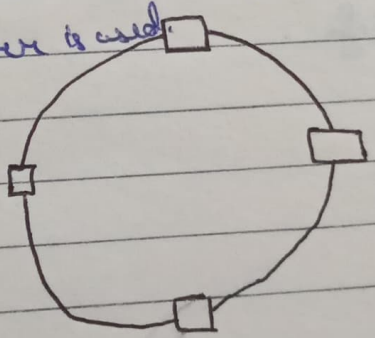
Bus network is a network topology in which nodes are directly connected to a common half duplex link called a bus.

Advantages of Bus Topology.
→ Easy to expand by joining the two cables together.
→ Very cost-effective
→ Works very efficient well when there is a small network.

Disadvantages.
→ Not great for large networks
→ Identification of problem becomes difficult if whole network goes down.
→ Network topology is very slow as compared to other topologies.

~~Star~~
~~Is a network topology~~

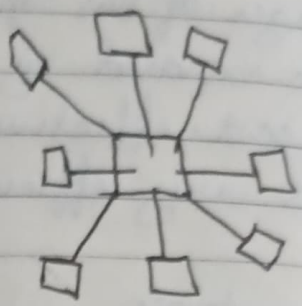
Ring (Ring interface Unit device is used)
If the loop gets bigger repeater is used.



advantages
→ High speed transfer
→ Cost effective
→

Disadvantages.
→ If one system get down the whole network get collapse
→ Less privacy.

Star (Hub)



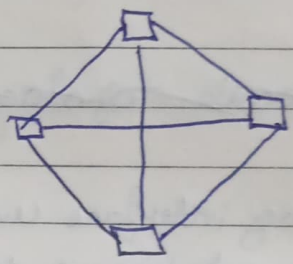
Adv

→ Broadcast use time managing
→ If one system fail ~~there~~ other will be continue to network.
→ Easy to setup, → Diagnosis is easy.

Disadvantages

→ More cables required
→ If centre system fails ~~on~~ whole network collapse.
→ Less secure because of broadcast.

Mesh



Adv

→ Secure
→ Availability high.

Disad

→ More cables
→ Complicated
→ Expensive.

Tree

Adv

Hybrid

ISO-OSI Reference model. (Open System interconnection)
→ Network architecture / Layered structure / level structure of error controlling for maintaining msg accuracy. (Network communication)
~~are added~~ attachments (header) are headed.

Layer 5 [H]

Layer 4 [H4 | H] → [H1] [H2]

H = Header
T = Tailor.

Layer 3 [H3 | H4 | H] [H3 | H2]

Layer 2 [H2 | H3 | H4 | H | T1] [H2 | H3 | H4 | H2 | T2]

Layer-1

7 Layer Model

Application
↕
Presentation
↕
Session Layer
↕
Transport Layer
↕
Network Layer
↕
Data link layer (Frame)
↕
Physical Layer

Transmission Mode
→ Data bit.

function of activities individual
(Responsible for transmitting bit)
Handle electrical/Mechanical/Procedural functionals (Products)

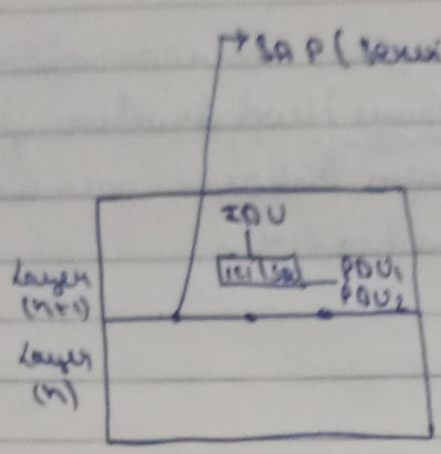
Responsible for Routing Communication for source to destination Addressing Logical Packet transmission

Packet/Message/Circuit switching

responsible for framing

MAC

error control
→ Flow control
→ Access control
→ Addressing (NIC Card)



IDU → Information Data Unit
ICI → Information control Interface
SDU → Service data unit
PDU → Protocol Data Unit

LAN	MAN	WAN
Small size upto 1km	Size upto 10km	Above 10km
No. of systems 2 - 1000	No. of System 10, upto 10,000	No. of system ~~upto~~ above 10,000
Lan Card Network Interface Card	Optical Cable/ Fiber Cable	Satellites
RJ45 (connector)		
Private	Public	Public.
Highest speed	~~High speed than~~ Moderate	Low.
Support Broadcast	Unicast	Unicast

Address

Socket Address
- Port Address
- Logical Address
  - Network Address
  - Host Address
- Physical Address (Printed on LAN or NIC ~~card~~).

