

Computer Networks I

What is Computer Networks?

- **Computer network** A collection of computing devices that are connected in various ways in order to communicate and share resources

Usually, the connections between computers in a network are made using physical wires or cables

However, some connections are **wireless**, using radio waves or infrared signals

Client Server Architecture

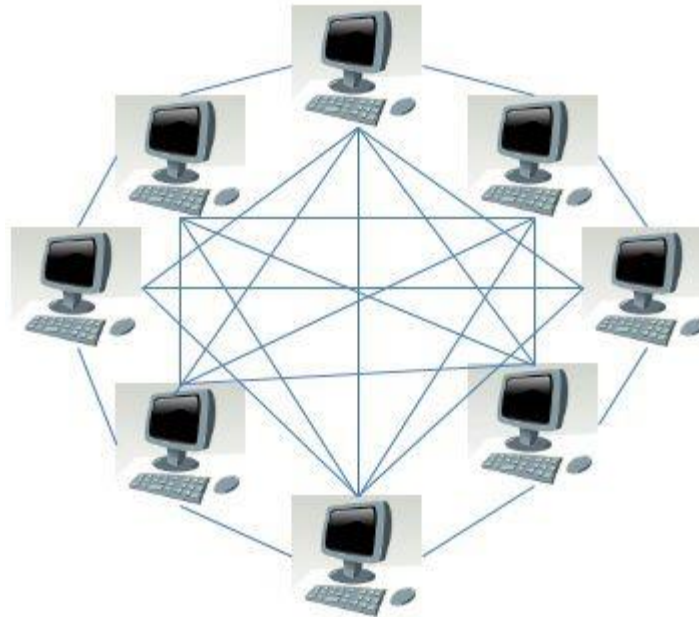
- The Client-Server network model is widely used network model. Here, **Server** is a powerful system that stores the data or information in it. On the other hands, the **Client** is the machine which let the users access the data on the remote server. It's always client requesting for a service from server and server is responsible to provide the service.



Client-Servers Network Model

Peer to peer architecture

- Unlike Client-Server, the Peer-to-Peer model does not distinguish between client and server instead each **node** can either be a client or a server depending on whether the node is **requesting** or **providing** the services. Each node is considered as a **peer**.



Peer-to-Peer Network Model

BASIS FOR COMAPAIISON	CLIENT-SERVER	PEER-TO-PEER
Basic	There is a specific server and specific clients connected to the server.	Clients and server are not distinguished; each node act as client and server.
Service	The client request for service and server respond with the service.	Each node can request for services and can also provide the services.
Focus	Sharing the information.	Connectivity.
Data	The data is stored in a centralized server.	Each peer has its own data.
Server	When several clients request for the services simultaneously, a server can get bottlenecked.	As the services are provided by several servers distributed in the peer-to-peer system, a server in not bottlenecked.
Expense	The client-server are expensive to implement.	Peer-to-peer are less expensive to implement.
Stability	Client-Server is more stable and scalable.	Peer-to-Peer suffers if the number of peers increases in the system.

LAN, MAN and WAN

- The geographical area covered by LAN is small upto 1km, whereas, MAN covers relatively large(5 to 50kms)and WAN covers the greatest of all.
- LAN is confined to schools, hospitals or buildings, whereas, MAN connects small towns or Cities and on the other hand, WAN covers Country or a group of Countries.
- Devices used for transmission of data are-
LAN: WiFi, Ethernet Cables.
MAN: Modem and Wire/Cable
WAN: Optic wires, Microwaves, Satellites.
- LAN's transmit data at a faster rate than MAN and WAN.
- Maintenance of LAN is easier than that of MAN and WAN.
- The bandwidth available for transmission is higher in LAN than MAN and WAN.
- Data transmission errors and noise are least in LAN, moderate in MAN and high in WAN.

PAN

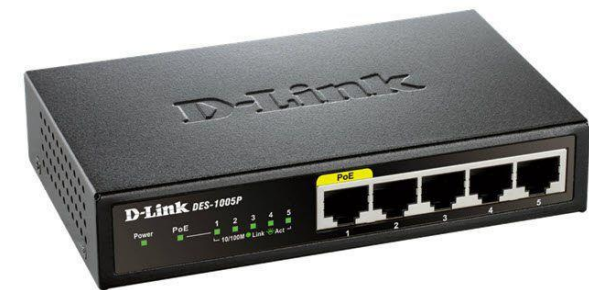
- A personal area network (**PAN**) is the interconnection of information technology devices within the **range** of an individual person, typically within a **range** of 10 meters.

