ECOM 4314

Data Communications

Fall September, 2010

Chapter 3 Outline

- Transmission Media
- GUIDED MEDIA
- UNGUIDED MEDIA

Transmission Media

- Transmission media is channel/path that can carry information from source to destination.
- Transmission media are located below the physical layer and controlled by physical layer.
- Transmission media is usually free space, metallic cable, or fiber optic.

Transmission Media

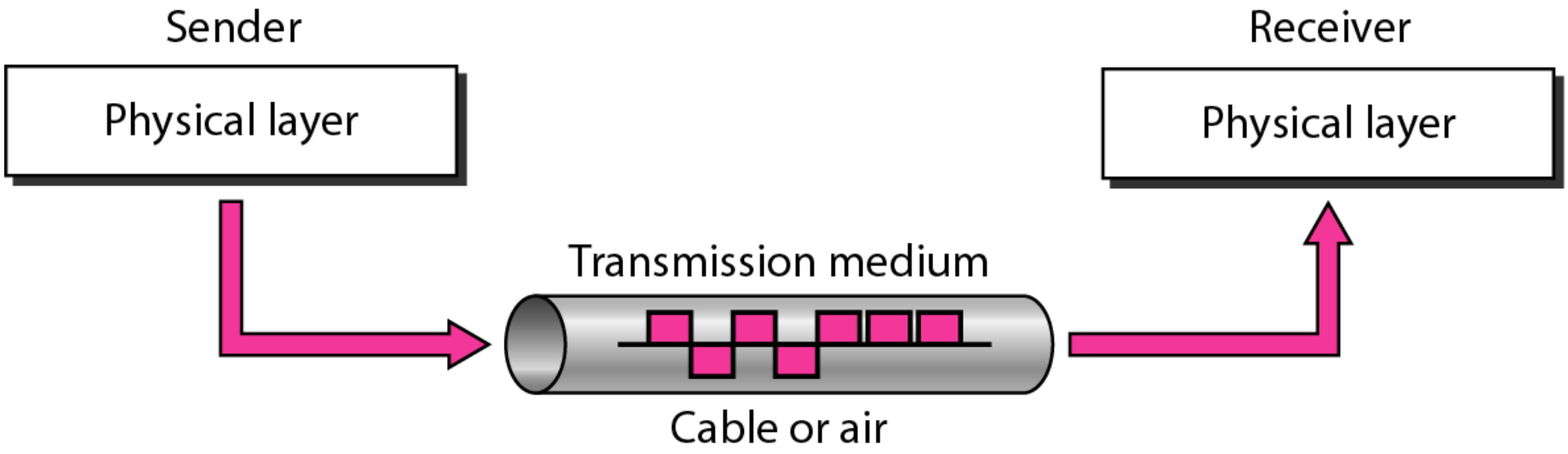


Figure 7.1 *Transmission medium and physical layer*

Transmission Media

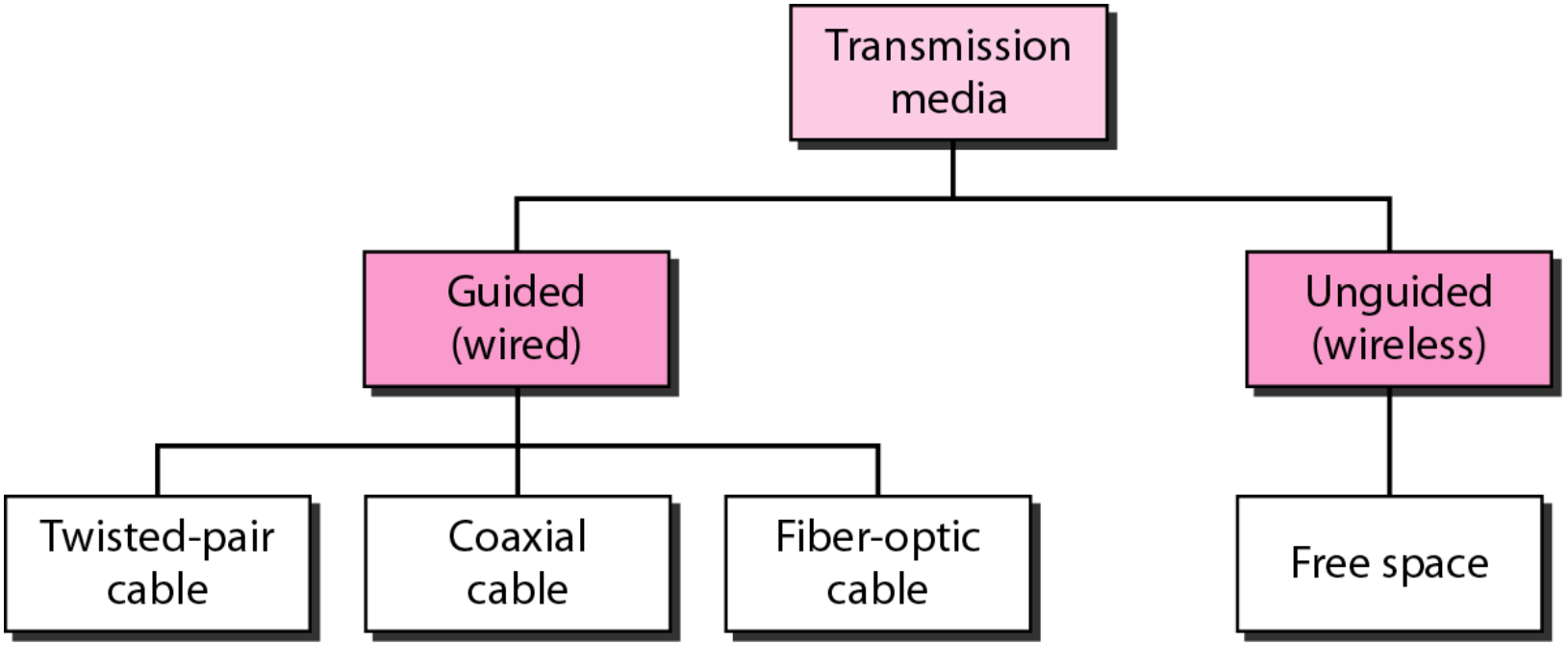


Figure 7.2 *Classes of transmission media*

Guided media

- Guided media, which are those that provide a channel from one device to another, include twisted-pair cable, coaxial cable, and fiber-optic cable.
- A signal traveling along any of these media is directed and contained by physical limits of the medium.

Twisted-pair cable

- It consists of two conductors each with its own plastic isolation.
- One used to carry signal , other is ground reference. The receiver use difference between two.