Physical ~~Ada~~ Layer
- ~~Re~~ Responsible for transmitting individual bit.
- Handle electrical, mechanical, procedural & functional activit
- Data Rate
- Transmission Mode.

Data Link Layer
- Responsible for framing
- error control
- flow control
- access control
- address - MAC

Network Layer
- Responsible for transmitting packet from source to destination.
- Routing
- Packet/ Message / Circuit Switching
- ~~A~~ W/w level Address — Logical Address.

Transport Layer
- Responsible for transmitting entire msg from source to destination.
- Responsible for reliable communication
  - guarantee of ~~to~~ ~~communication~~ / quality of service
  - flow control for end to end
  - error control for end to end
  - Multiplexing.

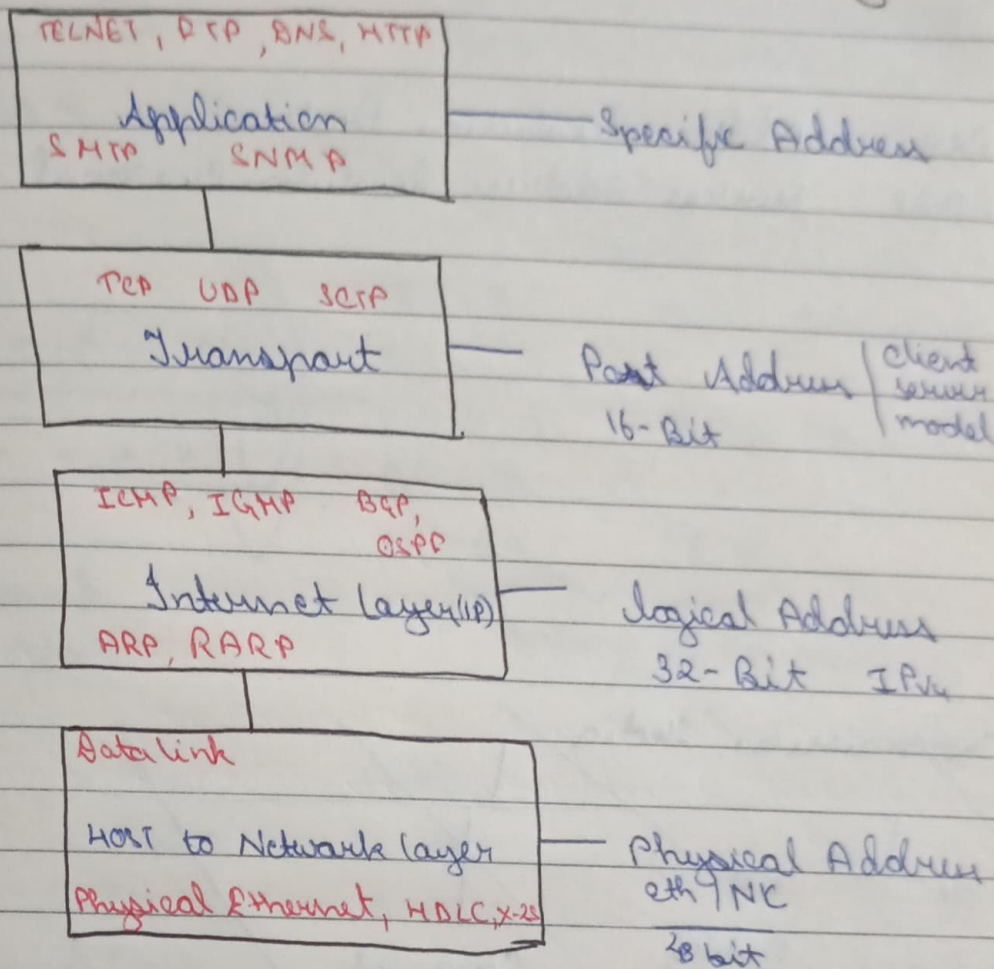
Session Layer
- ~~Dai~~ Establishment
- Synchronization of different application.
- Maintainance.
- Dialogue control (using concept of checkpoint).

Presentation Layer
- Translate in appropriate form.
- Syntax working
- Simantic (
- Compression
- Better utility.
- encryption.

Application Layer
- ~~Authentication~~ ~~resources~~ user authentication.
- Password checking
- Login
- Resource ~~allocation~~ allocation.

