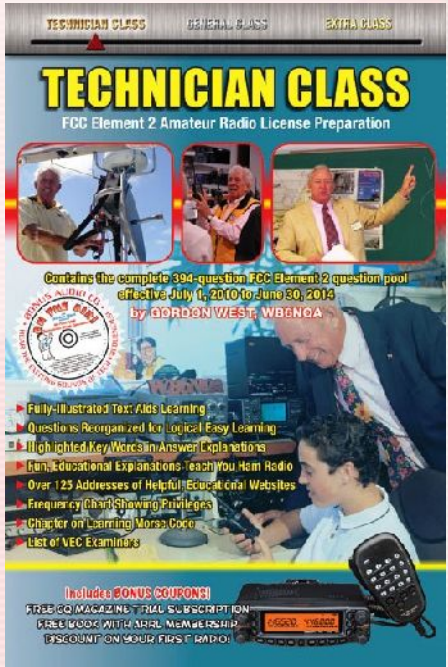
Technician Licensing Class

Weak Signal Propagation

Presented by

Ryan Caron
NX1U

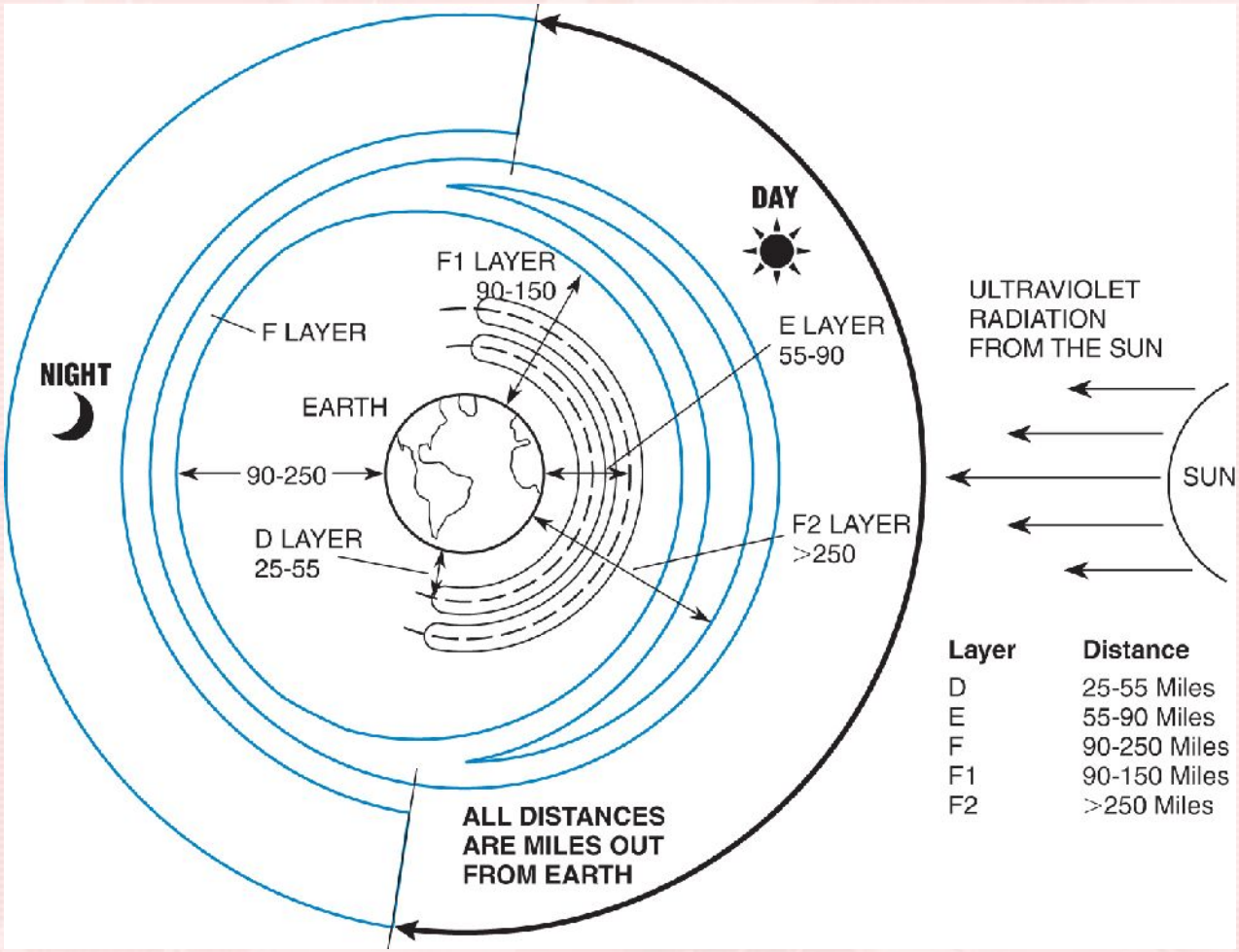


Amateur Radio Technician Class
Element 2 Course Presentation

- **ELEMENT 2 SUB-ELEMENTS**
  (Groupings)

  - **About Ham Radio**
  - **Call Signs**
  - **Control**
  - **Mind the Rules**
  - **Tech Frequencies**
  - **Your First Radio**
  - **Going On The Air!**
  - **Repeaters**
  - **Emergency!**
  - **Weak Signal Propagation**

Weak Signal Propagation



Ionosphere Layers

Basically five layers: D, E, F, F1, and F2.

