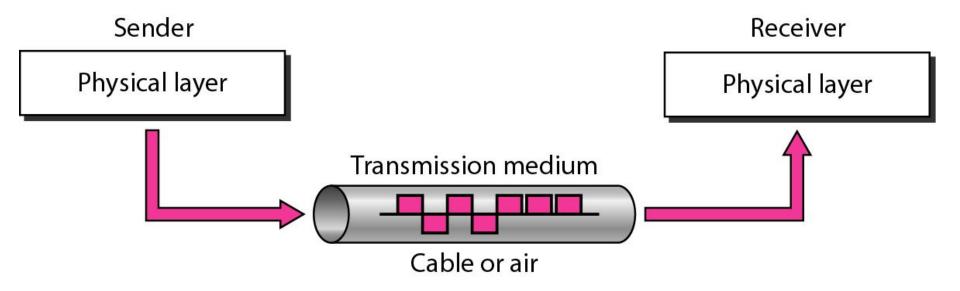
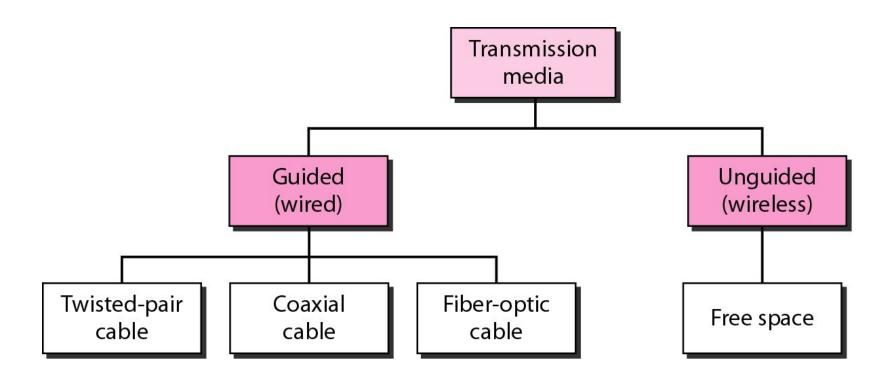
#### Figure 7.1 Transmission medium and physical layer



#### Figure 7.2 Classes of transmission media



## 7-1 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.

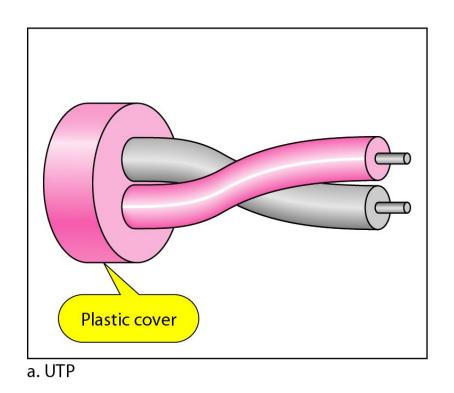
# Topics discussed in this section:

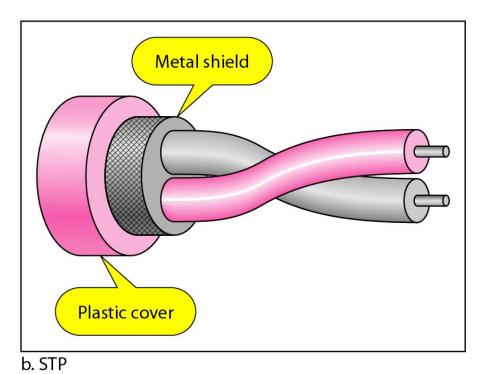
Twisted-Pair Cable Coaxial Cable Fiber-Optic Cable

