
Understand Radio waves

ANAND SYSTEMS ENGINEERING





HOUSE



CAFE



SCHOOL



COLLEGE



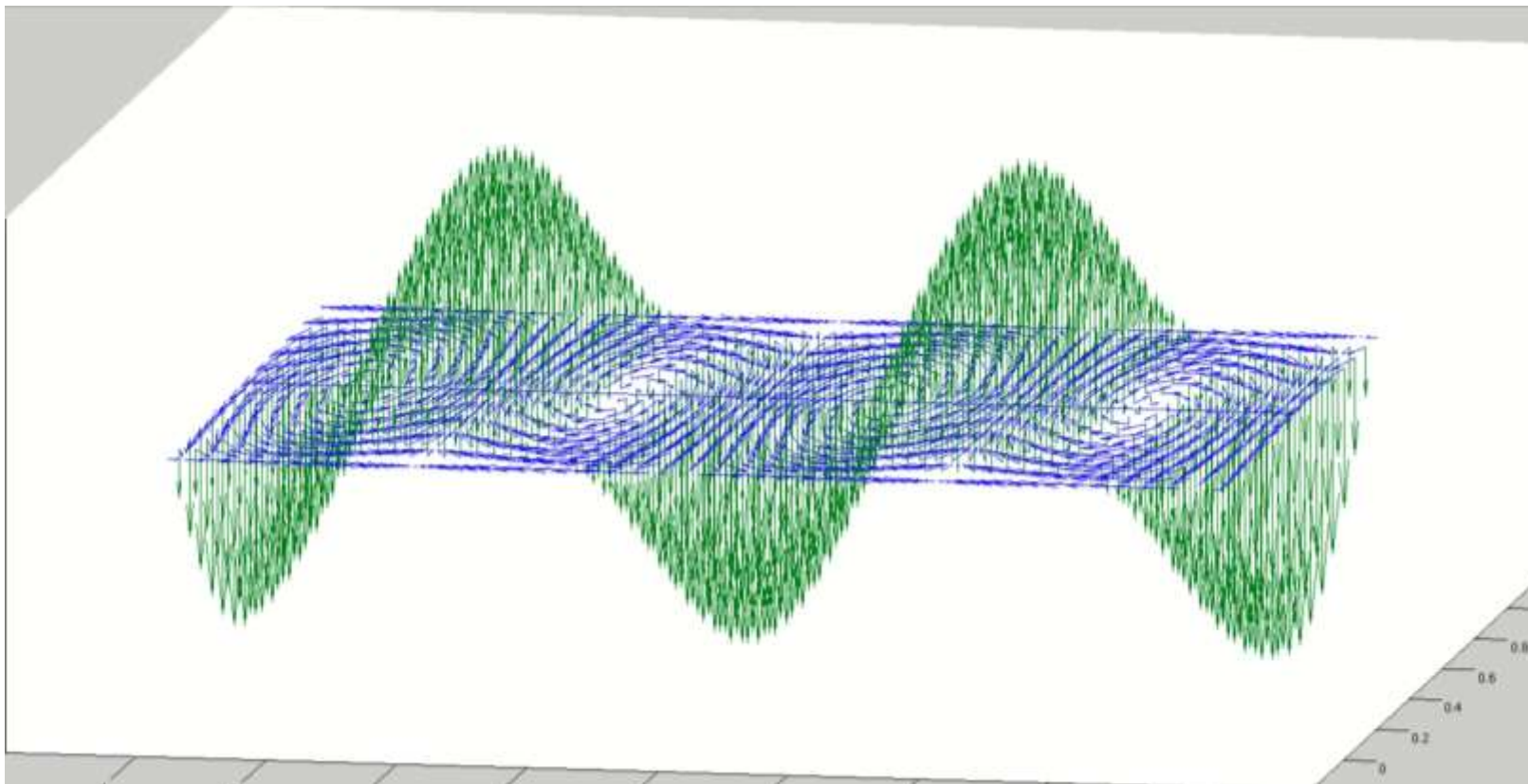
OFFICE



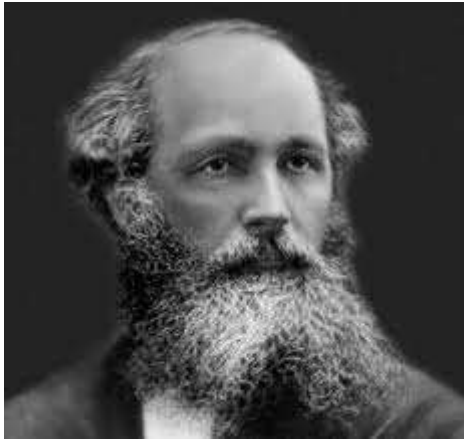
MALL

FEW APPLICATIONS of RADIOWAVES





RADIO WAVES are traveling Electric and Magnetic Waves



James Maxwell

1867

