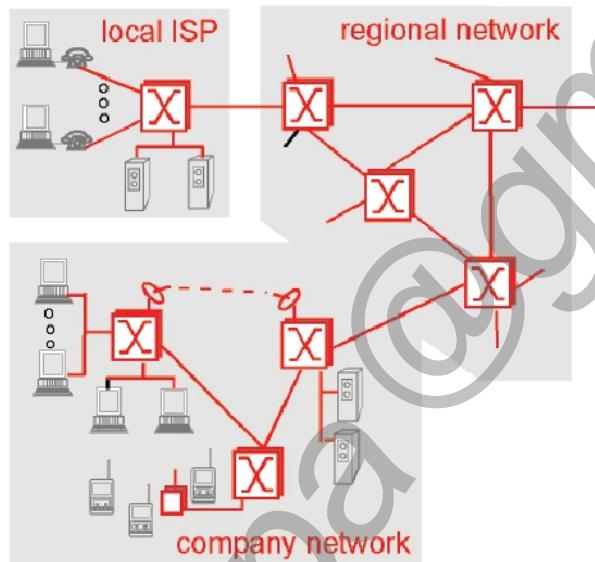


Chapter-1

Introduction to computer network

Introduction

- A collection of computers and other devices that are connected together by communication channel for sharing information and resources is called computer network.
- The resources may include file, folder, disk drive, printer, scanner etc.
- Internet is an example of computer network i.e. network of network is called internet.
- Two computers connected to the network can communicate with each other.
- Not all the nodes in the network are computers but are just network devices like switches, router etc. to facilitate communication.



Use/Applications of computer Network

- Exchange of information between different computers. (File sharing)
- Interconnected small computers in place of large computers.
- Communication tools (voice , video)
- In distributed applications (Railway reservation system, Distributed databases etc.).
- Communication in mobile computers, such as laptop and handheld computers is possible through wireless networking.

Advantages of Computer network

- Better communication: Using computer network, different people can communicate with each other all over the world. People can communicate at low cost via email, chatting, telephone, SMS etc.
- Better resource sharing: In computer network, resources such as printer, scanner, fax machine etc. can be shared among different users.
- Data / application sharing: in a computer network, any authorized user can access data and applications stored on other computer in network.
- Inexpensive: We can interconnect multiple small computers in place of one large computer to increase the cost/performance ratio.

Disadvantages of Computer network

- Network Hardware, Software and Setup Costs
- Hardware and Software Management and Administration Costs
- Undesirable Sharing
- Data Security Concerns

Network Model/Structure

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

- Personal Area Network (PAN)
- Campus Area Network(CAN)
- Country Area Network(CAN*)
- GAN

1. Local Area Network

- A LAN is privately owned network that operates within a single building like home, office, factory etc.
- A LAN is a computer network covering a small geographical area.
- LAN are perfect for sharing resources like printer, fax within a building but they can't connect distant sites.
- Wireless LAN is popular now a days in which wireless router act as access point.
- The standard for the wireless LANs is called **IEEE802.11**
- The standard for the wired LANs is **IEEE802.3** and popularly called as Ethernet.

2. Metropolitan Area Network

- A metropolitan area network (MAN) is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN).
- A metropolitan area network, or MAN, consists of a computer network across an entire city, college campus or small region
- A MAN covers a city like Cable television network.
- A MAN is often used to connect several LANs together to form a bigger network.
- Recently developments in high speed wireless internet access have resulted in another MAN, which has been standardized as IEEE 802.16 and popularly known as WIMAX.

3. Wide Area Network

- A WAN spans large geographical area, often a country or continent or entire world.
- In LAN, the hosts and subnets are owned and operated by a person or organization but in WAN, the hosts and subnets are owned and operated by different people or organizations
- The largest and most well-known example of a WAN is the Internet.
- WANs are used to connect LANs, MANs and other types of networks together, so that users and computers in one location can communicate with users and computers in other locations

4. Personal Area Network

- PAN let devices communicated over the range of a person i.e. less than 2 meters.
- A common example is a wireless network that connect a computer with its peripherals.
- A short range wireless network called Bluetooth helps to connect these components without wire.
- PANs also can be used to develop other technologies that communicate over short range such as RFID (Radio-Frequency Identification) on smart card.

