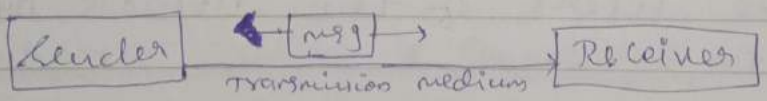
DATA COMMUNICATION AND OPTICAL FIBRE

(data communication → dc)

⇒ components of data communication =

1) msg.
2) Senter
3) Receiver
4) Transmission media → It is the physical path by which a msg travels fm Senter to Receiver.
   eg → Twisted pair wire, coaxial cable, filere optic wire & radio waves.
5) protocol → It is a set of rules that governs data communication.

* Set of rules (protocols) — Rule 1, Rule 2, Rule n
  Set of rules (protocols) — Rule 1, Rule 2, Rule n



⇒ Network → It is a set of devices connected by communication links.
A node can be a comp, printer, / any other device capable of Sending / receiving data generated by other nodes on the ntwrk.

⇒ Components of ntwrk =

1) Servers → They are the comp that hold

Shared files, Prgms & ntwrk OS.

* Servers provide access to ntwrk resources to all the users of the ntwrk.

2) Clients = clients / workstations are comp that access & use the ntwrk & shared ntwrk resources.

3) Transmission media =

4) Shared data → Are the data that file servers provide clients such ~~that~~ as data files, printer accessed prgm & email

5) Network Interface card (NIC) =
It prepares (formats) & sends data, receives data & controls data flow b/w the comp & ntwrk.

6) Shared printers & other peripherals =
They are hardware resources provided to the users of the ntwrk byte servers

7) Local OS = It allows personal comp to access files, print to a local printer & use 1/more storage devices that are located on the comp.
eg → windows

⇒ Network OS (NOS) =

The NOS runs on servers that allows the comp to communicate over the ntwrk.

* Hub = It is a device that splits ~~that~~ a ntwrk connection into multiple comp
- It is like a distribution center.
- when a comp requests info ~ from a ntwrk / a specific comp, it sends the request to the hub through a ntwrk connection.
- Hub will receive the request & transmit it to the entire ntwrk.

* Switch = It is like a hub bt build-in with advanced features.
- It connects devices together on a comp ntwrk, process & forward data to the destination device.

* Router = It is a ntwrking device that forwards data packets btw diff ~ comp ntwrks.

=> Network cables & Connectors =

* cable is 1 transmission media that can transmit communication signals. There are several t. media types including coaxial cable, fibre optic cable, wireless connections, etc

* Repeater =

- It is a communication device that connects 2 segments of the ntwrk connection

- used to extend the ntwrk connection length to enlarge ntwrks.
- WAN contains many repeaters.

* **Bridge** =
- It interconnects 2 ntwrks using same technology.
- It is more sophisticated than a repeater.
- Sometimes it is necessary to divide ntwrks into subnets to reduce the amount of traffic on each larger subnets / for security reason.

* **Modem** =
It is a devia that modulates an analog carrier signals (sounds) to encode digital info, & that also demodulate such a carrier signal to decode the transmitted info.

eg→ used whn a comp communicates with anthr comp ovr a telephone ntwrk.

* **WAP** (wireless Access Point) =
- They are a transmitor & receiver device used for wireless LAN (WLAN) radio signals.
- It is typically a seperate ntwrk device with a build-in antena, transmitor & adaptor.
- It also typically has several ports allowing a way to expand the

ntwrk to support additional clients.

→ protocols = (p)

* Communication b/w comp on a ntwrk are defined by protocols.
* Ntwrk (p) are formal standards & policies comprised on rules, procedures & formats that define communication b/w 2 | more devices ovr a ntwrk.
* Ntwrk comps run a series of protocols → (p) stack.

2) Firewall =

* It is a networking device either hardware | software based that controls access to the ntwrk.
* This control access is designed to protect data & resources frm outside threats

=) Network criteria =

a) performance = It can be measured in many ways –
* Transit time (msg deliv time)
* Response time (enquiry & response time)

- Transit time is the amount of time required for a msg to travel frm 1 device to anthr.
- Response time is the elapsed time

data & transfer → transmission media

b/s an enquiry & a response.

b) Reliability = % of a ntwrk depends on accuracy, freq & failure.

c) Security = It include protect frm unauthorised access.

=> Ntwrk Standards & (P) =

* Elemnts of protocols =

a) Syntx = Refers to the str / formats of the data, meaning the order in which they are prsnted.

b) Semantics = The word s. refers to the meaning of each section of bits.

