UNIT-1

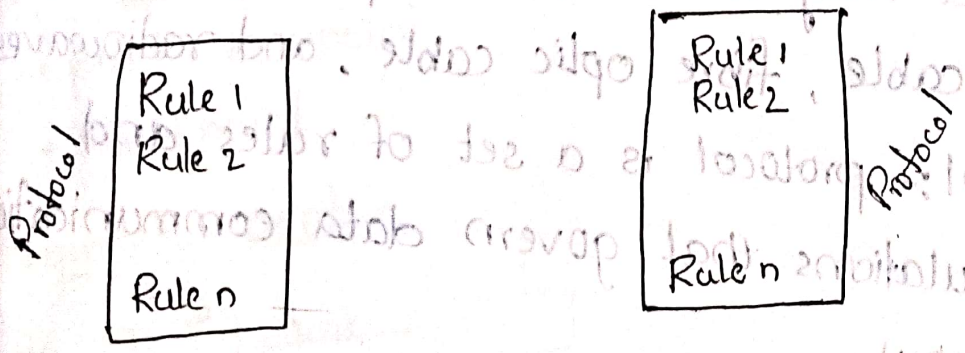
Introduction to DATA COMMUNICATION and NETWORK MODEL

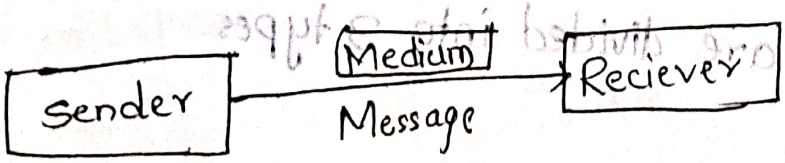
1. Data Communication:-

Data communications systems is effectiveness is depends on four fundamental characteristics.

1. Delivery.
2. Accuracy
3. Timeliness
4. Jitter.

Components:-





1. Sender
2. Reciever
3. Message
4. Medium
5. Protocol

A data communications system has five components. 1. Mess

1. Message :- Text. Numbers, Audio, Video, images etc...

2. Sender :- It may be a computer, work station, telephone handset, video camera etc...

3. Reciever :- Computer, work station, telephone etc...

4. Medium :- It is the physical part to which a message is transmitted from the sender to the receiver.

It may be a twisted-pair wire, coaxial cable, fibre optic cable, and radiowaves.

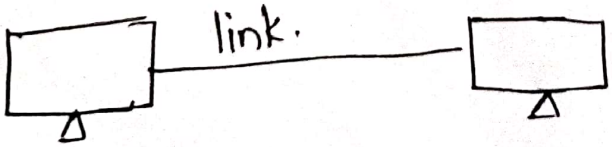
5. Protocol :- protocol is a set of rules and regulations that govern data communication

II DATA FLOW :-

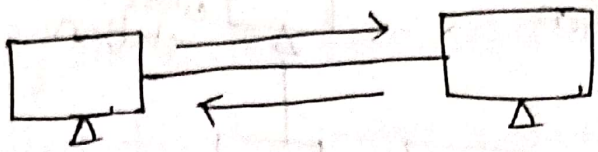
Dataflow are divided into 3 types.

1. Simplex
2. Half- Duplex.
3. Full- Duplex.

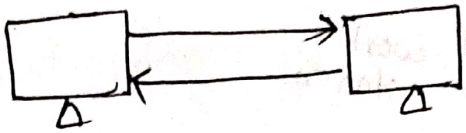
1. Simplex :-



2. Half - Duplex :-



3. Full - Duplex :-



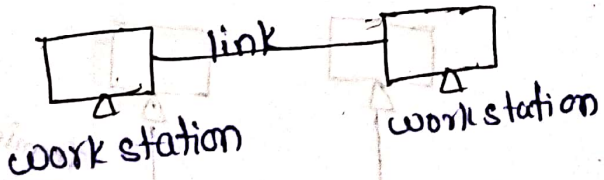
III NETWORK CRITERIA :-

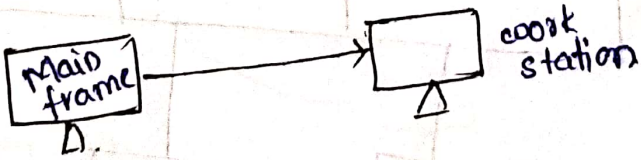
- performance
- Reliable
- Security.

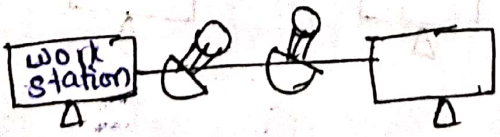
IV Types of connections :-

- point - to - point
- Multipoint.

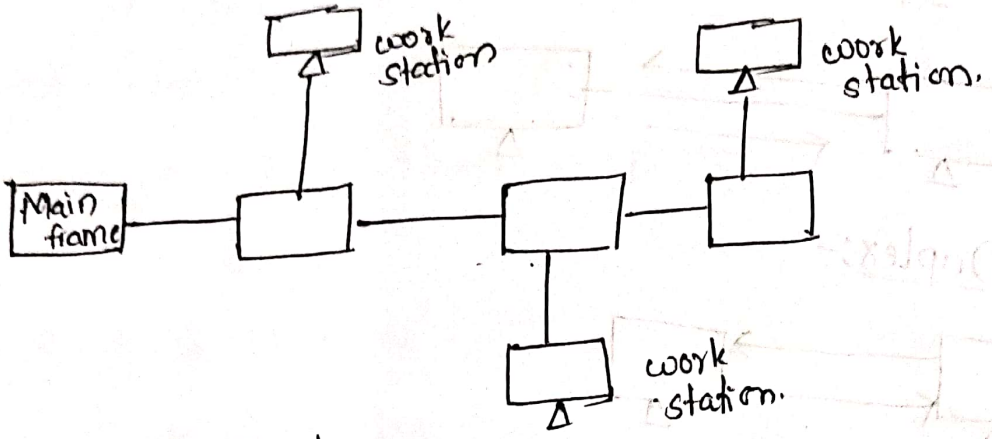
Point - to - point :-

1. 

2. 

3. 

* Multipoint:-



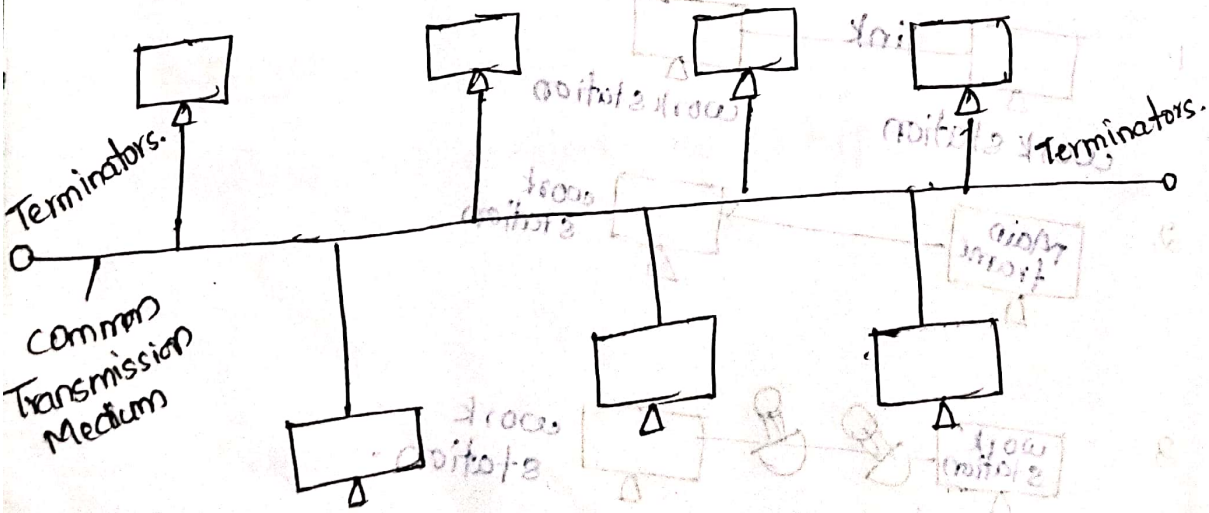
* Physical Topology:-

1) Bus Topology
2) Ring Topology
3) Star Topology
4) Mesh Topology
5) Hybrid Topology.

→ The Relation ship among the two nodes is of two nodes.

a) peer-to-peer
b) primary-secondary.

1. Bus Topology:-



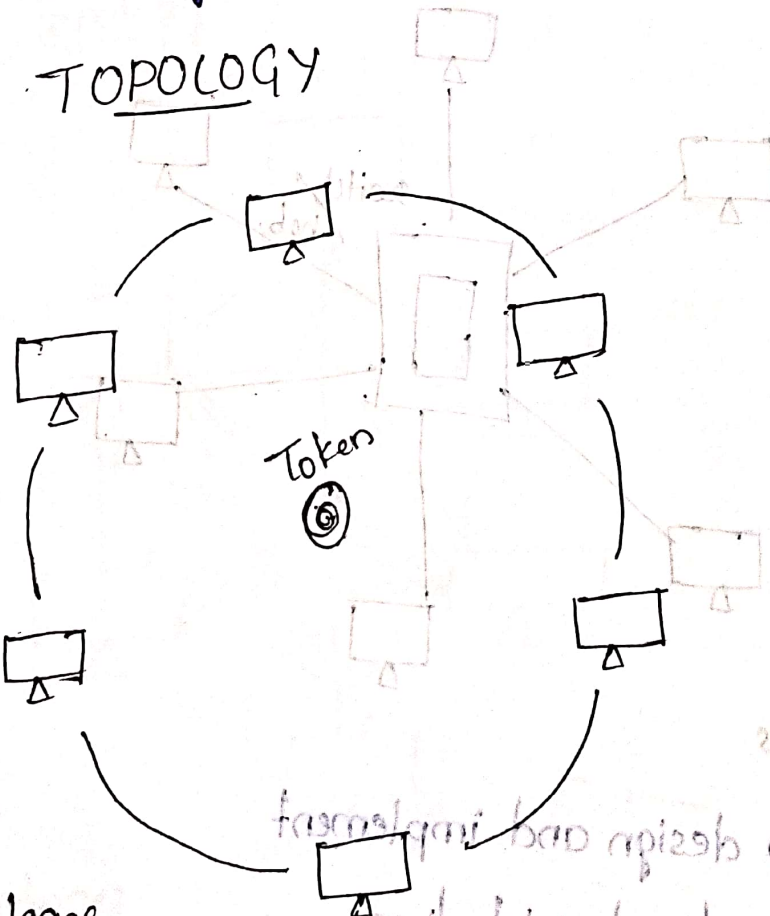
Advantages of Bus Topology:-

→ Only one wire - less expensive
→ Suited for temporary ~~networ'd~~ network.
→ Node failures does not effect others.

Disadvantages of Bus Topology:-

→ Not fault tolerent
→ Limited cable length
→ No security.

RING TOPOLOGY



Advantages

→ Performance better than bus topology.
→ All nodes with equal access.

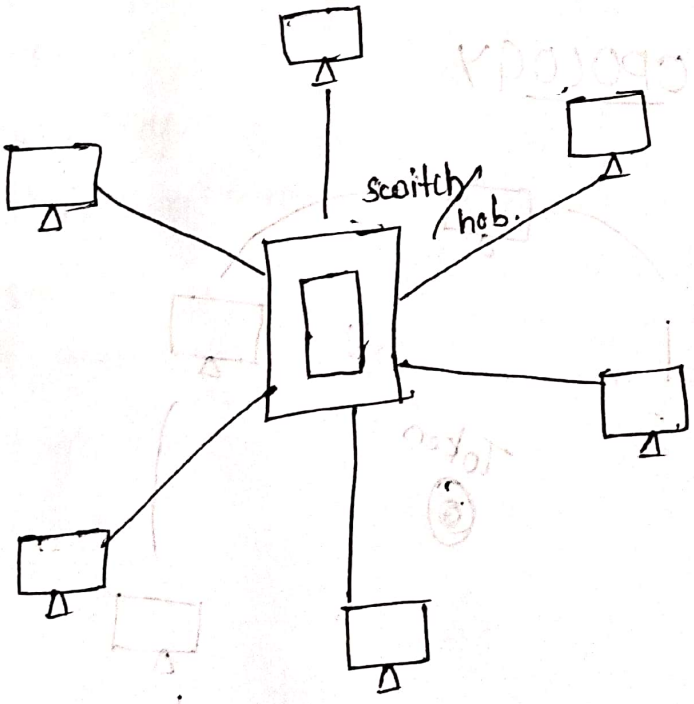
Disadvantages

→ Uni directional- single point of failure will effect the whole network.

→ Heavy load - low performance.

→ No security.

STAR TOPOLOGY



Advantages

→ Easy to design and implement

→ Centralized administration.

→ Scalable

Disadvantages

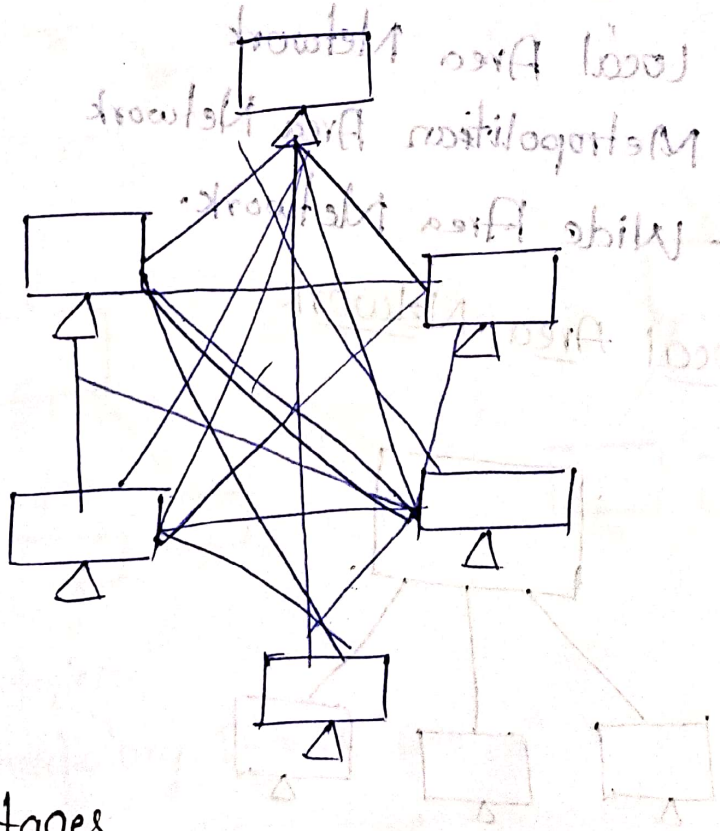
→ Single point of failure ie effects the whole network.

→ Communication of performance will be effected when there is overloaded switch/hob

→ Increased cost due to switch/hob

Note:- Extended star topology using repeater

Mesh Topology



Advantages

→ Fault tolerent

→ Reliable

Disadvantages

→ Issues with broadcasting messages.

