

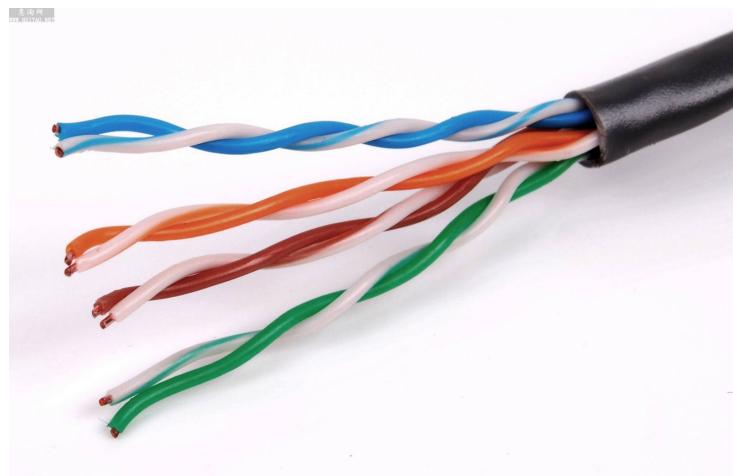
NETWORK COMPONENTS AND THE DIFFERENT PIECES OF THE INTERNET

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LINKS

1. Wired links
 - A) Twisted pair cables
 - a) Unshielded Twisted Pair Cables
 - b) Shielded Twisted Pair Cables
 - B) Coaxial cables
 - C) Optical fibers
2. Wireless links

TWISTED PAIR CABLES

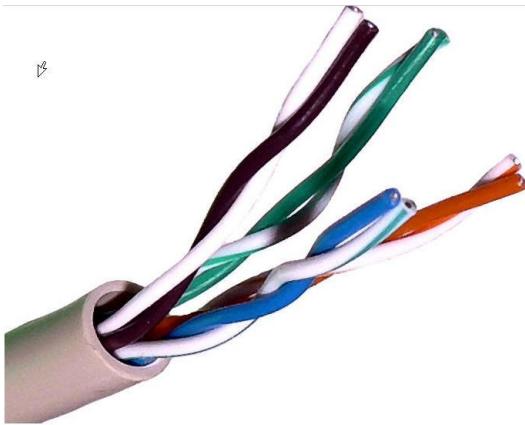
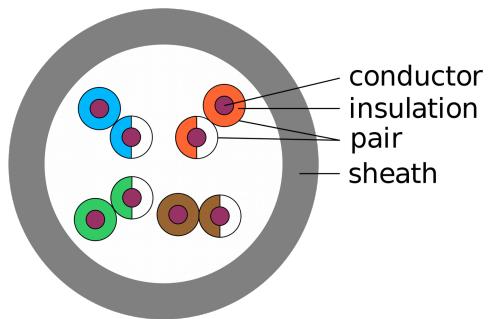


Two wires are needed to transmit a single signal since it is transmitted as a voltage difference. The line undergoes electro magnetic interference from outside and noise is added to the signal. If both the lines undergo the same effect of interference then the receiver will have the original signal since the voltage difference is measured. Twisted pairs are designed so that both the lines take almost the same path and will undergo the same interference. Even two parallel lines will have some difference of the interference since the source of interference is from a side. But when it is twisted, the interference is almost the same.

Even the transmitting cable itself induces an electro magnetic disturbance in the space nearby. So every line has an effect on the other nearby wires. But twisting a pair of wires carrying opposite signals will cancel out the resultant disturbance of the electro magnetic field nearby. This is another reason why twisted pairs are used in transmission.

Unshielded Twisted Pair Cables

UTP



Unshielded twisted pair cables are bundles of twisted pairs inside an insulating cover. These are mostly used for near and mid range data transmission. Popular examples are the cables connecting the telephone network inside the house, Ethernet cables in a office etc;

The unshielded twisted pair cables are the cheapest of the data transmission cable types.

