



Computer Network: LAN, MAN, WAN

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Computer Network

- **In general**, a network is a **group of interconnected entities**, such as **computers, devices, or people**, that can **communicate and share information** with one another.
- In the context of technology, **a network typically refers to a group of computers and other devices** that are connected together to **share resources, such as files, printers, and internet connections.**

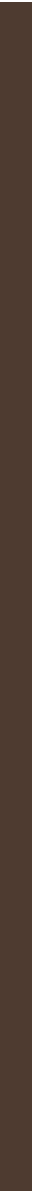
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- There are different types of networks, such as **Local area networks (LANs)**, **Metropolitan area networks (MAN)**, **Wide area networks (WANs)**, and **Wireless networks**, which vary in terms of their **size and the types of devices** that are connected to them.
 - A computer network are connected together to share resources and communicate with one another, **either through physical cables or wireless connections.**
 - They are used for **sharing files, accessing the internet, and enabling communication** between devices.

LAN

WAN

CATEGORIES
OF
NETWORKS

MAN






➤ There are **other types of Computer Networks** also, like :

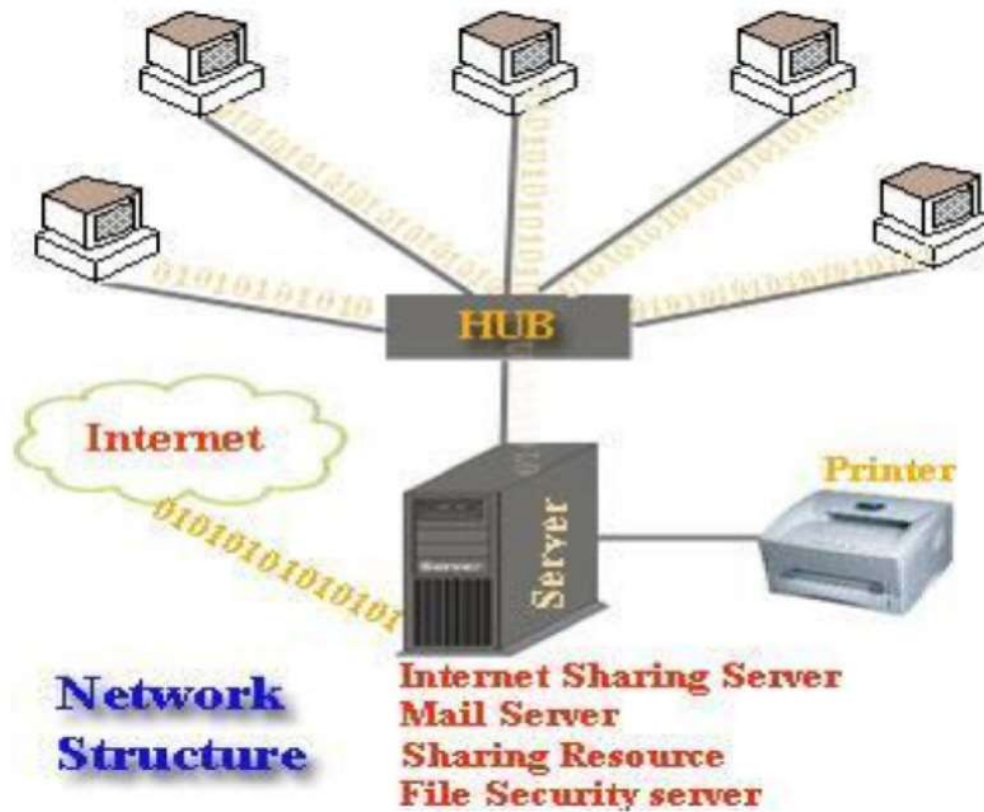
- PAN (Personal Area Network)
- SAN (Storage Area Network)
- EPN (Enterprise Private Network)
- VPN (Virtual Private Network)

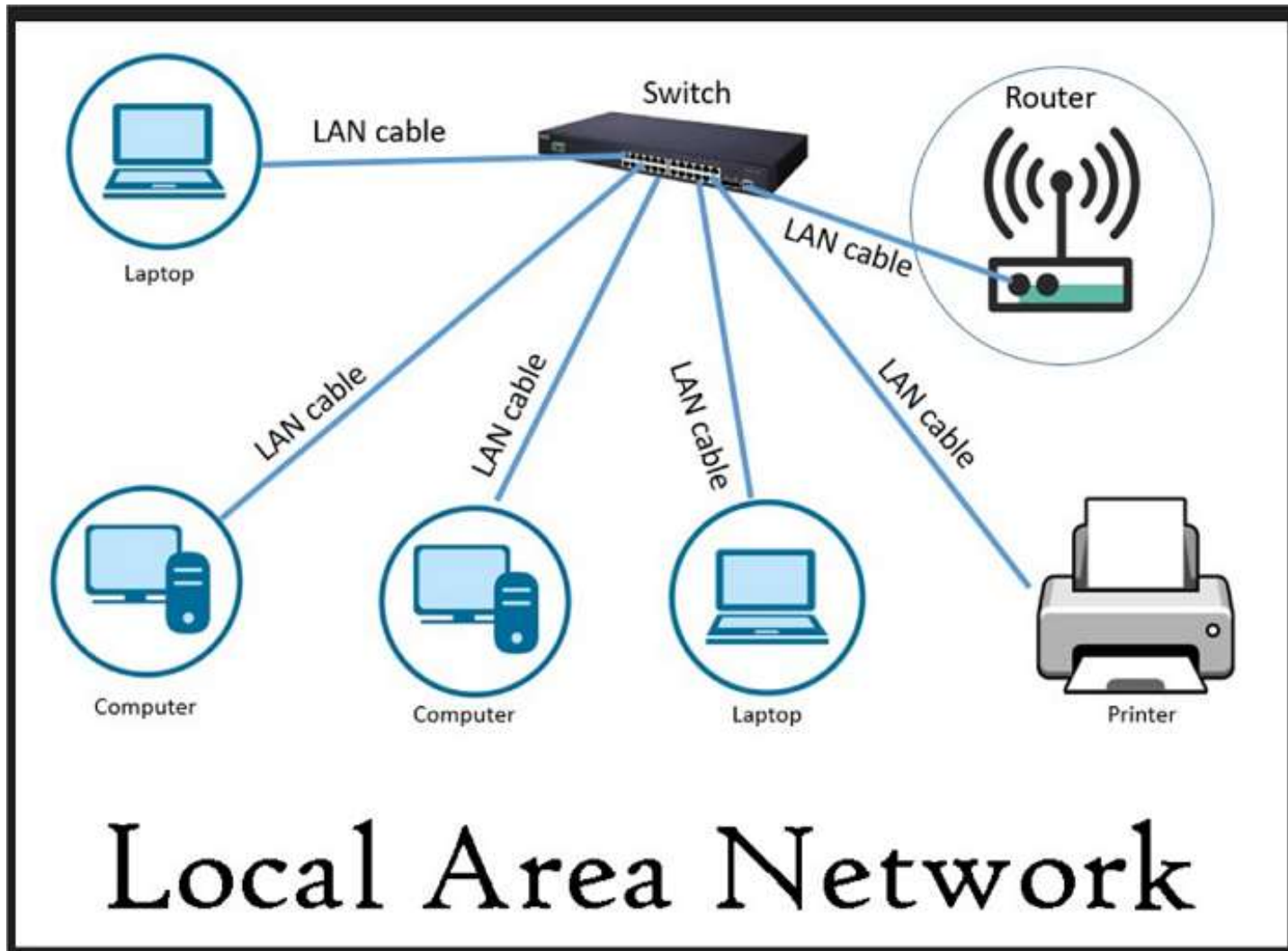
Local Area Network (LAN)

- A Local Area Network (LAN) is a type of computer network that covers a relatively **small geographical area**, such as an **office building, school, hospital or home**.
- A LAN typically consists of a group of **interconnected computers, servers, printers, and other devices** that are connected to a common communication medium, such as **Ethernet cables or Wi-Fi**.
- This can include sharing **internet connections, storage devices, files and documents, accessing shared printers and other hardware devices, and communicating with other** users on the network.
- Some common LAN topologies include **bus, star, and ring** configurations.
- The devices on a LAN can be connected directly to one another, or they can be **connected through a central hub or switch**, which enables them to communicate with one another more efficiently.

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- A network which consists of less than **500 interconnected devices** across several buildings, is still recognised as a LAN.
 - LAN is very high speed network (**10 Mbps to 100 Mbps**) which is faster than MAN and WAN.
 - LANs cover a smaller geographical area (Size is limited to a **few kilometres**)
 - LANs are privately owned.

