

# **EE303 Lesson 1: Introduction**

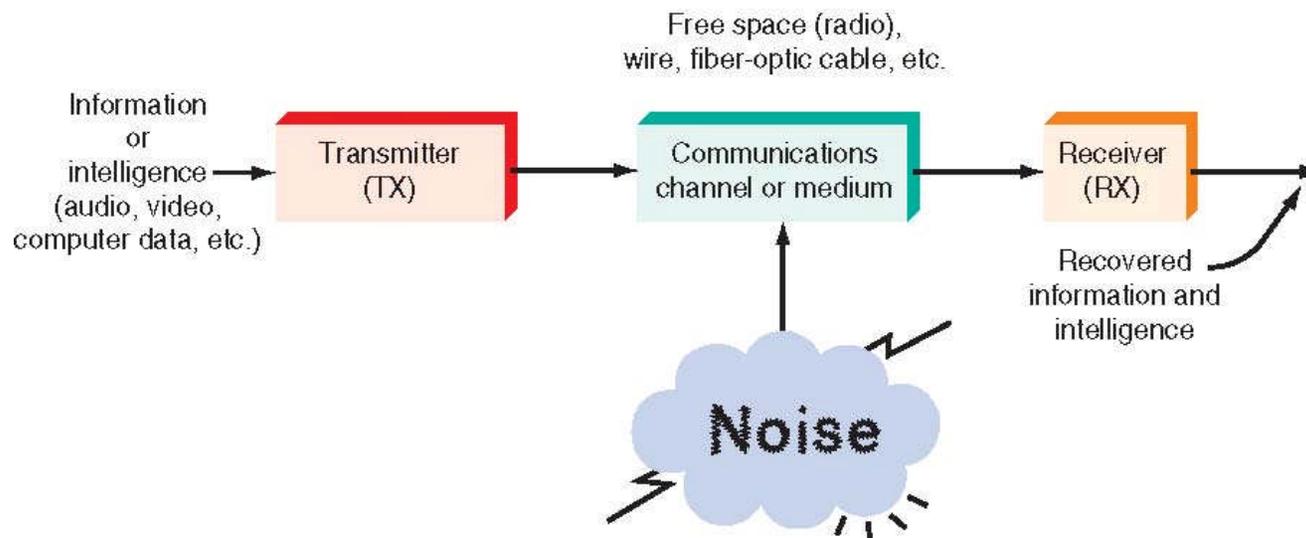
# Communications

- The purpose of a communications system is to transmit information over a distance.
- Information can take numerous forms
  - Audio – speech, music
  - Video
  - Sensor data – temperature, pressure, etc.
  - Data – digital information



