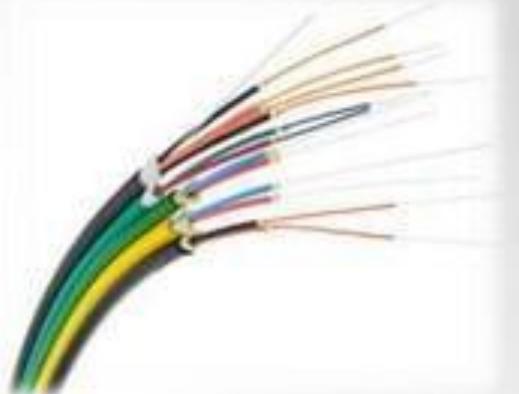


Transmission Media



Content

- **Transmission Media**
- **Guided Media:**
 - Twisted Pair
 - UTP
 - STP
 - Co-Axial Cable
 - Fibre Optic Cable
- **Propagation Modes**
- **Transmission Impairment**
- **Unguided Media:**
 - Propagation Methods
 - Radio Waves
 - Antenna
 - Microwaves
 - Infrared

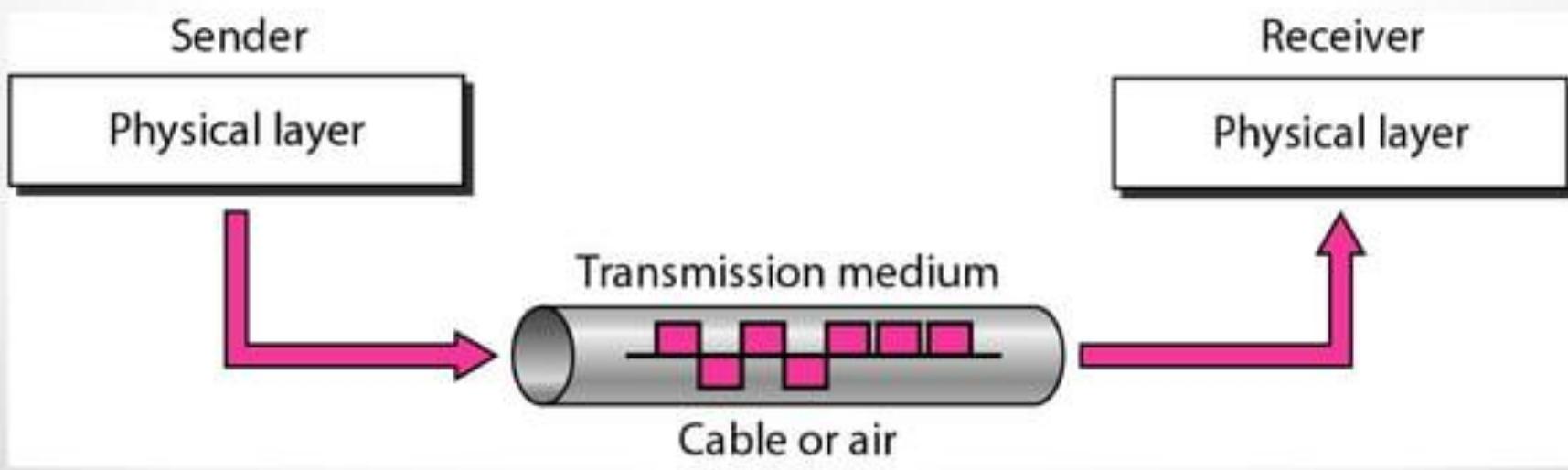
What is Transmission Media ?

In data communication,

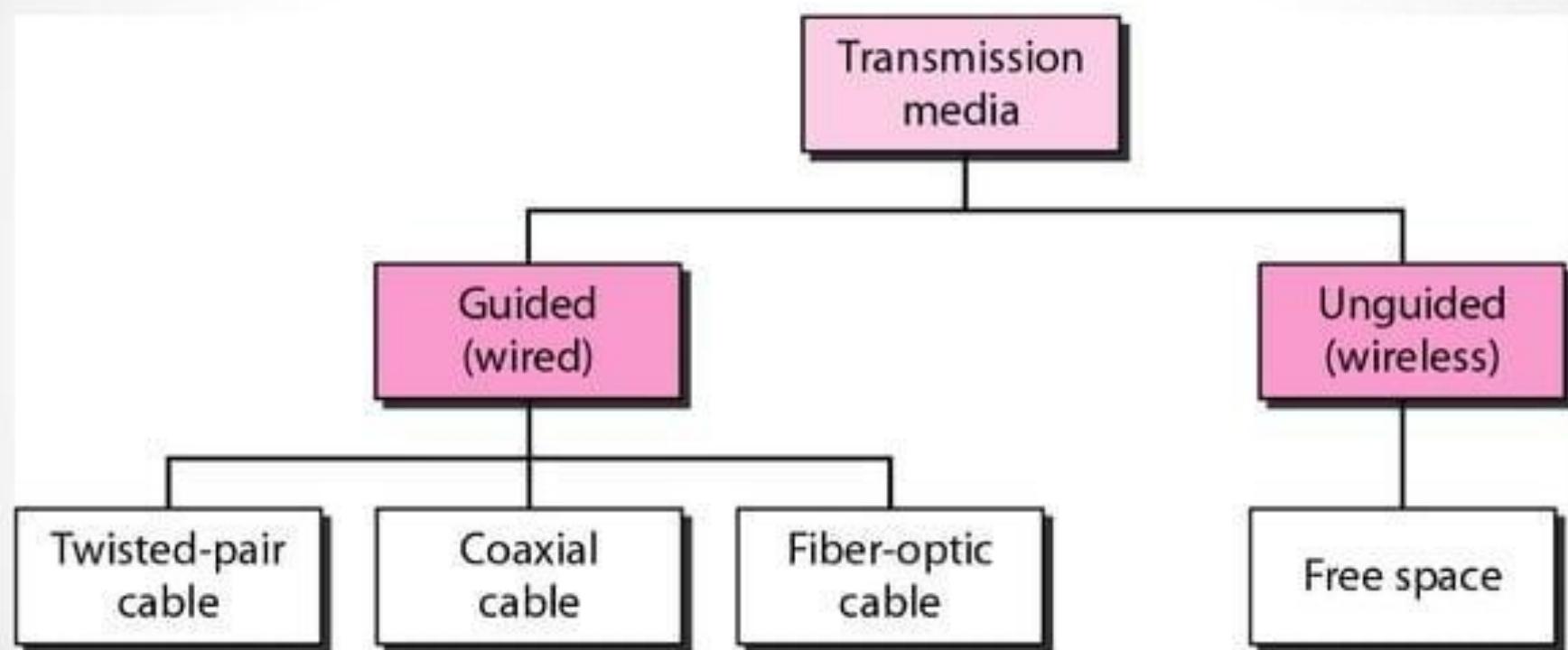
- **Transmission media** is a pathway that carries the information from sender to receiver.
- We use different types of cables or waves to transmit data.
- Data is transmitted normally through electrical or electromagnetic signals.

Description

- Transmission media are located below the physical layer
- Computers use signals to represent data.
- Signals are transmitted in form of electromagnetic energy.

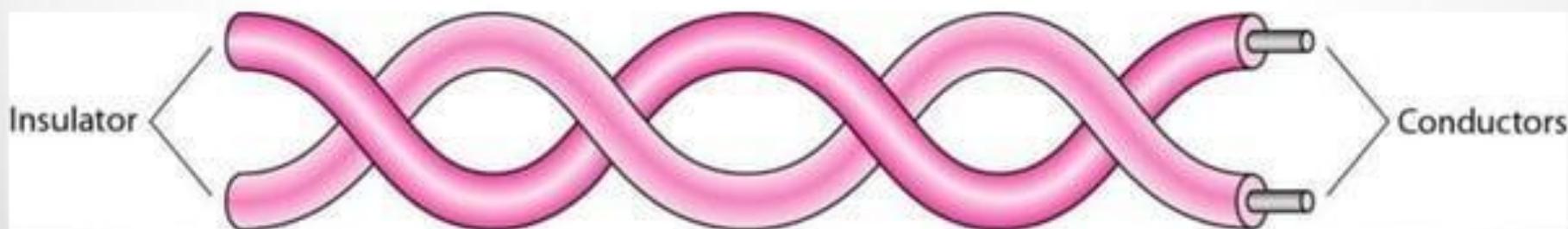


Classification of Transmission media



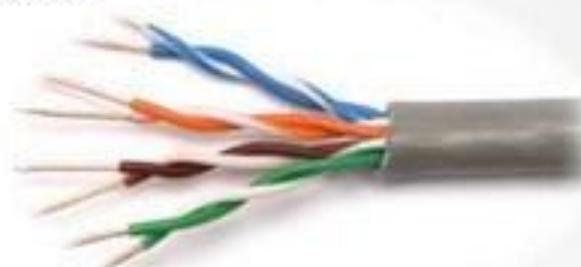
Twisted-pair cable

- A twisted pair consists of two conductors
- Basically copper based
- With its own plastic insulation, twisted together.



