

5.0 TRANSMISSION MEDIA

School of Education
Faculty of Social Sciences and Humanities

5.1

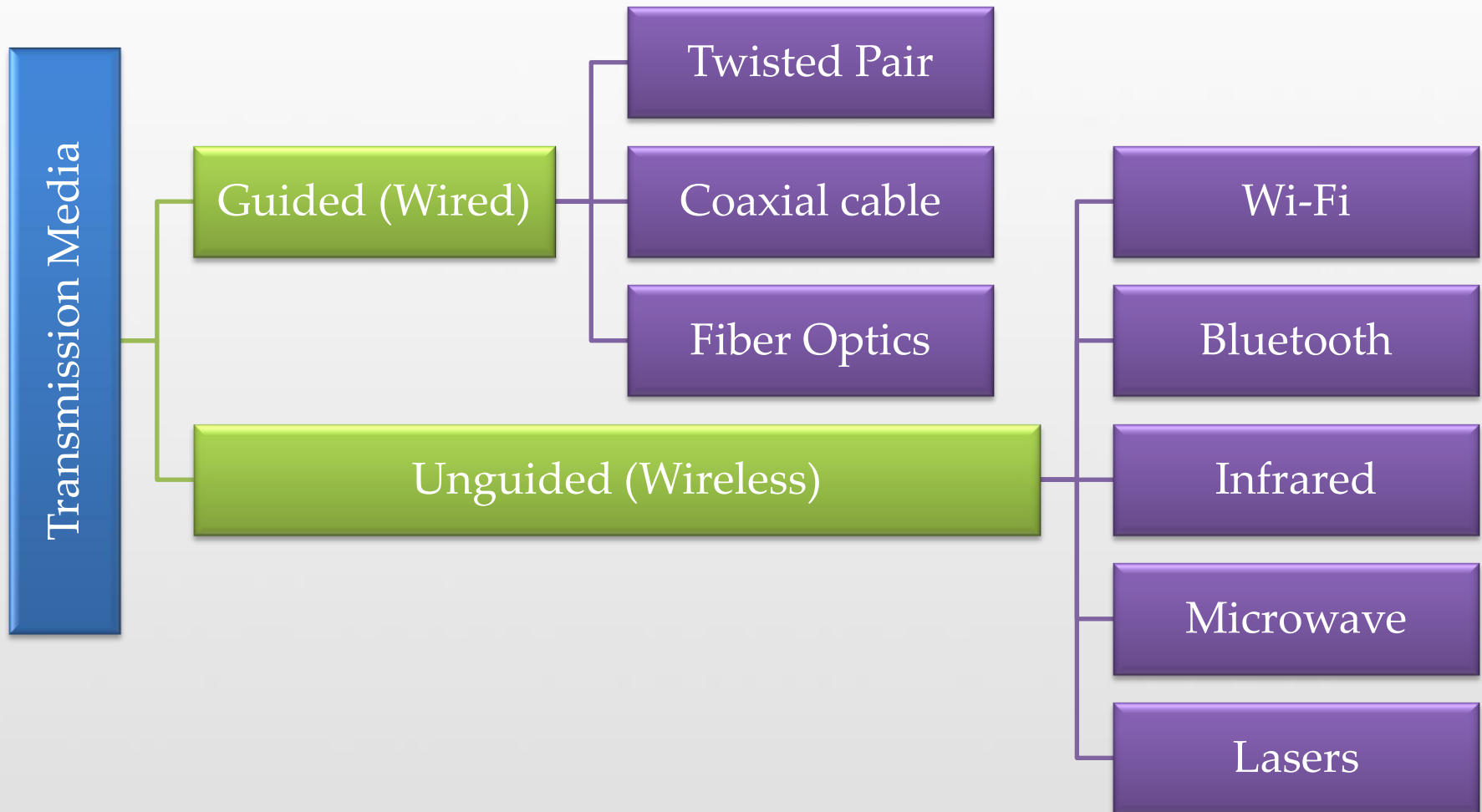
TRANSMISSION MEDIA

Transmission Media

- Sending of data from one device to another is called **transmission of data**
- Medium used to transmit the data is called **Media**
- Transmission of data through Medium is called **Transmission Media**



Types of Transmission Media



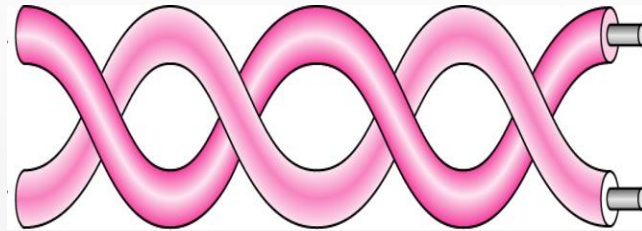
5.2

GUIDED (WIRED)

Guided (Wired)

- The medium itself is more important in determining the limitations of transmission.
- The transmission capacity, in terms of either data rate or bandwidth, depends critically on the distance and on whether the medium is point-to-point or multipoint.

