# Computer Networks Chapter (5) Transmission Media

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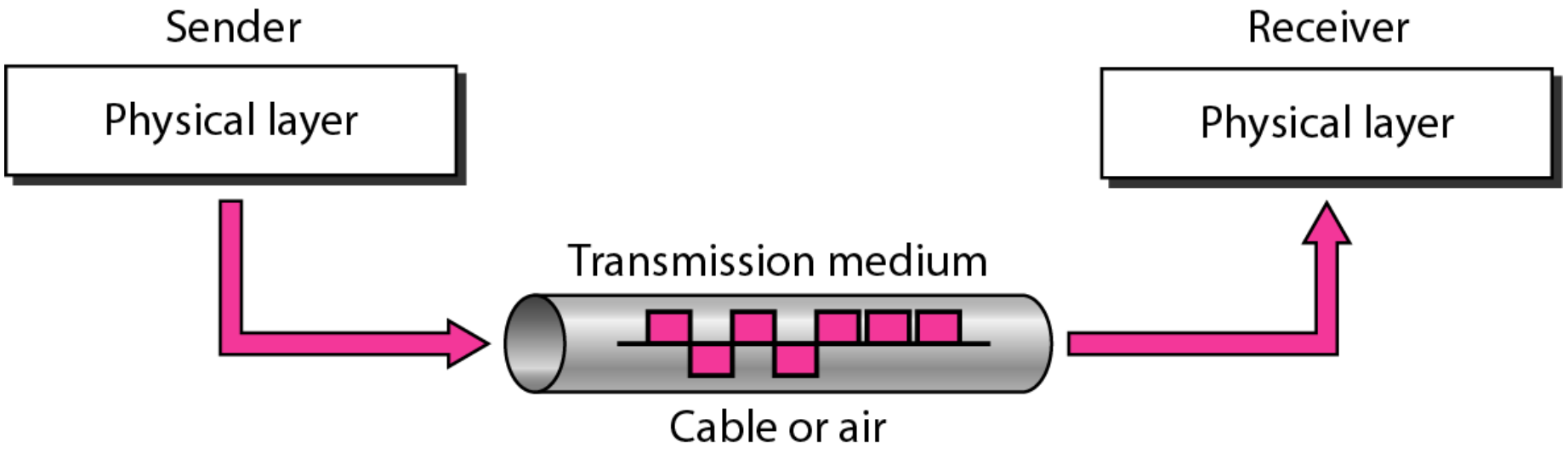
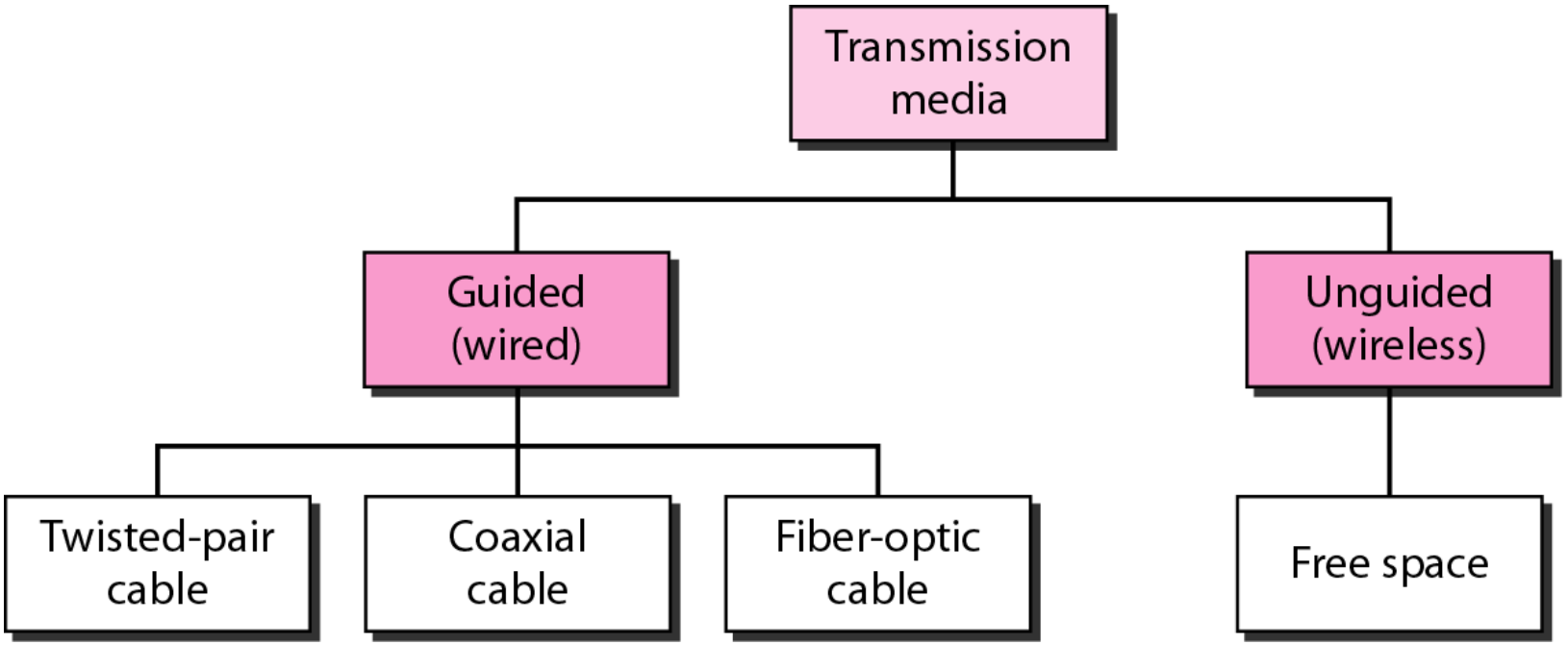
# Chapter 5

# Transmission Media

**Figure 5.1** *Transmission medium and physical layer*



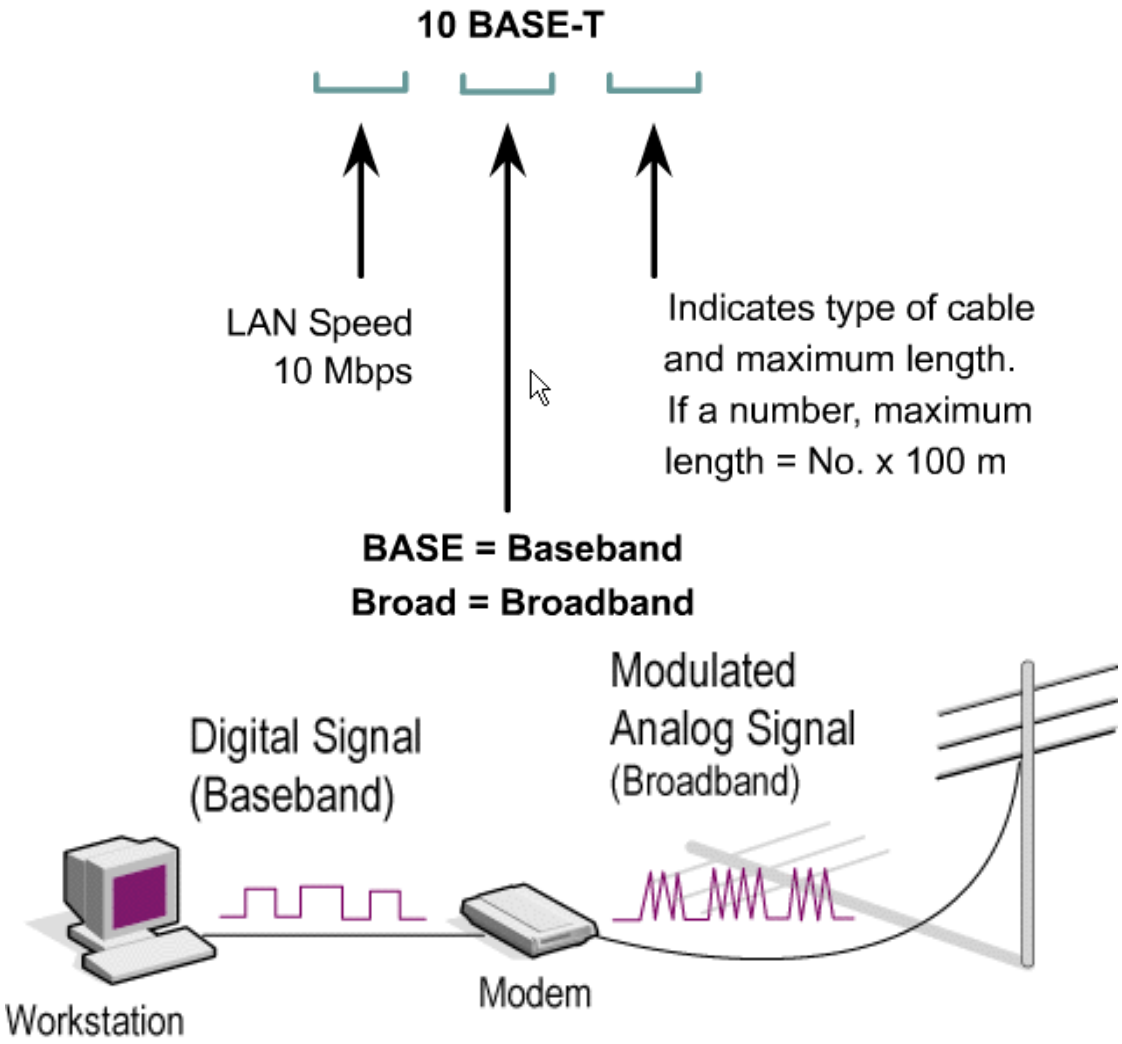
## Figure 5.2 *Classes of transmission media*