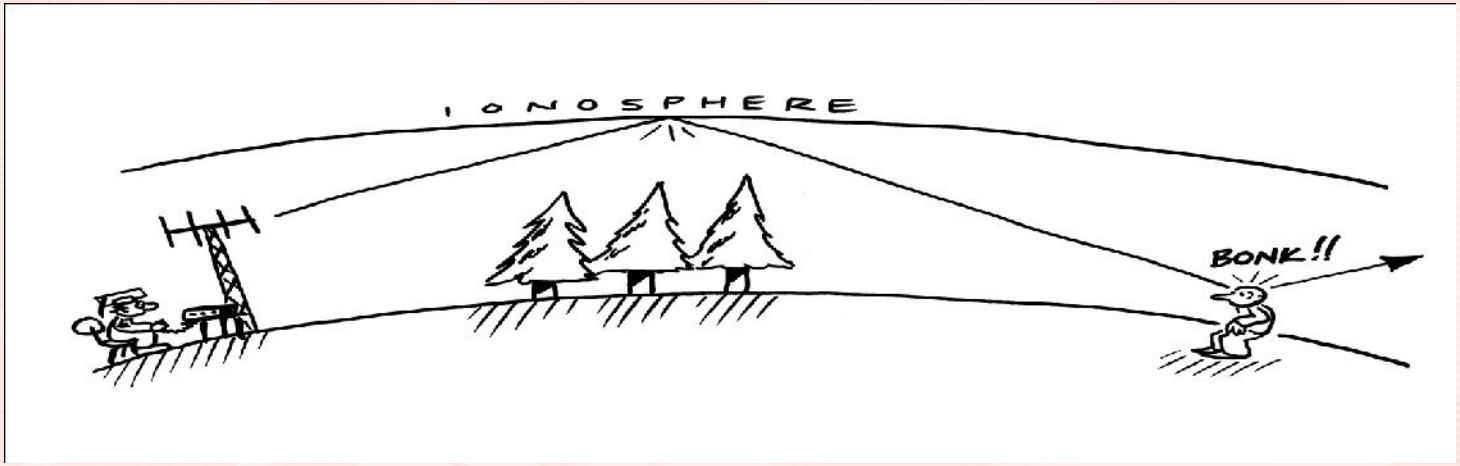
Differences in Day-time and Night-time:

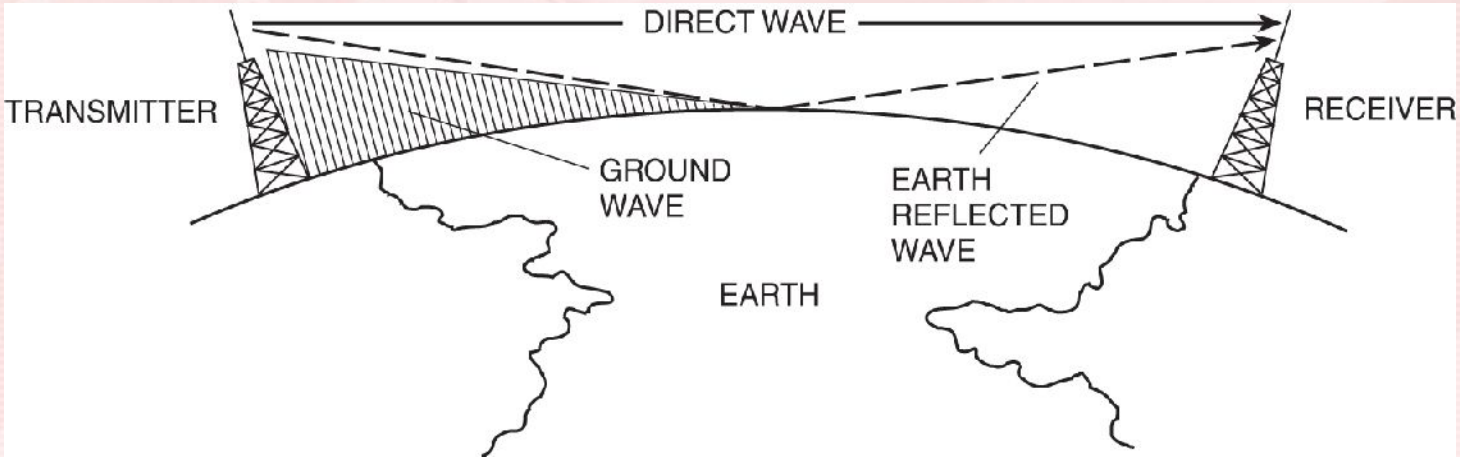
D and E disappear at night.

F1 and F2 combine at night to become just F.

