NETWORK AND TELECOMMUNICATION

ACADEMIC BACKGROUNDS:

- 1987-1993 Georgia University of Technology (Former USSR) **Specialize: Radio Transmitting Device of Satellite Telecommunication Systems** (Master of Science).
- 1997-1998 Advanced course at the Saint–Petersburg State University of Technology in computer simulation of ground stations Modem for Sputnic communication (Russia).

PREVIOUS EMPLOYMENT:

- 2002-2018 The World Bank Cambodia (IT Analyst, Client Services).
- 1999 -2001 Worked as Systems Engineer at VIRTU International Limited.
- 1995 -1997 Worked as assistant manager in operation and technical department at CAMINTEL.
- 1993 – 1995 Worked as engineer in Operations and Technical Department in HUB-station (ex-UNTAC Networks) at Ministry of Post and Telecommunications of Cambodia.

Teaching Experiences:

- 2000 Royal Academy of Cambodia (MSc.IT).
- 2002 Build Bright University (MSc.IT).
- 2019 National Polytechnic Institute of Cambodia (BSc.Telecom).
- 2020 Norton University (BSc.IT)
- 2023 Cambodia Academy of Digital Technology (BSc.Telecom).

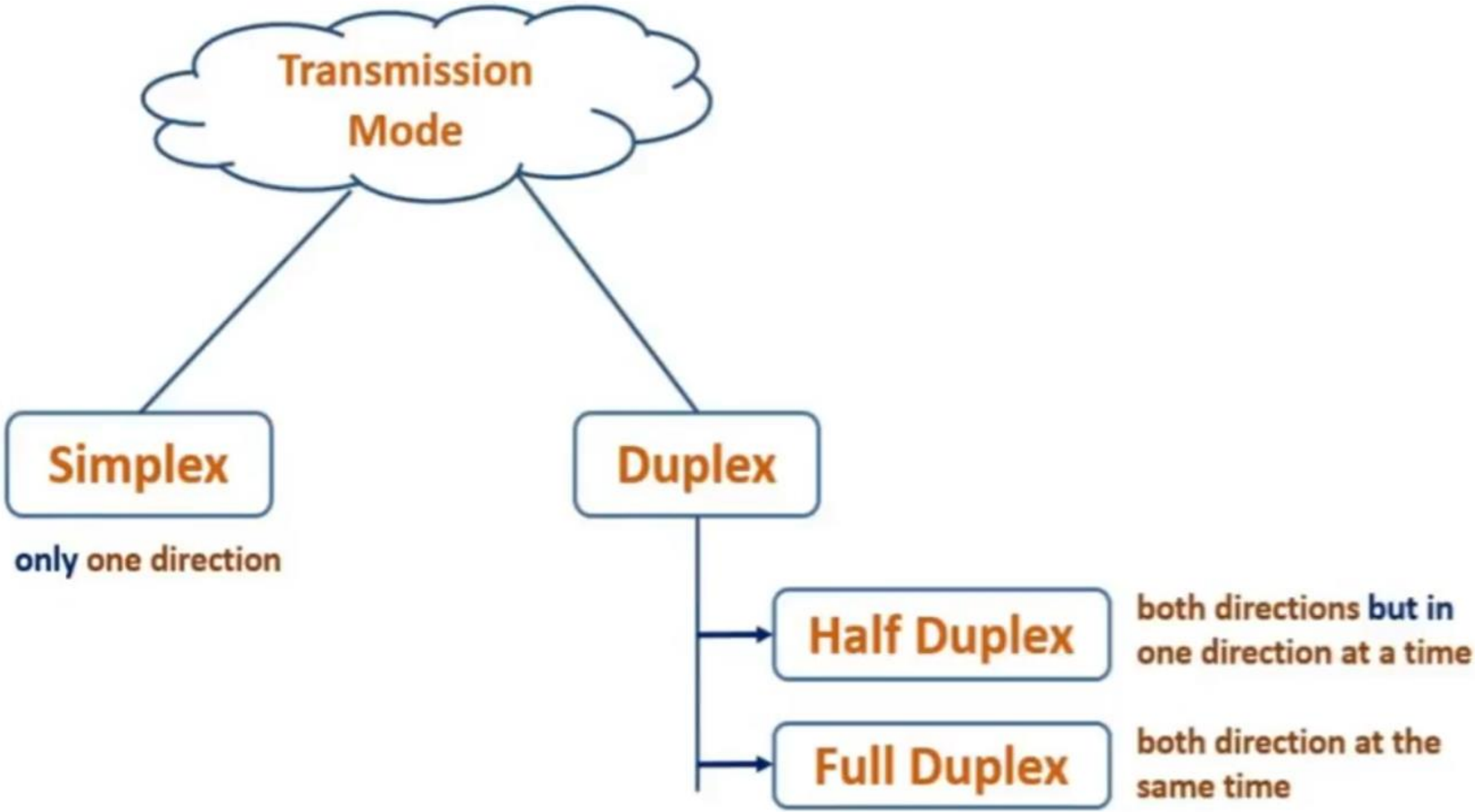
Data Communication Mode

Data Transmission Mode

Simplex **Half Duplex** **Full Duplex**

Transmission Mode

- The term **Transmission Mode** defines the direction of the flow of information between two communication devices.
- The way in which data is transmitted from one place to another is called data transmission mode.
- It indicates the **direction of flow of information**.
- It is also called the **data communication mode**.
- Data transmission modes are also referred to as **directional modes.**

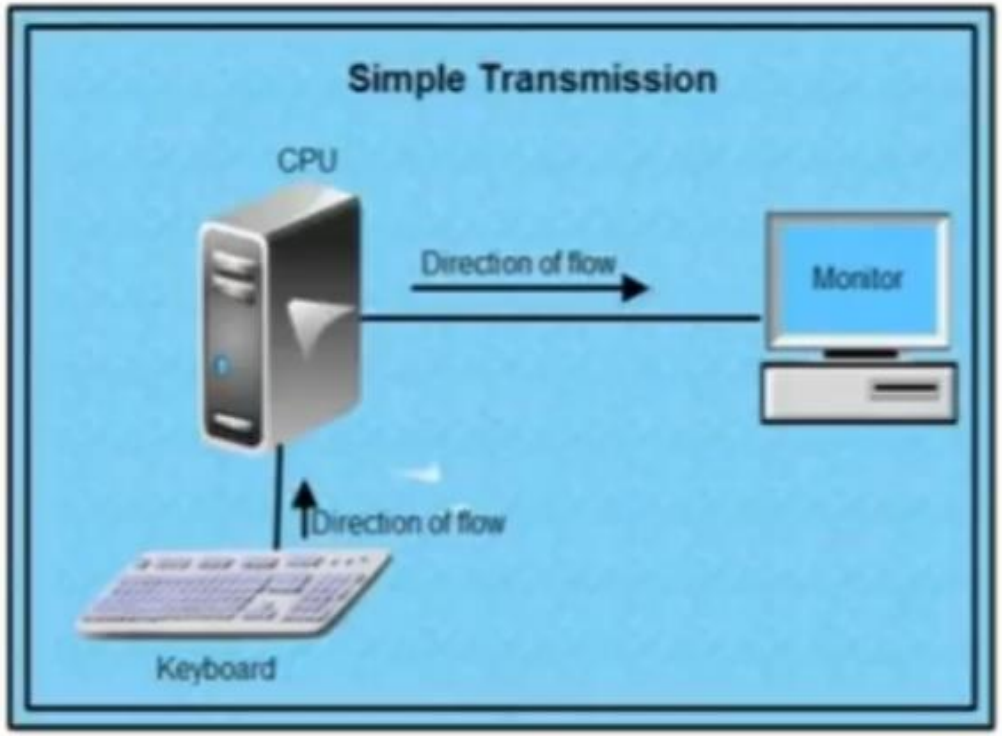

Transmission Mode
Simplex
only one direction
Duplex
Half Duplex
both directions but in one direction at a time
Full Duplex
both direction at the same time

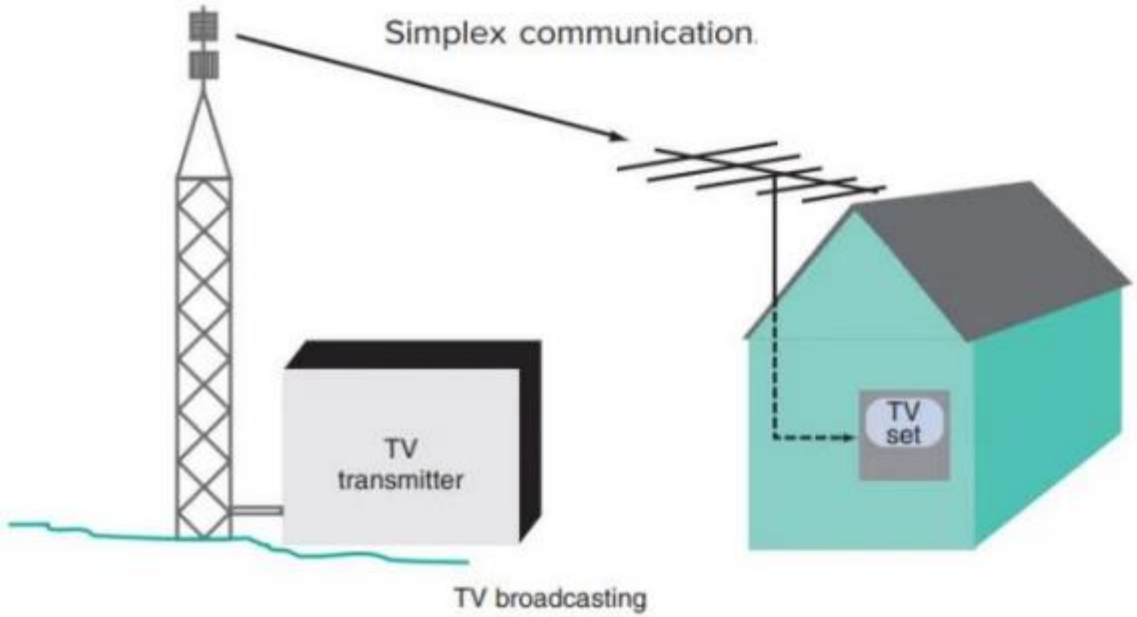
Simplex Mode

- Data can flow in only one direction
- i.e. communication is unidirectional.
- In this mode, a sender can only send data but can't receive it similarly , a receiver can only receive data but can't send it.

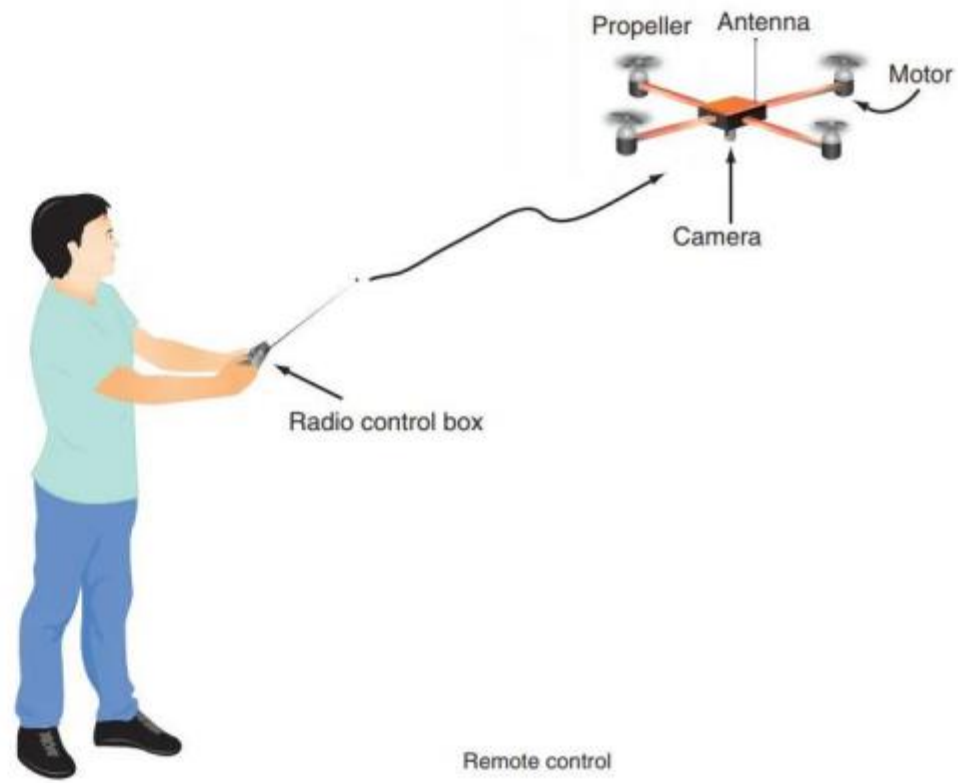
Simplex Mode

- Some Examples of Simplex Mode:-
  - Keyboard or Mouse inputs to CPU.
  - CPU outputs to Monitor.
  - Computer-to-Printer.
  - Scanner-to-Computer.
  - Radio and T.V Transmission



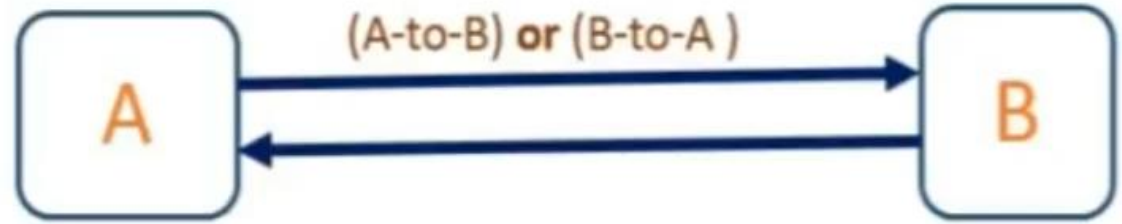


TV broadcasting

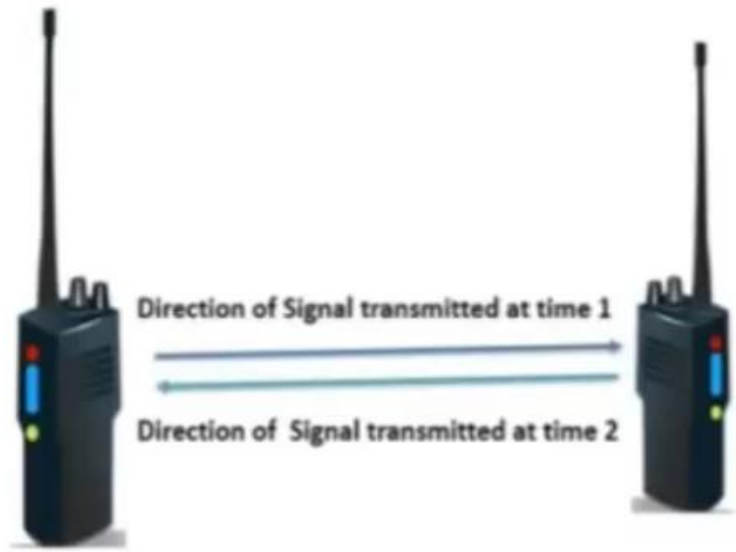


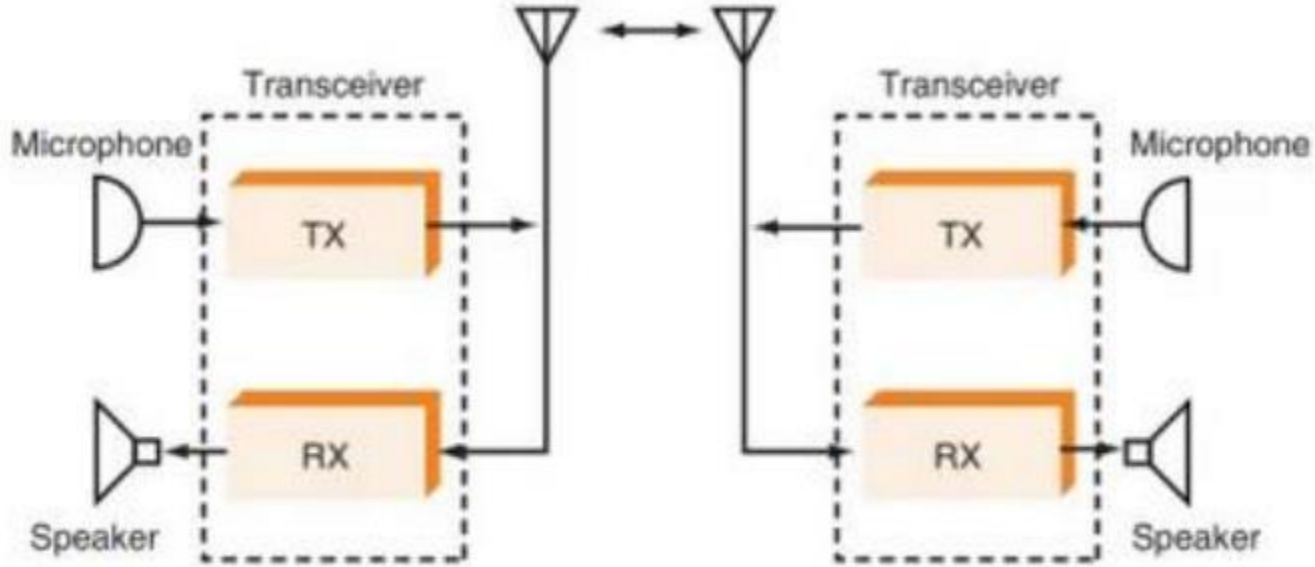
Remote control

Half Duplex Mode

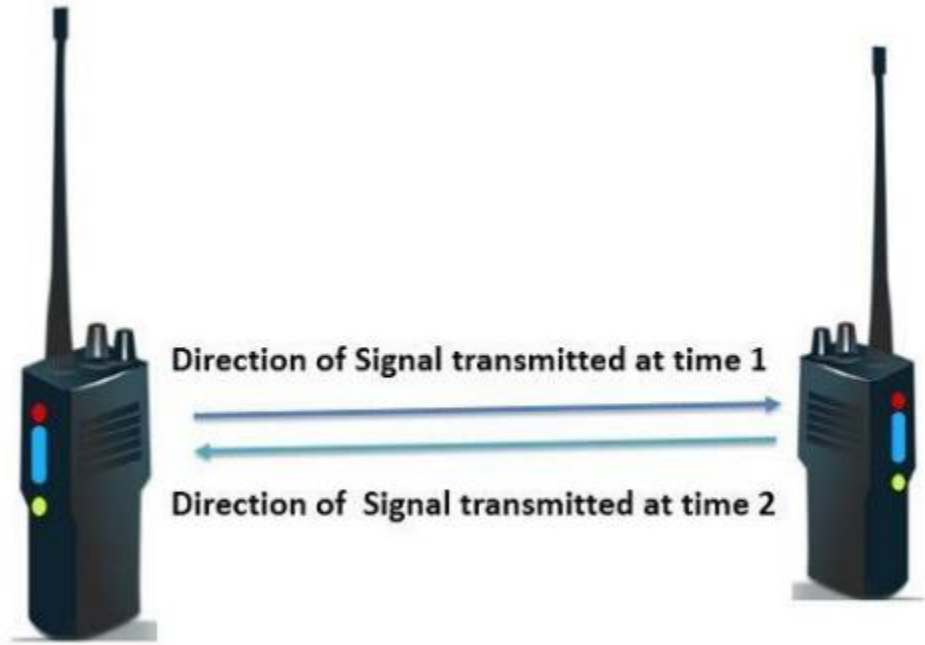


- Data can flow in both directions but in one direction at a time.
- When one device is sending the other can only receive and vice versa.
- For Examples:
  - Walkie-Talkie
  - Internet Browsers

