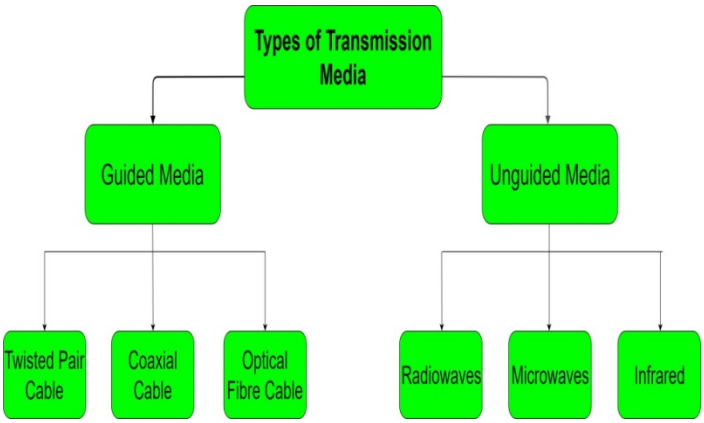
Types of Transmission Media

In data communication terminology, a transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one place to another. Transmission Media is broadly classified into the following types:



1. Guided Media:
It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

- High Speed
- Secure
- Used for comparatively shorter distances

There are 3 major types of Guided Media:

(i) Twisted Pair Cable –
It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

1. **Unshielded Twisted Pair (UTP):**
   This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.

   Advantages:

- Least expensive
- Easy to install
- High speed capacity

Disadvantages:

- Susceptible to external interference
- Lower capacity and performance in comparison to STP
- Short distance transmission due to attenuation

2. **Shielded Twisted Pair (STP):**
   This type of cable consists of a special jacket to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.

   Advantages:

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparitively faster

Disadvantages:

- Comparitively difficult to install and manufacture
- More expensive
- Bulky

(ii) Coaxial Cable –
It has an outer plastic covering containing 2 parallel conductors each having a separate insulated protection cover. Coaxial cable transmits information in two modes: Baseband mode(dedicated cable bandwidth) and Broadband mode(cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.

Advantages:

- High Bandwidth
- Better noise Immunity
- Easy to install and expand
- Inexpensive

Disadvantages:

- Single cable failure can disrupt the entire network

(iii) Optical Fibre Cable –
It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for transmission of large volumes of data.

Advantages:

- Increased capacity and bandwidth
- Light weight
- Less signal attenuation

Disadvantages:

- Difficult to install and maintain
- High cost
- Fragile

2. Unguided Media:
It is also referred to as Wireless or Unbounded transmission media.No physical medium is required for the transmission of electromagnetic signals.

Features:

- Signal is broadcasted through air
- Less Secure
- Used for larger distances

There are 3 major types of Unguided Media:

(i) Radiowaves –
These are easy to generate and can penetrate through buildings.The sending and receiving antennas need not be aligned. Frequency Range:3KHz – 1GHz. AM and FM radios and cordless phones use Radiowaves for transmission.

Further Categorized as: (i) Terrestrial and (ii) Satellite.

(ii) Microwaves –
It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range:1GHz – 300GHz. These are majorly used for mobile phone communication and television distribution.

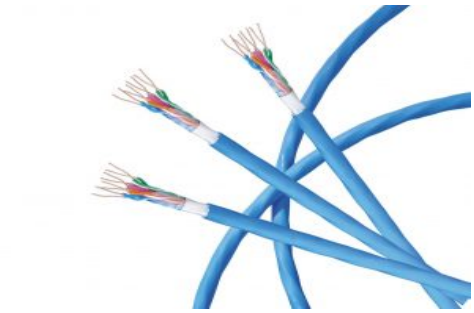
(iii) Infrared –
Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range:300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.

Twisted Pair, Coaxial and Fiber Optic Cables

Most of us know the general distinction between ADSL, COAX and Fiber internet, but the cabling behind these connections may be more of a mystery. The three most common types of communication cables are Twisted Pair, Coaxial, and Fiber Optic.