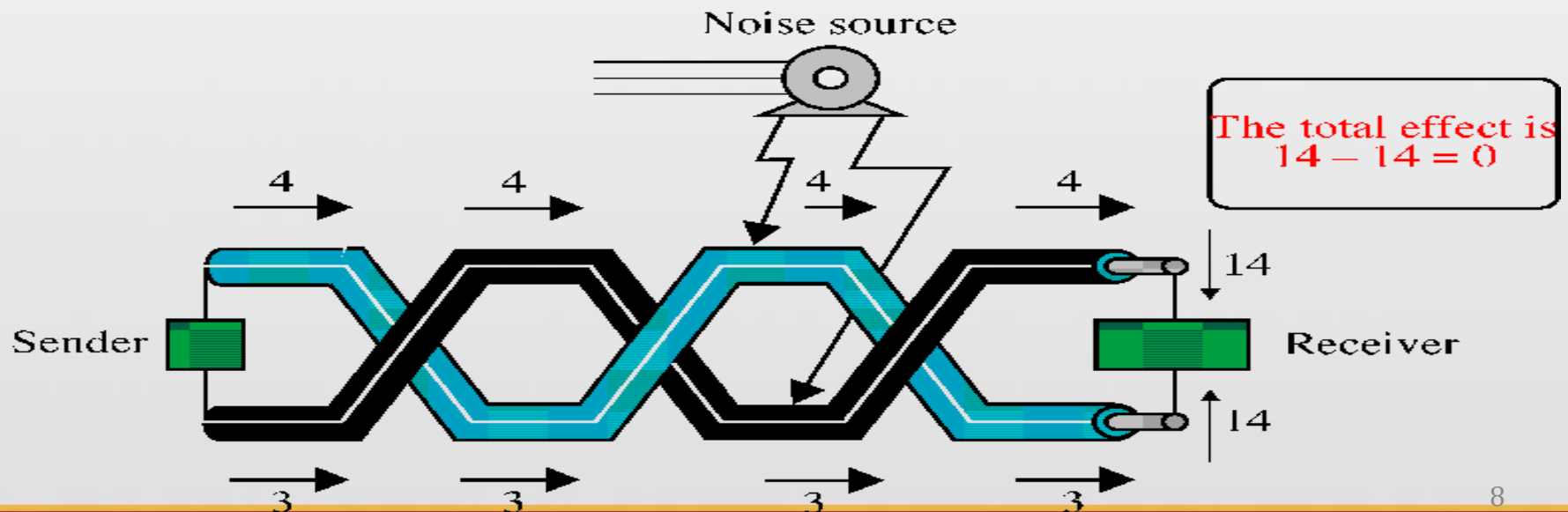
Twisted Pair



- A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.
- The twisting tends to decrease the crosstalk interference between adjacent pairs in a cable.
- Twisted pair may be used to transmit both analog and digital transmission.
- Twisted pair is limited in distance, bandwidth, and data rate.

Twisted Pair

- If the pair of wires are not twisted, electromagnetic noises from, e.g., motors, will affect the closer wire more than the further one, thereby causing errors



Twisted Pair - Applications

- Most common medium
- Telephone network
 - Between house and local exchange (subscriber loop)
- Within buildings
 - To private branch exchange (PBX)
- For local area networks (LAN)
 - 10Mbps or 100Mbps

Twisted Pair - Pros and Cons

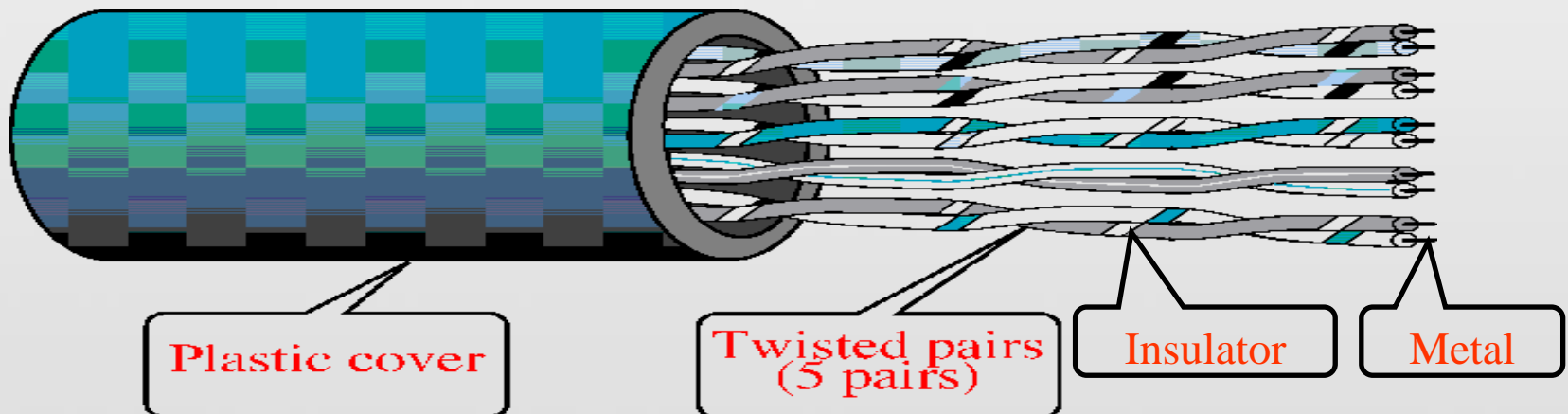
- Cheap
- Easy to work with
- Low data rate
- Short range

Twisted Pair - Transmission Characteristics

- Analog
 - Amplifiers every 5km to 6km
- Digital
 - Use either analog or digital signals
 - repeater every 2km or 3km
- Limited distance
- Limited bandwidth (1MHz)
- Limited data rate (100MHz)
- Susceptible to interference and noise

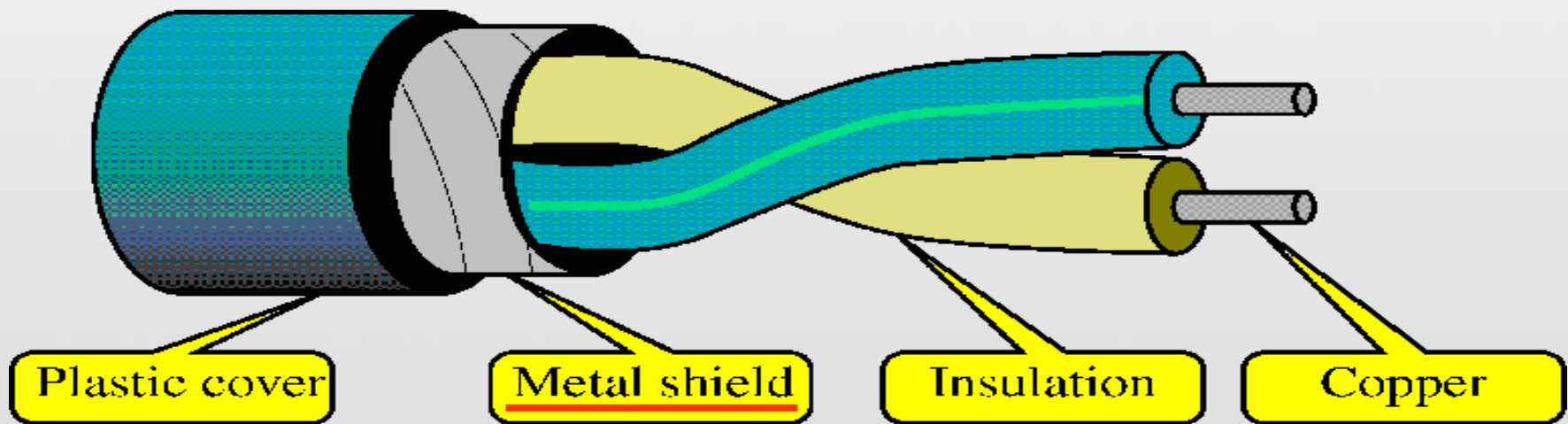
Unshielded and Shielded TP

- Unshielded Twisted Pair (UTP)
 - Ordinary telephone wire
 - Cheapest
 - Easiest to install
 - Suffers from external EM interference



