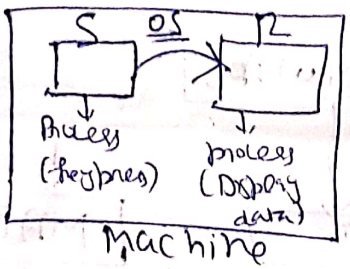
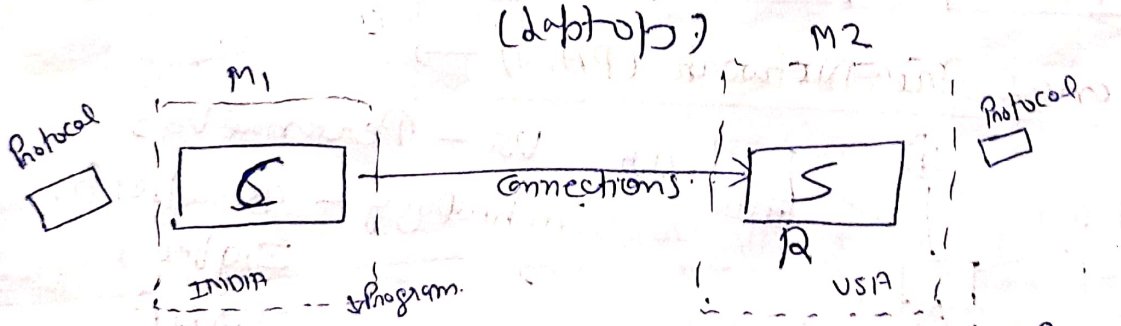
Introduction to Computer Network (1)

→ A computer N/w is a collection of various computing devices. It means we have to connect various homogeneous, hetrogeneous kind of devices.

→ The purpose of computer Networks is that they can share something, the main part of a computer Network is to share the data.

Note→ OS is dealing with Interprocess communication. (when a process communicates with another process in the same machine then that is called Interprocess communication).

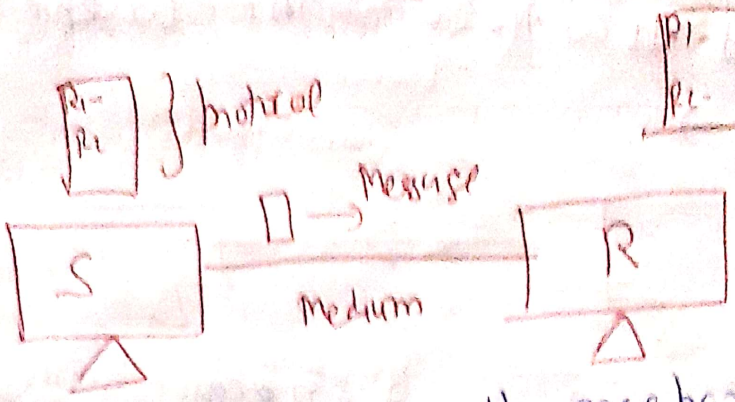




where the client & server is present on different machines, the concept of computer Network comes opening facebook Account is my laptop (example).

⟹ The functionality of a computer Network is that the client and server which are physically separated should feel that they are present in the same machine, but they are Actually not. this is the main function of a computer Network.

Computer N/w Components →

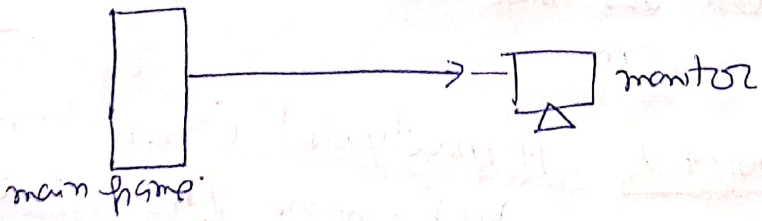


Communication means are the exchange of info b/w two devices via some form of transmission medium such as wired or wireless. There are 5 components –

① Message → Info to be communicated.
② Sender → device that send data.
③ Receiver → device that Receive data.
④ Transmission Medium → It is the physical path by which a message travel from sender to receiver. like – twisted-pair wire, coaxial cable.
⑤ Protocol → It is a set of rules that govern communication. (French & English).

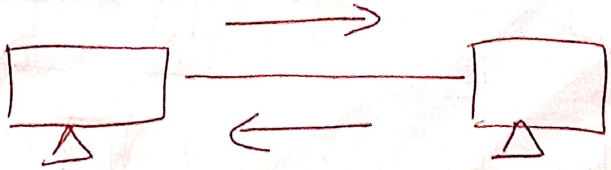
Data flow → Communication b/w two devices can be Simplex, half duplex or full duplex.

Simplex → the communication is unidirectional.



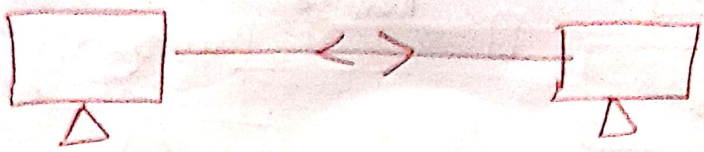
→ only one of the two devices on a link can transmit. ex- keyboard & monitor.

Half Duplex →



In half-duplex mode, each station can both transmit & receive but not at the same time. walkie-talkies.

Full duplex →



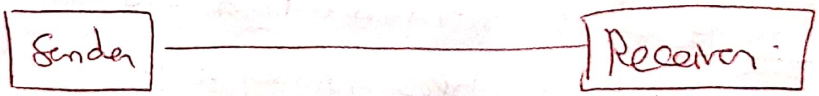
both station can transmit & receive simultaneously telephone network.

Physical Structures →

Type of Connection → A n/w is two or more devices connected through a link. A link is a communication pathway that transfer data from one device to another.

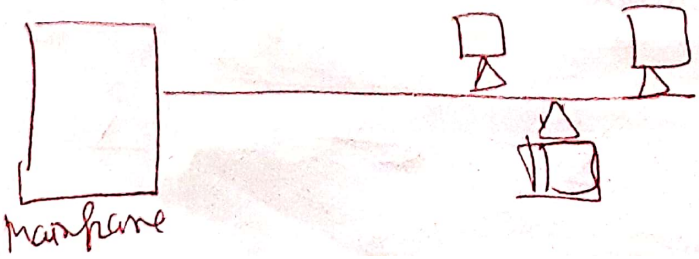
→ There are two possible types of connections -

① point to point → A point to point connection provides a dedicated link b/w two devices.



→ The entire capacity of link is reserved for transmission b/w those two devices eg remote control & television system.

② Multipoint → A multipoint connection is one in which more than two specific devices share a single link.

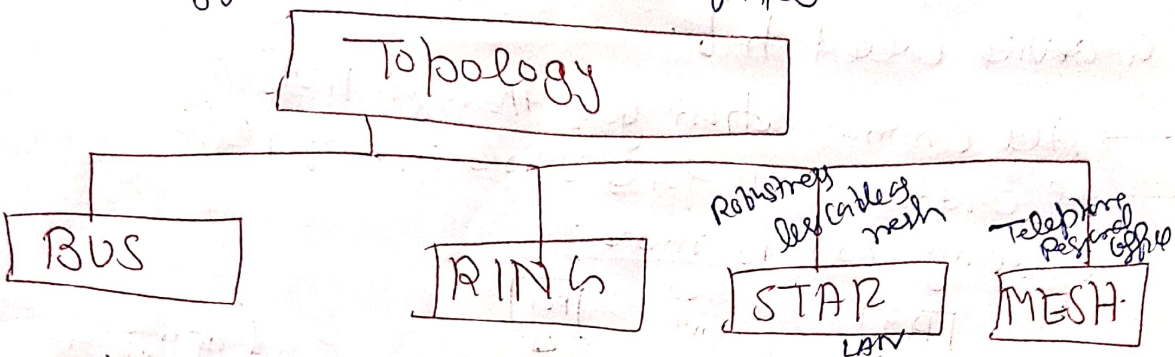


→ In multipoint connection, the capacity of the channel is shared either spatially or temporally —

Physical Topology → Topology refers to the physical or logical arrangement of a network.

→ There are 4 basic topologies -

→ topology describes appearance of N/W



Bus Topology → (Multipoint Connection)

→ easy to install, use for small N/W.

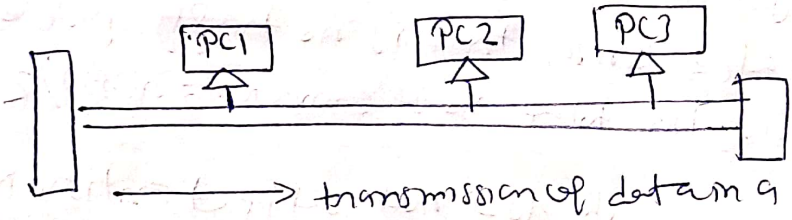
→ cheap

→ Easy to expand (difficult fault isolation)

→ slow speed as only one system can transmit at a time.

→ less Reliable & less secure.

→ faulty cable bring down whole N/W.



→ transmission of data in a single direction.

RING Topology → (multipoint data Connection).

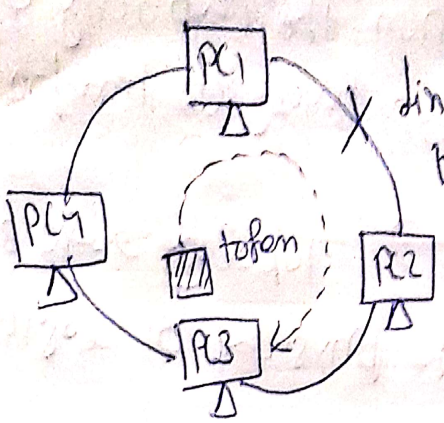
→ In this each computer is connected to the next computer with the last one connected to the first. → Token passing is used.

→ fault in any link disables entire N/W.

→ Difficult to troubleshoot the ring.

→ Unidirectional communication.

dedicated point to point connection with only two devices on either side of it.

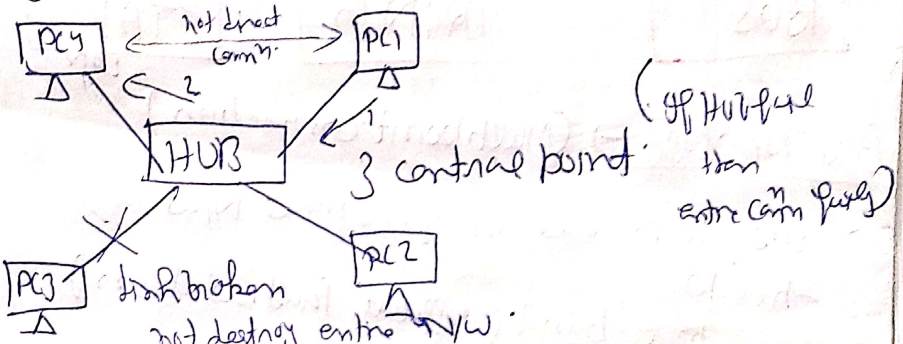


link/cable broken (entire N/w fail)

→ less Reliable (single point of failure)
→ secure (less)

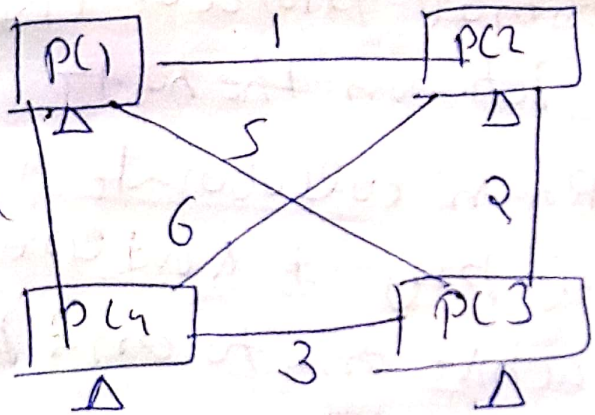
3- Star Topology → All the wires from the computers go to a central location having a device called hub.

→ All communication goes through HUB.
→ If central HUB fails whole N/w fails.
→ Cabling cost is more.



4- Mesh Topology → (point to point connection).

→ In this each device has a dedicated point to point link to every other device.
→ due to dedicated links, there is no traffic problem. If n no of devices then total no of connection = $n(n-1)/2$
→ failure of one link does not affect entire N/w.
→ More secure and private.
→ Easy fault diagnose (point to point)
→ Expensive due to higher cabling cost.
→ More Reliable.
→ Secure.