Understanding the differences between the three will shed light on how data travels through each cable, which ultimately affects your connection and things like speed, latency, security, cost, etc. Here is a general breakdown of the three different types of cable systems and what they are capable of:

1) Twisted Pair Cables:



Twisted pair cables are quite literally a pair of insulated wires that are twisted together to help reduce noise from outside sources. While this does help some, these cables are still very susceptible to outside noise. Twisted pair cables are the most cost-effective option of the three but that also brings about lower bandwidth and high attenuation. There are two types of twisted pair cables:

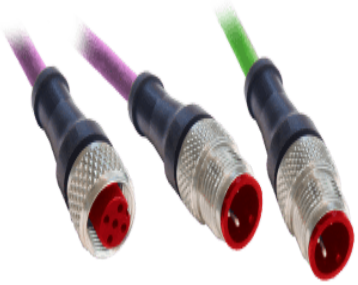
I. Unshielded twisted pair (UTP)

- 'Unshielded' meaning it does not rely on physical shielding to block interference
- Most commonly used cable of the two, often utilized for both residential and business use
- There are several UTP categories, which increase in bandwidth as you move up the scale, for example:
  - **CAT1** = up to 1Mbps | **CAT2** = up to 4 Mbps | **CAT5e** = up to 1Gbps

II. Shielded twisted pair (STP)

- 'Shielded' with a foil jacket to cancel any external interference
- Commonly used for large-scale enterprises for high-end applications as well as exterior cabling that may be exposed to environmental elements.

2) Coaxial Cables:



Coaxial cables are high-frequency transmission cables made up of a single solid-copper core. Data is transferred electrically over the inner conductor and has 80X more transmission capacity than twisted pair cables.

This type of cable is commonly used to deliver TV signals (its higher bandwidth makes it more suitable for video applications) and to connect computers in a network. Along with stable transmission of data, coaxial cables also have anti-jamming capabilities and can effectively protect signals from being interfered. The

cost is slightly higher than twisted pair but still considered more economical than fiber. There are also two types of coaxial cables:

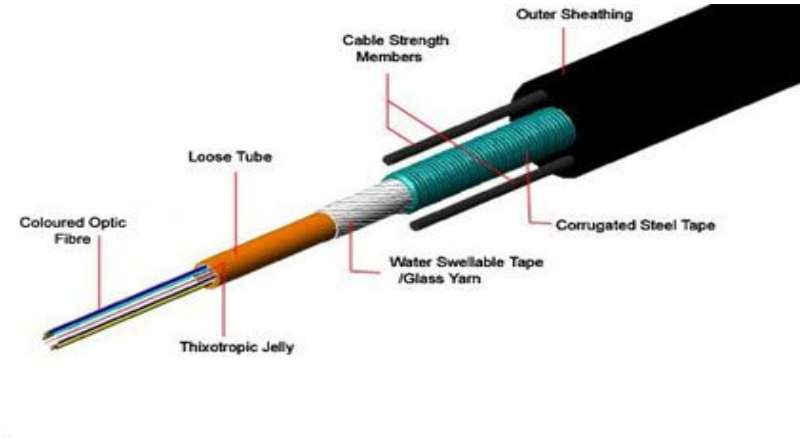
75 Ohm

- Most commonly used to transmit video signals
- Often connects video signals between different components like DVDs, VCRs, or receivers commonly known as A/V cables

50 Ohm

- Primarily utilized to transmit a data signal in a 2-way communication system
- Most commonly used for computer ethernet backbones, AM/FM radio receivers, GPS antenna, police scanners, and cell phone systems

3) Fiber Optic Cables:



Fiber is the newest form of transmission cable technology. Instead of transferring data over copper wires, these cables contain optical fibers that transmit data via light, rather than pulses of electricity. Each optical fiber is individually coated with plastic layers and contained in a protective tube, making it extremely resistant to external interference. The result is a very reliable and super-fast connection that has **26,000X more transmission capacity** than twisted-pair cables, but that also comes with a much higher cost. Again, there are two types of fiber cables:

I. Single mode

- Has a small core and only allows one mode of light to propagate at a time
- Because of this, the number of light reflections decrease as they pass through the core
- The result is low attenuation and data that is able to travel further and faster
- Commonly used in telecom, CATV networks, and Universities.