The down side of these is that they fail in the long range transmissions (even in mid ranges when there are strong electromagnetic interferences in the area.)

Shielded Twisted Pair Cables

Shielded twisted pair (STP)



Shielded twisted pair cables are made by covering the bundle of twisted pairs by a conducting foil (hollow cylinder) and grounding it. Some types have shielding for individual cables or else for individual pairs. Every conductor shielding is coated with an insulating layer.

Since there is a grounded conducting layer, any electromagnetic disturbance is cut off rather than affecting the data transmission. The noise is minimum so that the cables can transmit data over longer distances at better speeds.

Classification of Twisted Pair Cables by the Data Transmission Speed

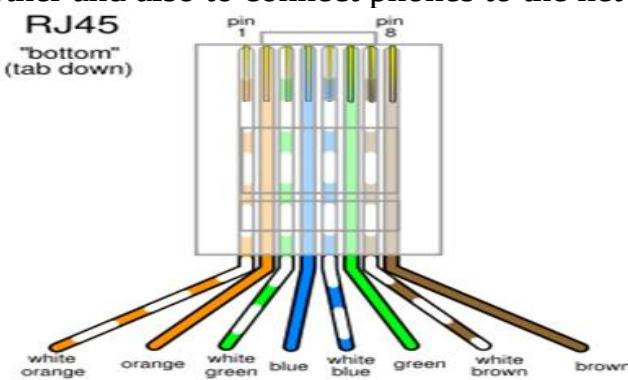
The cables are categorized into different groups such as cat 1, cat 2 by their data transmission speeds. The higher cat numbers have higher speeds and can transmit data over longer ranges.

The cat 1-5 are unshielded twisted pair cables and the cat 6 onwards are shielded twisted pair cables.

UTP Categories - Copper Cable				
UTP Category	Data Rate	Max. Length	Cable Type	Application
CAT1	Up to 1Mbps	-	Twisted Pair	Old Telephone Cable
CAT2	Up to 4Mbps	-	Twisted Pair	Token Ring Networks
CAT3	Up to 10Mbps	100m	Twisted Pair	Token Ring & 10BASE-T Ethernet
CAT4	Up to 16Mbps	100m	Twisted Pair	Token Ring Networks
CAT5	Up to 100Mbps	100m	Twisted Pair	Ethernet, FastEthernet, Token Ring
CAT5e	Up to 1 Gbps	100m	Twisted Pair	Ethernet, FastEthernet, Gigabit Ethernet
CAT6	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT6a	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT7	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (100 meters)

Twisted Pair Connectors

The most common connector for the twisted pair cables is the RJ-45 jack. This is mostly used to connect computers and hubs/switches, switches and hubs with each other and also to connect phones to the network.

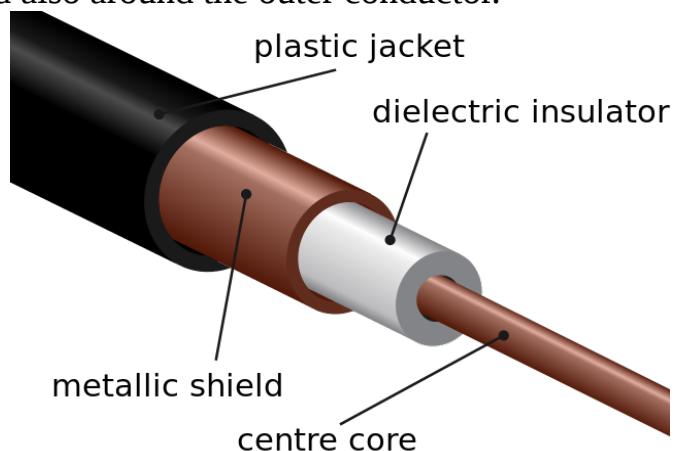


Auto MDIX

Auto MDIX technology enables the automatic configuration of a network. If it is enabled on either side of the cable, it configures the connection type so that the network personnel will not have to configure the things like crossovers manually.

