CHAPTER 11

Computer Networks

Network

It is an interconnection of computers and other hardware devices like printers, scanners, etc using a communication medium.

Advantages

1) Resource sharing - Any hardware /software resource in one system can be shared with other systems in the network.

2) Price-performance ratio - The cost of purchasing licensed software for each computer, can be reduced by purchasing network versions of such software in a network.

3) Communication – The computer network helps users to communicate with any other computer in the network through its services like e-mail, chatting, video conferencing, etc.

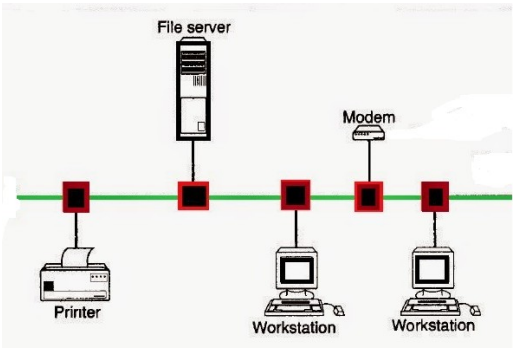

Fig 11.1 Computer Networks

4) Reliability- In a network, it is possible to backup data on multiple computers. This helps users to retrieve data in the case of failures in accessing data.

5) Scalability - Computing capacity can be increased or decreased easily by adding or removing computers to the network**.**

Some key terms

Bandwidth :

It measures the amount of data that can be sent over a specific connection in a given amount of time.

Noise:

It is unwanted electric or electromagnetic energy that lowers the quantity of data signals**.**

Node:

Any device which is directly connected to a network is called a Node.

Data communication devices:

A data communication device provides an interface between computer and the communication channel.

1) Switch:

- A switch is a device that connects several computers to form a network.
- It an intelligent device, because it can transmit the received data to the destination only.
- It will store the addresses of all the devices connected to it .

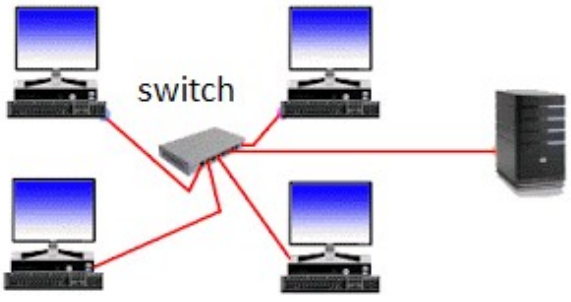

Fig 11.2 Switch

2) Bridge

- A bridge is a device used to segmentize a network.
- A network can be split into different segments and can be interconnected using a bridge.
- This reduces the amount of traffic on a network.

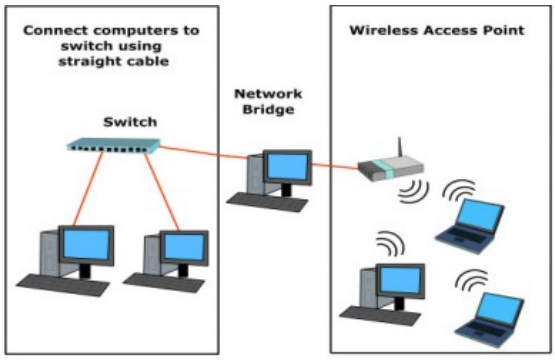

Fig 11.4 Bridge

3) Router

- A router is a device that can interconnect two networks of the same type using the same protocol.
- It can find the optimal path for data packets to travel and reduce the amount of traffic on a network.

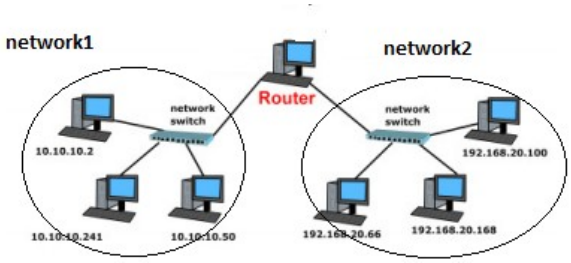

Fig 11.5 Router

4) Gateway :

- A gateway is a device that can interconnect two different networks having different protocols.
- It can translate one protocol to another.
- It can find the optimal path for packets to reach the destination.

