

UNIT-1::Part-2

Physical Layer

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Syllabus

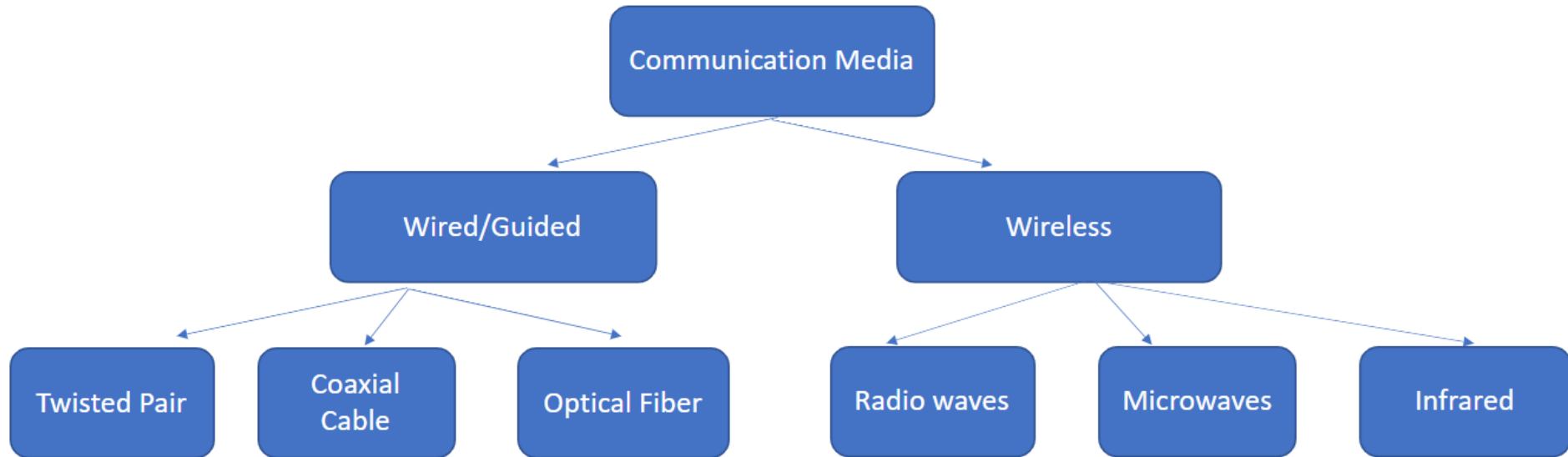
Physical Layer:

- **Guided Transmission Media**
- **Wireless transmission**
- **Mobile telephone system.**

Guided Transmission Media

Transmission Media

- Transmission media, or communication channels or communication lines, refer to the **physical media through which data is transmitted from one device to another.**
- They are used to establish communication between two or more devices.
- It allows them to exchange information and data.
- Types of Transmission Media
 - **Guided Transmission Media (Wired Transmission)**
 - **Unguided Transmission Media (Wireless Transmission)**



Guided Transmission Media

- Guided Transmission Media, also known as **Wired or Bounded transmission media**, is the physical medium through which the signals are transmitted.
- The transmitted signals are directed and confined in a narrow pathway using physical links.
- It provides us with features like **higher speeds, and better security** and is used preferably for comparatively **shorter distances**.
- There are three types of Guided Transmission Media:
 - **Twisted Pair cable**
 - **Coaxial cable**
 - **Fibre Optic Cable**

Twisted-Pair Cables

Twisted-Pair Cables

→ Twisted-Pair Cables are cables consisting of **two insulated conductor wires** (typically copper) wound and twisted together arranged in a regular spiral pattern.

- ◆ **One wire** carries the signal to the receiver.

- ◆ **Other Wire** is used as a ground reference.

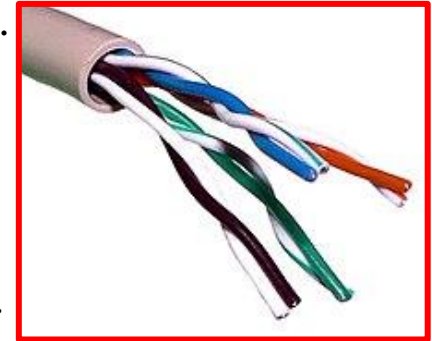
→ A twisted pair cable is **cheap** as compared to other transmission media.

→ Installation of the twisted pair cable is easy, and it is a lightweight cable.

