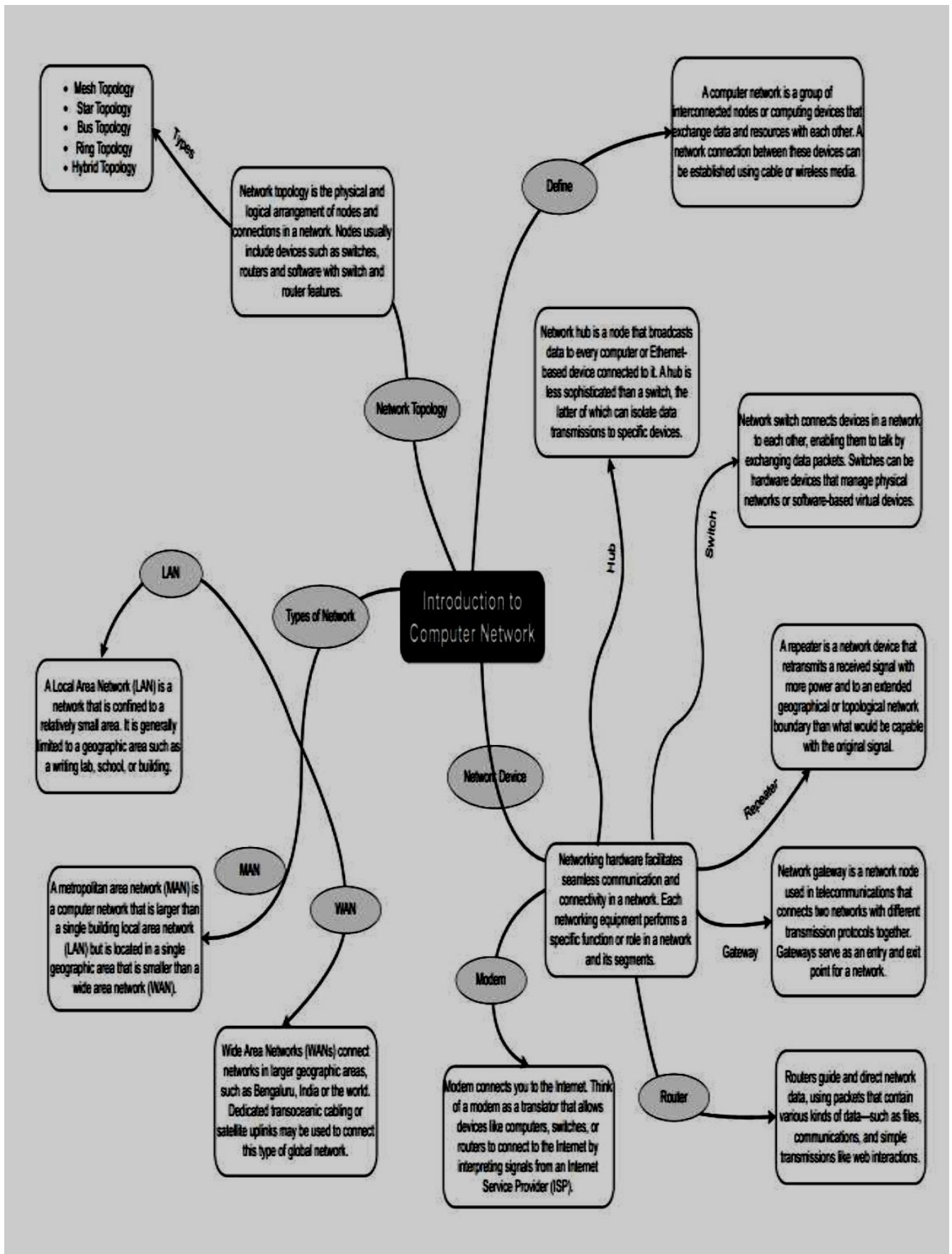


## Student Support Material

### Introduction to Computer Networks:

#### Some key points to remember

- A network is a crucial part of modern computing, allowing devices to communicate and share information. It can be a local network within a home or office or a global or world-wide network like the internet.
- Networking media, also known as transmission media, provide the physical means for data to travel from one device to another. These media come in various forms, each with its own advantages and disadvantages.
- Ethernet cables, often categorized as twisted-pair cables, are commonly used in local area networks (LANs). They offer reliability and high-speed data transmission over short distances.
- Optical fiber is an advanced networking medium that uses light signals to transmit data. It provides high bandwidth and is immune to electromagnetic interference, making it suitable for long-distance communication.
- Microwave communication relies on radio waves in the microwave frequency range. It is frequently used for point-to-point links, such as connecting two buildings in a city.
- Radio wave communication utilizes radio frequency waves for wireless data transmission. This is common in Wi-Fi networks and mobile communication.
- Satellite communication involves the use of geostationary or low-earth-orbit satellites to relay signals over vast distances. It's essential for global communication and broadcasting.
- Infrared communication uses infrared light to transmit data wirelessly, typically over short distances. It's commonly found in remote controls and some short-range data transfer applications.