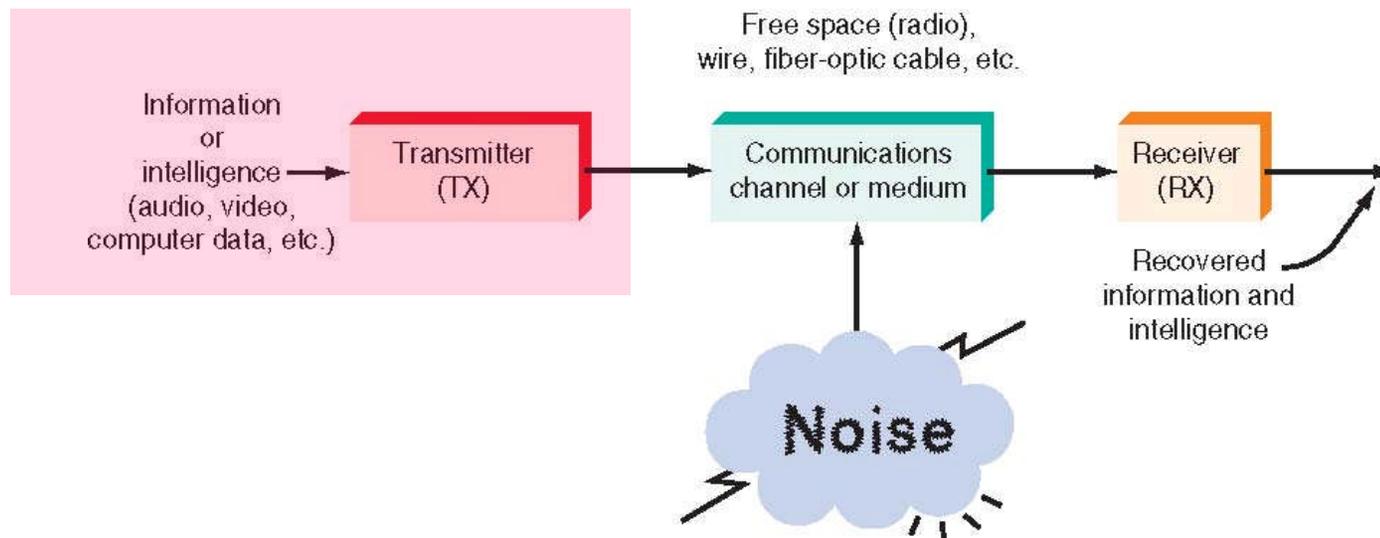
# Communication systems

- The fundamental components of all electronic communication systems are the
  - Transmitter
  - Communications channel (or medium)
  - Receiver



# Transmitter

- The purpose of the transmitter is to convert information into an electronic form suitable for the given communications channel.



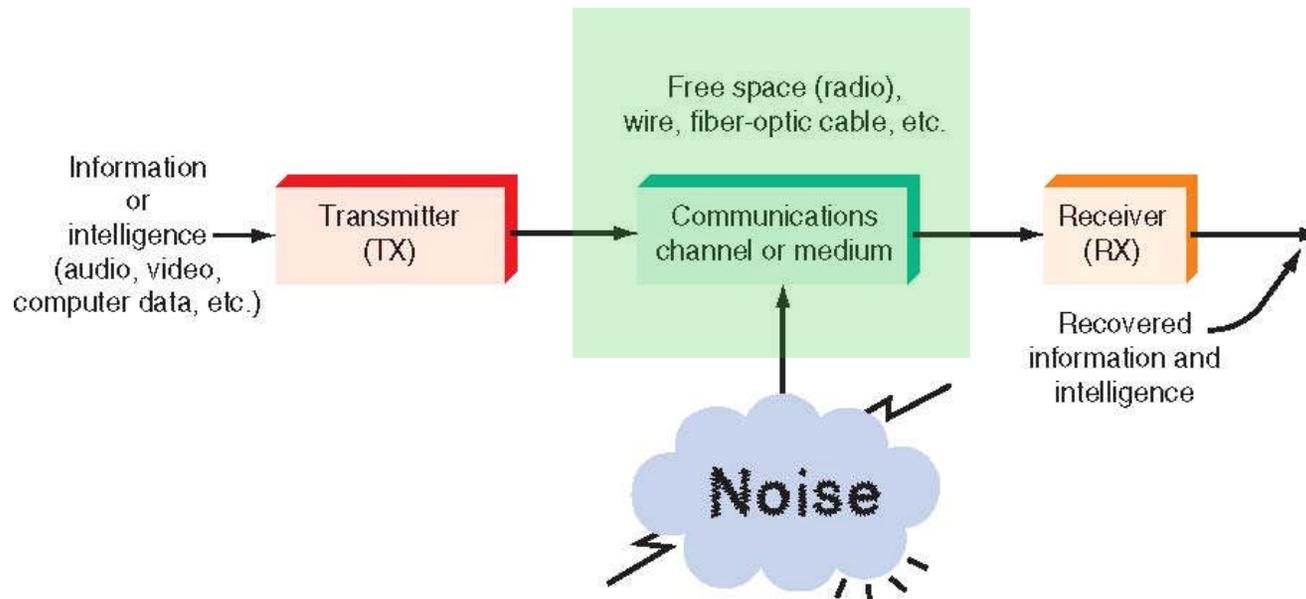


# Transmitter

- Conversion of a physical signal into an electrical signal is handled by a transducer.
- Transmitters use oscillators, amplifiers, filters, modulators and mixers to convert the input electrical signal into a format compatible with the transmission medium.

# Communications channel

- The communications channel is the physical medium through which an electronic signal travels.
- Many different types of media are used in communications channels.