→ Types:

- ◆ **Unshielded Twisted Pair Cable**

- ◆ **Shielded Twisted Pair Cable**



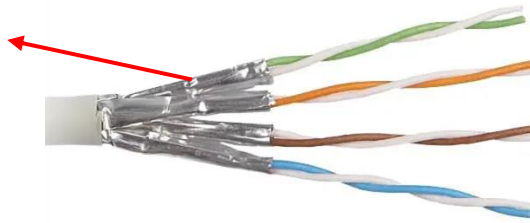
1. Unshielded Twisted Pair Cable



- UTP consists of 4 pairs of color-coded wires twisted around each other.
- The wires are twisted to prevent electromagnetic interference (EMI) and crosstalk between adjacent pairs.
- UTP is a type of copper cable commonly used for **networking and telecommunications**.
- The term "**unshielded**" means that UTP cables *do not have an overall metallic shield or foil layer to protect the twisted pairs from external interference*.
- Instead, each pair of wires is individually insulated, and the twisting of the pairs helps to cancel out electromagnetic interference.

2. Shielded Twisted Pair Cable

Metallic Shield

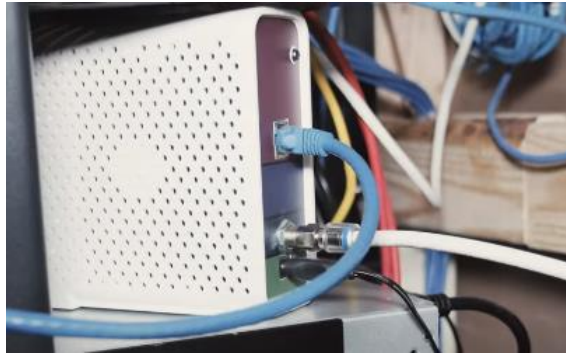


- Shielded twisted pair (STP) is a type of copper cable that is used for **networking and telecommunications**.
- It is similar to unshielded twisted pair (UTP) but *includes an additional metallic shield or foil layer around the individual twisted pairs*.
- The primary purpose of the shielding is to provide protection against electromagnetic interference (EMI) or Cross talks that can degrade the quality of data transmission.

Ethernet Categories

Category	Shielding	Max Transmission Speed
Cat 3	Unshielded	10 Mbps
Cat 5	Unshielded	100 Mbps
Cat 5e	Unshielded	1 Gbps
Cat 6	Unshielded or Shielded	1 Gbps
Cat 6a	Shielded	10 Gbps
Cat 7	Shielded	10 Gbps
Cat 8	Shielded	Upto 40 Gbps

- The difference between these categories is **the maximum speed** they can handle without having any crosstalk(interference).
- The number represents the **tightness of the twists** that are applied to the wire



Coaxial Cable



- Coaxial cable is a type of cable commonly used in networks, particularly for
 - **Cable television (CATV)**
 - **Broadband Internet**
- It consists of *a central conductor wire surrounded by a dielectric insulating material, which is further enclosed by a braided metal shield and an outer protective sheath.*
- The combination of these layers makes coaxial cable suitable for transmitting **high-frequency signals with minimal interference**
- Two kinds of coaxial cable are widely used.
 - One kind, **50-ohm cable**, is commonly used when it is intended for **digital transmission.**
 - The other kind, **75-ohm cable**, is commonly used for **analog transmission and cable television.**
- In the mid-1990s, cable TV operators began to provide Internet access over cable, which has made 75-ohm cable more important for data communication.

- A coaxial cable consists of a **stiff copper wire** as **the core**, surrounded by **an insulating material**.
- The insulator is encased by a **cylindrical conductor**, often as a closely woven **braided mesh**.
- The **outer conductor** is covered in a protective **plastic sheath**.