$n = 4$

$n(n-1)/2 = 4(4-1)/2$

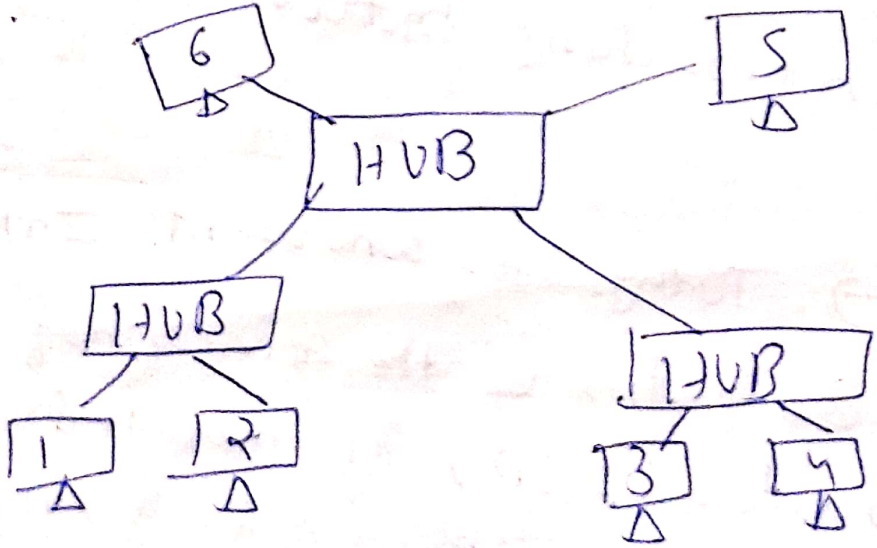
$= 6$ connections.

⑤ Tree Topology → variation of star topology.
(Hybrid)

→ Nodes in a tree are linked to a central HUB.

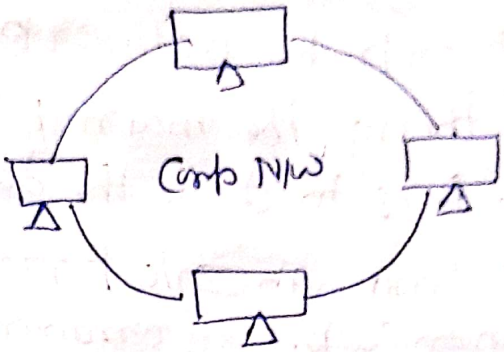
→ cabling cost is more

→ on failure of central HUB, entire N/w breaks down.

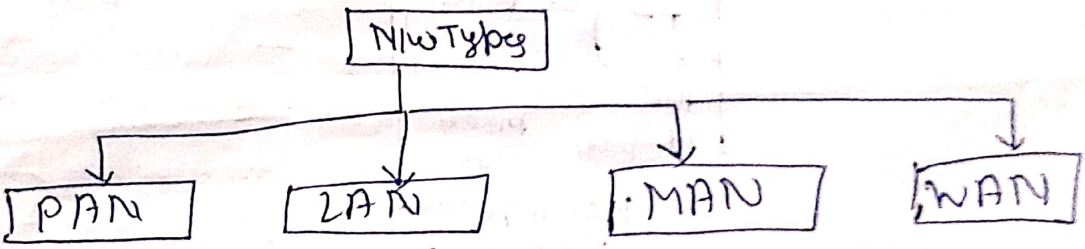


Types of Computer Networks →

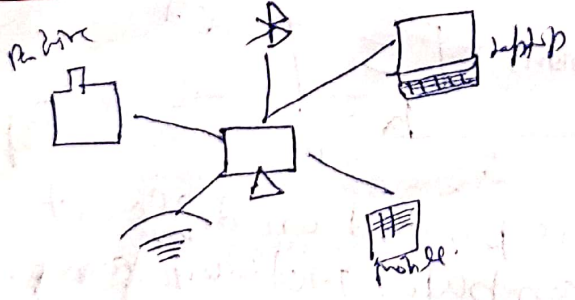
"A group of computers which are connected to each other for the purpose of sharing their resource is called computer Network".



First Computer Network → ARPANET stands for Advanced Research Project Agency Network.

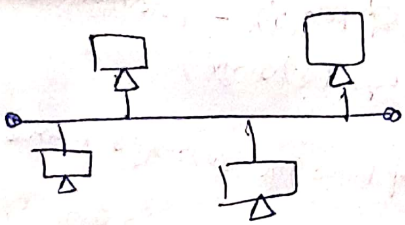


Personal Area Network (PAN) →



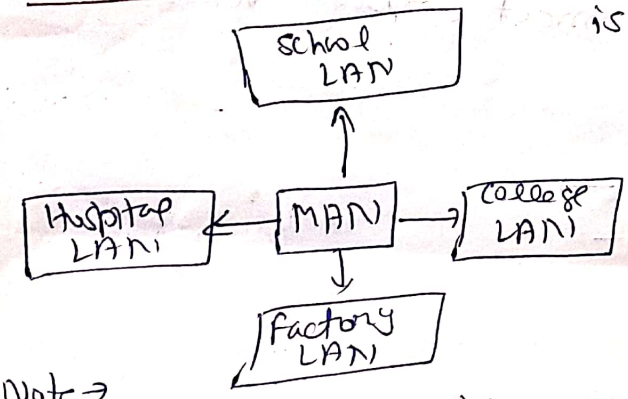
Use – Personal Uses
Technology – Bluetooth, Zigbee, IrDA
Range – 1–100 meter
Area – within a Room
Transmission speed – very high (bcoz low space)
ownership – Private
maintenance – very Easy
Error rate & cost – very low.

Local Area Network →



Use - office purpose
Technology use - Ethernet and wi-fi
Range - 1 - 5KM
Transmission speed - high
Area - within office, buildings, University
ownership - Private
Maintenance — Easy
Error rate & cost - low

Metropolitan Area Network →

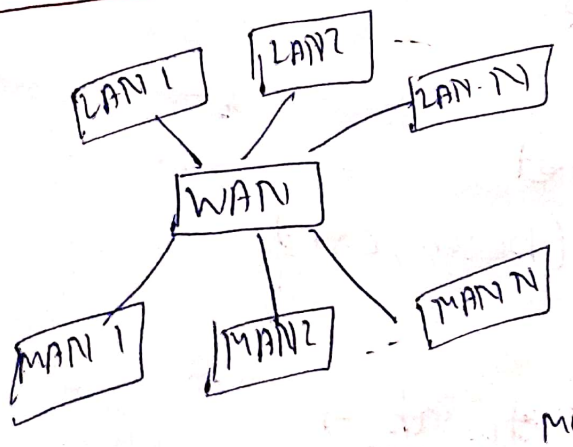


Note →
Speed depends directly on distance
if distance increase then speed decreases.

"Collection of LAN Network is called MAN."

Use - within city
Technology use - FDDI, CDDI, ATM (upto)
Range — 5-50KM
Transmission speed - Average
Area — within city like Mumbai
ownership — Private / Public
Maintenance — Difficult
Error rate & cost - High

Wide Area Network →



"Collection of LAN & MAN N/w is called WAN".

Range - Not fixed (Above 50KM)
Technology Used - leased line Dial up
Area — within Countries
ownership — Private / Public
Maintenance — very difficult
Error rate & cost — very high
Transmission speed - low.

Organization of Internet (ISP)

→ When two or more N/w's are connected, they become an internetwork / internet.

→ Internet — a collaboration of more than hundred of thousands of interconnected networks.

→ History →

In 1969, ARPANET was a reality, a small Network of connected computers developed.

→ four nods at the University of California at Los Angeles (UCLA), University of California at Santa Barbar (UCSB), Stanford Research Institute (SRI) & University of Utah, were connected via Interface Message processor (IMP) to form a N/w.

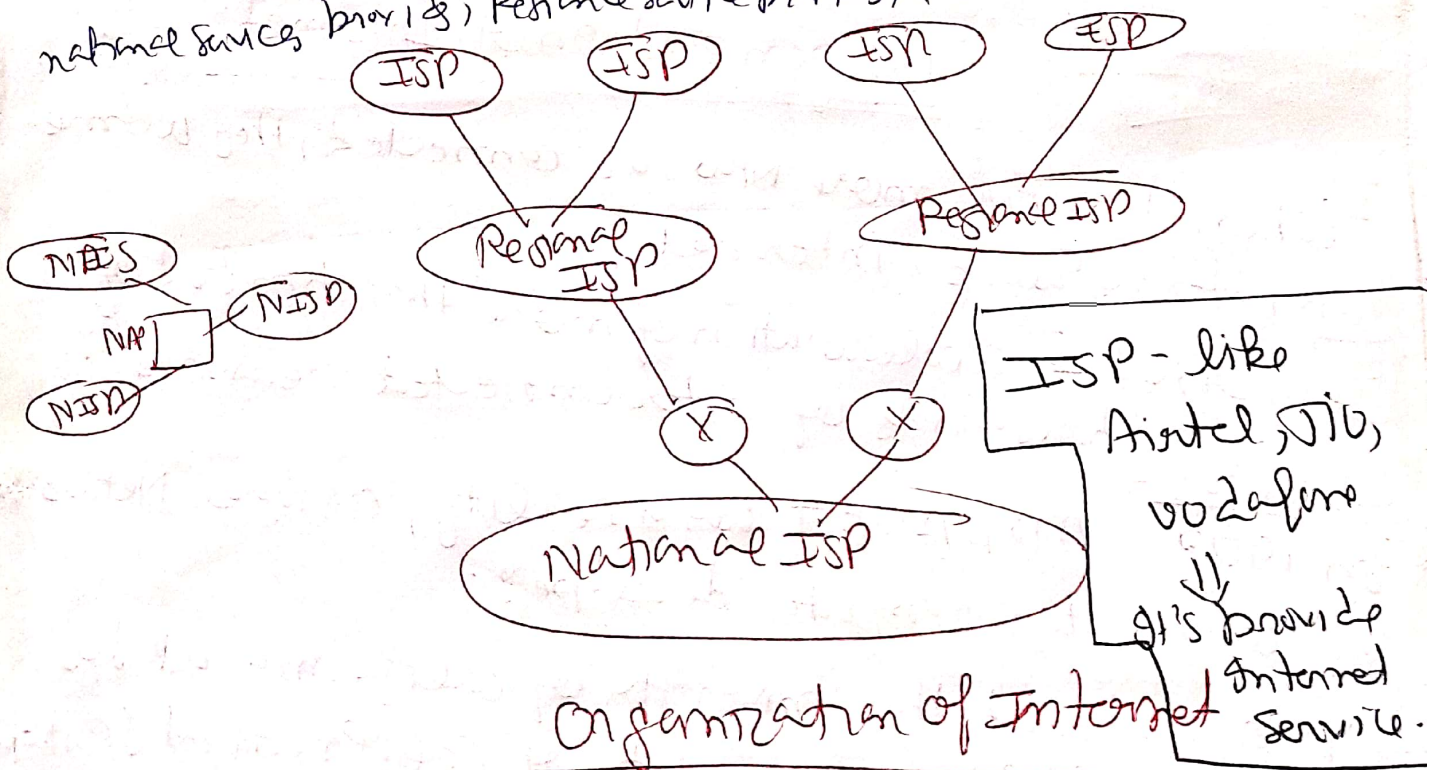
→ Software called N/w Control protocol (NCP) provided communication between the hosts.

→ In 1973 Vint Cerf & Bob Khan collaborate a project called Interneting project & outlined the protocol (TCP) to achive end to end delivery of packets

→ shorty thereafter split TCP into two protocol TCP & IP. Here IP handle routing while TCP responsible for error detection segmentation & reassembly.

→ The Internetworking protocol became as TCP/IP.

Internet today ⇒ Today, Users who wants Internet Connection use the services of Internet service providers (ISP) like international service provider, national service provider, Regional service provider & local service providers.



Organization of Internet

Scanned with OKEN Scanner

Protocol → A protocol is a set of rules that govern data communications. The key elements of a protocol are —

Syntax → structure of data, meaning the order in which they are presented.

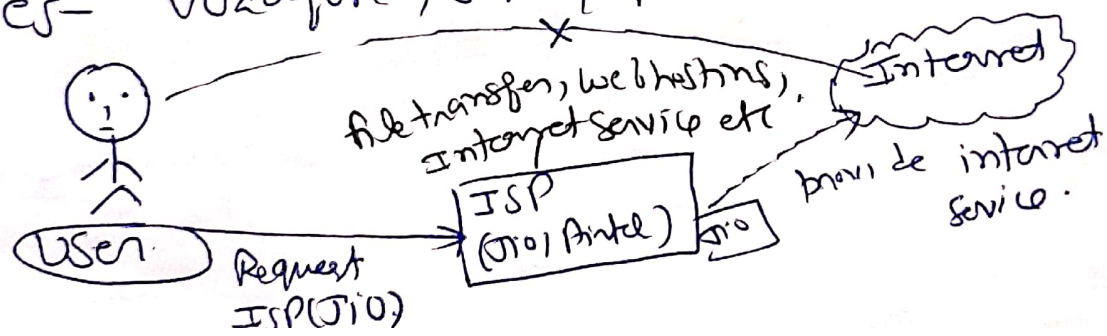
Semantic → refers to the meaning of each section of bits.

