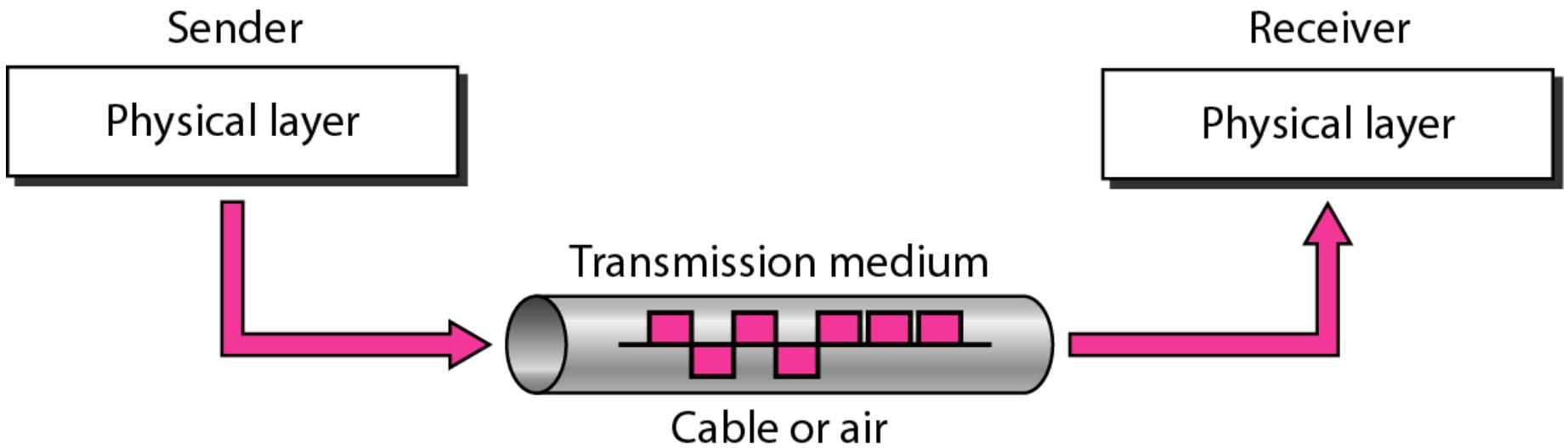
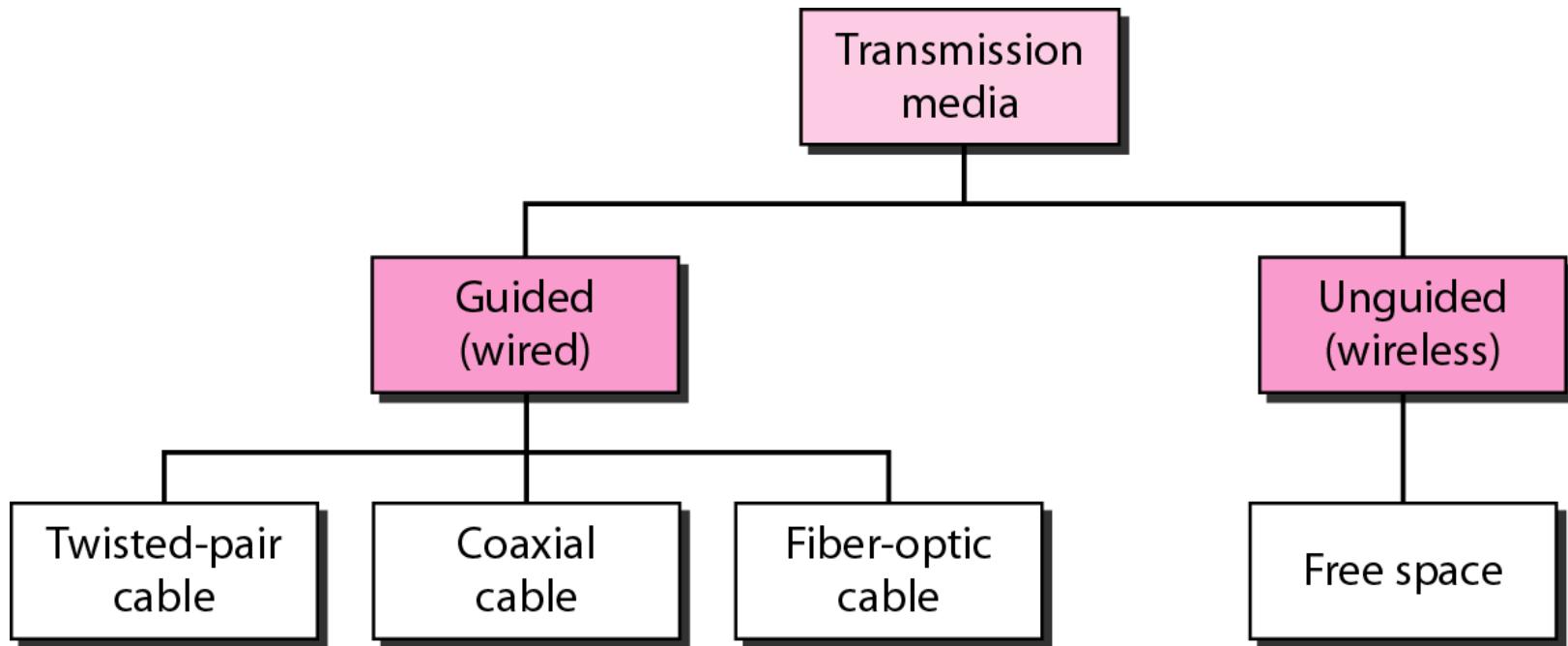