LAN

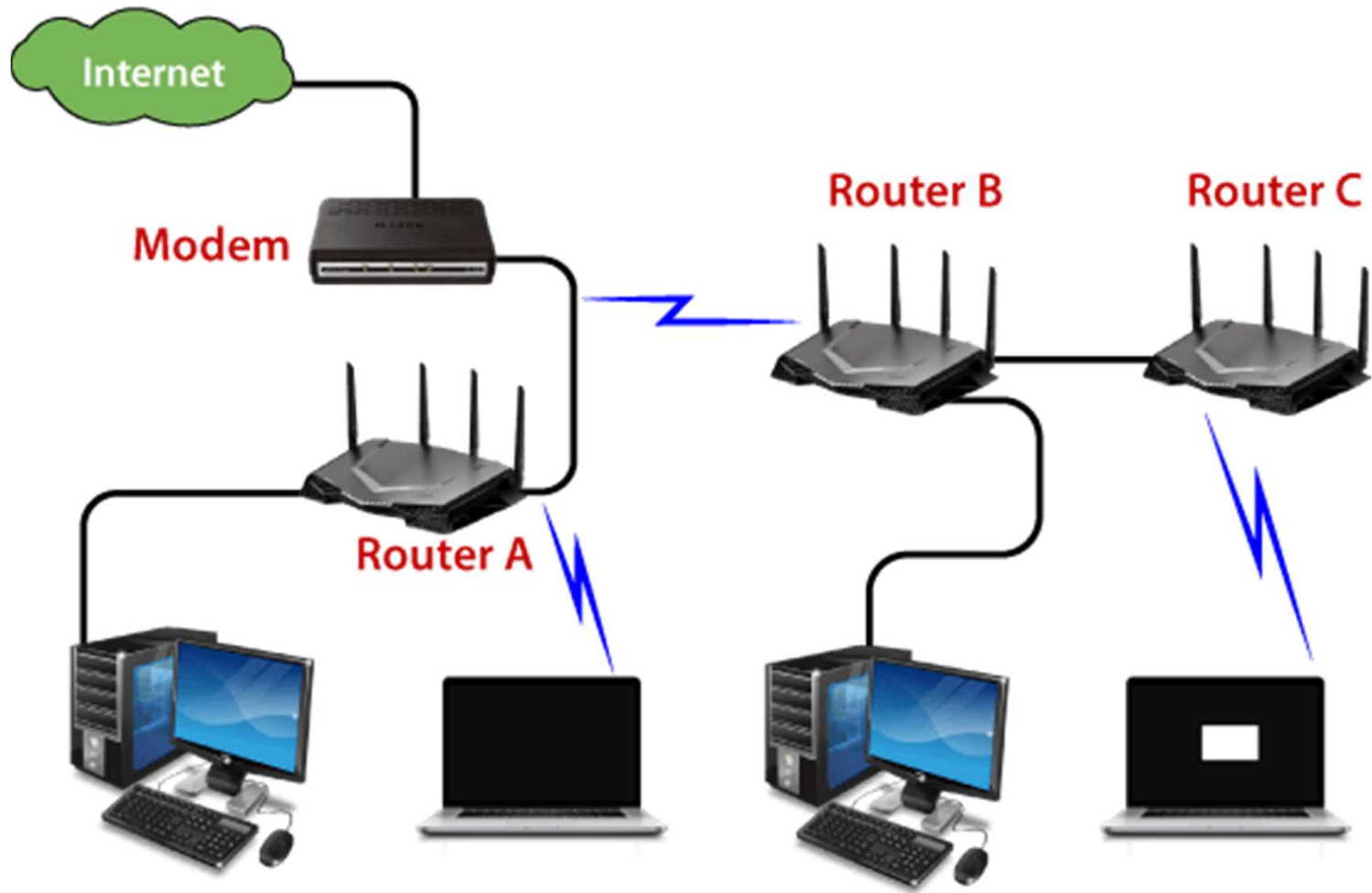






What is a Router?

- The router is a **physical or virtual internetworking device** that is **designed to receive, analyze, and forward data packets** between computer networks.
- A router examines a **destination IP address** of a given data packet, and it uses the headers and forwarding tables to decide the best way to transfer the packets.