# Electrical conductors

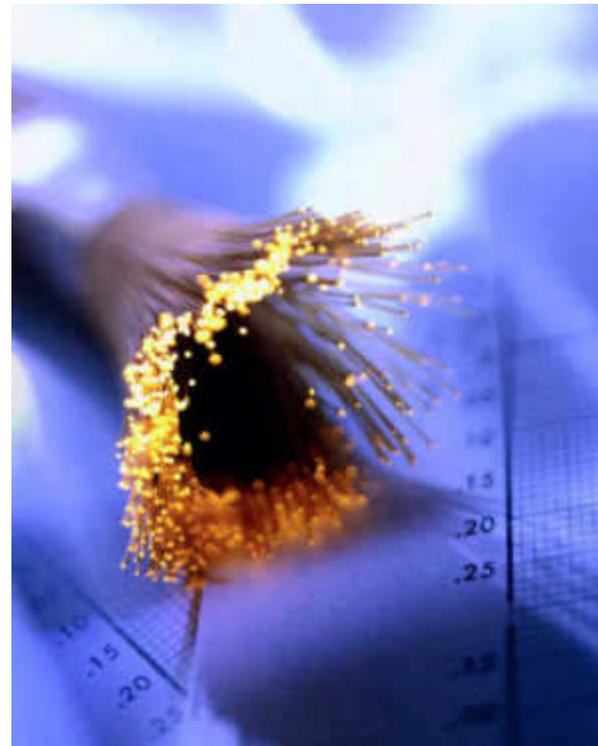
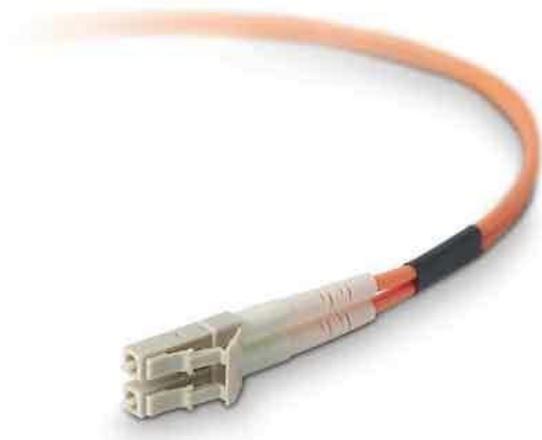
- Electrical conductors or wires were the first and simplest transmission medium.
- Examples include coaxial cable, copper phone lines, and twisted-pair Ethernet cables.





# Optical media

- Fiber optic cables information embedded in pulses of light produced by lasers.





