CNT3004 - Computer Network Concepts

Dr. C. Tidwell, Fall 2020

Chapter 7

Transmission Media

Figure 7.1 *Transmission medium and physical layer*

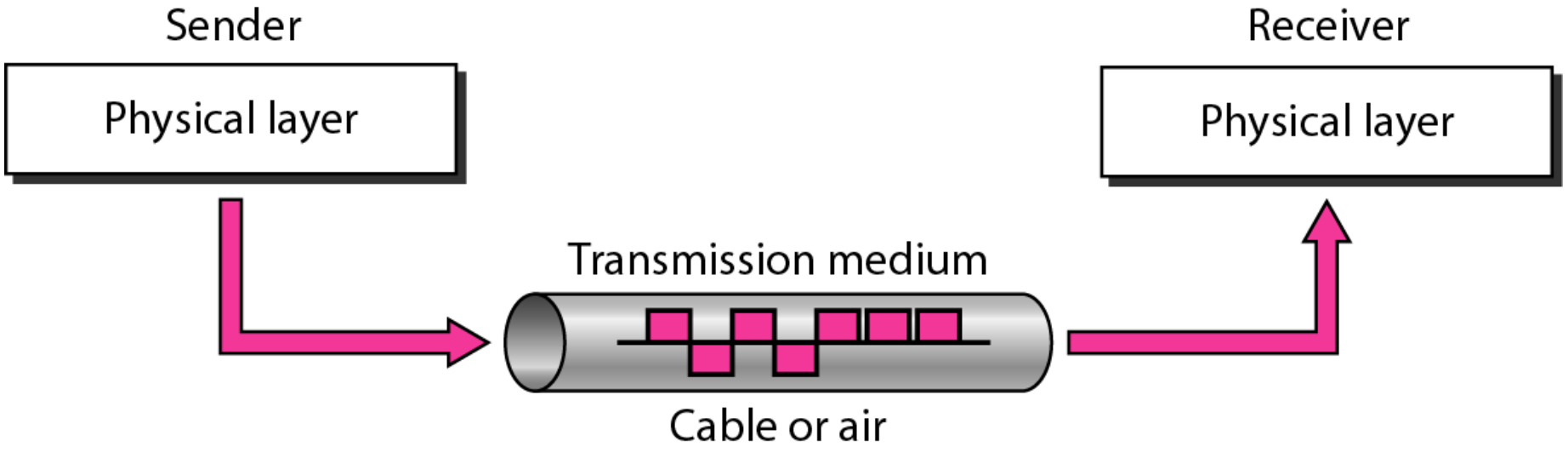
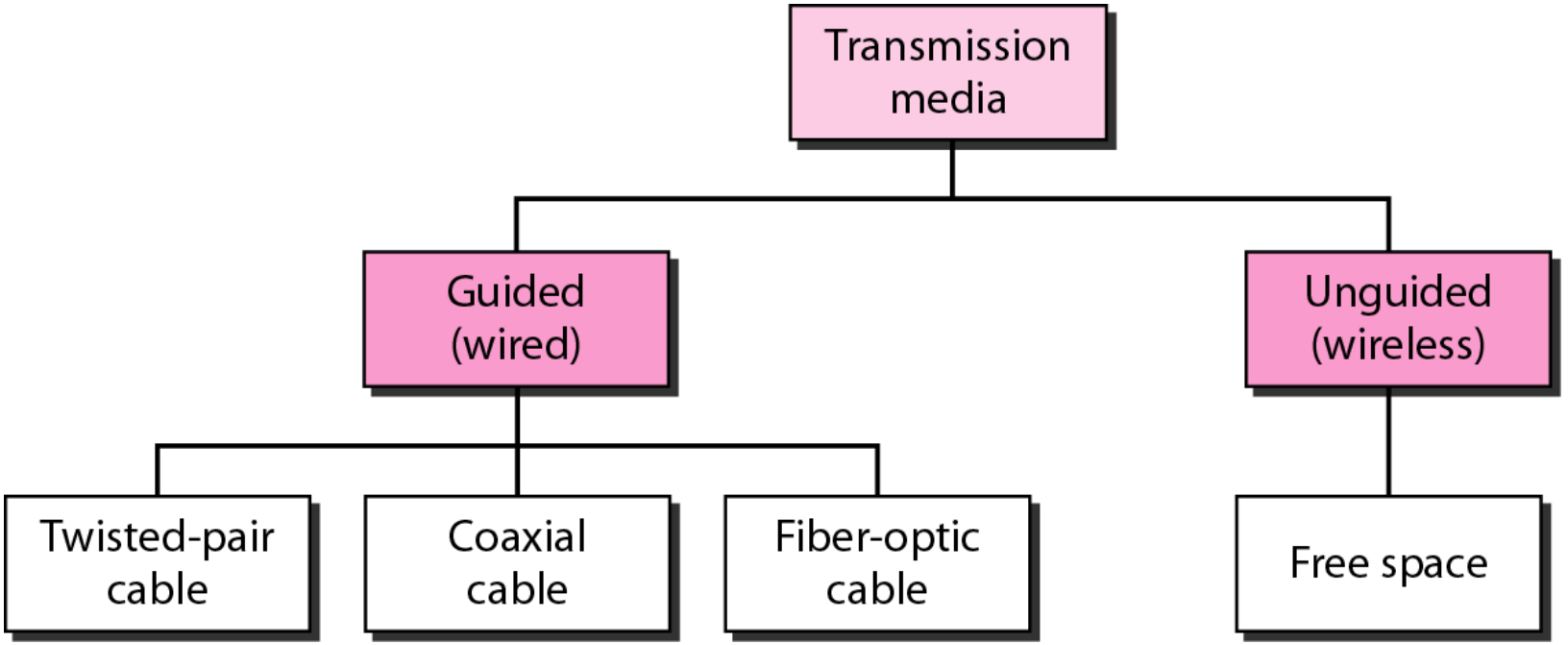


Figure 7.2 *Classes of transmission media*



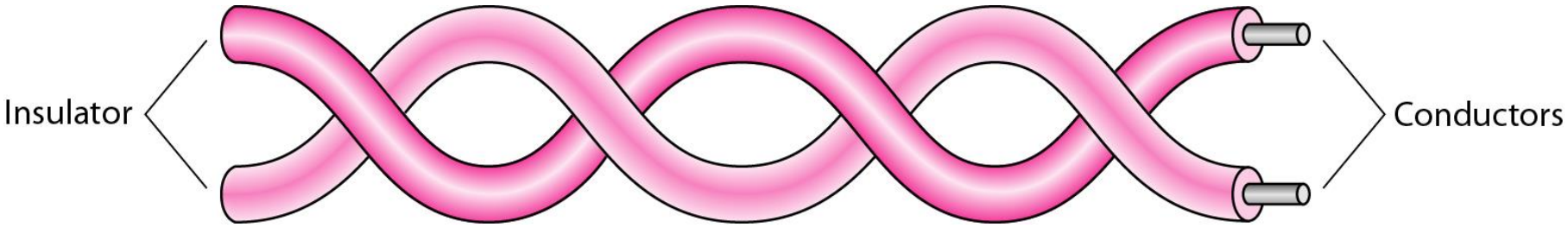
7-2 GUIDED MEDIA

Guided media, which are those that provide a conduit from one device to another, include twisted-pair cable, coaxial cable, and fiber-optic cable.

