

# Transmission Medium

- A transmission **medium can be broadly defined as anything that can carry information** from a source to a destination.
  - For example,
    - The transmission medium for two people having a dinner conversation is the air.
    - For a written message, the transmission medium might be a mail carrier, a truck, or an airplane
- In data communications, the transmission medium is usually free space, metallic cable, or fiber-optic cable.
- The information is usually a signal that is the result of a conversion of data from another form.
- In telecommunications, transmission media can be divided into two broad categories:
  - Guided(wired)
    - Guided media include twisted-pair cable, coaxial cable, and fiber-optic cable.
  - Unguided(wireless)
    - Unguided medium is free space
    - Divided into three broad groups: radio waves, microwaves, and infrared waves

# Wired Transmission Media

- Guided media, are those that provide a conduit from one device to another.
- Eg: 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.



FIBER OPTIC



TWISTED PAIR



COAXIAL

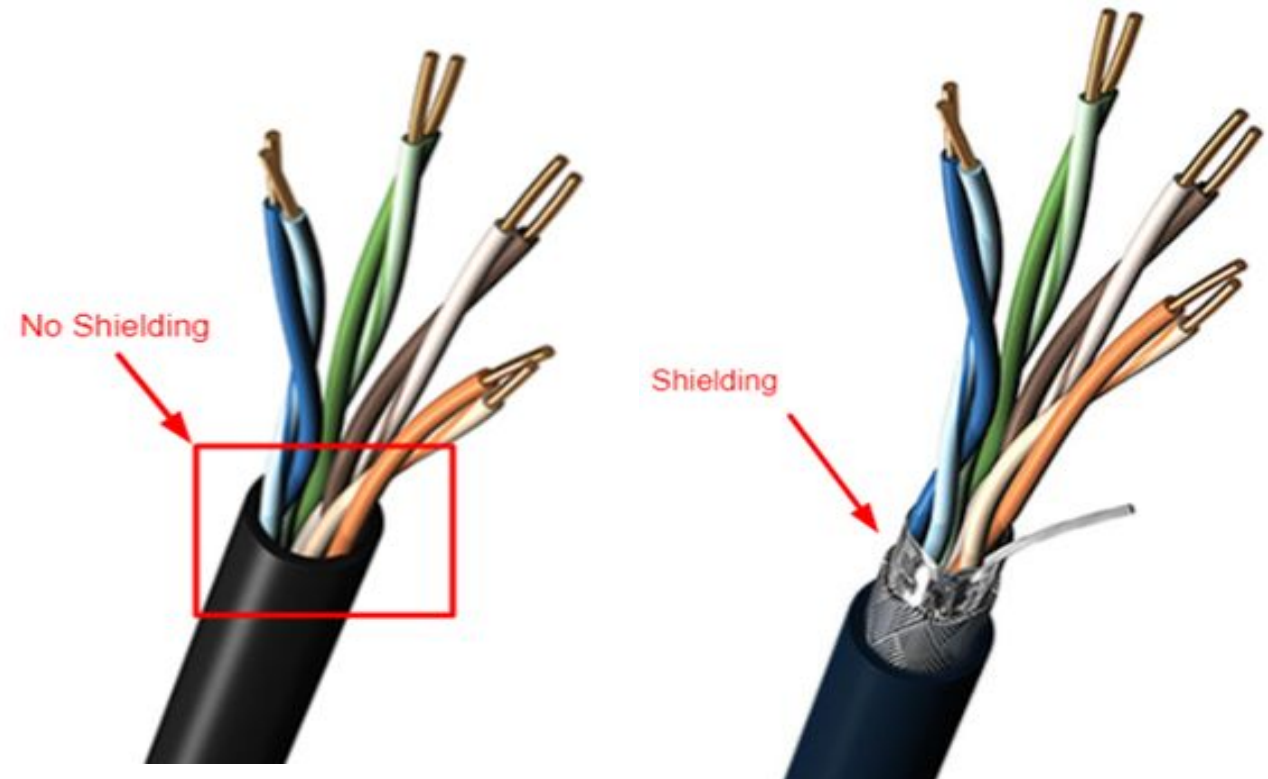
# Twisted Pair

- A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together.
- One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference.
- Types
  - unshielded twisted-pair (UTP).
  - shielded twisted-pair (STP).