TCP/IP Model

Addressing



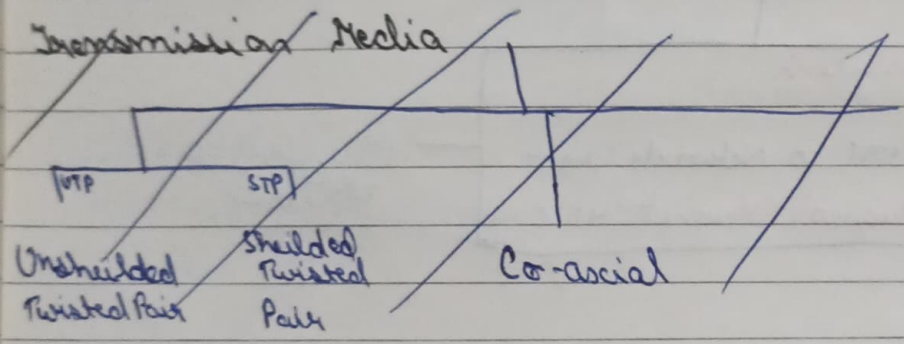
TELNET -
FTP
DNS
HTTP — Hyper Text Transfer Protocol.
SMTP
SNMP

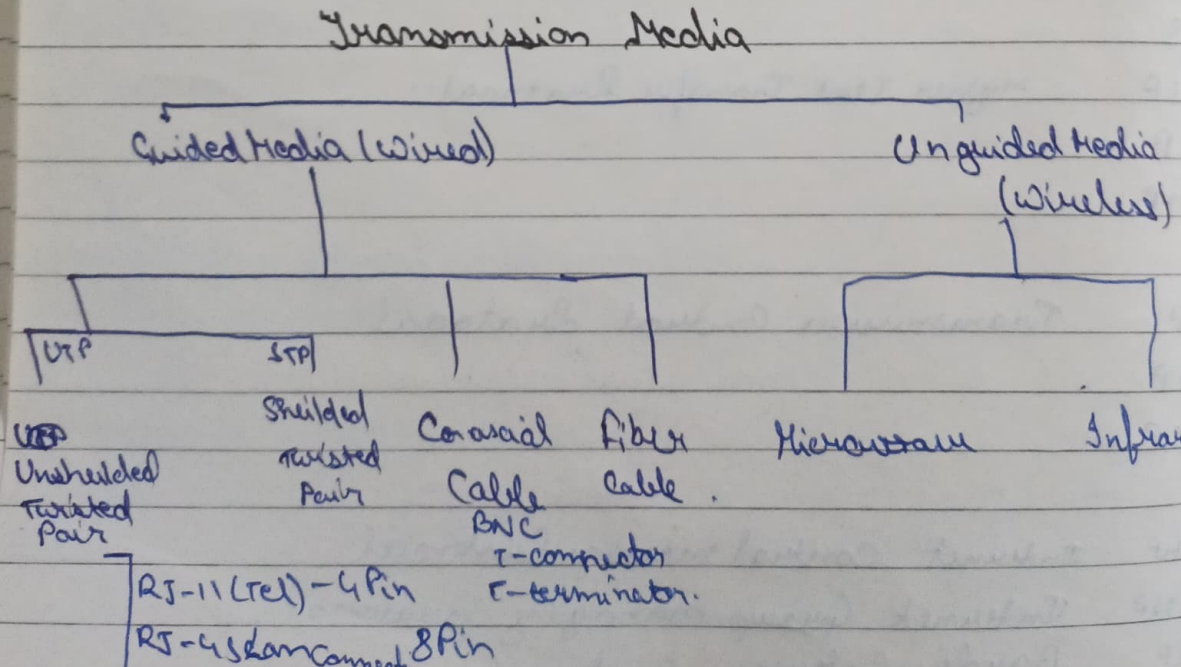
TCP — Transmission Control Protocol
UDP
SCTP

ICMP — Internet Control message Protocol
IGMP — Internet Group managing protocol.
BGP — Border Gateway Protocol

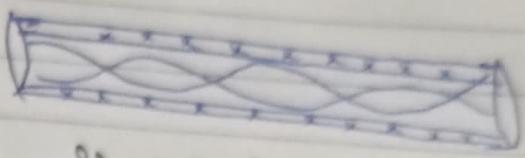
ARP Address Resolution Protocol

RARP Reverse Address Resolution Protocal.

