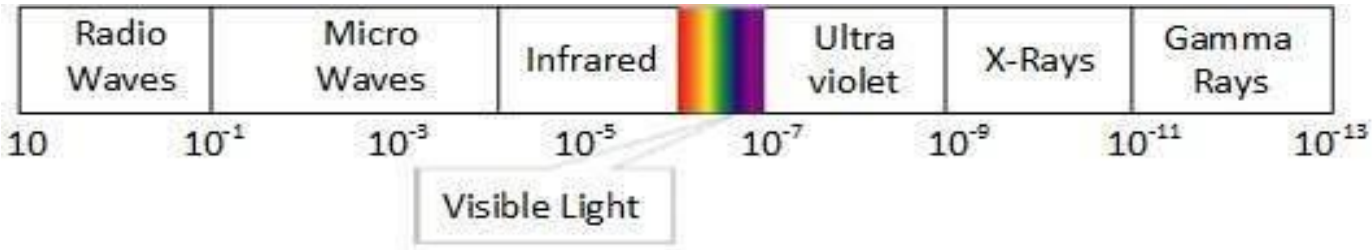
Wireless Communication

Wireless communication is also referred to as Unguided Media or Unbounded transmission media. In this mode, no physical medium is required for the transmission of electromagnetic signals. In wireless communication, we can transfer our message through the air, water, or vacuum i.e. Infrared, Radio waves, Microwave waves. So, we don't worry about the cables or any material to transfer messages, as we can send out a message without and medium.

When an antenna is attached to electrical circuit of a computer or wireless device, it converts the digital data into wireless signals and spread all over within its frequency range. The receptor on the other end receives these signals and converts them back to digital data.

A little part of the electromagnetic spectrum can be used for wireless transmission.



