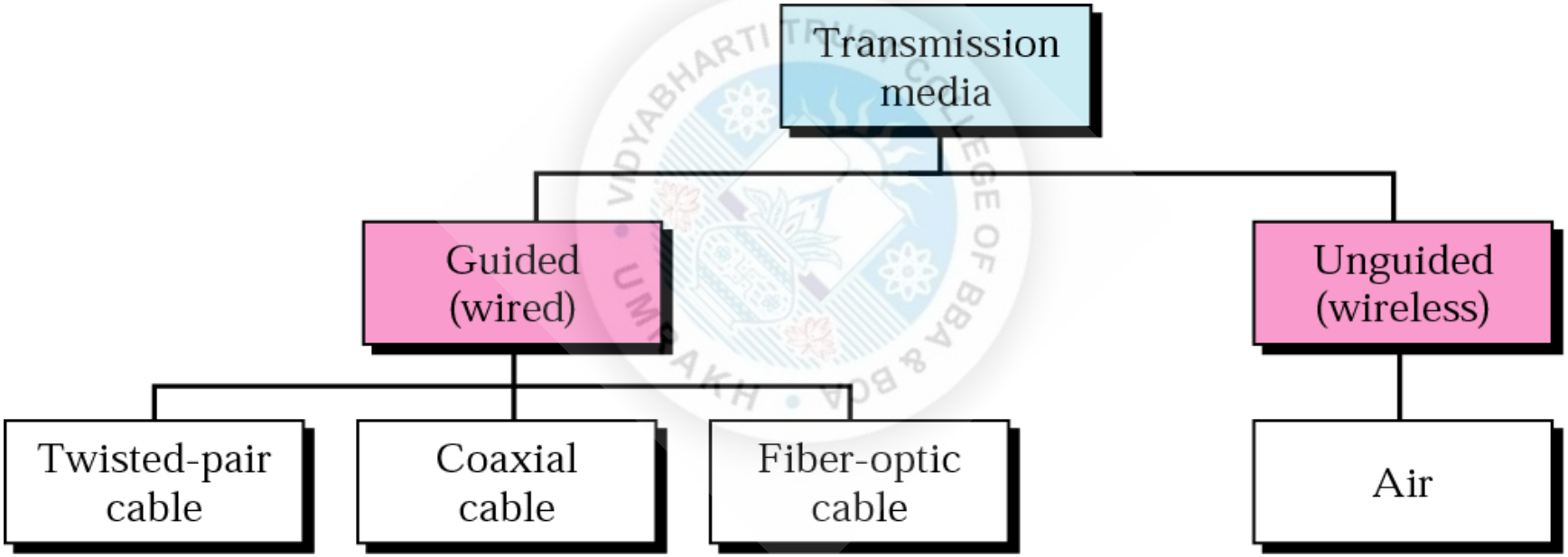
Transmission Media

By Amit Patel

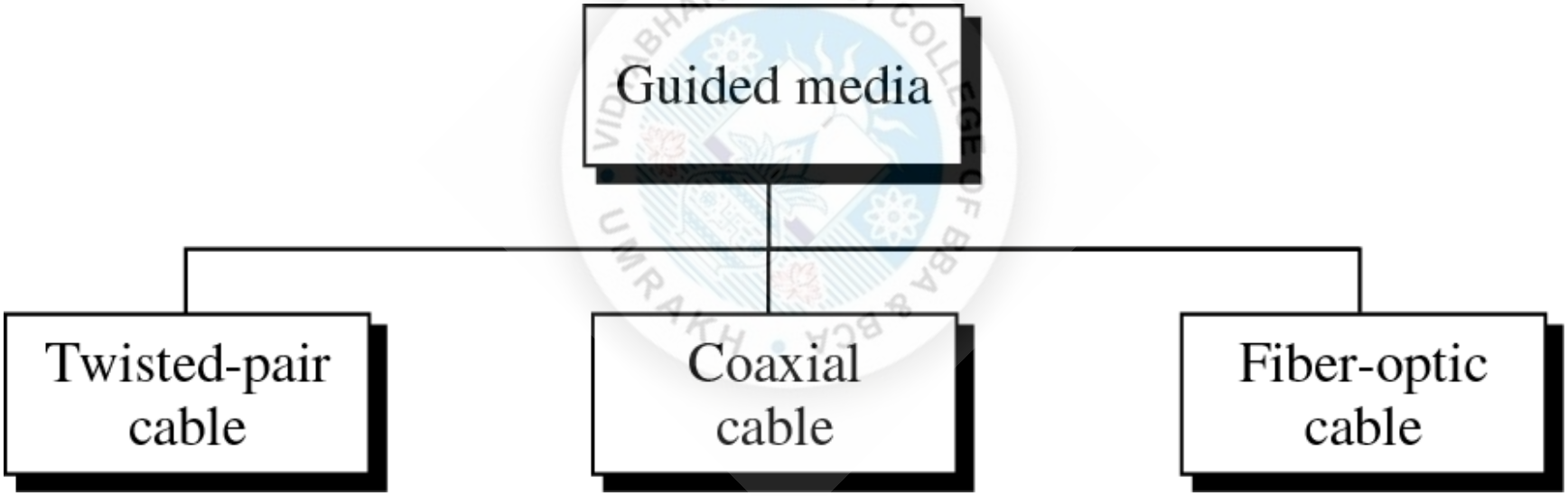
Transmission Media.

