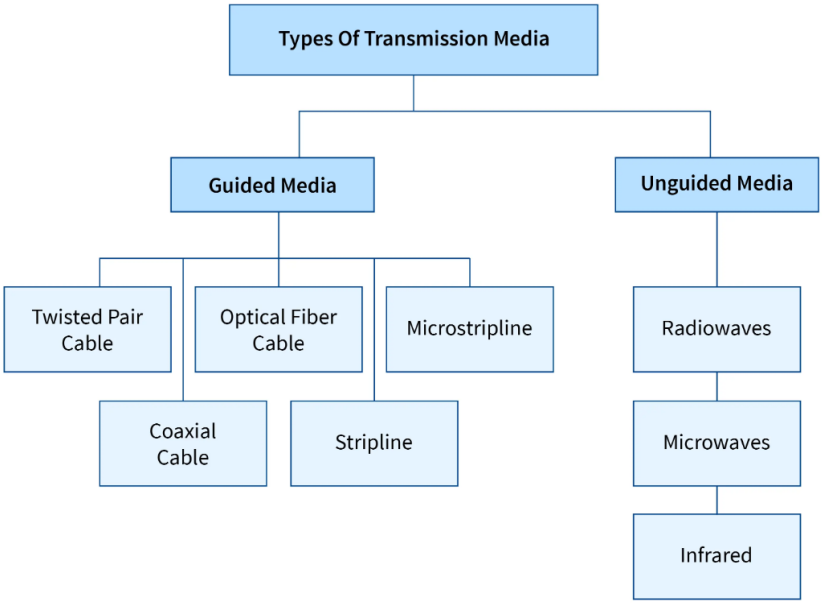
Experiment 1:-

Transmission Media:-

A transmission medium can be broadly defined as anything that can carry information from a source to a destination.

In data communication the definition of the information and the transmission medium is more specific. The transmission medium is usually free space, metallic cable or fiber-optic cable.

In telecommunication, transmission media can be divided into two broad categories: guided and unguided.



Guided media

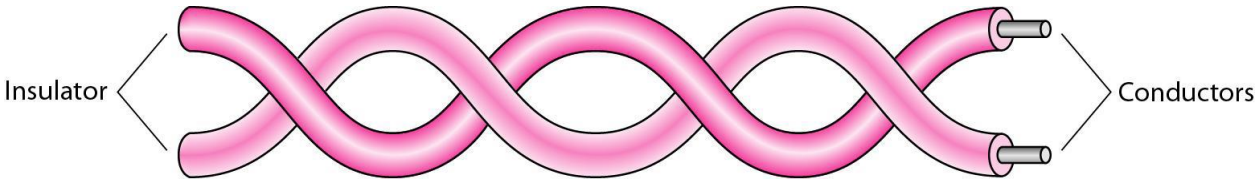
Guided media are those that provide a conduct form one device to another, include twisted pair cable, coaxial cable and fiber-optic cable. A signal travelling along any of these media is directed and contained by the physical limits of the medium.

Twisted Pair Cable

A twisted pair consists of two conductors (normally copper) each with its own plastic insulation, twisted together.

One of the wires is used to carry signals to the receiver, and the other is used only as ground reference. The receiver uses the difference between the two. In addition to the signal sent by the sender on one of the wires, interference (noise) and crosstalk may affect both wires and create unwanted signals.

If the two wires are parallel, the effect of these unwanted signals is not the same in both wires because they are at different location relative to the noise. This results in a difference at the receiver. By twisting the pairs a balance is maintained. Frequency range of Twisted Pair Cable is 100 Hz to 5 MHz.



Twisted pair cable comes in two forms:

1. Unshielded Twisted Pair (UTP),
2. Shielded Twisted Pair (STP).

1. Unshielded Twisted Pair (UTP)

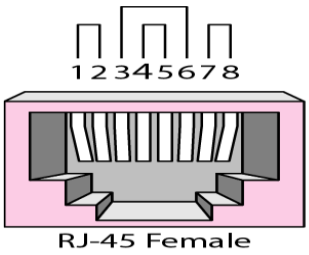
UTP is the most common type of telecomm. Medium and is use in telephone system, which consists of two conductor (Cu), each with of different plastic color insulation to identify specific conductor.

Advantage of UTP

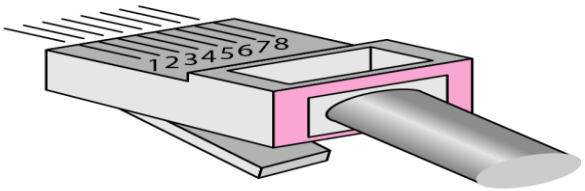
UTP is cheap, flexible and easy to install, higher grade of UTP are used in many LAN technologies.

UTP connector

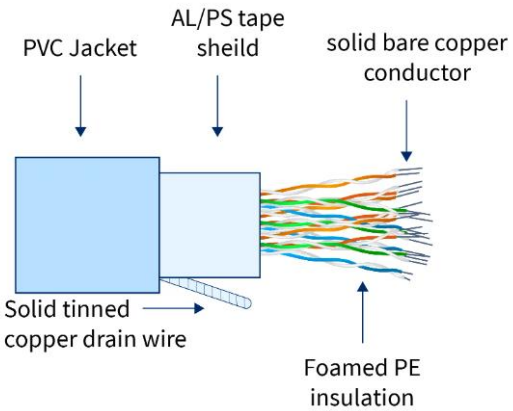
UTP is most commonly connected to n/w devices via a snap-in plug like RJ45 connector with 8 conductors.



RJ-45 Female



RJ-45 Male



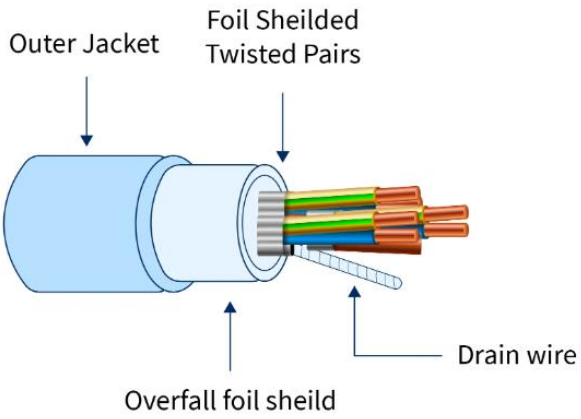
Unshielded Twisted Pair

2. Shielded Twisted Pair (STP)

STP has a metal foil or braided-mesh covering that encases each pair of insulated conductors. The metal casing prevents the penetration of electromagnetic noise.

