Space wave Propagation

→ Space wave propagation that happens at freq. > 30 MHz

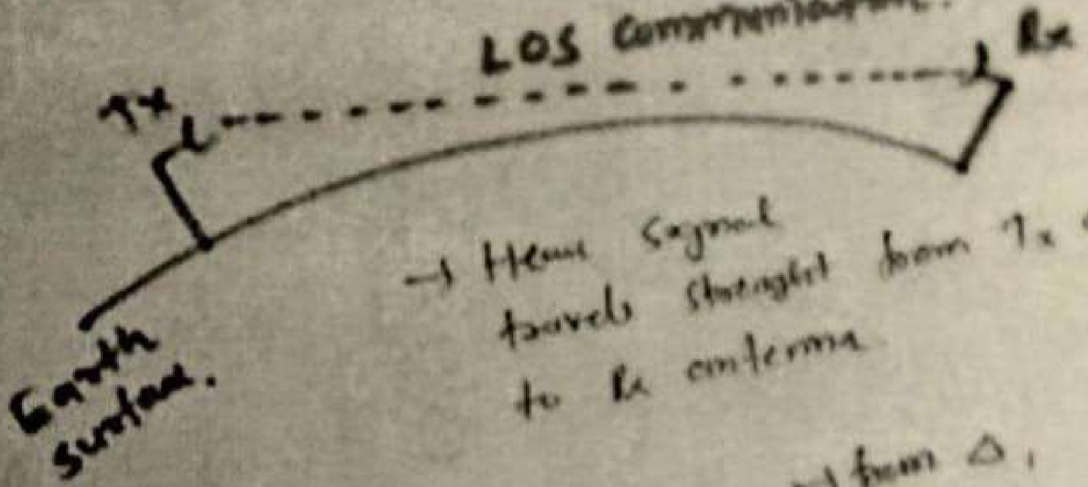
→ due to freq. is high, wavelength is very narrow that results propagation of wave by straight path.

→ at this freq. there no reflection & scattering will happen by ionosphere and troposphere.

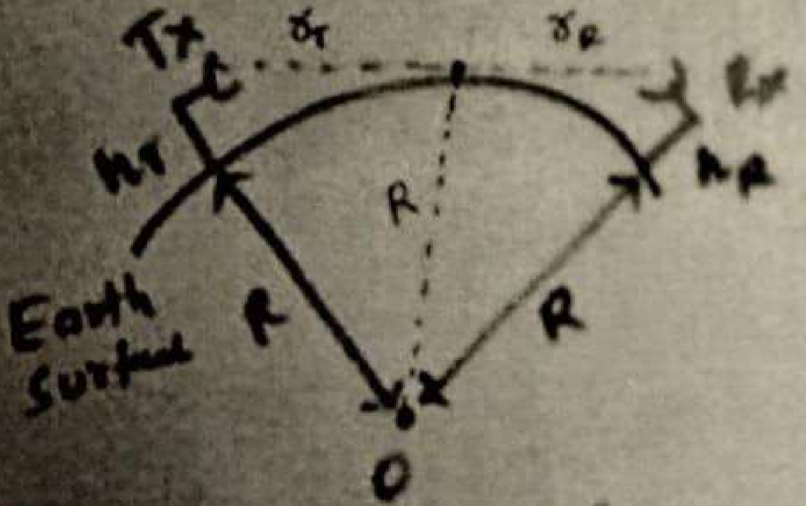
→ It has two different categories

1) Satellite Communication
2) LOS (Line of sight) Communication

→ LOS (Line of Sight) Communication



→ Hence signal travels straight from Tx antenna to Rx antenna



→ from △,

$\Rightarrow r_T^2 + R^2 = (h_T + R)^2$

$\Rightarrow r_T^2 + R^2 = h_T^2 + R^2 + 2$

$\rightarrow r_T^2 + R^2 = h_T^2 + R^2$

→ By neglecting h_T^2

$\Rightarrow r_T^2 = 2h_T R$

$\rightarrow r_T = \sqrt{2h_T R}$ — (1)