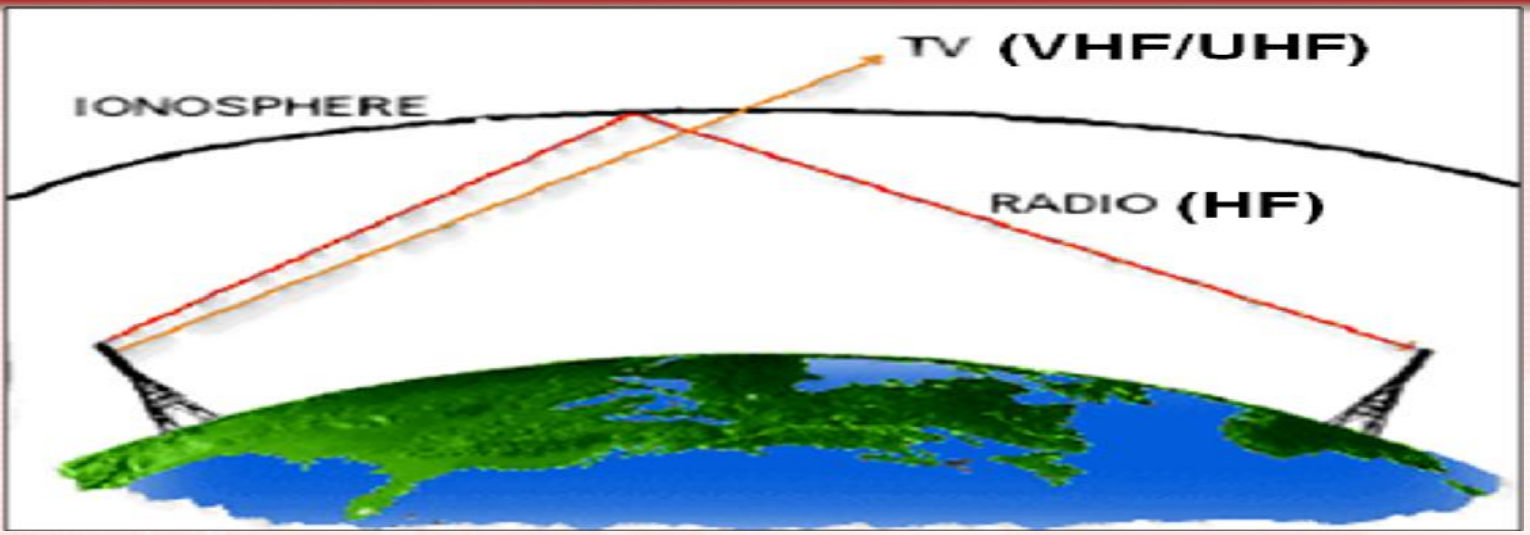
Weak Signal Propagation

- T5C7 Radio waves is a usual name for electromagnetic waves that travel through space.
  - Electromagnetic waves are RADIO WAVES

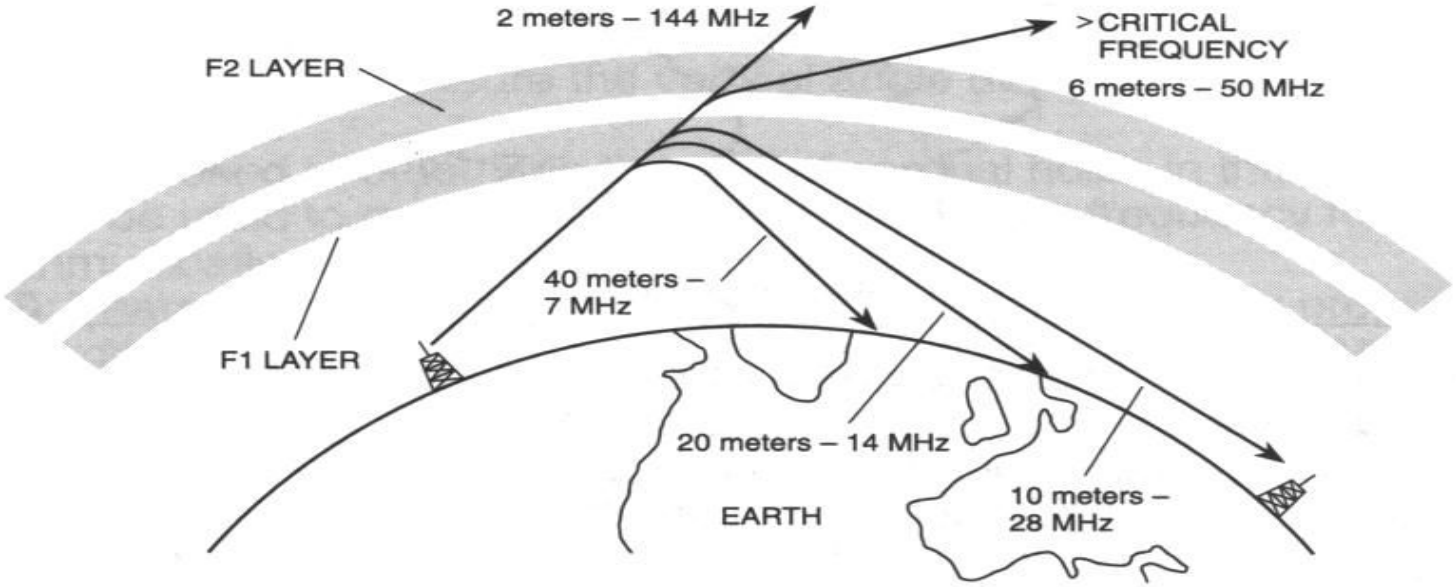




Weak Signal Propagation



HF bounces off ionosphere. VHF & UHF pass through.