Predicted EM waves

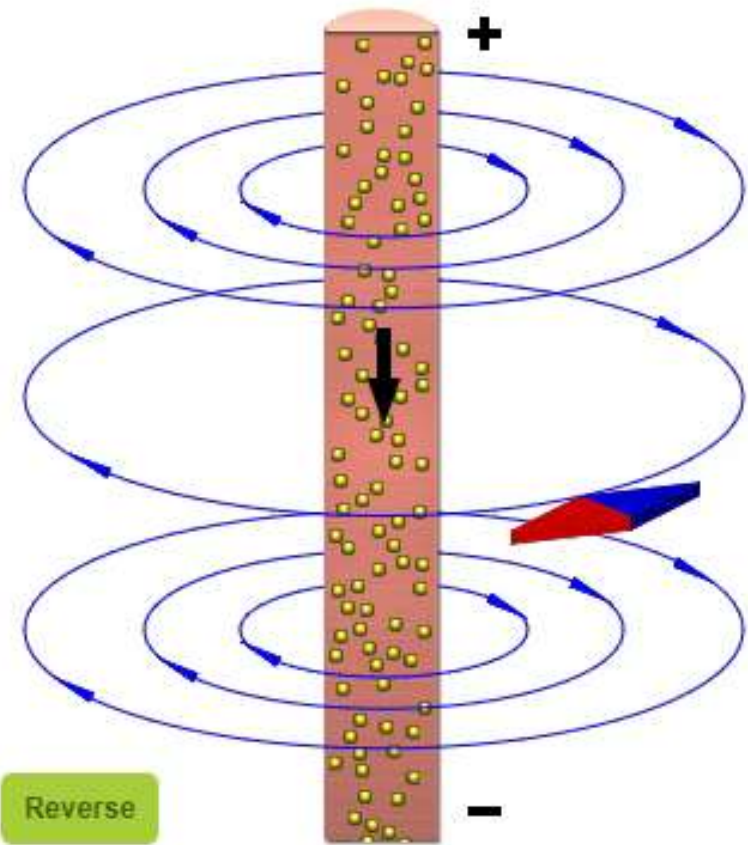


Heinrich Hertz

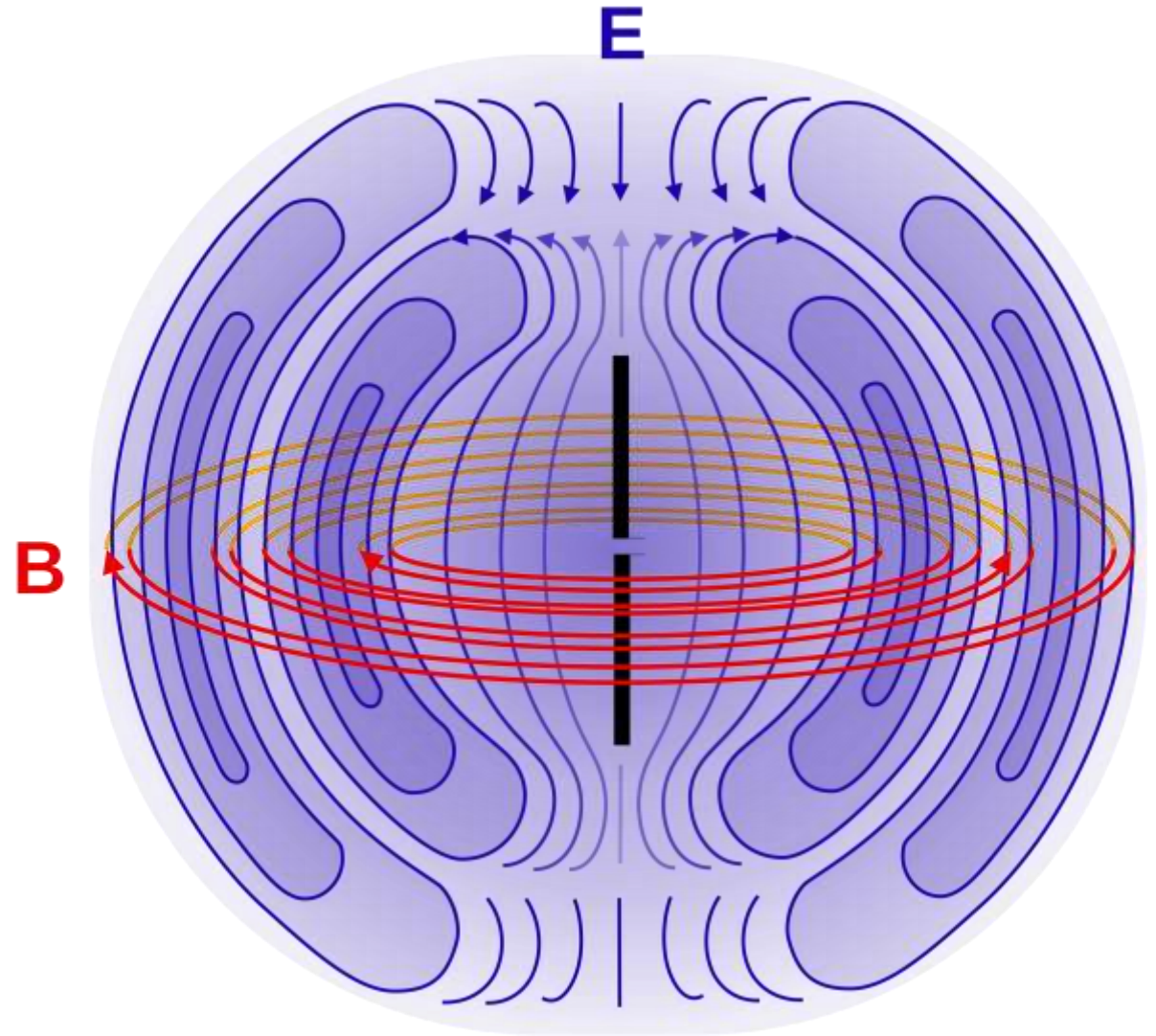
1887

Confirmed EM Waves





**Magnetic Field generated
when current flows in a wire**



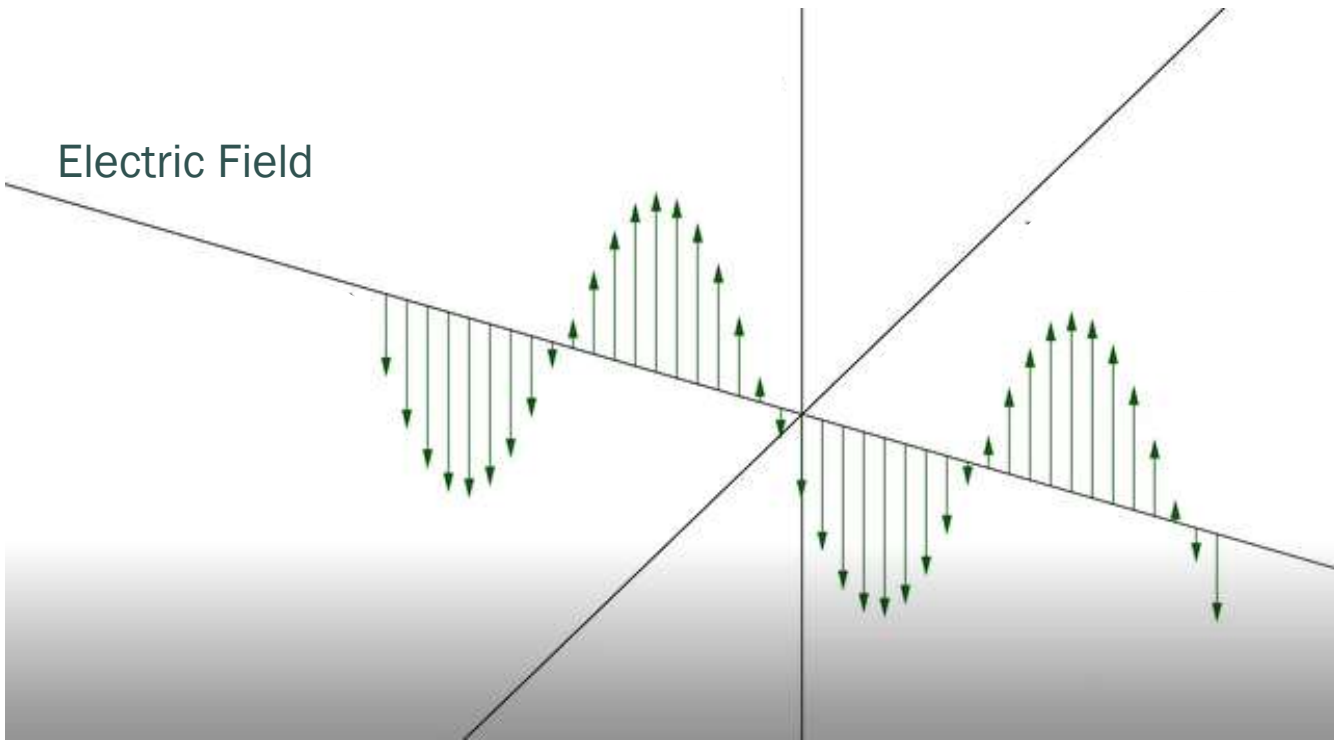
**Electric Field generated
when current flows in a wire**