# Figure 7.3 Twisted-pair cable

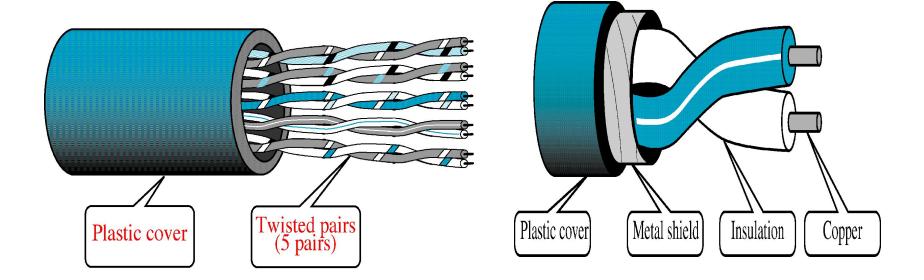


# Figure 7.4 UTP and STP cables





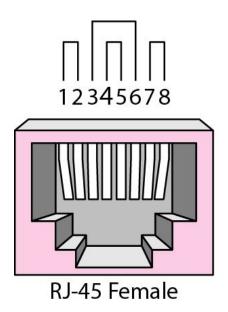
# UNSHIELDED SHEILDED

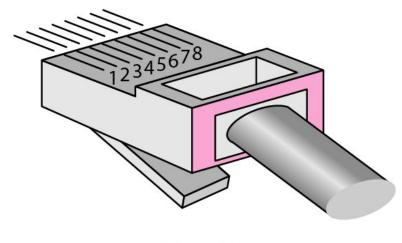


## Table 7.1 Categories of unshielded twisted-pair cables

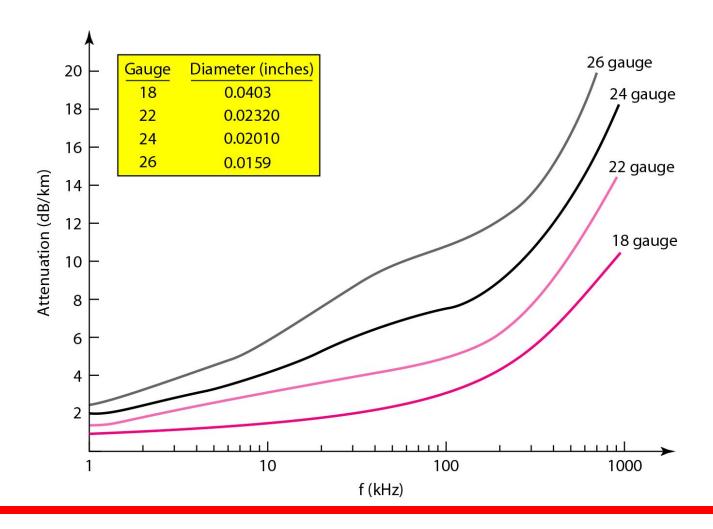
Category	Specification	Data Rate (Mbps)	Use
1	Unshielded twisted-pair used in telephone	< 0.1	Telephone
2	Unshielded twisted-pair originally used in T-lines	2	T-1 lines
3	Improved CAT 2 used in LANs	10	LANs
4	Improved CAT 3 used in Token Ring networks	20	LANs
5	Cable wire is normally 24 AWG with a jacket 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

