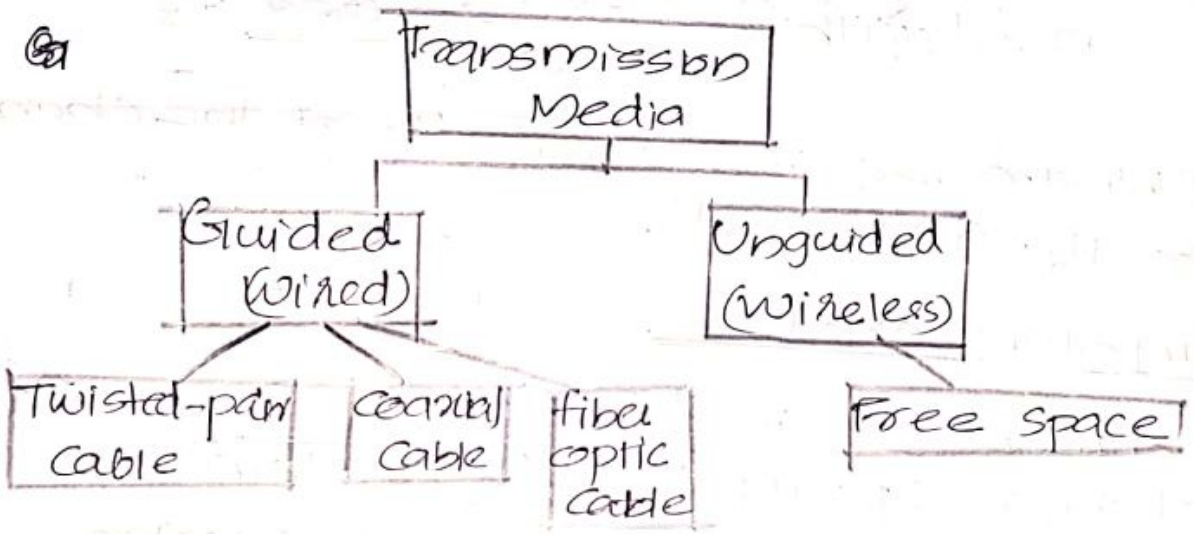
Module: 2

22/08/19

Transmission Media

- Guided
- Unguided



Guided Media

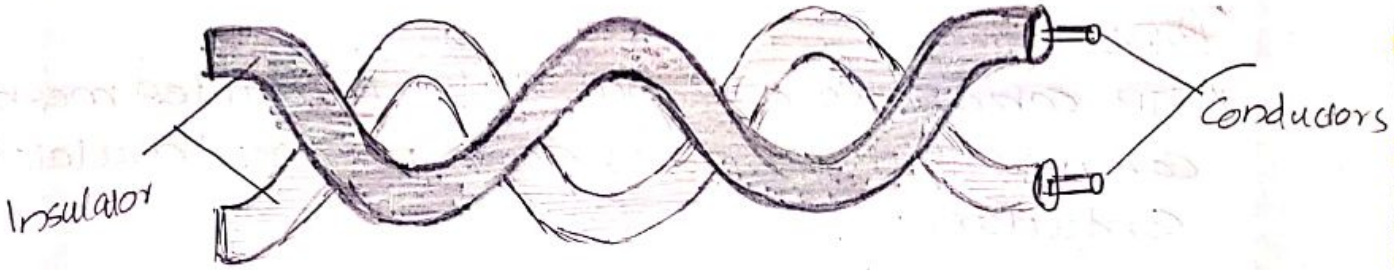
- Guided Media, which are those that provide a channel from one device to another.

