

# **Data Communication Medium**

# Data Transmission Media

- Data Transmission occurs between sender and receiver over some Transmission Medium or Transmission Media.
- Transmission Media may be classified into **Two Types** :
  - i) **Guided Media [Wired Technology]**
  - ii) **Unguided Media [Wireless Technology]**

## i) Guided Media (Wired Network)

- In Guided Media Signals are Passed in a “ same physical path”
- Example:
  - i) Twisted pair Cable
  - ii) Coaxial Cable
  - iii) Fiber Optic Cable

## ii) Unguided Media (Wireless Network)

- In Unguided Media Signals are Passed in the form of “ **Electromagnetic Waves**”
- Example :
  - i) Mobile phones
  - ii) Satellite microwave
  - iii) Infrared

# Transmission Media

The physical path between transmitter and receiver.

- **Repeaters or amplifiers** may be used to extend the length of the medium.
- Communication of electromagnetic waves is *guided* or *unguided*.

# Data Transmission Channel

## Guided Channels

Twisted pair cable

Coaxial Cable

Optical Fibre

## Unguided Channels

Radio waves

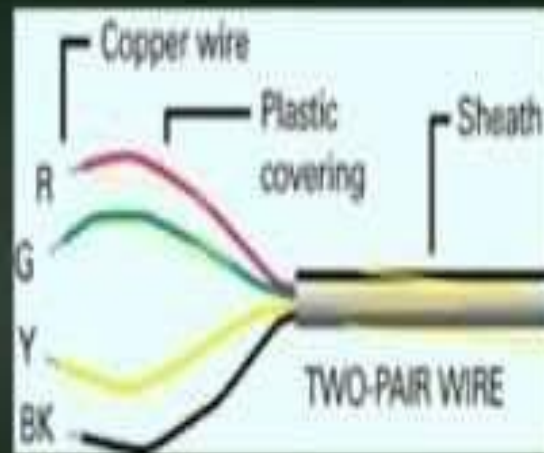
Micro waves

Infrared

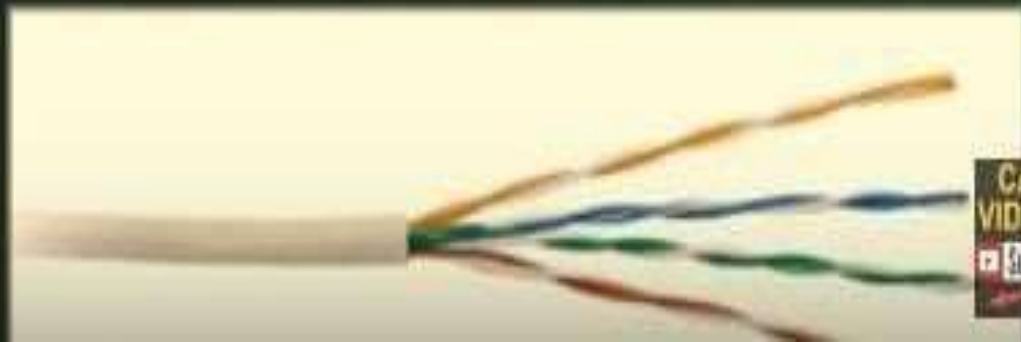
## Guided Media

- Guided media provide a physical connection using wire or cable between two devices.
- A signal traveling through guided media is directed and contained within the physical limits of the medium

