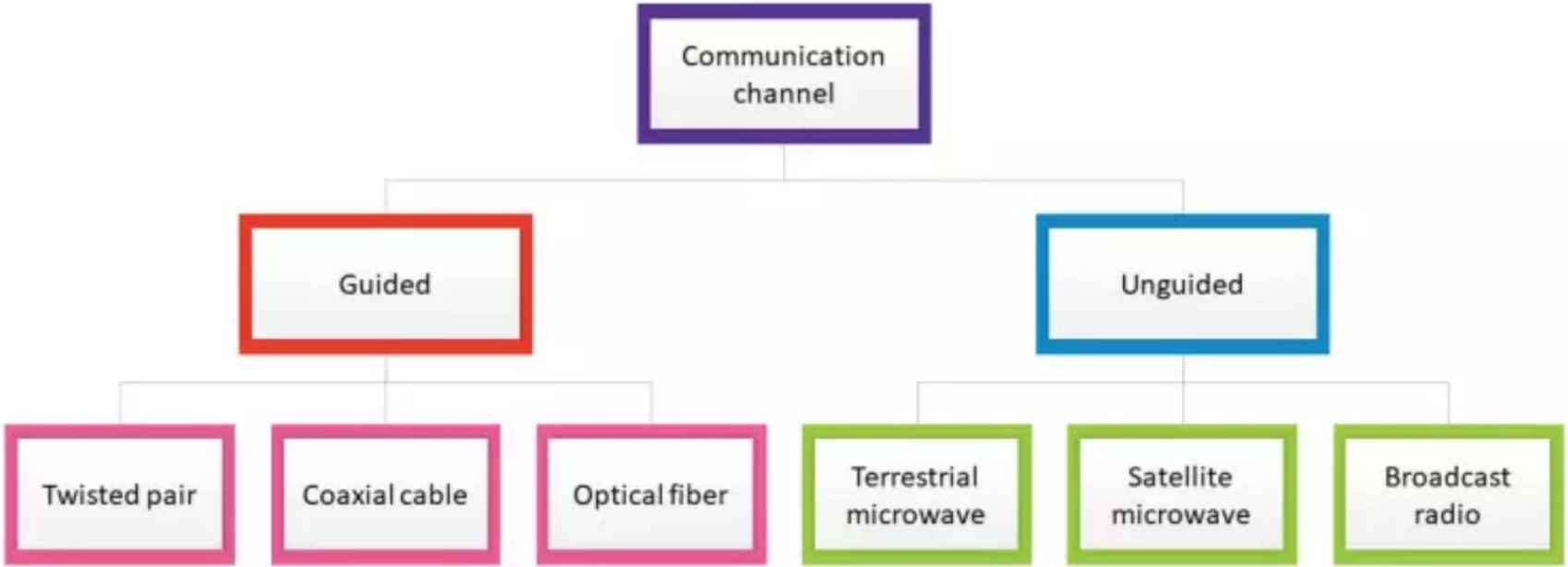
Transmission Media

FIT

TYPES OF COMMUNICATION CHANNELS PPT PRESENTATION



Guided Media/Wired Channel

- It is defined as the physical medium through which the signals are transmitted.
- It is also known as Bounded media.
- A signal traveling along any of these media is directed and contained by the physical limits of the medium.

Types of Guided Transmission Media

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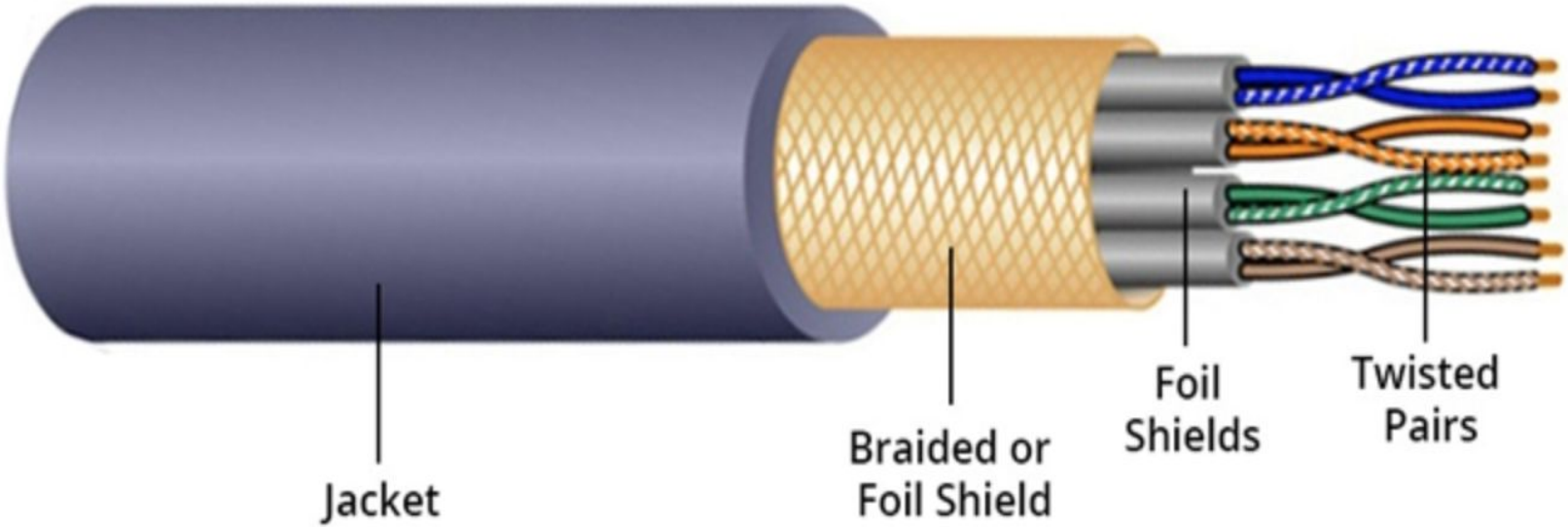
1. Twisted Pair Cable
2. Coaxial Cable
3. Fiber-Optic Cable

Twisted Pair Cable



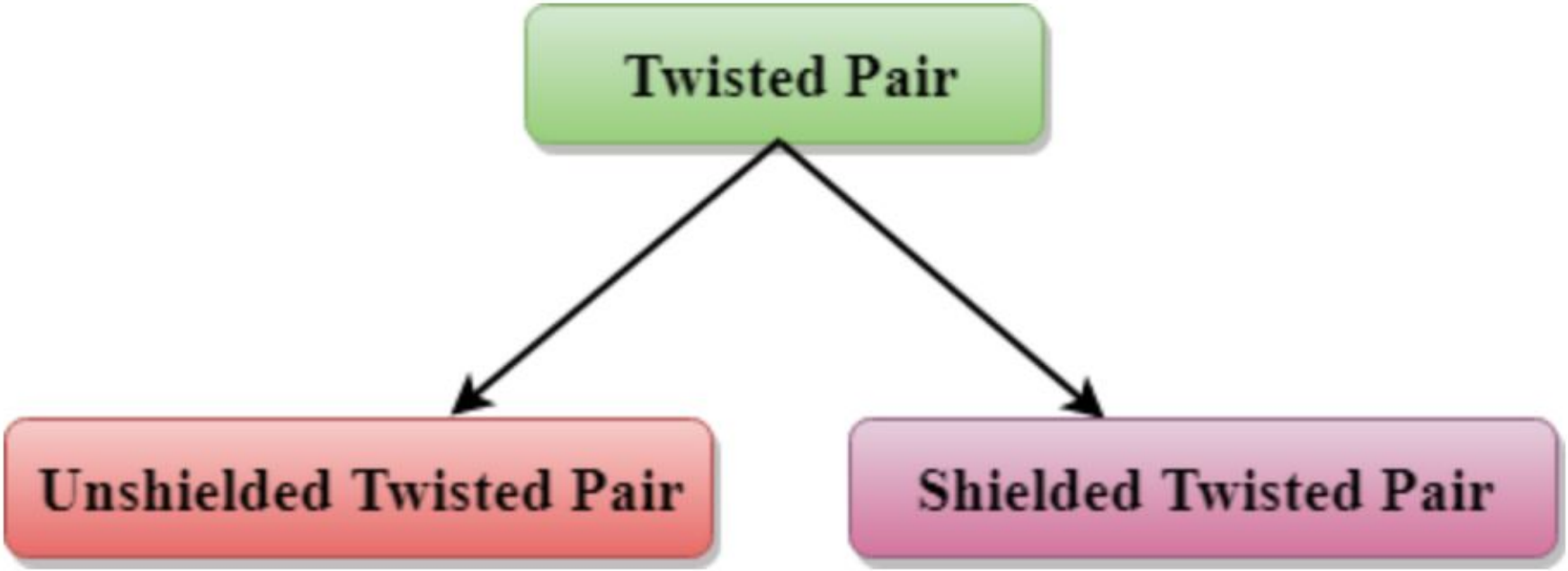
Twisted Pair Cable

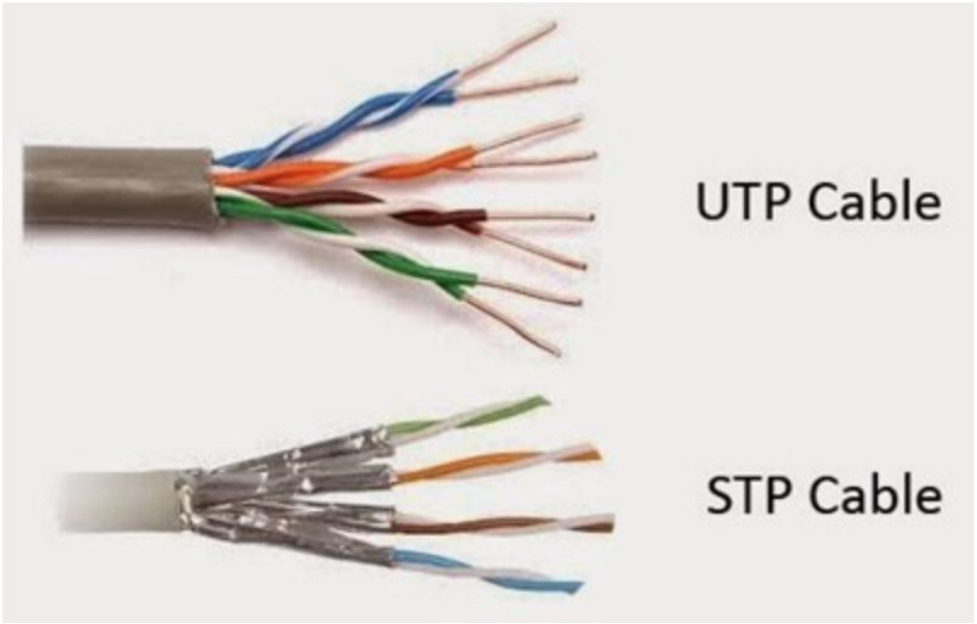
- Twisted pair cable is often used in Telephone communication and Ethernet networks.
- A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.
- The degree of reduction in noise interference is determined by the number of turns per foot.
- Increasing the number of turns per foot decreases noise interference.