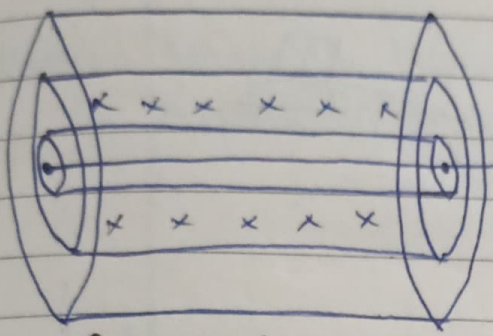




Unshielded Twisted Pair



Shielded Twisted Pair



Co-axial Cable

RG-8 Thin Ethernet
RG-9 " "
RG-... Thick Ethernet
RG-58 " "
RG-64 TV

Variant of Co-axial cable

Cat 1	1 Pair	1 Mb/s
2	2 Pair	4 mb/s
3	3 Pair	10 mb/s
4	4 Pair	16 mb/s
5	4 Pair	100 mb/s
6	4 Pair	100 mb/s
7	4 Pair	100 mb/s

Switching Techniques Purpose to send message from source to destination. / connection establishment

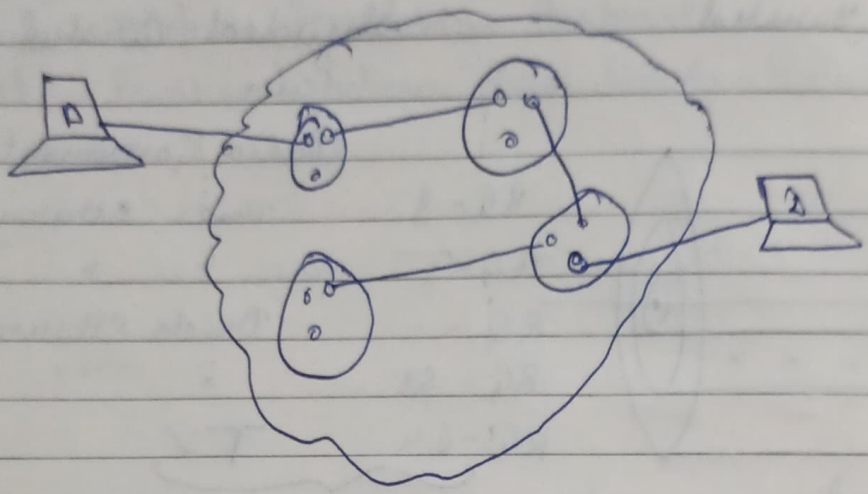
① Message Switching (store & forward technique) Horse in cooling.
② Circuit Switching (Telephone Network) Dedicate path established for source to destination
③ Packet Switching (Internet) Data transferred in form of packets

Message → Adv → Independent Route. Popular for telegraphy Network messages

Disadv - Delay
→ storage space is required.

for test msg.

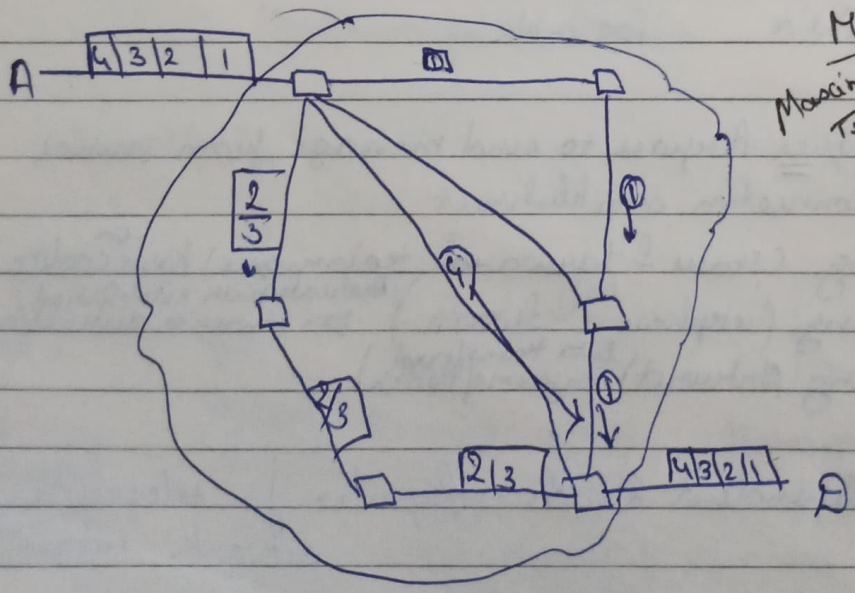
Circuit switching :



Adv - Reliable

Disadvantage : Delay in link establishment.
- Traffic management is poor.