## Twisted pair cable

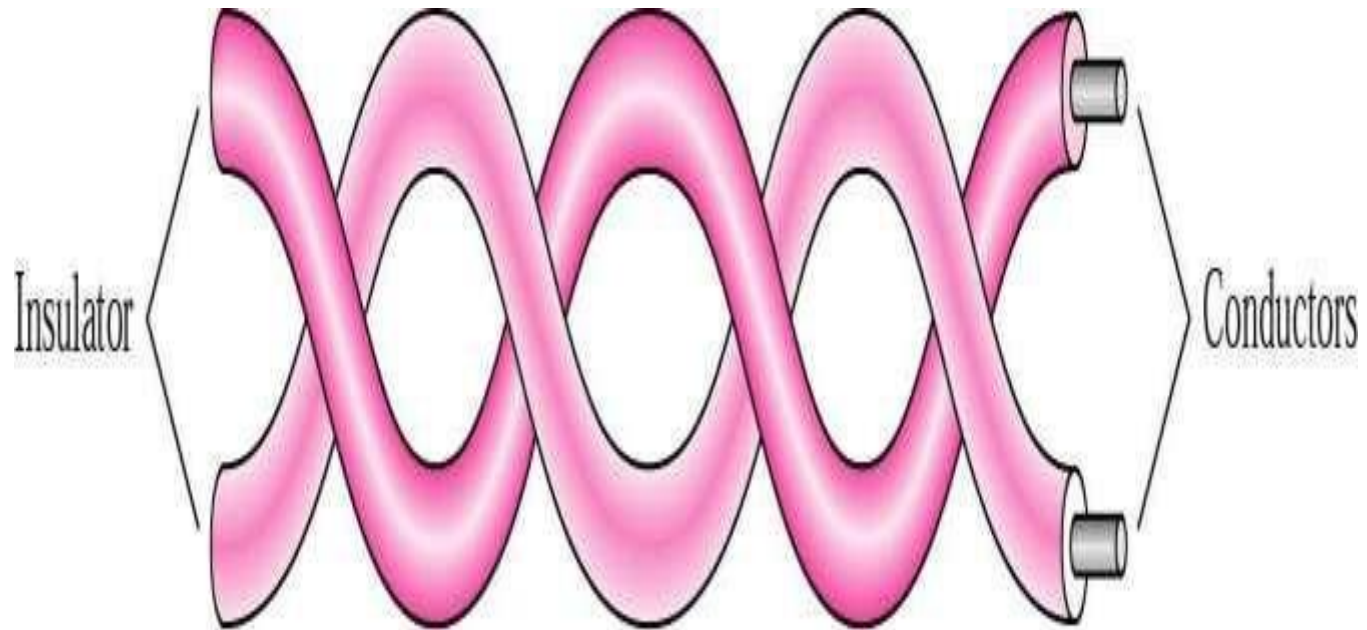


- This cable is the most commonly used and is **cheaper** than others.
- It is **lightweight, cheap, can be installed easily**, and they support **many different types of network**.
- A twisted pair cable **consists of two conductors** which are normally **made of copper**.
- Each conductor has its **own plastic insulation typically 1 mm thick**.
- These cables are twisted together.

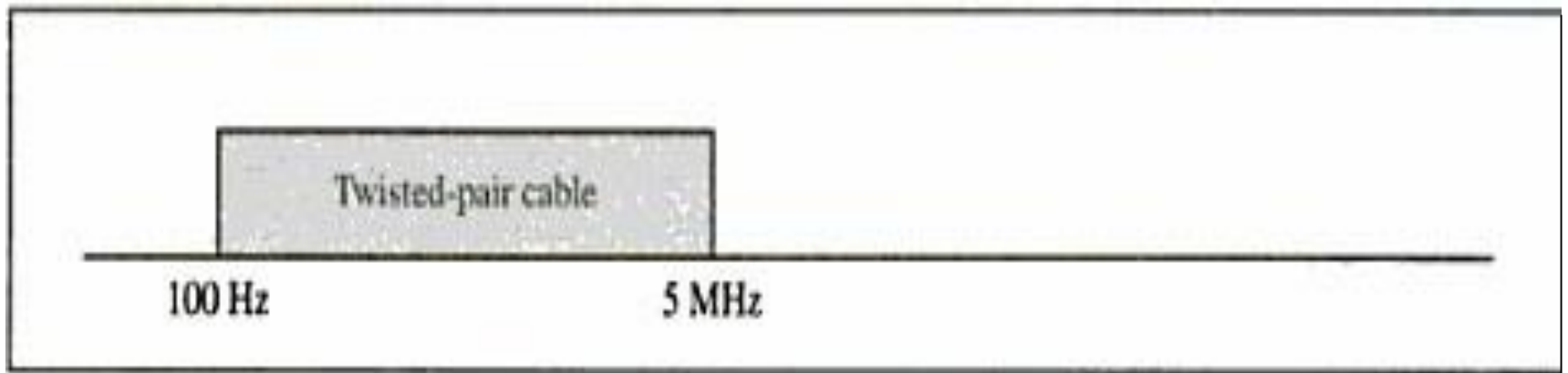
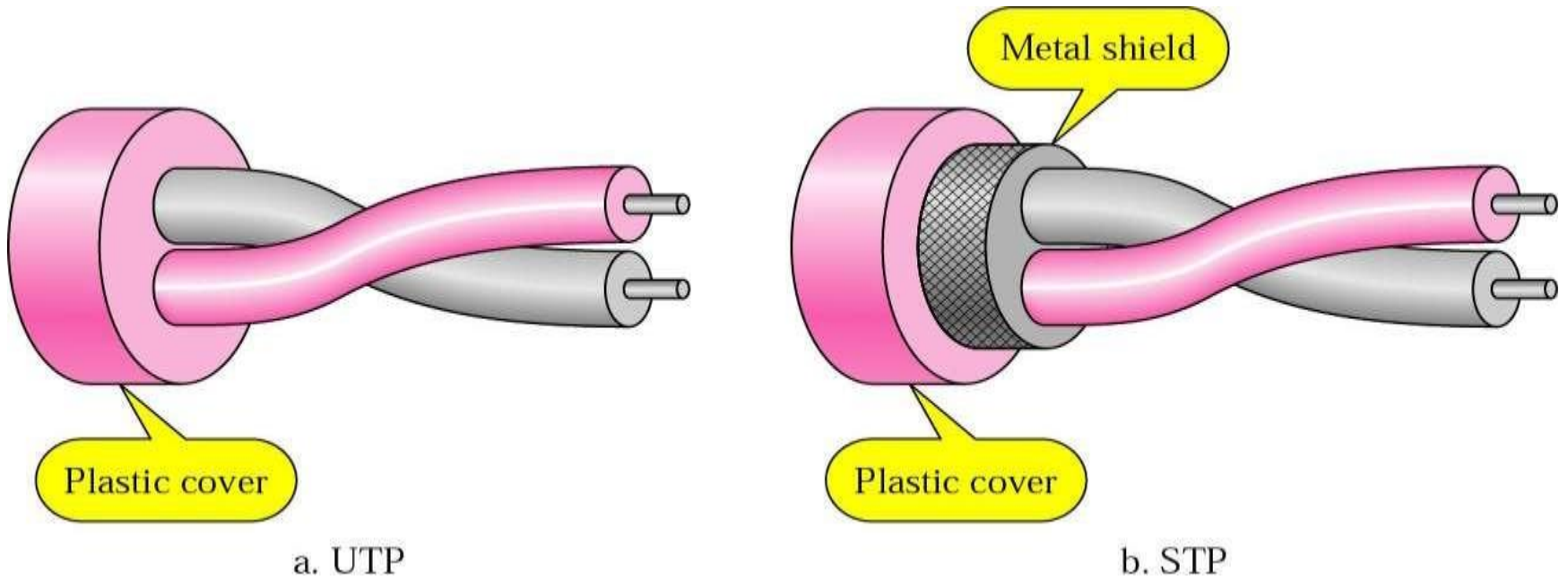