# 5-1 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.

# Cable Specifications



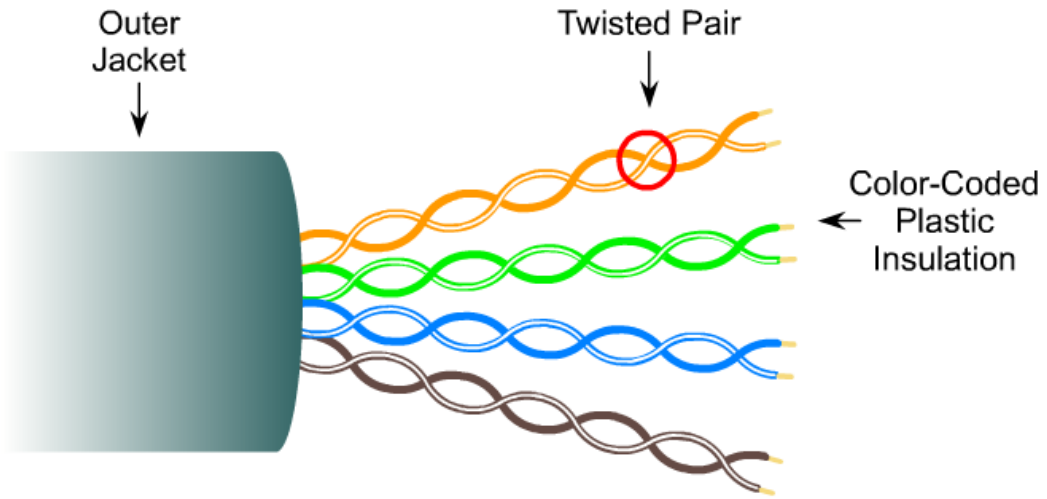
# Cable Specifications

- **10BASE-T**
  - Speed of transmission at 10 Mbps
  - Type of transmission is baseband, or digitally interpreted
  - **T** stands for twisted pair
- **10BASE5**
  - Speed of transmission at 10 Mbps
  - Type of transmission is baseband
  - **5** represents the capability of the cable to allow the signal to travel for approximately 500 meters before attenuation could disrupt the ability of the receiver to appropriately interpret the signal being received.

# Cable Specifications

- **10BASE2**
  - Speed of transmission at 10 Mbps
  - Type of transmission is baseband
  - **2** represents the capability of the cable to allow the signal to travel for approximately 200 meters, before attenuation could disrupt the ability of the receiver to appropriately interpret the signal being received.

# Unshielded Twisted Pair (UTP)



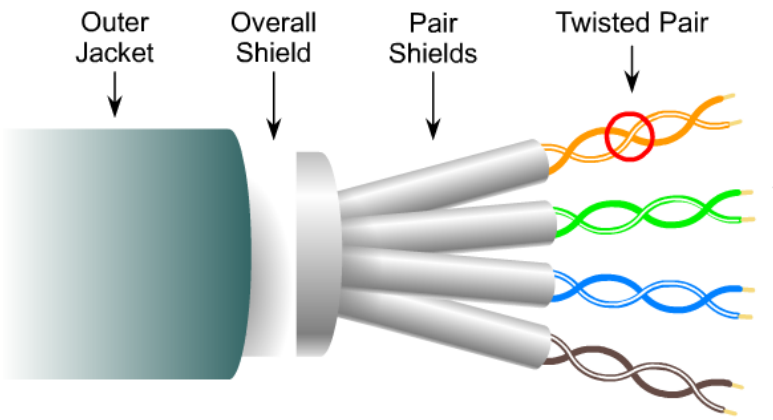

**Unshielded Twisted Pair UTP** is a four-pair wire medium used in a variety of networks. Each of the eight copper wires in the UTP cable is covered by insulating material.

-Each pair of wires is twisted around each other. This type of cable relies on the cancellation effect produced by the twisted wire pairs to limit signal degradation caused by EMI and RFI.

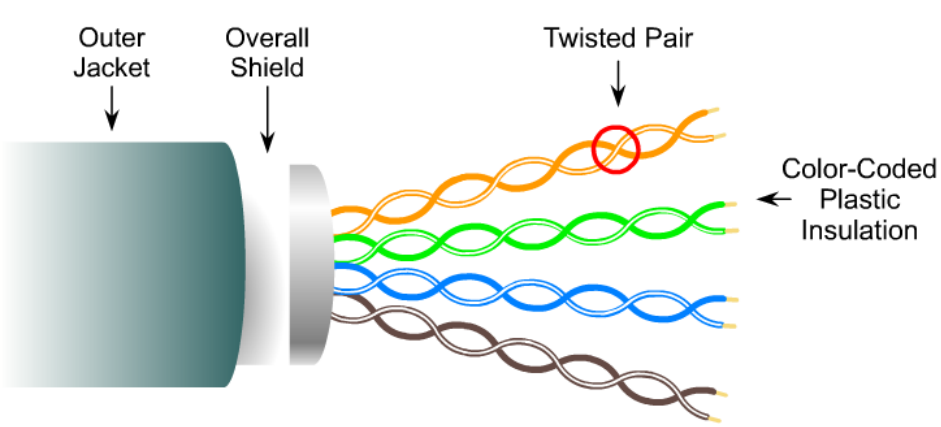
- Reduce crosstalk between the pairs in UTP cable, the number of twists in the wire pairs varies.