Packet switching



MTU
Maximum Transfer Unit

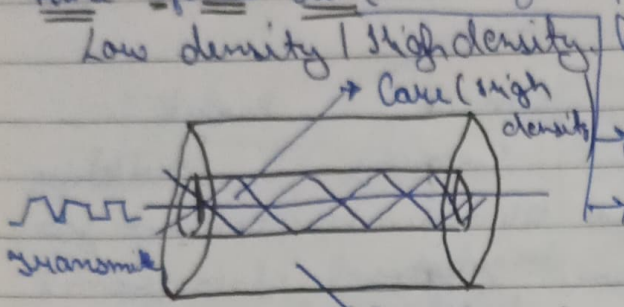
Message switching

Parameter	Message switching	Circuit switching	Packet switching
Application	Telegraph network for transmission of telegram	Telephone network for ~~bidirectional~~ conversation, real time transmission of voice	Internet for data gram & reliable stream service b/w computers
End Terminal	Telegraph & Teletype	Telephone & modem	Computers
Information type	Morse,	Analog voice, PCM digitalized	Binary Information
Transmission system	Digital Data over different transmission media, avoid	Analog & digital data over diff. t	digital mode
Addressing scheme	Geographical address	Hierchaical no. plan	Hierarchical addressing system
Routing Scheme	Mannual	Route selected during call setup.	Each packet routed independently.

Transmission Media

Fibre optical Cable - nature of Light / Glass-Plastic

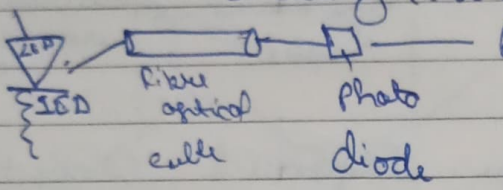
Low density / High density (propagation mode)



→ Multi mode
→ single mode

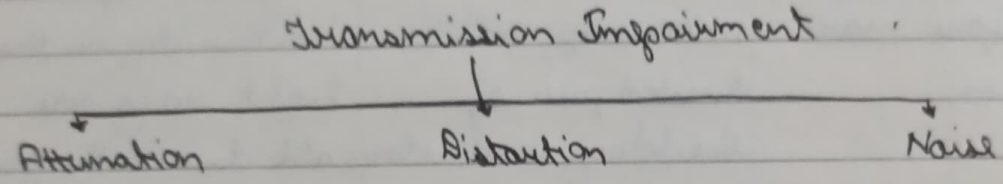
constant density
→ Step index mode
→ Graded-index (Variable density)

Cladding (less density)

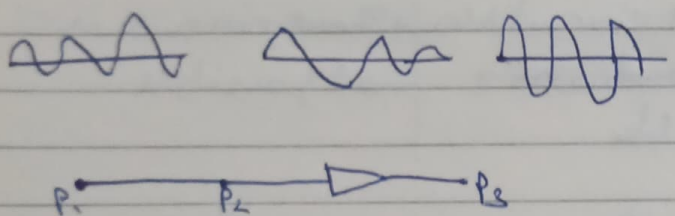


Twisted Pair Cable	Co-axial Cable	Fibre Optical Cable.
• Transmission of signals takes place in electrical form over the metallic conducting wire.	• Transmission of signals takes place in electrical form over the inner conductor of the cable	• Signal transmission takes place in an optical form over the glass fibre.
• Noise immunity is low. Therefore more distortion.	• Higher noise immunity than the twisted pair of shielding conductor	• Highest noise immunity as the light rays are calb due to the pressure unaffected by electrical noise.
• Short circuit b/w two conductor is possible.	• Short circuit b/o two conductor is possible.	• Short circuit is not possible.
• Affected due to external magnetic field.	Less affected due to external magnetic field.	Not affected.
• cheapest	Moderate	Expensive
• Can support low data rates.	• Moderate or High data rates	• Very high data rate.
• Low Bandwidth	Moderate Band width	High.
• Noise capacity per	Noise capacity per segment is 50 - 100	Noise capacity per segment is 2

attenuation is very high.	Attenuation is Low	Attenuation is very low.
Installation is ~~fairly~~ easy.	Installation is fairly easy	Installation is not easy
Electromagnetic interface can take place	EMI is reduced due to shielding	EMI is not present.



original Attenuated Amplified

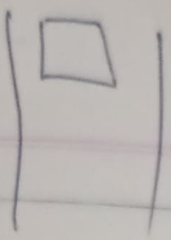


Decibel

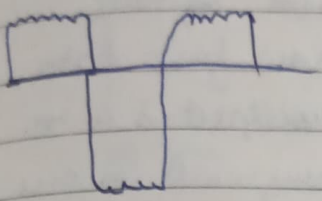
Denoted as Db. measures the relative strength of two signals or a signal at two different points, note that the Db is negative if a signal is attenuated & positive if a signal is amplified.

$$dB = 10 \log_{10}\left(\frac{P_2}{P_1}\right)$$

eg:- Imagine a signal travels through a transmission media & its power is reduced by half.



