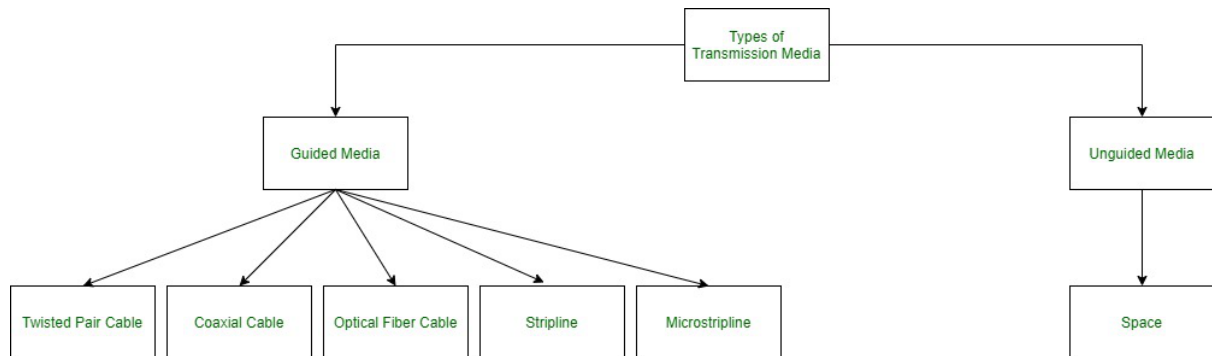


Types of Transmission Media

In data communication terminology, a transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one place to another. Transmission Media is broadly classified into the following types:



1. Guided Media: It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

- High Speed
- Secure
- Used for comparatively shorter distances

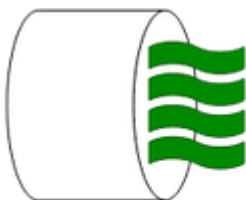
There are 3 major types of Guided Media:

(i) Twisted Pair Cable –

It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

- **Unshielded Twisted Pair (UTP):**

UTP consists of two insulated copper wires twisted around one another. This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.



Unshielded Twisted Pair

Advantages:

→ Least expensive

→ Easy to install

→ High-speed capacity

Disadvantages:

→ Susceptible to external interference

→ Lower capacity and performance in comparison to STP

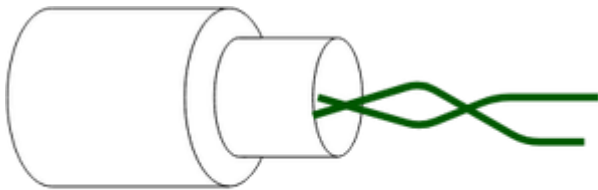
→ Short distance transmission due to attenuation

Applications:

Used in telephone connections and LAN networks

- **Shielded Twisted Pair (STP):**

This type of cable consists of a special jacket (a copper braid covering or a foil shield) to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.



Shielded Twisted Pair

Advantages:

→ Better performance at a higher data rate in comparison to UTP

→ Eliminates crosstalk

→ Comparatively faster

Disadvantages:

→ Comparatively difficult to install and manufacture

→ More expensive

→ Bulky

Applications:

The shielded twisted pair type of cable is most frequently used in extremely cold climates, where the additional layer of outer covering makes it perfect for withstanding such temperatures or for shielding the interior components.

(ii) Coaxial Cable –

It has an outer plastic covering containing an insulation layer made of PVC or Teflon and 2 parallel conductors each having a separate insulated protection cover. The coaxial cable transmits information in two modes: Baseband mode(dedicated cable bandwidth) and Broadband mode(cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.

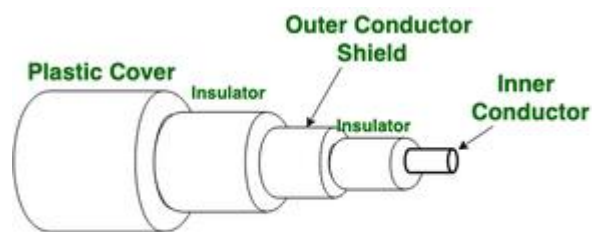


Figure of Coaxial Cable

Advantages:

- High Bandwidth
- Better noise Immunity
- Easy to install and expand
- Inexpensive

Disadvantages:

- Single cable failure can disrupt the entire network

Applications:

Radio frequency signals are sent over coaxial wire. It can be used for cable television signal distribution, digital audio (S/PDIF), computer network connections (like Ethernet), and feedlines that connect radio transmitters and receivers to their antennas.