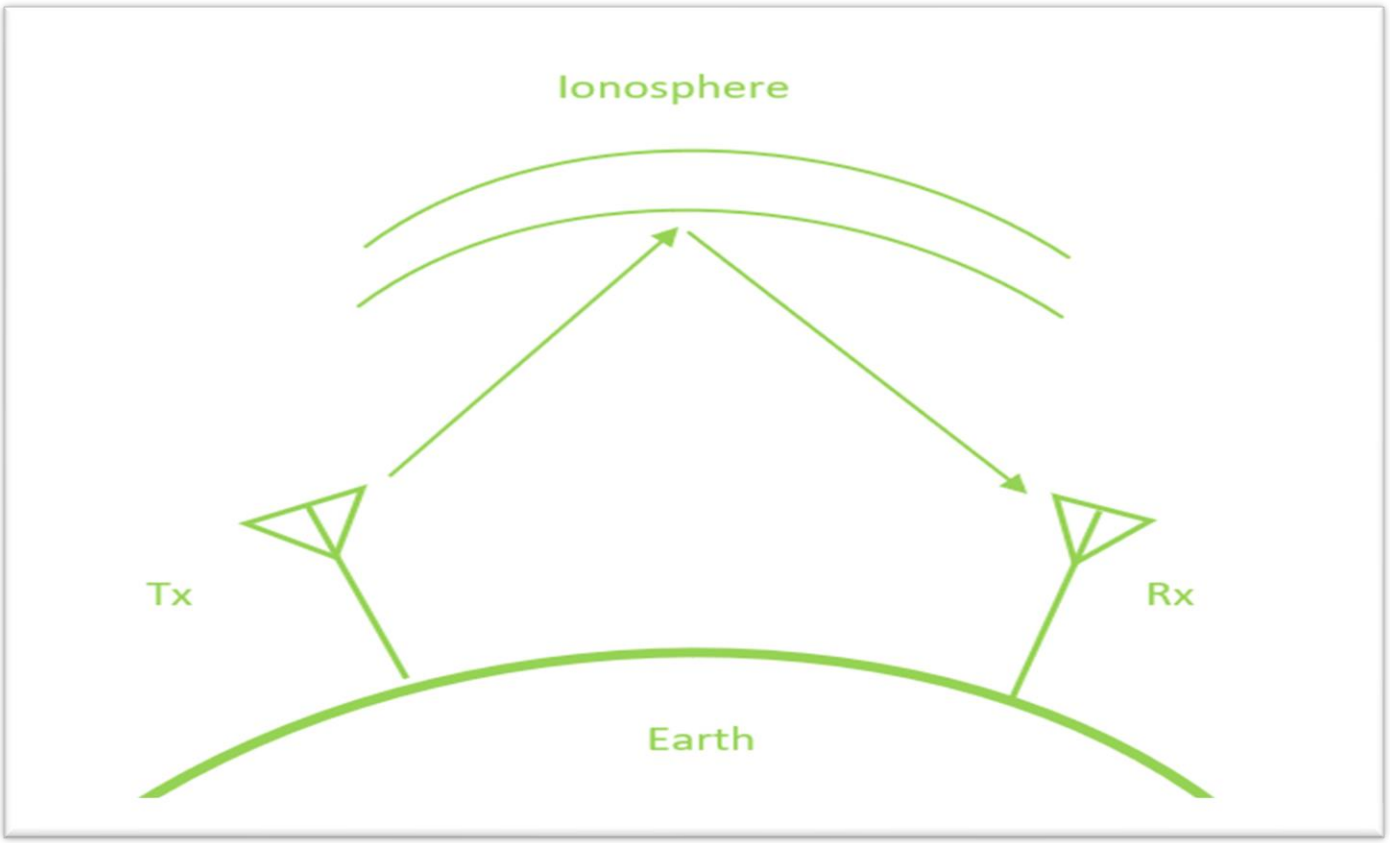
Propagation of Radio Waves

Radio waves can propagate through air, water, various solid objects, vacuum and etc. The ability of radio waves to propagate through various materials depends on the wavelength and the frequency of the radio waves.

Modes of Radio Wave Propagation

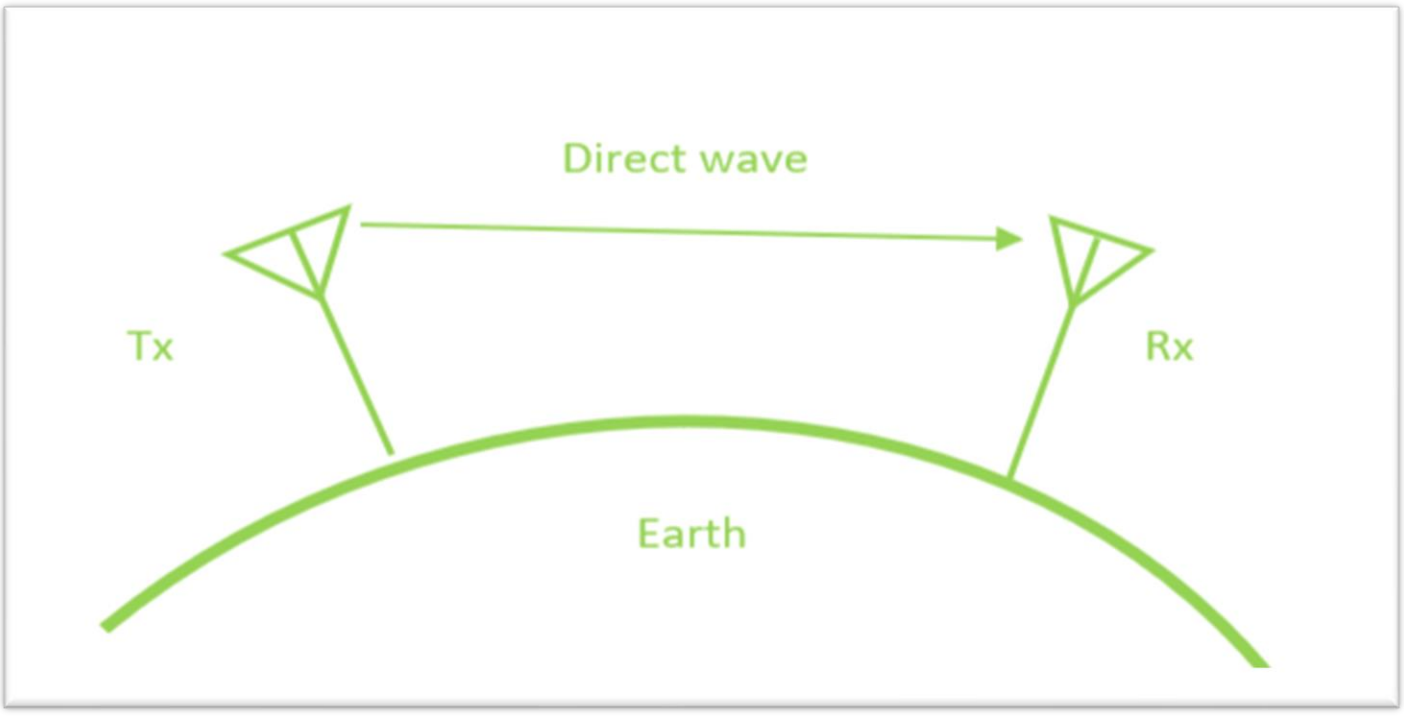
Sky Wave Propagation: This mode of propagation occurs when the signal is transmitted by the transmitting antenna (Tx) is reflected by the ionosphere layer (sky) and received by the receiving antenna (Rx) is known as sky wave propagation. The ionosphere is the layer of the earth's upper atmosphere that contains ionized gases and plasma. It protects the earth from harmful radiation.

