

Que : 1 Introduction of Ancient, Electronic and computerized Methods of communication.**What is Communication?**

It is the process of exchanging words, signs, or information with others. It is done either verbally or non-verbally. Communication enables us to pass information. We understand others because of communication. Effective communication brings people closer and together. Being able to communicate well is important for every human being. Communication is important in personal as well as corporate life. There are different people to communicate with. Our voices are heard only through communicating.

Every day we use different ways to communicate. For example, from your daily email to the radio we listen, the communication process is going on. Life without communication would be impossible to live. We understand and perceive things only because of this. The main purpose is to clearly convey our messages to each other.

Evolution in the Communication Methods:

Humans have been using different methods to communicate from the beginning. Let's have a look at the history of human communication briefly.

Cave Paintings:

Cave Paintings are the oldest methods of communicating. They were used to mark territories. Major events were also recorded through these paintings. They are usually found on the walls and ceilings of caves. Symbolic as well as religious functions were shown in these paintings. Chauvet Cave in France has the oldest cave painting. That painting was made around 30,000 B.C. South Sulawesi, Indonesia, and California Cave in Romania has the earliest cave paintings.

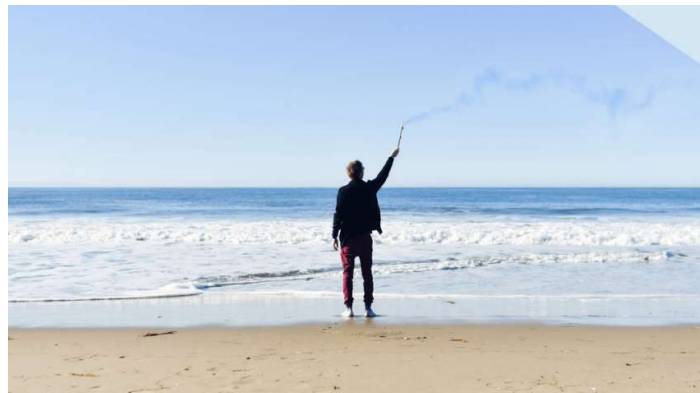


Symbols for Communication:

Different signs and symbols were used to deliver messages. Rock Carvings (Petro glyphs) were introduced in 10,000 B.C. These rock paintings drew pictures to convey stories. The carvings on the rock surface were also known as Rock Art. Later on, graphic symbols were used to present ideas or concepts. Chinese created characters for communication as well. Alphabets were created at the last. Evolution of communication was easier after the alphabet.

**Smoke Signals:**

These signals were used to send messages. They were mostly used in China. Chinese guards released smoke into the air. Smoke is depicted as a message to The Great Wall of China. A famous Greek Historian Polybius used smoke signals to represent the alphabet.

**Carrier Pigeons:**

Pigeons are known well for their directions. They were known to find their home, even after traveling long distances. People used to attach small letters to their necks, hoping they would fly to the receiver. Pigeons were also used by Ancient Romans to tell owners how their entries had been placed. They carried essential messages and helped in evolution of communication.

**Postal System:**

With raising awareness, people started to use courier services. Letters were delivered from one person to another through postal services. These systems were organized in India, China, Persia, and Rome. A Frenchman De Valyer started a postal system in 1653. The use of mailboxes and delivery of letters was done through the system.

**Newspapers:**

Newspapers are still a wide form of communication used. Every other house has a newspaper delivery every day. These papers deliver written news and also other important national events taking place. Two types of Newspapers are National and International. Their types depend upon the news they deliver about. The first printing press system was introduced in 1440 by German Johannes Gutenberg. The newspaper started to get more attention and changed communication forever.



Radios:

With the advent of Print Media, Radios were introduced after that. Radios are a source of news as well as entertainment for people. Wireless signals were studied and tested in detail. The scientists practiced using wireless power to share content. Radios are still installed in mobile phones, car systems. They were once a very important medium of communication.



Telegraph:

The first electrical communication system to send text messages was called Telegraph. Sending letters required energy and patience to wait for a reply. Telegraphs were introduced to send text messages more quickly than written messages. It helped in sending information across the country.



Telephone:

The first telephone was introduced by Alexander Graham Bell in 1876. Within 50 years of its invention, telephones became an essential part of every household and office. The devices transmitted human audio into signals. These signals were then transmitted through wires. Landline telephone service began in 1900s. People could talk on calls for hours through long distances. It was the most reliable form of the communication system. Mobile phones were introduced in 1973 and the mode of communication was changed entirely.

**Television:**

Even today, Televisions are a great source of entertainment. They are a mode of indirect communication to the larger audience. Many people in history put in tremendous efforts to introduce Televisions. The early Televisions displayed black and white pictures after the World War II. But with the advancement, colors were added to the screen. Today, there are several features in Televisions that provide us more entertainment and information.