Eg: twisted-pair cable, coaxial cable & fiber optic

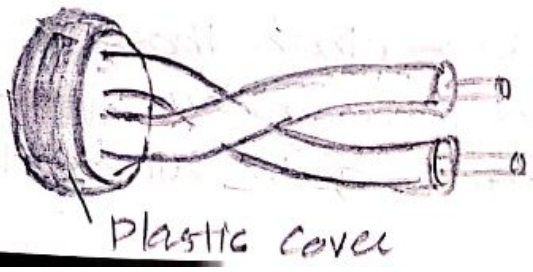
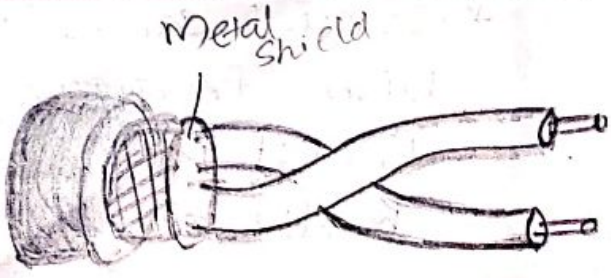
* A signal traveling along any of these media is directed and contained by the physical limits of the medium.
* Twisted-pair and coaxial cable use metallic (copper) conductors that accept and transport signals in the form of electric current.
* Optical fiber is a cable that accepts and transports signals in the form of light.

Twisted-Pair Cable

* A twisted pair consists of 2 conductors (normally copper), each with its own plastic insulation, twisted together.



* One of the wires is used to carry signals to the receiver, and the other is used only as a good reference.
* The receiver uses the difference b/w the two.
* In addition to the signal sent by the sender one of the wire.
* If the 2 wires are parallel, the effect of these unwanted signals is not the same in both wires because they are at diff. locations relative to the noise or crosstalk sources (eg: one is closer and the other is farther).
* This results in a difference at the receiver.
' By twisting the pairs, a balance is maintained.

Unshielded twisted-Pair Cable	Shielded twisted-pair cable
	

* The most common twisted pair cable used in communications is referred to as unshielded twisted pair (UTP)

* IBM has also produced a version of twisted pair cable for its use called Shielded TP (STP).

*STP

*STP cable has a metal foil or braided mesh covering that encases each pair of insulated conductors.

*Although metal casing improves the quality of cable by preventing the penetration of noise or cross talk, it's bulkier and more expensive.

Applications.

*Twisted-pair cables are used in telephone lines to provide voice and data channels.

*The local loop-the line that connects subscribers to the central telephone office.. commonly consists of unshielded TP cables.

* The DSL lines that are used by the telephone companies to provide high-data-rate connections also use the high-bandwidth capability of unshielded TP cables.