1. Sky wave propagation occurs in the ionosphere.
2. The range of frequencies that can be used for sky wave propagation is typically between 3 and 30 MHz.



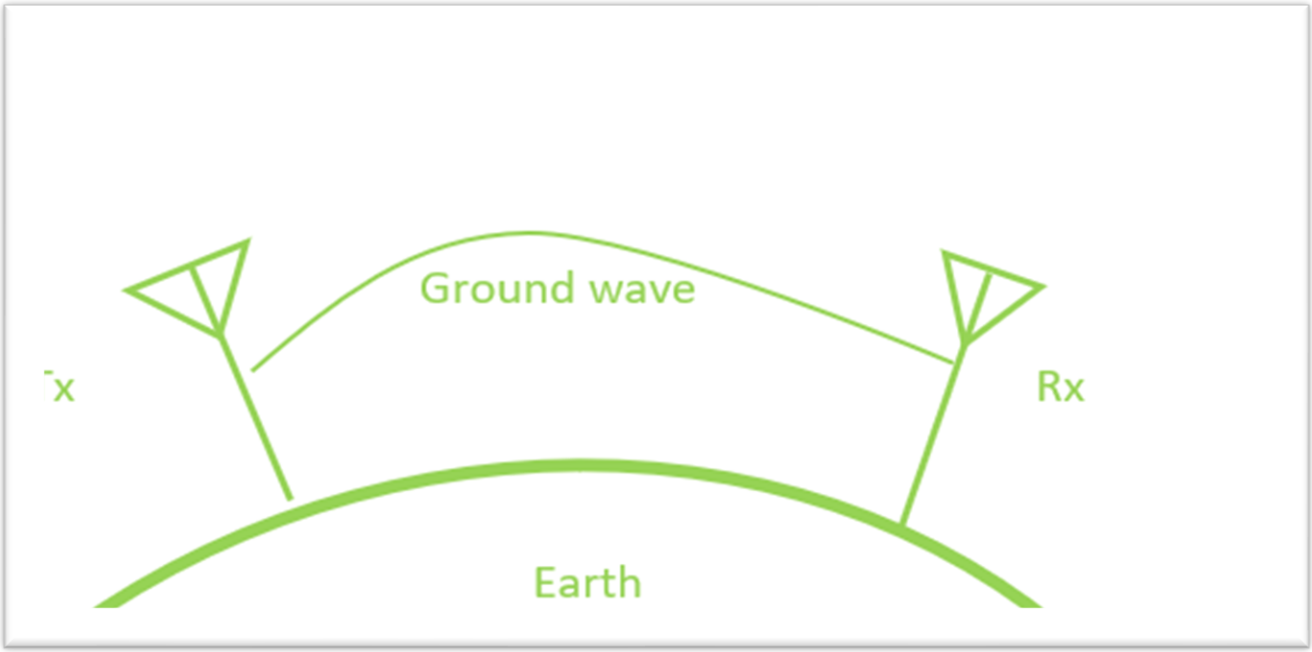
Space Wave Propagation of Radio Waves: This mode of propagation occurs when the transmitting wave travels directly to the receiving antenna directly without any reflection, refraction, and deflection phenomenon. It is also called direct wave propagation or line-of-sight transmission.