**Internet:**

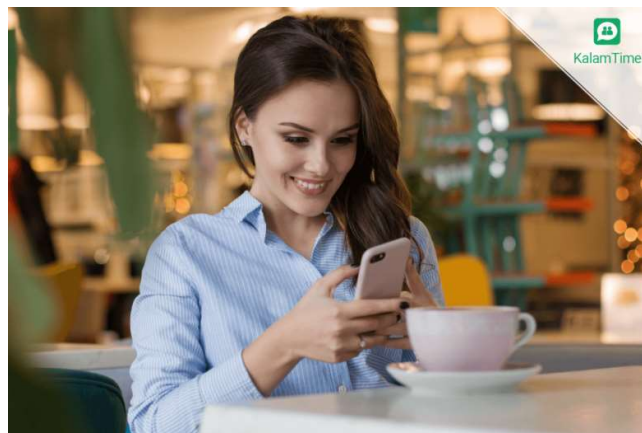
The world of the Web has brought people closer. Tim Berners-Lee invented the World Wide Web in 1990. Satellites support the internet. Through the internet, we can search for anything, anywhere in the whole world. Wireless connections via Wi-Fi began in 1991. Since then, people seem to be addicted to the internet. Nowadays, every small activity of our lives, business, and education involves the use of the internet. We highly depend upon the internet for our development as a nation as well as a generation.

**E-mail:**

Microsoft Business Email is the most formal way of communication used in offices. John Vittal in 1975 developed a software to support mails. From that invention, many mailing platforms have been created. E-mails are better for record-keeping and cost-saving.

**Text Message:**

Various network providers are used for sending text messages. The first text message was sent by Neil Papworth, an engineer, in 1992. From that day to now, text messaging has been a game of few minutes. People instantly chat through text messages. With advanced internet, online messaging apps have been introduced. These applications help connect people. They share texts through the internet.



Social Media:

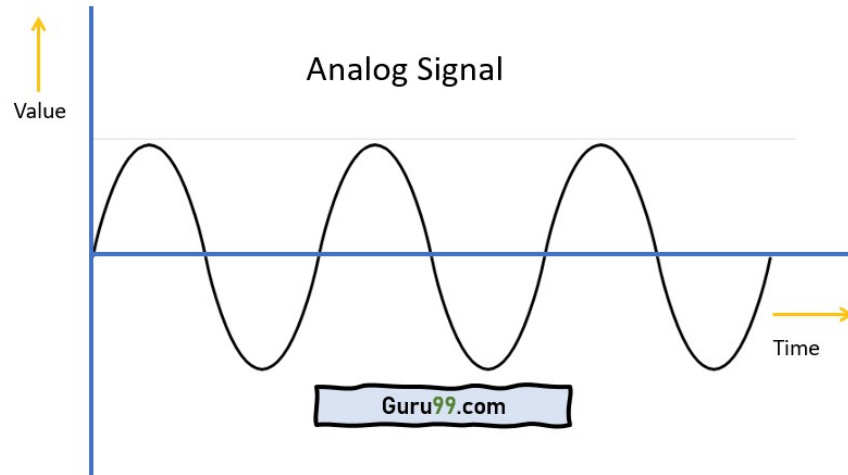
People share their entire life events on social media. Social media platforms help people share pictures, videos, and almost everything on the internet. It is the latest mode of communication in the digital world. Smart phones have made this more convenient. Social media apps can be downloaded into smart phones. Users of social media in this generation are obsessed with these platforms. They share the daily smudge of their lives on these apps. Social media has revolutionized the way we communicate. We can see what other people are doing through their social media profiles. It is now easy to check up on your friends who live far.

Communication has been made a lot easier. Distance is not an issue anymore. You can talk to any person you want, either living far or near. Better communication has helped us gain better social skills. From verbal speech to our text messages, we communicate about life each day. A feature of privacy through end to end encryption has been added to our daily communication through cell phones and other gadgets.



Que : 2 Digital and Analog Data

A signal is an electromagnetic or electrical current that is used for carrying data from one system or network to another. In both these technologies, the information, such as any audio or video, is transformed into electric signals.

What is an Analog Signal?

Analog signal is a continuous signal in which one time-varying quantity represents another time-based variable. These kind of signals work with physical values and natural phenomena such as earthquake, frequency, volcano, speed of wind, weight, lighting, etc.

Example: real world example clock, multimeter and joystick.