Medium by which data travels from sender to receiver.

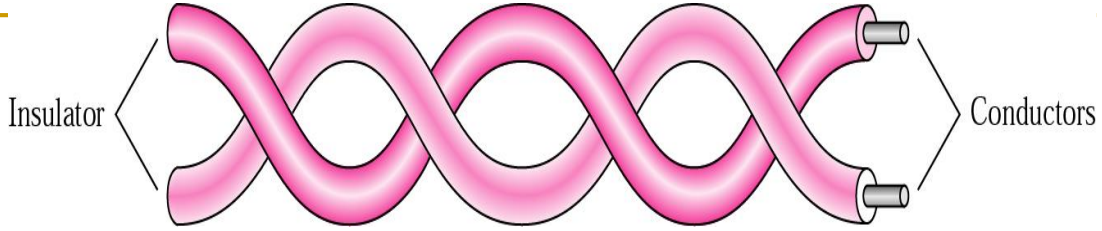


Guided Media

Transmission medium in which data/signal is guided by the cable or Wire.



Twisted Pair



- A type of cable that consists of two independently insulated wires twisted around one another.
- The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction. A pair of cables twisted around each other forms a twisted pair cable.
- Consist two conductors, each with its own plastic insulation.
- One wire used to carry signal, other is used as ground reference.
- A pair of wires forms a circuit that can transmit data.
- Why twisted? : The pairs are twisted to provide protection against *crosstalk*, the noise generated by adjacent pairs.

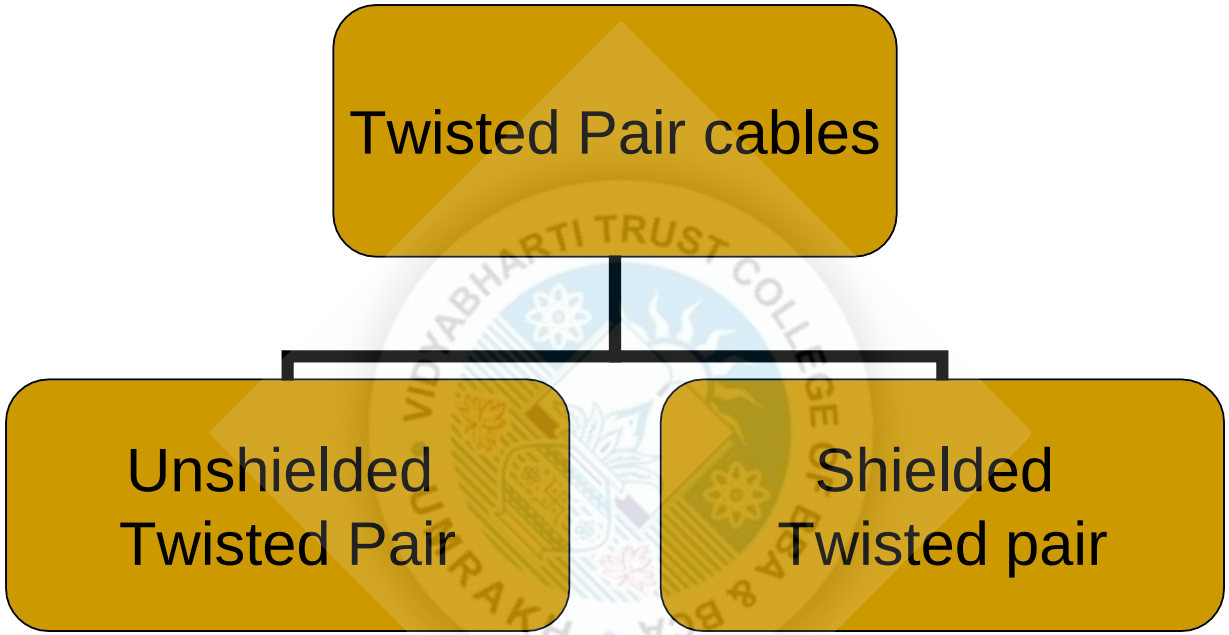
Twisted Pair

- When electrical current flows through a wire, it creates a small, circular magnetic field around the wire.
- When two wires in an electrical circuit are placed close together, their magnetic fields are the exact opposite of each other. Thus, the two magnetic fields cancel each other out.
- They also cancel out any outside magnetic fields.
- Twisting the wires can enhance this *cancellation effect*. Using cancellation together with twisting the wires, cable designers can effectively provide self-shielding for wire pairs within the network media.

