

Waves, Frequency, Wavelength, Amplitude, Time, Applications



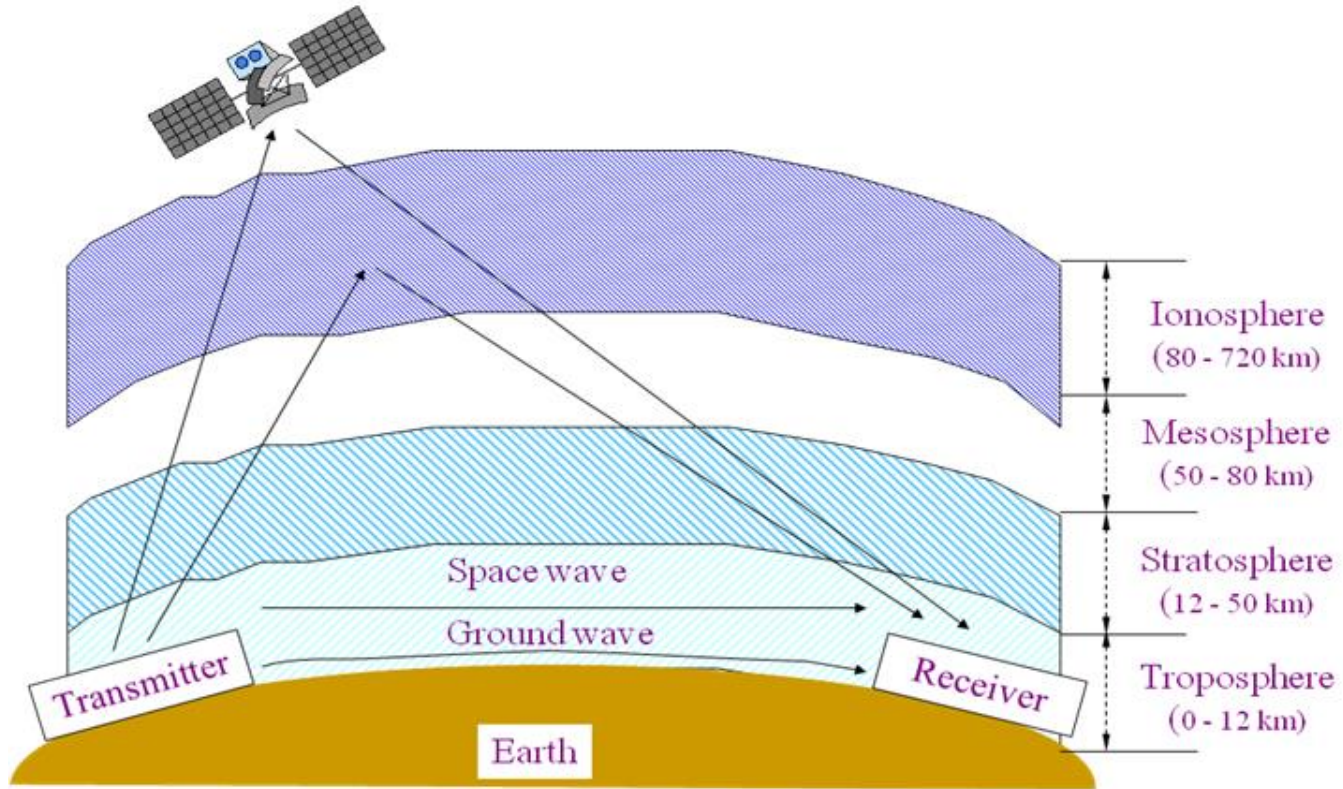
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Types of Waves



Speed, Wavelength, Frequency

$$\begin{aligned} \checkmark \text{ Light speed} &= \text{Wavelength} \times \text{Frequency} \\ &= 3 \times 10^8 \text{ m/s} \\ &= 300,000 \text{ km/s} \end{aligned}$$