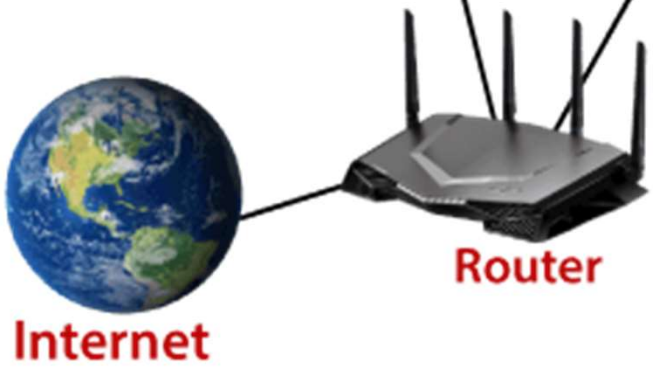





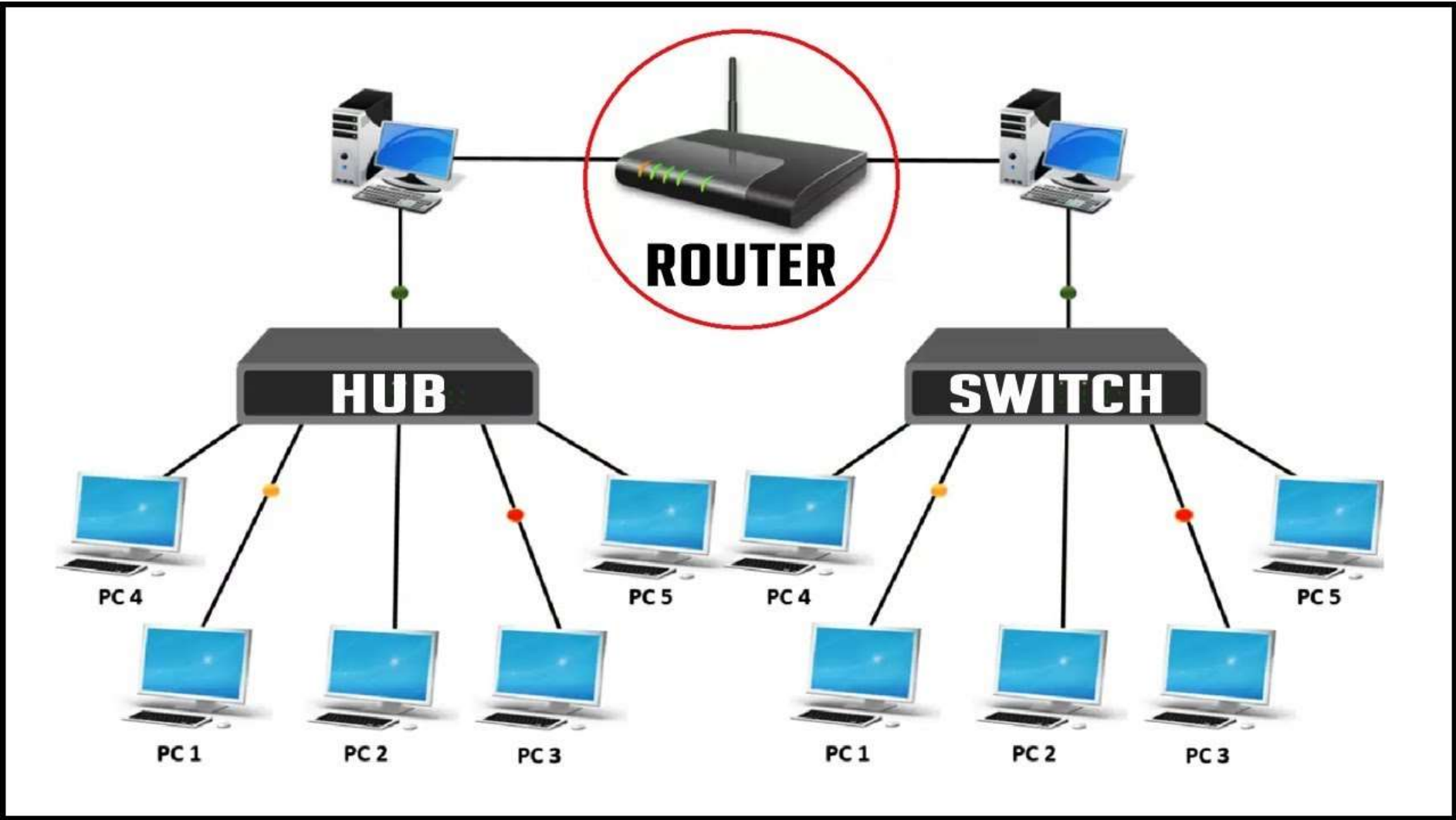
LAN 1-Sales Department

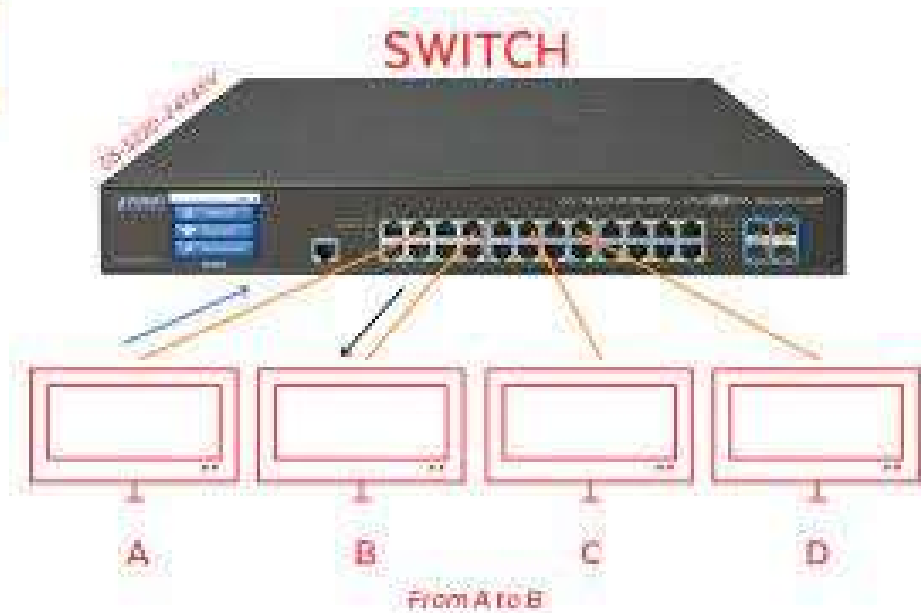



LAN 2- Accounts Department

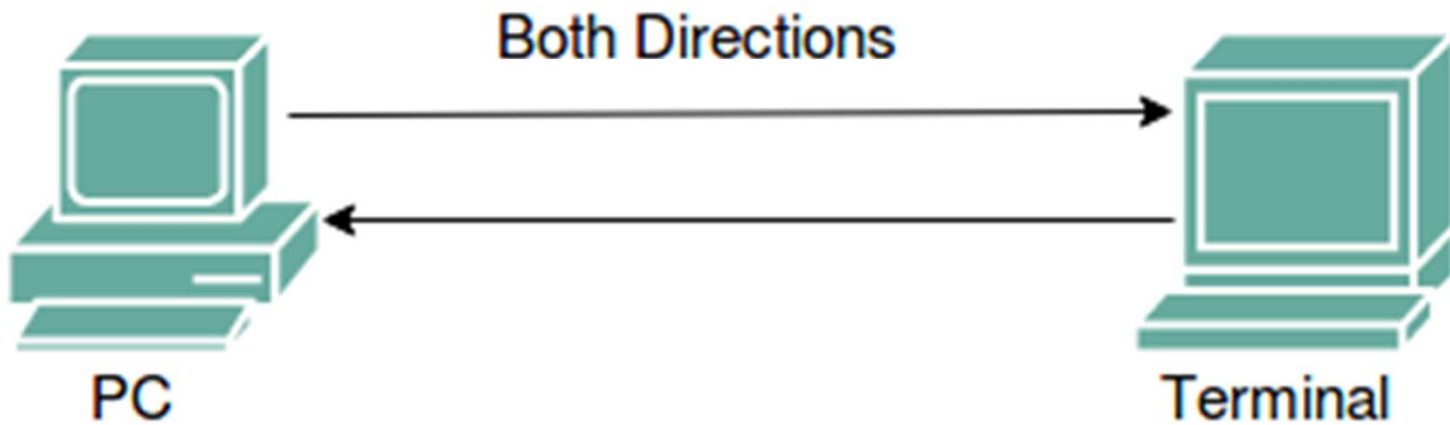
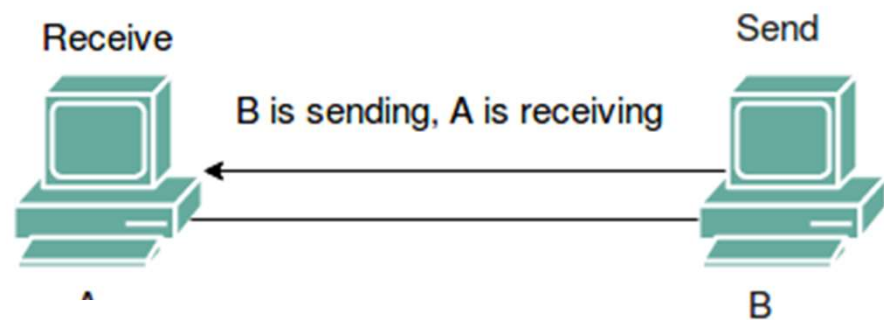
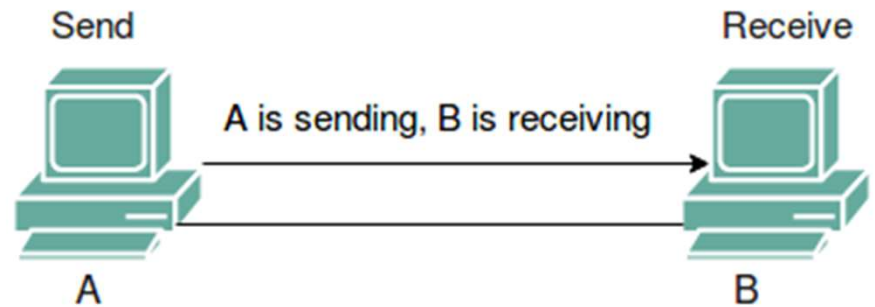
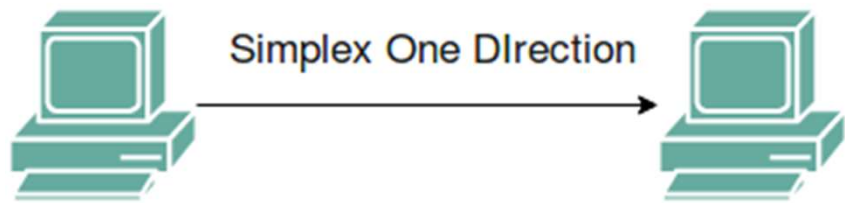


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- **Hub:-** A Hub is a **networking device**. It helps to connect several devices to a single network and also connects segments of LAN. Hub works at the physical layer and contains many ports. When any device intends to connect to a network then it can be plugged into one of these ports.
 - **Switch:** A Switch is a **networking device**. It connects multiple devices together on a single network and routes the information. The Switch uses a data link layer to work on. The packet switching technique is used to transmit the data packet over the network.
 - **Hub and Switch:** Hub and Switch **are the network connecting devices**, both help to **connect various devices**.
 - In Hub, **half duplex transmission technique** is utilized.
 - In switch, **full duplex transmission technique** is utilized.





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- **Simplex Mode** – In Simplex mode, the communication is **unidirectional**, as on a **one-way street**. Only one of the two devices on a **link can transmit, the other can only receive**. The simplex mode can use the **entire capacity of the channel to send data** in one direction.
 - **Half-Duplex Mode** – In half-duplex mode, each station can **both transmit and receive**, but **not at the same time**. When **one device is sending, the other can only receive**, and **vice versa**. The entire capacity of the channel can be utilized for each direction.
 - **Full-Duplex Mode** – Full-duplex mode is used when communication in **both directions is required all the time**. In full_duplex mode, signals going in one direction share the capacity of the link with signals going in another direction, this sharing can occur in two ways:



- **Coaxial Cable:** Coaxial Cable is the type of guided media is made of **Plastics, copper wires** which is used to transmit the signal is in **electrical form** rather than light form.
- Its installation and implementation is easy but **it is less efficient than optical fiber** also it provides **moderate high bandwidth (B)** in comparison of optical fiber.

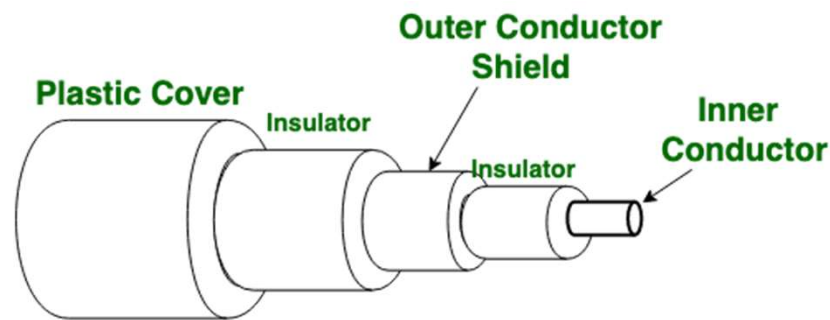


Figure of Optical Coaxial Cable

- **Optical fiber Cable:** Optical Fiber is the type of guided media is **made of plastics and glasses** which is used to transmit the signal is in **light form** or **optical form**.
- It provides the **high bandwidth (B)**. Its **Installation and implementation is not so easy** like coaxial cable.