- Through the use of STP we can eliminate the phenomenon called ***cross talk.***
- STP has the same quality consideration as UTP.

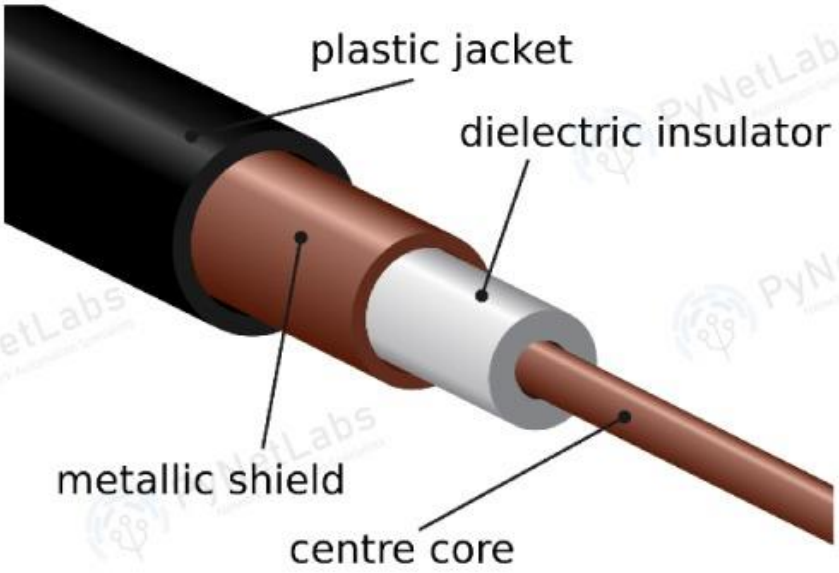
- STP is more expensive than that of UTP but less susceptible to noise.



Shielded Twisted Pair

Coaxial Cable

Coaxial Cable carries signals of higher frequency ranges than those in twisted pair cable, in part because the two media are constructed quite differently. Instead of having 2 wires coaxial has a central conductor of solid or stranded wire(usually copper) enclosed in an insulating sheath, which is in turn encased in an outer conductor of metal foil, braid or a combination of the two. The outer metal wrapping serves both as a shield against noise and as the second conductor, which completes the circuit. The outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.



Application

Coaxial Cable was widely used in analog telephone networks cable TV networks also use coaxial cables. Another common application of coaxial cable is in traditional ethernet LANs.

Coaxial cable connectors

There are number of connectors available for coax some of them are

1. *BNC (bayonet n/w connector)*
2. *T-connectors* which allow secondary cable to branch off from main line
3. *Terminators* used in Bus topologies.

Fiber Optic Cable

In addition, optical fiber, a physical medium, has also become the standard for long-distance communications. Optical fibers are transparent, flexible wires composed of glass (silica) or plastic that are just a little thicker than a human hair. It acts as a waveguide, allowing light to travel between the fiber's two ends.
Fiber optic communications rely heavily on optical fibers because they allow for greater bandwidths (data rates) and transmission over greater distances than traditional modes of communication. It contains strands of glass fibers inside an insulated casing. The route for light is provided by the core, located in the center. The core is surrounded by cladding that reflects light to prevent loss of signal and allow the passage of light.

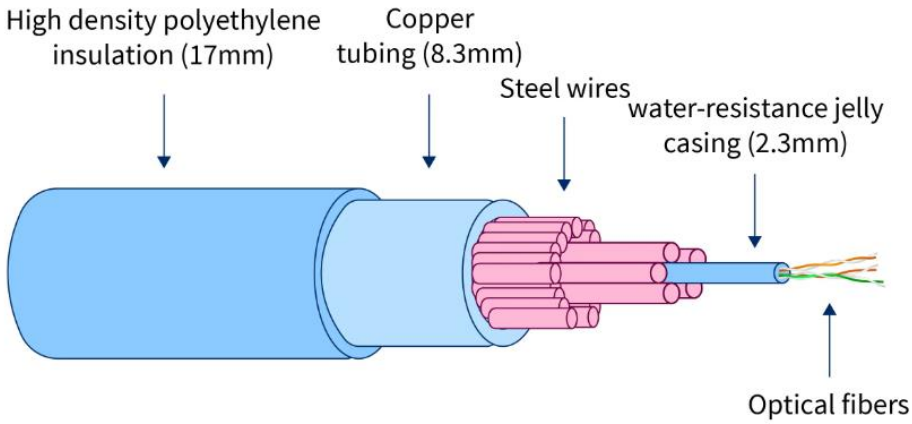
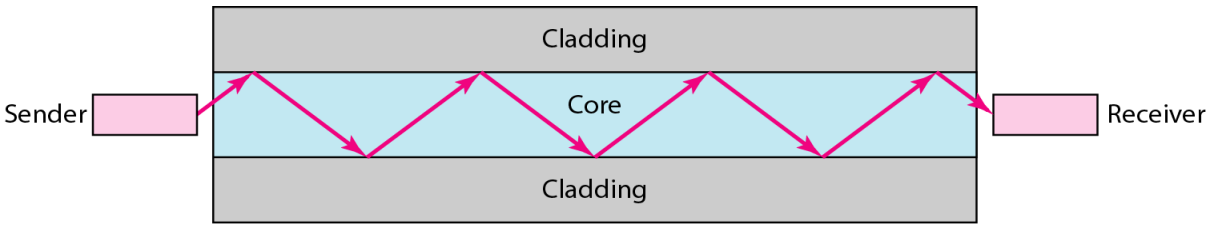


Figure of Optical Fibre Cable



Advantages of optical fiber:

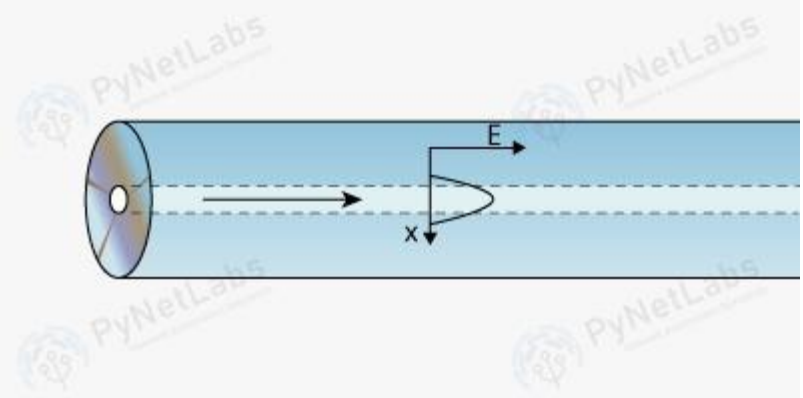
- Higher Bandwidth
- Less Signal Attention
- Immunity to electromagnetic interference
- Resistance to corrosive materials
- Light Weight
- Greater immunity to tapping.

Disadvantages of optical Fiber

- Installation and maintainance
- Unidirectional light propagation
- Cost (High Cost)

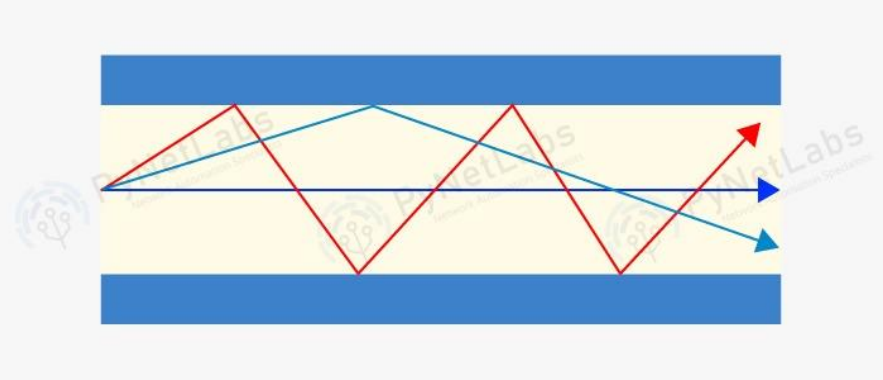
1.Single mode

- Single strand of glass fiber
- Single data signal
- Can span large distances
- Uses laser
- Transmission speeds are faster



2.Multi-mode

- Can carry multiple modes of the data signal
- Can carry multiple light signals
- Can span lesser distances than single mode
- Uses LED
- Transmission speeds are lower than single mode



Unguided Media

Unguided media transports electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication. Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

Electromagnetic spectrum for wireless communication

Unguided signals can travel from the source to destination in several ways: ground propagation, sky propagation and line-of-sight propagation.

In **ground propagating**, radio waves travel through the lowest portion of the atmosphere, hugging the earth. These low-frequency signals emanate in all directions from the transmitting antenna and follow the curvature of the planet. Distance depends on the amount of power in the signal, the greater the power, the greater the distance.

In **sky propagation**, higher frequency radio waves radiate upward into the ionosphere, where they are reflected back to the earth.

In **live-of-sight propagation**, very high frequency signals are transmitted in straight lines directly from antenna to antenna.

Radio waves:

- Electromagnetic waves ranging in frequencies between 3KHz and 1 GHz are normally called radio waves.
- Radio wave for the most part is omni-directional. The transmitting and receiving antenna's do nt need to be aligned.
- Radio waves particularly those of low and medium frequencies can penetrate walls.
- Omnidirectional Antennas used in AM and FM radio, television, maritime radio etc.

Microwaves:

- Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.
- Electromagnetic waves (Microwaves) are unidirectional.
- Microwave propagation is line-of-light.
- Very high-frequency microwaves cannot penetrate walls.
- Unidirectional antennas are used.

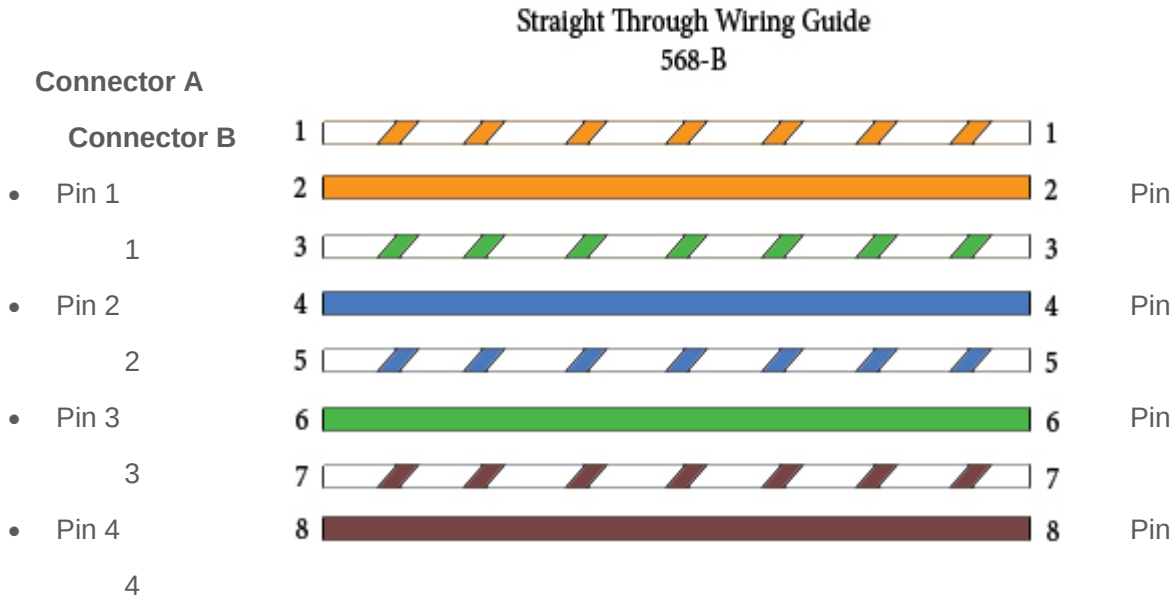
Infrared:

Infrared with frequencies from 300GHz to 400THz can be used for short range communication. Infrared waves, having high frequencies, cannot penetrate walls. This advantageous characteristic prevents interference between one system and another, a short range communication system is one room cannot be affected by another system in the next room.