# Transmission Media

# Physical Layer



# Classes of Transmission Media



# **Guided Media**

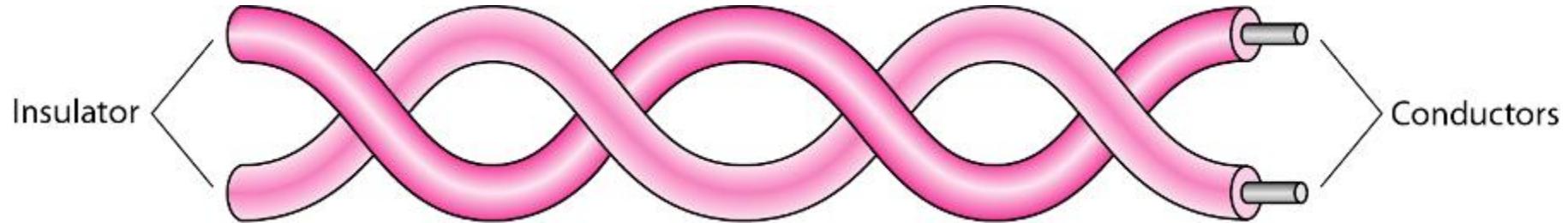
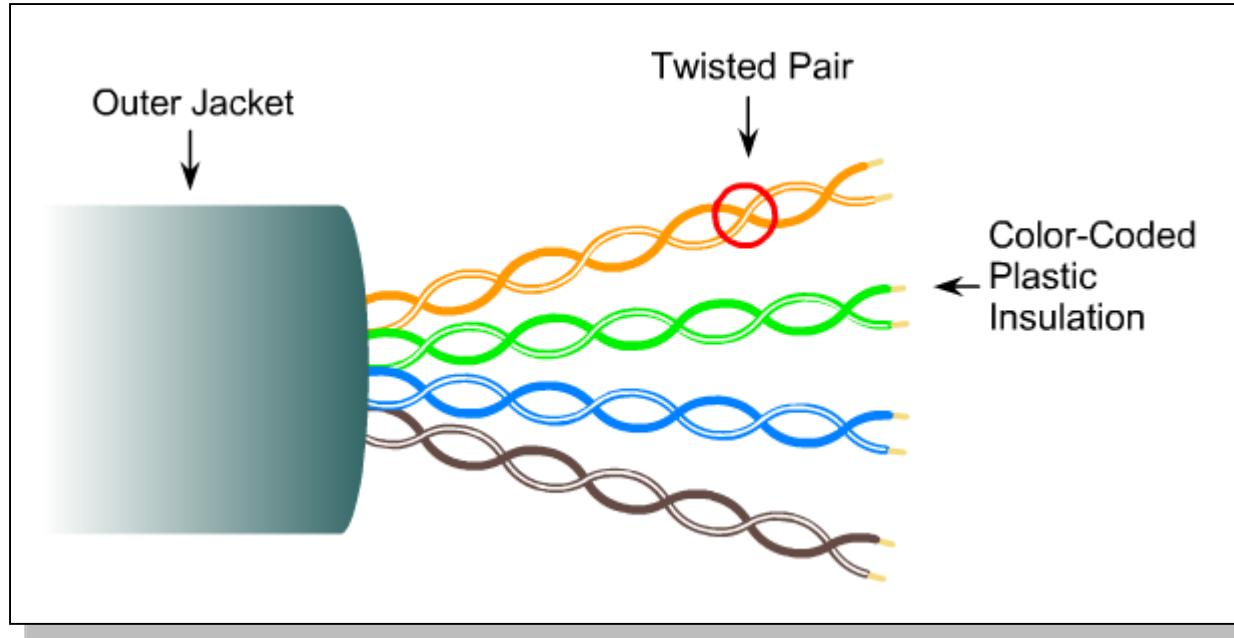
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- Provide a conduit from one device to another
- Include
  - twisted-pair cables
  - coaxial cables
  - fiber-optic cables

