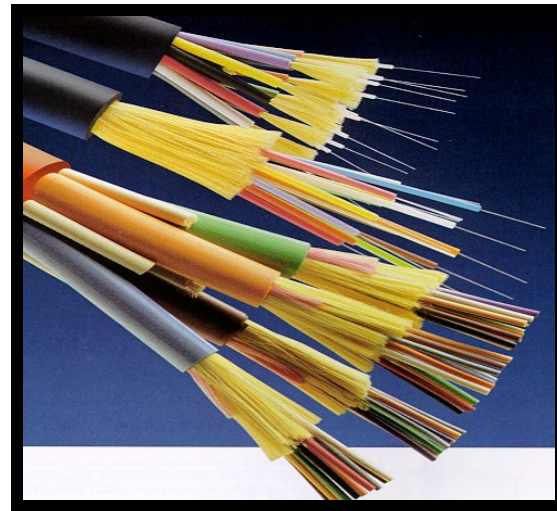
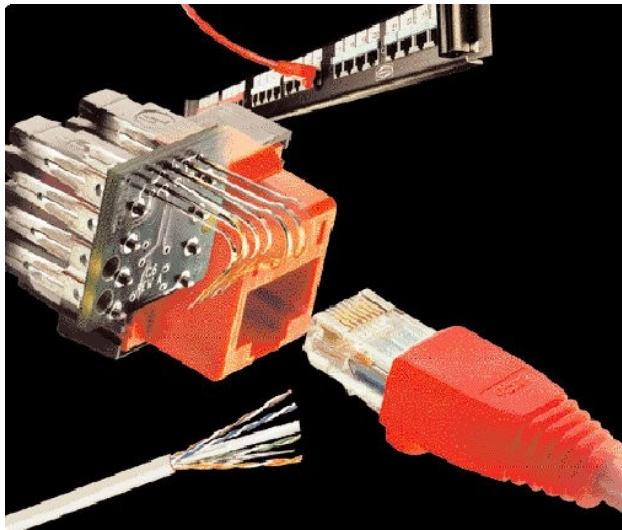
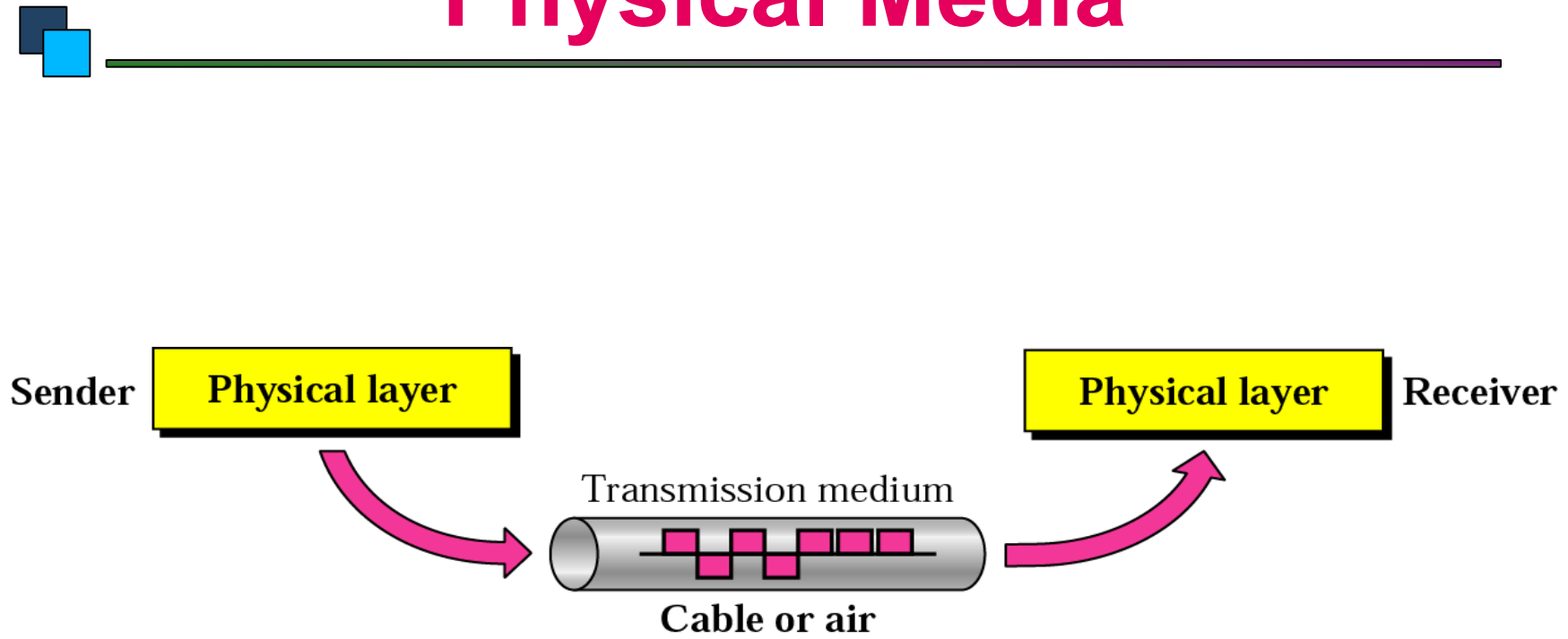