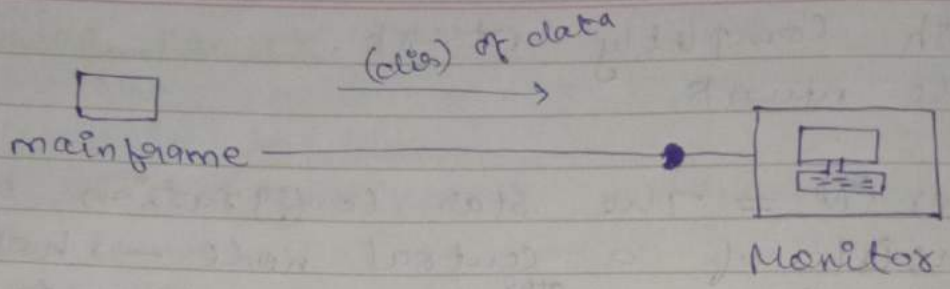
c) Timing = refers to 2 characteristics: when data should be sent & how fast they can be send.

=> Channel transmission modes =

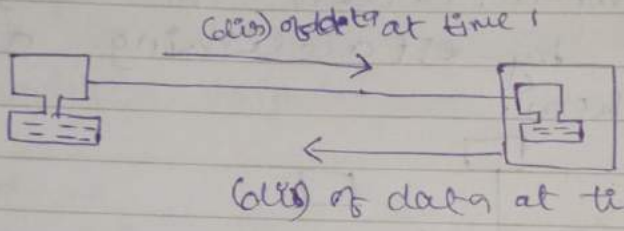
3 types of c.t. modes →

a) Simplex = Communication is undirectional, as on 1 way street only 1 of the 2 devices on a link can transmit the other can only receive.

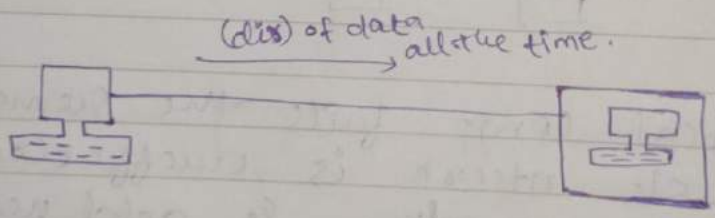
- Keyboards & traditional monitors are eg of s. devices.



b) Half duplex = Here, each station can both transmit & receive data.



c) Full duplex = Here both stations can transmit & receive simultaneously.



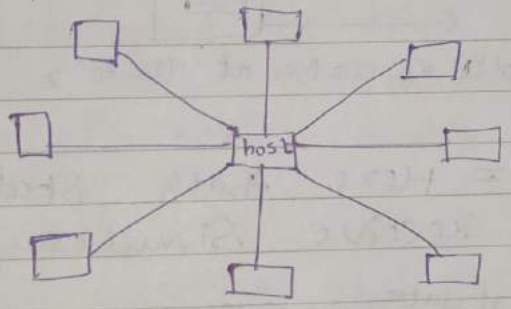
⇒ Network Topologies = (T)

* Term topology refers to the way in which the individual comp, → nodes of a ntwrk are linked together.
* Diff types of (T) are —

1) Star ntwrk —
2) Ring ntwrk
3) Bus ntwrk
4) Completly connected ntwrk.

5) mesh completly ntwrk.
6) Tree ntwrk

1) Star (N) = The star configration of ntwrk consist of a central node → host, to which all other nodes are connected by a single path, the routing () is performed by the central comp, which centrally controls communication b/p any 2 local comp by estalelishing a logical path b/p them.



Adv
* If any local comp fails the remaining portion of ntwrk is unaffected.
* It is easy to modify & add new nodes to a star ntwrk without disturbing the rest of ntwrk.

Disadv
* ~~The system~~ If the central comp fails the entire ntwrk fails.
* Each device requires its on calele segment.
* Installation & configration is difficult.

2) Ring ntwrk =

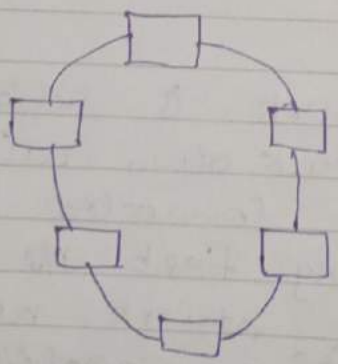
* All the nodes in a ntwrk are connected in a closed circle of cable (ie) this configration is a ring arrangmnt of communicating nodes & there is no controlling in the ntwrk.

* Adv →

* A ring is relatevly is to instal & reconfigure
* Link failure can be easily found as each device is connected to its immediate neighbours only.

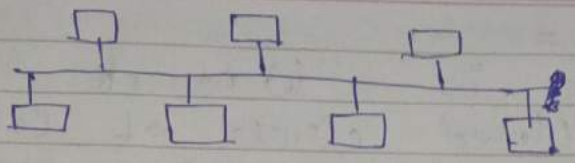
Disadv →

* max ring length & no. of devices is limited,
* Adding / removing nodes distrupts the ntwrk.