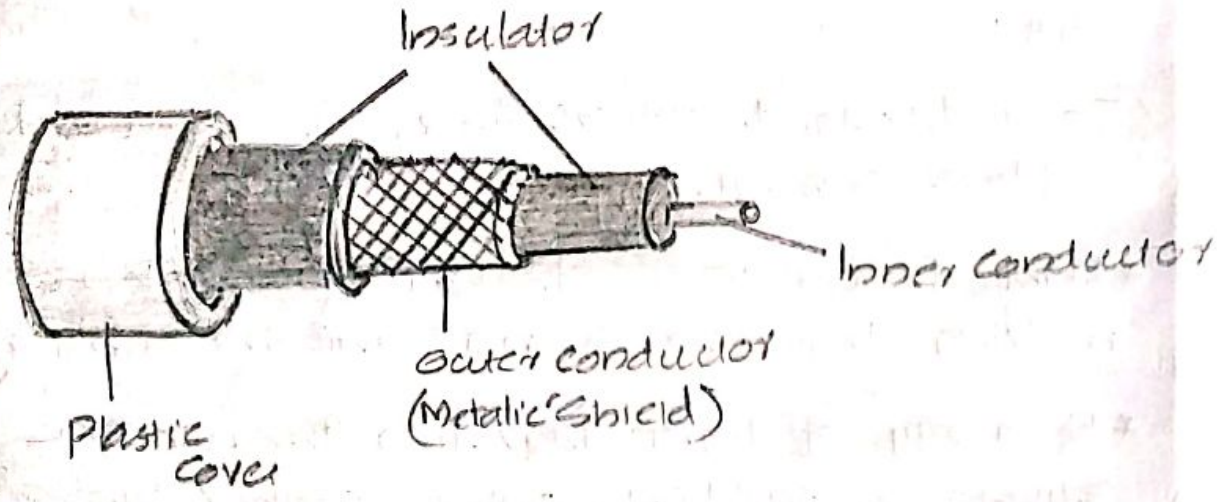
Coaxial Cable

*Coaxial cable (or coax) carries signals of higher frequency ranges than those in twisted pair cable, in part because the 2 media are constructed quite differently.

* Instead of having 2 wires, coax has a central core conductor of solid or standard wire (usually copper) enclosed in an insulating sheath, which is, in turn, encased in an outer conductor of metal foil, braid, or a combination of the two.

* The outer metallic wrapping serves both as a shield against noise and as the 2nd conductor, which completes the ckt.

* This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.



Categories of coaxial Cables

Coaxial cables are categorized by their radio govt. (RG) ratings.

Category	Impedance	Use
RG-59	75Ω	Cable TV
RG-58	50Ω	Thin Ethernet
RG-11	50Ω	Thick Ethernet.

Application

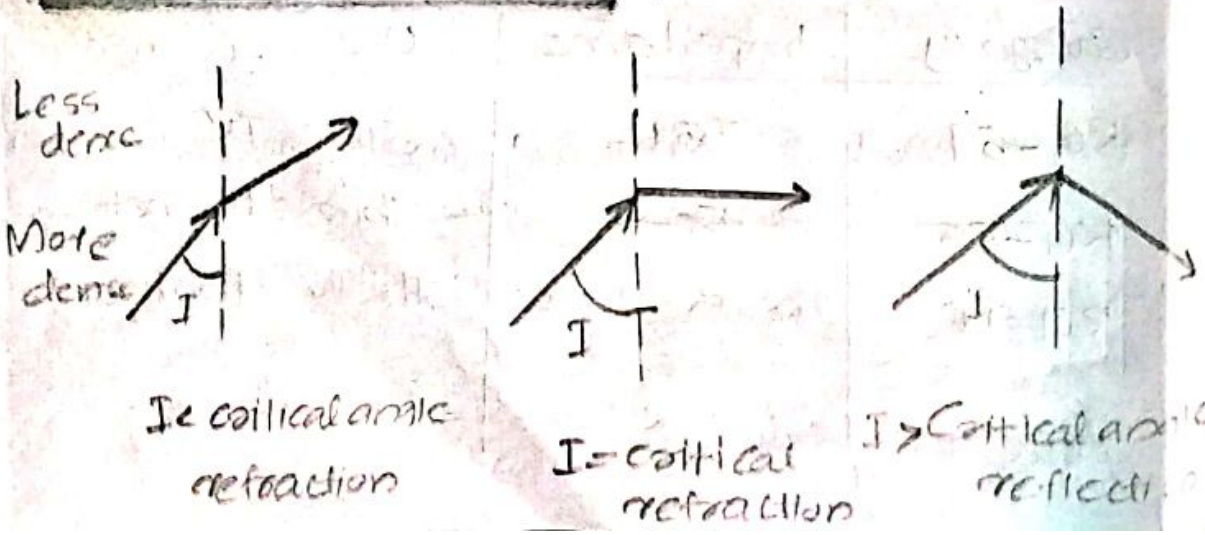
* Telephone
* Television Cable
* Traditional ethernet LAN's.