# Figure 7.5 UTP connector





## Figure 7.6 UTP performance



## Figure 7.7 Coaxial cable

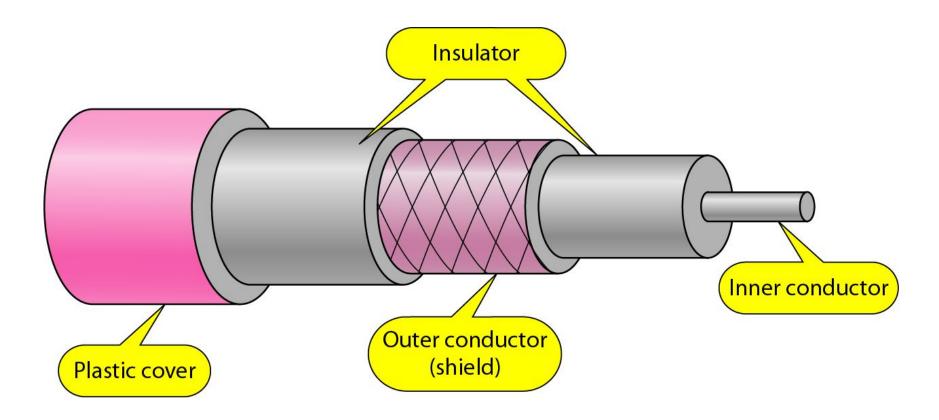
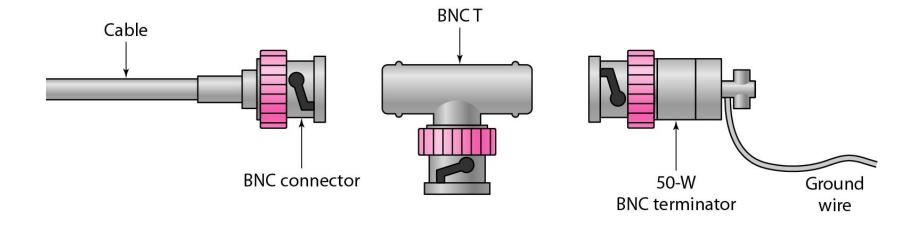


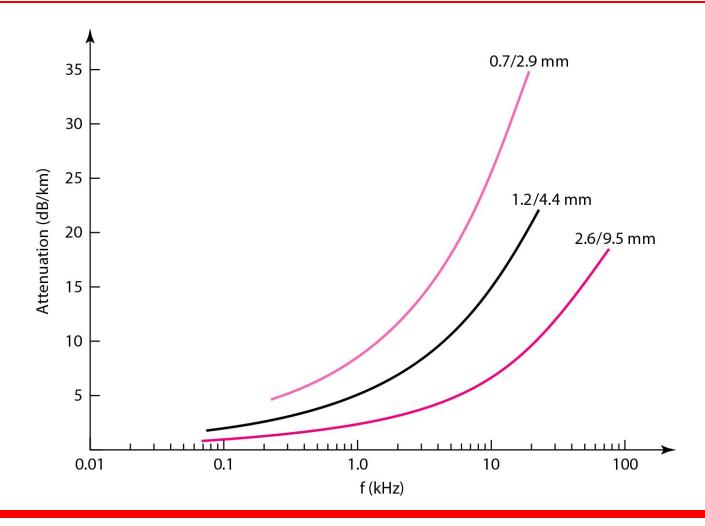
 Table 7.2
 Categories of coaxial cables