3) Bus ntwrk =

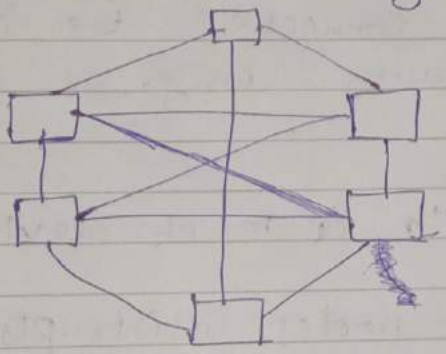
* Here, nodes share a single commun channel.
* Each nodes has a unique address.
* All nodes will receive a msg, bt only the address node will respond.



~~Data & Signals~~

4) Completly connected ntwrk =

* Has separate physical link for connecting each node to any other node



Adv →

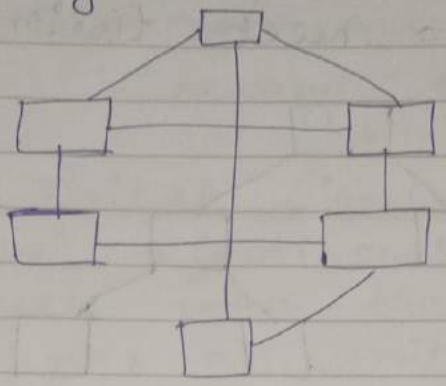
* This type of ntwrk is reliable, - As any line break down will affect only commu of the connected comp.
* commu is very fast b/z any 2 nodes.
* Each node of ntwrk need not have individual routing capability.

Disadv →

* It is the most expensive system from the point of view ~~from the~~ of line cost.
* large amount of cabling & ~~high~~ I/O ports required.
* Difficulty in installation.
* Difficult to reconfigure.

5) Mesh ntwork =

* Here, each node is connected more than 1 node to provide alternative rules in case the node is either down / the node to busy.



Adv →

* Dedicated link b/p nodes ensure optimum data rate & less traffic prbm.
* Better privacy & security.
* Failure of any will not cause failure of entire ntwork.
* point to point links makes fault identification & fault isolation easy.

Disadv →

* Large amount of cabling & I/O ports required.
* Difficulty in installation
* Difficult in reconfigure.

6) Tree ntwork = (Star + Bus = Tree(N))

* Also → hierarchical Topology / tree topology.
* It is a combination of bus & star topolgies.

* Term analog data refers to info that is contin..
* Digital data refers to info that has discreate states.
* Analog → eg → Sound.
* Digital → eg → Data are stored comp memory in the form of 0 & 1's.

b) Analog & Digital Signals =

* Analog Signal → continously varying electromagnetic wave that ~~can~~ may be propogated over a verity of media.

fig ⑥

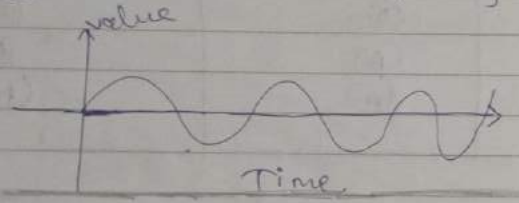


fig - ⑥

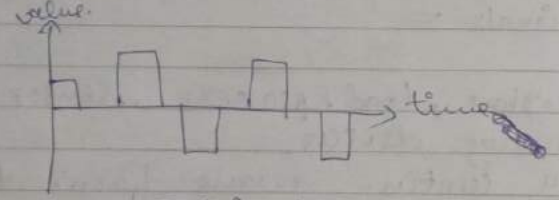


fig - ⑥

Digital

* A digital signal is a sequence of discreate discon tin.. vol pulses
* Each pulse is a signal elemnt. Thus a digital can hue only a limited no. of defined values.

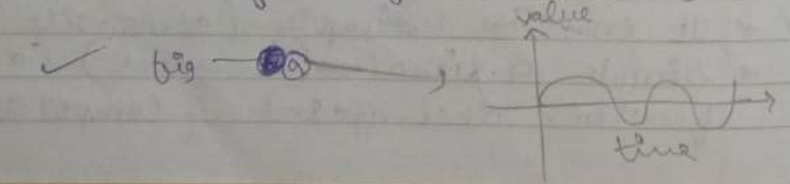
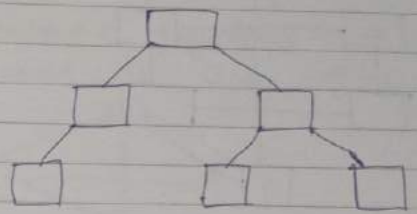


fig - ⑥

* It consist of grps of ☆ configured nodes connected to a linear bus back bone cable.
* It allow for the expansion of an existing ntwrk & enables to configure a ntwrk to meet their needs.