→ Expensive and impractical for large network

Note:- Broadcast:-

↓

one sender and all receivers

HYBRID TOPOLOGY

Combination of different topologies

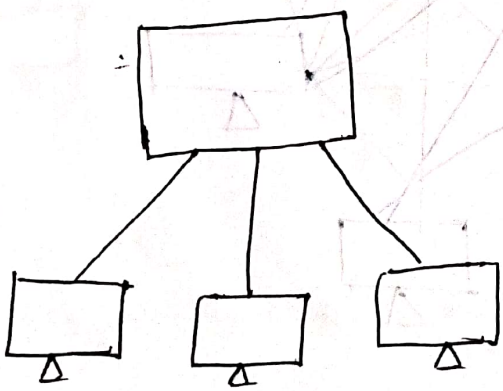
NETWORK MODEL

i. LAN - Local Area Network

ii, MAN - Metropolitan Area Network

iii, WAN - Wide Area Network.

i, LAN - Local Area Network



wired (ethernet)

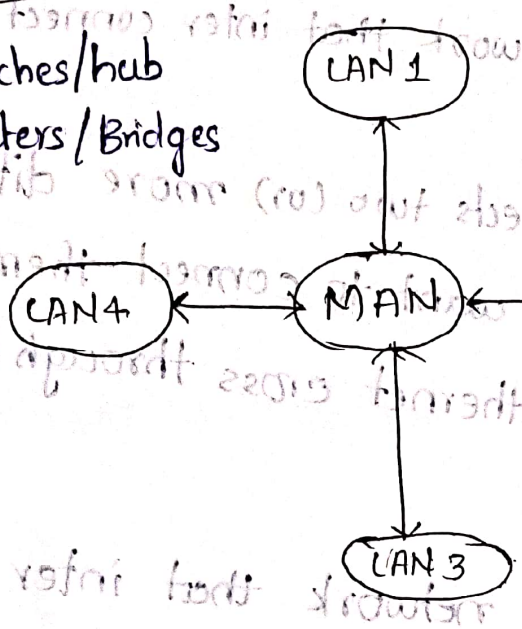
wireless (wi-fi)

→ Depends on size, type and topology.

ii) MAN - Metropolitan Area Network

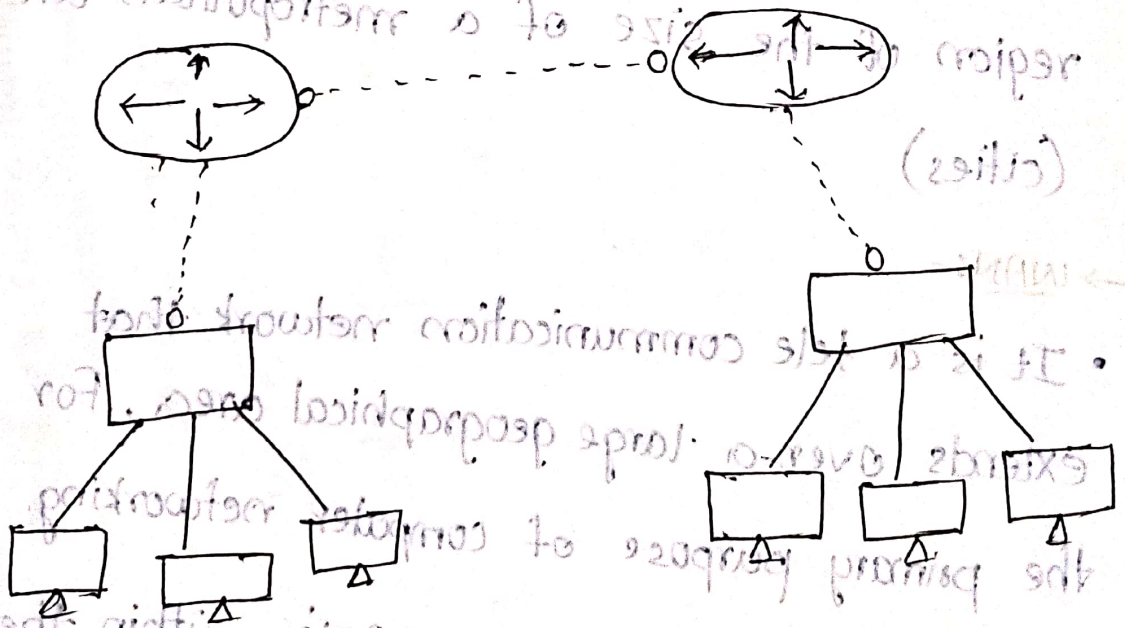
→ Switches/hub

→ Routers / Bridges



→ Depends on size, type, topology

iii) WAN - Wide Area Network



→ End devices.

→ Intermediatory Devices.

→ Depends on sizes, types, topology.

→ LAN

- It is a computer network that inter connect

- Ethernet - which connects two (or) more different kind of nodes, if we want to connect them directly we go for ethernet cross through cable.

→ MAN

- It is a computer network that inter connects users with computer resources in a geographical region of the size of a metropolitan area (cities)

→ WAN:-

- It is a tele communication network that extends over a large geographical area, for the primary purpose of computer networking.
- In WAN two (or) more LAN's within the country can communicate each other.

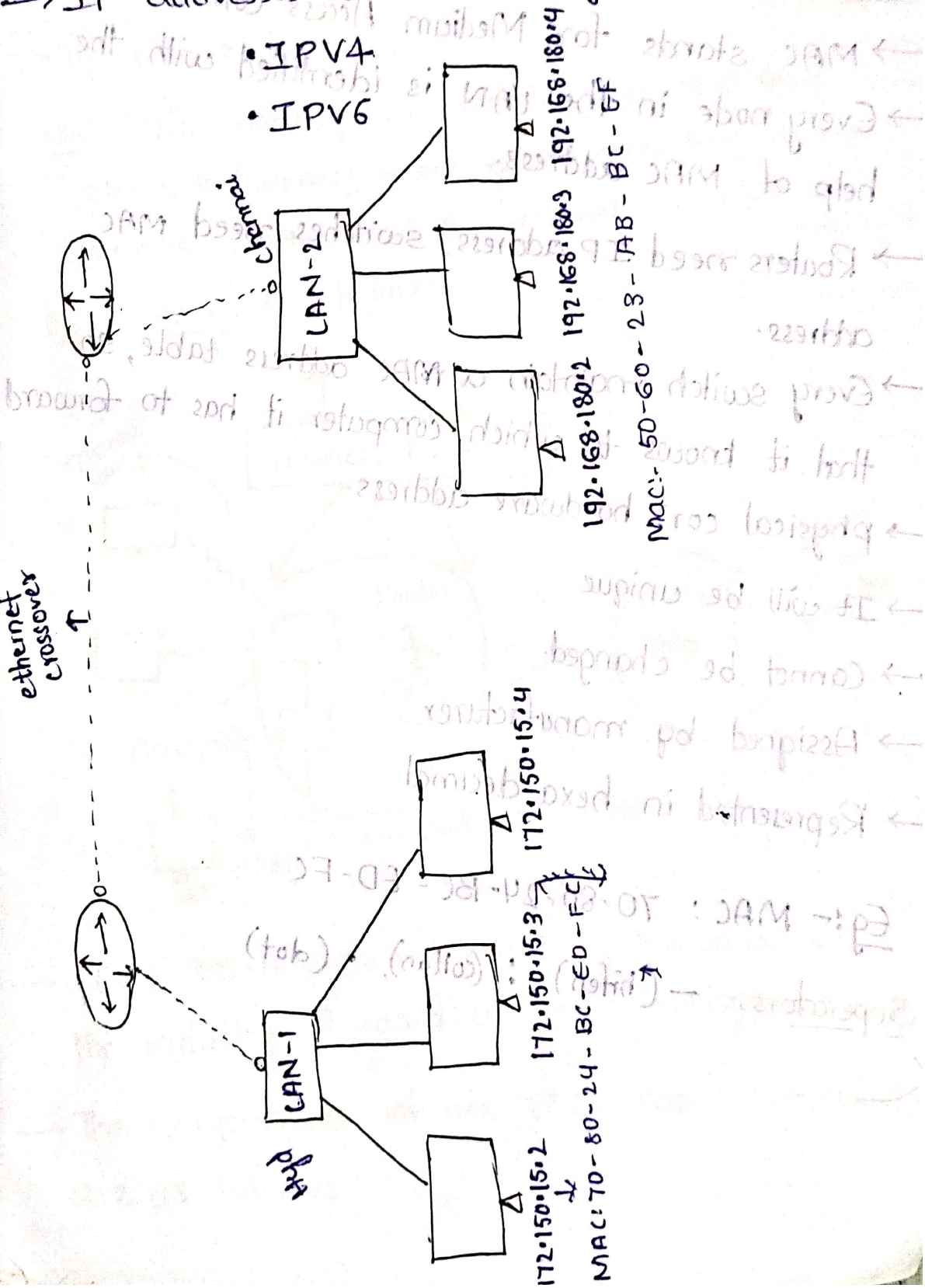
BASICS OF IP ADDRESSING

→ IP stands for Internet Protocol.

→ Every node in the computer Network is identified with the help of IP address.

→ IP addresses are of two types:

- IPV4
- IPV6



→ IPV4 addresses are represented in decimals and it has four octets (x.x.x.x)

→ Each of x value takes from 0.0.0.0 to 255.255.255.255

BASICS OF MAC:

→ MAC stands for Medium Access Control.

→ Every node in the LAN is identified with the help of MAC address.

→ Routers need IP address, switches need MAC address.

→ Every switch maintain a MAC address table, so that it knows to which computer it has to forward

→ physical or hardware address.

→ It will be unique.

→ Cannot be changed.

→ Assigned by manufacturer

→ Represented in hexa-decimal

Eg:- MAC : 70-80-24-BC-ED-FC

Seperators:- - (hifen) : (collan), . (dot)

Wireless Network:-

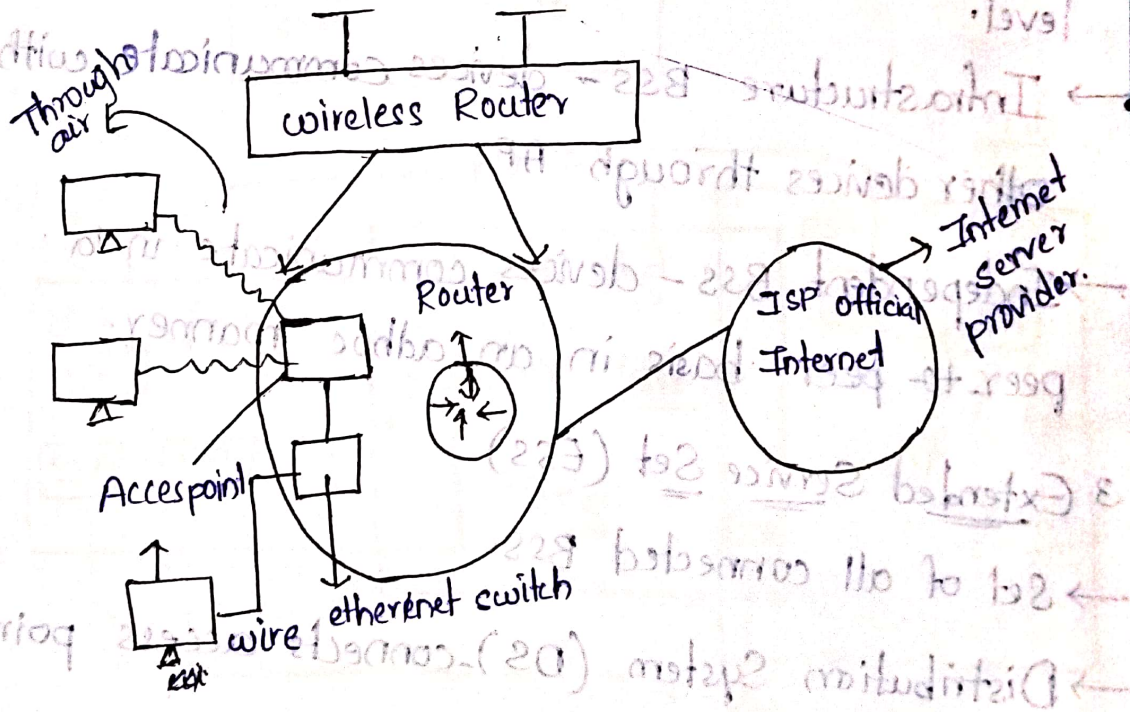
→ Wireless is the connecting devices without wire is made up of electromagnetic wave (or) infrarate waves.

→ The wireless devices contains antennas (or) sensors

→ Types of Networks.

Wifi:- The industry standard wireless local Area Network (WLAN) technology for connecting devices to one another and the internet. wi-fi (wireless fidelity)

IEEE 802.11 Architecture:-



→ IEEE 802.11 standard, popularly known as wi-fi the industry standard WLAN technology.

→ The components of an IEEE 802.11 architecture are as follows.

1. Station (sta) comprises all devices and equipment that are connected to the wireless land.

→ station can be of two types WAP (or) AP (wireless access point (or) Access point)

→ Wireless Access points are generally wireless routers that form the base station (or) access.

→ Clients:- Workstation, laptops, computers, printers etc.

2. Basic Service Set (BSS):

→ Group of stations communicating at physical layer level.

→ Infrastructure BSS - devices communicate with other devices through AP.

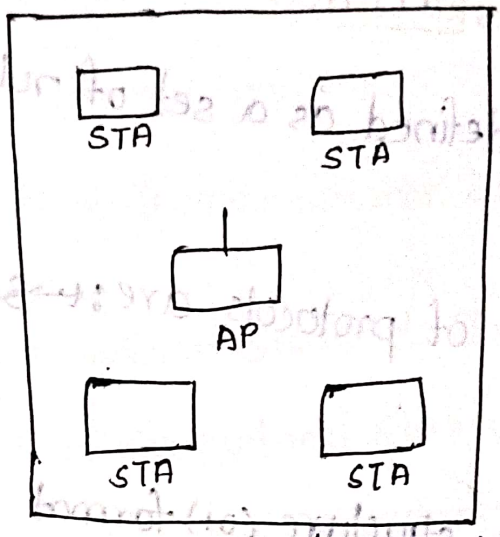
→ Independent BSS - devices communicate in a peer-to-peer basis in an adhoc manner.

3. Extended Service Set (ESS)

→ Set of all connected BSS.

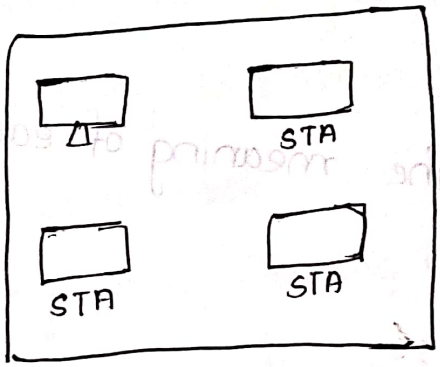
→ Distribution System (DS) connects access point in ESS.

1.



Infrastructure of Network "BSs with an AP"

2.



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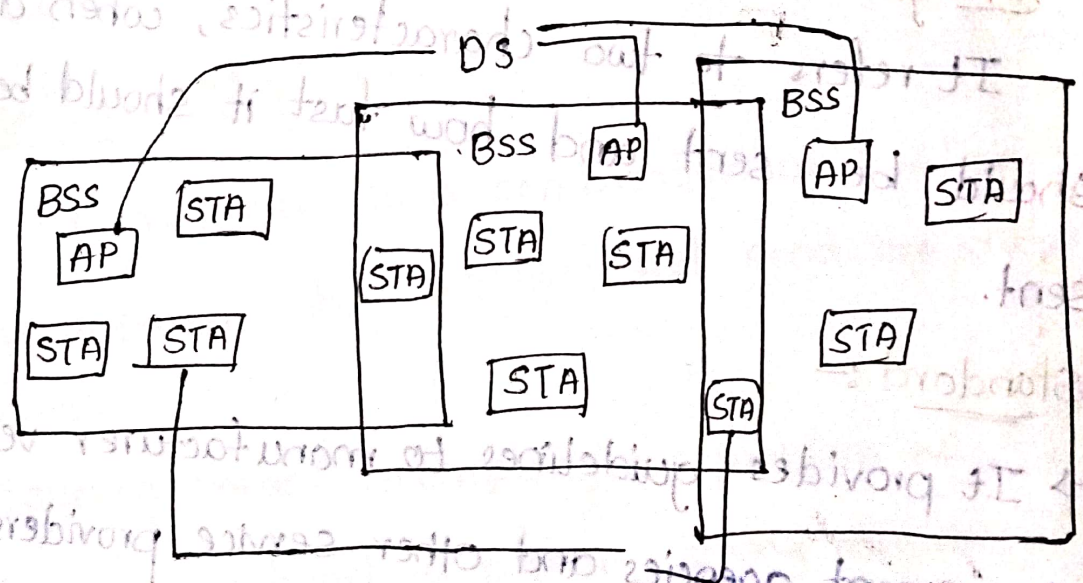


Protocols and Standards

→ A protocol is defined as a set of rules that govern the data.

→ The key elements of protocols are: ~~Syntax~~

1. Syntax:-

It refers to the structure (or) format of the data.

2. Semantic:-

It refers to the meaning of each section of bits

3. Timing:-

It refers to two characteristics, when data should be sent and how fast it should be sent.

Standard :-

→ It provides guidelines to manufacturer vendo government agencies and other service providers.

Data communication fall into two categories.

1. Defactor ("By fact" (or) By convention)
2. De-jure ("By law" (or) By regulation)

The organisations which maintain standards:-

1. International organisational for standardisation (ISO)
2. International Telecommunication union-telecommunication (ITU-T)
3. American National Standards Institute (ANSI)
4. Institute of electrical and Electronic Engineers (IEEE)
5. Electronic Industries Association (EIA)

Internet Standards Organisation:-

1. Internet Engineering Task Force (IETF)
2. Internet Research Task Force (IRTF)
3. Internet Engineering Steering Group (IESG)
4. Request for Comments (RFC)

Network Models:-

A network is a combination of hardware and software that receives and send the data

Layer:-

Layering means decomposing the problem of building a network into more ~~manag~~ manable manageable components.

- Higher layer
- Middle layer
- Lower layer.

Connection oriented and connectionless oriented services

Layers can offer two types of services

1. Connection oriented service.
2. Connectionless oriented service.

1. Connection oriented service:-

- Establish the connection
- Use the connection.
- Release the connection.