# STP Vs UTP

- STP cable has a metal foil or braided mesh-covering that encases each pair of insulated conductors while UTP does not.
- metal casing improves the quality of cable by preventing the penetration of noise or crosstalk, but it is bulkier and more expensive



# Twisted Pair Connector

- The most common UTP connector is RJ45 (RJ stands for registered jack).
- The RJ45 is a keyed connector, meaning the connector can be inserted in only one way.



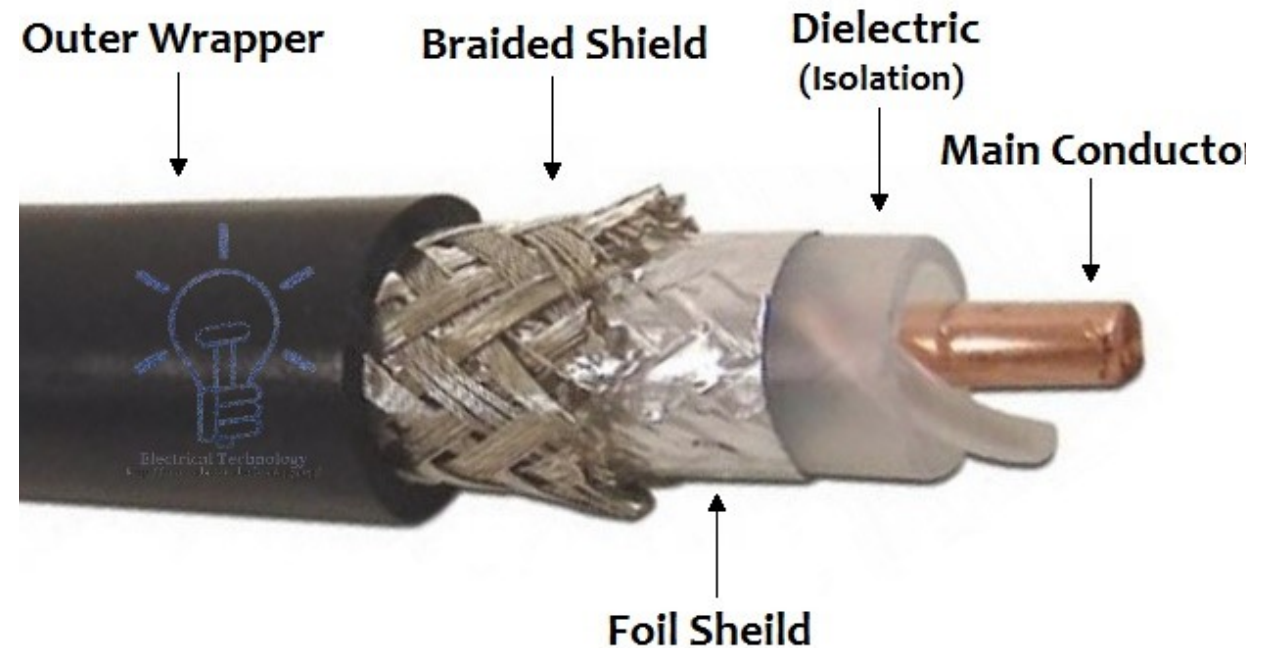
# Twisted Pair

- Applications

- Twisted-pair cables are used in telephone lines to provide voice and data channels.
- The local loop-the line that connects subscribers to the central telephone office-commonly consists of unshielded twisted-pair cables.
- The DSL lines that are used by the telephone companies to provide high-data-rate connections also use the high-bandwidth capability of unshielded twisted-pair cables.
- Local-area networks, such as 10Base-T and 100Base-T, also use twisted-pair cables.