PHYSICAL MEDIA



Physical Media



Physical Media

Copper

-  Coaxial Cable - Thick or Thin
-  Unshielded Twisted Pair - CAT 3,4,5,5e&6

Optical Fiber

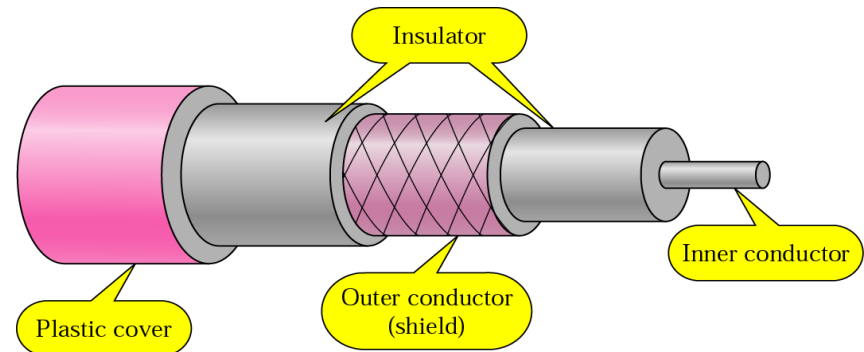
-  Multimode
-  Singlemode

Wireless

-  Short Range
-  Medium Range (Line of Sight)
-  Satellite

Copper Media: Coaxial Cable

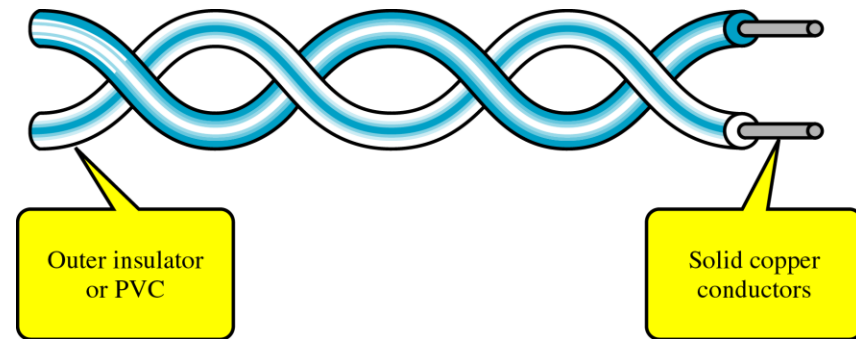
- Coaxial cable is a copper-cored cable surrounded by a heavy shielding and is used to connect computers in a network.
- Outer conductor shields the inner conductor from picking up stray signal from the air.
- High bandwidth but lossy channel.
- Repeater is used to regenerate the weakened signals.