Repeaters

- A repeater operates at the **physical layer**.
- Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network.
- An important point to be noted about repeaters is that they do not amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength.
- It is a **2 port device**.

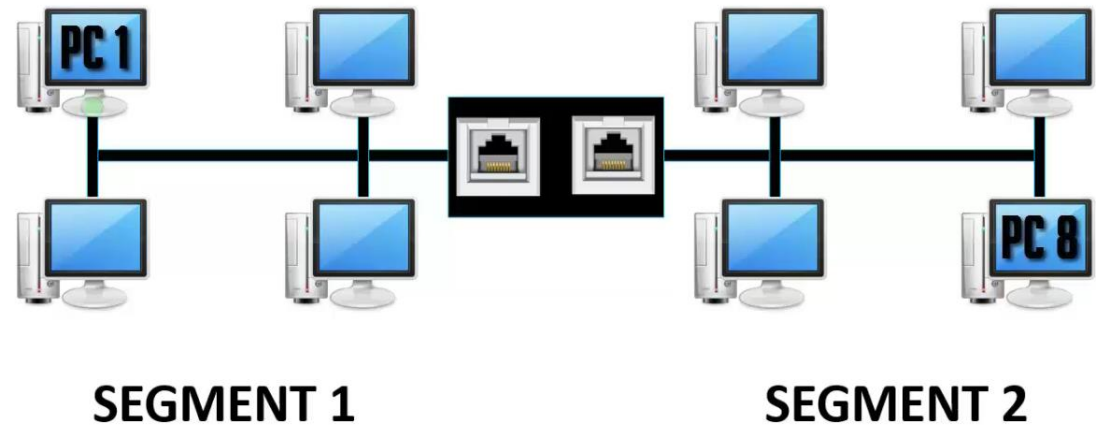
Networking Devices(HUBS)

- A hub is basically **a multiport repeater.**
- A hub connects multiple wires coming from different branches.
- Hubs **cannot filter data**, so **data packets are sent to all connected devices.** In other words, collision domain of all hosts connected through Hub remains one.
- Also, they **do not have intelligence to find out best path** for data packets which leads to inefficiencies and wastage.



Networking Devices(Bridges)

- A bridge operates at **data link layer**.
- A bridge is a repeater, with add on functionality of **filtering content by reading the MAC addresses** of source and destination.
- It is also used for interconnecting two LANs working on the same protocol. It has a single input and single output port, thus making it a **2 port device**.



Networking Devices(Switches)

- Switch is **data link layer** device.
- A switch is a **multi port bridge** with a buffer and a design that can boost its efficiency(large number of ports imply less traffic) and performance.
- Switch can **perform error checking** before forwarding data, that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only. In other words, switch divides collision domain of hosts, but [broadcast domain](#) remains same.
- **NOTE: Bridges and switches can connect two LANs so used in same building for connection**