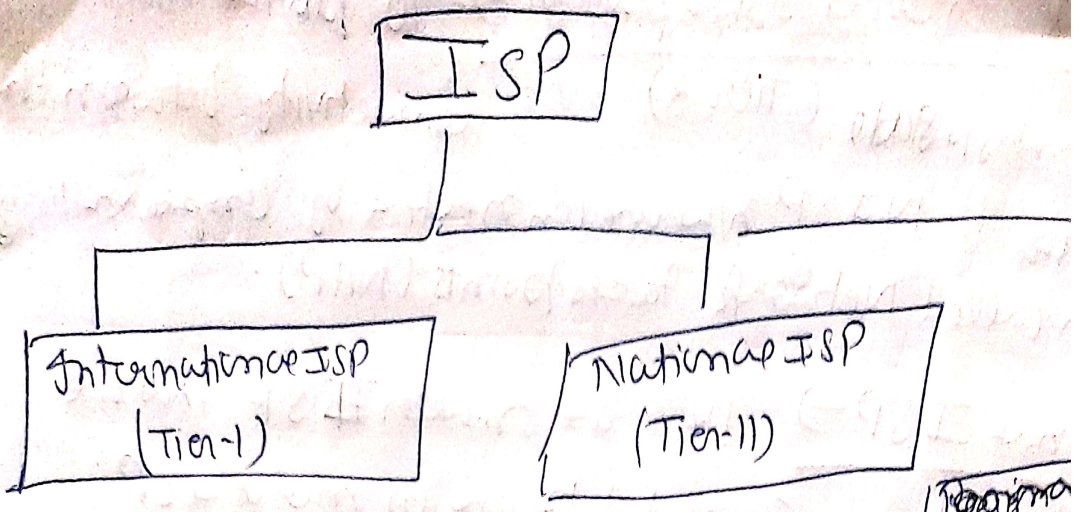
Timing → refers to when data should be sent & how fast they can be sent?

for big organization use Ethernet / frame relay ISPs & for small Area use wifi, DSL, cable Modem etc.

ISP

→ ISP stands for internet service provider.
→ It is a company which provide internet service to its customer is called ISP.
for ex- Vodafone, Jio, Airtel etc.





Tier-I → Provide Internet service for all over the world (through ocean) like AT&T, VSNL

→ Connect nations together.

Tier-II → only for country. (like JIO, Airtel, Idea etc)

→ Connect country to state.

Tier-III → only for city like (MTNL, Spectra)

→ Connect any city to home.

→ provide direct service to the user.

Characteristics of Computer Networks →

1. Resource Sharing - Printer (Goal of CN)
2. Communication - Media - provide data communication
3. Back up - provide backups (storage)
4. Scalability - If size of N/w the so performance may not be degrade.
5. Reliability - offer same service even any system is crashed.
6. Centralised Mgmt - attack & already printer in one system & share among users
7. Security.

Networking Devices → Hub, switch, Bridge, Gateway, Modem, Router, Repeater etc "Use to connect computer Network to Network"

Advantages of Networking →

1. File Sharing
2. Open to everyone
3. Easy to add new device
4. Backup & storage
5. Security

Disadvantages of Networking →

1. N/w device required
2. Virus attack
3. High speed Internet
4. Required Handler (person, cost)
5. Sever

Application of Computer Network →

1- **Bussiness Application** → Resource sharing, Desktop sharing
- Web Application
- Email, VOIP,

2- Home Application → Internet Surfing
Entertainment
Education
Social N/W

3- Mobile User → Hotspot, GPS, m-Commerce
wearable devices (Smartwatch)

4- Social Issue → Social platform (Twitter),
wikipedia etc.

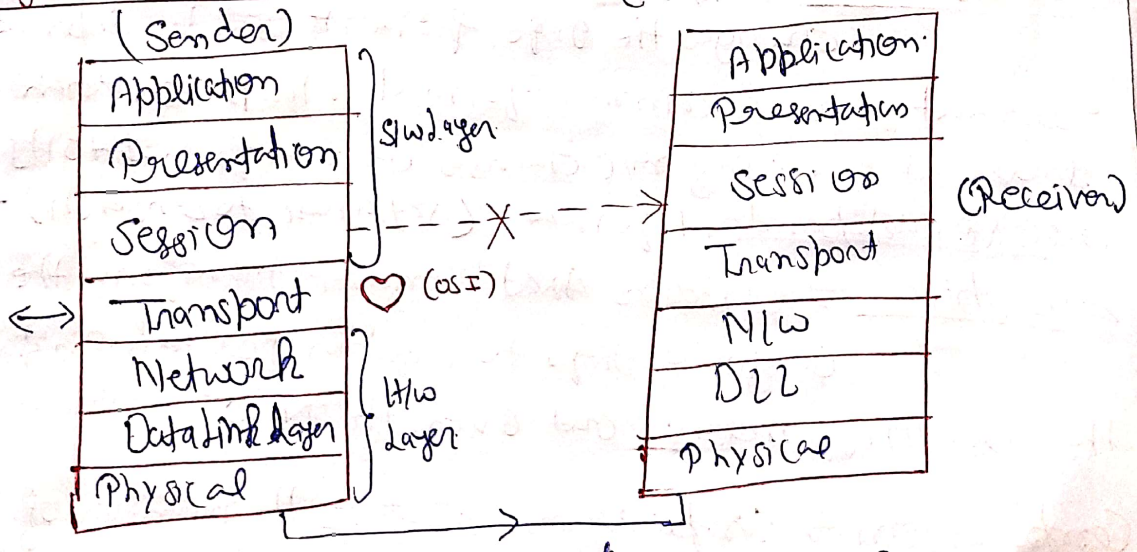
Open System Interconnection Model

It is a layered framework for the design of N/W system that allows communication between all types of Computer System.

→ Seven separate layers.

→ Each layer calls upon the services of the layer just below it. (All people seem to need Dominos pizza)

Layer in OSI Model → It is a Reference Model (not implemented)



→ developed by ISO in 1984. It is also known as OSI - ISO Reference Model.

→ OSI stands for Open System Interconnection model developed by International Organization for Standardization.

(1) Application layer →

→ Application layer enables the user, whether human or S/w, to access the network.

→ This layer is responsible for providing services to user.

Services provided →

Network Virtual Terminal → It allows a user to logon to a remote host.

File Transfer → allows user to access files in a remote host.

Mail services → provides basis for email forwarding & storage.

(2) Presentation Layer → This layer is concerned with the syntax & semantic of the info exchanged between two system.

Responsibilities →

Presentation layer is responsible for Translation, compression & encryption.

Translation → The presentation layer at the sender changes the info from its sender dependent format into a common format & the presentation layer at receiving m/c changes common format to its receiver-dependent format. (Japanese to English).

Encryption → It means that sender transforms the original info to another form & sends the resulting message out over the N/W.

Compression → Compression reduces the number of bits contained in the information.

(3) Session layer → (dialog Controller)

It establishes, maintains & synchronizes the interaction among communicating system.

Responsibilities →

Dialog Control → It allows the communication between two processes to take place in either half duplex or full duplex mode.

Synchronization → session layer allows a process to add checkpoints to a stream of data. for ex- a file of 100 pages, it is advisable to insert checkpoints after every 10 pages to ensure that each pages in record & ack independently.

(4) Transport Layer → This layer is responsible for process - to - process delivery of the entire message. (end to end).

Responsibilities →

Service point Addressing → transport layer header include a type of address called service point address (port address).

Note → N/w layer get each pkt to the correct computer
Transport layer gets entire message to the correct process on that computer.

Segmentation & Reassembly → A message is divided into transmittable segments, with each segment containing a sequence No. so that reassemble the message correctly upon arriving at the destination.

Connection Control → Transport layer can be either connectionless or connection oriented.

Flow Control → Flow control at this layer is performed end to end.

Error Control → Sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss, duplication).

⑤ Network layer → This layer is responsible for the source-to-destination delivery of a packet across multiple links. this layer ensure that each packets gets from its point of origin to its final destination.

Responsibilities →

Logical Addressing → If the pkt passes the n/w boundary we need logical addressing to distinguish source & destination system.

Routing → when independent networks or links are connected to create internetworks or large n/w, the connecting devices (route, switch etc) route the packets to their final destination.

⑥ Data link layer → The data link layer is responsible for moving frames from one hop (node) to the next.

Responsibilities →

framing → The data link layer divides the stream of bits received from the n/w layer into manageable data units called frames.

Physical Addressing → If frame are distributed to diff systems in the n/w, the DLL add header to frame to define sender/Receiver of the frame.

Flow Control → If the rate at which data are absorbed by the receiver is less than

the rate at which data are produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.

Error control → The data link layer add reliability by adding mechanism to detect and retransmit damaged or lost frames. It also uses a mechanism to recognize duplicate frames.

① Physical layer → This layer is responsible for movements of individual bits from one hop(node) to the next.

Responsibilities →

Physical characteristics of interfaces & medium → this layer define the type of transmission medium also define the feature of the interface b/w the devices.

Representation of bits → The physical layer data consist of a stream of bits (0 or 1) with no interpretation. To be transmitted bits must be encoded into signal.

Data rate → the no of bits sent each second is also defined by physical layer.

Synchronization of bits → the sender & receiver clock must be synchronized.

Use same bits rate.

Line Configuration → physical layer is concerned with the connection of devices to the media like point to point configuration multipoint configuration.

Physical Topology → topology defines how devices are connected to make a network like - star, mesh etc.

Transmission Mode → physical layer also define the direction of transmission between two devices - simplex, half duplex & full duplex.

TCP/IP Protocol Suite

→ It is developed before OSI Model.
→ Contains four/5 layers Architecture
→ also known as TCP/IP Protocol suit.
→ Developed by ARPANET
→ support client server & peer to peer

Application
Transport
Network
Data link
Physical

Application
Transport
Internet
Network Access layer

Process to process
Host to Host (Port Address)
Source to destination
Node to Node

→ Implemented model not documented work

Application Layer →
→ Data Representation / Application Interface.

→ Application layer provide services to the end users to work over n/w or internet for eg- file transfer etc.

→ Imp protocol in this layer is — DNS, DHCP, HTTP, FTP, TFTP, SMTP, SNMP etc.

(all protocols help to run internet).

Transport Layer → responsible for transporting data & setting up communication between the application & the lower layers.

→ Imp protocol in this layer is — TCP (connection oriented), UDP (connectionless)

→ UDP use for watching video, videocall etc. (Access real time data)

Network layer → protocol in this layer is IP. This protocol is responsible for logical transmission of data over the entire network. ICMP/IGMP/RARP/ARP

→ Sender & Receiver IP Address

→ Routing → Connection oriented Protocol.

Network Access Layer (Physical layer) → Combination of Physical & Data link layer PDU looks out for Hardware address i.e. MAC address.

~~protocols in this layer is ICMP, IGMP, ARP, RARP~~

→ In this layer does not define any specific protocol.

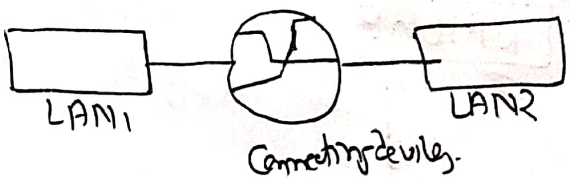
→ Use for physical Transmission of data.

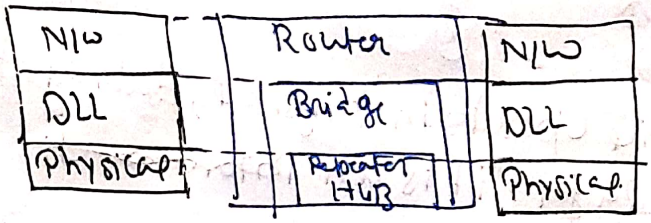
Diff b/w TCP/IP OR OSI Model →

OSI	TCP/IP
(1) 7 layers	(2) 5 layers

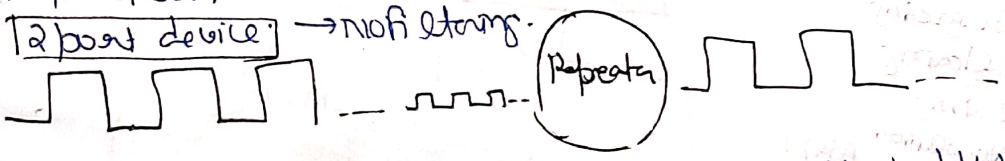
2- Model was defined before the implementation of protocols	After the implementation of protocol, TCP/IP model was define.
3- Theoritical Model	Practical / Reality Model
4- It has separate session & presentation layer.	It has combined the session & presentation layer in Application layer.
5- Provid both connection-oriented & Connectionless services by N/w layer.	Provide only connection less services by N/w layer.
Note- Connection oriented ⇓ Transport layer.	Note- Connection oriented + Connectionless ⇓ Transport layer.
6- Guaranteed reliable delivery of packets.	No guarantee of delivery of packets
7- Easy to add new technology.	very difficult to add technology.
8- Strict layered structure	loosely layered structure.