Continue….

- Used in Telephone system & LAN
- EMI (Electro Magnetic Interference) : is disturbance that affects an electrical circuit due to either electromagnetic radiation emitted from an external source. The disturbance may interrupt, or otherwise degrade or limit the effective performance of the circuit.

Types of Twisted Pair



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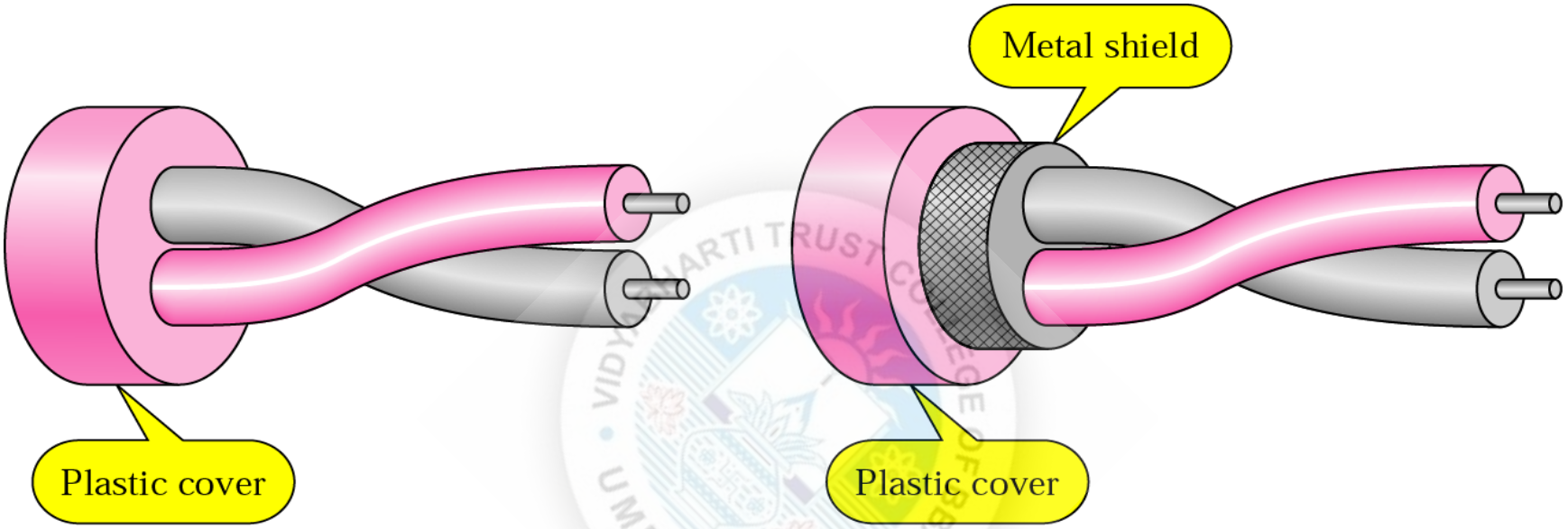
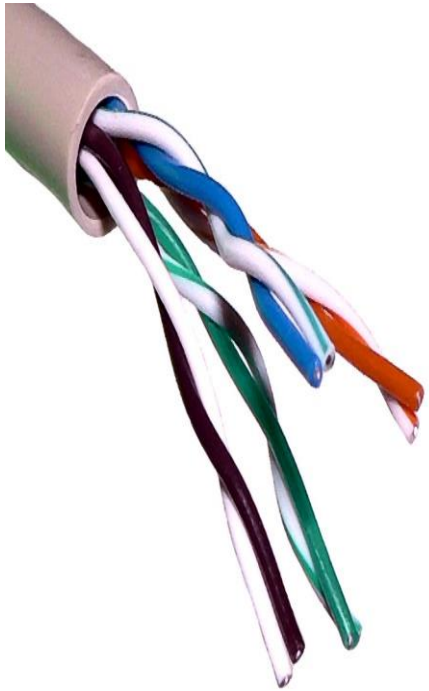


a. UTP

b. STP

UTP Cables



- Pair of unshielded wires round around each other
- No metallic shield.
- Unprotected against electrical interference.
- Due to Low cost extensively used in telephone system and LAN.
- Maximum segment length is 100 meters.
- each pair uniquely color coded when it is packaged in multiple pairs.