Topics discussed in this section:

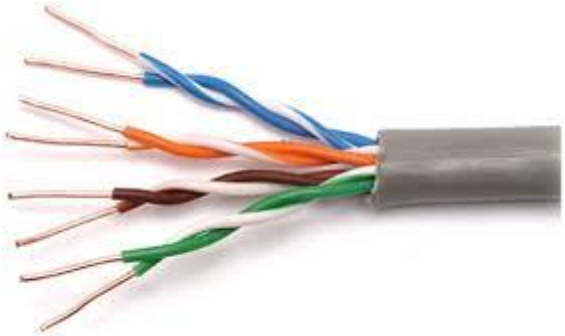
Twisted-Pair Cable
Coaxial Cable
Fiber-Optic Cable

Figure 7.3 *Twisted-pair cable*



Why twisted?
To make unwanted signals interference cancel out each other.

Unshielded Twisted Pair



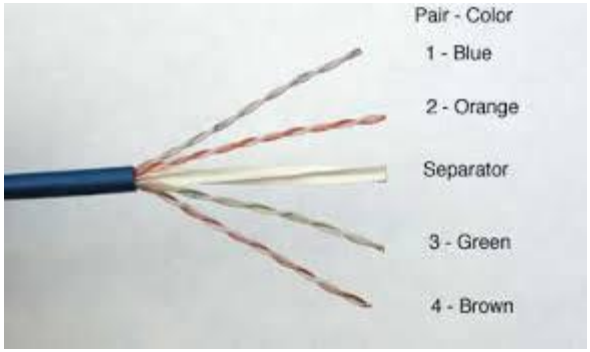
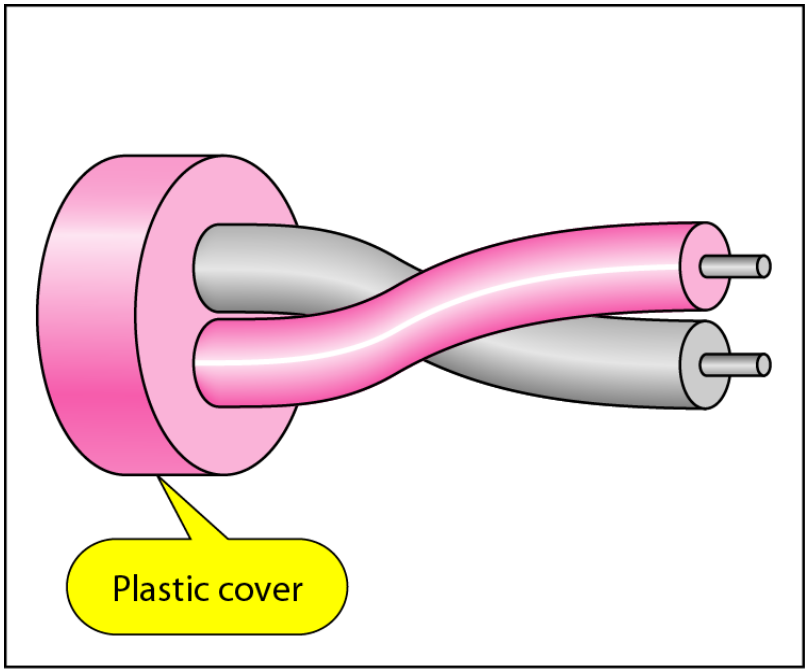
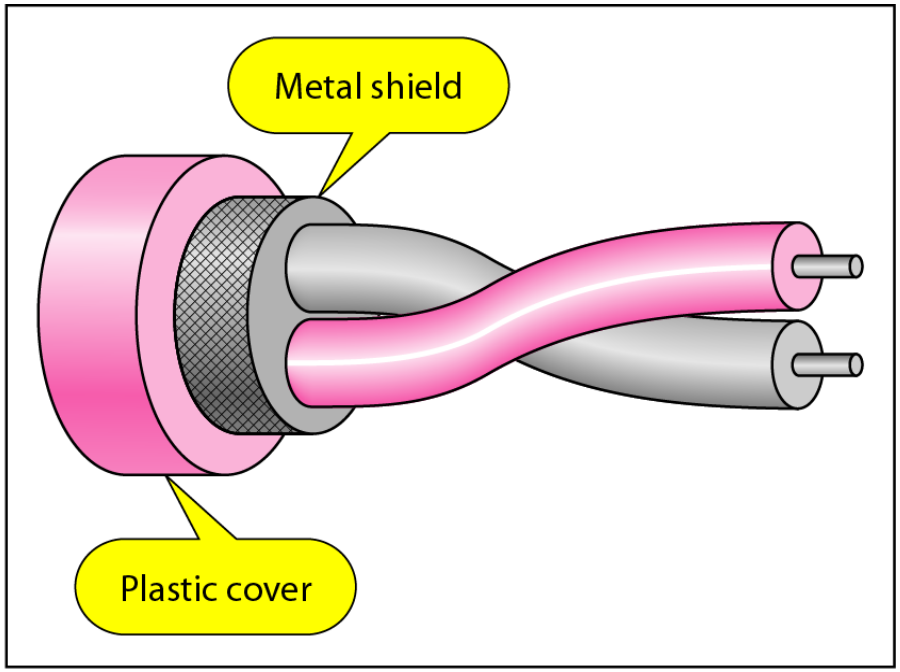


Figure 7.4 *UTP (unshielded twisted pair) and STP (shielded twisted pair) cables*