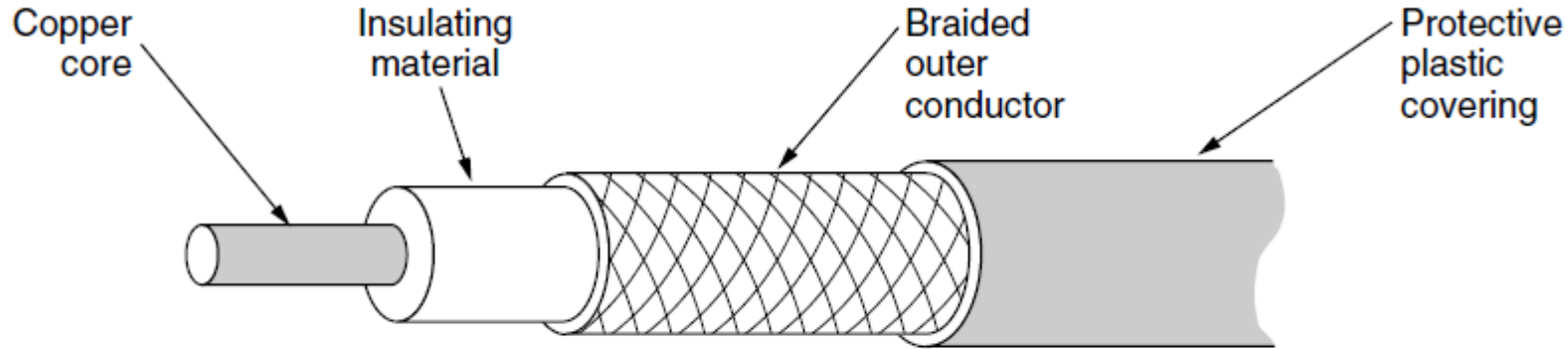
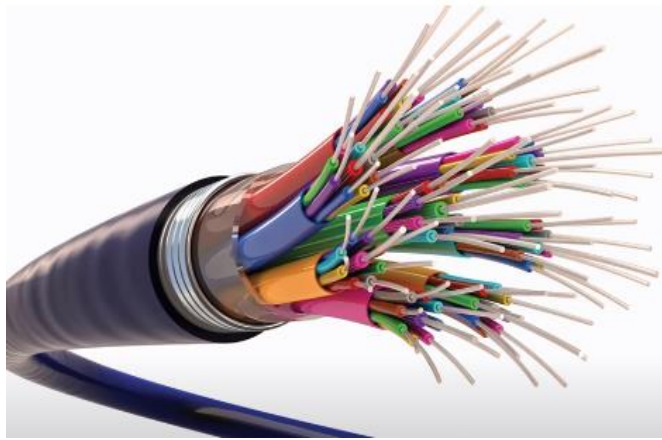
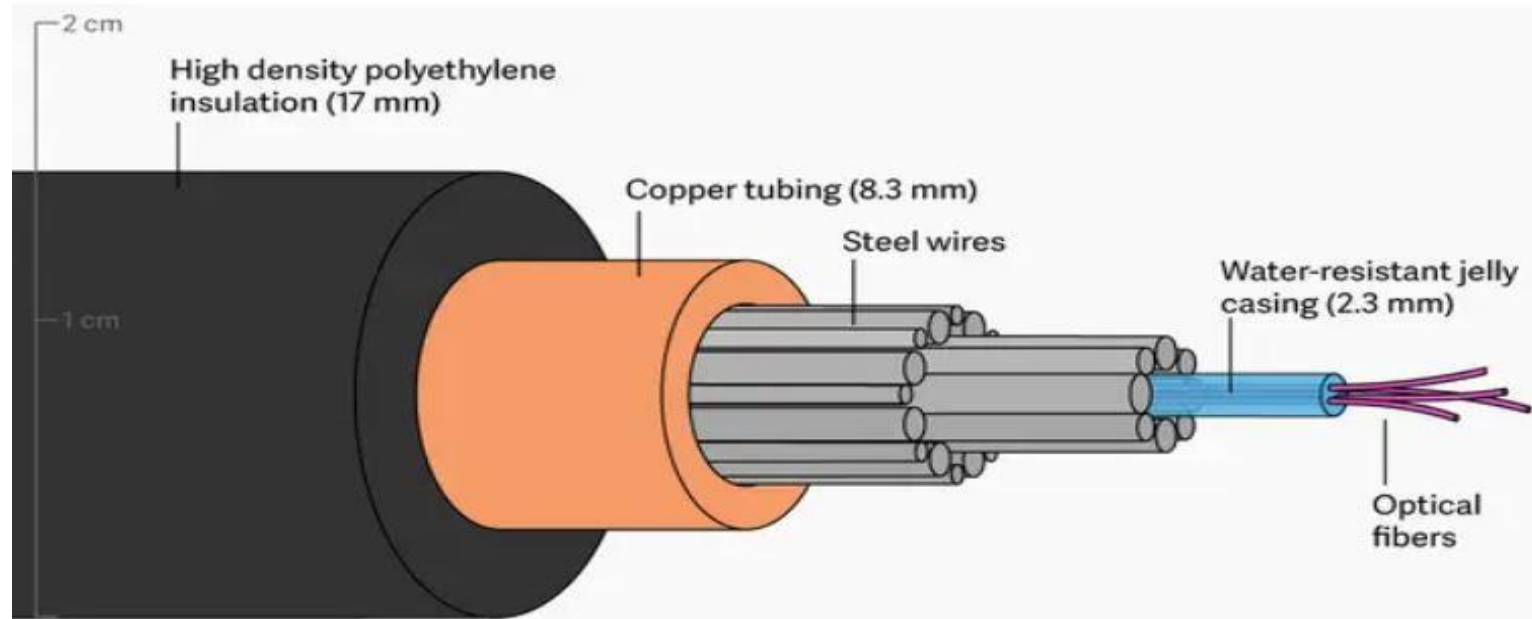