2. Connectionless oriented service

Connectionless service is much the same as the postal service

3. Quality of service:-

- Reliable
- Unreliable

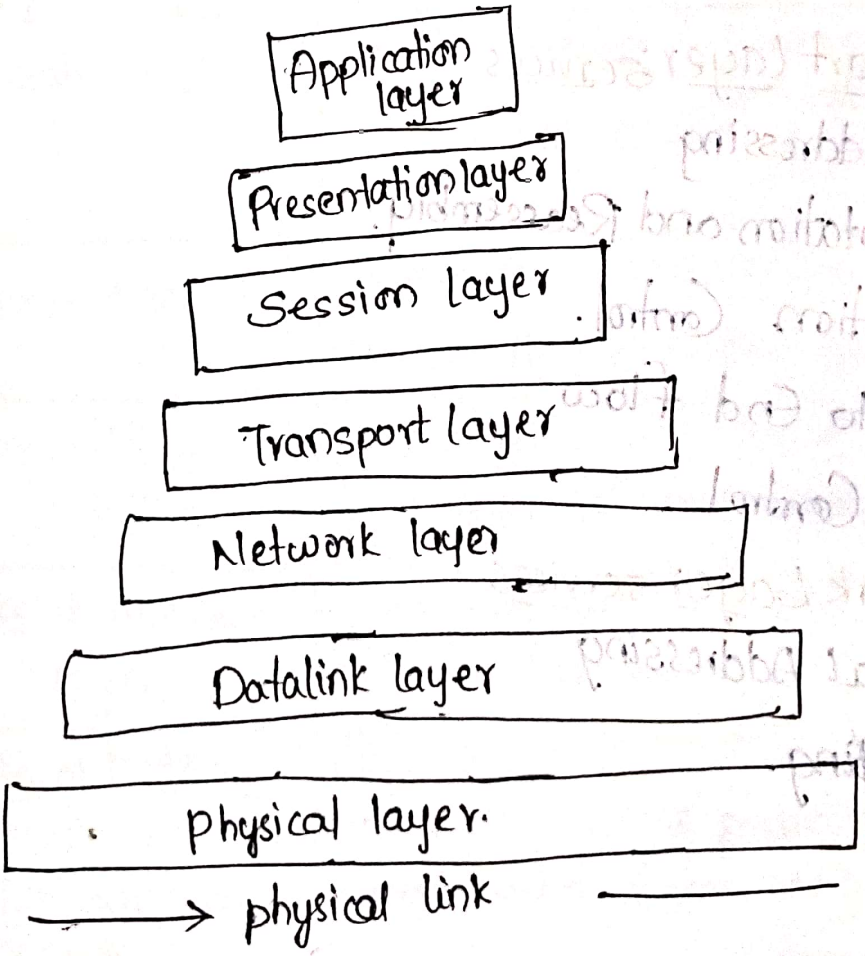
Service Primitives:-

A primitive means operation. A service is described by a set of primitives.

- Listen
- Connect
- Send
- Receive
- Disconnect.

OSI Model

The purpose of the OSI Model is to facilitate communication between different systems without requiring changes to the logic of the underlying hardware and software.



Services provided by the Application Layer

① FTAM (File Transfer and Access Management)
→ It allows to send the data to remote the computer or receive the data from the remote computer.

② Mail services (allows to access email services)

③ Directory services (provides access to data globally)

Presentation layer services :

- Translation.
- Encryption
- Compression

Session Layer services

- Dialog control
- Synchronization.

Transport Layer services

- port addressing
- segmentation and Reassembly.
- Connection Control.
- End-to End flow
- Error Control

Network Layer services

- Logical Addressing
- Routing.

Datalink layer services

- Framing
- physical Addressing
- Flow control
- Error control
- Access Control

Physical layer services

- physical characteristics of the media
- Representation of bits
- Data rate (Transmission ~~layer~~ Rate)
- Synchronization of bits.
- Line configuaration — point to point (or) point to multipoint
- physical topology
- Transmission mode

TCP/IP layers	Functionalities.
Application layer	provides interface between users and network to access network resources.
Transport layer.	Segmentation, process to process communication, error free delivery.
Internet layer.	Moving packets from source to destination, provides routing.
Network interface layer.	Control the hardware and media that constitute the network.

Protocol Data unit (PDU):—

PDU's are named according to the protocols of the TCP/IP suite, data, segment, packet, frame and bits.

Application layer - Data
Transport layer - segment
Network layer - packet
Datalink layer - frames
physical layer. - Bits.

DATA AND SIGNALS:-

signals:-

It is a function that represents the variation of a physical quantity with respect to time. Two type of signals

1. Analog signal
2. Digital signal.

Analog signals have continuous electrical signals. while Digital signals have non-continuous electrical signals.

1. Analog signal:-

→ It is the signal that can take any value in the defined range.

→ All real life signal are analog in nature

Ex: Human's voice.

2. Digital Signal:-

→ It is the signal that can take on of the finite values at any given time.

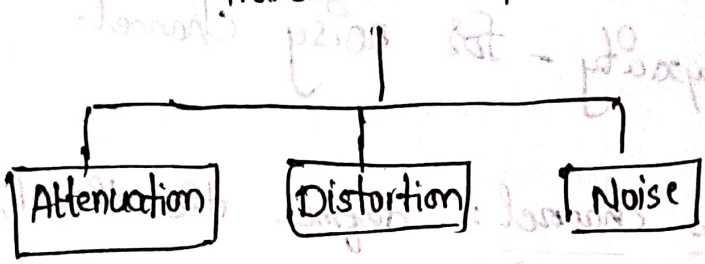
→ In case of digital signals, we discretize both time and magnitude

Ex:- Files in a disc.

Transmission impairment:-

When the received signal is not identical to the transmitted one due to the transmission impairment. The quality of the signals will get destroyed due to trasmission impairment.

causes of Transmission Impairment



Attenuation:-

It means loss of energy.

Distortion:-

Distortion occurs where there is a change in shape of signal.

Noise:- When data is travelled over a transmission medium, some unwanted signal is added to it which creates the signal.

Data rate: Refers to the speed of data transfe a channel. It is generally computed in bits per second (bps). Higher data rates are expressed as Kbps ("kilo" bits per second i.e 1000 bps) Mbps ("Mega" bits per second, i.e, 1000 kbp) Gbps ("Giga" bits per second)

1. Bandwidth of the channel
2. Number of levels of signals that are used.
3. Noise present in the channel.

Data rate can be calculated using two theoretical formulas:

- Nyquist Bit Rate - for noiseless channel.
- Shannon's Capacity - for noisy channel.

For a Noiseless channel: defines the theoretical maximum bit rate.

The theoretical formula for the maximum bit rate is: maximum bit rate = 2 x Bandwidth x $\log_2 V$

Here, maximum bit rate is calculated in bps.

- Bandwidth (The difference between the maximum frequency and the minimum frequency) is the bandwidth of the channel.
- V is the number of discrete levels in the signal.

→ called the shannon capacity to determine the theoretical highest data rate for a noisy channel

capacity = Bandwidth x $\log_2(1+SNR)$

→ Here, capacity is the maximum data rate of the channel in bps.

Bandwidth is the bandwidth of the channel

SNR is the signal-to-noise ratio.

→ SNR is actually the ratio of what is wanted (signal-to) what is not wanted (noise) a high SNR means the signal is less corrected by Noise. If low SNR means the signal is more corrected by the Noise.

→ SNR = $\frac{\text{Average signal power}}{\text{Average noise power}}$

Performance:-

The examination and review of collective network information and review of collective network information to describe the quality of services delivered by the underlying computer network is knows as "network performance".

Hence, to measure the performance of a network here are the major factors to be considered.

- Transit time
- Response time.
- Bandwidth.

Band width in bps

Bandwidth = capacity.

Eg:- Gigabit Ethernet can provide a bandwidth of 1 Gbps.

Bandwidth in Hertz

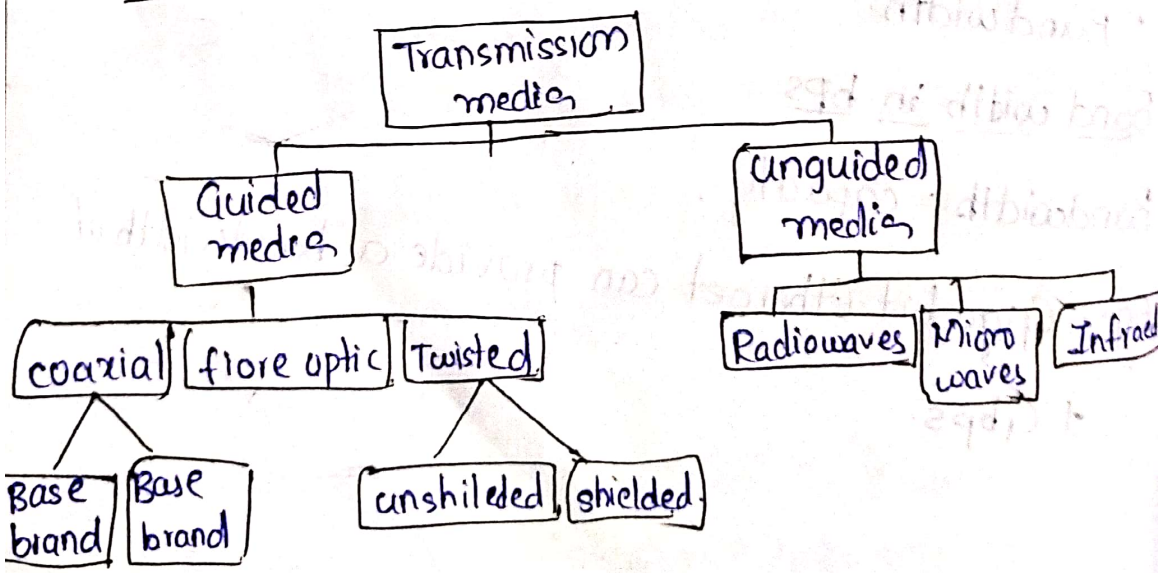
→ Arrange of frequencies used to transmit signals which is measured in hertz

→ A link may have a bandwidth of "B" bps but we can only send "T" bps through this link with T<B always.

Delay/Latency:- As we discussed, Throughput is the number of data packets successfully delivered in a given time. Delay is the measure of time taken to do the delivery.

The latency or delay defines how long it takes for an entire message to completely arrive at the destination from the time taken to the delivery.

Classification of Transmission media:-



Guided Media:-

It is also referred to as wired or bounded transmission media signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:-

→ High speed
→ Secure
→ used for comparatively shorter distance.

Types of Guided Media:-

1. Twisted pair:-

Copper wire are the most common wires used for transmitting signals because of good performance at low costs. However, if two or more wires are lying together they can interfere with each other's signals. To reduce this electromagnetic interference, pair of copper wires are twisted together in helical shape like a DNA molecule.

A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.

unshielded twisted pair (UTP)

UTP is an unshielded twisted pair cable used in computer and telecommunication medium

Advantages:-

→ It is cheap
→ Installation of the unsheilded twisted pair is easy.
→ It can be used for high speed LAN.

Disadvantages:-

→ This cable can only be used for shorter distances because of attenuation.

→ lower capacity and performance in comparision to STP

Shielded twisted pair (STP)

A STP is a type of twisted pair cable that contains an extra wrapping foil or copper braid jacket to protect the cable from defects like cuts, noise and signal to the interference.

Advantages:-

→ It has lower noise and attenuation than UTP

→ It is shielded with a plastic cover that protects the STP cable from a harsh environment and increases the data transmission rate.

Disadvantages:-

→ It is more expensive as compared to UTP and coxial cable.

→ It has a higher attenuation rate.

Coxcial Cable:-

→ Coaxial cable is very commonly used transmission media, for example, TV wire is a coxial cube.

→ The name of the cable is coxial as it contains two conductors parallel to each other.

→ It has a higher frequency.

Coaxial cable is two types:-

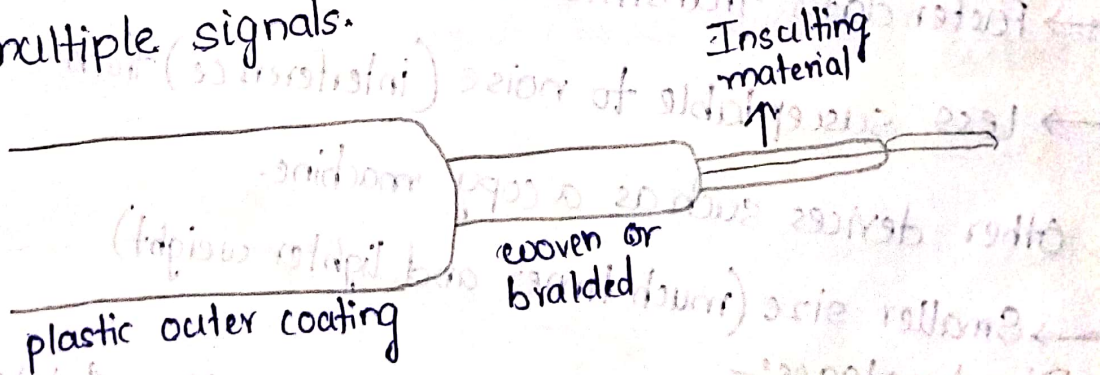
1. Base bond transmission
2. Broad band transmission.

1. Baseband transmission:-

It is defined as the process of tramitting a single signal at high speed.

2. Broad band transmission:-

It is defined as the process of transmitting multiple signals.



Advantages:-

→ The data can be transmitted at highspeed.

→ It has better shielding as compared to

twisted pair cable.

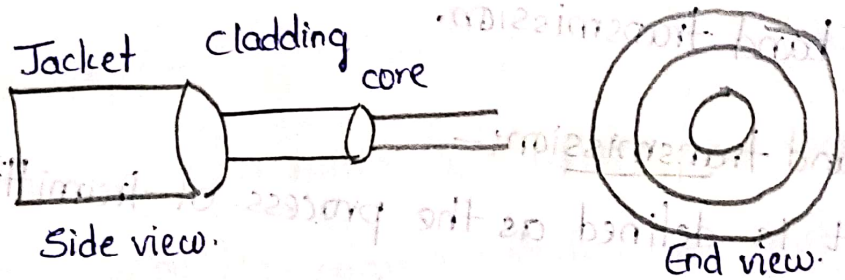
→ It provides higher bandwidth.

Disadvantages:-

→ It is more expensive as compared to twisted pair cable.

→ It any fault occurs in the cable causes the failure in the entire network.

Fibre Optic Cable:-



Advantages:-

→ Capability of carrying significantly more signals than wire cable.

→ Faster data transmission.

→ Less susceptable to noise (interference) from other devices such as a copy machine.

→ Smaller size (much tinner and lighter weight)

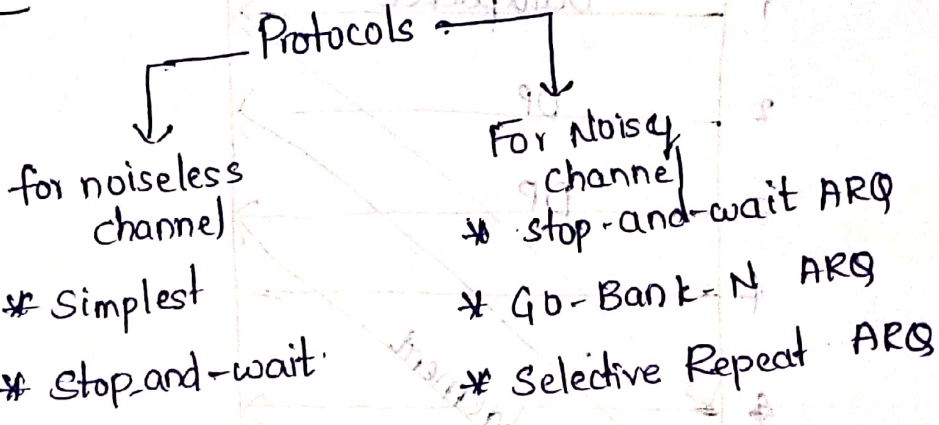
Disadvantages:-

Fibre optic cables are it costs more than twisted pair or coxial cable and can be difficult to install and modify.

Error Control:-

→ Error control is a combination of both error detection and error correction it ensures that the data received at the receiver end in the same as the one send by the sender.

Protocols:-



ARQ (Automatic Repeat Request)

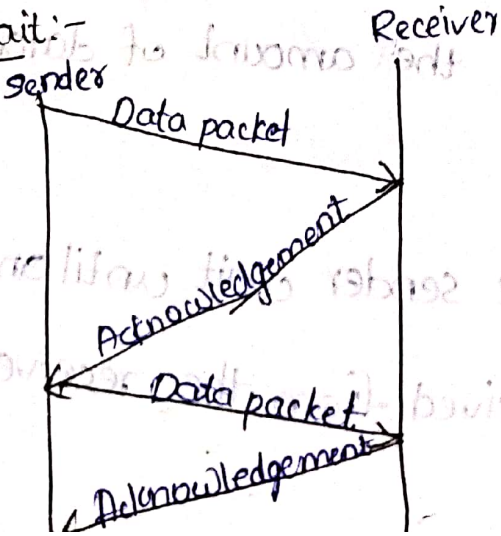
Fig:- Taxonomy of protocols.