**Advantages of Analog Signals**

Here, are pros/benefits of Analog Signals

- Easier in processing
- Best suited for audio and video transmission.
- It has a low cost and is portable.
- It has a much higher density so that it can present more refined information.
- Uses less bandwidth than digital sounds

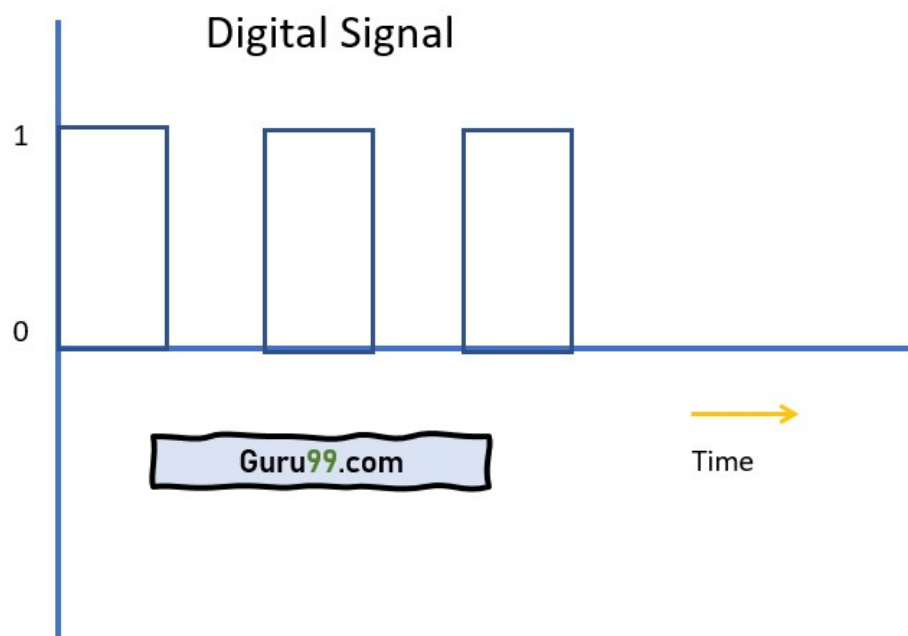
- Provide more accurate representation of a sound
- It is the natural form of a sound.

Disadvantages of Analog Signals

Here are cons/drawback of Analog Signals:

- Analog tends to have a lower quality signal than digital.
- The cost of the Analog wire is high and not easily portable.
- Low availability of models with digital interfaces.
- Recording analog sound on tape is quite expensive if the tape is damaged
- It offers limitations in editing
- Tape is becoming hard to find
- Quality is easily lost
- Data can become corrupted
- Offers poor multi-user interfaces

What is a Digital Signal?



- A digital signal is a signal that is used to represent data as a sequence of separate values at any point in time. It can only take on one of a fixed number of values. This type of signal represents a real number within a constant range of values.

Example: real world example clock, multimeter and joystick.

23:59:59



Advantages of Digital Signals

Here, are pros/advantages of Digital Signals:

- Digital data can be easily compressed.
- Any information in the digital form can be encrypted.
- Equipment that uses digital signals is more common and less expensive.
- A lot of editing tools are available
- You can edit the sound without altering the original copy
- Easy to transmit the data over networks

Disadvantage of Digital Signals

- Processor speed is limited
- Develop quantization and round-off errors
- It requires greater bandwidth
- Systems and processing is more complex.

Give difference between analog and digital data/signal

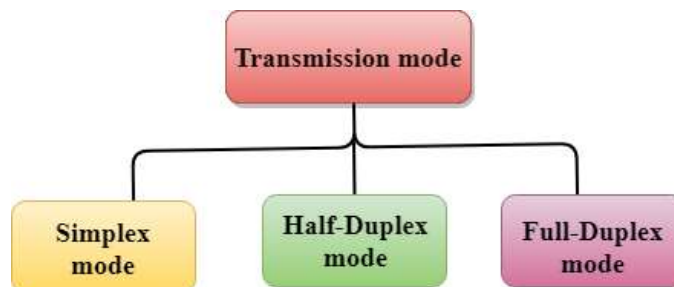
| Analog | Digital |
|---|--|
| An analog signal is a continuous signal that represents physical measurements. | Digital signals are time separated signals which are generated using digital modulation. |
| It is denoted by sine waves | It is denoted by square waves |
| It uses a continuous range of values that help you to represent information. | Digital signal uses discrete 0 and 1 to represent information. |
| Temperature sensors, FM radio signals, Photocells, Light sensor, Resistive touch screen are examples of Analog signals. | Computers, CDs, DVDs are some examples of Digital signal. |
| The analog signal bandwidth is low | The digital signal bandwidth is high. |

| | |
|---|--|
| Analog hardware never offers flexible implementation. | Digital hardware offers flexibility in implementation. |
| It is suited for audio and video transmission. | It is suited for Computing and digital electronics. |
| Analog signal doesn't offer any fixed range. | Digital signal has a finite number, i.e., 0 and 1. |

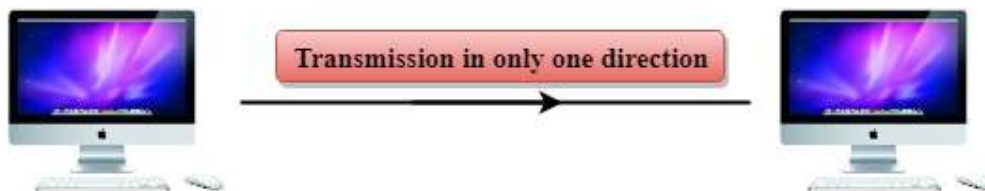
Que : 3 What is Data transmission mode? Explain various data transmission modes.

