for transmission of information.
② Noise & distortion	Get affected by noise.	Immune from Noise & distortion.
③ Error Probability	Error probability is high.	Error probability is low.
④ Hardware	Hardware is complicated and less flexible than digital system.	Hardware is flexible than analog system.

	cost	Low cost	High cost
⑥ Bandwidth requirement		Low	High
⑦ Power required		High	Low
⑧ Modulation used	Amplitude and angle modulator	Pulse coded Modulation (PCM)	
⑨ Representation	Analog signal can be represented by square wave. by sine wave.	It is represented	
⑩ Signal value		consist of continuous value.	consist of discrete value
⑪ Example	Voice, sound, etc.		computer, etc.

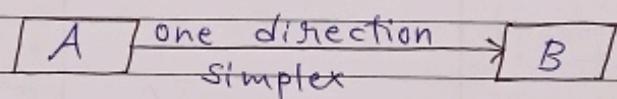


# Data communication model - Data communication refers to the exchange of data between a source and a receiver. Data communication is said to be a local if communication devices are in the same building or a similar restricted geographical area.



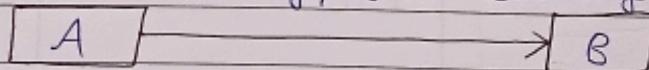
# Medium - It is a channel or physical path through which the message is carried from sender to receiver. A medium can be a wire like twisted pair wire, coaxial cable, fibre optics cable or wireless like laser, radiowave, microwave.

# Simplex - It is a unidirectional communication mode.

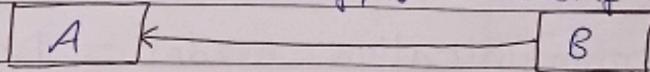


# Half-Duplex - It is a two way direction communication but one at a time.

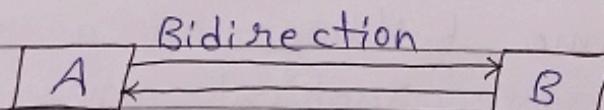
A is sending, B is receiving



A is receiving, B is sending

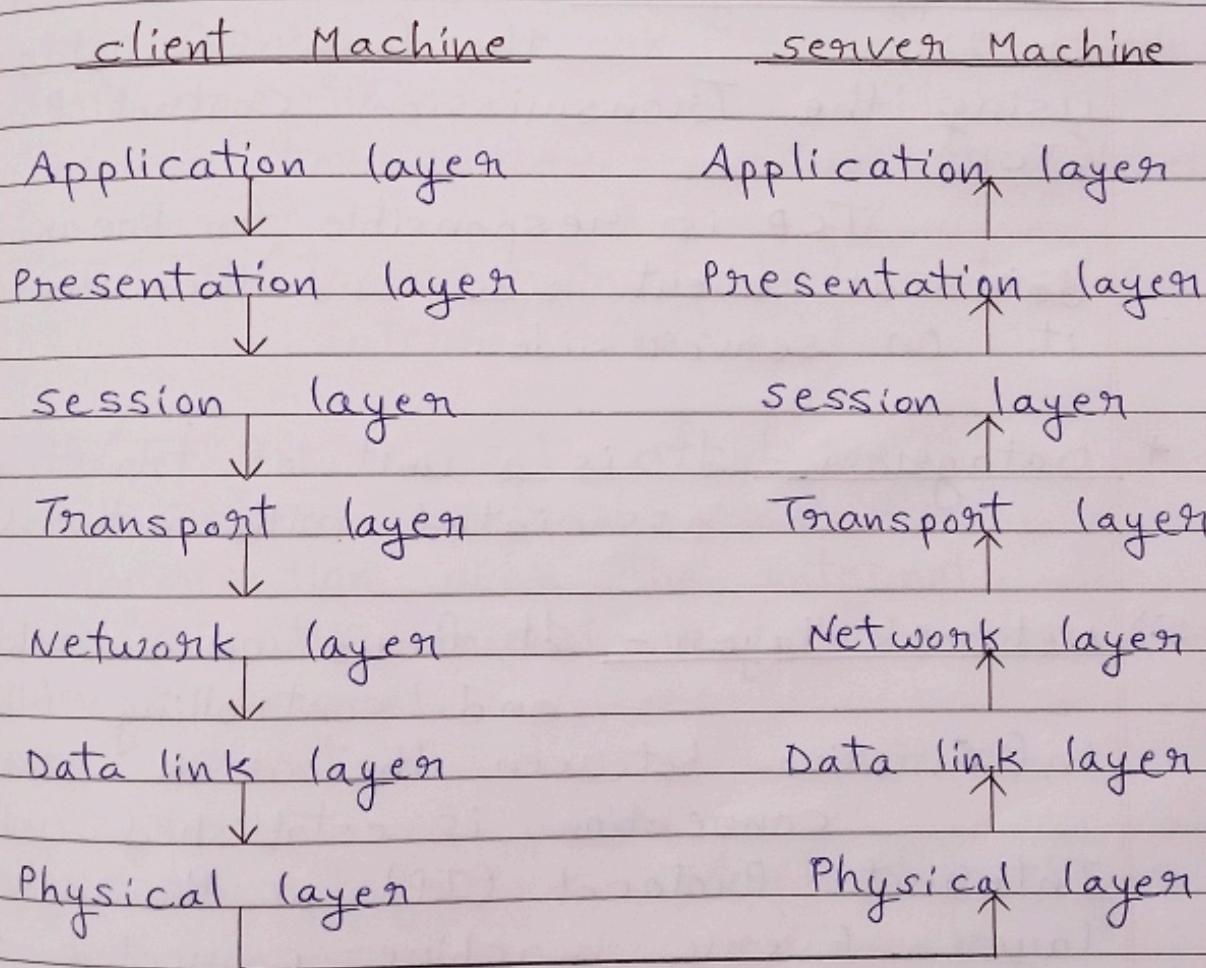


# Full-Duplex - It is a two way direction communication simultaneously.



## # OSI (Open System Interconnection) model

- \* It is a network protocol model.
- \* Network protocol is a set of rules governing exchange of information in an easy, reliable and secure way.
- OSI model is a network protocol model that consists of following seven layers-



↑ Application layer - It is the topmost layer of the network that is responsible for sending application request by the user to the lower levels. Typically applications are HTTP, FTP, etc.



2.) Presentation layer - This layer is concerned with representation of data.

3.) session layer - It is responsible for establishing a session between two work stations that want to exchange the data.

4.) Transport layer - Data is transmitted in the form of Datagram using the Transmission Control Protocol (TCP).

TCP is responsible for breaking up data at client side and then reassemble it on server side.

\* Datagram - It is a unit of transfer associated with networking.

5.) Network layer - It focus on switching and controlling flow of information between the work stations.

Connection is established using Internet Protocol (IP) at the network layer. Every machine connected to the Internet is assigned a unique address by the protocol to easily identify the source and destination machine.

6.) Data link layer - Actually data transmitted in bits at the data link



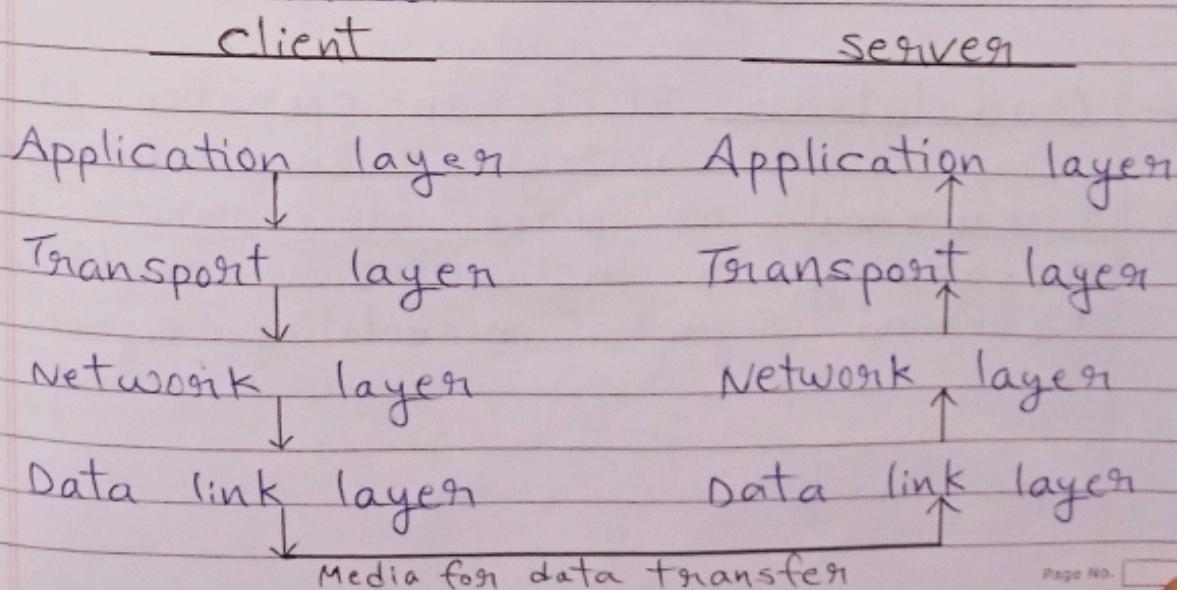
layer using destination address (IP address) provided by network layer.