5. Campus Area Network

- A MAN is often used to connect several LANs together to form a bigger network.
- When this type of network is specifically designed for a college campus, it is sometimes referred to as a campus area network, or CAN.

7. Global Area Network(GAN)

- A global area network (GAN) refers to a network composed of different interconnected networks that cover an unlimited geographical area.
- The term is loosely synonymous with Internet, which is considered a global area network.

Differentiate LAN, MAN and WAN.

DISTINGUISH BETWEEN LAN,WAN,MAN

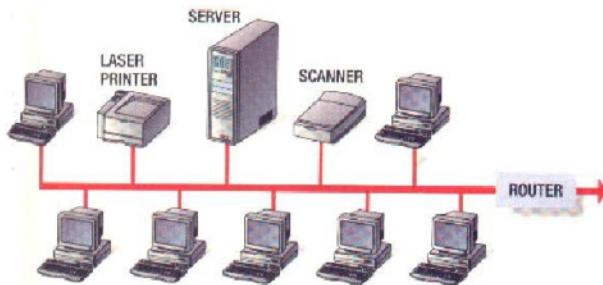
PARAMETERS	LAN	WAN	MAN
Ownership of network	Private	Private or public	Private or public
Geographical area covered	Small	Very large	Moderate
Design and maintenance	Easy	Not easy	Not easy
Communication medium	Coaxial cable	PSTN or satellite links	Coaxial cables, PSTN, optical fibre, cables, wireless
Bandwidth	Low	High	moderate
Data rates(speed)	High	Low	moderate

Network Topologies

- Topology is the **physical layout of network** or simply is the geometric arrangement of the computers in the network.
- The term topology refers to the way a network is laid out, either physically or logically.
- Physical topologies describe how the cables are installed.
- Logical topologies describe how the network messages travel.
- While physical topology refers to the way network devices are connected to cables and wires, logical topology refers to how the devices, cables and wires appear connected.
- There are seven basic topologies possible mesh, star, tree, bus, distributed bus, hybrid and ring.
- A consideration while choose topology is the relative status of devices to be linked.
- Two devices can be linked as peer to peer (all the devices share the link equally) or primary-secondary (one device control the traffic and the other devices must transmit through it).
- Tree and star are more convenient for primary-secondary network.
- Mesh and ring are more convenient for peer-to-peer network.

1. Bus Topology

- A bus is the simplest physical topology. It consists of a single cable that runs to every workstation.
- This topology uses the least amount of cabling, but also covers the shortest amount of distance.
- If one device wants to send data to another device on the network, it puts message addressed to that device on the bus.
- A single computer is allowed to send data at one time.
- Here all the computers are connected serially one after another, so data will flow through all the intermediate computers, so each computer receive the data, check the address and if the address enclosed in data doesn't match then the computer reject the data and like this data flows to the next computer and the process continues till the destination computer receive the data after matching the address or end of cable is encountered.
- As the number of computer increases, the speed of the network starts decreasing.
- Terminator is used to close the ends.



Advantage of Bus Topology

- The bus is simple, reliable in small network, easy to use and easy to understand.
- The bus require the least amount of cable to connect the computers together and is therefore is less expensive than other cabling arrangement.

Disadvantage of Bus Topology

- Computers can transmit at any time, and the computers on most bus network do not coordinate with each other to reserve times to transmit. So there is a chance of collision of data.
- The increase in number of computer decreases the speed of network considerably.
- A cable break or malfunctioning can bring the whole network down causing all network activity to stop.

2. Ring Topology

- Similar to bus except that the nodes are connected in a circle.
- First computer is connected to the last computer in the network.
- Each computer connects to two other computers, joining them in a circle creating a unidirectional path where messages move workstation to workstation.
- Each entity participating in the ring reads a message, then regenerates it and hands it to its neighbor until it arrives at its intended destination.
- This topology is found in peer-to-peer network



Advantages of Ring Topology

- The fair sharing of the network resources.
- Suitable for small network.