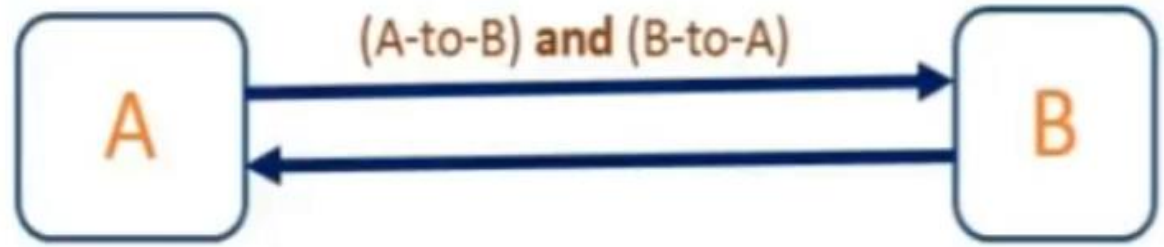




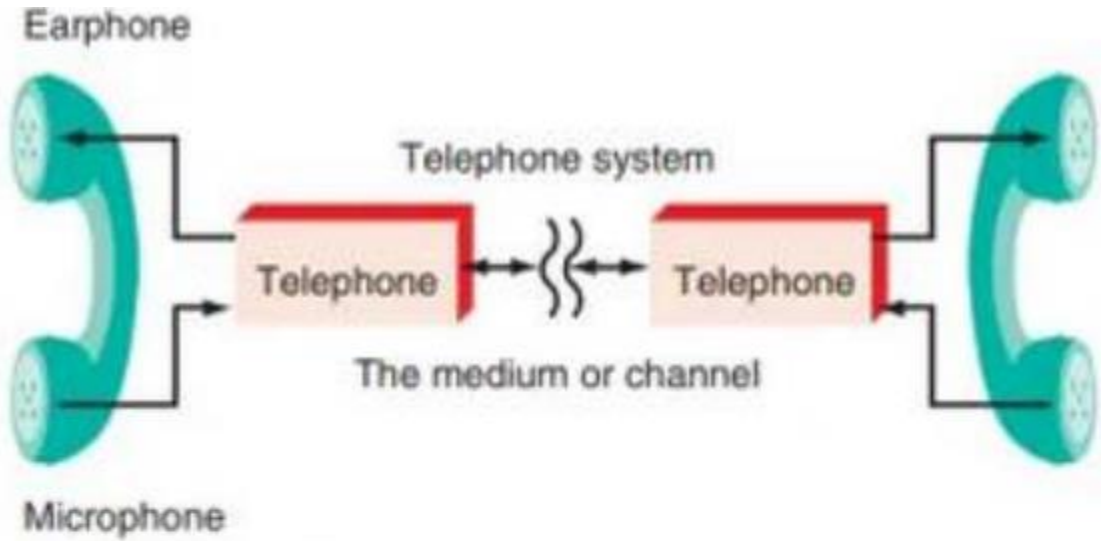
Half duplex (one way at a time)



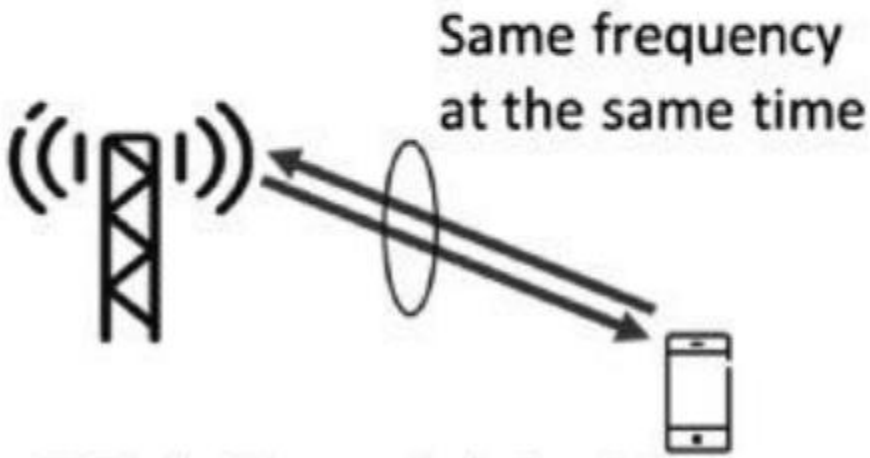
Full Duplex Mode



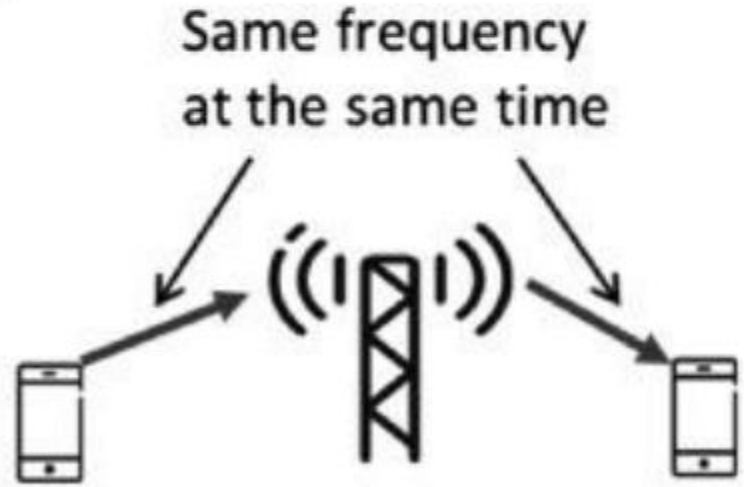
- Data can flow in both direction at the same time.
- it is bidirectional.
- Data can be sent in both directions simultaneously.
- We can send as well as we receive the data.
- Example of Full Duplex is a Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time.



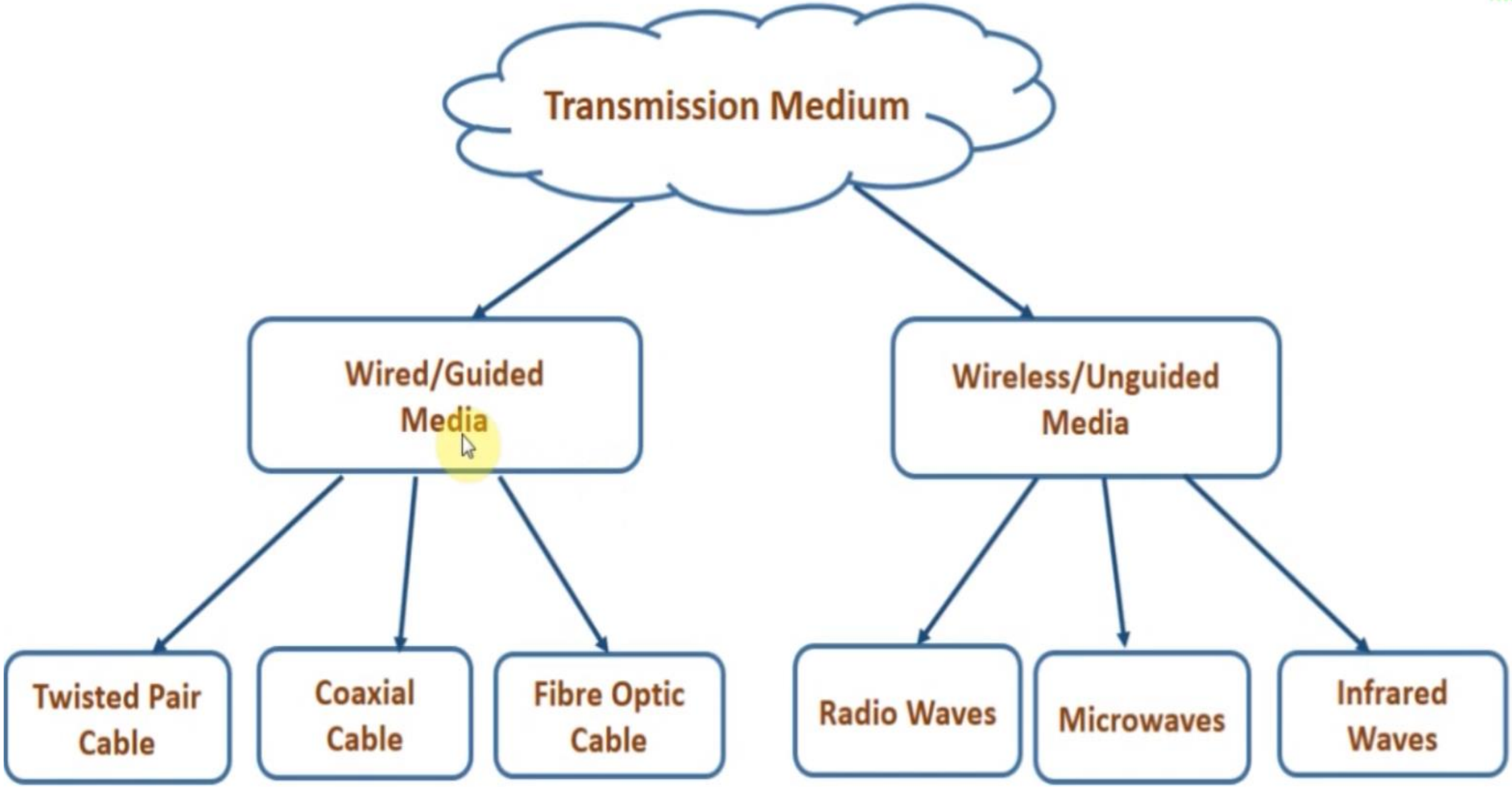
Full duplex (simultaneous, two-way)



Full duplex on link level



Full duplex on cell level


Transmission Medium
Wired/Guided Media
Wireless/Unguided Media
Twisted Pair Cable
Coaxial Cable
Fibre Optic Cable
Radio Waves
Microwaves
Infrared Waves

Communication Channels

(Communication Media or Transmission Media)

Communication channel is a path that connects the sender and receiver for transmission of information over a network.

Guided Media

(wired or bounded media)

Data signals are enclosed in a cabling media.


Twisted Pair


Coaxial


Fibre Optics

Unguided Media

(wireless media)

Electromagnetic waves of different frequencies are used


Microwave


Radio Wave


Cellular


Infrared


Satellite

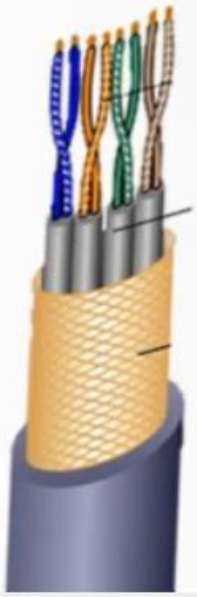
Communication Channels

(Communication Media or Transmission Media)

Guided Media

(wired or bounded media)

Twisted Pair



Coaxial

Fibre Optics

Unguided Media

(wireless media)

Microwave

Radio Wave

Cellular

Infrared

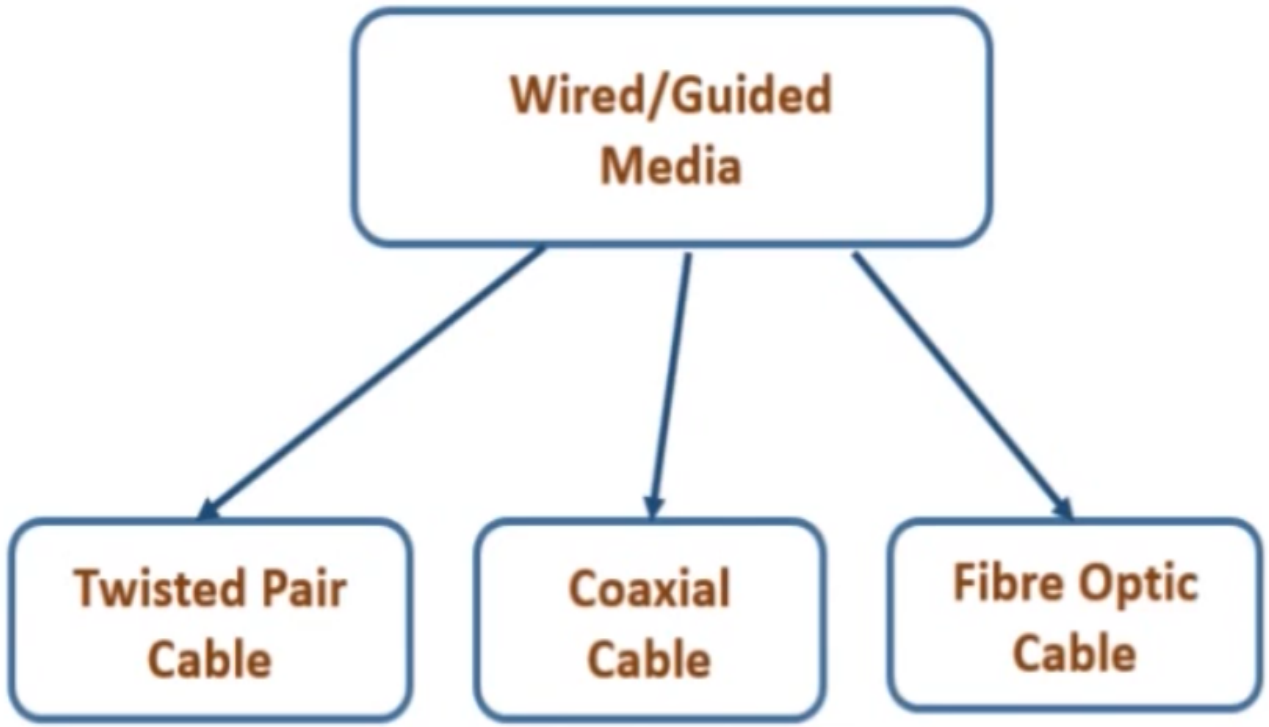
Satellite

Transmission Medium

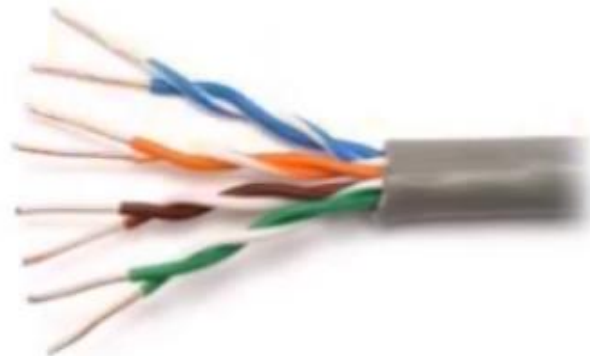
- Transmission medium is the way in which data is transmitted from one place to another.
- It provide a pathway over which the message can travel from sender-to-receiver.
- Each of the message can be sent in the form of data by converting them into binary digits.
- These binary digits are then encoded into a signal that can be transmitted over the appropriate medium.