System, Frequency, Wavelength

System	Frequency	Wavelength
AC current	60 Hz	5,000 km
FM radio	100 MHz	3 m
Cellular	800 MHz	37.5 cm
Ka band satellite	20 GHz	15 mm
Ultraviolet light	10^{15} Hz	10^{-7} m

Frequencies for Mobile Communication

- ✓ VHF-/UHF-ranges for mobile radio
- ✓ Simple, small antenna for cars
- ✓ Deterministic propagation characteristics, reliable connections

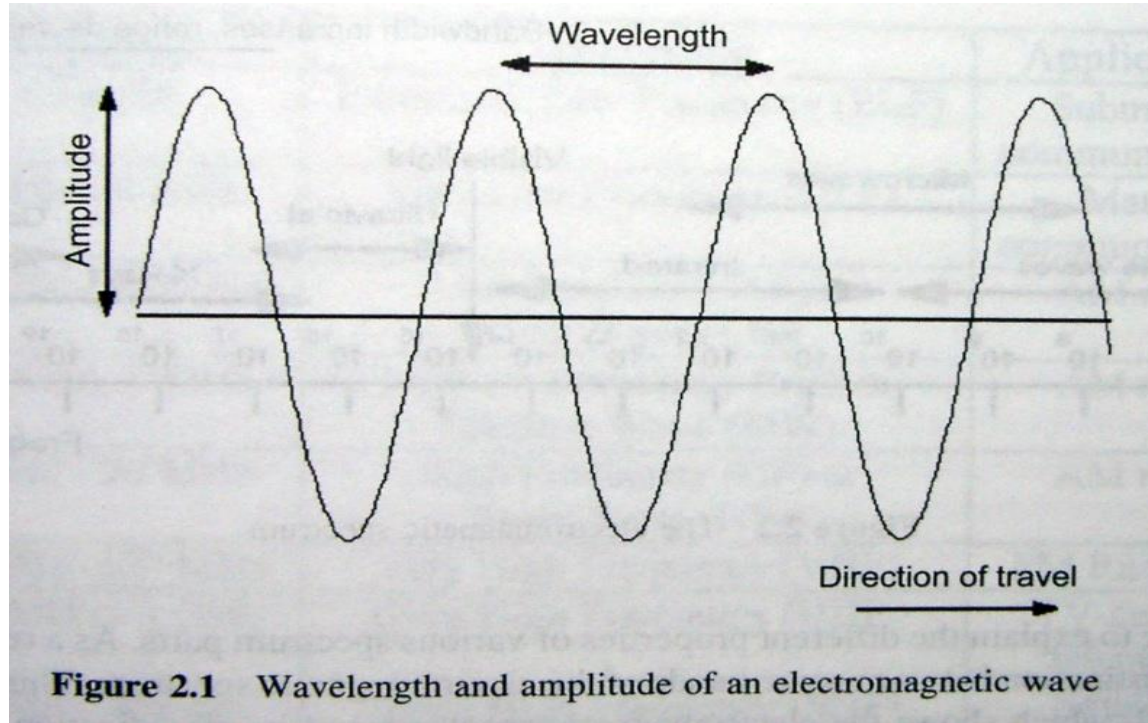
Frequencies for Mobile Communication

- ✓ SHF and higher for directed radio links, satellite Communication
- ✓ Small antenna, beam forming
- ✓ Large bandwidth available