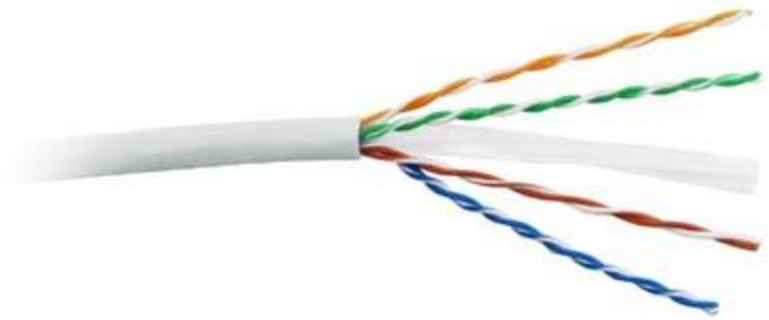
a. UTP

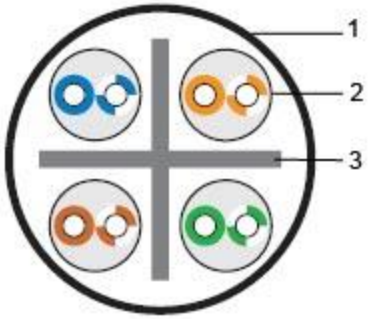


b. STP

Example: Ethernet, phone line

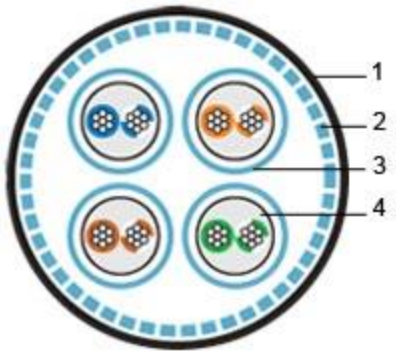
UTP cables





1 – Jacket
2 – Solid twisted pair
3 – Spacer

SSTP cables



1 – Jacket
2 – Shield-braid
3 – Shield-foil
4 – Stranded twisted pair

Figure 7.5 *UTP connector*

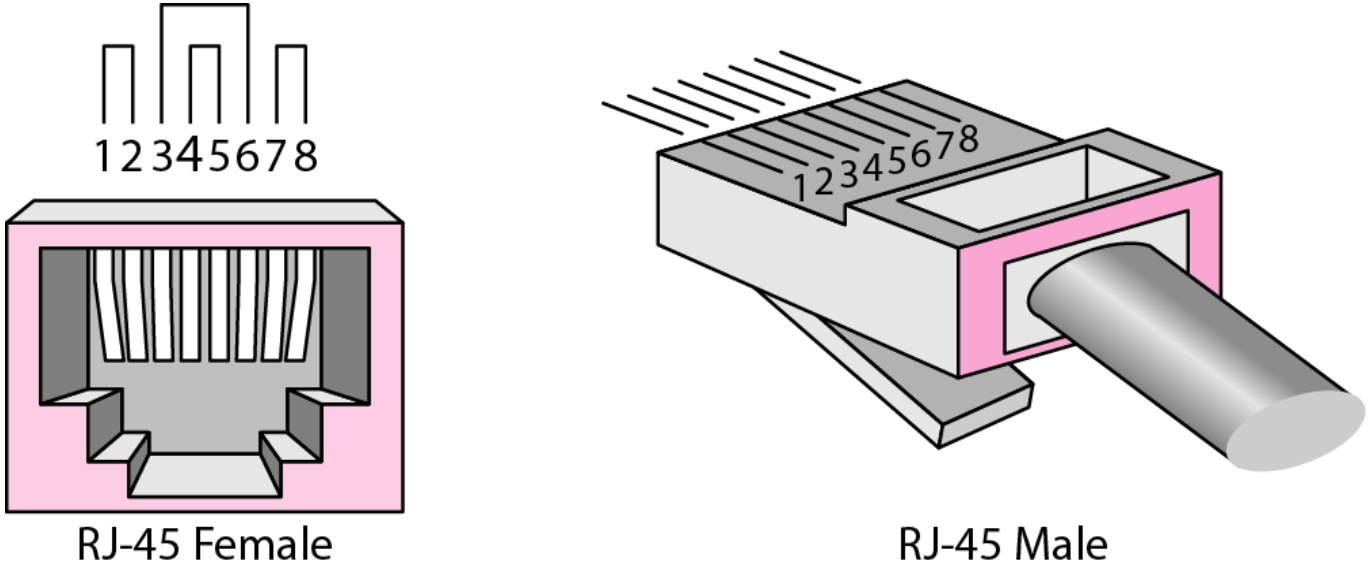


Figure 7.7 *Coaxial cable*

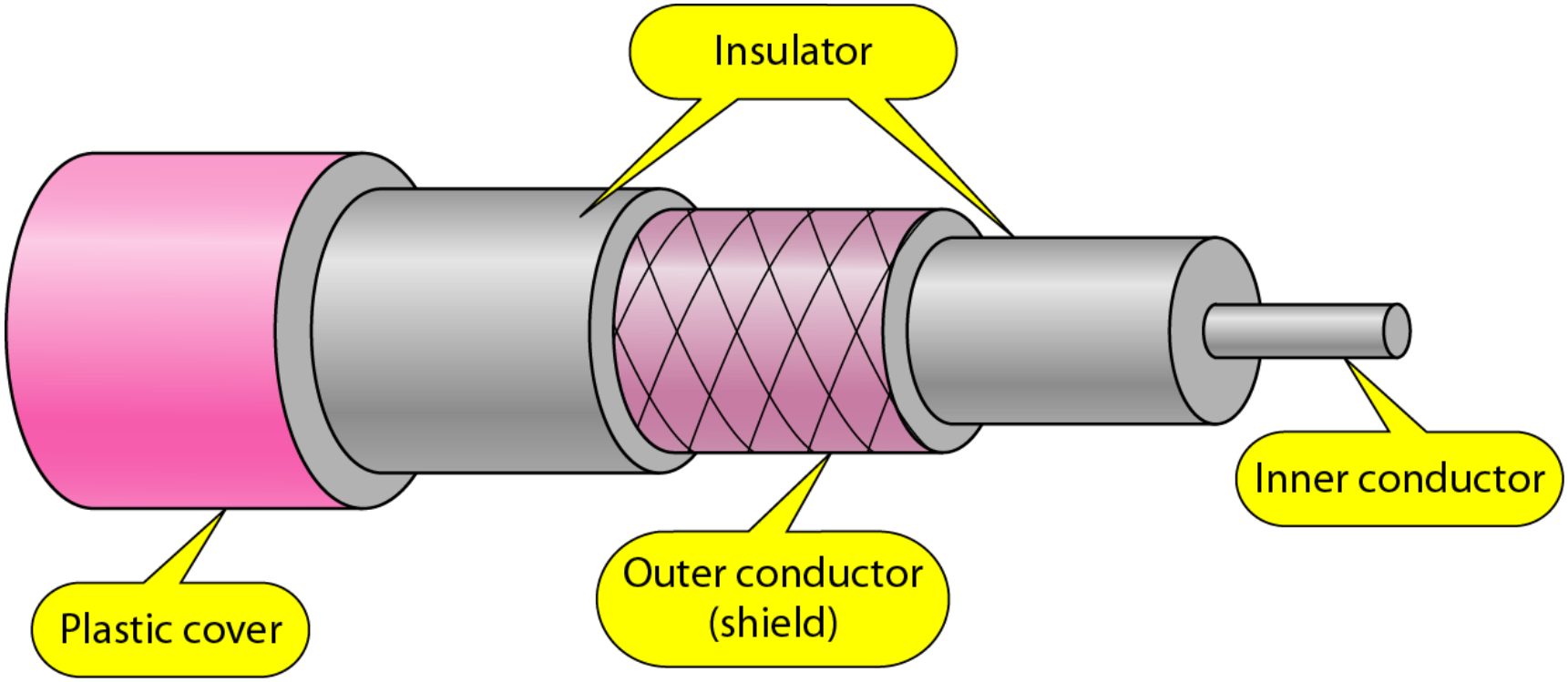
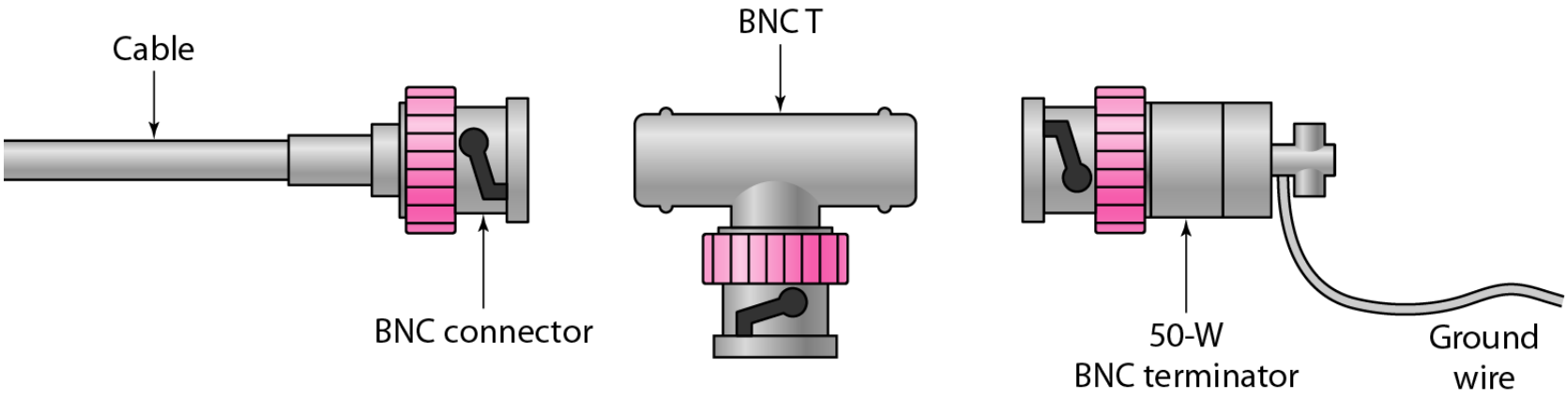