- The way in which data is transmitted from one device to another device is known as **transmission mode**.
- The transmission mode is also known as the communication mode.
- Each communication channel has a direction associated with it, and transmission media provide the direction. Therefore, the transmission mode is also known as a directional mode.
- The transmission mode is defined in the physical layer.

The Transmission mode is divided into three categories:



- Simplex mode
- Half-duplex mode
- Full-duplex mode

Simplex mode

- In Simplex mode, the communication is unidirectional, i.e., the data flow in one direction.
- A device can only send the data but cannot receive it or it can receive the data but cannot send the data.
- This transmission mode is not very popular as mainly communications require the two-way exchange of data. The simplex mode is used in the business field as in sales that do not require any corresponding reply.

- The radio station is a simplex channel as it transmits the signal to the listeners but never allows them to transmit back.
- Keyboard and Monitor are the examples of the simplex mode as a keyboard can only accept the data from the user and monitor can only be used to display the data on the screen.
- The main advantage of the simplex mode is that the full capacity of the communication channel can be utilized during transmission.

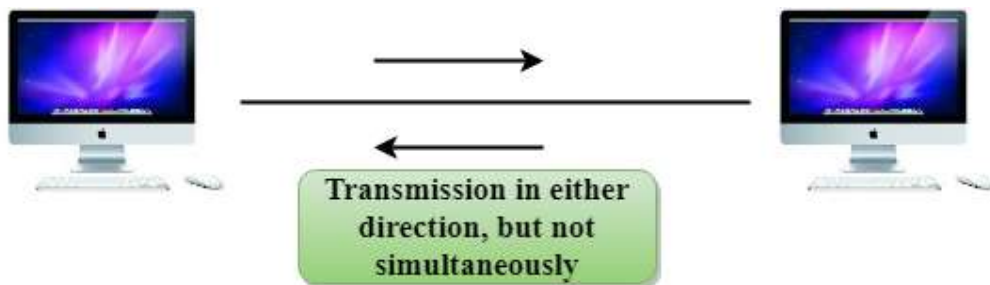
Advantage of Simplex mode:

- In simplex mode, the station can utilize the entire bandwidth of the communication channel, so that more data can be transmitted at a time.

Disadvantage of Simplex mode:

- Communication is unidirectional, so it has no inter-communication between devices.

Half-Duplex mode



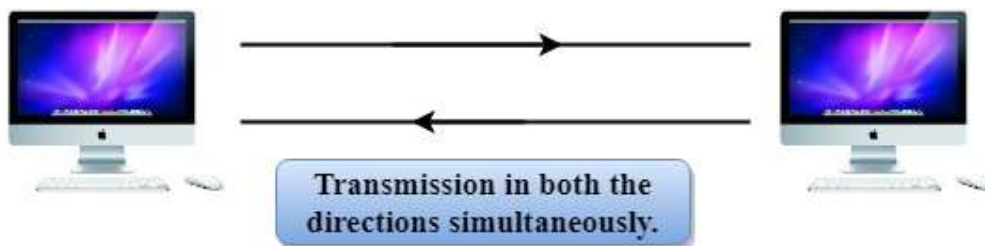
- In a Half-duplex channel, direction can be reversed, i.e., the station can transmit and receive the data as well.
- Messages flow in both the directions, but not at the same time.
- The entire bandwidth of the communication channel is utilized in one direction at a time.
- In half-duplex mode, it is possible to perform the error detection, and if any error occurs, then the receiver requests the sender to retransmit the data.
- A **Walkie-talkie** is an example of the Half-duplex mode. In Walkie-talkie, one party speaks, and another party listens. After a pause, the other speaks and first party listens. Speaking simultaneously will create the distorted sound which cannot be understood.

Advantage of Half-duplex mode:

- In half-duplex mode, both the devices can send and receive the data and also can utilize the entire bandwidth of the communication channel during the transmission of data.

Disadvantage of Half-Duplex mode:

- In half-duplex mode, when one device is sending the data, then another has to wait, this causes the delay in sending the data at the right time.

Full-duplex mode

- In Full duplex mode, the communication is bi-directional, i.e., the data flow in both the directions.
- Both the stations can send and receive the message simultaneously.
- Full-duplex mode has two simplex channels. One channel has traffic moving in one direction, and another channel has traffic flowing in the opposite direction.
- The Full-duplex mode is the fastest mode of communication between devices.
- The most common example of the full-duplex mode is a telephone network. When two people are communicating with each other by a telephone line, both can talk and listen at the same time.

Advantage of Full-duplex mode:

- Both the stations can send and receive the data at the same time.

Disadvantage of Full-duplex mode:

- If there is no dedicated path exists between the devices, then the capacity of the communication channel is divided into two parts.