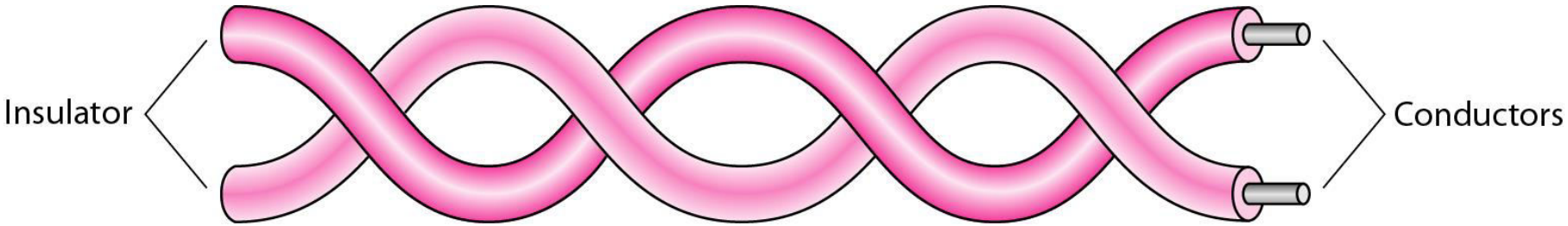


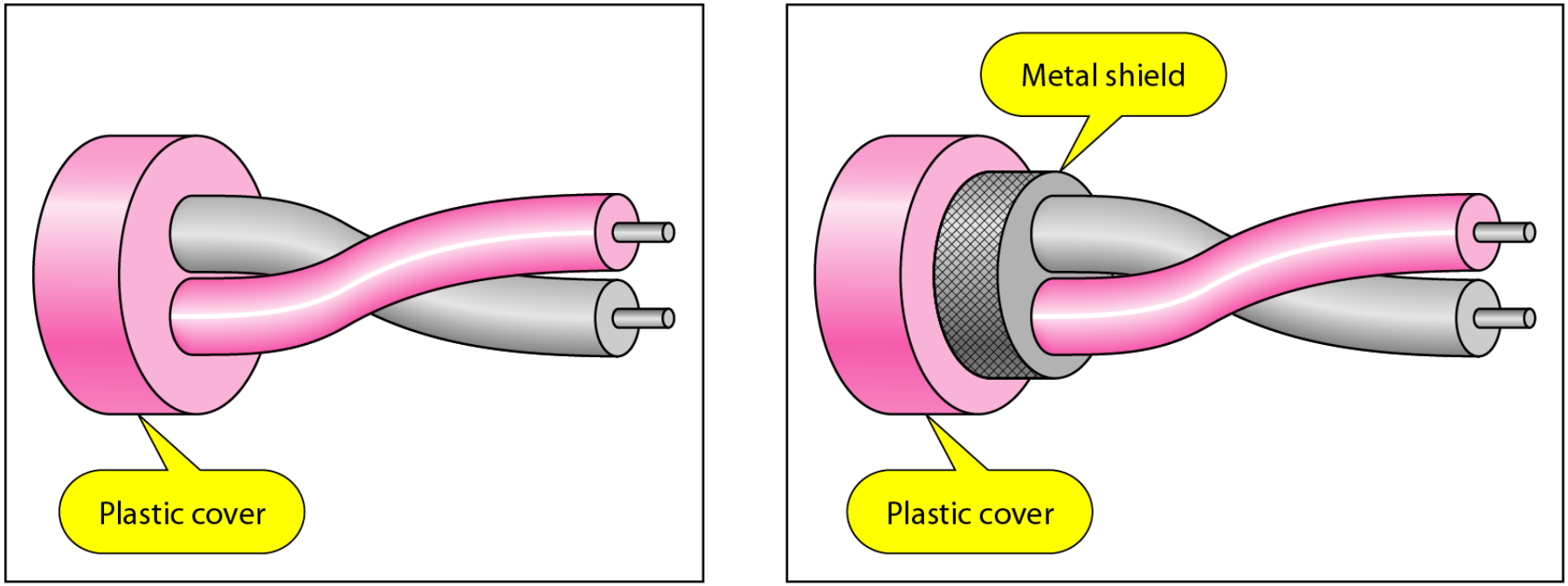
Figure 7.3 *Twisted-pair cable*

Twisted-pair cable

- If the two wires are parallel, the effect of unwanted signal is not the same in both wires, this results in a difference at the receiver.
- By twisting the pairs, a balance is maintained.
- For example, suppose one wire is close to noise and other is farther , in the next twist the reverse is true.
- Twisting make both wire are equally affected by external influences.

Twisted-pair cable type

- Unshielded twisted-pair (UTP)
- Shielded twisted-pair (STP)



a. UTP

b. STP

Figure 7.4 *UTP and STP cables*

Table 7.1 *Categories of unshielded twisted-pair 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

Twisted-pair cable

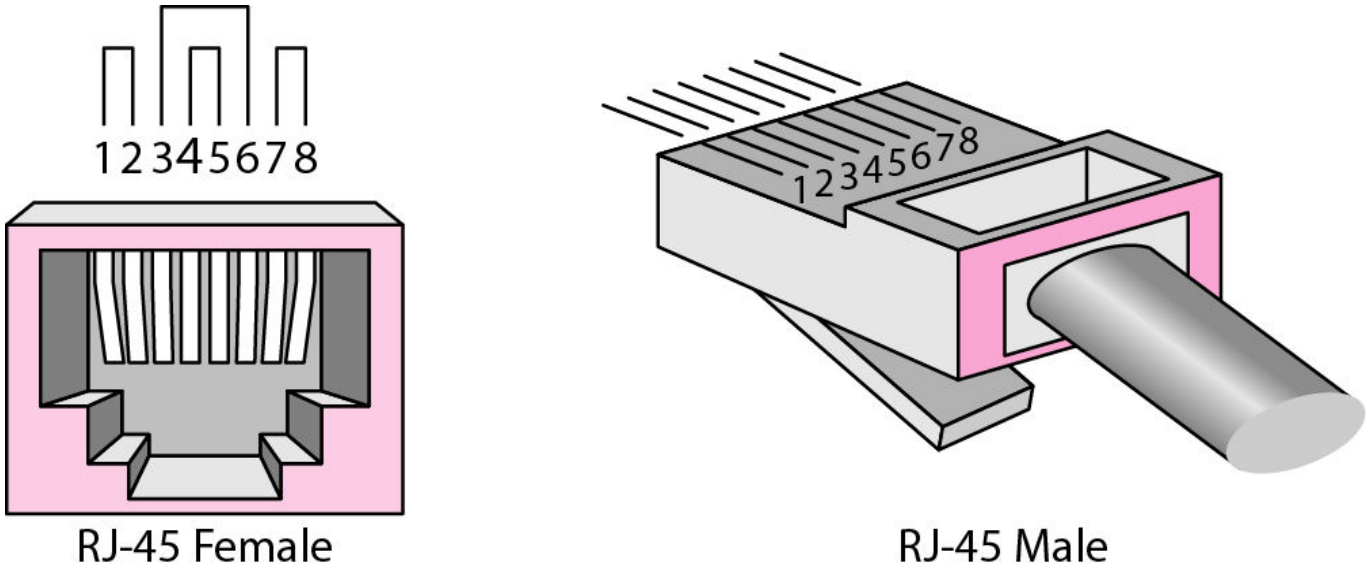
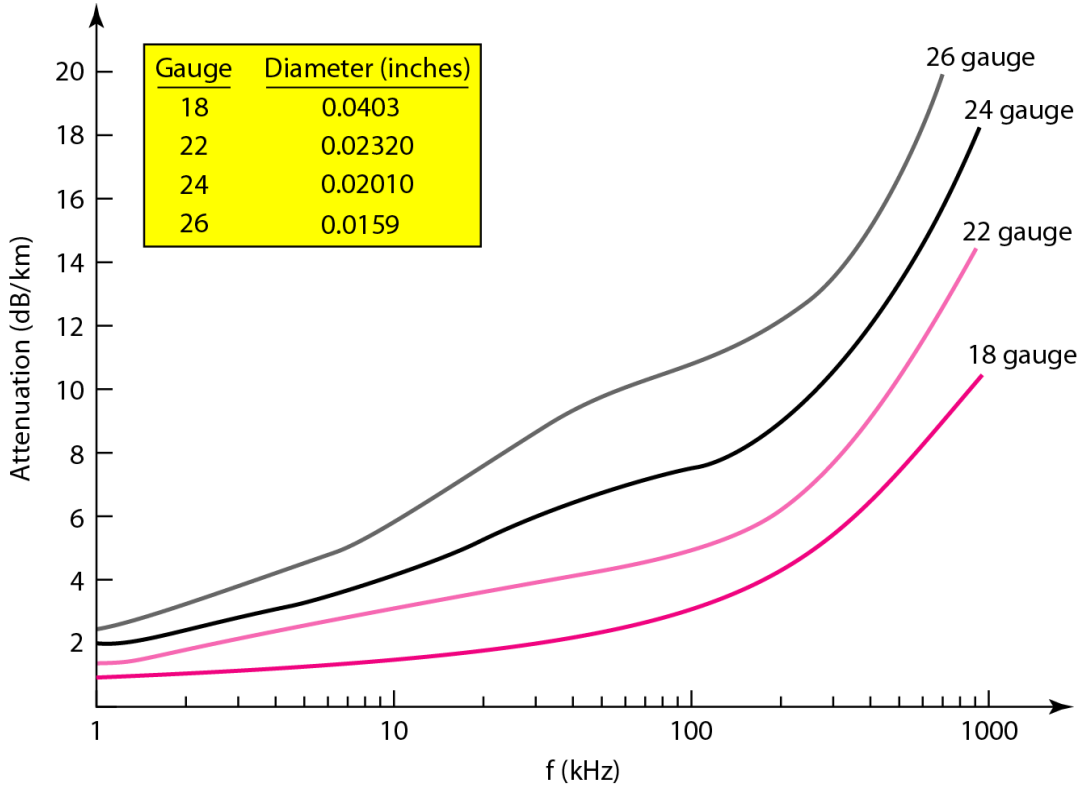


Figure 7.5 *UTP connector*

Twisted-pair cable performance

- With increasing frequency , the attenuation sharply increase.