Flow Control:-

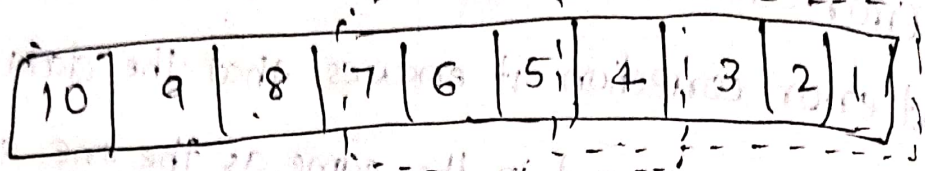
→ stop and wait protocol (sends only one frame at a time)

→ sliding window protocol (sends several frames at a time)

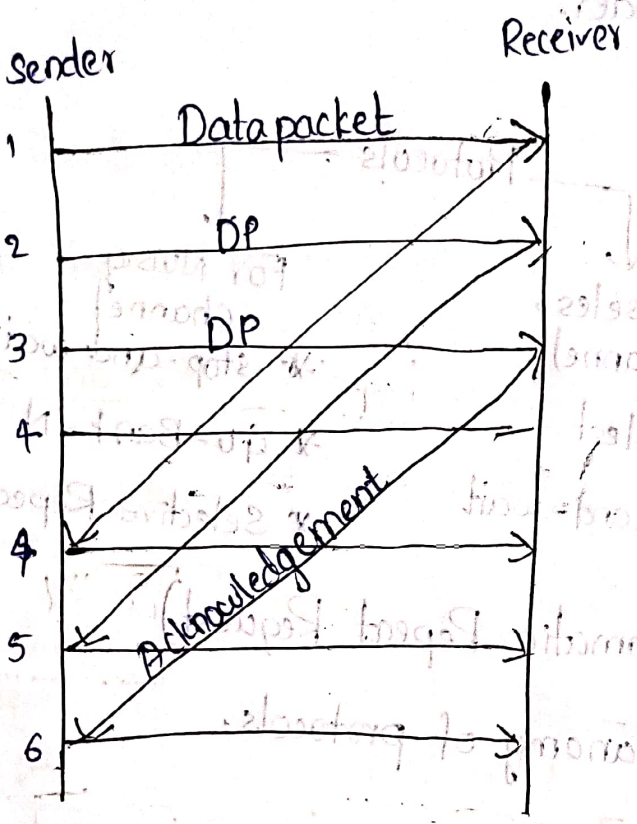
Stop & wait:-



Sliding-window Protocol:-



window size = 4



Flow control:-

→ Flow control is essential function of the datalink layer.

→ It determines the amount of data that sender can send.

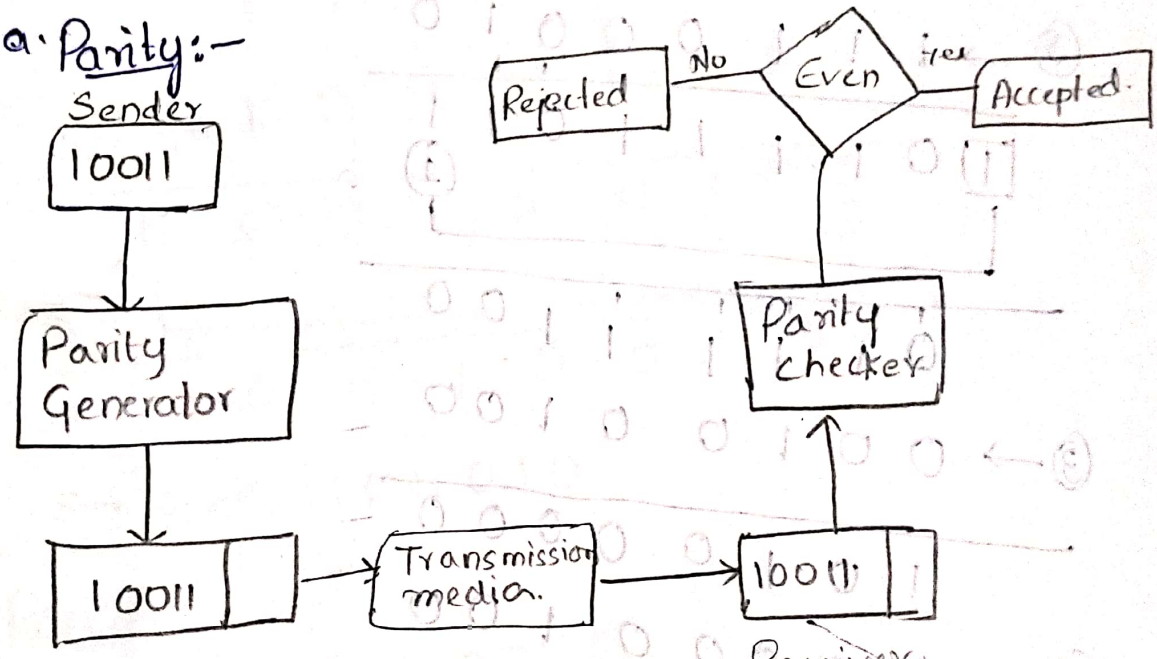
→ It makes the sender wait until an acknowledgement is received from the receiver's end.

→ Methods of flow control are stop and wait, sliding window.

Error Correction and Detection:-

1. Error Detection:-
   a. Parity
   b. Checksum
   c. CRC (cyclic Redundancy check)

a. Parity:-



Note:- Rule: P_1 – check one bit, skip one bit

P_1 → check 1 bit skip 1 bit

1, 3, 5, 7 . . . . .

P_2 → check 2 bit skip 2 bit

2, 3, 6, 7, 10, 11 . . . .

P_4 → check 4 bit skip 4 bit

4, 5, 6, 7, 12, 13, 14, 15 . . . .

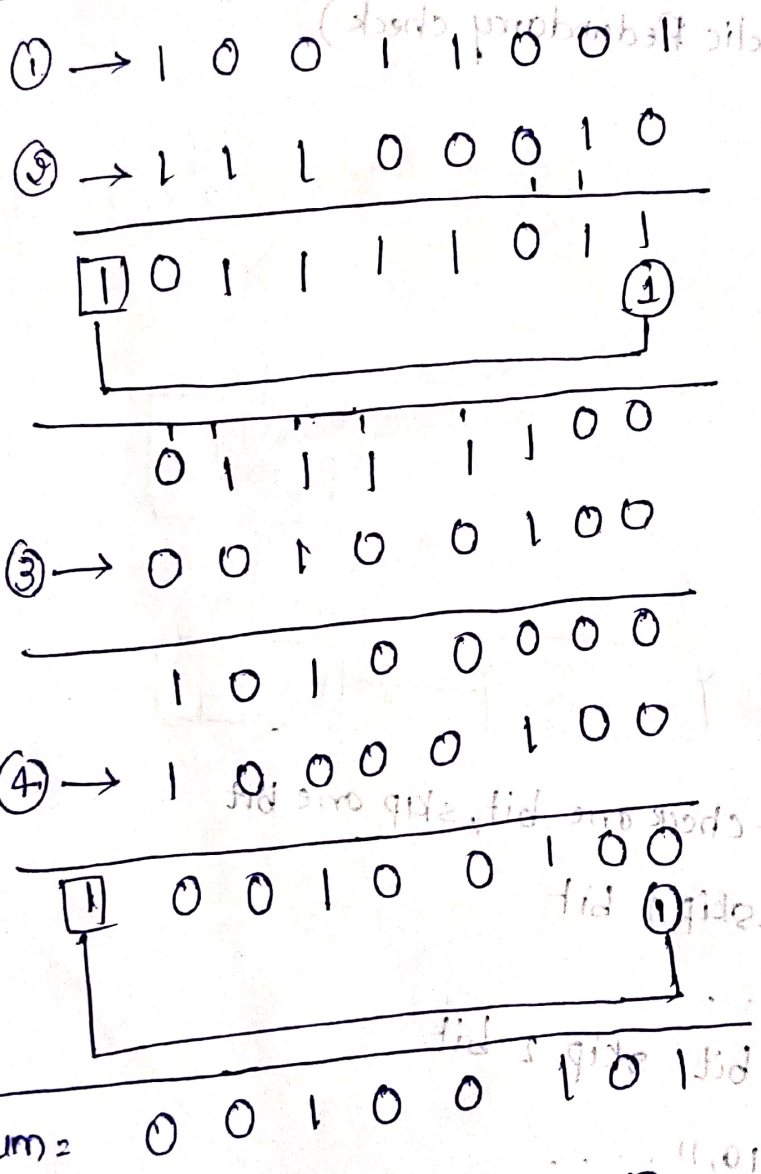
Checksum:-

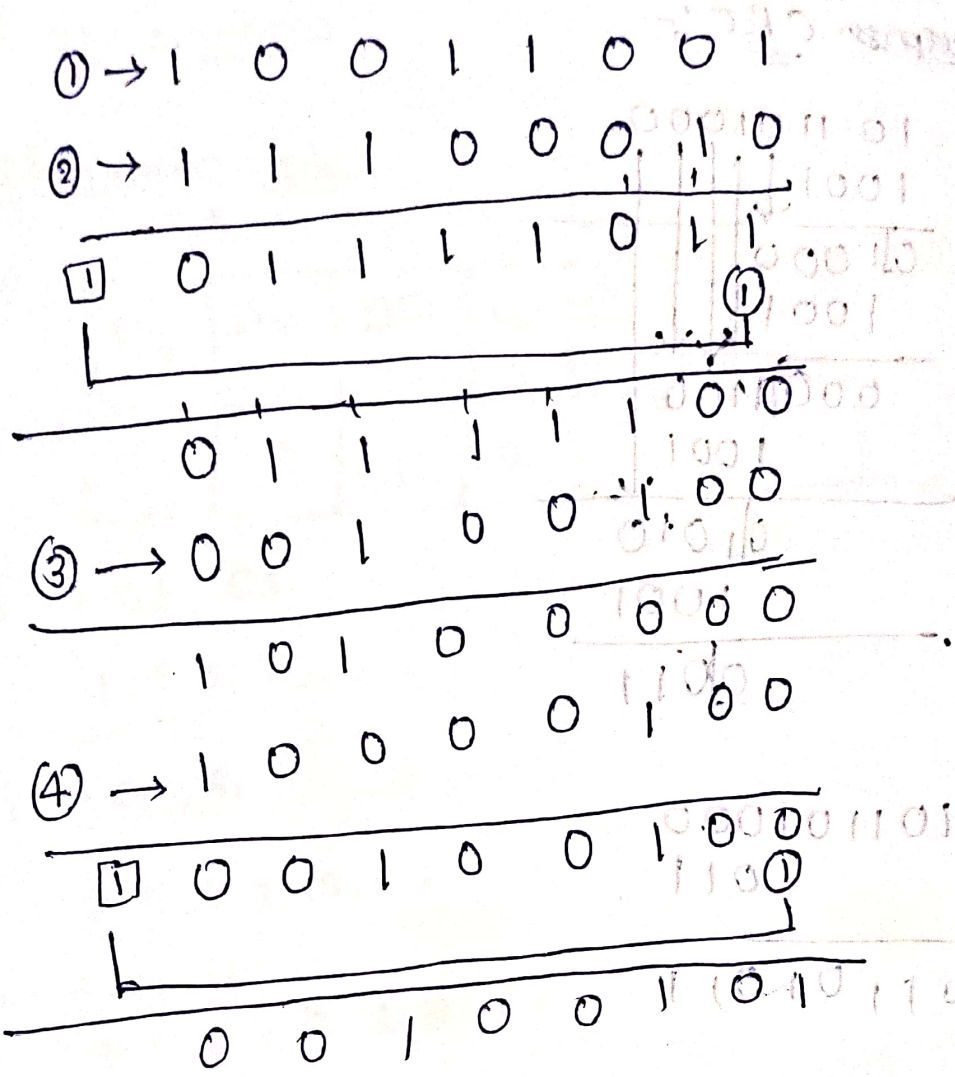
10011001	11100010	00100100	10000100

m = 8 (bits)

k = 4 (parts)

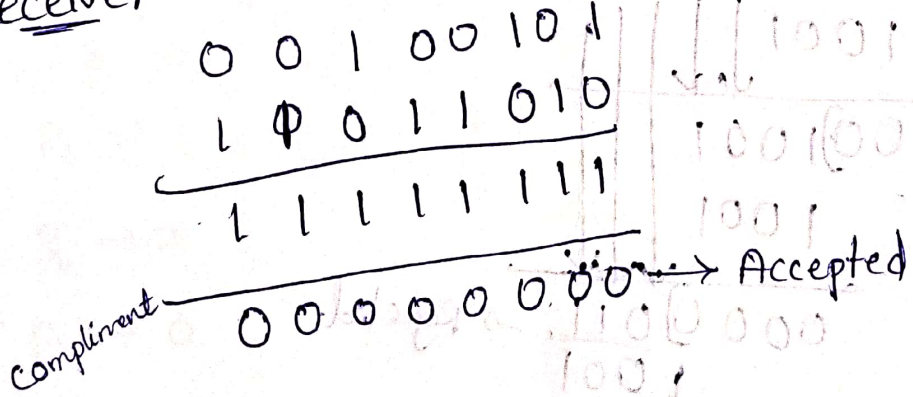
Sender side:-





S → CS$_{11}$ = 11011010

Receiver



~~Checksum~~ CRC :-

Sender

```
10 11 01 000
1001
-----------
 01 000
  1001
-------
 000 1100
    1001
-------
  010
   1001
-------
   011
```

```
10110 1000
    011
-------
10101 1
```

Receiver

```
10110 1011
1001
-------
 00 1001
   1001
-------
 0000 011   → Rejected
    1001
-------
    1010
```

Error Corrections:-

1. Hamming Code:-

D_7	D_6	D_5	P_4	D_3	P_2	P_1
1	0	1	0	1	0	1

$P_1 \rightarrow C_1, S_1$

1, 3, 5, 7 - - - -

$P_2 \rightarrow C_2, S_2$

2, 3, 6, 7, 10, 11

$P_4 \rightarrow C_4, S_4$

4, 5, 6, 7, 12, 13, 14, 15 - - - - - -

odd = 1

even = 0

$P_1 \rightarrow D_3 \; D_5 \; D_7$

1 1 1

$P_1 \rightarrow 1$

$P_2 \rightarrow 0$

$P_4 \rightarrow 0$

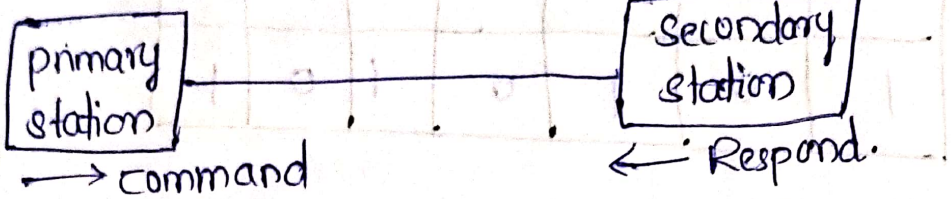
HDLC

High level Data link control (HDLC)

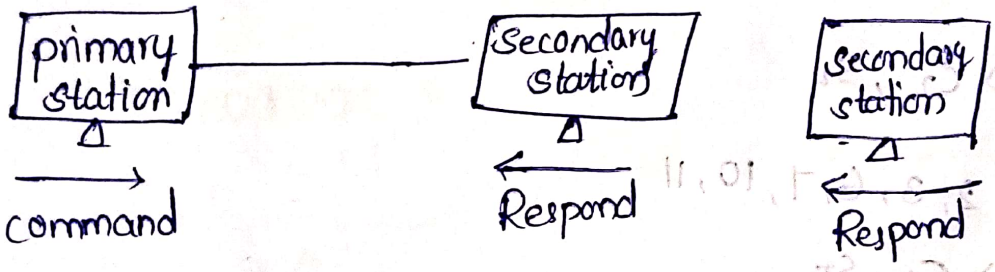
→ HDLC is a bit oriented protocol for communication over point-to-point and multi-point links.

point-to-point:-

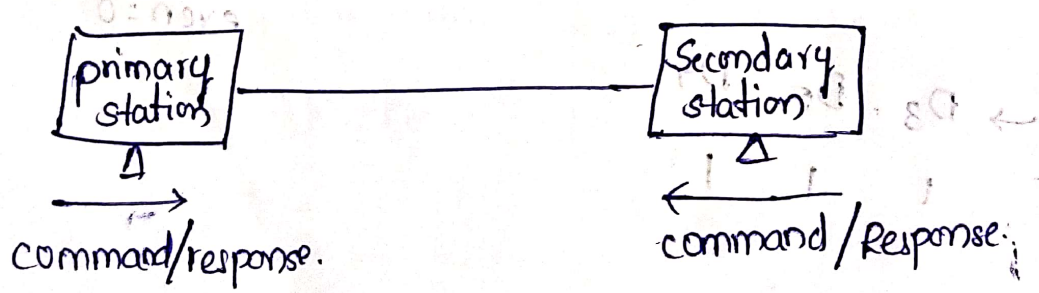
A primary station can send commands a secondary station can only respond.