It also resolves problems by damage, lost or duplicate frames.

7.) Physical layer - It is the lowest layer that connects the two systems that need to communicate. It transmits data in bits and manages simplex and duplex transmission. It also manages network interface cards, hardware interface like, cable, transmission terminators, voltage, label, etc.

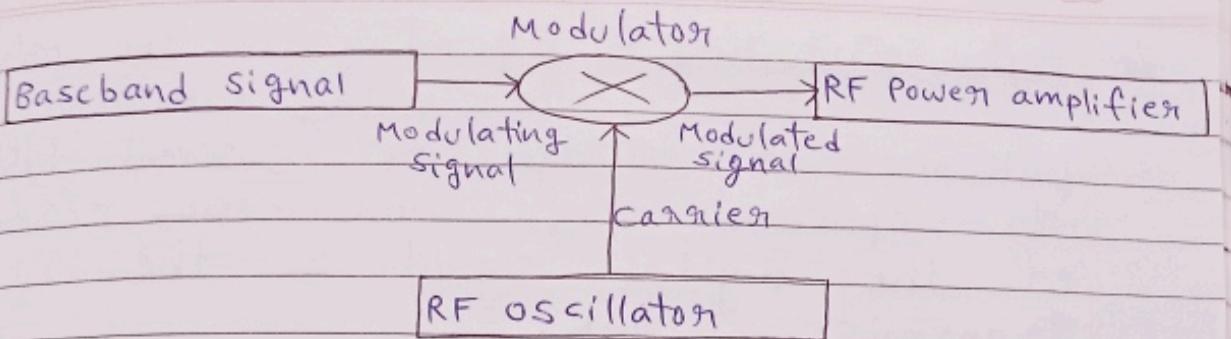
## # TCP/IP (Transmission Control Protocol / Internet protocol)

TCP/IP is a set of layered architecture protocol used for communication over the Internet. The communication model is called client/server model.





- 1.) Application layer - Protocol like HTTP, FTP, etc.
  - 2.) Transport layer - Data is transmitted in form of datagram using transmission control protocol (TCP). TCP is responsible for breaking up data at client side and then reassemble it on server side.
  - 3.) Network layer - Connection is established using Internet Protocol (IP) at the network layer. Every machine connected to internet is IP address by the protocol to easily identify source and destination machine.
  - 4.) Data Link layer - Actual data transmission in bit occurs at the data link layer using the destination address provided by network layer.
- # Modulation - It is an operation of varying amplitude or frequency or phase of carrier signal according to instantaneous amplitude of baseband signal / modulating signal.



# RF (Radio Frequency) - Radio Frequency carrier

signals are high frequency radio wave.  
It generally comes from Radio frequency.

# Types of Modulation -

- (i) Analog Modulation
- (ii) Digital Modulation

# Types of Analog Modulation -

- (i) Amplitude Modulation
- (ii) Frequency Modulation
- (iii) Phase Modulation

# Types of Digital Modulation -

- (i) Amplitude shift keying
- (ii) Frequency shift keying
- (iii) Phase shift keying



# Data Encoding - Encoding is the process of using various patterns of voltage or current level to represent ones and zeros zeroes of the digital signal on the transmission link.

→ The common type of Encoding are -

- ① Unipolar
- ② Polar
- ③ Bipolar
- ④ Manchester

## # Encoding Techniques -

The data encoding techniques are divided into following type depending upon the type of conversion.

- ① Analog data to analog signal
- ② Analog data to digital signal
- ③ Digital data to analog signal
- ④ Digital data to digital signal

### 1.1 Analog data to analog signal -

The modulation techniques such as Amplitude modulation, Frequency modulation and phase modulation of analog signals are under this category.

## 2.7 Analog data to digital signal -

This process can be termed as digitization, which is done by pulse code modulation (PCM).

## 3.7 Digital data to analog signal -

The modulation technique such as,

- (i) Amplitude shift keying (ASK)
- (ii) Frequency shift keying (FSK)
- (iii) Phase shift keying (PSK)

## 4.7 Digital data to digital signal -

There are several ways to mapping digital data to digital signal.

Non Return to zero (NRZ) : It is divided into two types,

- a) NRZ-L (Level)
- b) NRZ-I (Inverted)

\* Non Return to zero (NRZ) - NRZ code has 1 for

high level and 0 for low voltage level.

This main behavior of NRZ code is that the voltage level remains constant during bit interval. The end and start of bit will not be indicated and it will remain the same voltage stage if the values of previous bit and



the value of present bit are same.

Q) Represents digital data: 100110101 into NRZ-L.

0 => hero (high)

1 => zero (Low)

1	0	0	1	1	0	1	0	1

→ NRZ-L

Q) Represents digital data: 10011100 into NRZ-I.

0 => No direction change

1 => direction change

1	0	0	1	1	1	0	0

→ NRZ-I

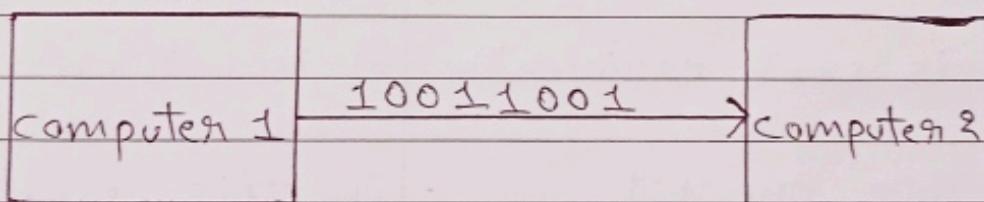
## # Digital data transmission :-

There are two methods for transferring data between computers.

- a) Serial Transmission
- b) Parallel Transmission

a) Serial Transmission - In serial transmission data bit flow from one computer to another computer in bi-direction.

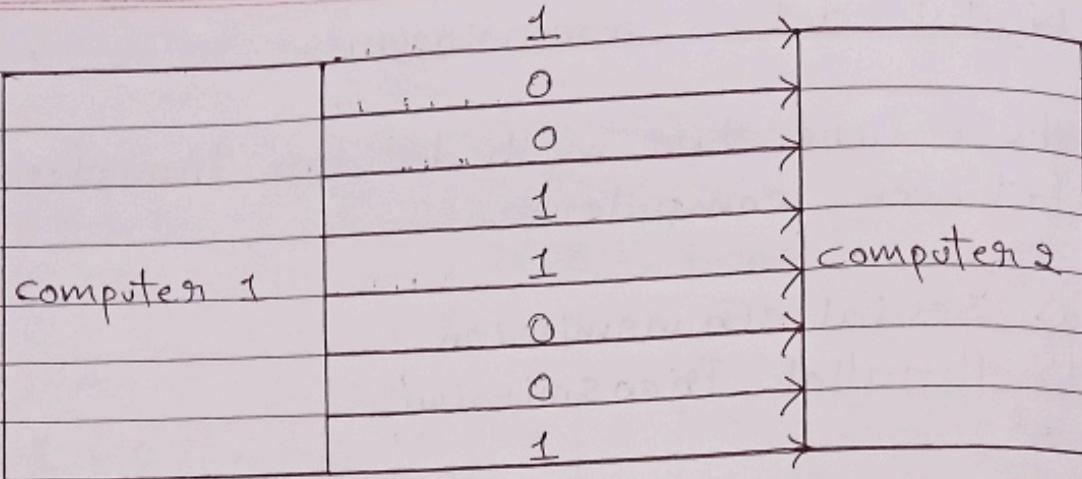
In this transmission, one bit flows at one clock pulse. In serial transmission, 8 bit are transferred at a time having a start and stop bit.



b) Parallel Transmission - In parallel transmission many bits are flow together simultaneously from one computer to another computer.