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- Connector : RJ45 (Registered Jack)
- EIA (Electronic Industries Association) has developed standard to classify UTP.
- Classification are determined by cable quality.
- Each category is suitable for specific use.

Category	Bandwidth	Data Rate	Digital/Analog	Use
1	very low	< 100 kbps	Analog	Telephone
2	< 2 MHz	2 Mbps	Analog/digital	T-1 lines
3	16 MHz	10 Mbps	Digital	LANs
4	20 MHz	20 Mbps	Digital	LANs
5	100 MHz	100 Mbps	Digital	LANs
6 (draft)	200 MHz	200 Mbps	Digital	LANs
7 (draft)	600 MHz	600 Mbps	Digital	LANs

Shielded Twisted Pair

- Produced by IBM
- Pair of wires round around each other is placed inside shield.
- shielded in an attempt to prevent electromagnetic interference.
- Better protection from EMI, RFI and crosstalk as compared to UTP

Advantages

- Being the oldest method of data transmission, trained manpower to repair and service this media of communications are easily available.
- In a telephone system, signals can travel several kilometers without amplification when twisted pair wires are used.
- Used for both analog and digital data transmission.
- Least expensive media for transmission for short distances.

Disadvantage

- Easily pick up noise signals which results in higher error rates .
- Being thin in size, it is likely to break easily.
- Support Less Speed

Types of Transmission

- In a transmission media, you can allocate bandwidth in two ways
  - Baseband
  - Broadband

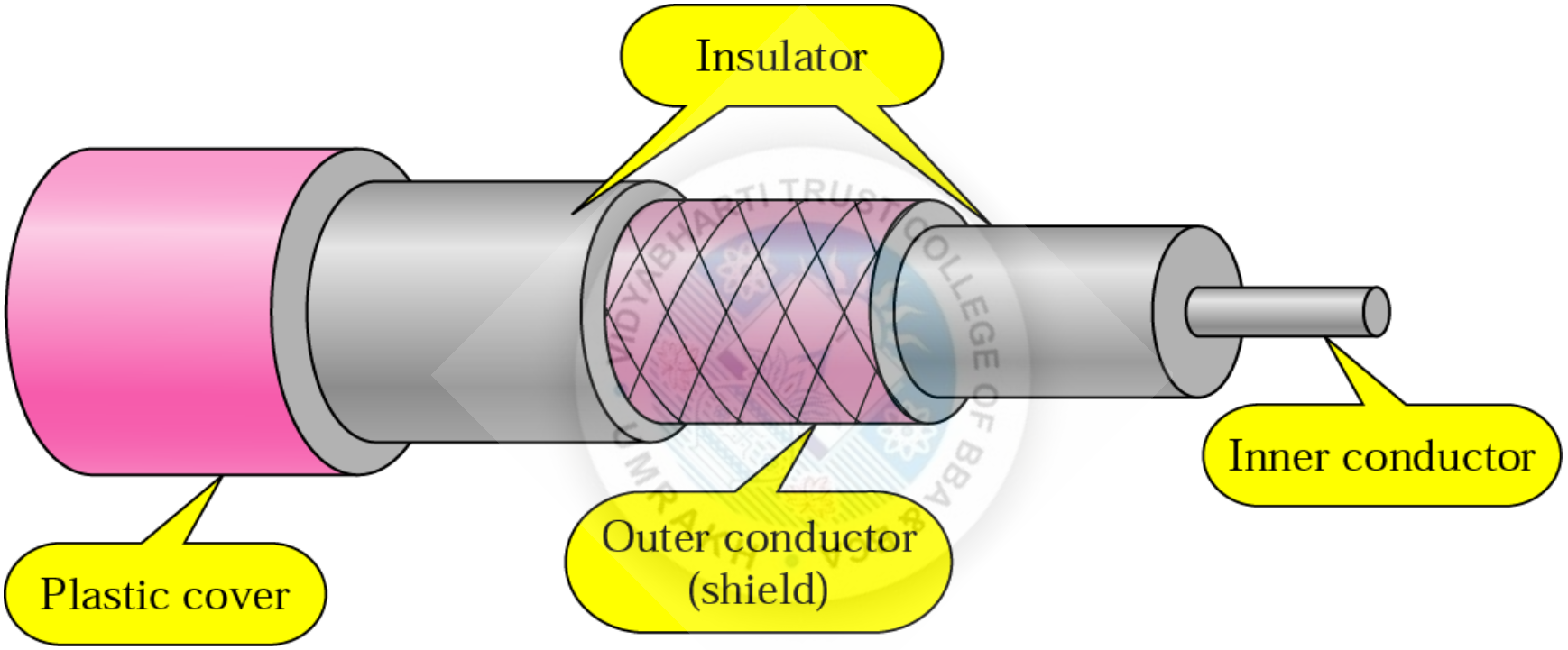
Baseband Transmission

- It utilize full bandwidth of the media like a single transmission path.
- Generally used by digital signals.
- More reliable than broadband.