Twisted Pair Description

- Provide protection against cross talk or interference(noise)
- One wire use to carry signals to the receiver
- Second wire used as a ground reference
- For twisting, after receiving the signal remains same.
- Therefore number of twists per unit length, determines the quality of cable.



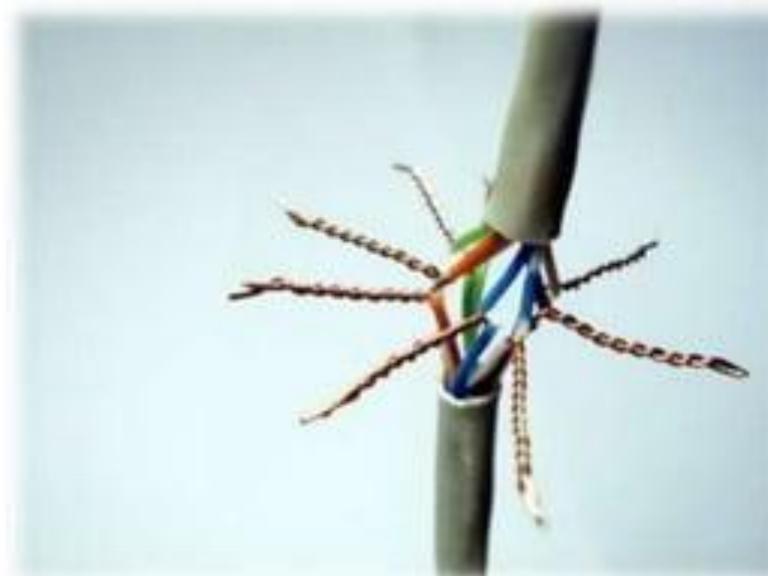
Twisted Pair

Advantages:

- Cheap
- Easy to work with

Disadvantages:

- Low data rate
- Short range

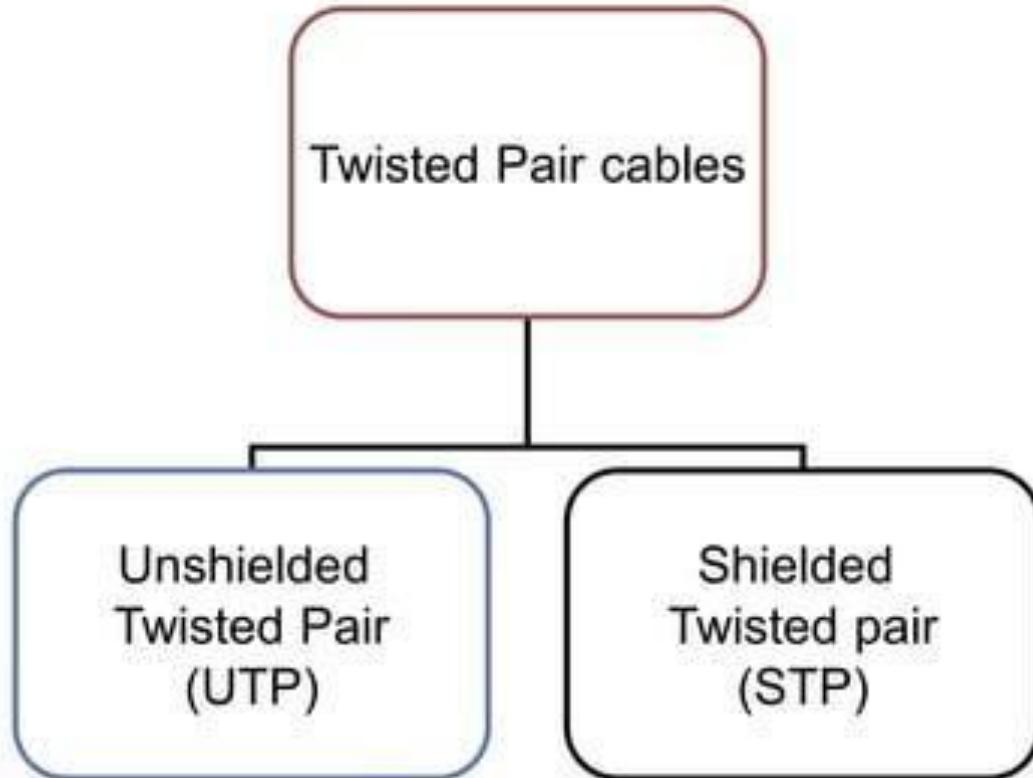


Twisted Pair - Applications

- Very common medium
- Can be used in telephone network
- Connection Within the buildings
- For local area networks (LAN)



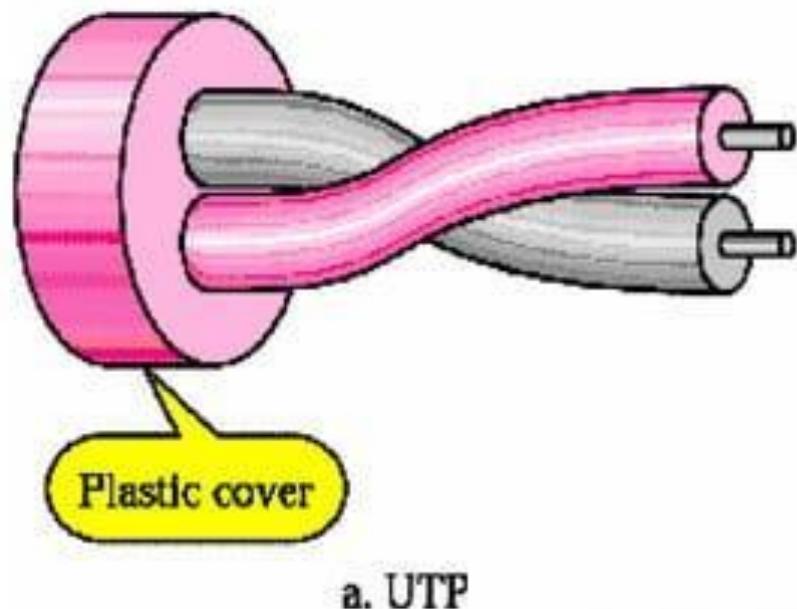
Twisted Pair Cables



Unshielded Twisted Pair (UTP):

