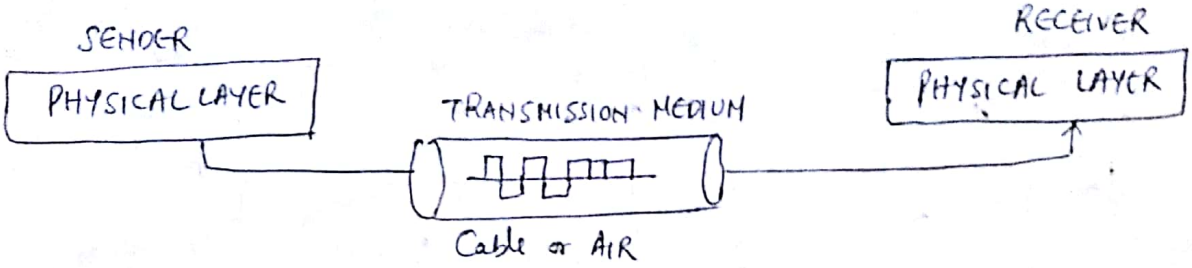
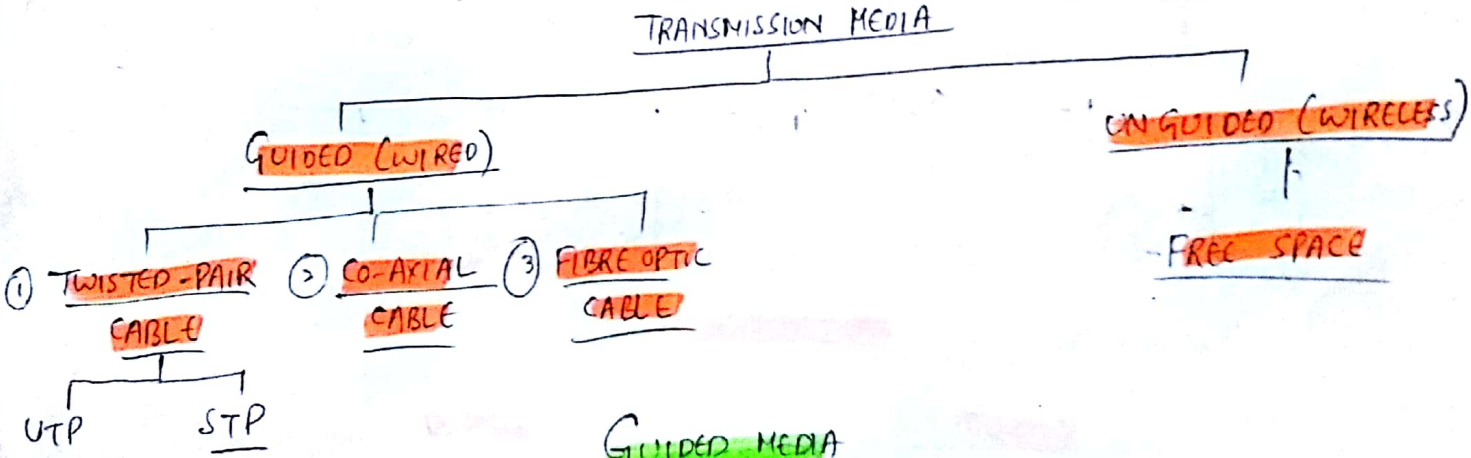
CHAPTER 2 TRANSMISSION MEDIA

- Transmission media are actually located below the physical layer & directly controlled by the Physical layer.
- Transmission media belong to layer 0. Anything that can carry info" from source to destination is TM



- Transmission medium is actually free space, metallic cable or fibre-optic cable.

CLASSIFICATION OF TM



GUIDED MEDIA

- Twisted Pair & co-axial cable use metallic (copper) conductors that accept & transport signals in the form of electric current.
- optical fibre accepts & transports signals in the form of light.