Unshielded and Shielded TP

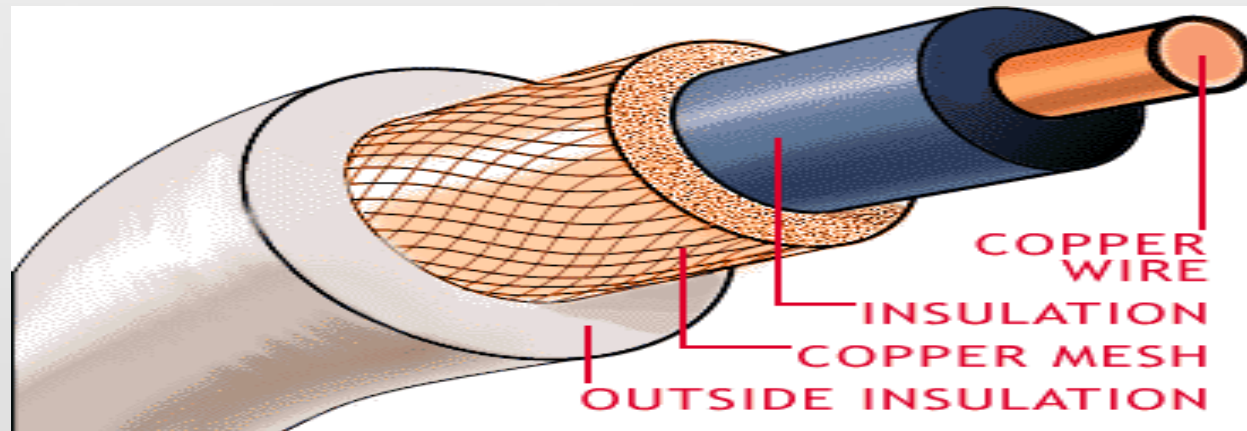
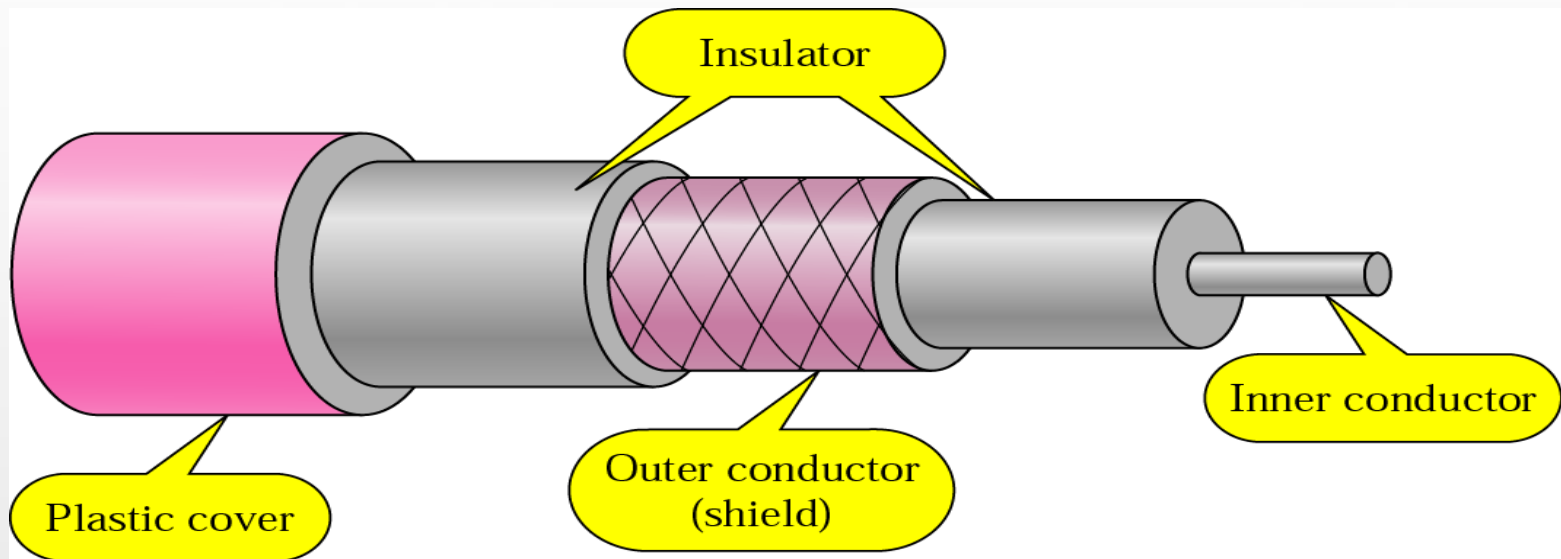
- Shielded Twisted Pair (STP)
 - Metal braid or sheathing that reduces interference
 - More expensive
 - Harder to handle (thick, heavy)



UTP Categories

- Cat 3
 - up to 16MHz
 - Voice grade found in most offices
 - Twist length of 7.5 cm to 10 cm
- Cat 4
 - up to 20 MHz
- Cat 5
 - up to 100MHz
 - Commonly pre-installed in new office buildings
 - Twist length 0.6 cm to 0.85 cm
- Cat 5E (Enhanced)
- Cat 6
- Cat 7

Coaxial Cable



Coaxial Cable Applications

- Most versatile medium
- Television distribution
 - Ariel to TV
 - Cable TV
- Long distance telephone transmission
 - Can carry 10,000 voice calls simultaneously
 - Being replaced by fiber optic
- Short distance computer systems links
- Local area networks

Coaxial Cable - Transmission Characteristics

- Analog
 - Amplifiers every few km
 - Closer if higher frequency
 - Up to 500MHz
- Digital
 - Repeater every 1km
 - Closer for higher data rates

Coaxial Cable

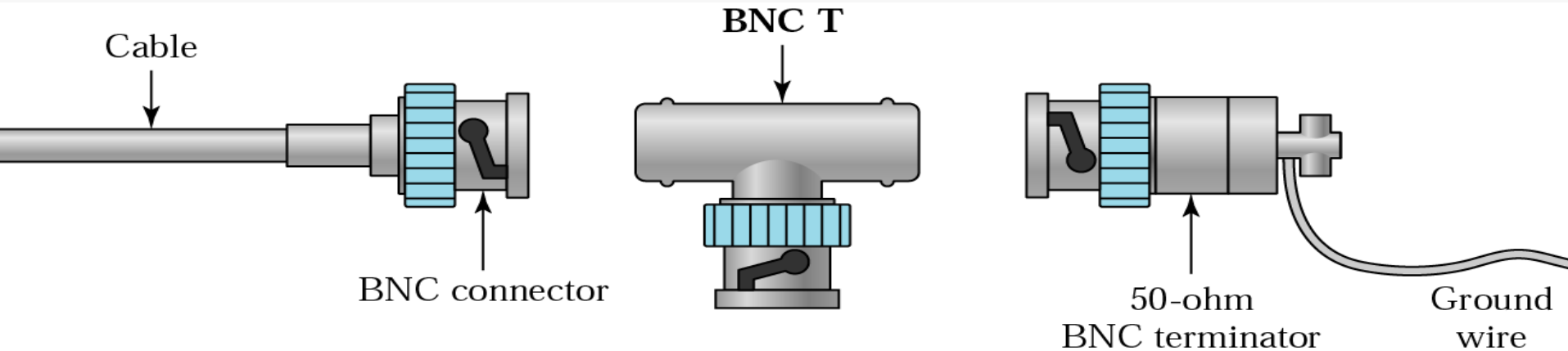
Advantages

- Better than twisted pair cable.
- Used as shared cable network
- Used for broadband transmission.
- Higher bandwidth upto 400 MBPS

Disadvantages

- Expensive compared to twisted pair cables
- The coaxial cables are not compatible with twisted pair cables.