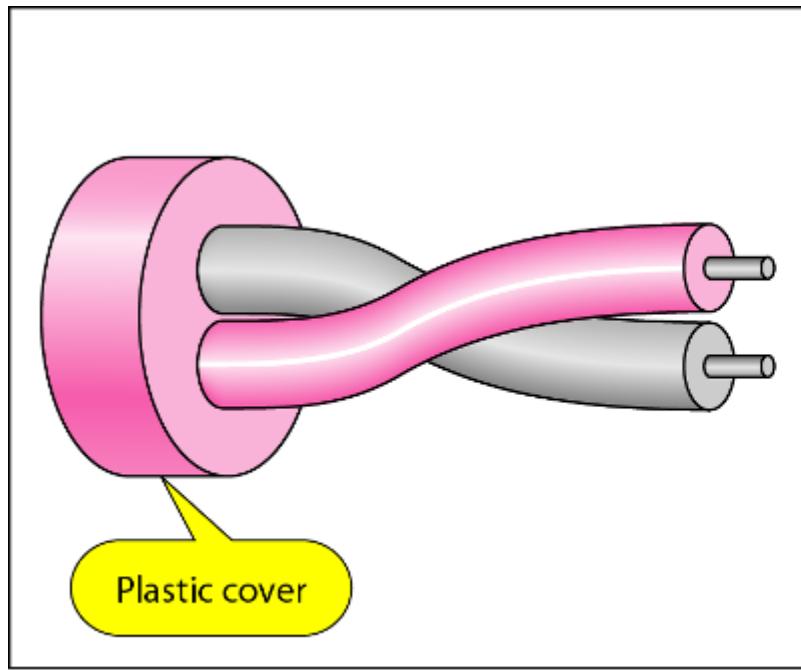
# **Guided Media:**

## ***Copper Media***

# Twisted-Pair Cable

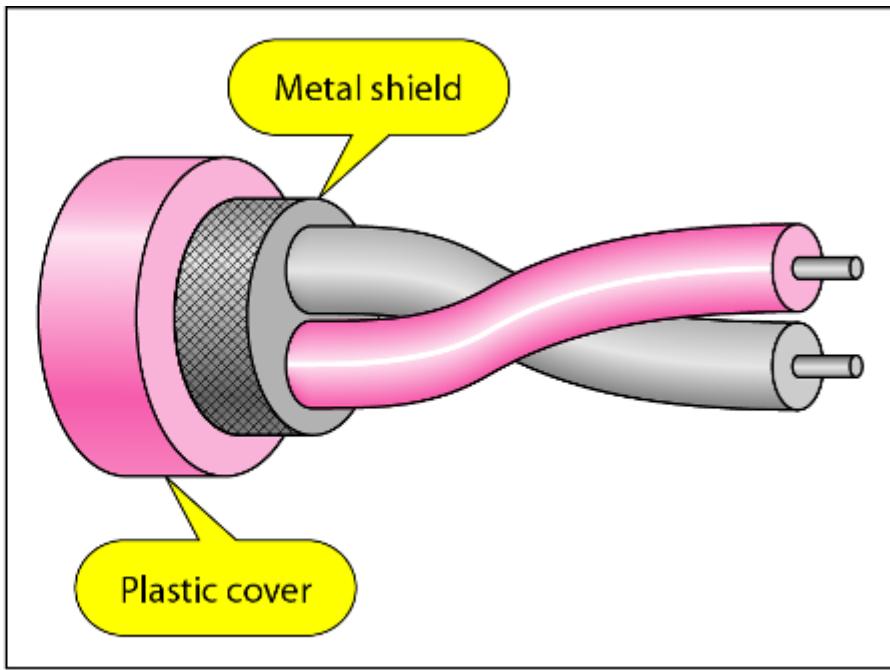


# UTP and STP Cables



a. UTP

*UTP – Unshielded Twisted Pair*



b. STP

*STP – Shielded Twisted Pair*

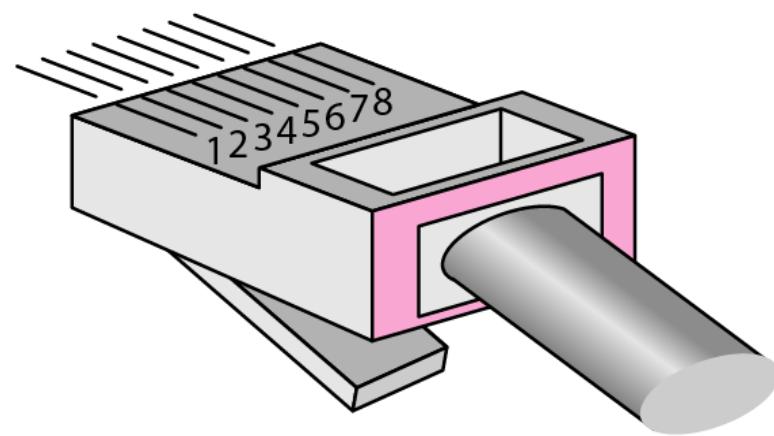
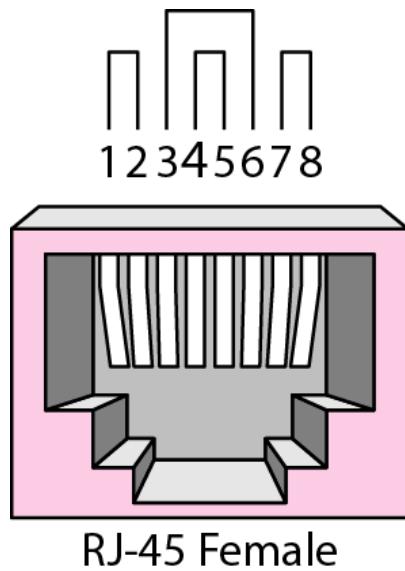
# Categories of UTP/STP Cables

<i>Category</i>	<i>Specification</i>	<i>Data Rate (Mbps)</i>	<i>Use</i>
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

