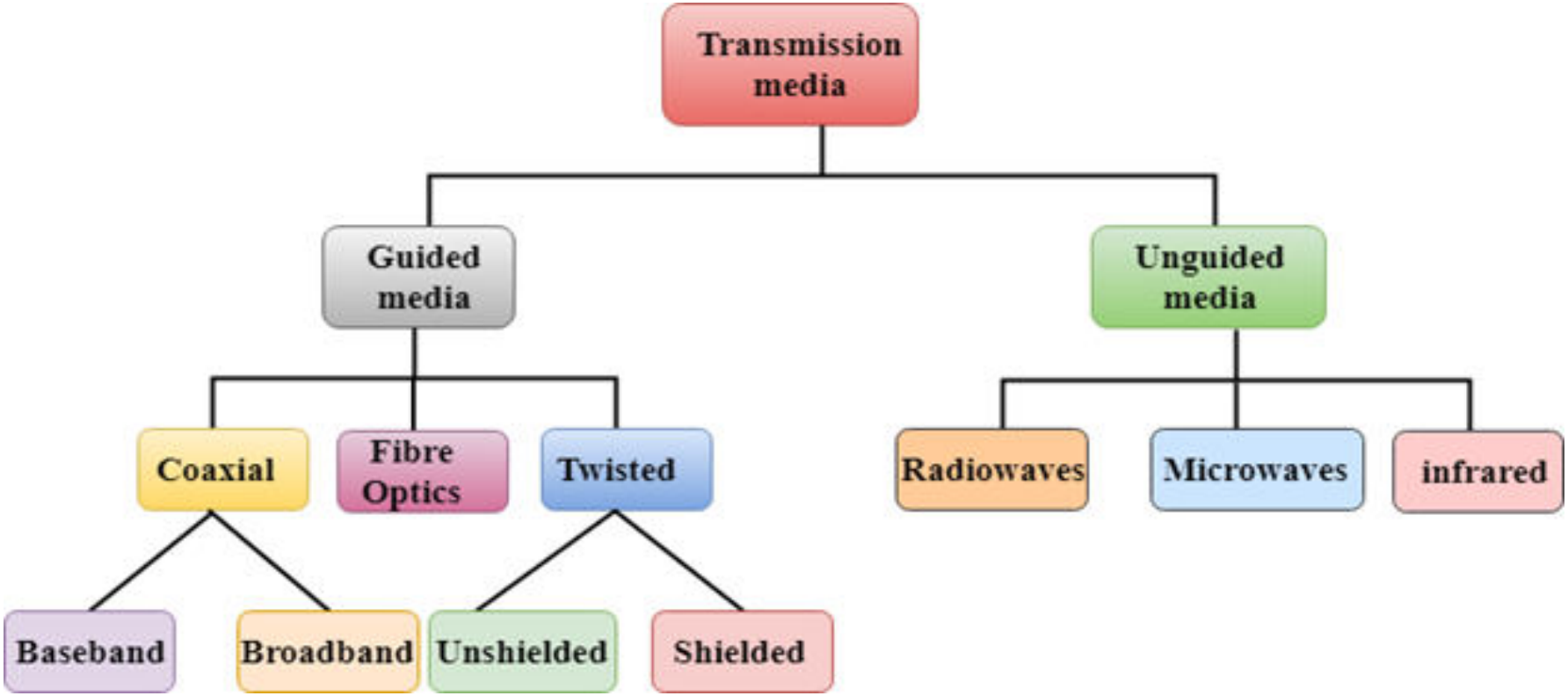
Computer Network

Lecture-13

Dharmendra Kumar (Associate Professor)
Department of Computer Science and Engineering
United College of Engineering and Research, Prayagraj

Transmission Media

- A transmission medium can be broadly defined as anything that can carry information from a source to a destination.
- The transmission medium is usually free space, metallic cable, or fiber-optic cable.



GUIDED MEDIA

Guided media, which are those that provide a conduit from one device to another, include twisted-pair cable, coaxial cable, and fiber-optic cable. 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.

