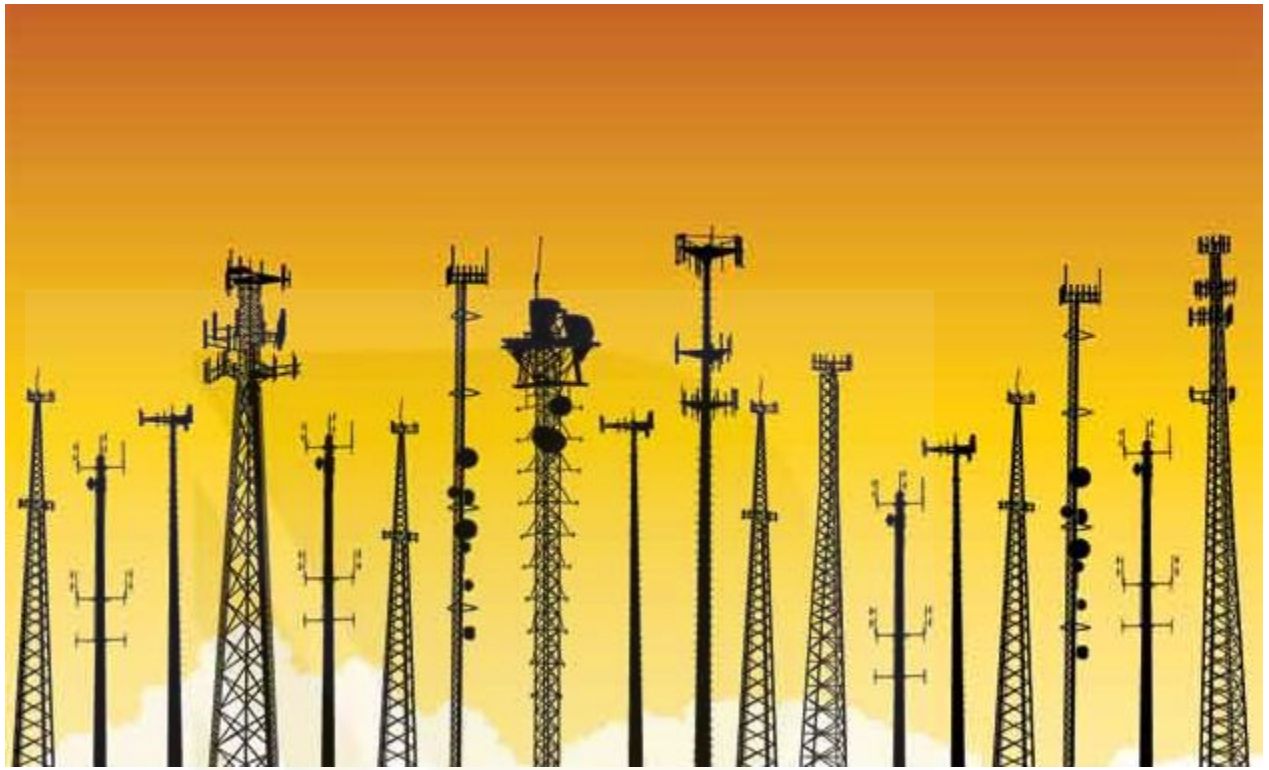


RF Components and Basic Concepts

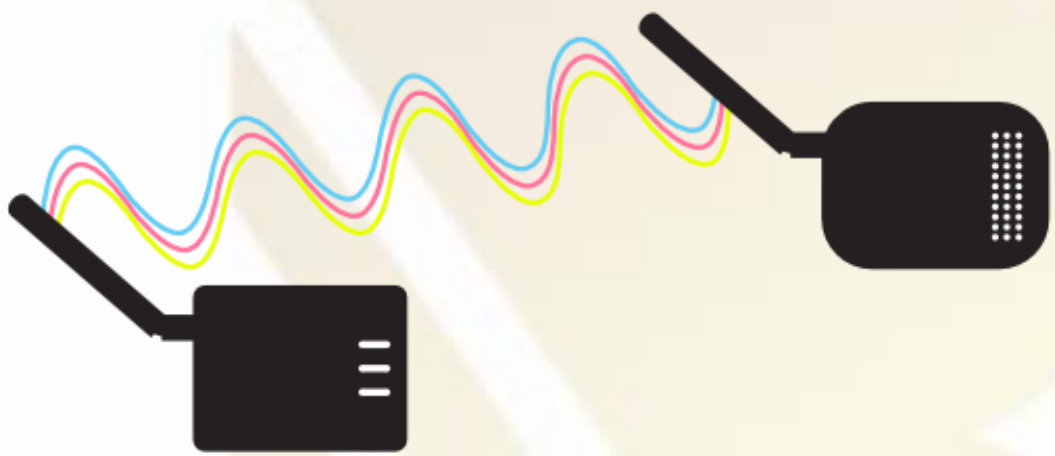
1.1 - What is Radio Frequency ???

What is Radio Frequency ?

- **Radio frequency** (**RF**) is any of the electromagnetic wave frequencies that lie in the range starting from around 3 kHz to 300 GHz.

- Using antennas, transmitters and receivers, an RF field can be used for various types of wireless broadcasting and communications.

- Many types of wireless devices make use of RF fields. Cellphones, radio and television broadcast stations, Wi-Fi and Bluetooth, satellite communications systems, and two-way radios all operate in the RF spectrum.