COAXIAL CABLES

Coaxial cables are presently used mainly for television networks. But they were used for computer networks and voice transmission in the past. A coaxial cable consists of a conducting wire in the middle surrounded by a hollow cylindrical conductor. The outer conducting layer can be a mesh. These two lines are used to transmit a signal as the difference of the voltages. An insulating layer is present in between the two conducting lines and also around the outer conductor.

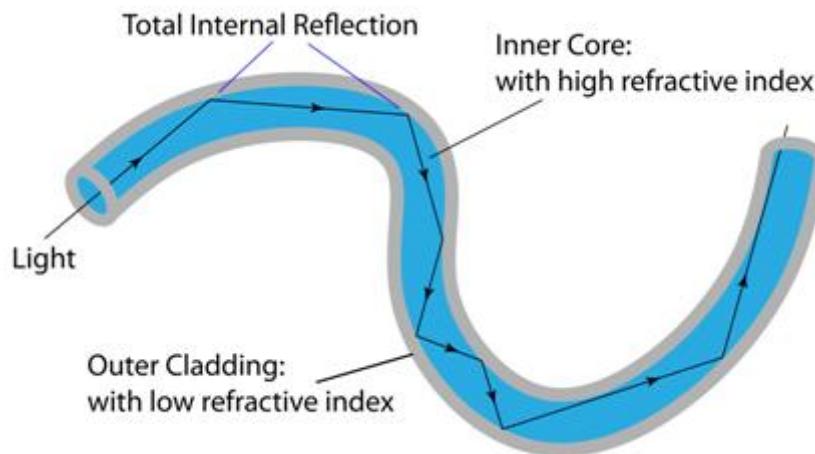


Coaxial Cable Connectors

The coaxial cables are connected to the devices using RF connectors. They have threads so the cables could be physically connected to the port. There are male and female types of connectors.



OPTICAL FIBERS



The optical fibers use optical signal instead of electrical signals to transmit data. A fiber of transparent material is used as the wave guide to carry the signal. Most often the infra red light is used.

Even though the light tends to go on straight lines, the optical fibers are able to send the light along the bends by using the principle of total internal reflection of light. The fiber is surrounded with a coating of material with lower refractive index to facilitate this.

The optical fibers are used for longer range data transmission at faster speeds. Transmission of data between floors, building, cities and even between continents (the backbone of the Internet) is done using optical fibers.

There are two types of fiber optic cables as,

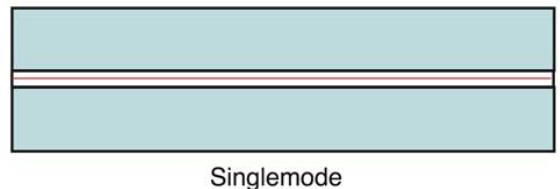
1. Single mode fiber.
2. Multi mode fiber.

There are two factors to be considered when it comes to choosing a type of optical fiber. They are the bandwidth (the rate of data transfer – measured in Mbps Megabits per second) and the attenuation (the loss of light intensity of the signal per unit length of transmission – measured in dB/km decibels per kilometer).

Single Mode Fiber

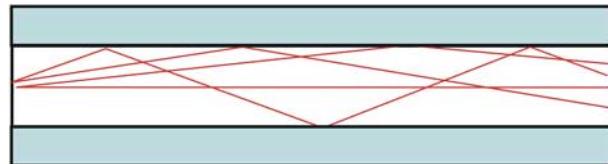
These are very thin (around 10 microns in diameter). These have higher bandwidth and lower attenuation. They facilitate data transmission over very long ranges

(sometimes able to transmit a signal over a several kilo meters between two amplification points. The downside of single mode fibers is their high cost.



Multi Mode Fiber

Multi mode fiber has a diameter around 50 microns. They allow more than a single band of signals to pass through. These cables cannot transmit data over very large distances. But these are relatively cheaper so they are used in most of the institute networks.



