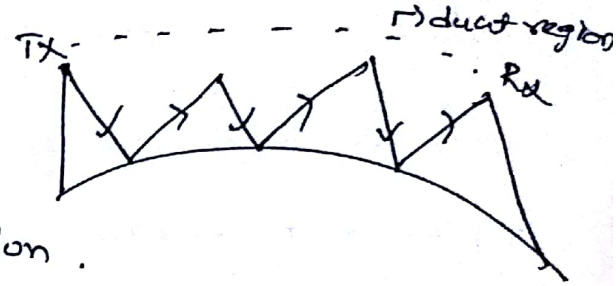
Duct propagation



→ The duct propagation is phenomenon of propagation in atmosphere duct region.

→ The duct region existing b/w 2 levels where the variation of modified refraction index with height is minimum and surface bending the atmosphere.

→ In duct propagation the ray which is parallel to the earth surface

→ The wave is traveling around the earth with succesive reflection from the earth.

→ The modified refractive index (M) is defined by the sum of refractive at a given height and the ratio of height to the mean geometrical radius.

$$(M) = \left(\eta - 1 + \frac{h}{\gamma}\right) \times 10^6$$

$\eta \rightarrow$ refractive index, $h \rightarrow$ height above ground

$\gamma \rightarrow$ radius of earth

→ Duct propagation is happens when $\frac{dm}{dh}$ is negative.

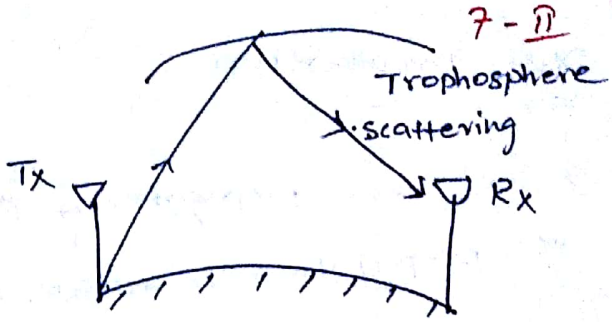
→ In duct propagation, the dielectric constant changes rapidly with height

→ It is happening during the monsoons.

→ It is not a standard propagation.

→ It can be operated at VHF & UHF.

Trophosphere Scattering



→ There is mechanism by which propagation is possible with scattering of refractive rays.

→ The scattering takes place in trophosphere region.

→ It is suitable for high frequency (i.e above 160 MHz)

→ This propagation is used to get large field strength at Receiver even waves are in shadow region.

→ In this case EM waves are generated by high power transmitted antenna with high gain and waves are reaches to upper layer of Trophosphere.

→ Due to the refractive index the scattering waves are existing and reaches to the receiver.

Advantages

→ It reduces the no. of stations (antennas)

→ It's provides the reliable multichannel communication.

disadvantages

→ The instalation cost is high.

→ high sensitive.

Fading :-

→ Fading is basically, the undesirable variation in the intensity of the signal received at the receiver.

→ The fading is defined as the fluctuations in the received signal strength caused due to variations in height & density of Ionization in different layers.

→ E-layer is exist only in day time & during the night time E-layer is weekly ionised.

→ E-layer is mostly useful for long distance radio communication during daring day time.

→ The critical frequency is 3 MHz – 5 MHz.

Characteristics of F_1 – layer

→ Height of F_1 – layer is 140 – 250 km

→ It exists at height of above 180 km in day time.

→ Its thickness above 20 km.

→ It reflects at high frequency.

→ It's combining with F_2 – layer during day time

→ critical frequency is 5 MHz – 6 MHz

Characteristics of F_2 layer

→ Height of F_2 layer is 250 – 400 km.

→ The thickness above 200 km.

→ It is most important layer for high frequency communication.

→ The critical frequency is 8 MHz in day time & 6 MHz in night time.

→ It is topmost layer of atmosphere.

Critical frequency

→ It is defined as highest frequency of Ionosphere layer that will reflect back to earth by that particular layer at vertical incident.

→ The critical

Maximum usable frequency (MUF)

→ MUF is the highest frequency of the wave that can reflect back by the layer from specific angle of incident other than vertical incident.

– Now consider the refractive index

$$\eta = \frac{\sin\phi i}{\sin\phi r} = \sqrt{1 - \frac{81N}{f^2}}$$

Angle of reflection $= 90^\circ = \phi r$

$$\frac{\sin\phi i}{\sin 90^\circ} = \sqrt{1 - \frac{81 N_{max}}{f_{MUF}^2}}$$

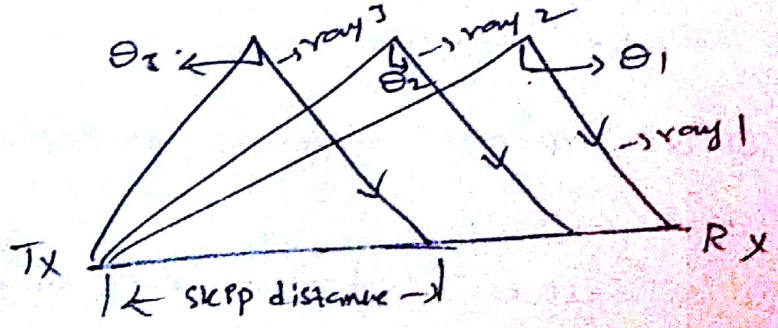
$$\boxed{f_{muf} = f_c \sec\phi i}$$

→ This means that MUF is greater than the critical frequency by a factor $\sec\phi i$.