Multi-point:-

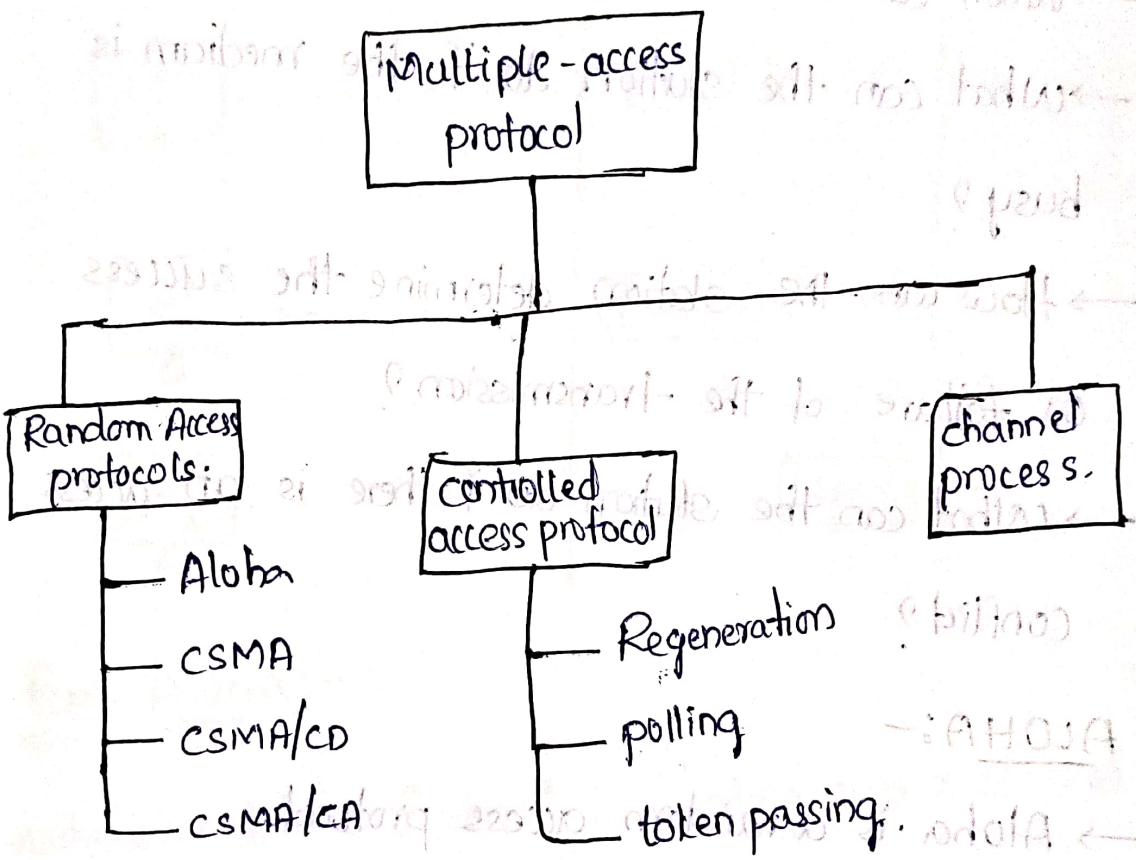


Asynchronised balanced mode:-



UNIT-3

Multiple Access Schemes, wired LAN and Wireless LAN



Random Access:-

→ In this, all stations have same superiority that is no station has more priority than another. Any station can send data depending on mediums state (idol or busy).

→ Each station has the right to the medium without being controlled by any other station.

To avoid access conflict, each station follows a processor :-

→ When can the station access the medium?

→ What can the station do if the medium is busy?

→ How can the station determine the success or failure of the transmission?

→ What can the station do if there is an access conflict?

ALOHA :-

→ Aloha is a random access protocol.

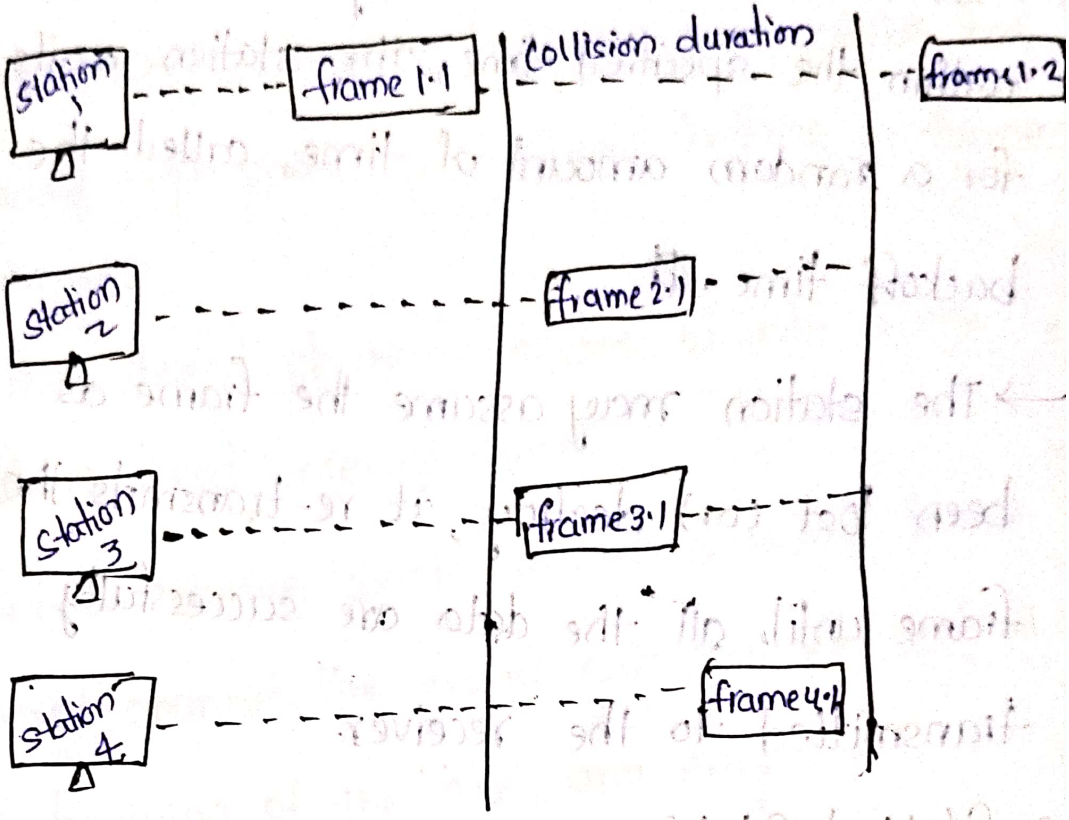
→ It was actually designed for WLAN. But it is also applicable for share medium.

→ In this multiple station can transmit data at the same time and can hence lead to colligence and data been garbled.

→ It is of two types.

1. pure Aloha
2. Slotted Aloha.

1. Pure Aloha:-



Pure Aloha:-

→ Whenever data is available for sending over a channel at stations, we use pure Aloha.

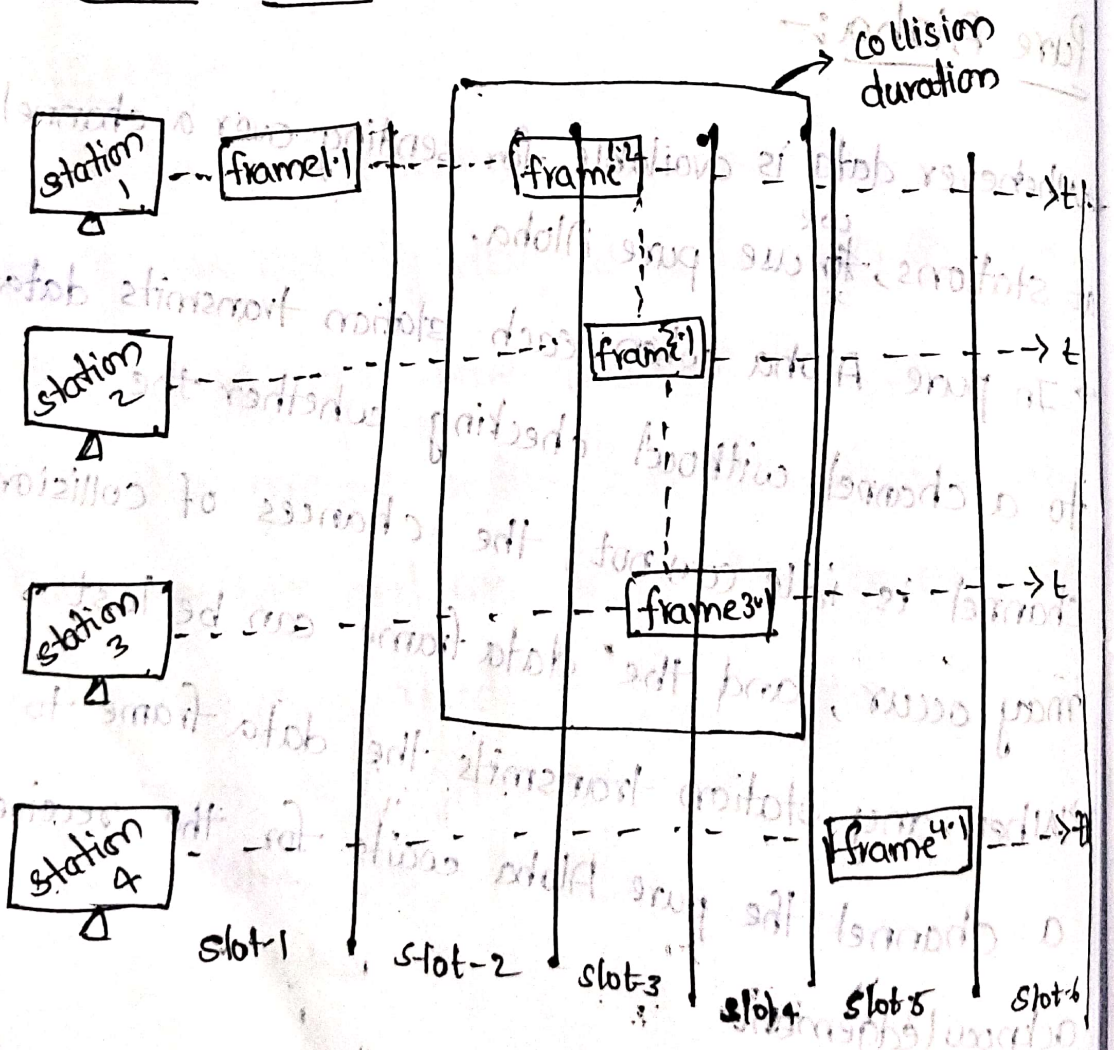
→ In pure Aloha when each station transmits data to a channel without checking whether the channel is idle or not, the chances of collision may occur, and the data frame can be lost.

→ When any station transmits the data frame to a channel the pure Aloha waits for the receiver acknowledgement.

→ If it does not acknowledge the receiver end within the specified time, the station waits for a random amount of time, called the backoff time.

→ The station may assume the frame as been lost (or) destroy, it re-transmits the frame until all the data are successfully transmitted to the receiver.

2. Slotted Aloha:-



→ Slotted aloha is designed to overcome the pure aloha efficiency because pure aloha has a very high possibility of frame hitting or frame collapse.

→ The shared channel is divided into slots that is fixed interval time.

→ If a station wants to send a frame to a shared channel, the frame can only be sent at the begining of the slot, and only one frame is allowed to be sent to each slot.

→ If a station misses out the allowed time it must waits for the next slot.

CSMA :-

Carrier sense multiple access protocol

There are two types of CSMA.

1. CSMA/CD
   Collision Detection.
2. CSMA/CA
   Collision Avoidance.

principle of CSMA:-

* "sense" before transmit"

(or)

"listen before talk"

* Carrier busy = Transmission is taking place.
* carrier idle = No transmission currently taking place.

Types of CSMA:-

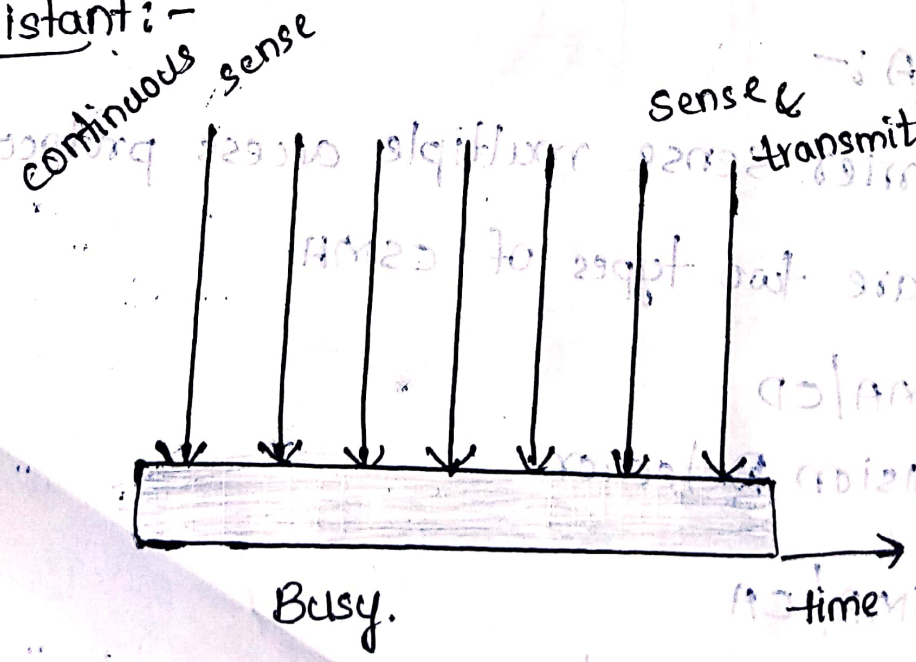
1- persistant

Non- persistant

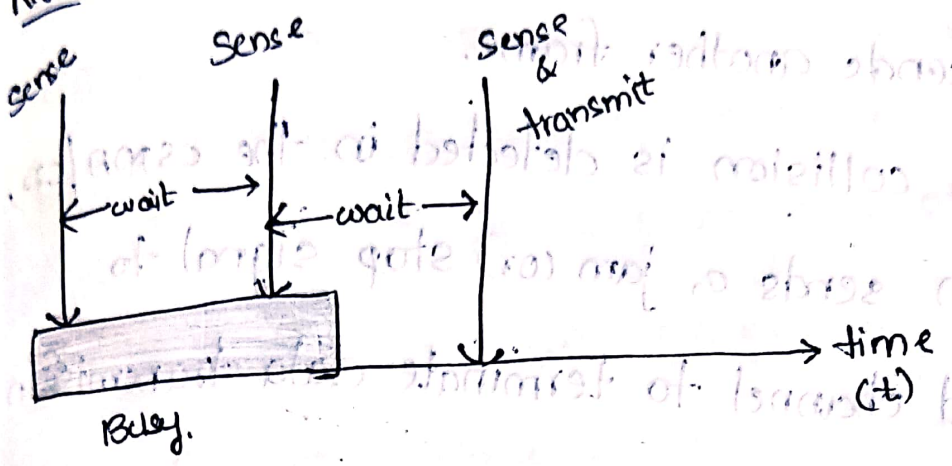
p- persistant

0- persistant

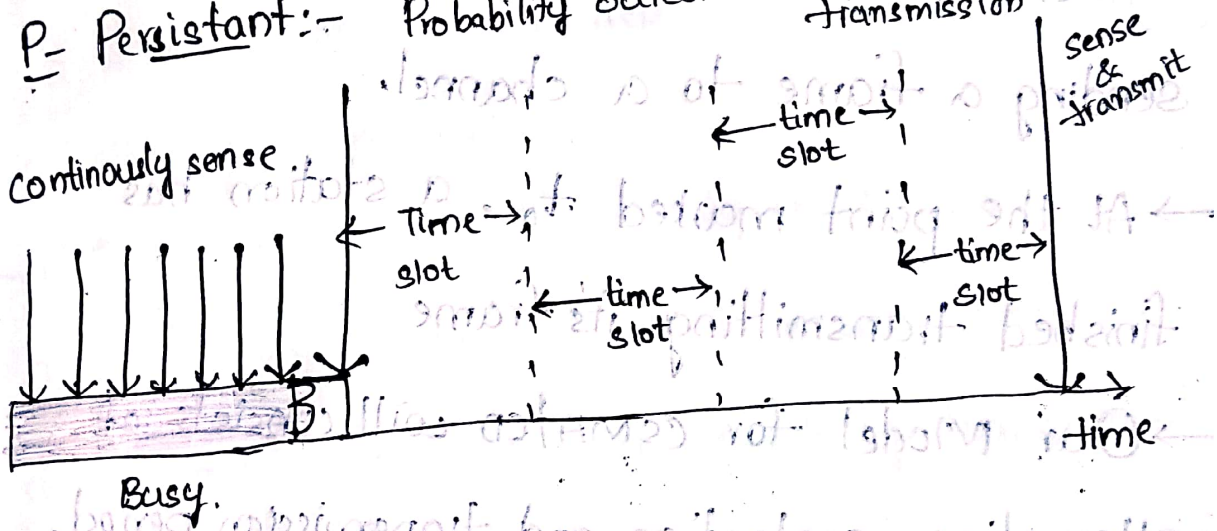
1- persistant:-



Non-Persistant



P- Persistant:- Probability outcome doesn't allow transmission



CSMA/CD (Carrier Sense Multiple Access ~~Action~~ / Collision Detection).