Description

- Pair of unshielded wires wound around each other
- Easiest to install



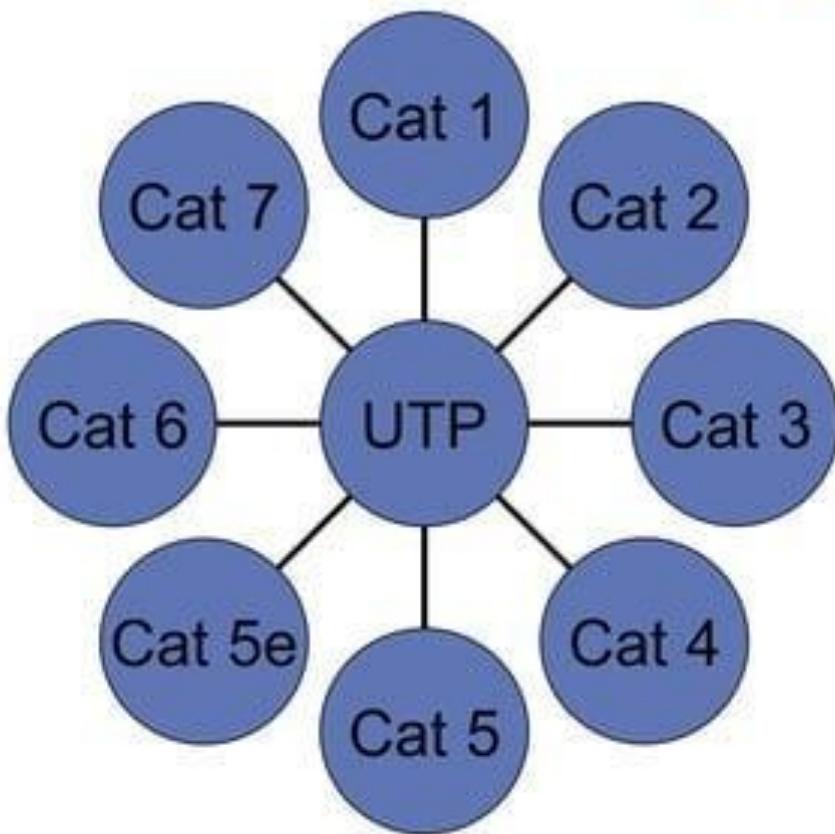
Applications

UTP :

- Telephone subscribers connect to the central telephone office
- DSL lines
- LAN – 10Mbps or 100Mbps



UTP Cable Types

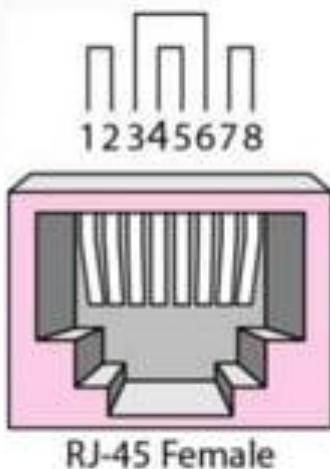


Cat means category according to IEEE standards. IEEE is de jure standard

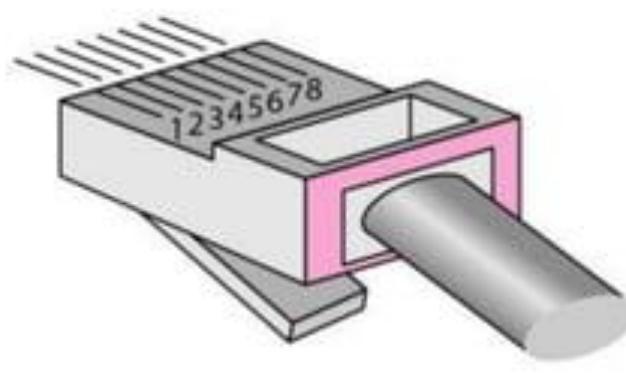
Categories of UTP cables

| Category | Specification | Data Rate (Mbps) | Use |
|----------|--|------------------|-----------|
| 1 | Unshielded twisted-pair used in telephone | < 0.1 | Telephone |
| 2 | Unshielded twisted-pair originally used in T-lines | 2 | T-1 lines |
| 3 | Improved CAT 2 used in LANs | 10 | LANs |
| 4 | Improved CAT 3 used in Token Ring networks | 20 | LANs |
| 5 | Cable wire is normally 24 AWG with a jacket and outside sheath | 100 | LANs |
| 5E | An extension to category 5 that includes extra features to minimize the crosstalk and electromagnetic interference | 125 | LANs |
| 6 | A new category with matched components coming from the same manufacturer. The cable must be tested at a 200-Mbps data rate. | 200 | LANs |
| 7 | Sometimes called SSTP (shielded screen twisted-pair). Each pair is individually wrapped in a helical metallic foil followed by a metallic foil shield in addition to the outside sheath. The shield decreases the effect of crosstalk and increases the data rate. | 600 | LANs |

UTP connector and Tools

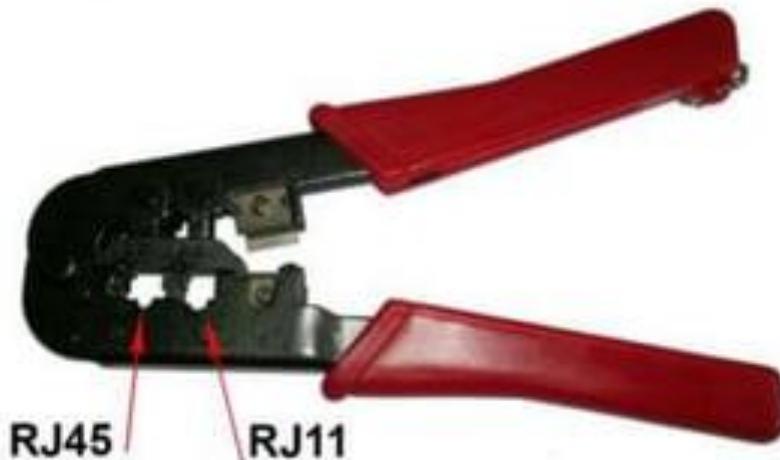


RJ-45 Female



RJ-45 Male

RJ45 (RJ stands for registered jack) is a keyed connector, it means that it can be inserted in only one way



Crimper Tool

Advantages of UTP:

- Affordable
- Most compatible cabling
- Major networking system

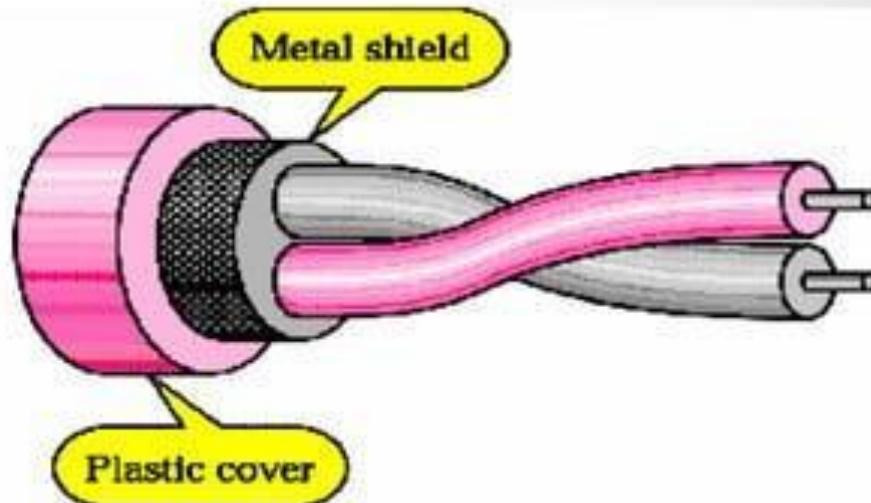


Disadvantages of UTP:

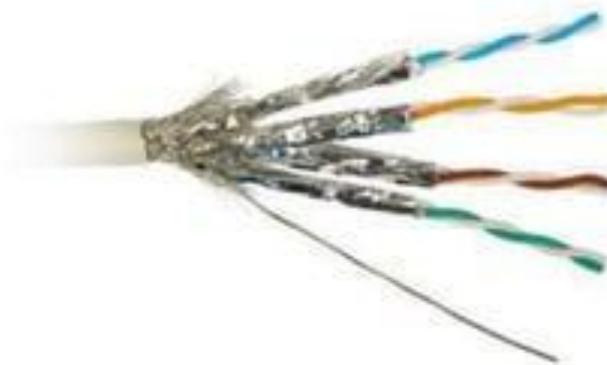
- Suffers from external Electromagnetic interference

Shielded Twisted Pair (STP)