1. TWISTED-PAIR CABLE - Consists of two conductors (normally copper) each with its own plastic insulation, Twisted together.
   - One of the wire is used to carry signals to the receiver & the other is used only a ground reference. The receiver uses the difference b/w the two.

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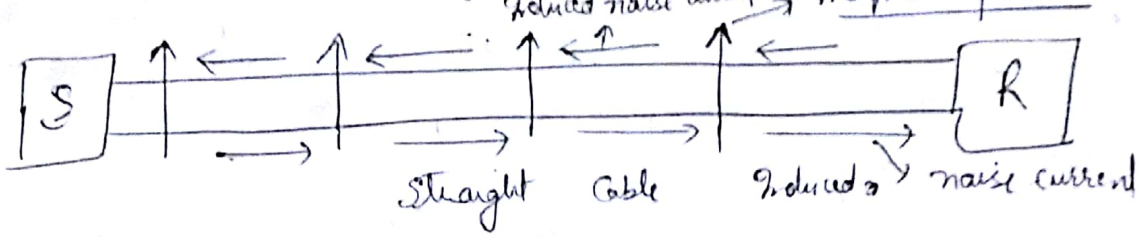
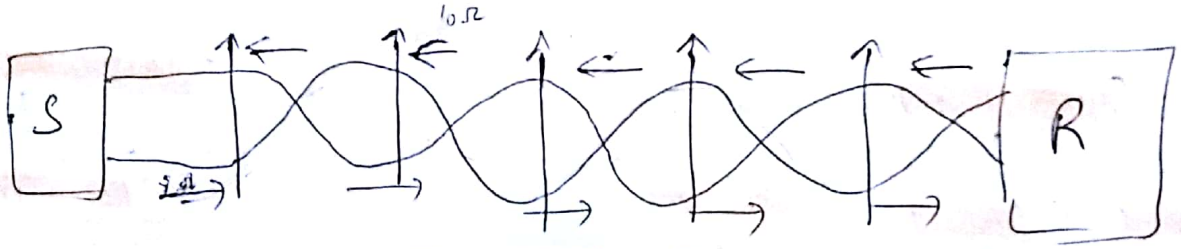
Why Twisting of Cables is done ?

Naises are generated in signal lines by magnetic fields from the environment. So the naise current in data lines is the result of that magnetic field.

In a straight cable, all naise current is flowing in the same direction, just like in an ordinary transformer coil



When the cable is twisted, in some parts of signal lines, the direction of the naise current is the opposite from the current in other parts of the cable. Because of this, the resulting naise current lowers down as compared to ordinary straight cable



TWISTED PAIR CABLE

UTP	&	STP
• Unshielded TWISTED PAIR		• SHIELDED TWISTED PAIR CABLE
• Mast commonly used in communication		• Not used frequently (Expensive)
• Does not cover an extra layer		• STP Cable has a metal foil or braided mesh to cover insulated conductors.

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ROUGH SHEET

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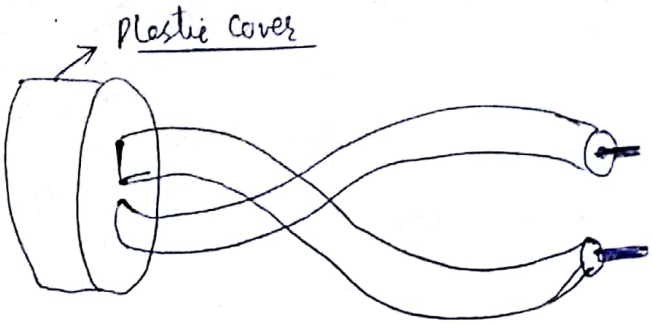
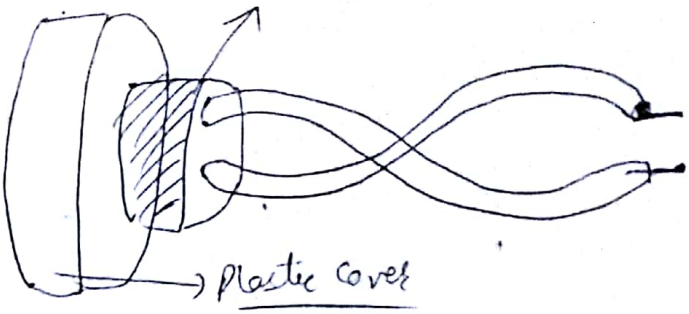
ght in weight & less expensive than STP