# Categories of UTP/STP Cables

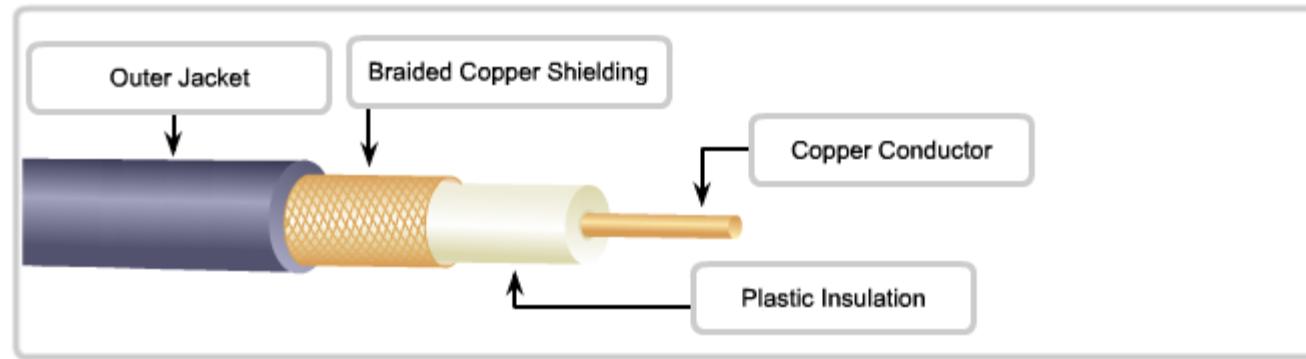
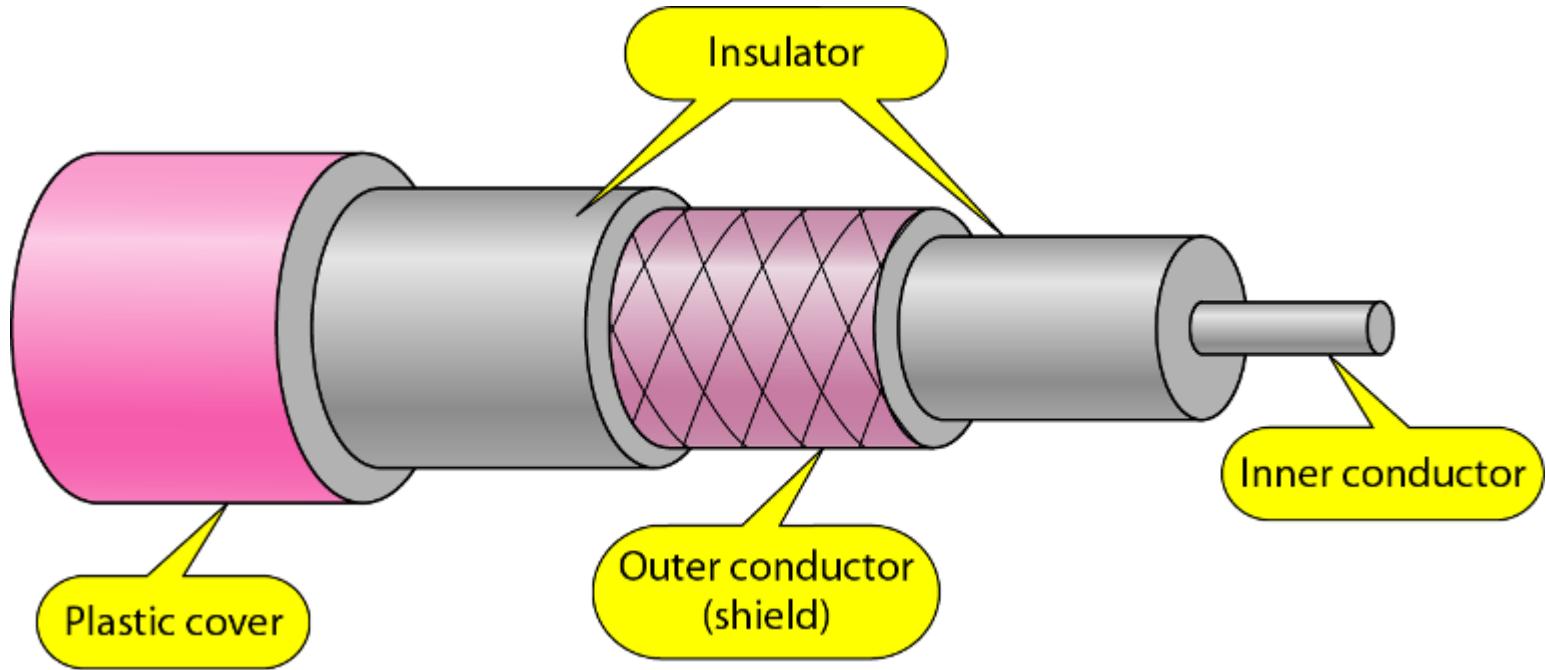
Category	Bandwidth	Digital/Analog	Use
1	very low	Analog	Telephone
2	< 2 MHz	Analog/digital	4Mbps token ring
3	16 MHz	Digital	10-100 Mbps Ethernet
4	20 MHz	Digital	16 Mbps token ring
5	100 MHz	Digital	100 – 1000 Mbps Ethernet
5E	100 MHz	Digital	100 – 1000 Mbps Ethernet
6	250 MHz	Digital	1 – 10 Gbps Ethernet
6A	500 MHz	Digital	1 – 10 Gbps Ethernet
7	600 MHz	Digital	10 Gbps Ethernet
7A	1000 MHz	Digital	40-100 Gbps Ethernet

# UTP Connectors



*RJ – Registered Jack*

# Coaxial Cable



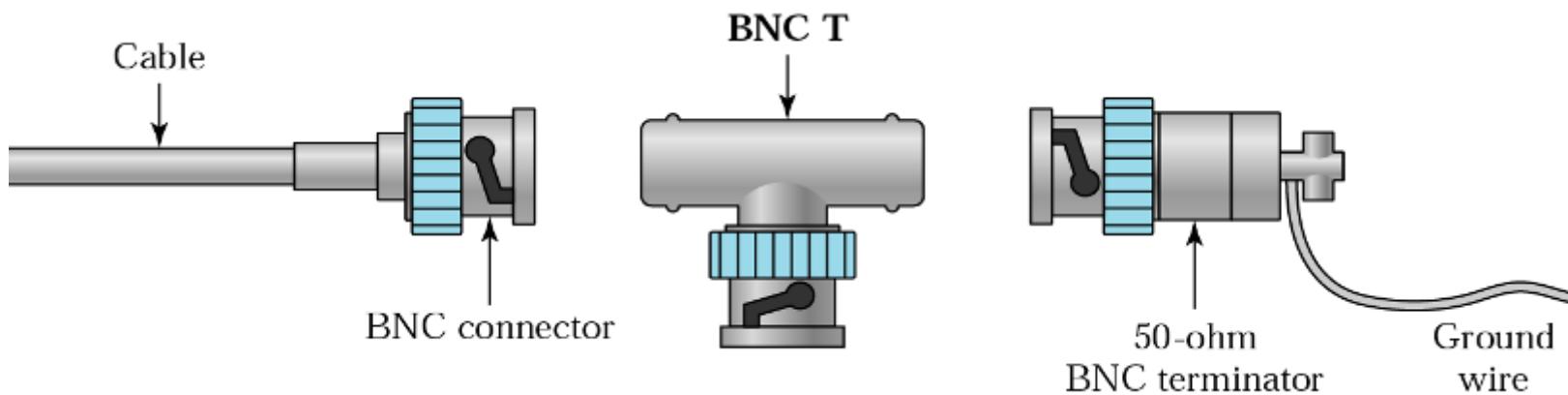
# Categories of Coaxial Cables

<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

*RG – Radio Government*

# BNC Connectors

- Bayonet Network Connector
  - aka. Bayonet Neil-Concelman
- Used with coaxial cables

