

## UNIT I

### ELECTROMAGNETIC SPECTRUM

# ELECTROMAGNETIC SPECTRUM

□ Wireless communication is based on the principle of broadcast and reception of electromagnetic waves.

□ These waves can be characterized by their frequency ( $f$ ) or their wavelength ( $\lambda$ )

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# Propagation

## Speed of Propagation

$$C = \lambda * f$$

$c$  is the speed of light ( $3 \times 10^8 m/s$ )

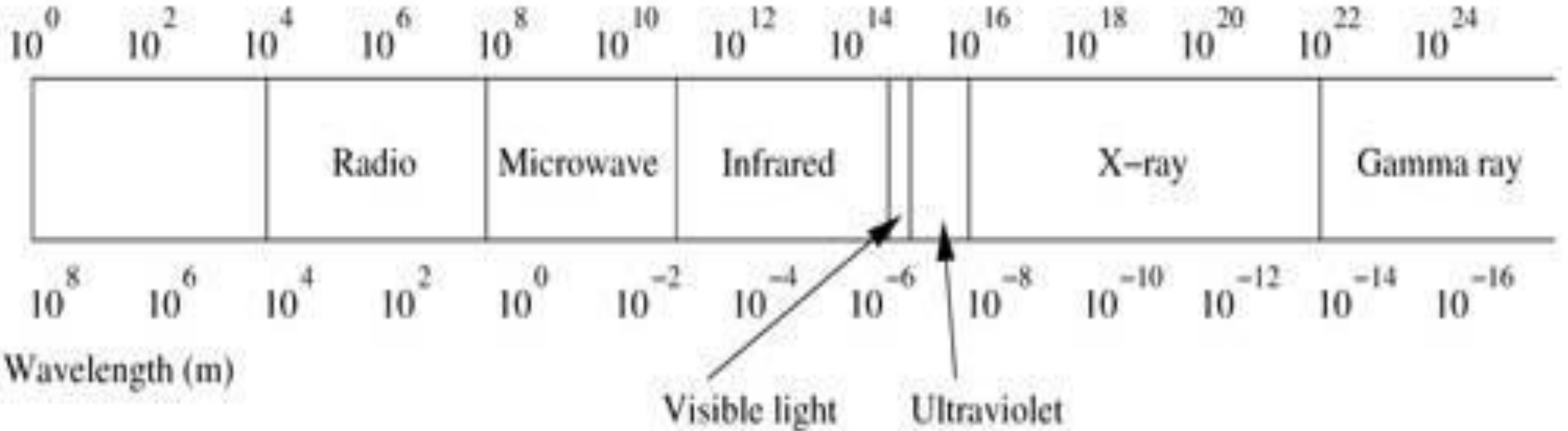
$f$  is the frequency of the wave in Hz,

$\lambda$  is its wavelength in meters.



# Pictographic view of the electromagnetic spectrum

Frequency (Hz)



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# Radio waves

Band Name	Frequency	Wavelength	Applications
Extremely Low Frequency (ELF)	30 to 300 Hz	10,000 to 1,000 Km	Powerline frequencies
Voice Frequency (VF)	300 to 3,000 Hz	1,000 to 100 Km	Telephone communications
Very Low Frequency (VLF)	3 to 30 KHz	100 to 10 Km	Marine communications
Low Frequency (LF)	30 to 300 KHz	10 to 1 Km	Marine communications
Medium Frequency (MF)	300 to 3,000 KHz	1,000 to 100 m*	AM broadcasting
High Frequency (HF)	3 to 30 MHz	100 to 10 m	Long-distance aircraft/ship communications
Very High Frequency (VHF)	30 to 300 MHz	10 to 1 m	FM broadcasting
Ultra High Frequency (UHF)	300 to 3,000 MHz	100 to 10 cm	Cellular telephone
Super High Frequency (SHF)	3 to 30 GHz	10 to 1 cm	Satellite communications, microwave links
Extremely High Frequency (EHF)	30 to 300 GHz	10 to 1 mm	Wireless local loop
Infrared	300 GHz to 400 THz	1 mm to 770 nm	Consumer electronics
Visible Light	400 THz to 900 THz	770 nm to 330 nm	Optical communications

\* Throughout this book, the unit *m* refers to meter(s).

# Propagation waves

- VLF, LF, and MF bands the propagation of waves, also called as ground waves
- The process of communication involves the transmission of information from one location to another.
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- Wave is a disturbance that transfers energy through medium or space with negligible or no amount of mass transfer.
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# Microwave

- Microwave transmissions (in the SHF band) tend to **travel in straight lines** and hence can be narrowly focused.
- Microwaves are a type of electromagnetic radiation, as are radio waves, ultraviolet radiation, X-rays and gamma-rays.
- Microwaves have a range of applications, including communications, radar.
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# Infrared waves

- Infrared waves and waves in the EHF band (also known as millimeter waves) are used for **short- range communication**.
- Infrared waves, or infrared light, are part of the electromagnetic spectrum.
- People encounter Infrared waves every day; the human eye cannot see it, but humans can detect it as heat.





# Visible light

- The visible light part of the spectrum is just after the infrared portion.
- The visible light spectrum is the segment of the electromagnetic spectrum that the human eye can view.
- Visible light is a form of electromagnetic (EM) radiation, as are radio waves, infrared radiation, ultraviolet radiation, X-rays and microwaves



# SPECTRUM ALLOCATION

Many methods have been tried out for this frequency allocation among multiple competing carriers, some of which are described below

- **Beauty contest method**

- **Lottery system**

- **Auctioning method**

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Thank You