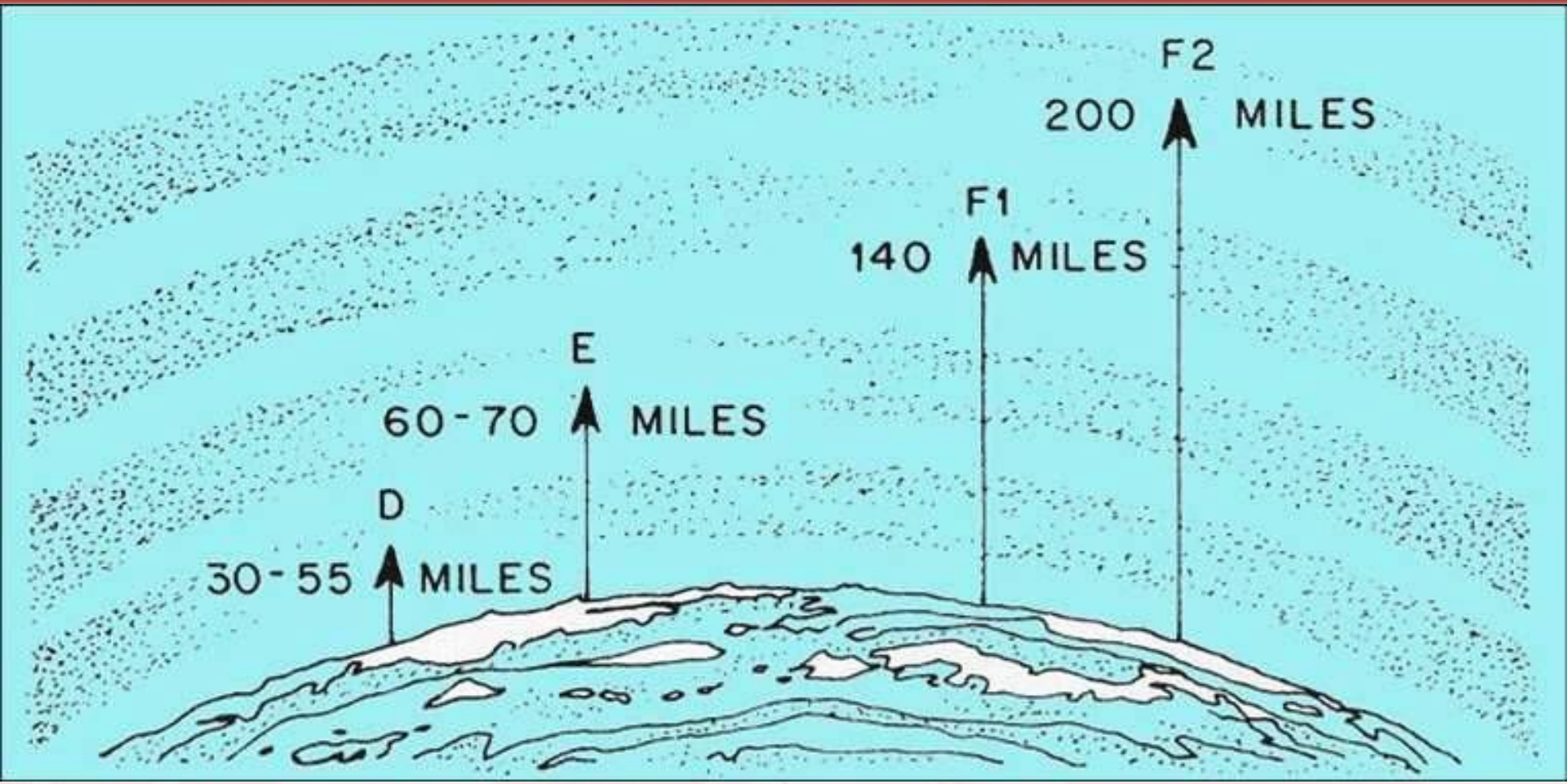
Observe differences between:

10-meters,

20-meters

40 meters

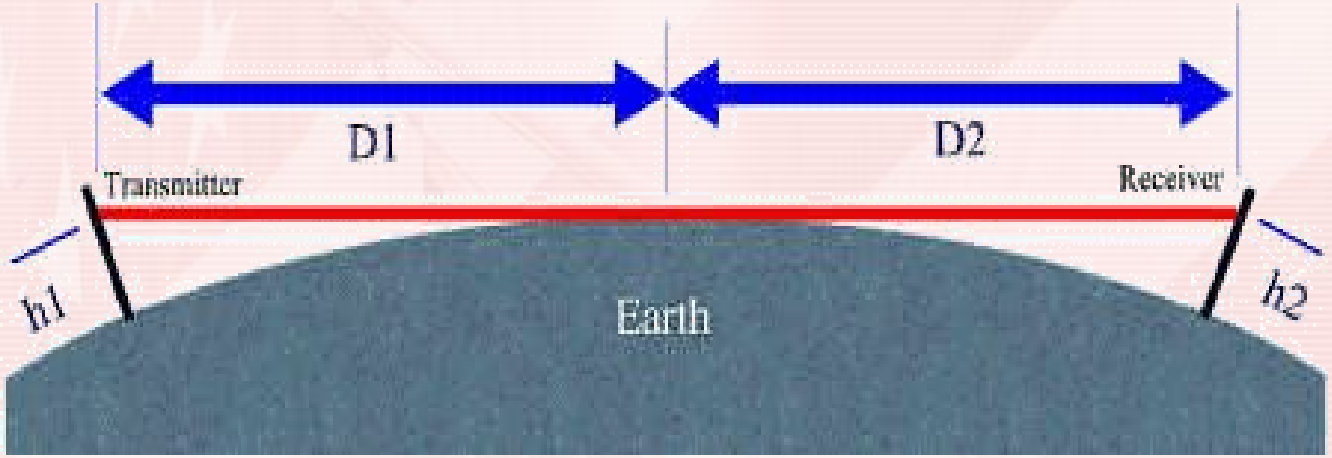
Weak Signal Propagation



Different layers in the Ionosphere and their miles from the earth

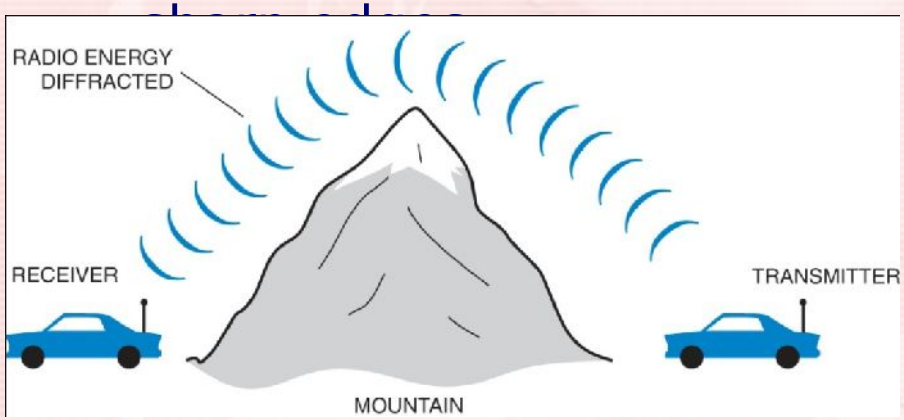
Weak Signal Propagation

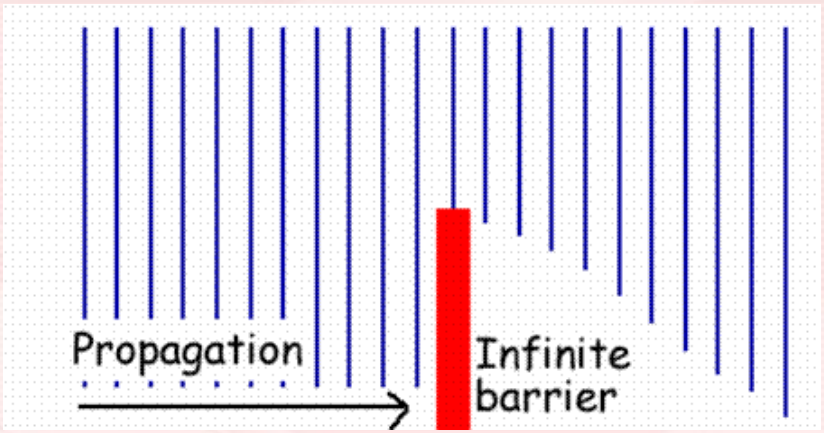
- T3C10 The distance at which radio signals between two points are effectively blocked by the curvature of the Earth is the radio horizon.
  - VHF & UHF radio signals will generally travel “line of sight.”
  - VHF & UHF radio signals are blocked by the curvature of the Earth.



Weak Signal Propagation

- T3C11 VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations because the Earth seems less curved to radio waves than to light.
  - the Earth seems less curved to VHF and UHF radio signals.
- T3C5 The term "knife-edge" propagation refers to signals that are partially refracted around solid objects exhibiting sharp edges

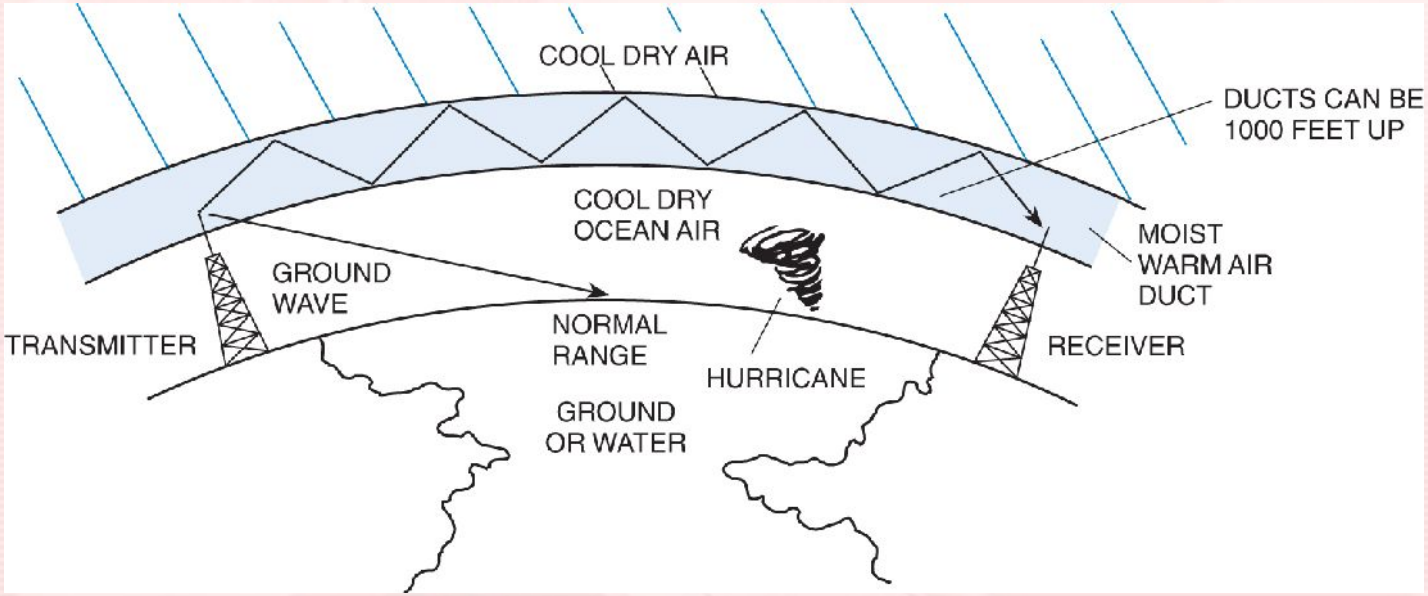




Knife-Edge Diffraction

Weak Signal Propagation

- T3C6 Tropospheric scatter is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis.
- T3C8 Temperature inversions in the atmosphere causes "tropospheric ducting".