Infrared signals can be used for short range communication in a closed area using line-of-sight propagation.

Straight Cabling Technique

Straight-Through refers to cables that have the pin assignments on each end of the cable. In other words Pin 1 connector A goes to Pin 1 on connector B, Pin 2 to Pin 2 etc. Straight-Through wired cables are most commonly used to connect a host to client. For cat5e patch cables, the Straight-Through wired cat5e patch cable is used to connect computers, printers and other network client devices to the router switch or hub (the host device in this instance).



- Pin 1 1
- Pin 2 2
- Pin 3 3
- Pin 4 4

Pin
Pin
Pin
Pin

- Pin 5 Pin 5
- Pin 6 Pin 6
- Pin 7 Pin 7
- Pin 8 Pin 8

Crossover Cabling Technique

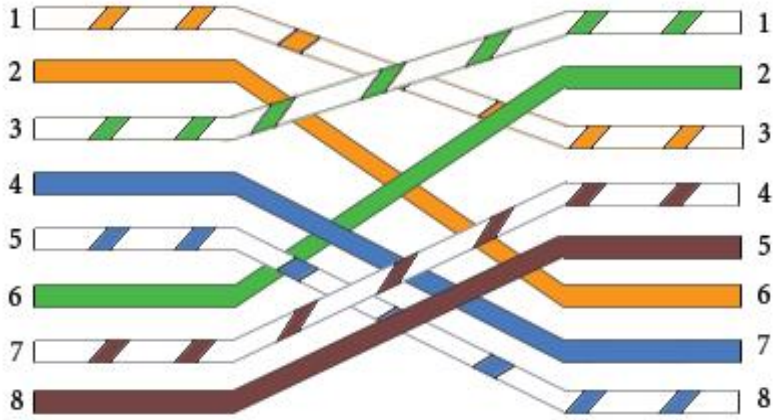
Crossover wired cables (commonly called crossover cables) are very much like Straight-Through cables with the exception that TX and RX lines are crossed (they are at opposite positions on either end of the cable. Using the 568-B standard as an example below you will see that Pin 1 on connector A goes to Pin 3 on connector B. Pin 2 on connector A goes to Pin 6 on connector B etc. Crossover cables are most commonly used to connect two hosts directly. Examples would be connecting a computer directly to another computer, connecting a switch directly to another switch, or connecting a router to a router. Note: While in the past when connecting two host devices directly a crossover cable was required. Now days most devices have auto sensing technology that detects the cable and device and crosses pairs when needed.

Crossover Wiring Guide
568-B

Connector A

Connector B

- Pin 1
  3
- Pin 2
  6
- Pin 3
  1
- Pin 4
  7



Pin

Pin

Pin

Pin

- Pin 5 Pin 8
- Pin 6 Pin 2
- Pin 7 Pin 4
- Pin 8 Pin 5

Different Type of CAT Cables

Ethernet cables have been evolving since the beginning of the Ethernet standard in 1985. Many different categories of Ethernet cable have been developed, and each category has different specifications as far as shielding from electromagnetic interference, data transmission speed, and the possible bandwidth frequency range required to achieve that speed.

Category 1

Category 1 typically telephone communication cable CAT-1 cable is used as level-1 or vice grade copper is a grade of unshielded twisted pair cabling designed for telephonic communication, at one-time the most for telephonic communication for data transmission.

Category 2

Category 2 cable also known as CAT-2 or level 2 is grade of unshielded and twisted pair cabling designed for telephone and data communication. Maximum speed is 2 Mbps.

Category 3

Category 3 Ethernet cable, also known as Cat 3 or station wire, is one of the oldest forms of Ethernet cable still in use today. It is an unshielded twisted pair (UTP) cable that is capable of carrying 10 megabits per second (Mbps) of data or voice transmissions. Its maximum possible bandwidth is 16 MHz. Cat 3 cable reached the peak of its popularity in the early 1990s, as it was then the industry standard for computer networks. With the debut of the faster Category 5 cable, however, Cat 3 fell

out of favor. It still can be seen in use in two-line telephone systems and older 10BASE-T Ethernet installations.

Category 4

Category 4 is that cable which contains 4 unshielded twisted pair UTP copper wire with a data rate of 20Mbps. It is used generally jacketed with an outside sheath used in token Ring.

Category 5

Category 5 (Cat 5) Ethernet cable is the successor to the earlier Category 3. Like Cat 3, it is a UTP cable, but it is able to carry data at a higher transfer rate. Cat 5 cables introduced the 10/100Mbps speed to the Ethernet, which means that the cables can support either 10 Mbps or 100 Mbps speeds. A 100 Mbps speed is also known as Fast Ethernet, and Cat 5 cables were the first Fast Ethernet-capable cables to be introduced. They also can be used for telephone signals and video, in addition to Ethernet data. This category has been superseded by the newer Category 5e cables.

Category 5e

The Category 5e standard is an enhanced version of Cat 5 cable, which is optimized to reduce crosstalk, or the unwanted transmission of signals between data channels. This category works for 10/100 Mbps and 1000 Mbps (Gigabit) Ethernet, and it has become the most widely used category of Ethernet cable available on the market. While Cat 5 is common in existing installations, Cat 5e has completely replaced it in new installations. While both Cat 5 and Cat 5e cables contain four twisted pairs of wires, Cat 5 only utilizes two of these pairs for Fast Ethernet, while Cat 5e uses all four, enabling Gigabit Ethernet speeds. Bandwidth is also increased with Cat 5e cables, which can support a maximum bandwidth of 100 MHz. Cat 5e cables are backward compatible with Cat 5 cables, and can be used in any modern network installation.

Category 6

One of the major differences between Category 5e and the newer Category 6 is in transmission performance. While Cat 5e cables can handle Gigabit Ethernet speeds, Cat 6 cables are certified to handle Gigabit Ethernet with a bandwidth of up to 250 MHz. Cat 6 cables have several improvements, including better insulation and thinner wires, that provide a higher signal-to-noise ratio, and are better suited for environments in which there may be higher electromagnetic interference. Some Cat 6 cables are available in shielded twisted pair (STP) forms or UTP forms. However, for most applications, Cat 5e cable is adequate for gigabit Ethernet, and it is much less expensive than Cat 6 cable. Cat 6 cable is also backwards compatible with Cat 5 and 5e cables.

