THE BASICS OF RADIO WAVE PROPAGATION

Some Definitions:

Aurora

Favorite propagation results from CME or coronal stream. Occurs at the polar regions of the earth due to irregular shape and constant movement of the earth's magnetic field. Fading (QSB) is common in the reflected radio waves. During aurora narrow band modes such as CW and digital are the most reliable for DX contacts.

Backscatter

Backscatter occurs when radio waves hit the F2 layer and are reflected towards the earth within a very small radius surrounding the transmitting station. Signals using backscatter sound hollow or barrel like.

Blind Zone

The Blind Zone is an area around the radio station which cannot normally be worked by either ground waves or normal ionospheric sky waves. Some stations can be worked by intermittent backscatter propagation.

Es:

A mode of propagation producing well known short skip radio contacts off the E layer of the ionosphere. Occurs mostly during the summer months.

F2:

The most common mode of propagation is sky waves reflected off the F2 layer of the ionosphere. These reflections are responsible for most DX contacts.

Gray-Line

This area occurring along the sunset and sunrise zones. Signals which travel along the gray-line region often experience significant improvements in the received signal strength. This is because the radio wave absorbing D layer disappears faster than the higher altitude radio wave propagating F2 layer around the same time of sunset (and vice-versa for sunrise).

THE IONOSPHERE

The Ionosphere:

A collection of ionized particles and electrons in the uppermost portion of the earth's atmosphere.

D-Layer:

The lowest part of the ionosphere. The D layer appears at an altitude of 50-95 km. This layer has a negative effect on radio waves because it only absorbs radio energy particularly those frequencies below 7MHz. It develops shortly after sunrise and disappears shortly after sunset. This layer is responsible for the compete absorption of sky waves from the 80m and 160m amateur bands as well as the AM broadcast band during the daytime hours.

E-Layer:

The part of the ionosphere located just above the D layer at an altitude of 90-150km. This layer can only reflect radio waves having frequencies less than 5MHz. It has a negative effect on frequencies above that. The E layer develops shortly after sunrise and disappears a few hours after sunset.

Es-Layer:

This is also called the sporadic E layer. Different from the normal E layer, altitude varies anywhere between 80km and 120km. Capable of reflecting radio waves well into the VHF band. Usually appears mostly during the summer and sometimes during the winter.

F-Layer:

The highest part of the ionosphere. The F layer appears a few hours after sunset when the F1 & F2 layers merge. The F layer is located between 250km & 500km in altitude. Even well into the night this layer may reflect radio waves up to 20 MHz and occasionally up to 25 MHz.

F1-Layer:

The F-1 layer is located between 150 km & 200km in altitude. It occurs during daylight hours. Just before sunrise, the sun begins to shine on the upper part of the atmosphere containing the F layer. The sunlight causes this F layer to split into 2 distinct layers called the F1 & F2 layers. Maximum ionization of the F1 layer is reached at midday; this layer merges with the F2 layer a few hours after sunset to reform the F layer. Finally, this layer reflects radio waves only up to about 10 MHz.

F2-Layer:

This important layer of the ionosphere is the uppermost part of the earth's atmosphere and is located between 250km and 450 km in altitude. At the higher latitudes north or south of the equator, this layer is located at lower altitudes. The maximum ionization of the F2 layer is usually reaches one hour after sunrise and typically remains at this level until shortly after sunset. The layer shows great variability with varying peaks during the day. In contrast to all other layers the maximum ionization of the F2 layer usually peaks during winter months. Most importantly, this layer can reflect radio waves up to 50 MHz during sun spot

maximum and maximum usable frequencies (MUF) can extend beyond 70 MHz on rare occasions.

The K & the A Indices:

The higher the K index the more unstable propagation becomes, the effect is stronger at high latitudes but weaker at low latitudes. When storm level is reached, propagation strongly degrades, possibly fade-out at high latitudes.

K0 = inactive

K1 = very quiet

K2 = quiet

K3 = unsettled

K4 = active

K5 = minor storm

K6 = major storm

K7 = severe storm

K8 = very severe storm

K9 = extremely severe storm

As with the K index, the higher the A index, the more unstable propagation becomes. Classification of A indices are as follows:

A0 - A7 = quiet

A8 - A15 = unsettled

A16 - A29 = active

A30 - A49 = minor storm

A50 - A99 = major storm

A100 - A400 = severe storm