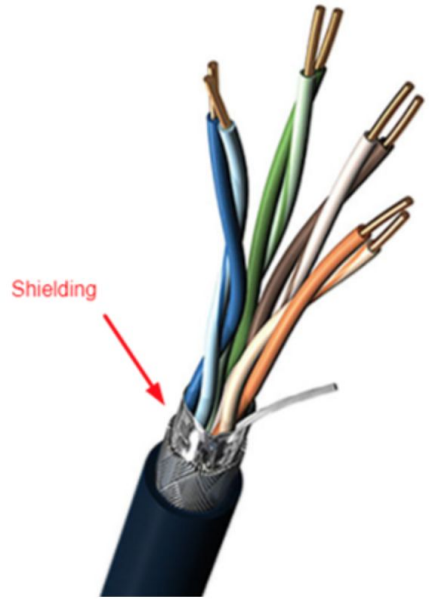
Twisted Pair Cable

- The pairs are twisted together to provide protection against crosstalk, the noise generated by adjacent pairs.
- The frequency range for twisted pair cable is from 0 to 3.5KHz.
- There are two types of twisted pair Ethernet cable: unshielded twisted pair (UTP) and shielded twisted pair (STP).

Types of Twisted Pair




UTP Cable
STP Cable


Shielding


No Shielding

UTP(Unshielded Twisted Pair)

- UTP is used for connections within short range.
- UTP cable has no protective coating and no shielding
- The categories of UTP have been developed from Category 1 to Category 7.
- UTP is commonly used for home networking.

Types of UTP

- **Category 1**: Category 1 is used for telephone lines that have low-speed data.
- **Category 2**: It can support upto 4Mbps.
- **Category 3**: It can support upto 16Mbps.
- **Category 4**: It can support upto 20Mbps. Therefore, it can be used for long-distance communication.
- **Category 5**: It can support up to 200Mbps.

Types of UTP(contd...)

- **Cat 6** supports data transfer speeds up to 10 Gbps at 250 MHz with even less (or no) crosstalk interference, due to the cable's improved insulation. However, its 10 Gbps speed is effective only up to 164 feet.

Advantages of UTP

- Cheap
- Installation of UTP is easy
- It can be used for high speed LAN

Disadvantages of UTP

- This cable can only be used for shorter distances because of attenuation.

Shielded Twisted Pair

- A shielded twisted pair is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.

Advantages of STP

- The cost of the shielded twisted pair cable is not very high and not very low.
- An installation of STP is easy.
- It has higher capacity as compared to unshielded twisted pair cable.
- It has a higher attenuation.
- It is shielded that provides the higher data transmission rate.

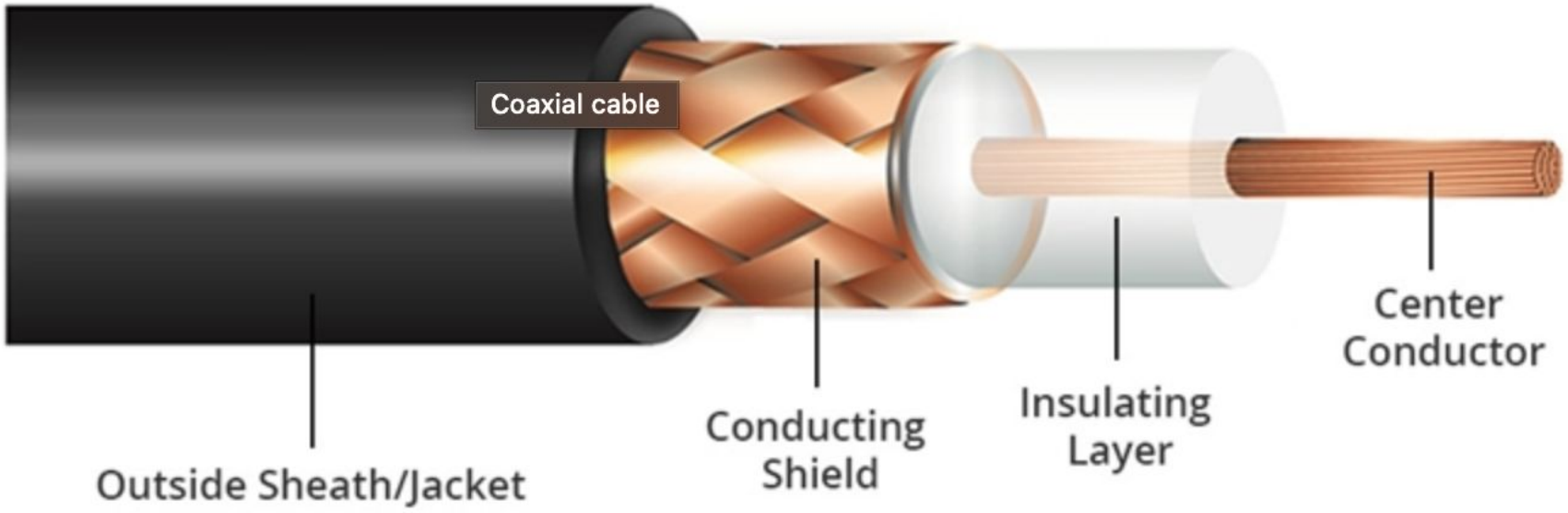
Disadvantages of STP

- It is more expensive as compared to UTP and coaxial cable.
- It has a higher attenuation rate.

Coaxial Cable

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.

Coaxial Cable



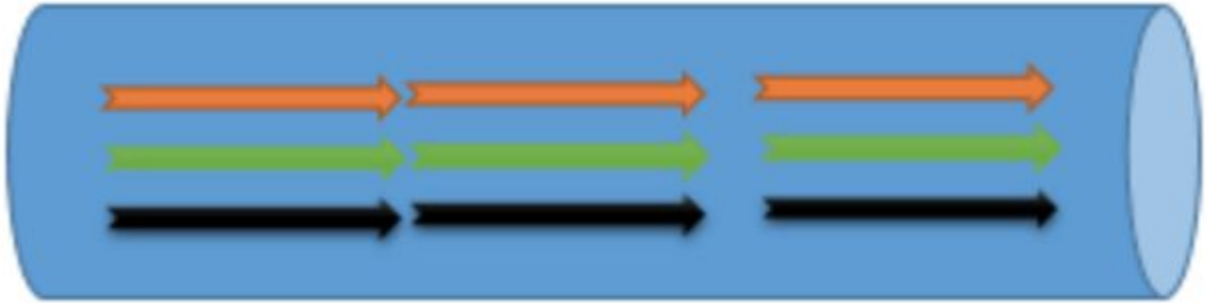
Coaxial Cable

- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh.
- The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the EMI(Electromagnetic interference).

Types of Coaxial Cable

- **Baseband transmission:** It is defined as the process of transmitting a single signal at high speed.
- **Broadband transmission:** It is defined as the process of transmitting multiple signals simultaneously.

Baseband



Broadband

Advantages of Coaxial Cable

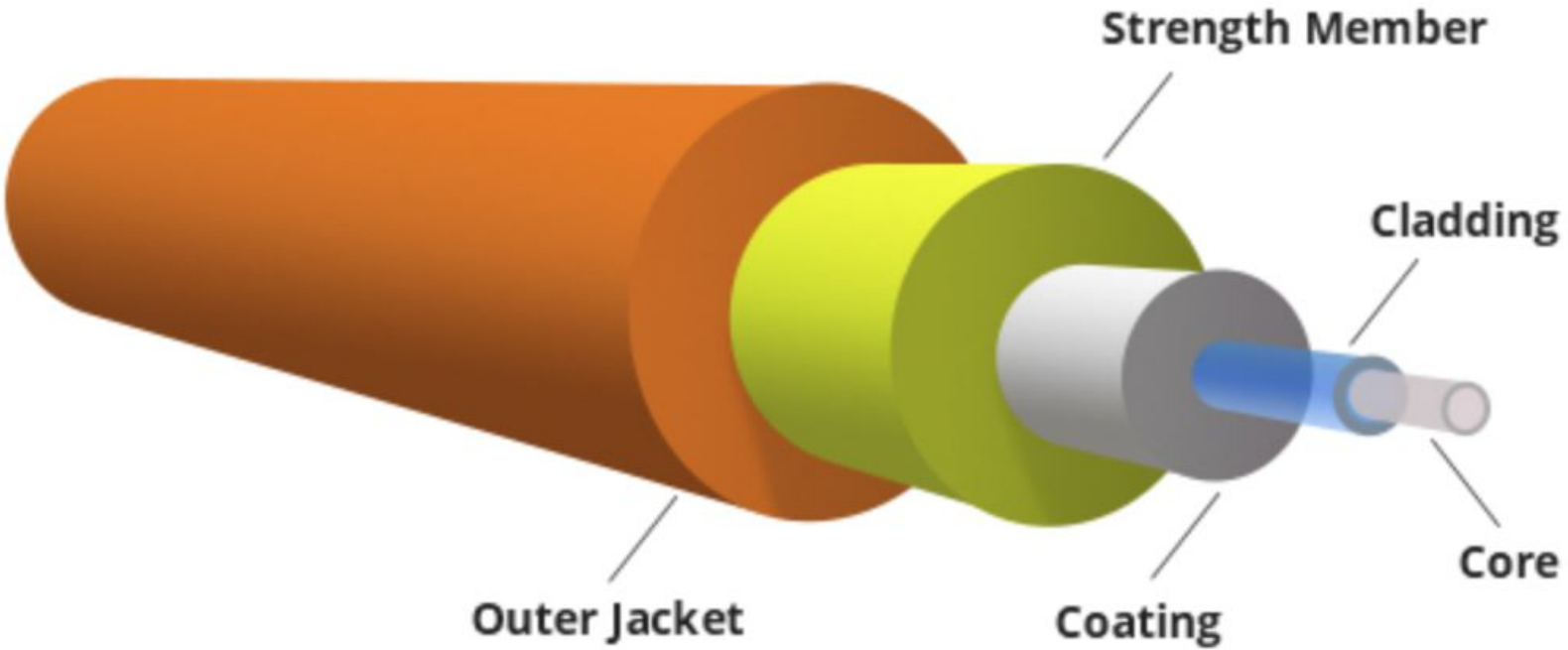
- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