Skip distance

→ The skip distance is the shortest distance from the transmitter, measured along surface of the earth, at which a sky wave of fixed frequency will return back to the earth.

→



(4) Sky wave propagation

→ Ionosphere wave propagation is also called as sky wave propagation.

→ Em waves directed upwards at some angle from the earth surface is called sky wave.

→ The sky wave propagation is useful in frequency range of 2-30 MHz

→ It is used for long distance communication.

Refractive Index of sky wave (or) Ionosphere

→ The Refractive index of Ionosphere is defined as

$$\eta = \sqrt{\varepsilon_r}$$

$$\varepsilon_r = 1 - \frac{NQe^2}{\varepsilon_0 m\omega^2}$$

N → $\bar{e}$ density

m → mass of $\bar{e}$ at rest.

Qe → magnetic of $\bar{e}$

ε_0 → 8.85×10^{-12} F/m, $\omega = \omega_c$ → freq.

$$\frac{NQe^2}{\varepsilon_0 m\omega_c^2} = 1 \Rightarrow f_c^2 = \frac{Qe^2 N}{\varepsilon_0 m(2\pi)^2}$$

$$\varepsilon_r = 1 - \frac{f_c^2}{f^2}, \quad \eta = \sqrt{1 - \frac{f_c^2}{f^2}}$$

$$f_c = 9\sqrt{N}$$

$$\eta = \sqrt{1 - \frac{81N}{f^2}} \;//$$

Ionosphere wave propagation / sky wave

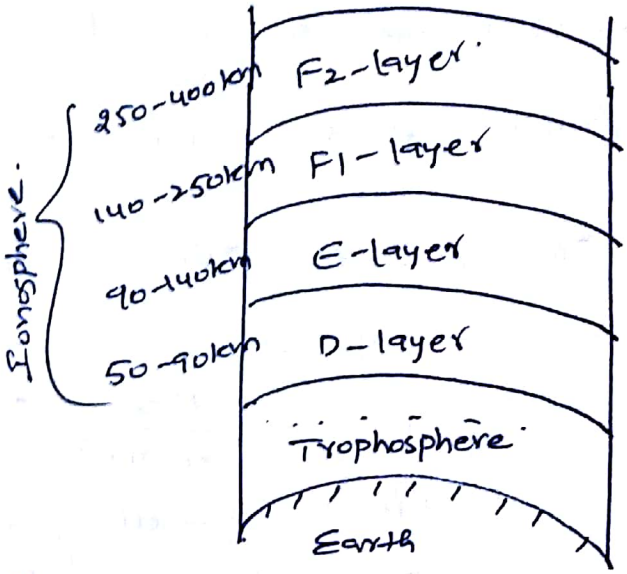
→ The upper path of the atmosphere b/w 50 km – 400 km above the earth in ionisation is Ionosphere.

→ It observes the large amount of radiation energy from the sun.

→ Ionosphere is not uniform but it is distributed in different layers

Characteristic of Ionosphere

→ Ionosphere is devided into different layer and each layer has its own characteristics.



Characteristic of D-layer

→ It is the layer of Ionosphere.

→ The height of the D-layer is 50-90 km above the surface of earth.

→ The thickness of D-layer is 10 km.

→ The D-layer is present in day time only and its vanish in the night time.

→ The D-layer reflects at very low frequency (low frequencies.

→ The critical frequency of D-layer is 100 kHz – 180 kHz

Characteristics of E-layer

→ It is next to the D-layer.

→ Height of the E-layer is 90 – 140 km above earth surface.

→ The thickness of E-layer is 25 km.

→ when the angle of incident is large ray1 return to a ground at a long distance from the transmitter.

→ The angle reduced ray 3 return to a point close to the transmitter.

→ The transmission path is limited by a skip distance and curvature of the earth.

$$d_s = \frac{2h}{\tan\theta_c}$$

h → height of layer

θ_c → critical angle

→ when the operating frequency $f = f_{muf}$

→ The skip distance interms of f_c & f_{muf} and h

$$d_s = \frac{2h}{\tan\theta_c}$$

$$d_s = 2h\left[\left(\frac{f_{muf}}{f_c}\right)^2 - 1\right]^{1/2}$$

=.