Adv →

* point to point wiring for individual segmnts.
* Supported by several hardware & software vendors

Disadv →

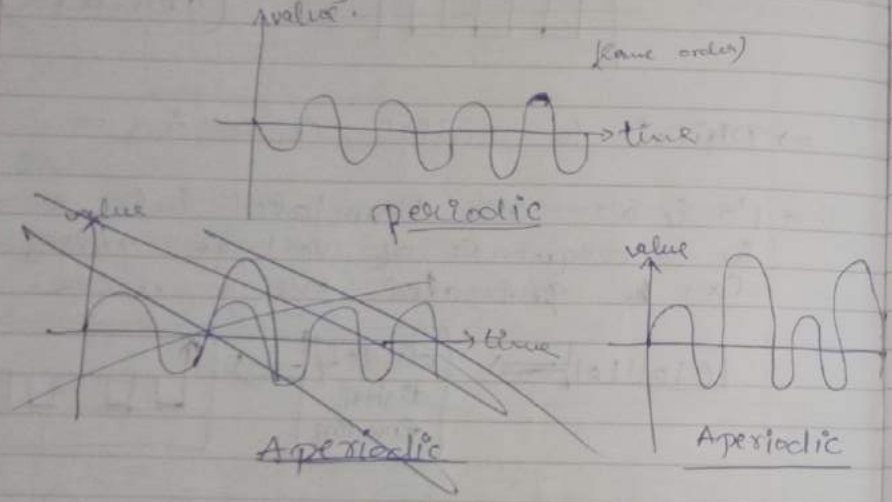
* If the backbone line breaks the entire segmnts goes down.
* More difficult to configure & wire than othr topologies.
* overall length of each segmnt is limited by the type of cabeling used.

=> Data & Signal =

a) Analog & Digital Data =

* Data can be analog / digital.

can be decomposed to multiple Sinewaves.
* The height of an a. Signal → Amplitude
* Freq refers to the no. of cycles in 1 sec.
* period & freq are inverse of each other.
* A periodic Signals changes constantly without repeating a pattern.



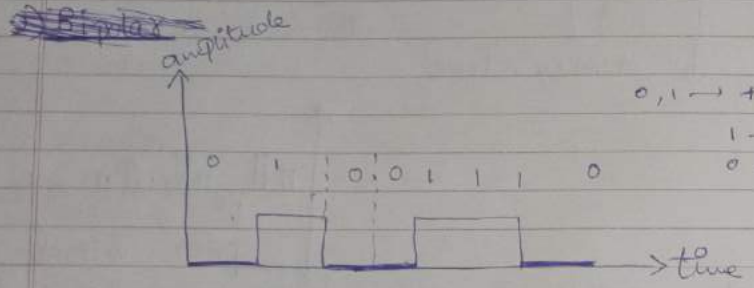
→ Digital Signals =
* Digital data is discrete, discontinuous representation of any data / info.
* Bit interval refers to the time taken to send a single bit.
* Bit rate refers to the no. of bit intervals as per sec / no. of bits send in 1 sec.
* Comp, CD's, DVD's are the eg.

⇒ Encoding & modulation =
* (E) & (M) are 2 techniques used to provide the means of mapping info / data into diff. wave forms.
* Comp ntwork is used for commun. of data frm 1 station to anthr station in the ntwork.
* Data can be either in analog / digital form.

Data	Signal	Approach
Digital (D)	Digital (D)	Encoding (E)
Analogue (A)	(E)	(M)
(A)	(A)	(M)
(D)	(A)	

→ Analog Signals =
* microphns, loadspeakers, sensors are the analog devices.
* It is a contin. wave form that changes ovr time.
* Both analog & digitals Signals can be periodic / aperiodic.
* In a periodic Signal, a pattern is repeated ovr same time intval.
* A single full pattern → cycle. & time taken for a cycle → period
* It can be simple / composite.
* Simple a. Signal → (Sin wave) cannot be frurther decomposed & composite one's

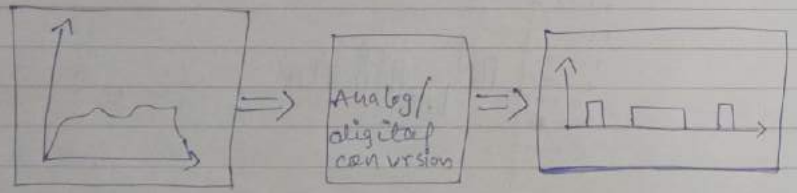
usually 1 & other is represented by 0 voltage.