(iii) Optical Fiber Cable –

It uses the concept of refraction of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for the transmission of large volumes of data.

The cable can be unidirectional or bidirectional. The WDM (Wavelength Division Multiplexer) supports two modes, namely unidirectional and bidirectional mode.

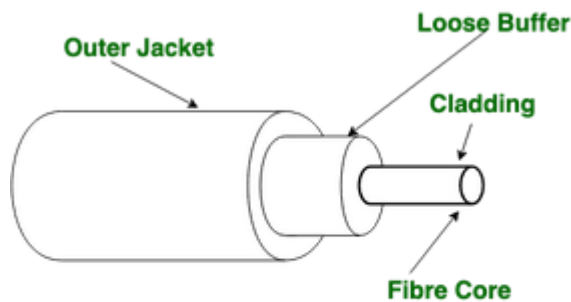


Figure of Optical Fibre Cable

Advantages:

- Increased capacity and bandwidth
- Lightweight
- Less signal attenuation
- Immunity to electromagnetic interference
- Resistance to corrosive materials

Disadvantages:

- Difficult to install and maintain
- High cost
- Fragile

Applications:

- Medical Purpose: Used in several types of medical instruments.
- Defence Purpose: Used in transmission of data in aerospace.
- For Communication: This is largely used in formation of internet cables.
- Industrial Purpose: Used for lighting purposes and safety measures in designing the interior and exterior of automobiles.

(iv) Stripline

Stripline is a transverse electromagnetic (TEM) transmission line medium invented by Robert M. Barrett of the Air Force Cambridge Research Centre in the 1950s. Stripline is the earliest form of the planar transmission line. It uses a conducting material to transmit high-frequency waves it is also called a waveguide. This conducting material is sandwiched between two layers of the ground plane which are usually shorted to provide EMI immunity.

(v) Microstripline

In this, the conducting material is separated from the ground plane by a layer of dielectric.

2. Unguided Media:

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

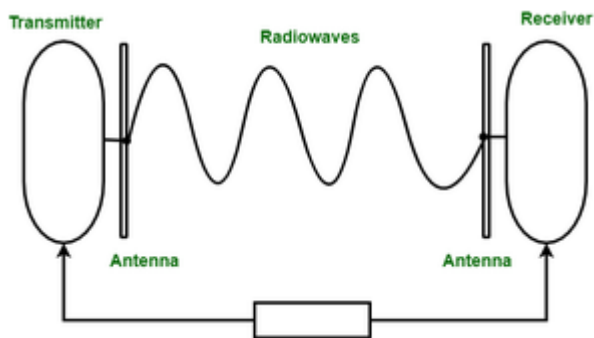
Features:

- The signal is broadcasted through air
- Less Secure
- Used for larger distances

There are 3 types of Signals transmitted through unguided media:

(i) Radio waves –

These are easy to generate and can penetrate through buildings. The sending and receiving antennas need not be aligned. Frequency Range: 3KHz – 1GHz. AM and FM radios and cordless phones use Radio waves for transmission.



Further Categorized as (i) Terrestrial and (ii) Satellite.

(ii) Microwaves –

It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range: 1GHz – 300GHz. These are majorly used for mobile phone communication and television distribution.

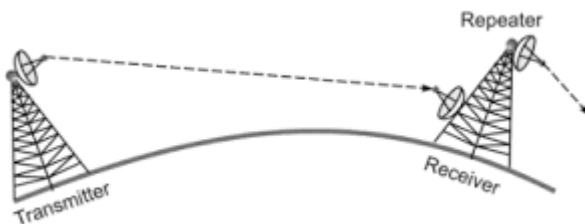
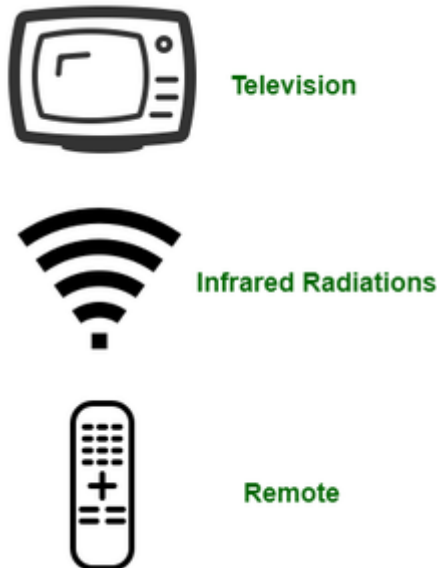


Fig: Microwave Transmission

Microwave Transmission

(iii) Infrared –

Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range:300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.