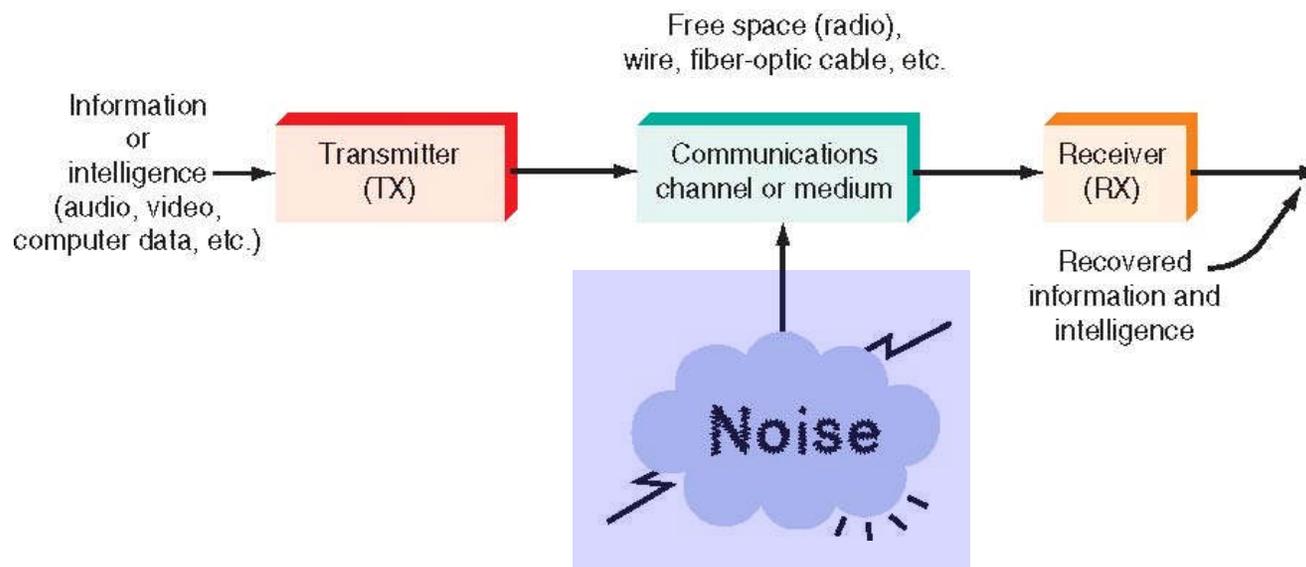
# Free space

- When electromagnetic radiation is transmitted across air (or a vacuum) between transmitter and receiver that are not physically connected, it is called transmission via free space.
- Examples include wireless or radio transmission.



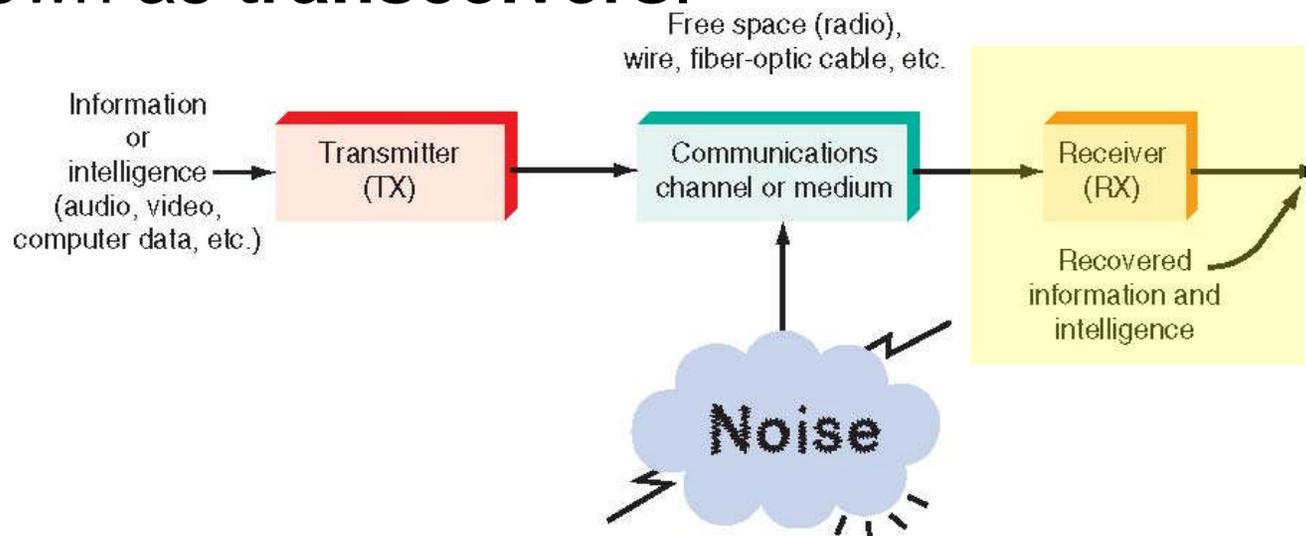
# Noise

- Noise refers to the corruption of the original information signal.
- Noise is one of the fundamental limiting factors on all communications systems.



# Receivers

- The receiver refers to the electrical circuitry that converts the transmitted signal back into a useable form.
- Two-way equipment commonly incorporates both transmitter and receiver functions and are known as **transceivers**.