Wired/Guided Transmission Media

- Guided transmission media are the cables that are tangible or have physical existence.
- Bounded transmission means having connectivity between a source and destination using cables or wires. The signals have to travel through this channel i.e. physical media



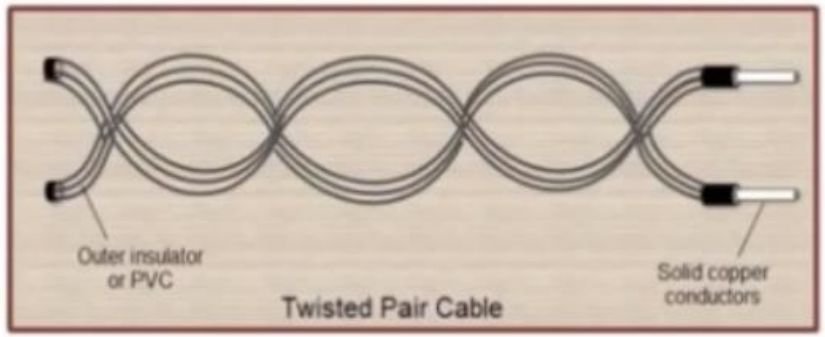
Twisted Pair Cable

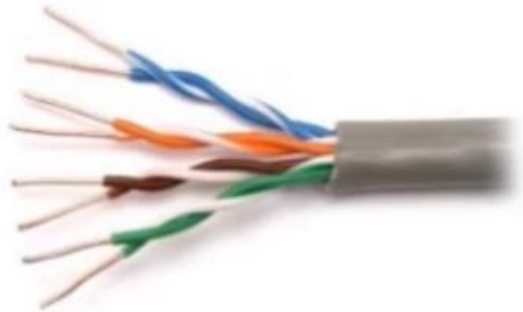


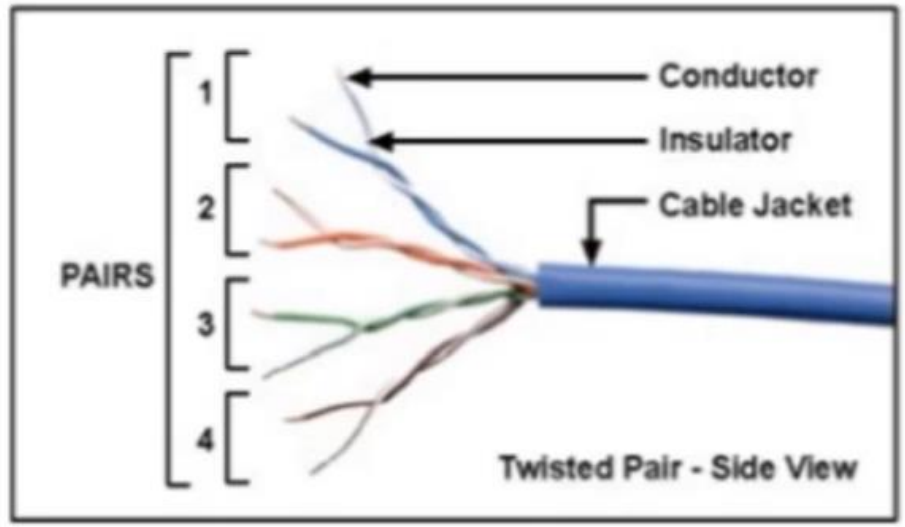
- A twisted pair cable is a pair of copper wires.

- Copper wires are the most common wires used for transmitting signals because of good performance at low costs.

Twisted Pair Cable

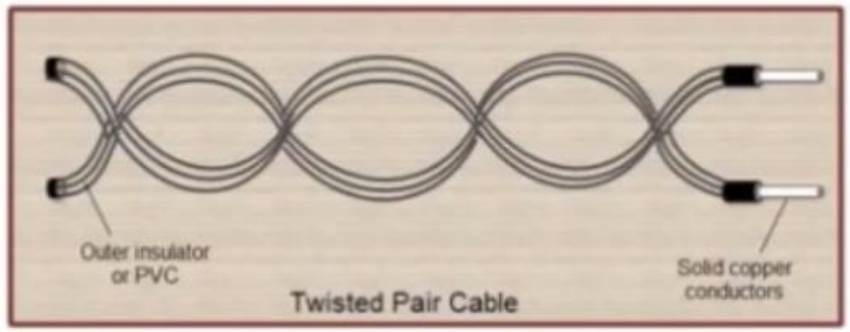


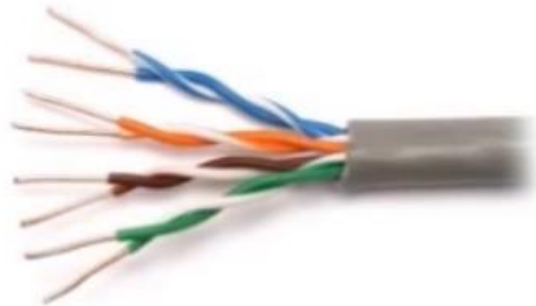


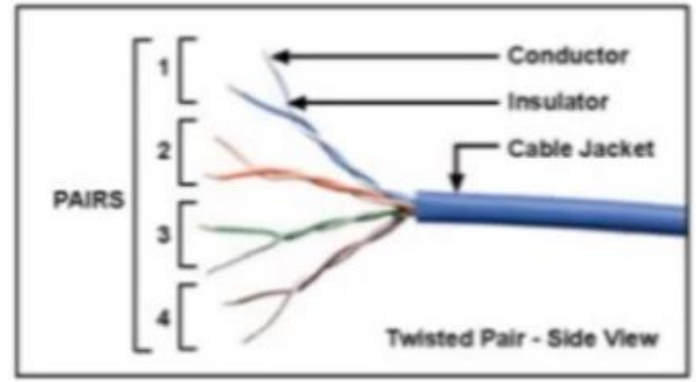


- A twisted pair cable is a pair of copper wires.
- Copper wires are the most common wires used for transmitting signals because of good performance at low costs.
- A twisted pair consists of two conductors(normally copper), each with its own plastic insulation, twisted together to form a single media.

Twisted Pair Cable



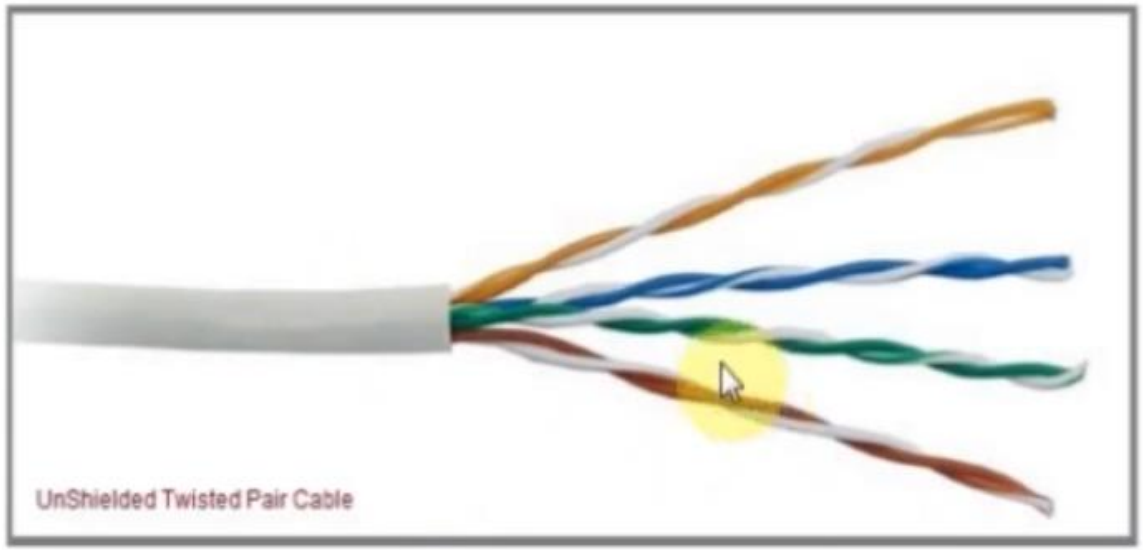


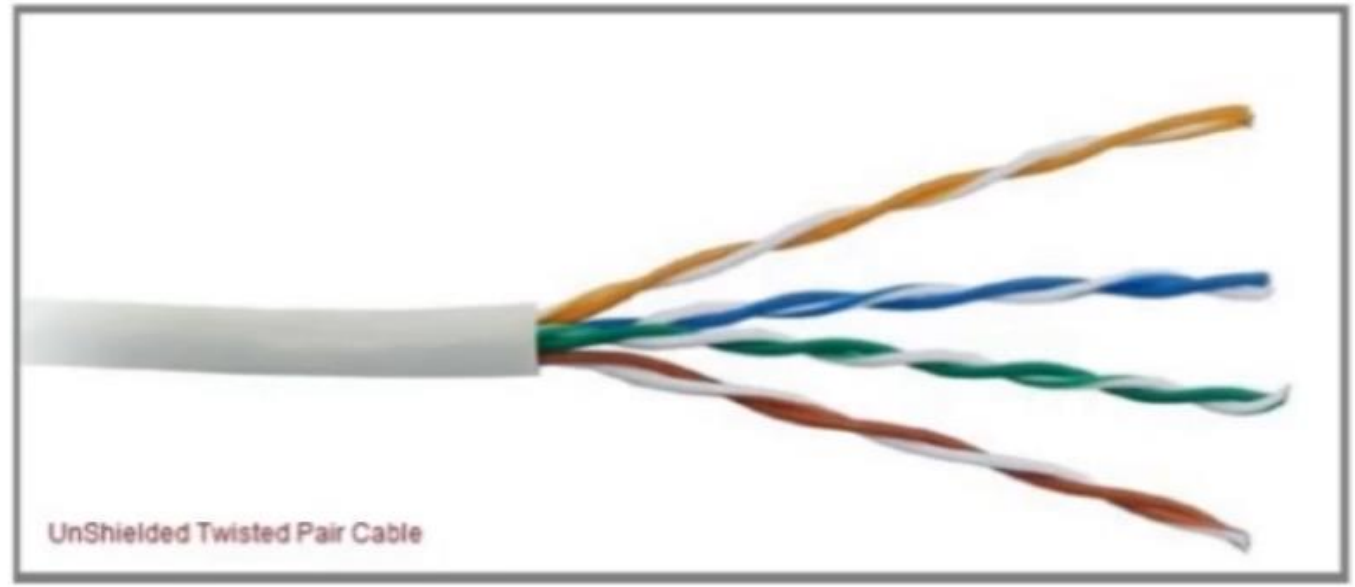


- Out of these two wires, only one carries actual signal and another is used for ground reference.
- To identify every cable, these cables are colour coated.
- The twists between wires are helpful in reducing noise (electro-magnetic interference) and crosstalk.
- This type of cable is used in telephone lines to provide voice and data channels.

Types of Twisted Pair

- The two types of twisted pairs are:
  - **1. Unshielded twisted pair (UTP)**
  - **2. Shielded twisted pair (STP)**

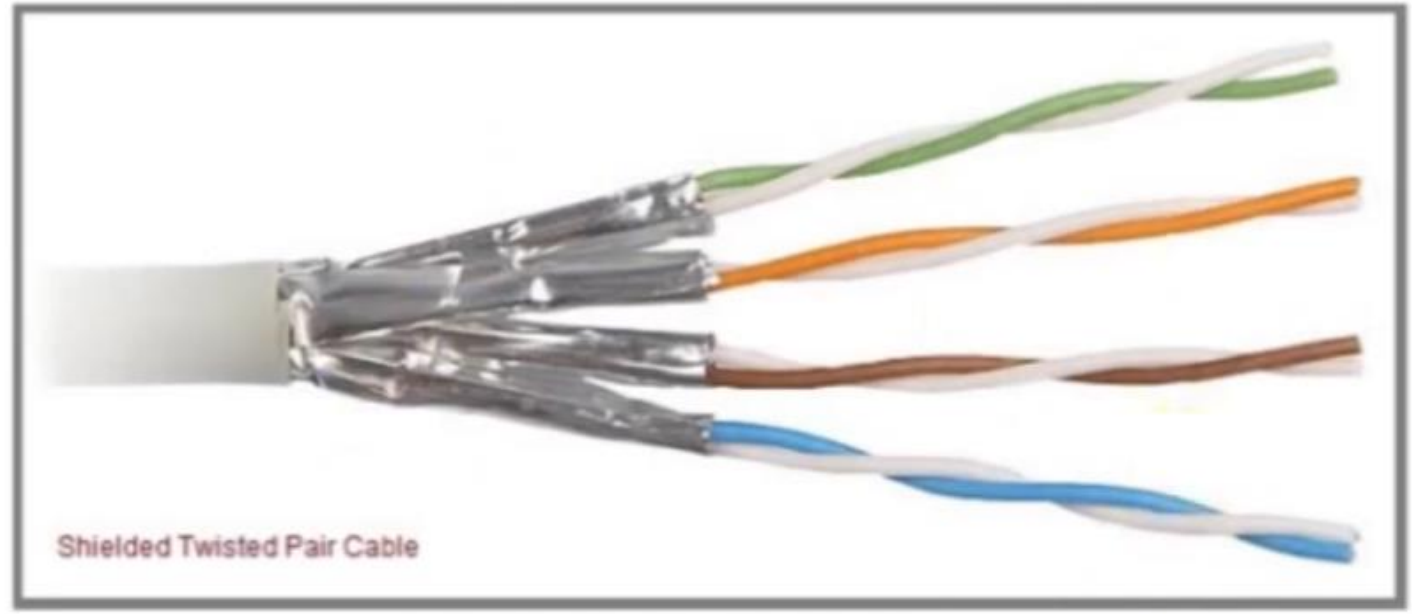




- **Unshielded twisted pair (UTP):-**
  - UTP is more common.
  - UTP cost less than STP and easily available due to its many use.
  - Due to its low cost, UTP cabling is used extensively for local-area networks (LANs) and telephone connections.
  - UTP cables consist of 2 or 4 pairs of twisted cable.
  - Cable with 2 pair use RJ-11 connector and 4 pair cable use RJ-45 connector.

RJ-11	RJ-45
6 pin 	8 pin 

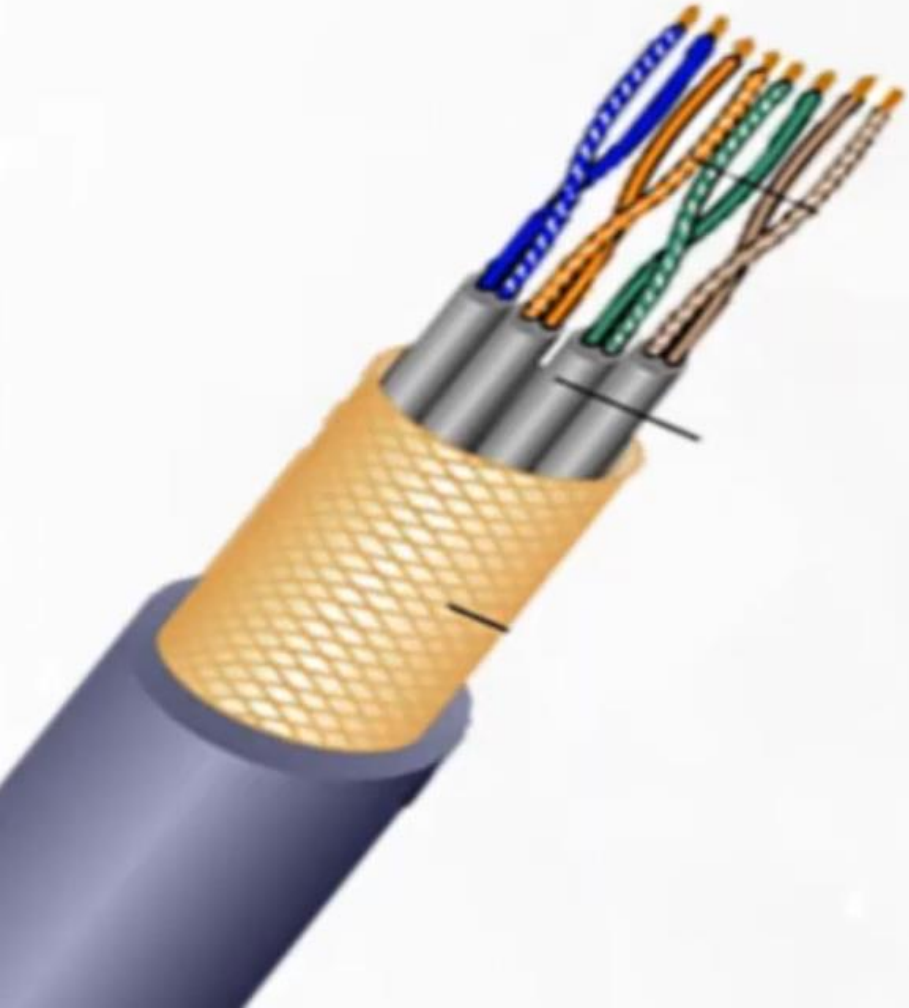
- RJ-45 connectors is used with Ethernet cables in computer networking.
- RJ-11 connectors is used in connecting telephone units.



- **Shielded twisted pair (STP):-**
  - This type of cable has a metal foil covering which encases each pair of insulator conductors.
  - Electromagnetic noise penetration is prevented by metal casing. Shielding also eliminates crosstalk.
  - It is similar to UTP but has a mesh shielding that's protects it from EMI which allows for higher transmission rate.
  - It is more expensive than coaxial and unshielded twisted pair.