. Bulkier & more expensive

Metal Shield



CATEGORIES OF UTP CABLES

- Classified into 7 categories
- Categories determined by cable Quality with 1 as the lowest & 7 as the highest

UTP Category	Data rate	Max length	APPLICATION
CAT 1	UPTO 1MBPS	—	old Telephone Cables
CAT 2	UPTO 4MBPS	—	Token ring n/w
CAT 3	UPTO 10 MBPS	100 M	Token ring & 10 base T Ethernet
CAT 4	UPTO 16 MbPS	100 M	Token ring n/w
CAT 5	UPTO 100 MbPS	100 M	Ethernet, Fast Ethernet, Token ring
CAT 6	UPTO 1GBPS	100M	Gigabit Ethernet, 10 G Ethernet (55 metres)
CAT 7	UPTO 10 GBPS	100M	Gigabit Ethernet, 10 G Ethernet (100 m)

Connector used

- Most common UTP connector is RJ 45
- RJ stands for registered jack.

Performance of Twisted Pair cable

- To Measure the performance, comparison of attenuation versus frequency & distance is taken

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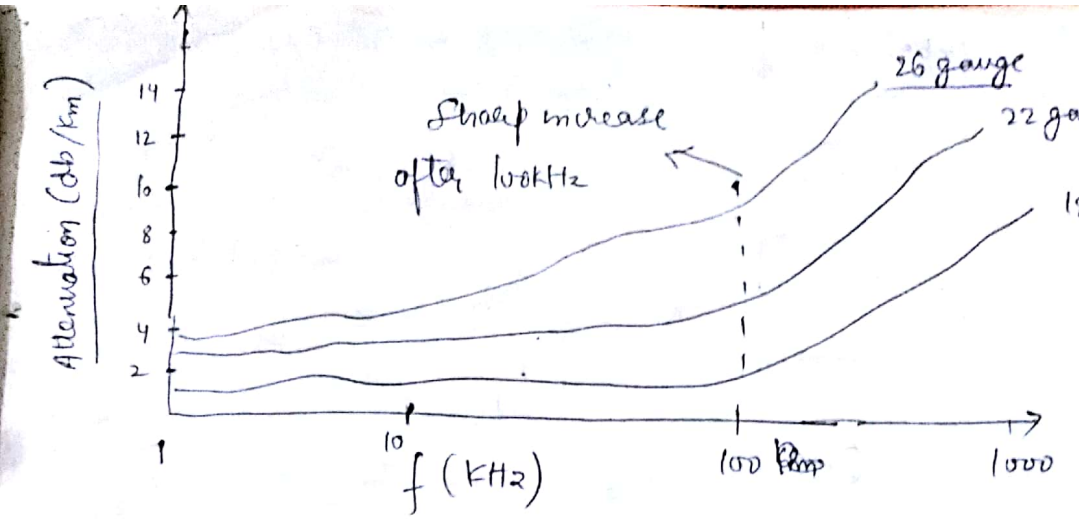
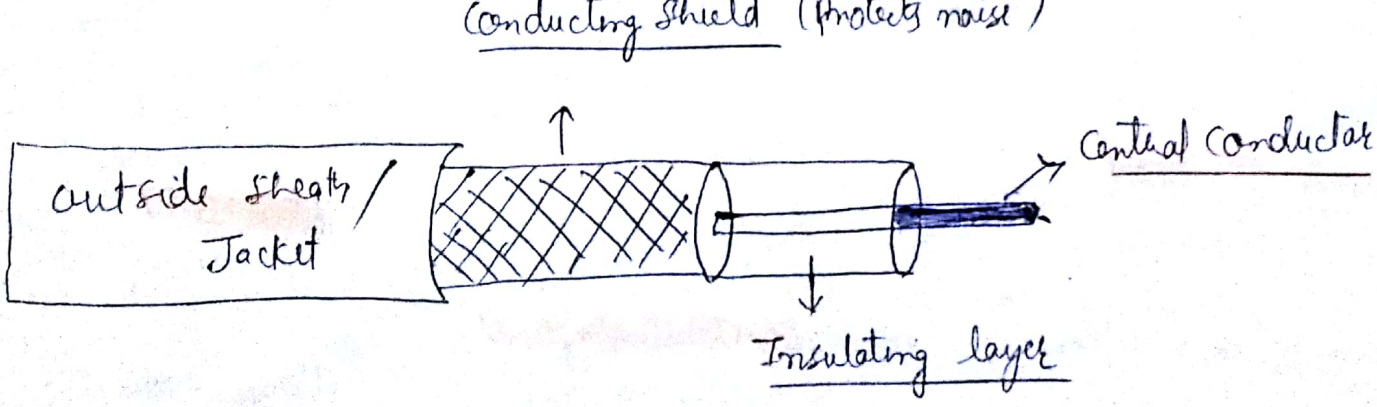