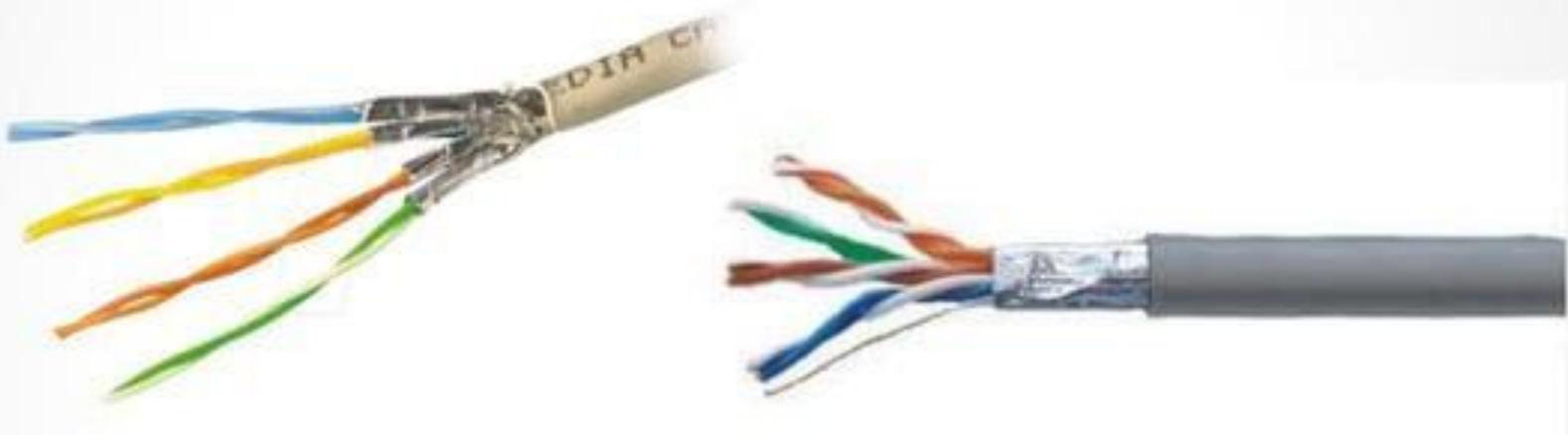
- Pair of wires wound around each other placed inside a protective foil wrap
- Metal braid or sheath foil that reduces interference
- Harder to handle (thick, heavy)



b. STP



STP Application



- STP is used in IBM token ring networks.
- Higher transmission rates over longer distances.

Advantages of STP:

- Shielded
- Faster than UTP

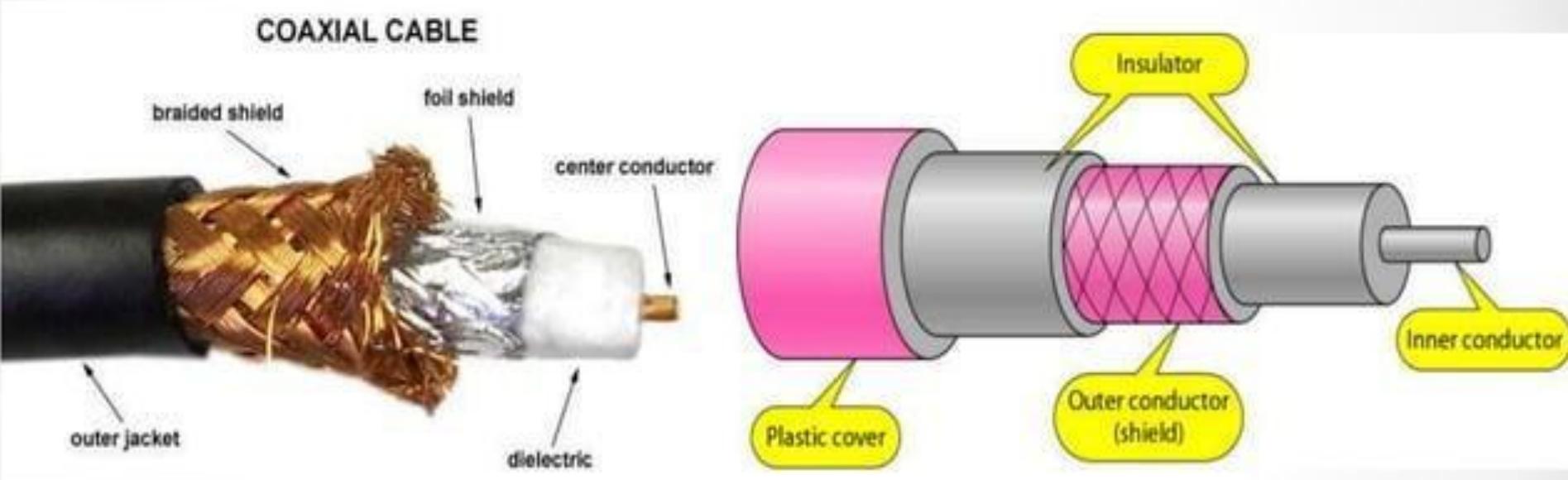


Disadvantages of STP:

- More expensive than UTP
- High attenuation rate

Co-axial Cable

Co-axial cable carries signal of higher frequency ranges than twisted pair cable



- Inner conductor is a solid wire
- Outer conductor serves as a shield against noise and a second conductor
-

Categories of coaxial cables

| <i>Category</i> | <i>Impedance</i> | <i>Use</i> |
|-----------------|------------------|----------------|
| RG-59 | 75 Ω | Cable TV |
| RG-58 | 50 Ω | Thin Ethernet |
| RG-11 | 50 Ω | Thick Ethernet |

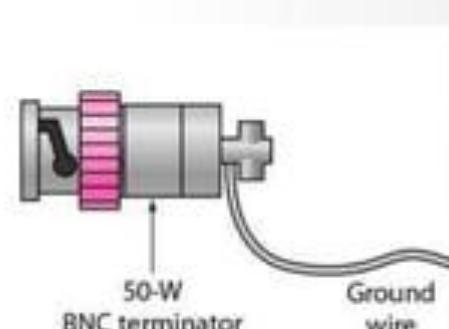
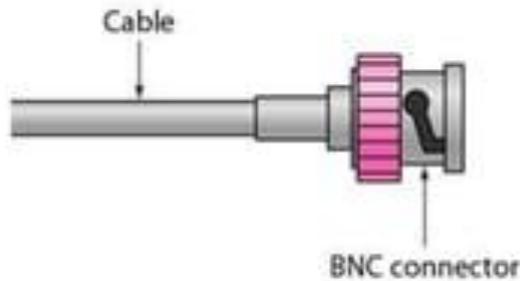
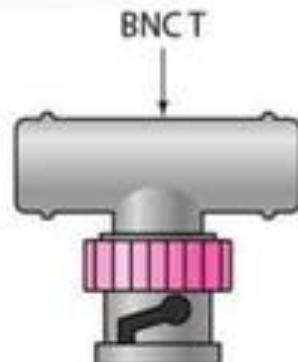
Coaxial cables are categorized by Radio Government (RG) ratings,
RG is De Jure standards

Coaxial Cable Connectors

BNC Connectors – Bayone Neil Concelman

To connect coaxial cable to devices we need coaxial connectors

- BNC Connector is used at the end of the cable to a device
Example: TV set connection
- BNC T connector used to Ethernet networks to branch out connection to computer or other devices
- BNC terminator is used at the end of the cable to prevent the reflection of the signal



Coaxial Cable Applications

- Most versatile medium
- Television distribution
- Long distance telephone transmission
- Can carry 10,000 voice calls simultaneously
- Short distance computer systems links
- Local area networks
-



COAXIAL CABLE

ADVANTAGES

- Easy to wire
- Easy to expand
- Moderate level of Electro Magnetic Interference



DISADVANTAGE

- Single cable failure can take down an entire network
- Cost of installation of a coaxial cable is high due to its thickness and stiffness
- Cost of maintenance is also high