Coaxial Cable – Connector

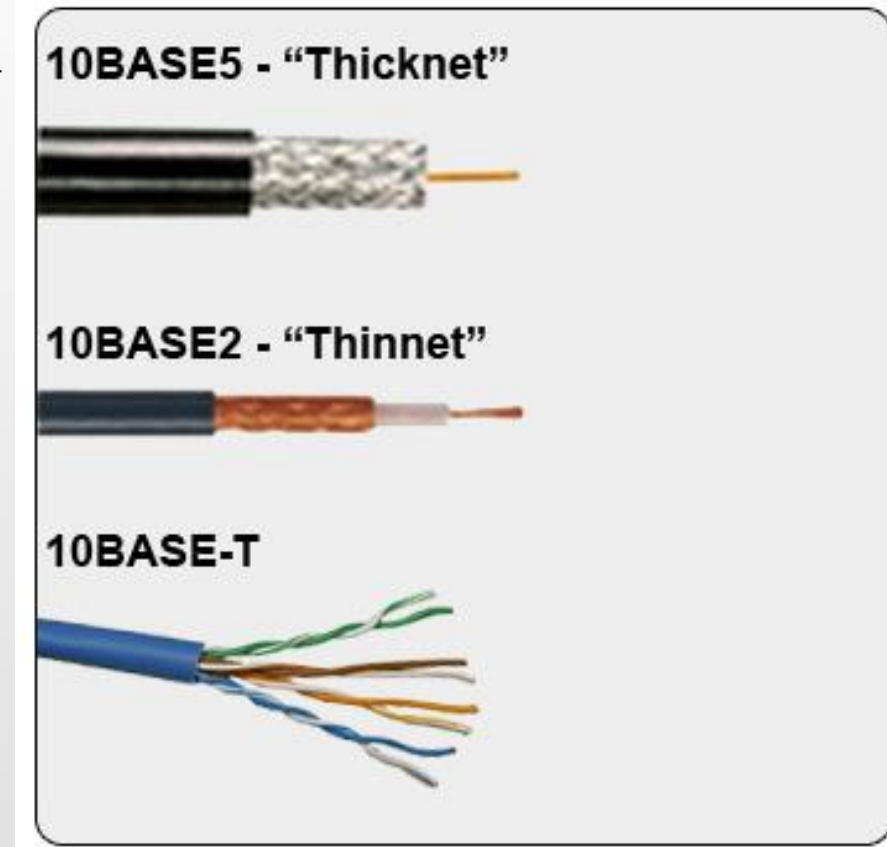


- BNC Connectors are used for connecting two coaxial cables together at connecting points is when repeaters are required

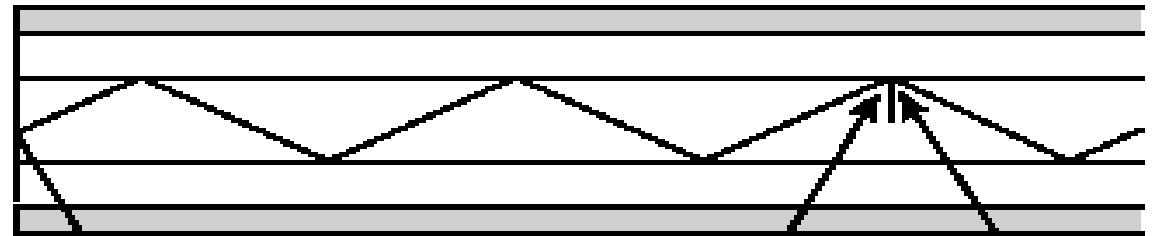
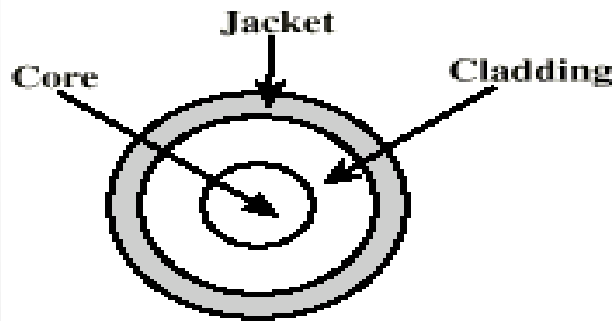
TYPES OF COAXIAL CABLES

There are two types of coaxial cables:

1. **Thicknet:** It is a thicker than thinner. It is used up to 500 meters long.
2. **Thinner:** It is used up to 185 meters long.



Fiber Optics

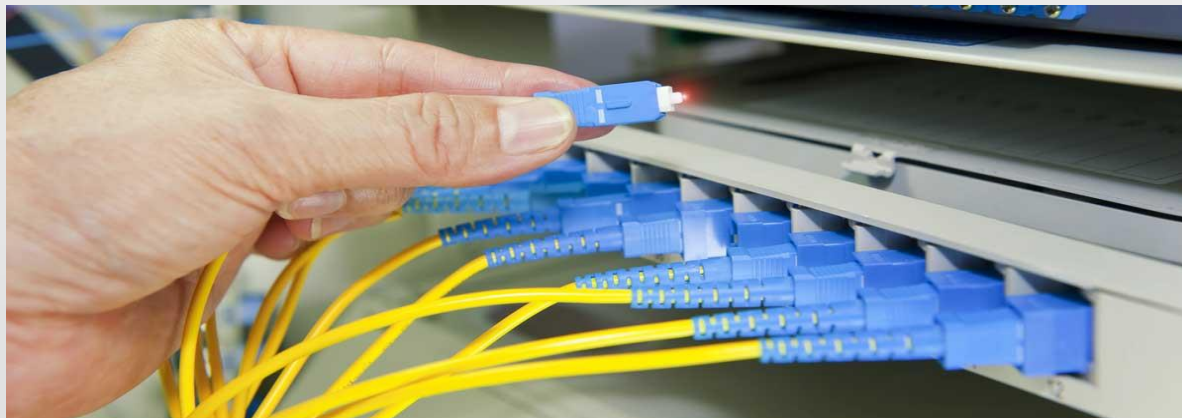


- Glass or plastic core
- Laser or light emitting diode
- Specially designed jacket
- Small size and weight