- The RF spectrum is divided into several ranges, or bands.

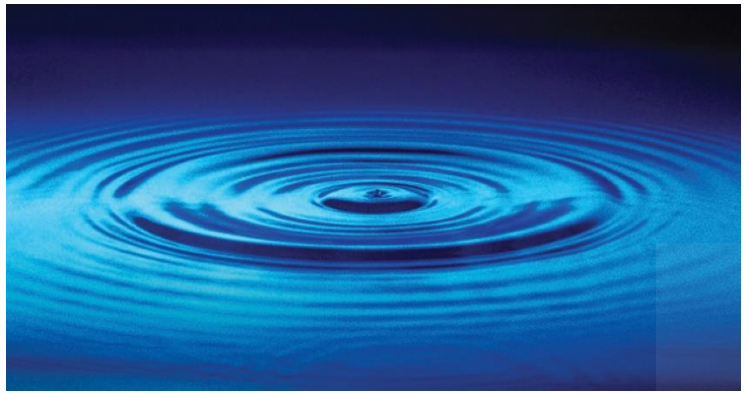
- With the exception of the lowest-frequency segment, each band represents an increase of frequency corresponding to an order of magnitude (power of 10).

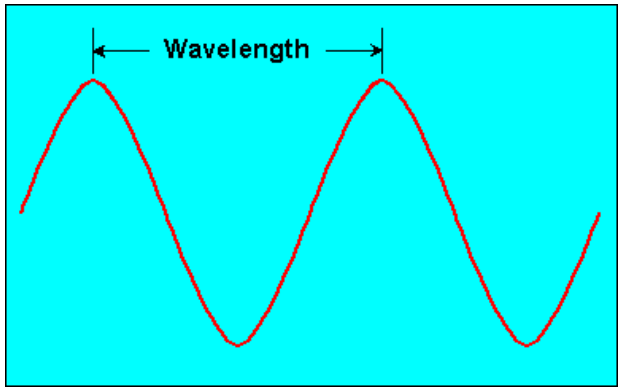
- The following table depicts the eight bands in the RF spectrum, showing frequency and bandwidth ranges. The super high frequency (SHF) and extremely high frequency (EHF) bands are often referred to as the *microwave spectrum.*