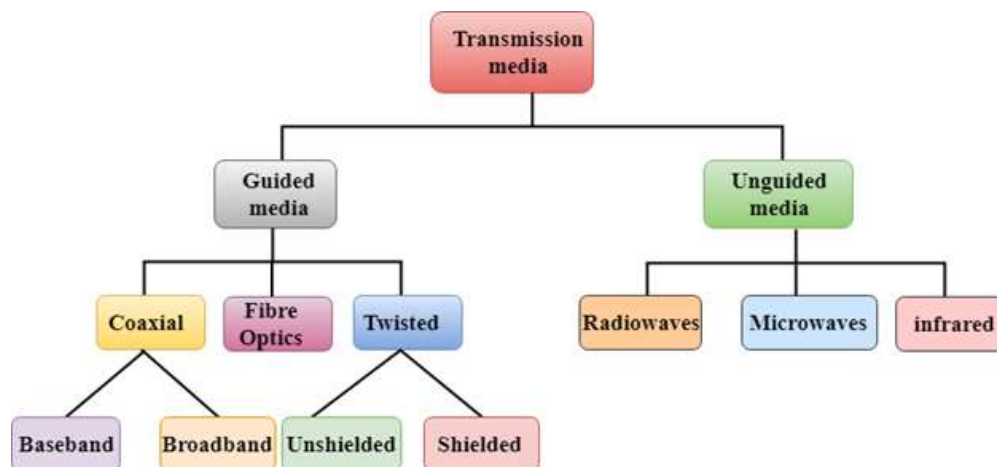
Differences b/w Simplex, Half-duplex and Full-duplex mode

| Basis for comparison | Simplex mode | Half-duplex mode | Full-duplex mode |
|----------------------------|---|---|--|
| Direction of communication | In simplex mode, the communication is unidirectional. | In half-duplex mode, the communication is bidirectional, but one at a time. | In full-duplex mode, the communication is bidirectional. |
| Send/Receive | A device can only send the data but cannot receive it or it can only receive the data but cannot send it. | Both the devices can send and receive the data, but one at a time. | Both the devices can send and receive the data simultaneously. |
| Performance | The performance of half-duplex mode is better than the simplex mode. | The performance of full-duplex mode is better than the half-duplex mode. | The Full-duplex mode has better performance among simplex and half-duplex mode as it doubles the utilization of the capacity of the communication channel. |
| Example | Examples of Simplex mode are radio, keyboard, and monitor. | Example of half-duplex is Walkie-Talkies. | Example of the Full-duplex mode is a telephone network. |

Que : 4 what is transmission media? Explain guided and unguided transmission media.

- Transmission media is a communication channel that carries the information from the sender to the receiver. Data is transmitted through the electromagnetic signals.
- The main functionality of the transmission media is to carry the information in the form of bits through **LAN**(Local Area Network).
- It is a physical path between transmitter and receiver in data communication.
- In a copper-based network, the bits in the form of electrical signals.
- In a fibre based network, the bits in the form of light pulses.
- In **OSI**(Open System Interconnection) phase, transmission media supports the Layer 1. Therefore, it is considered to be as a Layer 1 component.
- The electrical signals can be sent through the copper wire, fibre optics, atmosphere, water, and vacuum.
- The characteristics and quality of data transmission are determined by the characteristics of medium and signal.
- Transmission media is of two types are wired media and wireless media. In wired media, medium characteristics are more important whereas, in wireless media, signal characteristics are more important.
- Different transmission media have different properties such as bandwidth, delay, cost and ease of installation and maintenance.
- The transmission media is available in the lowest layer of the OSI reference model, i.e., **Physical layer**.

Classification Of Transmission Media:



- Guided Transmission Media
- UnGuided Transmission Media

Guided Media

It is defined as the physical medium through which the signals are transmitted. It is also known as Bounded media.

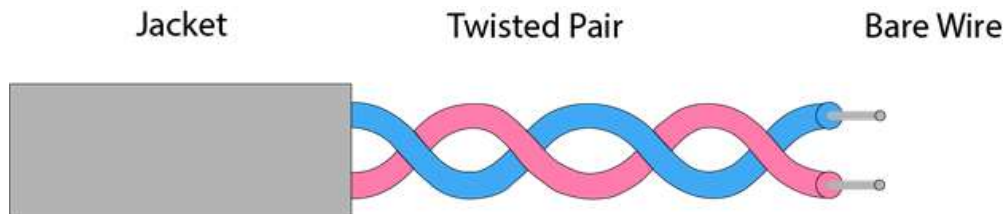
Types Of Guided media:

Twisted pair:

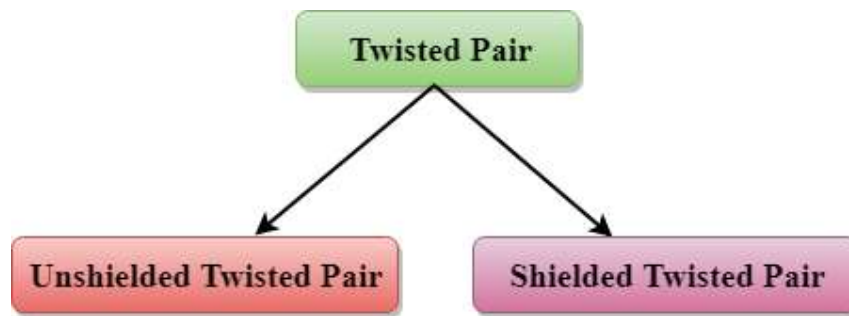
Twisted pair is a physical media made up of a pair of cables twisted with each other. A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz.