### **Definition of Network:**

- A group of two or more similar things or people interconnected with each other is called network
- A computer network is an interconnection among two or more computers or computing devices which allows computers to share data and resources among each other.
- Apart from computers, networks include networking devices like switch, router, modem, etc. Networking devices are used to connect multiple computers in different settings.

### **Advantages of Networks:**

- Enhancement of Communication and Information Availability
- Convenient Sharing of Resources
- Easy File/Data Sharing
- Highly Flexible
- Affordable
- Increases Cost Efficiency
- Networking Boosts Storage Capacity
- Enhanced Security and Data Protection

### **Disadvantages of Networks:**

- Security vulnerabilities.
- Potential for data breaches
- Network congestion
- Reliability issues.
- Dependency on network infrastructure.

### **Components of a network:**

The main components of a computer network are:

1. **Nodes:** These are the individual devices connected to the network, such as computers, printers, servers (service provider), clients (service users), mobile devices etc.
2. **Communication channels:** These are the transmission media that carry data between nodes, such as cables (twisted-pair, coaxial, fibre optic), wireless signals, or satellite links.
3. **Network devices:** These are hardware components that enable communication and manage the network, such as routers, switches, modems, and access points.

4. **Network software:** It includes protocols, services, and applications that facilitate communication and data exchange between nodes.

## Types of Networks

Various types of computer networks ranging from network of handheld devices (like mobile phones or tablets) connected through Wi-Fi or Bluetooth within a single room to the millions of computers spread across the globe.

Computer networks are broadly categorised as (as per layout):

- PAN (Personal Area Network)
- LAN (Local Area Network)
- MAN (Metropolitan Area Network)
- WAN (Wide Area Network)

### Personal Area Network (PAN):

A PAN is a network of local devices for personal network. It generally includes only one computer or workstation connected in limited area with different devices. A computer connected with mobile Bluetooth, printer, speaker is a PAN.

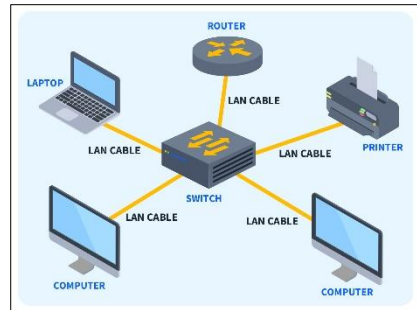
- A PAN can be set up using guided media (USB cable) or unguided media (Bluetooth, Infrared).
- For very small distance, almost 01 workstation with various communication devices connected
- Private Communication
- Example: **Bluetooth, Infrared**



### Local Area Network (LAN):

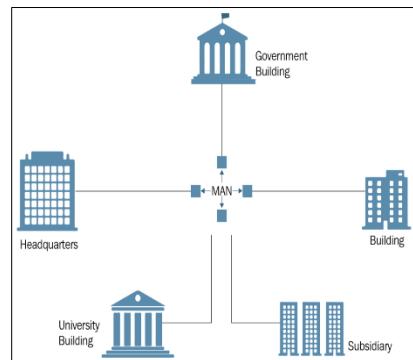
- It is a network that connects computers, mobile phones, tablet, mouse, printer, etc., placed at a limited distance.