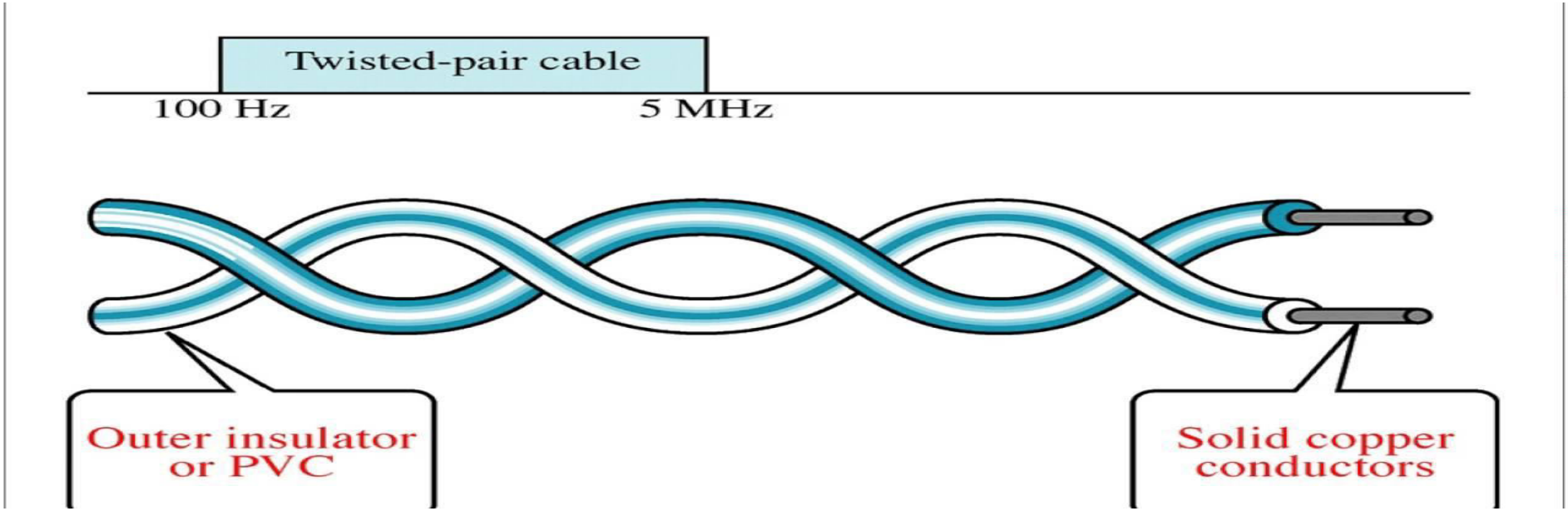
GUIDED MEDIA

Twisted-Pair Cable

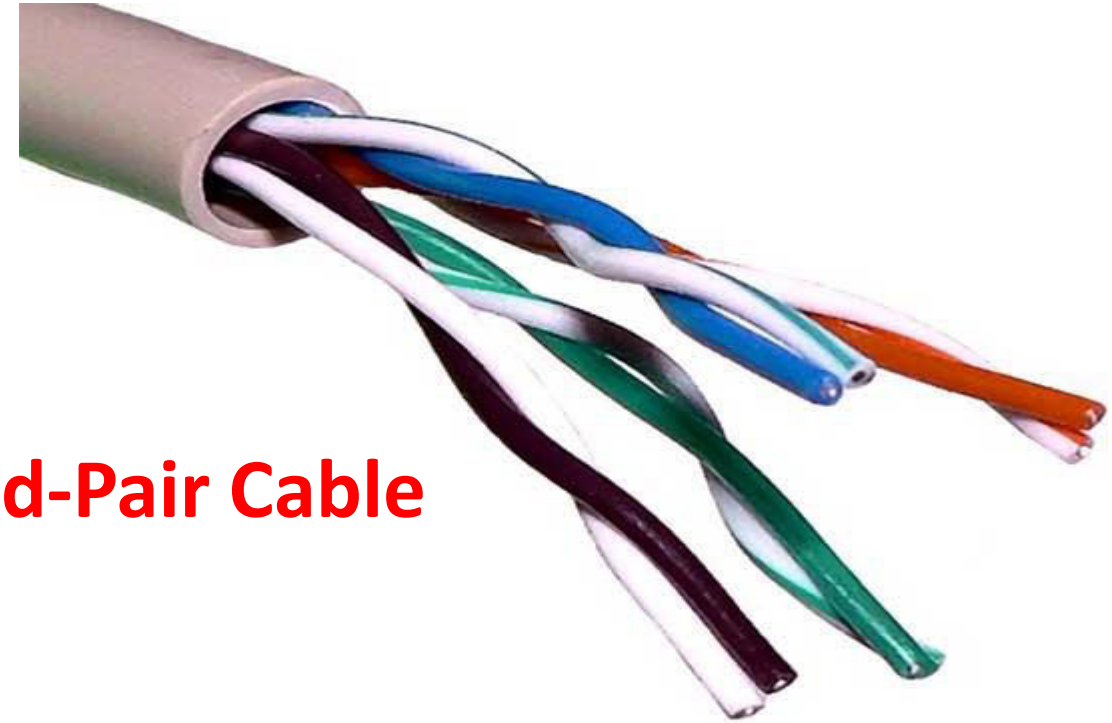
A twisted pair cable is made of two plastic insulated copper wires twisted together to form a single media. Out of these two wires, only one carries actual signal and another is used for ground reference.