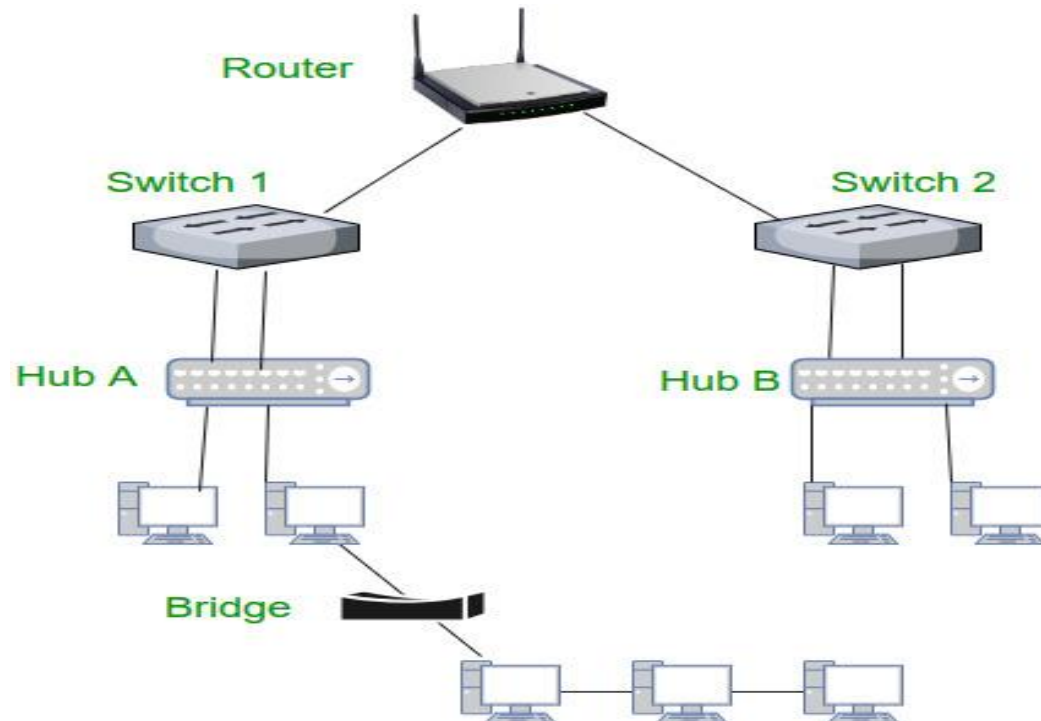
Networking Devices(Routers)

- Router is mainly a **Network Layer device**
- A router is a device like a switch that **routes data packets based on their IP addresses**. Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets.