Twisted Pair

Speed: 10 mbps to 10 gbps



Characteristics

- Most popular
- Used in LAN and Local Telephone Lines
- Can carry voice and data signals
- Copper wires pair are insulated by plastic
- Wires are twisted together in order to reduce noise.
- It is of two types, Unshielded Twisted Pair(UTP) and Shielded Twisted Pair (STP).
- Inexpensive and easy to install and maintain.

Disadvantages

- Unsuitable for long distance
- Speed is less than coaxial cable or fibre optics.

Comparison between UTP and STP

Sr. No.	Parameter	UTP (Unshielded)	STP (Shielded)
(1)	Data Rate	10-100 Mbps	150 Mbps
(2)	Cable length	100 meter max	500 meter max
(3)	Electrical interference	most Interference and cross talk occurs	Less Interference and cross talk occurs
(4)	Installation	Easy to install	Very easy to install
(5)	Cost	Lowest	Little costly

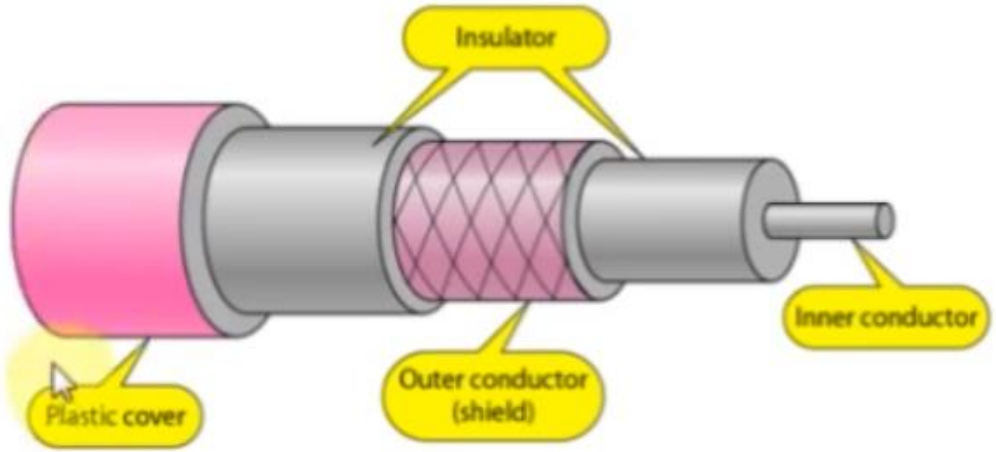
Coaxial Cable

- **Coaxial cables** are copper cables with better shielding than twisted pair cables, so that transmitted signals may travel longer distances at higher speeds.

- The shield minimizes electrical and radio frequency interference.

- Coaxial cabling is the primary type of cabling used by the cable television industry and is also widely used for computer networks, such as Ethernet.

Coaxial Cable



- Coaxial cable has two wires of copper.
- The core/inner copper wire in centre and is made of solid conductor. It is enclosed in an insulating sheath.
- The second/outer copper wire is wrapped around, and is used to protect from external electromagnetic interference(Noise).
- This all is covered by plastic cover used to protect the inner layers from physical damage such as fire or water.

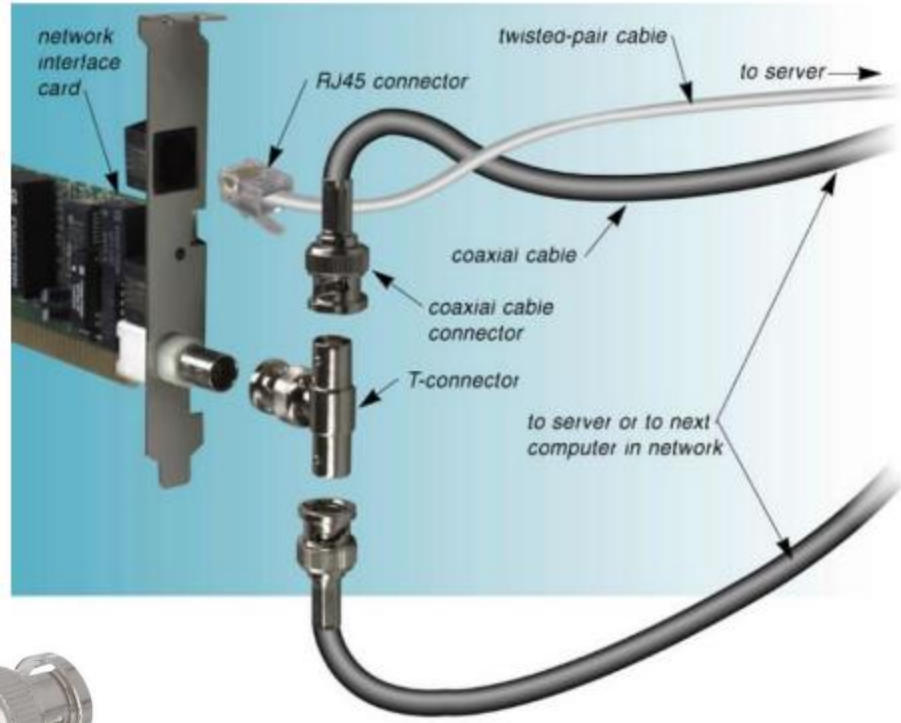
Coaxial Cable Standards

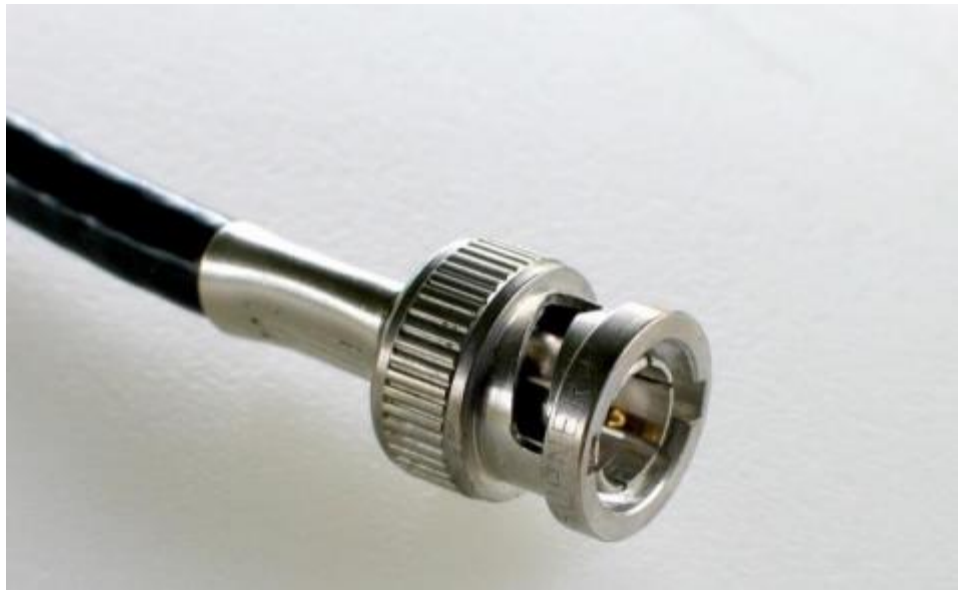
- Coaxial cables are categorized by their Radio Government (RG) ratings. Each RG number denotes a unique set of physical specifications
  - 50-Ohm RG-7 or RG-11 : used with thick Ethernet.
  - 50-Ohm RG-58 : used with thin Ethernet
  - 75-Ohm RG-59 : used with cable television

50 Ohm

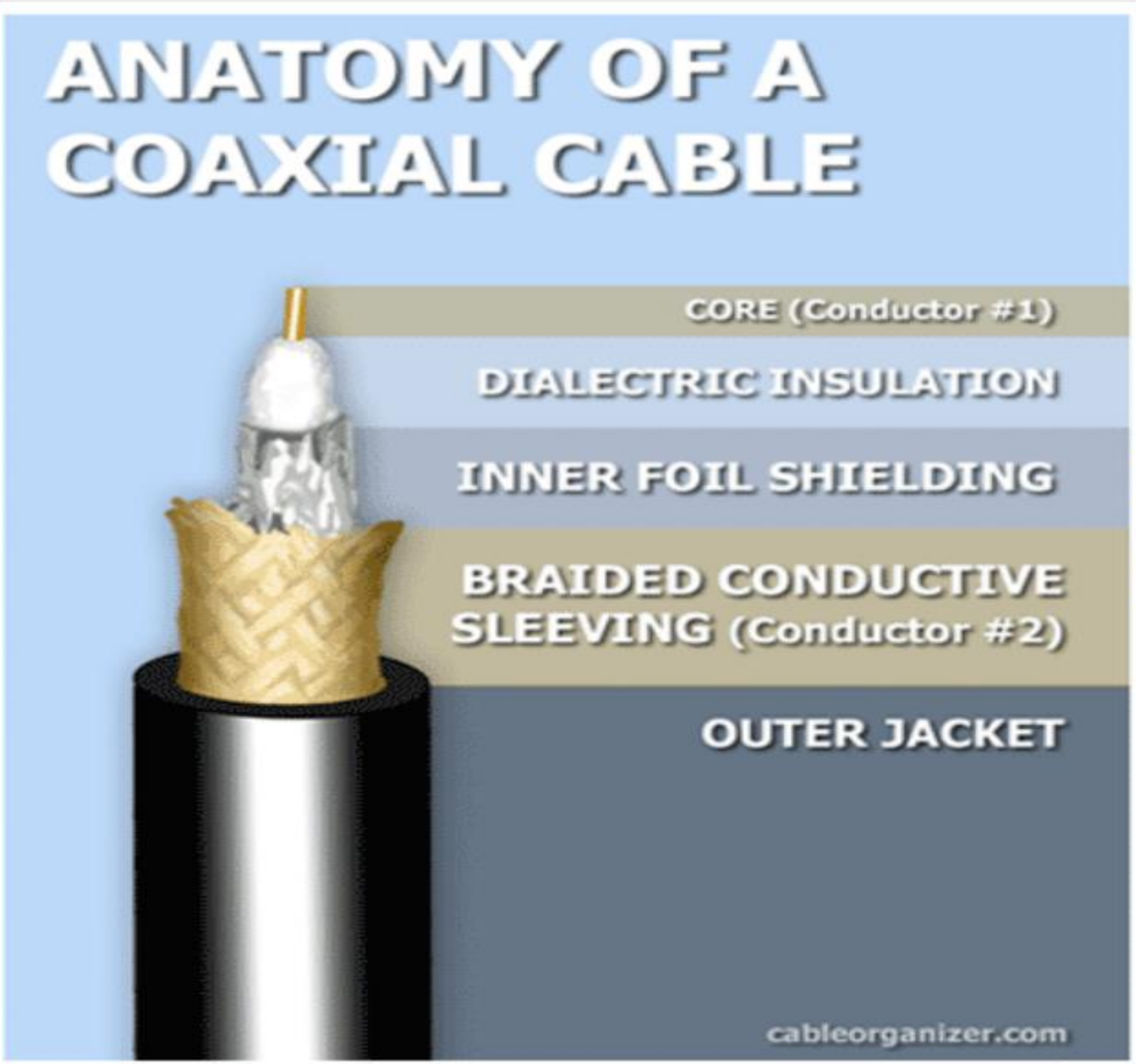
75 Ohm

RG CABLE


network interface card
RJ45 connector
twisted-pair cable
to server
coaxial cable
coaxial cable connector
T-connector
to server or to next computer in network



- ប្រភេទខ្សែប្រើប្រាស់សម្រាប់វិស័យទូរគមនាគមន៍មានដូចខាងក្រោម៖



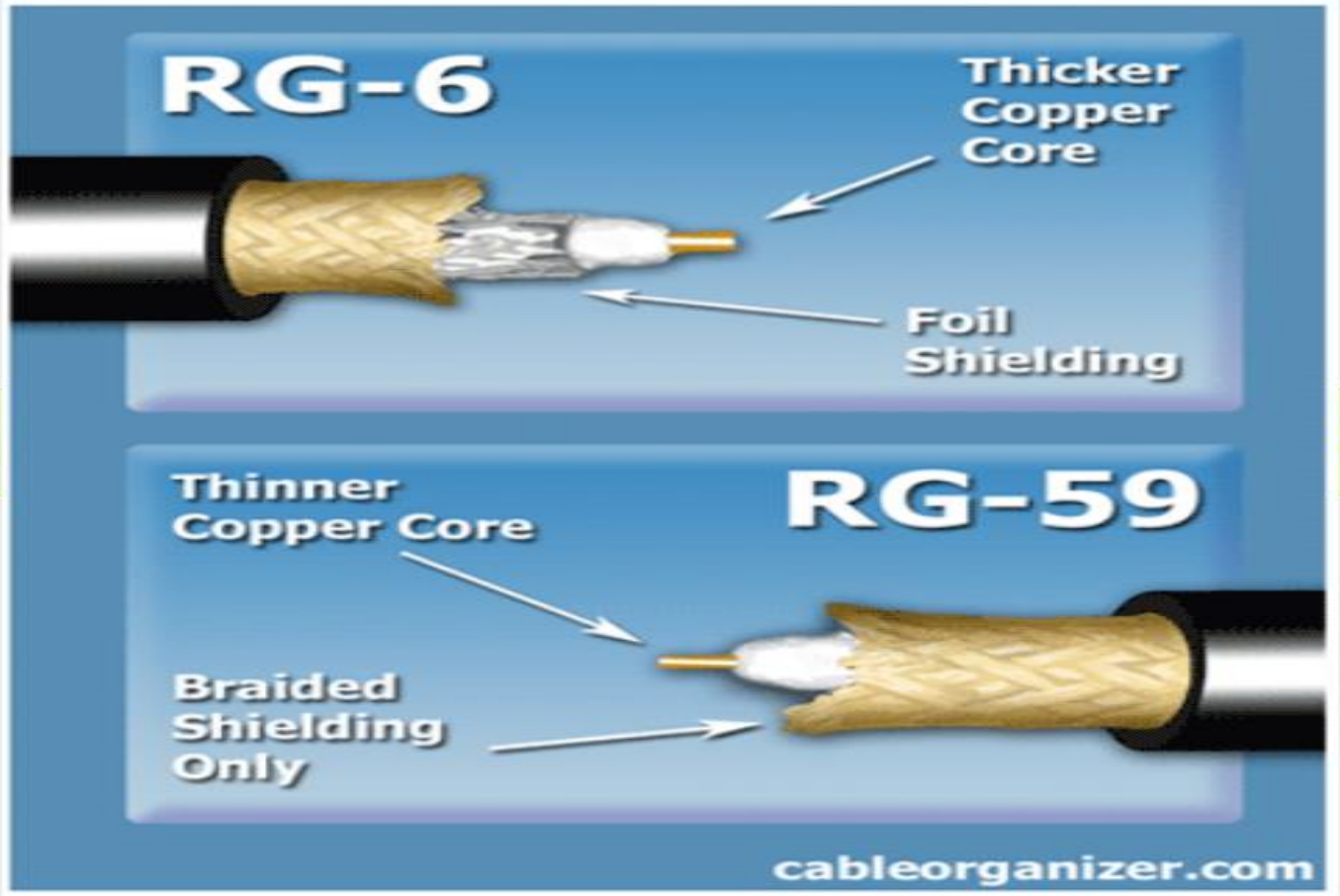
What is Coaxial Cable?

Everyone's heard of coaxial cable, right? Or maybe you've heard it by its hip nickname: "coax" (that's two syllables, co + ax…not the word that means “to draw forth”). It's a fairly common type of shielded data transmission cable, which is made up of two conductors that are coaxially oriented (hence the name), but separated by a layer of insulation. The make-up of your typical coax is as follows: the core consists of a metal wire (conductor #1), which is then surrounded by a layer of nonconductive dielectric insulation, which is itself covered in metallic mesh, foil and/or braid (conductor #2), and then whole shebang is wrapped in a protective outer sheathing, or jacket, which holds everything together and locks out moisture and impurities (sorry Phil Collins, a jacket is required…if you don't get that reference, ask an old person about the 80's).

What is Coaxial Cable Used For?

Good question! Coax is designed to carry high-frequency signals, and to protect those signals against electromagnetic interference (EMI) from external sources. Most people probably associate it with their cable television (CATV) service, and probably have not-so-fond memories of squeezing behind the TV to try and thread the end of the cable onto the wall outlet and/or the back of the TV set. But you'll find these cables in lots of other applications, including commercial radio communications, ham radio, undersea cable systems, closed-circuit television (CCTV), home video equipment, and broadband Ethernet application.