→ The CSMA/CD protocol works with a medium Access control layer.

→ Therefore it first sense the shared channel before broadcasting the frame, and if the channel is idle, it transmits a frame to check weather the transmission was successful.

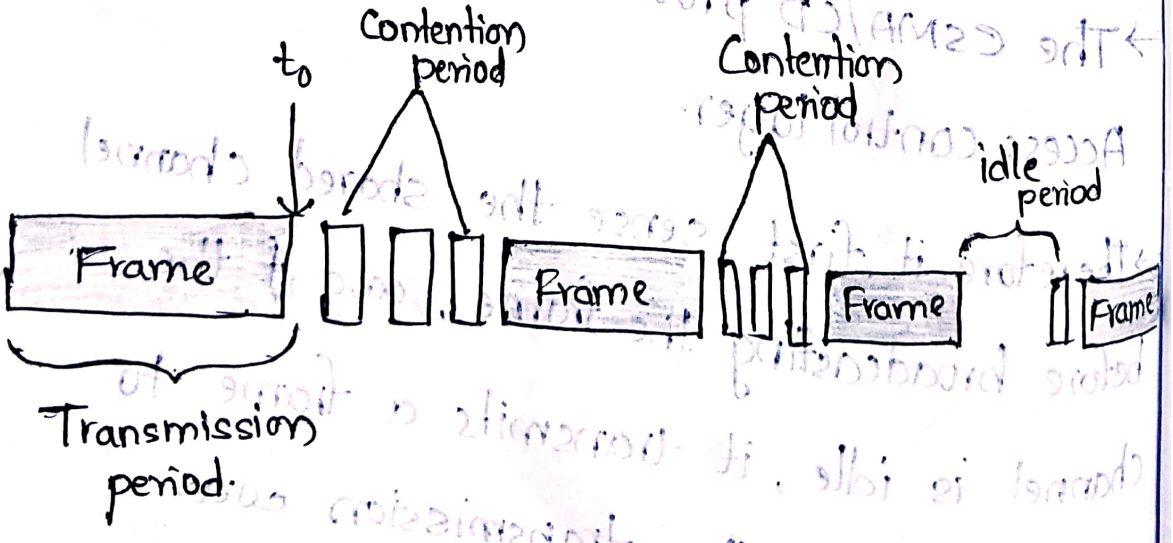
→ If the frame is successfully received, the station sends another frame.

→ If any collision is detected in the CSMA/CD, the station sends a jam (or) stop signal to the shared channel to terminate data transmission.

→ After that it waits for a random time before sending a frame to a channel.

→ At the point marked t_0, a station has finished transmitting its frame

→ Our Model for CSMA/CD will consists of alternating contention and transmission period, with idle period occuring when tolls all stations are quite.



CSMA/CA

→ It is a carrier sense multiple Access/collision Avoidance network protocol for carrier transmission of data frames. It is a protol protocol that works with a medium access control layer.

→ When a data frame is sent to a channel, it receives an acknowledgement to check whether the channel is clear.

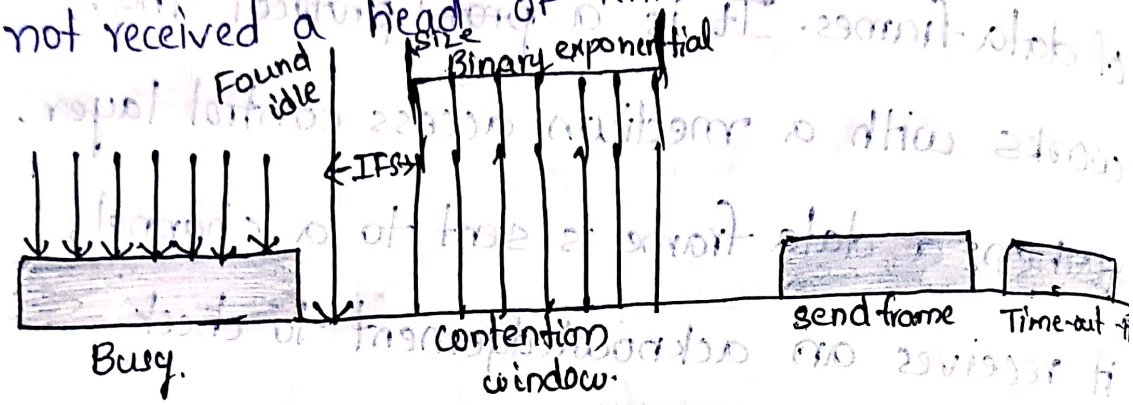
→ If the station receives only a single acknowledgement (own), that means the data frame has been successfully transmitted to the receiver.

→ Following are the methods used in the CSMA/CA to avoid the collision.

1. Interframe space:- In this method the station waits for the channel to become idle, and if it gets the channel is idle, it does not immediately send the data. It waits for some time. And this time period is called interframe.

2. Contention Window:- In this contention window, the total time is divided into different slots

3. Acknowledgement:- In the acknowledgement method the sender station sends the data frame, to the shared channel if the acknowledgement is not received a head of time.



Controlled Access:-

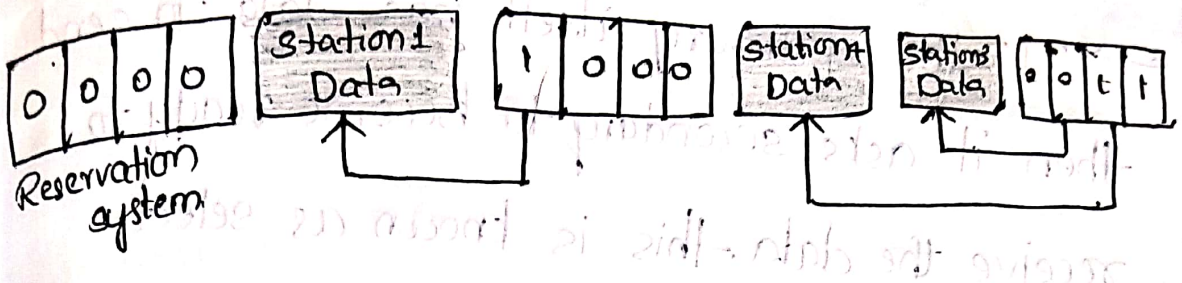
→ In controlled Access protocol a station cannot send data unless it has right to send it.

→ There are three popular controlled access methods

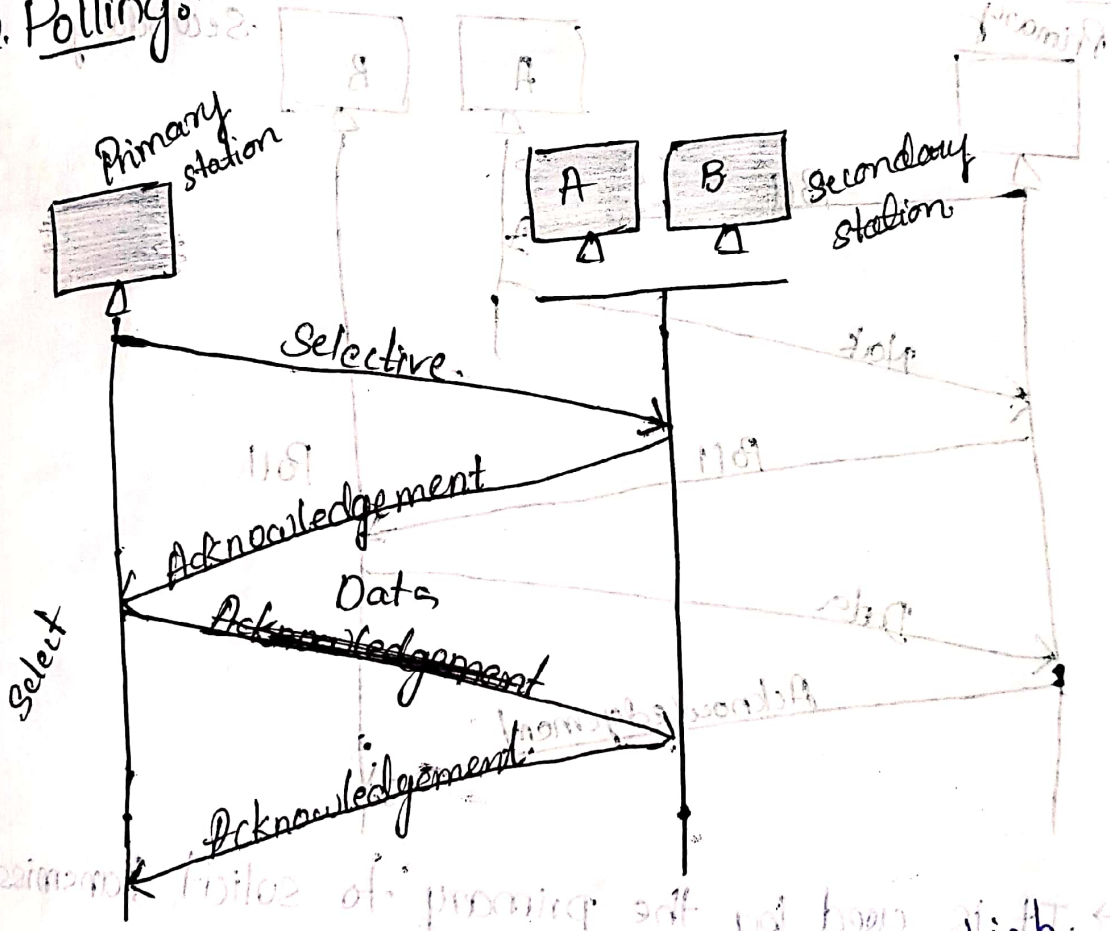
1. Reservation system.
2. Polling.
3. Token passing.

1. Reservation System:-

→ A station needs to send a frame had to reserve the channel before sending the frame. If there are N stations then the reservation frame consists of exactly N number of mini slots in the frame.



2. Polling:-

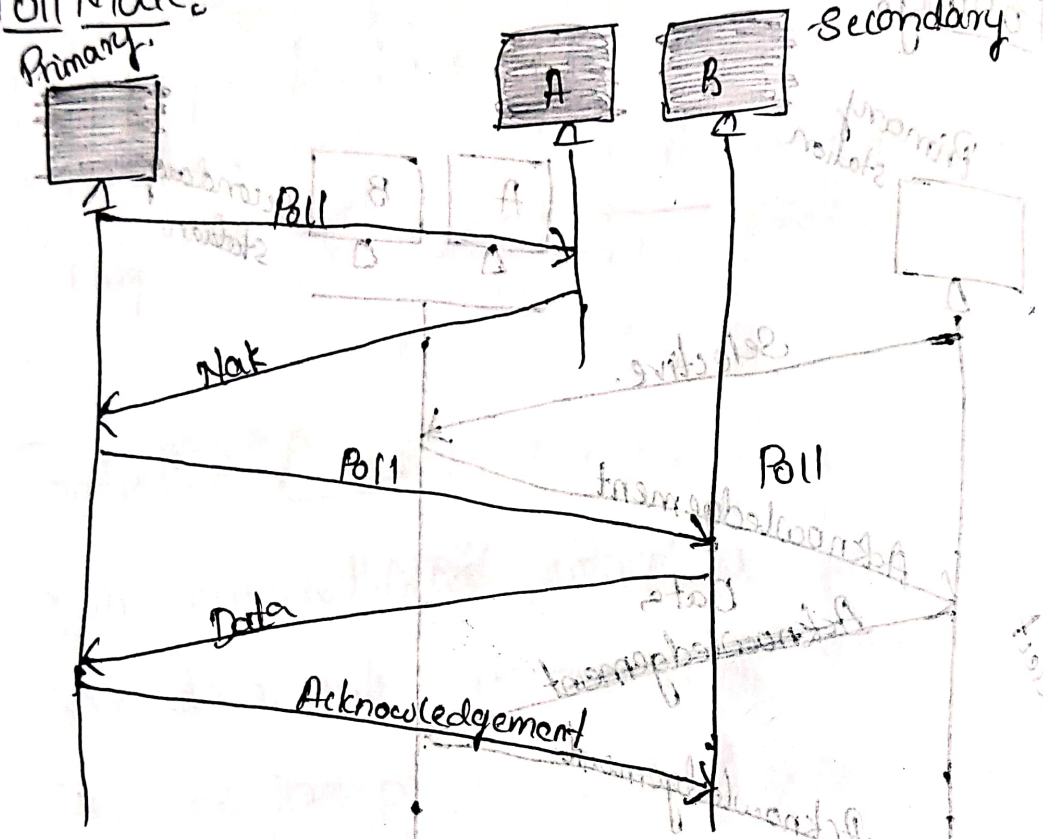


→ polling works with the system in which there is a primary device and others are secondary devices.

→ Data transfer occur to the primary device. The primary device asks each of the secondary device wether it has any data to send this is knocon as polling.

→ If the primary itself has data to send then it asks secondary to become ready to receive the data. this is known as select.

Poll Mode:-



→ It is used by the primary to solicit transmissi from the secondary.

→ When the primary is ready to receive data in polls a secondary whether it has any data to send.

→ If the secondary has no data to send then it sends a negative acknowledgement (NAK) to the primary.

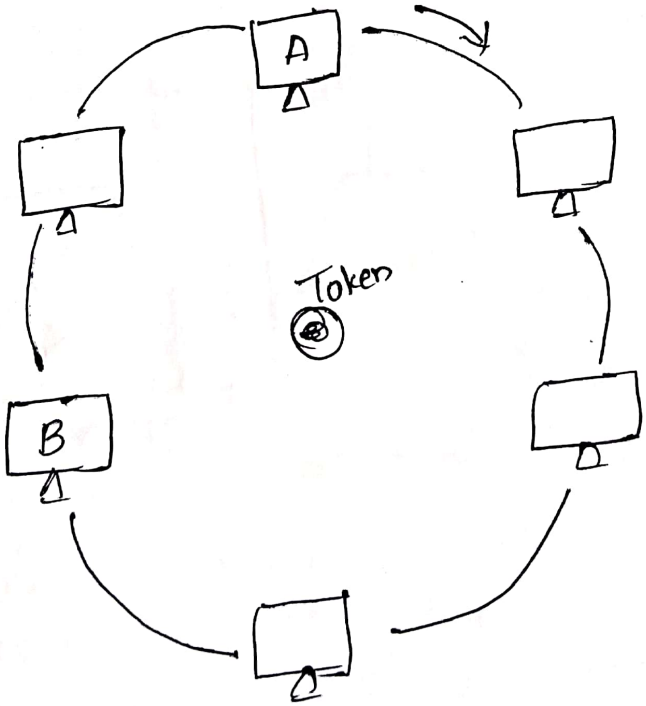
→ the primary then polls the next secondary. If the secondary has data to send then it sends the data to the primary.

→ primary sends positive acknowledgement in response.

Select Mode:-

→ When the primary device has to send, it sends an SEL (select) command to the secondary to make it know about the incoming data.

TOKEN PASSING:- (page:138)



Channelization:-

→ It is a multiple access method in which the available bandwidth of a link shared in time, frequency, (or) through code, between different stations.