Figure 7.8 *BNC connectors*



**Not commonly used today (if at all); was popular in Bus networks in the 80s and 90s*

Twisted-pair cable vs. coaxial cable

Bandwidth: coaxial > twisted-pair

Transmission distance: twisted-pair > coaxial

Thus cable needs frequent use of repeaters.

Figure 7.10 *Bending of light ray*

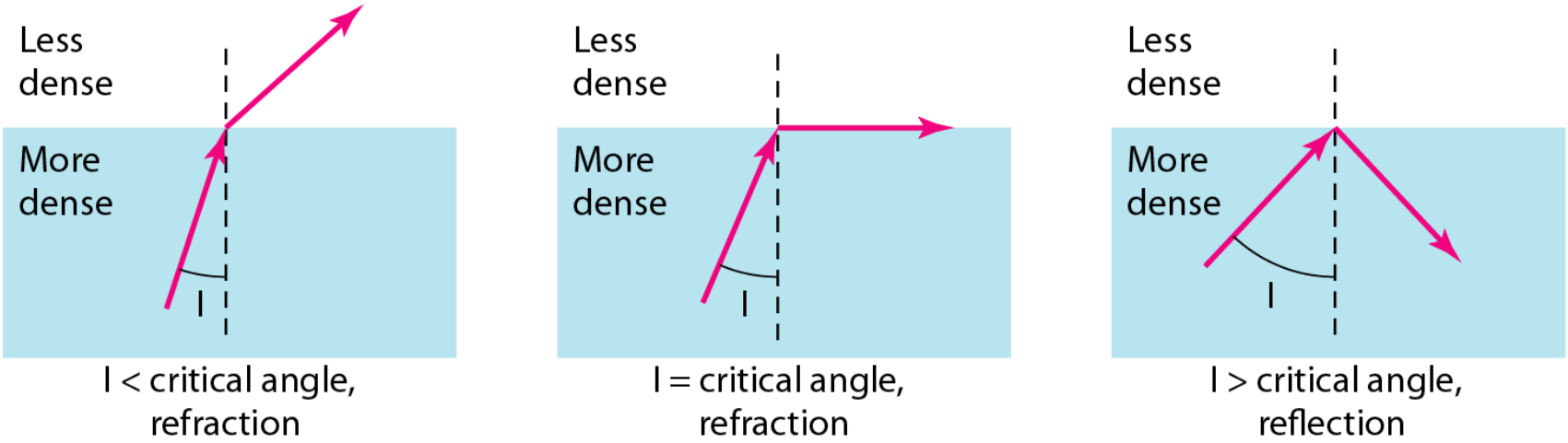
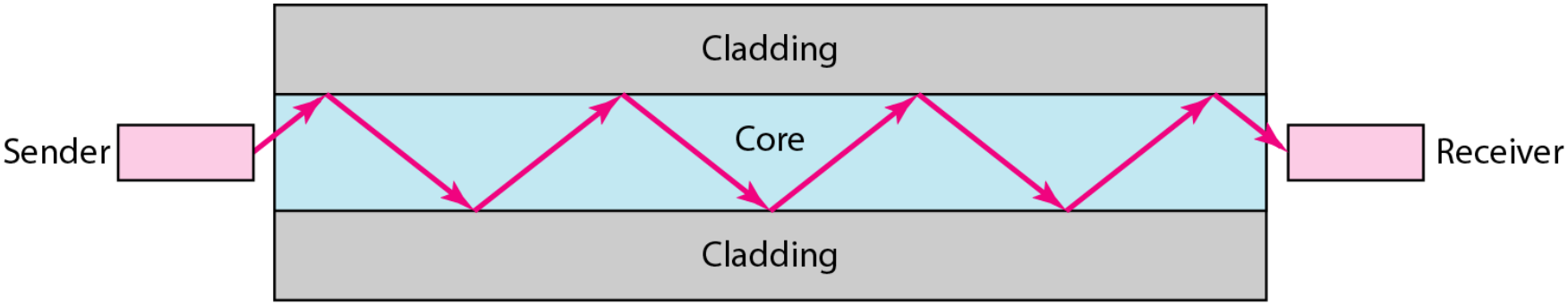


Figure 7.11 *Optical fiber*



This is the reason why optical fiber cannot be bended arbitrarily.