# Shielded Twisted Pair (STP and ScTP)

**STP – Shielded Twisted Pair**

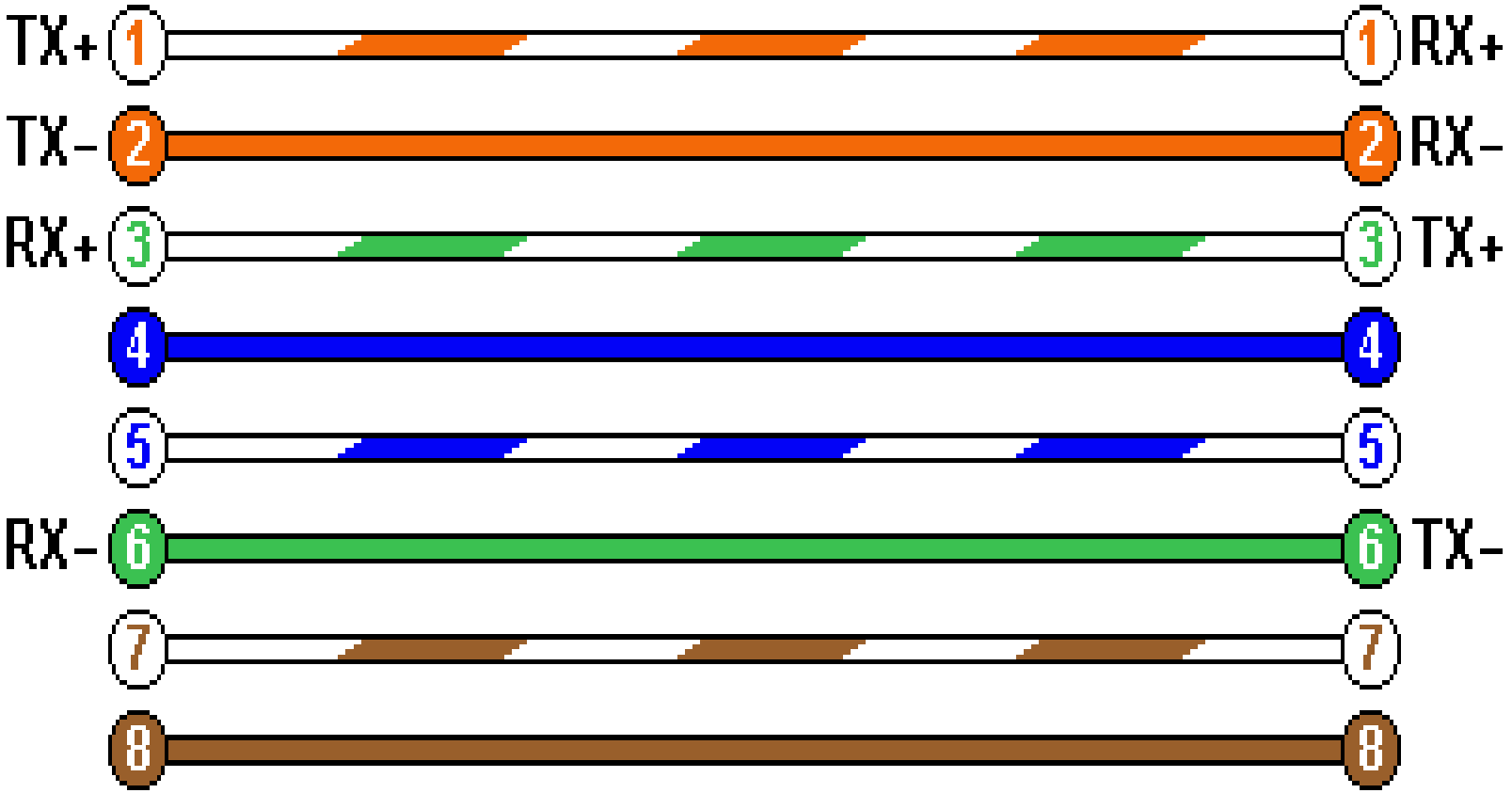



**ScTP – Screened Twisted Pair**

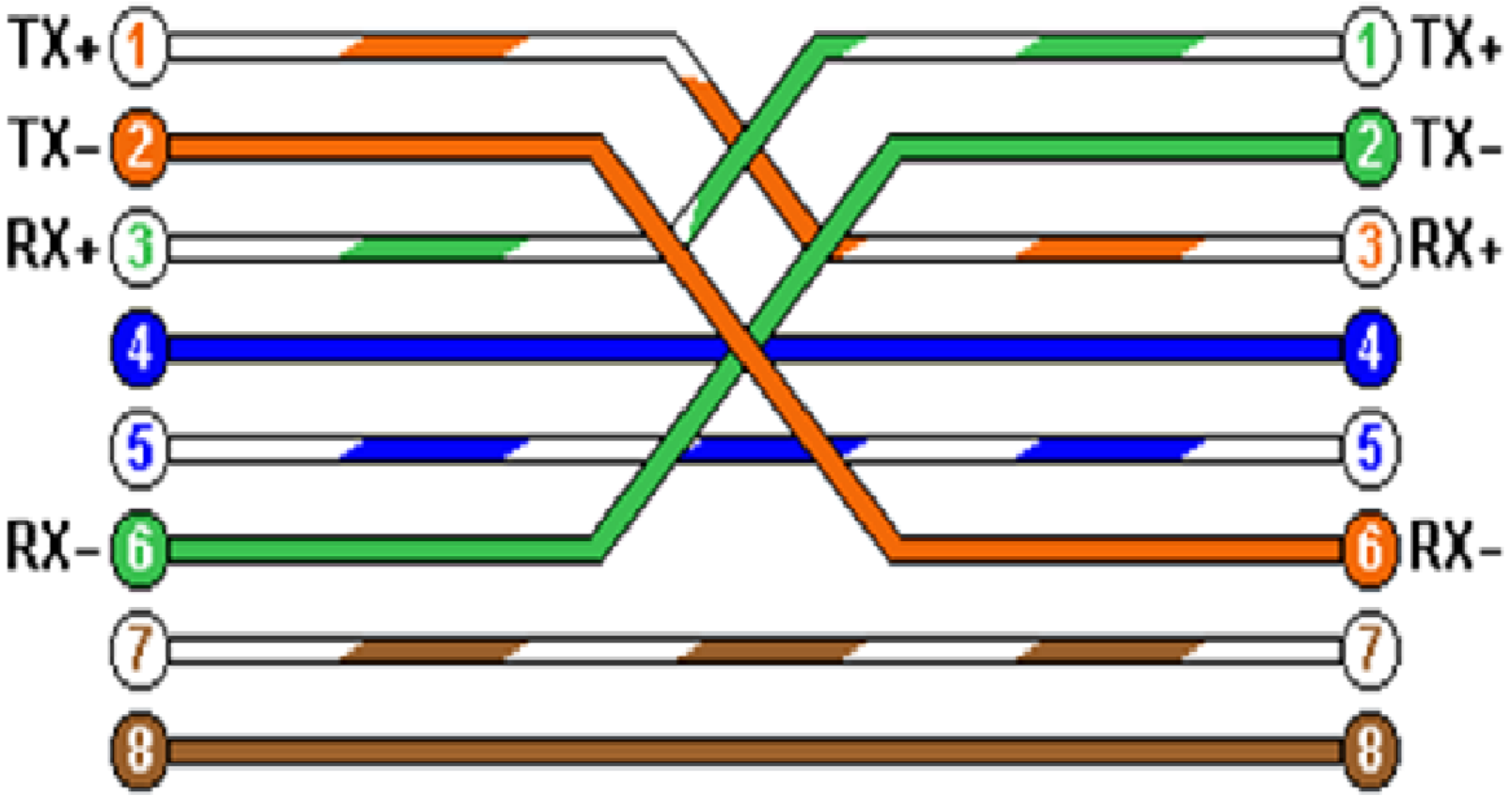



- **Shielded twisted-pair cable (STP)** combines the techniques of shielding, cancellation, and twisting of wires.
  - Each pair of wires is wrapped in metallic foil.
  - The four pairs of wires are wrapped in an overall metallic braid or foil.
- A new hybrid of UTP with traditional STP is **Screened UTP (ScTP),** also known as **Foil Twisted Pair (FTP).**
  - ScTP is essentially UTP wrapped in a metallic foil shield, or screen.

