Ionospheric propagation

Ionospheric propagation

- ***Ionospheric propagation*** is responsible for the ability to do ***intercontinental broadcasting*** and communication.
- Long distance radio transmission is carried out on the HF bands (3 to 30 MHz), often referred to as ***shortwave*** bands.
- This type of propagation utilizes the fact that the earth's ionosphere acts as a ***radio mirror***.
- The actual phenomena is based on ***refraction*** in higher layers in the ionosphere. The radio mirror is produced by ionization of the upper atmosphere.

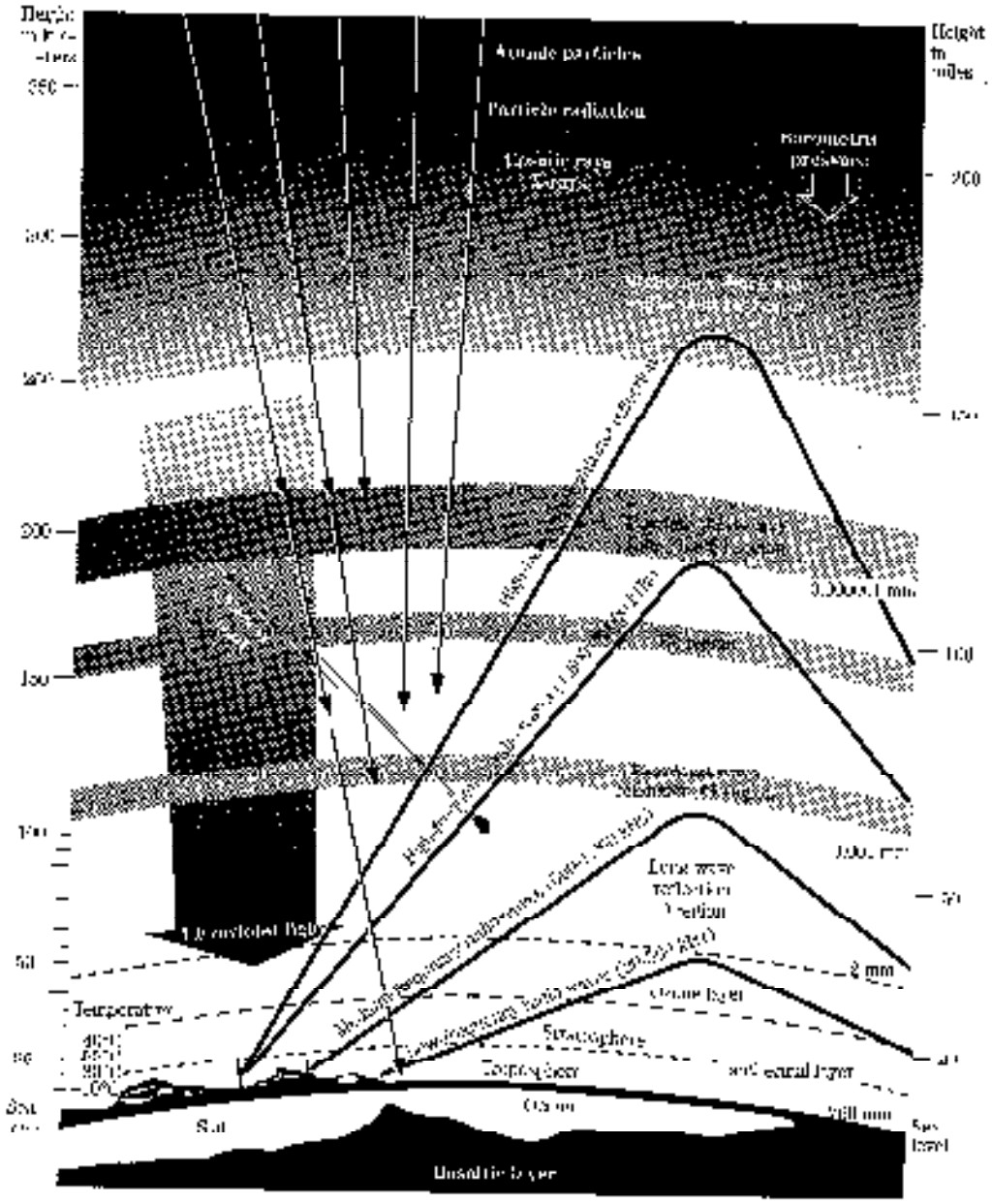
Ionospheric propagation

- Several sources of energy cause ***ionization*** of the upper atmosphere. Cosmic radiation from outer space is one source, but the majority of ionization is caused by ***solar energy***.
- The air density is very low and energy from the sun strips away electrons from the outer shells of oxygen and nitrogen molecules. The electrons becomes negative ions, while the remaining portion of the atom forms positive ions.
- Because the air is so rarefied at those altitudes those ions can travel great distance before they recombine to electrically neutral atoms again. As a result the average ionization level remains high in that region.

Ionospheric propagation

- The ionosphere is divided, for purpose of radio propagation studies, into various layers that have different properties.
- The real physical situation is such that layers do not have sharply defined boundaries, but instead fade into each another.