Magnitude

Magnetic Field

Electric Field

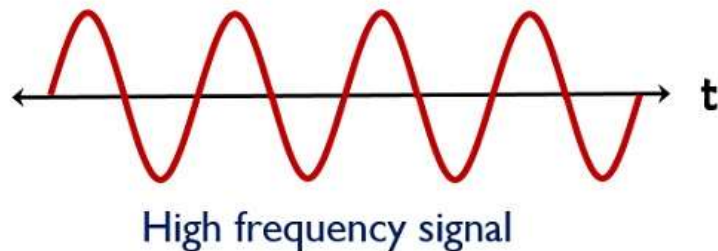
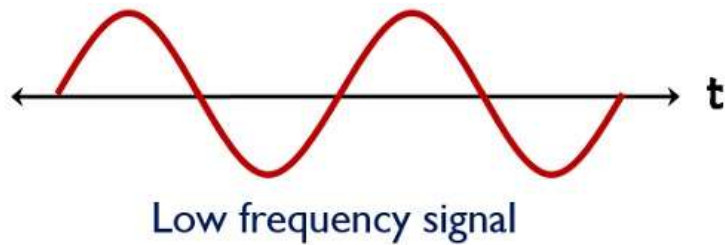


$$\frac{\text{magnitude of Electric field}}{\text{magnitude of Magnetic field}} = \text{speed of light } (3 \times 10^8 \text{ m/s})$$



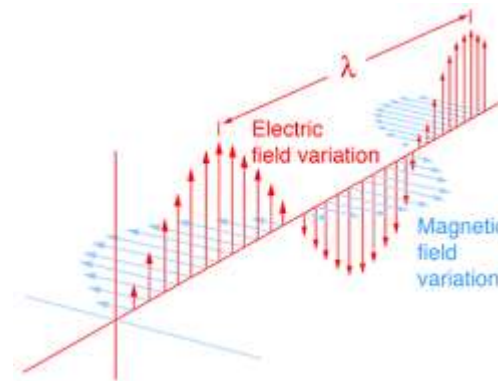
Properties

Frequency (f) is number of waves traveling in a Second .



Circuit Globe

Wavelength (λ) is defined as the distance between two points of similar cycles of periodic wave.



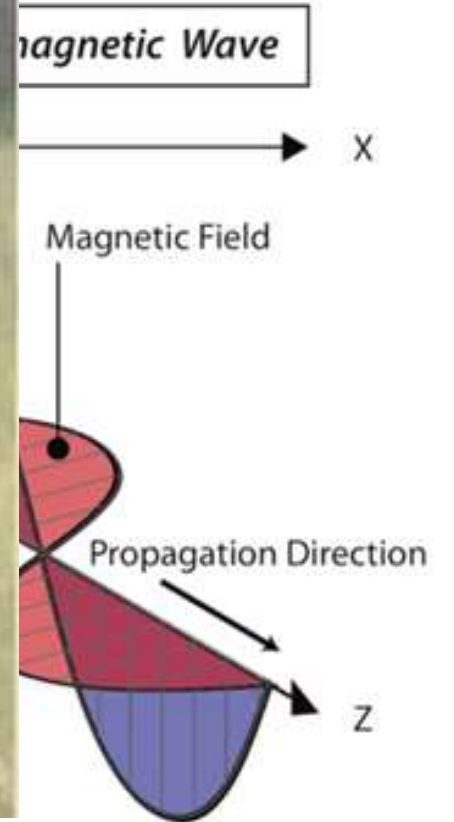
$$\lambda = \frac{\text{Speed of light}}{\text{frequency}} = \frac{3 \times 10^8 \text{ m/s}}{f}$$



Radio Waves



Visible Light



Electromagnetic radiation

Normal camera

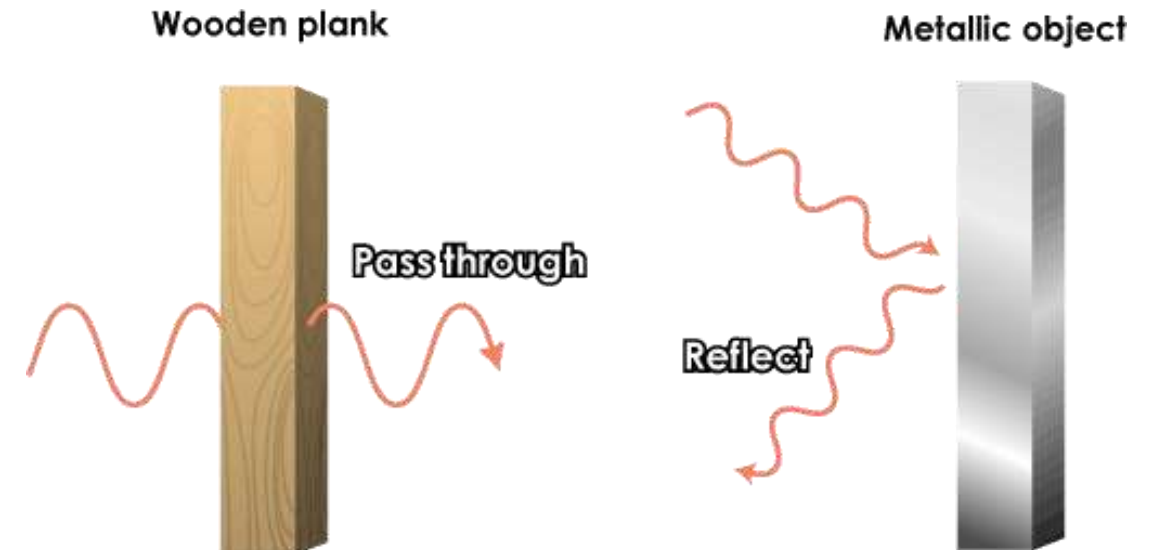
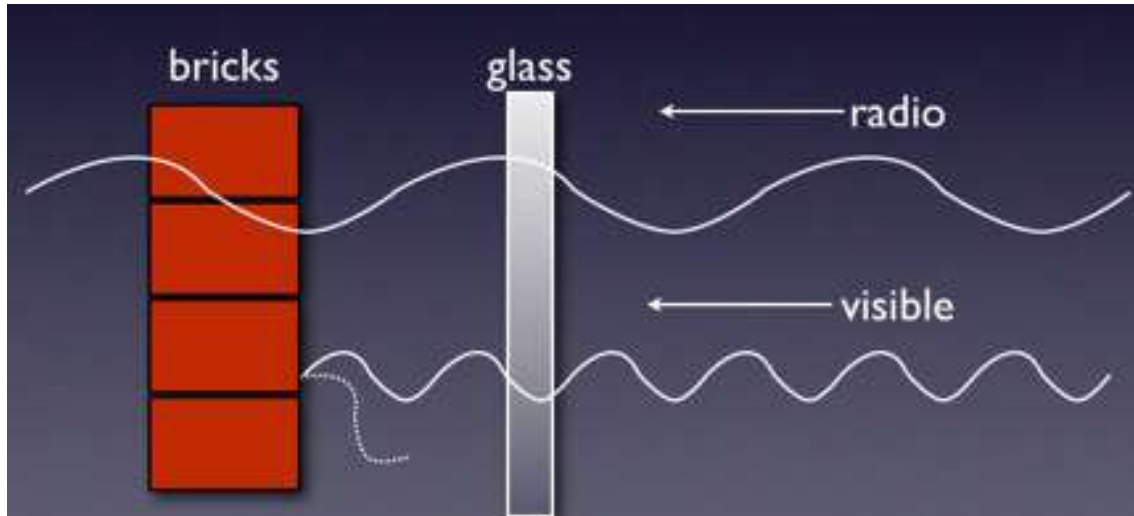