2) Bipolar =

* uses 3 voltage levels like — +ve, -ve & 0
* 0 level used to represent binary 0

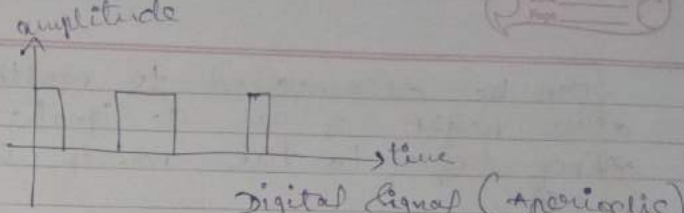
* Analog to digital conversion →

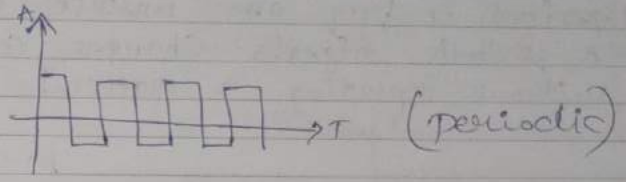


* The info represented by using a continuous wave form is converted to a series of digital pulses of 1's & 0's

* Conversion steps →

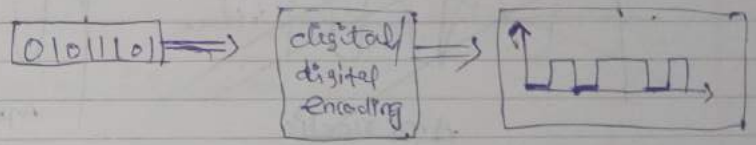
1) Amplitude of the analog signal is measured at equal intervals → Sampling
To generate a series of pulses, this process → Pulse Amplitude Modulation (PAM)



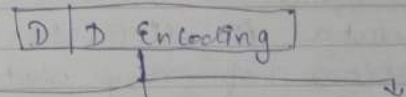


=> Digital to digital conversion =>

* 1's & 0's are translated into a ~~square~~ in a sequence of voltage pulses that can be propogated over a wire.

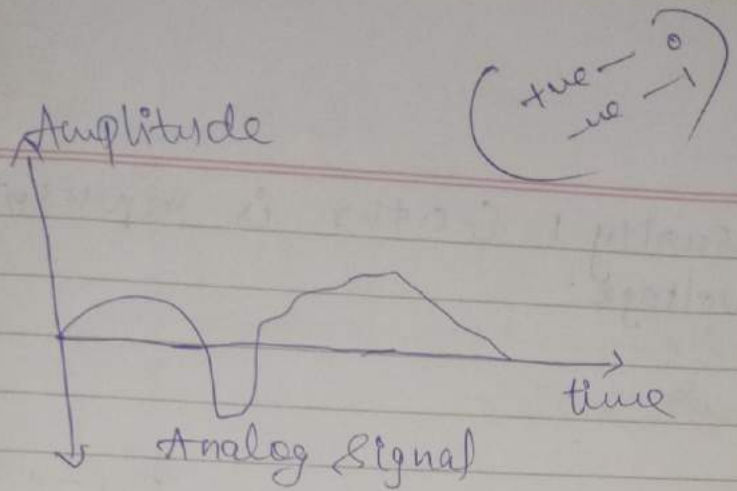


* 3 methods D-D conversion are available,

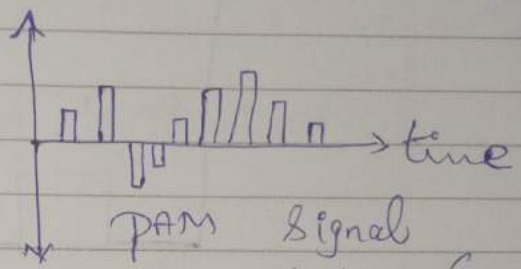


Unipolar Polar Bipolar.

1) unipolar. = *polarity of a pulse represents whether it is +ve / -ve.
*unipolar Encoding uses only 1 polarity (i.e) either +ve / -ve voltage represents 1 of the 2 binary states,

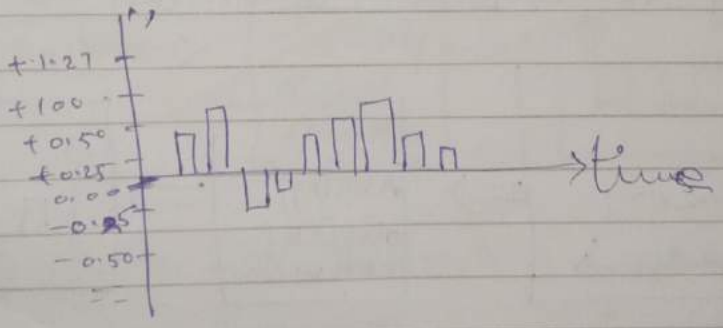


(+ve → 0, -ve → 1)



2) Next process of pulse code modulation (PCM) which includes the following procedure —

a) Integral values in a specific range are assigned to the PAM pulses.
This process → quantization

