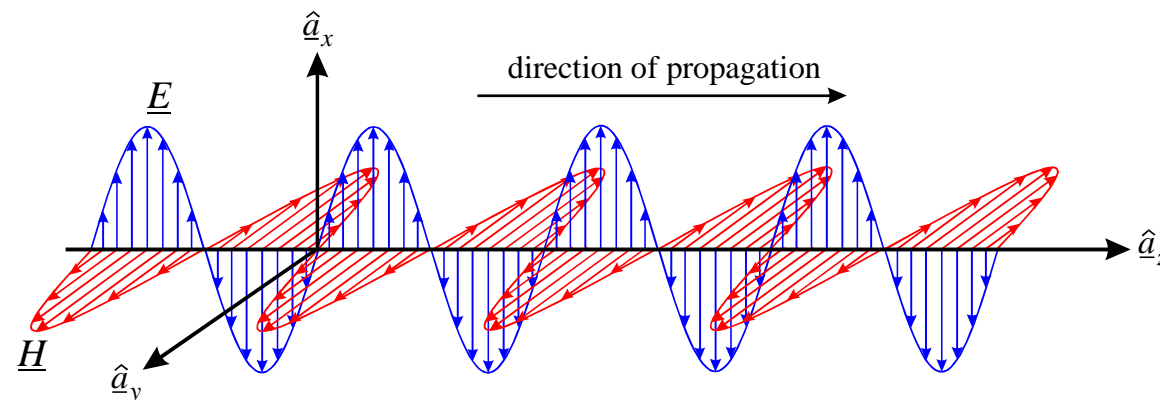


UK Foundation Amateur Radio License Propagation

Propagation of Radio Waves

- Radio waves (and light waves) are both electromagnetic (EM) waves
- When this EM energy is transmitted from an antenna, it is said to have been ***propagated***
- Radio waves normally travel in straight lines



Source: Cardiff University School of Engineering, EN2066
Module, Section 7

Main Factors Affecting Propagation

1. Reflection

- Off a smooth surface, such as the side of a building or the sea (if it is larger than one wavelength of the propagating EM wave)

2. Refraction

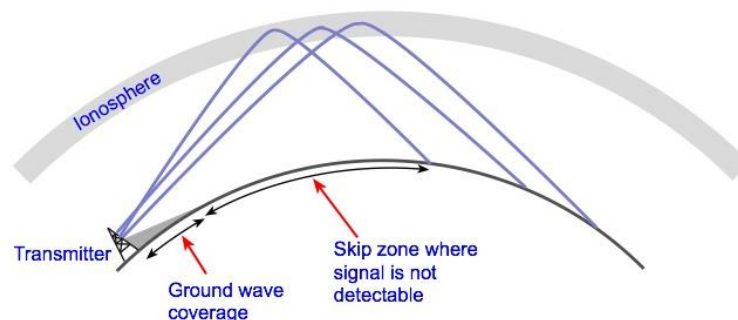
- The same process as when light is bent in a prism (this can be used to our advantage in the ionosphere)

3. Diffraction

- Or scattering, such as going over or round an edge: A building, a hill ect.

Modes of Propagation

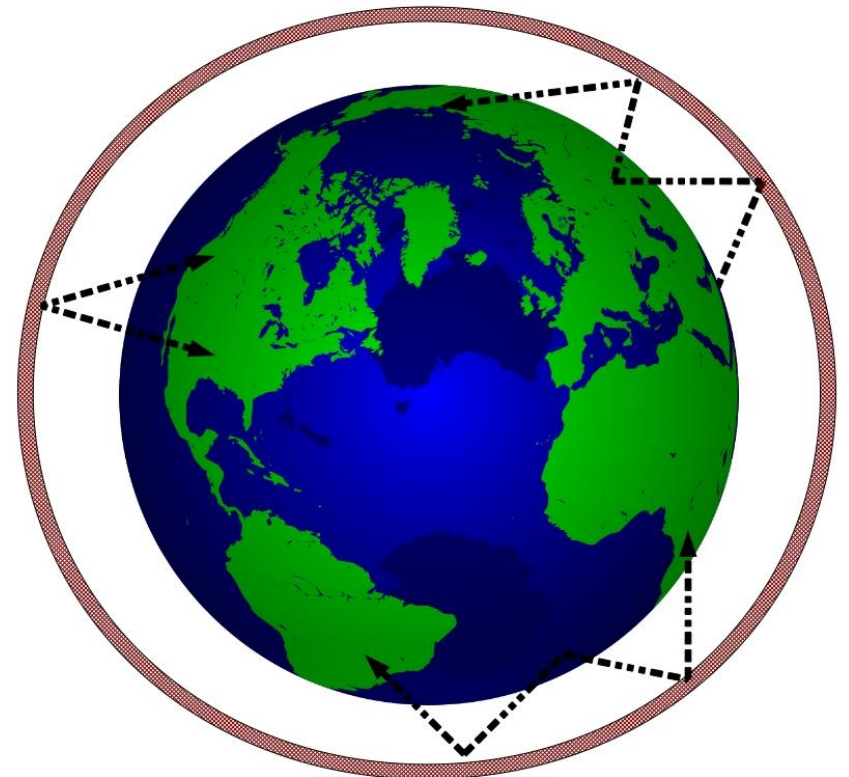
- Ground waves
- Space (or tropospheric) waves
- Sky (or ionospheric) waves
 - The ionosphere can refract (or bend) radio waves, allowing propagation beyond line-of-sight



Source: <https://www.electronics-notes.com/images/propagation-ionospheric-skip-zone-01-700w.jpg>

The Ionosphere

- Layers of ionised air between 70 and 400km above Earth
- UV radiation from the sun is absorbed by air molecules in the upper atmosphere.
- The result is ionisation, with electrons of these molecules being ejected due to the energy received by the UV rays.
- The air in this region now contains free electrons and positively-charged gas molecules – ions.
- As the UV energy moves down through this atmospheric layer it decreases in intensity, resulting in lower levels of ionisation.
- There are several layers of ions of different composition and height, ranging between 70km and 400km above the Earth - These areas are collectively referred to as the *ionosphere*.



Source:

<https://upload.wikimedia.org/wikipedia/commons/d/d5/Skywave.jpg>

Effects of Propagation

- The weather can affect EM propagation, especially at higher frequencies: Snow, ice, rain
- The time of day can also dramatically affect the range of a radio signal, due to the ionosphere being more (or less) ionised at a particular time