Infrared camera



Photo credit : NASA

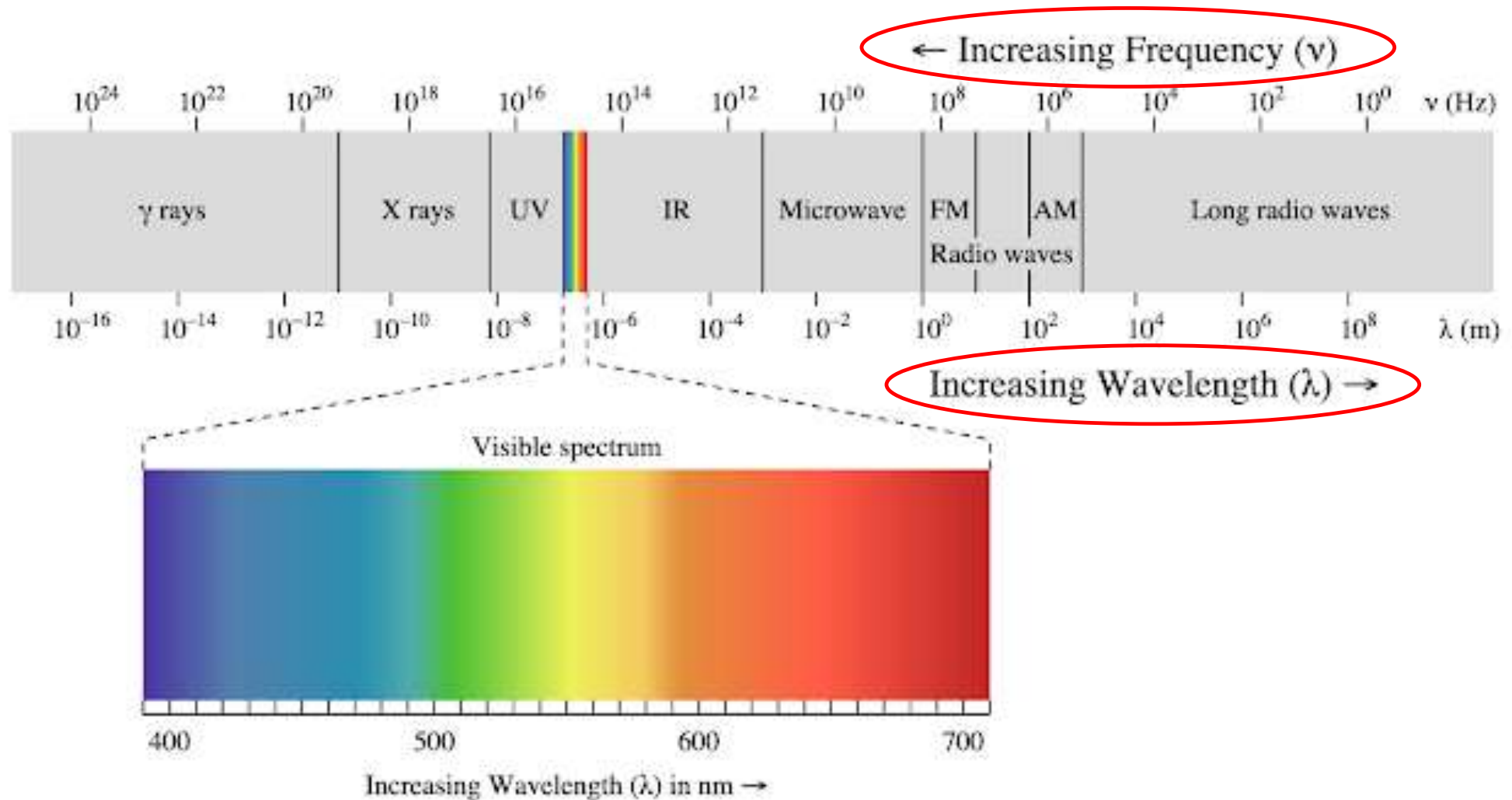
Radio Wave Travelling properties



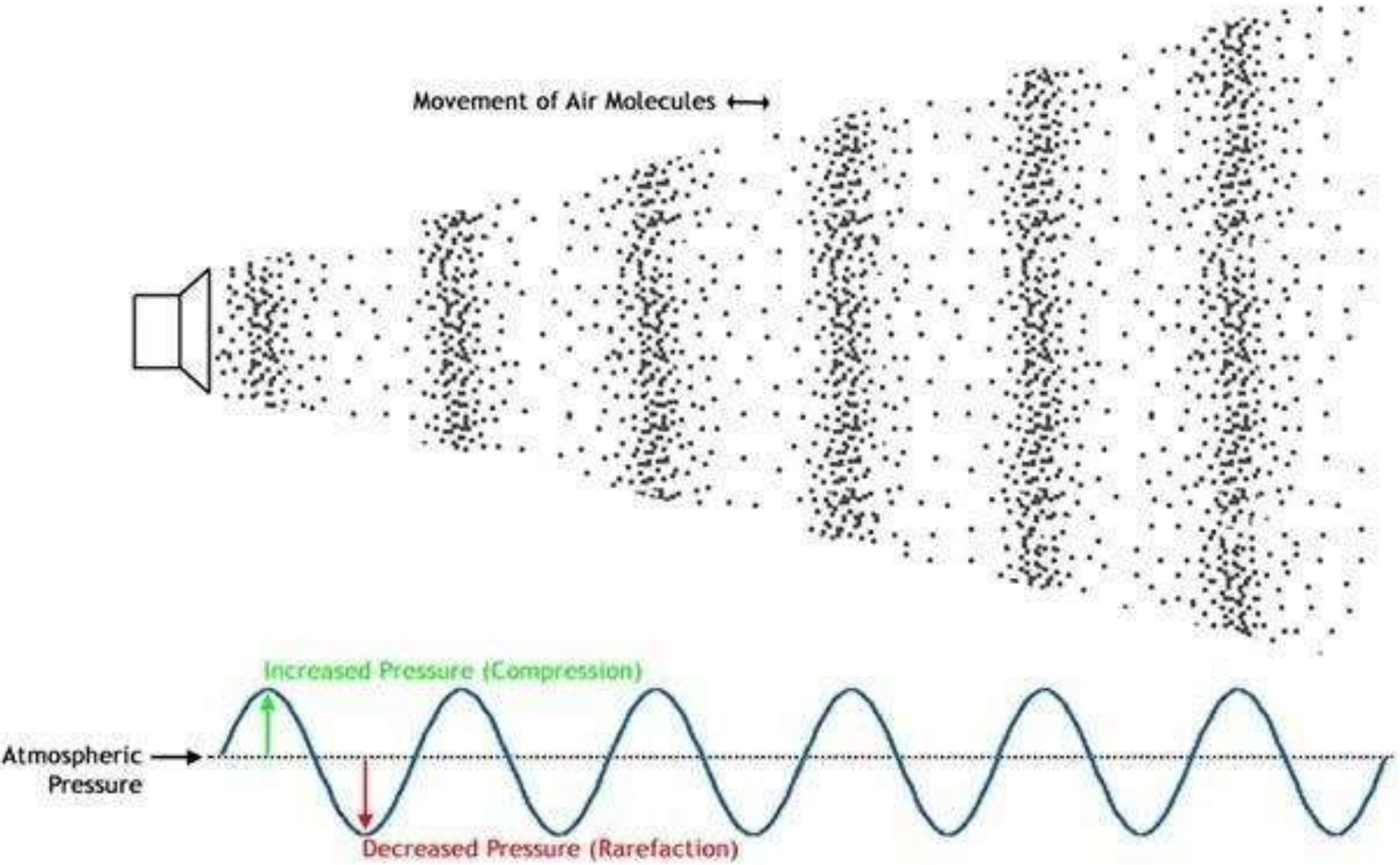
Radio waves , like all other EM waves, travel at the speed of light and don't require any medium to travel