- The geographical area covered by a LAN can range from a single room, a floor, an office having one or more buildings in the same premise, laboratory, a school, college, or university campus.
- Connected with wires, Ethernet cables, Fibre Optics or Wi-Fi
- LANs provide the short-range communication with the high-speed data transfer rates
- Can be extended up to 1 km
- Data transfer from 10 Mbps to 1000 Mbps (Mbps- Megabits per Second)



### Metropolitan Area Network (MAN)

- Metropolitan Area Network (MAN) is an extended form of LAN which covers a larger geographical area like a city or a town.
- Data transfer rate is less than LAN
- Cable TV Network, Cable based broadband internet are some common examples.
- Can be extended up to 30-40 Kms (normally covers a city)
- Many LANs are connected together to form MAN

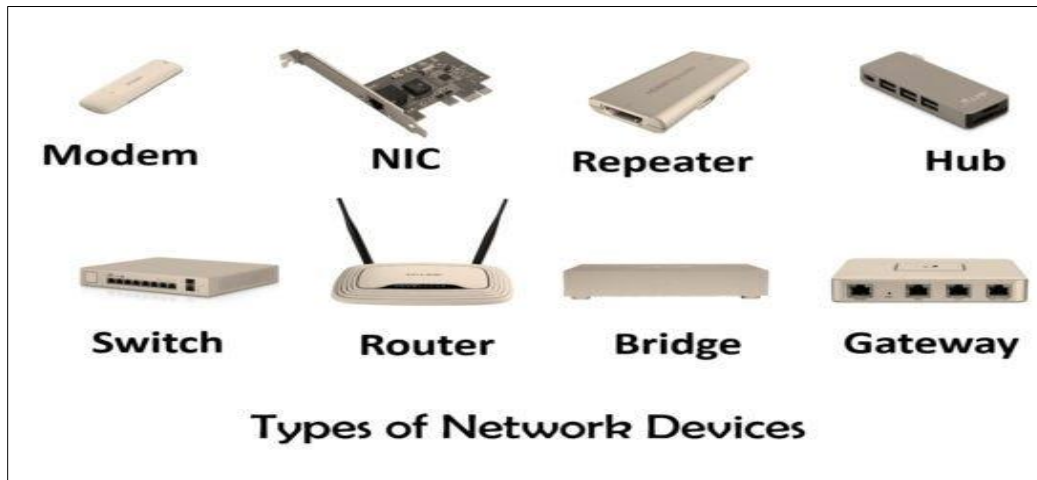


### Wide Area Network (WAN)

- Connects computers and others LANs and MANs, which are spread across different geographical locations of a country or in different countries or continents.
- The Internet is the largest WAN that connects billions of computers, smartphones and millions of LANs from different continents.

### Network Devices:

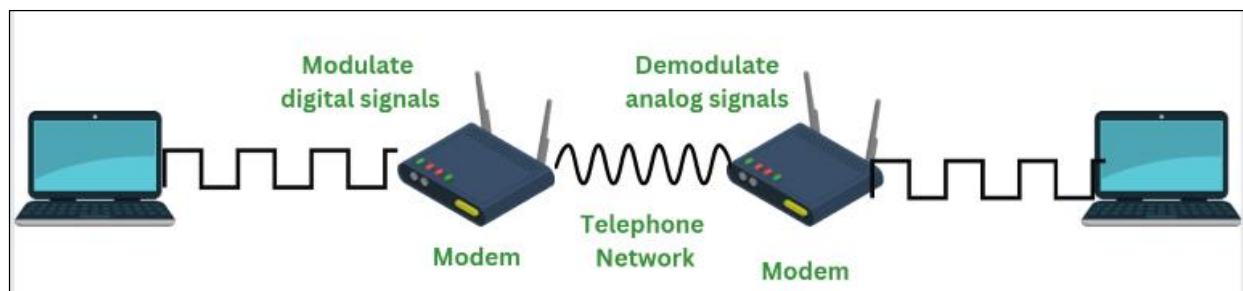
To communicate data through different transmission media and to configure networks with different functionality, we require different devices like Modem, Hub, Switch, Repeater, Router, Gateway, etc.



#### **Modem:**

- Stands for '**MO**dulator **DEM**olulator'
- Device used for conversion between analog signals and digital bits.
- Modems connected to both the source and destination nodes

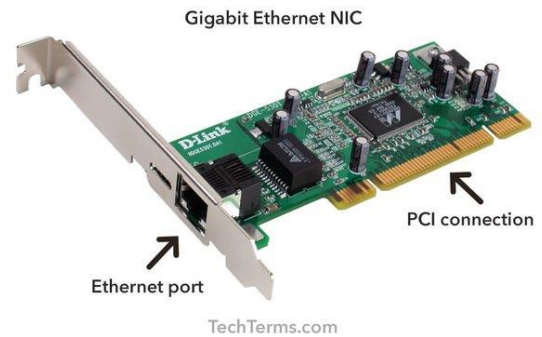
The modem at the sender's end acts as a modulator that converts the digital data into analog signals. The modem at the receiver's end acts as a demodulator that converts the analog signals into digital data for the destination node.