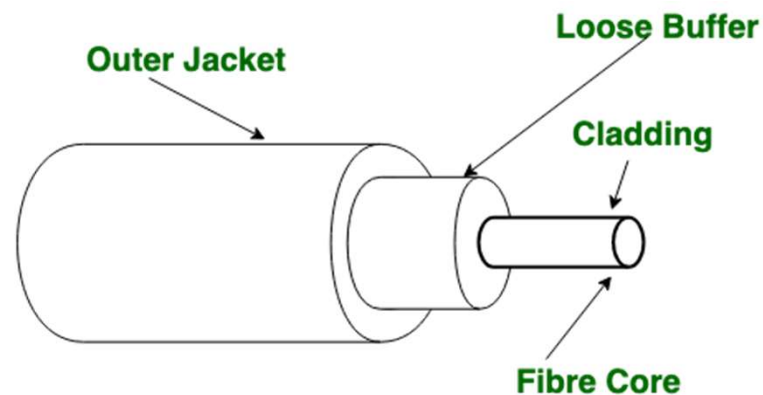


Figure of Optical Fibre Cable



Termination point or Endpoint

- The termination point or endpoint is where a **network cable or transmission line physically ends** and is connected to a device, such as a **computer, switch, router**, or other network equipment.
- In the context of Ethernet networks, terminators are used to **prevent signal reflections** that can occur when a signal reaches the end of a cable and is reflected back, causing interference and reducing signal quality. A terminator is a device that is connected to the end of the cable to absorb the signal and prevent it from reflecting back.



Merits

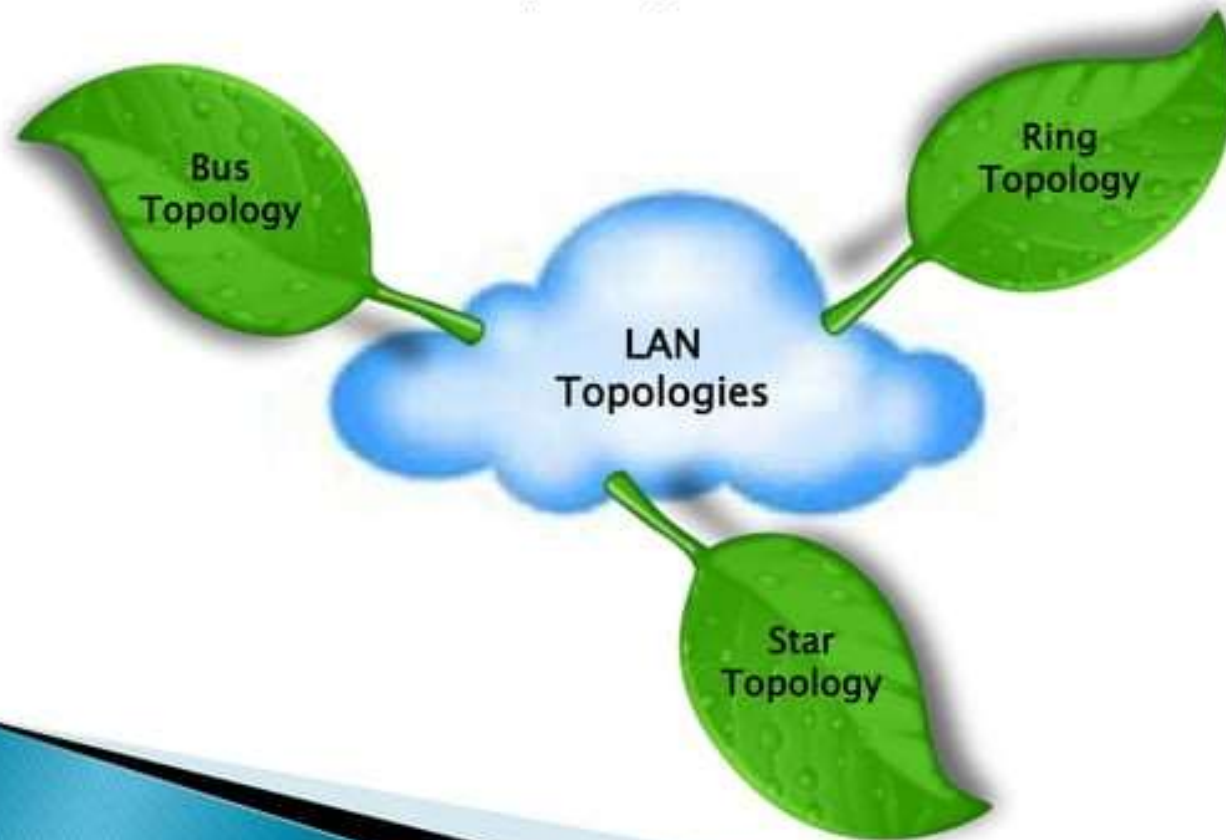
1. **Increased Productivity:** LANs allow for the sharing of resources **such as printers, scanners, and data storage devices, which can increase efficiency and productivity.** Instead of having to purchase multiple devices for each workstation, LANs allow for centralization and sharing.
2. **Cost Savings:** As mentioned above, LANs can save costs by **reducing the need for multiple devices** and the associated maintenance costs. Additionally, LANs can reduce the need for paper-based communication by allowing for electronic communication and file sharing.
3. **Improved Collaboration:** LANs facilitate collaboration between individuals and teams by **allowing for the easy sharing of information and resources.** This can lead to increased innovation and problem-solving within organizations.
4. **Enhanced Security:** LANs can be secured with passwords and other security measures to prevent unauthorized access to information. This can be particularly important for organizations that handle sensitive information.
5. **Scalability:** LANs can be easily scaled to accommodate the changing needs of an organization. New devices and users can be added to the network without the need for significant infrastructure changes.

Demerits

- **High Implementation Costs:** The **initial setup cost** for a LAN can be quite high, particularly for small businesses or organizations. This includes the cost of **hardware, software, and the expertise** required to set up and maintain the network.
- **Technical Complexity:** LANs can be complex to set up and maintain, requiring specialized technical expertise. This can be a challenge for smaller organizations that do not have the resources to hire dedicated IT staff.
- **Security Risks:** LANs can be vulnerable to security breaches, particularly if they are not properly secured. Hackers can gain access to sensitive information or even take control of the entire network, causing significant damage.
- **Dependence on Centralized Resources:** LANs rely on centralized resources such as servers and storage devices. If these resources fail, the entire network can be affected.
- **Limited Range:** LANs are designed for use within a limited geographical area, typically a single building or campus. This can be a limitation for organizations with multiple locations or remote workers.
- **Bandwidth Limitations:** LANs can be limited in terms of bandwidth, particularly if they are not properly configured. This can result in slow data transfer speeds and decreased productivity.