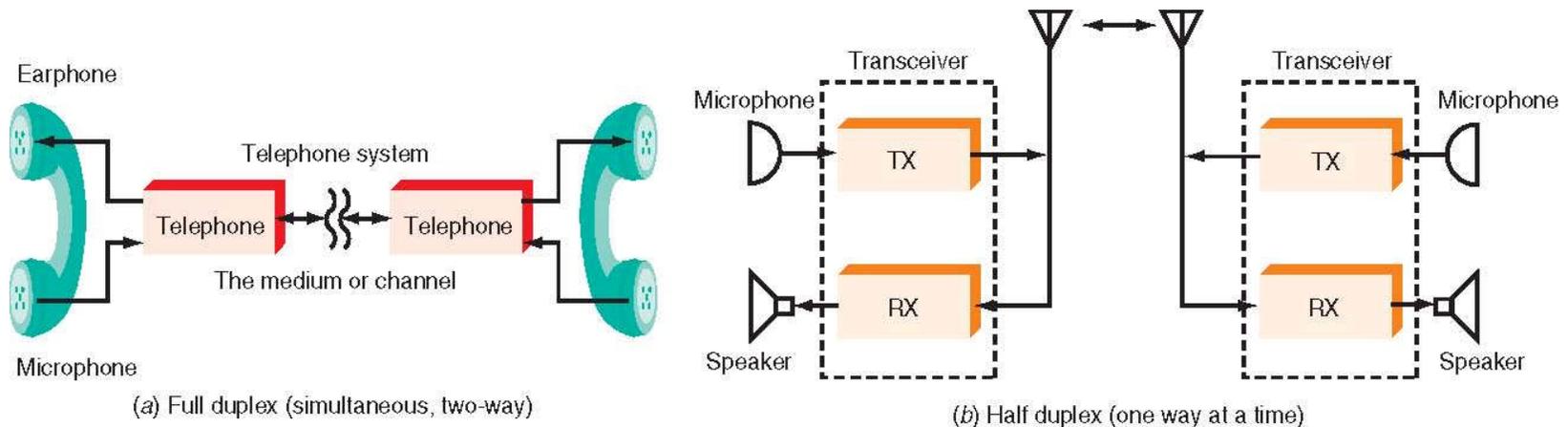
# Types of electronic communications

- Communications systems fall under broad classifications.
- One-way communication is referred to as **simplex** communication.
- Example include broadcast TV, radio, or pagers.



# Duplex

- Two-way communication is called duplex.
- Simultaneous two-way communication is referred to as **full-duplex**.
- When only one party at a time can transmit, it is called **half-duplex**. (CB radio, air traffic control)

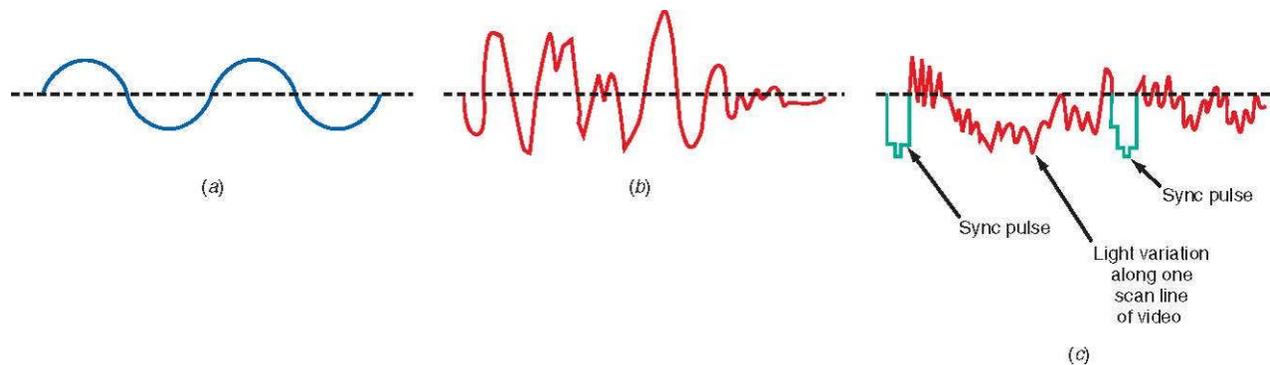




# Analog signals

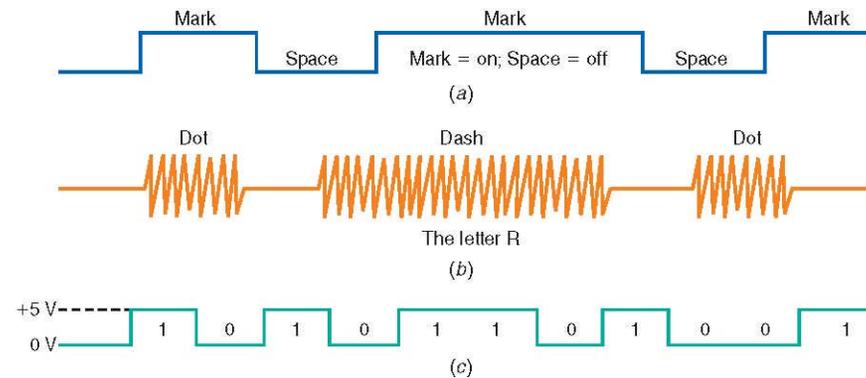
- An analog signal is a continuously varying such as in voice or music.