→ Similarly

$\rightarrow r_R = \sqrt{2h_R R}$ —

→ total Range for LOS

$r = r_T + r_R$

$= \sqrt{2h_T R} + \sqrt{2h_R R}$

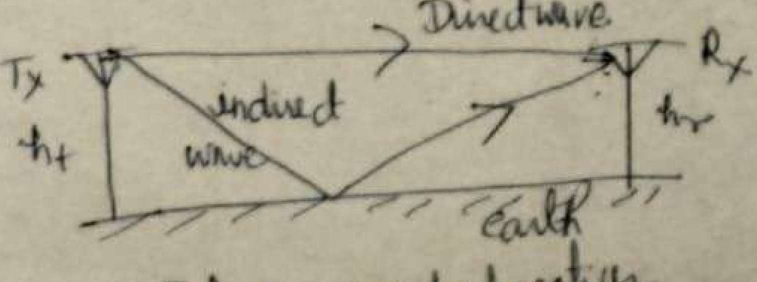
above 30MHz

Space wave propagation → In space wave propagation the radio waves travels from Tx antenna to receiving antenna through space, i.e earth's troposphere.

The height of troposphere from the surface of earth is 15 km.

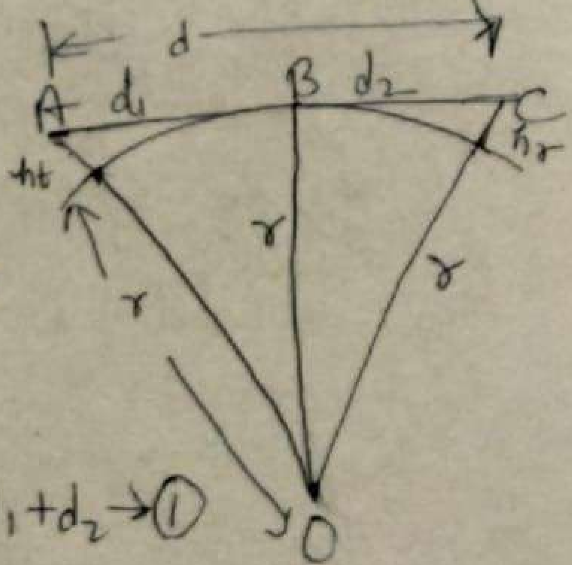
In space wave propagation the space wave can reach to the receiving antenna through →

(i) via direct wave & (ii) via ground reflected wave.



Space wave propagation

Range of Space wave propagation →



Let 'd' is distance b/w Tx & Rx, the height of receiving and Transmitting antennas are h_t & h_r respectively above ground.

So line of sight distance $d = d_1 + d_2$ → (1)

Let 'r' is radius of earth. ($r = 6370$ km)

In Δ ABO → $AO^2 = AB^2 + BO^2$

$$(h_t + r)^2 = d_1^2 + r^2$$

$$d_1^2 = (h_t + r)^2 - r^2$$

$$d_1^2 = h_t^2 + r^2 + 2h_t r - r^2$$

$$d_1^2 = h_t^2 + 2h_t r$$

$$\boxed{d_1 = \sqrt{h_t^2 + 2h_t r}} \quad (2)$$

In $\Delta OBC \rightarrow$

$$OC^2 = BC^2 + BO^2$$

$$(h_r + r)^2 = d_2^2 + r^2$$

$$d_2^2 = (h_r + r)^2 - r^2$$

$$d_2^2 = h_r^2 + r^2 + 2h_r r - r^2$$

$$\boxed{d_2 = \sqrt{h_r^2 + 2h_r r}} \rightarrow (3)$$

put the value of d_1 & d_2 in eqn (1) we get

$$d = d_1 + d_2 = \sqrt{h_t^2 + 2h_t r} + \sqrt{h_r^2 + 2h_r r}$$

Since $r >> h_t, h_r$

so

$$d = \sqrt{2h_t r} + \sqrt{2h_r r}$$

$$d = \sqrt{2r}\,(h_t^{1/2} + h_r^{1/2})$$

$$d = \sqrt{2 \times 6370 \times 10^3}\,(h_t^{1/2} + h_r^{1/2})$$

$$\boxed{d = 3.57(h_t^{1/2} + h_r^{1/2})}$$

km