Disadvantages of Coaxial Cable

- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network.

Fiber Optic Cable

- Fiber optic cable transmits data as pulses of light going through tiny tubes of glass.
- The transmission capacity of optical fiber cable is 26,000 times higher than that of twisted pair cable.


Strength Member
Cladding
Core
Coating
Outer Jacket

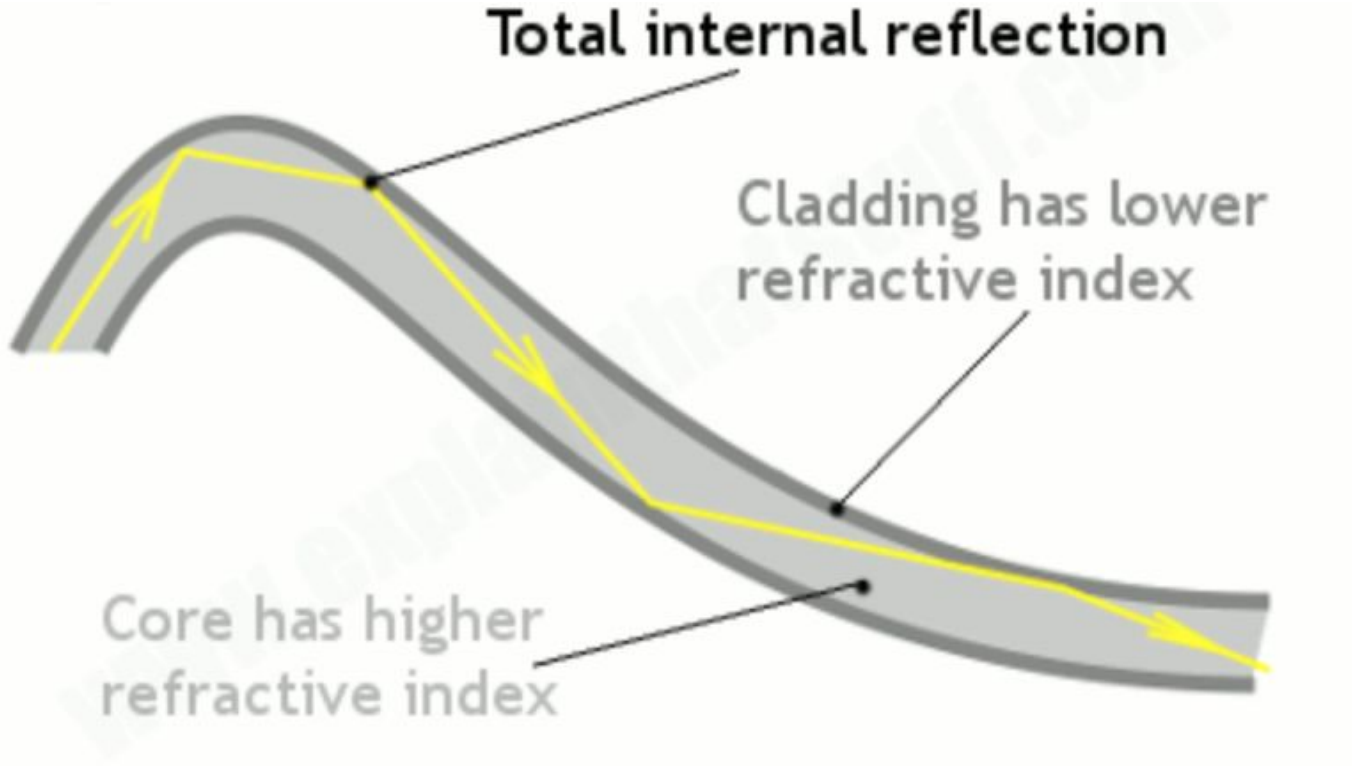
Basic Elements of Fibre Optic

- **Core**: The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- **Cladding**: The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.

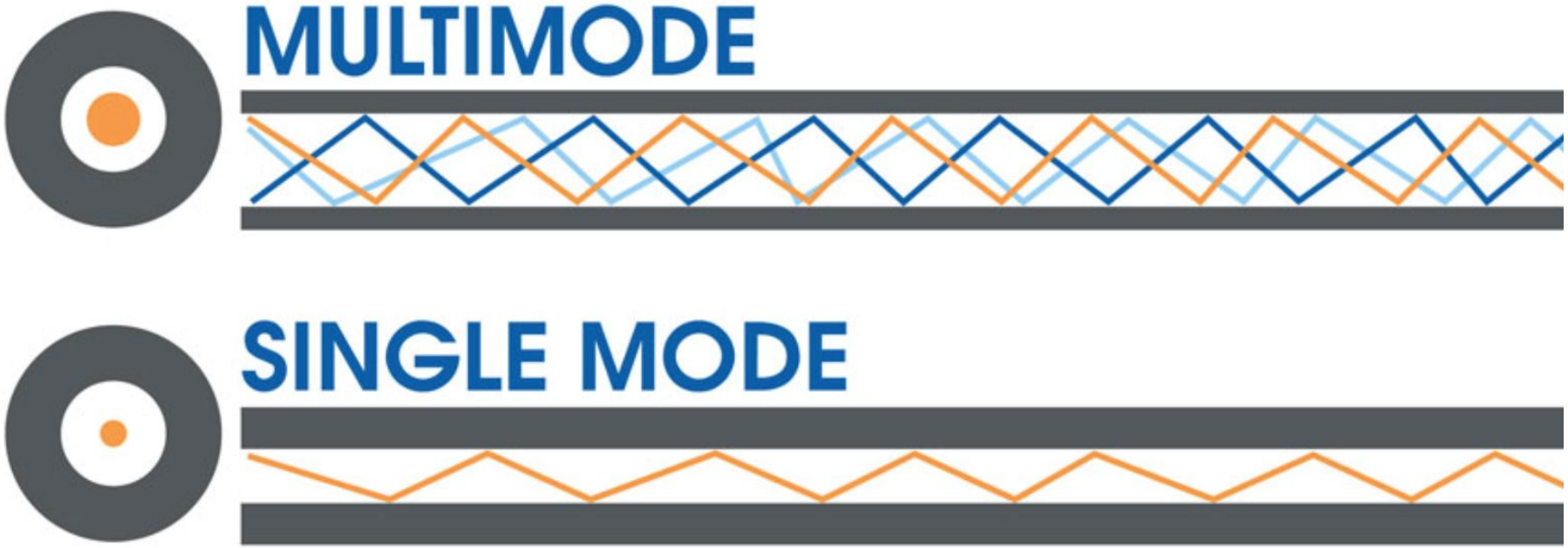
Basic Elements of Fibre Optic

- **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

How Signal Travels in Fibre Optic



Types of Fibre Optic



Advanatages of Fibre Optic

- Greater Bandwidth
- Faster speed
- Longer distances
- Better reliability
- Thinner and Sturdier

Characteristic	Twisted Pair	Coaxial Cable	Fibre Optic
Signal Transmission	Electric form	Electric form	Optical form
External Magnetic Field	Highly affected	Moderately affected	Unaffected
Cause of Power loss	Conduction/Radiation	Conduction	Scattering, Absorbtion,Bending
Bandwidth	Low	Moderate	High
Electromagnetic Interference(EMI)	EMI exists	EMI is reduced	EMI absent
Installation	Easy	Moderately Difficult	Difficult