# Twisted-pair cable

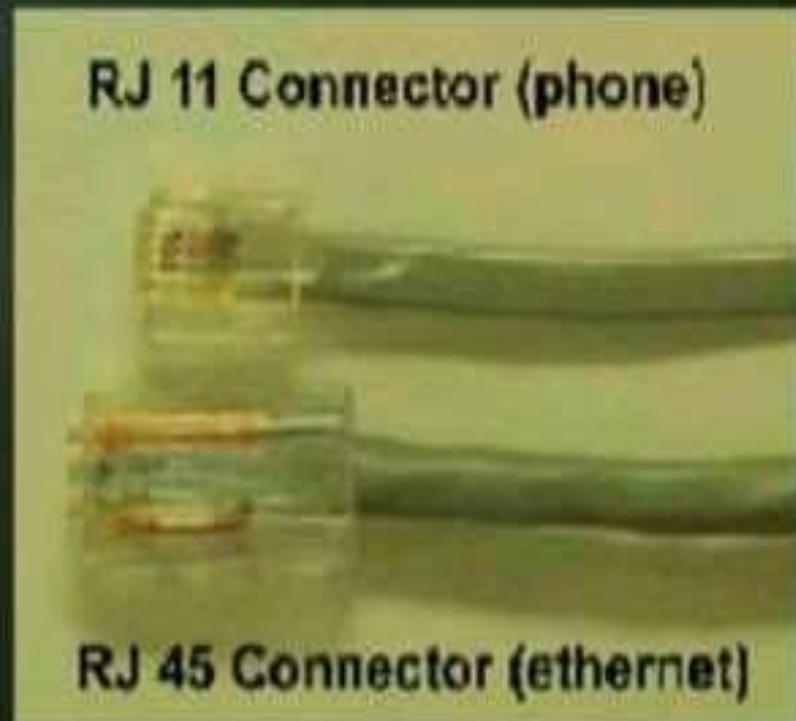


# *UTP and STP*



## Unshielded Twisted Pair Cable

- It is the most common type of telecommunication which consists of two conductors usually copper, each with its own colour plastic insulator.



RJ 11 Connector (phone)

RJ 45 Connector (ethernet)

- Identification is the reason behind coloured plastic insulation.
- UTP cables consist of 2 or 4 pairs of twisted cable. Cable with 2 pair use RJ-11 connector and 4 pair cable use RJ-45 connector.

## Advantages :

- Installation is easy
- Flexible
- Cheap
- It has high speed capacity,
- 100 meter limit
- Higher grades of UTP are used in LAN technologies like Ethernet

## Disadvantages :

- Bandwidth is low when compared with Coaxial Cable
- Provides less protection from interference.

## Shielded Twisted Pair Cable

- This cable has a metal foil or braided-mesh covering which encases each pair of insulated conductors.



- Electromagnetic noise penetration is prevented by metal casing.
- Shielding also eliminates crosstalk
- It is faster than the unshielded and coaxial cable.
- It is more expensive than coaxial and unshielded twisted pair.

### Advantages :

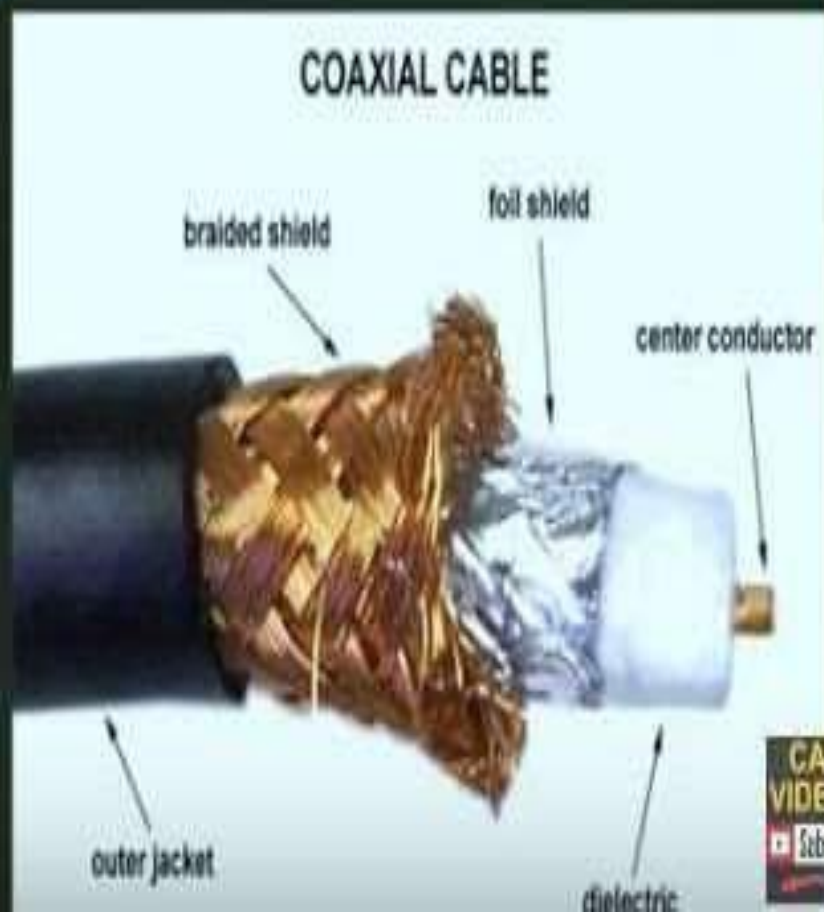
- Easy to install
- Performance is adequate
- Can be used for Analog or Digital transmission
- Increases the signalling rate
- Higher capacity than unshielded twisted pair
- Eliminates crosstalk