Coaxial cable

- Coaxial cable carries signals of higher frequency ranges than those in twisted-pair.
- Instead of having two wires, coax has central core conductor of solid wire enclosed in insulating sheath which in true encased in outer conductor of metal foil .

Coaxial cable

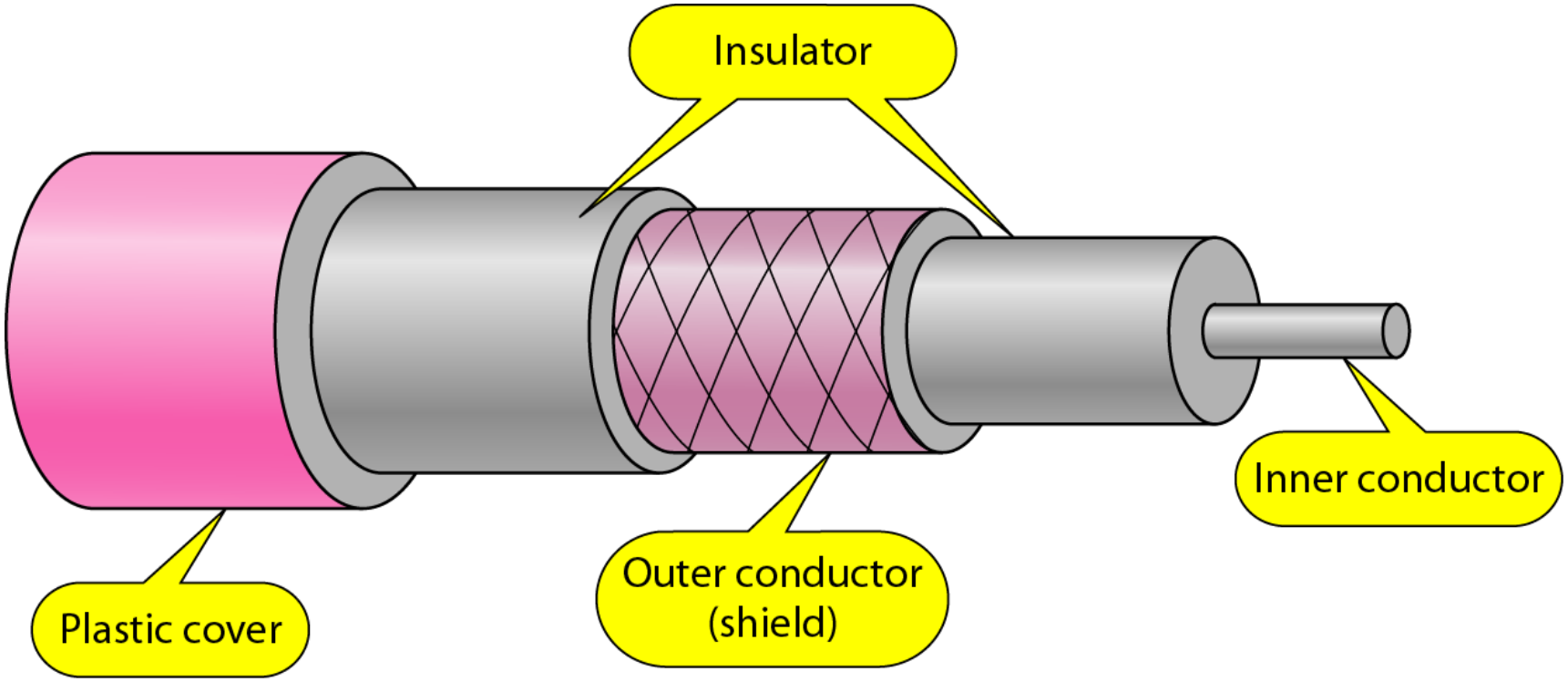


Figure 7.7 *Coaxial cable*

Coaxial cable

Table 7.2 *Categories of coaxial cables*

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

Coaxial cable

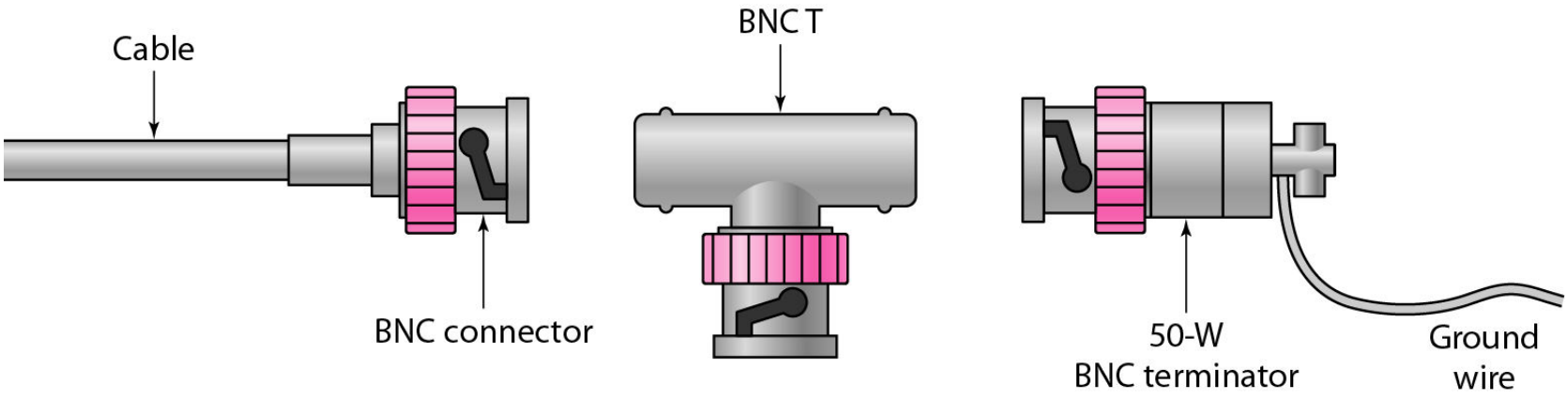


Figure 7.8 *BNC connectors*

Coaxial cable

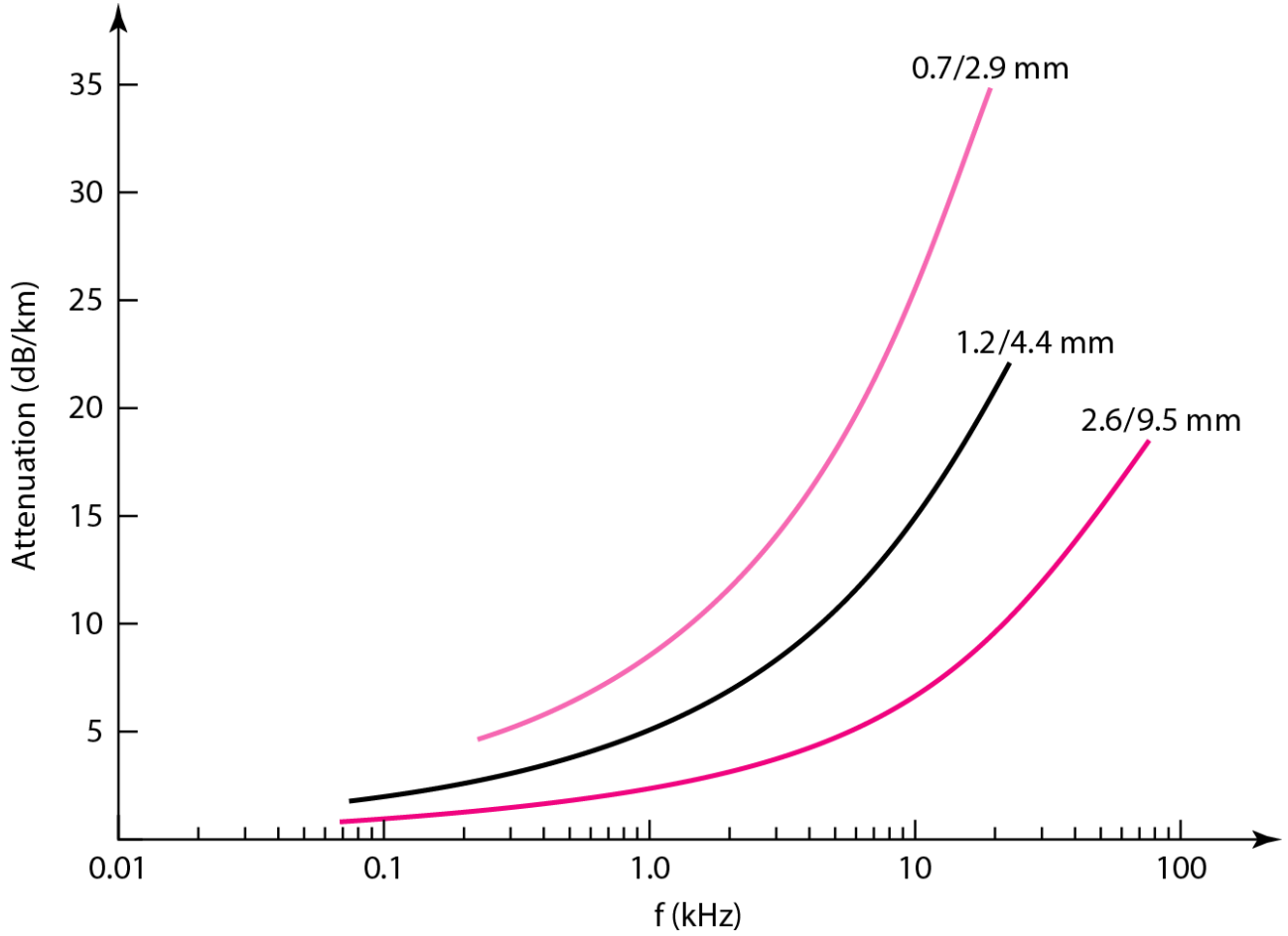


Figure 7.9 *Coaxial cable performance*

Optical Fiber

- Light travels in straight line as long as it is moving through a single uniform substance.
- If a ray of light traveling through one substance suddenly enters another substance of difference density, the ray change direction.