Analog signals. (a) sine wave “tone.” (b) voice. (c) video (TV) signal.



# Digital signals

- Digital signals change in discrete increments and represent digital (binary) information such as is used by computers.

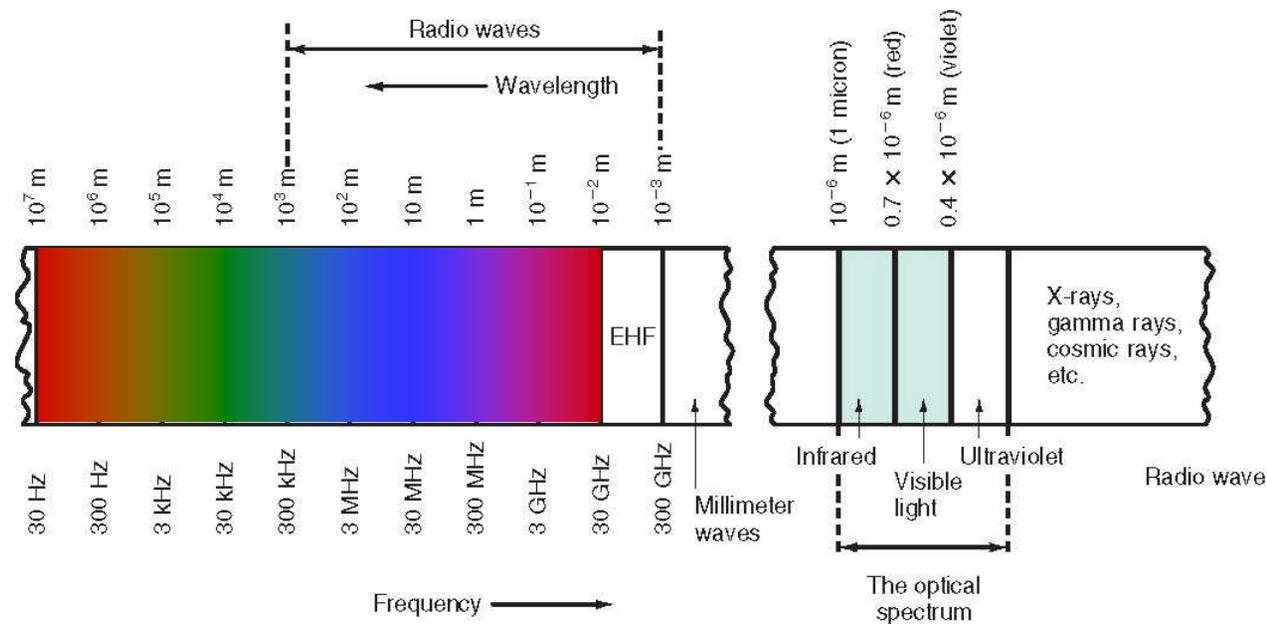


Digital signals



# Electromagnetic spectrum

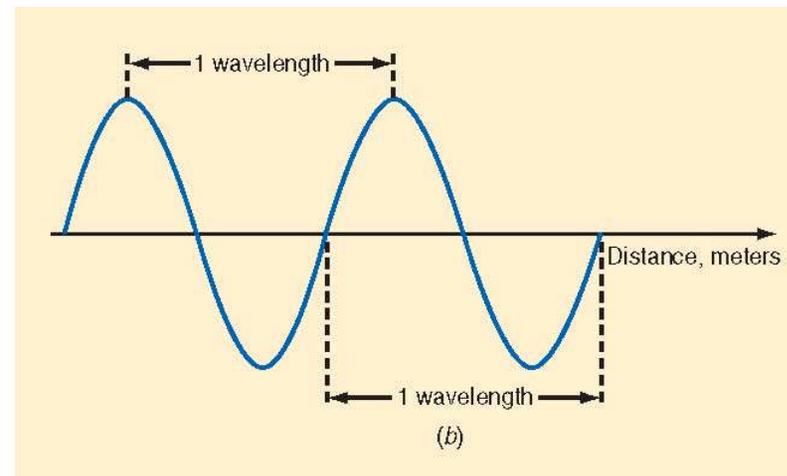
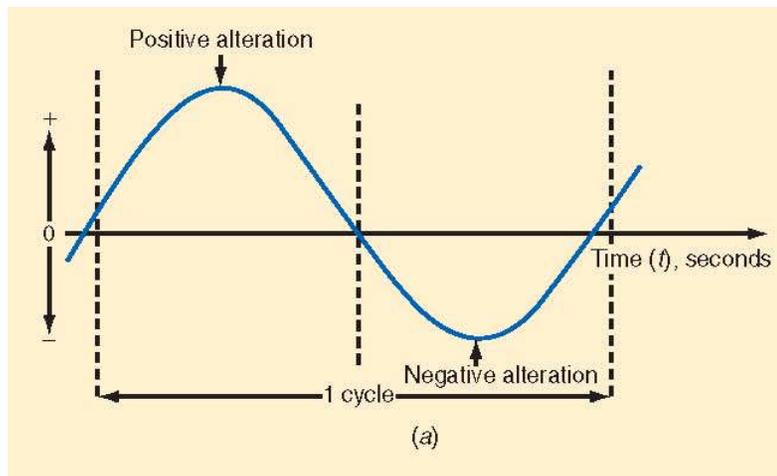
- Electromagnetic radiation propagates in waves.
- The entire range of frequencies of these electromagnetic waves is known as the electromagnetic spectrum.



The electromagnetic spectrum