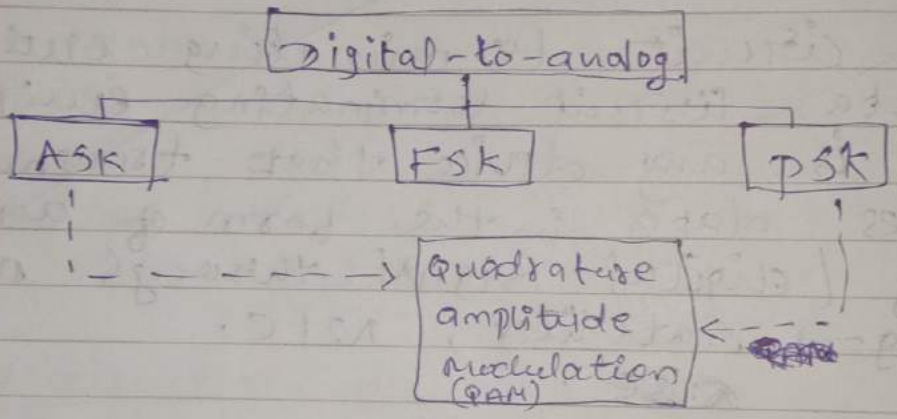


b) Each value is converted to binary equivalent. (no of bits depends on the level of precision needed) Here we use 8 bits, 7 bits for magnitude & 8th bit for sign (+ve → 0, -ve → 1)

c) Binary bits are converted to digital signals using any digital-to-digital conversion technique.

⇒ Digital to analog Conversion :-

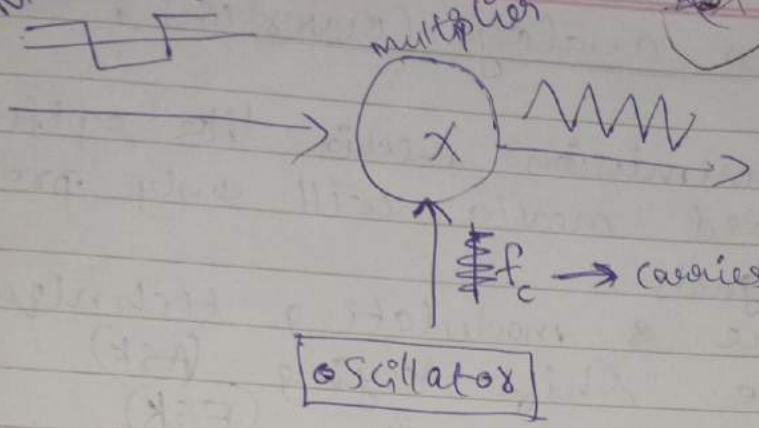
* Some transmission media like optical fibre & unguided media will only propagate analog signals.
* There are 3 modulating techniques —
1) Amplitude Shift keying (ASK)
2) Frequency " " (FSK)
3) Phase " " (PSK).



(1) ASK :
Here, the amplitude of the carrier signal is varying to create signal element both freq & phase remains constnt while the amplitude changes.

(2) Phase Shift keying :- (PSK)

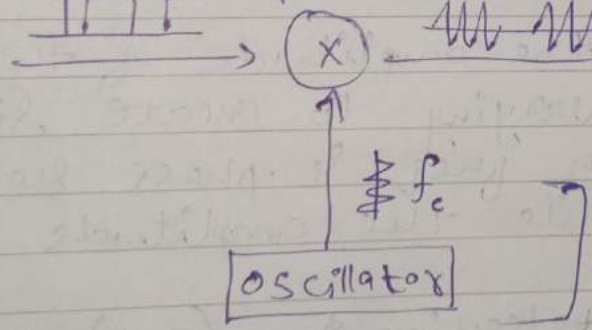
* Here, the phase of carrier is varying to represent to / more different signal elemnt both amplitude & freq remain constnt as the phase changes.



DCE (Data communication Equipmnt)

* Data circuit terminating equipmnt.
* A data circuit terminating equipmnt. (DCE) is any device that transmits / receives data in the form of an analog / digital signal through ntwrk.
  eg → Satellites, NIC.

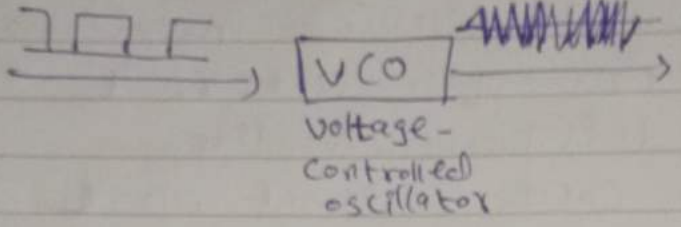
ASK →



(3) Freq Shift keying :- (FSK)

* In FSK, the freq of the carries signals is varying to represent data.
* The freq of the modulated signal is constnt for the duration of 1 signal elemnt, it changes for the

nxt signal element if the data element changes.