Gauge
measure of thickness of wi

Applications - (1) used in telephone lines to provide voice & data channels.
(2) DSL lines used by telephone companies to provide high data rate also used UTP
(3) LAN, such as 10Base T, 100Base T also use TPC

COAXIAL CABLES

- Coaxial cables act as a high frequency transmission cable which contains a single solid-copper core.
- It has over 80 times the transmission capability of TPC.
- It is commonly used to deliver television signals & to connect computers in a n/w as well.



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Coax has a central core conductor of solid/stranded wire (usually copper) enclosed in an insulating sheath, encased in an outer-conductor of metal foil, braid or a combination of two.

- The outer metallic wrapping serves both as a shield against noise & as the second conductor, which completes the circuit.
- The whole cable is protected by a plastic cover.

Co-axial Standards:

- Standards are categorized by their radio govt (RG) ratings

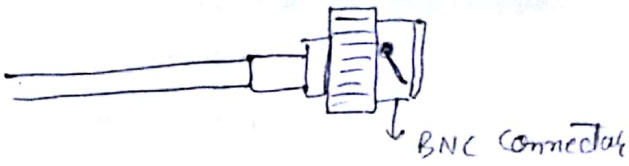
Category	Use
1 RG-59	Cable TV
2. RG-58	Thin Ethernet
3 RG-11	Thick Ethernet

Co axial Cable connectors

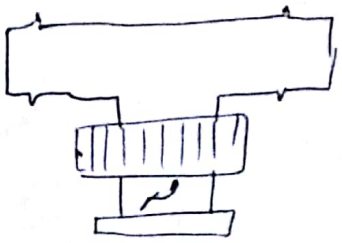
- BNC (Bayone-Neill Concelman) most common type of connector used