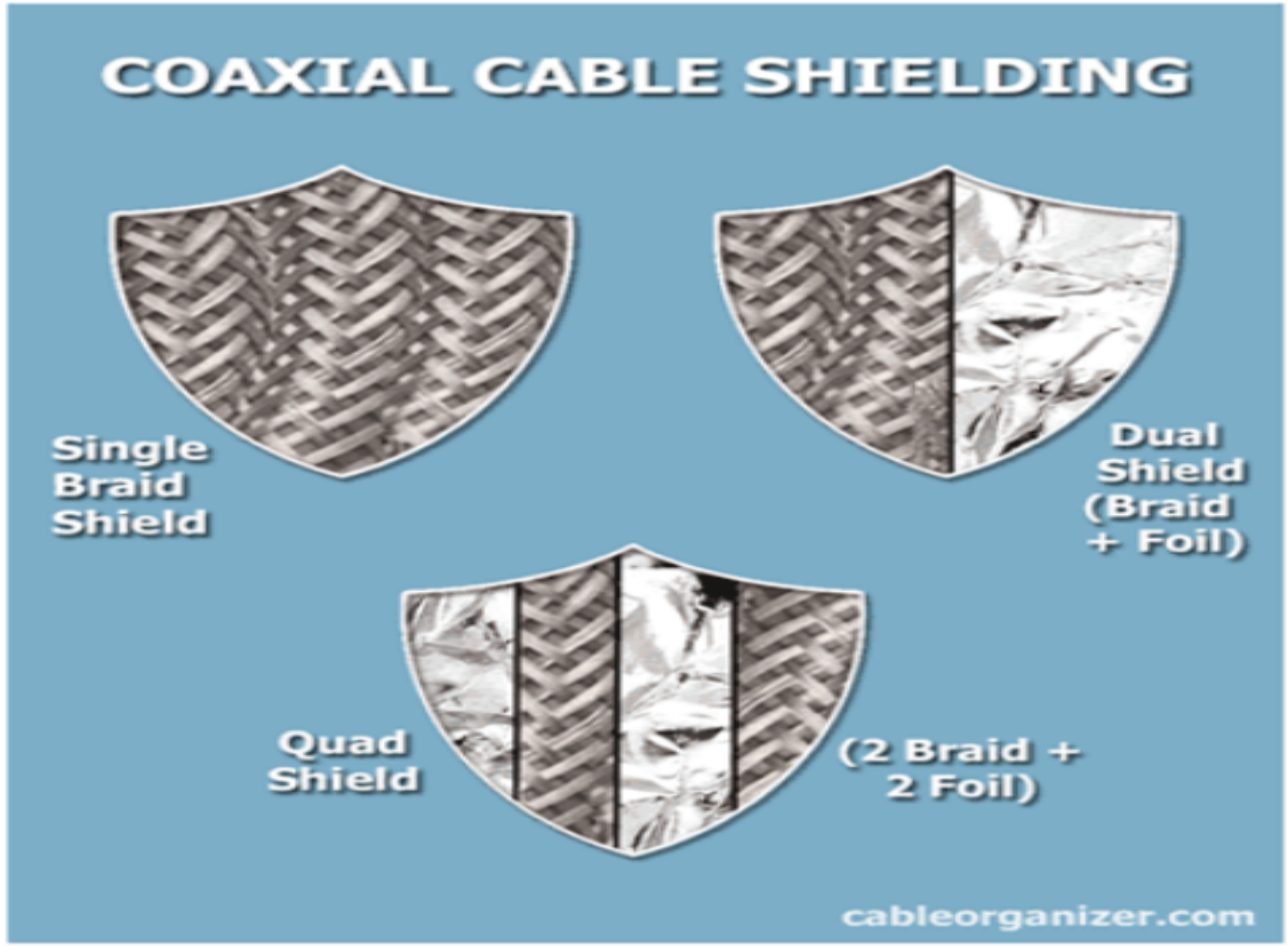
Back Next



What Does the "RG" in Coaxial Cable Types Like "RG-6" and "RG-59" Stand For?

Really Good? Rapid Growth? Rockstar Groupies? No silly, none of those. It turns out, the "RG" is short for "Radio Guide", a term that dates back to the World War II era, when the military made heavy use of coax, and developed a set of standards to specify different grades and their applications. Even though us civilians still refer to coaxial cables by their original RG numbers today, these standards are now obsolete in the actual military, which now uses the umbrella specification of MIL-C-17.

There are dozens of RG specifications, but there's no real rhyme or reason to the numbers they're assigned; it's actually pretty random. When it comes to the most commonly utilized specifications, both RG-6 and RG-59 cables are widely used in residential settings, especially when it comes to TV. The difference is found in the specific signals they're used for: RG-59 is the norm for standard Cable (CATV), while RG-6 is the coax that handles digital video signals and satellite TV. When you compare the two types side by side, RG-6 has a larger core conductor, thicker dielectric insulation, and anywhere from 2 to 4 layers of shielding, versus RG-59's one. These physical differences make RG-59 best suited to low-frequency transmissions and short cable runs, and RG-6 the ideal choice to carry high frequency signals over long distances. So basically; 6 rules, 59 drools. However, the shielding used by both respective types is typically tailored to their use, which means RG-59 is better for short-range, “baseband” applications (video projectors, component video, etc.), and 6 is geared toward long-range, satellite and cable feeds.

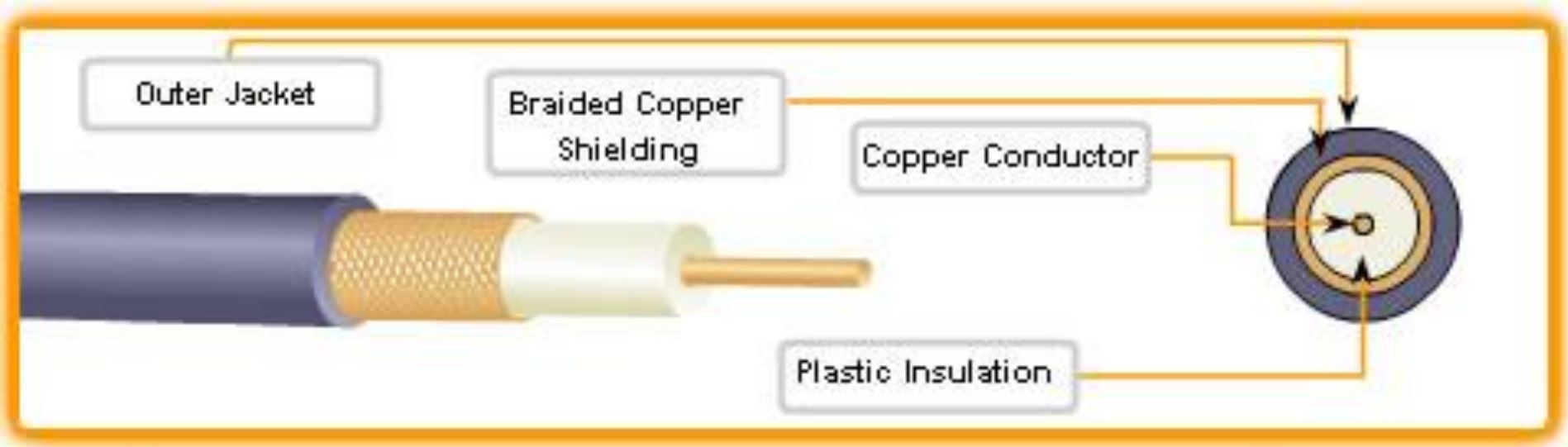


What Makes One Cable Better than Another?

In the coax world, better shielding equals less signal interference, so that's one good way to measure a cable's quality. Types of shielding can vary greatly, as can the amount present from one cable to next – coax typically has anywhere from one to four layers. The best coaxial shields are the ones that offer the highest density, or percentage of cover. Tightly-woven metal braid makes an excellent choice – not only is it highly conductive, it can provide as much as 95% coverage. To deal with that extra pesky 5%, some manufacturers combine braid with an additional layer or two of metallic foil (like a coaxial baked potato!), which helps to block small amounts of EMI that often manage to seep into the cable through tiny holes found in the braid.

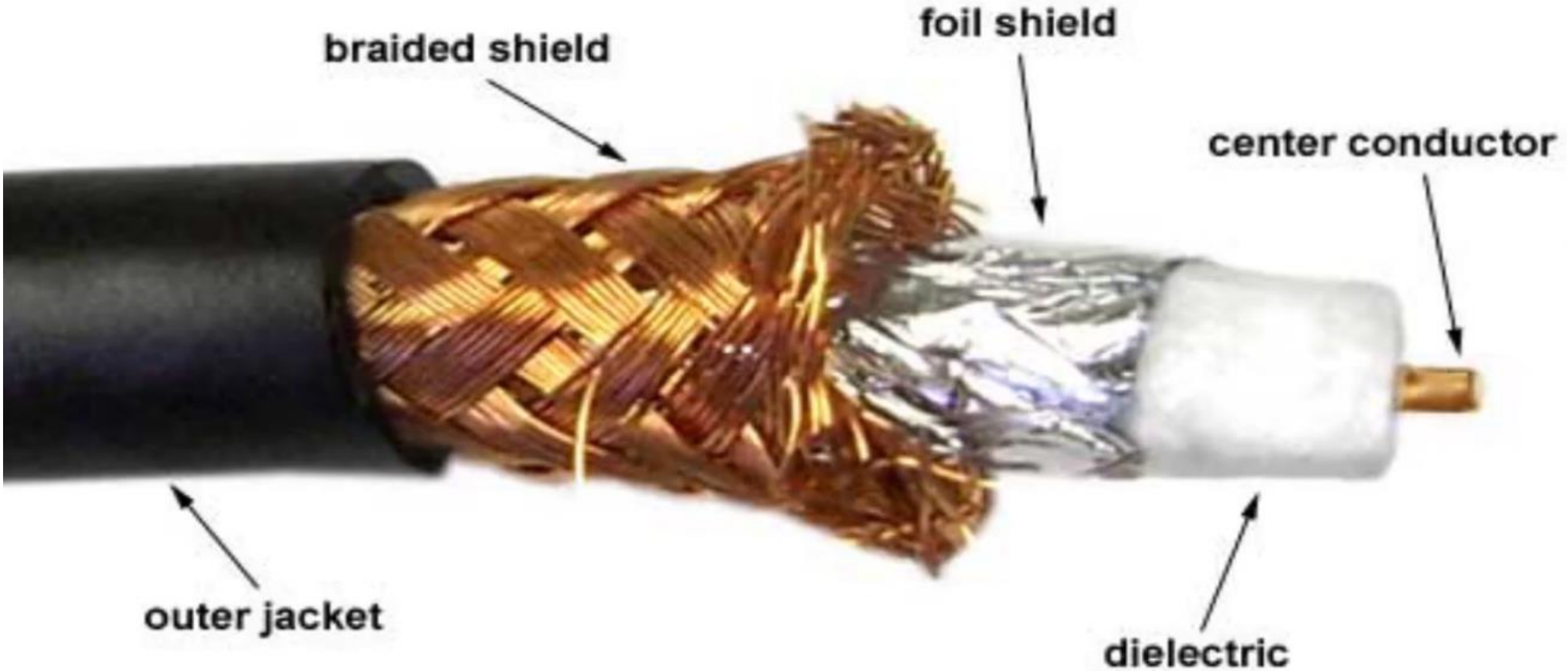
When it comes to cable quality, conductor materials can be a controversial topic that's sure to stir up debate. While some manufacturers and A/V enthusiasts will tout the benefits of silver and oxygen-free copper (OFC), the truth is that – used as core conductors – these metals generally don't perform any better than standard or tinned copper. They do, however, sound really fancy, and are often used to justify obscene price mark-ups on what is, essentially, the same cable. In the end, we'd recommend trusting a cable's specifications over hoity-toity labeling.

So, now that you're up to speed, why not head over and check out our coaxial cables?

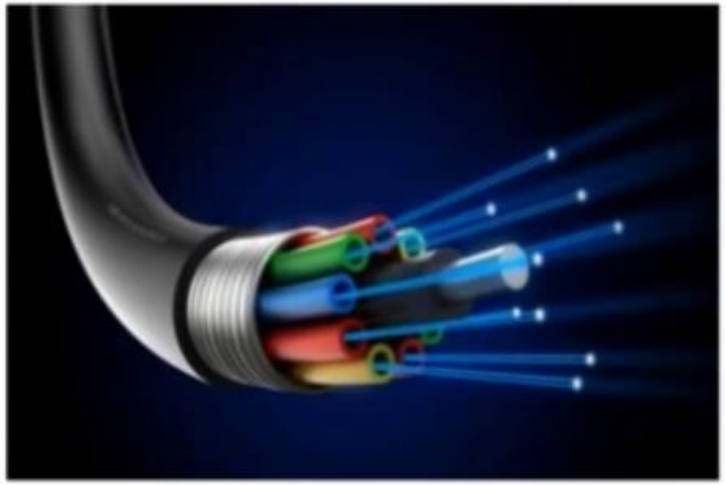

Outer Jacket
Braided Copper Shielding
Copper Conductor
Plastic Insulation

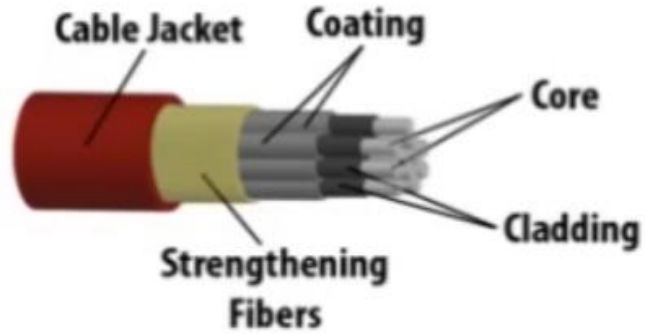

Coaxial Connectors
BNC
N type
F type

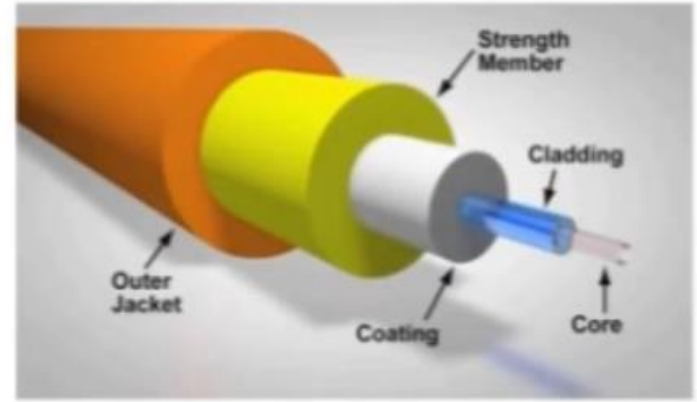
COAXIAL CABLE



Fibre Optics Cable







- A fibre optic cable is made of high quality of thin glass or plastic and is used to transfer digital data signals in the form of light up to distance of thousand of miles.
- Fibre optic cables are not affected by electromagnetic interference, so noise and distortion is very less.
- Fibre optic cables carry communication signals using pulses of light generated by small lasers or light-emitting diodes (LEDs).
- The cable consists of one or more strands of glass, each only slightly thicker than a human hair. The centre of each strand is called the core, which provides the pathway for light to travel. The core is surrounded by a layer of glass called cladding that reflects light inward to avoid loss of signal and allow the light to pass through bends in the cable. No light escapes the glass core because of this reflective **cladding.**

Coaxial Cable (coax)

Speed: 10 mbps to 100 mbps

Characteristics

- It is used for video transmissions for televisions or for long-distance telephone lines and LANs
- Single solid copper wire core that is covered by insulating material.
- Copper mesh is used to cover the insulated copper wire to protect from electromagnetic waves.
- Carries both analog and digital signals.
- Carries high-frequency range signals
- It is of two types, thicknet and thinnet.

Disadvantages

- Expensive than twisted pair
- Not compatible with twisted pair cables

Fibre Optics

Speed: 100 gbps+

Characteristics

- Used for Internet or long distance communication
- Digital signals are sent as light pulses which are translated back into electrical signals
- Fine glass strand surrounded by glass cladding and protective layer
- Glass cladding reflects light back into the core, guiding the light along the wire
- Thousands of transmissions can be carried on a single strand
- Secure and has very low signal loss.

Disadvantages

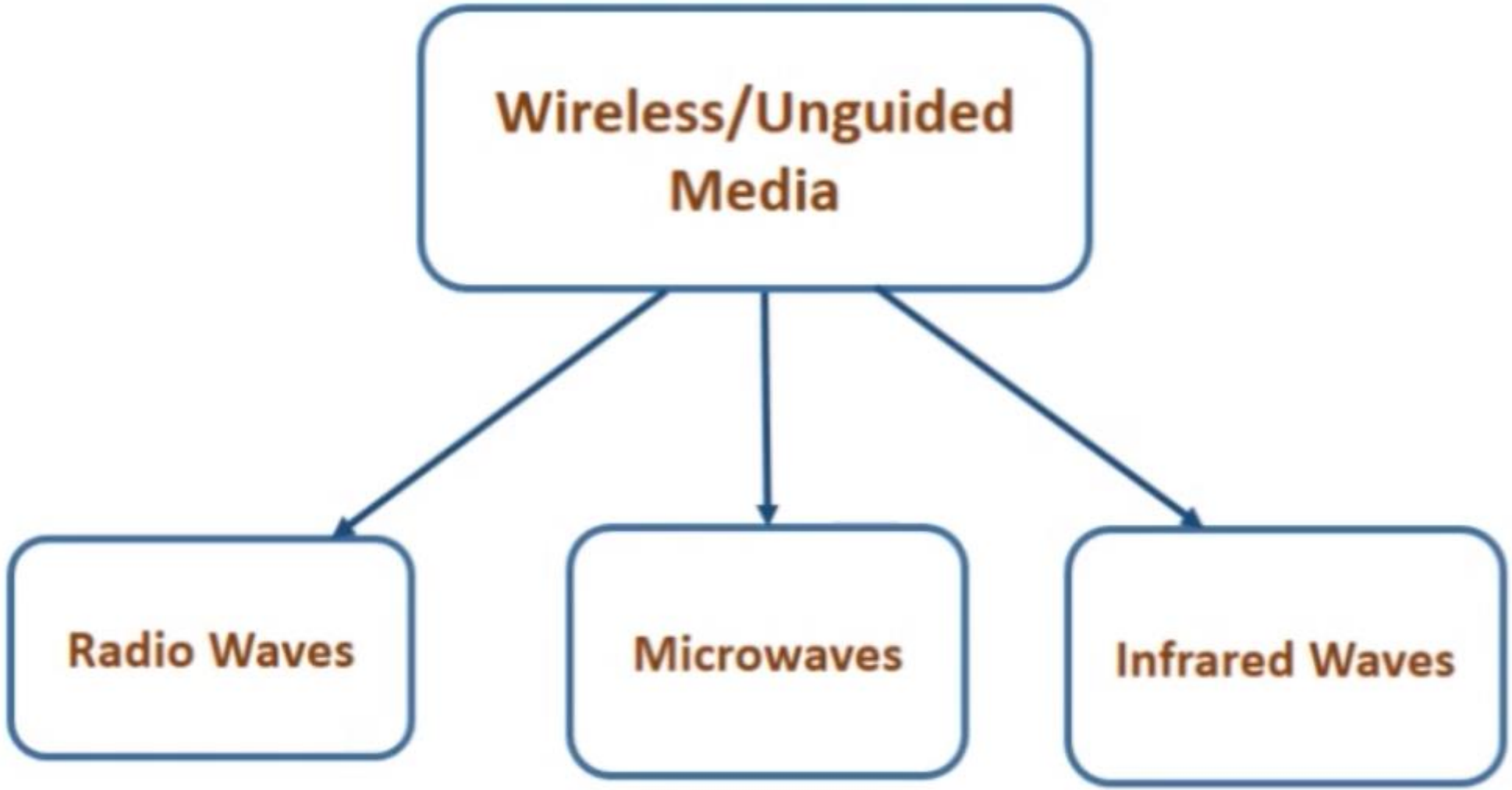
- Expensive, difficult to install and modify.

