SMCN

1. The electromagnetic wave equation:

E field: $\vec{e}(t,x) = \vec{E}\sin(2\pi ft + \frac{2\pi}{\lambda}x)$

$\vec{h}(t,x) = \vec{H}\sin(2\pi ft + \frac{2\pi}{\lambda}x)$

$\vec{E}$ = Amplitude of electric field

f = frequency, λ = wavelength

$\vec{H}$ = Amplitude of Magnetic field.

(2) x = Amount of space the wave travels in time T

Also x = the distance between two consequentive points in space with same phase (0 phase — 0 Amplitude value or 90° — Maximum Aplitude value

(3) v (velocity of the wave

$v = f\lambda$.

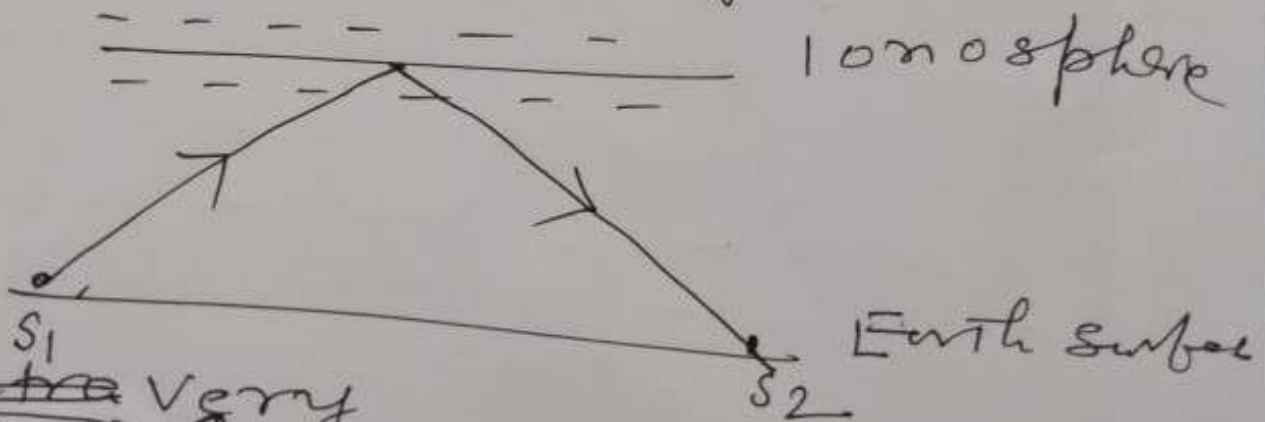
Power $\propto E^2$

E: amplitude

Electromagnetic sprectrums

1. Medium wave:
530 KHz to 1602 KHz
use: Medium wave Radio
- Hops along the surface of earth

② short wave (HF Band)
- 3 MHz to 30 MHz -
used for short wave Radio transmission for long distance



3. ~~Ultra~~ Very High frequency HF (VHF)
30 MHz - 300 MHz
- FM Radio
- ~~Television~~ Television Transmission.

4. Ultra High Frequency (UHF)
300 MHz → 3000 MHz (= 3 GHz)
- Television Broadcasting
- Mobile cellular phone
Broadcasting

5 1 GHz to 1000 GHz
- Microwave:
use: L Band 1 - 2 GHz
S " 2 - 4 GHz (Satellite
C " 4 - 8 GHz (")
X " 8 - 12 "
Ku " 12 - 18 "
K " 18 - 26.5 "
Ka " 26.5 - 40 GHz

WLAN (2.4 + 80 MHz)
(5 GHz + 80 MHz)

Properties of Microwave

(1) Line of sight propogation like light.