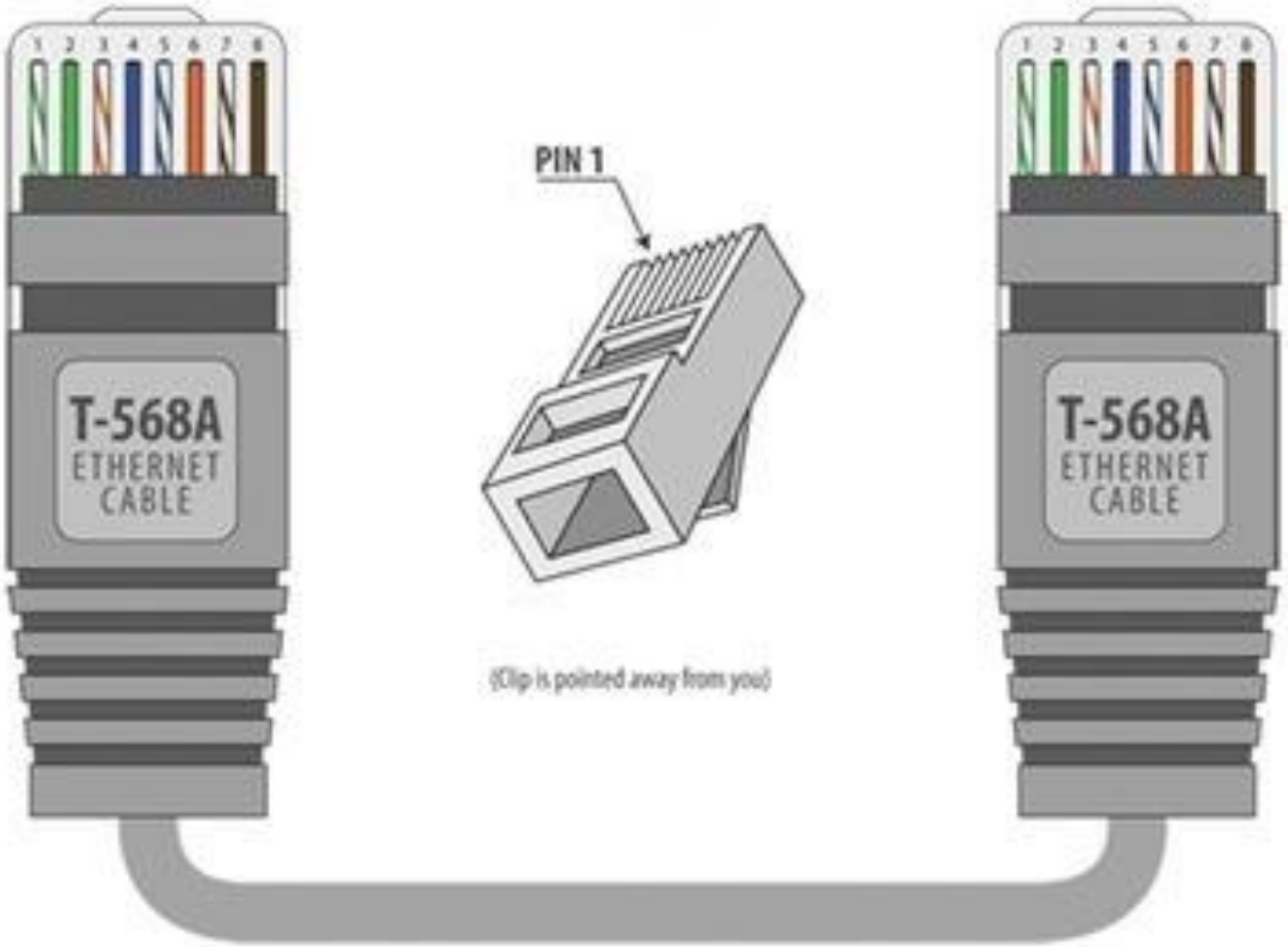
# UTP Straight-through Cable



# UTP Cross-over Cable



# Wiring-Diagram



# Straight- or Crossover

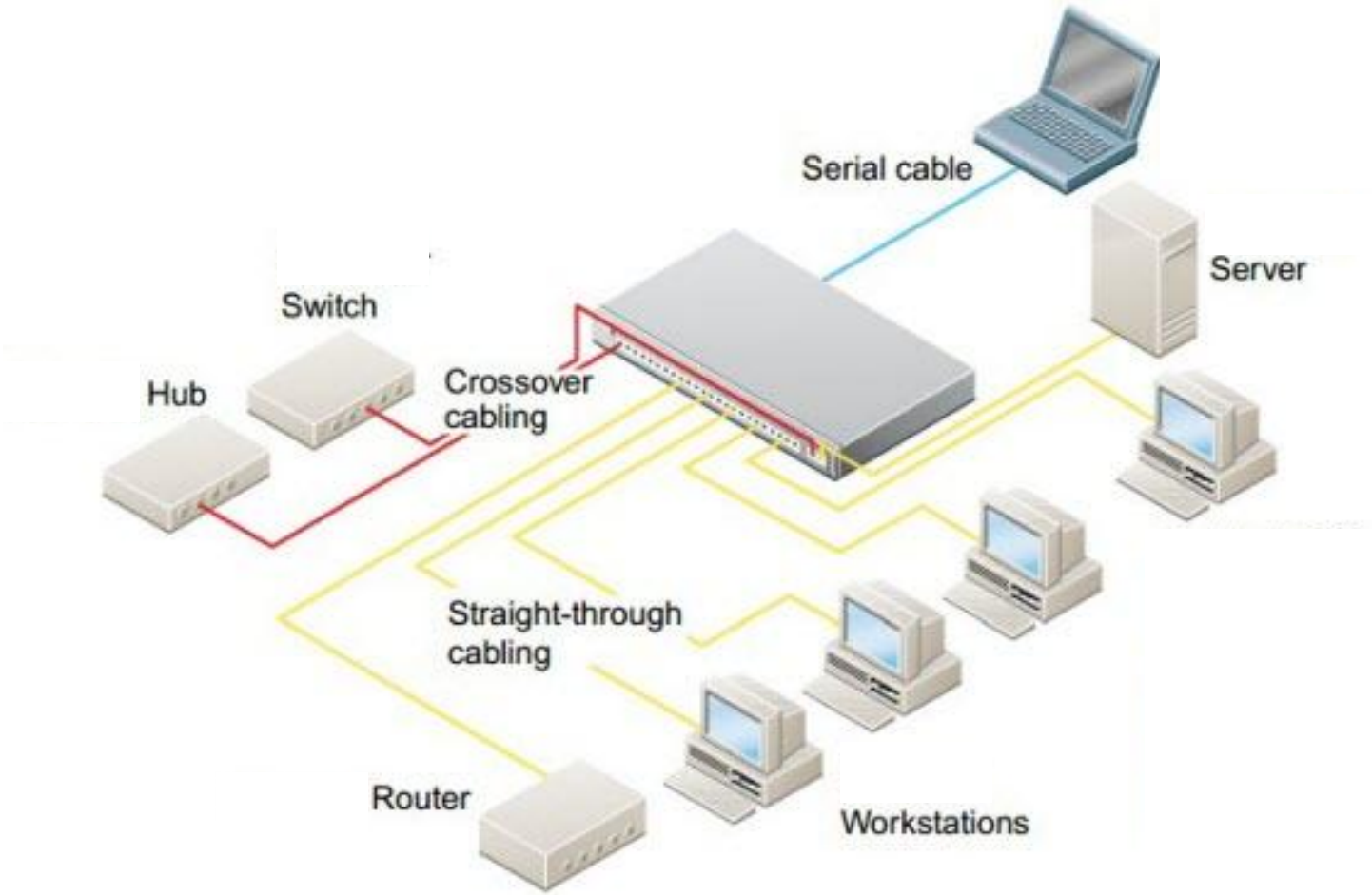
**Use straight-through cables for the following cabling:**

- **Switch to router**
- **Switch to PC or server**
- **Hub to PC or server**

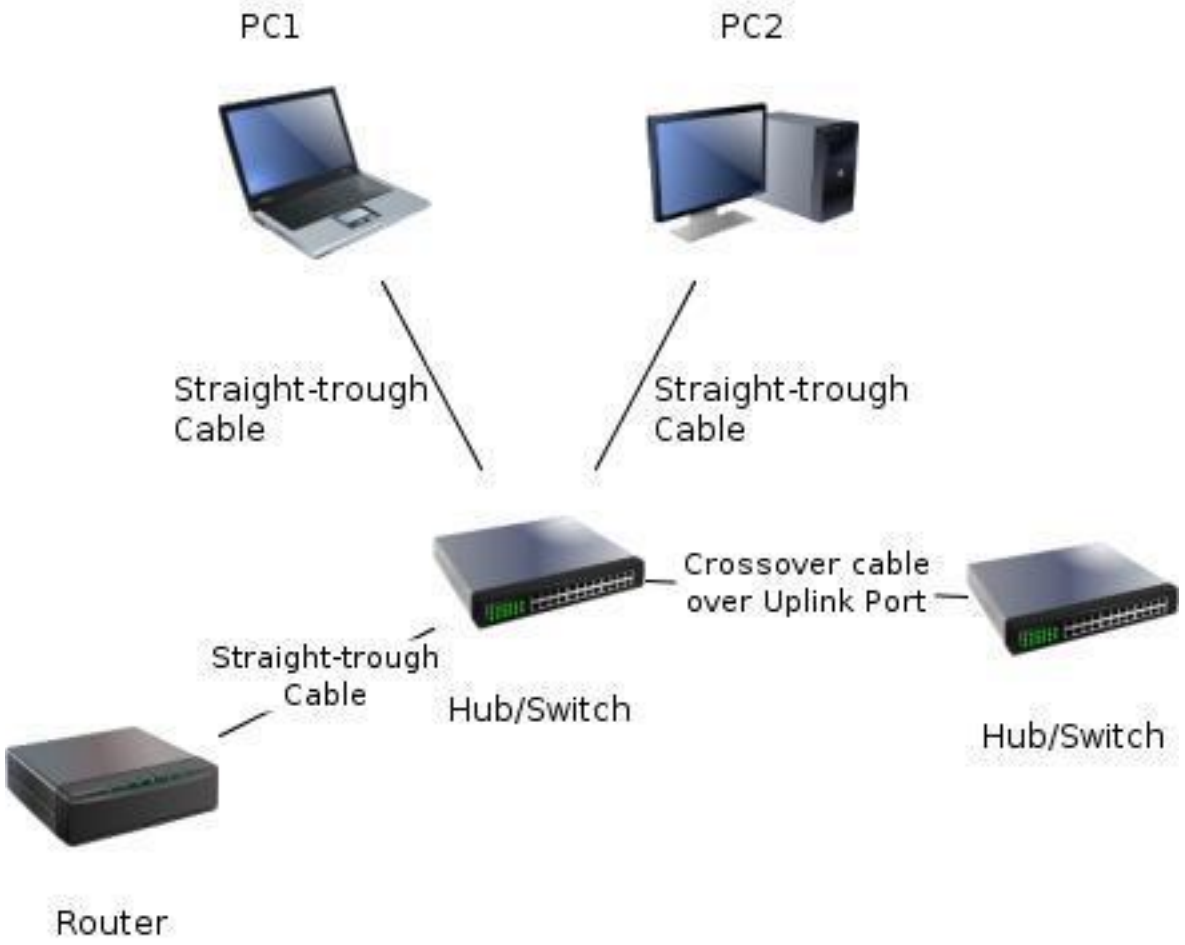
**Use crossover cables for the following cabling:**