#### **Ethernet Card:**

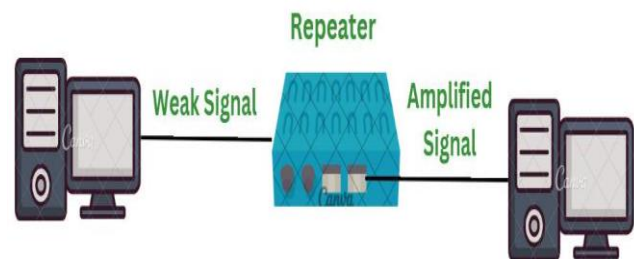
Also known as Network Interface Card (NIC) is a network adaptor used to set up a wired network.

- Interface between computer and the network
- Circuit board mounted on the motherboard of a computer
- Ethernet cable connects the computer to the network through NIC.
- Data transfer between 10Mbps to 1 Gbps
- Each NIC has a MAC address, which helps in uniquely identifying the computer on the network.



### Repeater

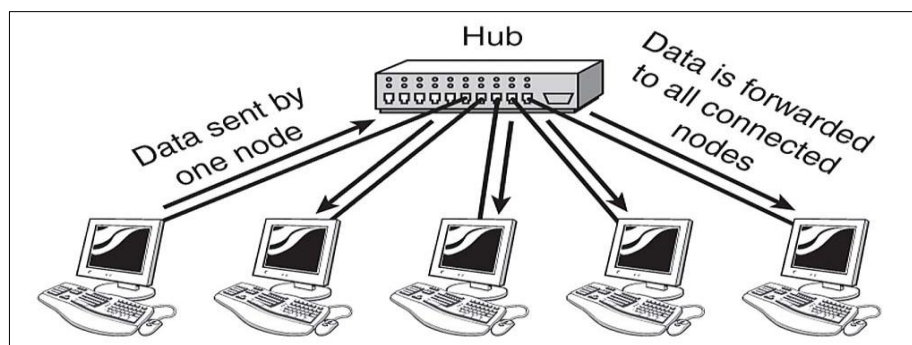
- Data are carried in the form of signals over the cable
- Signals lose their strength beyond 100 m limit and become weak.
- The weakened signal appearing on the cable is regenerated and put back on the cable by a repeater



### Hub

An Ethernet hub is a network device used to connect different devices through wires / cables. Data arriving on any of the lines are sent out on all the others.

The limitation of hub is that if data from two devices come at the same time, they will collide.



### ***Types of Hub:***

Passive Hub: This type does not amplify or boost the signal. It does not manipulate or view the traffic that crosses it.

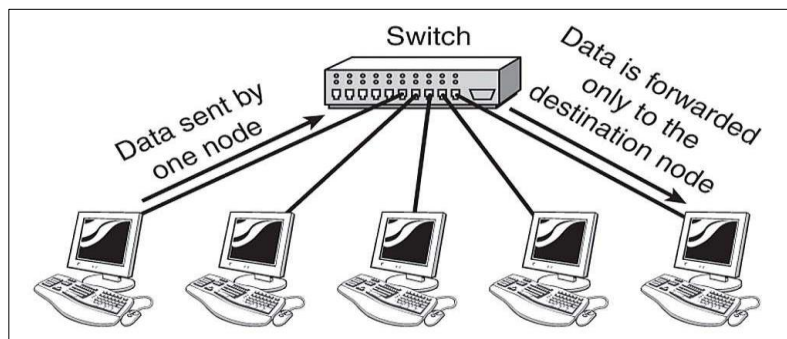
Active Hub: It amplifies the incoming signal before passing it to the other ports.

### **Switch**

Like a hub, a network switch is used to connect multiple computers or communicating devices.

When data arrives, the switch extracts the destination address from the data packet and looks it up in a table to see where to send the packet. Thus, it sends signals to only selected devices instead of sending to all.

Can forward multiple packets at the same time.



