* Electromagnetic Spectrum

1. Audio frequency

20 – 20,000 Hz

30 Hz $\Rightarrow$ $\lambda = \frac{c}{f} = \frac{3\times10^{8}\ m/s}{30\ Hz} = 10^{7}\ m$

(지구 = 1 정도)

3000 Hz $\Rightarrow$ $\lambda = 10^{6}\ m = 1000\ Km$

2. Radio frequency

① Low freq. : 30 kHz – 300 kHz
(10 km) (1 km)

② Medium freq : 300 kHz – 3 MHz
(1000 m)

③ High freq : 3 MHz – 30 MHz
(100 m)

④ Very High freq : 30 MHz – 300 MHz
(VHF) (1 m)

⑤ Ultra High freq : 300 MHz – 3 GHz
(UHF) (0.1 m)

3. Microwave (1 GHz 이상)

① Centimeter wave : 3 GHz – 30 GHz
(10 cm) (1 cm)

② Millimeter wave : 30 GHz – 300 GHz
(10 mm) (1 mm)

③ Submillimeter wave : 10 wave/cm – 100 cm^{-1}
(1 mm) (0.1 mm)
300 GHz – 3 THz

4. Infrared

① Far infrared : 100 cm^{-1} – 1000 cm^{-1}
(10^{-4} m) (10^{-5} m)
3 THz 30 THz

② (Intermediate) infrared : 1000 cm^{-1} – 2 eV
(10^{-5} m) (10^{-6} m)
30 THz 300 THz

* $E = h\nu$
$= h\frac{c}{\lambda}$ [J], $c = \lambda\nu$ (λ: wavelength, ν: freq., c: velocity)

$h = 6.626 \times 10^{-34}$ J·s
$c = 3 \times 10^{8}$ m/s

$1\ eV = 1.602 \times 10^{-19}$ J

5. Visible light : $\frac{2}{3}$ eV, $\lambda < 1\ \mu m$

6. Ultra violet : $\frac{2}{3}$ eV – $\frac{2}{3}$ 100 eV
(10^{-7} m) (10^{-8} m)

7. X-ray : 수백 eV – 수백 keV
(10^{-9} m) ($10^{-11} - 10^{-12}$ m)

8. Gamma ray : 수백 keV – 수백 MeV
($10^{-11} - 10^{-12}$ m) ($10^{-15} - 10^{-16}$ m)
↑
femto meter

변조 (Modulation)

1. 100Hz → $\lambda = \frac{c}{f} = \frac{3\times10^8\ m/s}{100\ 1/s} = 3000\ km$

안테나 길이 $= \frac{\lambda}{2} = 1500\ km$

2. 음성 주파수 대역의 신호 끼리는 혼신 발생

3. 안테나 사이즈 길이는 수 λ 이상 필요
(coupling 에 의한 간섭 발생)

- 음성 신호 : 20 – 20,000 Hz
- 음성 : 300 – 3400 Hz
- AM : 50 – 4500 Hz
- FM : 50 – 15000 Hz
(30)

⇒ 다중 통신 필요.