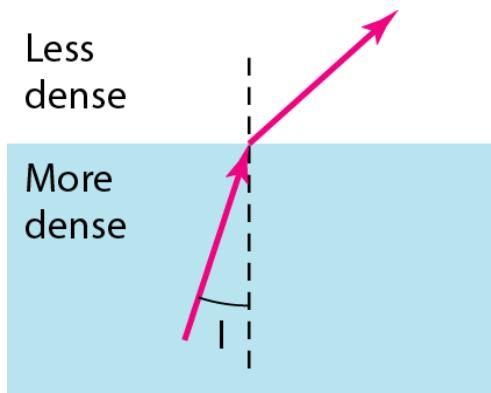


# **Guided Media:**

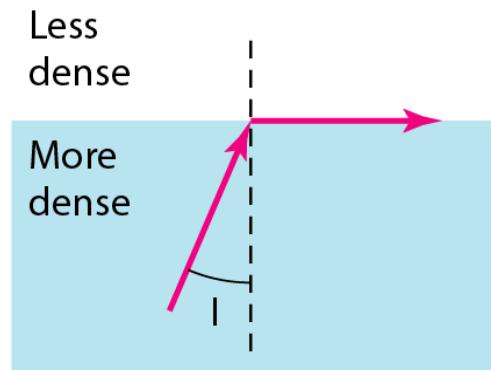
## ***Optical Media***

# Optical Fiber

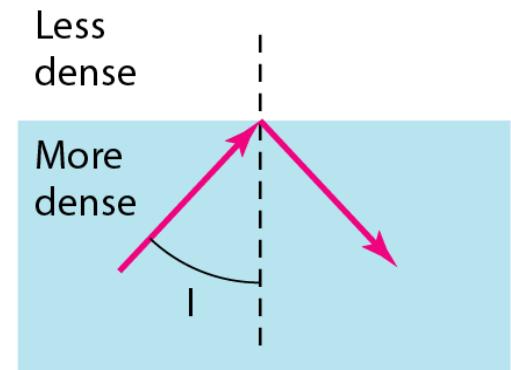
- Based on physics of light



$I <$  critical angle,  
refraction

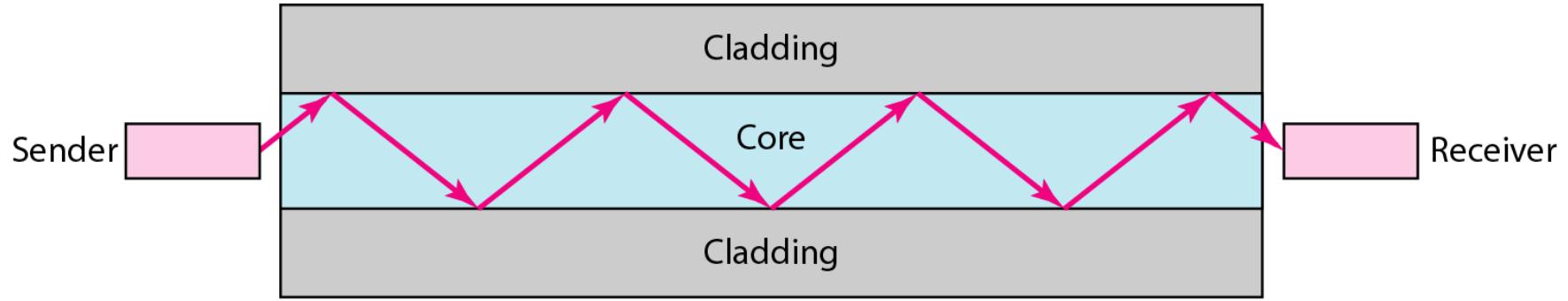


$I =$  critical angle,  
refraction

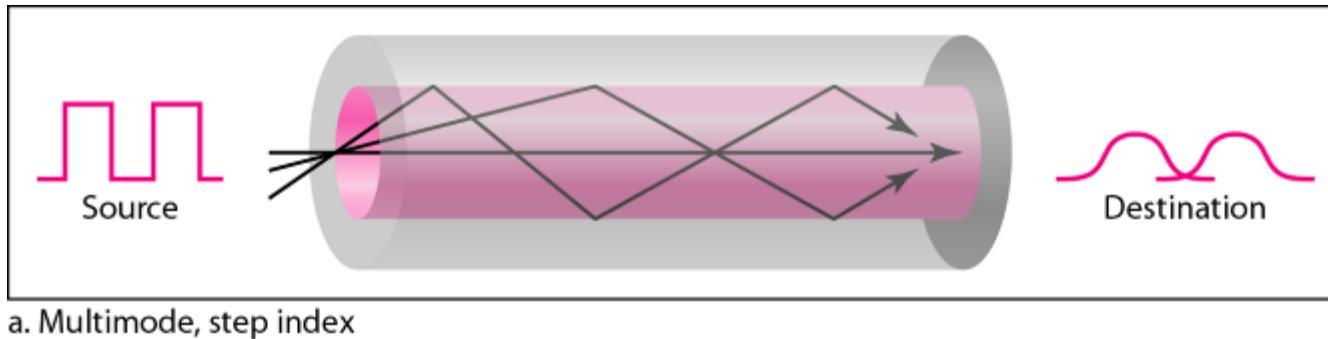


$I >$  critical angle,  