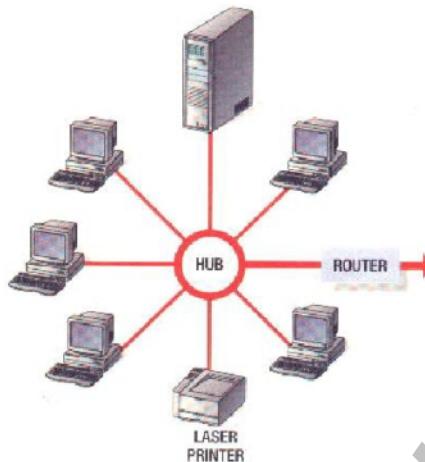
Disadvantages of Ring Topology

- Failure of one computer on the ring can affect the whole network.
- It is difficult to troubleshoot the ring network.
- Adding and removing computers disrupts the network.

3. Star Topology

- Each computer on star network communicate with the central hub that resends the message either to all computers (broadcast) or only to destination computer.
- The hub can be active or passive.

- An active hub regenerates the electrical signal and sends it to all the computers connected to it. This type of hub is also called as multiport repeater.
- A passive hub only act as connector point and doesn't amplify or regenerate the signal. This type of hub does not require electrical power to run.



Advantages of Star Topology

- It is easy to modify and add new computers to a star network without disturbing the rest of the network.
- Single computer failure do not bring down the whole star network.
- Troubleshooting is easy in star network as hub can detect the network failure.

Disadvantages of Star Topology

- If the central hub fails, the whole network fails to operate.
- Star network require additional device at the central point to rebroadcast.

4. Tree Topology / Clustered Star Topology

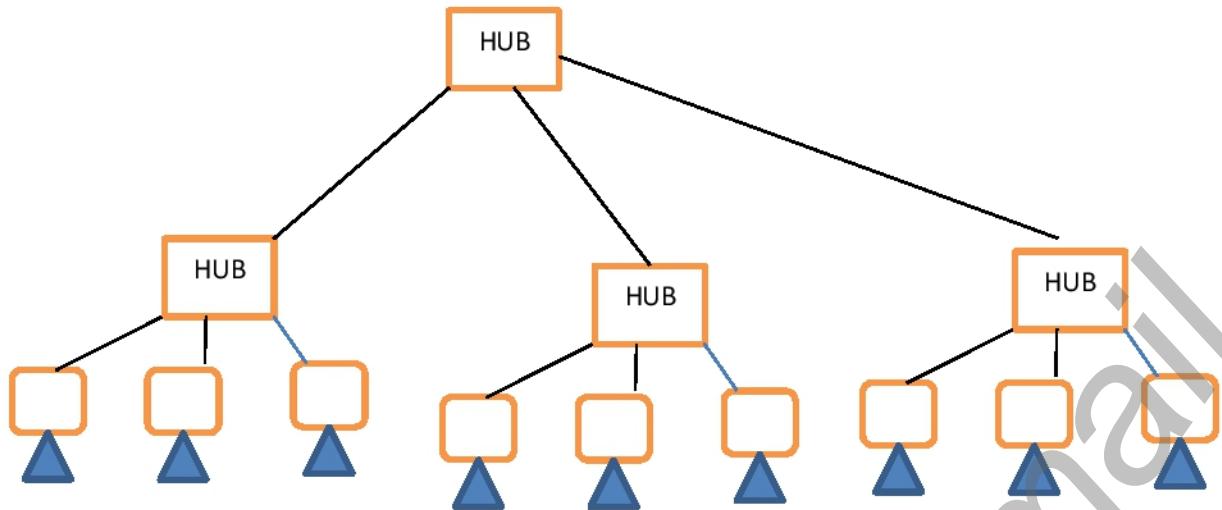
- It is a variation of star topology.
- As in the star nodes , tree are also linked to central hub that control the traffic to other network.
- However not every device connect directly to the central hub.
- The central hub in the tree is called active hub.
- Multiple star networks central hub (secondary hub), which may be active or passive, are connected to the active hub of the tree.
- A good example of tree topology can be seen in cable TV technology where the main cable form the main office is divided into many branch and each branch is divided into smaller branches and so on. The hubs are used when a cable is divide.