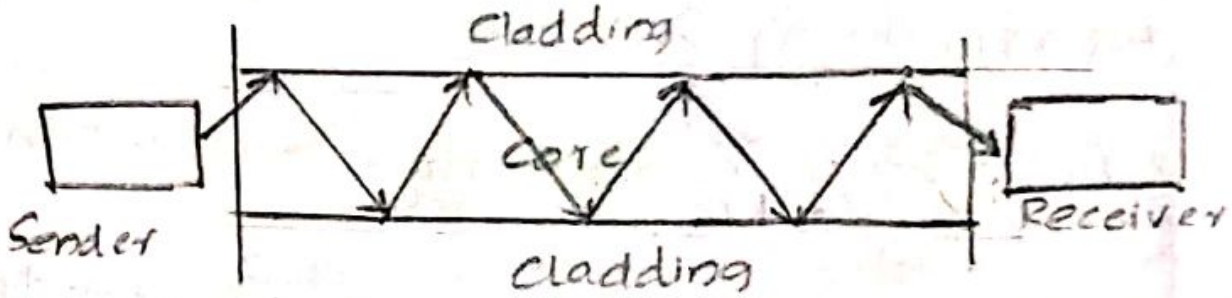
- But most them got replaced by optic fiber cable.

Fiber-Optic Cable

* A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.
* To understand optical fiber, we first need to explore several aspects of the nature of light.
* Light travels in a straight line as long as it is moving through a single uniform substance.
* If a ray of light traveling through one substance suddenly enters another substance (of a different density), the ray changes direction.

Bending of light ray





Core: Central tube of very thin size made up of optically transparent di-electric medium & carries the light from transmitter to the receiver.

Cladding : Outer optic material surrounding the core having reflecting index lower than the core. It helps to keep the light within the core throughout the phenomena of total internal reflection.

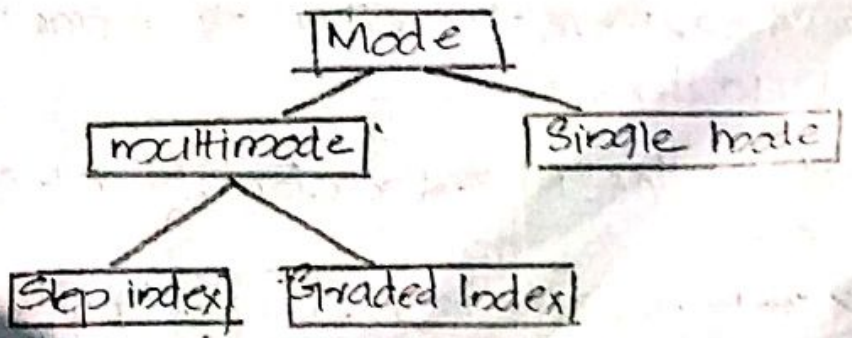
~~Glass Co~~

Plastic coating: Protect the fiber made up of ~~silicon~~ Silicon and rubber.

21/08

Propagation Modes

- Current technology supports 2 modes (multimode and single mode) for propagating light along optical channels, each requiring fiber with different physical characteristics.
- Multimode can be implemented in two forms: step-index or graded index.



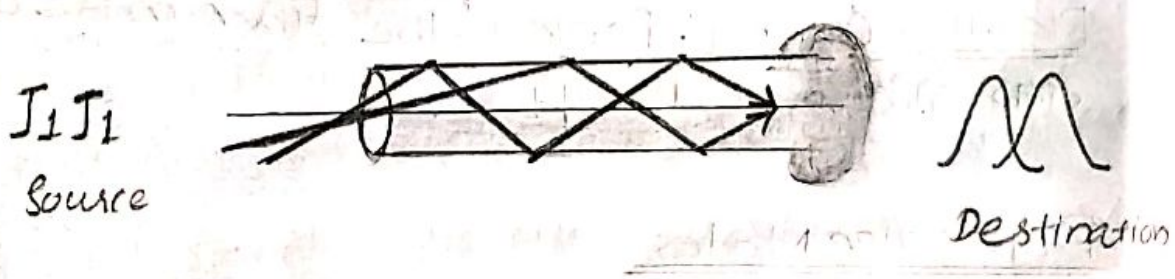
1.1. Multimode step-index fiber

* The density of the core remains constant from the center to the edges.