### **Difference between Hub and Switch**

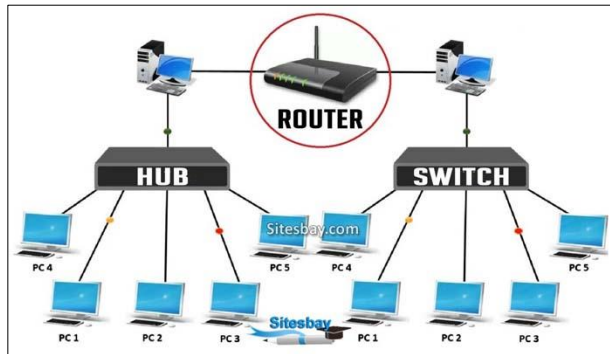
The main difference between hub and switch is that **hub replicates what it receives on one port onto all the other ports** whereas **switch keeps a record of the MAC addresses of the devices attached to it** and forwards data packets onto the ports for which it is addressed across a network. Hence, switch is an intelligent Hub.

### **Router**

A network device that can receive the data, analyse it and transmit it to other networks.



Compared to a hub or a switch, a router has advanced capabilities as it can analyse the data being carried over a network, decide or alter how it is packaged, and send it to another network of a different type.



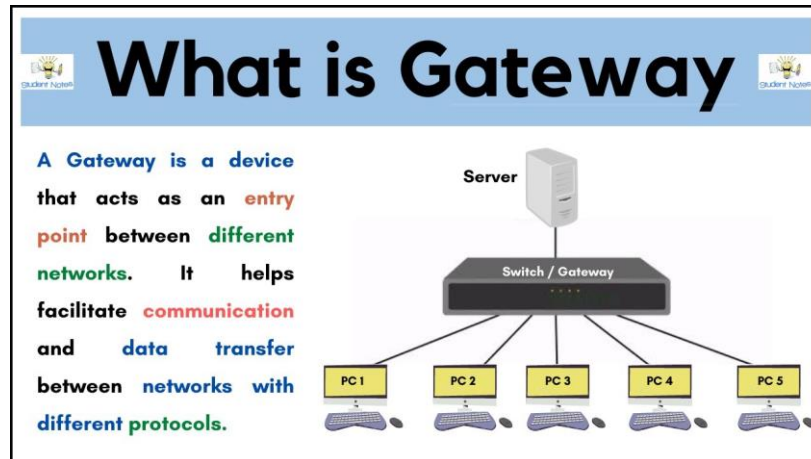
- A router can be wired or wireless.
- A wireless router can provide Wi-Fi access to smartphones and other devices.
- Wi-Fi routers perform the dual task of a router and a modem / switch.
- It connects to incoming broadband lines, from ISP (Internet Service Provider) and

converts them to digital data for computing devices to process.

## Gateway

A gateway is a device that connects dissimilar networks (Networks with different software and hardware configurations and with different transmission protocol).

- Gateway serves as the entry and exit point of a network, as all data coming in or going out of a network must first pass through the gateway in order to use routing paths.
- Also maintain information about the host network's internal connection paths and the identified paths of other remote networks.
- It can be implemented as software, hardware, or a combination of both because network gateway is placed at the edge of a network and the firewall is usually integrated with it.



## Network Topologies

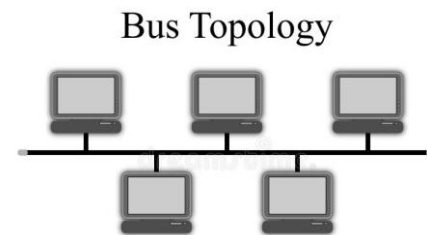
The arrangement of computers and other peripherals in a network is called its topology. The topology is normally be applied in local area network. Some common topologies are as follows:

### 1. Bus Topology

Each communicating device connects to a transmission / communication medium, known as bus backbone.

#### Advantages:

- Data transmitted in both directions
- Simplicity in design and installation.
- Cost-effective for small networks.
- Easy to add or remove devices.
- Data can be received by any of the nodes of network
- Single backbone wire /bus used to connect computers so cheaper and easy to maintain



#### Disadvantages:

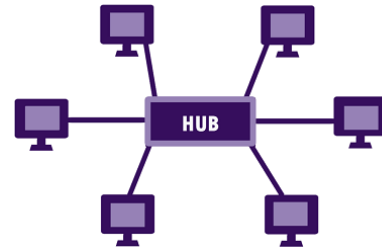
- Less secure
- Less reliable
- Susceptible to signal reflections and collisions, which can degrade performance.
- Difficult to troubleshoot if a fault occurs.

## **2. Star Topology**

Each communicating device is connected to a central node, which is a networking device like a hub or a switch.