It is faster as compare to serial transmission to transmit the bits.

Parallel transmission is used for short distance.



# Differences b/w serial transmission and parallel transmission -

Serial Transmission	Parallel Transmission
1) In this, data (bit) flows in bi-direction.	In this, data flows in multiple <del>direction</del> lines.
2) It is cost-efficient.	It is not cost-efficient.
3) In this, one bit transferred at one clock pulse.	In this, eight bits transferred at one clock pulse.
4) It is slow in comparison of parallel transmission.	It is fast in comparison of serial transmission.
5) Generally, it is used for long distance.	Generally, it is used for short distance.

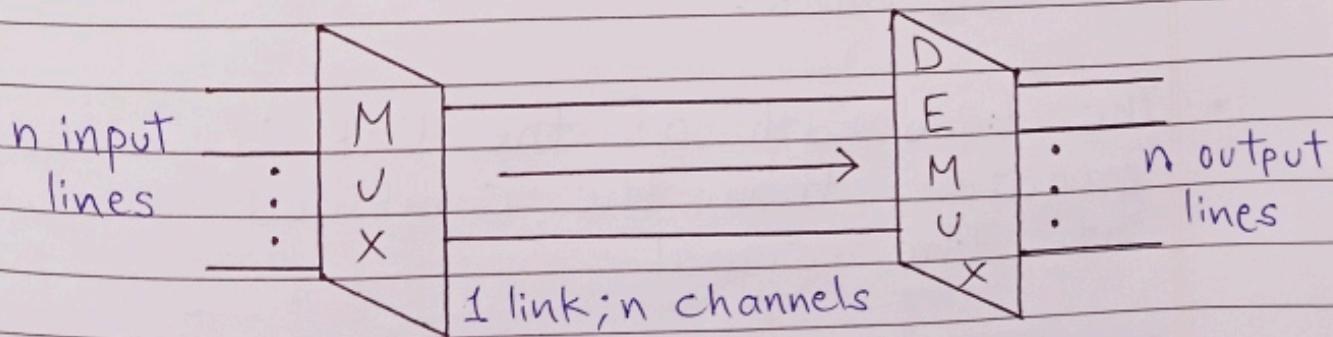


## Multiplexing in Computer Networks

The set of techniques that allows the simultaneous transmission of multiple signals across a single data link is commonly referred to as Multiplexing.

Multiplexing is done by using the hardware that is called as Multiplexer (MUX).

- The Multiplexer (MUX) mainly combines 'n' input lines in order to generate '1' output line (many-to-one) on the sender side.
- On the receiver side, this stream is fed into the demultiplexer (DEMUX), which then separates the stream back to its component transmission (one-to-many) and then directs them to their corresponding lines.
- The main aim of the multiplexing technique is to share scarce resources.





## \* Advantages of Multiplexing :-

- with the help of multiplexing, more than one signal can be sent easily over a single medium or link.
- Multiplexing helps in the effective utilization of the bandwidth of the medium.

## \* Categories of Multiplexing :-

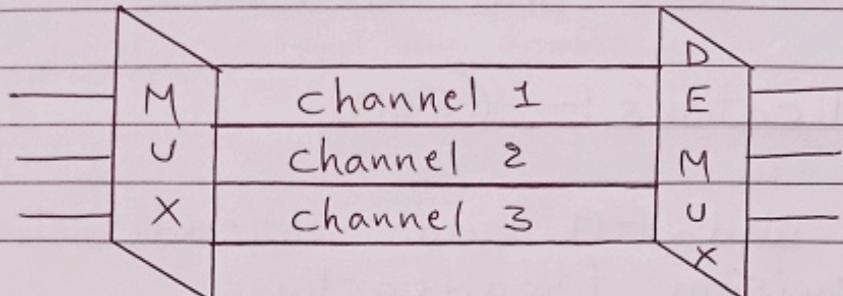
- 1) Frequency - division multiplexing (FDM)
- 2) Wavelength - division multiplexing (WDM)
- 3) Time - division multiplexing (TDM)
  - a) Synchronous TDM
  - b) Asynchronous TDM

### 1) Frequency - division multiplexing (FDM) - (Analog Technique)

- with this technique, signals having different frequencies are combined in a composite signal and then transmitted on the link.
- The bandwidth of the link is must be greater than the combined bandwidths of the signal.
- Each signal is of a different frequency.



- The channel is usually separated by the strips of unused bandwidth that is the guard bands in order to prevent the signals from overlapping.



#### \* Advantages :- (FDM)

- The simultaneous transmission of large number of signals is done easily.
- The demodulation of FDM is easy.
- There is no need for synchronization between the transmitter and receiver for proper operation.
- In the case of slow narrowband fading, there is only one single channel that gets affected.

#### \* Disadvantages :- (FDM)

- Communication channels must have a very large bandwidth.
- There occurs the problem of crosstalk while using FDM.



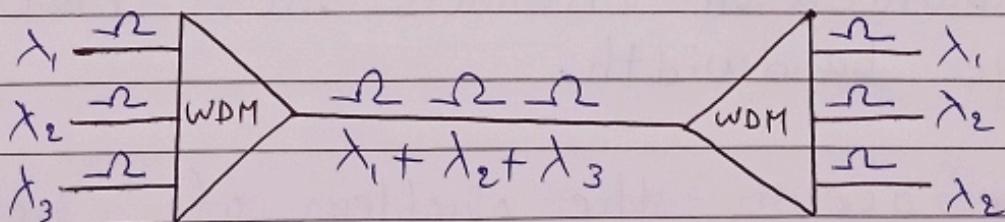
- In the case of wideband fading, all channels in the FDM gets affected.
- There is a need for a large number of filters and modulators.

### \* Applications :- (FDM)

- AM and FM radio broadcasting
- Television broadcasting
- First-generation cellular telephones

## 2) Wavelength-division Multiplexing (WDM) - (Analog Technique)

- This technique is similar to FDM.
- with this technique, different signals that include optical or light signals are transmitted through the optical fiber.
- The high data rate capability of optical fiber cable gets utilized.
- Prism is used for combining the various light waves and then this signal gets broken down into different light waves with the help of demultiplexer.



### \* Advantages :- (WDM)

- with the help of WDM, the full-duplex transmission is possible.
- WDM is easy to reconfigure.
- The technique is less expensive and the expansion of the system is easy.
- This technique provides high security.

### \* Disadvantages :- (WDM)

- There is the use of optical equipment so cost increases.
- Utilization of bandwidth can be inefficient which causes difficulty in wavelength tuning.
- The main concern in this technique is scalability.

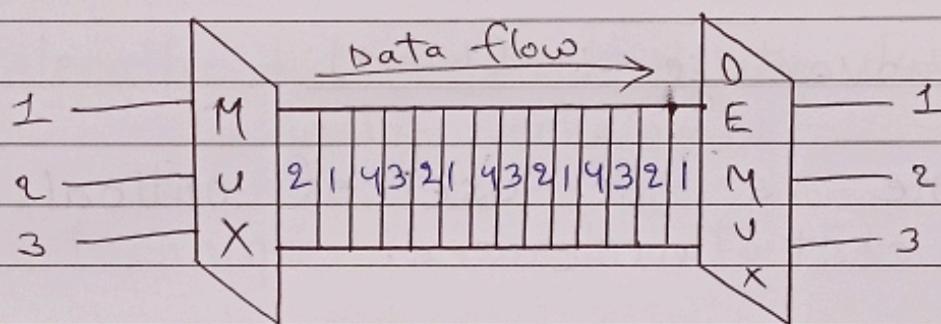
### 3.) Time - division Multiplexing (TDM) - (Digital Technique)

- In this technique, the channel / link is divided on the basis of time instead of frequency.
- The total available time on the channel



is divided between the different users on the channel.