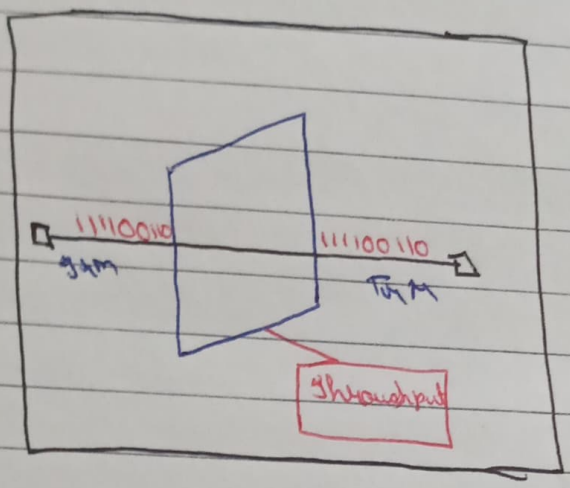
Distortion means that the signal changes its form or shape



Noise is another problem. Several type of noise

~~Throughput~~ Throughput

Throughput is a no. of unit that can be produced by production process within a certain period of time. The throughput is a measurement of how fast data can pass ~~through~~ through a point; Throughput is a no. of bits that can pass this wall (imaginary wall) in one second.

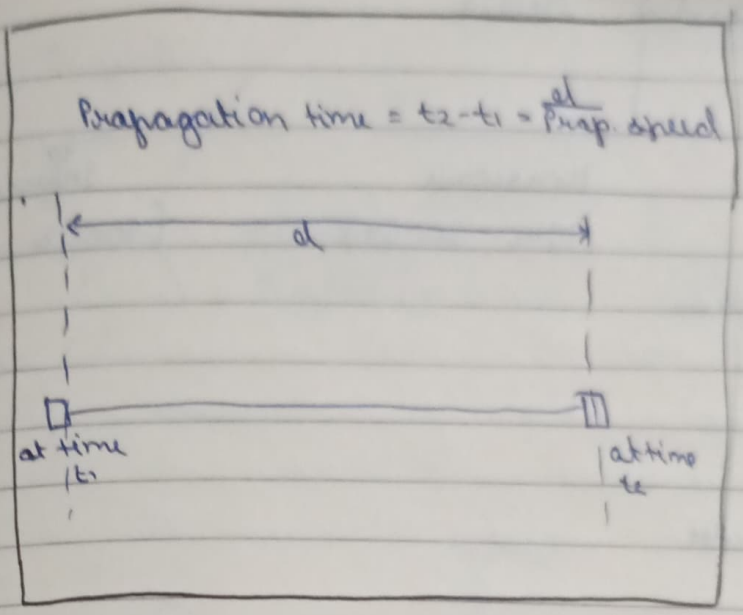


Propagation Speed.

The propagation speed measures the distance that signal or bit can travel through a medium in one second. The propagation speed of electromagnetic signals depend on the medium & the frequency of the signal.

Propagation Time

The propagation time measure the time required for a signal/bit to travel from one point of the transmission media to another. The propagation time, is calculated by dividing the distance by propagation speed



Shannon Capacity

Engineers are often interested in maximum data rate of channel. Shanon introduced a formula to determine the theoretical highest datarate for the channel

$$C = B \log_2(1 + S/N)$$

B = Bandwidth of the channel
S/N = S is the signal to noise ratio of
c = Capacity or Shannon capacity of the channel in bit/second / b/sec.

Q) A telephone line normally has a bandwidth of 3000 Hz. The signal to noise ratio is usually 3162. For the channel find the shannon capacity.

$$C = B \log_2(1 + S/N)$$
$$= 3000 \log_2(1 + 3162)$$
$$= 3000 \log(3163)$$

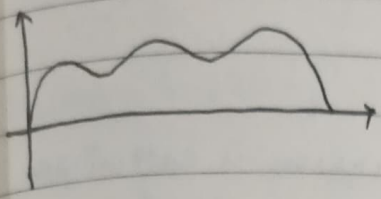
Unguided Media

- Radio wave (10KHz - 1GHz)
- Microwave (1GHz - 300GHz)
- Infrared (300GHz - 400THz)

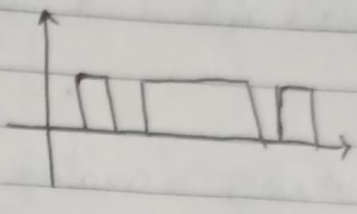
The range of EM spectrum b/w (10KHz - 1GHz) is RF

Short wave used in radio.
Very high frequency used in FM radio & TV
RF is regulated & require a license from a regulatory body.
Can broadcast some directionally.
Various type of antenna's are used to broadcast these signals.
Radio tower, half-wave dipole
Random length wire Yagi
Computer network applications
radio wave fall into three category.
1) Low power signal frequency
2) high " "
3) Spread spectrum.