reflection

# Optical Fiber



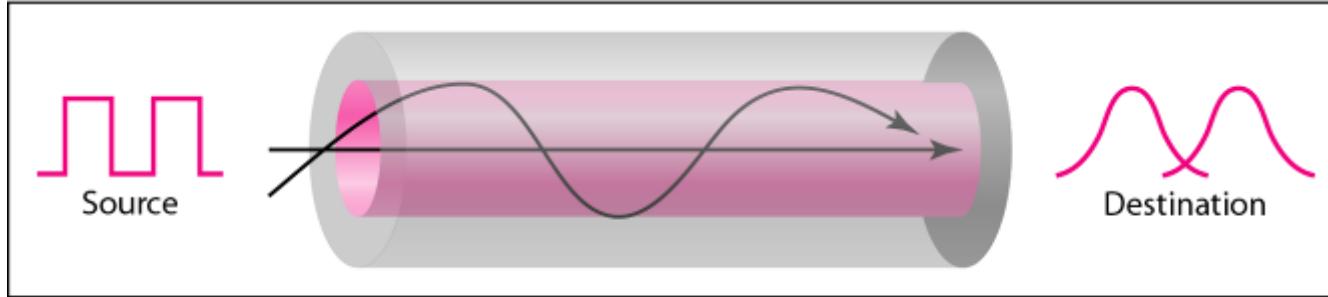
# Propagation Modes



a. Multimode, step index

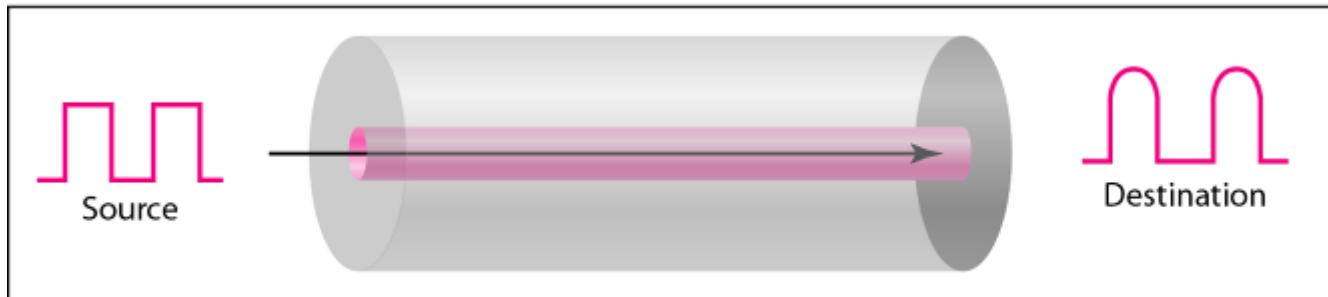
The density of the core remains constant from the center to the edges. A beam of light moves in a straight line until it reaches the interface of the core and the cladding. At the interface, there is an abrupt change due to a lower density;