Wireless Transmission in Computer Network

Wireless transmission is a form of unguided media. Wireless communication involves no physical link established between two or more devices, communicating wirelessly. Wireless signals are spread over in the air and are received and interpreted by appropriate antennas.

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 electromagnetic spectrum can be used for wireless transmission.

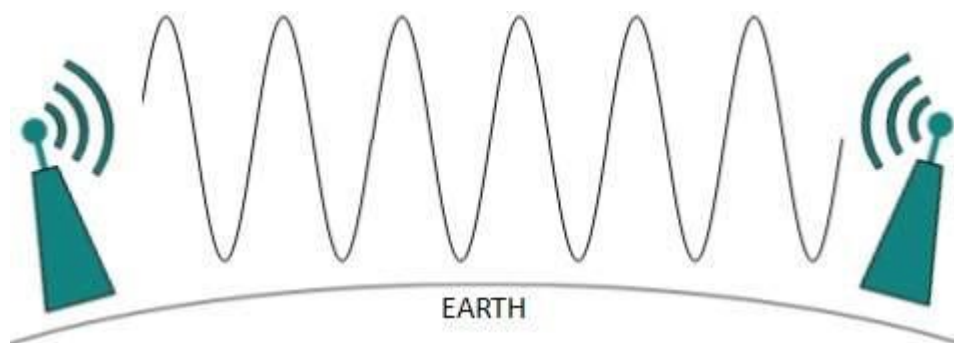


Radio Transmission

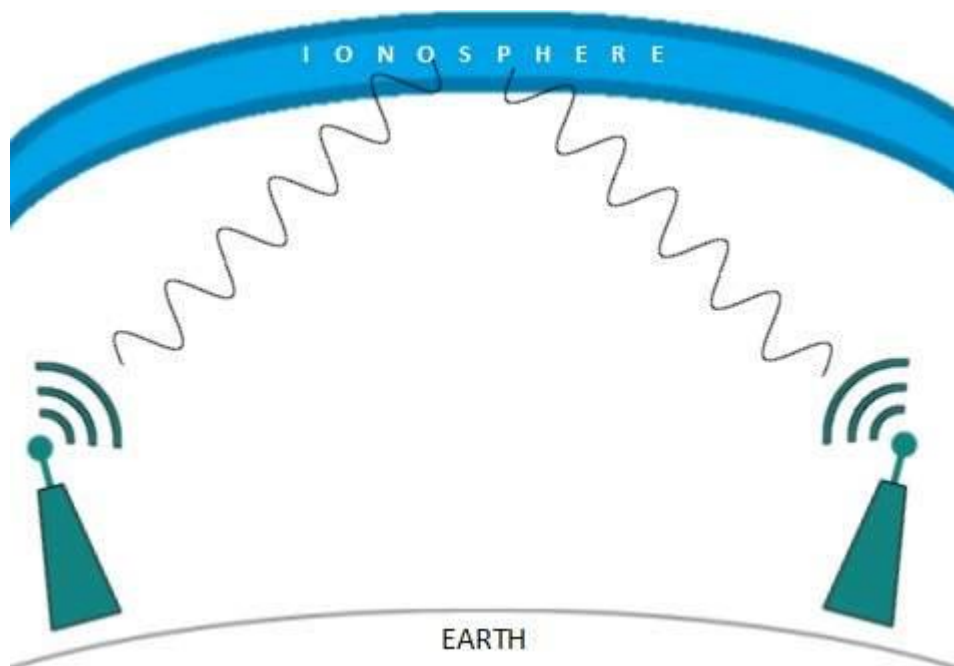
Radio frequency is easier to generate and because of its large wavelength it can penetrate through walls and structures alike. Radio waves can have wavelength from 1 mm – 100,000 km and have frequency ranging from 3 Hz (Extremely Low Frequency) to 300 GHz (Extremely High Frequency). Radio frequencies 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 kilometers, over the earth's surface.