## Disadvantages :

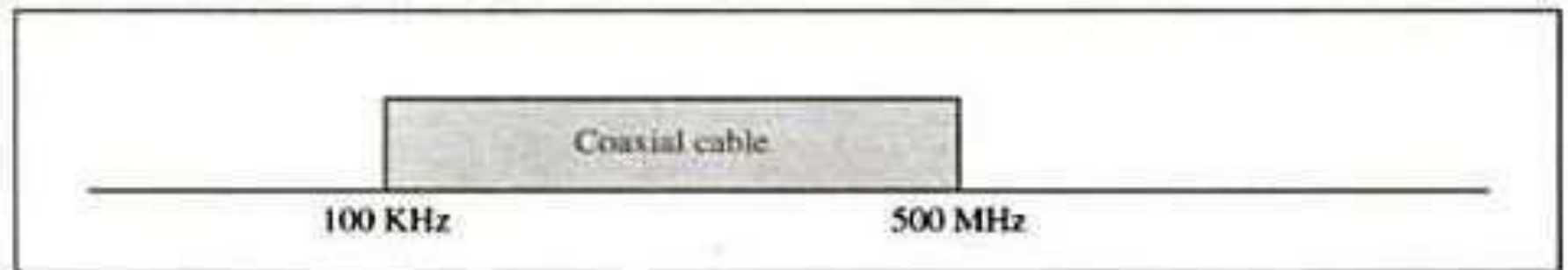
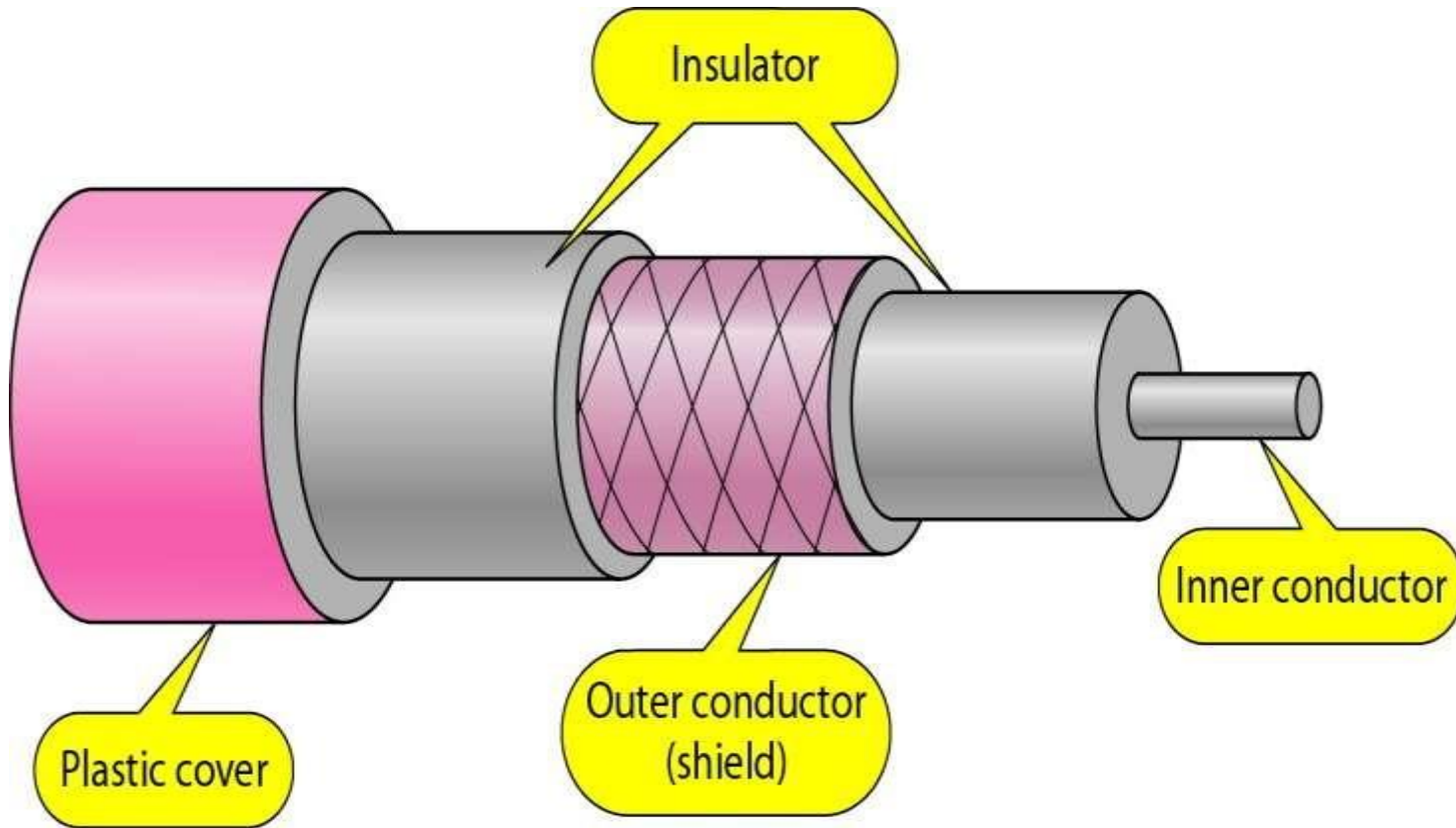
- Difficult to manufacture
- Heavy