The twists between wires are helpful in reducing noise (electro-magnetic interference) and crosstalk.

The receiver uses the difference between the two.



GUIDED MEDIA



Twisted-Pair Cable

GUIDED MEDIA

There are two types of twisted pair cables:

- Unshielded Twisted Pair (UTP) Cable
- Shielded Twisted Pair (UTP) Cable

Unshielded Twisted Pair (UTP) Cable

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

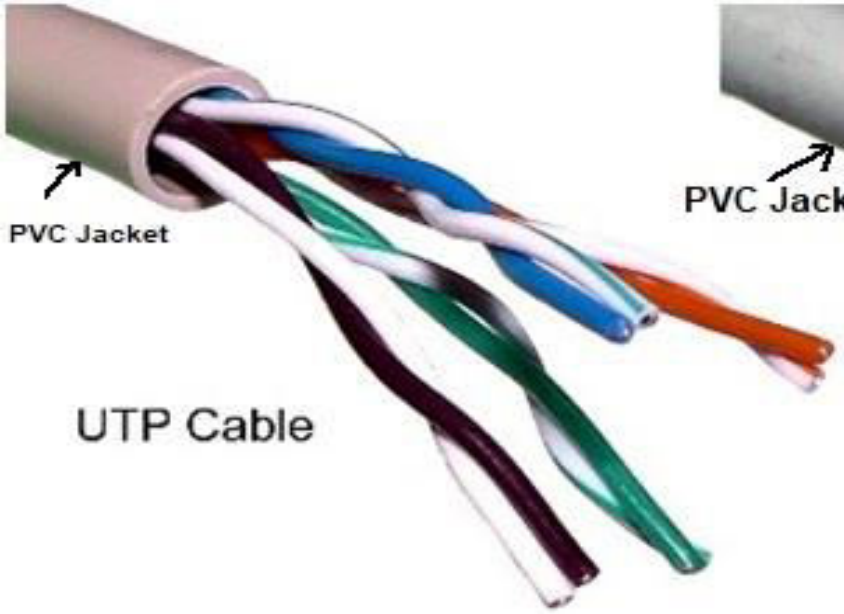
The Electronic Industries Association (EIA) has developed standards to classify unshielded twisted-pair cable into seven categories. Categories are determined by cable quality, with 1 as the lowest and 7 as the highest. Each EIA category is suitable for specific uses.

In computer networks, Cat-5, Cat-5e, and Cat-6 cables are mostly used. UTP cables are connected by RJ45 connectors.

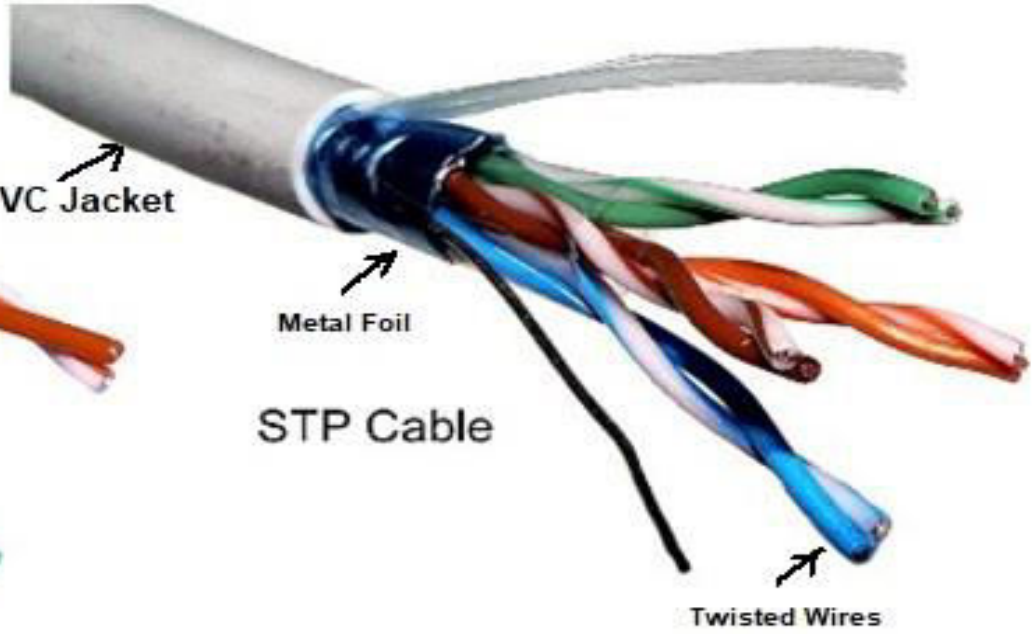
Shielded Twisted Pair (STP) Cable

STP cable has a metal foil or braided-mesh covering that encases each pair of insulated conductors. Metal casing improves the quality of cable by preventing the penetration of noise or crosstalk.