Broadband Transmission

- Distributes full bandwidth into number of transmission path.
- Generally used by analog signals.
- Less reliable than baseband.

Co-axial Cable



Co-axial Cable

- A coaxial cable is one that consists of two conductors that share a common axis.
- Has central core conductor of solid enclosed in an insulating sheath, which is encase in outer conductor of metal foil.
- Carries signal of higher frequency range than TP .
- Outer conductor is a shield against noise.
- Whole cable is protected by plastic cover.
- A cable that is used in video, communications, and audio.

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- Coaxial cable is a two-conductor cable in which one conductor forms an electromagnetic shield around the other. The two conductors are separated by insulation.
- This media is used in base band and broadband transmission.
- Two types of coaxial cables are widely used:
  - 50 ohm cable : Used for digital Transmission
  - 75 ohm cable: Used for analog transmission.
- They are often installed either in a device to device daisy chain (Ethernet) or a star (ARC net).

Co-axial Cable Standard

- Categorized by their Radio Government (RG) ratings.
- RG number denote unique set of physical specification.
- Each cable adapted for specific function.

Category	Use
RG-59(Thick)	Cable TV
RG-58(Thin)	Camera
RG-11	Digital TV
RG-6	Digital TV

Types of Co-axial Cable

- There are 2 types of cable
  - Thin co-axial cable
  - Thick co-axial cable

Thin Co-axial Cable

- Thin coaxial cable is also referred to as thinnet.
- 10Base2 refers to the specifications for thin coaxial cable carrying Ethernet signals.
- The 2 refers to the approximate maximum segment length being 200 meters. In actual fact the maximum segment length is 185 meters.
- Thin coaxial cable is popular in school networks, especially linear bus networks.
- "Base" means digital transmission.

Thick Co-axial Cable

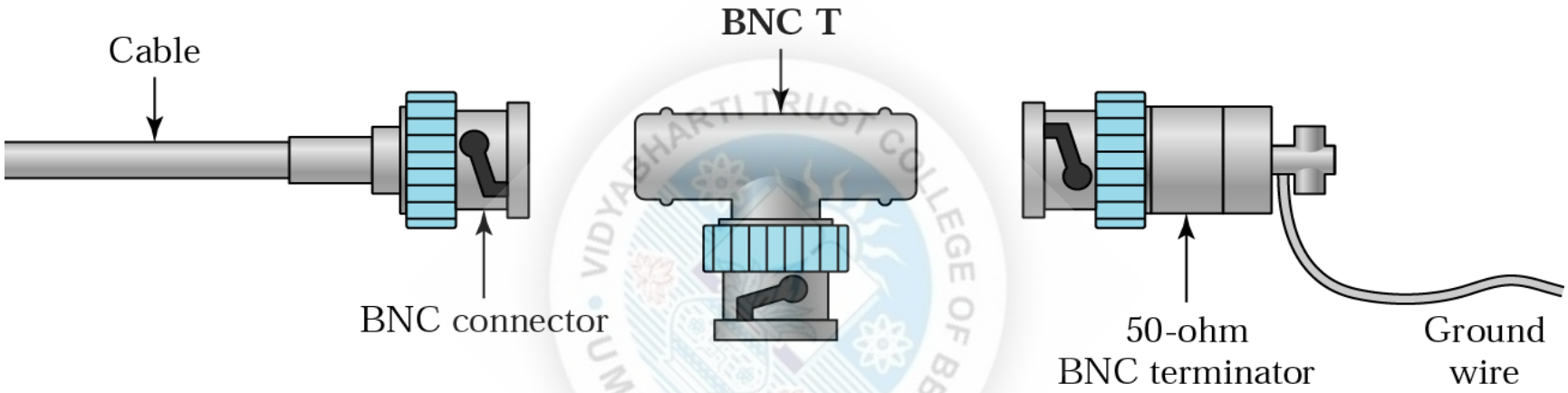
- Thick coaxial cable is also referred to as thicknet.
- 10Base5 refers to the specifications for thick coaxial cable carrying Ethernet signals.
- The 5 refers to the maximum segment length being 500 meters.
- Thick coaxial cable has an extra protective plastic cover that helps keep moisture away from the center conductor.
- This makes thick coaxial a great choice when running longer lengths in a linear bus network. One disadvantage of thick coaxial is that it does not bend easily and is difficult to install.