Electromagnetic spectrum

The entire range of frequencies of EM waves is called As Electromagnetic spectrum



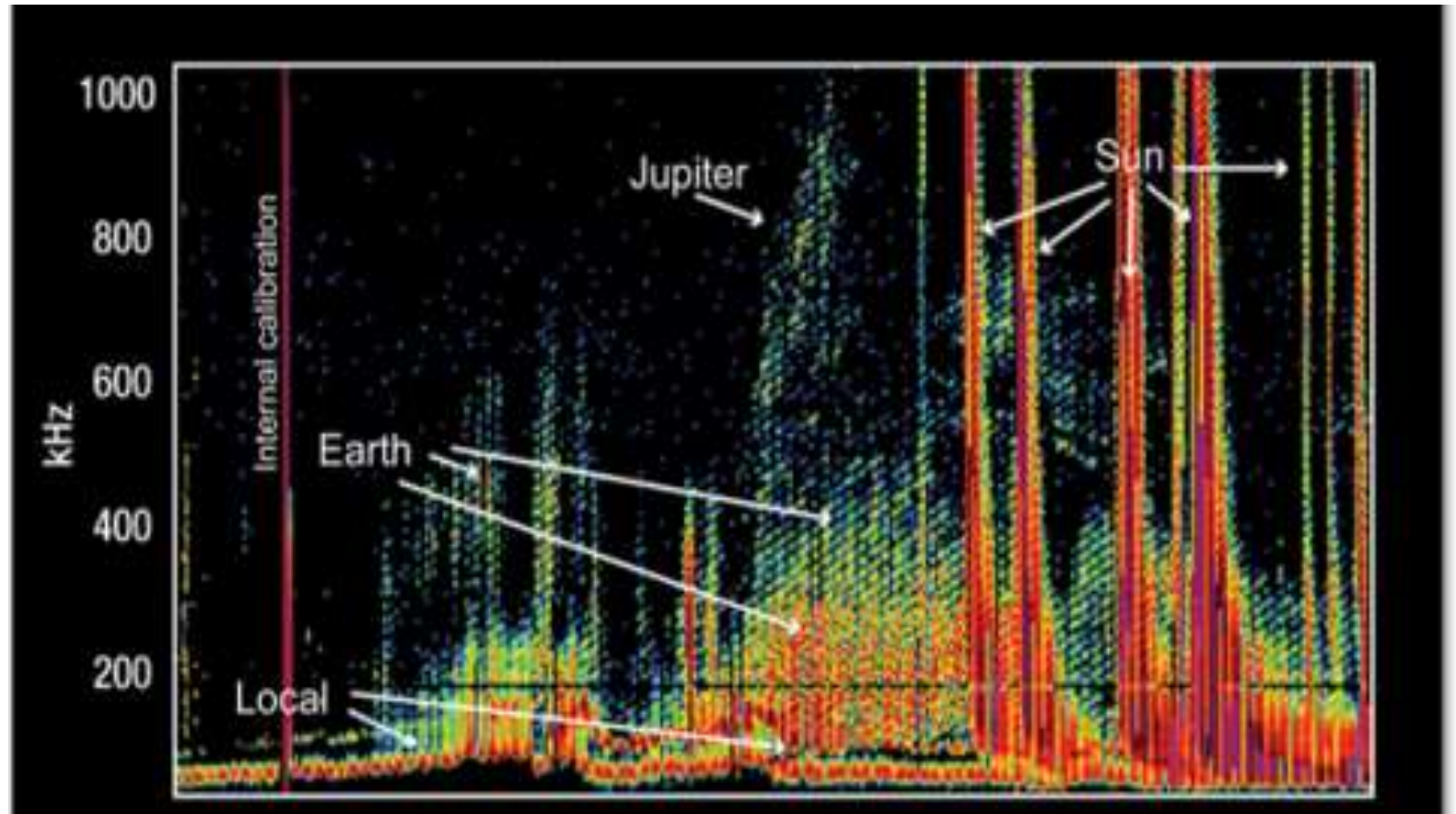
Sound Propagation



Natural Radio Emissions



One Day Radio Emissions of Solar system



Credit: NASA/GSFC Wind Waves Michael L. Kaiser

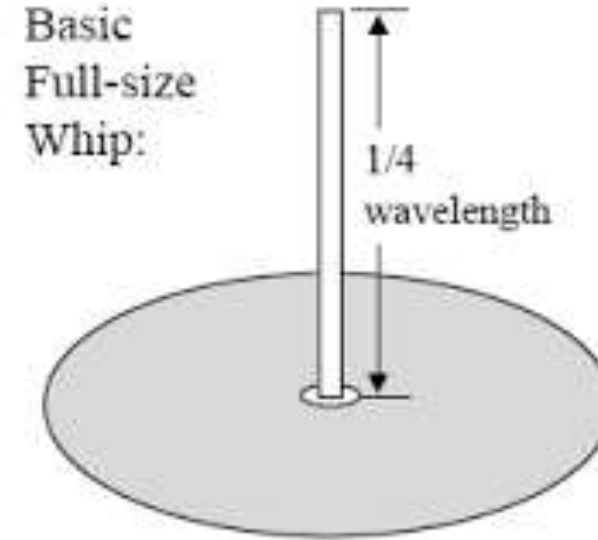


Calculate Length of Antenna