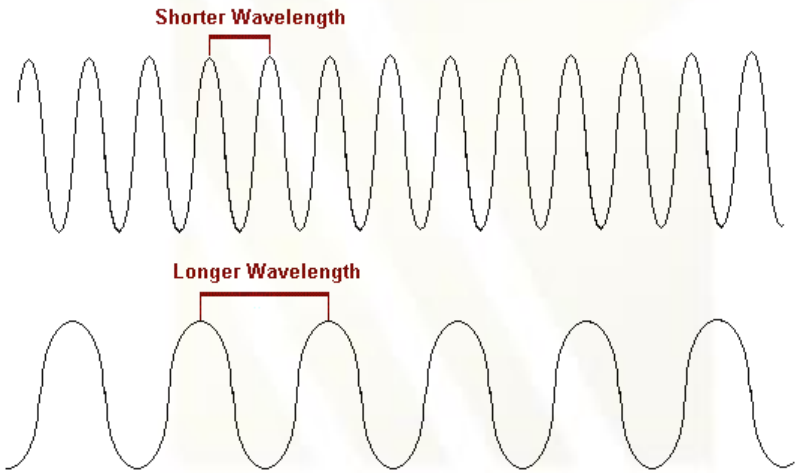
$$\text{Wavelength} = \frac{\text{Speed of Light}}{\text{Frequency of Oscillation}}$$

$$\text{Frequency of Oscillation} = \frac{\text{Speed of Light}}{\text{Wavelength}}$$

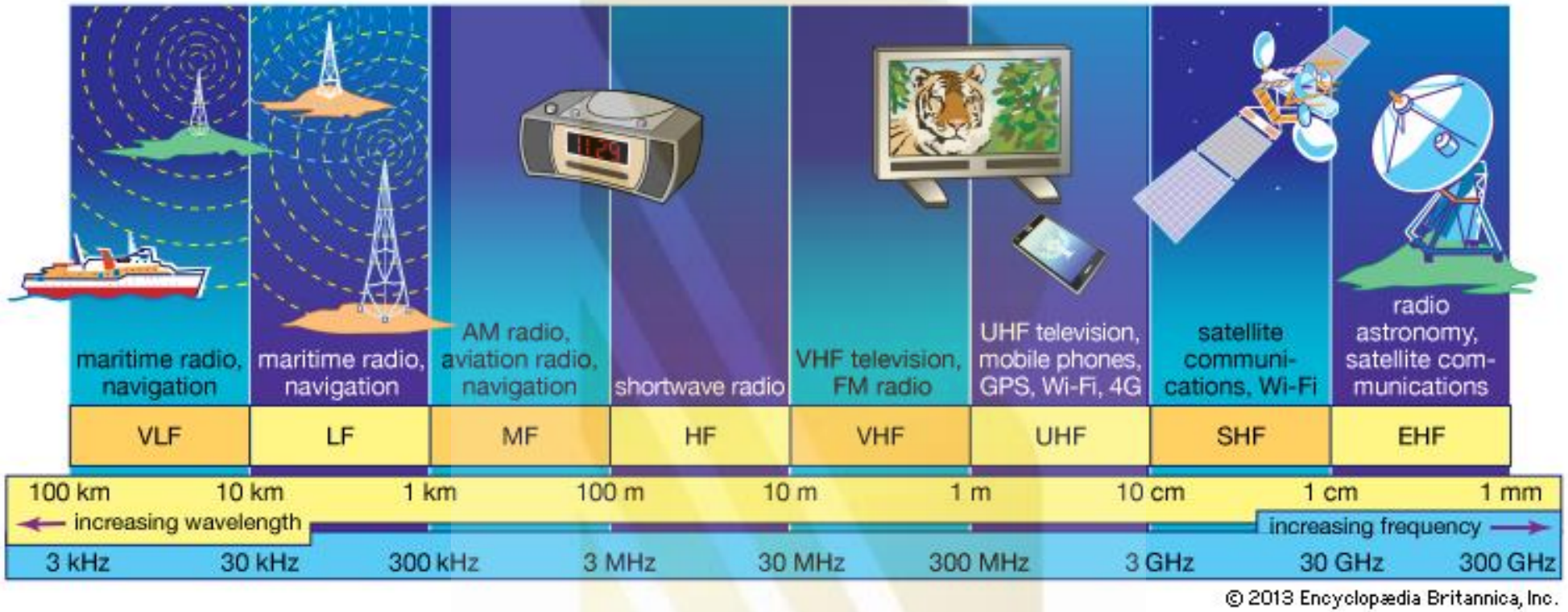
Designation	Abbreviation	Frequencies	Free-space wavelengths
Very Low Frequency	VLF	9 kHz to 30 kHz	33 km to 10 km
Low Frequency	LF	30 kHz to 300 kHz	10 km to 1 km
Medium Frequency	MF	300 kHz to 3 MHz	1 km to 100 m
High Frequency	HF	3 MHz to 30 MHz	100 m to 10 m
Very High Frequency	VHF	30 MHz to 300 MHz	10 m to 1 m
Ultra High Frequency	UHF	300 MHz to 3 GHz	1 m to 100 mm
Super High Frequency	SHF	3 GHz to 30 GHz	100 mm to 10 mm
Extremely High Frequency	EHF	30 GHz to 300 GHz	10 mm to 1 mm