(PSK)

→ DCE (Data communication equipment)

* Data circuit terminating equipment.
* A data circuit terminating equipment (DCE) is any device that transmit/ receives data in the form of an analog / digital signal through ntwrk.
  eg → satellites, NIC.

⇒ Modems = (M)

* (M) is application for modulator / demodulator.
* It is used for data transfer from 1 comp ntwrk to antar comp ntwrk through telephone lines.

→ Modulator =

* used to convert info from digital mode to analogue & transmitting end.

→ Demodulators =

* Convert the same from analogue to digit receiving end.

* This conversion → digitizing.

(1) DSL (M) (Digital Subscriber Line)
* It is a communication medium, which is used to transfer internet through copper wire tele commu- line.
* Along with cable internet, DSL is one of the most popular base ISP (intrnt Servie provider) provide broadband intrnet access.

(1) Symmetrical DSL (SDSL) =
* Splits the upstream & downstream freq evenly, providing equal speeds both uploading & downloading data transfer.

(2) Assymmetric DSL (ADSL) =
* It provides a wider freq ~~many~~ range for downstream transfer, which offers Several times faster down stream speeds.
* ADSL connection may offer ~~20~~ 20 mbps downstream & 1.5 mbps upstream.

- DTE (Data terminal equipment) & DCE are used to describe to different hardware grp
- The term DTE is used primarily for those devices that display user info
- It also include any devices that stores / generate data for the user.

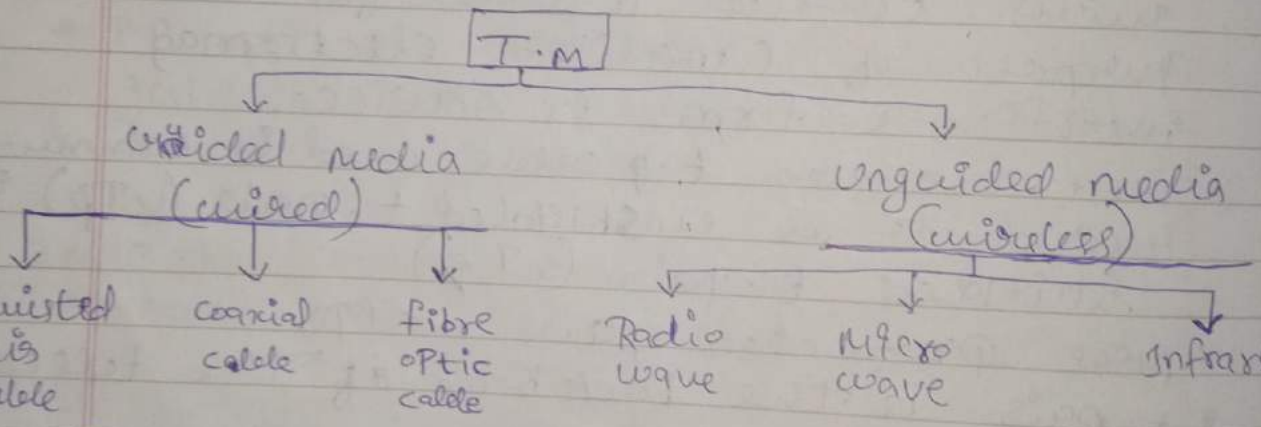
② Cable modems =

* It is usually connected to a personal comp / router using an Ethernet connection that operates at line speeds of 10 / 100 Mbps

③ Radio & microwave (M)
④ Mobile broadband (M)

=> Transmission Media :- → Guided media, → Unguided media

[medium used for data communication].



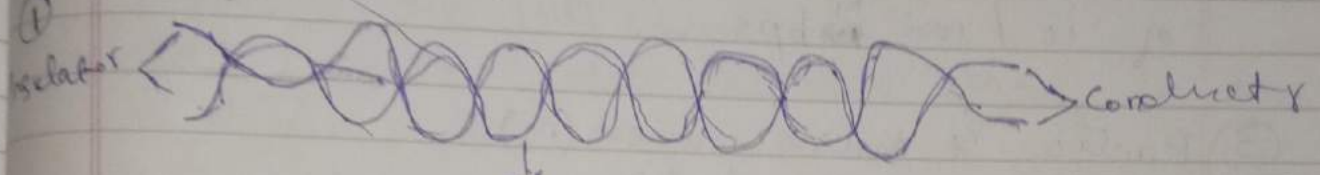
Guided Media	Unguided Media
* Signal energy propogate within the guided media.	Signal energy propogates through air.
* G. media is mainly suitated point-to-point communication	U. media is mainly used for broadcasting purpose.
* Signal Propogates in G. media in the form	Signal propogates in U. media in the

of Vol / crut.

form of electromag waves.