GUIDED MEDIA

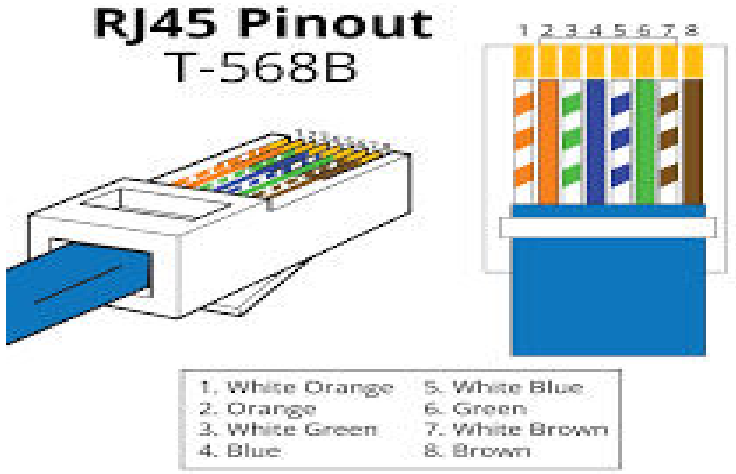


UTP Cable



STP Cable

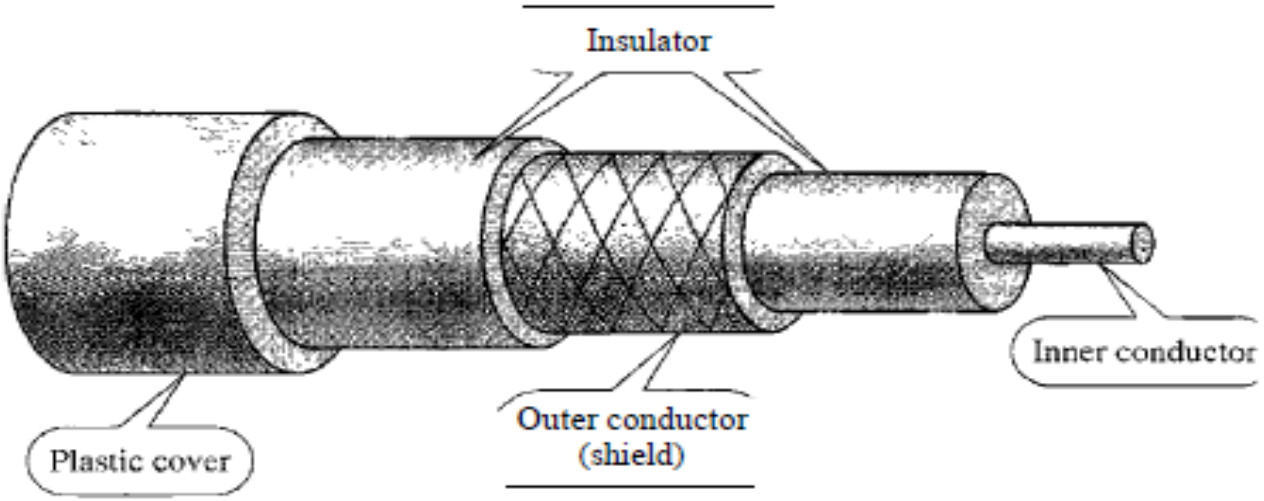
RJ45 connector



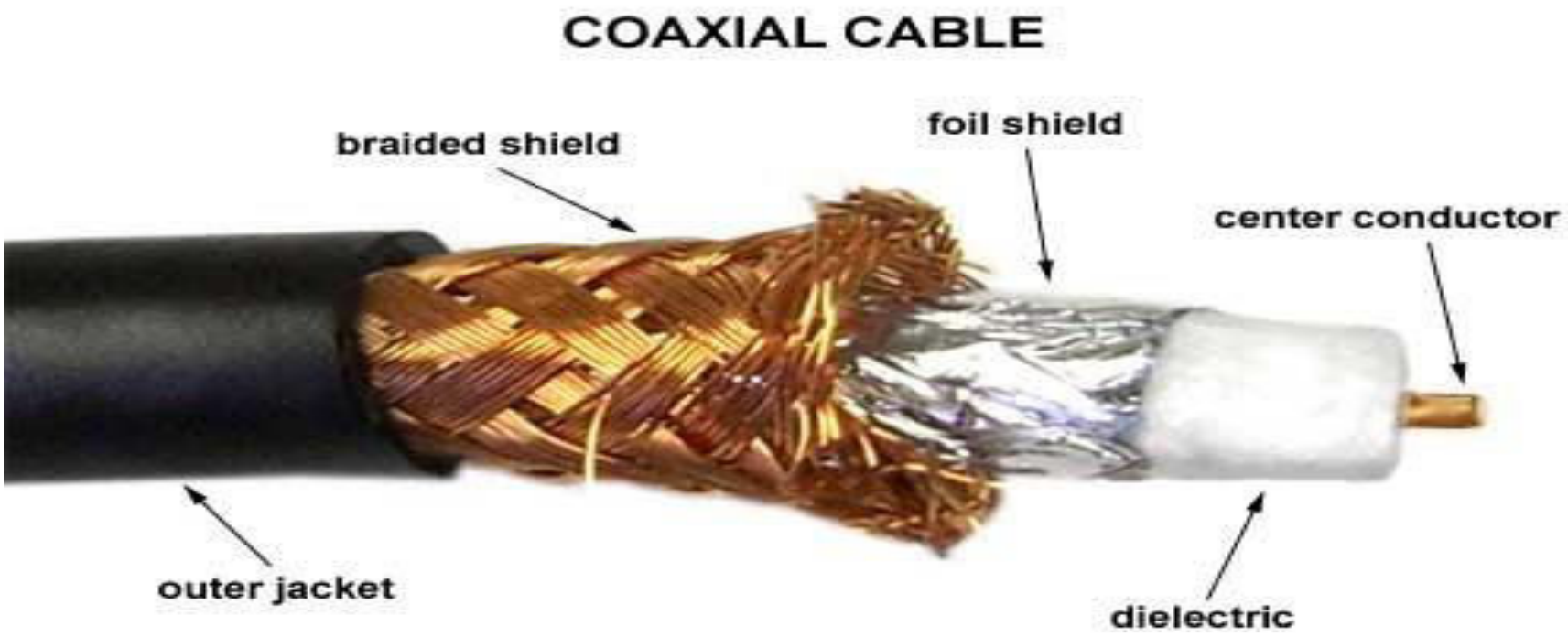
Guided Media

Coaxial Cable

Coaxial cable (or coax) carries signals of higher frequency ranges than those in twisted pair cable Instead of having two wires. Coax has a central core conductor of solid or stranded 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 second conductor, which completes the circuit. This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.



Guided Media



Guided Media

Coaxial Cable Standards

Coaxial cables are categorized by their radio government (RG) ratings. Each RG number denotes a unique set of physical specifications, including the wire gauge of the inner conductor, the thickness and type of the inner insulator, the construction of the shield, and the size and type of the outer casing. Each cable defined by an RG rating is adapted for a specialized function.