Wavelength


Shorter Wavelength
Longer Wavelength

Application Vs frequency



Why Operate at Higher Frequencies?

- The frequency spectrum is quite fragmented and dense. This encompasses one of the reasons that we are constantly pushing applications into higher and higher frequencies.

- However, some of the other reasons accounting for this push into higher frequencies include efficiency in propagation, immunity to some forms of noise and impairments as well as the size of the antenna required. The antenna size is typically related to the wavelength of the signal and in practice is usually ¼ wavelength.

- This leads to a very interesting question. Typically, data is structured and easily represented at low frequencies; how can we represent it or physically translate it to these higher RF frequencies?

- For example, the human audible range is from 20 Hz to 20 kHz. Cell phones, however, operate at around 850 MHz. How does this happen?

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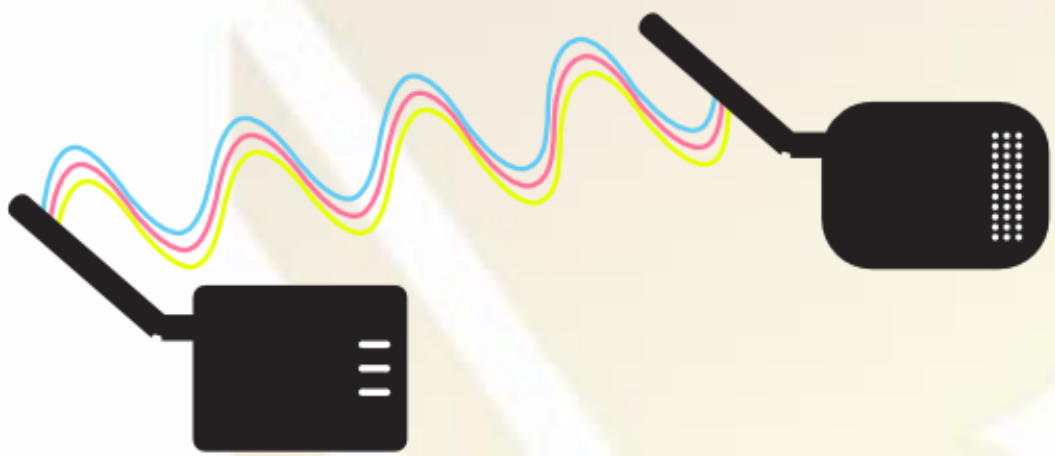


20 kHz
20 kHz
20 Hz
850 MHz
1 GHz