* eg — 1) twisted pair cables
2) coaxial cables
3) optical fibre cables

eg — 1) micro wave / radio links
2) Infrared wave.

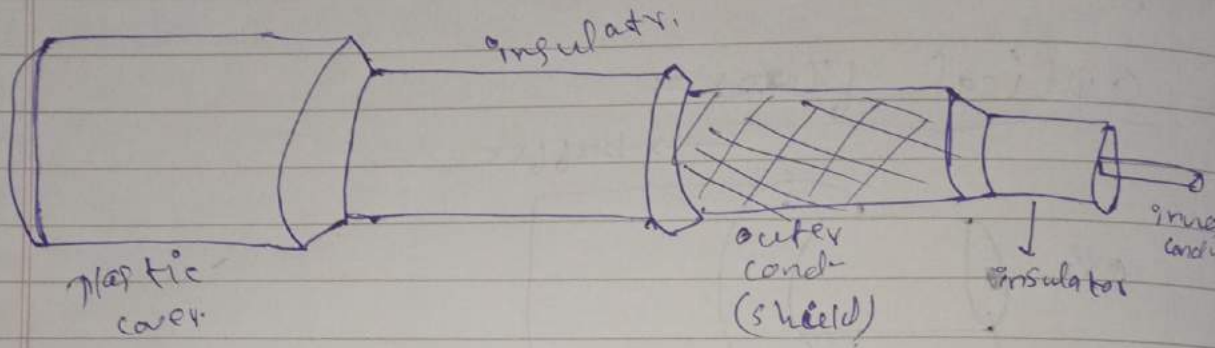


↓ Twisted pair cable.

* It is the least expensive & most widely used t. media.
* A t. pair consist of 2 insulated copper wires twisted together for the purpose of cancelling electromag interference frm ex sources.
* most common t.p cable used in communis referred to as unshielded t. pair (UTP) & shielded t. pair (STP)
more protected pair — STP.
* t. pair is the backbone of the telecom industry.
* It is most common t. media for analog & digital data.

Adv * low cost of installation on premises
disadv * High error rate.
* Limited data rate.
* Short distance required b/w repeators

② Coaxial caleles =



* A centre conductor
* Insulation covering the centor cond- called dielectric
* A braided metallic shield surrounding the dielectric
* An optional foil shield b/w guided metallic shield & dielectric
* An outer Jacket.

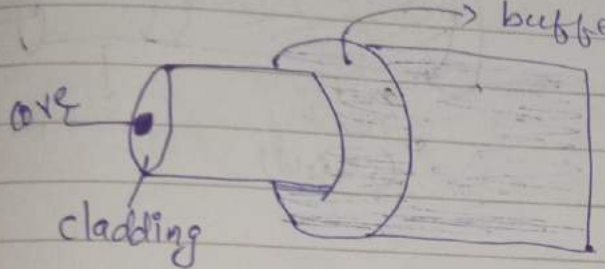
* 10 mbps trawnission rate
* max calele length portion net is 185 m. & thicknet is 500 m
* flexilele & easy to work with

Adv
* used to transmit both analog & digital signal
* can be used for longer dis) at highes data rates.
* Excellent noise immunity.

disad
* (dis) is limited
* nom of node connection is limited
* proper connectors & terminations is must

* local area network
* short run systembase.

3) Optical fiber =



optical principle of

* uses total internal reflection to capture the light transmitted in an optical fibre & confined the light to the core of the fiber.
* A o. fibre is comprised of a light carrying core in the center, surrounded by a cladding that acts to traps light in the core.
* Glass fibre is covered by a plastic buffer coating that protects it from the environment & allows easy handling for termination
* The index of refraction of glass / any optical material is a measure of the speed of light in the material & changes in index of refraction are what causes the light to bent.

* trasmission rate 100 mbps.
* most expensive cable
* support voice, video & data
* not effected by the electrical interferences.

adv * light weight
* Small size
* more strengths
* Security
* Safe & easy installation.

disad * high initial cost
* Maintance & repairing cost
* undisturbed light propagation.

II Ungaided media (wireless) =

* radio wave → freq 3KHz to 1GHz
* Micro wave → freq 1GHz to 300GHz
* Infrared wave → " 300GHz to 400GHz.

wavelength from around 1mm (300GHz) nominal from edge of the visible spectrum around 700 nm.

⇒ Transmission Impairment =

a) Attennation =

It mean a loss of energy when a signal travels through a medium it loss some of its energy overcoming the resistnce of the medium.

b) Distortion =

It means the signal changes its form/shapes.

c) Noise = It is the another cause of

Impairment of several types of noise like thermal noise, Impulse noise, Induced noise may corrupt the signal.

~~d) Multiplexing~~