Network devices / Connecting devices → Two or more devices are connected to each other for the purpose of sharing data transmission.

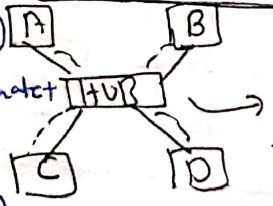




Repeaters → This devices operates only in the physical layer.
→ A Repeater receive a signal & before it becomes too weak / corrupted, regenerates and retimes original bit pattern. → forwarding → collision
→ 2 port device → No filtering.



Hub → In star Topology, Repeater is called Hub.
→ It is a multiport repeater → Use to connect two similar LAN.
→ Passive Hub (forward)
→ Active Hub (Regenerate & forward)
→ Intelligent Hub (N/W mgmt chk fun)



→ Repeater in star topology.
→ collision

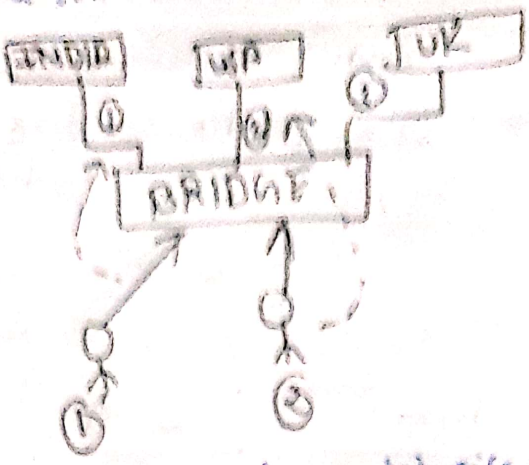
Note → Repeater / Hub forwards every bit. They don't have the intelligence to filter data.

Bridge → → The device operate in both physical & data link layer.
→ bridge are used to connect two diff LAN. like Token bus to Token Ring.

→ No collision (use store & forward)
As physical layer device – Regenerates the signal
As data link layer device – check MAC address of the frame.

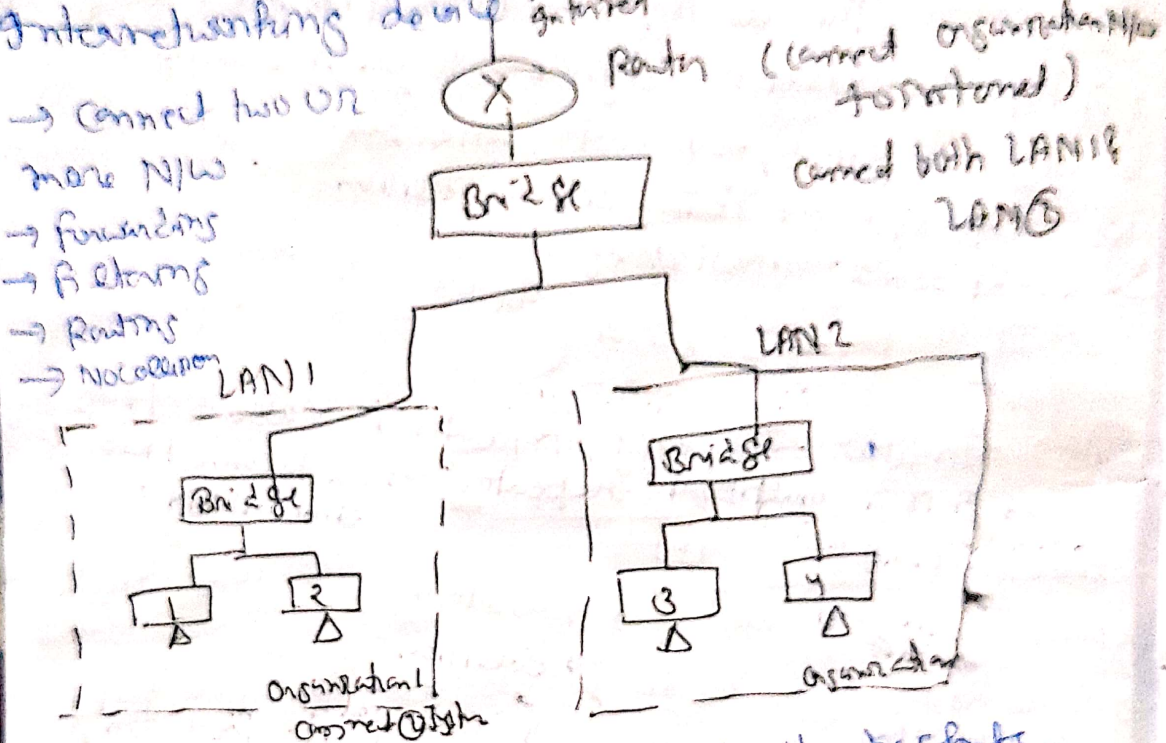
→ A bridge has filtering capability.
→ bridge can check the destination address of a frame & can decide from which outgoing port the frame

Should be send out



Router → The device operates in physical, data link and Network layer it is an interconnecting device used in interconnecting devices

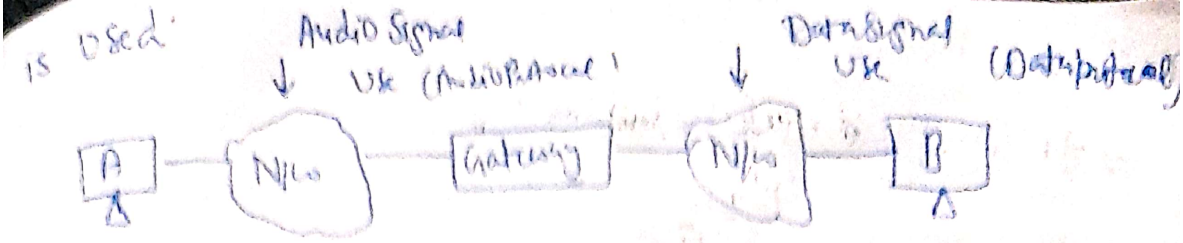
→ connect two or more N/w
→ forwarding
→ filtering
→ Routing
→ No collision



→ Router main work is to Route the packets through shortest distance.
→ Router has physical & logical (IP) address for each of its interfaces
→ A Router changes the physical address of the packets (both source & destination) when it forwards the packets.

Gateways → When the N/w that must be connected are using completely different protocol from each other, a hardware device called gateway

is used



Switch → A switch is a device which provide bridging functionality with greater efficiency. layer 2 (Data link layer) Devices.
A switch act as a multiport bridge in a LAN

Type → 1- Store & forward switch (transfer complete data)
2- Cut through switch (transfer bit by bit).

→ bridge is a 2 port devices while switch is a multi-port devices.

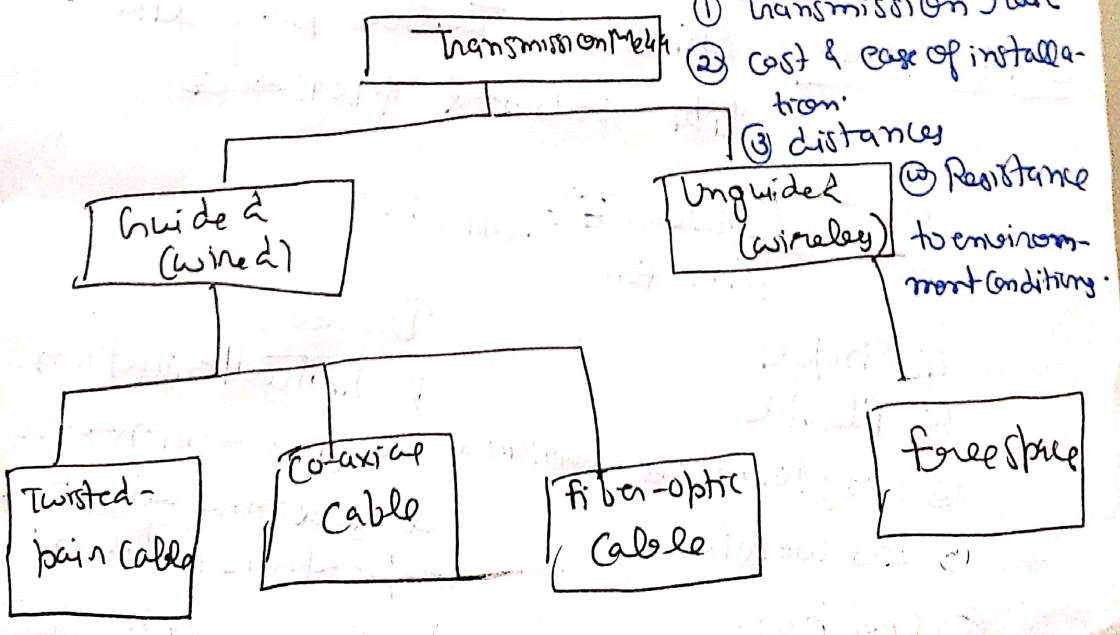
→ Collision Domain is 0

Physical layer

Transmission Media →

A transmission medium can be defined as anything that can carry information from a source to a destination.

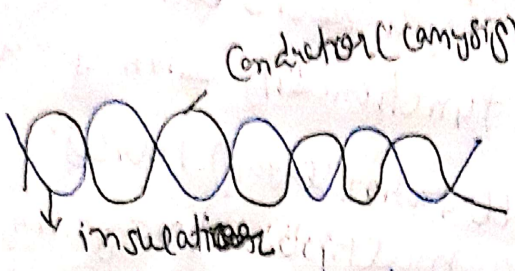
factors of selecting TM →
① Transmission rate
② cost & ease of installation
③ distances
④ Resistance to environment conditions.



Guided Media →

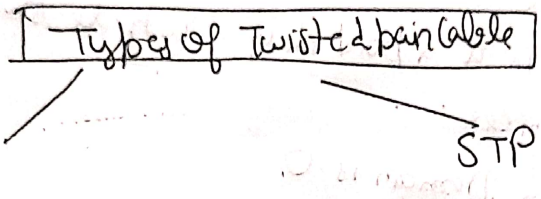
→ It includes cables/wires.

① Twisted pair cable →



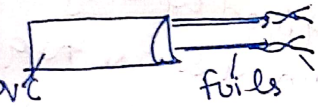
→ It consist of two identical wire wrapped together in double helix.

→ Twisting of wire reduce crosstalk.



UTP Cable → Unshielded Twisted pair. like 10Base T, 100 Base T.

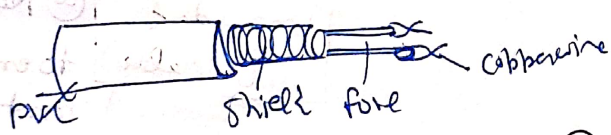
10 Mbps
Base – Baseband (data time sequential)
T – Distance (100 m)



→ Used for electrical communication.

STP Cable → Shielded Twisted pair like –

~~like 10Base2 10Base5~~



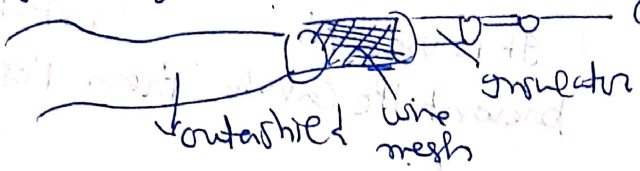
Adv →
① Simple
② flexible
③ Easy to install/maintain
④ Low weight
⑤ Cheaper.

Disadv →
1) high attenuation carrying a signal for large distance without repeaters is problem.
2) Low Bandwidth.

Co-axial Cable →

Consist of solid wire core (concentric conductors) surrounded by one or more foil, wire, shields each separated by plastic insulator.

→ suitable for high speed communication used in television signal- like 10 Base 2, 10 Base 5



Types of Co-axial cable

Thicknet

It is thicker than thinnet
maximum length is 500m long

Thinnet

It is much thinner
maximum length is 185m.

Adv →

1- All transmission characteristics (attenuation, Data rate etc) are much better than Twisted pair cable.
2- used for Broad Band Transmission (normally)
3 High bandwidth (100 mbps)

Note →
(at a time one)
baseband - Digital
broadband - Analog
(more than one at a time)

Disadv → 1- Expensive
2- Not compatible with twisted cable.