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

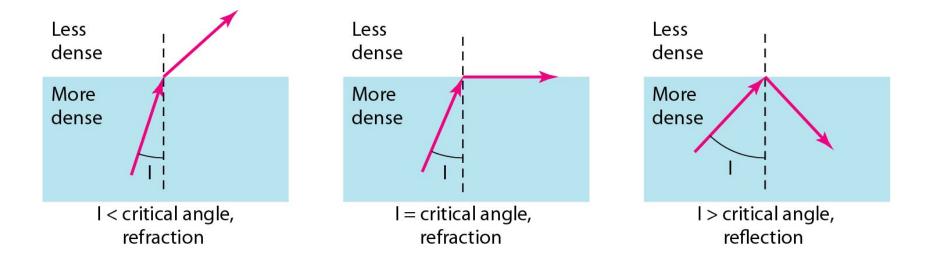
## Figure 7.8 BNC connectors



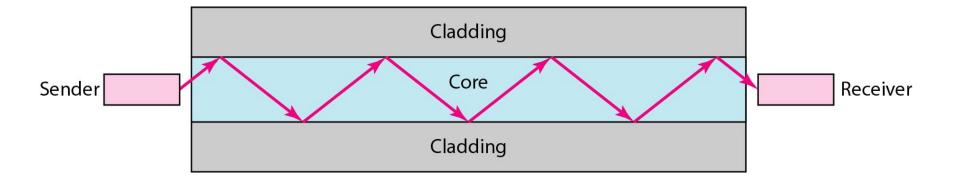
# Figure 7.9 Coaxial cable performance



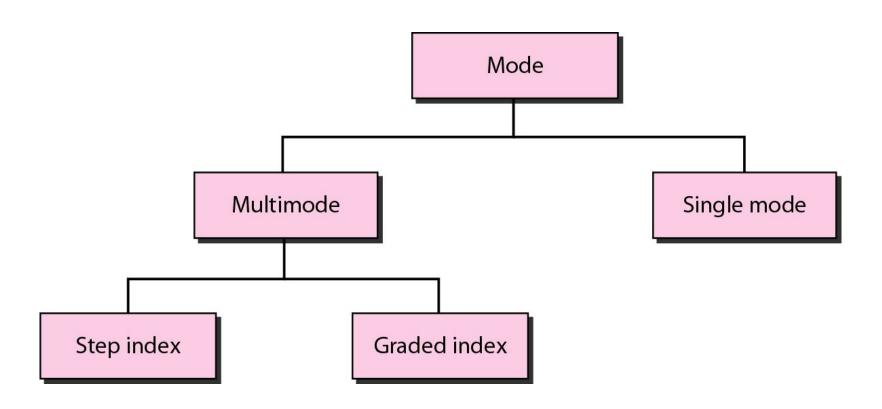
# Figure 7.10 Bending of light ray



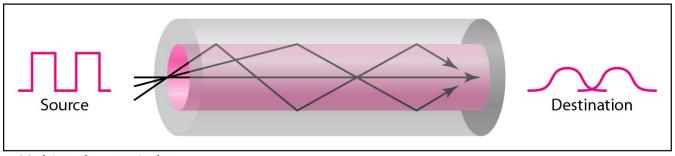
# Figure 7.11 Optical fiber



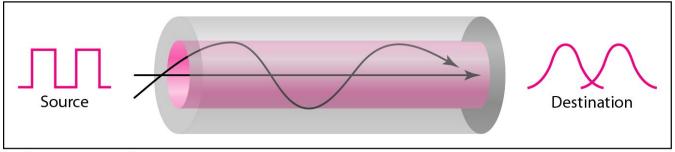
## Figure 7.12 Propagation modes



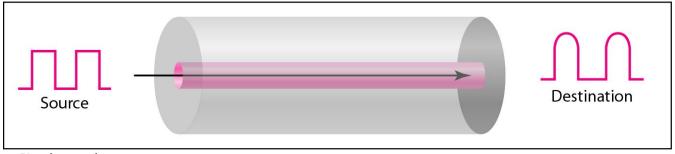
# Figure 7.13 Modes



a. Multimode, step index



b. Multimode, graded index

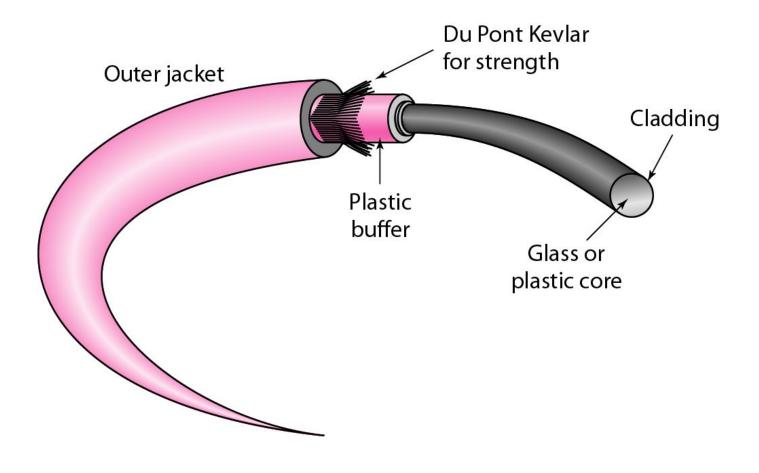


c. Single mode

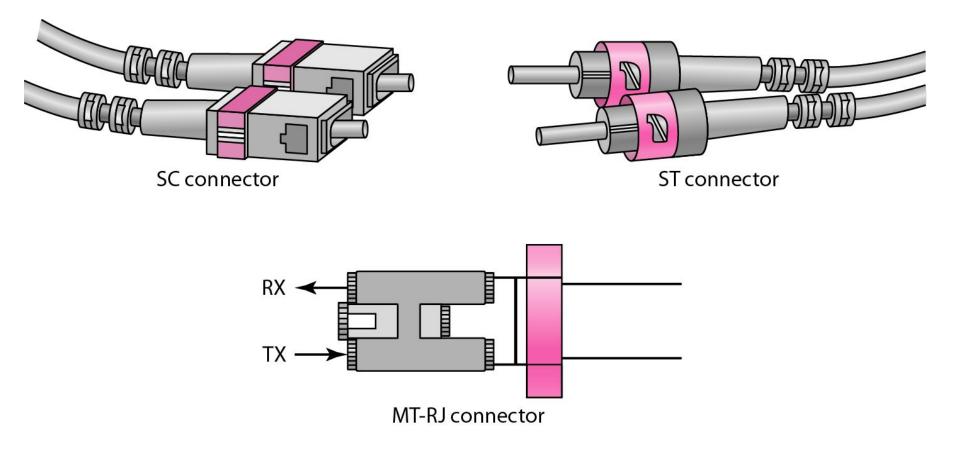