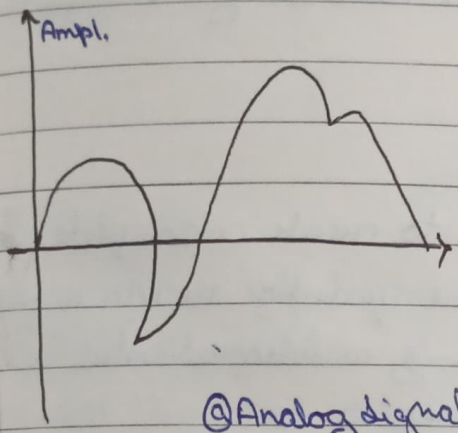
Analog to Digital



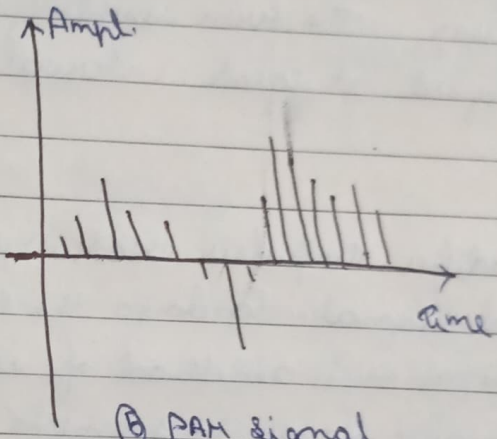
⇒ Analog to Digital conversion.



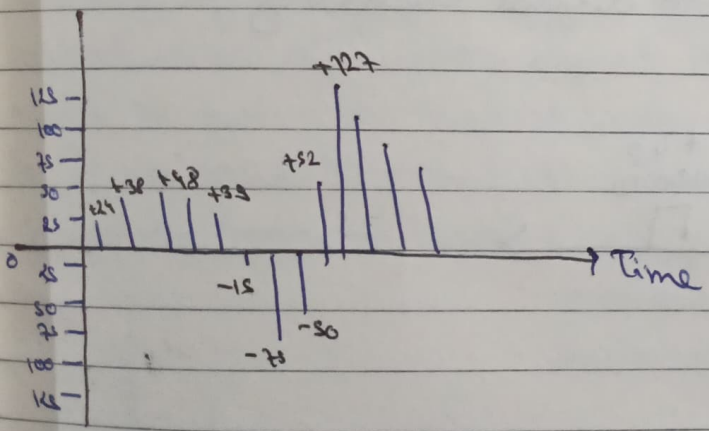
PAM



(A) Analog signal



(B) PAM signal



PAM

PCM

+24 00011000

+38 00100110

+48 00110000

-15 10001111

Six GT

Modulation is the process of converting data into electrical signals optimised for transformation.