Optical Fiber

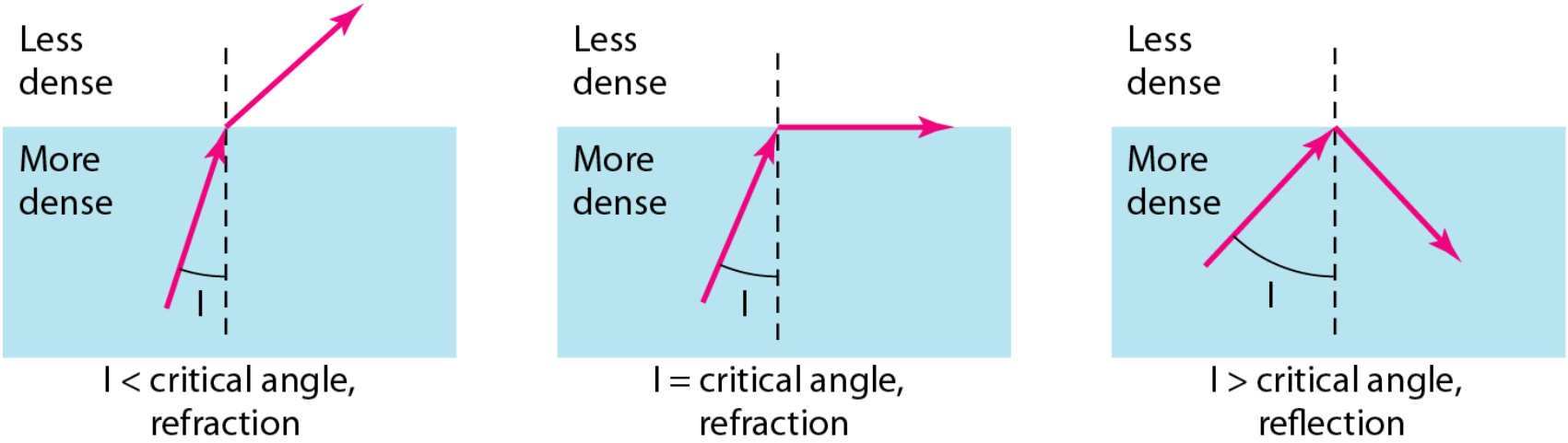


Figure 7.10 Fiber optics: ***Bending of light ray***

Optical Fiber

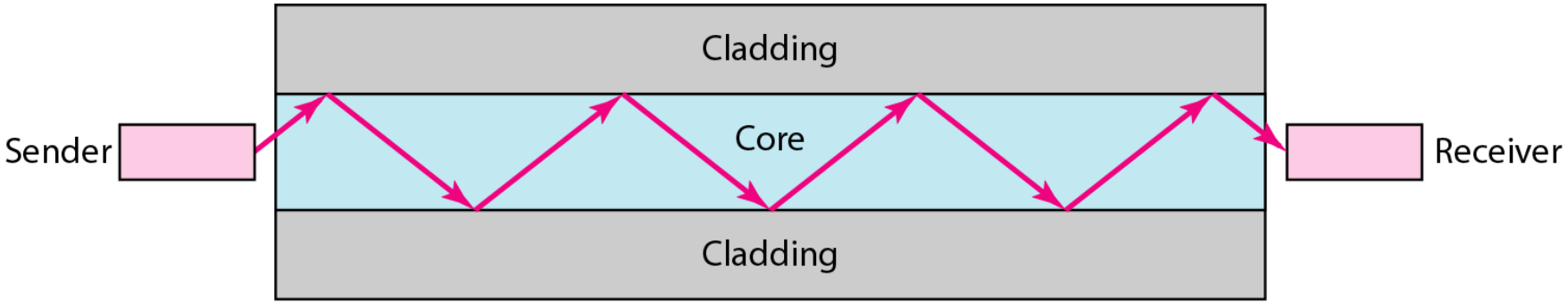


Figure 7.11 *Optical fiber*

Propagation modes

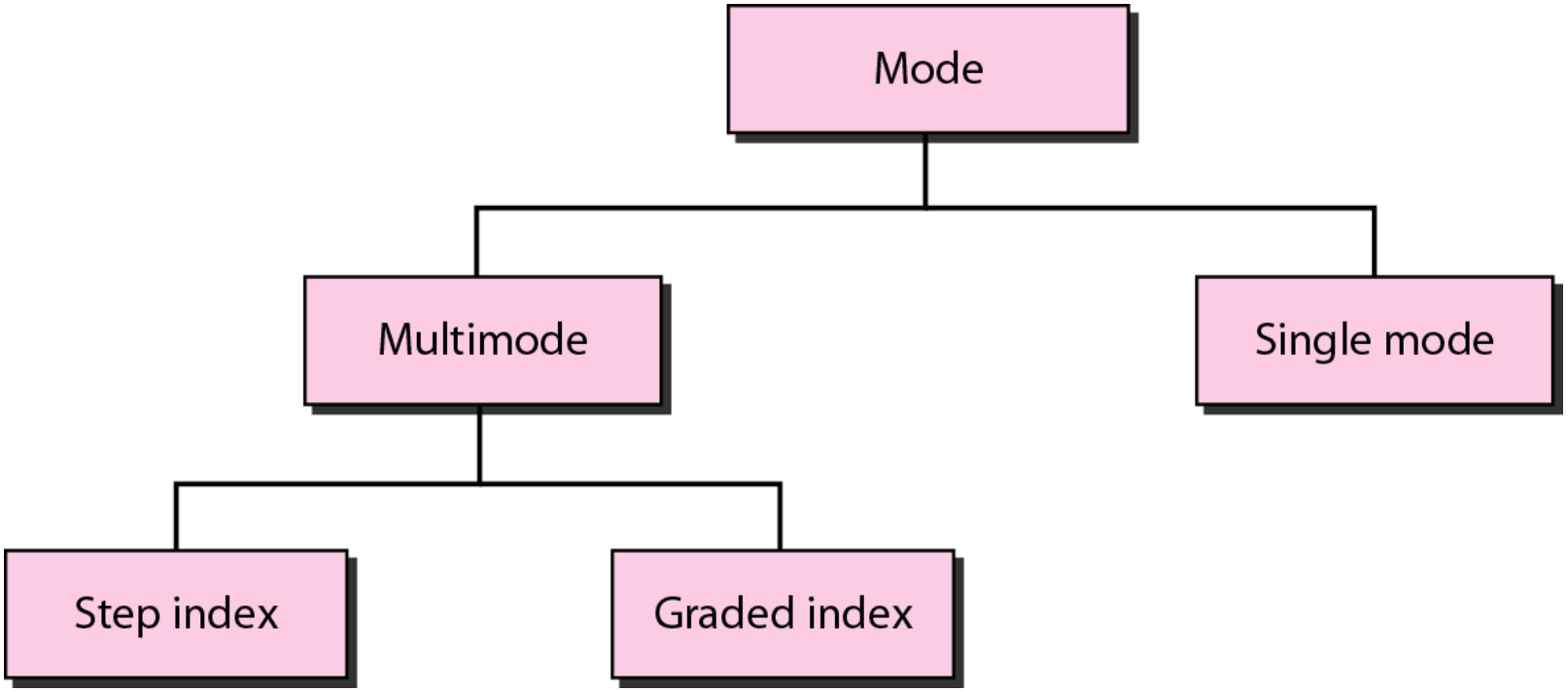
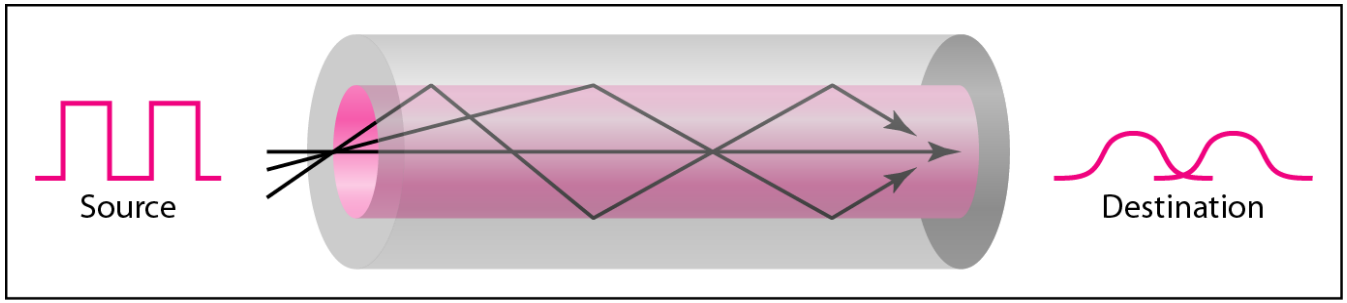
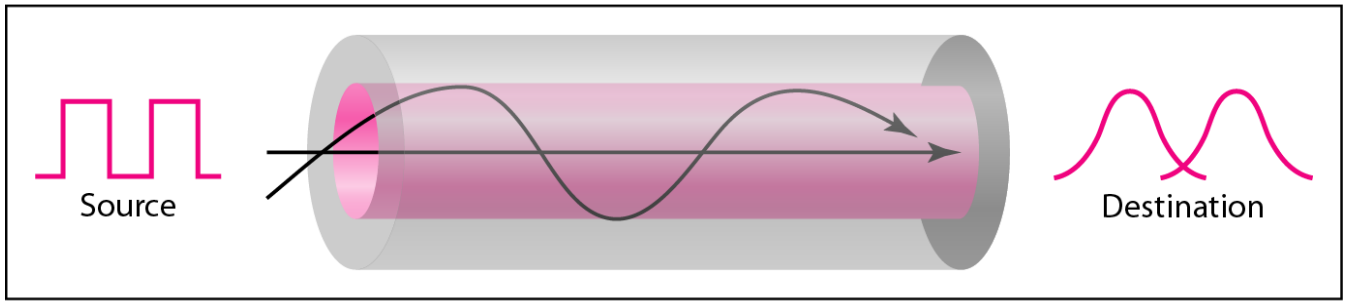