Category 6a

Category 6 a cable, or augmented Category 6 cable, improves upon the basic Cat 6 cable by allowing 10,000 Mbps data transmission rates and effectively doubling the maximum bandwidth to 500 MHz. Category 6a cables are usually available in STP form, and, as a result, must have specialized connectors that ground the cable.

Category 7

Category 7 cable, also known as Class F, is a fully shielded cable that supports speeds of up to 10 Gbps (10,000 Mbps) and bandwidths of up to 600 Mhz. Cat 7 cables consist of a screened, shielded twisted pair (SSTP) of wires, and the layers of insulation and shielding contained within them are even more extensive than that of Cat 6 cables. Because of this shielding, they are thicker, more bulky, and more difficult to bend. Additionally, each of the shielding layers must be grounded, or else performance may be reduced to the point that there will be no improvement over Cat 6, and performance may be worse than Cat 5. For this reason, it's very important to understand the type of connectors at the ends of a Cat 7 cable.

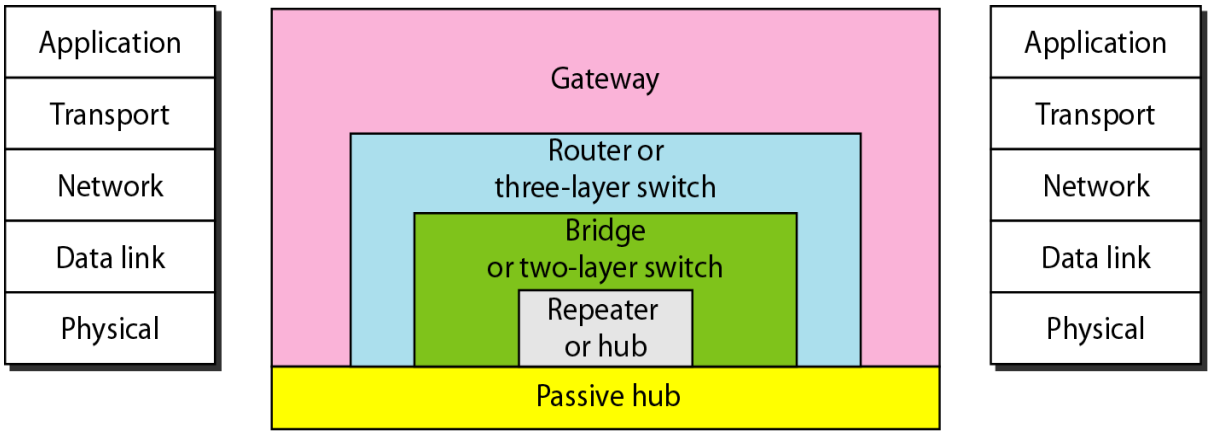
The following table summarizes the most common types of Ethernet cables, including their maximum data transmission speeds and maximum bandwidths.

Ethernet Type	Bandwidth	Cable Type	Maximum Distance
10Base-T	10Mbps	Cat 3/Cat 5 UTP	100m
100Base-TX	100Mbps	Cat 5 UTP	100m
100Base-TX	200Mbps	Cat 5 UTP	100m
100Base-FX	100Mbps	Multi-mode Fiber	400m
100Base- FX	200Mbps	Multi-mode Fiber	2Km
1000Base-T	1Gbps	Cat 5e UTP	100m
1000Base-TX	1Gbps	Cat 6 UTP	100m
1000Base-SX	1Gbps	Multi-mode Fiber	550m
1000Base-LX	1Gbps	Single-mode Fiber	2Km
10GBase-T	10Gbps	Cat 6a/Cat 7 UTP	100m
10GBase-LX	10Gbps	Multi-mode Fiber	100m
10GBase-LX	10Gbps	Single-mode Fiber	10Km

With each successive category, there has been an increase in data transmission speed and bandwidth. To fully future-proof a network installation, the highest categories are recommended, but only if all of the other equipment on the network is capable of similar speeds. Otherwise, expensive cables will be only as fast as the slowest piece of hardware on the network.

Experiment 2:

Various Interconnecting Devices

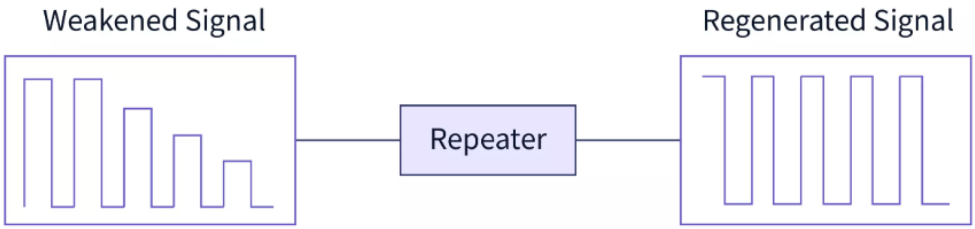


Repeaters

- A **physical layer** device the acts on **bits** not on **frames** or packets
- Can have two or more interfaces
- When a bit (0,1) arrives, the repeater receives it and **regenerates** it, the transmits it onto all other interfaces
- Used in LAN to **connect cable segments** and **extend** the **maximum cable length** ➔ extending the **geographical LAN range**
    - Ethernet 10base5 – Max. segment length 500m – 4 repeaters (5 segments) are used to extend the cable to **2500m**)
    - Ethernet 10Base2- Max. segment length 185m - 4 repeaters (5 segments) are used to extend the cable to **925m**
- Repeaters do not implement any **access method**
    - If any two nodes on any two connected segments transmit at the same time **collision** will happen

A repeater is a device that operates only in the physical layer. Signals that carry information within a network can travel a fixed distance before attenuation endangers the integrity of the data. A repeater receives a signal and, before it becomes too weak or corrupted, regenerates the original bit pattern. The repeater then sends the refreshed signal. A repeater can extend the physical length of a LAN

A repeater can overcome the 10Base5 Ethernet length restriction. In this standard, the length of the cable is limited to 500 m. To extend this length, we divide the cable into segments and install repeaters between segments. Note that the whole network is still considered one LAN, but the portions of the network separated by repeaters are called segments. The repeater acts as a two-port node, but operates only in the physical layer. When it receives a frame from any of the ports, it regenerates and forwards it to the other port.