# Propagation Modes



b. Multimode, graded index

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



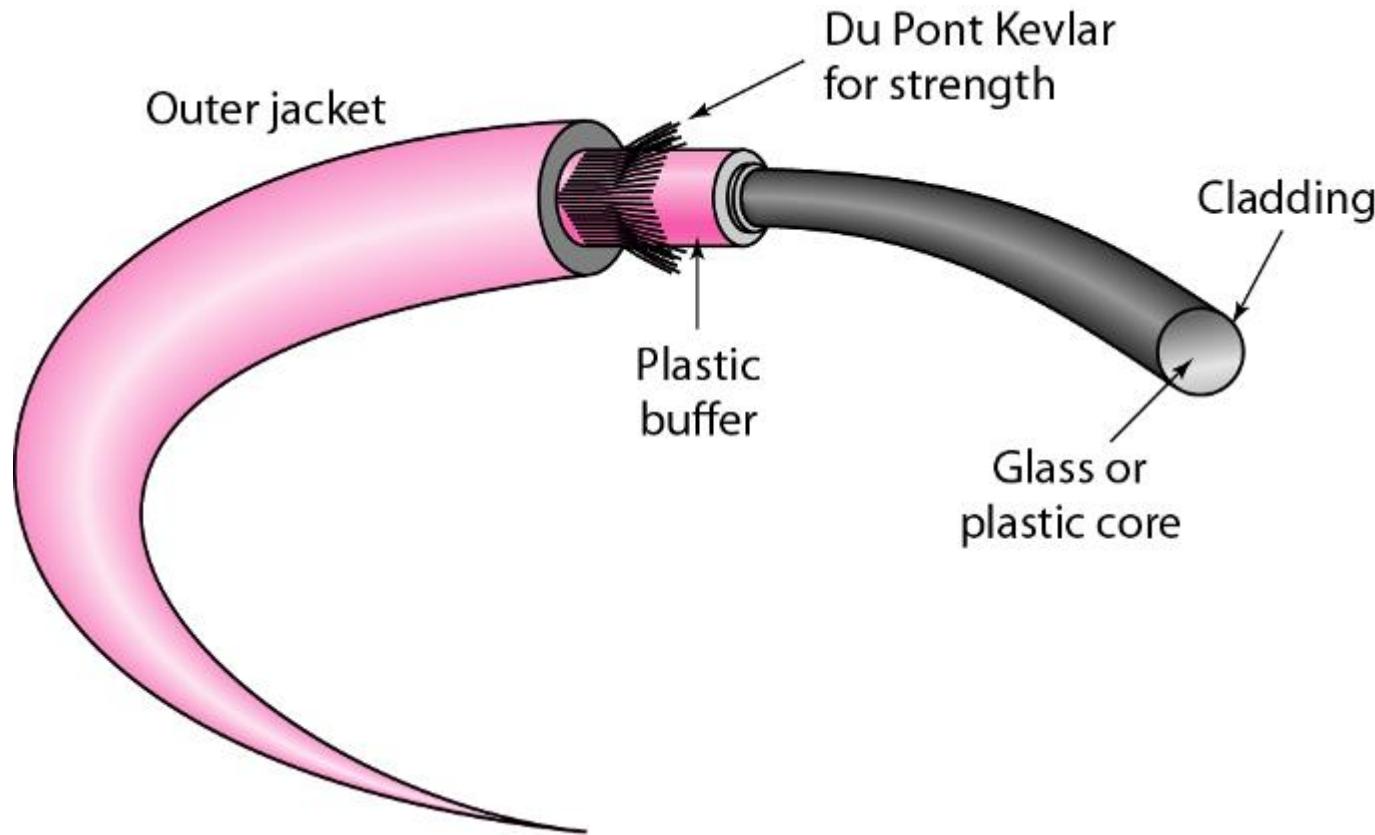
c. Single mode

# Fiber Types

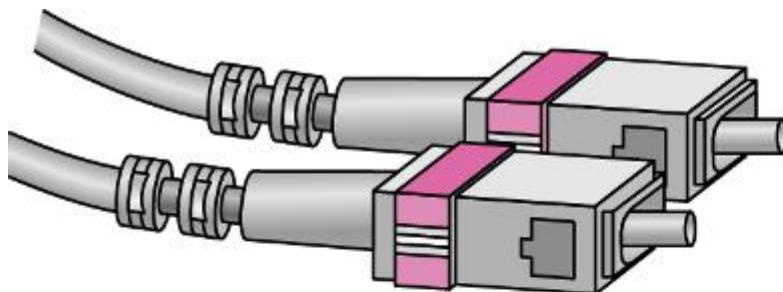
Optical fibers are defined by the **ratio of the diameter of their core to the diameter of their cladding**, both expressed in micrometers.

Type	Core ( $\mu m$ )	Cladding ( $\mu m$ )	Mode
50/125	50.0	125	Multimode, graded index
62.5/125	62.5	125	Multimode, graded index
100/125	100.0	125	Multimode, graded index
7/125	7.0	125	Single mode

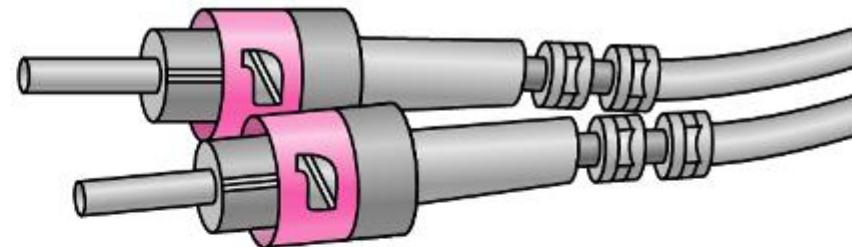
# Fiber Construction



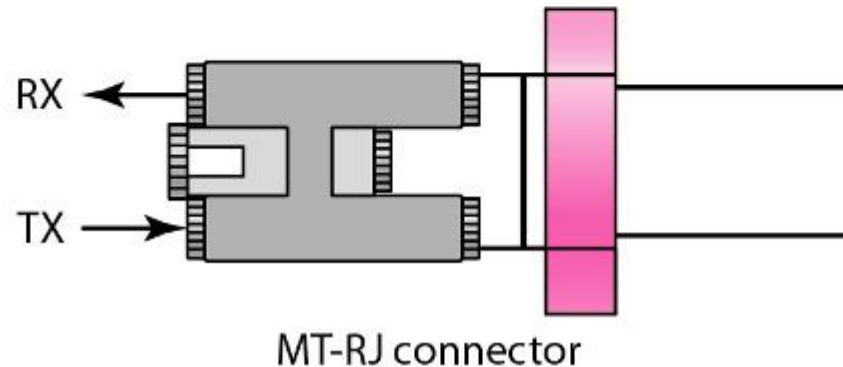
# Fiber-Optic Cable Connectors



SC connector



ST connector



MT-RJ connector

- **Subscriber channel (SC)** connector is used for cable TV.
- **Straight-tip (ST)** connector is used for connecting cable to networking devices.
- **MT-RJ** is a connector that is the same size as RJ45.

# **Advantages and Disadvantages**

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- Advantages of Optical Fiber
  - Higher bandwidth.
  - Less signal attenuation.
  - Immunity to electromagnetic interference.
  - Light weight.
- Disadvantages of Optical Fiber
  - Installation and maintenance.
  - Unidirectional light propagation.
  - Cost.