TYPES OF FIBER MODES

MODE

- SINGLE MODE – light follows one path; light is sent using a Laser
  - Much more expensive to implement and run.
- MULTIMODE – light follows different paths; light is sent using an LED (Light Emitting Diode)
  - Most common type of fiber optic cable implementation. Speeds are not as fast, but still much faster than UTP or Coax cable.
  - STEP INDEX – refers to the index of the refraction of the light.
  - GRADED INDEX – decreases the distortion from the refraction of the light

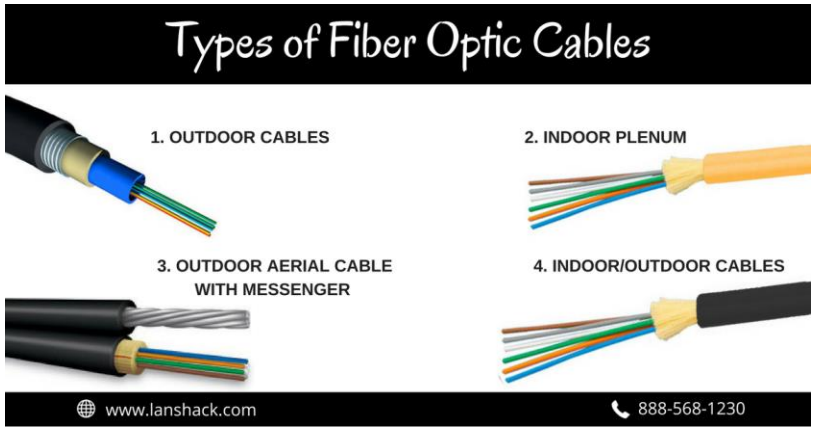


Figure 7.14 *Fiber construction*

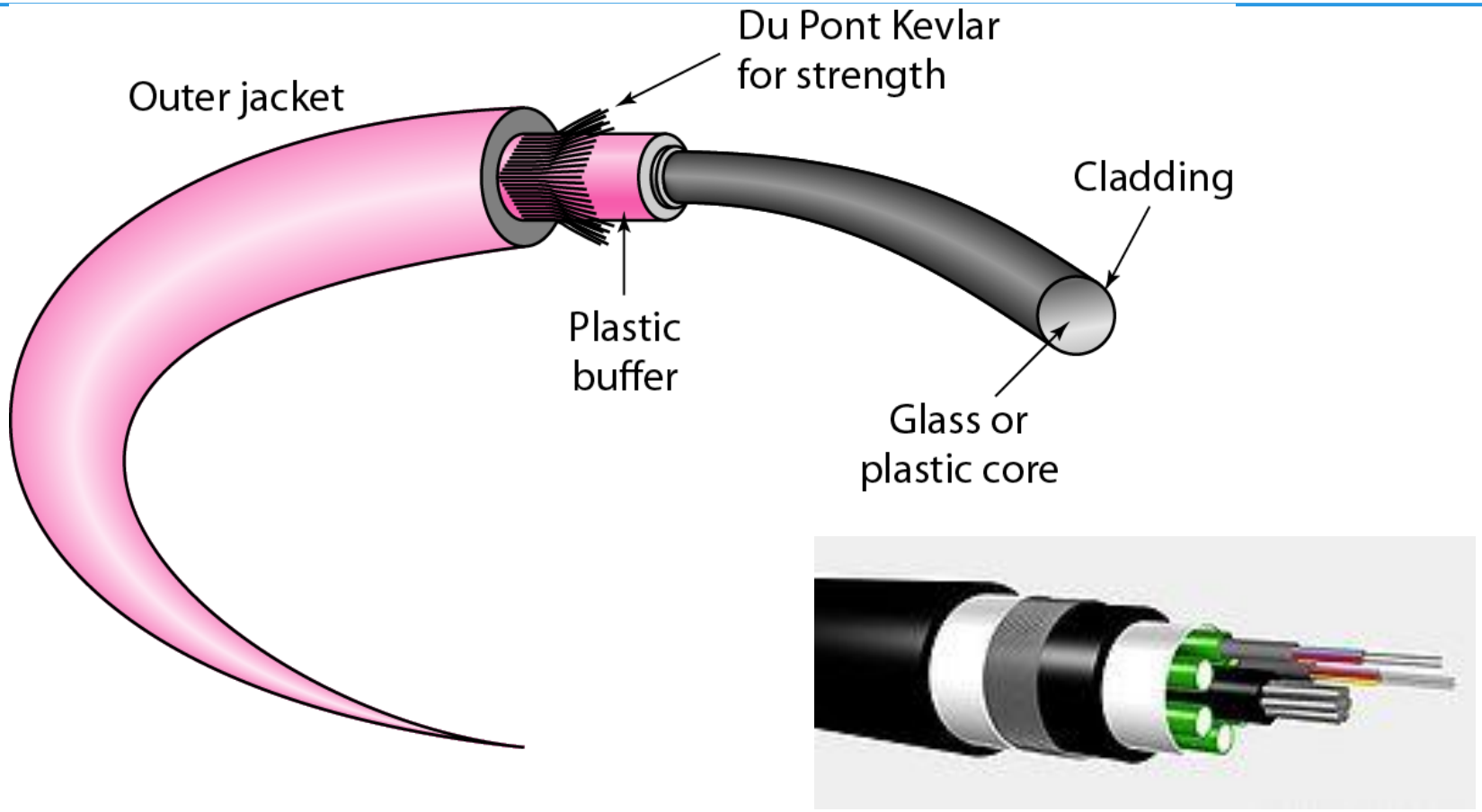
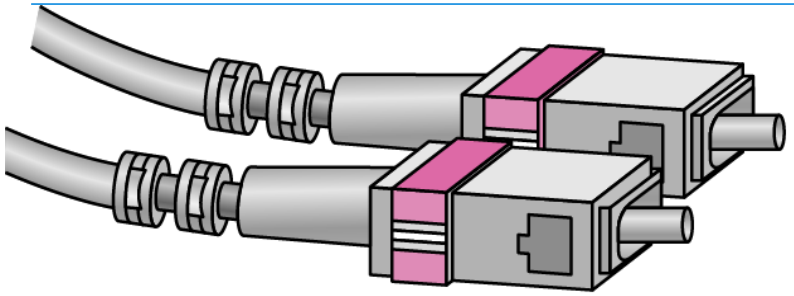
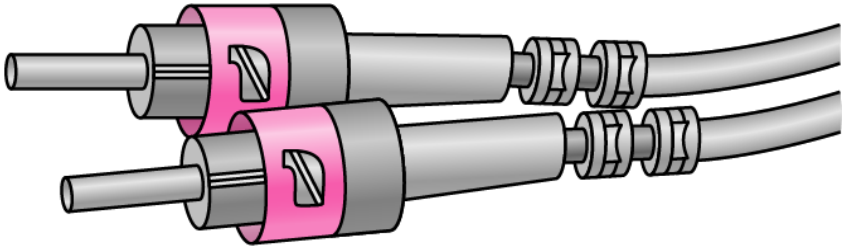