# Frequency and wavelength

- Frequency ( $f$ ) is the number of cycles per second of a wave measured in hertz (Hz).
- Wavelength ( $\lambda$ ) is the distance traveled by one cycle of a wave measure in meters.





# Speed of light

- Recall that the speed of wave propagation is given by

$$c = f\lambda$$

- For electromagnetic waves traveling in air (or vacuum),  $c$  is roughly  $3 \times 10^8$  m/s.

# Example Problem 1

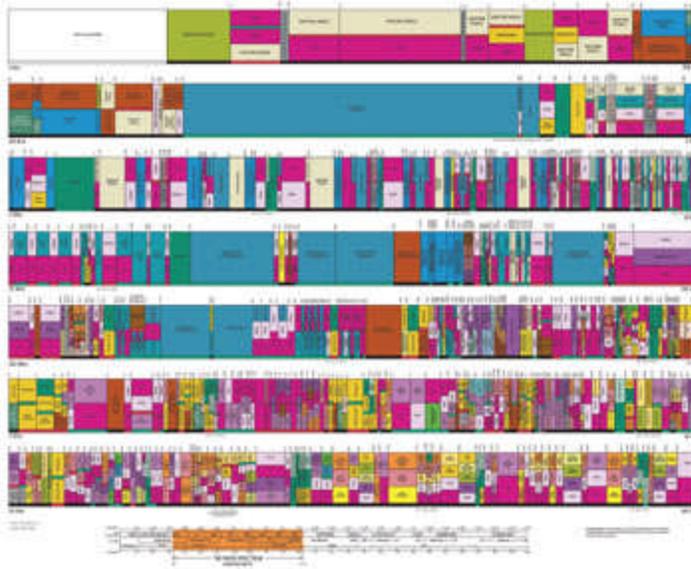
What is the wavelength of an FM radio station whose frequency is 101.1 MHz?





# Frequency ranges

- The electromagnetic spectrum is divided up by frequency ranges.