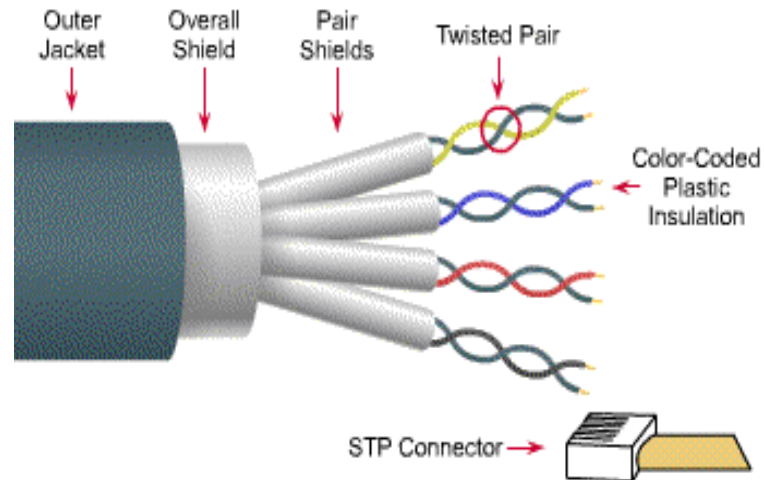
Category	Impedance	Use
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet

Copper Media: Twisted Pair

- Twisted-pair is a type of cabling that is used for telephone communications and most modern Ethernet networks.
- A pair of wires forms a circuit that can transmit data. The pairs are twisted to provide protection against crosstalk, the noise generated by adjacent pairs.
- There are two basic types, shielded twisted-pair (STP) and unshielded twisted-pair (UTP).

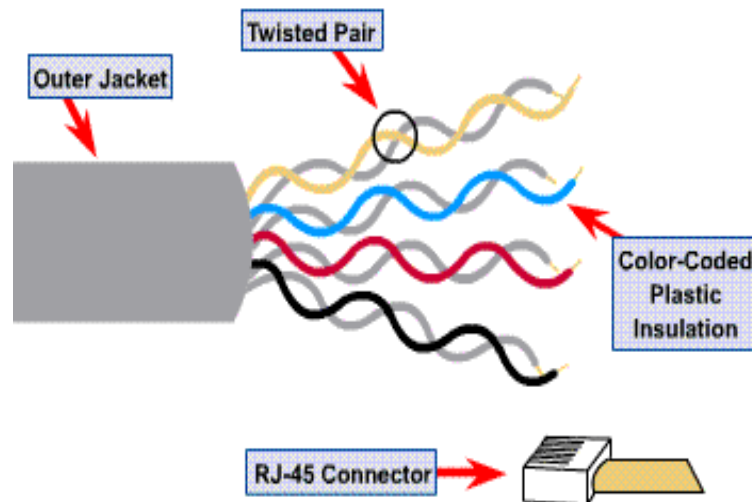


Shielded Twisted Pair (STP)



- Speed and throughput: 10-100 Mbps
- Cost per node: Moderately expensive
- Media and connector size: Medium to Large
- Maximum cable length: 100m (short)

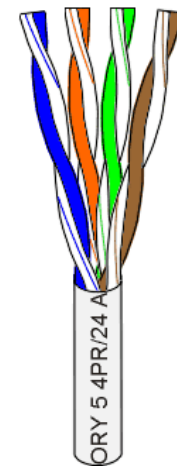
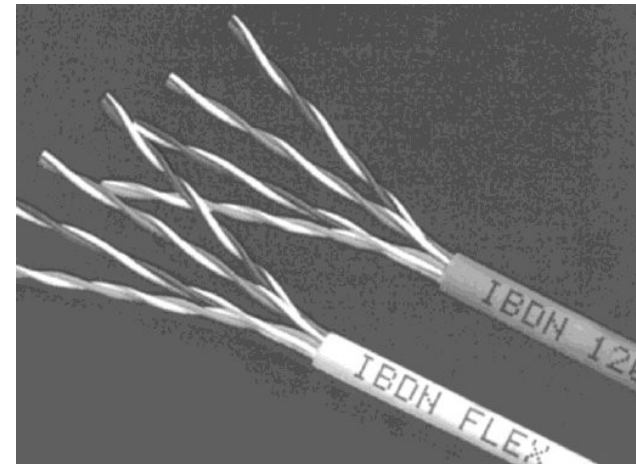
Unshielded Twisted Pair (UTP)