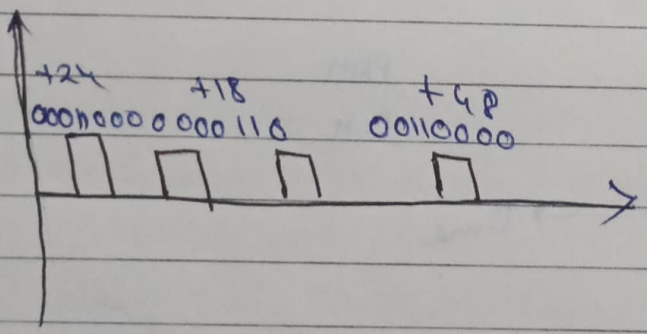
PAM

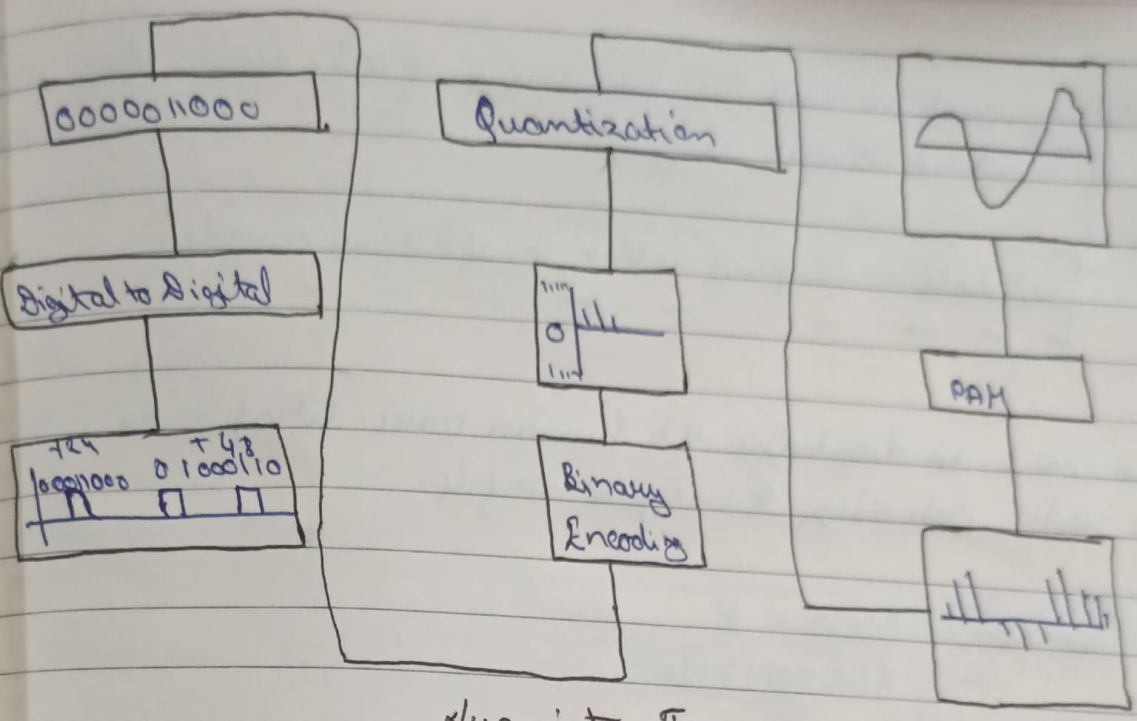
The 1st step in analog to digital conversion is called PAM. This technique takes an analog signal samples it & generates series of pulses based on the result of the sampling. The term sampling means measuring the amplitude of signal at equal intervals.

PCM

PCM modifies the pulses created by PAM to create a complete digital signal. To do so the PCM first quantize the PAM signal. Quantization is a method of assigning a integral value in a specific range to sample intenses.

PCM is actually made up of 4 separate process - Pam, Quantization, Binary encoding & digital to digital encoding.





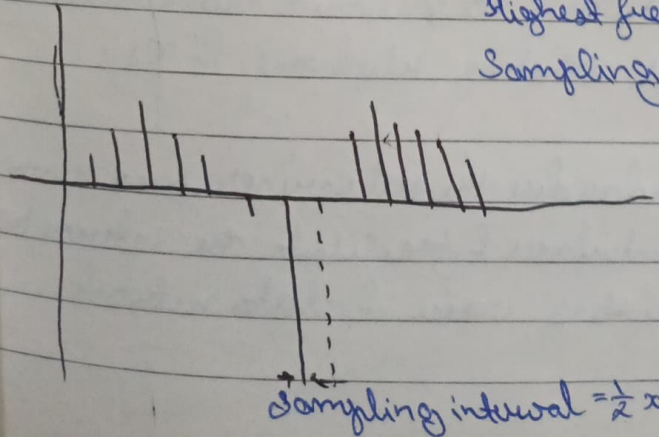
Nyquist Theorem

Sampling Rate

The accuracy of digital reproduction of any analog signal depends on the no. of sample taken using PAM & PCM we can reproduce the wave form exactly by taking infinite samples. Actually it requires remarkably little information for the receiving device to reconstruct the analog signal. Acc. to nyquist theorem to ensure the accurate reproduction of original analog signal using PAM, the sampling rate must be twice the highest frequency of the original signal. So, if we want to sample telephone device with max. frequency 4000Hz we need a sampling rate of 8000 sample/sec

Highest frequency = x Hz

Sampling Rate = 2x sample/second



Sampling must be twice the frequency of the means the signal must be sample every $\frac{x}{2}$

eg:-

Bit rate = Sampling rate × no. of bits per sample.

q) We want to digitalize the human voice. What is the bit rate assuming 8 bit per sample.

⇒ Bit rate = 8000 × 8
= 64000 kb/s

ITU (International Telecommunication Union) 1970

ITU-T International Telecommunicath Union - Telecommunicath

CCITT (Consultative commonity for international for telegraph & telephony.

ISDN Integrated service digital network.

It is a set of protocol that combines digital telephony & data transport services. The whole idea is to digitalize telephone network to permit transmission of audio, video & text over existing telephone lines.

ISDN is an effort to standardise the subscriber services provide user, network interfaces & facilitate the integration of capabilities of existing voice & data network

The goal of ISDN is to form a wide area network that provides universal end to end connectivity over digital media. This can be done by integrating all the seperate transmission services in to one without adding new link or subscriber line.

ISDN - services.

1) Bearer services
2) Teleservices
3) Supplementary services.