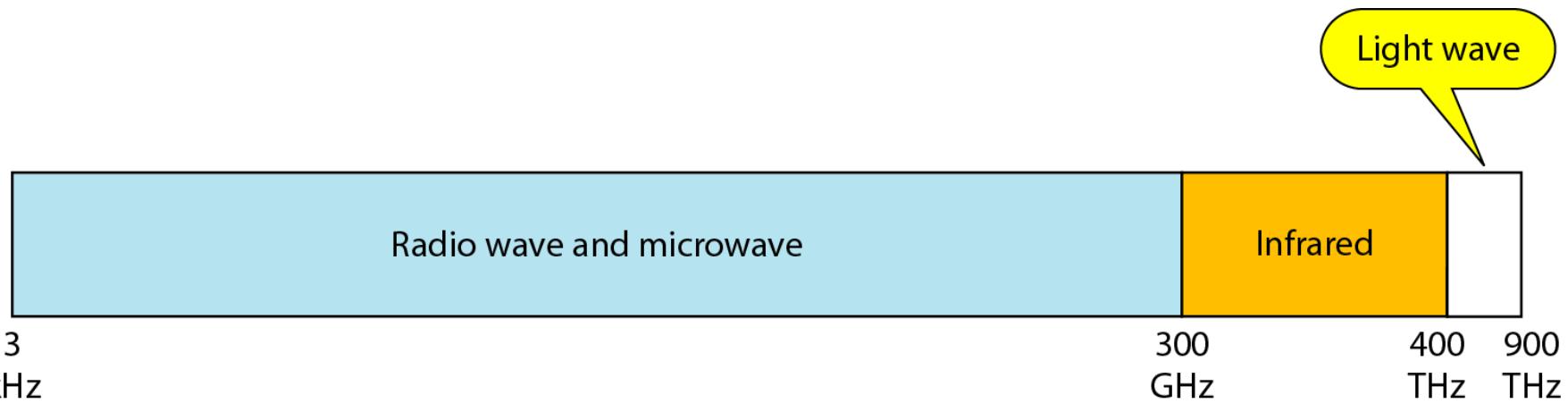
# **Unguided Media**

# **Unguided Media: Wireless**

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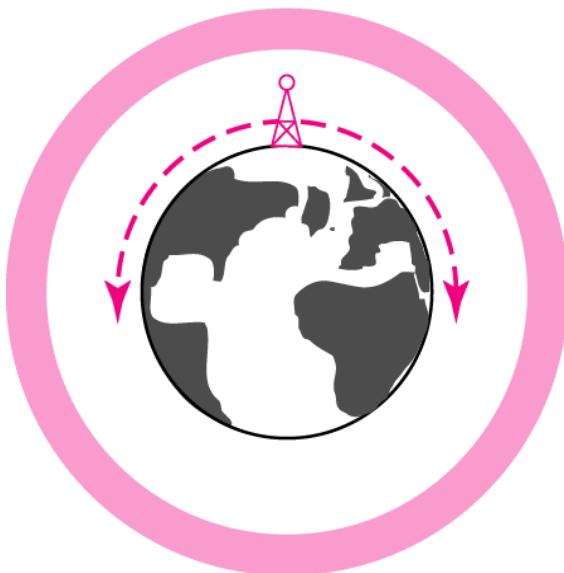
- Transport electromagnetic waves without using a physical conductor
  - Radio Waves
  - Microwaves
  - Infrared
- Often referred to as wireless communication

# Electromagnetic Spectrum



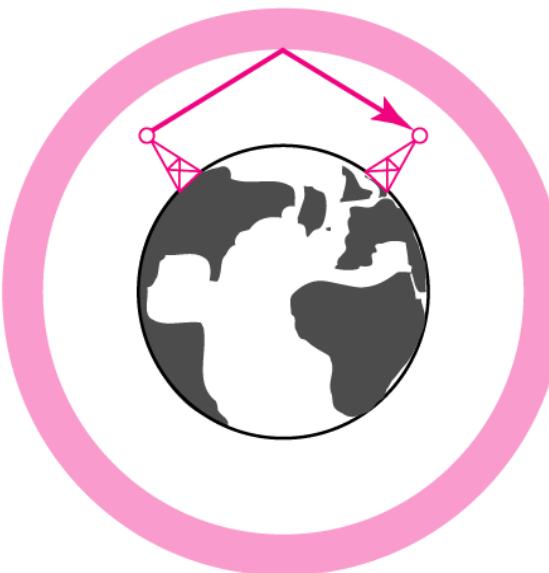
# Propagation Methods

Ionosphere



Ground propagation  
(below 2 MHz)

Ionosphere



Sky propagation  
(2–30 MHz)

Ionosphere

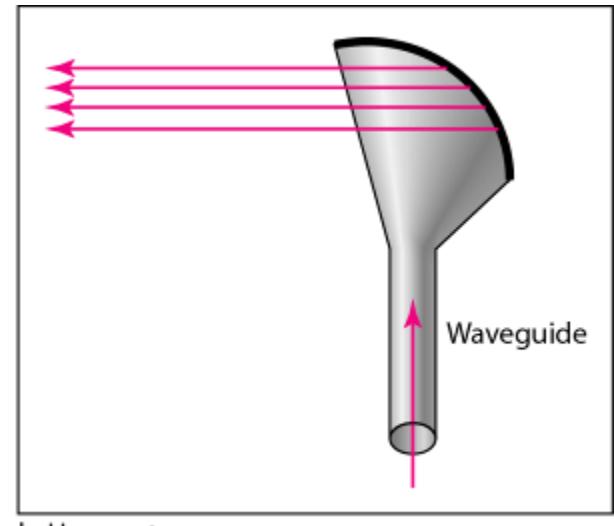
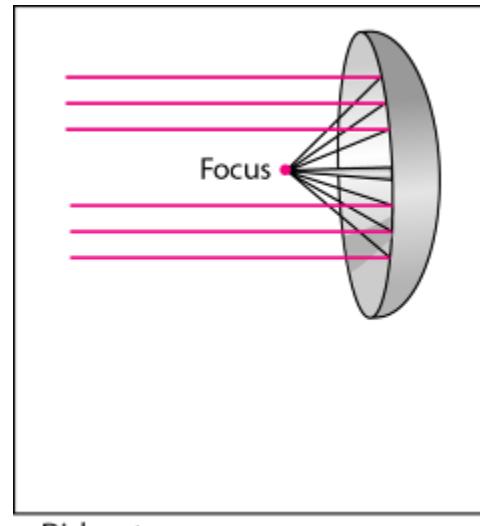
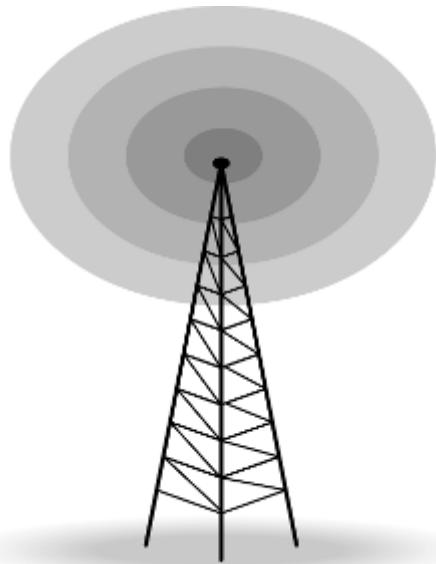


Line-of-sight propagation  
(above 30 MHz)

# Bands

<i>Band</i>	<i>Range</i>	<i>Propagation</i>	<i>Application</i>
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 and line-of-sight	VHF TV, FM radio
UHF (ultrahigh frequency)	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
SHF (superhigh frequency)	3–30 GHz	Line-of-sight	Satellite communication
EHF (extremely high frequency)	30–300 GHz	Line-of-sight	Radar, satellite

# Antennas



Omni-directional Antenna

Unidirectional Antennas

# Wireless Transmission Waves