Three Popular types of BNC connectors

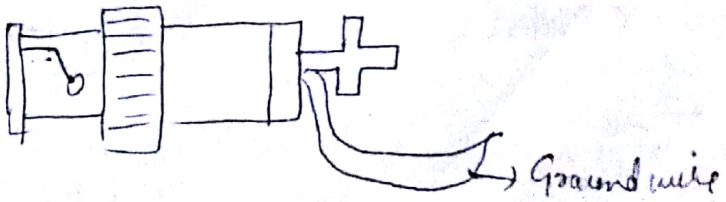
(1) BNC connector



(2) BNC T connector



(3) BNC TERMINATOR



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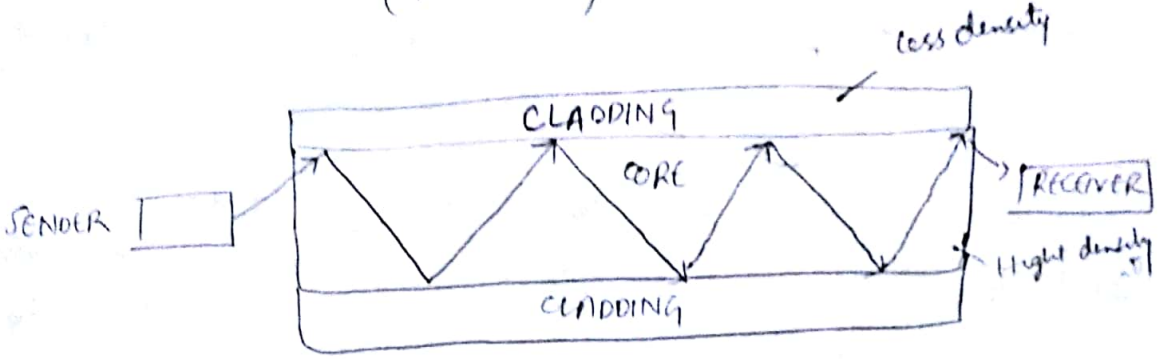
① REFRACTION - Turning or bending of wave such as light or soundwave when it passes from one medium to another.

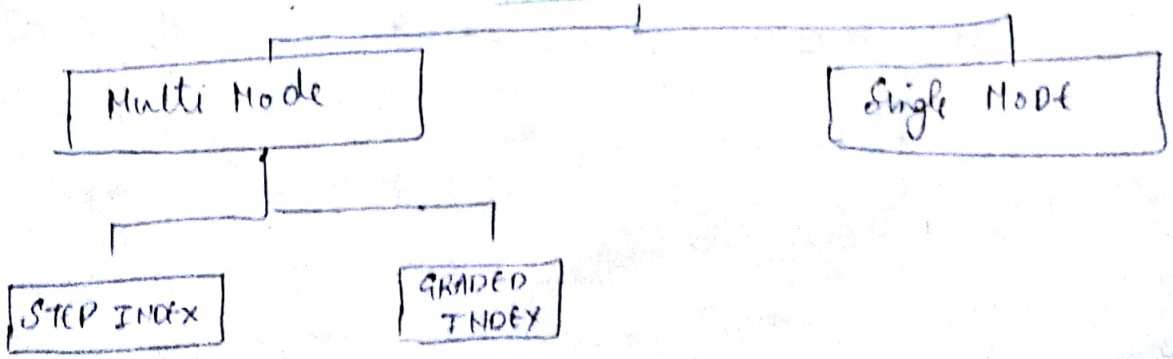
② Critical angle - Small angle of incidence for which light is totally reflected

CASE 3 - OPTICAL fibre follows Case 3 called Total Internal reflection Principle. In TIR when angle of incidence is greater than the critical angle, the ray reflects (makes a turn) & travels in the same substance (ie denser)



- An optical fibre is made upof Core & cladding
- A glass or plastic core is surrounded by a cladding of less density glass or plastic.
- The difference in density of two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refracted into it.

PROPAGATION MODES



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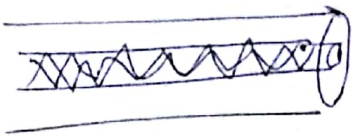
MULTIMODE

- In multimode, multiple beams from a light source move through the core in different paths.