- Thus, the division into layers is somewhat arbitrary.
- These layers are designated D, E and F.
- Where F is further subdivided into F1 and F2.

Ionospheric propagation



D layer

- D layer is the lowest layer(40 to 80 km).
- It is not as ionized as higher layers.
- It exists during the warmer months of the year. Because of greater height of the sun above the horizon and more hours of daytime.
- It disappears directly after local sunset.
- The D layer exhibits a large amount of absorption of medium and short wave (to such extent that signals below 4 to 6 MHz are completely absorbed by the D layer)

E layer

- The E layer exists from approximately 80 to 120 km above the earth's surface.
- This region is ionized during daytime, peaking at midday.
- The ionization level drops off sharply in the late afternoon and disappears after local sunset.
- During most of the year the E layer is abstractive and will not reflect radio signals. During the summer months can E layer propagation occur (50-150 MHz).

F layer

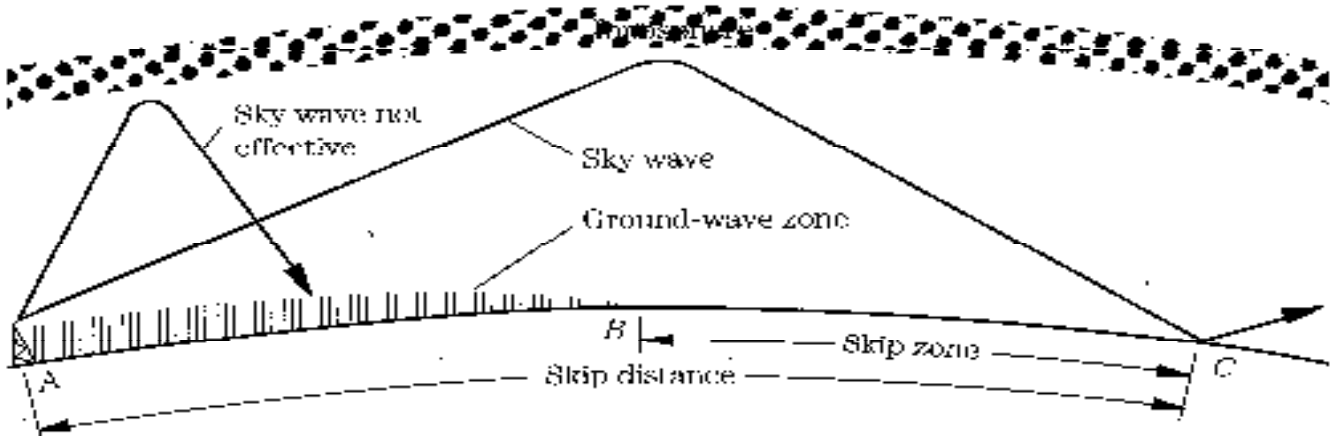
- The F layer of the ionosphere is the region that causes ion-distance shortwave communication.
- The layer is located at 150-400 km above the earth's surface.
- The ionization levels remain high during day time, and decay slowly after local sunset. Minimum levels are reached just prior to local sunrise.
- During the day there are actually two identifiable and distinct sub layers, named F1 and F2.
- The F1 layer is found approximately 150 to 250 km above the earth's surface.