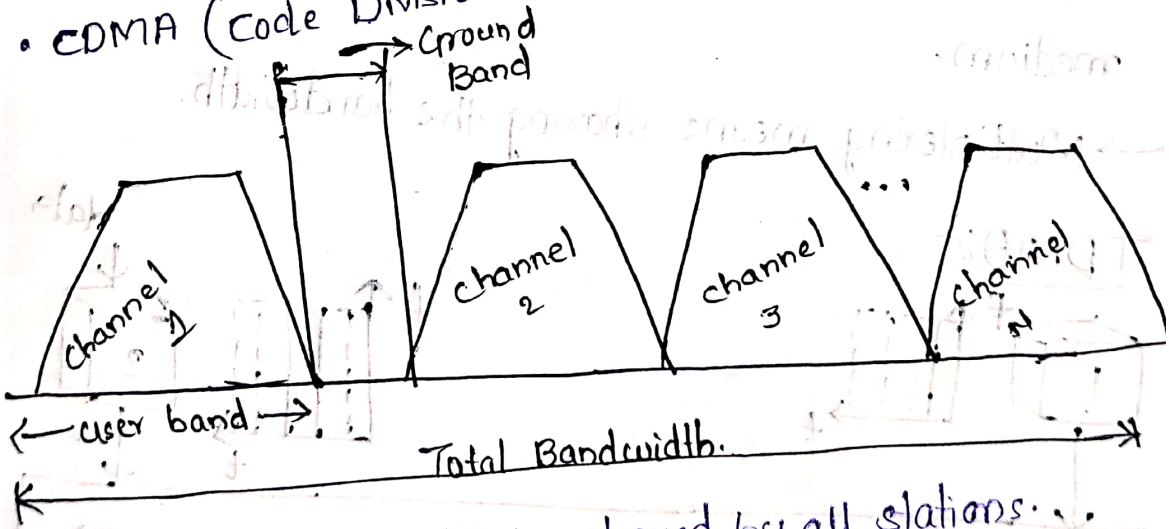
Multiplexing:-

→ In computer networking, multiple signals are combined together thus travel simultaneously in a shared medium.

→ Multiplexing means sharing the bandwidth.

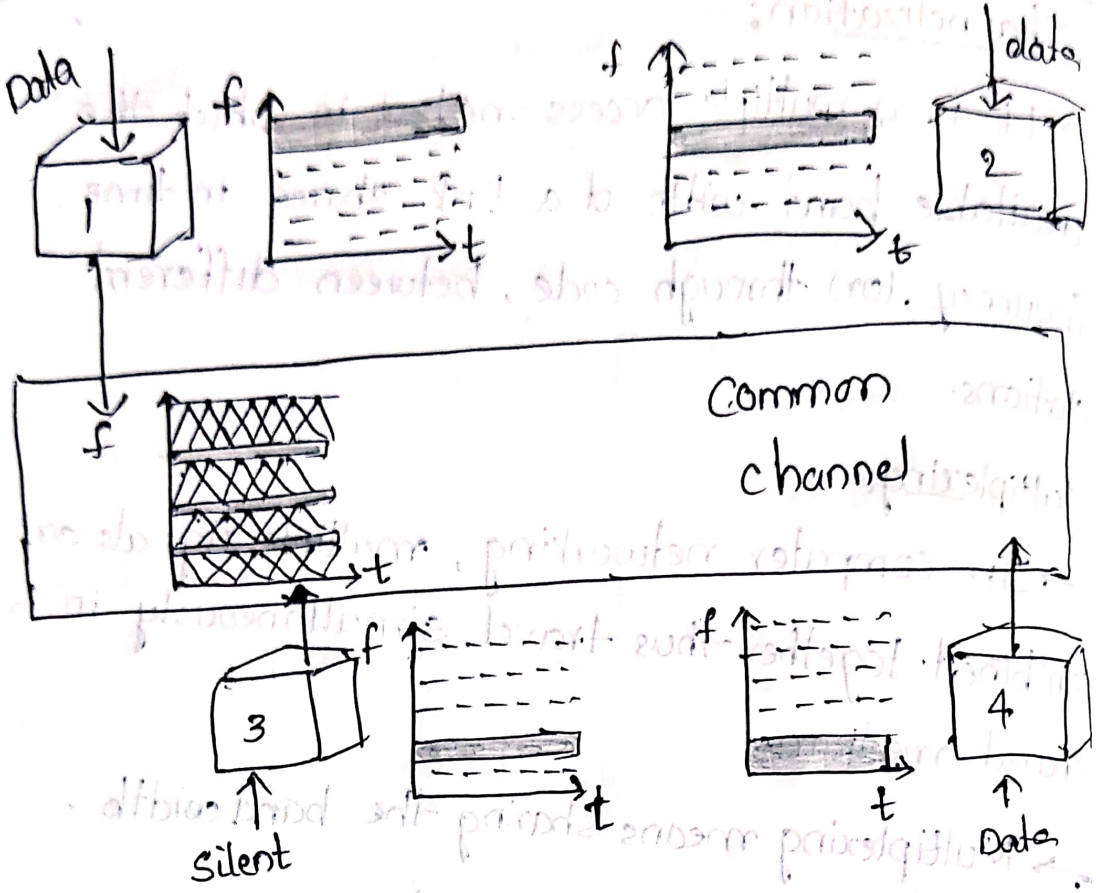
→ It (channelisation) consists of three protocols.

- FDMA (frequency Division Multiple Access)
- TDMA (Time Division Multiple Access)
- CDMA (Code Division Multiple Access)



→ The available bandwidth is shared by all stations...

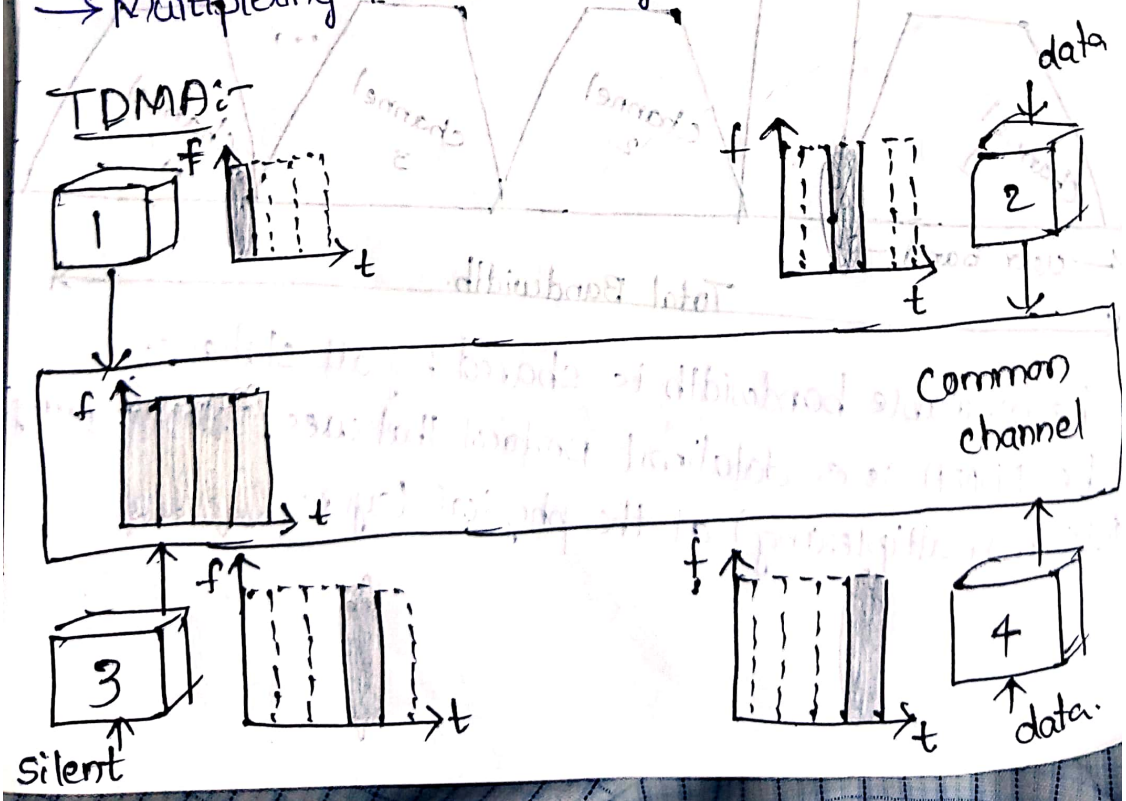
⇒ The FDMA is a datalimit protocol that uses FDM (frequency division multiplexing) at the physical layer.



Multiplexing:—

→ Multiplexing means multiple signals are combined together thus travel simultaneously in a shared medium.

→ Multiplexing means sharing the bandwidth.



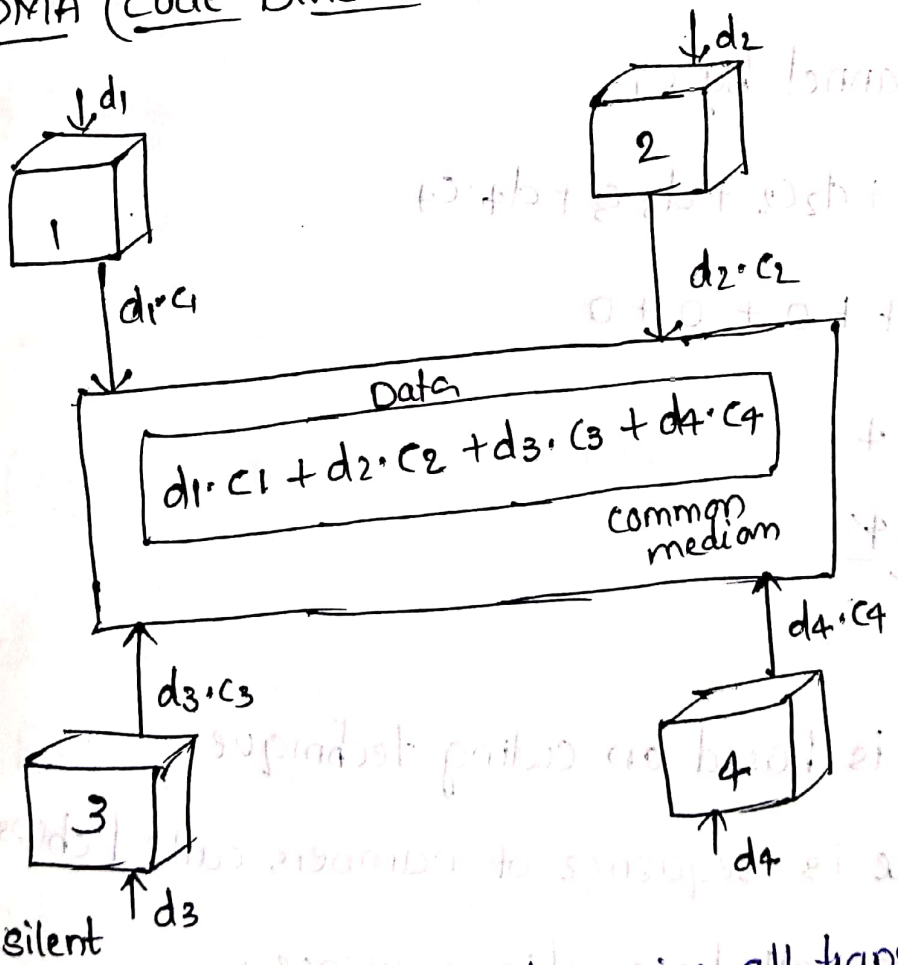
→ the time division multiple access (TDMA) method of multiple access is suitable for the digitally modulated signals.

→ In TDMA, the bandwidth of the channel is shared by the stations in time.

→ Each station can send data during it allocated time slot.

→ The beginning of the slot and the location of the slot must be known by each station.

CDMA (Code Division Multiple Access)



→ In CDMA, one channel carries all transmission simultaneously.

→ CDMA differs from FDMA because only one channel occupies the entire bandwidth of the link.

→ The assigned codes have two properties.

1. If we multiply each code by another, we get zero(0)
2. If we multiply each code by itself, we get four(4)

Example:-

Let us assume that if station 2 wants to hear that station 1 is saying then, it multiplies on the channel by c_1.

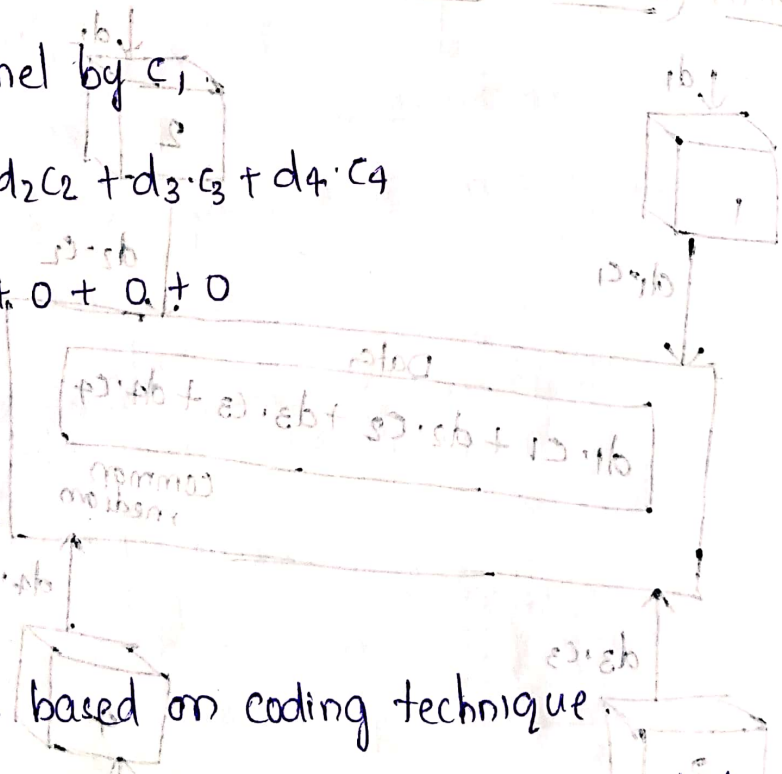
$$\text{Data} = d_1c_1 + d_2c_2 + d_3 \cdot c_3 + d_4 \cdot c_4$$

$$= d_1 \times 4 + 0 + 0 + 0$$

$$= d_1 \times 4$$

$$= \frac{d_1 \times 4}{4}$$

$$= d_1$$



→ CDMA is based on coding technique.

→ Here code is sequence of numbers called chips. So this is called as chip sequence.

→ The chip sequences are also called as Orthogonal sequences.

Chip Sequences Properties:

$[+1 +1 +1 +1]$ C_1

$[+1 -1 +1 -1]$ C_2

$[+1 +1 -1 -1]$ C_3

$[+1 -1 -1 +1]$ C_4

chip sequences.

→ Each sequence is made of N elements (M means number of stations)

→ Multiply sequence by a number.

$2\,[+1 +1 -1 -1] = [+2 +2 -2 -2]$ C_3.

→ Multiply two different sequences → 0.

$[+1 +1 -1 -1]$ C_3 $\cdot$ $[+1 +1 +1 +1]$ C_1 $= 0$

→ Adding 2 sequences.

$[+1 +1 -1 -1]$ C_3 $+$ $[+1 +1 +1 +1]$ C_1

$= [+2 +2 0 0]$

Data representation in CDMA:-

Data bit 0 → -1

Data bit 1 → +1

Silence → 0

Ethernet:-

→ It is a way connecting computers together in a LAN. The basic idea of its design is that multiple computers can allow to access it & can send the data at anytime.

→ There are 2 kinds of ethernet:

1. Classic ethernet
2. Switched ethernet.

1. Classic Ethernet:-

→ It is a single long cable to which all the computers are attached.

→ The first variety in thin ethernet, which is sent more easily and mode connections using industry standard BNC connectors.

→ Thin ethernet is cheaper & easy to install

→ It is run only upto 185 meter per segment.

→ A series of cables segments connected by repeaters.

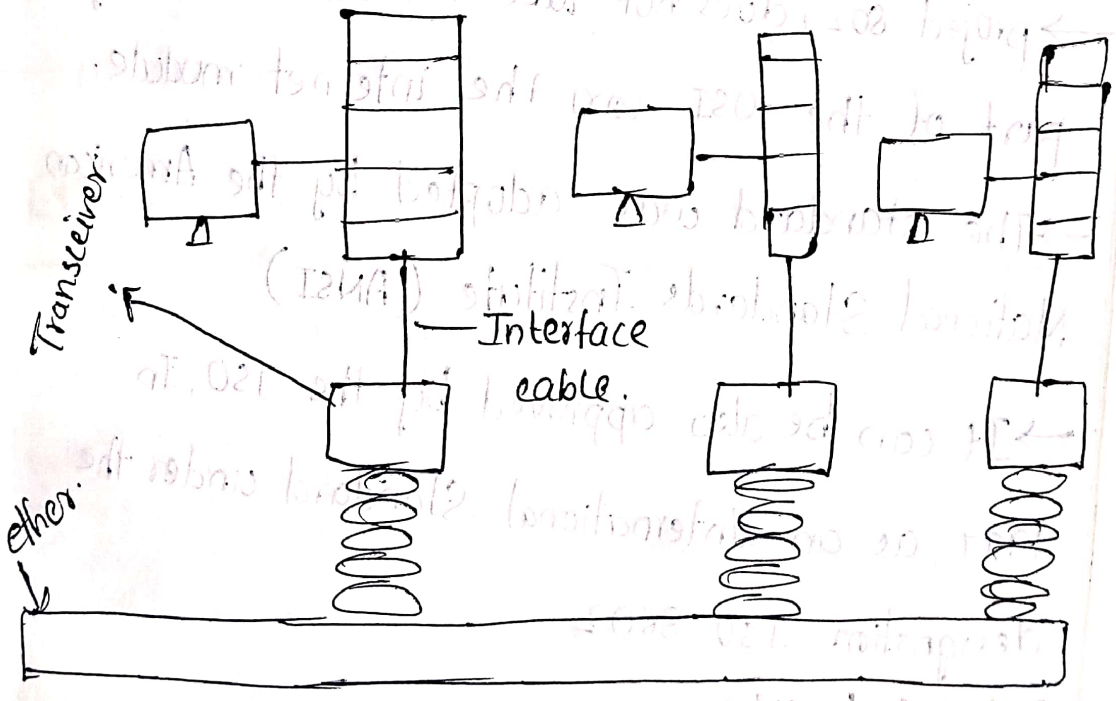
→ It contains multiple cable segments & multiple repeaters.