Fiber-Optic Cable

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

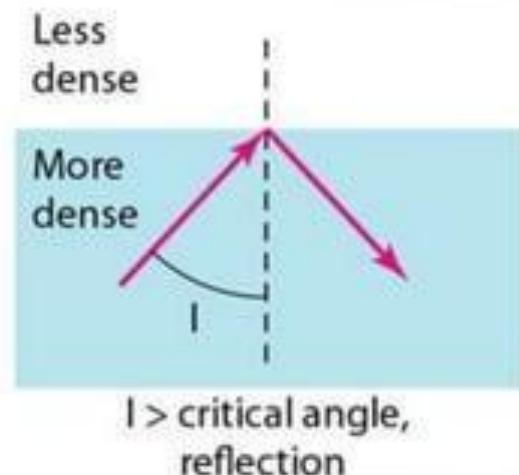
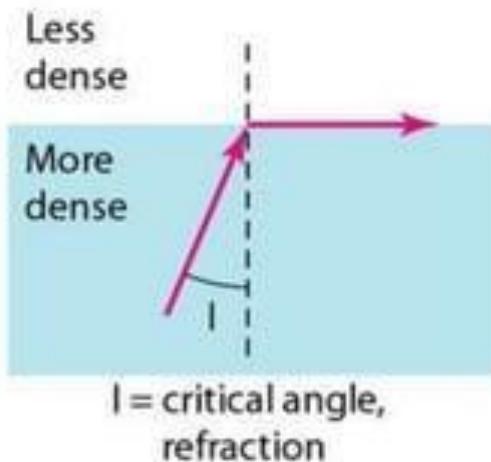
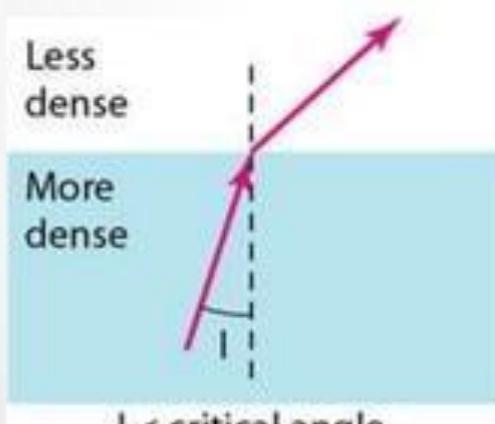
Nature of light:

- Light travels in a straight line
- If light goes from one substance to another then the ray of light changes direction
- Ray of light changes direction when goes from more dense to a less dense substance



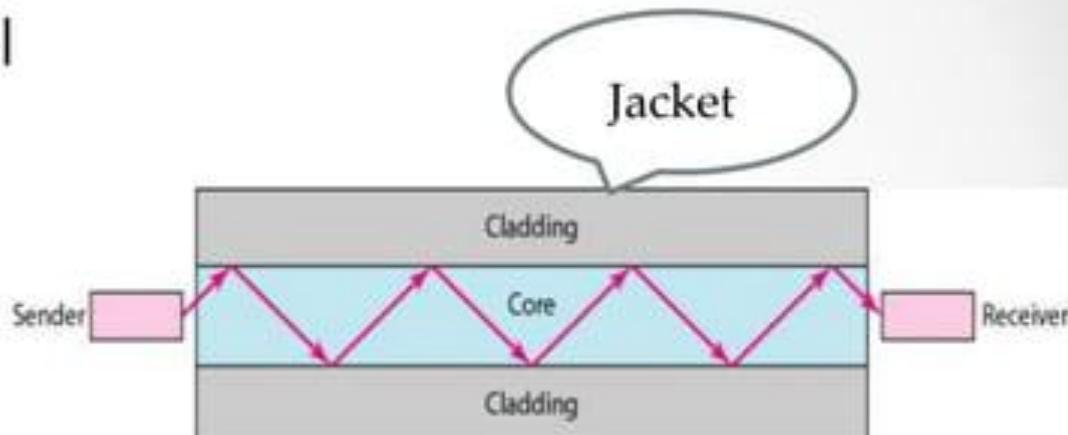
Bending of light ray

- Angle of Incidence (I): the angle the ray makes with the line perpendicular to the interface between the two substances
- Critical Angle: the angle of incidence which provides an angle of refraction of 90-degrees.



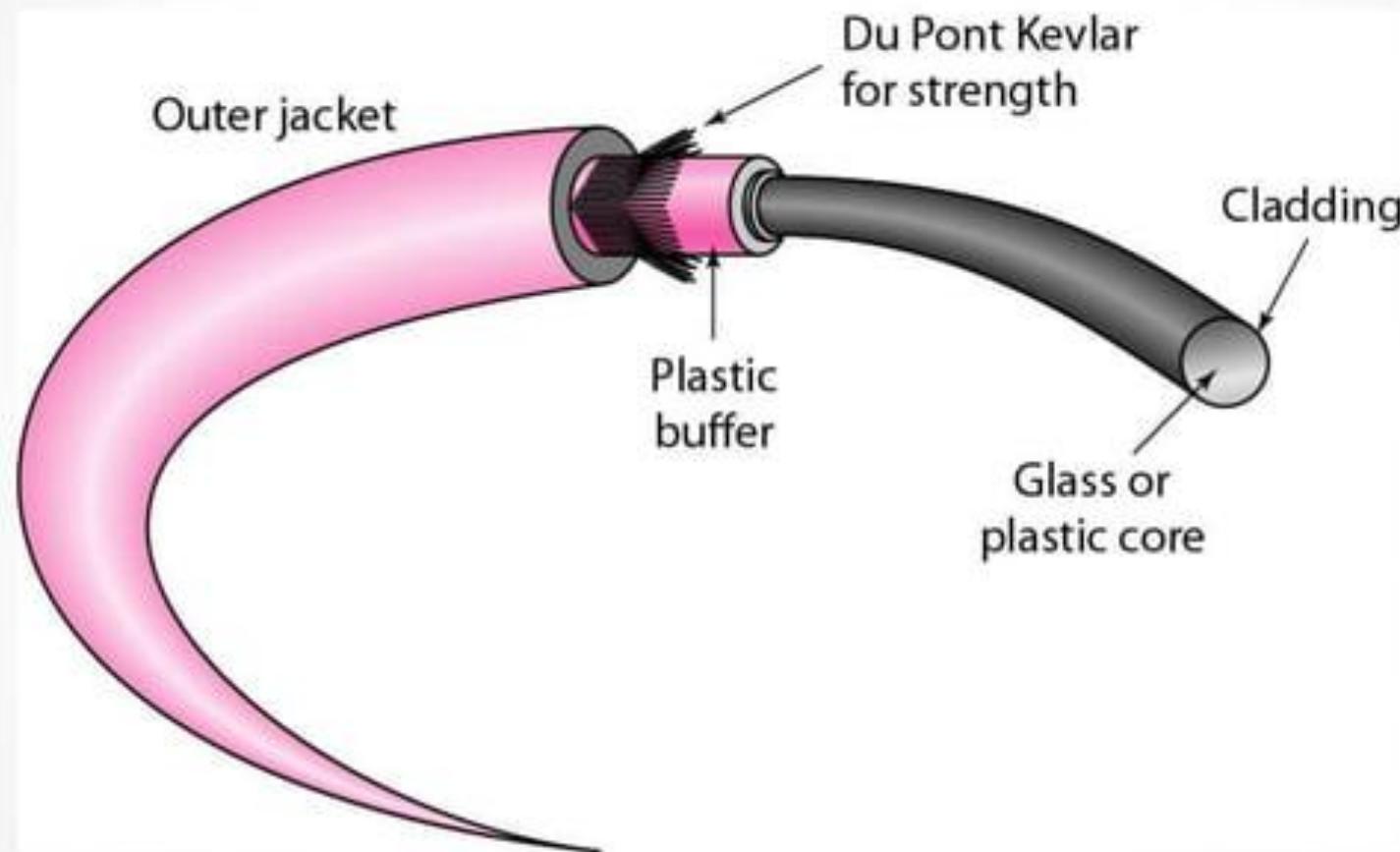
Optical fiber

- Uses reflection to guide light through a channel
- Core is of glass or plastic surrounded by Cladding
- Cladding is of less dense glass or plastic

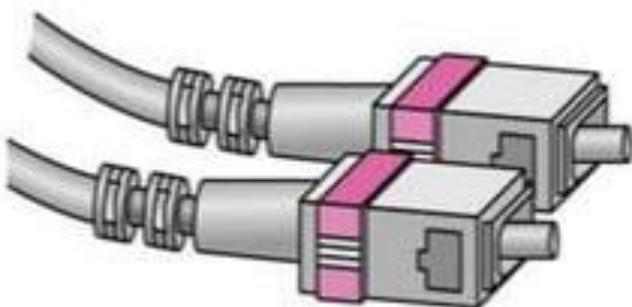


An optical fiber cable has a cylindrical shape and consists of three concentric sections: the core, the cladding, and the jacket(outer part of the cable).