Figure 2-4. A coaxial cable.



Fiber Optics

- Fiber optic cables are a type of transmission media that use **thin strands of glass or plastic fibers** to transmit data as pulses of light.
- They provide **high-speed, long-distance, and secure communication** for various applications, including telecommunications, networking, and data transmission.



- Fiber optic cables are similar to coax, except without the braid. Figure 2-8(a) shows a single fiber viewed from the side.
- At the center is the glass core through which the light propagates.
- In **multimode fibers**, the core is typically **50 microns in diameter**, about the thickness of a human hair. In **single-mode fibers**, the core is **8 to 10 microns**.

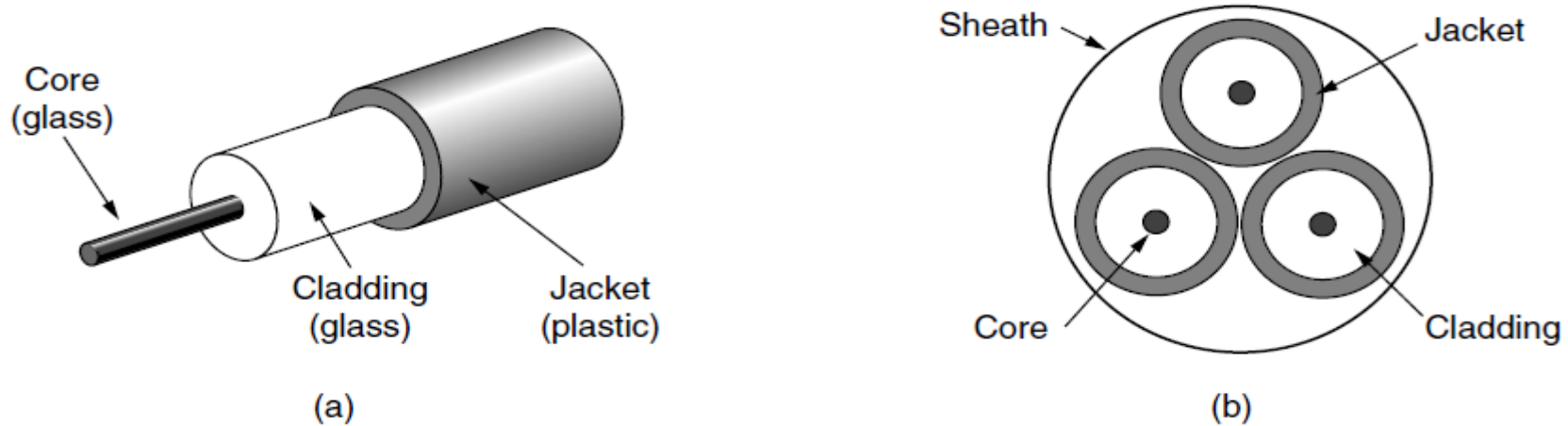
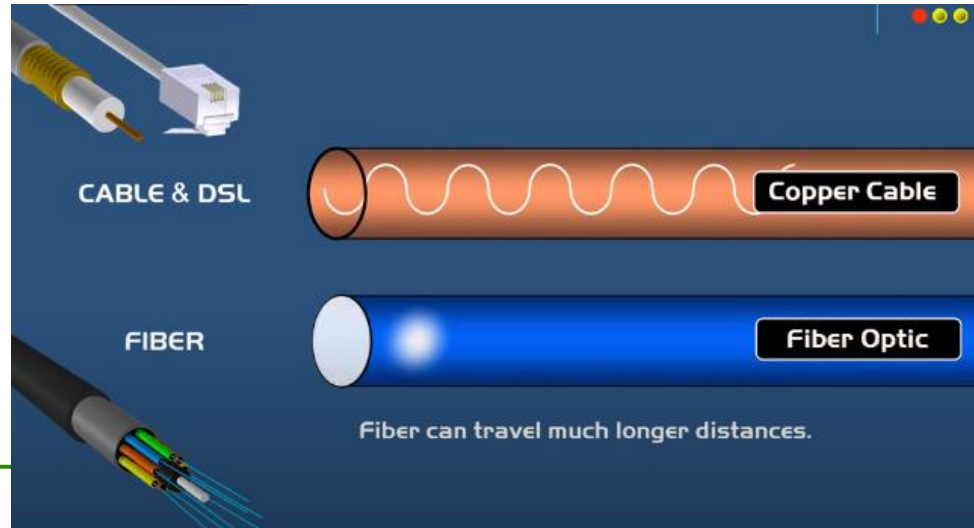