## Coaxial Cable

- Copper is used in this as centre conductor which can be a solid wire or a standard one.
- It is surrounded by PVC installation, a sheath which is encased in an



# Coaxial Cable





outer conductor of metal foil, braid or both.

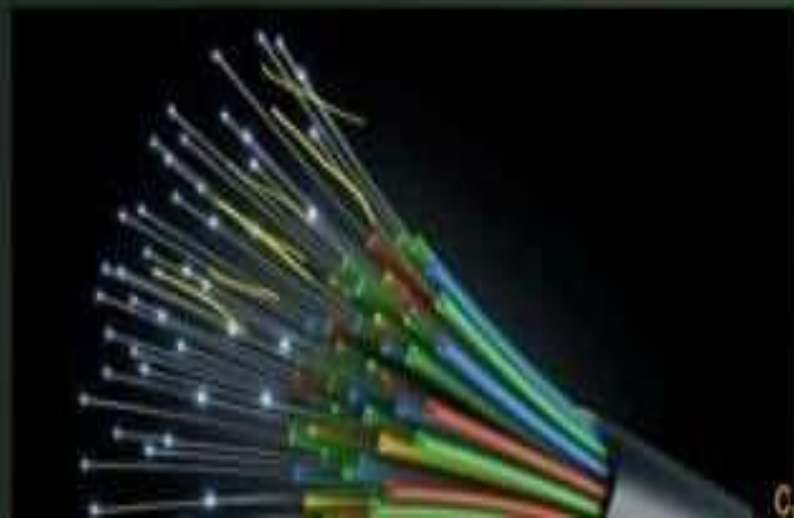
- Outer metallic wrapping is used as a shield against noise and as the second conductor which completes the circuit.
- The outer conductor is also encased in an insulating sheath.
- The outermost part is the plastic cover which protects the whole cable.

### Advantages :

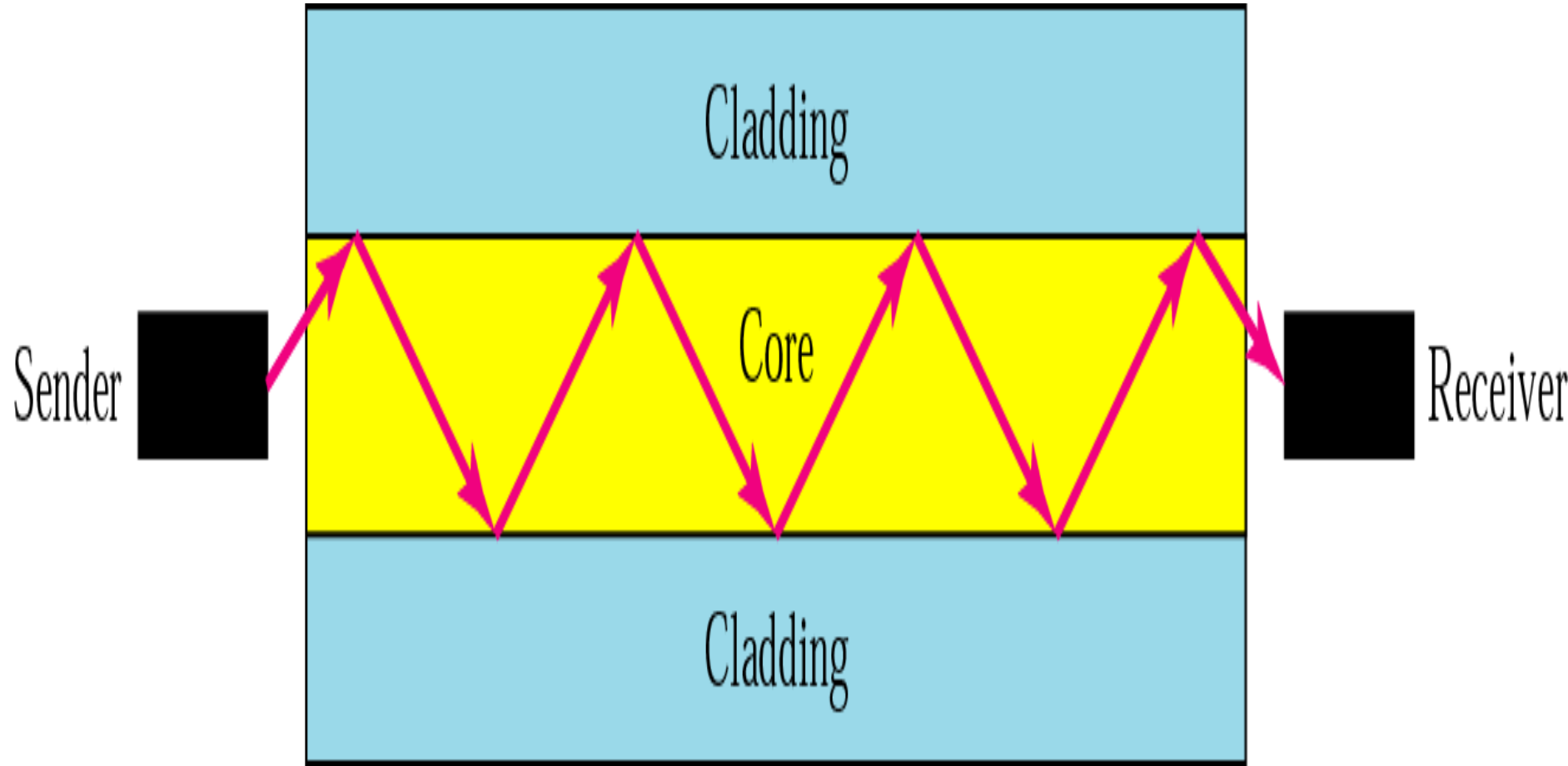
- Bandwidth is high
- Used in long distance telephone lines.
- Transmits digital signals at a very high rate of 10Mbps.
- Much higher noise immunity