2. Switched Ethernet:-

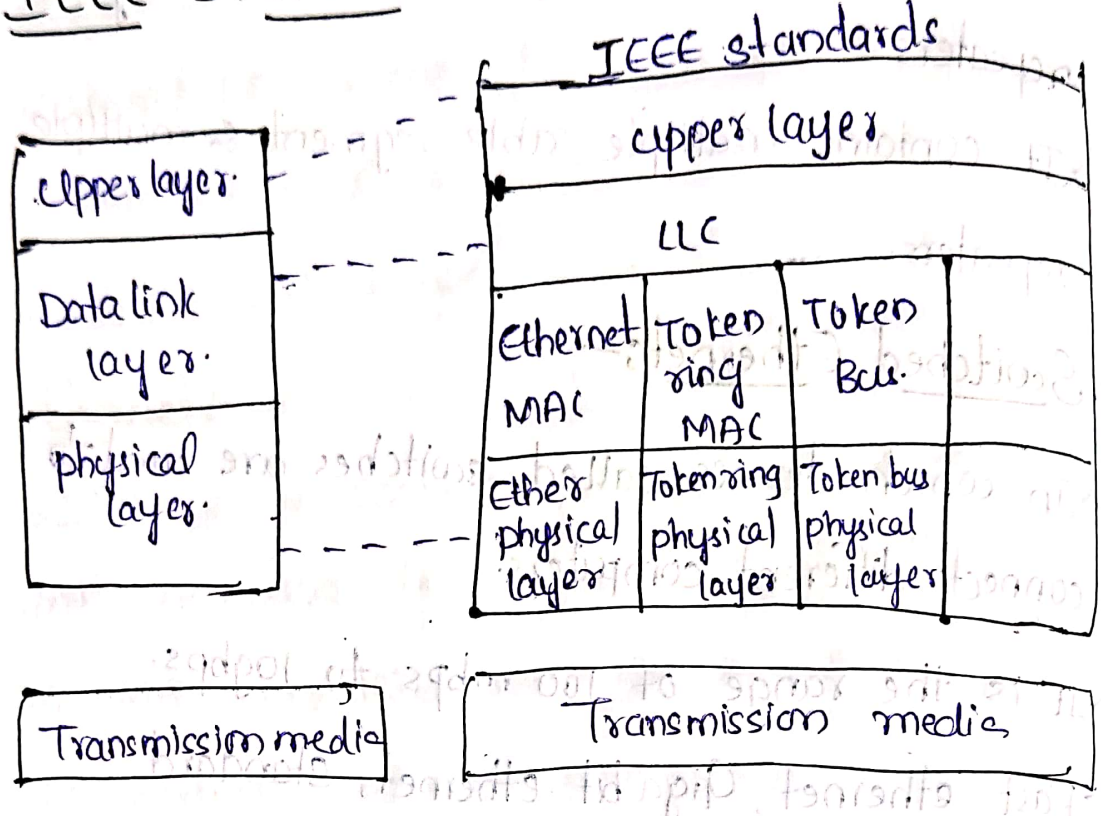
→ In which devices called switches are used to connect different computers.

→ It is the range of 100 mbps to 10gbps.

→ Fast ethernet, Giga bit ethernet, standard ethernet.



IEEE Standards:-



OSI layers.

→ project 802, does not take to substitute any part of the OSI (or) the internet module.

→ The standard was adopted by the American National Standards Institute (ANSI)

→ It can be also approved by the ISO, In 1987 as an International Standard under the designation ISO 8802

Data link layer:-

→ The datalink layer in the IEEE standard can be divided into two suppliers.

i, Logic link control

ii, Medium access control.

Logic Link Control:-

The data link layer provides the functions are framing, flow control and error control.

→ In IEEE project 802, flow control, error control and part of the framing duties are together into one sublayer called the logic link control.

Ethernet Evolution:-

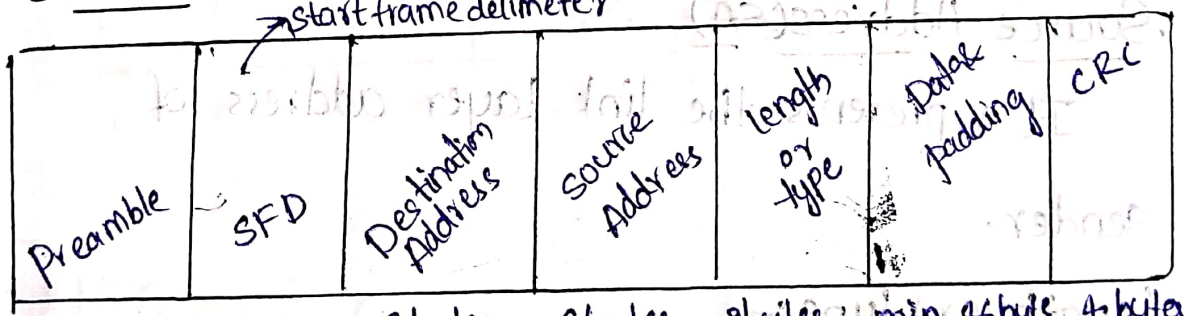
→ Standard Ethernet - 10 Mbps

→ Fast ethernet - 100mbps

→ Gigabit ethernet - 1Gbps

→ 10 Gigabit ethernet - 10 Gbps.

Ethernet Frame Format:-



Preamble:-

→ It is of 7bytes alternating zeros and ones (0's & 1's) used to used to alert the receiver to say that we are sending the data so get ready to receive it.

SFD (Start Frame Delimeter)

→ It is the pattern of 10101011

→ The last two (one) 1 bits tell the receiver that the rest of the frame is about to start.

→ If the receiver is not ready to accept the data, again we will find the SFD to say that we are going to send the next field will be with destination address, so get ready to receive it.

Destination Address:-

It represents the link layer address of receiver.

Source Address(SA)

It represents the link layer address of sender.

Length (or) type:-

Depending on whether the frame is standard ethernet or IEEE 802.3

Data:-

→ It contains the actual data.

→ It is the range of 46 bytes to 1500 bytes.

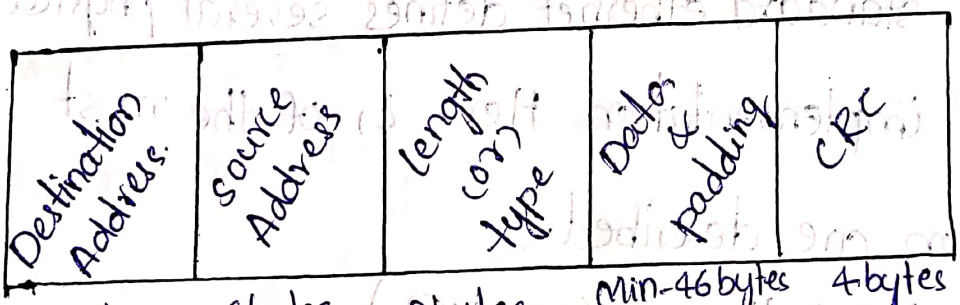
→ If more than 1500 bytes data it will be included in the next frame.

→ If it is less than 46 bytes, we have to padding with zeroes (0's)

CRC (Cyclic Redundancy Check):-

→ It is for error reduction.

Minimum (or) Maximum frame length:-



→ Min frame length

= 6 + 6 + 2 + 46 + 4

= 64 bytes.

→ Max frame length

= 6 + 6 + 2 + 1500 + 4

= 1518 bytes.

Addressing:-

→ Among the 16 bits; the first four bits provides identification to the fragment and the rest of 12 bits contain the sequence number that increments with each transmission,

It is of 3 types.

- Unicast
- Multicast
- Broadcast.

physical layer:-

→ The standard ethernet defines several physical layer implementation Here 4, of the most common are described.

Ethernet Cabelling:- (page: 152)

Name	Cable	Max segment	Nodes	Advantages
10 Base 5	thick coaxial	500 mts	100	Original cable
10 Base 2	Thin coaxial	185 mts	30	No hub needed
10 Base T	Twisted-pair.	100 mts	1024	Cheapest system
10 Base F	fibre-optics	2000 mts	1024	best between buildings.

Eg:- 10 Base 5

↓ ↓ ↳ 500 mts

Mbps Bandwidth

Changes in the Standard:-

The 10 Mbps standards ethernet has gone through several changes before moving to the higher data rates.

- Bridge ethernet
- Switched ethernet
- Full Duplex ethernet.

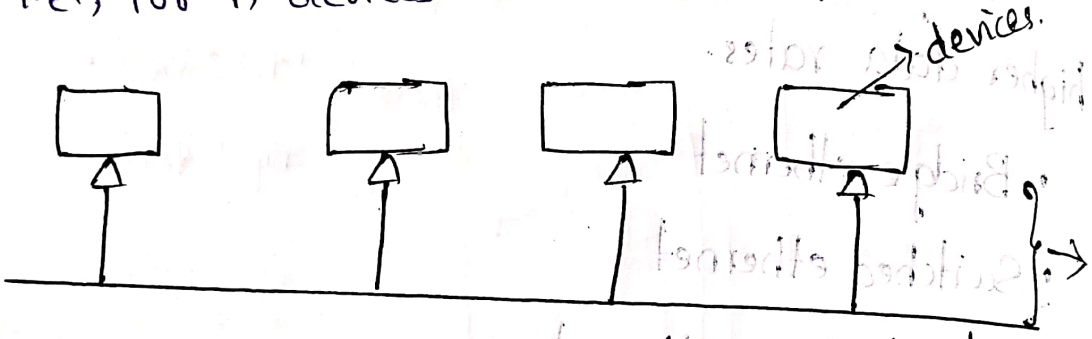
Bridged Ethernet :-

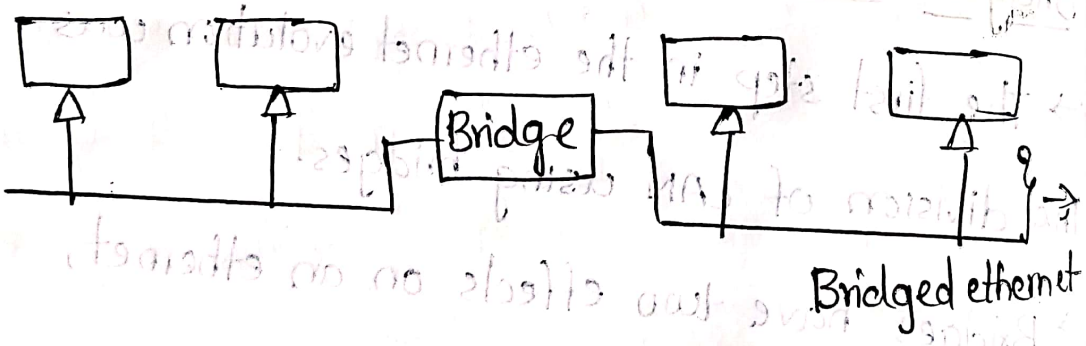
→ The first step in the ethernet evolution was the division of LAN using bridges.

→ Bridges have two effects on an ethernet, they are as follows:-

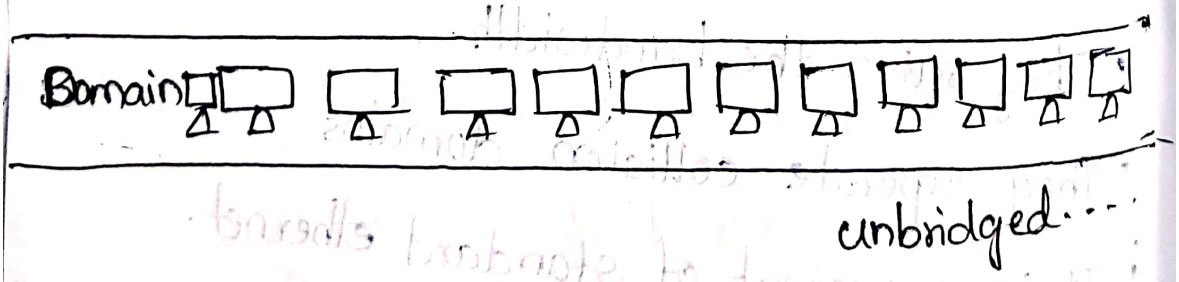
- They raise the bandwidth.
- They seperate collision domains.
- It is a varient of standard ethernet.
- In unbridged ethernet, 10 Mbps is shared among all the stations.

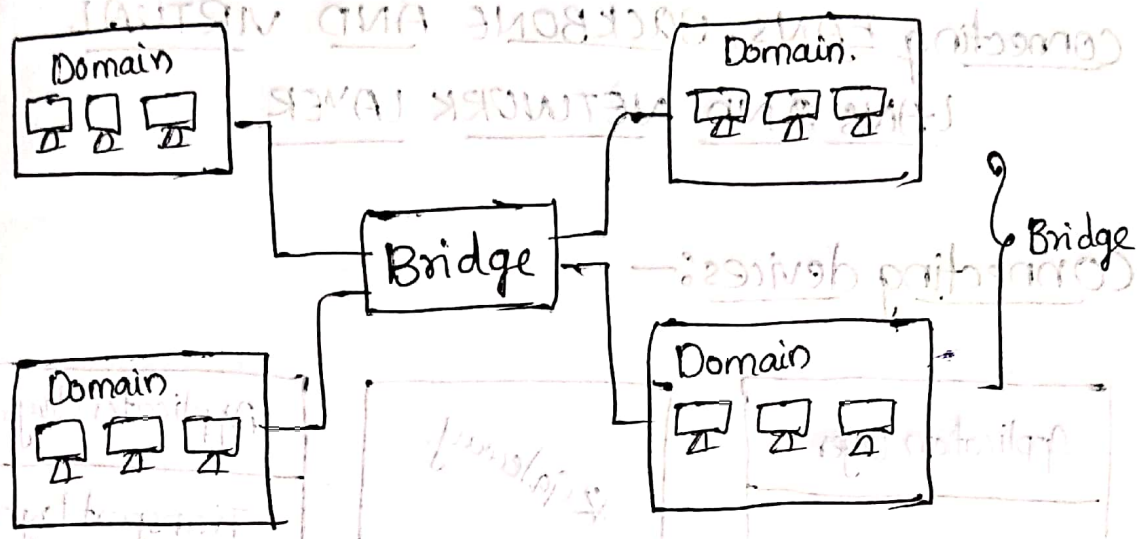
- A bridge divides the network into two or more networks (raising the bandwidth)
- Without bridge, if a device is there, it can have 10mbps, for two devices, it will be 5Mbps, for 4 devices, it will be 2.5mbps i.e., for n devices it will be 10/n



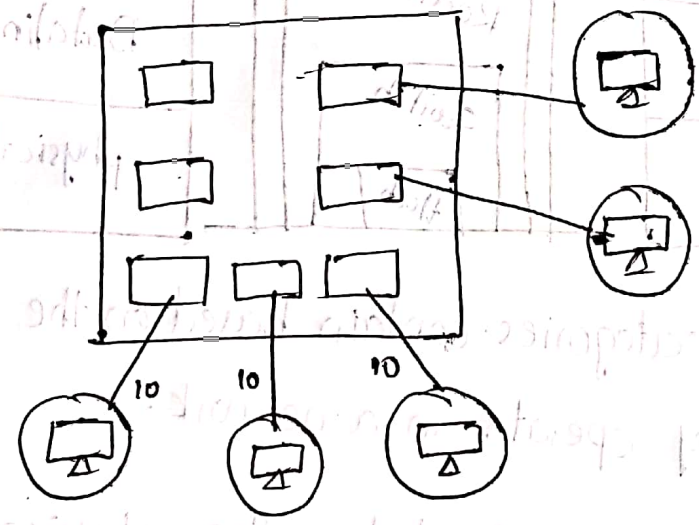


Collision Seperating domain:-





2. Switched ethernet :- page: 157



3. Full-Duplex ethernet :-