Characteristics

- 10 Mbps is the transmission rate.
- Maximum cable length for thinnet is 185 meter and for thicnet is 500 meters.
- Flexible and easy to work with thinnet.
- Less expensive then fiber optic.
- Good resistance to electrical interference.

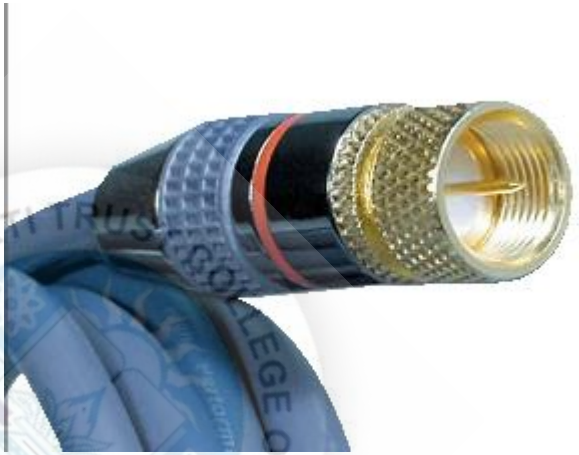
Co-axial Cable Connector

- Connector: BNC Connector (Bayone Neill Concelman)



BNC Connector

F-Type Connector



BNC Connectors

- BNC Connector : Used to connect the end of the cable
- BNC T Connector : Used in Ethernet network to branch out to a computer or other device.
- BNC Terminator : Used at the end of the cable to prevent the reflection of signal.

Application of Co-axial cable

- Cable TV
- Traditional Ethernet LAN

Advantages

- Better shield against EMI than twisted pair cable, so it can span longer distance at higher data bits per second (bps).
- It can be used for both analog and digital data transmissions.
- It is inexpensive as compared to twisted pair wires and UTP cables but easy to handle.
- Higher bandwidth.
- Excellent noise immunity

Disadvantage

- More expensive to install compare to twisted pair cable.
- The thicker the cable, the more difficult to work with.
- Proper connection and termination is must.
- Number of nodes connection is limited.

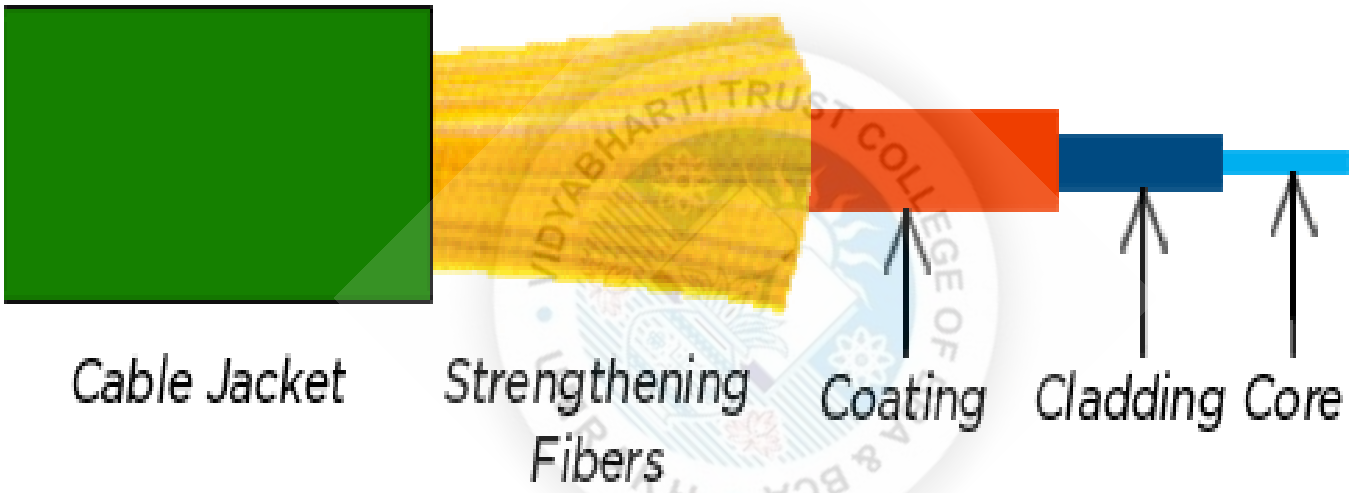
Fiber Optic Medium

- An optical fiber is a flexible, transparent fiber made of extruded glass (silica) or plastic, slightly thicker than a human hair.
- It can function as a waveguide, or “light pipe”, to transmit light between the two ends of the fiber with higher speed.
- Fiber means Glass Or Plastics and Optics means Light.
- Fiber Optics = Light guided in Glass.
- Electrical signals are converted into light signals
- A phenomenon called as total internal reflection is used for transmission
- LED or laser is used to transmit signal

