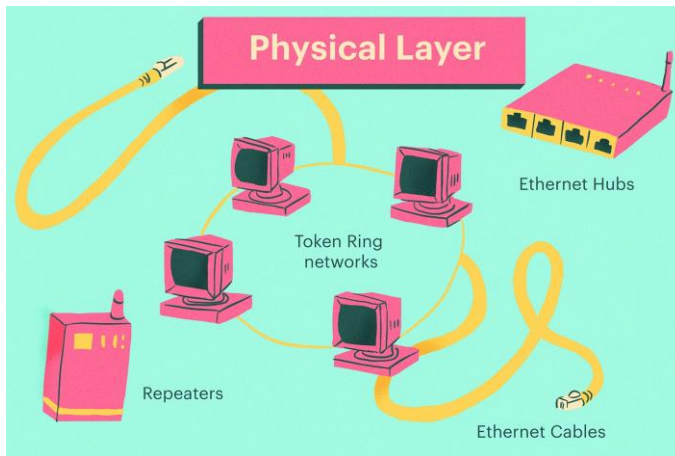# *MODULE-2: PHYSICAL LAYER*

Prepared by Prof. Amit K. Nerurkar

Module 2   **Physical Layer**

Unguided Media

It is also referred to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals. Features:

- Signal is broadcasted through air
- Less Secure
- Used for larger distances

Unguided signals can travel from the source to destination in several ways :
1) Ground propagation
2) Sky propagation
3) Line-of-sight propagation

Ground Wave Propagation

Ground wave propagation of the wave follows the contour of earth. Such a wave is called as **direct wave**. The wave sometimes bends due to the Earth's magnetic field and gets reflected to the receiver. Such a wave can be termed as **reflected wave**.
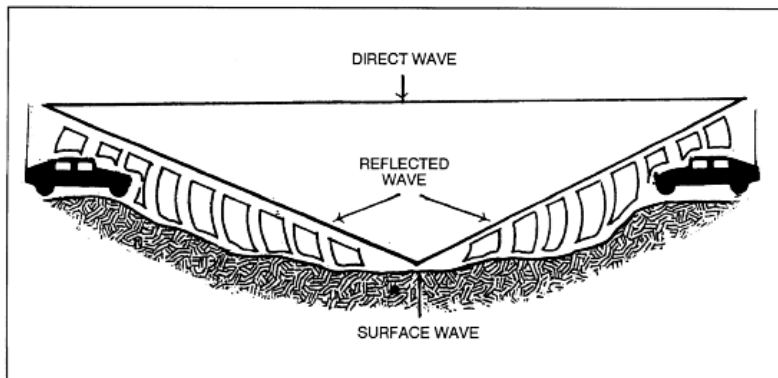

Figure: Ground Wave Propagation

Sky Wave Propagation

Sky wave propagation is preferred when the wave has to travel a longer distance. Here the wave is projected onto the sky and it is again reflected back onto the earth.
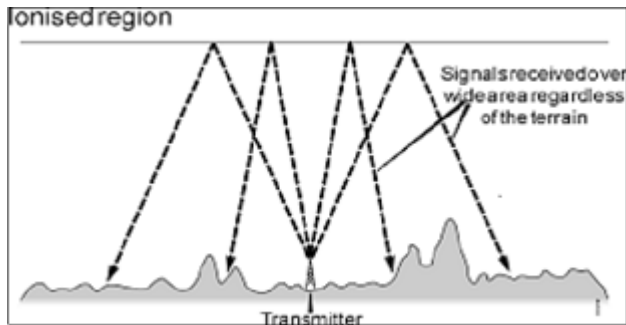

Ionised region

Signals received over wide area regardless of the terrain

Transmitter

Figure: Sky Wave

Line of Sight (LOS) Propagation

Among the modes of propagation, this line-of-sight propagation is the one, which we commonly notice. In the **line-of-sight communication**, as the name implies, the wave travels a minimum distance of sight. Which means it travels to the distance up to which a naked eye can see. Now what happens after that? We need to employ an amplifier cum transmitter here to amplify the signal and transmit again.