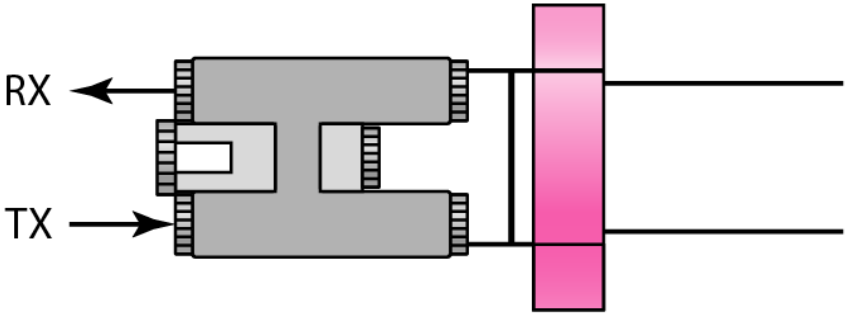
Figure 7.15 *Fiber-optic cable connectors*



SC connector



ST connector



MT-RJ connector

Pros and Cons for Optical Fiber Cable

Pros:

- *Higher bandwidth*
- *Less signal attenuation (50km without repeater; twisted pair and coaxial requires 5km per repeater)*
- *Immune to electromagnetic interference*
- *Resistance to corrosive materials*
- *Light weight*
- *Good resist to tapping*

Cons:

- *Installation and maintance*
- *One direction communication for one line (not duplex)*
- *Cost*

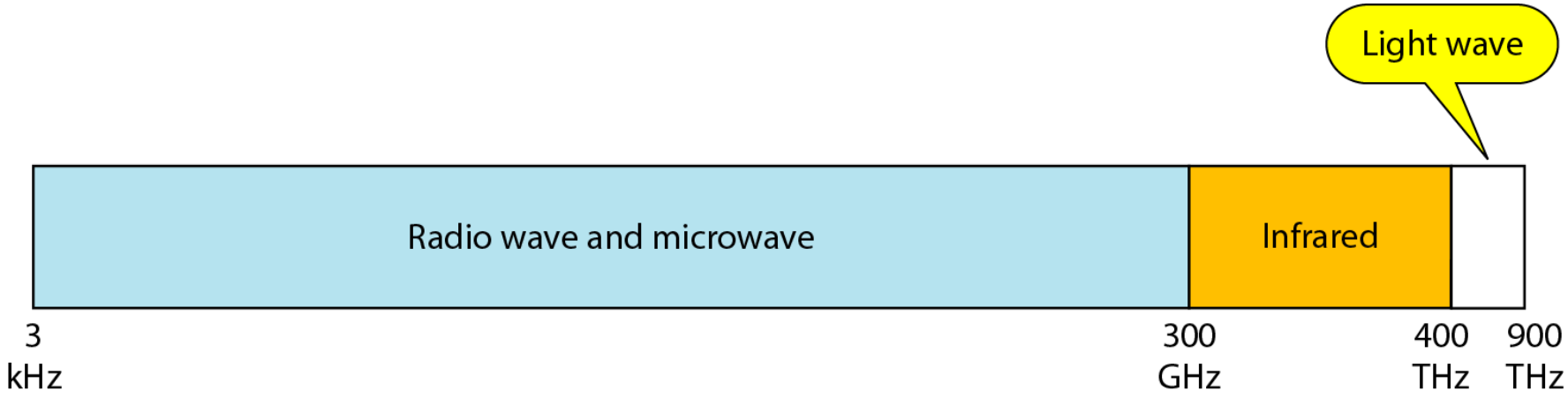
7.3 UNGUIDED MEDIA: WIRELESS

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

Topics discussed in this section:

Radio Waves
Microwaves
Infrared

Figure 7.17 *Electromagnetic spectrum for wireless communication*



Electromagnetic spectrum for wireless communication

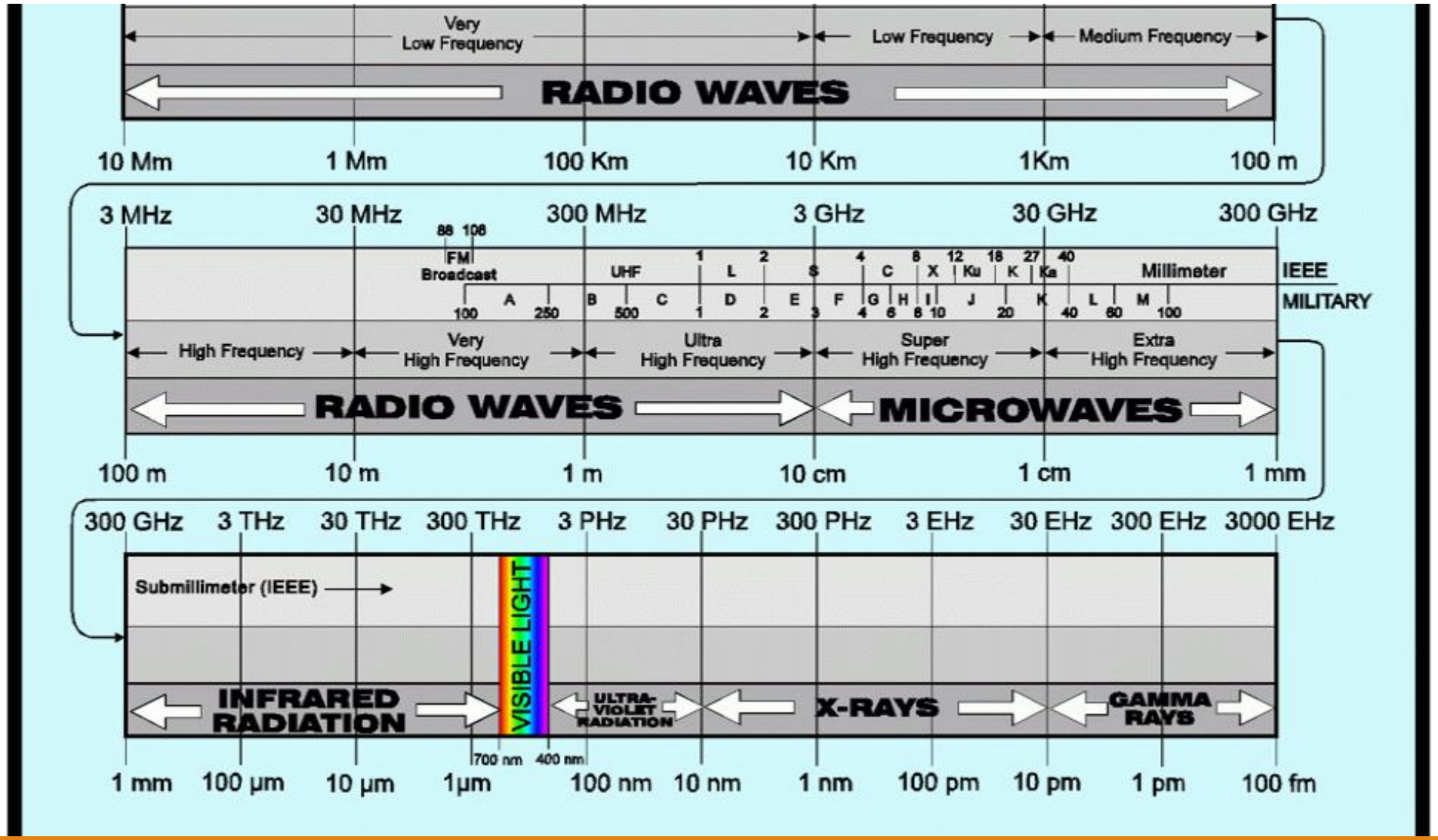
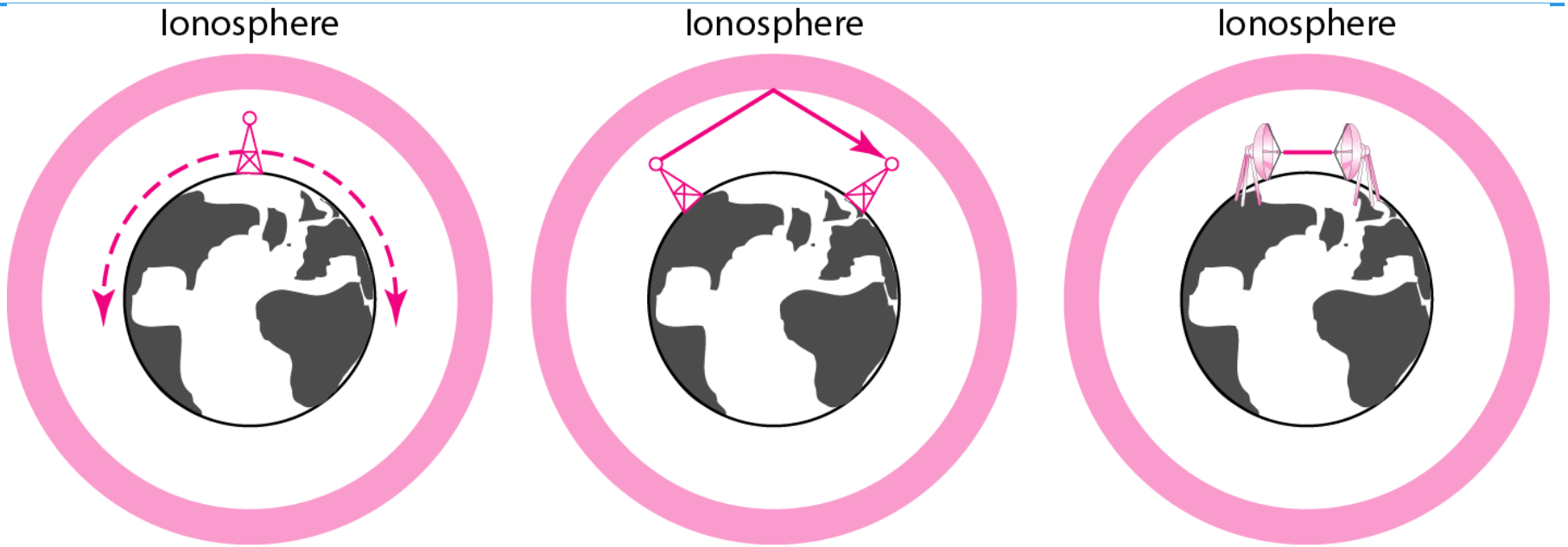