Advantages of Tree Topology

The advantages of tree topology is similar to that of star topology however the addition of secondary hub provides following advantages.

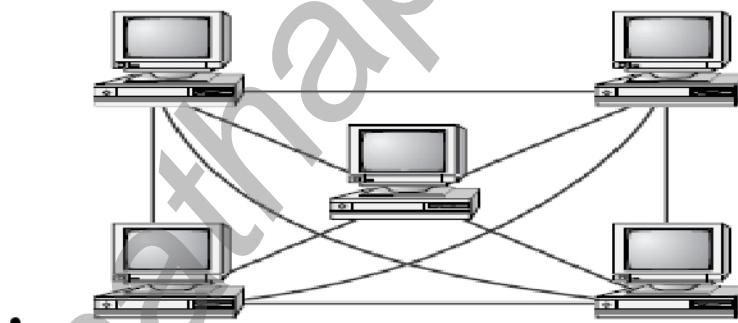
- It allows more device to be attached into a single central.
- Since the central hub is active, it increases the distance a signal can travel between the large number devices.
- It allow network to isolate and prioritize communications on different computer.





5. Mesh Topology

- The mesh topology is the simplest logical topology in terms of data flow, but it is the most complex in terms of physical design.
- In this physical topology, each device is connected to every other device.
- This topology is rarely found in LANs, mainly because of the complexity of the cabling.
- If there are N computers, there will be $(N \times (N-1)) \div 2$ cables in the network. For example, if you have five computers in a mesh network, it will use $5 \times (5 - 1) \div 2$, which equals 10 cables.
- The complexity of cabling is compounded when you add another workstation.
- Example: Internet is a mesh network



Advantage

- Cables must be run from each device to every other device. The advantage you gain from it is its high fault tolerance.
- With a logical mesh topology, however, there will always be a way of getting the data from source to destination.

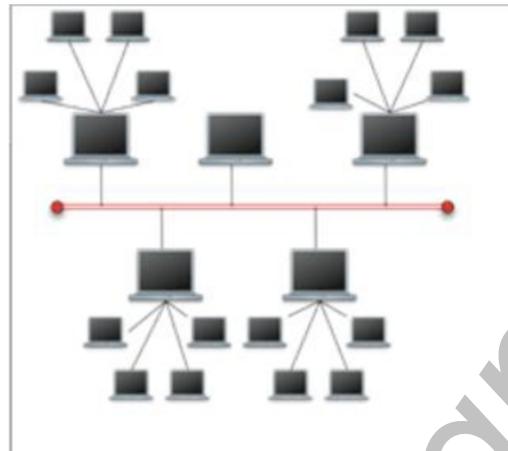
Disadvantages

- Lots of cable so the physical mesh topology is very expensive to install and maintain.
- Hard to setup
- Troubleshooting is extremely difficult

5. Hybrid Topology

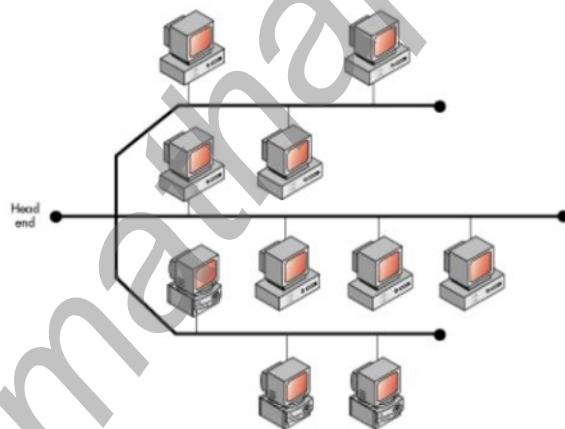
- Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies (e.g., bus, star, ring, etc.).