Figure 7.12 *Propagation modes*

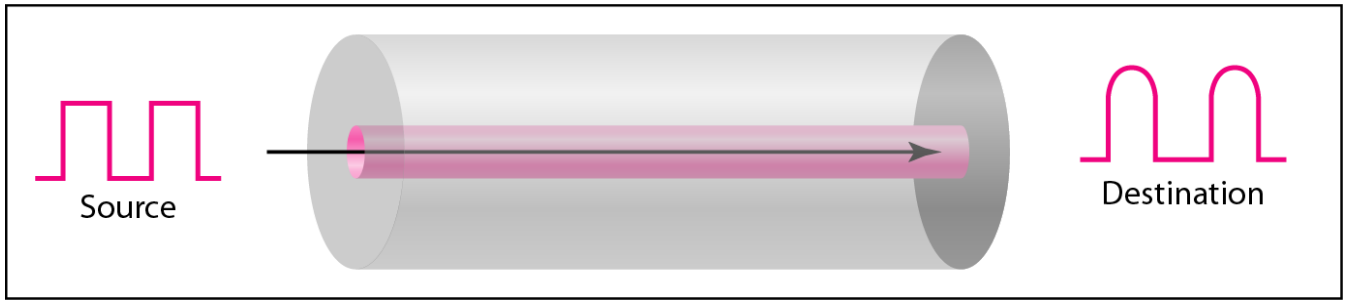
Figure 7.13 *Modes*



a. Multimode, step index



b. Multimode, graded index



c. Single mode

Optical Fiber

Table 7.3 ***Fiber types***

Type	*Core (μm)*	*Cladding (μm)*	*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