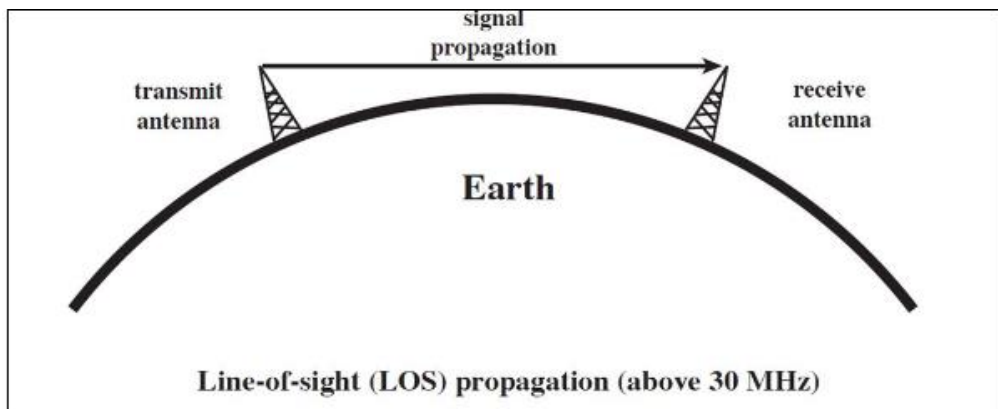This is better understood with the help of the following diagram.

signal propagation

transmit antenna

receive antenna

Earth

Line-of-sight (LOS) propagation (above 30 MHz)

Figure: Line of Sight

Types of Unguided Media

Radio waves have the longest wavelength and smallest frequency. They can travel long distances, but are not high energy waves, so they cannot penetrate through solid substances very well. This is why you might not be able to pick up a radio signal when you are driving between two mountains or when you are underground.
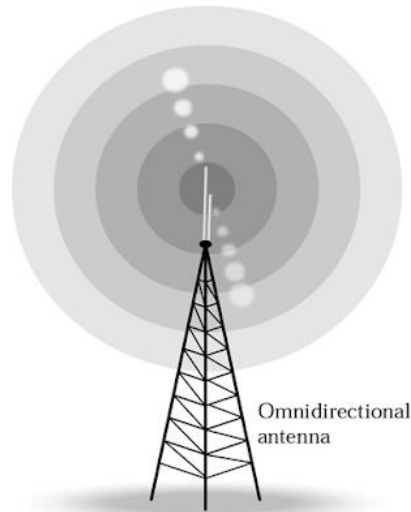

Omnidirectional
antenna

Figure: Radio Waves

Microwaves have frequencies that are higher than radio waves but lower than infrared waves. Microwaves are used for more than just cooking food, although they are great at that because they can make water molecules vibrate, heating them up very quickly. Microwaves are also used by cell phones, in radar guns that the police use to detect how fast you are driving, and by weather forecasters to predict the motion of clouds and storms.
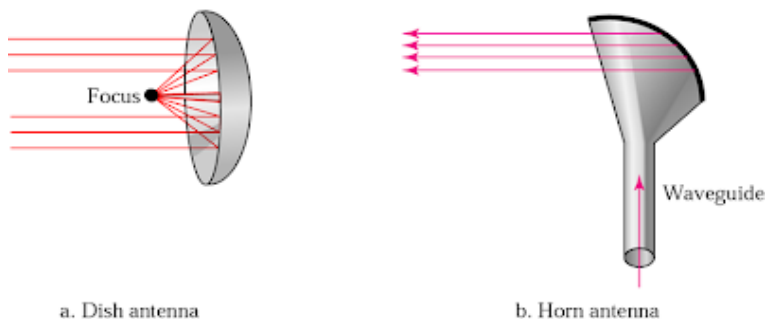

Focus

a. Dish antenna

Waveguide

b. Horn antenna

Figure: Microwaves

Infrared signals, with frequencies from 300Ghz to 4Thz, can be used for short-range communication. Infrared signals, having high frequencies never pass through walls. This is advantageous when communication systems are separated by physical walls. However we can not use infrared outside a building because the sun's rays contain infrared waves that interfere with the communication.