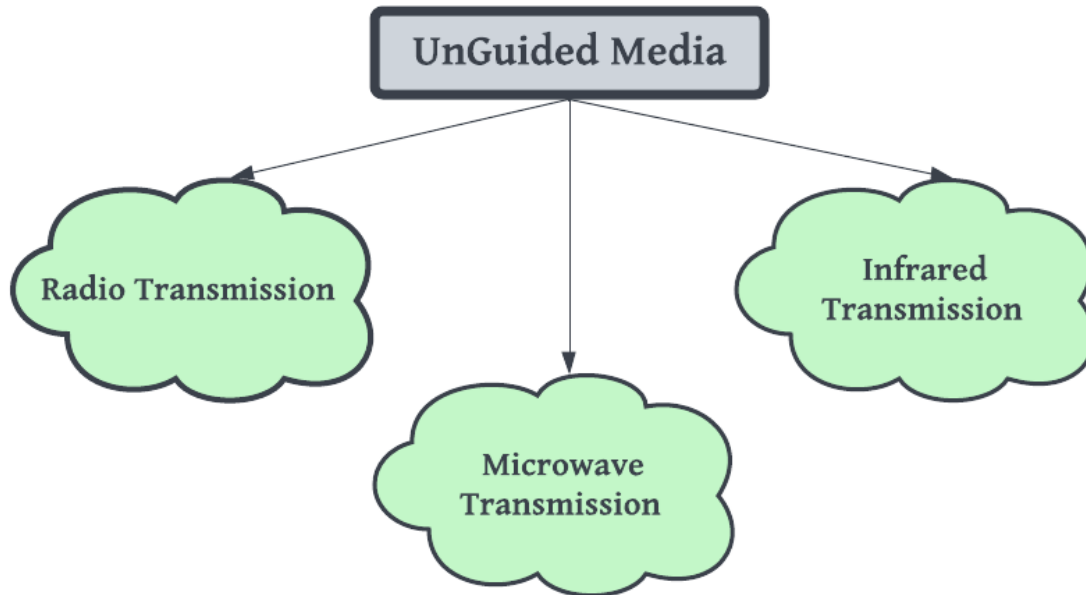
Figure 2-8. (a) Side view of a single fiber. (b) End view of a sheath with three fibers.

- The core is surrounded by a glass cladding with a lower index of refraction than the core, to keep all the light in the core.
- Next comes a thin plastic jacket to protect the cladding.
- Fibers are typically grouped in bundles, protected by an outer sheath. Figure 2-8(b)(Previous Slide) shows a sheath with three fibers.

Differences between cables and Fiber Optics



Wireless transmission medium



- Wireless transmission media, also known as unguided media, enable **the transmission of data without the use of physical cables.**
- These media use **electromagnetic waves or light** to carry signals through **the air or space.**
- 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.