* A beam of light moves through this constant density in a straight line until it reaches the interface of the core and the cladding.

* At the interface, there is an abrupt change due to a lower density; this alters the angle of the beam's motion.

* The term step index refers to the suddenness of this change, which contributes to the distortion of the signal as it passes through the fiber.



1.2. Multimode graded-index fiber

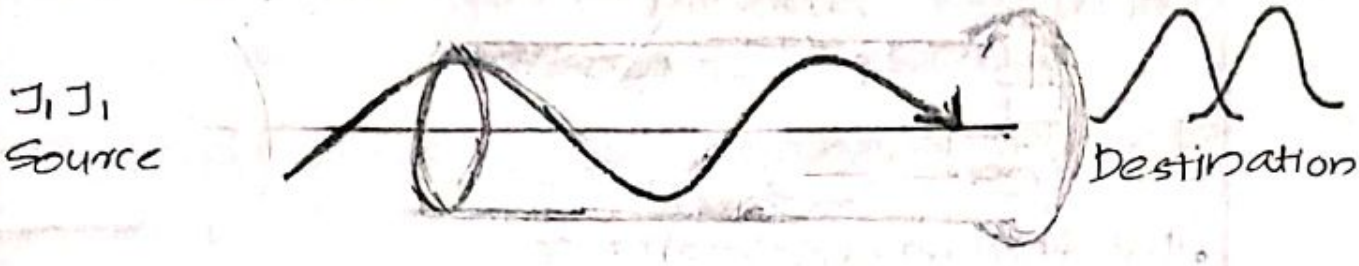
* It decreases this distortion of the signal through the cable.

* The word index here refers to the index of refraction.

* As we saw, above, the index of refraction is related to density.

* A graded-index fiber, therefore, is one with varying densities.

* Density is highest at the center of the core and decreases gradually to its lowest at the edge.



3. Single Mode

* Single-mode uses step-index fiber and a highly focused source of light that limits beams to a small range of angles, all close to the horizontal.
* The single mode fiber itself is manufactured with a much smaller diameter than that of multimode fiber, and with substantially lower density (index of refraction).
* The decrease in density results in a critical angle that is close enough to 90° to make the propagation of beams almost horizontal.
* In this case, propagation of diff. beam is almost identical, and delays are negligible.
* All the beams arrive at the destination "together" and can be recombined with little distortion to the signal.

Advantages of optical fiber:

* Higher bandwidth
* Less signal attenuation
* Immunity to electromagnetic interference.

* Resistance to corrosive materials
* Light weight.
* Greater immunity to tappings.

Disadvantages.

- Installation & maintenance

require expertise that is not yet available everywhere.

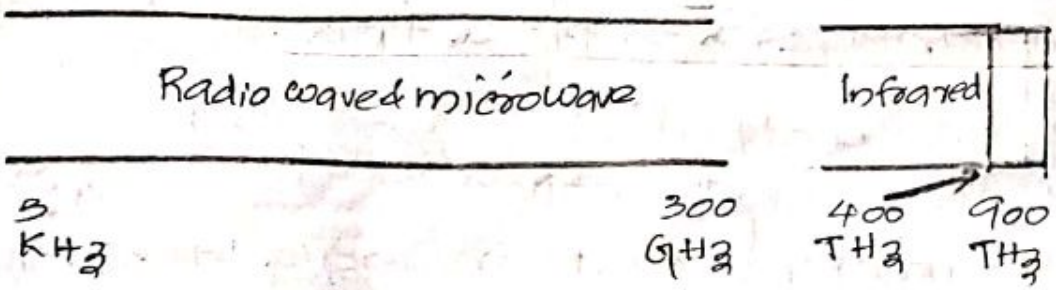
- Unidirectional light propagation.