Figure: Infrared

Bluetooth

It is a Wireless Personal Area Network (WPAN) technology and is used for exchanging data over smaller distances. This technology was invented by Ericson in 1994. It operates in the unlicensed, industrial, scientific and medical (ISM) band at 2.4 GHz to 2.485 GHz. Maximum devices that can be connected at the same time are 7. Bluetooth ranges upto 10 meters. It provides data rates upto 1 Mbps or 3 Mbps depending upon the version. The spreading technique which it uses is FHSS (Frequency hopping spread spectrum). A bluetooth network is called piconet and a collection of interconnected piconets is called scatternet.
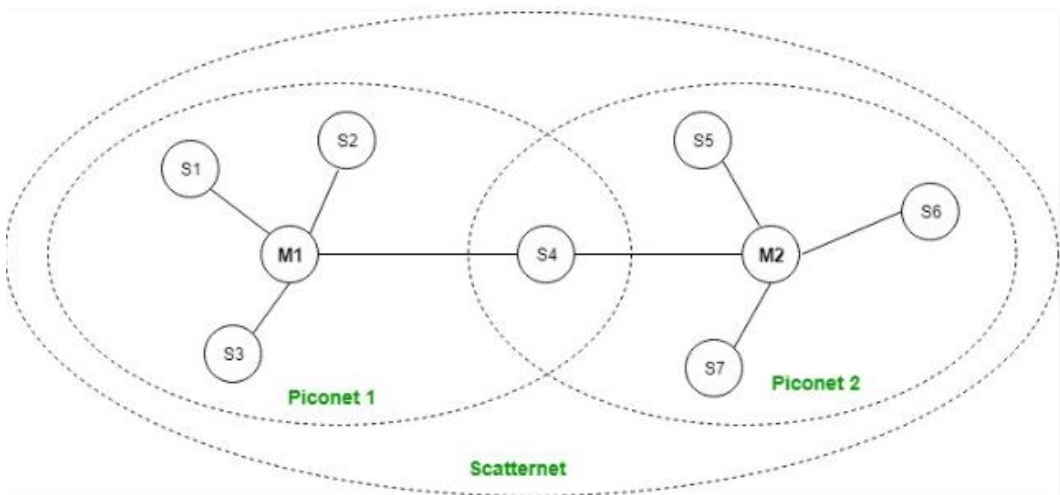
Bluetooth Architecture:

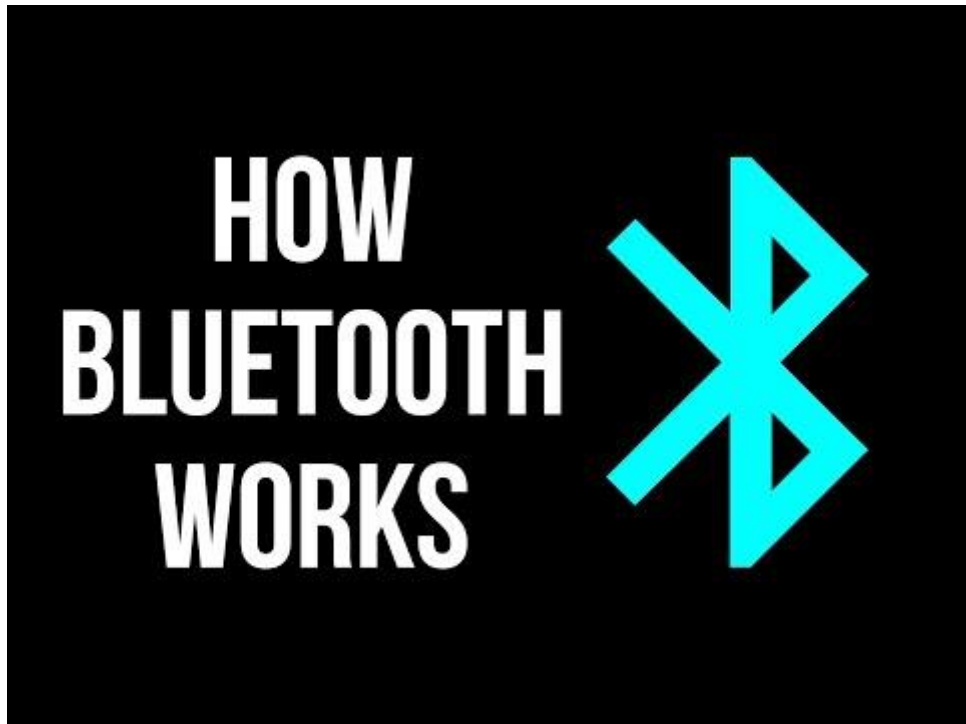**Figure:Bluetooth Architecutre**

Advantages:

- Low cost.
- Easy to use.
- It can also penetrate through walls.
- It creates an adhoc connection immediately without any wires.
- It is used for voice and data transfer.

Disadvantages:

- It can be hacked and hence, less secure.
- It has slow data transfer rate: 3 Mbps.
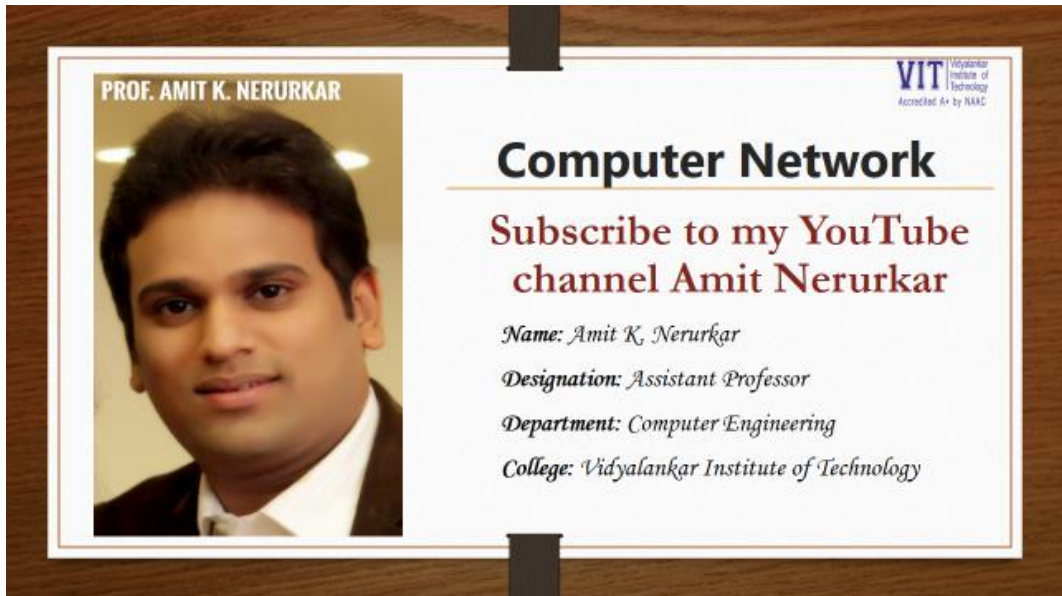- It has small range: 10 meters.

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4. https://www.tutorialspoint.com/antenna_theory/antenna_theory_types_of_propagation.htm
5. https://www.geeksforgeeks.org/bluetooth/

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