Multimode, Step-index

Fiber optic connectors

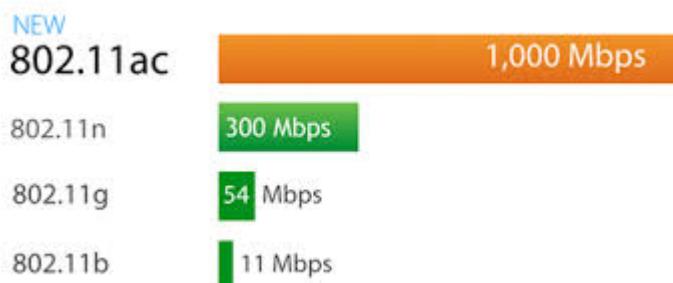
The optical fibers are connected to switches and hubs using a special type of connector that can convert the signals in between electrical and optical domains. There are special ports in the switches for these connectors. The practical limits of the data transmission rate of the fiber optical cables depends on the rate these connectors can convert the signals between optical and electrical natures.

WIRELESS LINKS



There are many types of wireless linking technologies present today. The most commonly used for local area networks is the Wi-Fi technology. Wi-Fi links are antennas that can transmit as well as receive Wi-Fi signals.

The transfer rates of wifi links varies with the technology used as in the following list



SYSTEMS / NODES

NETWORK DEVICES

- A) Hubs
- B) Switches
- C) Routers

Hubs



Hubs are one of the simplest devices used to connect computers in an Ethernet network. A hub consists of RJ-45 ports.

The hubs have a simple mechanism of sending all the data it gets to all the lines connected to it. So basically hub is not a very intelligent technology. The recipient computer's network card should decide whether to accept the data or not.

Hubs can be obtained with different number of ports to connect computers and one other port known as the Uplink port to connect it to an outer network.

Switches



Switches are also devices that has ports to connect many computers/devices using Ethernet cables and RJ-45 jacks.

The switches have more advanced mechanism to transfer data than the hubs so that they only send the data packets to the intended device. Routers can be used even to connect hubs (even hubs can be used to connect hubs but it is inefficient).

The switches do identify the devices connect to it using ip addresses.

Routers



Routers are very much sophisticated when compared to hubs and switches. Routers have advanced algorithms to direct the data packets within the network so that they can be used to connect two or more networks together.

Routers are used to connect different local area networks, wide area networks together. They are also used to connect a network to the Internet.

The routing algorithms work based on ip addresses.

NETWORK INTERFACES

- A) Ethernet cards/ports
- B) Serial ports
- C) Console ports

Ethernet Cards/ Ports

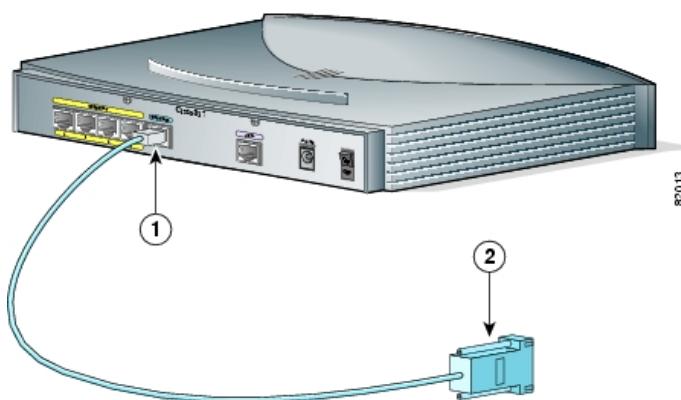


Ethernet ports are the ports for RJ-45 jacks that connect computers to the network. An Ethernet card (also known as the network card) is the hardware that controls the connection between computer and the network.

The older computers had no Ethernet port built in the motherboard so that they needed a separate “network card”. The modern computers have an Ethernet port in the motherboard itself so they have the module that was present in the “network card” on the motherboard itself.