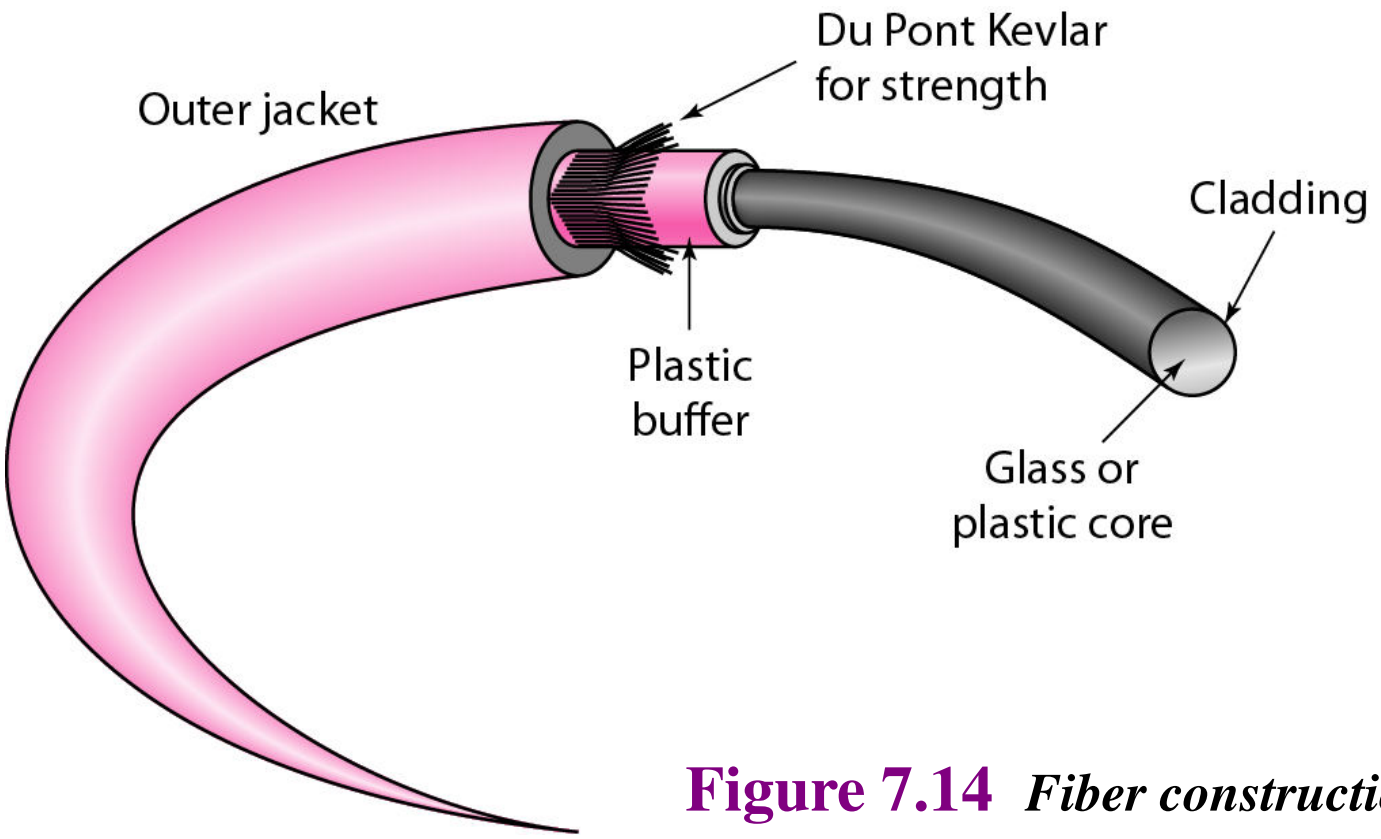


Figure 7.14 *Fiber construction*

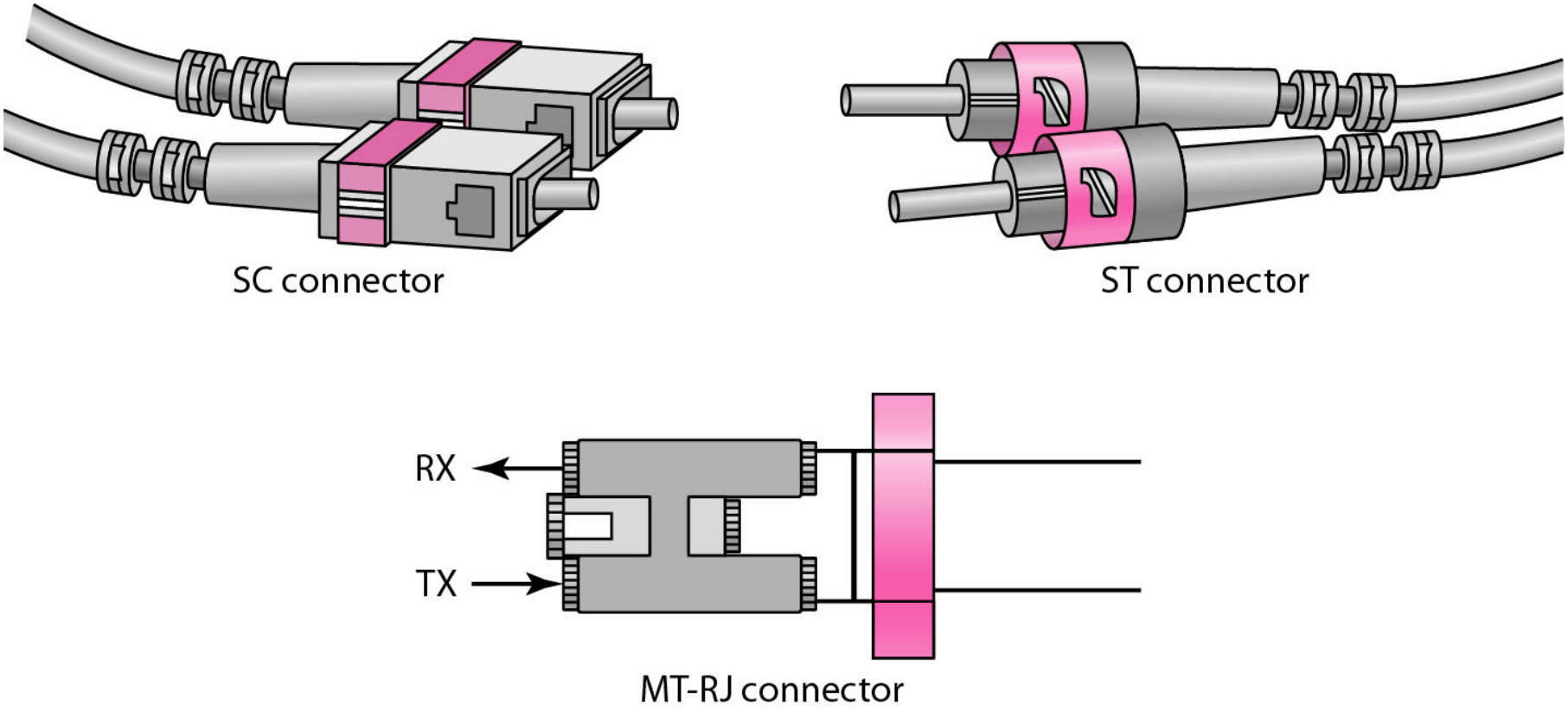
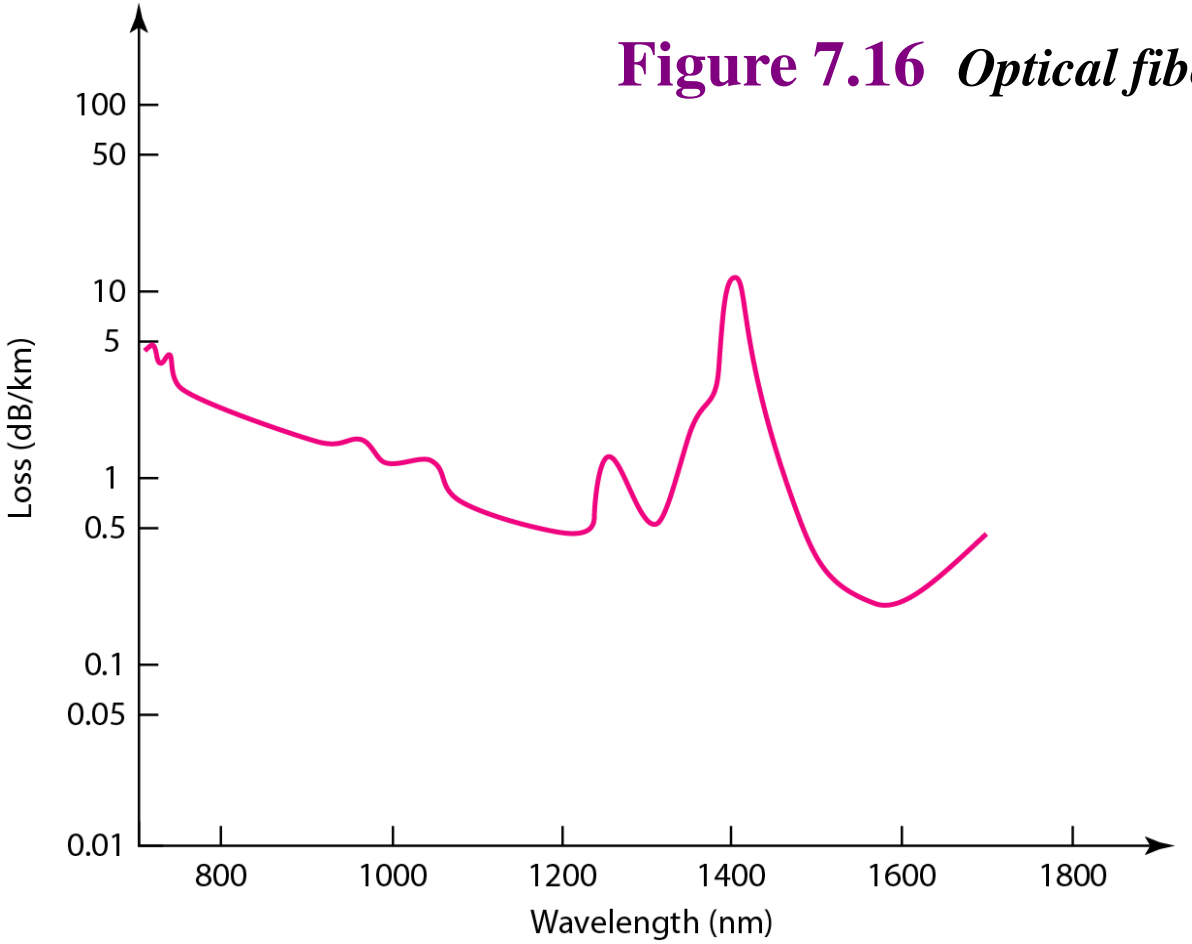


Figure 7.15 ***Fiber-optic cable connectors***

Figure 7.16 *Optical fiber performance*



Advantages/disadvantages

- Advantages
  - Noise resistance
  - Less signal attenuation
  - Higher bandwidth
- Disadvantages
  - Cost
  - Installation and maintenance
  - unidirectional light propagation.

Unguided Media

- Unguided media transport electromagnetic waves without using a physical conductor.
- This type of communication is often referred to as wireless communication.