Fiber Optic Medium

- Because a fiber-optic cable is light-based, data can be sent through it at the speed of light.
- Using a laser transmitter that encodes frequency signals into pulses of light, ones and zeros are sent through the cable.
- The receiving end of the transmission translates the light signals back into data which can be read by a computer.
- Used in telecommunication services like internet, telephone and television.

Fiber Optic : Structure



Components Of Fiber Optics

- Fiber optics cable is divided into five parts.
  - Core
  - Cladding
  - Coating
  - Strengthening Fiber
  - Cable Jacket

Core

- This is the physical medium that transports optical data signals from an attached light source to a receiving device.
- The core is a single continuous strand of glass or plastic that's measured in microns (μ) by the size of its outer diameter.
- The larger the core, the more light the cable can carry.
- All fibre optic cable is sized according to its core's outer diameter.
- The three multimode sizes most commonly available are 50, 62.5, and 100 microns.
- Single-mode cores are generally less than 9 microns.

Cladding

- This is the thin layer that surrounds the fibre core and serves as a boundary that contains the light waves and causes the refraction, enabling data to travel throughout the length of the fibre segment.
- Outer optical material surrounding the core that reflects the light back into the core.

Coating

- This is a layer of plastic that surrounds the core and cladding to reinforce and protect the fibre core from damage and moisture.
- Coatings are measured in microns and can range from 250 to 900 microns.

Strengthening fibres

- These components help protect the core against crushing forces and excessive tension during installation.

Cable jacket

This is the outer layer of any cable. Most fibre optic cables have an orange jacket, although some types can have black or yellow jackets.

Working of Fiber Optic

- Transfer data in the form of light pulse through cable.
- Fiber optic cable contain 2 main part : core and outer cladding. Each of them have different refractive index.
- When light is passed through the fiber optic, it is reflected and bounced by the core and cladding in zig zag motion. This process is called Total internal reflection.
- Total internal reflection defined as phenomena that happen when light travel from an optically denser medium to an optically less denser medium.

Refraction of Light

- As a light ray passes from one transparent medium to another, it changes direction; this phenomenon is called refraction of light. How much that light ray changes its direction depends on the refractive index of the mediums

Principle of Fiber Optic

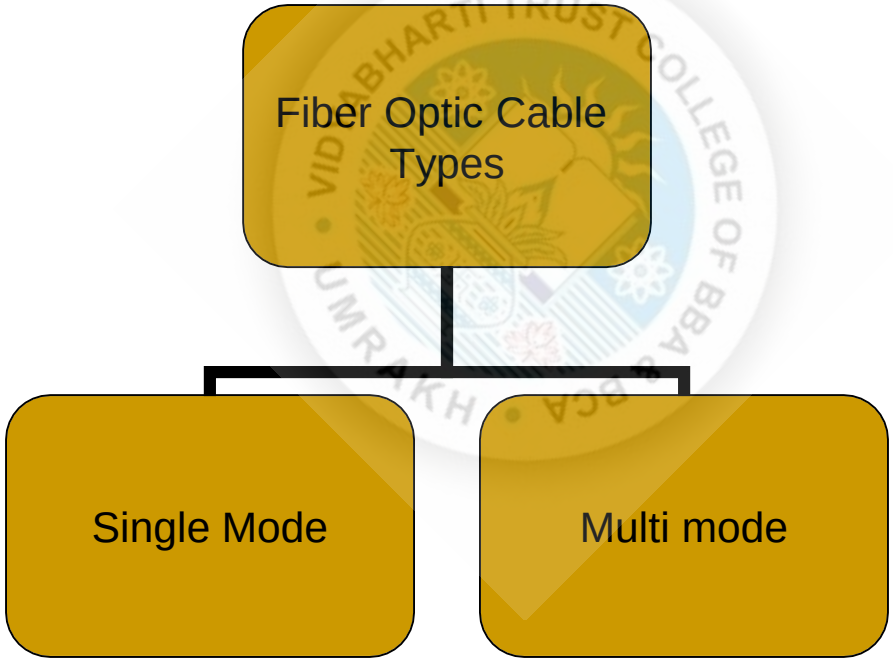
- In Fiber optic, core is located at the center and has protective outer layer called cladding.
- Both core and cladding are made up with different material.
- When light travel through the core, it travel and transmitting to the cladding. The cladding further reflect light back to the core and so on.
- When light from the core, strike to the border of the cladding with an angle less than 90 degree, it bounce off.
- Light is not escaped in any way and it only come out from the other end of the fiber.