- **Advantages of Optical Fibre:-**

  - Fibre optic cables have a much High bandwidth than metal cables. This means that they can carry more data.
  - Smaller Size and Lighter weight.
  - low attenuation
  - Not affected electromagnetic interference (No EMI interference)
  - Signals carrying data can travel long distances without weakening
  - Suitable for industrial and noisy areas

- **Disadvantages of Optical Fibre:-**

  - Optical fibre cables are expensive
  - Difficult to install
  - Maintenance is expensive and difficult


Wireless/Unguided Media
Radio Waves
Microwaves
Infrared Waves

Unguided Media

(wireless media)

Electromagnetic waves of different frequencies are used

Microwave

Radio Wave

Cellular

Infrared

Satellite

Wireless (Unguided/Unbound) Transmission Media

- A wave can be described as a disturbance that travels through a medium from one location to another location.
- A **wave** is a transfer of energy, usually through a form of matter called a **medium**.
- There are a special type of wave that can travel without a medium, called **electromagnetic waves (**also called **EM** waves) , which are waves like radio waves and microwaves.
- Unlike sound waves and water waves, electromagnetic waves don't need a fluid, or a solid, or even air to help them travel from one place to another. EM waves can travel across the great vacuum of space, which is why we see light from distant stars and planets.

Wireless (Unguided/Unbound) Transmission Media

- **Electromagnetic waves are formed when an electric field comes in contact with a magnetic field. They are hence known as 'electromagnetic' waves.**

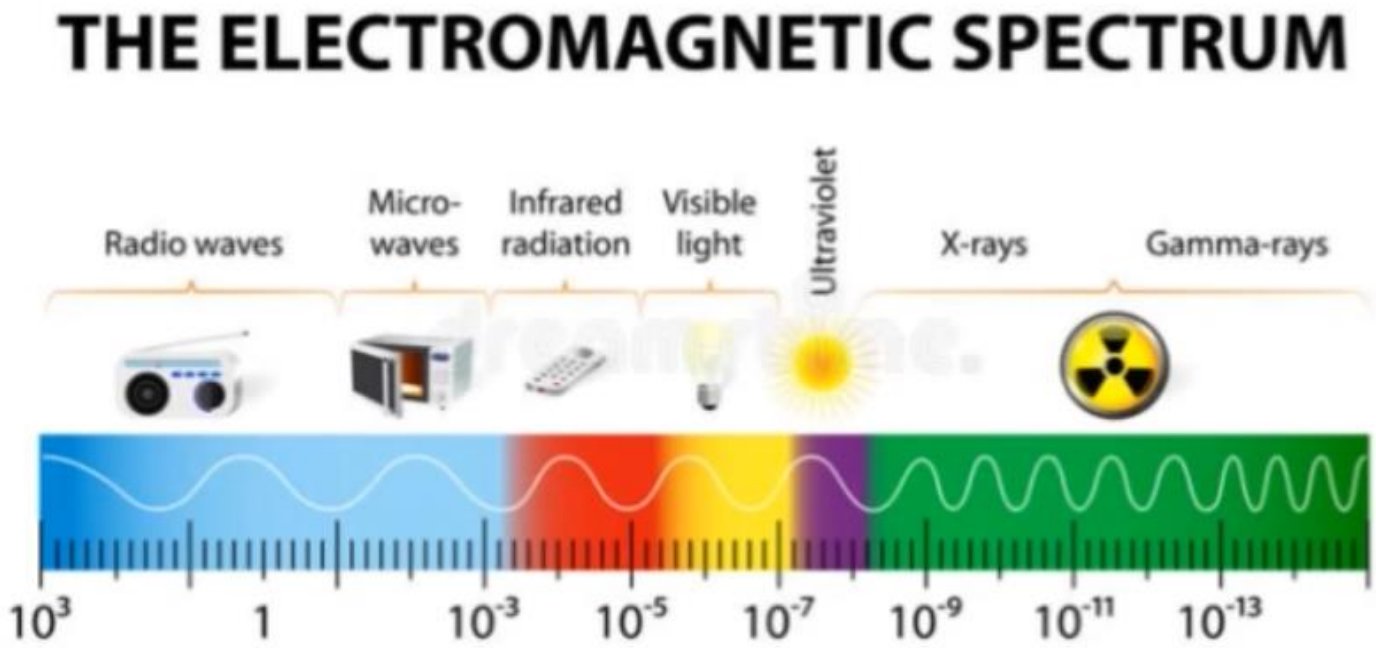
- **Electromagnetic (EM) radiation is a form of energy that is all around us and takes many forms, such as radio waves, microwaves, X-rays and gamma rays.**

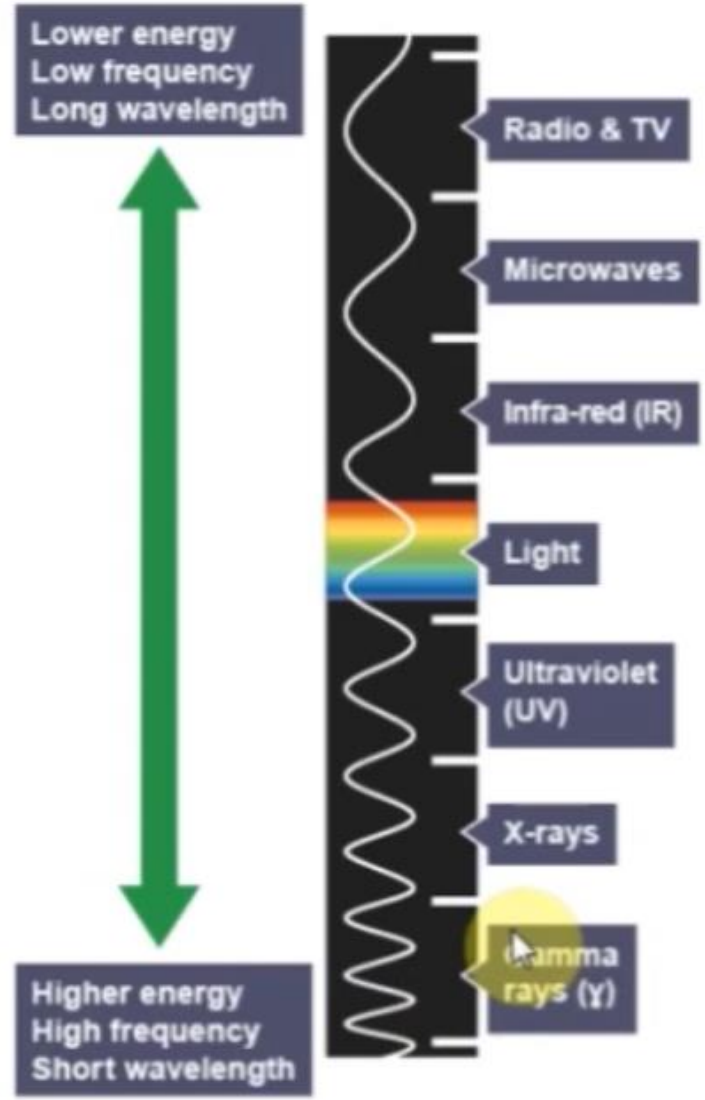
- **Sunlight is also a form of EM energy. Electromagnetic energy from the sun comes to Earth in the form of radiation.**

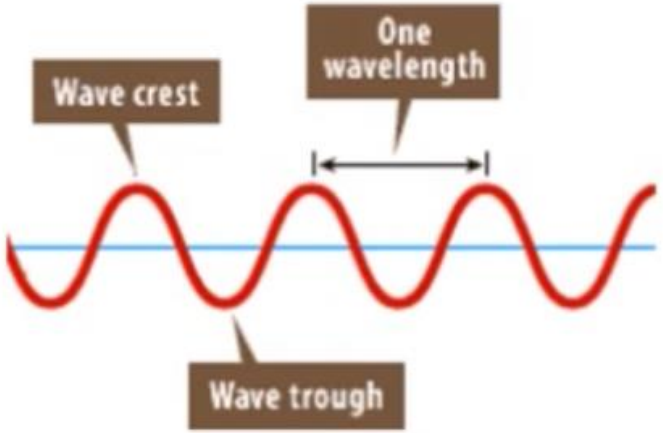
- The Electromagnetic Spectrum describes a wide range of different **electromagnetic waves**.

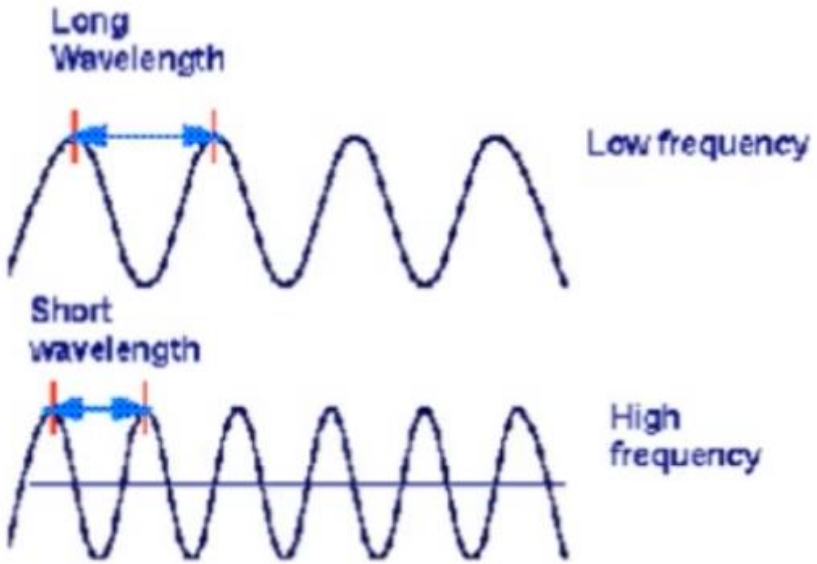
Wireless (Unguided/Unbound) Transmission Media

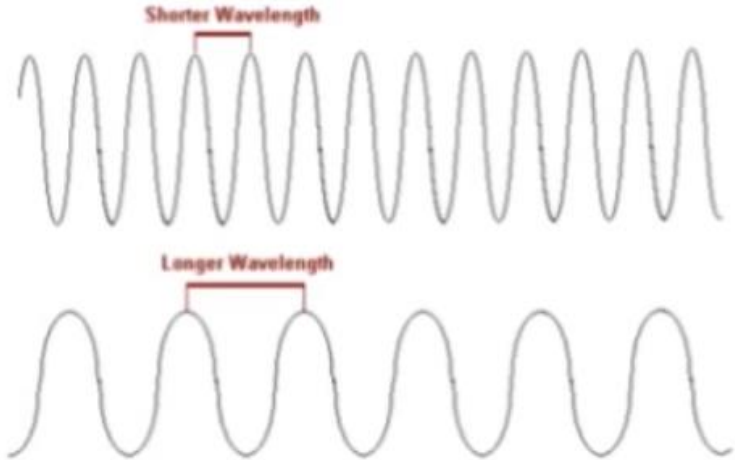
- A little part of electromagnetic spectrum can be used for wireless transmission.

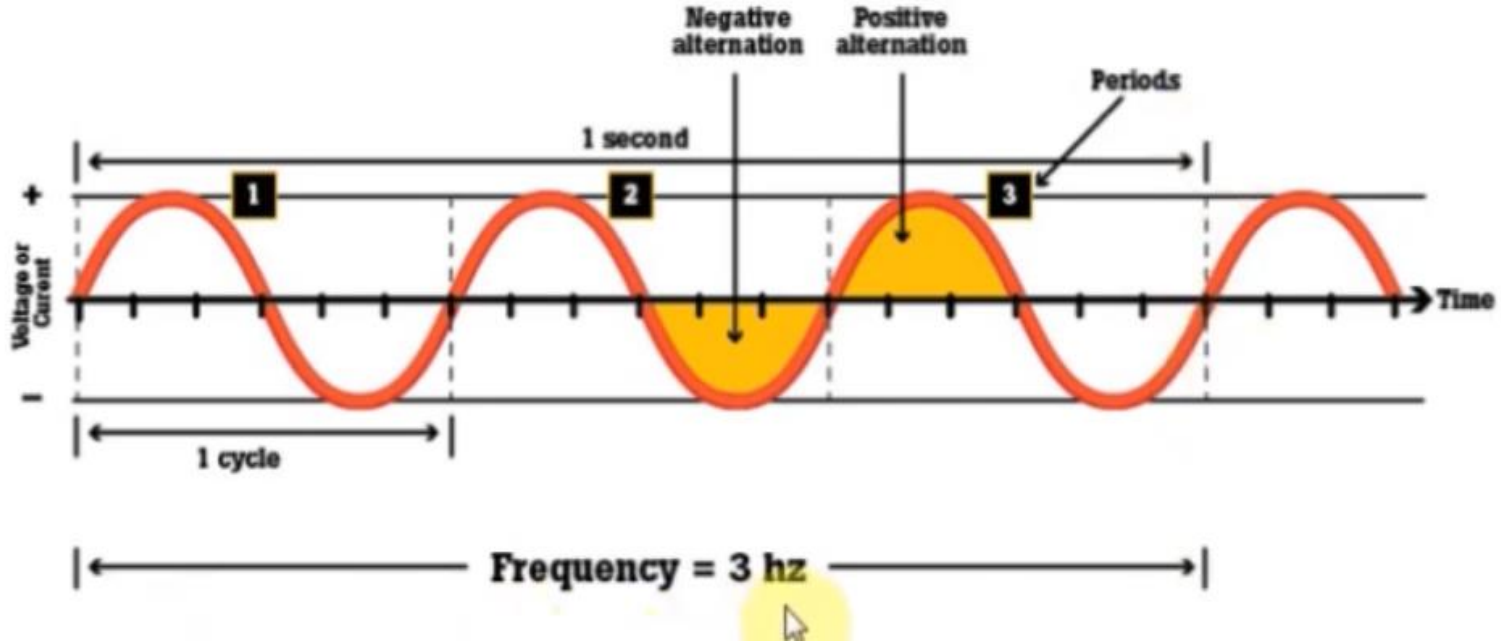





One wavelength
Wave crest
Wave trough

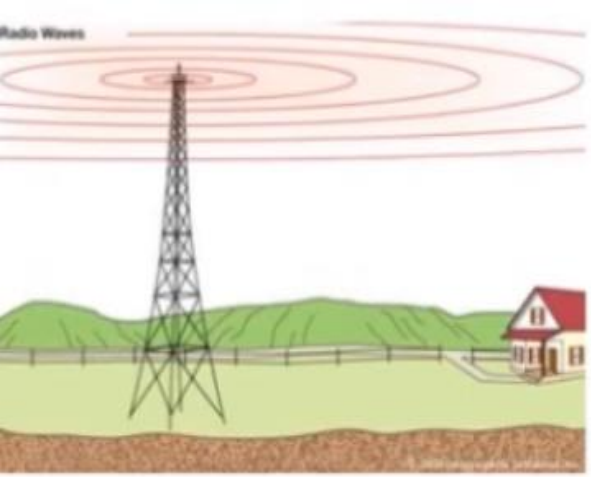

Long Wavelength
Low frequency
Short wavelength
High frequency


Shorter Wavelength
Longer Wavelength


Negative alternation
Positive alternation
Periods
1 second
1
2
3
+
-
Voltage or Current
Time
1 cycle
Frequency = 3 hz

Band	Frequency range	Wavelength range
Extremely Low Frequency (ELF)	<3 kHz	>100 km
Very Low Frequency (VLF)	3 to 30 kHz	10 to 100 km
Low Frequency (LF)	30 to 300 kHz	1 m to 10 km
Medium Frequency (MF)	300 kHz to 3 MHz	100 m to 1 km
High Frequency (HF)	3 to 30 MHz	10 to 100 m
Very High Frequency (VHF)	30 to 300 MHz	1 to 10 m
Ultra High Frequency (UHF)	300 MHz to 3 GHz	10 cm to 1 m
Super High Frequency (SHF)	3 to 30 GHz	1 to 1 cm
Extremely High Frequency (EHF)	30 to 300 GHz	1 mm to 1 cm

- Radio waves are EM (Electromagnetic)waves that have wavelengths between 1 millimetre and 100 kilometres (or 300 GHz and 3 kHz in frequency).
- Radio frequency is easy to generate because its has large wavelength and can travel long distance.
- Radio waves are generated by radio transmitters and received by radio receivers.
- Radio stations transmit radio waves using transmitters, which are received by the receiver installed in our devices. Both transmitters and receivers use antennas to radiate or capture radio signals
- It can penetrate walls easily, so these waves are widely used for communication both indoors and outdoors.