II. Multimode

- Has a larger core diameter that lets multiple modes of light propagate
- The amount of light reflections increase as they travel through the core, which allows more data to pass through
- Because of its high dispersion, multimode cables have lower bandwidth, higher attenuation and reduced signal quality further it travels
- Most commonly used for communication over short distances such as LAN, security systems, and general fiber networks.

What is a Connector (device)?

A device that terminates a segment of cabling or provides a point of entry for networking devices such as computers, hubs, and routers. Connectors can be distinguished according to their physical appearance and mating properties, such as jacks and plugs (male connectors) or sockets and ports (female connectors).

They can also be distinguished by their different pinning configurations, such as DB9 and DB15 connectors, which have 9 and 15 pins, respectively.

In addition, connectors are distinguished by the kind of electrical interfaces they support. Examples of different types of connectors include:

- Connectors for serial interfaces, such as RS-232 and V.35
- Ethernet connectors, such as RJ-45 and BNC connectors
- Fiber-optic cabling connectors, such as SC and ST connectors

1) (BNC Connector)

he Bayonet Neill-Concelman Connector (BNC connector) is a type of coaxial RF (Radio frequency) electrical connector that is used in place of coaxial connectors.

A BNC connector connects various radio frequencies up to 3GHz and voltages under 500V DC and are used in electronic architectures such as audio, video and networking. BNC is also used in avionics and high grade analog communications test equipment due to its low-signal-loss architecture. Co-axial ethernet cabling is nearly always terminated with BNC connectors.

2) RJ45 connectors-

Registered jack-45 (RJ45) refers to a cable termination specification that specifies physical male and female connectors and the pin assignments of wires-in telephone cables and other networks that use RJ45 connections.

RJ45 connections are also known as data jacks.

Registered jack-45 (RJ45) is an eight-wire connector used to connect computers on local area networks. They were initially used as a telephone-only standard, but have since been applied to high-speed modems and other computer networks.

The RJ-45 is often confused with the 8P8C standard which looks almost identical but has particular properties regarding signal loss as the cabling is always made up of twisted pairs, a noise cancelling technology. The most common confusion is where RJ-45 is thought to be the same as an Ethernet connector, which is actually an RJ45S (or 8P8C) connection. RJ-45 is a telephony specification and although the connectors are almost identical to 8P8C, they have different signal conduction characteristics.

3) AUI Connector

Acronym for Attachment Unit Interface connector, a standard 15-pin connector device for thicknet or 10Base5 cabling. The AUI connector on the free end of the drop cable attaches to the DB15 connector on the network interface card (NIC). The NIC has an AUI port connector for connecting the drop cable.

The other end of the drop cable typically connects to a transceiver. The transceiver is then joined to the thicknet cabling using a vampire tap that pierces the cable jacket and insulation to make a connection.

4) Optical Fiber Connector

An optical fiber connector is a flexible device that connects fiber cables requiring a quick connection and disconnection. Optical fibers terminate fiber-optic connections to fiber equipment or join two fiber connections without splicing. Hundreds of optical fiber connector types are available, but the key differentiator is defined by the mechanical coupling techniques and dimensions. Optical fiber connectors ensure stable connections, as they ensure the fiber ends are optically smooth and the end-to-end positions are properly aligned.

An optical fiber connector is also known as a fiber optic connector.