## Optical Fibre

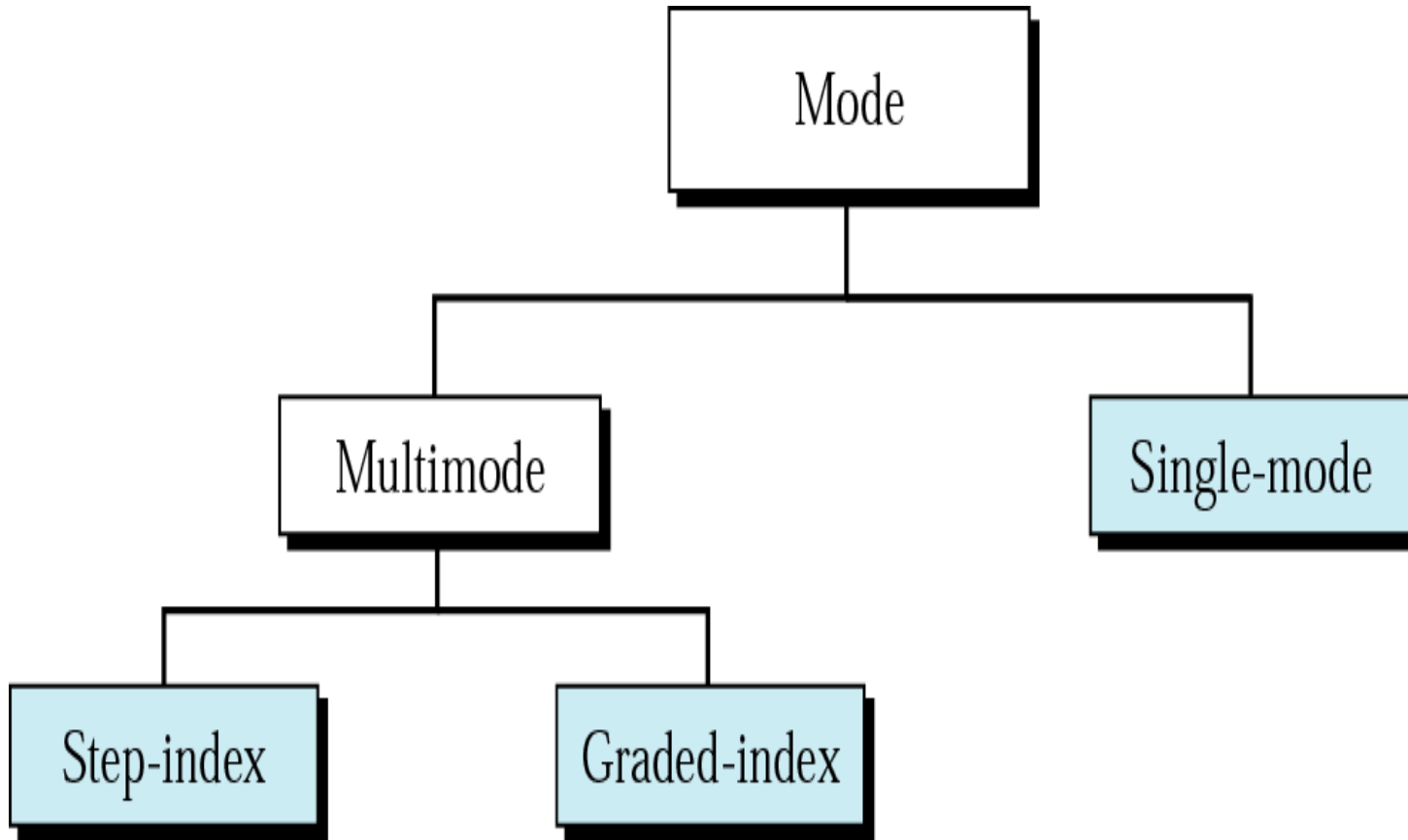
- A technology that uses glass (or plastic) threads (fibres) to transmit data.
- A fibre optic cable consists of a bundle of glass threads, each of which is capable of transmitting messages modulated onto light waves.
- Fibre optic cable has bandwidth more than 2 gbps (Gigabytes per Second)