- A particular time interval is allotted to each user on the channel and it is known as Time slot/slice.
- In the TDM, the data rate capacity should be much greater than the data rate that is required by the sending and receiving device.

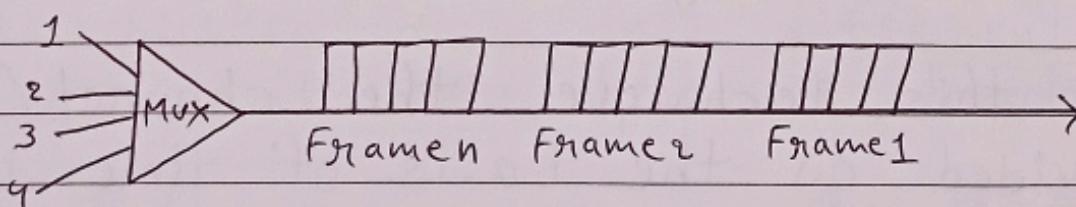


\* TDM is further categorized into two :

(i) Synchronous Time-Division Multiplexing -

In this technique, each of the input connection has an allotment in the output even if it is not sending the data.

4 input means 4 time slot



## \* Advantages :- (Synchronous TDM)

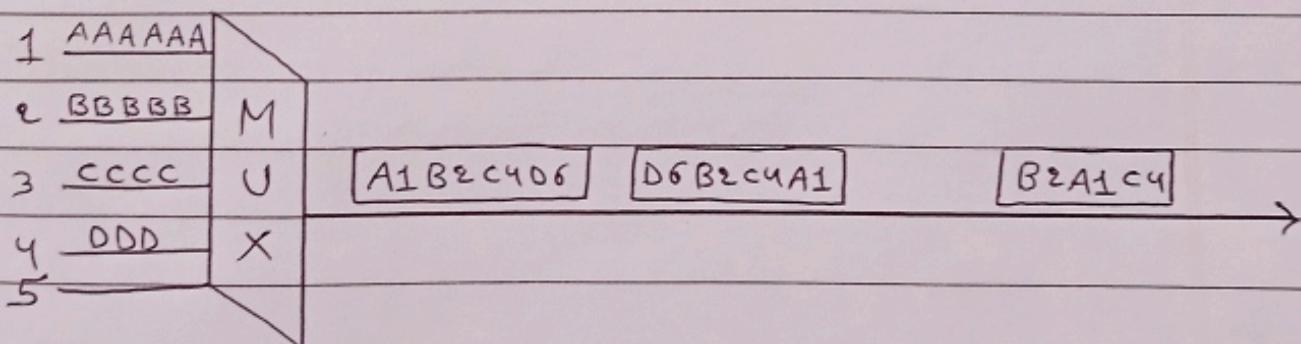
- The technique is easy to implement.
- The performance is guaranteed.

## \* Disadvantages :- (Synchronous TDM)

- If a user has no data to transmit in that case time slots will get wasted.
- In this multiplexing, the capacity of the transmission link must be always higher than the total capacity of the input lines.

## (ii) Asynchronous Time-Division Multiplexing -

It is also known as Statistical TDM.  
 In this, time slots are not fixed, rather time slots are allocated dynamically in order to improve the efficiency of bandwidth.





## \* Advantages :- (Asynchronous TDM)

- In this multiplexing, there is an efficient use of the capacity of transmission.

## \* Disadvantages :- (Asynchronous TDM)

- In this, frames are of different sizes.
- Buffer address information is also needed because there are no separate slots assigned for each user.
- This technique does not provide a fixed waiting time guarantee.



## # Guided and unguided data Transmission medium :-

The ~~co~~ telecommunication links are classified into two types.

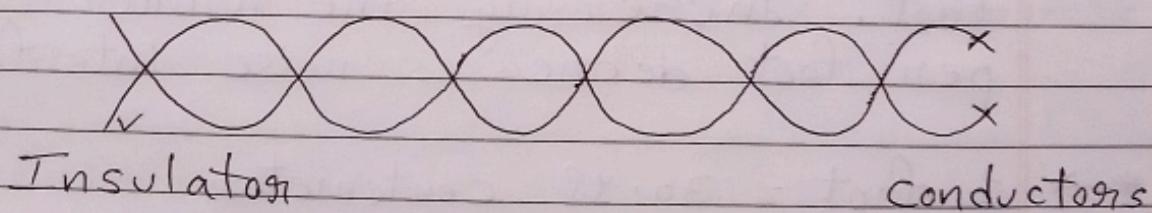
- 1) Guided Transmission Medium (wired)
- 2) Unguided Transmission Medium (wireless)

1) Guided Transmission Medium - It consists of physical connection b/w source and destination through a wire or a cable.

→ There are three basics of guided medium -

- ① Twisted pair cable
- ② Co-axial cable
- ③ Fibre optic

(1) Twisted Pair cable -



Twisted pair is a physical medium made up of a pair of cable twisted with each other.



## \* Advantages of twisted pair cable -

- a) A twisted pair cable is cheap as compare to other transmission medium.
- b) Installation of twisted pair cable is easy and it is light weighted cable.

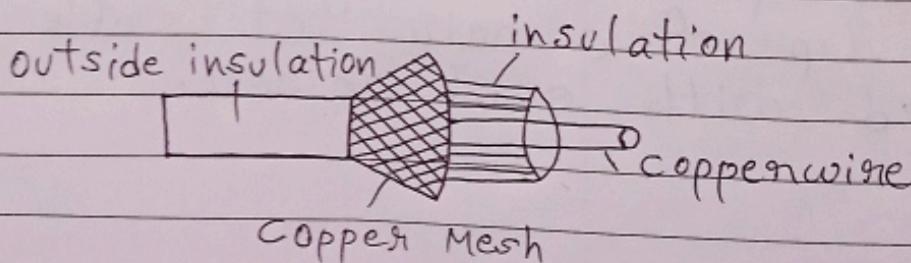
(>Note:-) The frequency range of twisted pair cable is from 0 - 3.5 kHz.

## \* working method of twisted pair cable-

A twisted pair consists of two insulated copper wire arranged in a regular spiral pattern. The degree of reduction in noise interference is determined by the number of turns per foot. Increasing the number of turns per foot decreases noise interference.

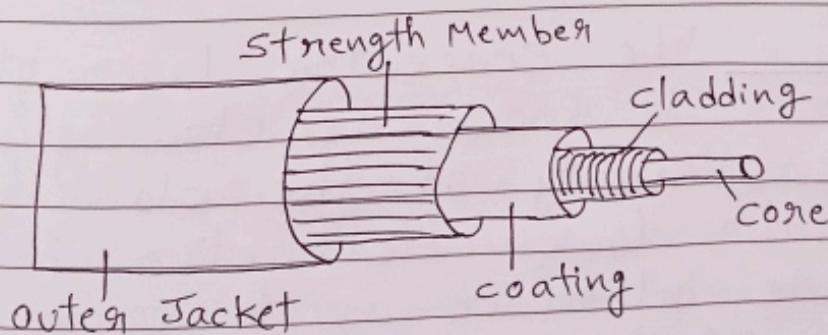
\*→ 1 foot = 30.48 centemeter

## (2) Co-axial cable -



- coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the EMI (Electromagnetic interference).

### (3) Fibre Optic -





- Fibre optic cable is a cable that uses electrical signals for communication.
- Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

#### \* Basic elements of Fibre optic cable :-

- Core - The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- cladding - The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the

light waves are transmitted through the fibre.

. Jacket - The protective coating consisting of plastic is known as a Jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

2) Unguided Transmission Media - An unguided transmission

transmits the electromagnetic waves without using any physical medium. Therefore it is also known as wireless transmission.

In unguided media, air is the media through which the electromagnetic energy can flow easily.