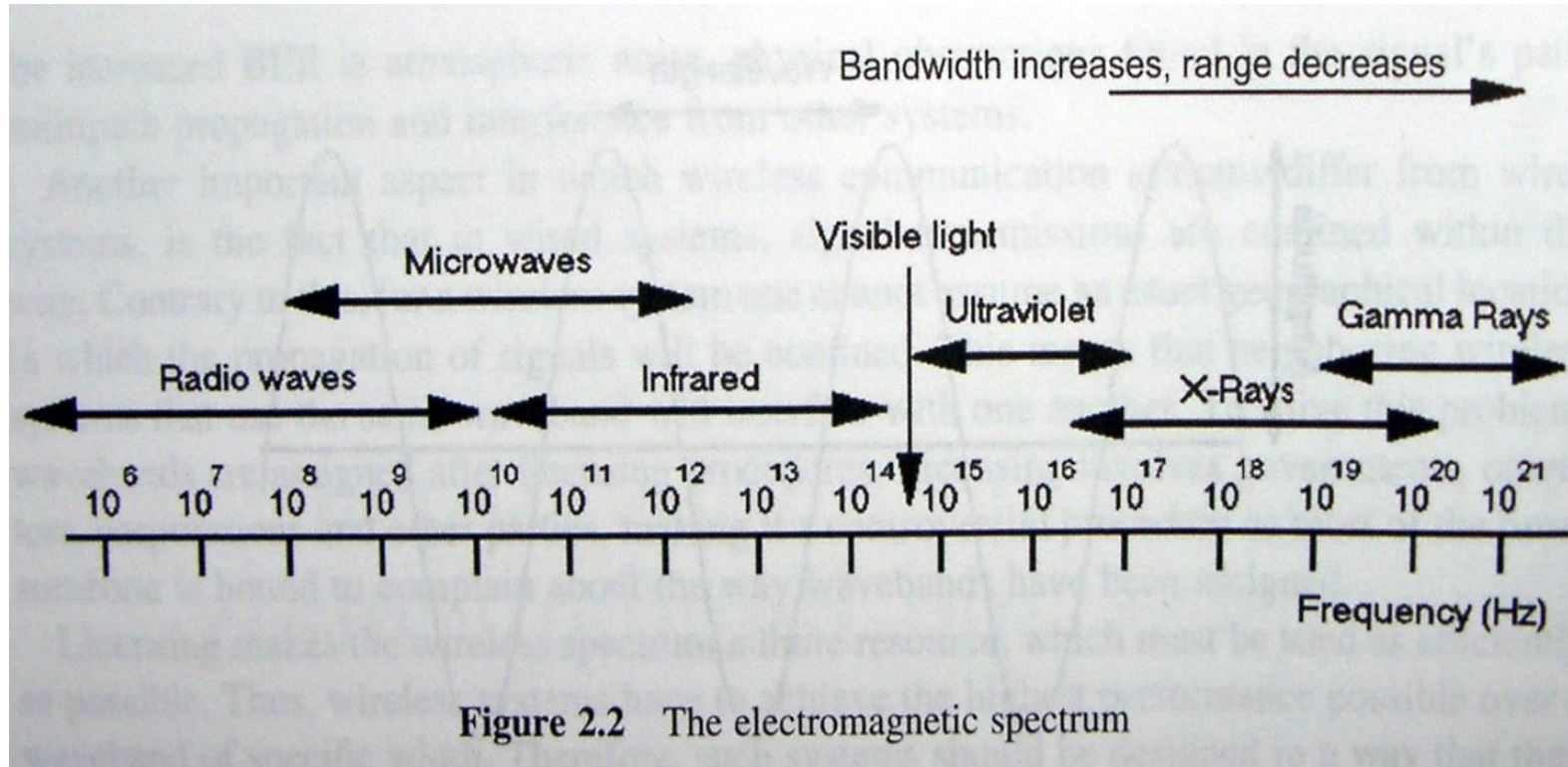
Frequencies for Mobile Communication

- ✓ Wireless LANs use frequencies in UHF to SHF range
- ✓ Some systems planned up to EHF
- ✓ Limitations due to absorption by water and oxygen molecules (resonance frequencies)
- ✓ Weather dependent fading, signal loss caused by heavy rainfall etc