LAN TOPOLOGIES

- There are three topologies of LAN Network



Bus Topology

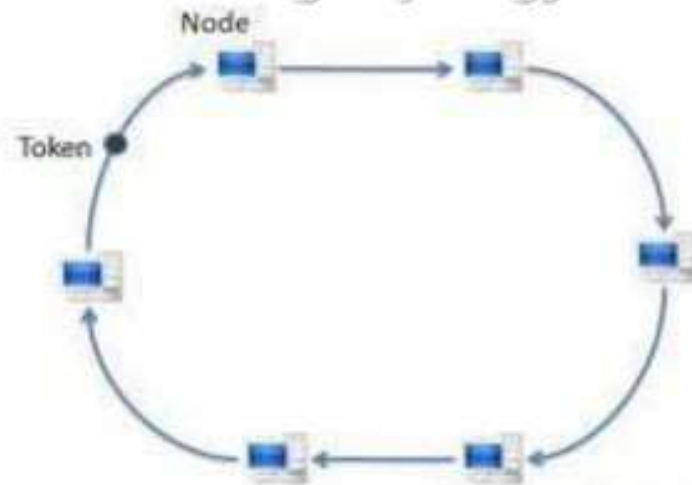


Star Topology



STAR TOPOLOGY

Ring Topology

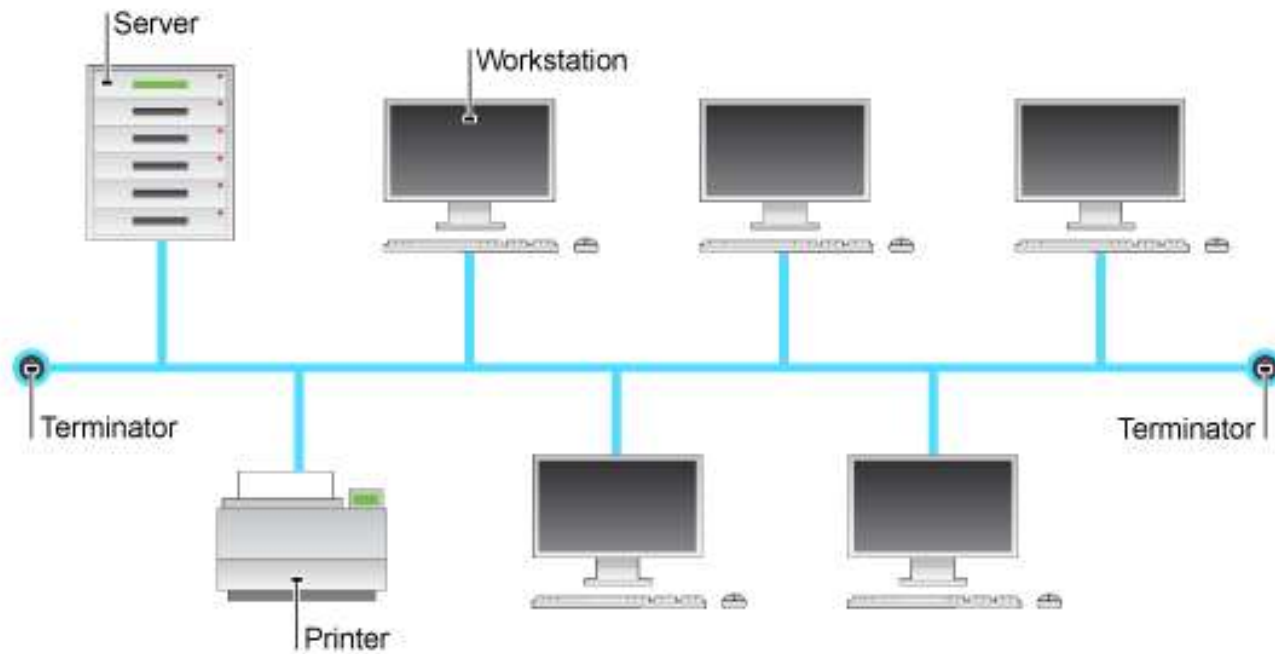


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BUS TOPOLOGY

Bus topology is a type of network topology in which **all devices are connected to a single cable**, called the **backbone or bus**. Here are some key features of bus topology:

1. **Physical Layout:** In a bus topology, all devices are **connected to a single cable**, which runs the entire length of the network. Each device is connected to the **cable through a T-connector**.
2. **Signal Propagation:** When a device transmits data on the bus, the **signal travels in both directions along the cable**. All devices on the network receive the signal, but only the device for which the signal is intended processes it.
3. **Terminators:** The **ends of the cable** on a bus topology must be terminated with a terminator, which **absorbs the signal and prevents it from bouncing back** and interfering with other signals on the network.
4. **Failure Risks:** A **single point of failure** in a bus topology **can bring down the entire network**. If the **backbone cable is damaged**, the entire network will be affected.
5. **Scalability:** Bus topology is not very scalable, as **adding new devices to the network can cause signal degradation** and increase the risk of collisions.
6. **Simple Configuration:** Bus topology is **relatively easy to configure** and **requires less cable than other topologies**, making it a cost-effective option for small networks.



Bus Topology



► **Advantages of Bus Topology :**

- ✓ It is the easiest network topology for connecting peripherals or computers in a linear fashion.
- ✓ It works very efficiently well when there is a small network.
- ✓ The length of cable required is less than a star topology.
- ✓ It is easy to connect or remove devices in this network without affecting any other device.
- ✓ Very cost-effective as compared to other network topology i.e. mesh and star
- ✓ It is easy to understand topology.
- ✓ Easy to expand by joining the two cables together.

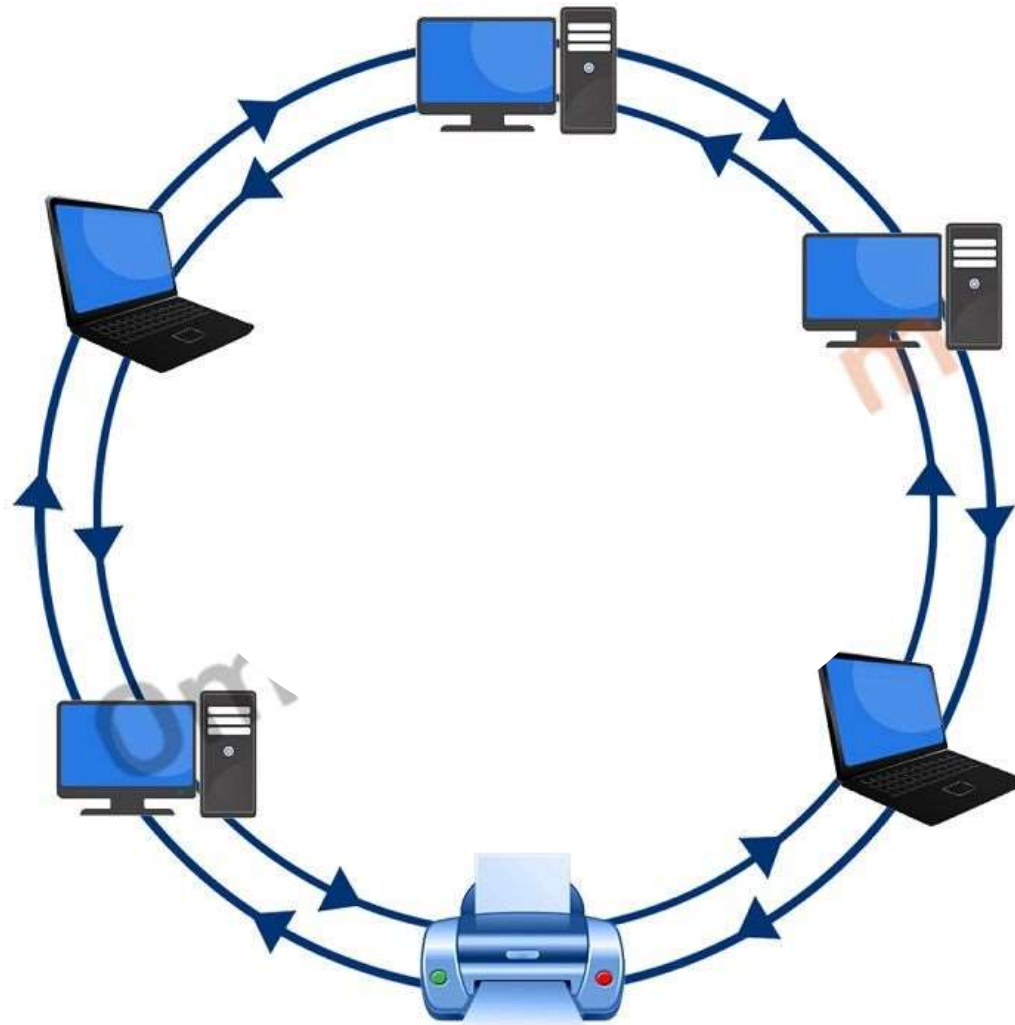
► **Disadvantages of Bus Topology :**

- ✓ Bus topology is not great for large networks.
- ✓ Identification of problems becomes difficult if the whole network goes down.
- ✓ Troubleshooting individual device issues is very hard.
- ✓ Need terminators are required at both ends of the main cable.
- ✓ Additional devices slow the network down.
- ✓ If the main cable is damaged, the whole network fails or splits into two.
- ✓ Packet loss is high.
- ✓ This network topology is very slow as compared to other topologies.

RING TOPOLOGY

Ring topology is a type of network topology in which all devices are connected in a circular loop, forming a closed circuit. Here are some key features of ring topology:

1. **Physical Layout:** In a ring topology, **all devices are connected in a closed loop**, with each device connected to the next device in the loop. **The signal travels around the loop in one direction only.**
2. **Signal Propagation:** When a device transmits data on the network, the **signal travels around the loop in one direction** until it reaches the intended recipient. **Each device on the network regenerates and retransmits** the signal to the next device in the loop.
3. **Failure Risks:** A **single point of failure** in a ring topology can **bring down the entire network**. If one device or cable in the loop fails, the entire network will be affected.
4. **Token Passing:** Ring topology uses a **token passing method** to control access to the network. Only the device holding the token can transmit data on the network.
5. **Scalability:** Ring topology is not very scalable, as adding new devices to the network can cause signal degradation and increase the risk of collisions.
6. **Simple Configuration:** Ring topology is relatively **easy to configure** and **requires less cable** than other topologies, making it a cost-effective option **for small networks**.