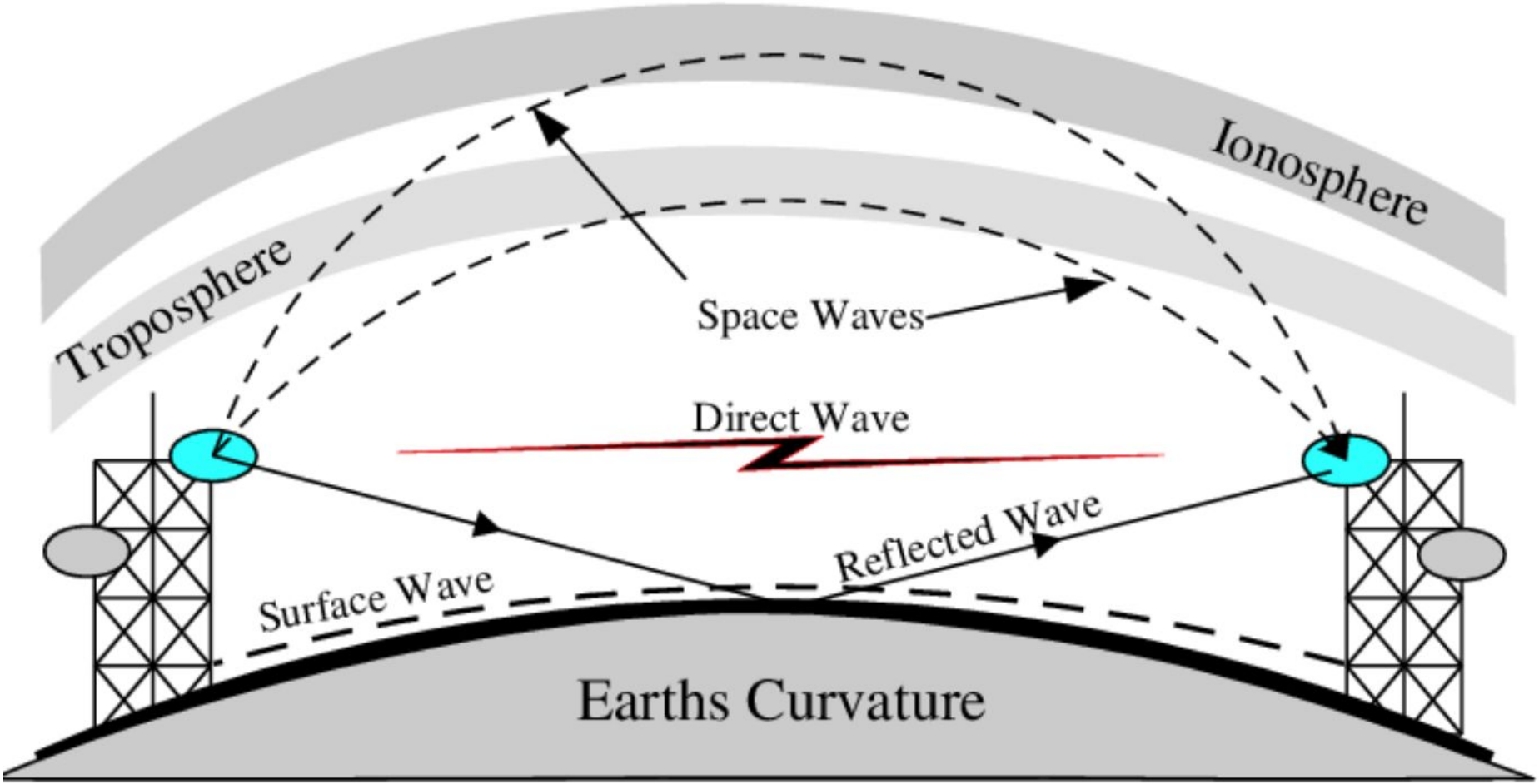
Characteristic	Twisted Pair	Coaxial Cable	Fibre Optic
Attenuation	High	Low	Very Low
Data Rate	Low	High	Highest
Noise Immunity	Low	High	Very High
Cost	Cheap	Moderate	Expensive
Repeater Spacing	2-10 Km	1-10 Km	10-100 Km

Unguided Transmission Media/ Wireless

- 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.

Radio Waves

- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.
- Radio waves are omnidirectional, i.e., the signals are propagated in all the directions.
- The range in frequencies of radio waves is from 3Khz to 1 khz.
- In the case of radio waves, the sending and receiving antenna are not aligned, i.e., the wave sent by the sending antenna can be received by any receiving antenna.
- An example of the radio wave is FM radio.


Ionosphere
Troposphere
Space Waves
Direct Wave
Reflected Wave
Surface Wave
Earths Curvature

Application of Radio Waves

- A Radio wave is useful for multicasting when there is one sender and many receivers.
- An FM radio, television, cordless phones are examples of a radio wave.

Advantages of Radio Wave Transmission

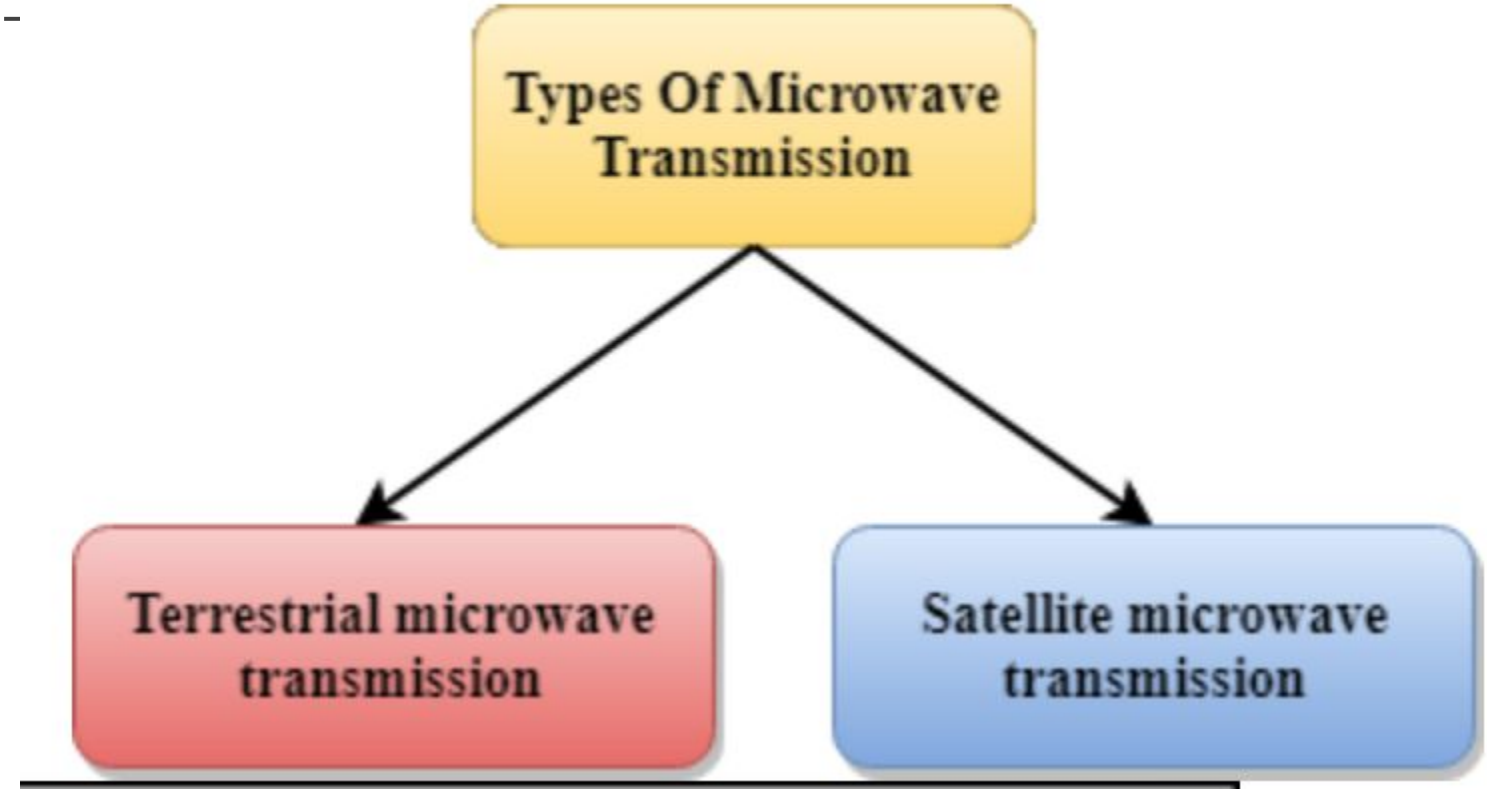
- Radio transmission is mainly used for wide area networks and mobile cellular phones.
- Radio waves cover a large area, and they can penetrate the walls.
- Radio transmission provides a higher transmission rate.

Microwave Transmission

- Microwaves are a line of sight transmission, meaning both the antennas sending and receiving should be properly aligned.
- The distance covered by the signal is directly proportional to the height of the antenna.
- Microwaves have a frequency Range between 1GHz - 300GHz.

Microwave Transmission

- Unlike radio waves, they are unidirectional, as they can move in only one direction, and therefore it is used in point-to-point communication or unicast communication such as radar and satellite.
- We use Microwaves in mobile phones communication and television distribution.


Types Of Microwave Transmission
Terrestrial microwave transmission
Satellite microwave transmission

Characteristics of Microwave

- The frequency range of terrestrial microwave is from 4-6 GHz to 21-23 GHz.
- It supports the bandwidth from 1 to 10 Mbps.
- It is inexpensive for short distance.
- t is expensive as it requires a higher tower for a longer distance.
- It is affected by environmental conditions and antenna size.