TYPES OF UNGUIDED MEDIA

Unguided Media

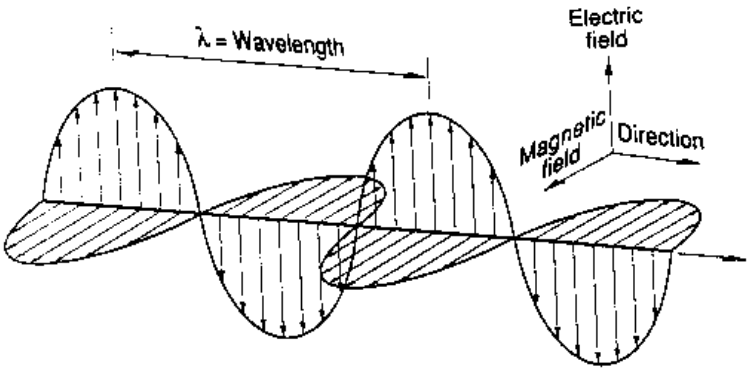
In unguided media transmission, messages or electromagnetic signals travel through air or space. Cables, connectors and other solid conductors are not required in unguided media systems. Wireless communication is particularly useful in those regions where cables are difficult to implement or install. The main types of unguided media are Radio waves, Microwaves and Infrared waves.

The Five main types of wireless media are:

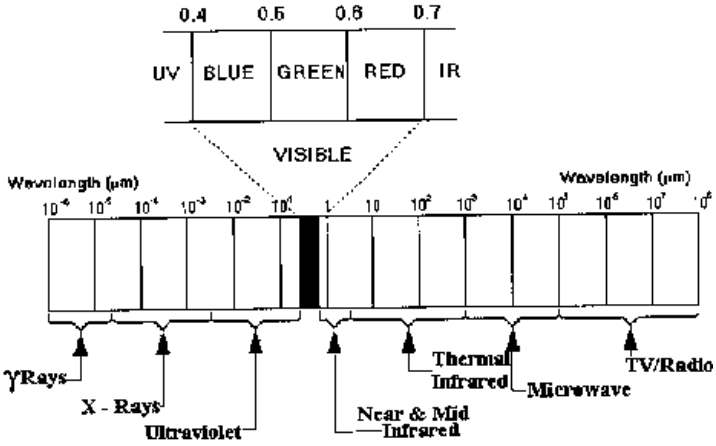
1. Electromagnetic spectrum

The Electromagnetic Spectrum

The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength. The sun, earth, and other bodies radiate electromagnetic energy of varying wavelengths. Electromagnetic energy passes through space at the speed of light in the form of sinusoidal waves. The wavelength is the distance from wavecrest to wavecrest (see figure below).

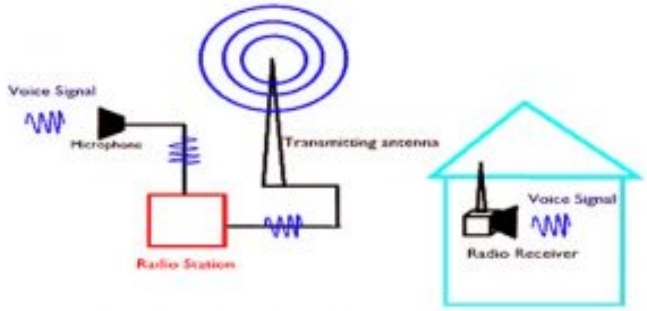


Light is a particular type of electromagnetic radiation that can be seen and sensed by the human eye, but this energy exists at a wide range of wavelengths. The micron is the basic unit for measuring the wavelength of electromagnetic waves. The spectrum of waves is divided into sections based on wavelength. The shortest waves are gamma rays, which have wavelengths of 10e-6 microns or less. The longest waves are radio waves, which have wavelengths of many kilometers. The range of visible consists of the narrow portion of the spectrum, from 0.4 microns (blue) to 0.7 microns (red).