Principle of Fiber Optic

- Cladding of the fiber is easily damage. To protect this damage, the plastic coating like the buffer is applied to protect the cladding.
- This buffer is normally tough layer and is known as Jacket. So the fiber function easily without any damage.

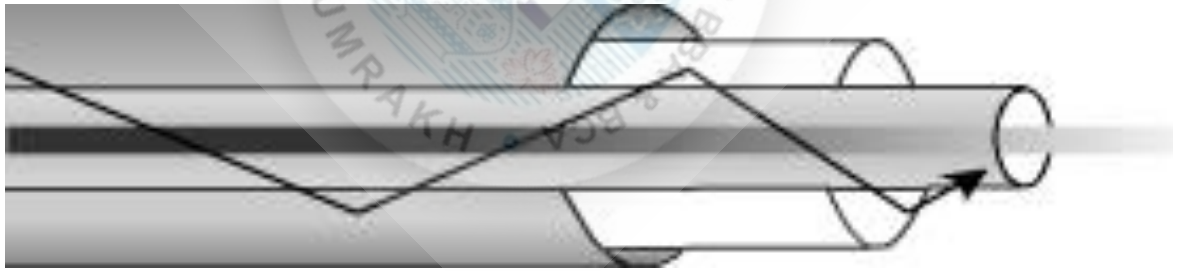
Fiber Optic Cable Types

- Fiber optic cables can carry signals in a single direction.



Single Mode Fiber Optic cable

- A type of cable that has only a single strand of glass fiber with a thin diameter.
- Fiber optic cables that use lasers are known as single mode cable.

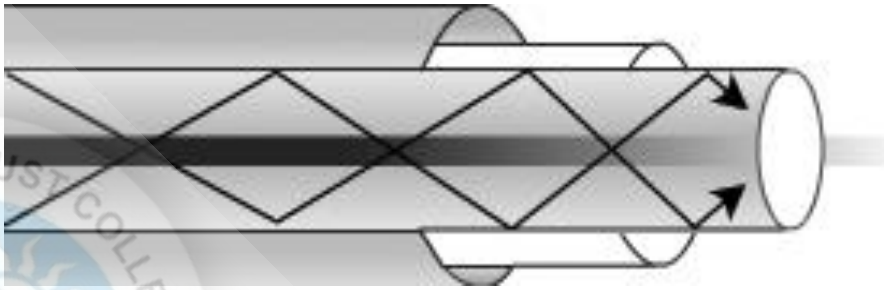


Single Mode Fiber Optic cable

- Used for long distance data transmission.
- Has small diameter core due to which it lessen the attenuation.
- Has more bandwidth than multimode fiber optic cable.
- More expensive than multimode fiber optic

Multi Mode Fiber Optic cable

- A type of cable that contains a glass fiber with a larger diameter.
- Transfer data to shorter distance.
- Due to its larger diameter, multiple light beam can be sent at a time so more transmission occurs.



Multi Mode Fiber Optic cable

- Signal loss, Interference and attenuation is more than single mode fiber.
- An LED is used to create light source.

Advantages

- **High Bandwidth** Fibre provides greater bandwidth than copper, so it's ideal for data-intensive multimedia applications.
- **Greater Distances** Very little signal loss occurs during transmission so data travels greater distances
- **Immunity and reliability** The fibre is made of glass, which is an insulator, making it immune to electromagnetic interference and radio-frequency interference (EMI/RFI),
- **Material cost and theft prevention** Conventional cable systems use large amounts of copper. In some places, this copper is a target for theft due to its value on the scrap market.

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Disadvantages

- High investment Cost
- Need more expensive optical transmitter and receivers.
- More difficult and expensive to splice than other cables.
- Affected by chemicals.
- Required special skills.

Fiber Optic Cable Connectors

- Straight Tip (ST) – Joins individual fibers to optical devices
- Subscriber Connector (SC) – Attaches two fibers to send and receive signals
- Medium Interface Connector (MIC) – Joins fiber to FDDI controller
- Sub Miniature Type A (SMA) – Uses individual connectors for each fiber stand
- Fiber Jack – Attaches two fibers in snap lock connector

Selection Criteria

When choosing the transmission media, what are the factors to be considered?

- Transmission Rate
- Distances
- Cost and Ease of Installation
- Resistance to Environmental Conditions