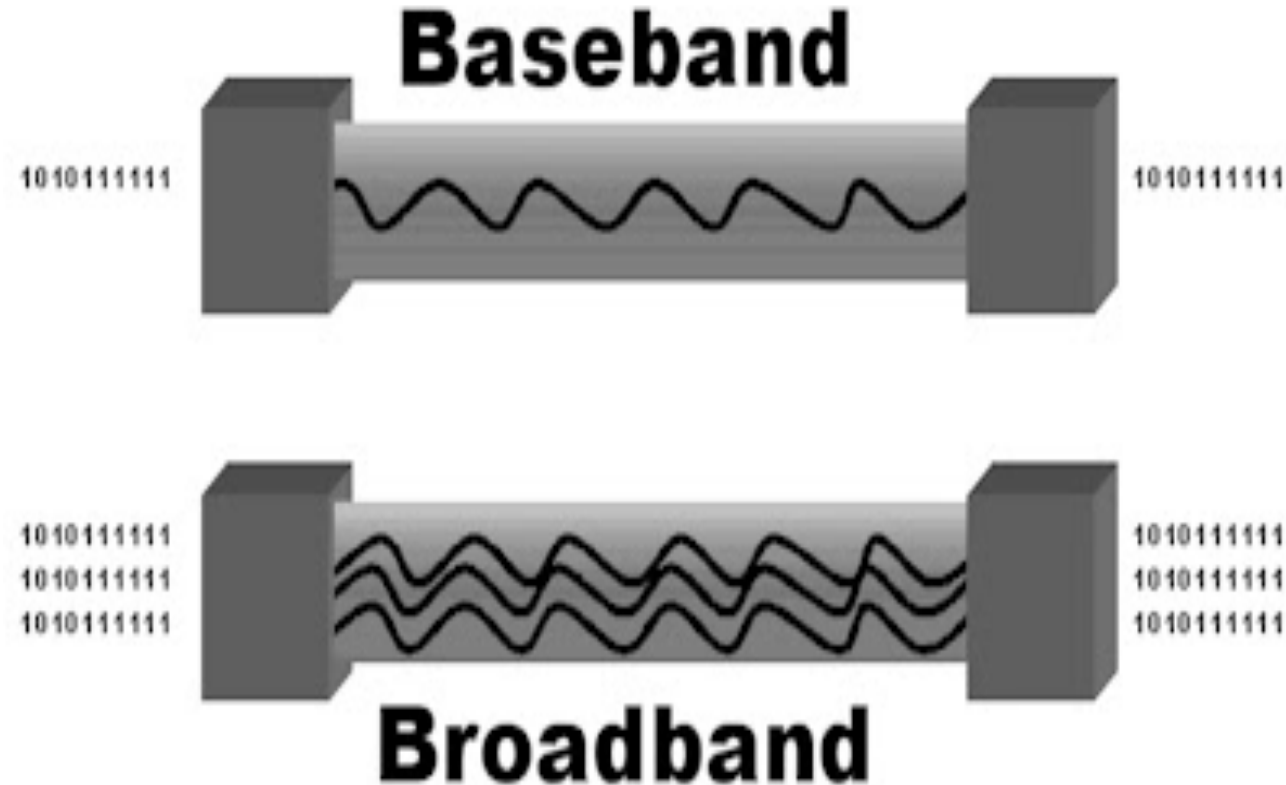
# Coaxial Cable

- Coaxial cable (or *coax*) carries signals of higher frequency ranges than those in twisted-pair cable.
- 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
- Types
  - Baseband
  - Broadband



# Baseband Vs Broadband

- Baseband
  - This is a 50 ohm ( $\Omega$ ) coaxial cable which is used for digital transmission. It is mostly used for LAN's. Baseband transmits a single signal at a time with very high speed.
- Broadband
  - This uses analog transmission on standard cable television cabling. It transmits several simultaneous signal using different frequencies. It covers large area when compared with baseband coaxial cable.