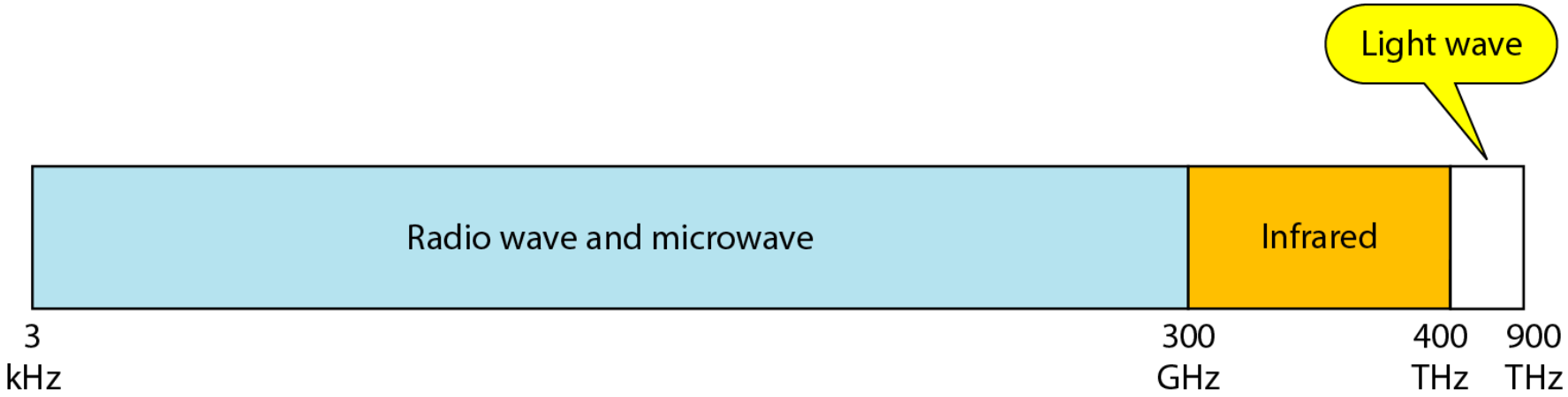
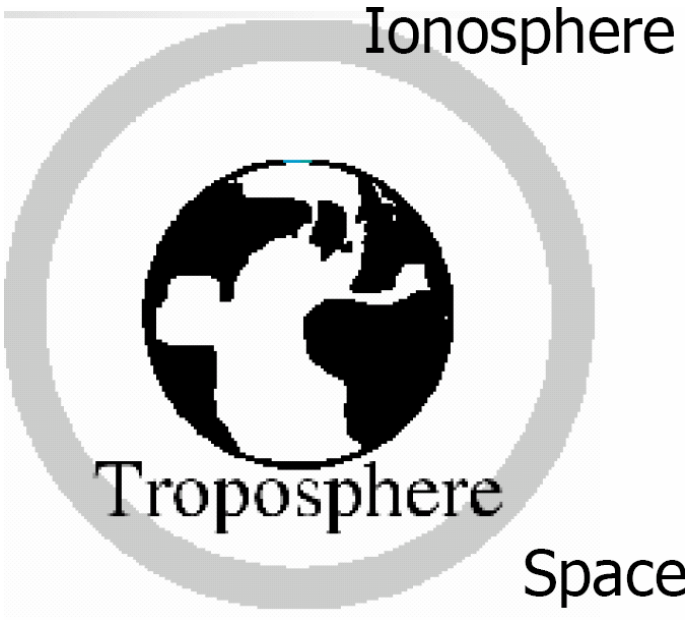


Figure 7.17 *Electromagnetic spectrum for wireless communication*

Earth Atmosphere

- Troposphere
  - 30 miles from earth
  - Air
  - Cloud, wind, weather
  - Jet plane travel
- Ionosphere
  - Between troposphere and space
  - Free electrically charged particles



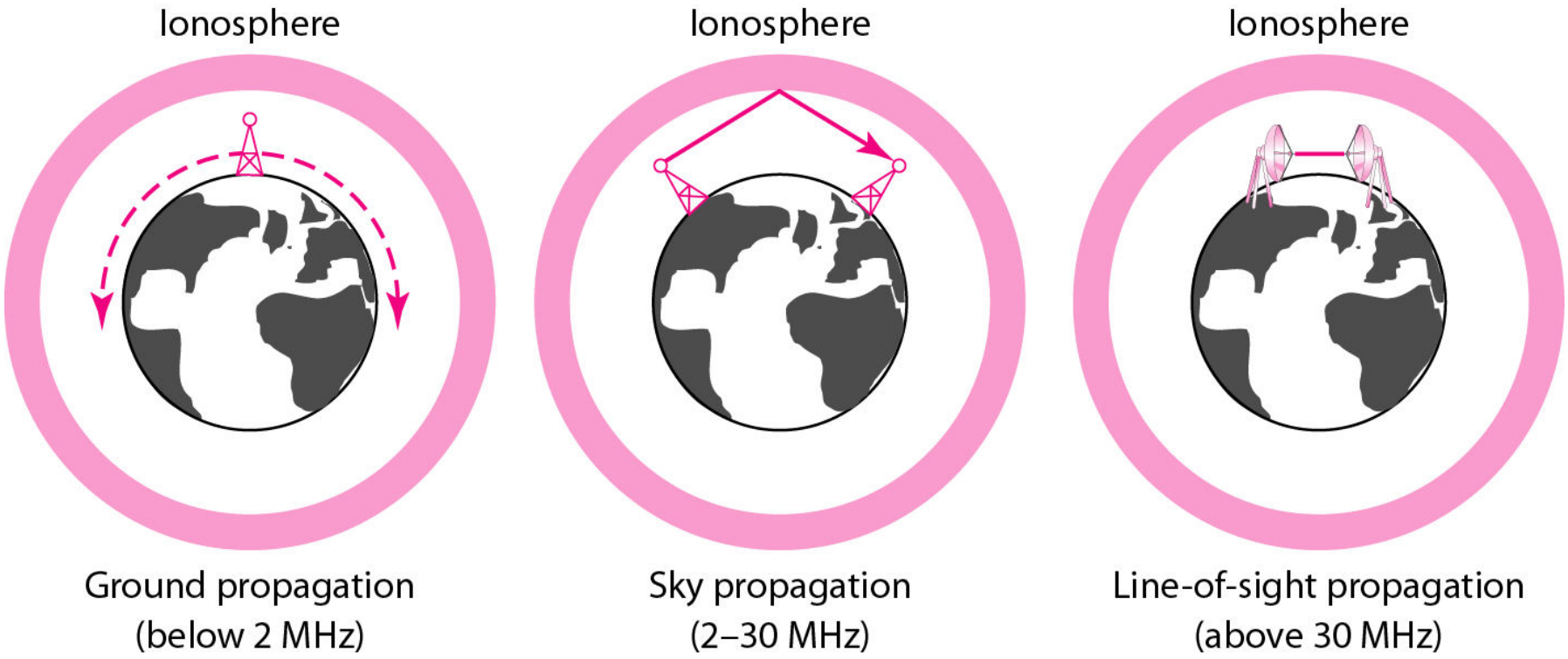
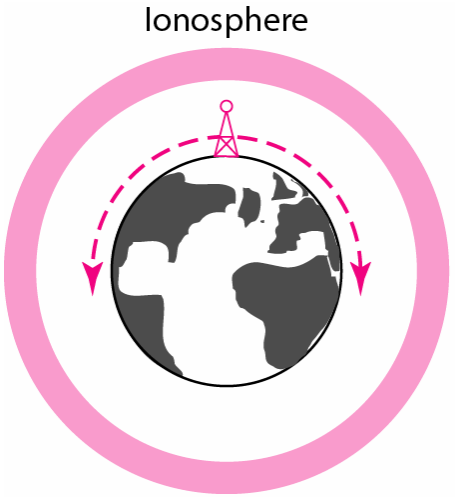


Figure 7.18 ***Propagation methods***

Ground propagation

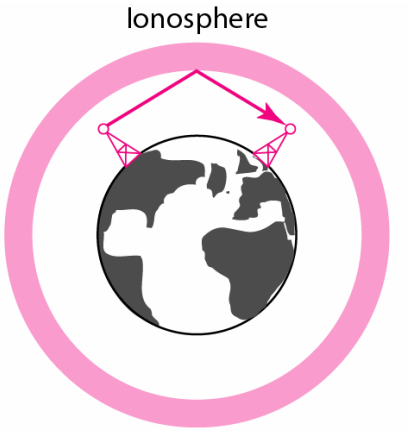
- Radio travels through the lowest portion of the atmosphere
- VLF (in range of 3KHz – 10 KHz)
  - Low attenuation
  - Atmosphere noise (heat & electricity)
  - For long-range radio navigation
- LF (in range of 30 KHz – 300 KHz)
  - For long-range radio navigation
  - Greater attenuation



Ground propagation
(below 2 MHz)