Propagation

- Cost

Unguided Media

* Unguided media transport electromagnetic waves without using a physical conductor.
* This type of communication is often referred to as wireless communication.
* Signals are normally broadcast though free space and thus are available to anyone who has a device capable of receiving them.
* The electromagnetic spectrum, ranging from 3KHz to 900THz, used for wireless communication.



Propagation Methods

* Unguided signals can travel from the source to destination in several ways: ground propagation, sky propagation, and line-of-sight propagation.

Ground propagation (below 2 MHz) | Sky propagation (2-30 MHz) | Line-of-sight propagation (above 30 MHz)

Ground propagation

* Radio waves travels through the lowest portion of the atmosphere, hugging the earth.
* These low frequency signals transmit in all directions from the transmitting antenna and follows curvature of the earth.
* Distance depend on the amount of power in the signal ie, the greater the power the greater the distance.

Sky propagation

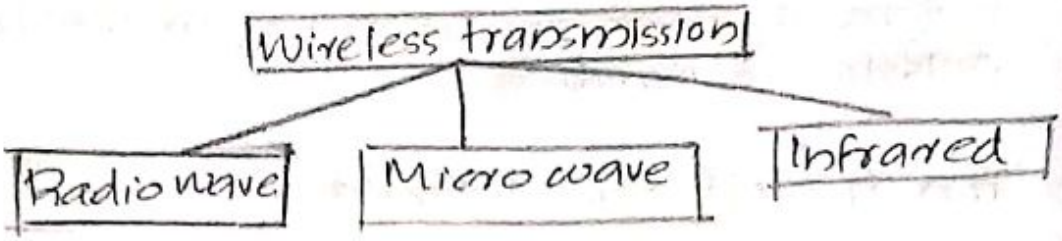
* Higher frequency radio waves radiate upward in to the ionosphere where they are reflected back to the earth.
* This types of transmission allows greater distance with lower ~~out~~ output power.

Line of sight Propagation

* Very high frequency signals are transmitted in straight lines directly from antenna to antenna.
* Antennas must be directional, facing each other.
* Electro magnetic spectrum defined as radio waves & microwaves is divided into 8 ranges called bands.

Band	Range	Propagation	Application
VLF (Very low frequency)	3-30 kHz	Ground	Long-range radio navigation.
LF (low frequency)	30-300 kHz	Ground	Radio beacons and navigational locators.
MF (Middle frequency)	300 kHz - 3 MHz	Sky	AM radio
HF (High frequency)	3-30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF (Very high frequency)	30-300 MHz	Sky & light-of sight	VHF TV, FM radio.
UHF (ultrahigh frequency)	300 MHz - 3 GHz	Line of sight	UHF TV, Cellular phones, pagers, satellite.
SHF (superhigh frequency)	3-30 GHz	Line of sight	Satellite Communication
EHF (extremely high frequency)	30-300 GHz	Line of sight.	Radio, Satellite

Wireless transmission Waves



Radio Waves

* Electromagnetic waves ranging in frequencies b/w 3kHz and 1GHz are normally called radio waves.
* Radio waves, for the most part, are omnidirectional. When an antenna transmits radio waves, they are propagated in all directions.
* This means that the sending & receiving antennas do not have to be aligned.
* A sending antenna sends waves that can be received by any receiving antenna.
* The omni directional property has a disadvantage too.

  - The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

* Radio waves, particularly those waves that propagate in the sky mode, can travel long distances.
* This makes radio waves a good candidate for long-distance broadcasting such as AM radio.
* Radio waves, particularly those of low and medium frequencies, can penetrate walls.
* It is an advantage because, for eg, an AM radio

can receive signals inside a building.

* It is a disadvantage because we cannot isolate a communication to just inside or outside a building.

Omnidirectional antenna

* Radio waves are used for multicast communications. such as radio and television, and paging systems.