Advantages of Microwave

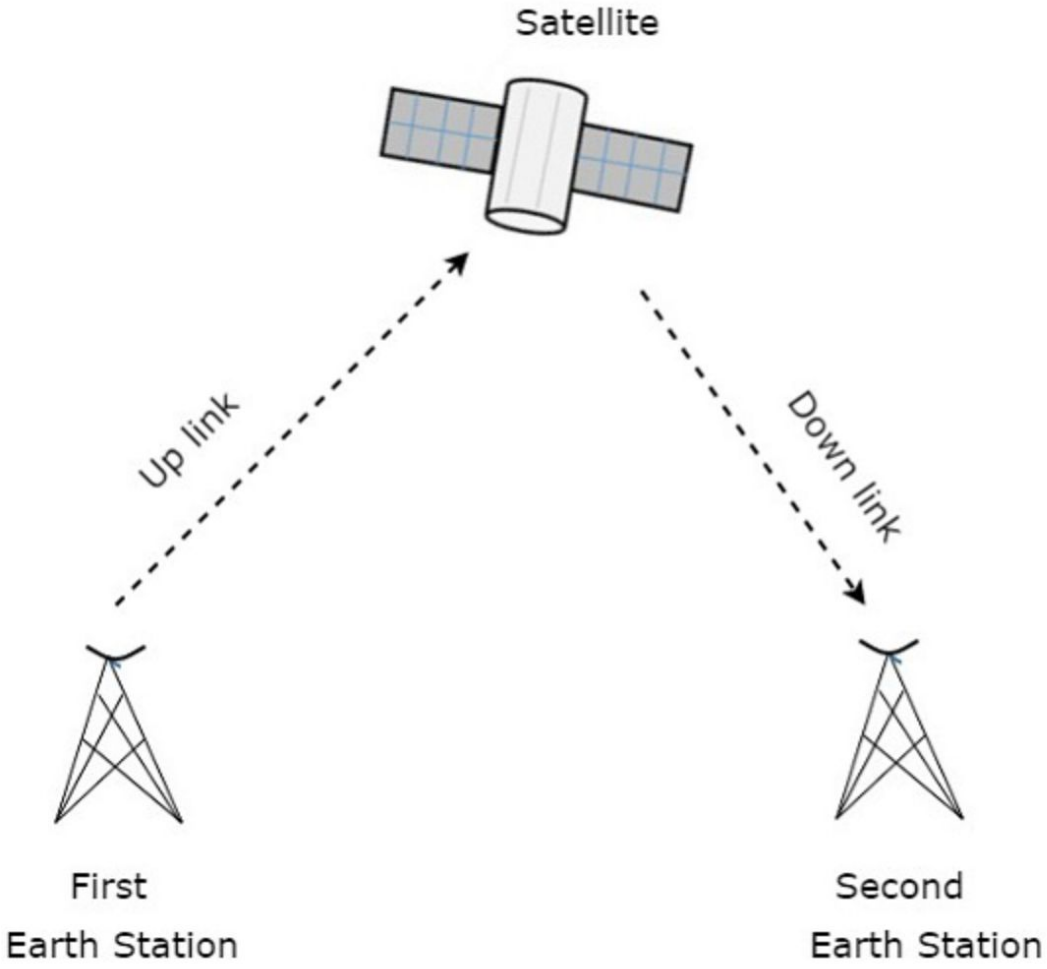
- Microwave transmission is cheaper than using cables.
- Microwave transmission provides an easy communication in terrains as the installation of cable in terrain is quite a difficult task.
- Communication over oceans can be achieved by using microwave transmission.

Disadvantages of Microwave Transmission

- Any malicious user can catch the signal in the air by using its own antenna.
- A signal can be moved out of phase by using microwave transmission.
- A microwave transmission is susceptible to weather condition. This means that any environmental change such as rain, wind can distort the signal.
- Allocation of bandwidth is limited in the case of microwave transmission.

Satellite Communication

- A satellite is a body that moves around another body in a particular path.
- A communication satellite is nothing but a microwave repeater station in space.
- It is helpful in telecommunications, radio and television along with internet applications.

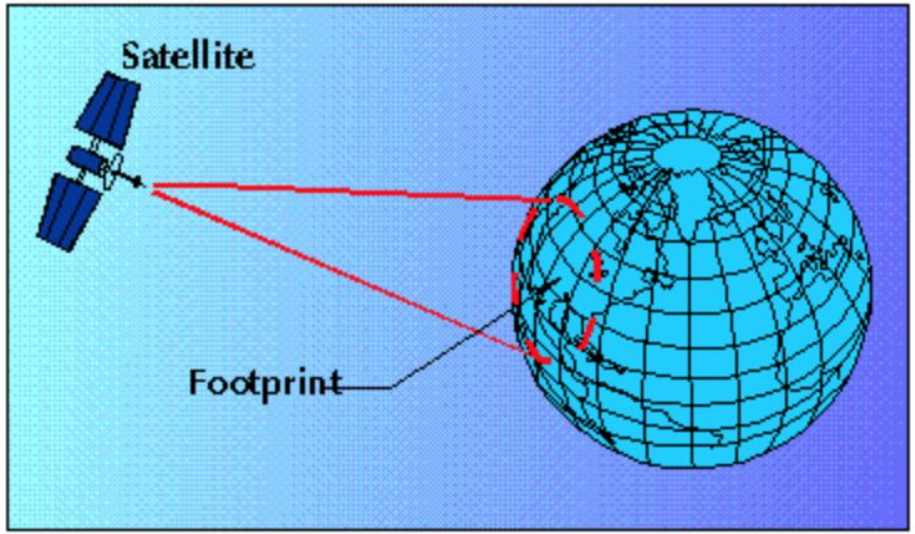

Satellite
Up link
Down link
First
Earth Station
Second
Earth Station

Satellite Communication

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

Satellite Footprint

In satellite communications, that portion of the Earth's surface over which a satellite antenna delivers a specified amount of signal power under specified conditions.



Advantages of Satellite Communication

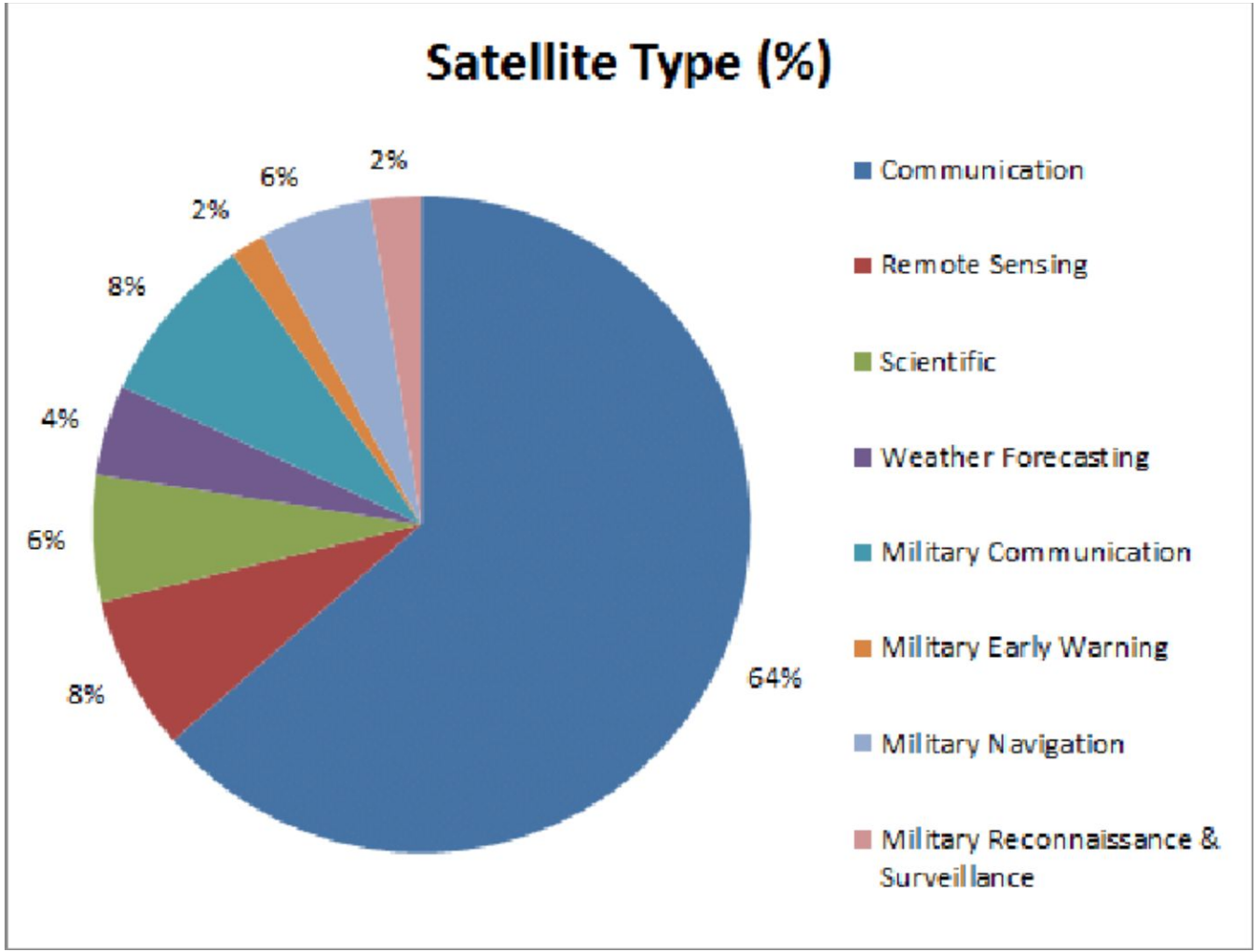
- Area of coverage is more than that of terrestrial systems
- Each and every corner of the earth can be covered
- Transmission cost is independent of coverage area
- More bandwidth and broadcasting possibilities

Disadvantages of Satellite Communication

- Launching of satellites into orbits is a costly process.
- Propagation delay of satellite systems is more than that of conventional terrestrial systems.
- Difficult to provide repairing activities if any problem occurs in a satellite system.
- Free space loss is more
- There can be congestion of frequencies.

Applications of Satellite Communication

- Radio broadcasting and voice communications
- TV broadcasting such as Direct To Home (DTH)
- Internet applications such as providing Internet connection for data transfer, GPS applications, Internet surfing, etc.
- Military applications and navigations
- Remote sensing applications
- Weather condition monitoring & Forecasting


Satellite Type (%)
64%
8%
6%
4%
8%
2%
6%
2%
Communication
Remote Sensing
Scientific
Weather Forecasting
Military Communication
Military Early Warning
Military Navigation
Military Reconnaissance & Surveillance

Types of Satellite Orbits

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1. GEO (Geostationary Satellite)
2. MEO (Medium Earth Orbit)
3. LEO (Lower Earth Orbit)

GEO (Geostationary Earth Orbit)

- Geostationary satellites have a distance of almost 36,000 km to the earth.
- Objects in GEO moves around the earth at the same speed as the earth rotates.
- Geostationary satellites remain in the same position relative to the surface of earth.