Light at less than critical angle is absorbed in jacket

Angle of incidence

Angle of reflection



Fiber Optics

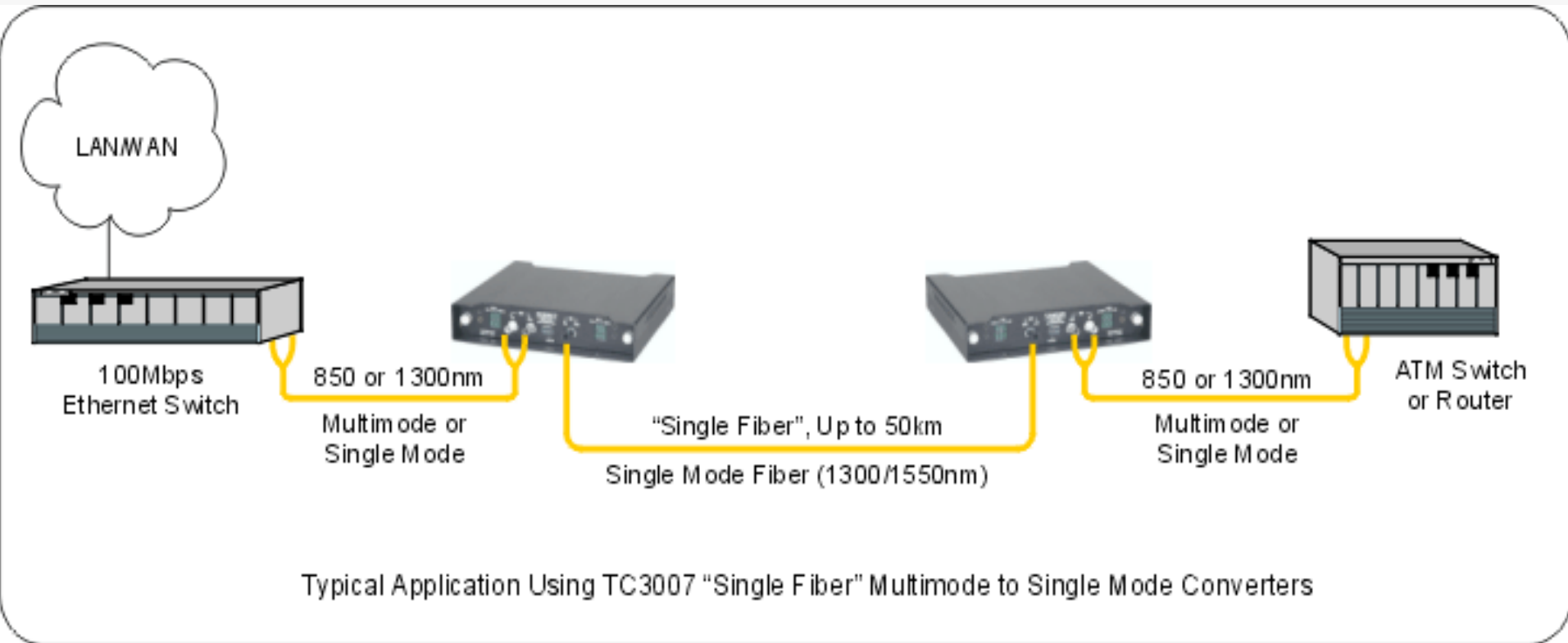
Single Mode



Multi Mode



Fiber Optics



Types of fibre optic cable

1. Single Mode: It is used up to 2kms and band width of up to 100Mbps
2. Multi Mode: It is used up to 100kms and band width of 2Gbps.

Fiber Optics - Benefits

- Greater capacity
 - Data rates of hundreds of Gbps
- Smaller size & weight
- Lower attenuation
- Electromagnetic isolation
- Greater repeater spacing
 - Dozens of km at least

Optical Fiber - Transmission Characteristics

- Light Emitting Diode (LED)
 - Cheaper
 - Wider operating temp range
 - Last longer
- Injection Laser Diode (ILD)
 - More efficient
 - Greater data rate



5.3

UNGUIDED (WIRELESS)

Wireless Transmission Frequencies

- 2GHz to 40GHz
 - Microwave
 - Highly directional
 - Point to point
 - Satellite
- 30MHz to 1GHz
 - Omnidirectional
 - Broadcast radio
- 3×10^{11} to 2×10^{14}
 - Infrared
 - Local