Switches



Routers

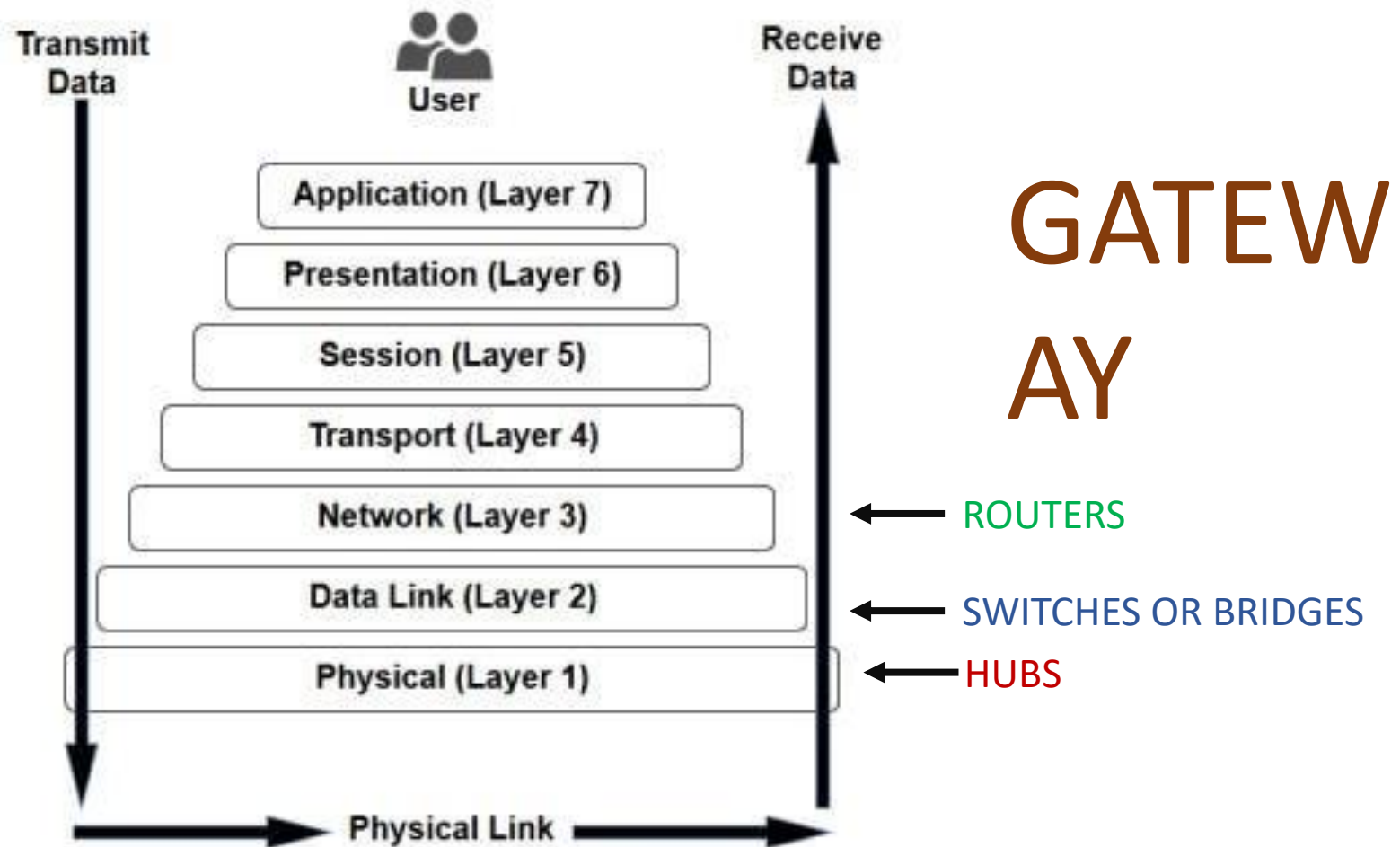


Networking Devices(Gateways)

- Gateways are also called **protocol converters** and can operate **at any network layer**.
- A gateway, as the name suggests, is a passage to **connect two networks together that may work upon different networking models**.
- They basically works as the messenger agents that take data from one system, interpret it, and transfer it to another system.
- Gateways are generally more complex than switch or router.

OSI Model(Open Source Interconnection)

The 7 Layers of OSI



Wired Media(Twisted Pair)

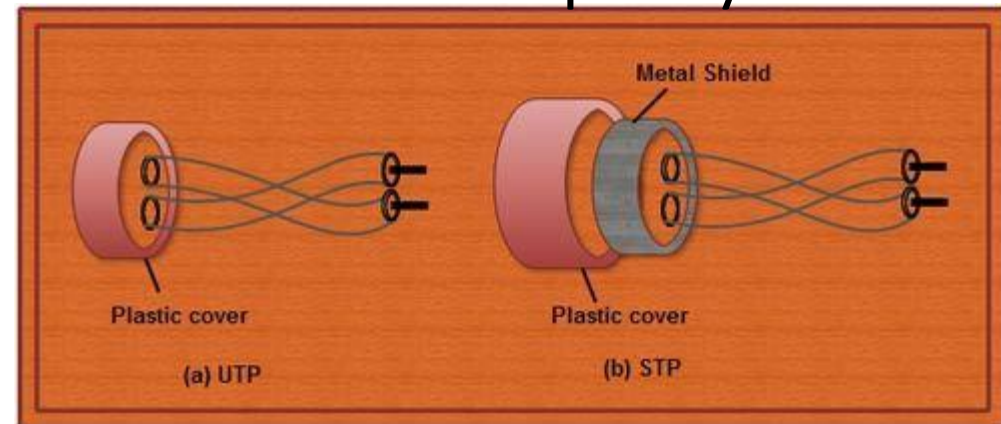
It is made up of two copper wires twisted together. Types of Twisted Pair are:

STP(Sheilded Twisted Pair)

UTP(Unsheilded Twister Pair)

Why to twist the wires?

- Twisting of wires will reduce the effect of noise or external interference.
- Number of twists per unit length will determine the quality of cable. More twists means better quality.



Wired Media(Twisted Pair)