Advantages of GEO

- Three Geostationary satellites are enough for a complete coverage of almost any spot on earth.
- Receivers and senders can use fixed antenna positions, no adjusting is needed.
- GEOs are ideal for TV and radio broadcasting.
- Lifetime expectations for GEOs are rather high, at about 15 years.
- Geostationary satellites have a 24 hour view of a particular area.

Advantages of GEO

- GEOs typically do not need handover due to the large footprints.
- GEOs don't exhibit any Doppler shift because the relative movement is zero.

Disadvantages

- Northern or southern regions of the earth have more problems receiving these satellites due to the low elevation above latitude of 60 degree, i.e. larger antennas are needed in this case.
- Shading of the signals in cities due to high buildings and the low elevation further away from the equator limits transmission quality.

Disadvantages of GEO

- The transmit power needed is relatively high (about 10 W) which causes problems for battery powered devices.
- These satellites can't be used for small mobile phones.
- Transferring a GEO into orbit is very expensive.
- The biggest problem for voice and also data communication is high latency of over 0.25s

Lower Earth Orbit

- LEO satellites are much closer to earth than GEO satellites, ranging from 500 to 1,500 km above the surface.
- LEO satellites do not stay in fixed position relative to the surface, and are only visible for 15 to 20 minutes each pass.

Uses of LEO

- Remote Industrial Business
- Defense Customers and Government
- Emergency Response
- Recreational Customers

Advantages of LEO

- Smaller footprints of LEOs allow for better frequency reuse, similar to the concepts used for cellular networks.
- A LEO satellite's proximity to earth compared to a Geostationary satellite gives it a better signal strength and less of a time delay, which makes it better for point to point communication.

Disadvantages of LEO

- Need for many satellites if global coverage is to be reached.
- The short time of visibility with a high elevation requires additional mechanism for connection handover between different satellites.
- Short lifetime of about five to eight years

Medium Earth Orbit (MEO)

- A MEO satellite situates in orbit somewhere between 6,000 km to 20,000 km above the earth's surface.
- MEO satellites are similar to LEO satellite in functionality.
- Medium earth orbit satellites are visible for much longer periods of time than LEO satellites usually between 2 to 8 hours.

Uses of MEO

- It delivers low-latency, high-bandwidth data connectivity to service providers, government agencies, and commercial enterprises.
- MEO satellites bring fibre-like performance to remote areas where laying fibre is not viable
- Navigation

Advantages of MEO

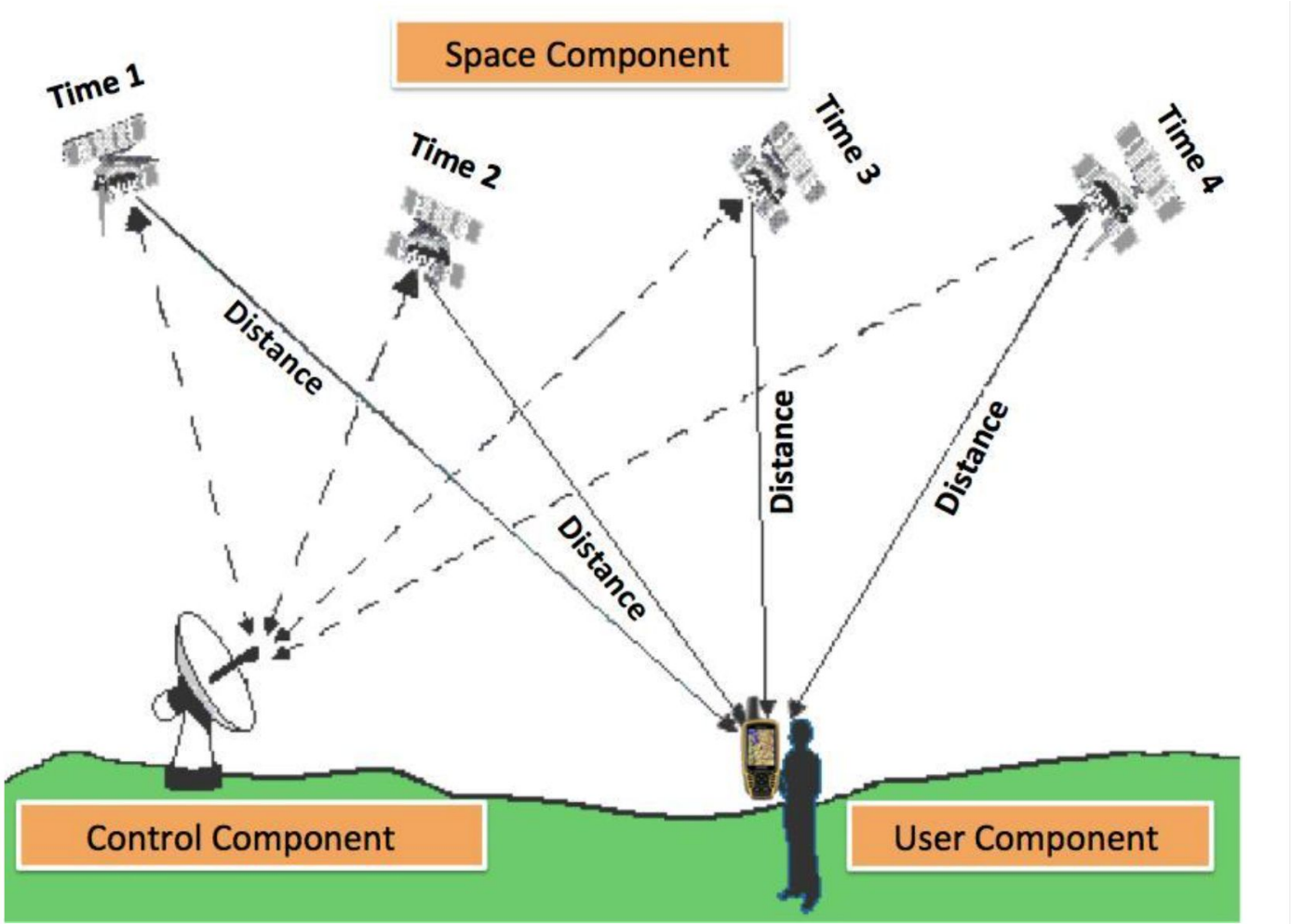
- The system only requires a dozen satellites which is more than a GEO system, but much less than a LEO system.
- MEO can cover larger populations, so requiring fewer handovers.
- A MEO satellite's longer duration of visibility and wider footprint means fewer satellites are needed in a MEO network than a LEO network.

Disadvantages of MEO

- Due to the larger distance to the earth, delay increases to about 70-80 ms.
- The satellites need higher transmit power and special antennas for smaller footprints.
- A MEO satellite's distance gives it a longer time delay and weaker signal than LEO satellite.

Global Positioning System(GPS)

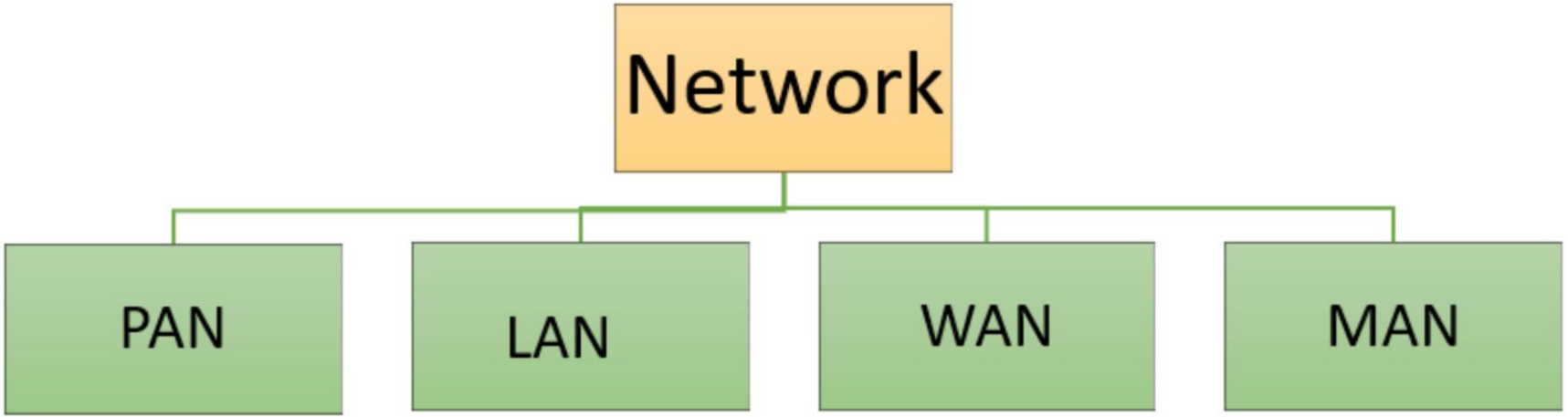
- Global Positioning System, is a satellite-based system consisting of a minimum of 24 satellites.
- These satellites orbit Earth at an altitude of about 12,500 miles (20,000 km).
- GPS system is made up of three parts: **satellites, ground stations, and receivers.**
- Uses the principle of Trilateration to calculate the location


Space Component
Time 1
Time 2
Time 3
Time 4
Distance
Distance
Distance
Distance
Control Component
User Component