Fiber Construction

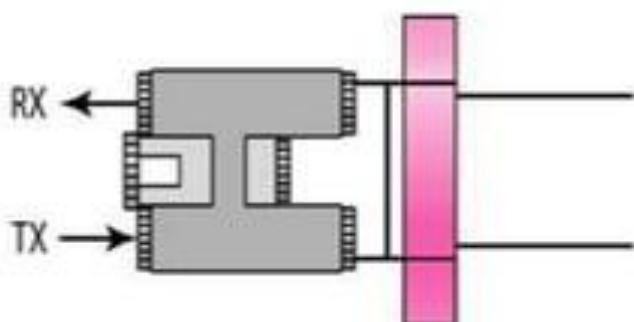


Fiber – Optic cable Connectors



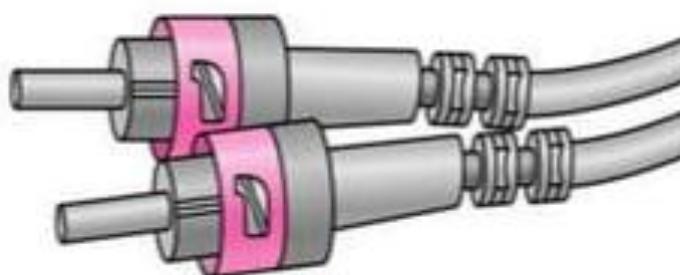
SC connector

Subscriber Channel (SC) Connector



MT-RJ connector

Same size as RJ45 connector



ST connector

Straight-Tip (ST) Connector

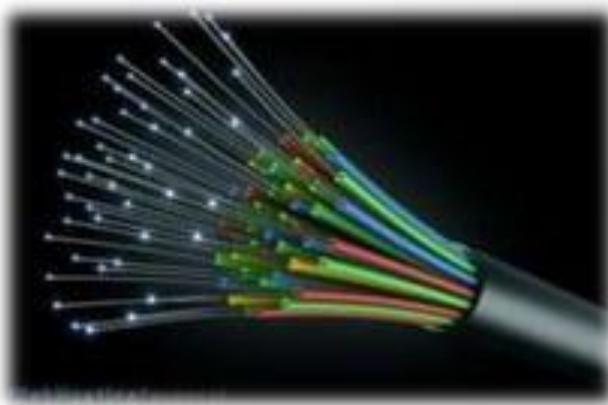
Areas of Application

- Telecommunications
- Local Area Networks
- Cable TV
- CCTV
- Medical Education



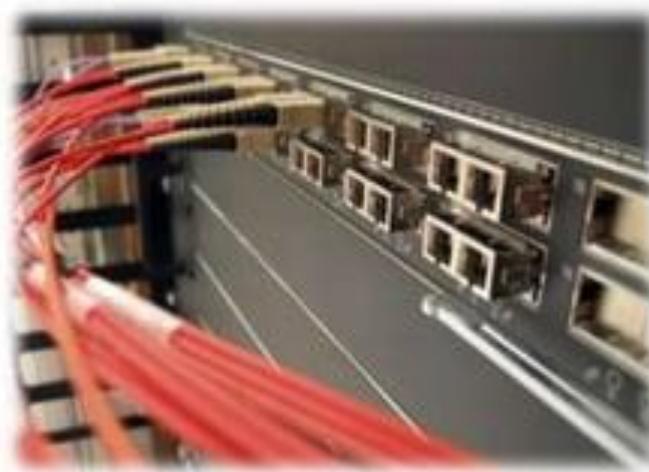
Optical Fiber Advantages

- Greater capacity
Example: Data rates at 100 Gbps
- Smaller size & light weight
- Lower attenuation
- Electromagnetic isolation
- More resistance to corrosive materials
- Greater repeater spacing facility
Example: After every 10s of km at least



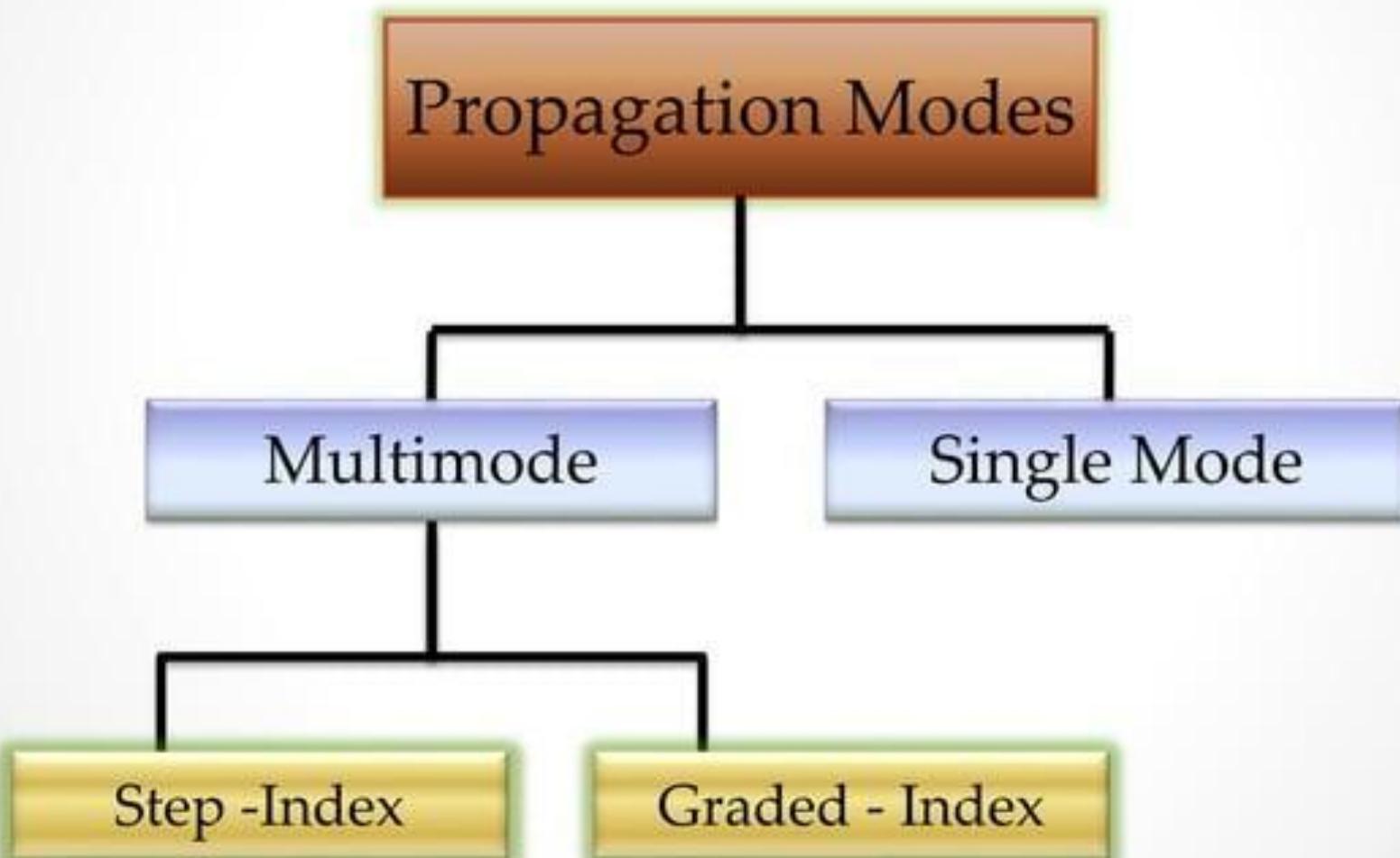
Optical Fiber Disadvantages

- Installation and maintenance need expertise
- Only Unidirectional light propagation
- Much more expensive