# Coaxial Cable Connector

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



**MALE BNC PLUG**



**FEMALE BNC JACK**



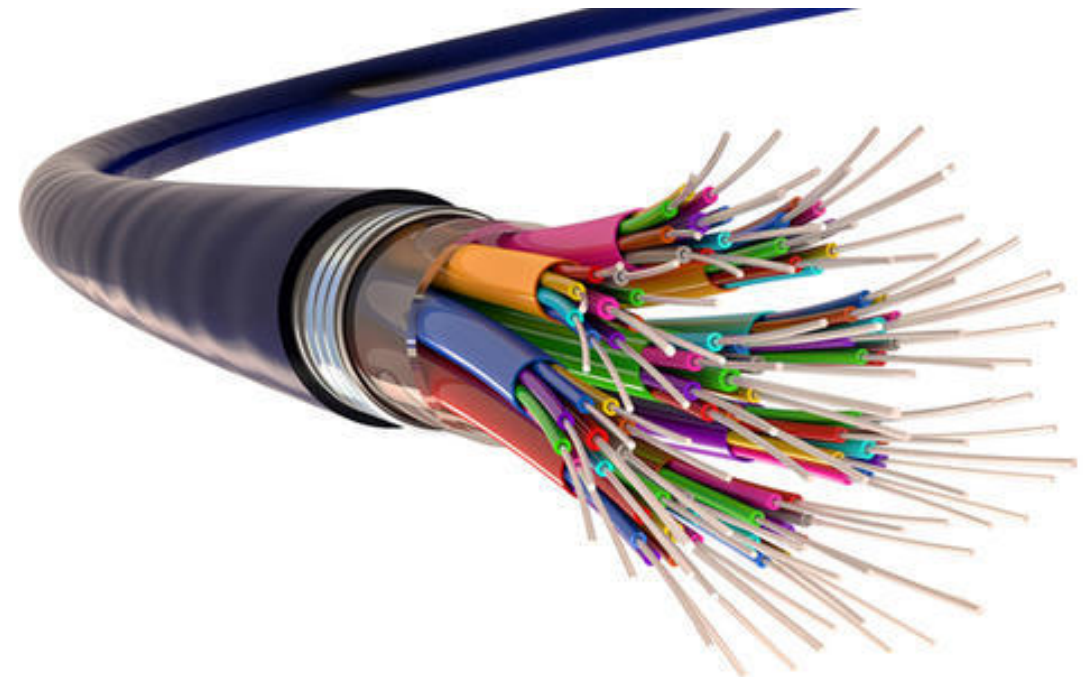
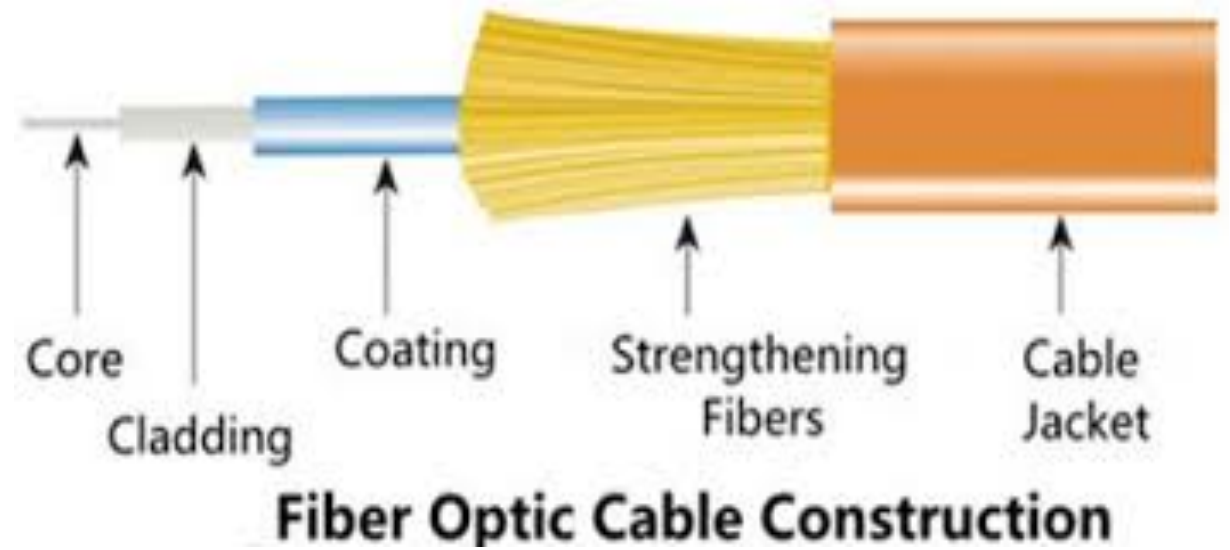
# Coaxial Cable

- Applications

- In the traditional cable TV network, the entire network used coaxial cable.
- hybrid networks use coaxial cable only at the network boundaries, near the consumer premises.
- Another common application of coaxial cable is in traditional Ethernet LANs. Because of its high bandwidth, and consequently high data rate, coaxial cable was chosen for digital transmission in early Ethernet LANs.
- The 10Base-2, or Thin Ethernet, uses RG-58 coaxial cable with BNC connectors to transmit data at 10 Mbps with a range of 185 m.
- The 10Base5, or Thick Ethernet, uses RG-11 (thick coaxial cable) to transmit 10 Mbps with a range of 5000 m. Thick Ethernet has specialized connectors

# 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.



# Fiber-Optic Cable Connector

- Common three types:
  - 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.