Ring Topology

► Advantages of Ring topology :

- ✓ In this data flows in **one direction** which reduces the chance of **packet collisions**.
- ✓ In this topology **additional workstations can be added** after without impacting performance of the network.
- ✓ **Equal access to the resources**.
- ✓ There is no need of server to control the connectivity among the nodes in the topology.
- ✓ **It is cheap to install and expand**.
- ✓ **Speed to transfer the data is very high** in this type of topology.
- ✓ Due to the presence of **token passing the performance** of ring topology becomes better than bus topology under heavy traffic.
- ✓ **Easy to manage**.
- ✓ Ring network is extremely orderly organized where every device has access to the token and therefore the opportunity to transmit.



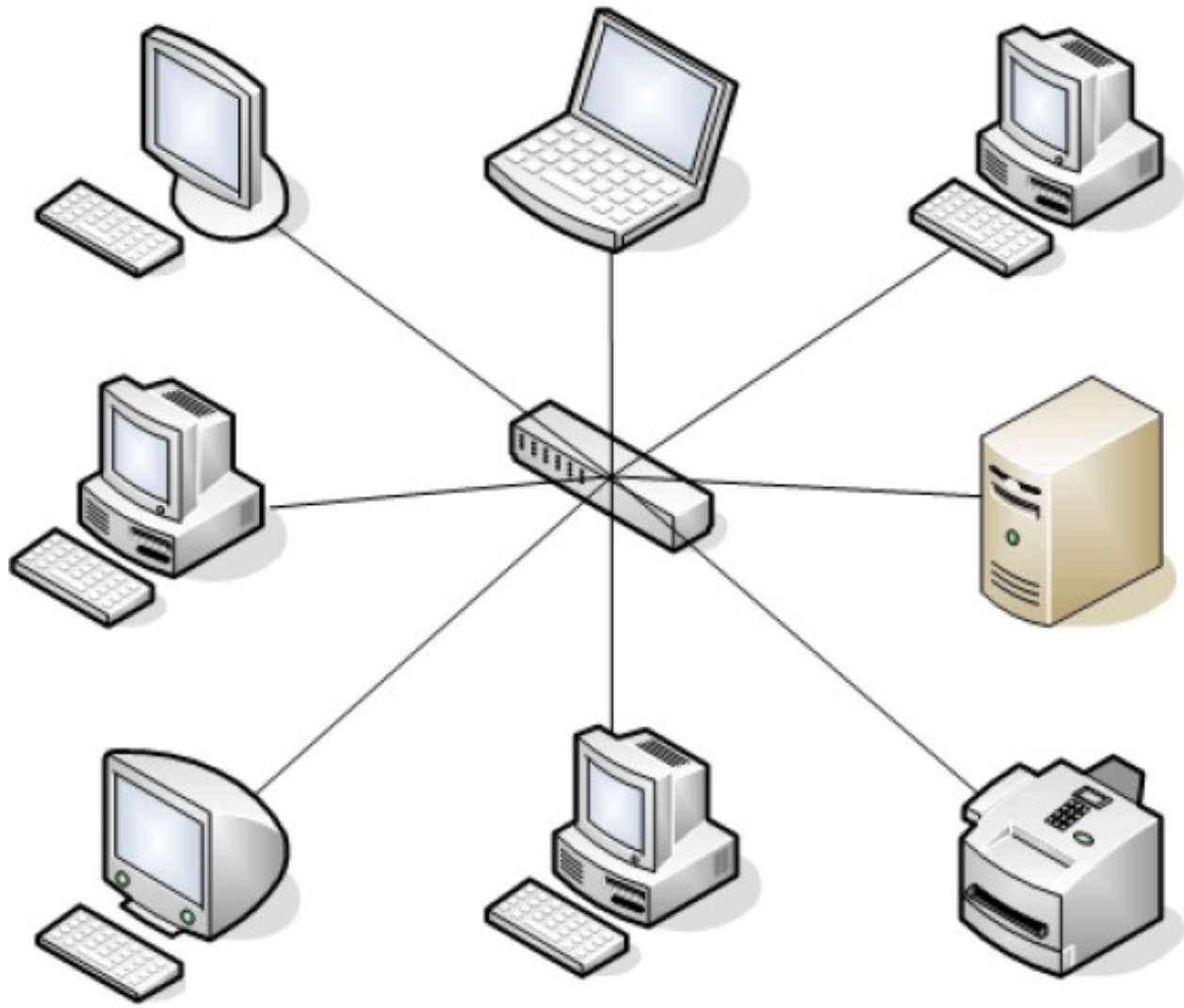
► Disadvantages of Ring topology :

- ✓ Due to the **Uni-directional Ring**, a data packet (token) must have to pass through all the nodes.
- ✓ If **one workstation shuts down, it affects whole network** or if a node goes down entire network goes down.
- ✓ It is **slower in performance** as compared to the bus topology
- ✓ It is **Expensive**.
- ✓ **Addition and removal of any node** during a network is difficult and may cause issue in network activity.
- ✓ Difficult to **troubleshoot the ring**.
- ✓ In order for all the computer to communicate with each other, **all computer must be turned on**.
- ✓ Total dependence in **on one cable**.

STAR TOPOLOGY

Star topology is a type of network topology in which **all devices are connected to a central device**, typically a **switch or hub**. Here are some key features of star topology:

1. **Physical Layout:** In a star topology, **all devices are connected to a central hub or switch**, which acts as a traffic cop for data transmission. Each device is connected to the hub or switch **through a separate cable**.
2. **Signal Propagation:** When a device transmits data on the network, the signal travels from the device to the central hub or switch, which then forwards the signal to the intended recipient.
3. **Redundancy:** Star topology offers redundancy, as the failure of one device or cable does not bring down the entire network. Only the affected device or cable is affected.
4. **Scalability:** Star topology is highly scalable, as new devices can be added to the network without affecting the performance of existing devices.
5. **Maintenance:** Star topology is relatively easy to maintain, as devices can be added, removed or replaced without disrupting the rest of the network.
6. **Cost:** Star topology requires more cabling than other topologies, making it a more expensive option for larger networks.





► Advantages of Star Topology

- ✓ It is very reliable – if **one cable or device fails then all the others will still work**
- ✓ It is high-performing as **no data collisions** can occur
- ✓ **Less expensive** because each device only need one I/O port and wishes to be connected with hub with one link.
- ✓ **Easier to put in**
- ✓ **Easy fault detection** because the link are often easily identified.
- ✓ **No disruptions** to the network **when connecting or removing devices.**
- ✓ Each device **requires just one port** i.e. to attach to the hub.
- ✓ If N devices are connected to **every other in star**, then the amount of cables required to attach them is N. So, **it's easy to line up.**