Sky propagation

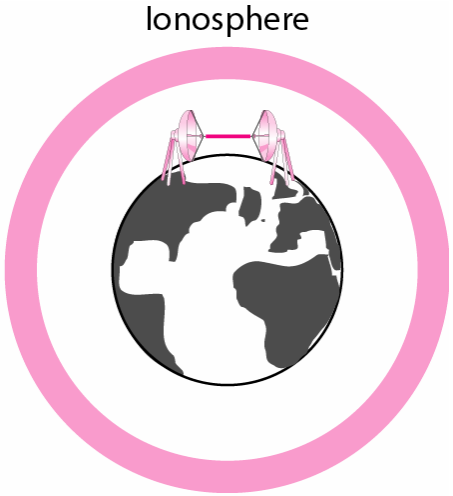
- Higher frequency radio waves radiate
- upward into ionosphere where they reflect back to earth.
- Allows greater distance with lower output power



Sky propagation
(2–30 MHz)

Line-of-sight propagation

- Very high frequency signals transmitted in straight
- lines from antenna to antenna.
- Antenna must be directional



Line-of-sight propagation
(above 30 MHz)

Band	*Range*	*Propagation*	*Application*
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

Wireless transmission waves

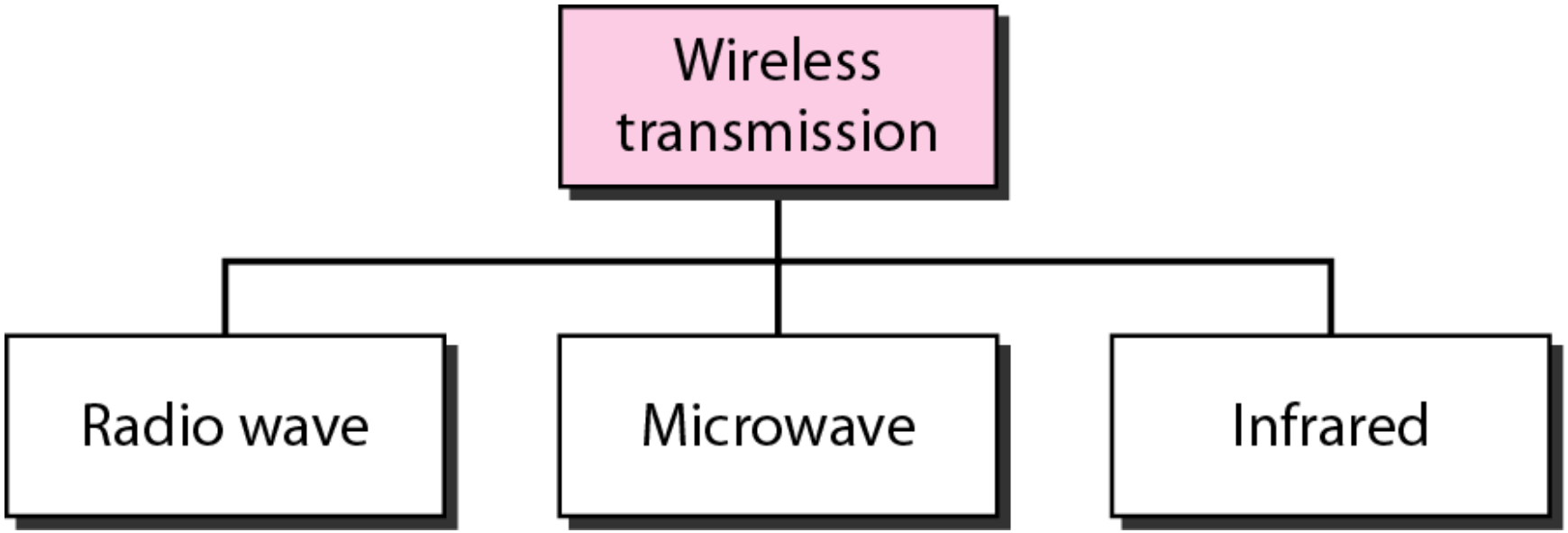


Figure 7.19 *Wireless transmission waves*

Radio waves

Radio waves are used for multicast communications, such as radio and television, and paging systems. They can penetrate through walls. Highly regulated. Use omni directional antennas

Radio waves

- Ranging from 3 KHz and 1 GHZ
- Omnidirectional, waves propagated in
- all directions
- Sender and receiver must not be aligned
- Propagate in sky mode
- With low frequencies can penetrate walls
- The radio wave band is relatively narrow

Microwave

- Ranges from 1 and 300 GHz
  - The can be narrowly focused
  - A pair of antenna can be aligned without
- Characteristics
  - Line-of-sight
  - Repeaters are needed for long distances
  - High frequency cannot penetrate walls
  - Microwave band is relatively wide, therefore wider
  - subbands can be assigned, (higher data rate)

Microwave

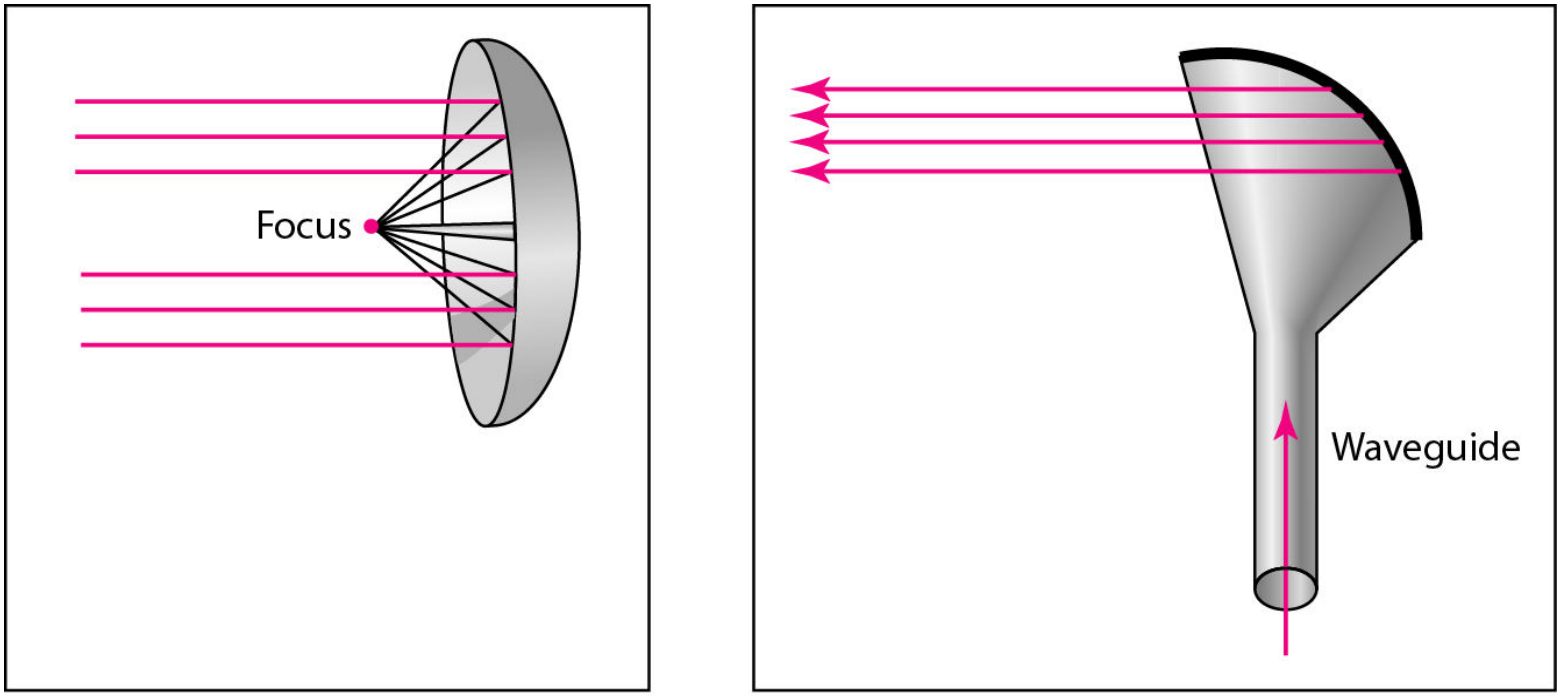


Figure 7.21 *Unidirectional antennas*

infrared

- Ranges from 300 GHz to 400 GHz
- Used for short range communication
- High frequency
- Cannot penetrate walls