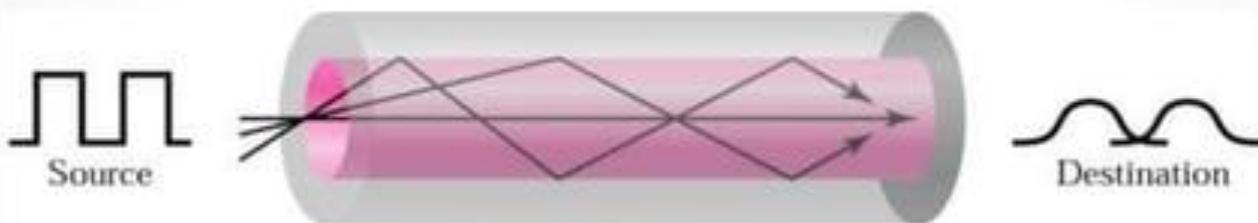


Propagation Modes

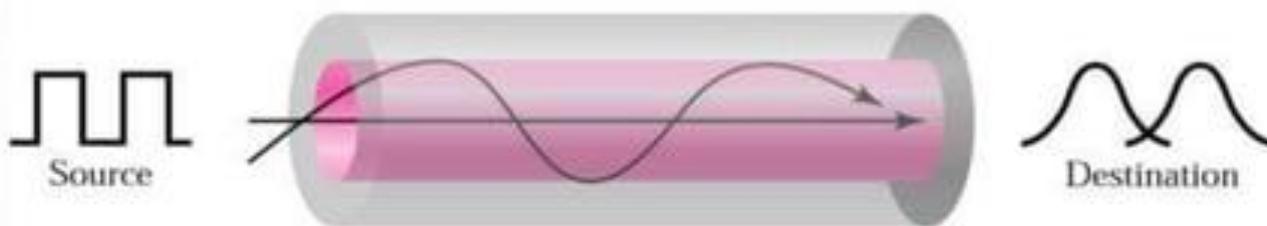
When signal goes from one point to another there are need for propagation modes.



Propagation Modes



a. Multimode, step-index



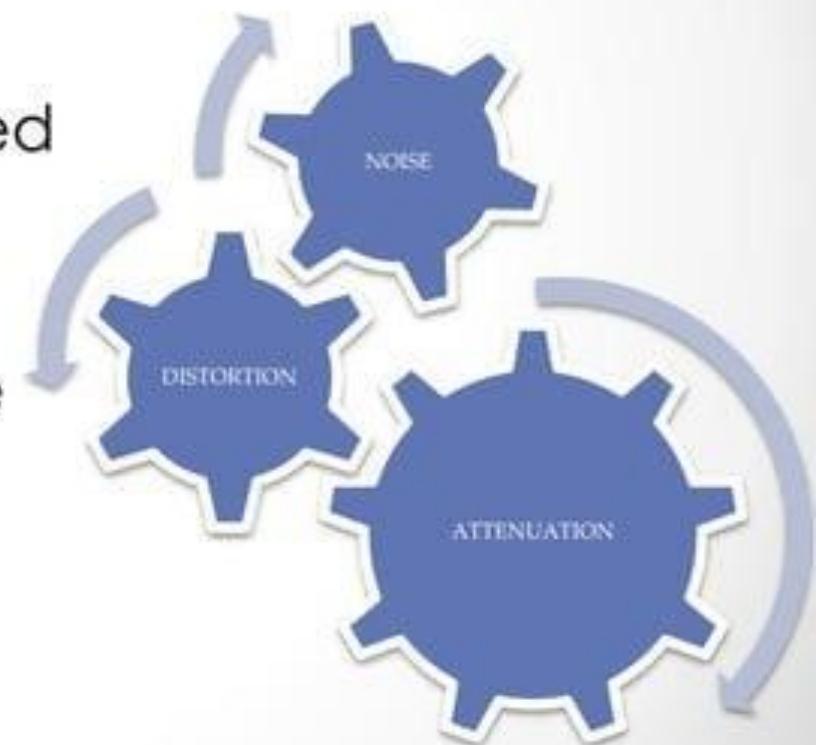
b. Multimode, graded-index



c. Single-mode

Transmission Impairment

- The Imperfection in transmission media causes signal impairment
- What is sent is not what is received due to impairment
- Three causes of impairment are
 - 1) Attenuation,
 - 2) Distortion
 - 3) Noise



Transmission Impairment

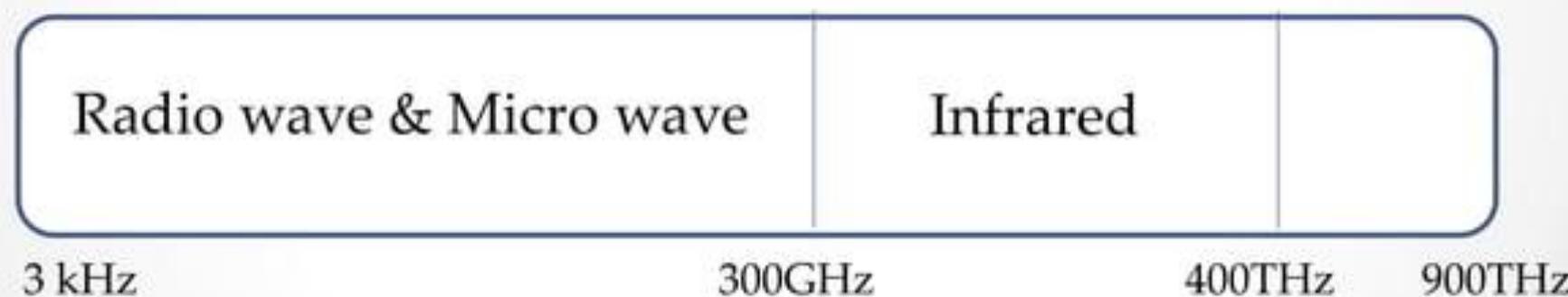
- Attenuation means a loss of energy.
- Distortion means that the signal changes its form or shape.
- Noise is another cause of impairment.
 - Several types of noise
Example: thermal noise, induced noise, crosstalk

Unguided Media: Wireless Transmission

Unguided media transport electromagnetic waves without using a physical conductor it is known as wireless communication.

Signals broadcast through free space and available to capable receiver

Electro magnetic spectrum for wireless communication:



Propagation methods

Unguided signals travels from the source to destination in several ways it is known as propagation.

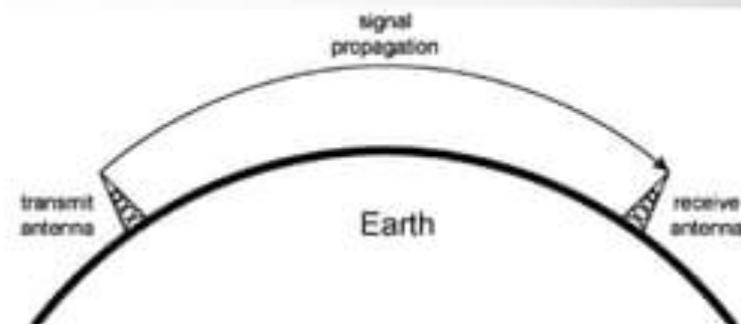
They are three types:

- Ground propagation
- Sky propagation
- Line-of-Sight Propagation



Ground propagation:

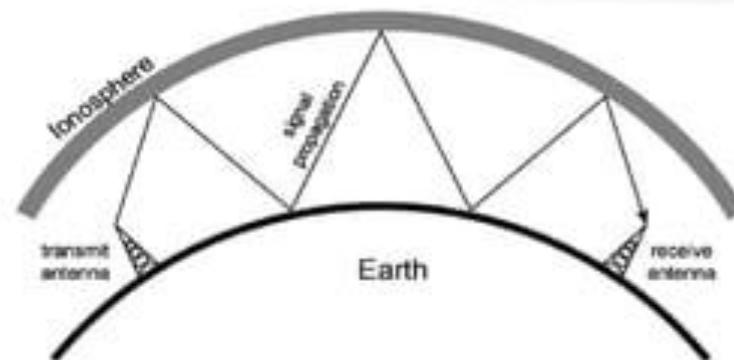
- Radio waves travel through the lowest portion of the atmosphere
- Touching the earth.



(a) Ground-wave propagation (below 2 MHz)

Sky propagation:

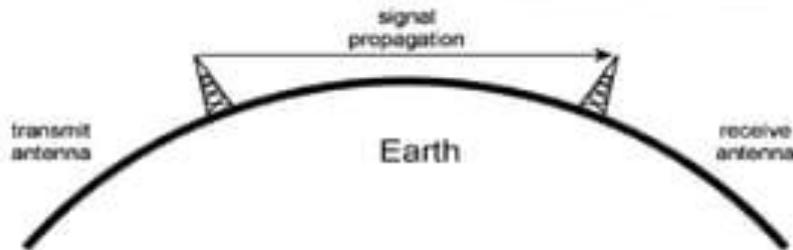
- Radio waves radiate to the ionosphere then they are reflected back to earth.