- Speed and throughput: 10-100 Mbps
- Cost per node: Least Expensive
- Media and connector size: Small
- Maximum cable length: 100m (short)

Unshielded Twisted Pair (UTP)

- Consists of 4 pairs (8 wires) of insulated copper wires typically about 1 mm thick.
- The wires are twisted together in a helical form.
- Twisting reduces the interference between pairs of wires.
- High bandwidth and High attenuation channel.
- Flexible and cheap cable.
- Category rating based on number of twists per inch and the material used
- CAT 3, CAT 4, CAT 5, Enhanced CAT 5 and now CAT 6.



Categories of UTP

- UTP comes in several categories that are based on the number of twists in the wires, the diameter of the wires and the material used in the wires.
- Category 3 is the wiring used primarily for telephone connections.
- Category 5e and Category 6 are currently the most common Ethernet cables used.

Categories of UTP: CAT 3

- ❑ **Bandwidth 16 Mhz**
- ❑ **11.5 dB Attenuation**
- ❑ **100 ohms Impedance**
- ❑ **Used in voice applications and 10baseT (10Mbps) Ethernet**

Categories of UTP: CAT 4

- ❑ 20 MHz Bandwidth
- ❑ 7.5 dB Attenuation
- ❑ 100 ohms Impedance
- ❑ Used in 10baseT (10Mbps) Ethernet

Categories of UTP: CAT 5

- ❑ **100 MHz Bandwidth**
- ❑ **24.0 dB Attenuation**
- ❑ **100 ohms Impedance**
- ❑ **Used for high-speed data transmission**
- ❑ **Used in 10BaseT (10 Mbps) Ethernet & Fast Ethernet (100 Mbps)**

Categories of UTP: CAT 5e

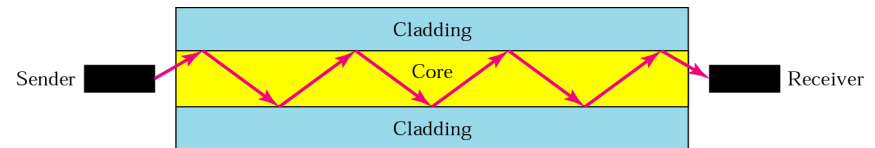
- ❑ 150 MHz Bandwidth
- ❑ 24.0 dB Attenuation
- ❑ 100 ohms Impedance
- ❑ Transmits high-speed data
- ❑ Used in Fast Ethernet (100 Mbps), Gigabit Ethernet (1000 Mbps) & 155 Mbps ATM

Categories of UTP: CAT 6

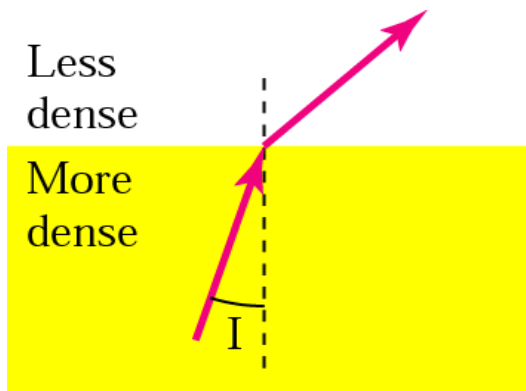
- 250 MHz Bandwidth
- 19.8 dB Attenuation
- 100 ohms Impedance
- Transmits high-speed data
- Used in Gigabit Ethernet (1000 Mbps) & 10 Gig Ethernet (10000 Mbps)