2. Radio transmission

Radio communication was one of the first wireless technologies developed and it is still in use. The portable multi-channel radios allow the user to communicate over short distances whereas citizen band and maritime radios provide communication services over long distances for truckers and sailors.



Radio frequency is a form of electromagnetic transmission used in wireless communication. RF signals are easily generated, ranging 3kHz to 300GHz. These are used in wireless communication because of their property to penetrate through objects and travel long distances.

Radio communication depends on the wavelength, transmitter power, receiver quality, type, size and height of the antenna.

Drawbacks

- These are frequency dependent
- These have the relatively low bandwidth for data transmission.

3. Microwave Transmission

Microwaves are the form of electromagnetic transmission used in wireless communication systems. The wavelength of microwave ranges from one meter to one millimetre. The frequency varies from 300MHz to 300GHz. These are widely used for long distance communications and are relatively less expensive.

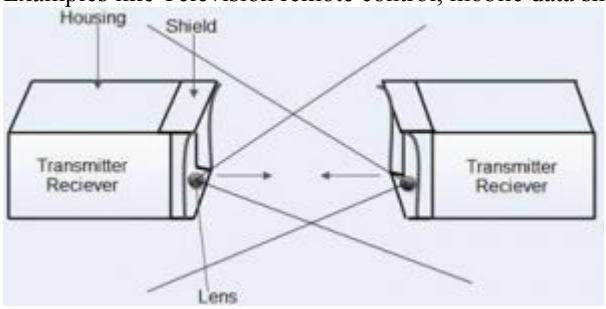
Microwave Transmission Node

Drawbacks

- The microwave does not pass through buildings.
- Bad weather affects the signal transmission.
- These are frequency dependent.

4. Infrared Transmission

Infrared radiations are electromagnetic radiations with longer wavelengths than visible light. These are usually used for short-range communications. These signals do not pass through solid objects.
Examples like Television remote control, mobile data sharing.

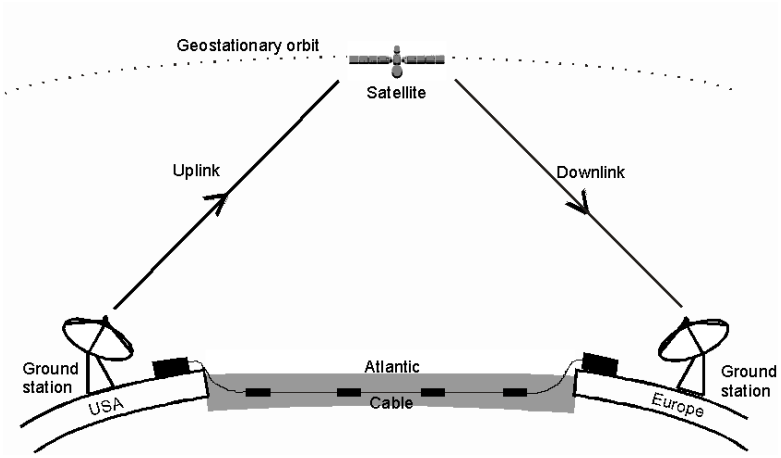


Infrared Transmission

5. Satellite Communication

The use of Satellite is to extend the coverage area. Signal is transmitted up and down between ground stations. The satellite is therefore used as a repeater for re-generating the signal.

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.
A repeater is a circuit, which increases the strength of the received signal and then transmits it. But, this repeater works as a transponder. That means, it changes the frequency band of the transmitted signal from the received one.
The frequency with which, the signal is sent into the space is called as Uplink frequency. Similarly, the frequency with which, the signal is sent by the transponder is called as Downlink frequency. The following figure illustrates this concept clearly.
The transmission of signal from first earth station to satellite through a channel is called as uplink. Similarly, the transmission of signal from satellite to second earth station through a channel is called as downlink


Geostationary orbit
Satellite
Uplink
Downlink
Ground station
USA
Atlantic
Cable
Europe
Ground station