Features:

- ★ **The signal is broadcasted through air**
- ★ **Used for larger distances**
- ★ **Unguided signals can travel in several ways:**
 - **Ground propagation**
 - **Sky propagation**
 - **Line-of-sight propagation**

Radio Transmission

- Radio frequency (RF) waves are easy to generate, **can travel long distances, and can penetrate buildings easily.**
- So they are widely used for communication, both indoors and outdoors.
- Radio waves also are **omnidirectional**, meaning that they travel in all directions from the source
- Radio waves can have
 - **Wavelength from 1 mm – 1,00,000 km**
 - **Frequency ranging from 3 Hz (Extremely Low Frequency) to 300 GHz (Extremely High Frequency).**
- Lower frequencies such as **VLF (Very Low Frequency), LF (Low Frequency), MF (Medium Frequency) bands** can travel **on the ground up to 1000 kilometers, over the earth's surface.**

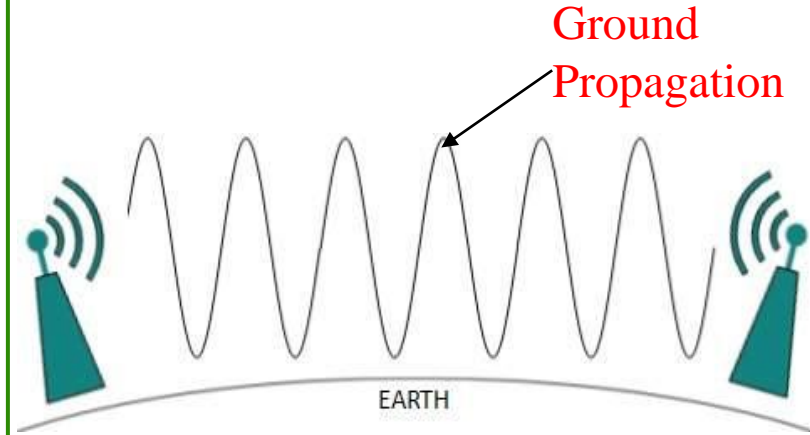


Fig: In the VLF, LF, MF bands, Radio waves follow the curvature of the Earth

Radio Transmission

- 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(High Frequency)** and **VHF(Very High Frequency)** bands are spread upwards.
- When they reach Ionosphere, they are refracted back to the earth.

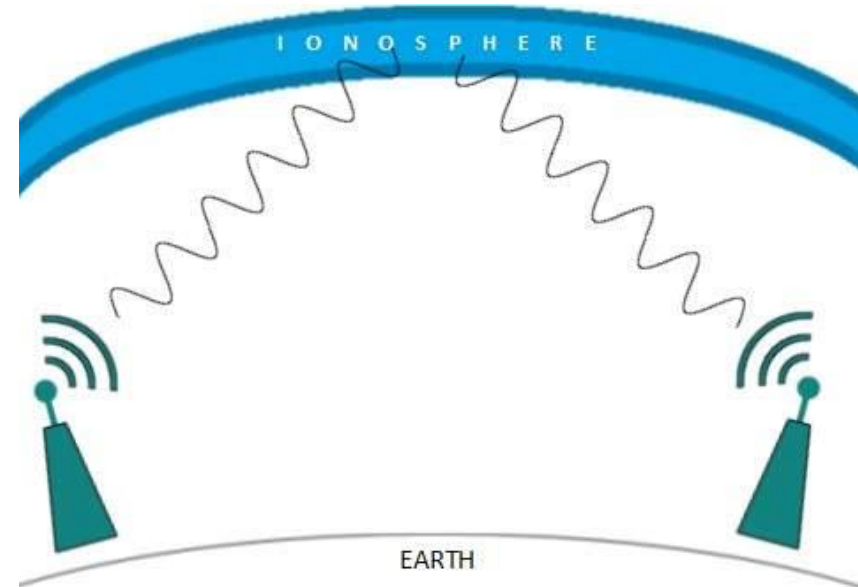


Fig: In HF,VHF bands, Radio Waves bounce off the Ionosphere

Advantages of Radio Waves

- Radio waves are **omnidirectional** (propagated in all directions).
- It can penetrate walls.

Radio Waves Uses:

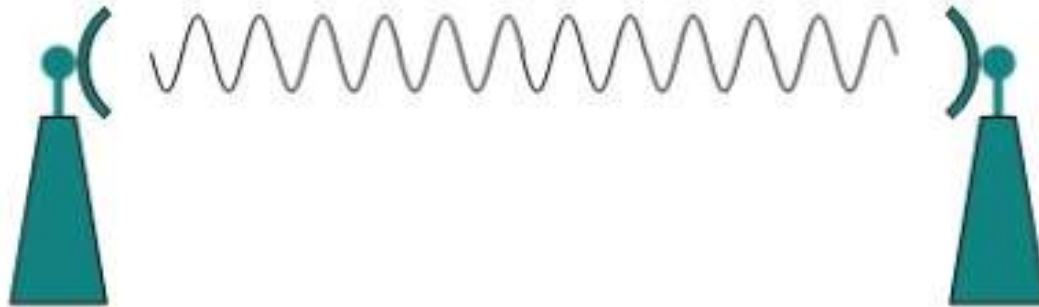
- FM radio
- Television
- Cellular Phones
- Wi-Fi