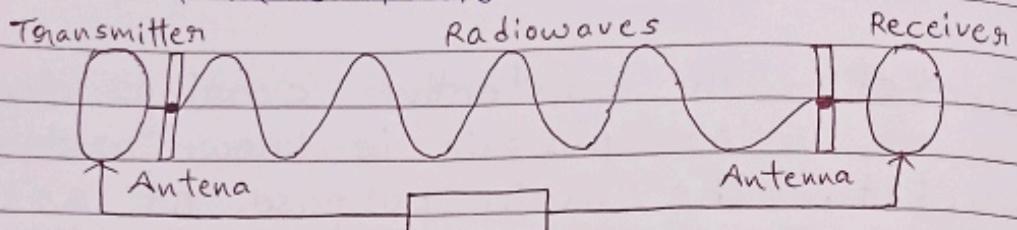
→ There are three types of signals transmitted through unguided media:

- ① Radio waves
- ② Microwaves
- ③ Infrared

① Radio waves - These are easy to generate and can penetrate through buildings. The sending and receiving antennas need not be aligned. Frequency Range : 3 KHz - 1 GHz. AM and FM radios



and cordless phones use radio waves for transmission.



② Microwaves - It is a line of sight transmission. i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range: 1 GHz - 300 GHz. These are mainly used for mobile phones communication and television distribution.

③ Infrared - Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range: 300 GHz - 400 THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.

\* Satellite - The satellite accepts the signal that is transmitted from the earth station, and it amplifies the signal. The amplified signal is



retransmitted to another earth station. The coverage area of a satellite microwave is more than the terrestrial microwave.

# connectors - Connectors are used to connect the media with networking devices, and they are specific for each transmission medium. RJ-45 connectors are used in twisted pair cables, F-Type connectors for coaxial cables, and MT-RJ, LC, SC and ST connectors are used for fibre optic cables.

### Physical and Data Link Layer

# ARQ - It is stand for Automatic repeat request also known as Automatic repeat query.

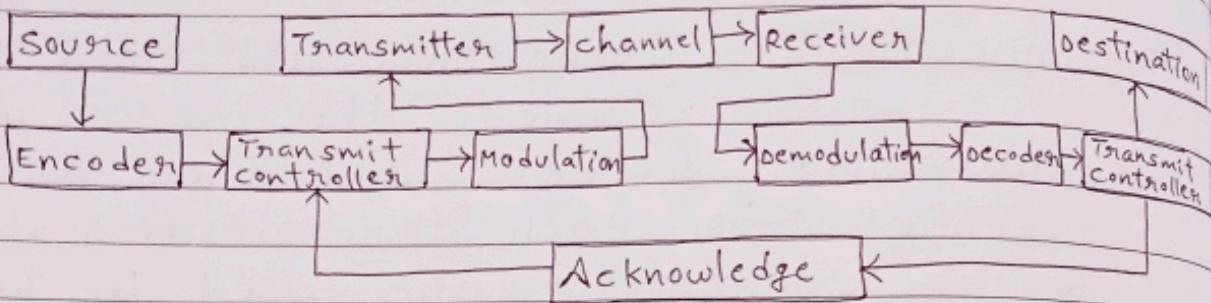
ARQ is an error control strategy used in a two way communication system. It is a group of error control protocols to achieve reliable data transmission over a unreliable source or service. These protocols reside in transport layer and data link layer of OSI (Open system interconnection) model.

These protocols are responsible for automatic retransmission of packets that



are found to be corrupted or lost during the transmission process.

### Automatic Repeat Request (ARQ)



# CRC - It stands for cyclic Redundancy check.

→ There are three main techniques for detecting errors in physical and data link layers are :

- ① Parity check
- ② checksum
- ③ CRC

CRC is a method of detecting accidental changes or errors in communication channels. CRC uses generator polynomial which is available on both sender and receiver side.

Date \_\_\_\_\_

Q. Find the CRC for the data blocks 1100 with the division 1011.



Data: 1100

polynomial generator:  $x^3 + x + 1$

division: 1011 (Coefficient of polynomial eqn)  
→ 4bit

formula = generator bit - 1

(011) 1100000

$$\therefore 4-1 = 3 \text{ (000)}$$

adding three bits to data

1100000

1011  
0111000

(Applying XOR gate)

1011

010100

1011

00010

$$1100000 - 00010 = 1100010$$

Answer.

Q. Find the CRC for the data blocks 100100 with the division 1101.

Data: 100100

$$4-1 = 3 \text{ bit}$$

division: 1101

1101) 100100000

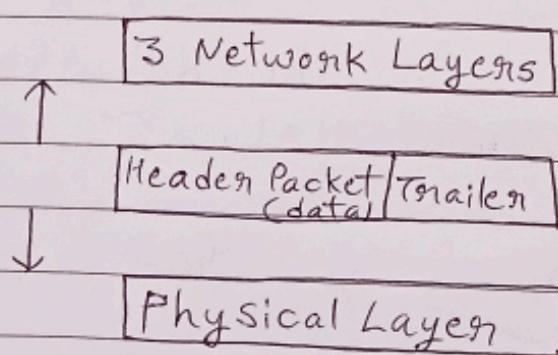


$$\begin{array}{r}
 100100000 \\
 1101 \\
 010000000 \\
 1101 \\
 01010000 \\
 1101 \\
 0111000 \\
 1101 \\
 001100 \\
 1101 \\
 0001
 \end{array}$$

$$(00100000 - 0001 = 10000000) \text{ Answer.}$$

## ## Framing in data link layer :-

Framing in data link layer is a point to point communication b/w two computers or devices consist of a wire in which data is transmitted as a stream of bits. Framing is the function of data link layer. Frames have header that consist information such as error checking codes.



## \* Types of Framing :-

Framing can be categorized into two types.

- ① Fixed size Framing
- ② Variable size Framing

1) Fixed size Framing - The frame of fixed size, so there is no need to provide boundaries to the frame.

2) Variable size Framing - Need to define the end of the frame as well as the begining of the frame so that the next frame will be decided.

## Topologies

# Network topologies are referred to the architecture under which we setup a computer network.

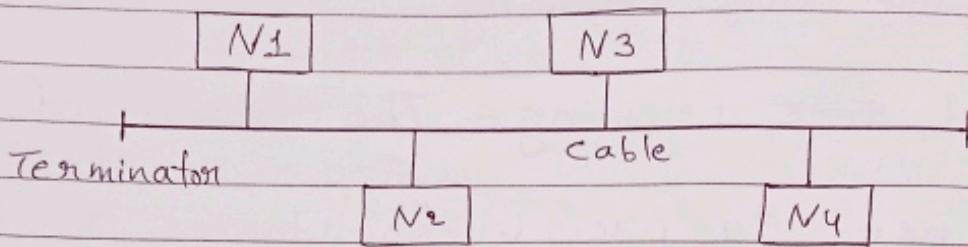
## \* Types of Network Topologies :-

1) Bus Topology - It is a network type in which every computer and network devices are connected to a single cable.

It transmits the data from one end to



another in single direction. No bidirectional feature in bus topology. It is a multipoint connection and a non-robust technology because if the backbone fails, the whole topology is crashed.



### → Advantages of Bus Topology -

- (i) The cost of the cable is less as compare to other topologies.
- (ii) If  $N$  devices are connected to each other in a bus topology then no of cables required to connect them is one which is known as backbone cable. So we can easily add and remove devices from the topologies.

### → Disadvantages of Bus Topology -

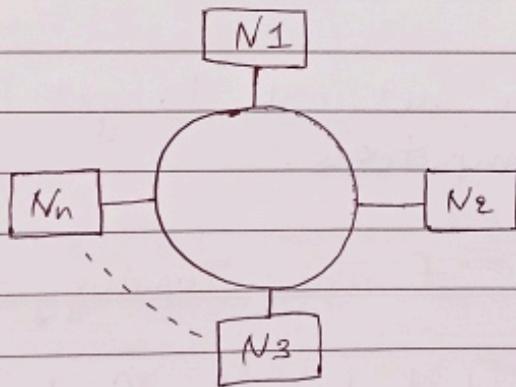
- (i) It is used to build small network setup.
- (ii) If the common cable fails then the whole system will crash on.
- (iii) If the network traffic is heavy, it increases collisions in the network. To

connection  
a  
bus fails,

Date \_\_\_\_\_

avoid this various protocols are used like aloha, CSMA (Carrier Sense Multiple Access), CSMA/CD, CSMA/CA.