- **USES:**

In telephone cables and internet connections

- **Advantages of Twisted pair cable**

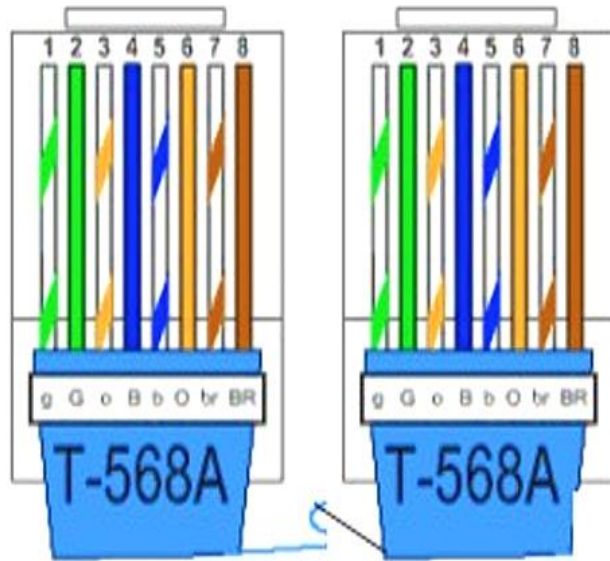
1. It can be used to carry both analog and digital data.
2. It is relatively easy to implement and terminate.
3. It is the least expensive media of transmission for short distances.
4. If portion of a twisted pair cable is damaged it does not effect the entire network.

- **Disadvantages of Twisted pair cable**

1. It offers poor noise immunity as a result signal distortion is more?
2. Attenuation is very high.
4. It offers very poor security and is relatively easy to tap.
5. Being thin in size, they are likely to break easily.