Serial Ports

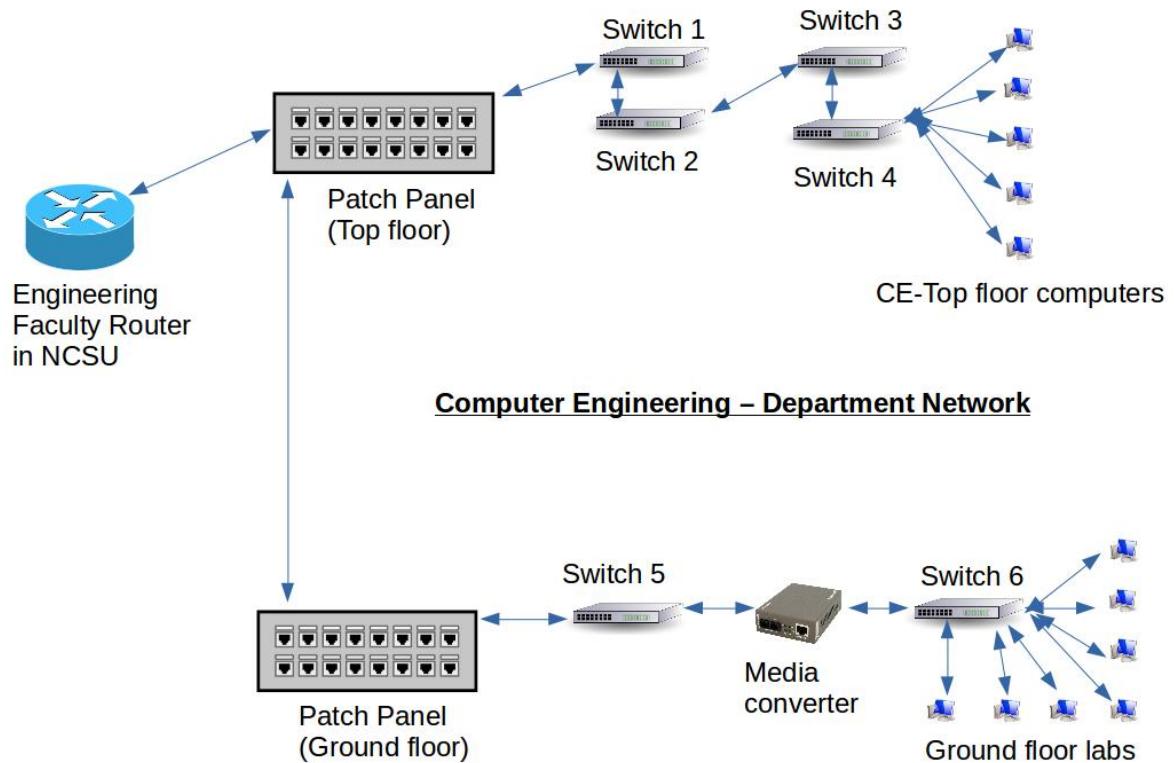
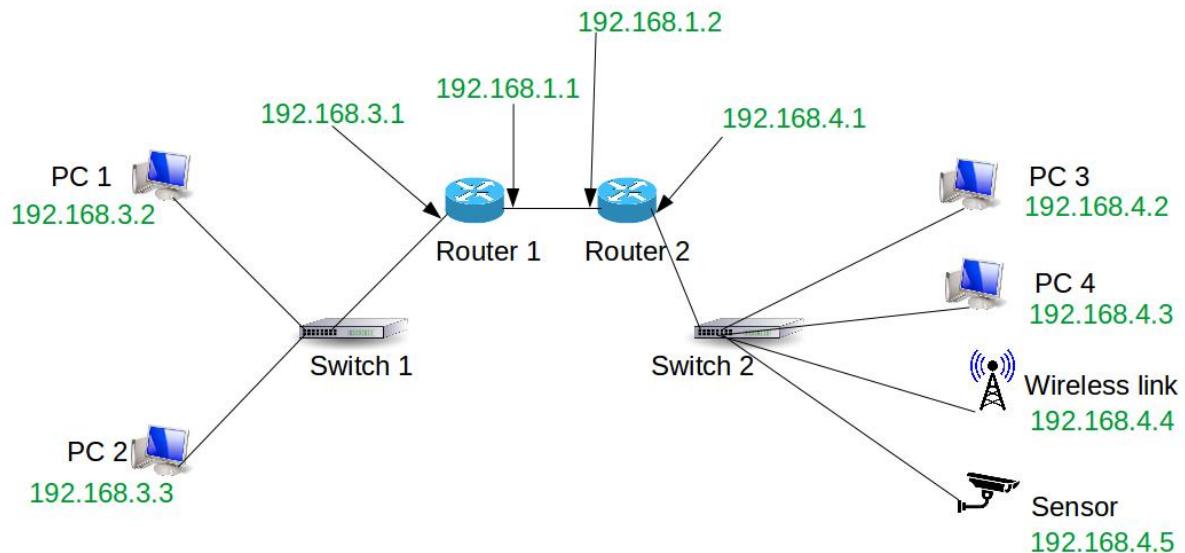
The serial ports were once used to connect the modems and routers which connect the computers to other networks. But as of present, the serial port is rarely used for networking.