Uses of GPS

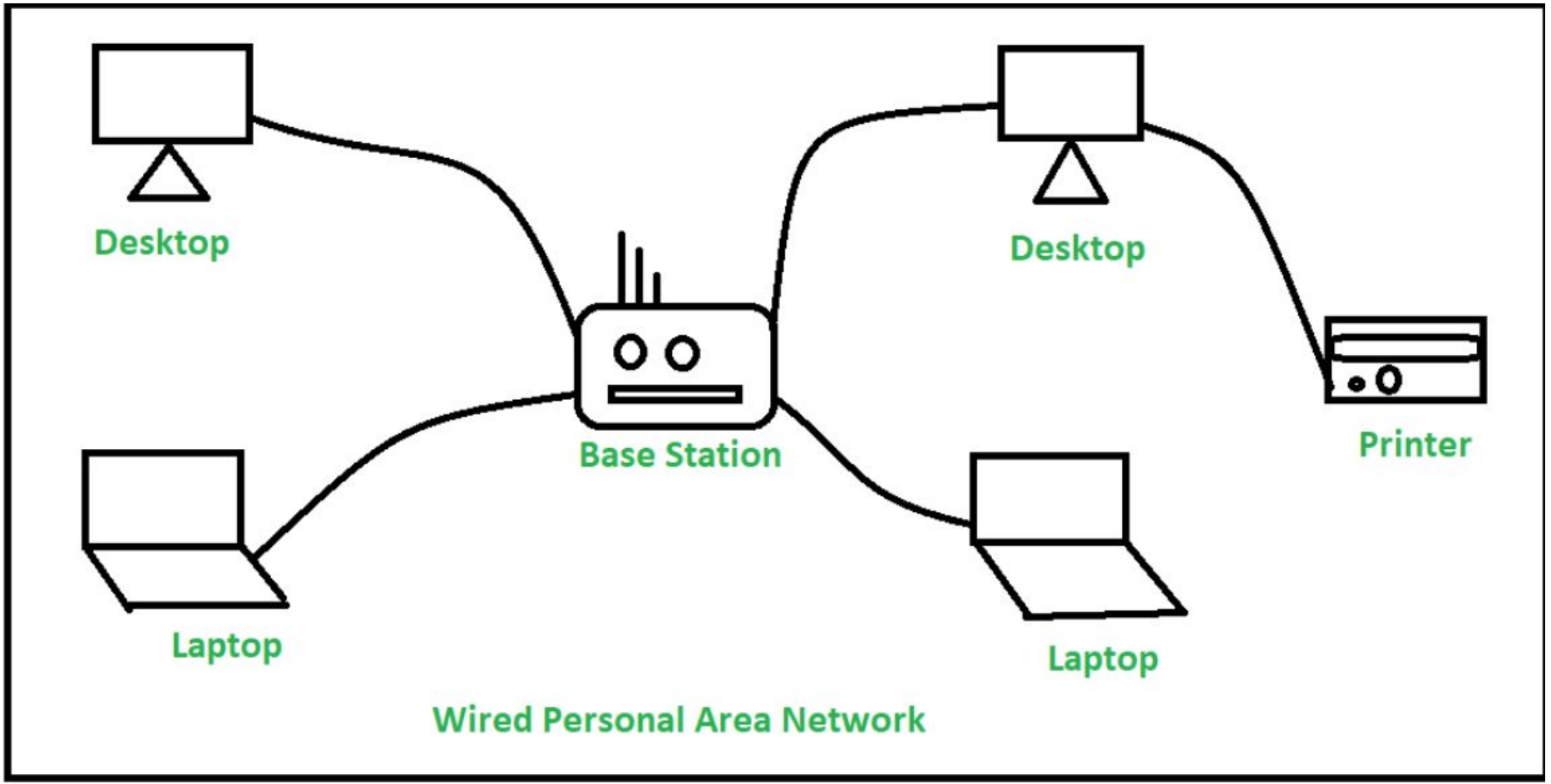
- Identify Location
- Support in Emergency
- Prevent Car Theft
- Surveying

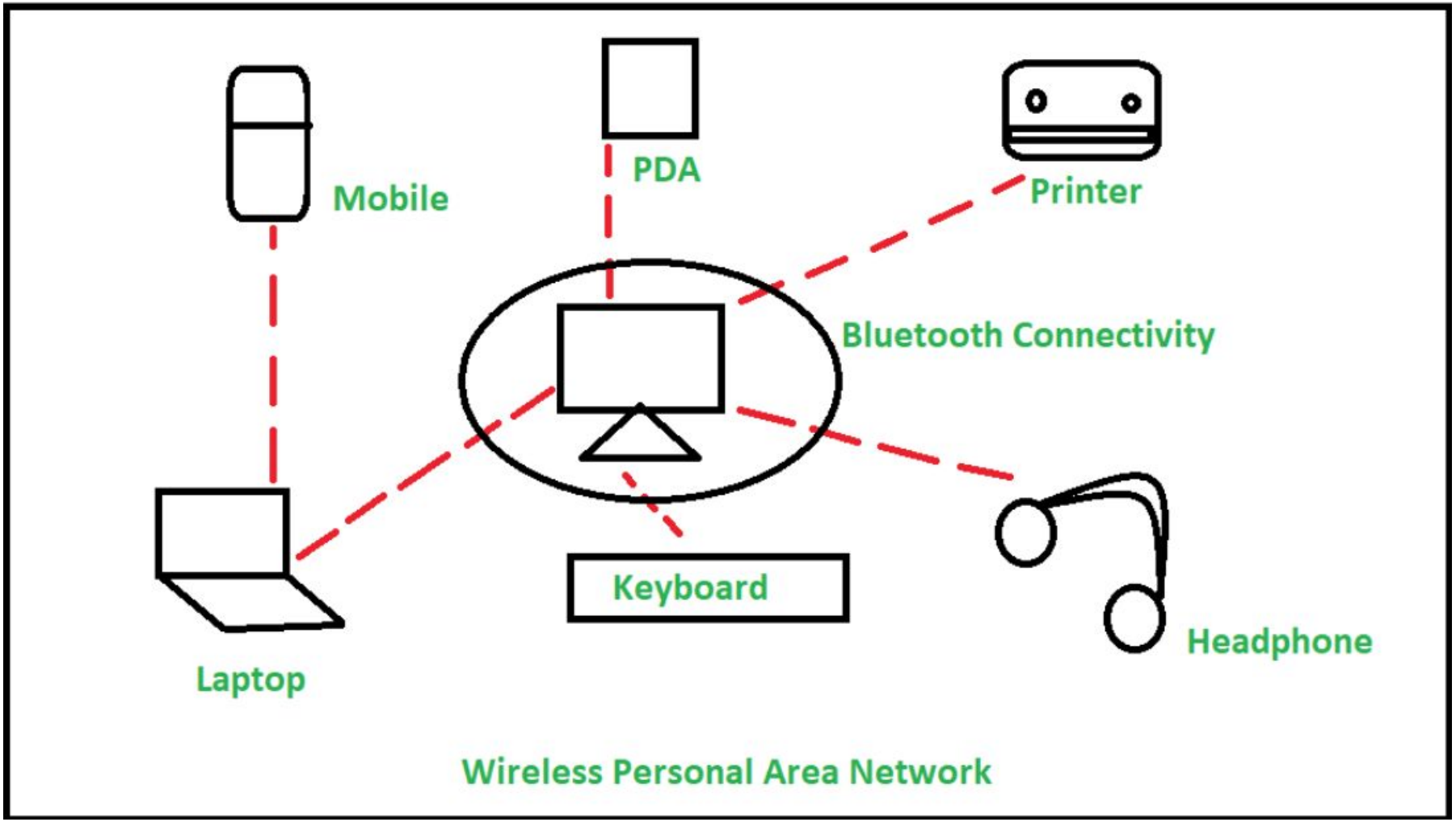
Area Networks



Personal Area Network

- A personal area network (PAN) is a computer network for interconnecting electronic devices within an individual person's workspace.
- It generally consists of a computer, mobile, or personal digital assistant.
- PAN can be used for establishing communication among these personal devices for connecting to a digital network and the internet.


Desktop
Desktop
Base Station
Printer
Laptop
Laptop
Wired Personal Area Network


Mobile
PDA
Printer
Bluetooth Connectivity
Keyboard
Laptop
Headphone
Wireless Personal Area Network

Characteristics of PAN

- It is mostly personal devices network equipped within a limited area.
- Allows you to handle the interconnection of IT devices at the surrounding of a single user.
- PAN includes mobile devices, tablet, and laptop.
- It can be wirelessly connected to the internet called WPAN.
- Appliances use for PAN: cordless mice, keyboards, and Bluetooth systems.

Advantages of PAN

- PAN networks are relatively secure and safe
- Relatively easy to set up
- Strictly restricted to a small area

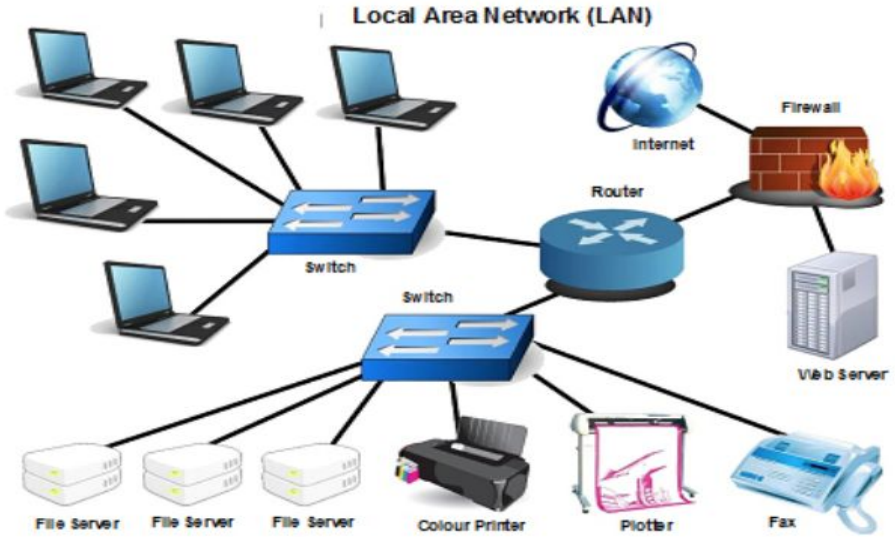
Disadvantages of PAN

- It may establish a bad connection to other networks at the same radio bands.
- Distance limits.
- It offers only short-range solution up to ten meters

Local Area Network(LAN)

- A local area network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home.
- A LAN can be small or large, ranging from a home network with one user to an enterprise network with thousands of users and devices in an office or school.