Fiber Media

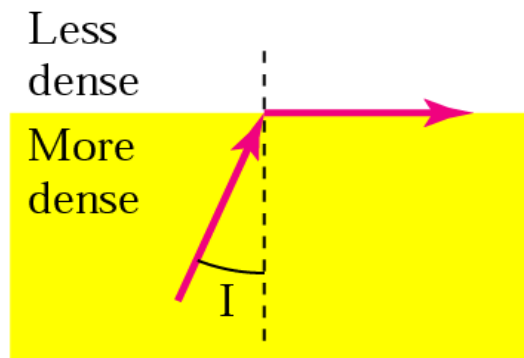
- ❑ Optical fibers use light to send information through the optical medium.
- ❑ It uses the principal of total internal reflection.
- ❑ Modulated light transmissions are used to transmit the signal.



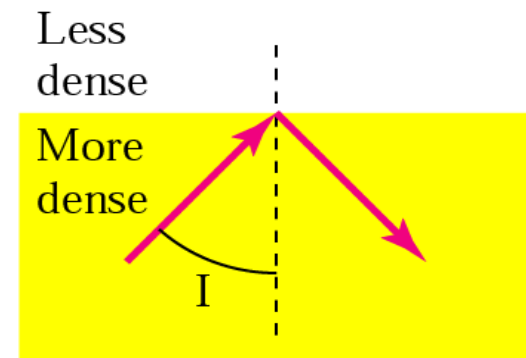
Total Internal Reflection



$I < \text{critical angle,}$
refraction



$I = \text{critical angle,}$
refraction



$I > \text{critical angle,}$
reflection

Fiber Media

- ❑ Light travels through the optical media by the way of total internal reflection.
- ❑ Modulation scheme used is intensity modulation.
- ❑ Two types of Fiber media :
 - ❑ Multimode
 - ❑ Singlemode
- ❑ Multimode Fiber can support less bandwidth than Singlemode Fiber.
- ❑ Singlemode Fiber has a very small core and carry only one beam of light. It can support Gbps data rates over > 100 Km without using repeaters.

