UNGUIDED MEDIA: WIRELESS

- Unguided medium transport electromagnetic waves without using a physical conductor.
- This type of communication is often referred to as wireless communication. Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

Figure 7.17 *Electromagnetic spectrum for wireless communication*

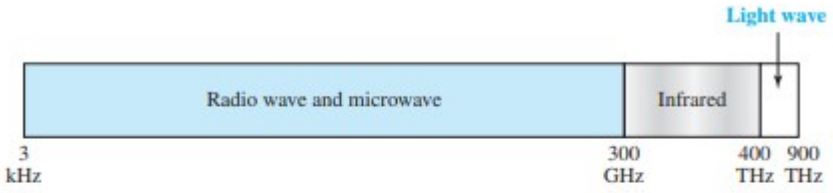
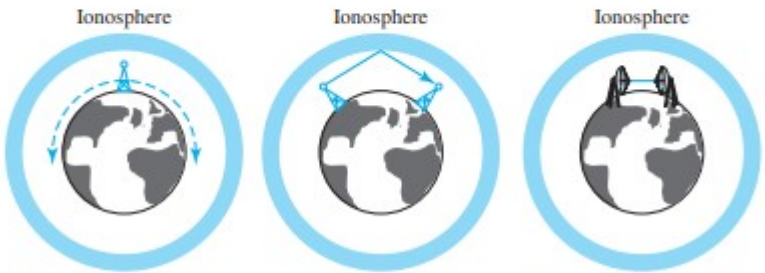


Figure 7.18 *Propagation methods*



- In ground propagation, radio waves travel through the lowest portion of the atmosphere, hugging the earth.
- . In sky propagation, higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth. This type of transmission allows for greater distances with lower output power.
- In line-of-sight propagation, very high-frequency signals are transmitted in straight lines directly from antenna to antenna.

Table 7.4 *Bands*

Band	*Range*	*Propagation*	*Application*
very low frequency (VLF)	3–30 kHz	Ground	Long-range radio navigation
low frequency (LF)	30–300 kHz	Ground	Radio beacons and navigational locators

Band	*Range*	*Propagation*	*Application*
middle frequency (MF)	300 kHz–3 MHz	Sky	AM radio
high frequency (HF)	3–30 MHz	Sky	Citizens band (CB), ship/aircraft
very high frequency (VHF)	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
ultrahigh frequency (UHF)	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
superhigh frequency (SF)	3–30 GHz	Line-of-sight	Satellite
extremely high frequency (EHF)	30–300 GHz	Line-of-sight	Radar, satellite

- ❖ We can divide wireless transmission into three broad groups: radio waves, microwaves, and infrared waves.

Radio Waves

- Electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves; waves ranging in frequencies between 1 and 300 GHz are called microwaves.
- Radio waves, for the most part, are omni directional. When an antenna transmits radio waves, they are propagated in all directions. This means that the sending and receiving antennas do not have to be aligned.
- A sending antenna sends waves that can be received by any receiving antenna.
- The omni directional property has a disadvantage, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.
- Radio waves, particularly those waves that propagate in the sky mode, can travel long distances.
- Applications

  The omni directional characteristics of radio waves make them useful for multicasting, in which there is one sender but many receivers. AM and FM radio, television, maritime radio, cordless phones, and paging are examples of multicasting.

Microwaves

- Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.
- Microwaves are unidirectional. When an antenna transmits microwaves, they can be narrowly focused. This means that the sending and receiving antennas need to be aligned.
- The unidirectional property has an obvious advantage.
- characteristics of microwave propagation:

  ❑ Microwave propagation is line-of-sight.

Since the towers with the mounted antennas need to be in direct sight of each other, towers that are far apart need to be very tall. Repeaters are often needed for longdistance communication

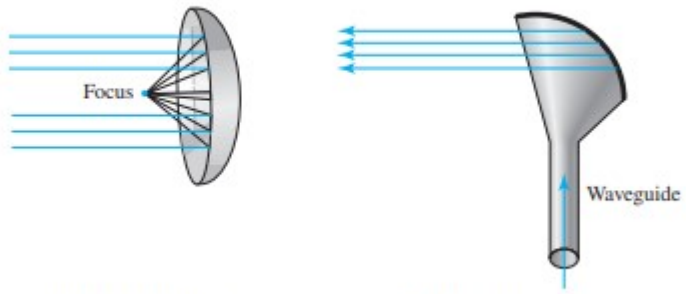
❑ Very high-frequency microwaves cannot penetrate walls. This characteristic can be a disadvantage if receivers are inside buildings.

❑ The microwave band is relatively wide, almost 299 GHz. Therefore wider subbands can be assigned, and a high data rate is possible.

❑ Use of certain portions of the band requires permission from authorities.

- Unidirectional Antenna Microwaves need unidirectional antennas that send out signals in one direction
- Two types of antennas are used for microwave communications: the parabolic dish and the horn

Figure 7.20 *Unidirectional antennas*



- Applications Microwaves, due to their unidirectional properties, are very useful when unicast (oneto-one) communication is needed between the sender and the receiver.
- They are used in cellular phones satellite networks and wireless LANs.

Infrared

- Infrared waves, with frequencies from 300 GHz to 400 THz (wavelengths from 1 mm to 770 nm), can be used for short-range communication.

- Infrared waves, having high frequencies, cannot penetrate walls. This advantageous characteristic prevents interference between one system and another;
- we cannot use infrared waves outside a building because the sun's rays contain infrared waves that can interfere with the communication.
- Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.