(a) ~~Multimode Step Index fibers~~

Multi mode



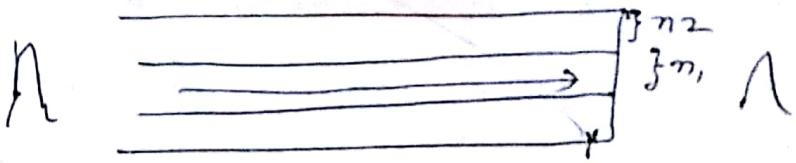
Single mode

- Refractive index - ratio of velocity of light in vacuum to its velocity in a specified medium

- The no. of modes in a fiber optic cable depends upon the dimension of the cable & variation of the indices of refraction of both core and cladding.

(1) Single mode Step Index -

$n_1 < n_2$



- Diameter of the core is fairly small as compared to cladding.
- It is 10 times thicker than core.
- This creates less attenuation & time dispersion.

FIBRE SIZES

- Less time dispersion means higher bandwidth (ie 50 to 100 GHz)
- Also most costly in Premises
- Used more with WAN.

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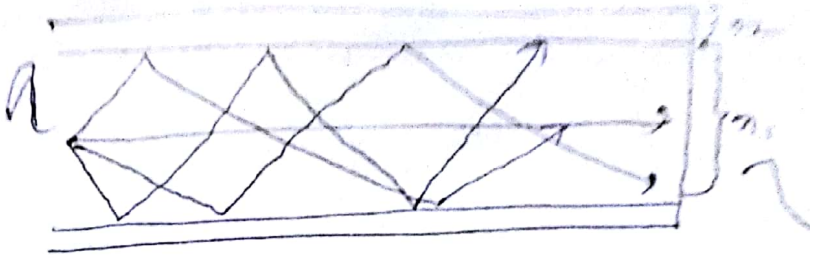
Multimode Step Index -

$n_1 > n_2$



Diameter of core is fairly large as compared to cladding.

The output pulse is significantly attenuated relative to the input pulse

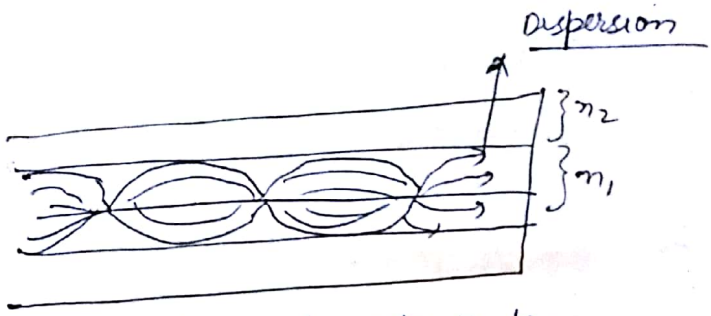
It also suffers significant time dispersion.

- Rays tend to leak into the cladding as they propagate down the fiber optic cable. They loose some of their energy into heat.
- This results in an attenuated o/p signal.

- Least costly & used in Premises upto 5km.

Multi mode Graded Index -

$n_1 > n_2$ (comparable not so much)



- The core is much larger than Single mode Step Index.
  There is little attenuation & time dispersion but not nearly as great as with Multimode step Index fiber

Advantages & Disadvantages

- Higher bandwidth
- less Signal attenuation
- Resistance to corrosive materials
- Light weight

? Cost
Installation & maintenance

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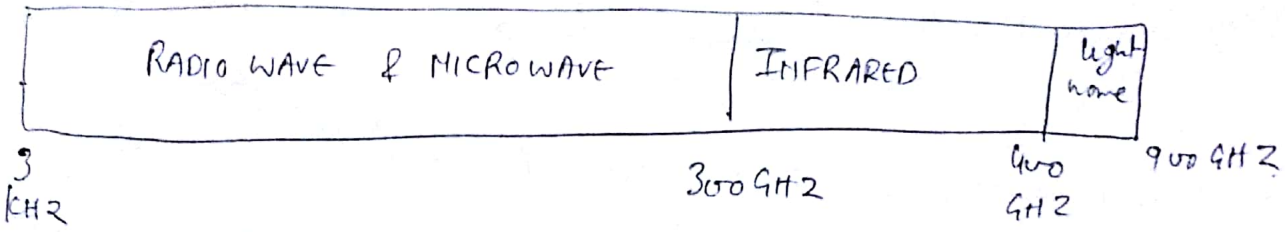
UNGUIDED MEDIA