LC Connector



SC Connector



ST Connector



MTRJ



MU



E 2000 Connector

# Fiber-Optic Cable

- Applications

- Fiber-optic cable is often found in backbone networks because its wide bandwidth is cost-effective
- Some cable TV companies use a combination of optical fiber and coaxial cable, thus creating a hybrid network. Optical fiber provides the backbone structure while coaxial cable provides the connection to the user premises. This is a cost-effective configuration since the narrow bandwidth requirement at the user end does not justify the use of optical fiber.
- Local-area networks such as 100Base-FX network (Fast Ethernet) and 1000Base-X also use fiber-optic cable.

# Wireless Transmission Media

- Unguided media transport electromagnetic waves without using a physical conductor.
- This type of communication is often referred to as wireless communication.
- Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.
- Unguided signals can travel from the source to destination in several ways:
  - Ground propagation,
  - sky propagation,
  - line-of-sight propagation,

# Wireless Transmission Media

- In ground propagation, radio waves travel through the lowest portion of the atmosphere, hugging the earth.
- In sky propagation, higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth.
- In line-of-sight propagation, very high-frequency signals are transmitted in straight lines directly from antenna to antenna



Ground propagation  
(below 2 MHz)



Sky propagation  
(2-30 MHz)



Line-of-sight propagation  
(above 30 MHz)



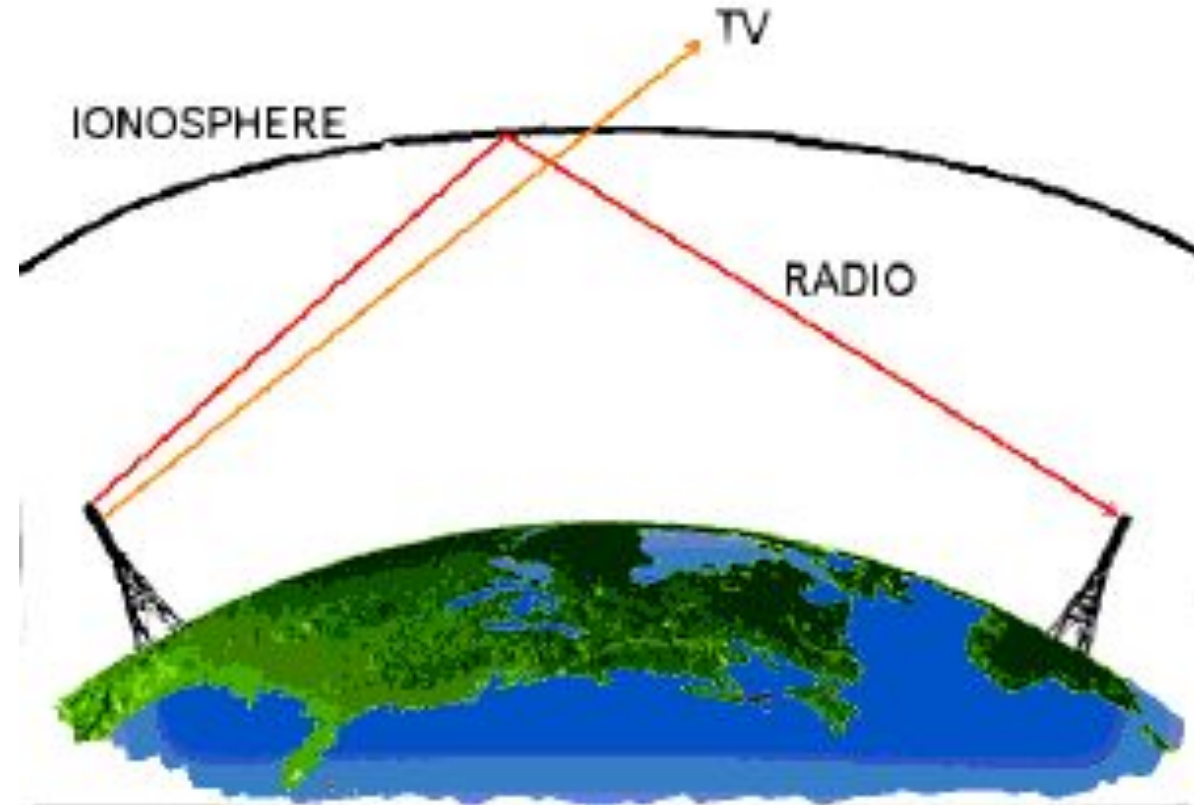
- The section of the electromagnetic spectrum defined as radio waves and microwaves is divided into eight ranges, called *bands*, each regulated by government authorities.
- These bands are rated from *very low frequency (VLF)* to *extremely high frequency (EHF)*.