► **Disadvantages of Star Topology**

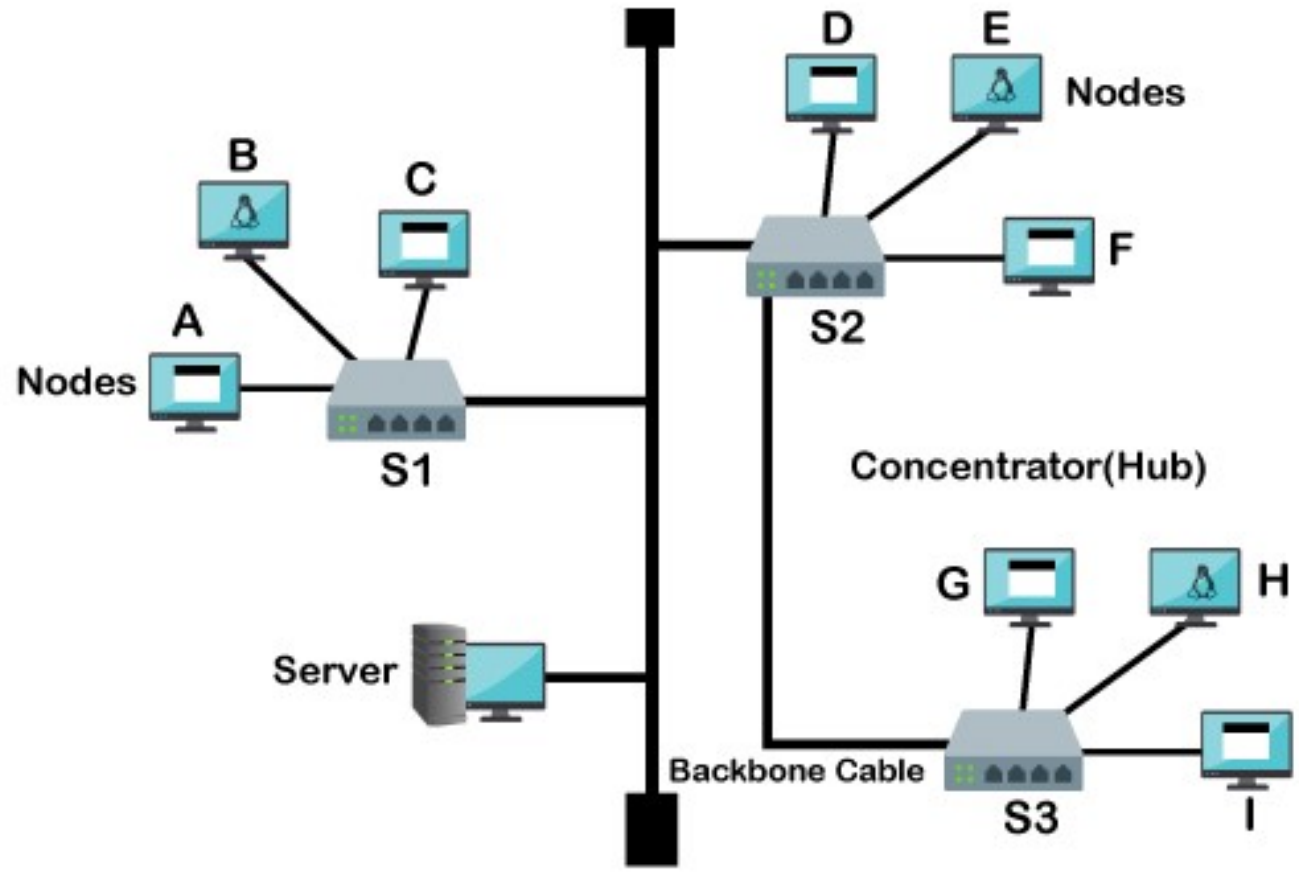
- Requires **more cable than a linear bus** .
- If the **connecting network device (network switch) fails**, nodes attached are disabled and can't participate in network communication.
- **More expensive** than linear bus topology due to the value of the connecting devices (network switches)
- **If hub goes down everything goes down**, none of the devices can work without hub.
- Hub requires more resources and **regular maintenance** because it's the central system of star .
- **Extra hardware is required** (hubs or switches) which adds to cost

TREE TOPOLOGY

- A tree topology is a type of network topology where the **nodes are arranged in a hierarchical structure resembling a tree, with a root node at the top and multiple branches that connect to other nodes** below it.
- In a LAN (local area network) context, a tree topology can be used to **interconnect multiple network devices such as computers, printers, and servers**.
- In a LAN tree topology, **the root node typically acts as a central hub or switch** that connects to multiple network segments, **each of which may have its own branch of connected devices**.
- The branches can then **connect to additional switches or hubs to expand the network**.
- One of the advantages of a tree topology is that it allows for **more efficient use of network bandwidth compared to a bus topology**, where all devices share the same communication channel.
- In a tree topology, each network segment can have **its own dedicated bandwidth**, which can help **prevent congestion and improve network performance**.
- However, a tree topology can also be **more complex to set up and maintain** compared to other topologies, and **network failures in the root node** can cause widespread disruption to the entire network.
- Additionally, the **cost of implementing a tree topology can be higher** due to the **need for multiple switches or hubs**.



Tree Topology



► Advantages of Tree Topology :

- ✓ This topology is the **combination of bus and star topology**.
- ✓ This topology provides a **hierarchical as well as central data arrangement** of the nodes.
- ✓ As the **leaf nodes can add one or more nodes** in the hierarchical chain, this topology provides high scalability.
- ✓ The **other nodes in a network are not affected if one of their nodes gets damaged** or does not work.
- ✓ Tree topology provides easy maintenance and easy fault identification can be done.
- ✓ A callable topology. **Leaf nodes can hold more nodes**.
- ✓ **Point-to-point wiring** for individual segments.
- ✓ Tree Topology is **highly secure**.
- ✓ **It is used in WAN**.



► Disadvantages of Tree Topology :

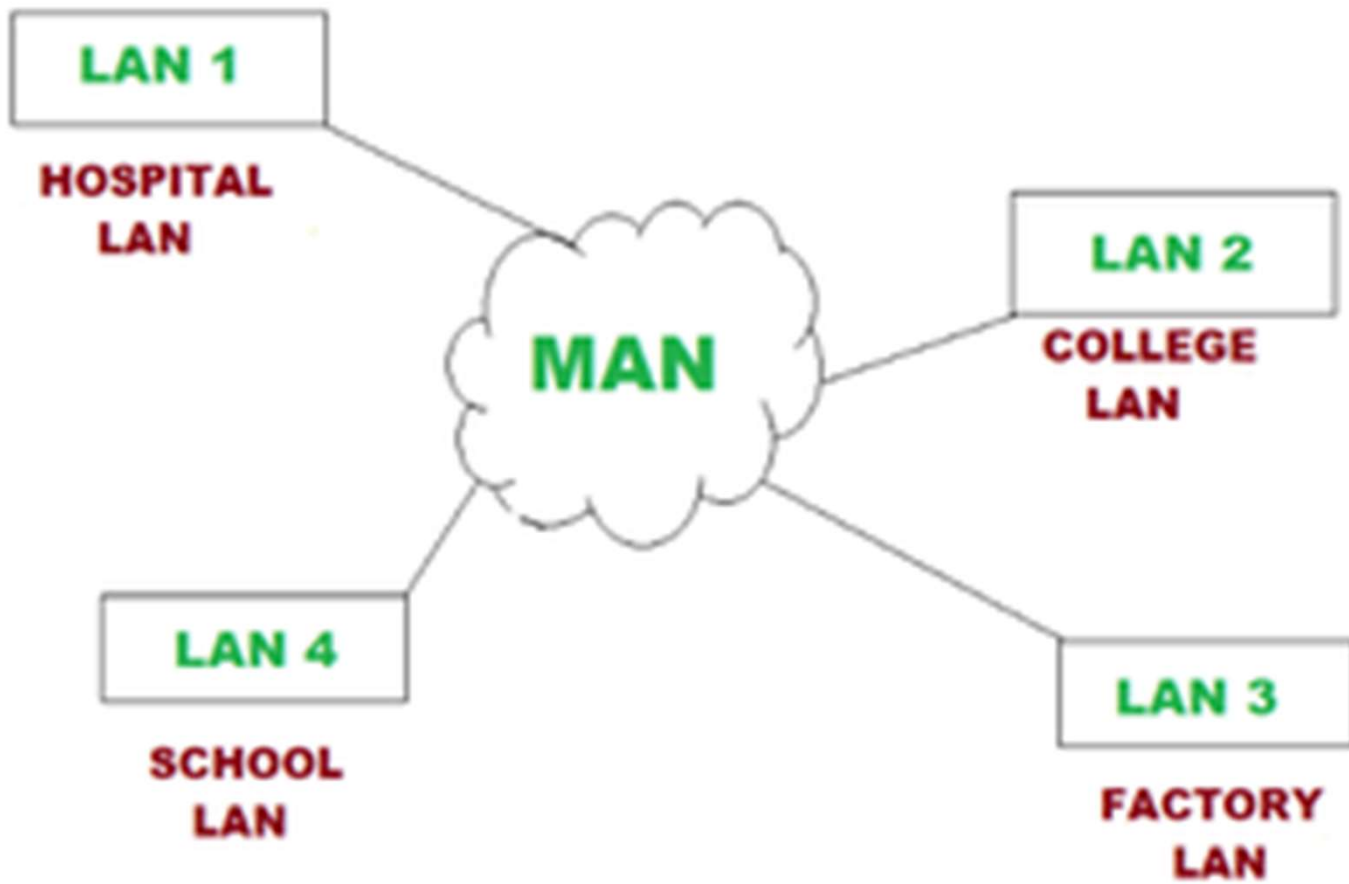
- ✓ This network is **very difficult to configure as compared to the other network topologies.**
- ✓ Due to the presence of a large number of nodes, the network performance of tree topology becomes a bit slow.
- ✓ If the computer on the first level is erroneous, the next-level computer will also go under problems.
- ✓ Requires a large number of cables compared to star and ring topology.
- ✓ As the data needs to travel from the central cable this creates dense network traffic.
- ✓ The Backbone appears as the failure point of the entire segment of the network.
- ✓ Treatment of the topology is pretty complex.
- ✓ The establishment cost increases as well.
- ✓ If the bulk of nodes is added to this network, then the maintenance will become complicated.

MAN (Metropolitan Area Network)

- MAN or Metropolitan area Network covers a **larger area than** that covered by a LAN and a **smaller area as compared to WAN**.
- Is **collection of LANs** with the same geographical area, for instance a city.
- Is a **network of computers** located at different sites **within a large physical area, such as a city**.
- MAN often acts as a **high speed network** (although **not as fast as LAN**) to allow **sharing of regional resources**.
- **Companies that have several branches within the city** such as **banks**, might find a MAN useful to them.
- MAN has a range of **5-50km**.
- It covers a large geographical area and may **serve as an ISP (Internet Service Provider)**.