Tropospheric Ducting

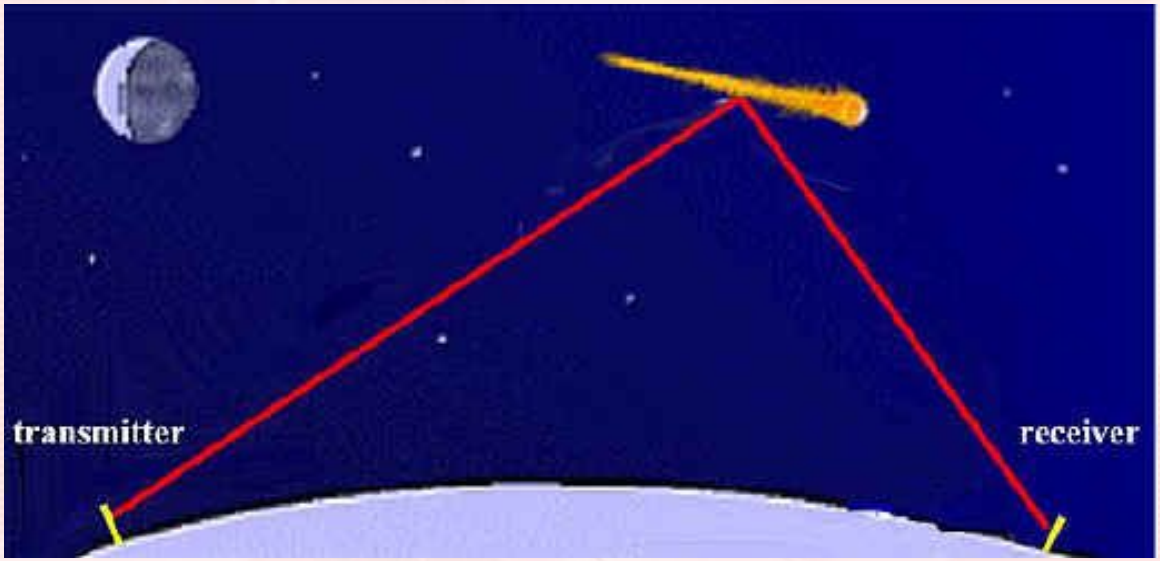
Weak Signal Propagation

- T3C3 A characteristic of VHF signals received via auroral reflection is that the signals exhibit rapid fluctuations of strength and often sound distorted.

Incoming signals from a distant station heard hundreds of miles away will sound fluttery and distorted by auroral bounce