2) Ring Topology - In this topology, it forms a ring connecting devices with its exactly two neighbouring devices. The number of repeaters are used for ring topology with a large number of nodes because if someone wants to send some data to the last node in the ring topology with hundred nodes, then data will have to pass through 99 nodes to reach the 100 node. So to prevent data loss repeaters are used in the network.



→ Advantages of ring topology -

(i) The possibility of collision is minimized.

→ Disadvantages of Ring Topology -

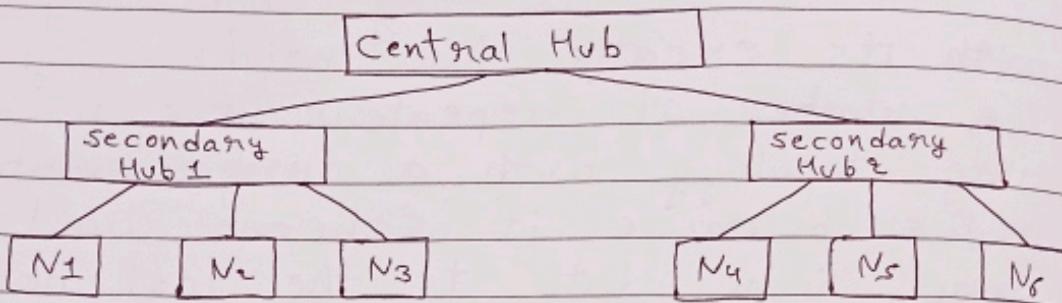
(i) Troubleshooting is difficult in this topology.

(ii) Adding and removing devices b/w stations



can disturb the whole topology.

3.) Tree Topology - This topology is a variation of star topology. It is a hierarchical flow of data.



→ Advantages of Tree Topology -

- (i) It allows to attach more devices by adding Hub.
- (ii) It allows the network to get isolate from different computers.

→ Disadvantages of Tree Topology -

- (i) If the central hub gets fail the entire system gets fail.
- (ii) The cost is high because of cables and hubs.

4.) star Topology - In star topology all the devices are connected to a single hub through a cable. This hub is the central node and all other nodes

are connected to the central node.

Note:- (i) The hub can be passive in nature.

→ Advantages of Star Topology -

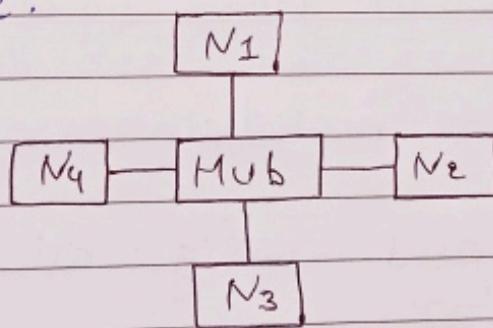
(i) Easy to setup.

(ii) Each device required only one port i.e. to connect to the hub.

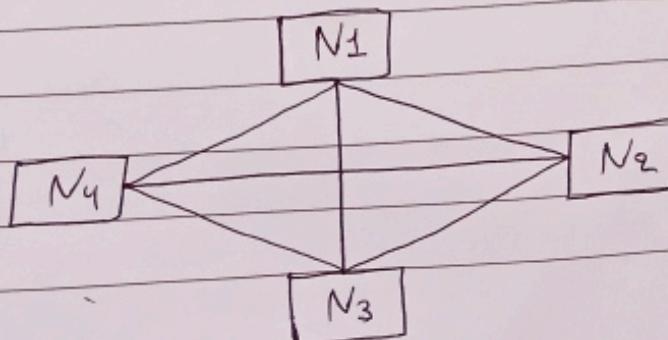
→ Disadvantages of Star Topology -

(i) If the central hub fails, the whole system fails.

(ii) The cost of installation is high due to hub and cable.



5.) Mesh Topology - In Mesh Topology every devices are connected to other devices by a particular channel.





Note:- (i) Every device is connected by other by dedicated channels and these channels are known as links.

(ii) Suppose  $N$  no of devices are connected with each other in a mesh topology, the total no of ports that are required by each device is  $(N-1)$ . So the total ports are required  $N*(N-1)$ .

### → Advantages of Mesh Topology -

- (i) It is robust (strong).
- (ii) It provides security and privacy.

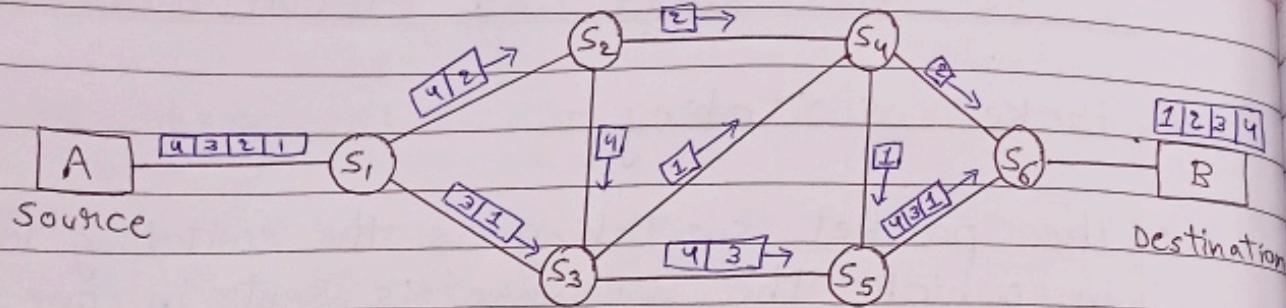
### → Disadvantages of Mesh Topology -

- (i) The cost of maintenance is high.
- (ii) Installation and configuration are difficult.
- (iii) The cost of cable is high as bulk wiring is required.

# Packet switching and circuit switching

## # Packet switching -

- The packet switching is the switching technique in which the message is sent in one go but it is divided into smaller pieces and they are sent individually.
- The message split into smaller pieces known as Packets and packets are given a unique number to identify their order at receiving end.
- Every packets contains some information in its header like source address, destination address, and sequence number.
- Packets will send across the network by shortest path as possible.
- All the packets are reassembled at receiving end in correct order.
- If any packet is missing or corrupted then the message is send to resend the message.
- If the correct order of packet is received then the acknowledgement message will be send.



## # circuit switching -

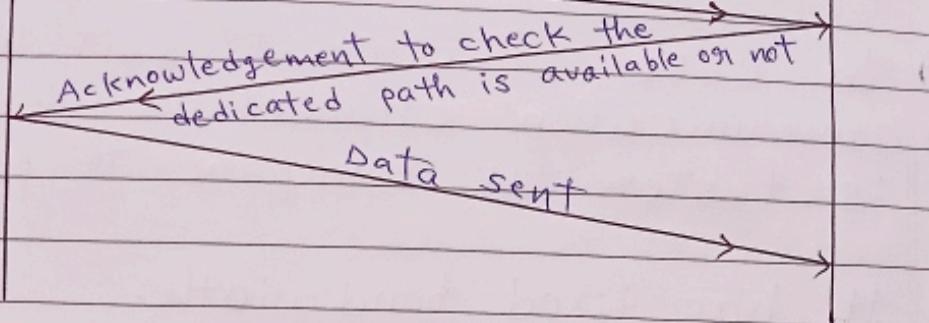
- Circuit switching is a switching technique that establishes a dedicated path b/w sender and receiver.
- In circuit switching once the connection is established then the dedicated path will remain to exist until the connection is terminated.
- A complete end to end path must exist before the communication take place.
- In case of circuit switching when the user wants to send the data, voice, video, a request signal is send to receiver then the receiver send back the acknowledgement to ensure the dedicated path is available or not. After receiving the acknowledgement, dedicated path transfer the data.