Types of Repeater
On the basis of signals that repeaters generate.
Analog Repeaters :
In an analog repeater, data is transmitted through analog signals to increase its amplitude. These repeaters are used in trunk lines to help broadcast multiple signals using frequency division multiplexing (FDM). It houses the linear amplifier as well as the filters.
Digital Repeaters :
In a digital repeater, data is transmitted in the form of binary digits such as 0s and 1s. While transmitting data, 0 and 1 values are generated, and it is capable of transmitting data over long distances.

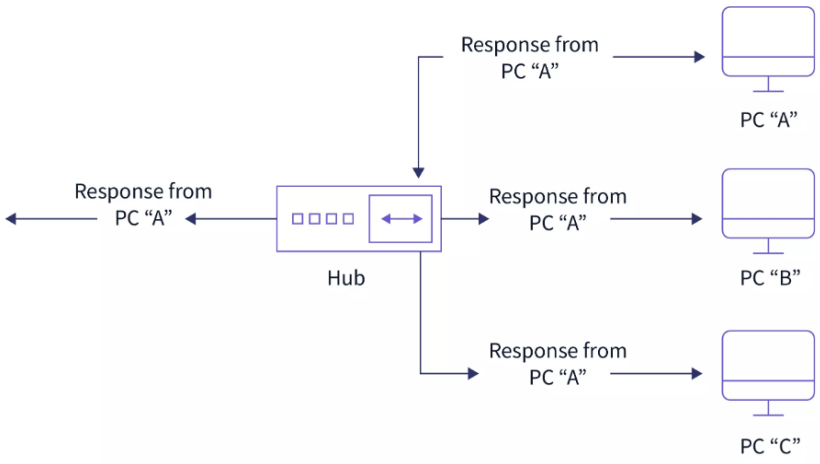
Based on the types of connected networks.
Wired Repeaters :
These repeaters are commonly used in wired Local Area Networks .
Wireless Repeaters :
They are commonly used in wireless LANs and cellular networks .

Based on the domain of LAN networks.
Local Repeaters :
They link LAN segments that are only slightly apart.
Remote Repeaters :
They connect LANs that are located far away.

Hubs

- Acts on the **physical layer**
- Operate on bits rather than frames
- Also called **multiport repeater**
- Used to connect stations adapters in a **physical** star topology but **logically** bus
- Connection to the hub consists of **two pairs of twisted pair wire** one for **transmission** and the other for **receiving**.
- Hub receives a bit from an adapter and sends it to **all** the other adapters without implementing any access method.
- does not do **filtering** (forward a frame into a specific destination or drop it) just it copy the received frame onto **all other links**
- The entire hub forms **a single collision domain**, and **a single Broadcast domain**
    - **Collision domain**: is that part of the network (set of **NICs**) when two or more nodes transmit at the same time collision will happen.
    - **Broadcast domain:** is that part of the network (set of NIC) where each NIC can 'see' other NICs' traffic **broadcast messages.**

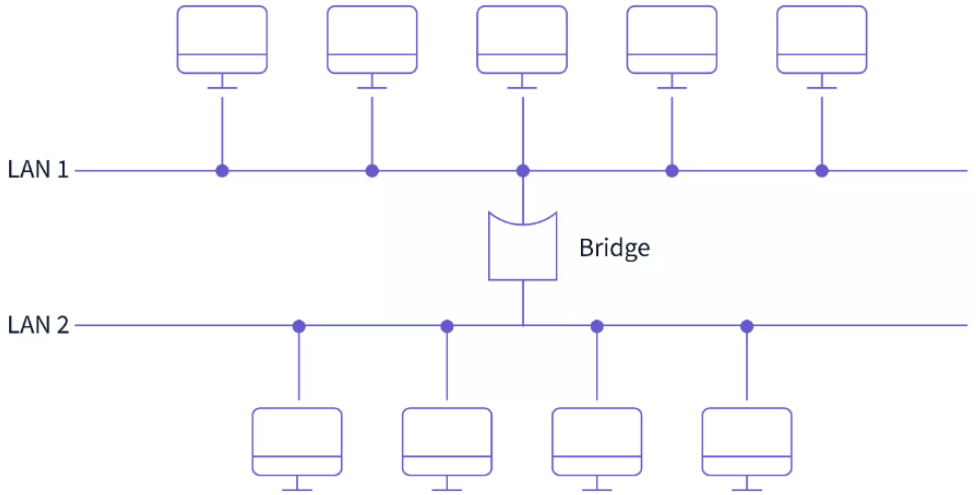
- Multiple Hubs can be used **to extend** the network length
- For 10BaseT and 100BaseT the maximum length of the connection between an adapter and the hub is 100 meters ➔ the maximum length between any two nodes is 200 m = maximum network length



- Backbone hub interconnects LAN segments
- **Advantage**:
  - Extends max distance between nodes
- **Disadvantages**
  - Individual segment collision domains become one large collision domain ➔ (**reduce the performance**)
  - Can't interconnect different Ethernet technologies(like 10BaseT & 100BaseT) because **no buffering** at the hub

Bridge

A bridge is a network device that operates at the data link layer device. A bridge is a repeater with the added functionality of filtering content by reading the MAC addresses of the source and destination. It is also used to connect two LANs that use the same protocol. It has a single input and output port, making it a two-port device.