### **Advantages:**

- Easy to install and manage.
- Easy to troubleshoot
- Very effective, efficient and fast
- A single node failure does not affect the entire network.
- Fault detection (if one connection fails, it doesn't affect the entire network) and removal of faulty parts is easier.
- High reliability for individual connections.



### **Disadvantages:**

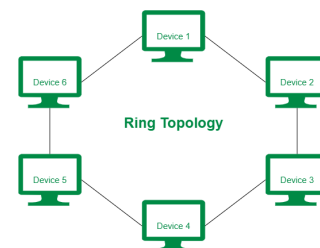
- Difficult to expand. Longer cable is required.
- The cost of the hub and the longer cables makes it expensive over others.
- In case hub fails, the entire network stop working.
- Dependent on the central hub; if it fails, the entire network can go down.
- Requires more cabling compared to some other topologies.

## **3. Ring Topology**

In a ring topology, devices are connected in a closed loop, where data circulates in one direction.

### **Advantages:**

- Each node is connected to two other devices, one each on either side
- The link in a ring topology is unidirectional.
- Equal access to the network for all devices.
- No collisions, as data travels in a predefined path.



### **Disadvantages:**

- Failure of one node breaks down the network.
- If one device or connection fails, it can disrupt the entire ring.

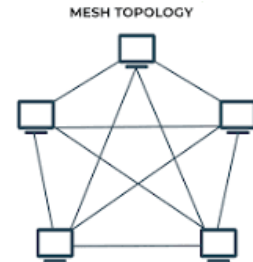
- Adding or removing devices can be complex.

#### **4. Mesh Topology**

In this type of topology each and every computer or workstation is directly connected to each other in the network, creating redundant paths.

##### Advantages:

- Can handle large amounts of traffic since multiple nodes can transmit data simultaneously
- If any node gets down doesn't affect other nodes
- Secure than other topologies as each cable carries different data
- High redundancy and fault tolerance.
- No single point of failure.



##### Disadvantages:

- Wiring / Cabling is complex and cabling cost is high in creating such networks
- There are many redundant or un-utilised connections
- High cabling and configuration complexity.
- Cost-prohibitive for large networks due to the number of connections.

#### **5. Tree or Hybrid Topology**

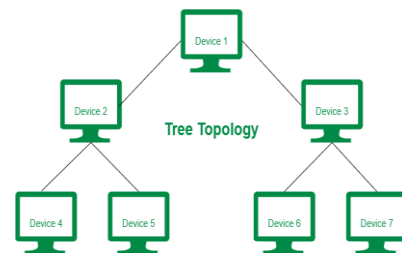
It is a hierarchical topology, in which there are multiple branches and each branch can have one or more basic topologies like star, ring and bus.

##### Features of Tree Topology

- Ideal if workstations are located in groups.
- Used in Wide Area Network.

##### Advantages of Tree Topology

- Extension of bus and star topologies.
- Expansion of nodes is possible and easy.



- Easily managed and maintained.
- It consists of multiple star-configured networks connected to a central bus.

### **Points to remember: Network Devices and Topologies**

- A modem is a device that modulates and demodulates digital data, allowing it to travel over analog communication lines like telephone or cable.
- Hubs are basic devices that connect multiple network devices in a LAN. They simply broadcast data to all connected devices.
- Switches are more intelligent than hubs. They operate at the data link layer and forward data only to the device that needs it, reducing network traffic.
- Repeaters are used to boost signal strength and extend the range of a network. They are commonly employed in wireless networks and in situations where long cable runs are necessary.
- Routers connect different networks and determine the best path for data to travel between them. They operate at the network layer of the OSI model.
- Gateways are devices that connect networks using different communication protocols or technologies, allowing them to communicate with each other.

### **15 Questions MLL**

:

1. Expand the following: a) APRANET    b) ISP

Ans.    a) Advanced Research Projects Agency Network

          b) Internet Service Provider

2. Write one advantage and one disadvantage of network?

Ans.    *Advantages:*

1. Sharing of resources.
2. Data protection.
3. Improved speed of communication.

*Disadvantages:*

Security concerns, server dependence, high setup costs, maintenance needs.

3. What is server and client?

Ans. Server is a computer or repository which facilitates networking tasks such as sharing of files, resources and communicating among hosts (clients) in a network.

Client is a node or workstation that requests for a service from a server. It is just like a consumer in that network.