# Table 7.3 Fiber types

Туре	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

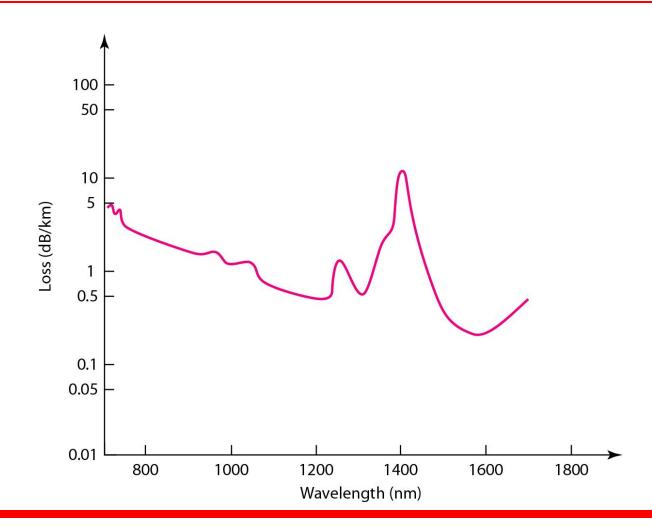
## Figure 7.14 Fiber construction



#### Figure 7.15 Fiber-optic cable connectors



## Figure 7.16 Optical fiber performance



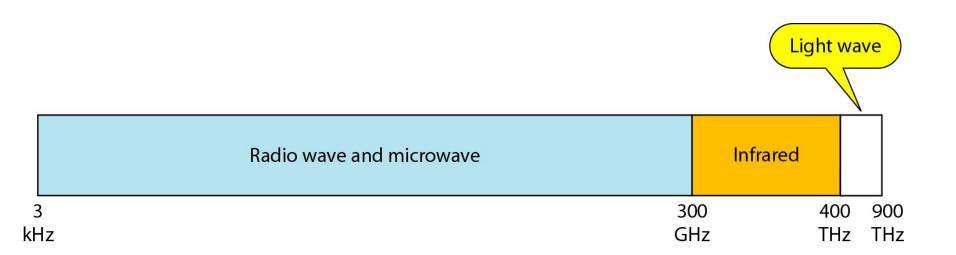
# 7-2 UNGUIDED MEDIA: WIRELESS

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

## Topics discussed in this section:

Radio Waves Microwaves Infrared

#### Figure 7.17 Electromagnetic spectrum for wireless communication



#### Figure 7.18 Propagation methods

lonosphere lonosphere lono

Ground propagation (below 2 MHz)