③ **Optical fibre Cable →** It consist of an inner glass core surrounded by a glass like material which has lower refractive index. like 100 Base FX n (2km)

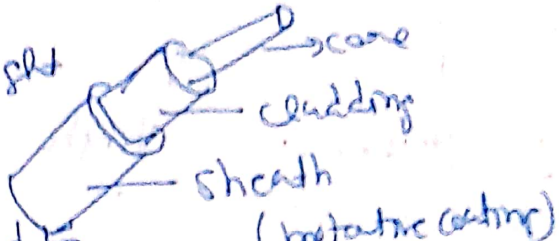
→ It works on the concept of Total Internal Reflection.

Con 2 n →
R.I core > R.I cladding
⑥ Angle of incidence > critical angle.

Parts of Fiber Cable →

Core → It is glass / plastic through which light travel.

Cladding → It's reflect light back to the core.



Protective Coatings → It is used to prevent the cable from fortile (like rain etc) environment.

Types of fiber optic cable

Single Mode
Support upto 2 KMS
Transmission rate 1 GBPS

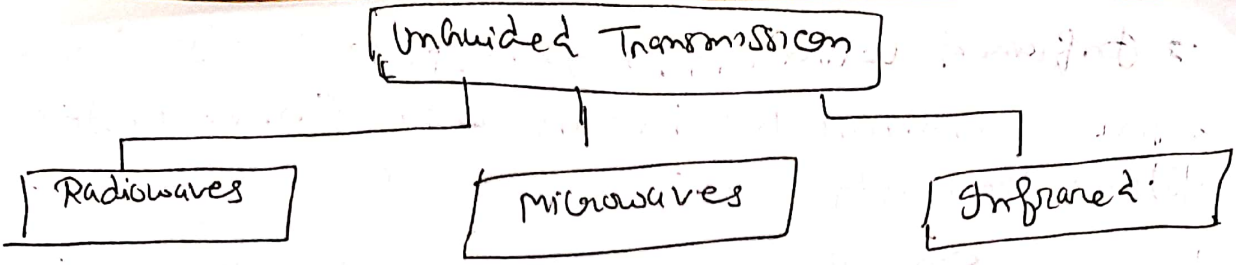
Multimode.
Support upto 100/2 KM
Transmission rate 2 GBPS.

Adv →
1- It is immune to electrical / Mechanical interface because use light signal.
2- Secure Transmission.
3- Use Broadband Transmission also
4- Suitable for Harsh environment.

Disadv →
① Installation problem.
② Most expensive
③ Connection loss.

Unguided Media →

→ Wireless Media.
→ It transmit the electromagnetic waves without using any physical medium. Therefore it is also known as wireless or unguided media.
→ In this media air is the medium through which the electromagnetic energy can flow easily.



Radiowaves → Radiowaves are electromagnetic waves (Omnidirectional) that are transmitted in all the direction of free space.

→ Radio waves are omnidirectional such that signal are propagate in all direction.

→ Rang in frequencies is from 3kHz to 1GHz

→ A Radio wave is useful for multicasting when there is one sender and many Receivers. Ex- FM radio, television, Cordless Phone.

Microwaves → There are two types of microwave (Unidirectional) transmission. Inexpensive (short Distance) Relatively expensive (long Distance) Microwaves are unidirectional as the sending & receiving antena is to be aligned such that the wave sent by the sending antena are narrowly focussed.

→ Range is 1 GHz to 300 GHz.

(a) Terrestrial Microwaves → , cellular phn, Satellite

(b) Satellite Microwave Communication → A satellite is a physical object that revolves around the earth at a known height. Satellite communication is more reliable nowadays

Infrared → An Infrared transmission is a wireless technology used for communication over short range.

→ Range from 300 GHz to 400 THz (Tetra)

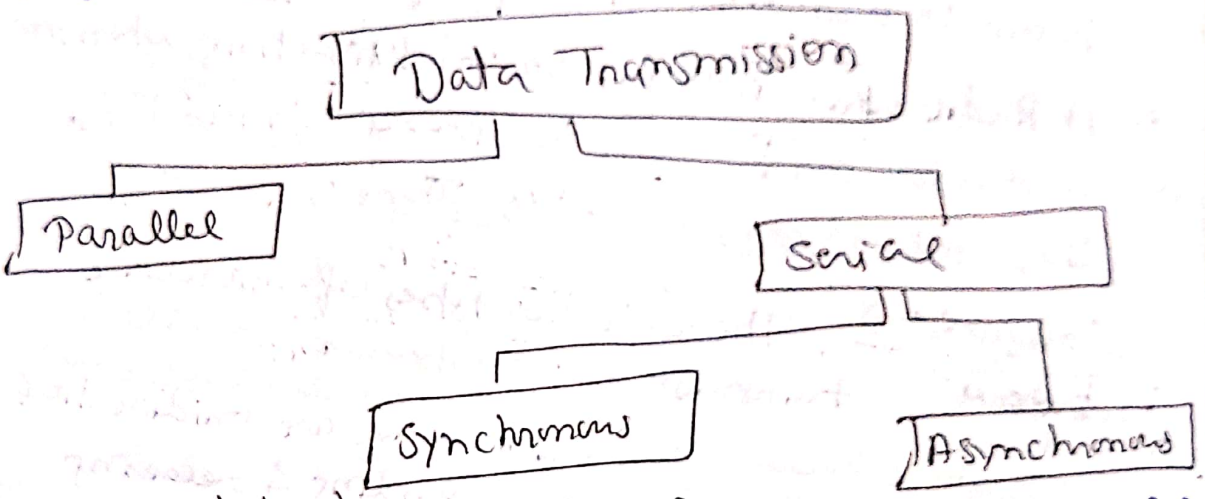
→ use for short Rang communication like data transfer between two mobile phone, TV Remote Operation etc

→ Infrared waves cannot penetrate walls therefore infrared communication in one room cannot be interrupted by the nearby rooms.

Signal transmission & Encoding

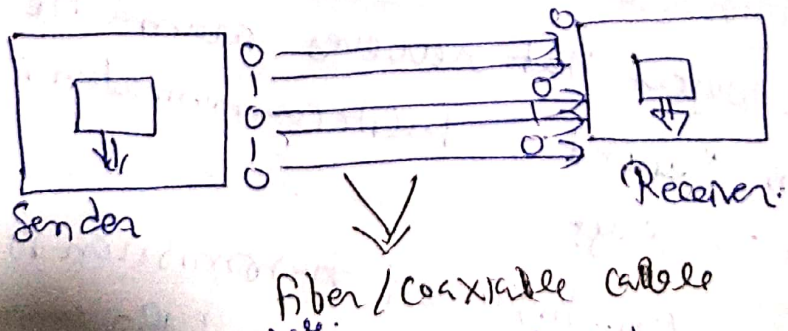
→ To transmit data we use (wire) media.

Data transmission refers to the process of transferring the data between two or more devices in analog or digital format. This data is transferred in the form of bits



Parallel data transmission → It sends multiple data bits at the same time over multiple channels.

Eg: Sender wants to transmit 5 bits data.



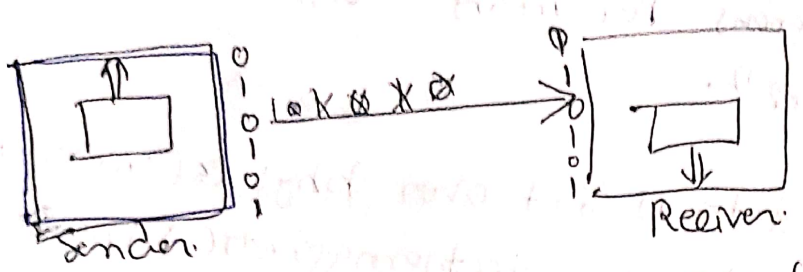
Adv → transmit whole data in one time

Disadv → Costly bcz we require individual cable for transmit bit.

Application → Used to transfer data for short distance.

Serial data transmission →

Serial data transmission sends data bits one after another over a single channel.



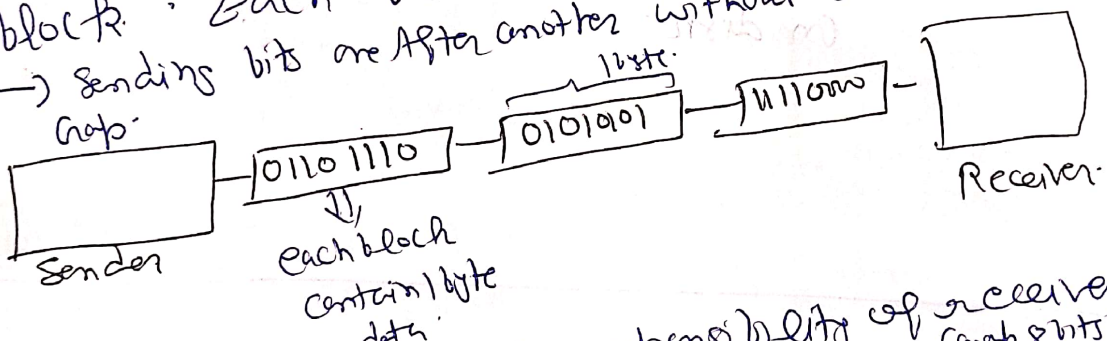
Adv → cheap bcoz use only one cable.

Disadv → more delay.

Application → use for transmission of data for longer distance.

Types of Serial data transmission →

Synchronous → In synchronous transmission a lot of data is sent in a block. Each block has many characters → Sending bits one After another without start/stop bits or

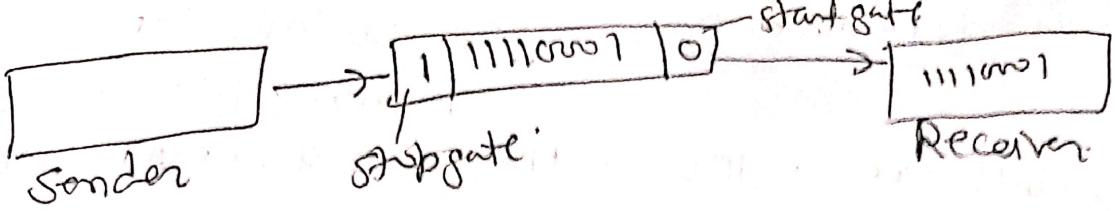


→ Grouping of bits is the responsibility of receiver. (No start & stop bits).

Asynchronous → In Asynchronous transmission every one character is sent at a time. whether that a character is number/ alphabet.

→ It uses 0 (start) & 1 (stop) bits for transferring data.

→ It is cheap & effective process.



→ Asynchronous here means "asynchronous at the byte level".

Note- when data is sent over physical medium, it's convert into electromagnetic signals.

data (Electromagnetic signal) can be
- Analog - like human voice
- Digital - like file on disk.

Analog signal → Continuous signal like human voice.

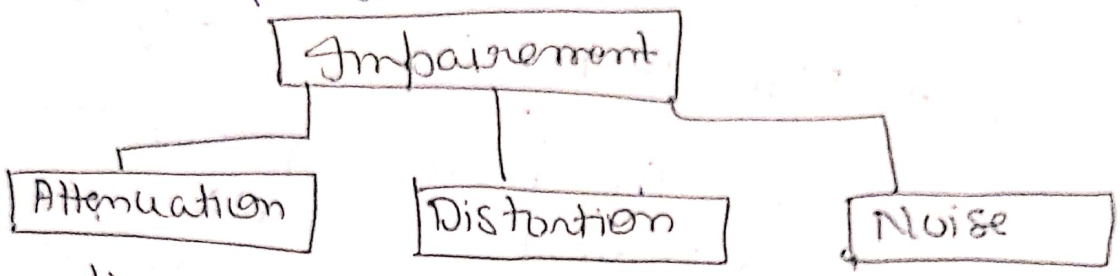
Digital signal → Discrete signal like file on disk.

Transmission Impairment

→ Signal travel through Transmission media, which are not perfect. This imperfection causes signal impairement.

→ It means what is sent is not what is received.

→ Three causes of impairement are attenuation, distortion & noise.

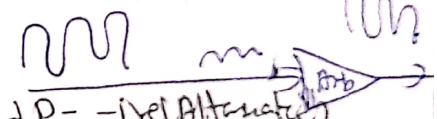


Attenuation → It means loss of energy (weaker signal).

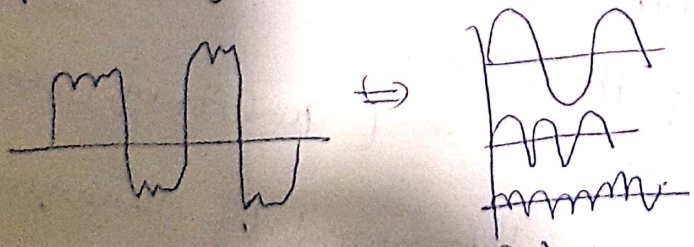
→ Amplifier are used to compensate for this loss of energy by amplifying the signal.