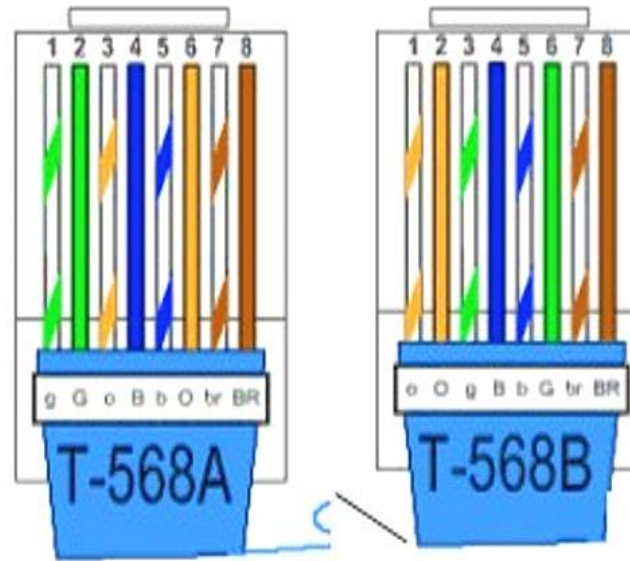
Color coding in twisted pair

Ethernet Cable Color Coding



Uses of Straight-Thru Cable

1. To Connect PC to Switch, Switch to Router, and Router to PC.



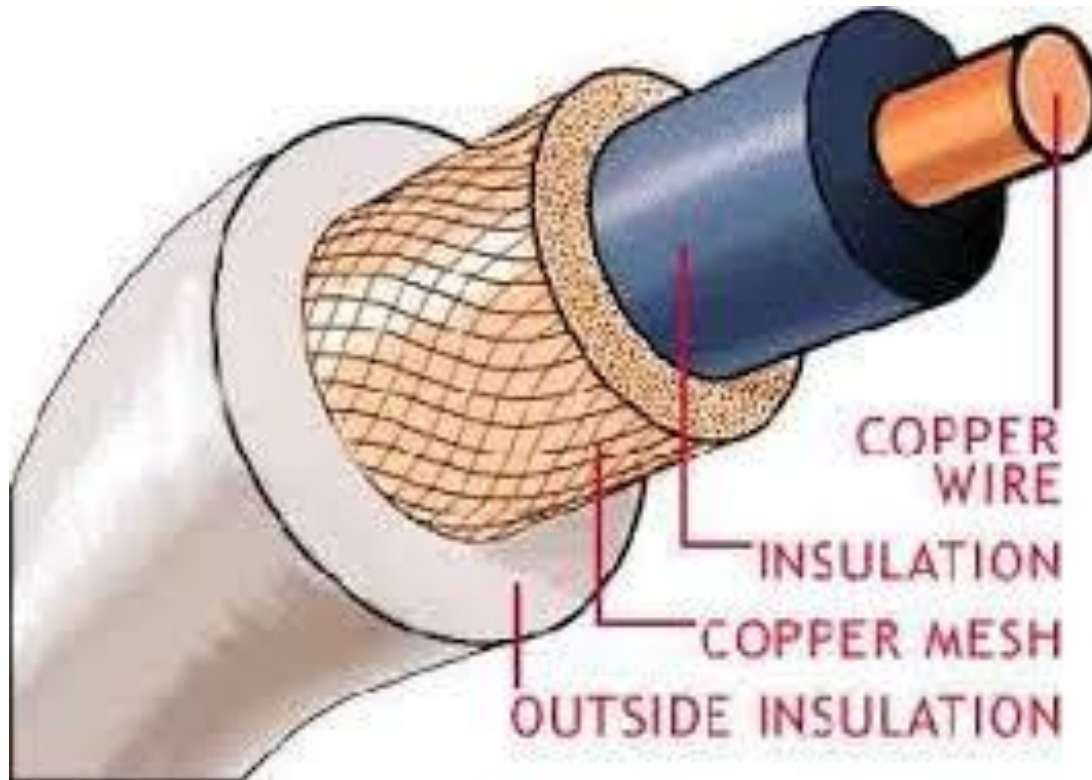
Uses of Cross-Over Cable

1. To Connect PC to PC, Switch to switch, and Router to router.

**Connector for Twisted Pair:
RJ(Registered Jack)**



Wired Media(Coaxial Cable)



Used basically for
TV connections

Connector: BNC(Bayonet
Neill–Concelman)



Advantages and disadvantages of coaxial cable

- **Advantages**

sufficient frequency range to support multiple channel, which allows for much greater throughput.

lower error rates. because the inner conductor is in a Faraday shield, noise immunity is improved, and coax has a lower error rates and therefore slightly better performance than twisted pair.

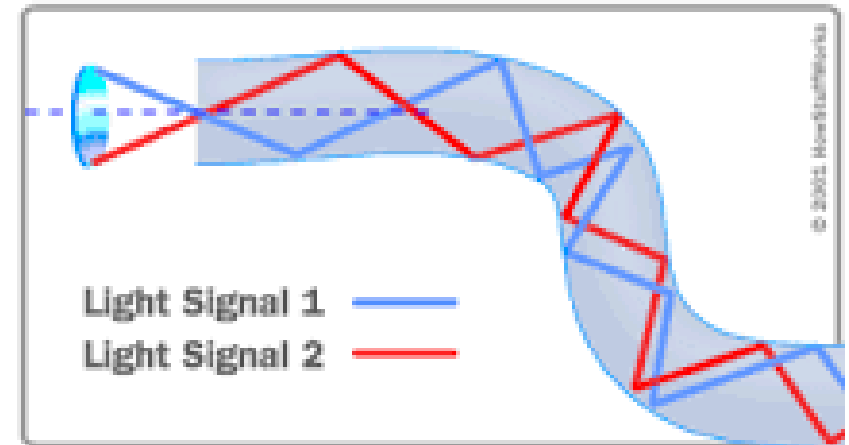
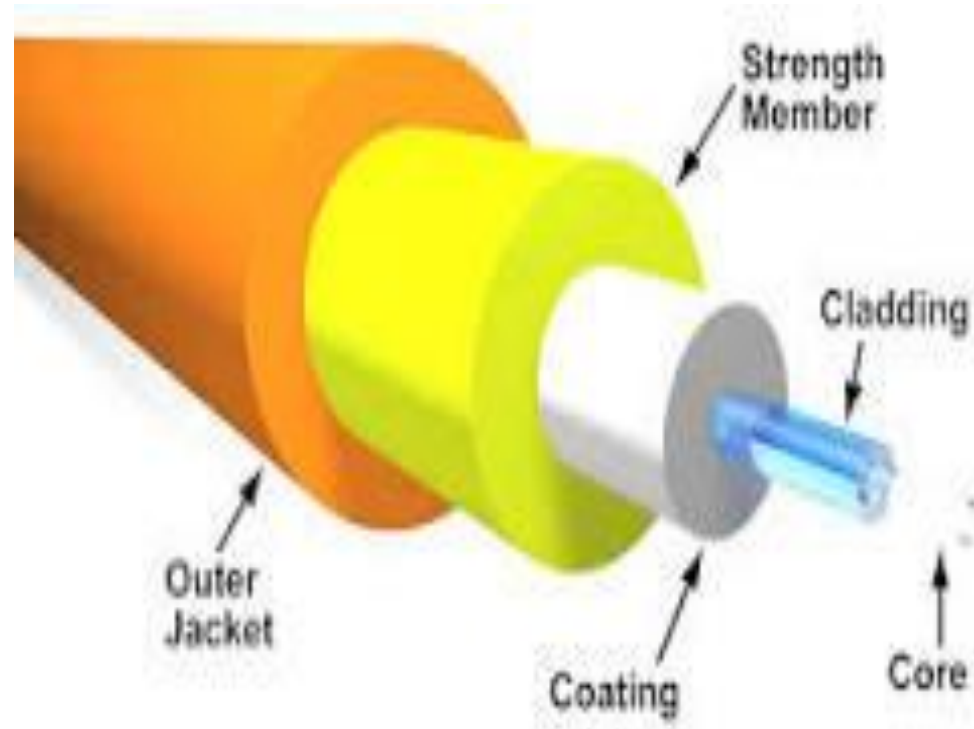
greater spacing between amplifiers coax's cable shielding reduces noise and crosstalk, which means amplifiers can be spaced farther apart than with twisted pair.