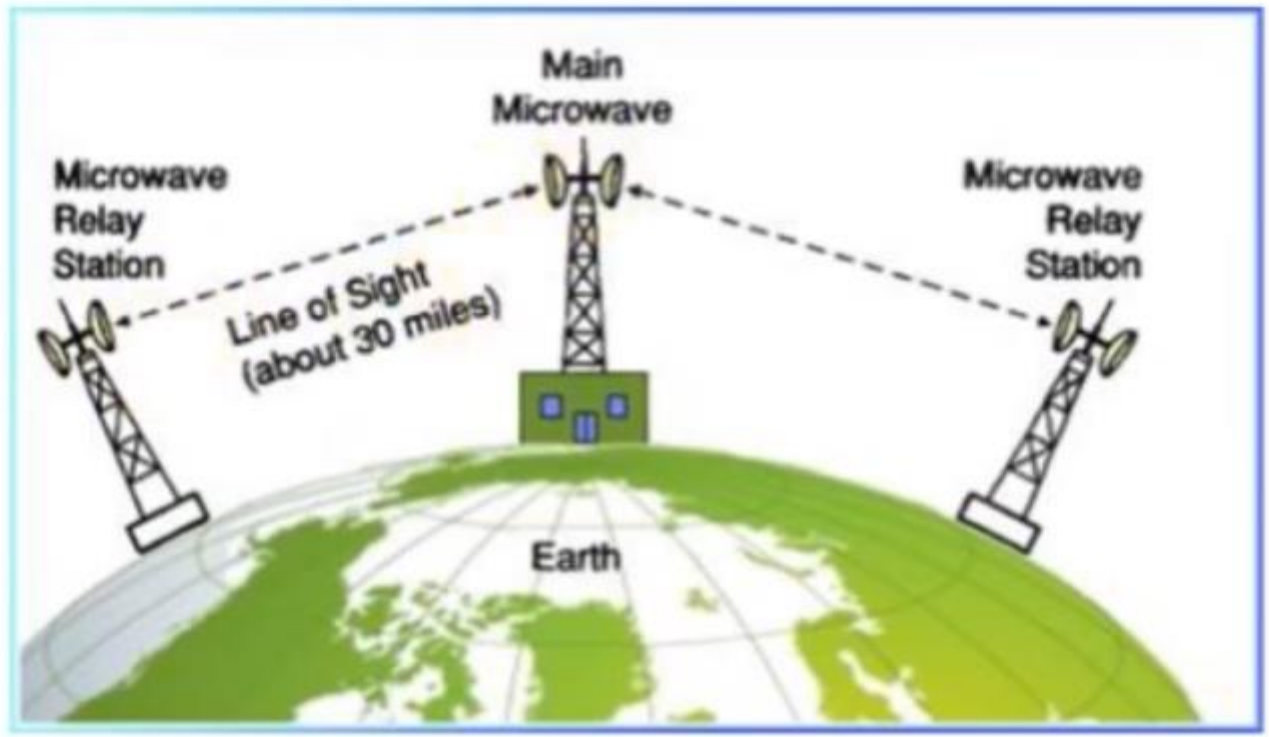
Radio Waves Transmission

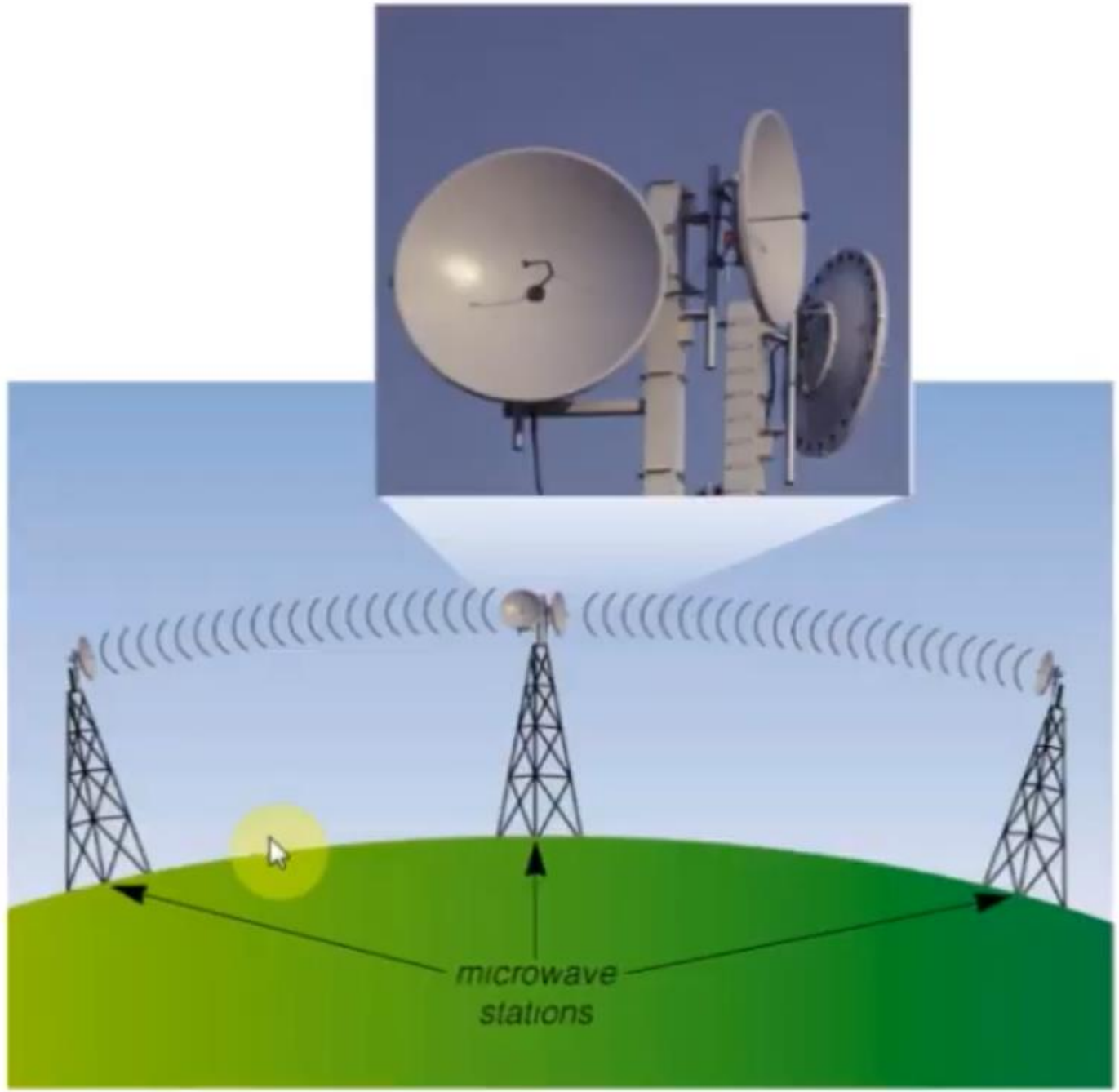
- Radio waves are omnidirectional means they travel in all the directions from the source.
- When an antenna transmits radio waves, they are propagated in all directions.
- A sending antenna send waves that can be received by any receiving antenna. The omnidirectional property has disadvantage, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signal using the same frequency or band.
- It is Used Mobile, AM/FM radio, television

Radio Spectrum

Radio Band	Frequency	Some Applications
Very Low Frequency VLF	3 KHZ to 30 KHz	Radio Navigation
Low Frequency LF	30 KHz to 300 KHz	Long Wave Radio
Medium Frequency MF	30 KHz to 3 MHz	AM Radio
High Frequency HF	3 MHz to 30 MHz	CB Radio (HAM) Point to Point Radio Search and Rescue Services
Very High Frequency VHF	30 MHz to 300 MHz	FM radio 88-108 MHz VHF Broadcast TV
Ultra High Frequency UHF	300 MHz to 3 GHz	UHF Broadcast TV Cellular Phones Microwave Links Wi-Fi in 2.4 Band Satellite Communications
Super High Frequency SHF	3 GHz to 30 GHz	Microwave Links Wi-Fi in 5 GHz Band Satellite Communications
Extra High Frequency EHF	30 GHz to 300 GHz	Microwave Links

- Microwaves are a type of radio waves with high frequencies. It can be classified as a subclass of radio waves. The frequency of microwaves lies in the 300 MHz to 300 GHz.
- Unlike radio waves, microwaves are unidirectional, in which the sending and receiving antennas need to be aligned.
- Microwaves are widely used for point-to-point communications because their small wavelength, which means that the signal is focused into a narrow beam. Additionally, each antenna must be within line of sight of the next antenna.
- 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.


Main
Microwave
Microwave
Relay
Station
Line of Sight
(about 30 miles)
Microwave
Relay
Station
Earth


microwave
stations

- Infrared signals have frequencies between 300 GHz to 400 THz. They are used for short-range communication.
- Infrared waves are used for very short distance communication like TV remote, wireless speakers, automatic doors, hand held devices etc.
- Infrared waves having high frequencies prevents interference b/w one system to another.
- Infrared signals have high frequencies and cannot penetrate walls. Due to its short-range communication system, the use of an infrared communication system in one room will not be affected by the use of another system in the next room. This is why using an infrared TV remote control in our home will not interfere with the use of our neighbour's infrared TV remote control.
- ***THE DISADVANTAGES OF USING INFRARED***
  - Infrared signals cannot be used for long distance communication. In addition, we cannot use infrared waves outside a building because sun's rays contain infrared waves that can interfere with communication.

Microwaves

Speed: 1 mbps to 10 gbps

Characteristics

- Used for high speed transmission
- Information is sent via microwaves from ground based transmitting and receiving stations
- Text, sound, and graphics are converted into microwave pulses and transmitted
- Microwave stations (a.k.a. repeater stations) must be placed every 50 kilometres to receive, amplify, and then pass the signal along

Disadvantages

- It cannot pass thru obstacles
- Can only use line of sight transmission.

Broadcast radio

Speed: 1 mbps to 10 mbps

Characteristics

- Used for cordless phones, AM & FM radio transmission for both voice and data.
- Can travel long distances and penetrates buildings
- Requires a transmitter to send broadcast radio signals and a receiver to receive it.
- The receivers uses an antenna to receive the signals
- An example of the short-range broadcast radio is Bluetooth,
  - Used in computers, mobiles, printers etc.
  - Transmit data at a rate of 1Mbps

Disadvantages

- Unidirectional and insecure
- Interference such as reflections from water

Cellular Radio

Speed: 10 mbps to 1 gbps

Characteristics

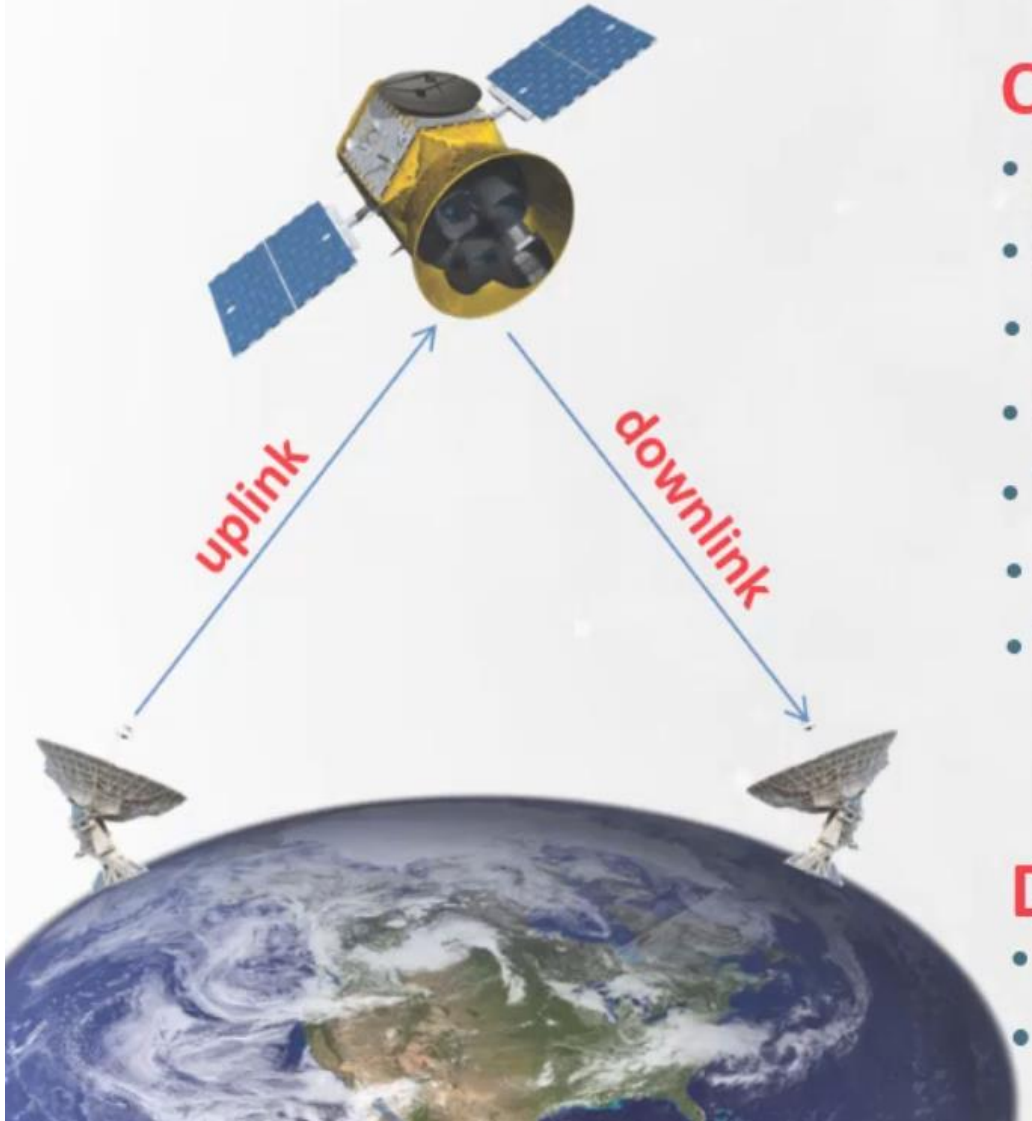
- Used in wireless modems and cellular telephone
- Uses high-frequency radio waves to transmit voice and digital data.
- Can connect notebooks or mobile computers to the celluar telephone to access the Web or send and receive the email, etc
- Personal Communications Services (PCS) is a set of technologies used for digital cellular devices like Laptops, cellular telephones, etc.

Disadvantages

- It requires complex infrastructure
- Well planned frequency spectrum distribution

Satellite Communication

Speed: 1 mbps to 10 gbps



Characteristics

- Is used for global communication,
- Satellites are placed in space and they orbit the earth.
- Receives microwave signals from the earth station.
- Satellites magnify the signals and retransmit them back
- The data transfer speed is very high
- It avoids the cost of cabling and repeater stations
- The transmission from the earth station to a satellite is called uplink. The transmission from the satellite to the earth station is called the downlink.

Disadvantages

- It is expensive and not easy to repair and maintain
- Weather and sunspots cause signal disturbance

Infra Red (IR)

Speed: 1 gbps

Thermometer

Remote

Characteristics

- Used in remote controls for televisions, optical mouse and entertainment devices
- Sends signals using infrared light wave that is invisible to us and is just above the red end of the colour spectrum.
- It Works over a moderate bandwidth 115 kbps and works upto few meters.
- IRDA port is fixed to transfer data
- Alternative to short-range range channel like Bluetooth.

Disadvantages

- It has short range and low bandwidth
- It requires a light of sight transmission.