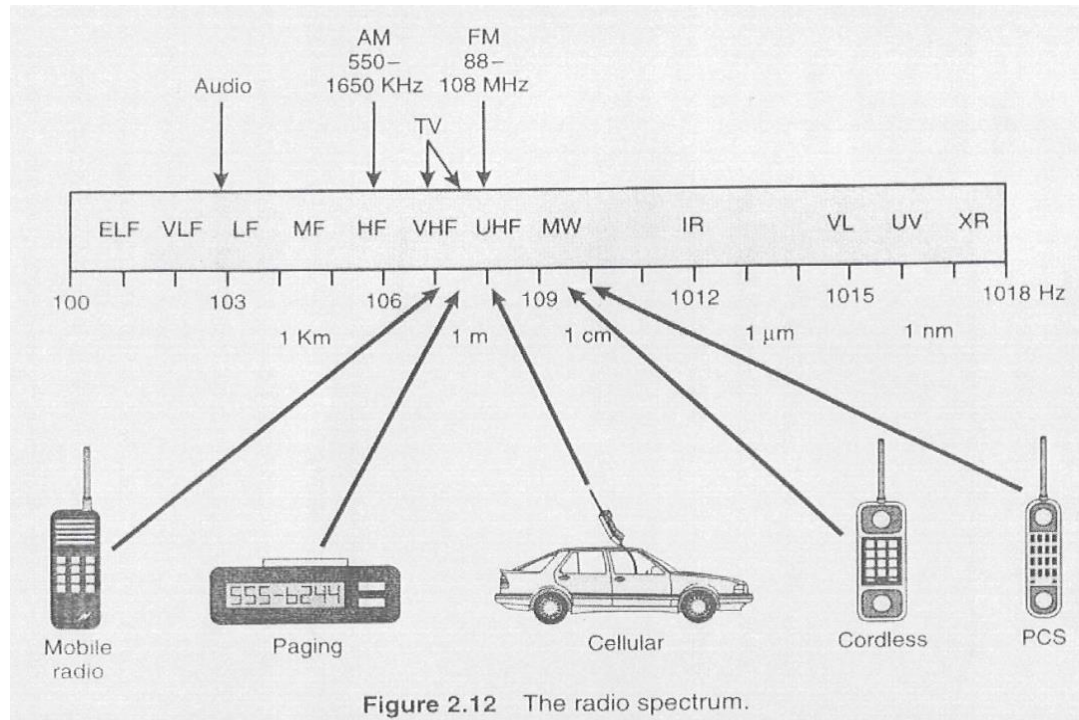
Wavelength and Amplitude



Electromagnetic Spread Spectrum



The Radio Spectrum



Frequencies and Applications

Frequency	Band name	Applications
< 3 KHz	Extremely Low Frequency (ELF)	Submarine communications
3 KHz -30 KHz	Very Low Frequency (VLF)	Marine communications
20 KHz -300 KHz	Low Frequency (LF) or Long Wave (LW)	AM radio
300 KHz -3 MHz	Medium Frequency (MF) or Medium Wave (MW)	AM radio
3 MHz - 30 MHz	High Frequency (HF) or Short Wave (HW)	AM radio
30 MHz -300 MHz	Very High Frequency (VHF)	FM Radio-TV
300 MHz - 3 GHz	Ultra High Frequency (UHF)	TV-cellular telephony
3 GHz - 30 GHz	Super High Frequency (SHF)	Satellites
30 GHz - 300 GHz	Extra High Frequency (EHF)	Satellites-radars

Figure 2.3 The various radio bands and their common use

Micro Waves Frequencies and Applications

Frequency	Band name	Applications
0.4 GHz - 1.5 GHz	L	Broadcasting-cellular
1.5 GHz - 5.2 GHz	S	Cellular
3.9 GHz - 6.2 GHz	C	Satellites
5.2 GHz - 10.9 GHz	X	Fixed wireless-satellite
10.9 GHz - 36 GHz	K	Fixed wireless-satellite
36 GHz - 46 GHz	Q	Fixed wireless
46 GHz -56 GHz	V	Future satellite
56 GHz -100 GHz	W	Future cellular

Figure 2.4 The various microwave bands and their common use

References

- ✓ Books:
 - ✓ Data communication and Networking, 4th Edition, Behrouz A Forouzan
 - ✓ Computer Networks, 4th Edition, Andrew S. Tanenbaum
- ✓ Various relevant Websites

Thank You