(b) Sky-wave propagation (2 to 30 MHz)

Line-of-Sight Propagation:

- In straight lines directly from antenna to antenna.



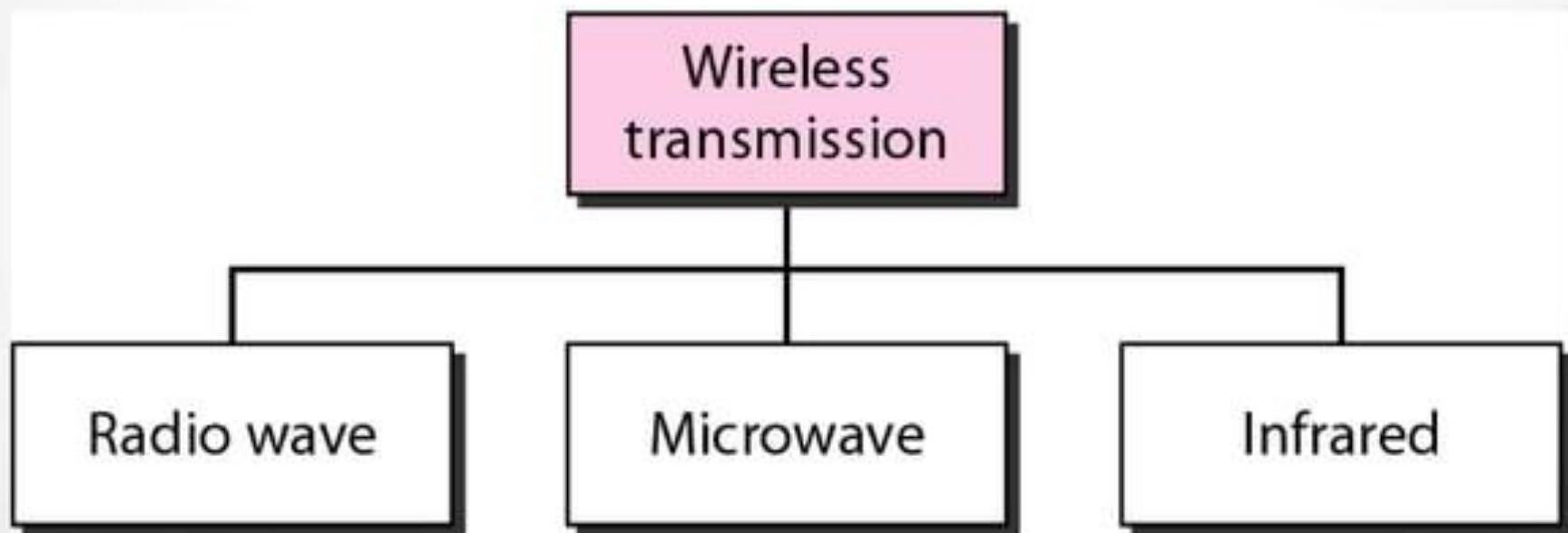
(c) Line-of-sight (LOS) propagation (above 30 MHz)

Bands using propagation method

| Band | Range | Propagation | Application |
|------|---------------|-----------------------|---|
| VLF | 3–30 KHz | Ground | Long-range radio navigation |
| LF | 30–300 KHz | Ground | Radio beacons and navigational locators |
| MF | 300 KHz–3 MHz | Sky | AM radio |
| HF | 3–30 MHz | Sky | Citizens band (CB), ship/aircraft communication |
| VHF | 30–300 MHz | Sky and line-of-sight | VHF TV, FM radio |
| UHF | 300 MHz–3 GHz | Line-of-sight | UHF TV, cellular phones, paging, satellite |
| SHF | 3–30 GHz | Line-of-sight | Satellite communication |
| EHF | 30–300 GHz | Line-of-sight | Long-range radio navigation |

Unguided Media

Wireless transmission waves



Unguided Media – Radio Waves



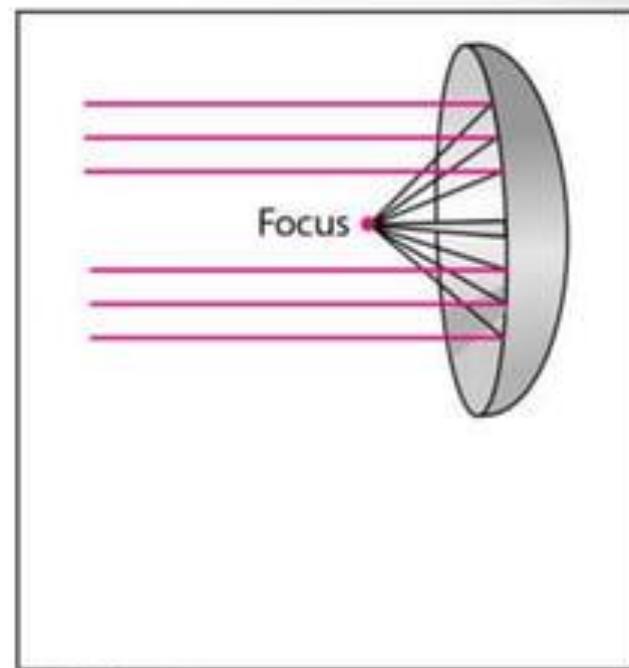
- Omnidirectional Antenna
- Frequencies between 3 KHz and 1 GHz.
- Used for multicasts(multiple way) communications, such as radio and television, and paging system.
- Radio waves can penetrate buildings easily, so that widely use for indoors & outdoors communication.

Antennas

An Antenna is a structure that is generally a metallic object may be a wire or group of wires, used to convert high frequency current into electromagnetic waves.

Antenna are two types:

- **Transmission antenna**
 - Transmit radio frequency from transmitter
 - Radio frequency then Convert to electromagnetic energy by antenna
 - Then, radiate into surrounding environment
- **Reception antenna**
 - Electromagnetic energy get in antenna
 - Then Antenna convert radio frequency to electrical energy
 - Then, Goes to receiver



Dish antenna

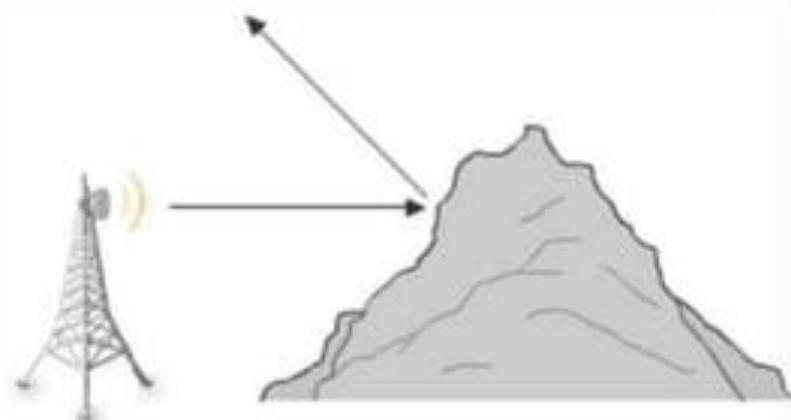
same antenna can be used for both purposes

Microwaves

Microwaves are ideal when large areas need to be covered and there are no obstacles in the path



Line of Sight Propagation



Ground Reflected Path

Micro waves Transmission



- Microwaves are unidirectional
- Micro waves electromagnetic waves having frequency between 1 GHZ and 300 GHZ.
- There are two types of micro waves data communication system : terrestrial and satellite
- Micro waves are widely used for one to one communication between sender and receiver,
example: cellular phone, satellite networks and in wireless LANs(wifi), WiMAX, GPS



Infrared

- Frequencies between 300 GHz to 400 THz.
- Used for short-range communication
- Example: Night Vision Camera, Remote control, File sharing between two phones, Communication between a PC and peripheral device,



References

- Data communication and Networking,
fourth edition

By : BEHROUZ A FOROUZAN
- And various relevant websites

Any Question ?



Thank You