(2) Absorbed by Fog, vegetation Raein

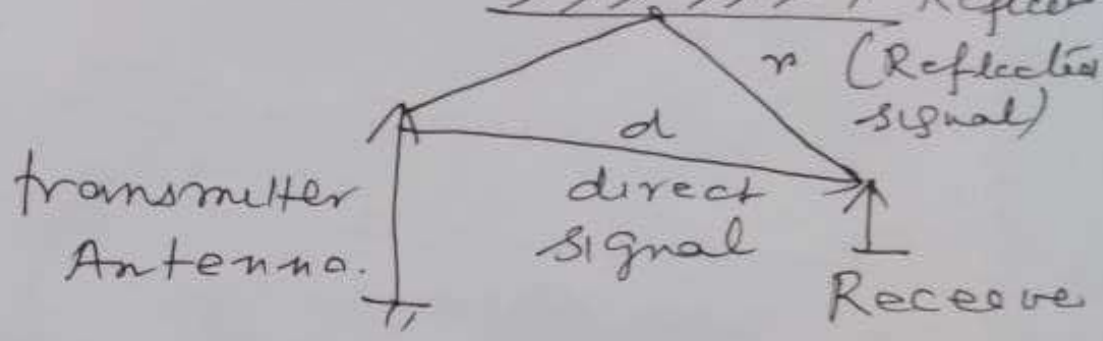
(3) Signal strength in Free space $\propto \frac{1}{x^2}$ (x = distance from transmitter Antenna.

~~(4) Multipath fading (starts from UHF)~~

5. Reflection — Full in Metal
   Partial in insulator
   - Refraction — 0 in Metal
     Partial in insulator
   - (i) wave can not travell Through metal.
   (ii) wave travels through insulator.

(5) Multipath fading starts from UHF

9.1. Multipath fading



Distance travelled by direct signal = d

" " " Reflected signal = r.

(i) $e(t,x) = E \sin\left(2\pi f t + \frac{2\pi}{\lambda} x\right)$

(ii) $e_d(t,d) = E \sin\left(2\pi f t + \frac{2\pi}{\lambda} d\right)$

(iii) $e_r(t,r) = E \sin\left(2\pi f t + \frac{2\pi}{\lambda} \cdot r\right)$

effective signal at the receiver

(iv) $e_e = e_d(t,d) + e_r(t,r)$

$= E \sin\left(2\pi f t + \frac{2\pi}{\lambda} \cdot d\right) + E \sin\left(2\pi f t + \frac{2\pi}{\lambda} \cdot r\right)$

(v) let $r = d + \lambda$

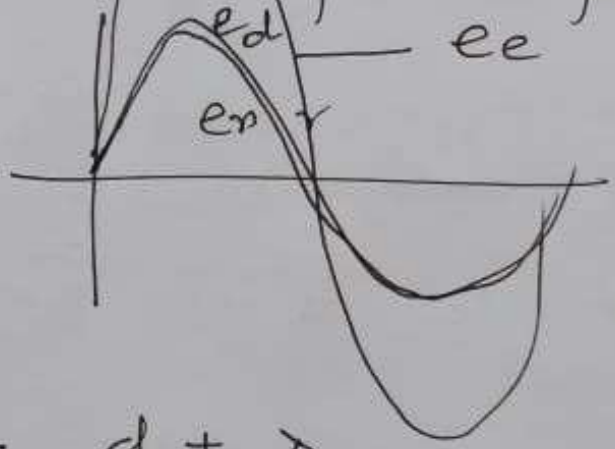
$e_e = E \sin\left(2\pi f t + \frac{2\pi}{\lambda} d\right) + E \sin\left(2\pi f t + \frac{2\pi}{\lambda}(d+\lambda)\right)$

$$= E \sin\left(2\pi ft + \frac{2\pi}{\lambda} d\right) + E \sin\left(2\pi ft + \frac{2\pi}{\lambda} d + 2\pi\right)$$

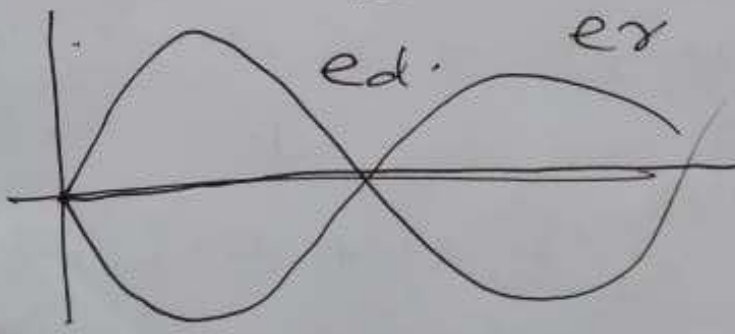
$$= 2E\left(\sin 2\pi ft + \frac{2\pi}{\lambda} d\right)$$

Equal strength double due to constructive interference

$\Rightarrow$ No multipath fading.



(VI) $\lambda = d + \frac{\lambda}{2}$



Full fading.