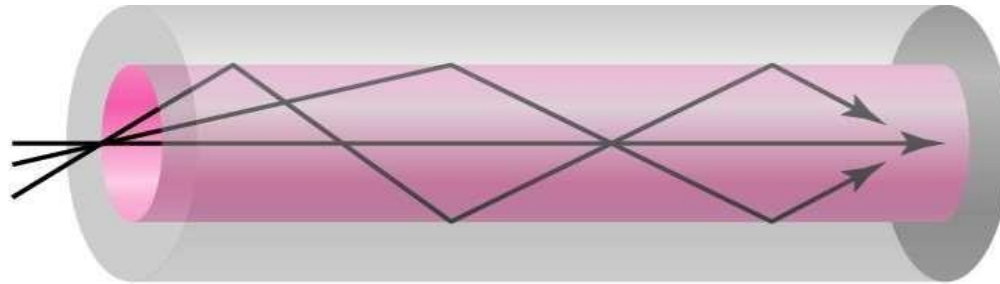
# Optical fibers



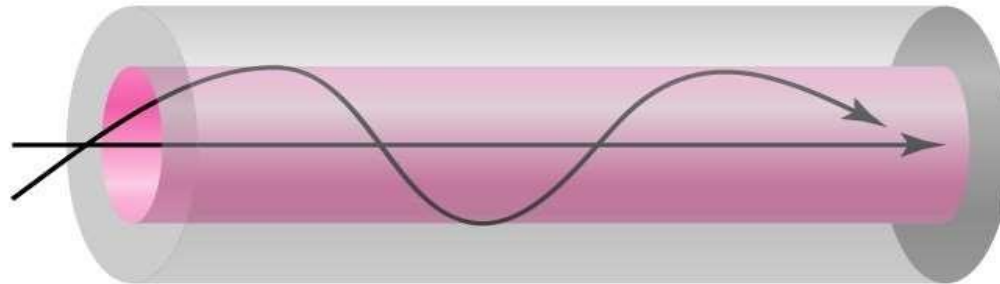
# Propagation Modes (Types of Optical Fiber )



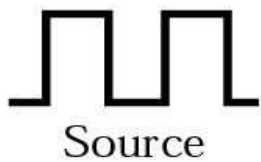
# *Propagation Modes*



a. Multimode, step-index



b. Multimode, graded-index



c. Single-mode

## Advantages

- Provides high quality transmission of signals at very high speed.
- Used for both analog and digital signals.
- These cables are much lighter than the copper cables
- Its transmission distance is greater than the twisted pair and it can run for 50Kms without regeneration.
- These are not affected by electromagnetic interference, so noise and distortion is very less.

## Disadvantages

- It needs expertise which is not available everywhere. So it is difficult to install.
- Propagation of light is unidirectional and we need two fibers for bidirectional communication.
- It is expensive because the cables and interfaces used are relatively expensive.

## Unguided Media

- Unguided media is used for **transmitting the signal without any physical media.**
- It transports electromagnetic waves and is often called **wireless communication.**
- Signals are **broadcast through air** and received by all who have devices to receive them.



## Radio waves

- 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, so the transmitter and receiver do not have to be carefully aligned physically.



- Radio waves can be received both inside and outside the building.
- Radio waves are very useful in multicasting and hence used in AM and FM radios, cordless phones and paging.
- If the communication is between single source and destination then it is called **unicast**;
- on the other hand, if one source is transmitting signal and any destination that is in the range may be able to reach it then it is called **broadcast**.

- **Multicast** is when a source transmits a signal for some specific group of destinations which may be more than one.

## Bluetooth

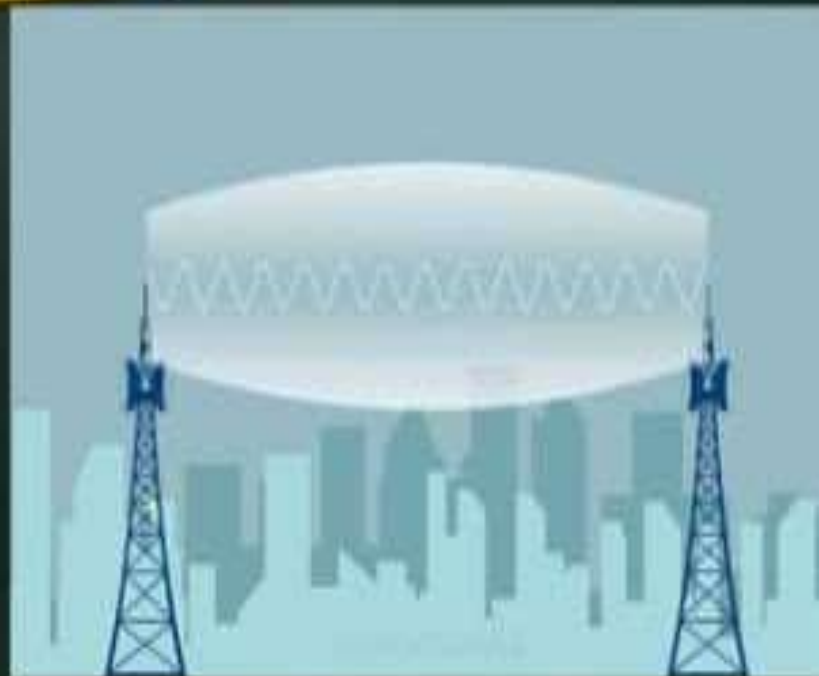
- Bluetooth is a very popular application of short wave length radio transmission in the frequency band of 2400 to 2480 MHz.
- It is a proprietary wireless technology standard used for exchanging data over short distances in mobile phones and other related devices.