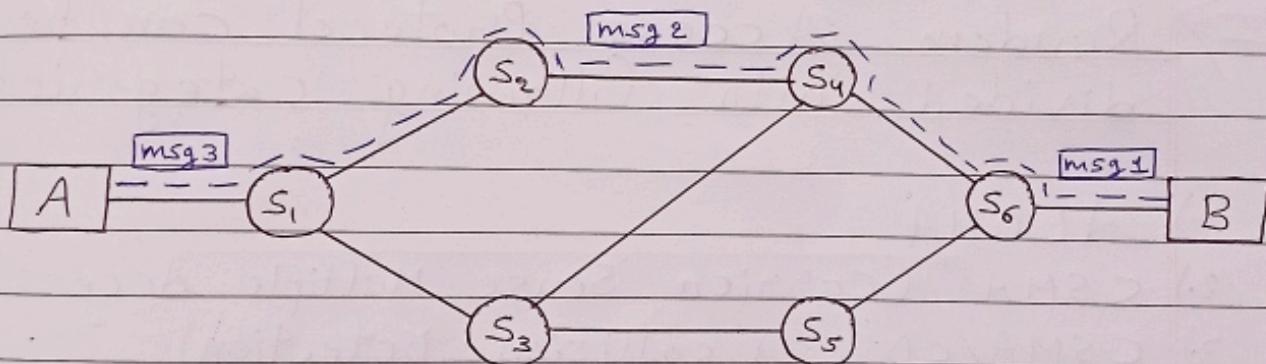
Sender

Request

Receiver



- circuit switching is used in public telephone network. It is used for voice transmission.
- Fixed data can be transferred at a time in circuit switching transmission.



\* Communication through circuit switching has three steps -

- ① circuit establishment
- ② Data Transfer
- ③ circuit Disconnect



## \* Advantages of circuit switching -

- ① In case of circuit switching the communication channel is dedicated. So it is faster as compare to packet switching.
- ② It has fixed bandwidth.

## \* Disadvantages of circuit switching -

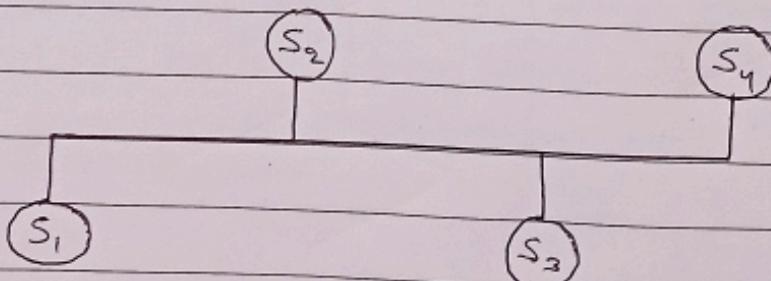
- ① It is more expensive than packet switching because a dedicated path is ready for each connection.

⇒ Random Access Protocol can be divided into following categories :-

- 1.) ALOHA
- 2.) CSMA (Carrier Sense Multiple Access)
- 3.) CSMA/CD (Collision Detection)
- 4.) CSMA/CA (Collision Avoidance)

## # Carrier Sense Multiple Access (CSMA) -

To minimize the chance of collision, therefore increase the performance the CSMA was developed.





### \* Principle of CSMA -

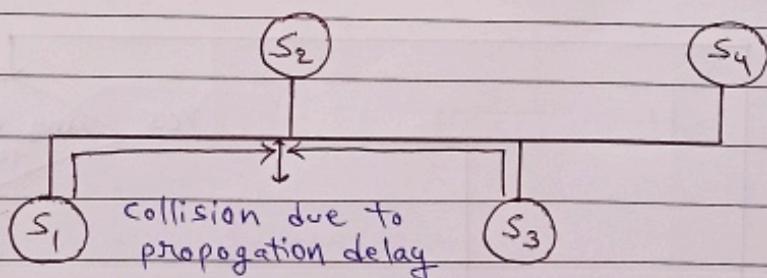
"Sense before transmit or listen before talk".

\* Carrier busy - Transmission is taking place i.e. channel busy.

\* Carrier idle - No transmission currently taking place.

The possibility of collision still exist because of propagation delay.

A station may sense the medium and find it idle, only because the first bit send by another station has not been received.



### # Carrier sense Multiple Access / Collision Detection -

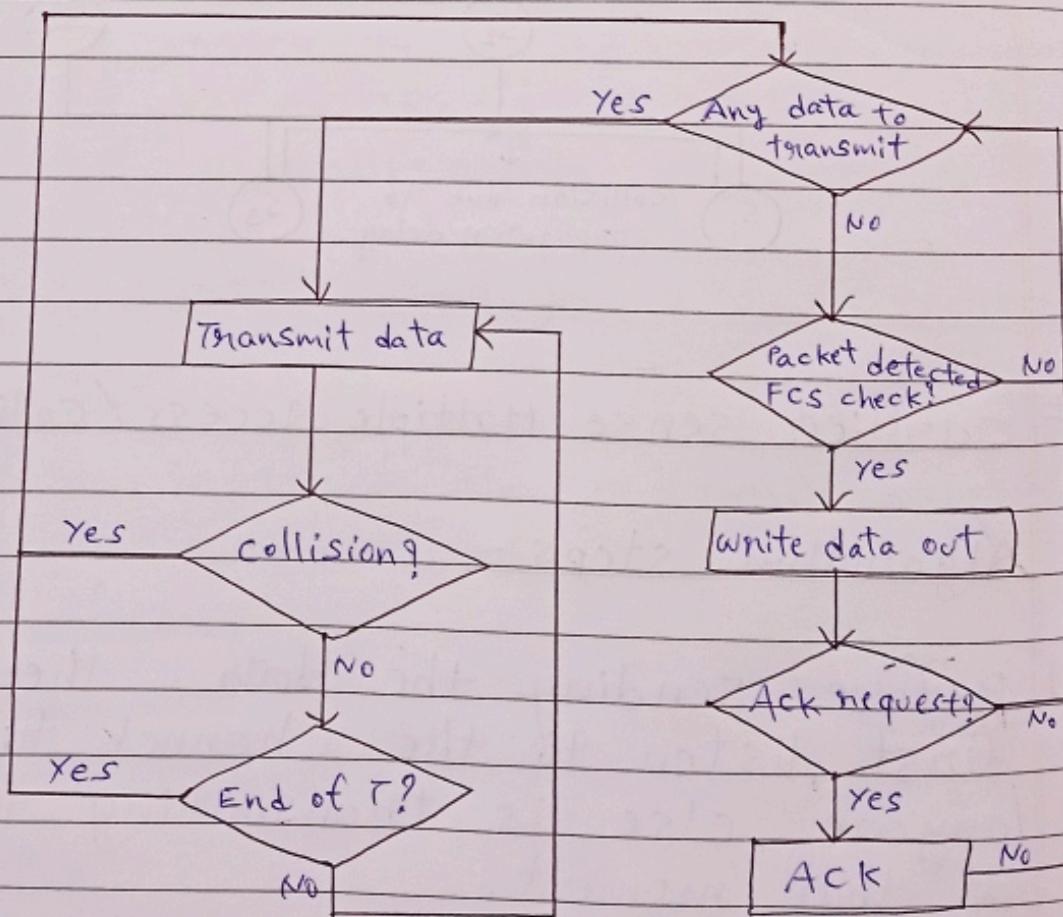
Algorithm steps -

- Before sending the data, the station first listen to the channel to see if anyone else is transmitting the data at that moment.



- (ii) If the channel is idle, the station transmits a frame.
  - (iii) If the channel is busy, then senses the transmission medium continuously until it becomes idle.
  - (iv) Transmit the data and check for collision. CSMA/CD does not use an acknowledgement system. It checks for successful and unsuccessful transmission through collision signals. During transmission if collision signal is received by the node, transmission is stopped, otherwise transmission take place.

## CSMA/CD





## CARRIER SENSE MULTIPLE ACCESS / COLLISION AVOIDANCE -

CSMA/CA is a network protocol for carrier transmission that operates in the medium access control (MAC) layer.

CSMA/CD deals with collision after their occurrence but CSMA/CA prevents collision before their occurrence.