→ To show loss/gain of energy unit "decibel" is used.

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$



Distortion → It means that signal changes its form or shape. Distortion occurs in composite signals.



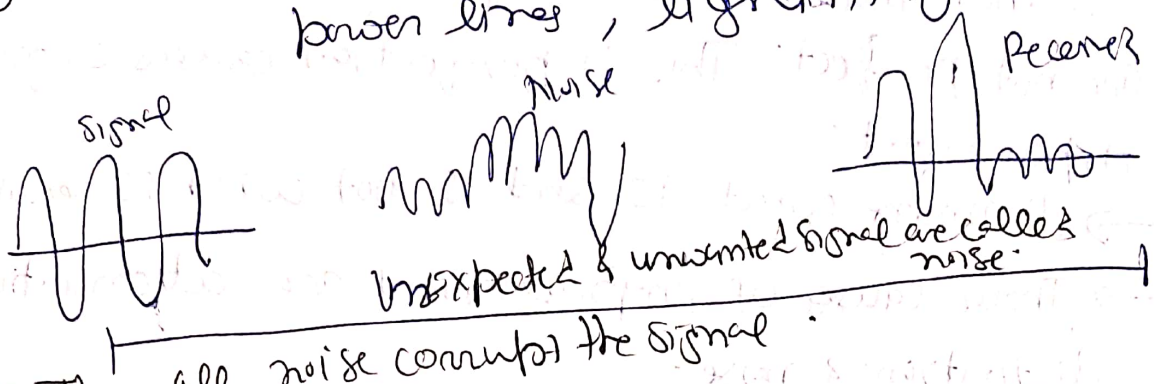
Noise → There are diff types of noise -

(a) Thermal - random noise of electrons in the wire creates an extra signal.

(b) Induced - from motors & appliances,

© Crosstalk → occur b/w two wire

② Impulse → spikes that result from power lines, lightning etc.



Unexpected & unwanted signal are called noise.

→ These all noise corrupt the signal.

Signal to Noise Ratio → (SNR)

→ To measure the quality of a system we use SNR. It indicate strength of the signal w.r.to the noise power in the system.

→ It is usually given in dB & referred as SNRdB.

$$SNR = \frac{\text{signal power}}{\text{Noise power}}$$

Data Rate → It represent how fast we can send data, in bits per second over a channel. data rate depends on three factors—

① The bandwidth available.
② The level of the signal
③ The level of noise (quality of channel)

→ Data Rate can be determined by two former—

① Noiseless Channel
② Noisy Channel.

① Noiseless Channel → Nyquist proposed a formula for noiseless channel is—

$$\text{Bitrate} = 2 \times \text{bandwidth} \times \log_2 L$$

where bandwidth = bandwidth of channel
L = is the signal level

② Noisy Channel → In 1944, claude Shannon design a formula to calculate bit rate for Noisy channel, called Shannon Capacity.

$$\underset{\text{(bitrate)}}{\text{Capacity}} = \text{bandwidth} \times \log_2 (1 + \text{SNR})$$

where SNR = signal to Noise Ratio
Capacity = is the capacity of the channel in bits/second (Bitrate)

Network performance → to judge the performance of N/w.

use four keywords (Criteria) -

① Bandwidth → "How much our N/w can able to transmitt the data."

→ Bandwidth measure in hertz or bps.
increase/freq. increase/data.

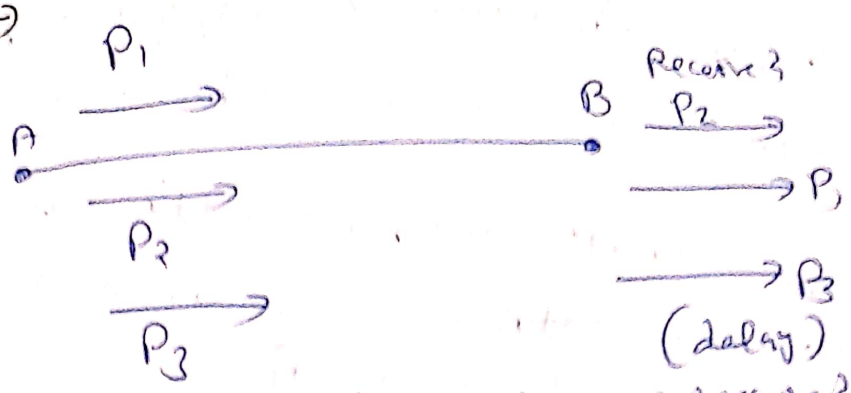
② Throughput → How fast the data can be transmitted.
(more)

③ Latency (Delay) → How much amount of time it takes the message to reach to the destination.
(min.)

A B

Latency = propagation time + Transmission time + Queuing time + Processing delay.
(bit sent A to B not arrives) (entire msg send A to B)
(time taken by msg A & B)

(4) Jitter →



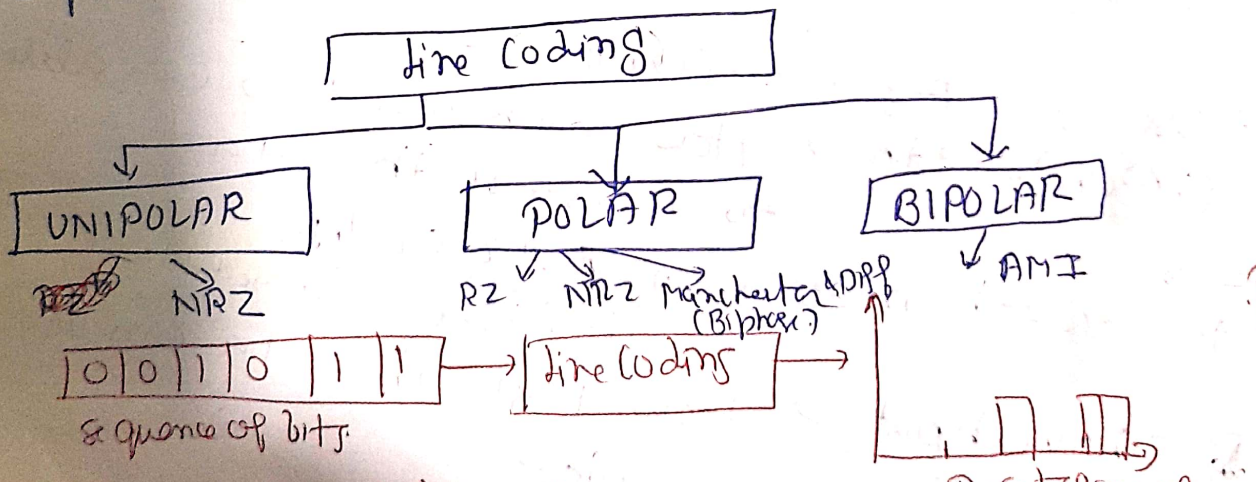
Just because of that synchronization problem will occur in N/w called Jitter. Ex:- dropping of Audio & video. If Jitter will occur in N/w so the performance of N/w will decrease.

Encoding

Encoding converts the stream of bits into a format recognizable by the next device in the N/w path.

Digital to Digital Conversion (line coding) →

It is the process of converting binary data, sequence of bits to a digital signal.



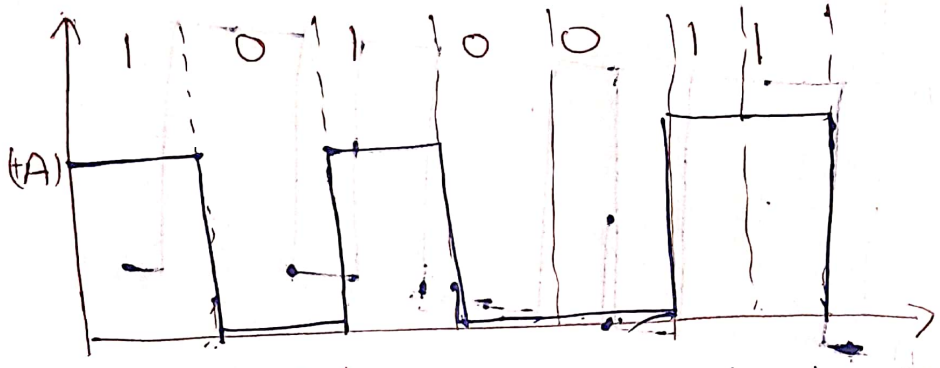
UNIPOLAR line coding → use only one voltage level other than zero.

(1) (0)
+(A) or 0

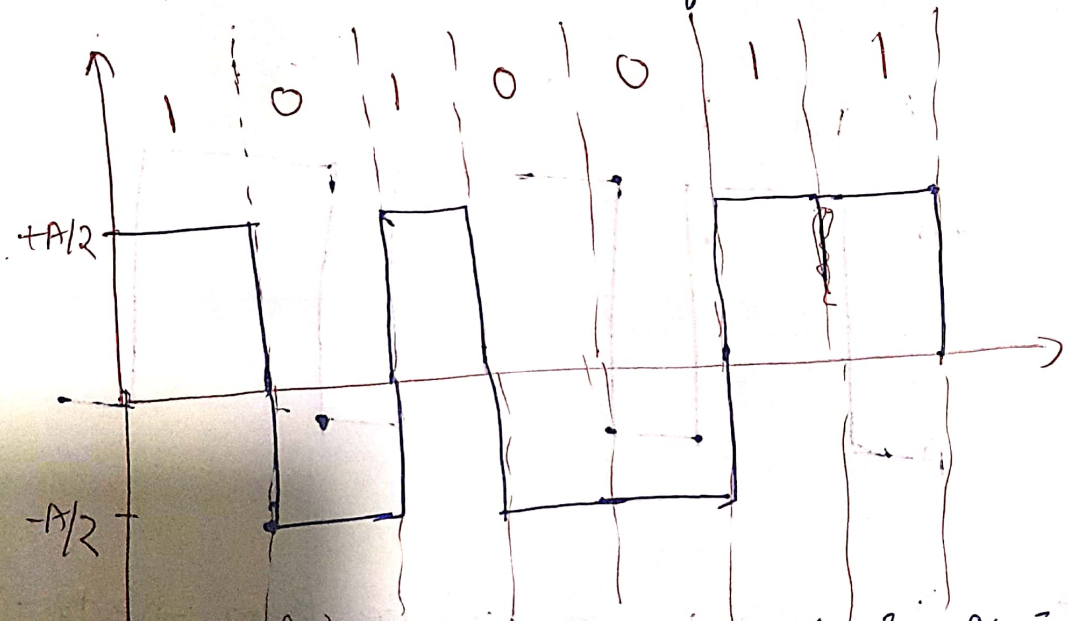
POLOR line coding → use Two voltage levels other than zero +A/2 & -A/2

Bipolar line Coding → Use three voltage levels: Pos; Nels; zero.

NRZ (Non Return zero) → Each 1 = Pulse of full bit duration T_b & amplitude = +A Each 0 = off pulse.

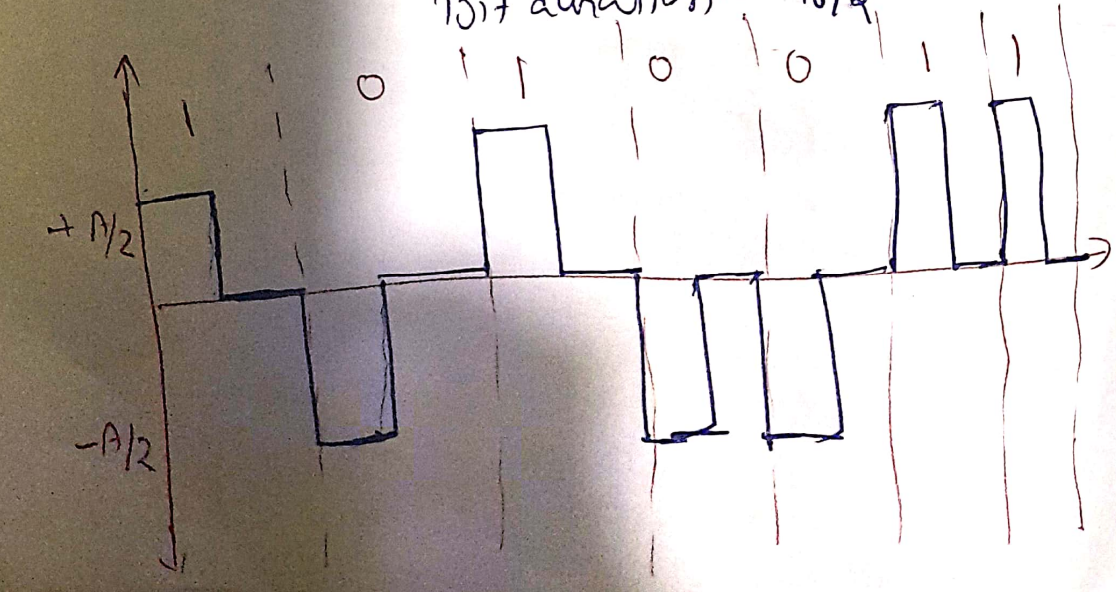


Polar NRZ line Coding → +A/2 of duration T_b = logic 1 and -A/2 of duration T_b = logic 0