Guided Media

Parameters	Twisted Pair	Coaxial Cable	Fibre Optics
Speed	*10 mbps to 10 gbps*	*10 mbps to 100 mbps*	*100 gbps+*
Used in	LAN and Local Telephone Lines	Video transmissions, telephone lines and LAN	Internet or long distance communication
Features	• Most popular • pairs of copper wires • Insulated by plastic • Wires are twisted together in order to reduce noise.	• Single solid copper wire core covered by insulating material. • It is of two types, thicknet and thinnet. • Carries high-frequency range signals	• Digital signals sent as light pulses which are translated back into electrical signals • Many transmissions can be carried on a single strand
Advantages	• Inexpensive and easy to install and maintain	• Carries both analog and digital signals.	• Secure and has very low signal loss.
Disadvantages	• Unsuitable for long distance • Speed is less	• Expensive • Not compatible with twisted pair cables	• Expensive, difficult to install and modify. • Difficult to repair

Comparision

Characteristics	UTP	STP	Coaxial Cables	Fiber Optic Cables
Bandwidth	10– 100 Mbps	10– 100 Mbps	10 Mbps	100 Mbps - 1 Gbps
Maximum cable segment	100 meters	100 meters	200 – 500 meters	2 k.m. – 100 k.m.
Interference rating	Poor	Better than UTP	Better than twisted pair wires	Very good as compared to any other cable
Installation cost	Cheap	Costly than UTP	Costly than twisted pair wires	Most costly to install
Security	Low	Low	Low	High

Unguided Media

PARAMETERS	Microwaves	Broadcast Radio	Cellular Radio	Satellite	Infra Red
Speed	*1 mbps to 10 gbps*	*1 mbps to 10 mbps*	*1 mbps to 1 gbps*	*1 mbps to 10 gbps*	*1gbps*
Used in	High speed transmission	Cordless phones, AM & FM radio	Wireless modems and cellular telephone	Global Communication	Remote controls for televisions, mouse etc
Features	• Information is sent via microwaves • Text, sound, and graphics are converted into microwave pulses and transmitted	• Can travel long distances and penetrates buildings • Requires a transmitter to send broadcast radio signals and a receiver to receive it.	• Uses high-frequency radio waves to transmit voice and digital data. • Connect notebooks or mobile computers to access the Web or send and receive the email, etc	• Satellites are placed in space and they orbit the earth. • Satellites magnify the signals and retransmit them back	• It Works over a moderate bandwidth 115 kbps and works upto 0 meters. • IRDA port is fixed to transfer data
Advantages	• Low power consumption	• Low running cost	• Less transmission power	• The data transfer speed is very high • No Cost of cabling and repeater stations	• Simple and easy to install
Disadvantages	• It cannot pass thru obstacles • Can only use line of sight transmission. • It also supports limited bandwidth.	• Unidirectional and insecure • Interference such as reflections from water	• It requires complex infrastructure • Well planned frequency spectrum distribution	• It is expensive and difficult to maintain • Weather and sunspots cause signal disturbance	• It has short range and low bandwidth • It requires a light of sight transmission.

Switching in Networking

Circuit Switching

Message Switching

Packet Switching

Circuit Switching

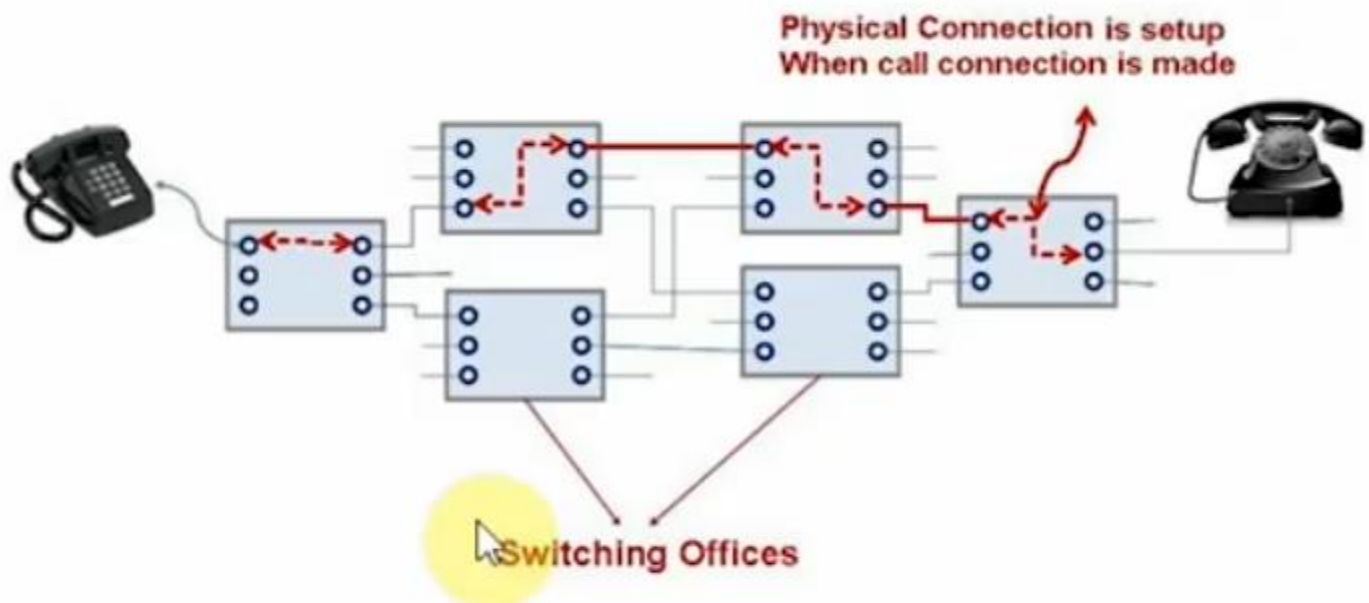
- When two nodes communicate with each other over a dedicated communication path, it is called circuit switching.
- There 'is a need of pre-specified route from which data will travels and no other data is permitted.
- In Circuit Switching a dedicated channel (or circuit) is set up for a single connection between the sender and recipient during the communication session.
- Once the connection is established between two parties, it will be available till end of the conversation.
- the channel is reserved between the users till the connection is active.

Circuit Switching

- In telephone communication system, the normal voice call is the example of Circuit Switching. The telephone service provider maintain a unbroken link for each telephone call.

- Applications which use circuit switching may have to go through three phases:
  - Establish a circuit
  - Transfer the data
  - Disconnect the circuit

Circuit Switching



Circuit Switching

Advantages of Circuit Switching :

- 1. The dedicated path/circuit established between sender and receiver provides a guaranteed data rate.
- 2. Once the circuit is established, data is transmitted without any delay as there is no waiting time at each switch.
- 3. Since a dedicated continuous transmission path is established, the method is suitable for long continuous transmission.

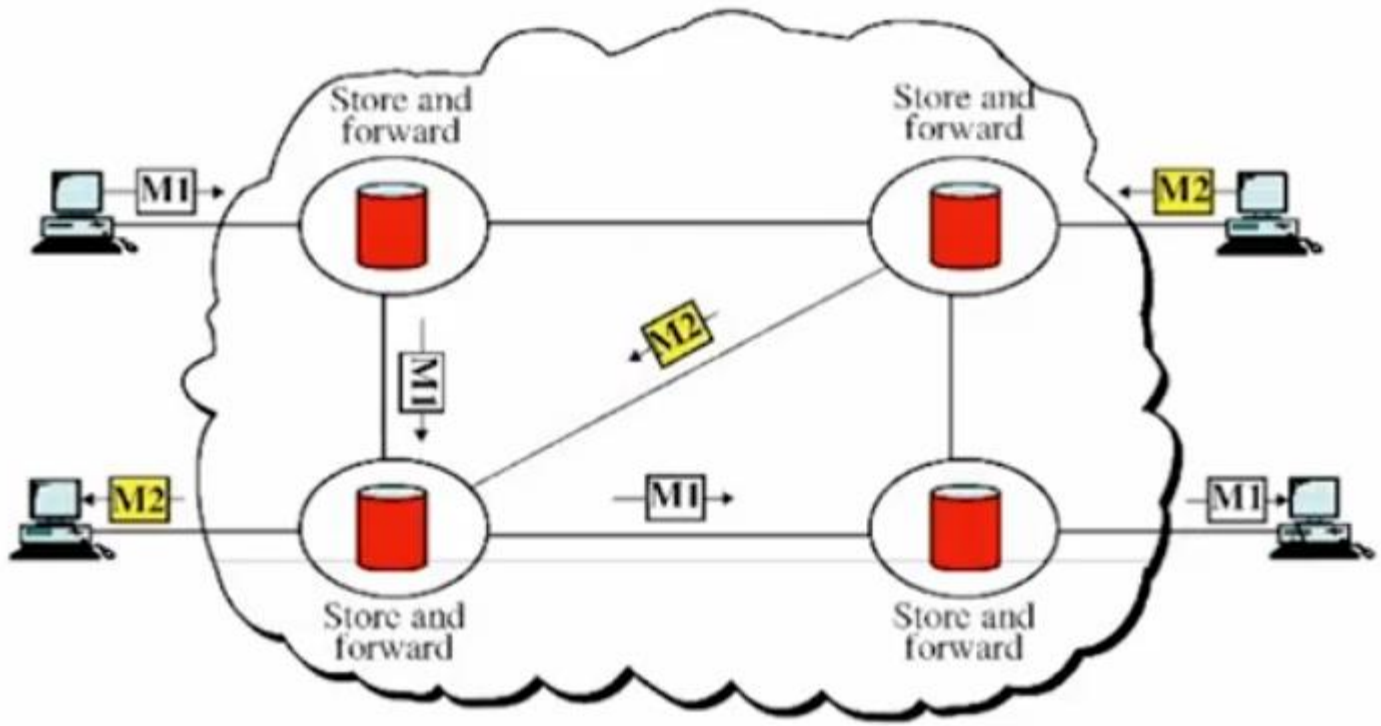
Disadvantages of Circuit Switching :

- 1. As the connection is dedicated it cannot be used to transmit any other data even if the channel is free.
- 2. It is inefficient in terms of utilization of system resources. As resources are allocated for the entire duration of connection, these are not available to other connections.
- 3. Dedicated channels require more bandwidth.
- 4. Prior to actual data transfer, the time required to establish a physical link between the two stations is too long.

Message Switching

- In message switching, it is not necessary to establish a dedicated path between transmitter and receiver.
- In Message Switching, when source node sends a message, the destination address is append to the message. So in message switching there is no need to establish a dedicated path b/w two communication nodes.
- For sending message, There are many intermediary message switching nodes which are responsible for transferring the message, and the message is transmitted as a whole from source node-to-destination node.
- Each message switching node receive the **entire message**, store it in its **entirely on disk**, and then transmit the message to the next node.
- If the next node does not have enough resources to accommodate large size message, the message is stored and switch waits.
- This type of network is called a store-and-forward network.
- Message switching is very slow because of store-and-forward technique.
- Message switching is not recommended for real time applications like voice and video.

Message Switching



Advantages :

- Channel efficiency can be greater compared to circuit-switched systems, because more devices are sharing the channel.
- Traffic congestion can be reduced, because messages may be temporarily stored in route.
- Message priorities can be established due to store-and-forward technique.

Disadvantages:

- Message switching is not compatible with interactive applications.
- Store-and-forward devices are expensive, because they must have large disks to hold potentially long messages
- Message switching is very slow because of store-and-forward technique.
- Message switching is not recommended for real time applications like voice and video.

Packet Switching

- In packet, Message are divided into smaller pieces called packets.
- Each packet includes source, destination and intermediate node address information so that individual packet can be routed through the internetwork independently.
- It is easier for intermediate networking devices to store small size packets and they do not take much resources either on carrier path or in the internal memory of switches.

Circuit Switching	Message Switching	Packet Switching
There is physical connection b/w transmitter and receiver	No physical path is set in advance b/w transmitter and receiver	No physical path is established b/w transmitter and receiver
All the packet uses same path	Packet are stored and forward	Packet travels independently
Need an end to end path before the data transmission	No need of end to end path before data transmission	No need of end to end path before data transmission
Reserves the entire bandwidth in advance	Does not reserve the bandwidth in advance	Does not reserve the bandwidth in advance
Waste of bandwidth is possible	No waste of bandwidth	No waste of bandwidth
It cannot support store and forward transmission	It support store and forward transmission	It support store and forward transmission
Not suitable for handling interactive traffic	Suitable for handling interactive traffic	Suitable for handling interactive traffic

Digital Communication

- A communication that involves using an electronic method such as email, instant/text messaging or electronic voice and video conferencing.

Difference between delayed and real-time communication

DELAYED COMMUNICATION

There is a time delay between the sending and receiving of information

A mailed letter is an example of delayed communication, and delayed exchanges are referred to as *asynchronous*

REAL-TIME COMMUNICATION

Information is sent and received instantly

A face-to-face conversation is an example of real-time communication, and real-time exchanges are referred to as *synchronous*

Delayed Communication (Asynchronous)

- Electronic Mail
- SMS

To Text or not to Text

- Use text if you must communicate, but are in a place or situation where speaking out loud would be inconsiderate or indiscreet
- Avoid texting while driving
- Avoid sending and responding to texts if you are in a social setting
- Avoid sending text messages late at night
- Do not attempt to send text messages while you are in an airplane that is taxiing, taking off, or landing

Real-time Communication (Synchronous)

- Sometimes there is just no substitute for real-time communications
- These technologies include:
  - Phone calls/conference calls
  - Online meetings/video conferences (conference calling)
  - Instant messaging

Phone Calls

- You are communicating with someone whom you do not know
- You must convey a complicated idea
- You must discuss a sensitive topic
- You require an immediate response
- You need to get a message to someone immediately

VoIP Conferencing (Voice Over Internet Protocol)

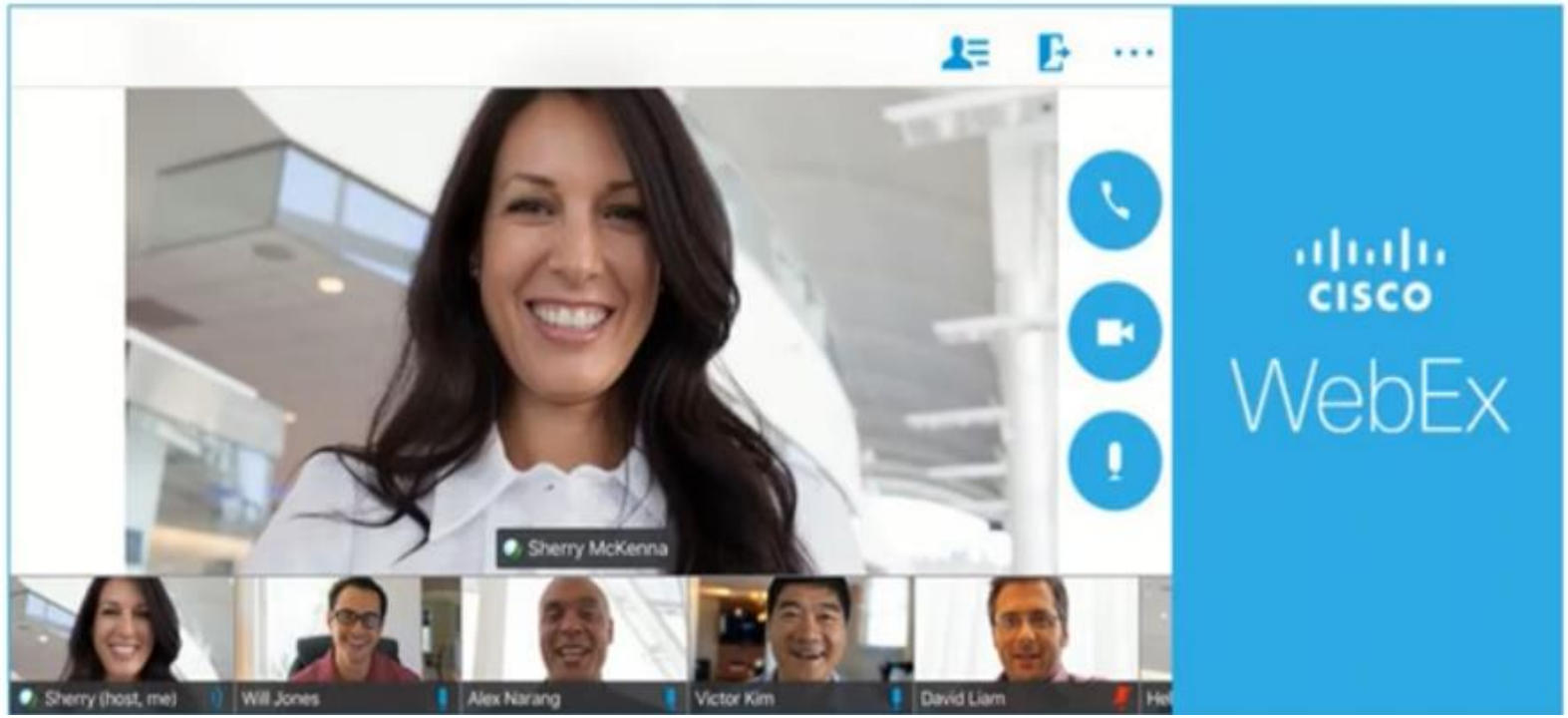
- VoIP phone calls use the Internet to transfer voice packets between the phones used in a call or conference call

Conference Calls

- A conference call is a call that involves three or more parties.
- Many business phones include a Conference button
- Most consumer phones include a Flash button which you can use to create a conference call if a conference calling service is included in your phone plan
- You can participate in conference calls on landline, mobile, and VoIP phones

WebEx

- WebEx is a hosted subscription service that you can use to conduct online meetings
- An online meeting is a meeting in which multiple participants can
  - Speak
  - Share files
  - Share visuals



Other Online Conference Apps

- Skype
- Google Hangouts
- Zoom
- Microsoft Teams

Streaming

- Streaming delivers content to your device in a steady, consistent flow of data
- When you stream media files from a web site, a media server streams the content to you in a client media player application
- If multiple people want to stream the same content, the media server sends a stream to each client
- Live streaming is the process of broadcasting real-time live audio/video footage as a video feed to an audience that accesses the stream over the Internet