F layer

- F2 layer is above F1 and extending it up to 400 km above the earth's surface.
- Beginning at local sunset, the lower regions of the F1 layer begin to de-ionize because of recombination of positive and negative ions. At some time after local sunset, the F1 and F2 merges into a single reduced layer beginning at 300 km.
- The F2 layer ionization begins to form shortly after local sunrise and reach maximum shortly before noon.

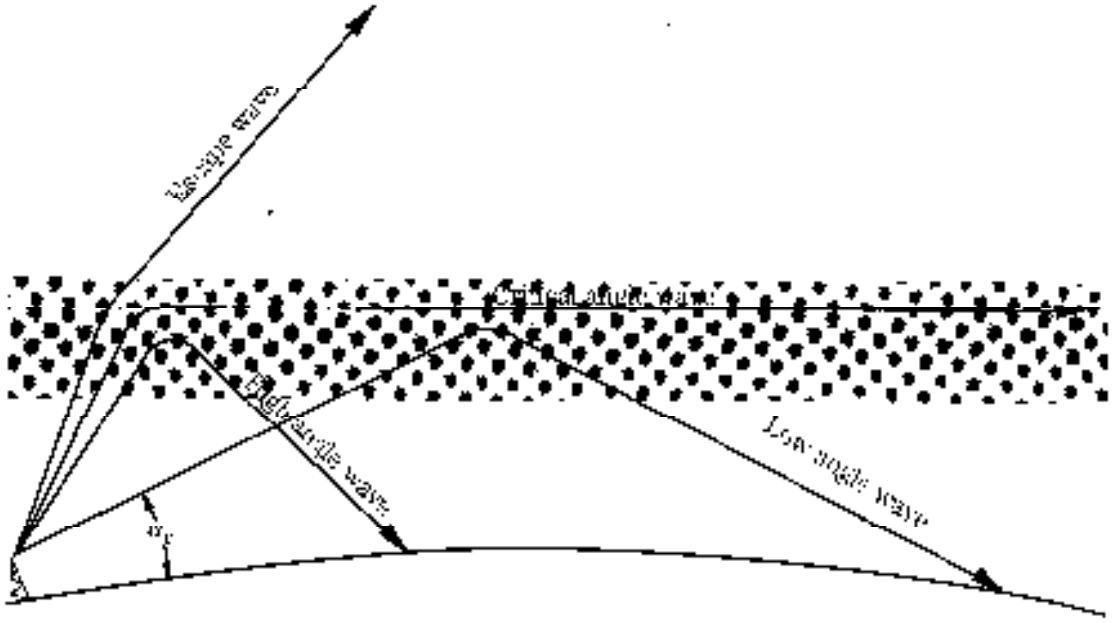
Ionospheric sky-wave propagation

- Sky-wave propagation occur because signals in the ionosphere are refracted so much that they are bent back toward the earth's surface (often called skip).



- The ***skip distance*** is the surface distance between the transmitter and the point where it returns to earth.
- The ***ground wave zone*** is the distance between the transmitter to the point where the ground wave is attenuated to a level below usefulness.
- The ***skip zone*** is the distance from the outer edge of the ground-wave zone to the skip distance.

Ionospheric sky-wave propagation



One of the factors affecting the length of the skip distance is the incident angle of the radio wave.

This angle is partially a function of the frequency, and partially a function of the natural radiation angle of the antenna Θ_1.

Actually the radiation angle is dependent on the configuration of the antenna.