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.

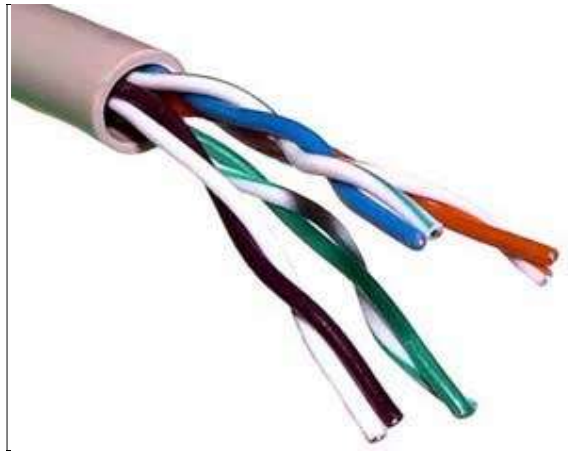


Types of Twisted pair:



Unshielded Twisted Pair:

An unshielded twisted pair is widely used in telecommunication.



Following are the categories of the unshielded twisted pair cable:

- **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 upto 200Mbps.

Advantages Of Unshielded Twisted Pair:

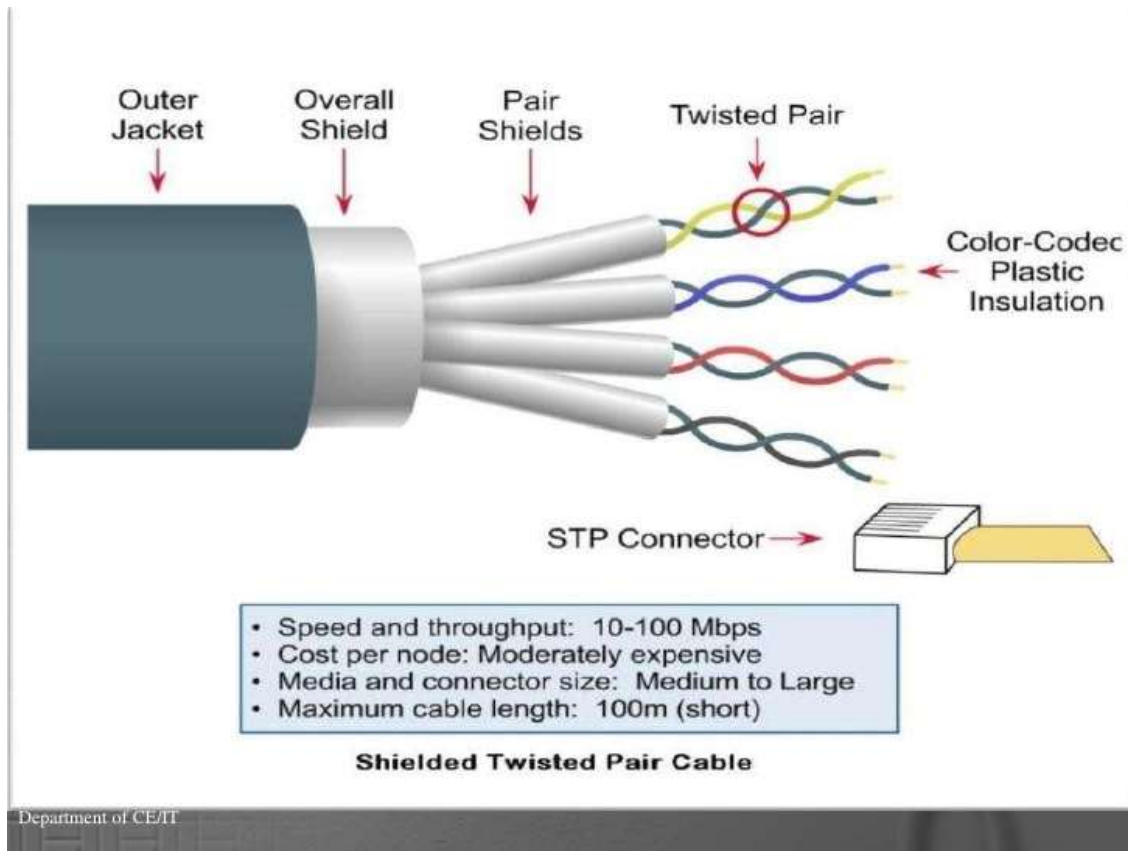
- It is cheap.
- Installation of the unshielded twisted pair is easy.
- It can be used for high-speed LAN.