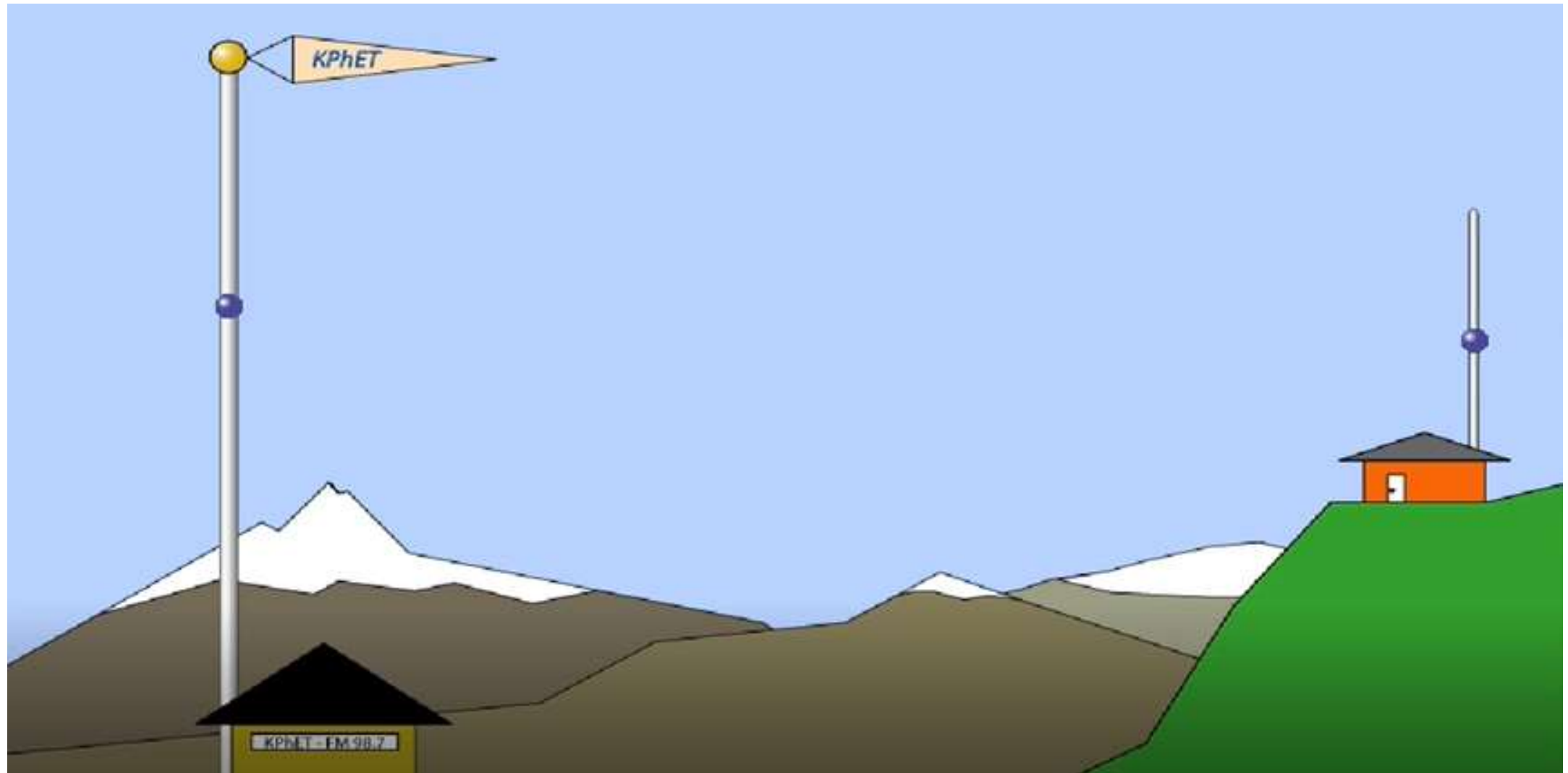
$$\lambda = \frac{\text{Speed of light}}{\text{frequency}} = \frac{3 \times 10^8 \text{ m/s}}{f} = \frac{3 \times 10^8 \text{ m/s}}{98.7 \times 10^6 \text{ hz}}$$

Wavelength = $\lambda = 3.0374 \text{ m}$

For A Monopole Antenna You can select
quarter wavelength Antenna = $3.0374/4 = 0.76 \text{ meter}$