- **Switch to switch**
- **Switch to hub**
- **Hub to hub**
- **Router to router**
- **PC to PC**
- **Router to PC**

# Straight- or Crossover



# Straight- or Crossover



# Twisted Pair - Applications

- Most common medium
- Telephone network
  - Between house and local exchange
- For local area networks (LAN)
  - 10Mbps or 100Mbps

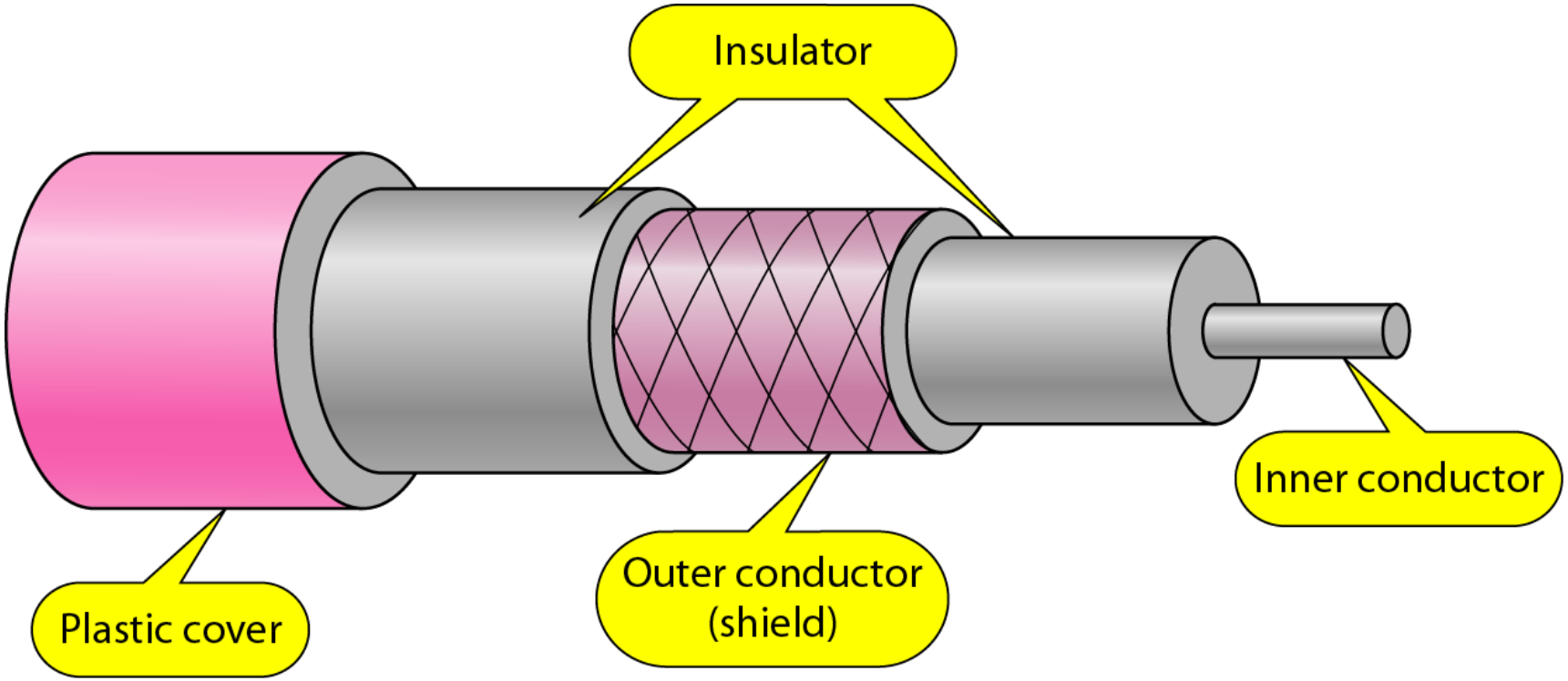
# Twisted Pair - Properties

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

# UTP Categories

| UTP Categories - Copper Cable | | | | |
|---|---|---|---|---|
| **UTP Category** | **Data Rate** | **Max. Length** | **Cable Type** | **Application** |
| **CAT1** | Up to 1Mbps | - | Twisted Pair | Old Telephone Cable |
| **CAT2** | Up to 4Mbps | - | Twisted Pair | Token Ring Networks |
| **CAT3** | Up to 10Mbps | 100m | Twisted Pair | Token Rink & 10BASE-T Ethernet |
| **CAT4** | Up to 16Mbps | 100m | Twisted Pair | Token Ring Networks |
| **CAT5** | Up to 100Mbps | 100m | Twisted Pair | Ethernet, FastEthernet, Token Ring |
| **CAT5e** | Up to 1 Gbps | 100m | Twisted Pair | Ethernet, FastEthernet, Gigabit Ethernet |
| **CAT6** | Up to 10Gbps | 100m | Twisted Pair | GigabitEthernet, 10G Ethernet (55 meters) |
| **CAT6a** | Up to 10Gbps | 100m | Twisted Pair | GigabitEthernet, 10G Ethernet (55 meters) |
| **CAT7** | Up to 10Gbps | 100m | Twisted Pair | GigabitEthernet, 10G Ethernet (100 meters) |

## Figure 5.6 *Coaxial cable*



# Coaxial 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.

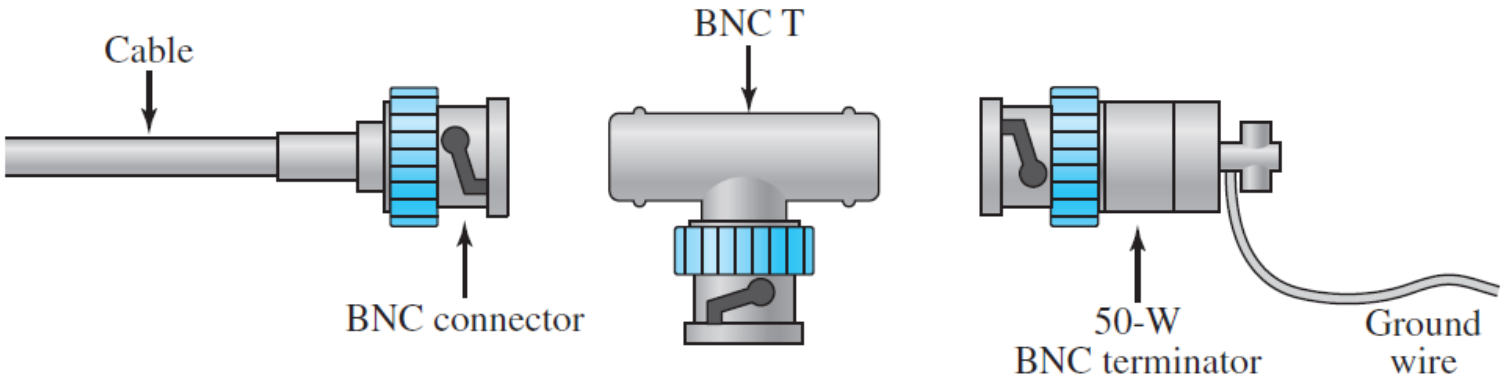
-The outer metallic wrapping serves both as a shield against noise and as the second conductor, which completes the circuit. This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.