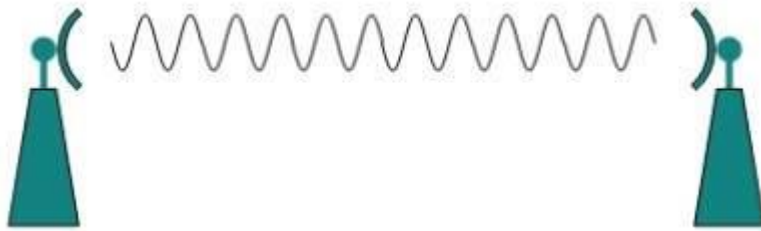
Radio waves of high frequencies are prone to be absorbed by rain and other obstacles. They use Ionosphere of earth atmosphere. High frequency radio waves such as HF and VHF bands are spread upwards. When they reach Ionosphere, they are refracted back to the earth.



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.

Infrared Transmission

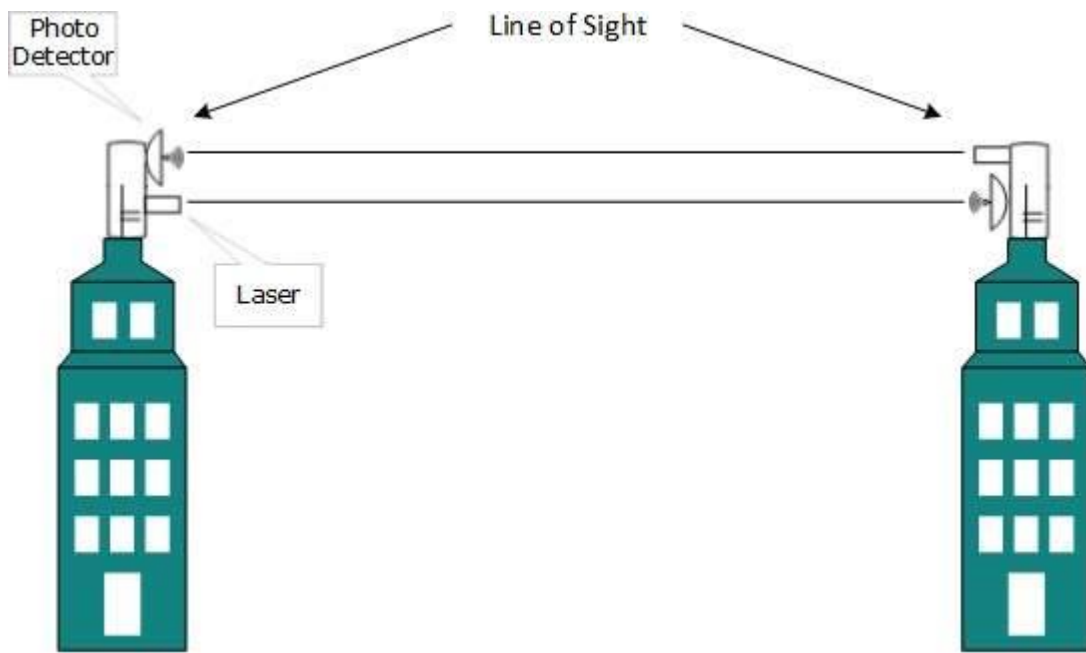
Infrared wave lies in between visible light spectrum and microwaves. It has wavelength of 700-nm to 1-mm and frequency ranges from 300-GHz to 430-THz.

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.

Light Transmission

Highest most electromagnetic spectrum which can be used for data transmission is light or optical signaling. This is achieved by means of LASER.

Because of frequency light uses, it tends to travel strictly in straight line. Hence the sender and receiver must be in the line-of-sight. Because laser transmission is unidirectional, at both ends of communication the laser and the photo-detector needs to be installed. Laser beam is generally 1mm wide hence it is a work of precision to align two far receptors each pointing to lasers source.



Laser works as Tx (transmitter) and photo-detectors works as Rx (receiver).

Lasers cannot penetrate obstacles such as walls, rain, and thick fog. Additionally, laser beam is distorted by wind, atmosphere temperature, or variation in temperature in the path.

Laser is safe for data transmission as it is very difficult to tap 1mm wide laser without interrupting the communication channel.