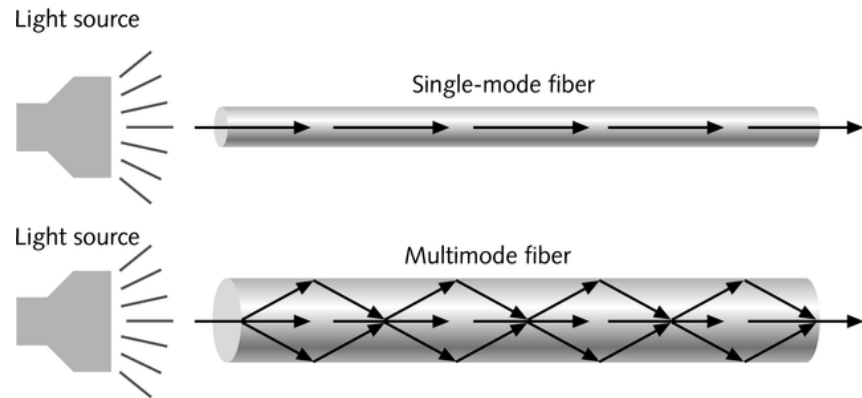
Single and Multimode Fiber

Single-mode fiber

- Carries light pulses along single path
- Uses Laser Light Source

Multimode fiber

- Many pulses of light generated by LED travel at different angles

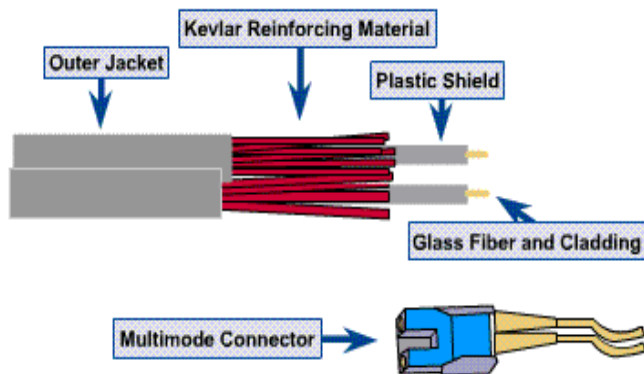
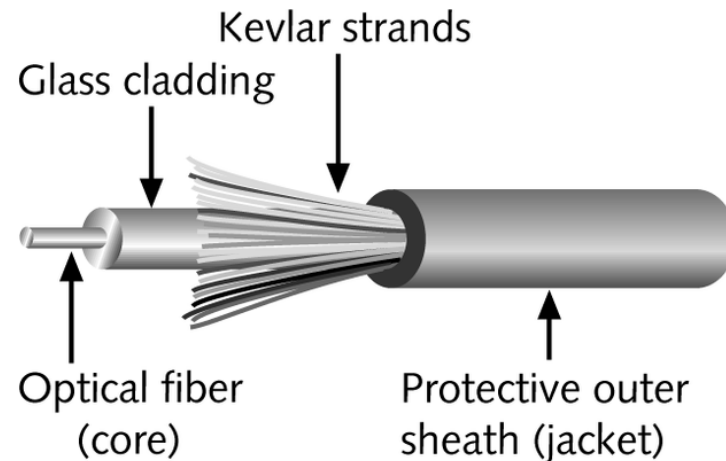


Fiber Media

- ❑ The bandwidth of the fiber is limited due to the dispersion effect.
- ❑ Distance Bandwidth product of a fiber is almost a constant.
- ❑ Fiber optic cables consist of multiple fibers packed inside protective covering.
- ❑ 62.5/125 μm (850/1310 nm) multimode fiber
- ❑ 50/125 μm (850/1310 nm) multimode fiber
- ❑ 10 μm (1310 nm) single-mode fiber

Fiber-Optic Cable

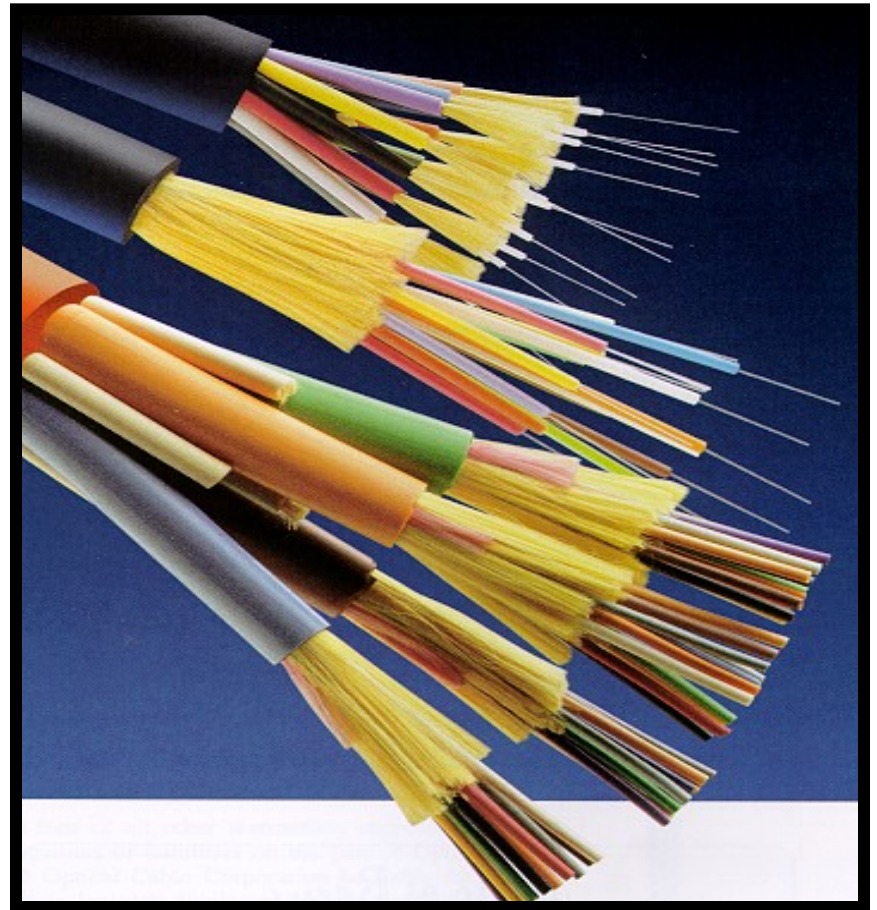
- Contains one or several glass fibers at its core
- Surrounding the fibers is a layer called cladding