- For LANs, coaxial cable offers several advantages. It can be run longer distances than UTP cable without the need for repeaters.

# BNC connectors

- The most common type of connector used today is the Bayonet Neill-Concelman (BNC) connector.

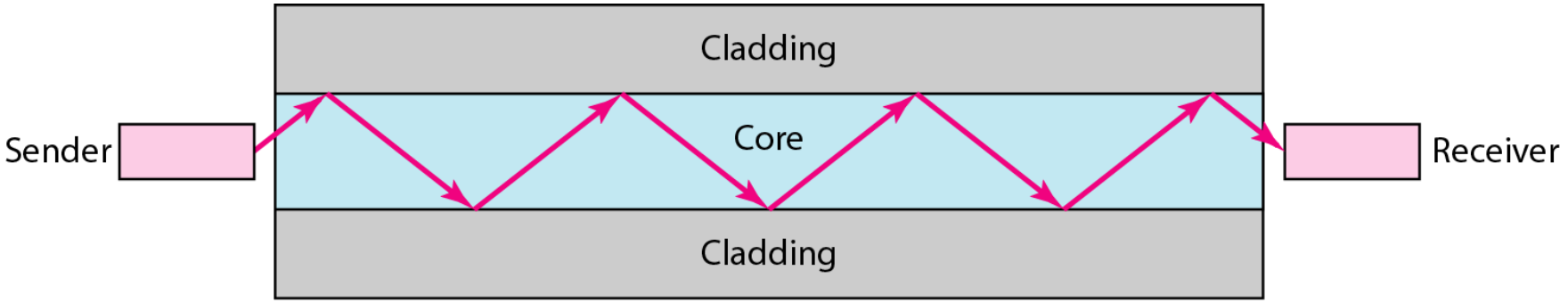
-Three popular types of these connectors: the BNC connector, the BNC T connector, and the BNC terminator.



# Coaxial Cable Applications

- 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

## Figure 5.7 *Optical fiber*



# Optical fiber

• A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.

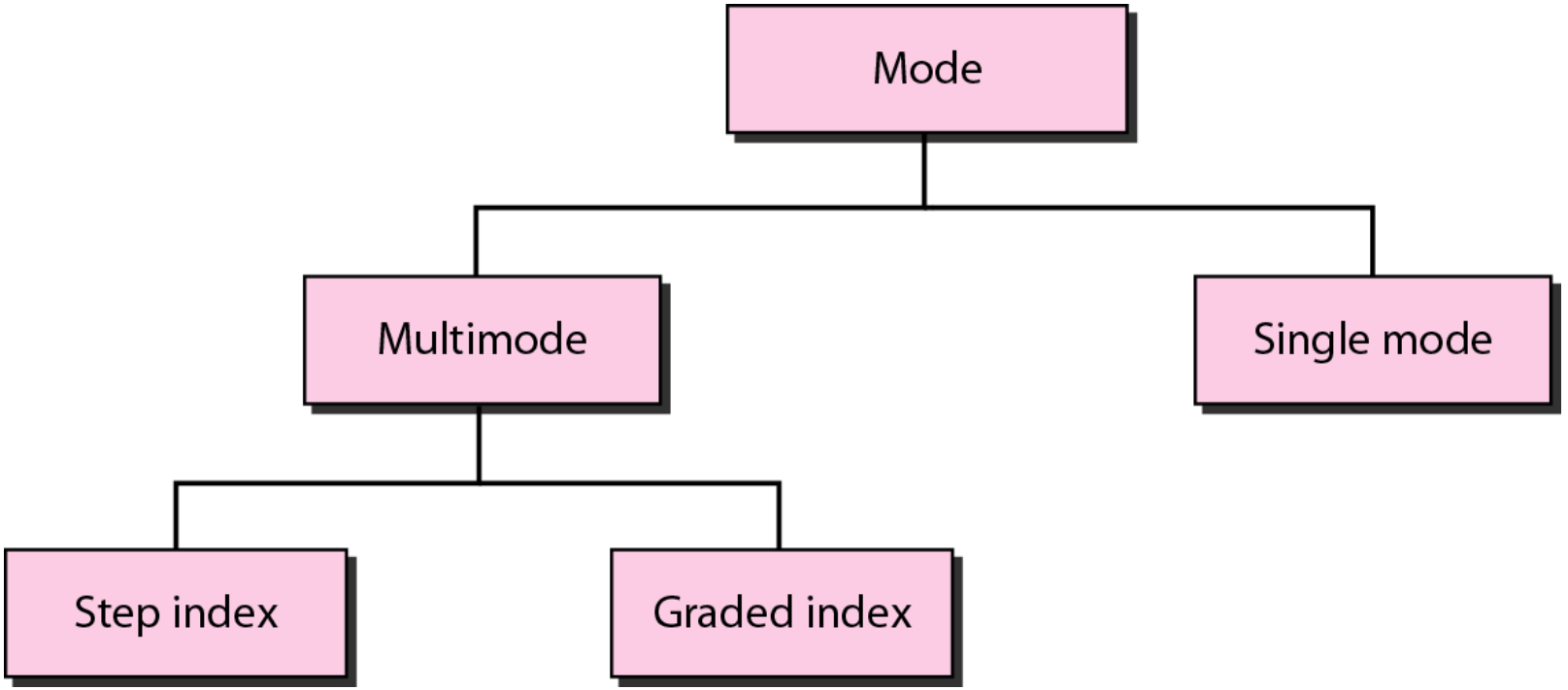
- Multimode is so named because multiple beams from a light source move through the core in different paths

- **Multimode step-index** fiber, the density of the core remains constant from the center to the edges.

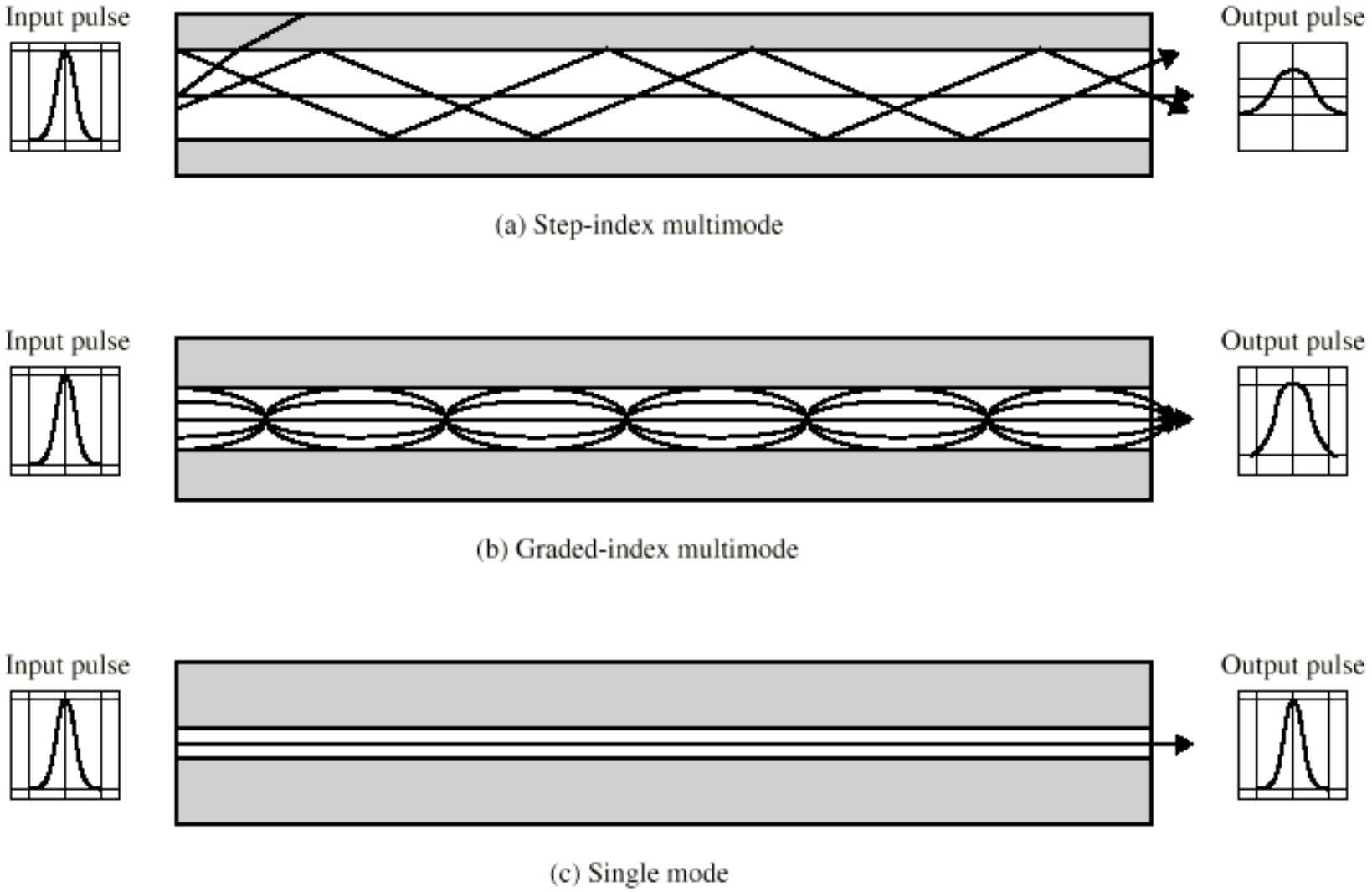
- **Multimode graded-index** fiber, decreases this distortion of the signal through the cable.