- A hybrid topology is always produced when two different basic network topologies are connected. One common examples for Hybrid network is Star bus network.
- A Star Bus network consists of two or more star topologies connected using a bus trunk (the bus trunk serves as the network's backbone).



6. Distributed Bus Topology

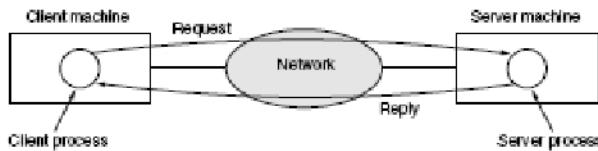
- In simple or linear bus topology, all the nodes of the network are connected to a common transmission medium which has exactly two endpoints.
- In distributed bus topology, all of the nodes of the network are connected to a common transmission medium which has more than two endpoints that are created by adding branches to the main section of the transmission medium.
- When the cable(trunk) branches, the division is made by means of a simple connector. This topology is susceptible to bottlenecking and single-point failure.



- The physical distributed bus topology functions is exactly the same fashion as the physical linear bus topology (i.e., all nodes share a common transmission medium).

Network Application Architecture/Model

1. Client server architecture



- In computer network, the computer that we use on daily basis are often called as host or end system.
- Host are further divided into two categories: Client and server
- So a network in which certain computers have special dedicated task, providing services to other computer in the network is called client server network.
- Client are basically low end system i.e. desktop or workstation while server are powerful machine that provides services to requesting client.
- In this architecture, the client process running on one end system request and receive information from server running on another end system.
- So client server model works on request response principle.
- Internet is based on client server architecture.

Advantage:

- Security
- Central data location
- Easy to administer when network is large
- Network performance can be monitored

Disadvantage:

- High cost due to central server
- Network administrator is required.
- If server is lost, data is also lost.

2. Peer to peer architecture

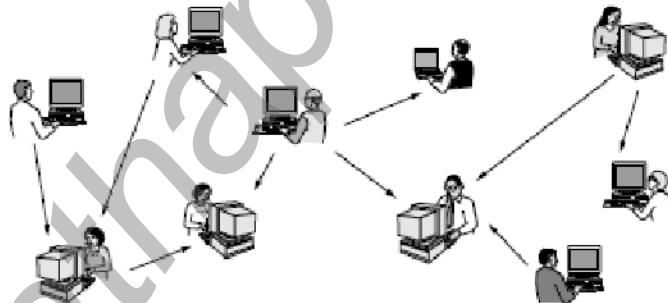


Figure 1-3. In a peer-to-peer system there are no fixed clients and servers.

- One of the simplest form of computer network is peer to peer network.
- Also called as p2p network.
- In this network, two or more end system are connected and share resources without going through a separate server computer.
- There is no dedicated server.
- The user at each workstation can decide which resources are shared on the network.
- In p2p network, all workstation are client and server at same time.
- Each workstation is connected with a simple and visible cabling system.
- The user then can administer their own computer and the resources they want to share on the network because each user is administrator of their own computer.
- However it is less secured because anybody in the network can access any shared resource.

Advantage:

- No need of central server, so is cheap.
- Sharing of data is easier.
- Backup of data.
- Shared administration.

Disadvantage:

- i. Insecure.
- ii. Complex of network is large.

3. Hybrid architecture

- Hybrid architecture are combination of p2p and client-server network.
- A common hybrid model is to have server that helps peers to find each other.
- This model provides better performance than both of the above model.
- One of the application that uses hybrid architecture is skype which used p2p for communication and also has centralized server as in client server model for finding address of remote party.

Assignment 1:

1. Explain briefly about Mobile Active network.
2. You are appointed as a Network Engineer of new multinational company. How you will choose the new Network topology for your organization?
3. Explain briefly about the intranet, extranet and internet.