Figure 7.18 *Propagation methods*



AM radio:
long wave: 148.5 kHz–283.5 kHz
Medium wave: 520 kHz–1,610 kHz
Short wave: 2.3 MHz–26.1 MHz

FM radio:
87.5 to 108.0 MHz

Table 7.4 *Bands*

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

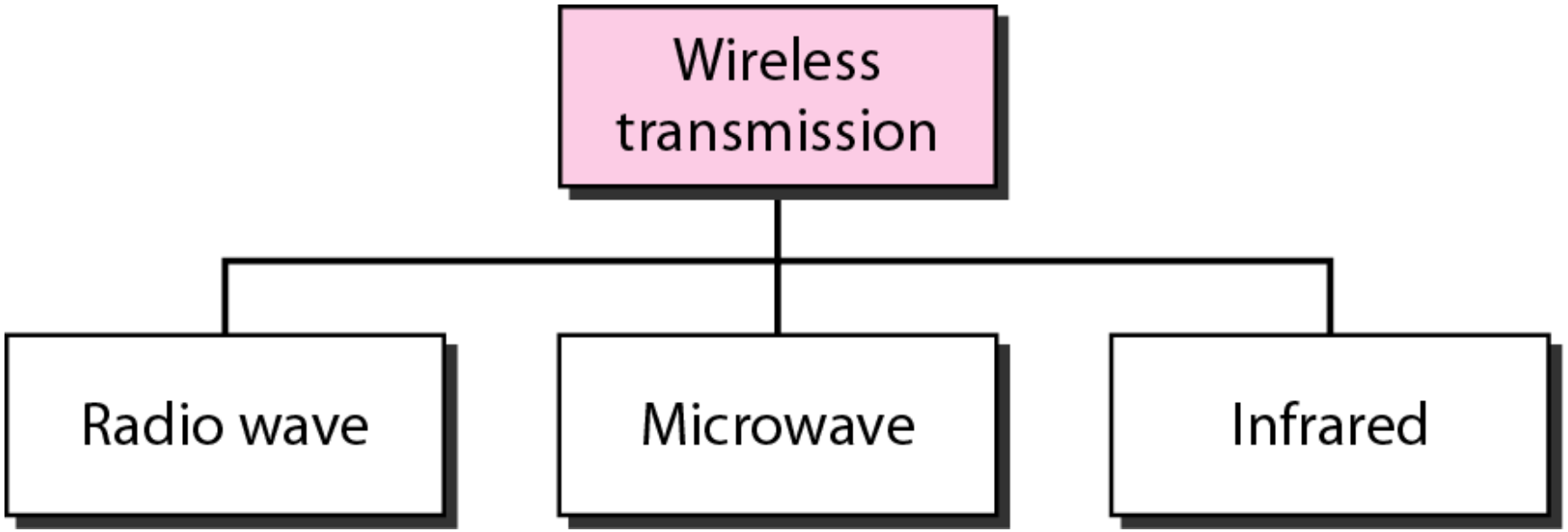
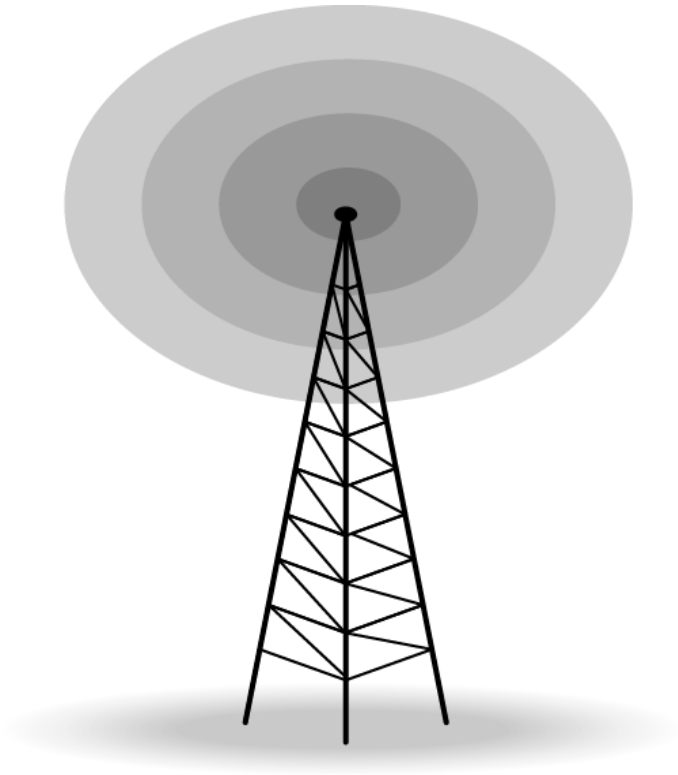