- **Disadvantages**

more expensive to install compare to twisted pair cable.

the thicker the cable, the more difficult to work with.

Wired Media(Optical Fibres)



Core is of glass material and cladding of a thick and dense material than glass to provide total internal reflection to transmit the signal in form of light waves.

Advantages and disadvantages

- **Advantages of Optical Fiber**

1. **Greater Bandwidth & Faster**
2. **Cheap**—Several miles of optical fiber cable can be made cheaper than equivalent lengths of copper wire.
3. **Thinner and Light-weighted**—Optical fiber is thinner, and can be drawn to smaller diameters than copper wire. They are of smaller size and light weight than a comparable copper wire cable, offering a better fit for places where space is a concern.
4. **Higher carrying capacity**—Because optical fibers are much thinner than copper wires, more fibers can be bundled into a given-diameter cable. This allows more phone lines to go over the same cable or more channels to come through the cable into your cable TV box.
5. **Less signal degradation**—The loss of signal in optical fiber is less than that in copper wire.
6. **Light signals**—Unlike electrical signals transmitted in copper wires, light signals from one fiber do not interfere with those of other fibers in the same fiber cable. This means clearer phone conversations or TV reception.
7. **Long Lifespan**—Optical fibers usually have a longer life cycle for over 100 years.

- **Disadvantages of Optical Fiber**

1. **Limited Application**—Fiber optic cable can only be used on ground, and it cannot leave the ground or work with the mobile communication.
2. **Low Power**—Light emitting sources are limited to low power.
3. **Fragility**—Optical fiber is rather fragile and more vulnerable to damage compared to copper wires. You'd better not to twist or bend fiber optic cables.
4. **Distance**—The distance between the transmitter and receiver should keep short or repeaters are needed to boost the signal.

Cloud Computing

- The term is generally used to describe data centers available to many users over the [Internet](#).
- Large clouds, predominant today, often have functions distributed over multiple locations from central servers.
- **Private Cloud:**
 - Private cloud is cloud infrastructure operated solely for a single organization, whether managed internally or by a third party, and hosted either internally or externally.
 - Undertaking a private cloud project requires significant engagement to virtualize the business environment, and requires the organization to re evaluate decisions about existing resources.
 - It can improve business, but every step in the project raises security issues that must be addressed to prevent serious vulnerabilities.

Cloud Computing

- **Public Cloud:**

- A cloud is called a "public cloud" when the services are rendered over a network that is open for public use.
- Public cloud services may be free.
- Technically there may be little or no difference between public and private cloud architecture, however, security consideration may be substantially different for services (applications, storage, and other resources) that are made available by a service provider for a public audience and when communication is effected over a non-trusted network.
- Generally, public cloud service providers like [Amazon Web Services](#) (AWS), [IBM](#), [Oracle](#), Microsoft and Google own and operate the infrastructure at their [data center](#) and access is generally via the Internet.

Topics not covered in this presentation

- Wireless Computer Networks(Microwaves, Radiowaves and satellite)
- NIC(Network Interface Card)
- MAC(Media Access Control Address)
- IoT(Internet of Things)