Artificial Radio Emissions





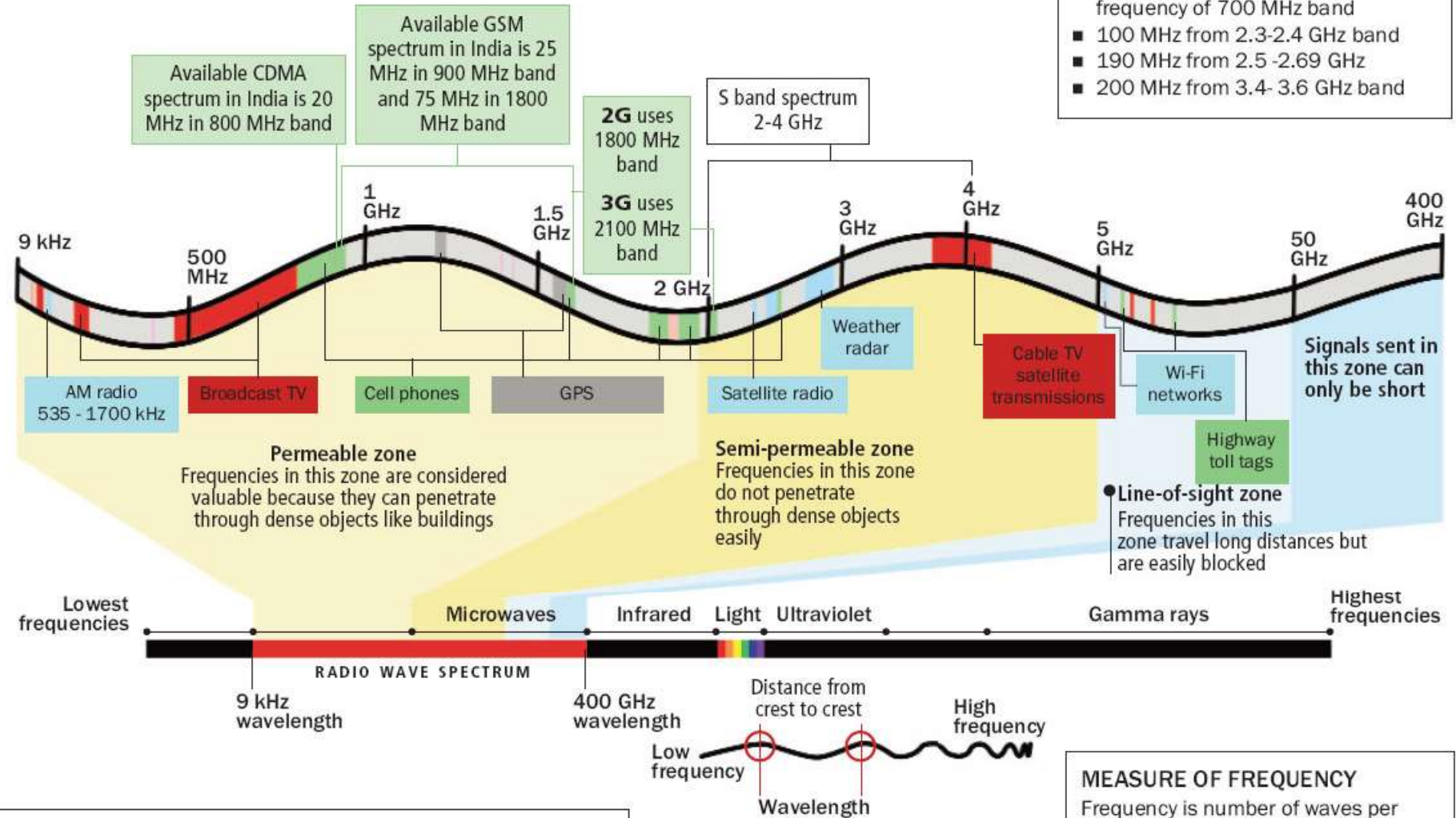
RADIO SPECTRUM

EVOLVING MOBILE TECHNOLOGY

- 1G:** Short for first generation wireless telephone technology. Mobile phone was first launched in the 1980s in this technology. Radio signals on 1G networks were analog, where information is transmitted by modulating a continuous signal, like sound waves. Used frequency band 824-894 MHz
- 2G:** Short for second generation wireless telephone technology. Mobile phone in India was launched based on this technology. Radio signals on 2G networks are digital. It allows data services for mobile phones, including text messages and downloading of ringtones. Uses 1800 MHz band
- 3G:** Short for third-generation wireless telephone technology. It supports services like mobile TV and high-resolution video. Uses 2.1 GHz band

BANDS AVAILABLE FOR MOBILE PHONE SERVICES

- 800 band = 824-844/869-889 MHz
- 900 band = 890-915 MHz/935-960 MHz
- 1800 band = 1710-1785/1805-1880 MHz
- 2100 band (2.1 GHz) = 1920-1980 MHz/2110-2170 MHz



WAYS TO FULFILL DEMAND

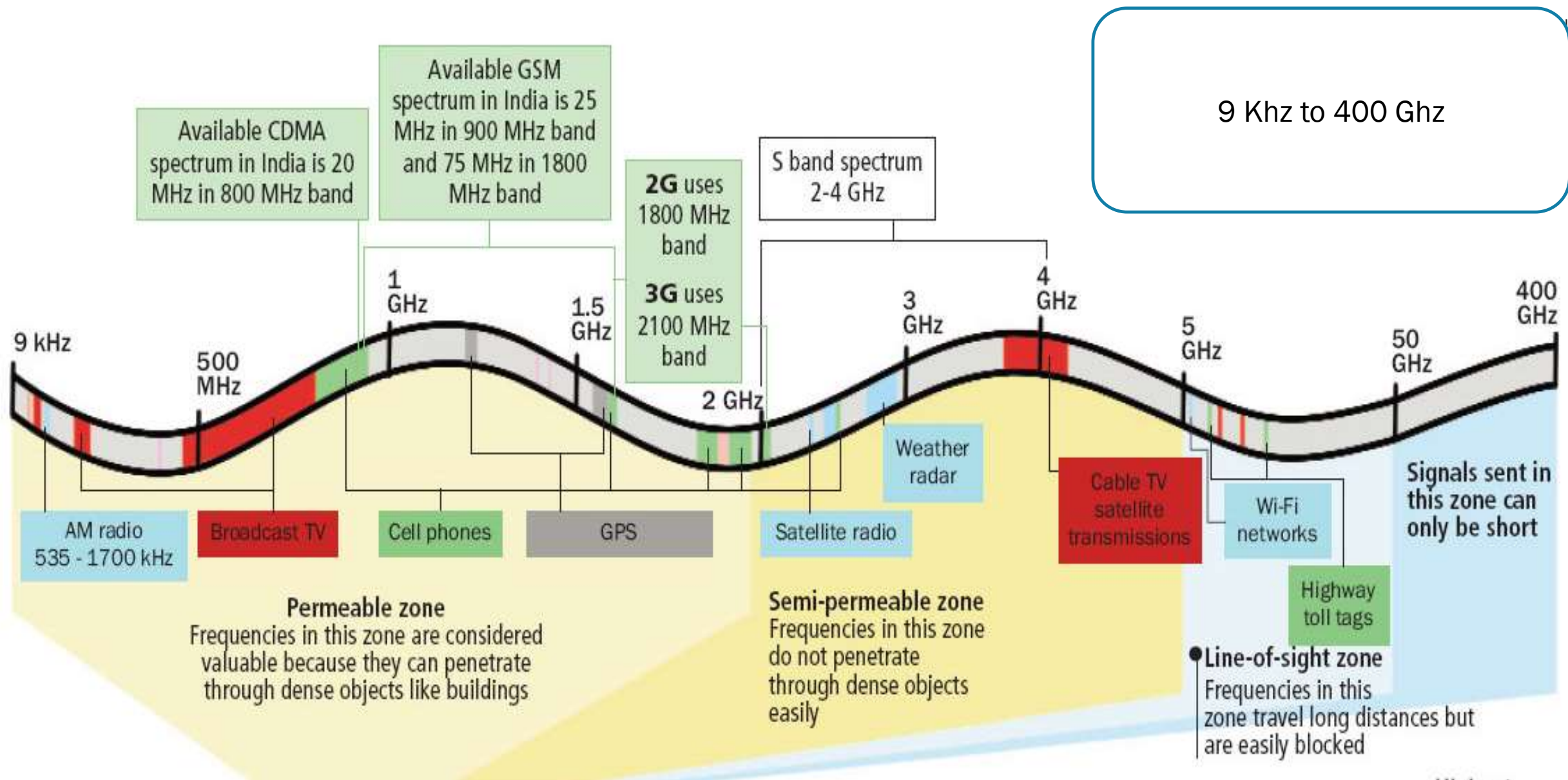
Telecom industry is looking towards new sources, including:

- 108 MHz from the broadcasting frequency of 700 MHz band
- 100 MHz from 2.3-2.4 GHz band
- 190 MHz from 2.5-2.69 GHz
- 200 MHz from 3.4-3.6 GHz band

MEASURE OF FREQUENCY

Frequency is number of waves per second. It is measured in hertz.