Category	Use
RG-59	Cable TV
RG-58	Thin Ethernet
RG-11	Thick Ethernet

Guided Media

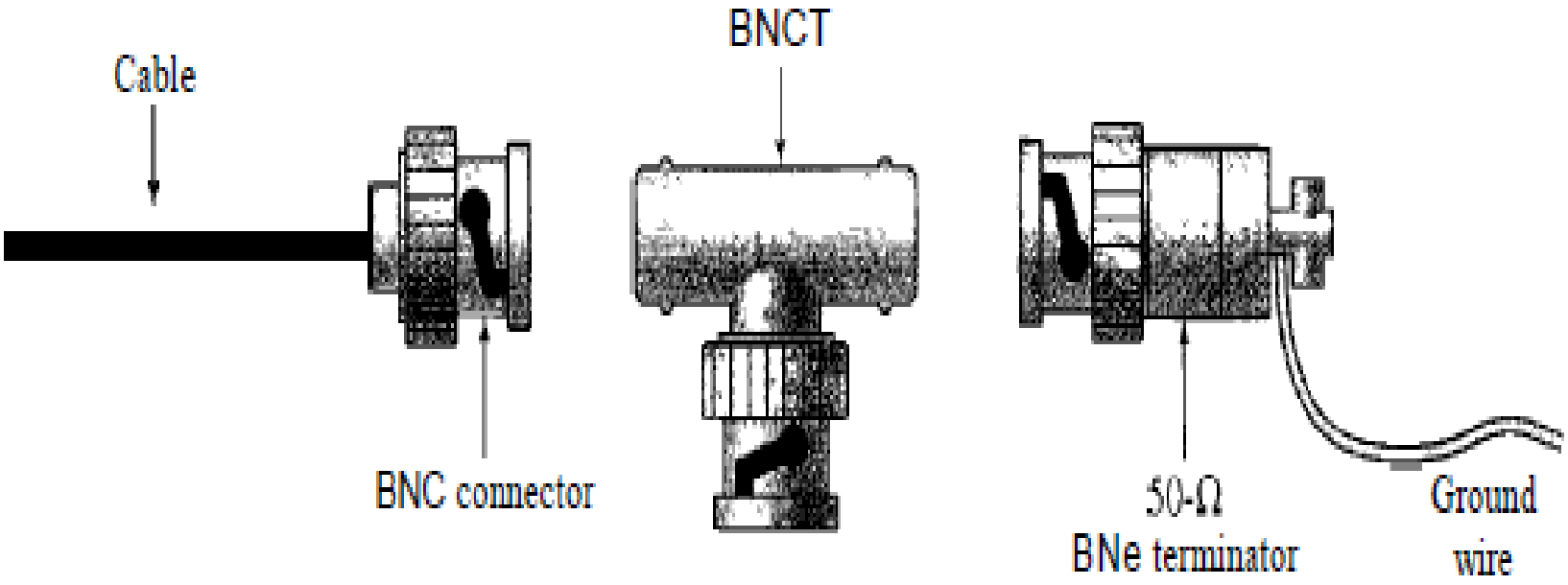
Coaxial Cable Connectors

The most common type of connector used today is the Bayone-Neill-Concelman (BNC), connector. Three popular types of these connectors are the BNC connector, the BNC-T connector, and the BNC terminator.

- The BNC connector is used to connect the end of the cable to a device, such as a TV set.
- The BNC T connector is used in Ethernet networks to branch out to a connection to a computer or other device.
- The BNC terminator is used at the end of the cable to prevent the reflection of the signal.

Guided Media

Coaxial Cable Connectors

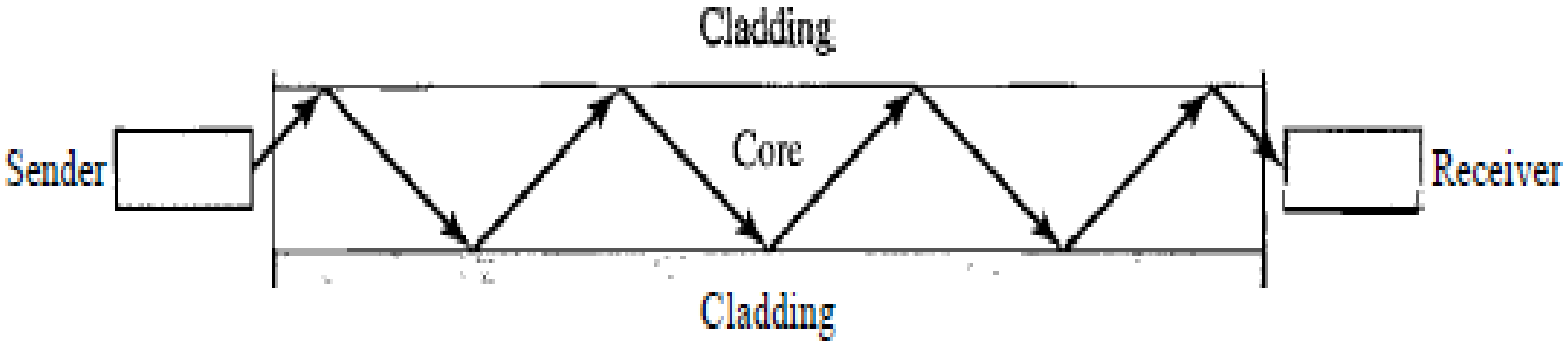


Guided Media

Fiber-Optic Cable

A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.