- Speed and throughput: 100+ Mbps
- Cost per node: Most Expensive
- Media and connector size: Small
- Single mode, maximum cable length: Up to 3000m
- Multimode mode, maximum cable length: Up to 2000m
- Single mode: One stream of laser-generated light
- Multimode: Multiple streams of LED-generated light

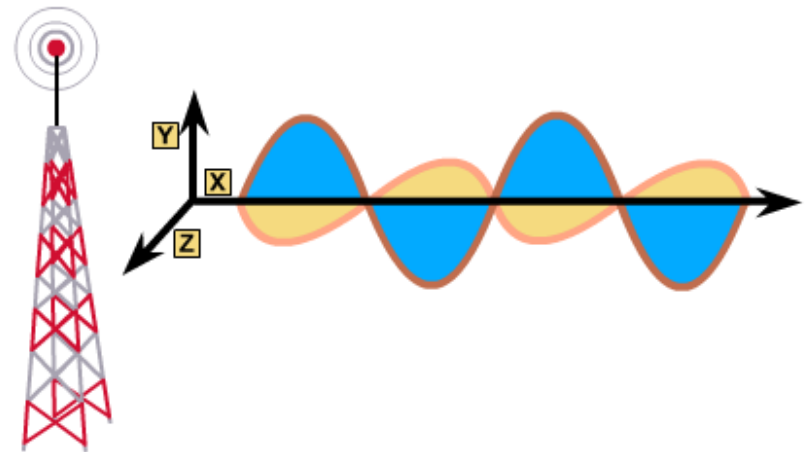
Fiber Optic Cable

- FO Cable may have 1 to over 1000 fibers



Wireless Media

- Very useful in difficult terrain where cable laying is not possible.
- Provides mobility to communication nodes.
- Right of way and cable laying costs can be reduced.
- Susceptible to rain, atmospheric variations and Objects in transmission path.