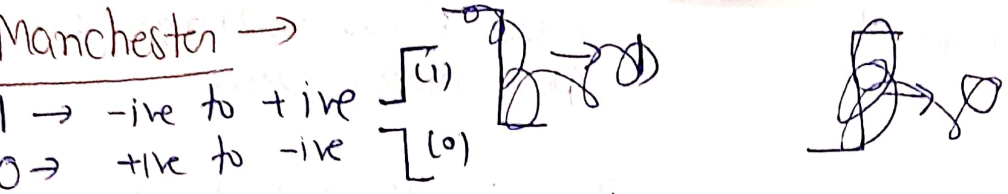
Polar RZ line Coding → +A/2 = logic 1 & -A/2 = logic 0

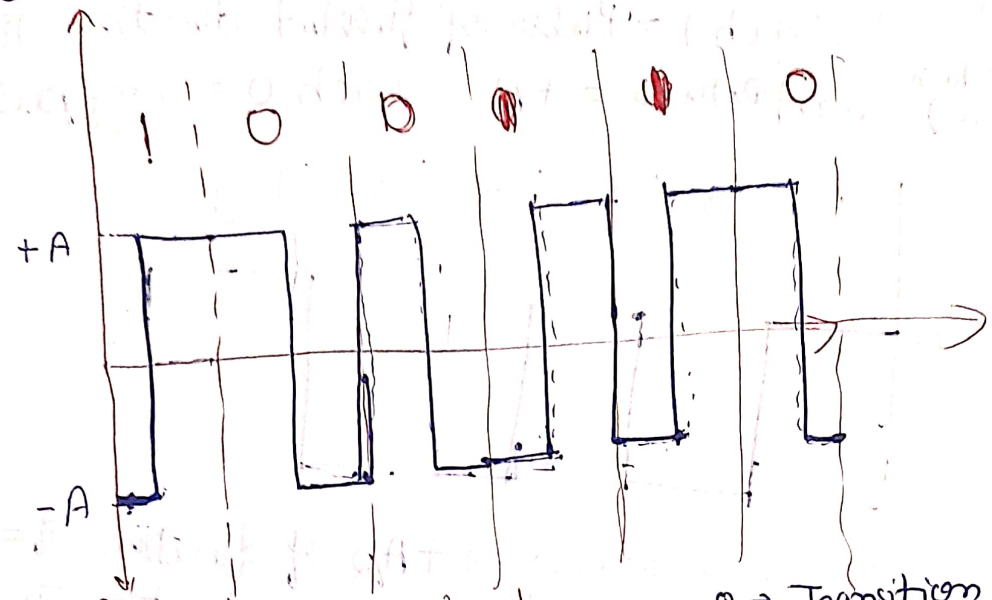
Bit duration = $T_b/2$.



Polar Manchester →

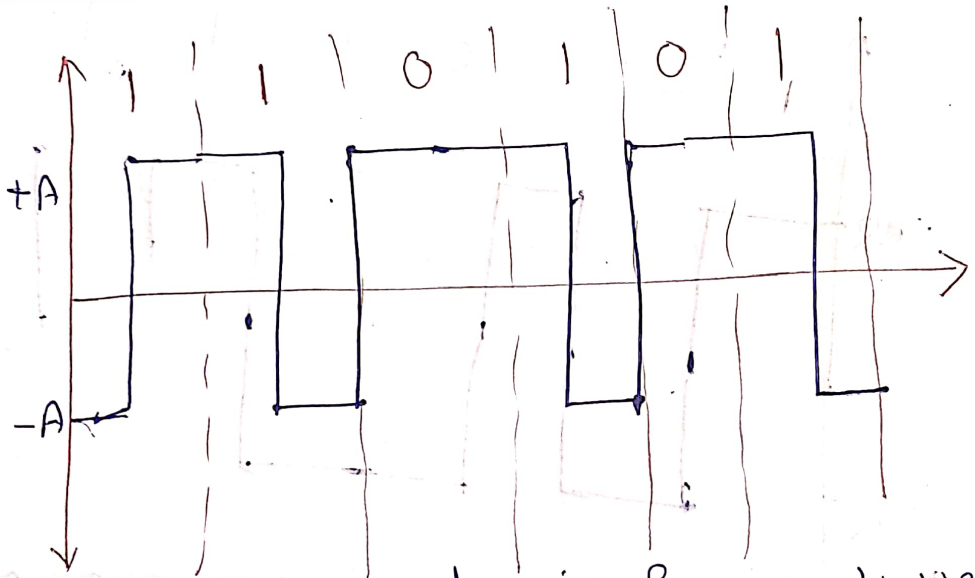
1 → -ive to +ive
0 → +ive to -ive





Polar Differential Manchester →

0 → Transition
1 → No Transition

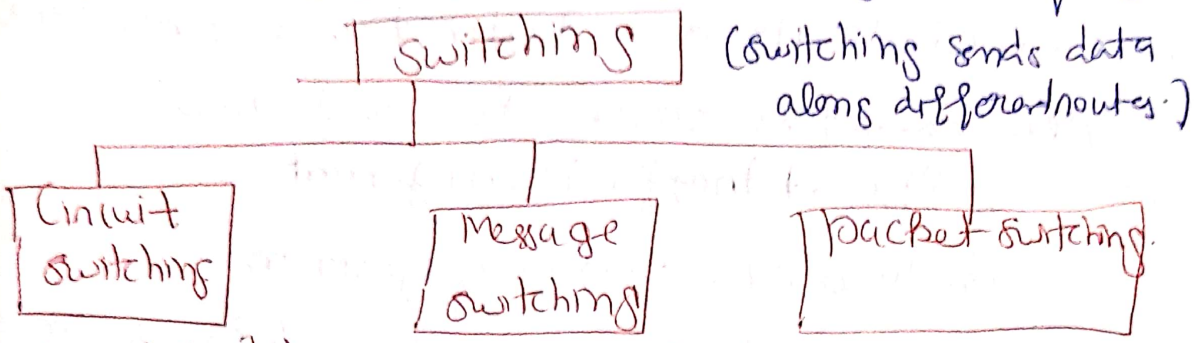


→ Always first transaction i.e. from -ive to +ive

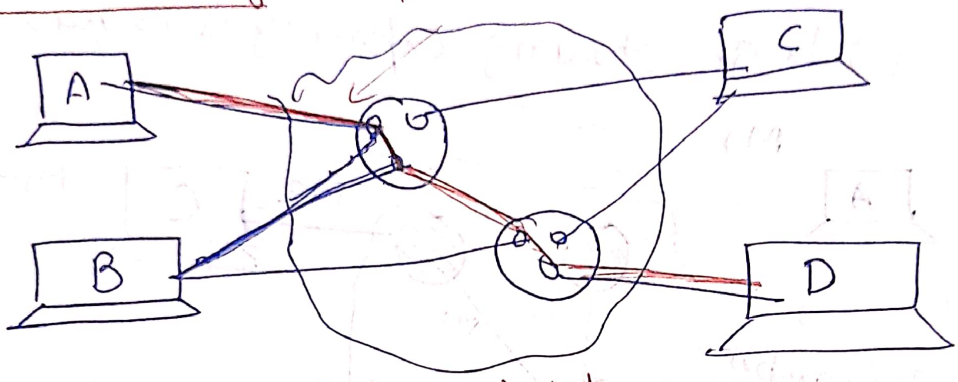
Switching

Switching is a process of forward packet coming from one port to port towards the destination.

→ A communication system consist number of switching nodes. there are three switching techniques.



Circuit Switching → Route A → D



If A want to send data to D.

→ Circuit switching is a transmission mode that involves setting up a dedicated end to end communication

→ Commonly used in Telephone systems.

→ Connection oriented services.

→ bcoz of dedicated connection No delay in data flow.

→ Data transfer using circuit switching is a three step procedure :—

① Circuit Establishment

② Data transfer

③ Circuit disconnection

Disadv → ① Link of the communication cannot be used to send any other data even when free.

② → more bandwidth is require.

③ Connection Establish time is more.

Message switching → There is no dedicated path between two communicating devices.

→ Each Message is treated as an independent unit & include its own destination & source address.

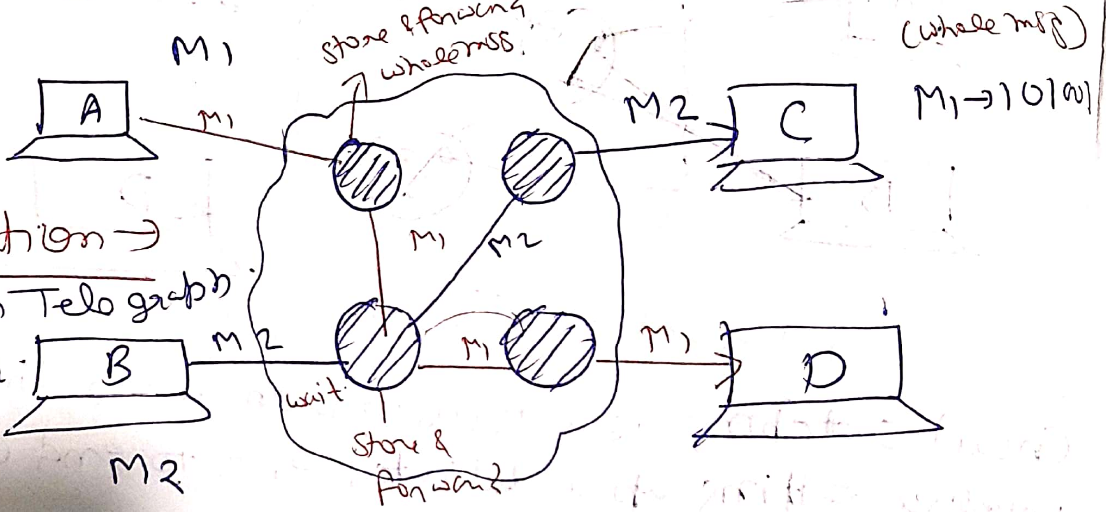
→ Also called as store & forward N/W.

Adv → ① Efficient traffic Management

② Reduces N/W traffic congestion.

Disadv → ① some delay due to store & forwarding

② Large storing capacity is required.



Application → Used in Telegraph Network.

Packet switching → In this message are broken up into packets. Individual packet takes different route to reach the destination.

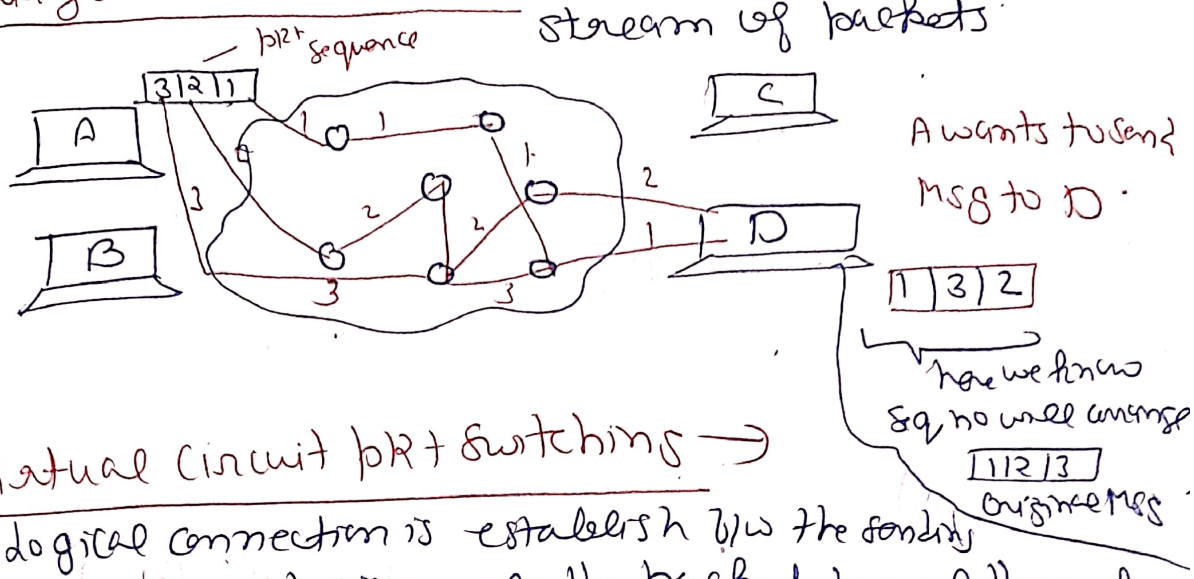
Adv → ① Required Bandwidth is Reduced.
(Bcoz msg break in to pkt)

② In link failure different route can be chosen for remaining packets.

pkt switching

- Datagram pkt switching — connection less (diff route)
- virtual circuit pkt switching — connection oriented (all pkt use same route i.e.)