- **Single-Mode** : uses step-index fiber and a highly focused source of light that limits beams to a small range of angles, all close to the horizontal.

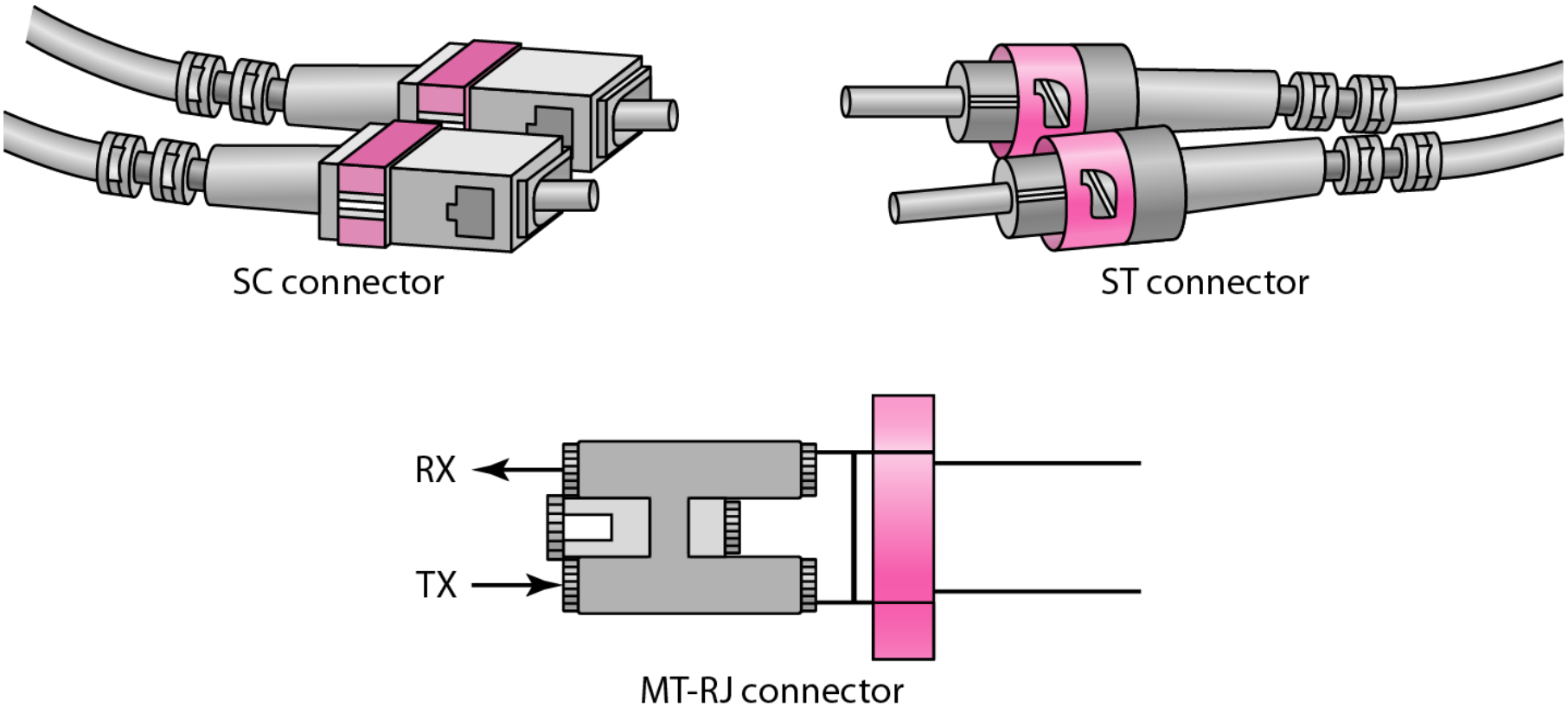
## Figure 5.8 *Propagation modes*



# Figure 5.9 *Modes*



## Figure 5.10 *Fiber-optic cable connectors*



# Advantages and Disadvantages of Optical Fiber

**Advantages**

- Higher bandwidth.

- Less signal attenuation.

- Immunity to electromagnetic interference.

-Resistance to corrosive materials.

-Light weight

-Greater immunity to tapping

**Disadvantages**

-Installation and maintenance

-Unidirectional light propagation

-Cost

# Media Comparison

| Characteristics | UTP | STP | Coaxial Cables | Fiber Optic Cables |
|---|---|---|---|---|
| Bandwidth | 10– 100 Mbps | 10– 100 Mbps | 10 Mbps | 100 Mbps - 1 Gbps |
| Maximum cable segment | 100 meters | 100 meters | 200 – 500 meters | 2 k.m. – 100 k.m. |
| Interference rating | Poor | Better than UTP | Better than twisted pair wires | Very good as compared to any other cable |
| Installation cost | Cheap | Costly than UTP | Costly than twisted pair wires | Most costly to install |
| Security | Low | Low | Low | High |