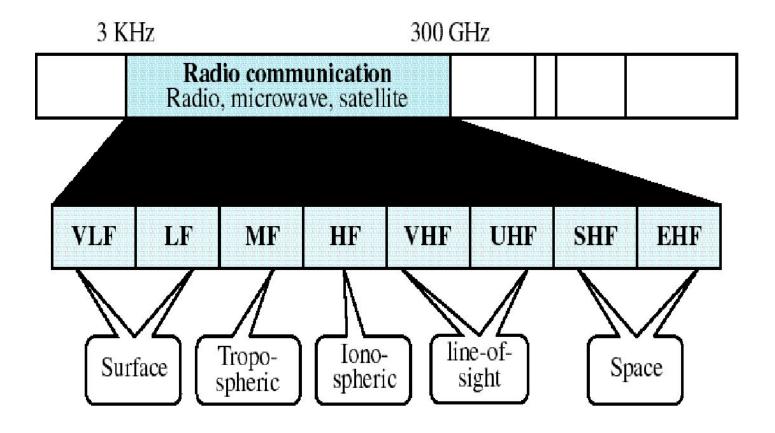
Sky propagation (2–30 MHz)

Ionosphere



Line-of-sight propagation (above 30 MHz)

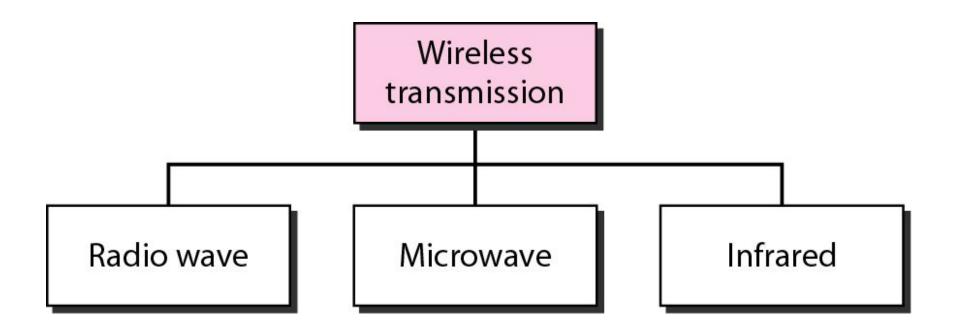




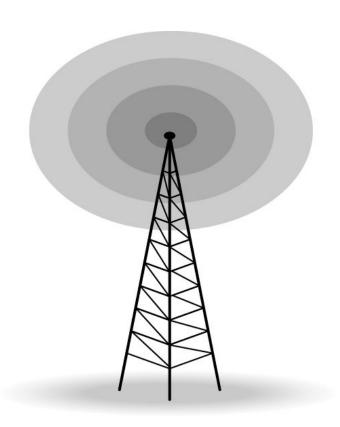
#### Table 7.4 Bands

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

#### Figure 7.19 Wireless transmission waves



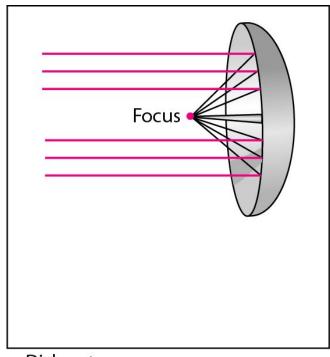
# Figure 7.20 Omnidirectional antenna



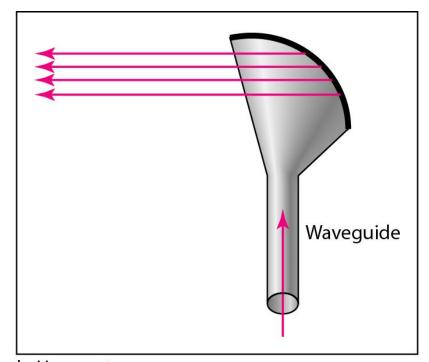
# Note

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

## Figure 7.21 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.