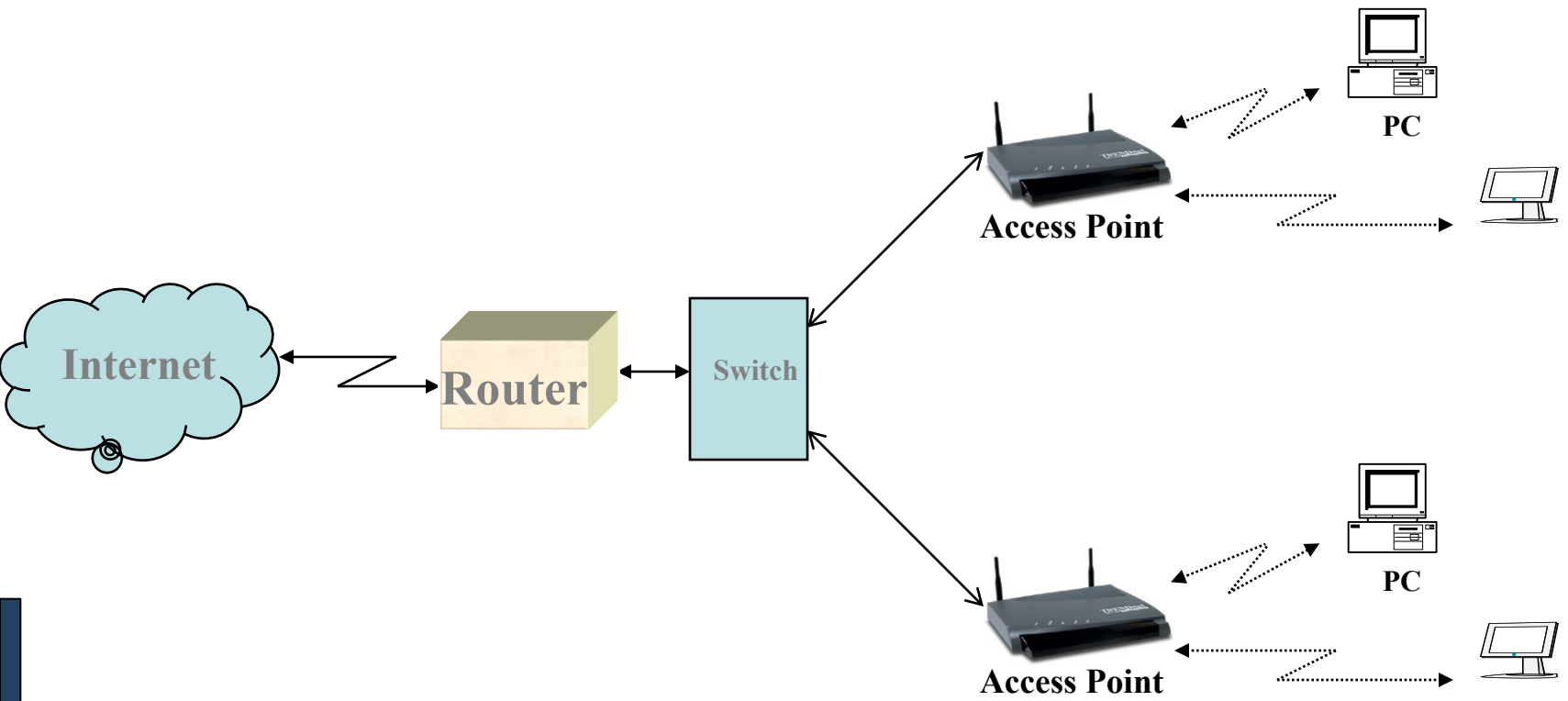
Wireless Media

- ❑ **Indoor : 10 – 50m : BlueTooth, WLAN**
- ❑ **Short range Outdoor : 50 – 200m: WLAN**
- ❑ **Mid Range Outdoor : 200m – 5 Km : GSM, CDMA, WLAN Point-to-Point, Wi-Max**
- ❑ **Long Range Outdoor : 5 Km – 100 Km : Microwave Point-to-Point**
- ❑ **Long Distance Communication : Across Continents : Satellite Communication**

Frequency Bands

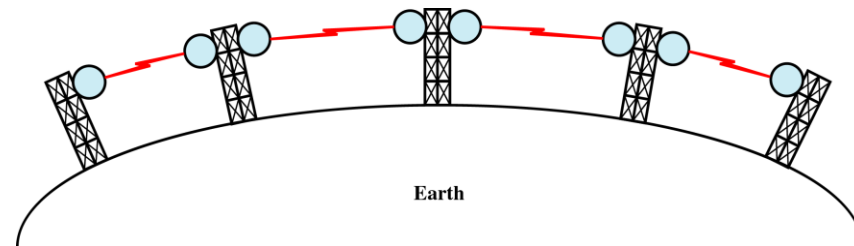
Band	Range	Propagation	Application
VLF	3–30 KHz	Ground	Long-range radio navigation
LF	30–300 KHz	Ground	Radio beacons and navigational locators
MF	300 KHz–3 MHz	Sky	AM radio
HF	3–30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
UHF	300 MHz–3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

Wireless LAN



Terrestrial Microwave

- ❑ Microwaves do not follow the curvature of earth
- ❑ Line-of-Sight transmission
- ❑ Height allows the signal to travel farther
- ❑ Two frequencies for two way communication
- ❑ Repeater is used to increase the distance Hop-by-Hop



Satellite Communication