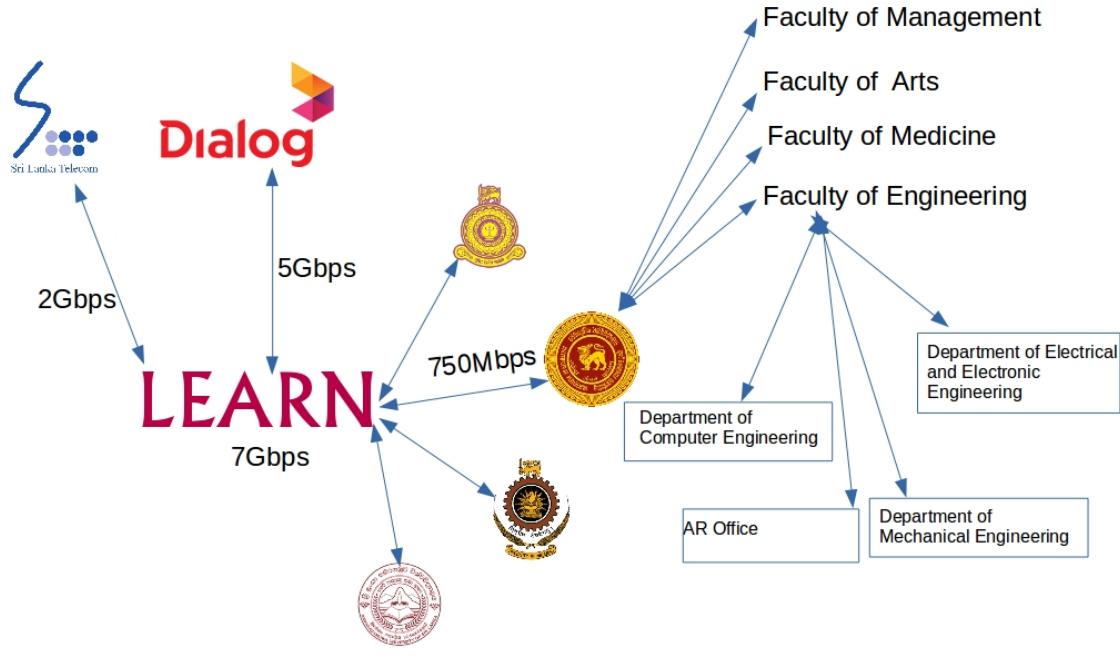


Console Ports

Console ports are used to manage the routers. The console port of the computer is connected to a RJ-45 jack in the router and a command line tool is used to configure the router.

EXAMPLE NETWORKS





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