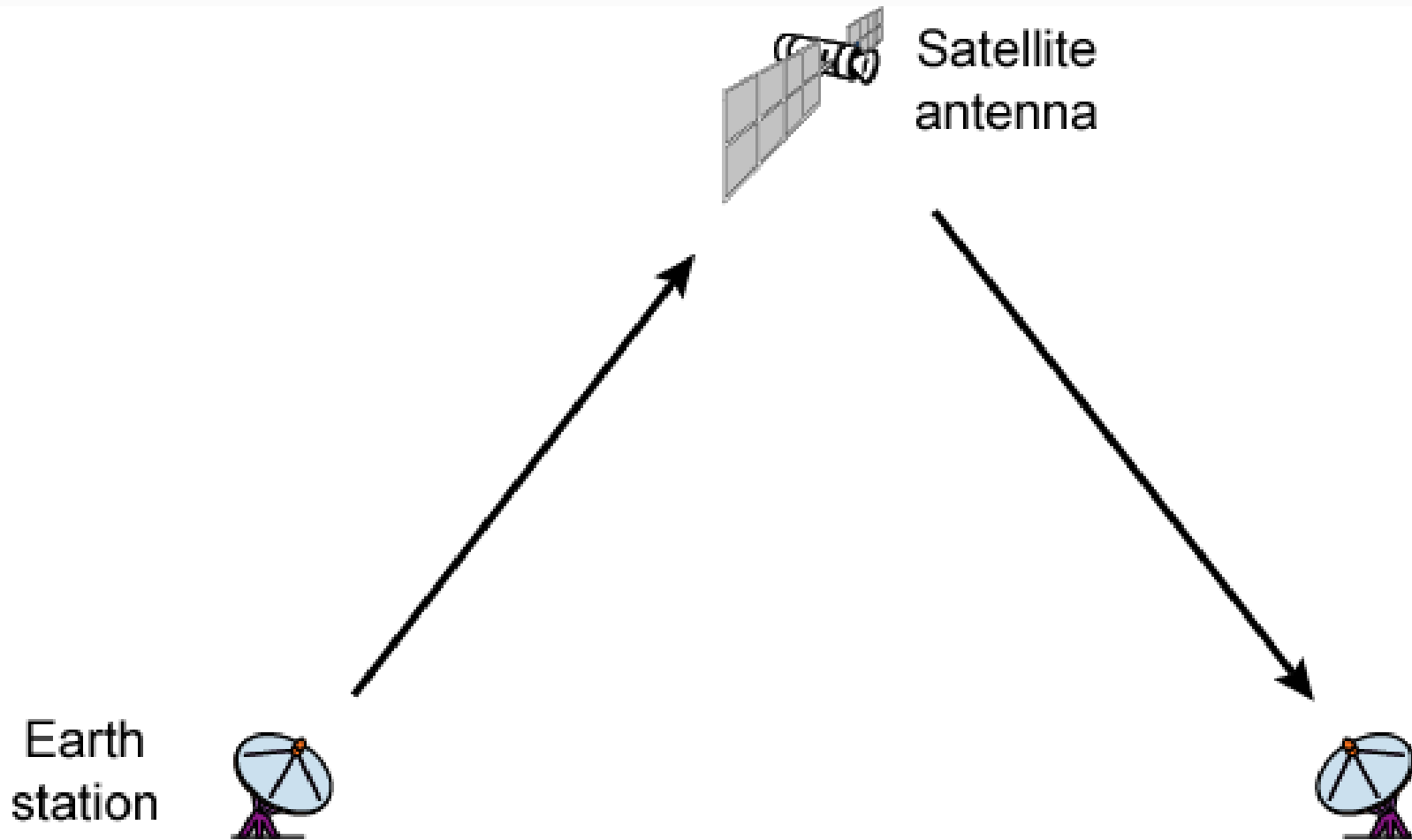
Antennas

- Electrical conductor (or system of..) used to radiate electromagnetic energy or collect electromagnetic energy
- Transmission
 - Radio frequency energy from transmitter
 - Converted to electromagnetic energy
 - By antenna
 - Radiated into surrounding environment
- Reception
 - Electromagnetic energy impinging on antenna
 - Converted to radio frequency electrical energy
 - Fed to receiver
- Same antenna often used for both

Satellite Microwave

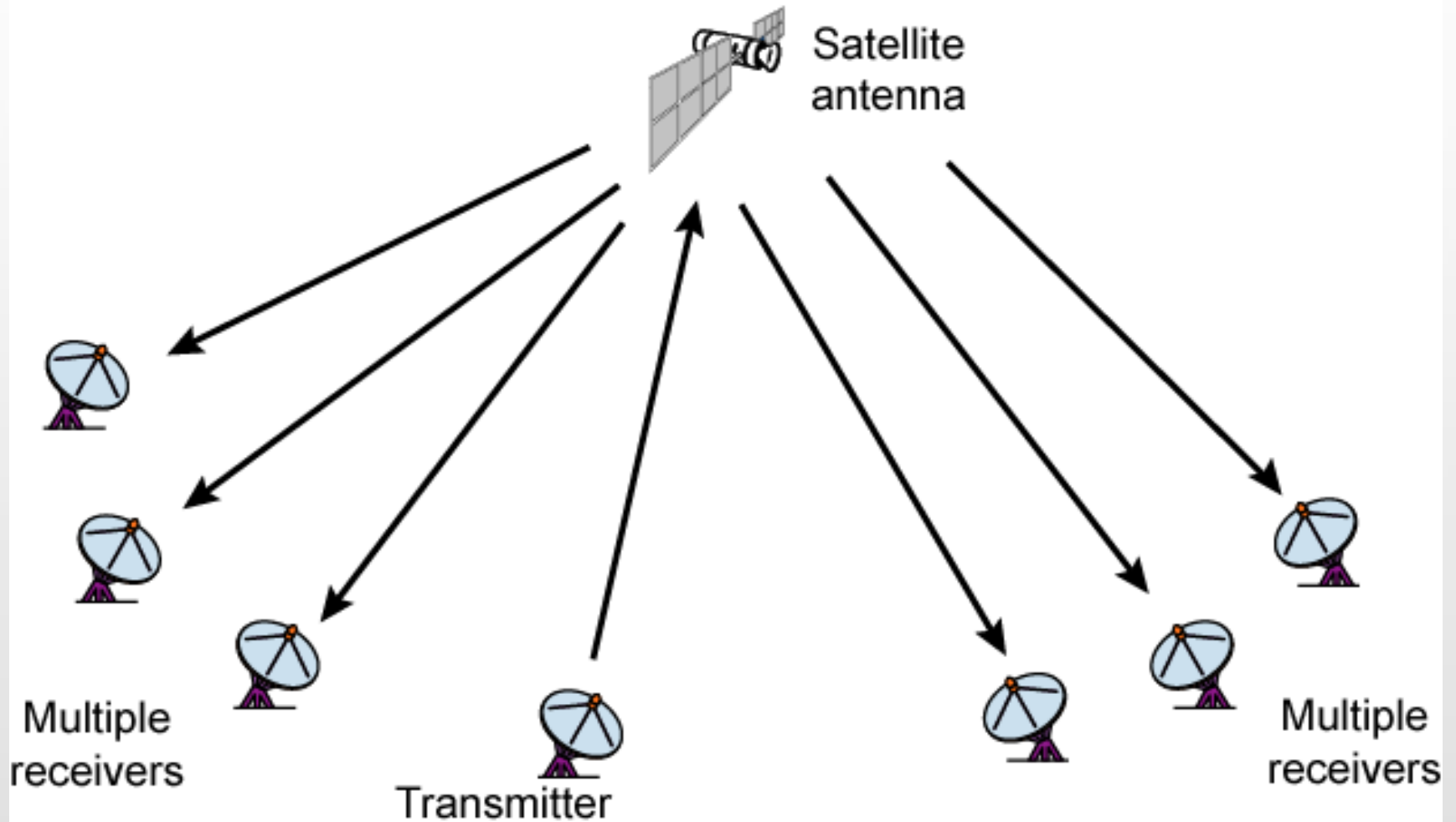
- Satellite is relay station
- Satellite receives on one frequency, amplifies or repeats signal and transmits on another frequency
- Requires geo-stationary orbit
 - Height of 35,784km
- Television
- Long distance telephone
- Private business networks