Omnidirectional

Microwave Transmission

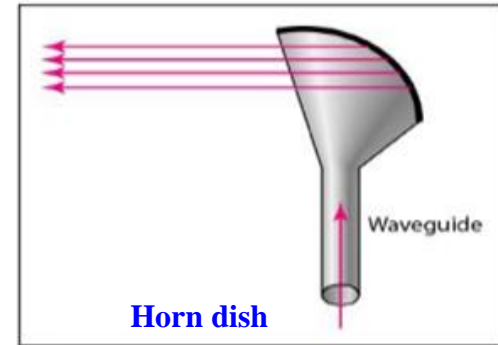
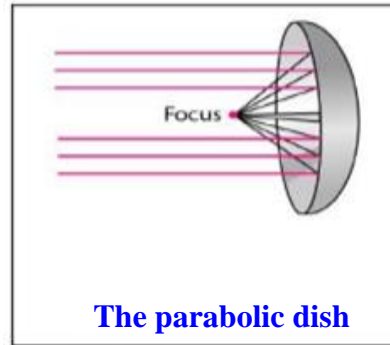
- Microwaves have **higher frequencies and shorter wavelengths** than **radio waves**.
- Microwaves are a form of electromagnetic radiation with wavelengths ranging from about **one millimeter to one meter (1mm to 1 m)**.
- Electromagnetic waves from frequencies between **1 GHz to 300 GHz** are called microwaves.



Unidirectional

Microwave Transmission

- Microwaves are **unidirectional**. The sending and receiving antennas need to be aligned.
- Microwaves need unidirectional antennas that send out signals in **one direction**.
- Two types of antennas are used for microwave communications:
 - The parabolic dish
 - The horn



- Microwave transmission uses **a line of sight propagation**.

Line-of-sight (LOS) transmission in the context of microwave communication refers to a direct and unobstructed path between the transmitting and receiving antennas.

For a successful line-of-sight communication, there should be a clear and straight line between the two antennas without any physical barriers or obstacles.

Advantages of Microwaves:

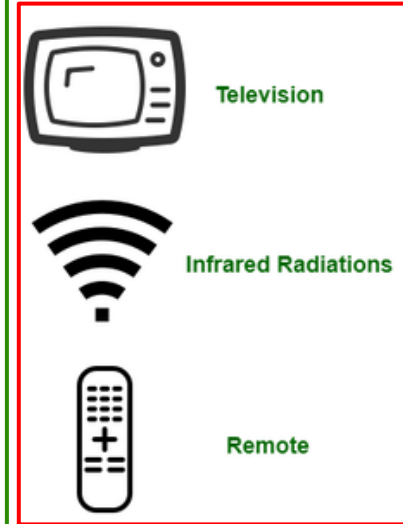
- Microwaves are unidirectional (sending and receiving antennas need to be aligned).
- It propagation is line-of-sight (the sending and receiving antennas need to be properly aligned with each other.)

Example of Microwaves

- Cellular phones
- Satellite networks
- Wireless LAN

Infrared Transmission

- Infrared waves are used for **very short distance communication**.
- Infrared waves, **having high frequencies, cannot penetrate walls**.
- This advantageous characteristic **prevents interference** between one system and another; a short range communication system in one room cannot be affected by another system in the next room
- Frequency Range: 300 GHz – 400 THz.
- **It is used in TV remotes, wireless mouse, keyboard, printer, etc.**
- Infrared radiation (IR), is electromagnetic radiation (EMR) with longer wavelengths than those of visible light, and **invisible to the human eye**.



Advantages of Infrared

- Infrared waves is used for short distance communication having high frequencies.
- Cannot penetrate walls.

Examples of Infrared Waves

- Burning charcoal
- Heat from an electric heater

Applications of Infrared

- Infrared Data Association (IrDA) is used for communication between devices such as PCs, keyboards, mice, and printers. IrDA port allows wireless keyboard to communicate with a computer.

Mobile telephone system

Assignment Topic