Datagram packet switching → Message is divided into stream of packets.



Virtual Circuit packet switching →

→ logical connection is established b/w the sending and receiving devices. all the packet travel through the same logical connection called virtual circuit.

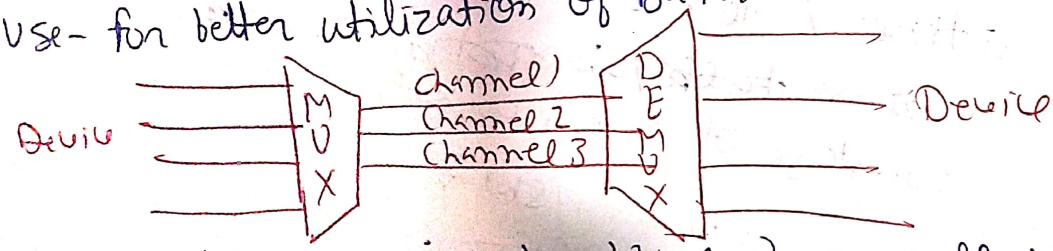
Adv → ① Increase bandwidth
② less transmission delay.

Disadv → ① Require large amount of RAM (due to storage & reassembly of pkt).
② Require more processing power.

Multiplexing

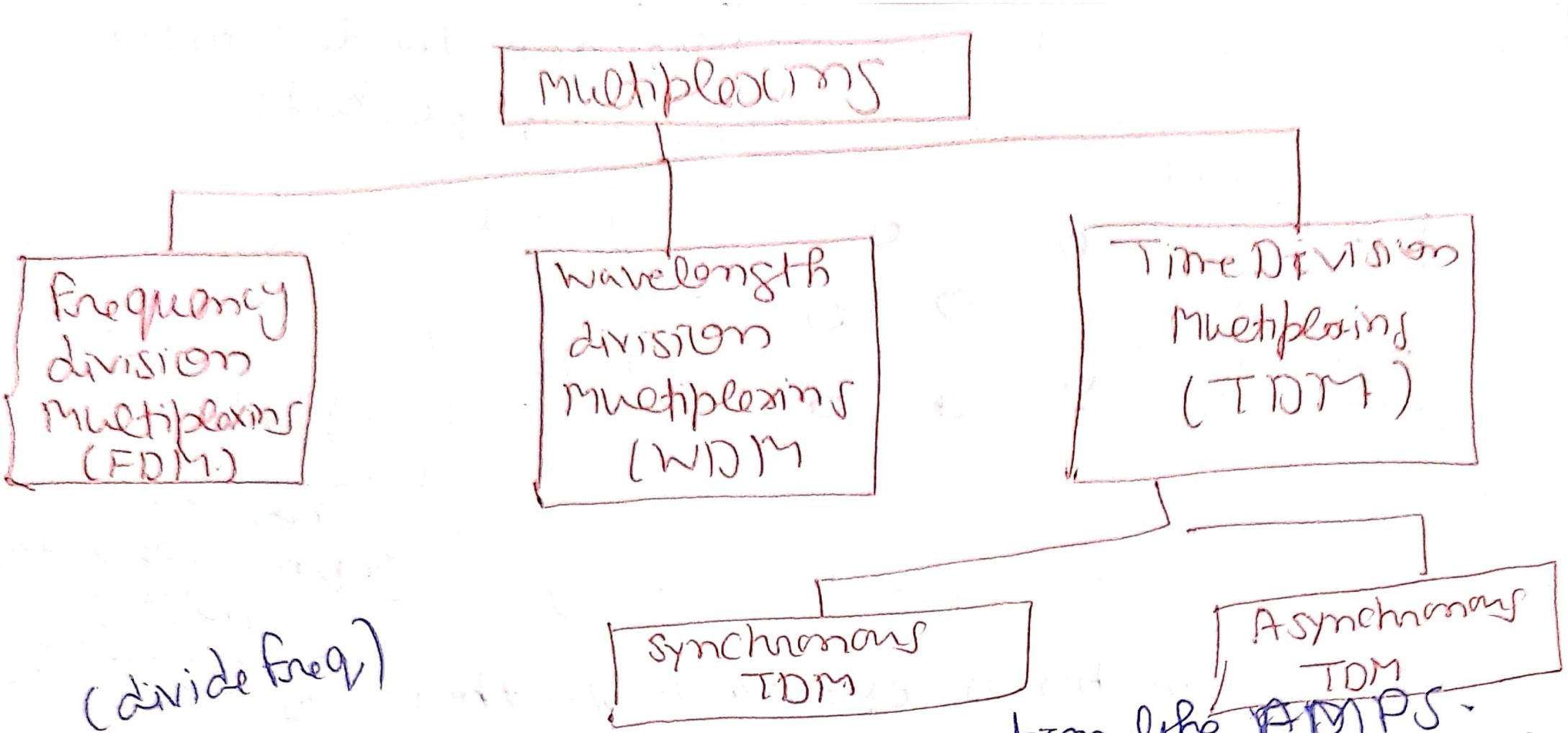
It is the set of techniques that allows the simultaneous transmission of multiple signal across a single data link.

Use- for better utilization of Bandwidth.



→ Multiplexing is achieved by a device called MUX that combine n input line to generate a single output line (many to one)

→ Demultiplexing is achieved by a device called DEMUX available at the receiving end. It separate

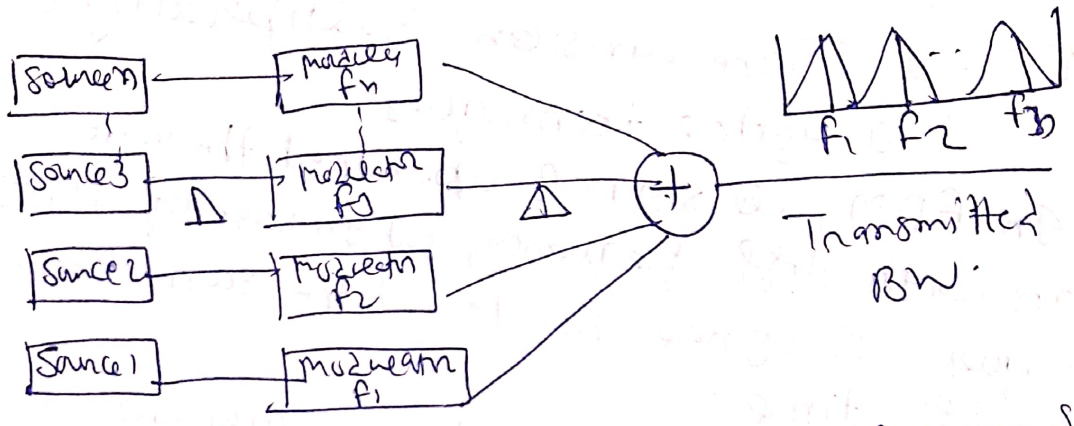


(divide freq)

first generation like PDTPS.

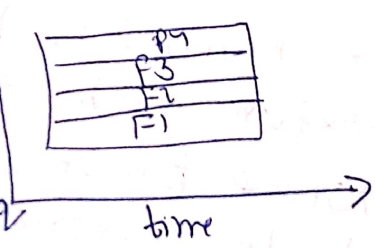
FDM → Frequency division Multiplexing is a technique in which available bandwidth of a single transmission medium is subdivided into several channel.

"Diff frequency for diff user"



→ FDM is used in radio broadcasts & TV N/W.
Ques- 91.1 fm Radiocity

→ These all freq band don't freq overlap to each other bcz of freq guard band.

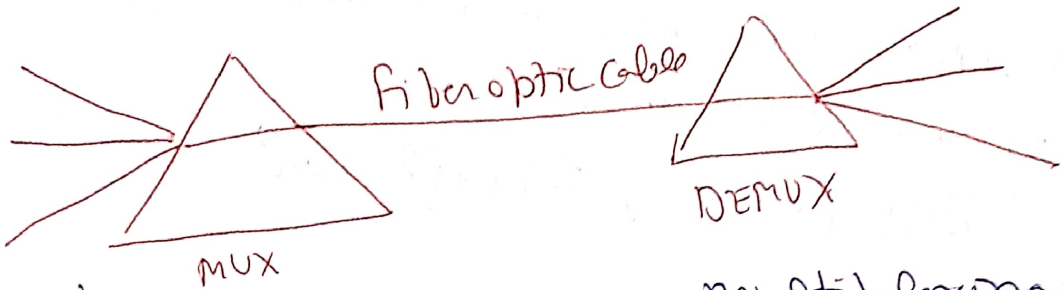


Adv → ① A large no of signal can be sent through
② FDM.
It does not require any synchronization between sender & receiver.

Disadv → It require a high bandwidth channel / wastage of bandwidth.

WDM → wavelength division Multiplexing is same as FDM except that the optical signals are transmitted through the fibre optic cable. It is an analog multiplexing technique. Optical signals from diff sources are combined to form a wider band of [illegible] with the help of MUX & separated signal [illegible] demux)

→ Multiplexing & demultiplexing can be achieved by using a Prism.



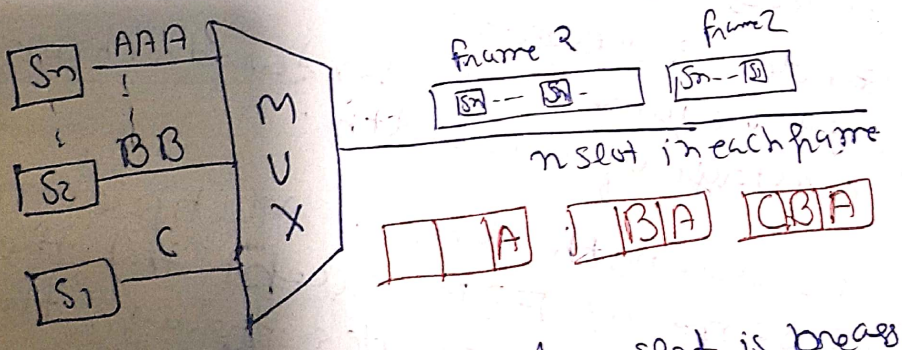
TDM → Time division multiplexing is a digital techniques.

→ In FDM, all signals operated the same time with diff frequency, but in case of TDM techniques all signal operate at the same freq with diff time.

→ In TDM, the total time available in the channel is distributed among diff users. Therefore each user is allocated diff time interval known as Time slot at which data is to be transmitted by the sender.

→ In TDM data is transmitted one by one not simultaneously.

@ Synchronous TDM →



→ In synchronous TDM time slot is preassigned to every device.

→ In synchronous TDM each device given same time slot irrespective of the fact that the device contains the data or not.

→ If device not contain data, then slot will remain empty.

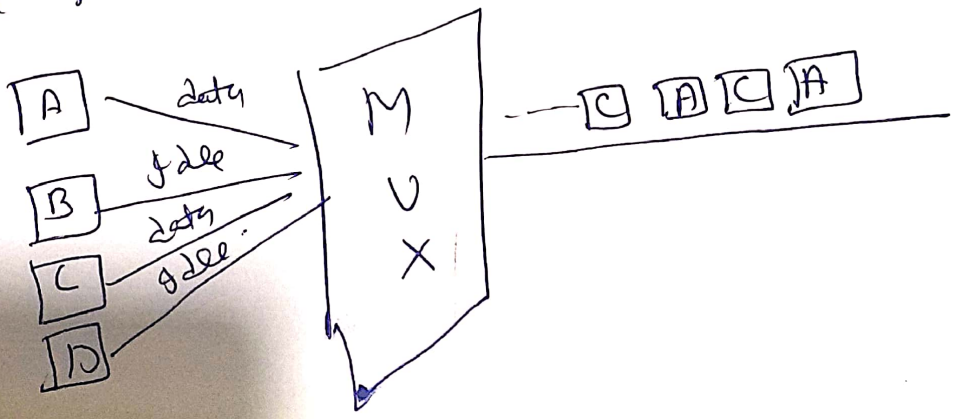
→ In STDM signal are sent in the form of frames. So if there are n device, n slots.

Disadv → The capacity of channel is not fully utilized.

Asynchronous TDM → It is also known as statistical TDM.

In A TDM time slot are not fixed. Time slot are allocated to only those devices which have the data to send. A TDM accept the incoming data streams & create a frame that contain only data with no empty slots.

→ In Asynchronous TDM, if there are n sending devices, then ~~only~~ there are m time slot where m is less than n (m<n).



→ In Asynchronous TDM each slot contain an address part that identifies the source of the data.