MAN (Metropolitan Area Network)

- MAN is basically a bigger version of LAN.
- MAN used similar technology of LAN
- It is a high speed network in cheaper cost
- It bigger than LAN AND smaller than WAN.
- It is designed to extend over a larger area such as an entire city.
- in this 2 or more than 2 LAN network with each other
- Example- cable tv network, telephone networks, DSL line.





Advantages:

- Provides **high-speed connectivity** over a larger geographical area than LAN.
- Can be used as an **ISP for multiple customers**.
- Offers **higher data transfer rates than WAN** in some cases.

Disadvantages:

- Can be **expensive to set up and maintain**.
- May experience **congestion and network performance issues** with increased usage.
- May have **limited fault tolerance and security** compared to LANs.

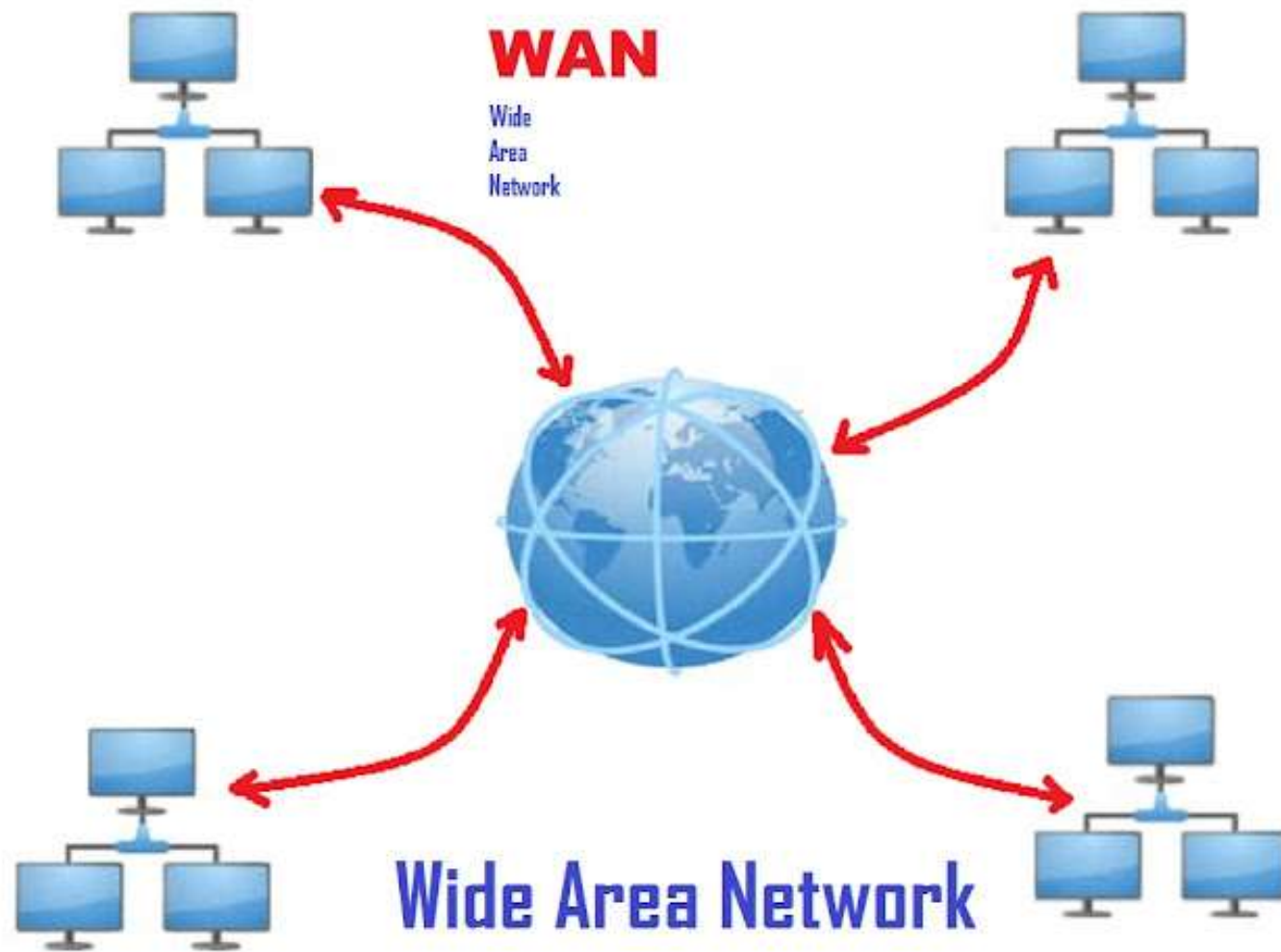
Wide Area Network (WAN)

- A Wide Area Network (WAN) is a type of network that covers a **large geographic area, such as a city, country, or even the entire world.**
- WAN is a wide area network that **consisting of two or more LANs or MANs.**
- A WAN is typically used to connect devices and networks that are **separated by long distances**, such as different offices of a company or **different cities.**
- WANs use a variety of technologies **to transmit data over long distances**, including **leased lines, satellite links.**
- **WANs are typically slower than Local Area Networks (LANs)** due to the longer distances in **transmitting data over long distances.**
- **WANs often use protocols** such as the **Internet Protocol (IP)** to enable devices to communicate with each other over the network.
- The first WAN was designed by the **U.S. Air Force** in the late **1950s.**



Some examples of WAN are below:

- ✓ Internet
- ✓ Most big banks
- ✓ Airline companies
- ✓ Stock brokerages
- ✓ Railway reservations counter
- ✓ Satellite systems





► Advantages of WAN

- ✓ WAN facilitates a **centralized data process**. That means all **workstations can share the data through the main server**.
- ✓ In WAN, the process of **data transfer is quick and affordable** because it covers a large geographical area.
- ✓ WAN enables a user or workstation to **unite with the world** and allows them to transfer data and do business at a global level.

► Disadvantages of WAN

- ✓ Wide Area Networks **can face traffic blockage**.
- ✓ When it comes to security aspects, **WAN is less secure as compared to the LAN and MAN**.
- ✓ WAN has **very low fault tolerance ability**.
- ✓ The **setup cost** in WAN is **high**.
- ✓ In WAN, you might feel the **server issue**.
- ✓ The **data transfer rate is slower than LAN**.

LAN vs MAN vs WAN

LAN	MAN	WAN
A local area network (LAN) is a network that links a small group of computers in a certain geographic region.	MAN is a much larger network that spans significant areas such as towns and cities.	The WAN network reaches out to a much greater area. It has the ability to link a number of countries. The Internet, for example, is a WAN.
The speed of LAN is high.	The speed of MAN is average.	The speed of WAN is low.
The ownership of LAN is private.	The ownership of MAN can be private or public.	The ownership of WAN can be private or public.
It is used in schools, colleges, and hospitals.	It is used for small towns/ cities.	It is used for countries/ continents.
It is easier and less expensive to design and maintain a LAN than it is to manage a WAN.	MAN design and maintenance is more difficult and expensive than LAN.	WAN design and maintenance is more difficult and expensive than LAN and MAN.



References

- ✓ Aggarwal, J.C. (2001). Principles, Methods and Techniques of Teaching. Delhi: Vikas.
- ✓ Aggarwal, J.C. (2008). Elementary Educational Technology. Delhi: Shipra Publication.
- ✓ Allison Little John (2003): Refusing Online Resources. A Sustainable Approach to eLearning, Kogan Page Limited.
- ✓ Bengalee, Coomi (1986). Introduction to Educational Technology: Innovations in Education. Mumbai: Saith.
- ✓ Bhatia, K.K. (2001). Foundation of Teaching Learning Process. Ludhiyana: Tandon Publishers.
- ✓ Bhatt, B. D., Sharma, S. R. (1992). Educational Technology: Concept and Technique. New Delhi: Kanishka Publ House.
- ✓ Dahiya, S.S. (2008). Educational Technology: Towards Better Teaches Preference. Delhi: Shirpa Publication.
- ✓ Das, R. C. (1993). Education Technology: A Basic Text. New Delhi: Sterling.
- ✓ Rastogi, S. (1998). Educational Technology for Distance Education. Jaipur: Rawat Publication.
- ✓ Salmon, G. (2002). E-Tivities: The Key to Active Only Learning. Sterling, VA : Stylus Publishing Inc. ISSN 0 7494 3686 7
Retrieved from <https://tojde.anadolu.edu.tr/tojde8/reviews/etivities.htm>
- ✓ Saxena, N. R. Swaroop, Oberoi, S.C. (2004). Essentials of educational technology and management. Meerut: R.Lall Book Depot.



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