1. Space wave propagation is commonly used for short-range radio communication
2. Space wave propagation is also used for satellite communication,
3. The maximum range is approximately 40 kilometres for radio waves at 100 MHz.
4. Space wave propagation is used in a wide variety of applications, including television broadcasting, mobile phones, wireless LANs, and remote sensing.



Ground Wave Propagation: This mode of propagation occurs when the transmitting waves travel along the earth's surface and are received at the receiving antenna is known as the Ground wave propagation. The range of the Ground wave Propagation depends on the frequency of the transmitted wave, the power of the transmitter, and the properties of the earth's surface and the earth's atmosphere.

1. Ground wave propagation requires a lower-power transmitter than other methods of radio wave propagation.
2. It is used for medium-range communication such as 100km to 1000km.
3. mostly the frequency used for the ground wave propagation lies between 3khz to 3Mhz.



Radio Transmission

Radio frequency is easier to generate and because of its large wavelength it can penetrate through walls and structures alike.Radio waves can have wavelength from 1 mm – 100,000 km and have frequency ranging from 3 Hz (Extremely Low Frequency) to 300 GHz (Extremely High Frequency). Radio frequencies are sub-divided into six bands.

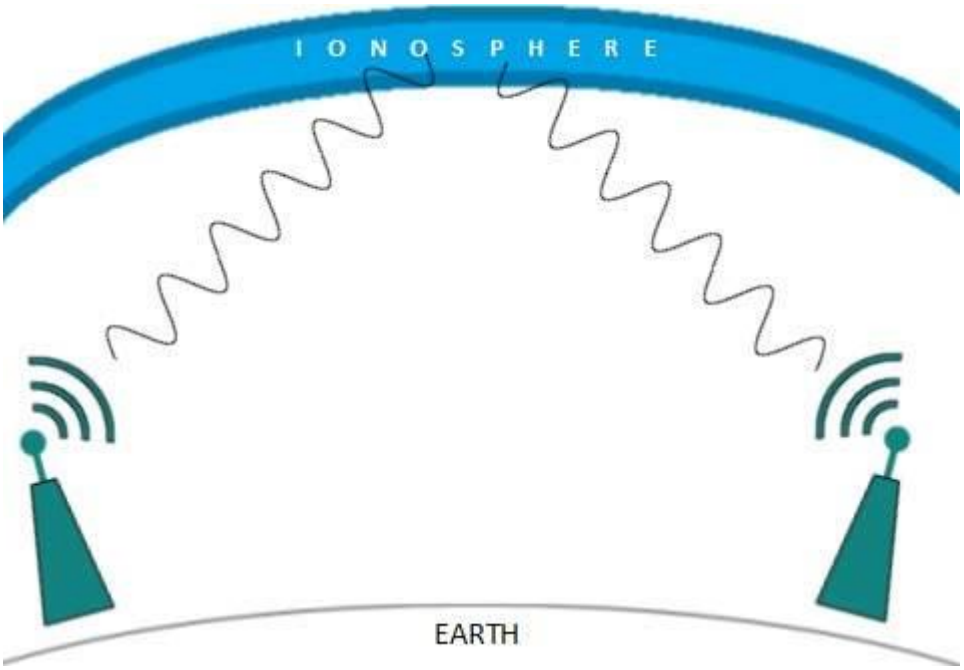
Radio waves at lower frequencies can travel through walls whereas higher RF can travel in straight line and bounce back.The power of low frequency waves decreases sharply as they cover long distance. High frequency radio waves have more power.

Lower frequencies such as VLF, LF, MF bands can travel on the ground up to 1000 kilometres, over the earth's surface.