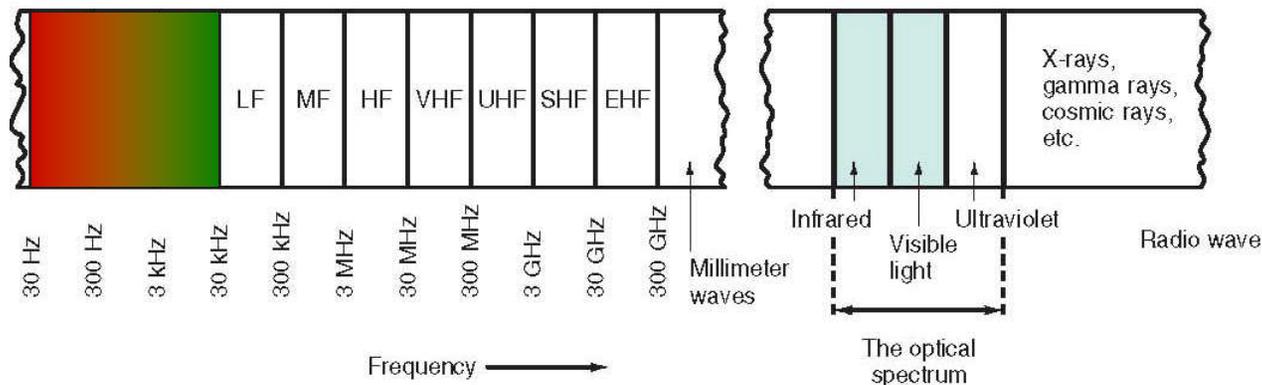


Name	Frequency
Extremely low frequencies (ELFs)	30–300 Hz
Voice frequencies (VFs)	300–3000 Hz
Very low frequencies (VLFs)	3–30 kHz
Low frequencies (LFs)	30–300 kHz
Medium frequencies (MFs)	300 kHz–3 MHz
High frequencies (HF)	3–30 MHz
Very high frequencies (VHF)	30–300 MHz
Ultra high frequencies (UHF)	300 MHz–3 GHz
Super high frequencies (SHF)	3–30 GHz
Extremely high frequencies (EHF)	30–300 GHz
Infrared	—
The visible spectrum (light)	—

[FCC Radio Frequency Allocation Table](#)

# Frequency ranges

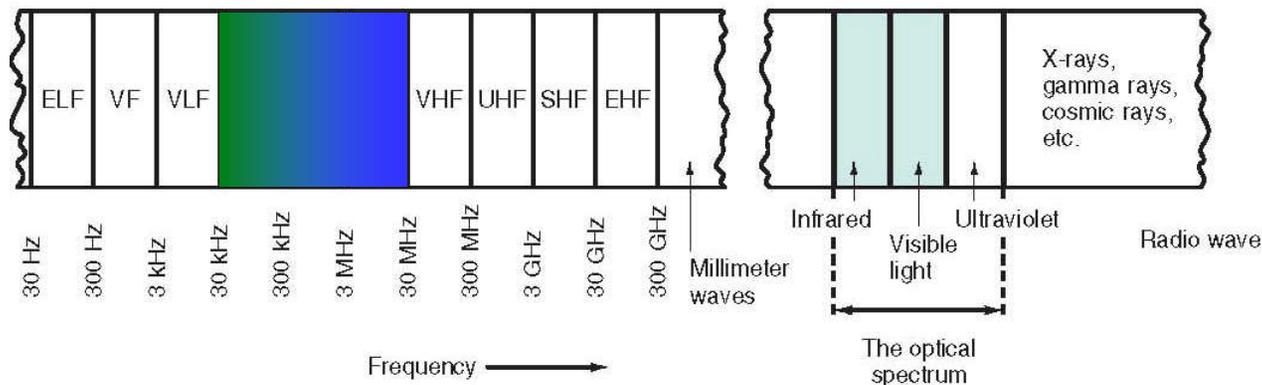
- Extreme low frequency (ELF) 30 to 300 Hz.
- Voice frequency (VF) 300 to 3000 Hz. Normal range of human speech.
- Very low frequency (VLF) 3 to 30 kHz. Used for communications with submerged submarines.





# Frequency ranges

- Low frequency (LF) 30 to 300 kHz. Long range radio navigation.
- Medium frequency (MF) 300 to 3000 kHz. Long range communication.
- High frequency (HF) 3 to 30 MHz. Known as “short wave” used two-way radio.



# Frequency ranges

- Very high frequency (VHF) 30 to 300 MHz. Radio communications and FM radio.
- Ultra high frequency (UHF) 300 to 3000 MHz. TV, military and cell phones.
- Super high frequency (SHF) 3 to 30 GHz. Microwave. Satellite communications and radar.