Types of Bridges
There are generally two types of bridges used in networking :

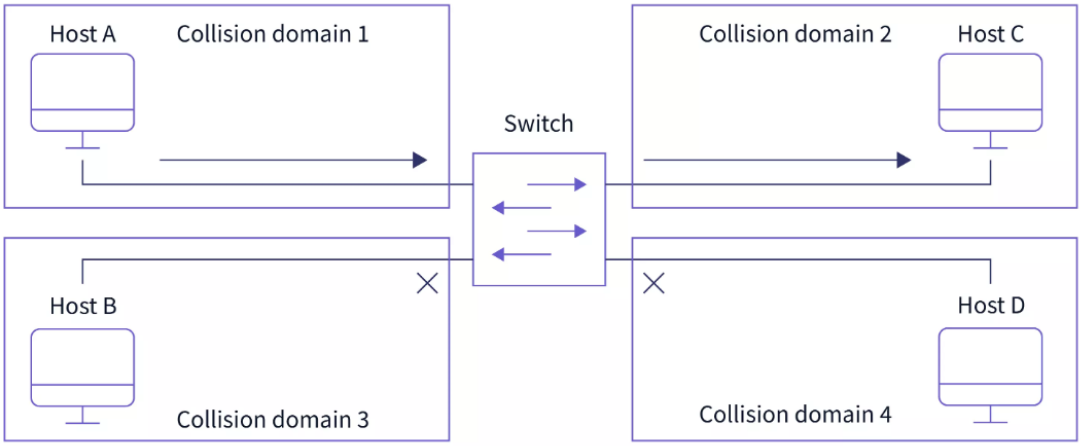
Transparent Bridges :
A transparent bridge is a type of bridge that monitors incoming network traffic to determine media access control (MAC) addresses. These bridges operate in a manner that is transparent to all networked hosts. A transparent bridge stores MAC addresses in a table similar to a routing table and uses that information to route packets to their destination.

Source Routing Bridges :
The source station performs the routing operation in these bridges, and the frame specifies which route to take. The host can find the frame by sending a special frame known as the discovery frame, which propagates throughout the network using all possible paths to the destination.

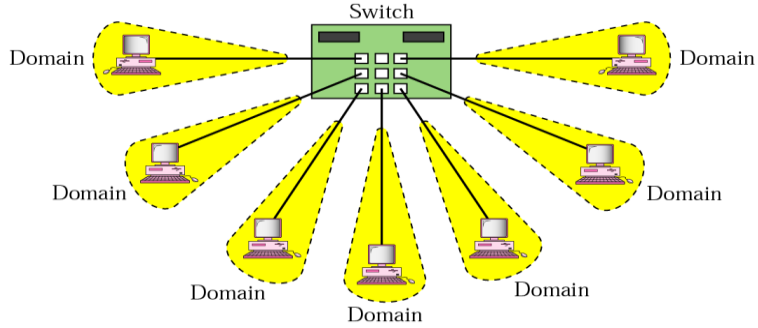
Switches

A network switch (also called switching hub, bridging hub, officially MAC Bridge) is a computer networking device that connects devices together on a computer network, by using packet switching to receive, process and forward data to the destination device. Unlike less advanced network hubs, a network switch forwards data only to one or multiple devices that need to receive it, rather than broadcasting the same data out of each of its ports.

A network switch is a multiport network bridge that uses hardware addresses to process and forward data at the data link layer (layer 2) of the OSI model. Switches can also process data at the network layer (layer 3) by additionally incorporating routing functionality that most commonly uses IP addresses to perform packet forwarding; such switches are commonly known as layer-3 switches or multilayer switches. Beside most commonly used Ethernet switches, they exist for various types of networks, including Fibre Channel, Asynchronous Transfer Mode, and InfiniBand.



- N-Port bridge where N is equal to number of stations
- Usually used to connect <u>individual computers</u> not LANs like bridge
- Allows more than one device connected to the switch directly to transmit **simultaneously**
- Can operates in **Full-duplex** mode (can send and receive frames at the same time over the same interface)
- Performs MAC address recognition and frame forwarding in **hardware** (bridge in software)
- *Two types :*
    - ***Store-and-forward***: switch receives the whole a frame on the input line, buffers it briefly , performs error checking, then routes it to the appropriate output line (similar to bridge). **Buffering** will cause some **delay**.
    - **Cut-through**: based on the fact that the destination address appears at the beginning of the MAC frame, so once the address is recognized the frame is directly sent to the appropriate output line if the output buffer is empty (no need to buffer it). ➔ no buffering delay ➔ NO ERROR CHECKING



Isolated collision domains

Types of Switches
There are generally four types of switches.
Managed Switch :
These are expensive switches used in organizations with large and complex networks because these types of switches can be customized to augment the functionalities of a standard switch. Augment functionalities like QoS (Quality of Service) enhancements such as higher security levels, better precision control, and complete network management. Despite their high cost, they are preferred in growing organizations due to their scalability and flexibility.

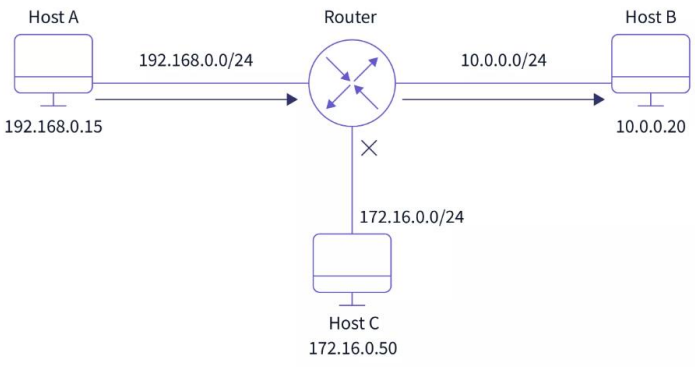
Unmanaged Switch :
These are low-cost switches that are commonly found in home networks and small businesses. They can be easily set up by simply connecting to the network, and they will immediately begin operating. They are called "U" managed because they do not need to be configured or monitored.

LAN Switch :
LAN switches connect devices on an organization's internal LAN. They are also known as Ethernet switches or data switches. These switches are especially useful for alleviating network congestion or bottlenecks. They allocate bandwidth in such a way that data packets in a network do not overlap.

PoE Switch :
PoE Gigabit Ethernets uses Power over Ethernet (PoE) switches. Devices linked to it can receive energy and data over the same line thanks to PoE technology, which combines data and power transmission over the same connection.

Routers

A router is a network device similar to a switch that routes data packets based on their IP addresses . The router is primarily a Network Layer device. A router is also known as an intelligent device because it can automatically calculate the best route to pass network packets from source to destination. A router examines a data packet's destination IP address and uses headers and forwarding tables to determine the best way to transfer the packets. It communicates between two or more networks using protocols such as ICMP.