It allows wireless devices to be connected to wireless host which may be a computer over short distances. You may have it for transferring data between a mobile phone and a computer provided **both have Bluetooth technology.**



## Microwave Transmission

- Travels in straight lines and therefore narrowly focused concentrating all the energy into a beam.
- Periodic repeaters are necessary for long distances.
- For transmitting and receiving, antennas should be aligned accurately.
- Can not penetrate through buildings.



- It operates in the GHz range with data rates in order of hundreds of Mbps per channel.
- Telecommunication carriers and TV stations are the primary users of microwave transmission.
- Before fiber optics, for decades these microwaves formed the heart of the long-distance telephone transmission system.

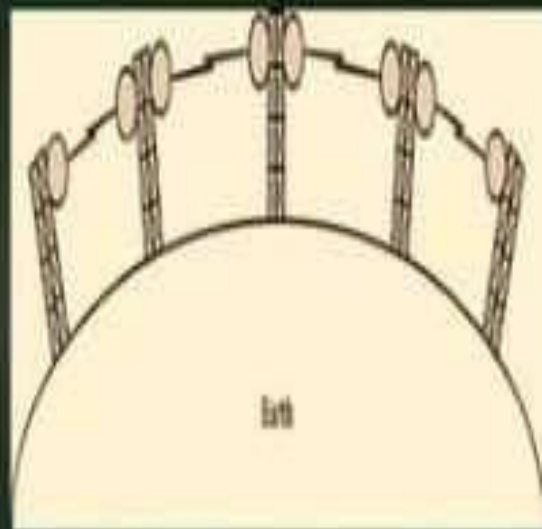
## Types of microwave communication systems

1. Terrestrial

2. Satellite

## Terrestrial Microwave

- The terrestrial microwave transmission typically uses the **radio frequency spectrum 2 to 40 GHz**.
- The transmitter is a **parabolic dish** (shaped like a bowl) and is mounted as high as possible to get the best frequency and transmission.
- An unblocked line of sight must be available between the source and the receiver.

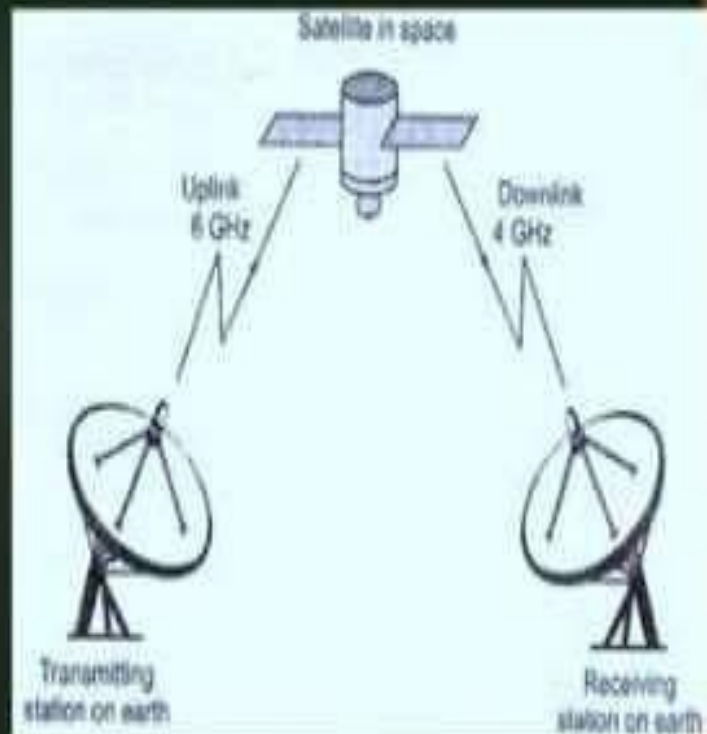


- Terrestrial microwaves are used for both radio (voice) and television transmission.
- It can be expensive to adhere to the 30-mile line of sight requirement.
- The towers and repeaters can be fairly costly and there is a risk of interference from aeroplanes, birds and rain.



## Satellite Microwave

- This is a microwave relay station which is placed in **outer space**.
- The satellites are launched either by rockets or space shuttles carry them.
- The signals **transmitted by earth stations are received, amplified, and retransmitted to other earth stations by the satellite.**
- These are positioned **3600KM above the equator with an orbit**



speed that exactly matches the rotation speed of the earth.

- As the satellite is positioned in a **geo-synchronous orbit**, it is stationery relative to earth and always stays over the same point on the ground. This is usually done to allow ground stations to aim antenna at a fixed point in the sky.
- Transmitting station can receive back its own transmission and check whether the satellite has transmitted information correctly.
- A single microwave relay station which is visible from any point.

- Satellite manufacturing **cost is very high**
- Cost of **launching satellite is very expensive**
- Transmission highly **depends on whether conditions**, it can go down in bad weather

Infrared

- Infrared signals range between **300 Giga-Hertz to 400 Tera-Hertz**.
- These can be used for **short range** communication.



- High range infrared rays cannot be used for long range communication as it cannot penetrate walls.
- Infrared signals are generated and received using optical transceivers.
- Infrared systems represent a cheap alternative to most other methods, because there is no cabling involved and the necessary equipment is relatively cheap.
- However, applications are limited because of distance limitations (of about one kilometer).

- It cannot be used outside building as rays of sun contain infrared which leads to interference in communication.
- Infrared having wide bandwidth can be used to transmit digital data with a very high data rate.