Disadvantage:

- 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.



Characteristics Of Shielded Twisted Pair:

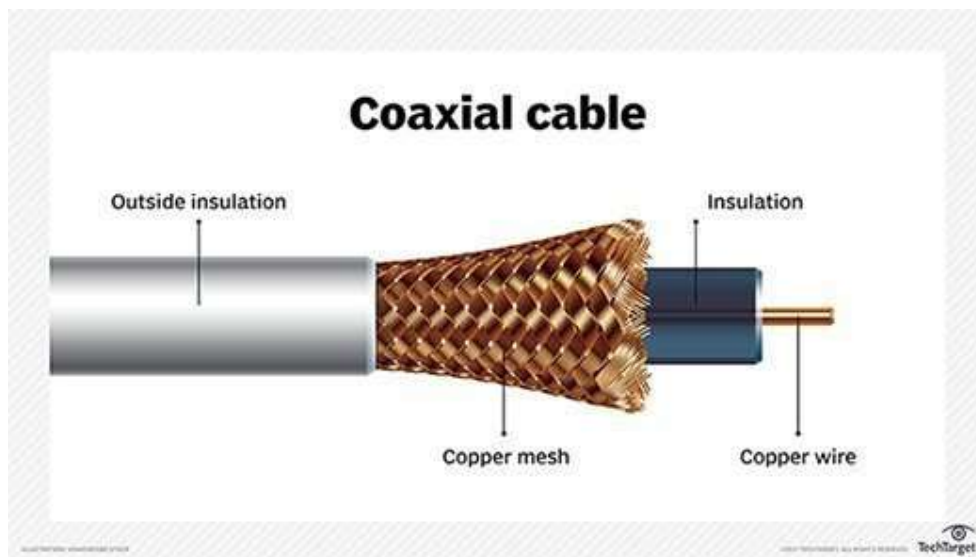
- The cost of the shielded twisted pair cable is not very high and not very low.
- An installation of STP is easy.
- It has higher capacity as compared to unshielded twisted pair cable.
- It has a higher attenuation.
- It is shielded that provides the higher data transmission rate.

Disadvantages

- 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.
- 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).



Coaxial cable is of two types:

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

Advantages Of Coaxial cable:

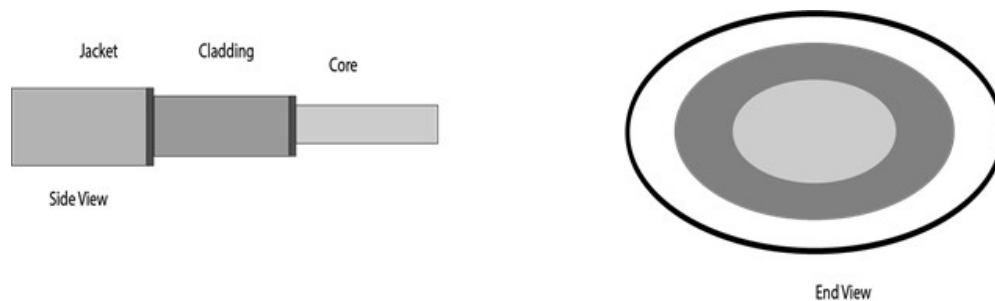
- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

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.

Fibre Optic

- Fibre optic cable is a cable that uses electrical signals for communication.
- Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

Diagrammatic representation of fibre optic cable:**Basic elements of Fibre optic cable:**

- **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.
- **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.

Following are the advantages of fibre optic cable over copper:

- **Greater Bandwidth:** The fibre optic cable provides more bandwidth as compared to copper. Therefore, the fibre optic carries more data as compared to copper cable.
- **Faster speed:** Fibre optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.
- **Longer distances:** The fibre optic cable carries the data at a longer distance as compared to copper cable.
- **Better reliability:** The fibre optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.
- **Thinner and Sturdier:** Fibre optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