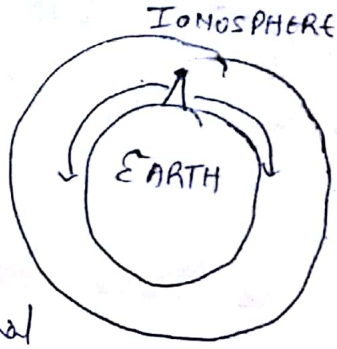
Transfer electromagnetic waves without using a physical conductor. often referred to as wireless communication.

Freq $\propto \frac{1}{\text{wavelength}}$



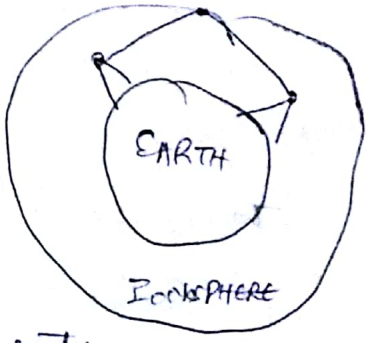
Propagation of UNGUIDED SIGNALS

(1) GROUND PROPAGATION (Below 2MHZ)



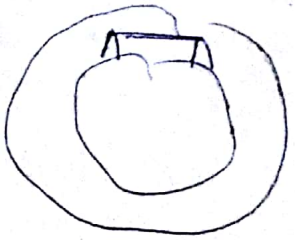
- Radio waves travel through lowest portion of atmosphere.
- Emanate in all directions
- Distance depends on the power of the signal

(2) SKY PROPAGATION –



- High frequency radio waves radiate upward into the ionosphere where they are reflected back to earth
- This type of transmission allows for greater distances with lower o/p power

(3) Line of Sight Propagation –



- very high Frequence signals are transmitted in straight line directly from antenna to antenna
- Antennas must be directly facing each other

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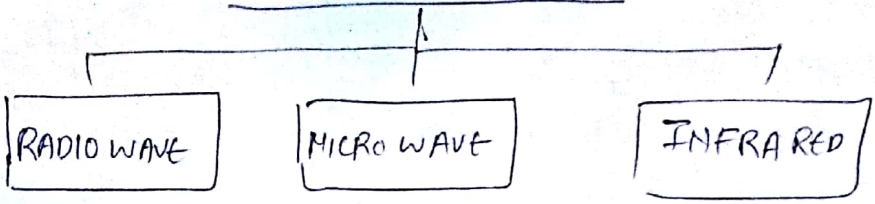
WIRELESS TRANSMISSION



(1) **RADIO WAVES** - Range of Frequency between 3KHz & 1GHz

- RW are omnidirectional ie when an antenna transmits radio waves, they are propagated in all directions.
- The RW transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency.
- RW, that propagate in sky mode can travel long distances This makes radio waves a good candidate for long distance broadcasting such as AM radio

Applications

- Omnidirectional characteristic of Radio wave makes it useful for multicasting in which there is one sender but many receivers.
- Example - FM radio, Television, maritime radio, Cordless Phones & Paging

(2) **MICROWAVES** - Range of Frequency is 1GHz and 300 GHz (High data rate)

- Are unidirectional. Means that Sending & receiving antennas need to be aligned.
- MW Propagation is line of sight.

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Applications

- Due to unidirectional property, very useful in unicast communication (one-to-one)
- used in cellular phones, satellite n/w & wireless LAN

(3) Infrared -

- Frequency from 300 GHz to 400 THz (wavelength from 1mm — 770 nm)
- short range communication.
- High frequency. Cannot Penetrate walls.

Applications

- Infrared signals can be used for short range communication in a closed area using line of sight propagation.

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