4. Define Communication channel?

Ans. Communication channel is a medium by which hosts in a network interact with each other hosts and server(s).

5. Write different types of Communication channels?

Ans: **Wired**: When host(s) and server(s) are connected with one another through **guided media**. Such as: co-axial cables, twisted paired cables, fibre optic cables.

**Wireless**: When host(s) and server(s) are connected with one another through **unguided media**. Such as: radio wave, micro wave, satellites, infrared, Bluetooth, laser etc.

6. How a protocol is important in communication?

Ans: A protocol is required to share information among devices in a network. A protocol refers to a pre-defined set of rules by which different parties of a network connect and interact with each other.

7. Expand followings: a) TCP / IP      b) OSI      c) mbps      d) Mbps

Ans: a) Transmission Control Protocol / Internet Protocol

b) Open System Interconnection

c) mega bits per second

d) Million bytes per second

8. Name the device for the following:

a) It stands for Modulator Demodulator      Ans: **MODEM**

b) It regenerates the signals      Ans: **Repeater**

9. Define Gateway?

Ans: Gateway is a key access point that acts as a "gate" between an organisation's network and the outside world of the Internet. Gateway serves as the entry and exit point

of a network, as all data coming in or going out of a network must first pass through the gateway in order to use routing paths.

10. Write about Router in brief?

Ans: A router is a network device that can receive the data, analyse it and transmit it to other networks. A router connects a local area network to the internet. A router can be wired or wireless. A wireless router can provide Wi-Fi access to smartphones and other devices.

11. Arjun, a student of Class XII, is little confused about hub and switch. Help him stating any one advantage of switch over hub?

Ans: A hub receives data from one node / server and sends / forwards the data to all other connected devices in that network. On the other hand, a switch extracts the destination address from the data packet and looks it up in a table to see where to send the packet. Thus it sends signals to only selected devices instead of sending to all. It can also forward multiple packets at the same time.

12. Name any 04 major components of a network?

Ans: Host, Server, Communication Channel, Network Services

13. Define any 01 difference between an active and a passive hub?

Ans: Active hub works as a repeater which amplifies signals and forward data, whereas passive sub just forward the data without any amplification.

14. Comment the sentence as a network administrator: "By using resource sharing, network cost can be reduced."

Ans: In networking, resource sharing means sharing of costly resource (Hardware, software or both) can be implemented easily. Installation of these resources can be in one node (server) and other nodes (clients) can use these resources with some permissions without installation in their workstations.

15. Do you think, "Switch is an intelligent hub"?

Ans: Yes, a switch is an intelligent hub, because hub just forward the data packets to all other destinations / workstations. But switch checks IP address and sends data to particular destination only.

## 20 Questions MCQs

1. What is a stand-alone computer?
  - a) a computer that is not connected to a network
  - b) a computer that is being used as a server
  - c) a computer that does not have any peripherals attached to it
  - d) a computer that is used by only one person

Ans: a) a computer that is not connected to a network

2. Hub is a:
  - a) Broadcast device
  - b) Unicast device
  - c) Multicast device
  - d) None of these

Ans.: a) Broadcast device

3. The device that can operate in place of a hub is a :
  - a) Switch
  - b) Bridge
  - c) Router
  - d) Gateway

Ans: a) Switch

4. A repeater takes a weak and corrupted signal and \_\_\_\_\_ it.
  - a) Amplifies
  - b) Regenerates
  - c) Resembles
  - d) Reroutes

Ans: b) Regenerates

5. Component that is required to connect the computer to a network is:
  - a) Network Interface Card
  - b) Hub
  - c) Switch
  - d) Wireless Access Point

Ans: a) Network Interface Card

6. A \_\_\_\_\_ is a networking device that filters network data.
  - a) Switch
  - b) Gateway
  - c) Router
  - d) Modem

Ans: a) Switch

7. A computer in a network that cannot be accessed outside of the local network without giving proper permission is called \_\_\_\_\_.
  - a) Intranet
  - b) Middleware
  - c) Internet
  - d) Modern

Ans: a) Intranet

8. A \_\_\_\_\_ device is used to connect multiple nodes in a network.



a) Hub      b) Repeater      c) Router      d) Modem

Ans: a) Hub

9. \_\_\_\_\_ is a device which seeks information on a network from server.