Satellite Point to Point Link



(a) Point-to-point link

Satellite Broadcast Link



(b) Broadcast link

Broadcast Radio

- Omnidirectional
- FM radio
- UHF and VHF television
- Line of sight

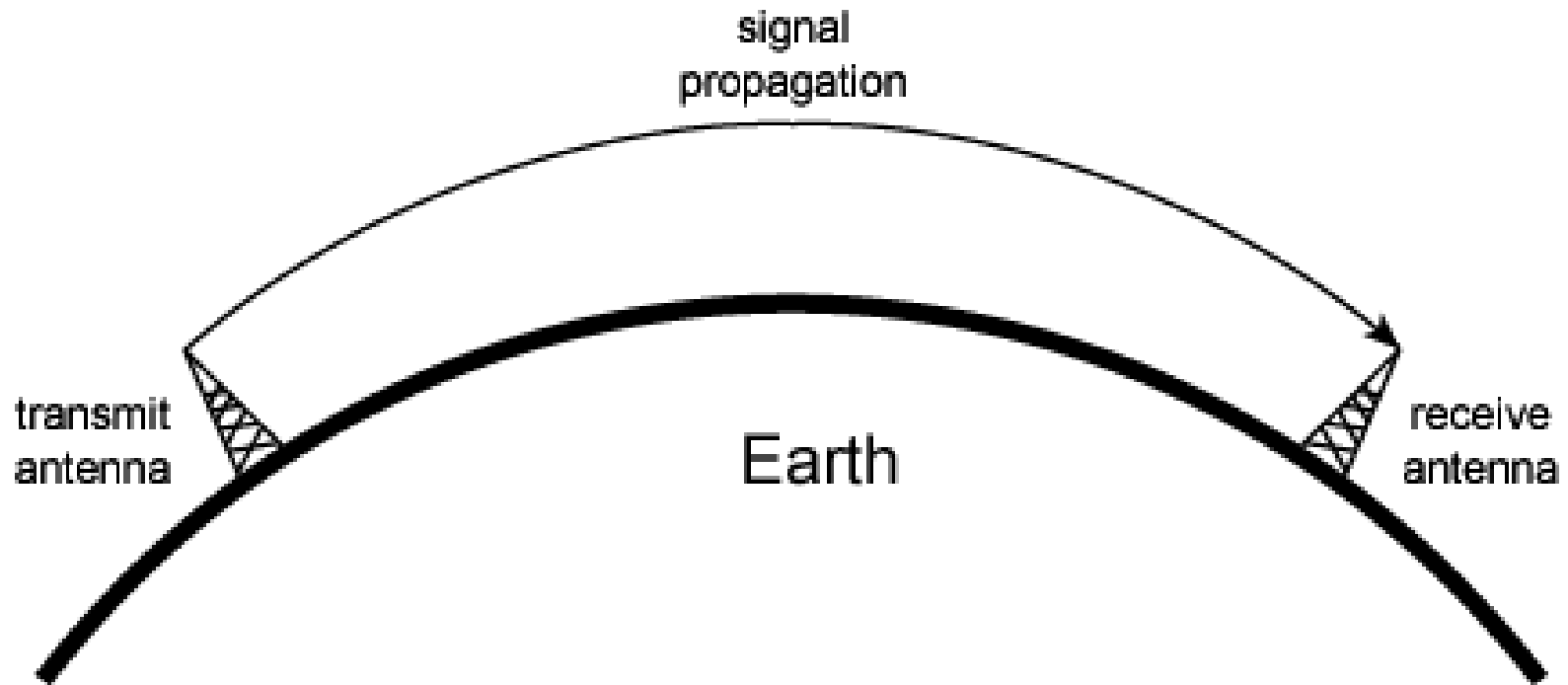
Infrared

- Modulate noncoherent infrared light
- Line of sight (or reflection)
- Blocked by walls
- e.g. TV remote control, IRD port

Wireless Propagation

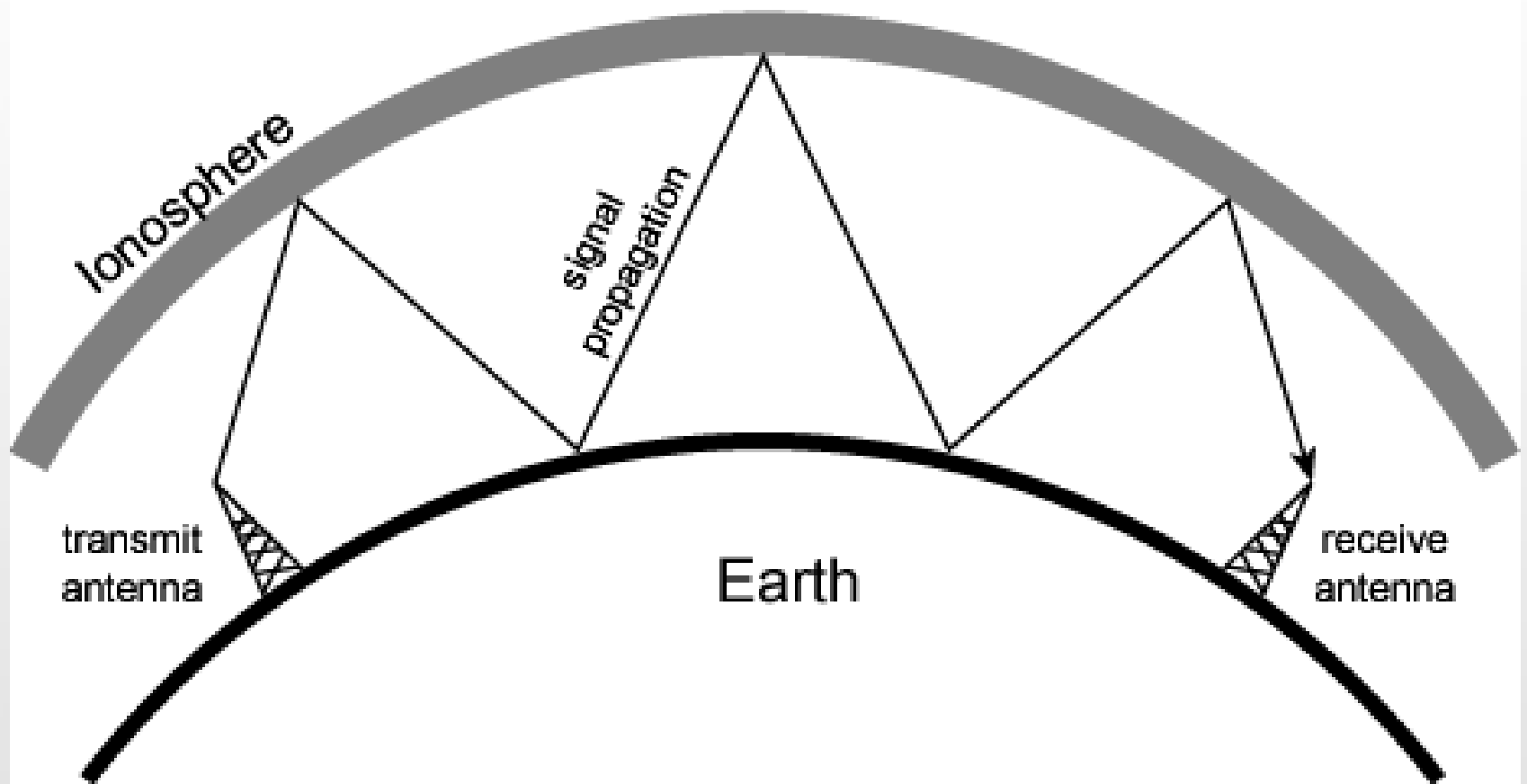
- Signal travels along three routes
 - Ground wave
 - Follows contour of earth
 - Up to 2MHz
 - AM radio
 - Sky wave
 - Amateur radio, BBC world service, Voice of America
 - Signal reflected from ionosphere layer of upper atmosphere
 - Line of sight
 - Above 30Mhz
 - May be further than optical line of sight due to refraction