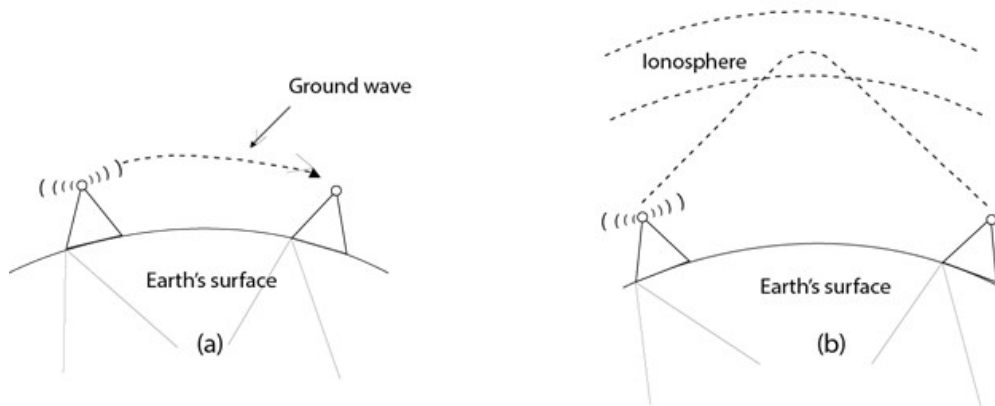
Unguided Transmission

- An unguided transmission transmits the electromagnetic waves without using any physical medium. Therefore it is also known as **wireless transmission**.
- In unguided media, air is the media through which the electromagnetic energy can flow easily.

Unguided transmission is broadly classified into three categories:

Radio waves

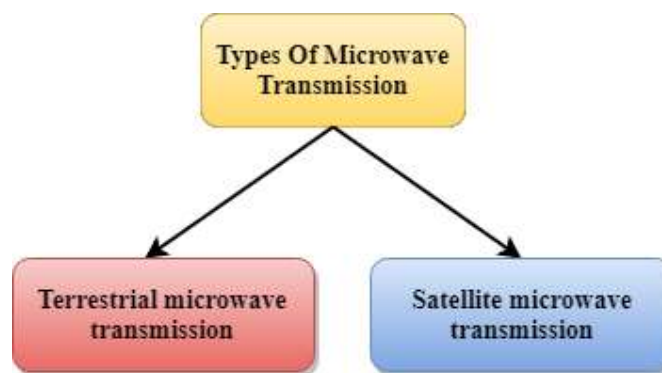
- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.
- Radio waves are omnidirectional, i.e., the signals are propagated in all the directions.
- The range in frequencies of radio waves is from 3Khz to 1 khz.
- In the case of radio waves, the sending and 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**.

**Applications 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 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.

Microwaves

Microwaves are of two types:

- Terrestrial microwave
- Satellite microwave communication.

Terrestrial Microwave Transmission

- Terrestrial Microwave transmission is a technology that transmits the focused beam of a radio signal from one ground-based microwave transmission antenna to another.
- Microwaves are the electromagnetic waves having the frequency in the range from 1GHz to 1000 GHz.
- Microwaves are unidirectional as the sending and receiving antenna is to be aligned, i.e., the waves sent by the sending antenna are narrowly focussed.
- In this case, antennas are mounted on the towers to send a beam to another antenna which is km away.
- It works on the line of sight transmission, i.e., the antennas mounted on the towers are the direct sight of each other.

Characteristics of Microwave:

- **Frequency range:** The frequency range of terrestrial microwave is from 4-6 GHz to 21-23 GHz.
- **Bandwidth:** It supports the bandwidth from 1 to 10 Mbps.
- **Short distance:** It is inexpensive for short distance.
- **Long distance:** It is expensive as it requires a higher tower for a longer distance.
- **Attenuation:** Attenuation means loss of signal. It is affected by environmental conditions and antenna size.

Advantages Of Microwave:

- Microwave transmission is cheaper than using cables.
- It is free from land acquisition as it does not require any land for the installation of 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:

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

Satellite Microwave Communication

- A satellite is a physical object that revolves around the earth at a known height.
- Satellite communication is more reliable nowadays as it offers more flexibility than cable and fibre optic systems.
- We can communicate with any point on the globe by using satellite communication.

How Does Satellite work?

The satellite accepts the signal that is transmitted from the earth station, and it amplifies the signal. The amplified signal is retransmitted to another earth station.

Advantages Of Satellite Microwave Communication:

- The coverage area of a satellite microwave is more than the terrestrial microwave.
- The transmission cost of the satellite is independent of the distance from the centre of the coverage area.
- Satellite communication is used in mobile and wireless communication applications.
- It is easy to install.
- It is used in a wide variety of applications such as weather forecasting, radio/TV signal broadcasting, mobile communication, etc.

Disadvantages Of Satellite Microwave Communication:

- Satellite designing and development requires more time and higher cost.
- The Satellite needs to be monitored and controlled on regular periods so that it remains in orbit.

- The life of the satellite is about 12-15 years. Due to this reason, another launch of the satellite has to be planned before it becomes non-functional.

Infrared

- An infrared transmission is a wireless technology used for communication over short ranges.
- The frequency of the infrared is in the range from 300 GHz to 400 THz.
- It is used for short-range communication such as data transfer between two cell phones, TV remote operation, data transfer between a computer and cell phone resides in the same closed area.

Characteristics Of Infrared:

- It supports high bandwidth, and hence the data rate will be very high.
- Infrared waves cannot penetrate the walls. Therefore, the infrared communication in one room cannot be interrupted by the nearby rooms.
- An infrared communication provides better security with minimum interference.
- Infrared communication is unreliable outside the building because the sun rays will interfere with the infrared waves.