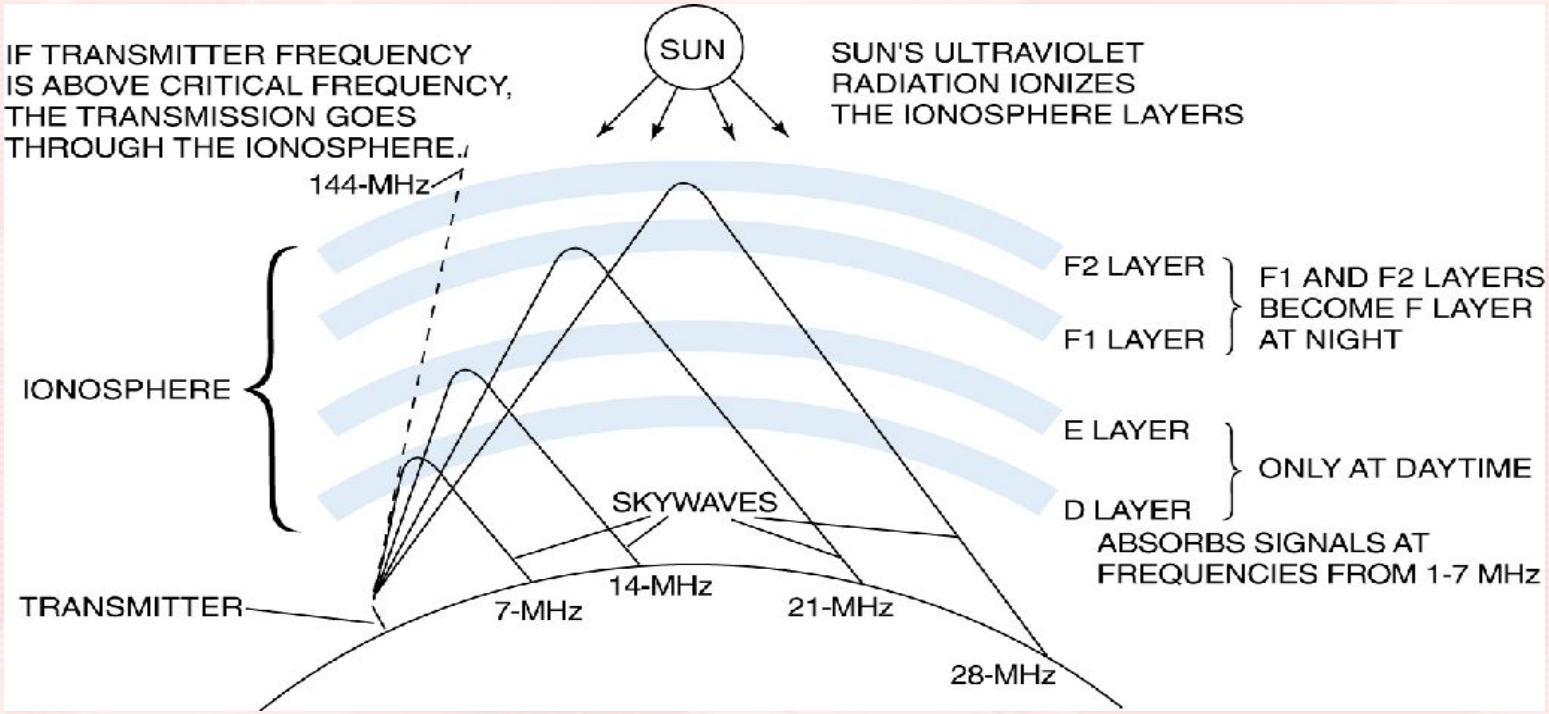
Weak Signal Propagation

- T3C7 The 6 meter band is best suited to communicating via meteor scatter.
  - Leonids and Geminids meteor showers provide these conditions
  - Bounce signals off meteor tail



Weak Signal Propagation

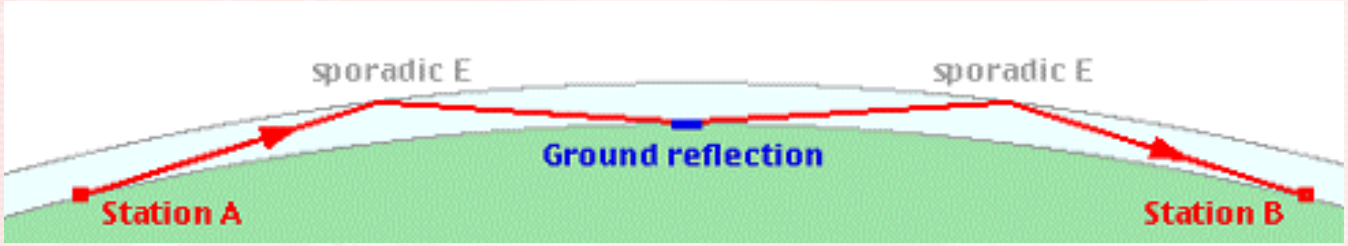
- T3A11 The ionosphere is the part of the atmosphere that enables the propagation of radio signals around the world.



Ionosphere and its layers

Weak Signal Propagation

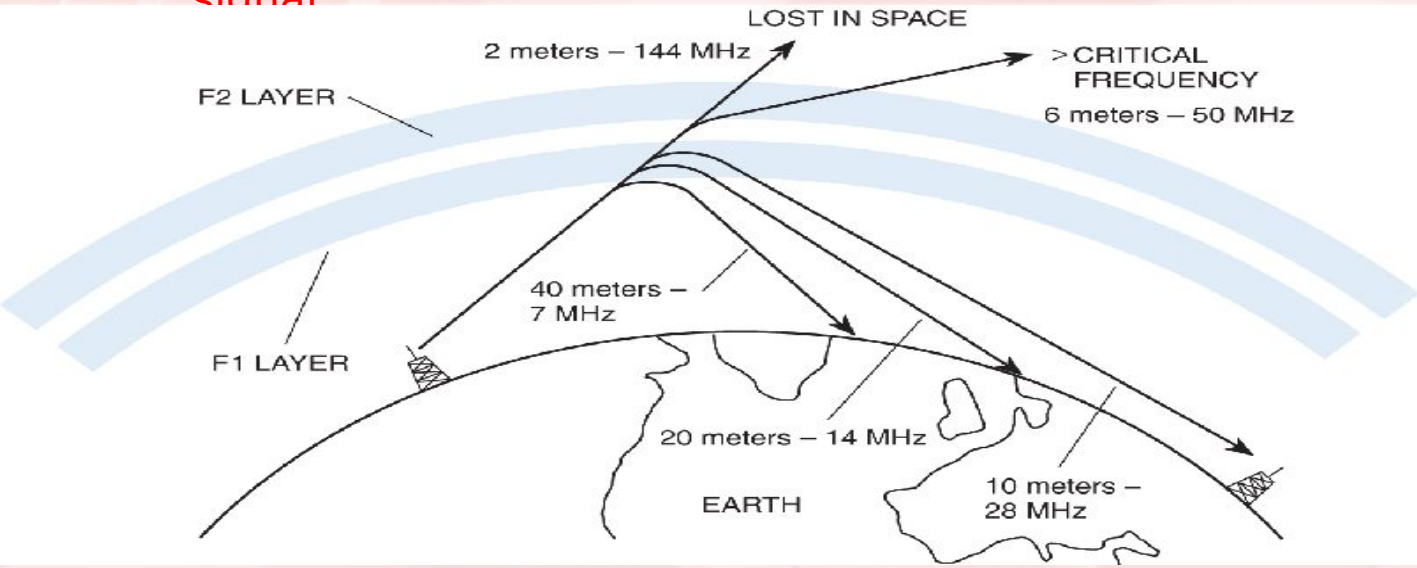
- T3C2 When VHF signals are being received from long distances these signals are being refracted from a sporadic E layer.
  - Sporadic-E refractions off ionized patches of the ionospheric E-layer are common in summer on 6-meters.



- T3C9 During daylight hours is generally the best time for long-distance 10 meter band propagation.