### Algorithm -

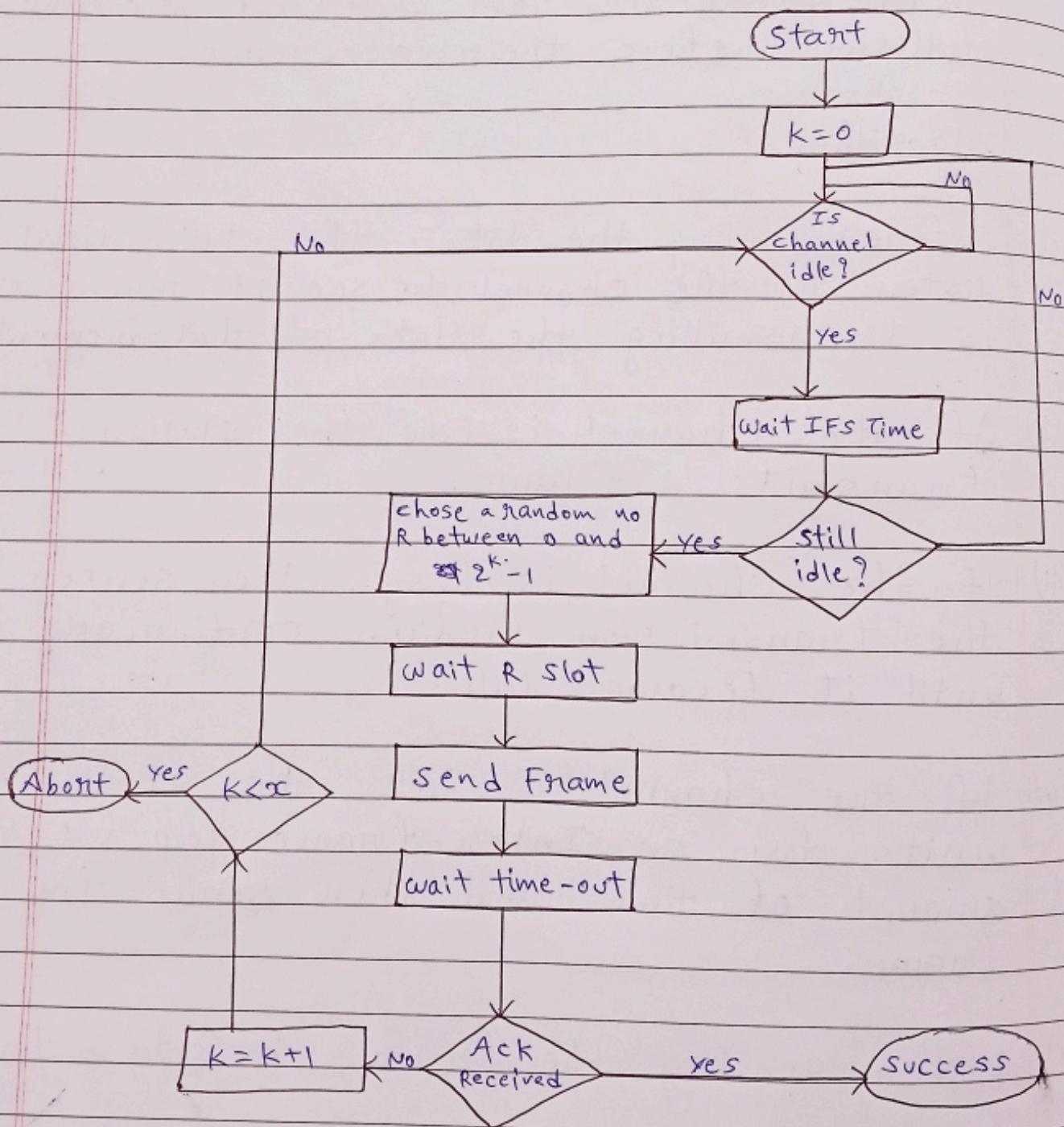
- (i) Before sending the data, the station first listens to the channel to see if anyone else is transmitting the data at that moment.
- (ii) If the channel is idle, the station transmits a frame.
- (iii) If the channel is busy, then senses the transmission medium continuously until it becomes idle.
- (iv) If the channel is idle, the station waits for an Inter-frame gap (IFG) amount of time and then sends the frame.
- (v) After sending the frame, it sets a timer.
- (vi) The station then waits for acknowledgement from receiver. If it receives the



acknowledgement before expiring of timer, it makes a successfull transmission.

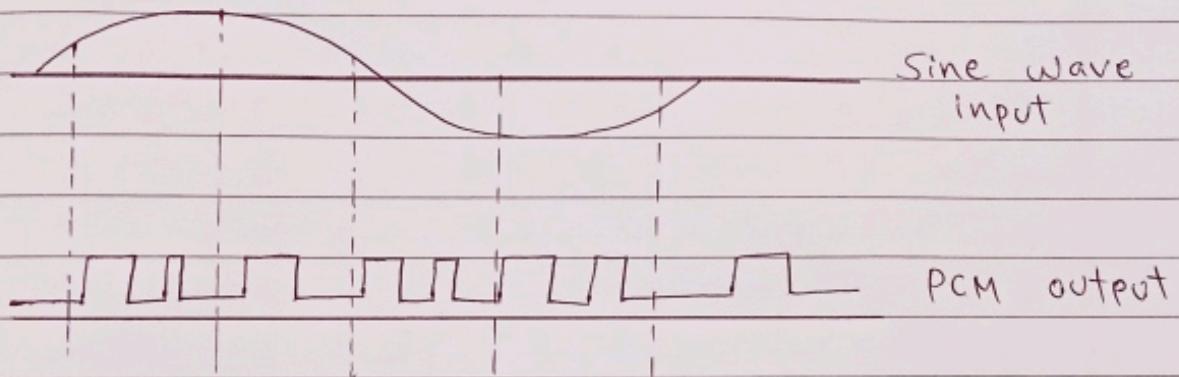
- (vii) otherwise, it waits for back-off time period and restarts the algorithm.

### CSMA/CA



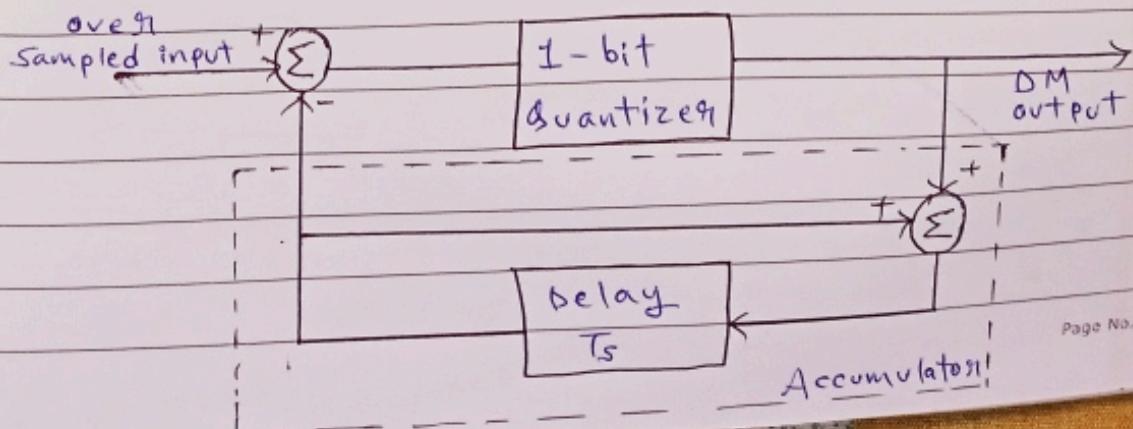
## # Pulse Code Modulation - (PCM) -

when a digital signal undergoes Pulse Code Modulation, it converts the analog information into a binary sequence (1 and 0). It is the standard form of digital audio in computers, compact discs, digital telephony and other digital audio applications.



## # Delta Modulation (DM) -

A delta modulation is an analog-to-digital and digital-to-analog signal conversion technique used for transmission of voice information where quality is not of primary importance. In delta modulation, the transmitted data are reduced to a 1-bit data stream.



# Routing - Routing is the process of selecting a path for traffic in a network or between or across multiple networks. Broadly, routing is performed in many types of networks, including circuit-switched networks, such as the Public switched telephone network and computer networks, such as the Internet.