Radio waves of high frequencies are prone to be absorbed by rain and other obstacles. They use Ionosphere of earth atmosphere. High frequency radio waves such as HF and VHF bands are spread upwards. When they reach Ionosphere, they are refracted back to the earth.

Uses:

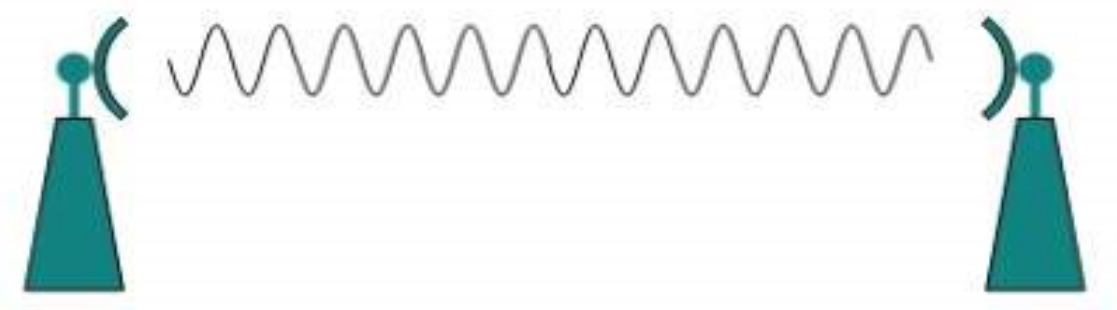
Radio waves are used in AM and FM radios, and cordless phones. Also, some private and government organization reserves certain radio frequencies for direct communication.



Microwave Transmission

Electromagnetic waves above 100 MHz tend to travel in a straight line and signals over them can be sent by beaming those waves towards one particular station. Because Microwaves travels in straight lines, both sender and receiver must be aligned to be strictly in line-of-sight.

Microwaves can have wavelength ranging from 1 mm – 1 meter and frequency ranging from 300 MHz to 300 GHz.



Microwave antennas concentrate the waves making a beam of it. As shown in picture above, multiple antennas can be aligned to reach farther. Microwaves have higher frequencies and do not penetrate wall like obstacles.

Microwave transmission depends highly upon the weather conditions and the frequency it is using.

Uses:
Microwaves are used in mobile phones communication and television distribution.

Infrared Transmission

Infrared wave lies in between visible light spectrum and microwaves. It has wavelength of 700-nm to 1-mm and frequency ranges from 300-GHz to 430-THz.

Infrared wave is used for very short-range communication purposes such as television and it's remote. Infrared travels in a straight line hence it is directional by nature. Because of high frequency range, Infrared cannot cross wall-like obstacles.

Uses:
As we have already have discussed they are used in TV remotes, Pc devices like mice, and keyboards.