# 5-2 UNGUIDED MEDIA: WIRELESS

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

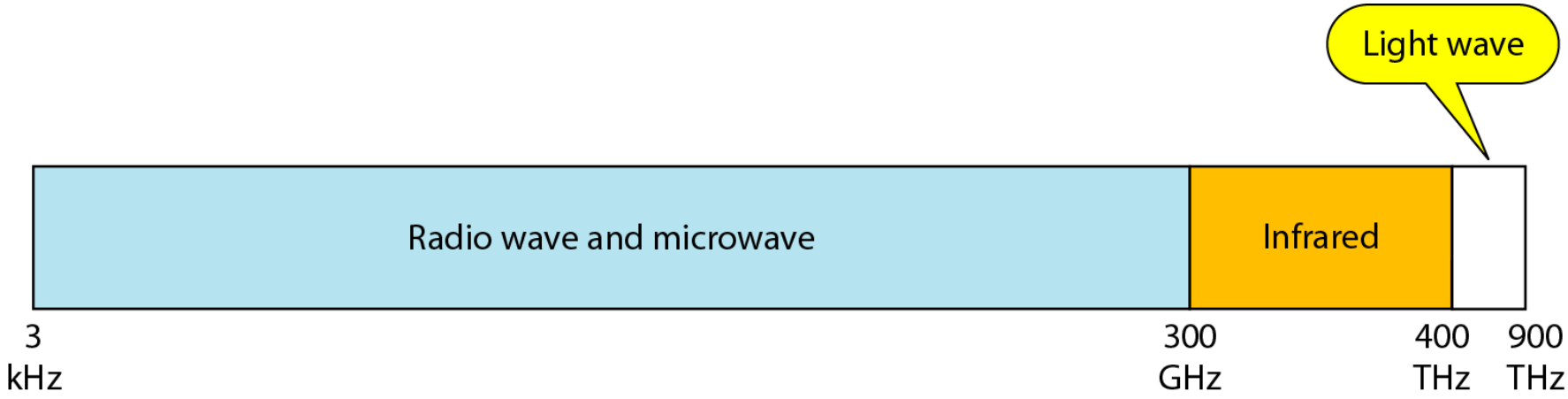
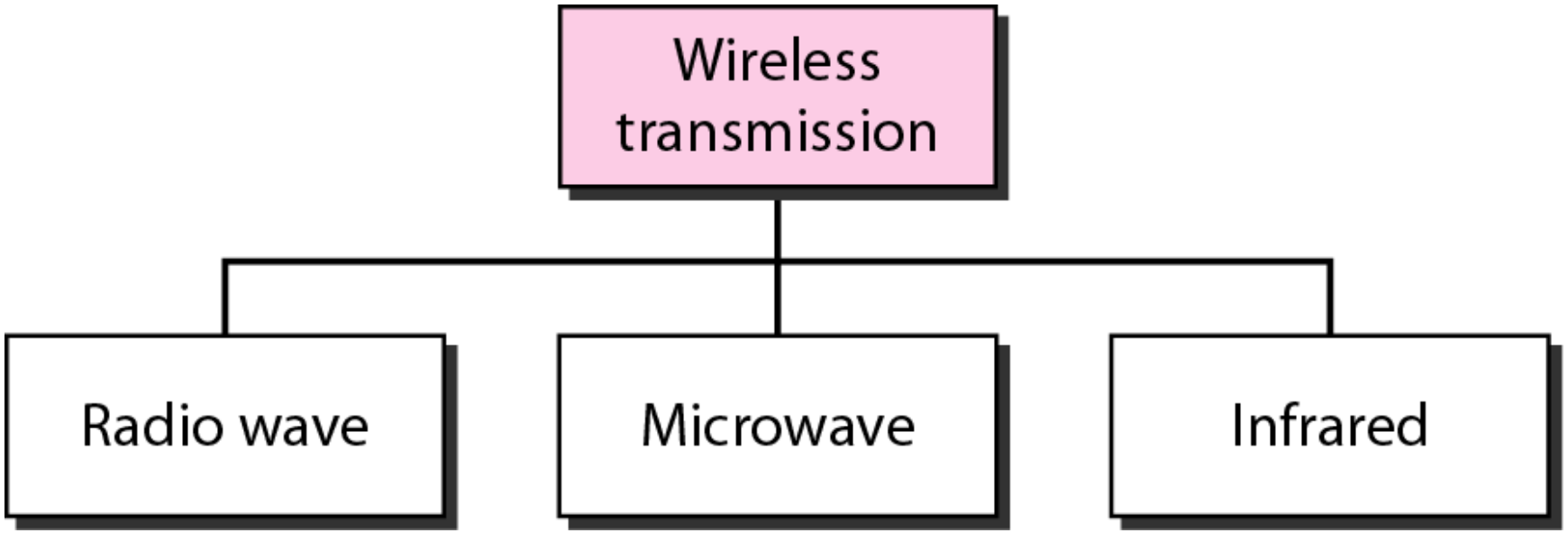


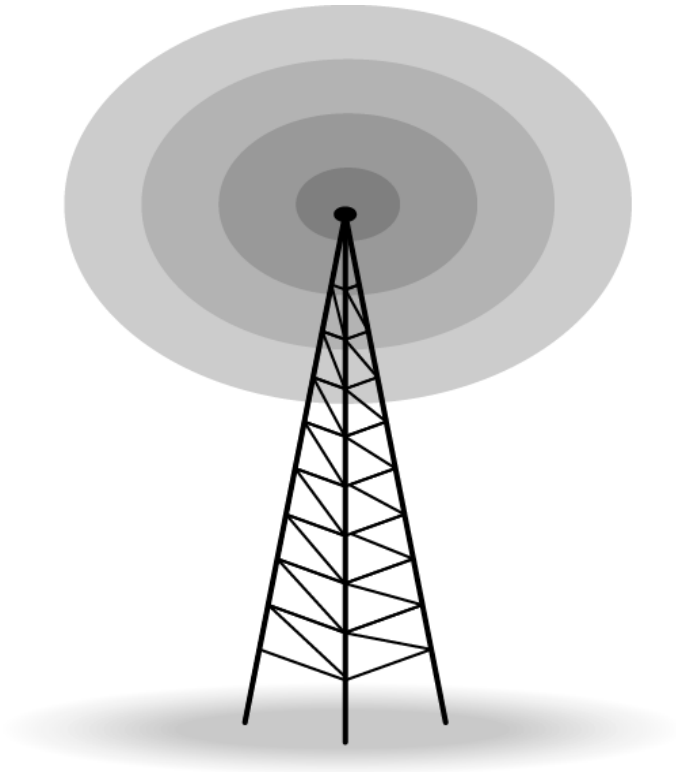

**Figure 5.11** *Electromagnetic spectrum for wireless communication*

**Figure 5.13** *Wireless transmission waves*



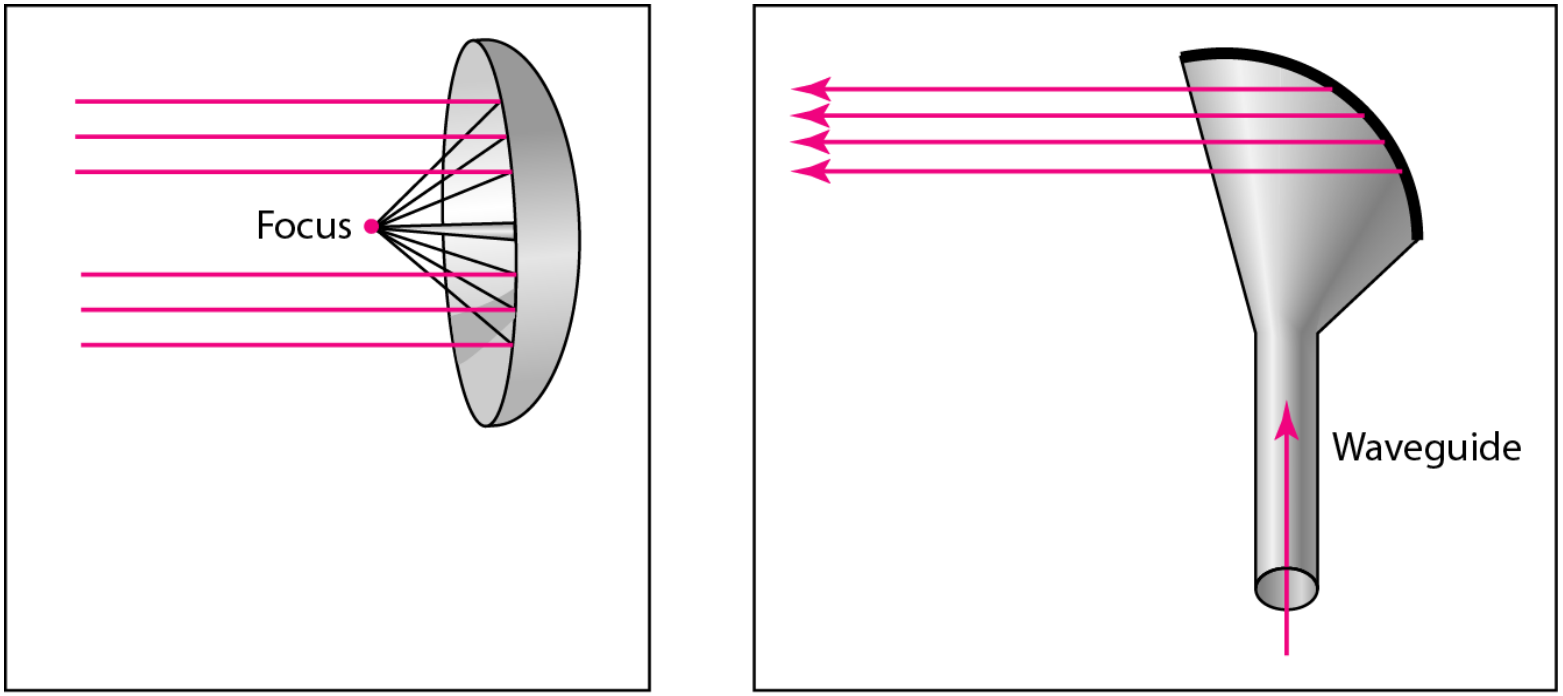
- **Radio waves are used for multicast communications, such as radio and television, and paging systems.**
- **They can penetrate through walls.**
- **Use omni directional antennas**

## Figure 5.14 *Omni directional antenna*



- Microwaves are used for unicast communication such as cellular telephones, satellite networks, and wireless LANs.
- Higher frequency ranges cannot penetrate walls.
- Use directional antennas - point to point line of sight communications.

## Figure 5.15 *Unidirectional antennas*




a. Dish antenna

b. Horn antenna

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