Figure 7.19 *Omnidirectional antenna*



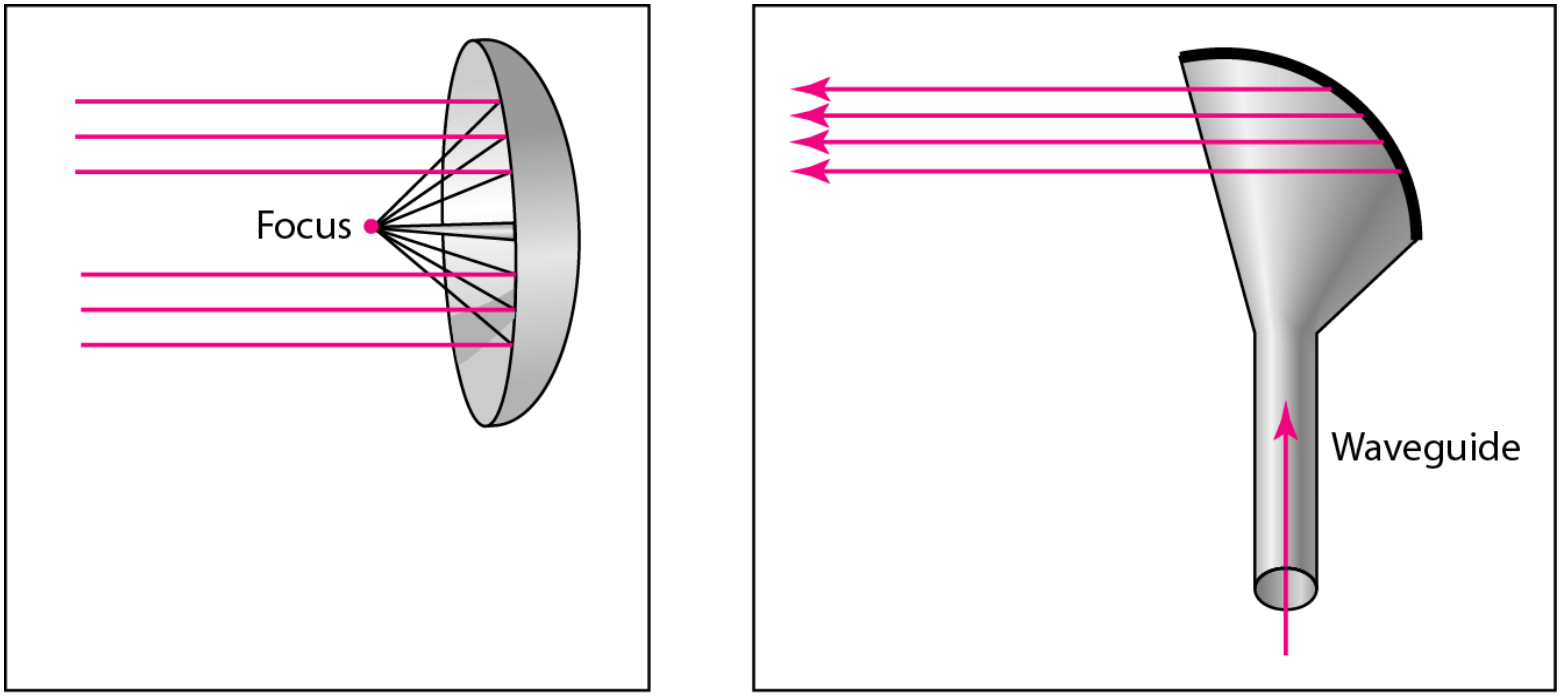
Example: Omnidirectional antenna

Use:
Wireless router

Note

Radio waves are used for multicast communications, such as radio and television, and paging systems.

Figure 7.20 *Unidirectional antennas*



a. Dish antenna

b. Horn antenna

Note

Microwaves are used for unicast communication such as cellular telephones, satellite networks, and wireless LANs.

Note

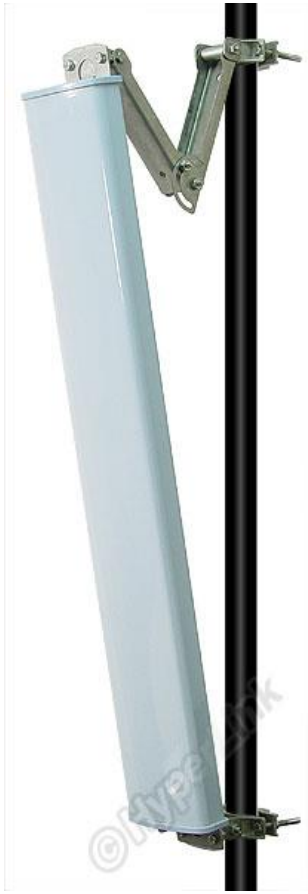
Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.

Example: Unidirectional Anntena

Use:
Wireless link connecting two remote WLANs

Example: Homemade Unidirectional Antenna - Can antenna

Example: Cellular Tower



Use:
Cellular Anntena Tower

Cellular Tower

More details: http://en.wikipedia.org/wiki/Cellular_tower

In suburban areas, masts are commonly spaced 1–2 miles (2–3 km) apart and in dense urban areas, masts may be as close as ¼-½ mile (400–800 m) apart.

The maximum range of a mast:
it is possible to get between 50 to 70 km (30–45 miles).

Check map of cell tower in your area:
http://www.gotreception.com/

Advantages and Disadvantages Wireless Communication

Advantages

- User Mobility
- Easy to install
- Reduced cost
- Scalability

Disadvantages

- High data error rate
- Lower transmission data rates
- Security
- Battery of Mobile Devices
- Health Issues

SUMMARY

1. Media can be either guided (wired) or unguided (wireless).

2. Both have their advantages and disadvantages.

3. The fastest of all media types is Fiber Optics, with speeds up to 100Gb/s and faster.

4. Wireless media, such as infrared (like your remote control), radiowaves and microwaves are used in networks.

5. Determining the best media for a network depends upon the needs and requirements of the end users.