a) Client      b) Networking      c) Workstation      d) All of these

Ans: a) Client

10. Which one of the following network devices is the routing device?

a) Hub      b) Router      c) Both      d) None

Ans: b) Router

11. Which one of the following network devices is used to connect different networks?

a) Hub      b) Router      c) Switch      d) None

Ans: b) Router

12. Which one of the following network devices not provides security measures to protect the network?

a) Hub      b) Router      c) Gateway      d) Bridge

Ans: b) Hub

13. Which one of the following network devices is the broadcast device?

a) Hub      b) Repeater      c) Router      d) Modem

Ans: a) Hub

14. Which one of the following network devices is used to create a network?

a) Hub      b) Repeater      c) Router      d) Switch

Ans: d) Switch

15. Which one of the following network devices can work with similar networks?

a) Repeater      b) Router      c) Gateway      d) All

Ans: b) Router

16. A network allows to

a) Resource sharing      b) File Sharing      c) Fast communication      d) All

Ans: d) All

17. In a network, receiver end is known as \_\_\_\_\_

a) Client      b) Server      c) Workstation      d) All of these

Ans: a) Client

18. Select odd one:

- a) Client      b) Server      c) Communication Medium      d) None

Ans: d) None

19. A Gateway can be implemented as:

- a) Hardware      b) Software      c) Both a and b      d) None

Ans: c) Both a and b

20. A passive hub

- a) Broadcast signal      b) Amplifies Signal      c) Amplifies and broadcast      d) All

Ans: c) Amplifies and broadcast

### 15 Questions Assertion and Reasoning

Given below are two statements. One labelled as Assertion (A) and the other as Reason (R):

Choose the correct answer from the options given below:

- a) Both (A) and (R) are true and (R) is the correct explanation of (A)
- b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
- c) (A) is true but (R) is false
- d) (A) is false but (R) is true

1. Assertion (A): An Intranet is a private network for sharing computing resources and information within an organization

Reason (R): Intranet is a private version of the Internet.

Ans: b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

2. Assertion (A): On a computer network the users work on network nodes only.

Reason (R): A server cannot act as a network node.

Ans: c) (A) is true but (R) is false

3. Assertion (A): There is a difference between a standalone computer and a computer as a network node.

Reason (R): A standalone computer needs a special hardware NIC to be a network node

Ans: a) Both (A) and (R) are true and (R) is the correct explanation of (A)

4. Assertion (A): A server is a computer but not every computer is a server.

Reason (R): A computer having the capabilities to serve the requests of other network nodes is a server.

Ans: a) Both (A) and (R) are true and (R) is the correct explanation of (A)

5. Assertion (A): A router is more powerful and intelligent than hub or switch.

Reason (R): It has advance capabilities as it can analyse the data and decide the data is packed and send to other network.

Ans: a) Both (A) and (R) are true and (R) is the correct explanation of (A)

6. Assertion (A): A repeater is a device that amplifies the data.

Reason (R): A hub is a device which is used to connect more than one device in a network.

Ans: b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

7. Assertion (A): A gateway connects dissimilar networks.

Reason (R): Gateway establishes a connection between local and external networks.

Ans: a) Both (A) and (R) are true and (R) is the correct explanation of (A)

8. Assertion (A): An access point is a device that connects dissimilar networks.

Reason (R): Access point broadcast wireless signals.

Ans: d) (A) is false but (R) is true

9. Assertion (A): A protocol means set of rules to transfer data in a network.

Reason (R): Local area network is an example of protocol.

Ans: c) (A) is true but (R) is false

10. Assertion (A): Router transmits data in more efficient way.

Reason (R): Router maintains a routing table.

Ans: a) Both (A) and (R) are true and (R) is the correct explanation of (A)

11. Assertion (A): In computer networking, a MODEM is considered as both input and output device.

Reason (R): MODEM sends data and receives data at the same time.

Ans: a) Both (A) and (R) are true and (R) is the correct explanation of (A)

12. Assertion (A): Both Client and Server is required to establish a communication.

Reason (R): Server is more powerful than a client.

Ans: b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

13. Assertion (A): A switch is a broadcasting device.

Reason (R): A hub is also a broadcasting device.

Ans: b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

14. Assertion (A): A repeater accepts signals and amplifies and extend the network.

Reason (R): A repeater must always be installed when data has to transmit in long distance.

Ans: c) Both (A) and (R) are true and (R) is the correct explanation of (A)

15. Assertion (A): A hub is a broadcast device.

Reason (R): A switch in intelligent hub.

Ans: d) (A) is false but (R) is true.