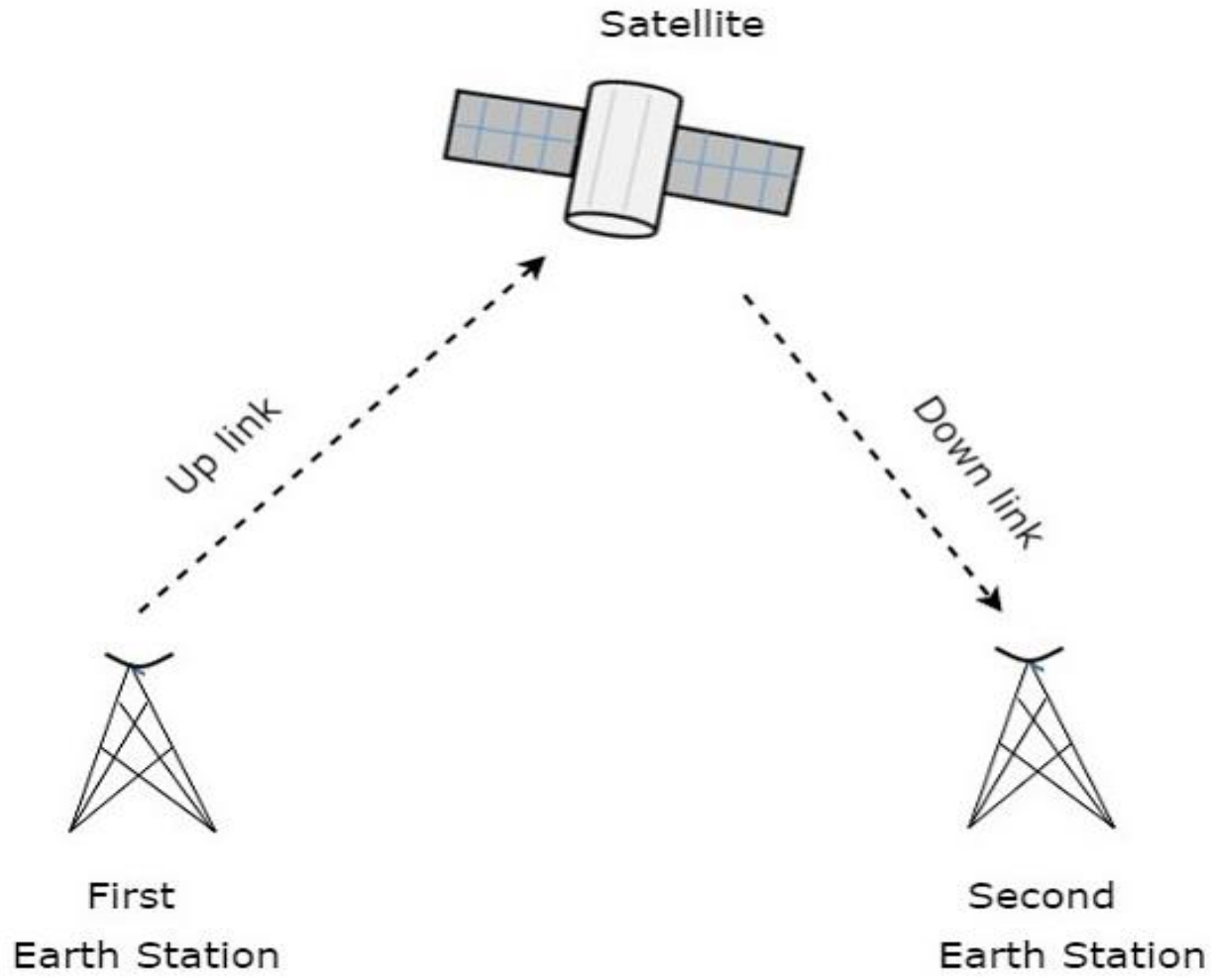
Satellite Communication

Communication refers to the exchange (sharing) of information between two or more entities, through any medium or channel. In other words, it is nothing but sending, receiving and processing of information.

If the communication takes place between any two earth stations through a satellite, then it is called as **satellite communication**. In this communication, electromagnetic waves are used as carrier signals. These signals carry the information such as voice, audio, video or any other data between ground and space and vice-versa.

The maximum hop or the station distance is limited to 1500KM only in both ground wave propagation and sky wave propagation. Satellite communication overcomes this limitation. In this method, satellites provide **communication for long distances**, which is well beyond the line of sight.

Since the satellites locate at certain height above earth, the communication takes place between any two earth stations easily via satellite. So, it overcomes the limitation of communication between two earth stations due to earth's curvature.



The transmission of signal from first earth station to satellite through a channel is called as **uplink**. Similarly, the transmission of signal from satellite to second earth station through a channel is called as **downlink**.

Uplink frequency is the frequency at which, the first earth station is communicating with satellite. The satellite transponder converts this signal into another frequency and sends it down to the second earth station. This frequency is called as **Downlink frequency**. In similar way, second earth station can also communicate with the first one.

The process of satellite communication begins at an earth station. Here, an installation is designed to transmit and receive signals from a satellite in an orbit around the earth. Earth stations send the information to satellites in the form of high powered, high frequency (GHz range) signals.

The satellites receive and retransmit the signals back to earth where they are received by other earth stations in the coverage area of the satellite. Satellite's **footprint** is the area which receives a signal of useful strength from the satellite.