- Operates at network layer = deals with **packets** not **frames**
- Connect LANs and WANs with similar or different protocols together
- Switches and bridges **isolate collision domains** but forward broadcast messages to **all LANs** connected to them. Routers **isolate both** *collision* domains and *broadcast* domains
- Acts like normal stations on a network, but have **more than one** network address (an address to each connected network)
- Deals with global address (network layer address (IP)) not local address (MAC address)
- Routers **Communicate with each other** and exchange routing information
- Determine best route using **routing algorithm** by special software installed on

them

- **Forward traffic if information on destination** is available otherwise **discard** it (not like a switch or bridge)

Types of Routers

There are various types of routers used in networking as follows :

Wireless Router :

These routers can generate a wireless signal in your home or office, allowing computers to connect to routers within a specific range and access the internet. When connected indoors, the wireless router's range is approximately 150 feet, when connected outdoors, the range is up to 300 feet.

Brouter :

A brouter is a hybrid of a bridge and a router. It acts as a bridge, allowing data to be transferred between networks, and it can also route data within a network to individual systems, much like a router. As a result, it combines the functions of a bridge and a router by routing some incoming data to the appropriate systems while transferring the rest to another network.

Core Router :

A core router is a kind of router that can route data within a network but cannot route data between networks. It is a computer communication system device that serves as the backbone of networks by connecting all network devices. It is used by internet service providers and offers a variety of fast and powerful data communication interfaces.

Edge Router :

An edge router is a low-capacity device that sits at the network's edge. It enables an internal network to communicate with external networks. For internet-based connectivity with distant networks, it uses an external BGP (Border Gateway Protocol).

Broadband Router :

Broadband routers are primarily used to provide computers with high-speed internet access. It is required when connecting to the internet via phone and using Voice over IP technology (VoIP). All broadband routers have three or four Ethernet ports for connecting laptop and desktop computers.

Gateway

A gateway is a network point that acts as an entrance to another network. On the Internet, a node or stopping point can be either a gateway node or a host (end-point) node.

A gateway is often associated with both a router, which knows where to direct a given packet of data that arrives at the gateway, and a switch, which furnishes the actual path in and out of the gateway for a given packet.

Types of Gateways

Gateways can be classified into two types based on the direction of flow.

Unidirectional Gateways :

These gateways allow alerts to go in only one direction. Changes that are made in the source ObjectServer are replicated in the destination ObjectServer or application, while changes made in the destination ObjectServer or application are not duplicated in the source ObjectServer. Unidirectional gateways can be thought of as archiving tools.

Bidirectional Gateways :
These gateways enable alerts to be sent from the source ObjectServer to the target ObjectServer or application, as well as feedback to the source. Changes to the contents of a source ObjectServer are replicated in a destination ObjectServer or application in a bidirectional gateway configuration. The destination ObjectServer or application replicates its alerts in the source ObjectServer.

Gateways can be classified into five types based on functionalities.
Network Gateway :
This is the most common gateway type, serving as an interface between two disparate networks that use different protocols. When the term gateway is used without specifying the type, it refers to a network gateway.
Cloud Storage Gateway :
This type of gateway translates storage requests into API calls to various cloud storage services. It enables organizations to integrate private cloud storage into applications without migrating to a public cloud.

IoT Gateway :
This type collects sensor data from IoT devices, translates sensor protocols, and processes sensor data before sending it.

Internet-To-Orbit Gateway (I2O) :
It connects Internet devices to satellites and spacecraft in orbit around the Earth. Project HERMES and the Global Educational Network for Satellite Operations are two prominent I2O gateways (GENSO).

VoIP Trunk Gateway :
This type of gateway makes it possible to use traditional telephone service equipment with a voice over IP (VoIP) network, such as landline phones and fax machines.

Advantages of Gateway

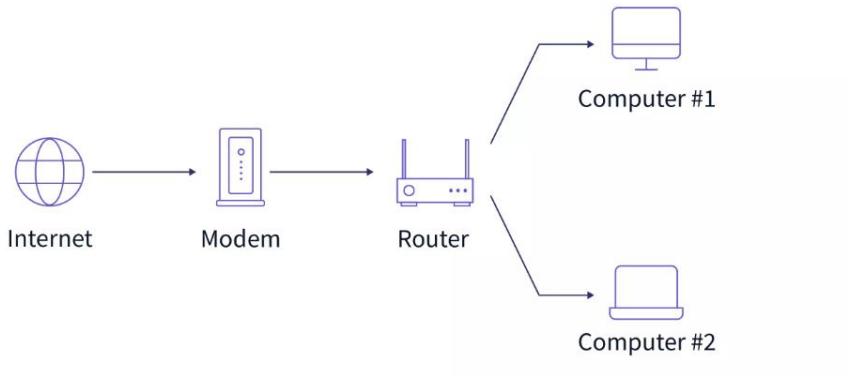
- A gateway increases network flexibility by allowing multiple computers to be connected to a single gateway. The gateway may be capable of interpreting data from computers.
- We can link two different kinds of networks.
- A gateway can effectively handle traffic problems.

Disadvantages of Gateway

- Gateways can never filter out the data.
- Protocol conversion is done, so the transmission rate is slower.

Modem

A modem is a network device that modulates and demodulates analog carrier signals (known as sine waves) to encode and decode digital data for processing. Because modems perform both of these tasks simultaneously, the term modem is a combination of "modulate" and "demodulate".



Types of Modem
There are generally five types of modem.

Optical Modem :
Instead of other metallic media, optical cables are used in optical modems. It converts digital data signals into light pulses transmitted via the optical fiber it employs.

Digital Modem :
Digital data are converted into digital signals by a digital modem. The digital data is modulated on the digital carrier signals before being transmitted over the digital transmission lines.

Acoustic Modem :
A specific modem called an "acoustic modem" can connect a phone handset to a gadget that traveling salespeople use to connect hotel phones. It has a microphone and speaker.

Smart Modem :
The smart modem has capabilities for auto-dialing, auto-redialing, and auto-answering. It has a microprocessor onboard that performs auto-dial and auto-answering tasks using the Hayes AT command set.

Short Haul Modem :
The short-haul modem is the one that is installed on your home computer. They are typically used to connect PCs in a building or office within this region and can transmit the data over distances of up to 20 miles .