LAN


Local Area Network (LAN)
Internet
Firewall
Router
Switch
Switch
Web Server
File Server
File Server
File Server
Colour Printer
Plotter
Fax

Characteristics of LAN

- It is a private network, so an outside regulatory body never controls it.
- LAN operates at a relatively higher speed compared to other WAN systems.
- There are various kinds of media access control methods like token ring and ethernet.

Advantages of LAN

- Computer resources like hard-disks, DVD-ROM, and printers can share local area networks. This significantly reduces the cost of hardware purchases.
- You can use the same software over the network instead of purchasing the licensed software for each client in the network.
- Data of all network users can be stored on a single hard disk of the server computer.
- You can easily transfer data and messages over networked computers.
- It will be easy to manage data at only one place, which makes data more secure.
- Local Area Network offers the facility to share a single internet connection among all the LAN users.

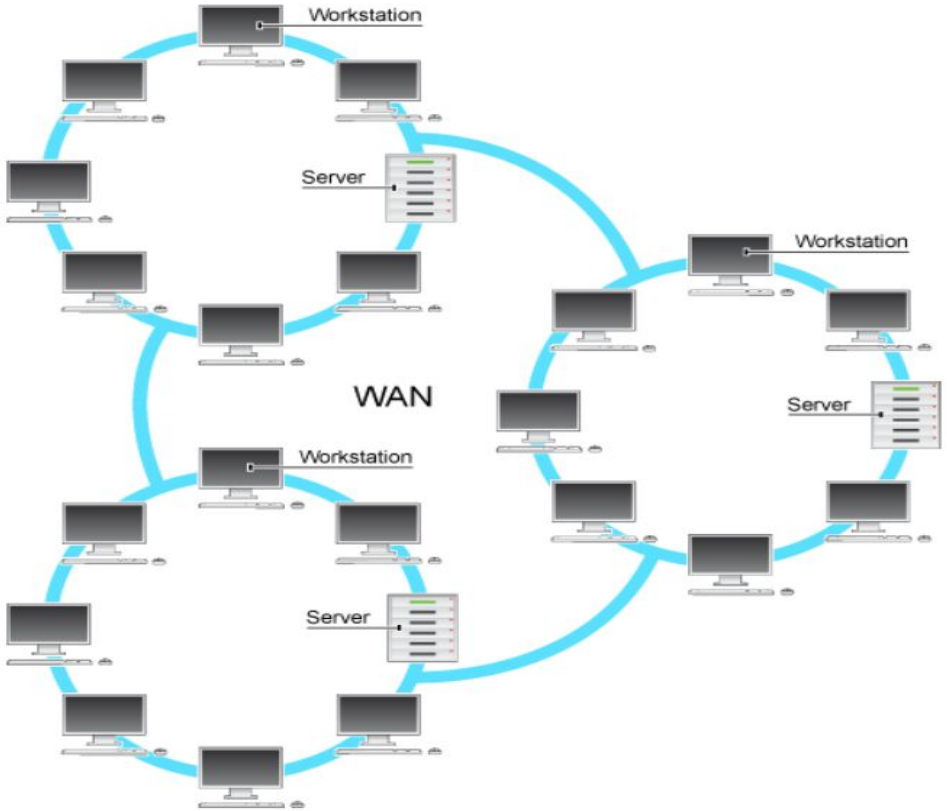
Disadvantages of LAN

- Initial cost of installing Local Area Networks is quite high.
- The LAN admin can check personal data files of every LAN user, so it does not offer good privacy.
- Unauthorized users can access critical data of an organization in case LAN admin is not able to secure centralized data repository.
- Local Area Network requires a constant LAN administration as there are issues related to software setup and hardware failures

Wide Area Network

- Computer network which is spread across a large geographical area.
- WAN network system could be a connection of a LAN which connects with other LAN’s using telephone lines and radio waves.
- It is mostly limited to an enterprise or an organization.

WAN


Workstation
Server
WAN
Workstation
Server
Workstation
Server

Characteristics of WAN

- The software files will be shared among all the users; therefore, all can access to the latest files.
- Any organization can form its global integrated network using WAN.

Advantages of WAN

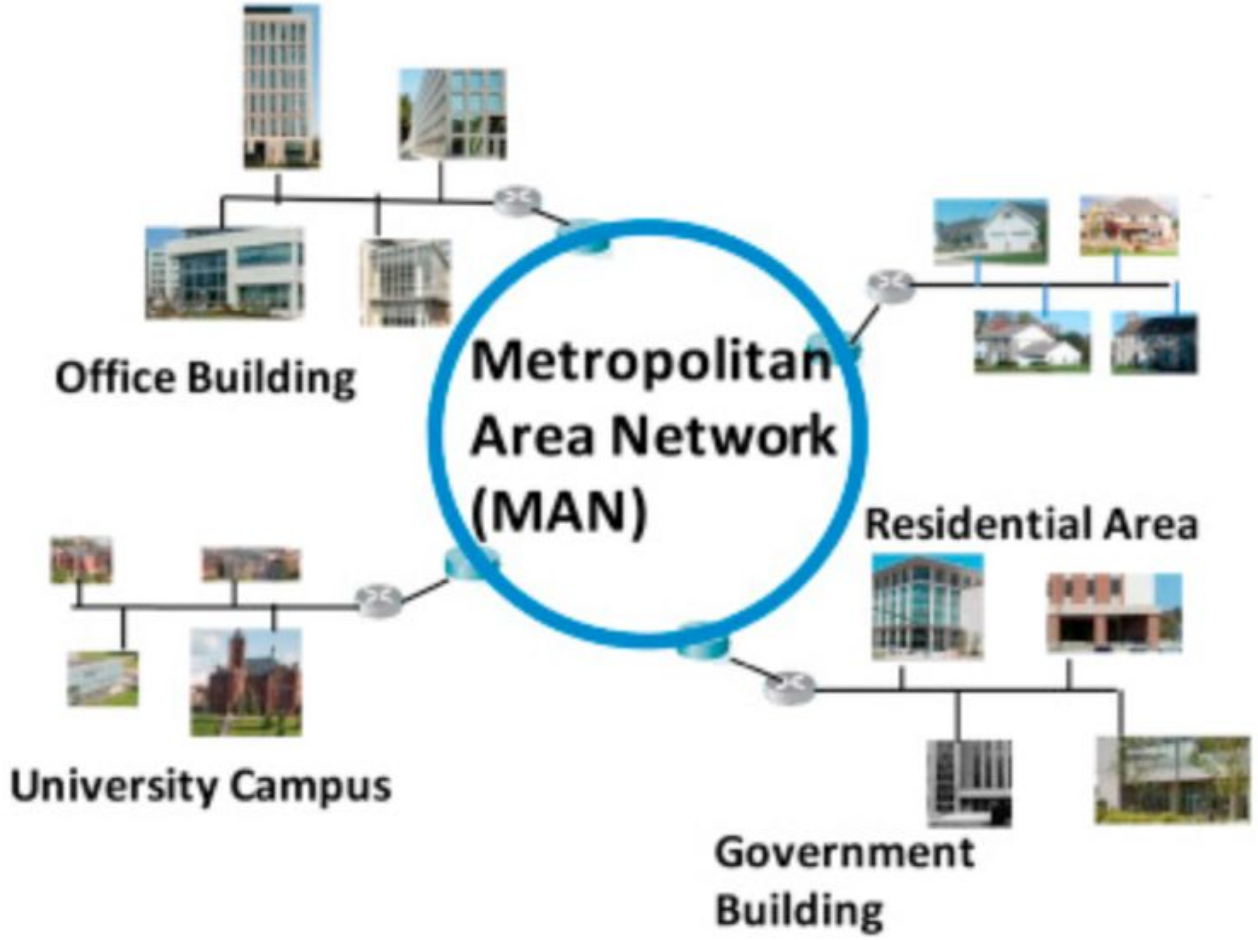
- WAN helps you to cover a larger geographical area. Therefore business offices situated at longer distances can easily communicate.
- Contains devices like mobile phones, laptop, tablet, computers, gaming consoles, etc.
- WLAN connections work using radio transmitters and receivers built into client devices.

Disadvantages of WAN

- The initial setup cost of investment is very high.
- It is difficult to maintain the WAN network. You need skilled technicians and network administrators.
- There are more errors and issues because of the wide coverage and the use of different technologies.
- It requires more time to resolve issues because of the involvement of multiple wired and wireless technologies.
- Offers lower security compared to other types of network in computer.

Metropolitan Area Network(MAN)

- A metropolitan area network (MAN) is a computer network that connects computers within a metropolitan area, which could be a single large city, multiple cities and towns, or any given large area with multiple buildings.
- A MAN is larger than a local area network (LAN) but smaller than a wide area network (WAN).


Office Building
Metropolitan Area Network (MAN)
Residential Area
University Campus
Government Building

Characteristics of MAN

- It mostly covers towns and cities in a maximum 50 km range
- Mostly used medium is optical fibers, cables
- Data rates adequate for distributed computing applications.

Advanatages of MAN

- It offers fast communication using high-speed carriers, like fiber optic cables.
- It provides excellent support for an extensive size network and greater access to WANs.
- The dual bus in MAN network provides support to transmit data in both directions concurrently.
- A MAN network mostly includes some areas of a city or an entire city.

Disadvantages of MAN

- You need more cable to establish MAN connection from one place to another.
- In MAN network it is tough to make the system secure from hackers