<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



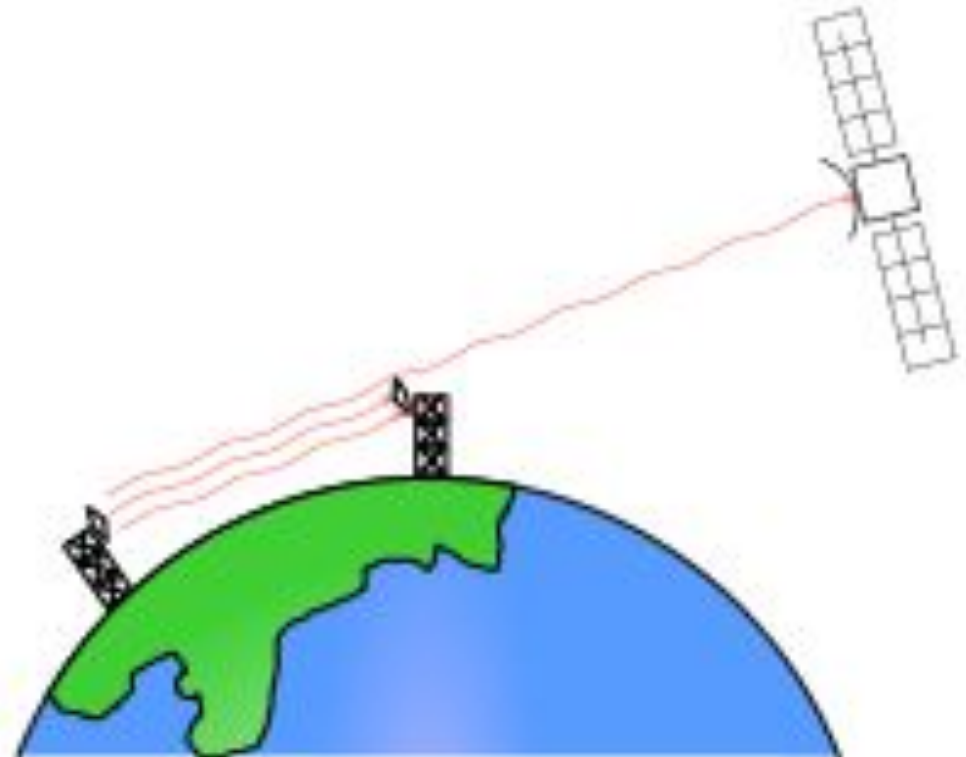
# Radio Waves

- Electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves.
- Radio waves, particularly those waves that propagate in the sky mode
- radio waves a good candidate for long-distance broadcasting.
- Radio waves use omnidirectional antennas that send out signals in all directions.
- Applications:
  - multicasting-in which there is one sender but many receivers.
  - AM and FM radio, television, maritime radio, cordless phones, and paging



# Microwaves

- Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.
- Microwaves are unidirectional.
- Microwave propagation is line-of-sight.
- Applications:
  - Unicast - one-to-one communication is needed between the sender and the receiver.
    - cellular phones, satellite networks and wireless LANs



# Infrared

- Infrared waves, with frequencies from 300 GHz to 400 THz (wavelengths from 1 mm to 770 nm).
- used for short-range communication.
- line-of-sight propagation.
- Applications:
  - used to transmit digital data with a very high data rate.