Ground Wave Propagation



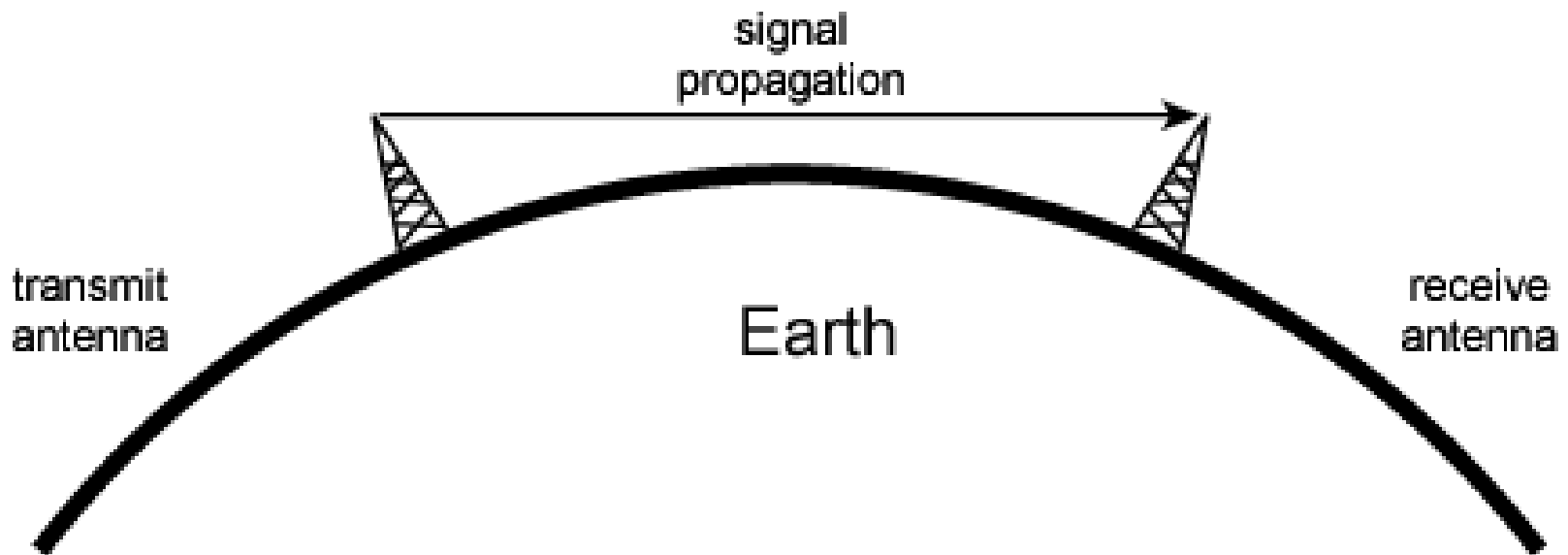
(a) Ground-wave propagation (below 2 MHz)

Sky Wave Propagation



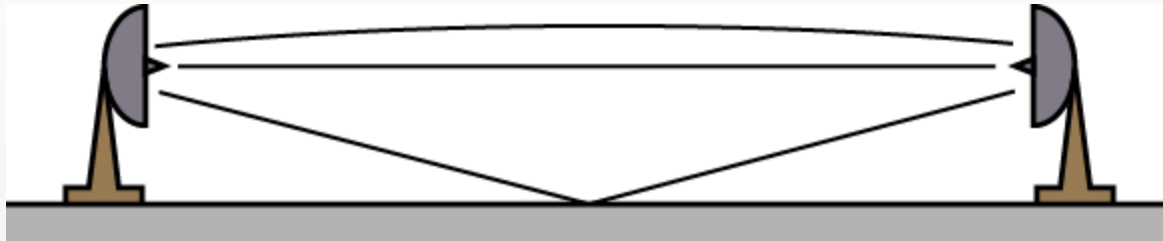
(b) Sky-wave propagation (2 to 30 MHz)

Line of Sight Propagation

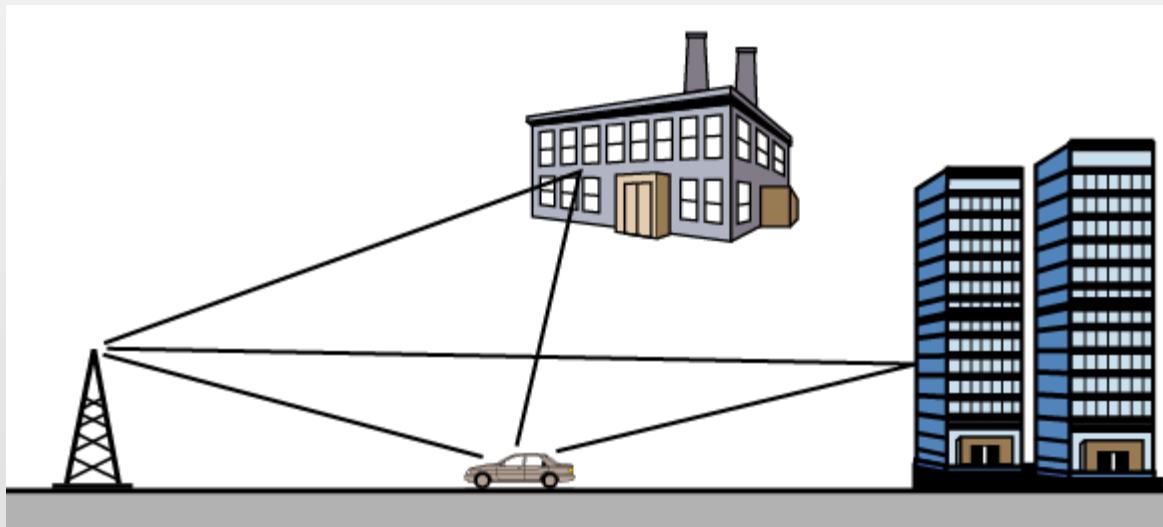


(c) Line-of-sight (LOS) propagation (above 30 MHz)

Multipath Interference



(a) Microwave line of sight



(b) Mobile radio