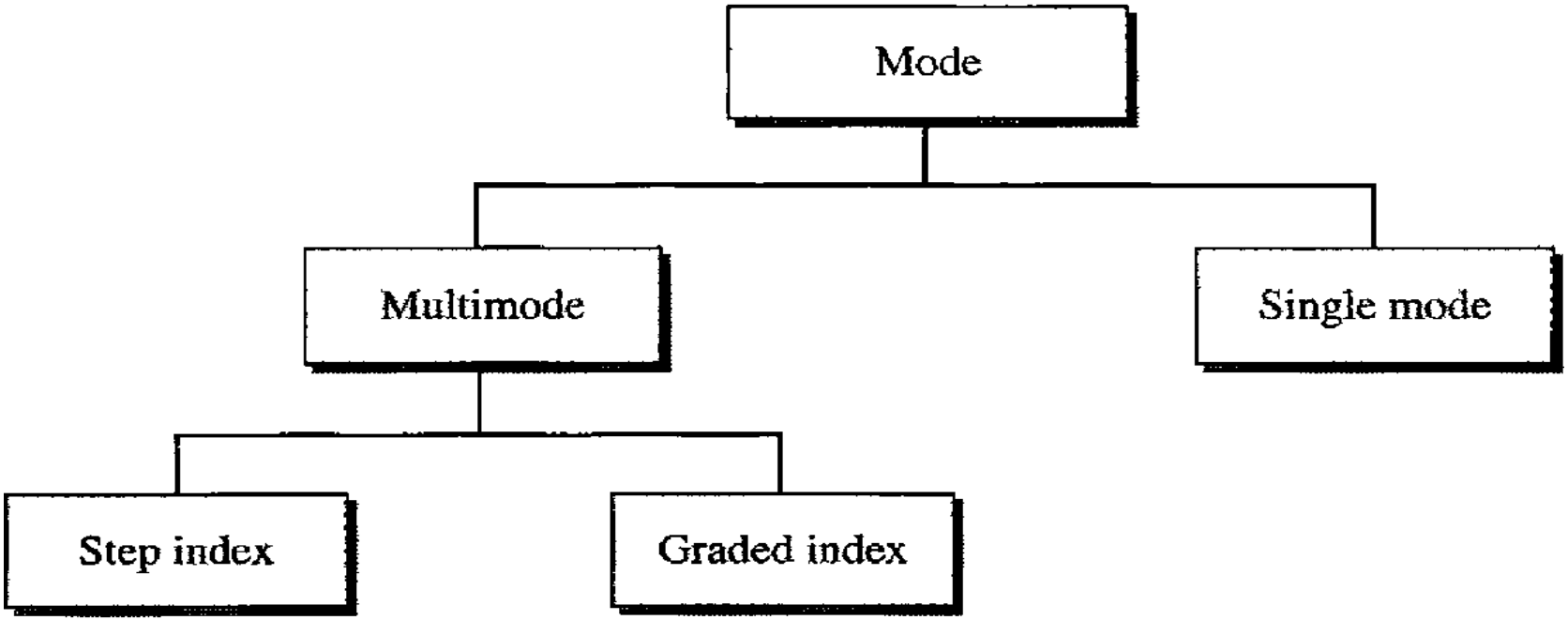
Optical fibers use reflection to guide light through a channel. A glass or plastic core is surrounded by a cladding of less dense glass or plastic. The difference in density of the two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refracted into it.



Guided Media

Propagation Modes

Current technology supports two 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.



Guided Media

Multimode

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

In 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.

A graded-index fiber is one with varying densities. Density is highest at the center of the core and decreases gradually to its lowest at the edge.