Weak Signal Propagation

- T3A9 A common effect of "skip" reflections between the Earth and the ionosphere is the polarization of the original signal becomes randomized.
  - Skip happens when signals refract and reflect off the ionosphere.
    - DX stations 1000 miles away come booming in.
  - Every 30 seconds signal goes from strong to weak and back.
    - Caused by random, ever changing polarization of the original signal



Critical Frequency

Weak Signal Propagation

- T3C4 Sporadic E propagation is commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands.
- T3C1 UHF signals "direct" (not via a repeater) are rarely heard from stations outside your local coverage area because UHF signals are usually not reflected by the ionosphere.
  - REFRACTION IN THE IONOSPHERE:
    - When a radio wave enters an ionized layer, refraction, or bending of the wave, occurs.
    - Refraction is caused by an abrupt change in the velocity of the upper part of a radio wave as it strikes or enters a new medium.
    - The amount of refraction that occurs depends on three main factors:
      - (1) the density of ionization of the layer,
      - (2) the frequency of the radio wave,
      - (3) the angle at which the wave enters the layer
  - REFLECTION IN THE IONOSPHERE:
    - When a radio wave hits an obstacle, some/all of the wave is reflected, with a loss of intensity.
    - Reflection is such that the angle of incidence is equal to the angle of reflection.
- T3A8 The cause of irregular fading of signals from distant stations during times of generally good reception is due to random combining of signals arriving via different path lengths.

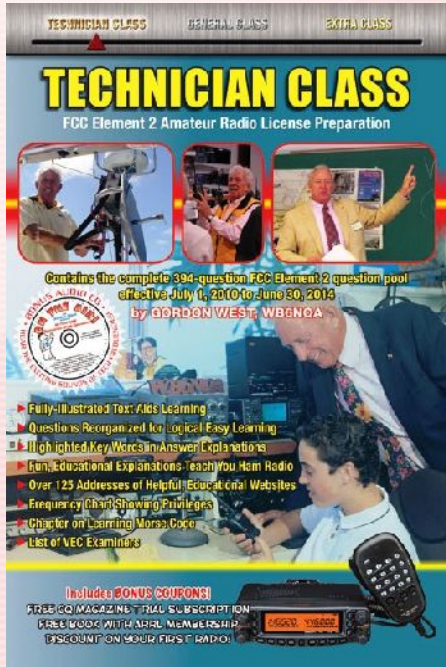
Element 2 Technician Class Question Pool

Weak Signal Propagation

Valid July 1, 2010

Through

June 30, 2014



T5C07 What is a usual name for electromagnetic waves that travel through space?

A. Gravity waves
B. Sound waves
C. Radio waves
D. Pressure waves

T3C10 What is the radio horizon?

A. The distance at which radio signals between two points are effectively blocked by the curvature of the Earth
B. The distance from the ground to a horizontally mounted antenna
C. The farthest point you can see when standing at the base of your antenna tower
D. The shortest distance between two points on the Earth's surface

T3C11 Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?

A. Radio signals move somewhat faster than the speed of light
B. Radio waves are not blocked by dust particles
C. The Earth seems less curved to radio waves than to light
D. Radio waves are blocked by dust particles

T3C05 What is meant by the term "knife-edge" propagation?

A. Signals are reflected back toward the originating station at acute angles
B. Signals are sliced into several discrete beams and arrive via different paths
C. Signals are partially refracted around solid objects exhibiting sharp edges
D. Signals propagated close to the band edge exhibiting a sharp cutoff

T3C06

What mode is responsible for allowing over-the-horizon VHF & UHF communication to ranges of ~300 miles on a regular basis?

A. Tropospheric scatter
B. D layer refraction
C. F2 layer refraction
D. Faraday rotation

T3C08 What causes "tropospheric ducting"?

A. Discharges of lightning during electrical storms
B. Sunspots and solar flares
C. Updrafts from hurricanes and tornadoes
D. Temperature inversions in the atmosphere

T3C03 What is a characteristic of VHF signals received via auroral reflection?

A. Signals from distances of 10,000 or more miles are common
B. The signals exhibit rapid fluctuations of strength and often sound distorted
C. These types of signals occur only during winter nighttime hours
D. These types of signals are generally strongest when your antenna is aimed to the south (for stations in the Northern Hemisphere)

T3C07 What band is best suited to communicating via meteor scatter?

A. 10 meters
B. 6 meters
C. 2 meters
D. 70 cm

T3A11

Which part of the atmosphere enables the propagation of radio signals around the world?

A. The stratosphere
B. The troposphere
C. The ionosphere
D. The magnetosphere

T3C02 Which of the following might be happening when VHF signals are being received from long distances?

A. Signals are being reflected from outer space
B. Signals are arriving by sub-surface ducting
C. Signals are being reflected by lightning storms in your area
D. Signals are being refracted from a sporadic E layer

T3C09 What is generally the best time for long-distance 10m band propagation?

A. During daylight hours
B. During nighttime hours
C. When there are coronal mass ejections
D. Whenever the solar flux is low

T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?

A. The sidebands become reversed at each reflection
B. The polarization of the original signal is randomized
C. The apparent frequency of the received signal is shifted by a random amount
D. Signals at frequencies above 30 MHz become stronger with each reflection

T3C04

Which of the following propagation types is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2m bands?

A. Backscatter
B. Sporadic E
C. D layer absorption
D. Gray-line propagation

T3C01 Why are "direct" (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?

A. They are too weak to go very far
B. FCC regulations prohibit them from going more than 50 miles
C. UHF signals are usually not reflected by the ionosphere
D. They collide with trees and shrubbery and fade out

T3A08

What is the cause of irregular fading of signals from distant stations during times of generally good reception.

A. Absorption of signals by the "D" layer of the ionosphere
B. Absorption of signals by the "E" layer of the ionosphere
C. Random combining of signals arriving via different path lengths
D. Intermodulation distortion in the local receiver