- 1 hertz = waves per second
- 1 kilohertz (kHz) = 1000 hertz
- 1 megahertz (MHz) = 1000 kHz
- 1 gigahertz (GHz) = 1000 MHz



9 KHz to 400 Ghz

Permeable zone
Frequencies in this zone are considered valuable because they can penetrate through dense objects like buildings

Semi-permeable zone
Frequencies in this zone do not penetrate through dense objects easily

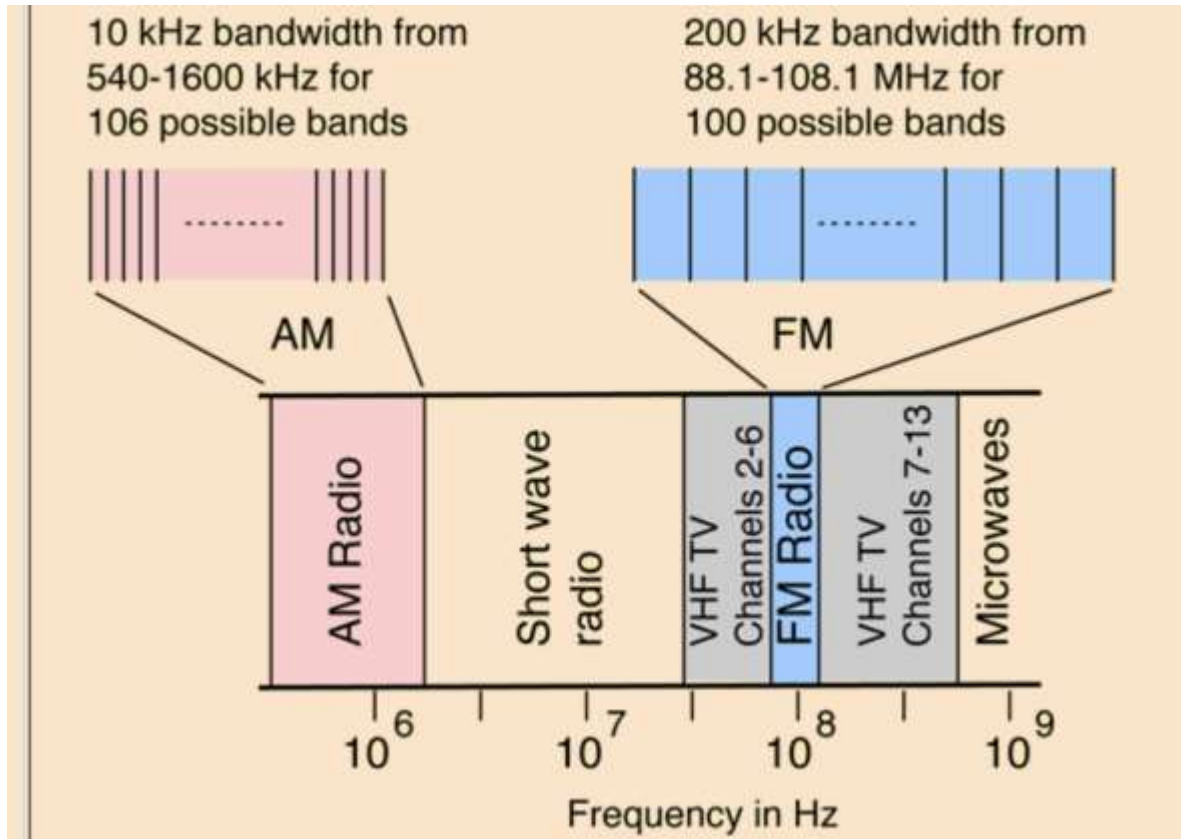
Line-of-sight zone
Frequencies in this zone travel long distances but are easily blocked

Signals sent in this zone can only be short



Indian submarines Antenna at [Vijayanarayanam](#) ,India

AM Band



RFID

13.56 Mhz



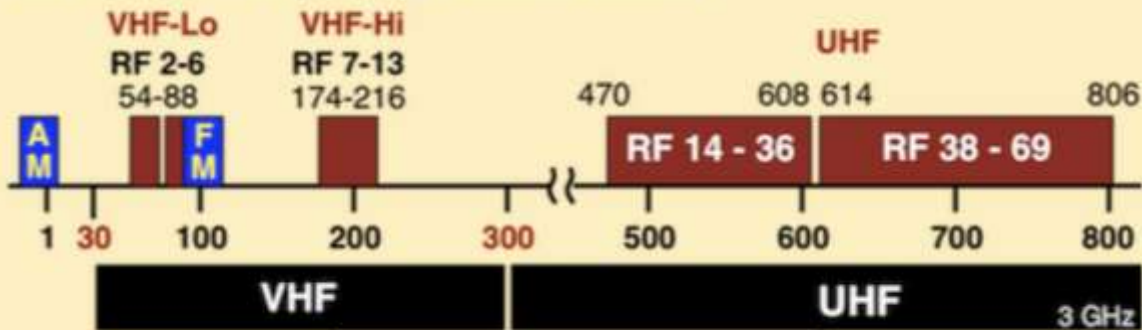
Television frequency bands



FM Radio



Television Frequency Bands (MHz)



88MHz to 108MHz band

Mobile Phone



2G - 800MHz / 1900MHz band.
3G - 2100 MHz
4G - 850 MHz / 1900 MHz / 2300 MHz
5G - will use the existing 4g bands as well as the 24-86 GHz

Crane Radio Remote Control



MORE INFORMATION



[Crane Radio Remote Control](#)



In India , 2.4 GHz band

GPS(Global Positioning System)



GPS - 1.57542 GHz / 1.2276 GHz band

WIFI



2.4 GHz and 5ghz band

Bluetooth



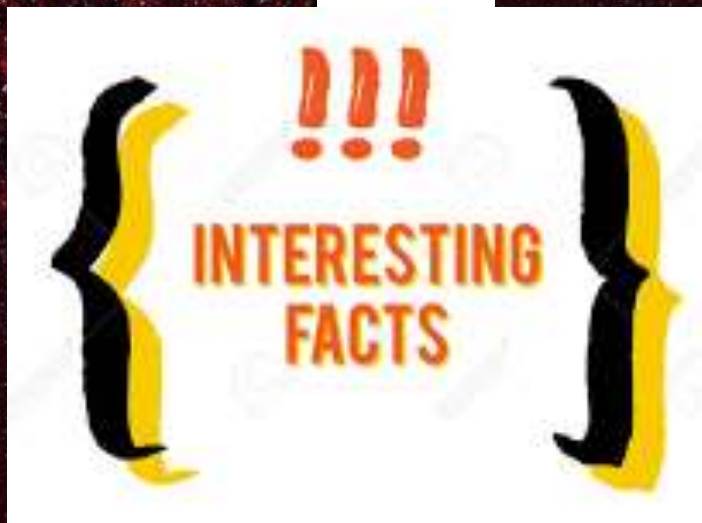
2.4ghz band

Hidden Universe

small portion of the sky in visible light



same portion of the sky with visible & radio light



The W50 “Manatee” Nebula shown in visible light (Left) and visible + radio light (Right)
National Radio Astronomy Observatory

STAR LINK

Ka & Ku Band