Guided Media

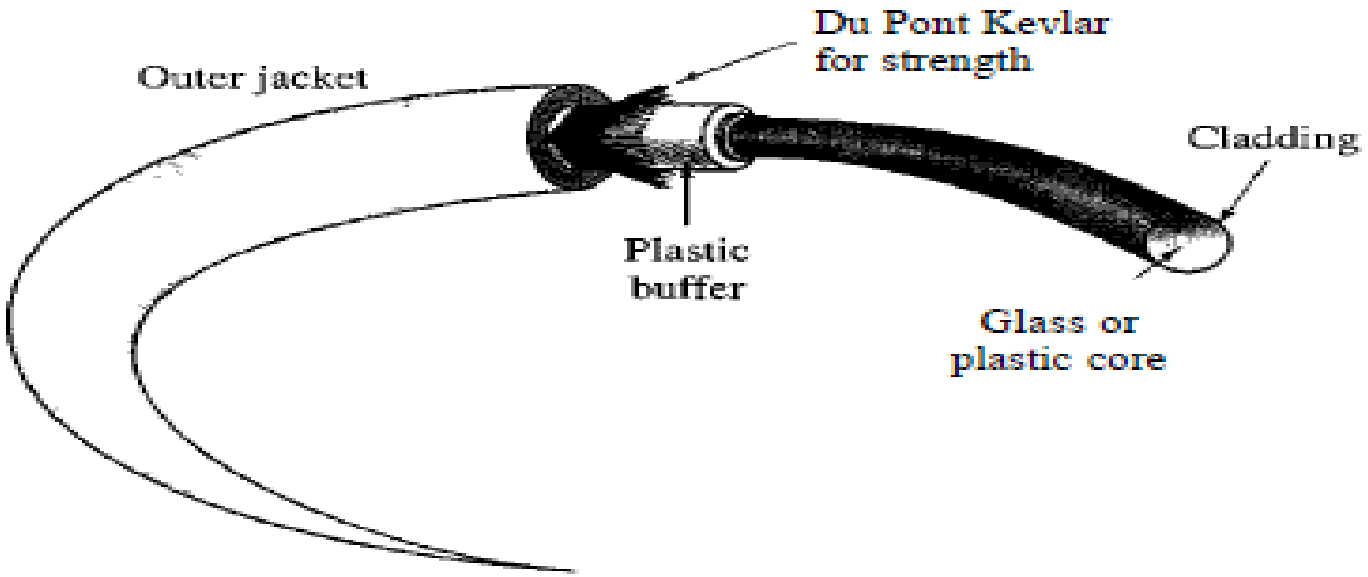
Single-Mode

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.

Guided Media

Cable Composition

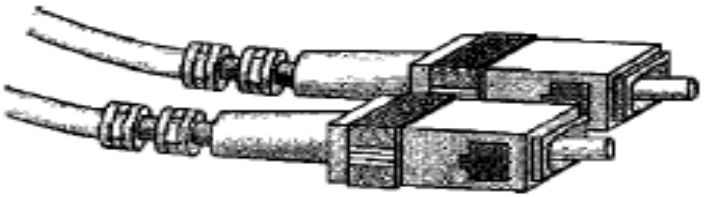
Following figure shows the composition of a typical fiber-optic cable. The outer jacket is made of either PVC or Teflon. Inside the jacket are Kevlar strands to strengthen the cable. Kevlar is a strong material used in the fabrication of bulletproof vests. Below the Kevlar is another plastic coating to cushion the fiber. The fiber is at the center of the cable, and it consists of cladding and core.



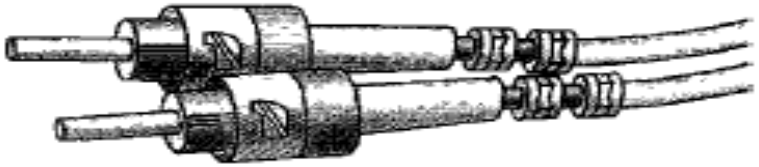
Guided Media

Fiber-Optic Cable Connectors

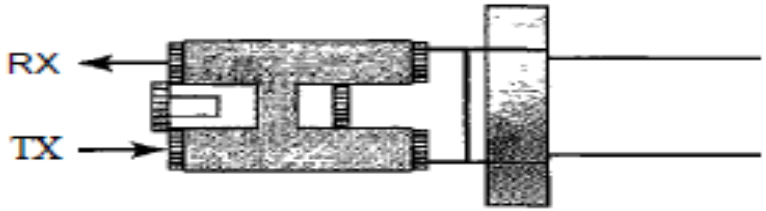
There are three types of connectors for fiber-optic cables, as shown in figure:



SC connector



ST connector



MT-RJ connector

The subscriber channel (SC) connector is used for cable TV. It uses a push/pull locking system. The straight-tip (ST) connector is used for connecting cable to networking devices. It uses a bayonet locking system and is more reliable than SC. MT-RJ is a connector that is the same size as RJ45.

Guided Media

Advantages of Optical Fiber

Fiber-optic cable has several advantages over metallic cable (twisted pair or coaxial).

- **Higher bandwidth.** Fiber-optic cable can support dramatically higher bandwidths (and hence data rates) than either twisted-pair or coaxial cable.
- **Less signal attenuation.** Fiber-optic transmission distance is significantly greater than that of other guided media. A signal can run for 50 km without requiring regeneration. We need repeaters every 5 km for coaxial or twisted-pair cable.
- **Immunity to electromagnetic interference.** Electromagnetic noise cannot affect fiber-optic cables.
- **Resistance to corrosive materials.** Glass is more resistant to corrosive materials than copper.
- **Light weight.** Fiber-optic cables are much lighter than copper cables.
- **Greater immunity to tapping.** Fiber-optic cables are more immune to tapping than copper cables. Copper cables create antenna effects that can easily be tapped.

Guided Media

Disadvantages of Optical Fiber

There are some disadvantages in the use of optical fiber.

- **Installation and maintenance.** Fiber-optic cable is a relatively new technology. Its installation and maintenance require expertise that is not yet available everywhere.
- **Unidirectional light propagation.** Propagation of light is unidirectional. If we need bidirectional communication, two fibers are needed.
- **Cost.** The cable and the interfaces are relatively more expensive than those of other guided media. If the demand for bandwidth is not high, then the use of optical fiber cannot be justified.