Fig 11.6 Gateway

<u>Modem:-</u> It **is a Data Terminal Equipment** that controls data flowing to or from a computer.

- A modem is a device used for communication between computers through telephone lines.
- The name is formed from **modulator and demodulator**.
- It converts digital signals received from a computer to analog signals for telephone lines and vice versa.

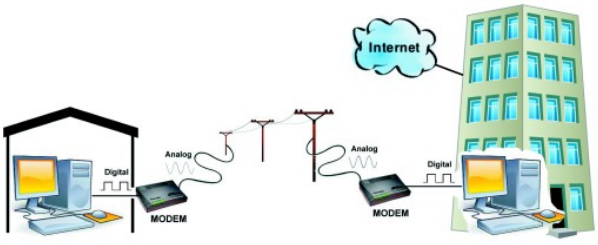

Fig 11.7 Modem

Network topologies Topology :

The way in which the nodes are physically interconnected to form a network.
Major topologies are bus, star, ring, and mesh.

1) Bus topology:

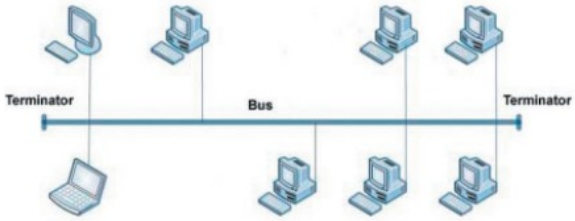

Fig 11.8 Bus topology

- In bus topology, all the nodes are connected to a main cable called bus.
- A small device called a terminator is attached to each end of the bus.

If a node has to send data to another node, it sends data to the bus. The signal travels through the bus and each node checks the bus and only the intended node will accept the data. When the signal reaches the end of the bus, the terminator absorbs the signal from the bus.

Characteristics of bus topology

1) Easy to install.
2) Requires less cable length and hence it is cost-effective.
3) Failure of a node does not affect the network.
4) Failure of cable (bus) or terminator leads to a breakdown of the entire network.
5) Fault diagnosis is difficult.
6) Only one node can transmit data at a time.

2) Star topology

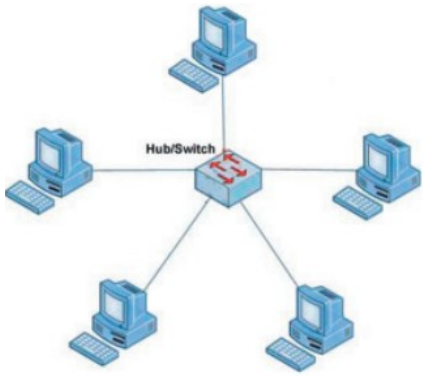

Fig 11.9 Star topology

- In star topology, each node is directly connected to a hub/switch.
- If any node has to send some information to any other node, it sends the signal to the hub/switch.
- The signal is then broad casted (in the case of a hub) to all the nodes but is accepted only by the intended node.
- In the case of a switch, the signal is sent only to the intended node.

Characteristics of star topology

1) More efficient compared to bus topology.
2) Easy to install.
3) Easy to diagnose faults.
4) Easy to expand depending on the specifications of the central hub/switch.
5) Failure of hub/switch leads to failure of the entire network.
6) Requires more cable length compared to bus topology.

3) Ring topology

- In ring topology, all nodes are connected using a cable that loops the ring or circle.
- A ring topology is in the form of a circle.
- Data travels only in one direction in a ring.
- Each node regenerates the signal and passes to the next node until it reaches the intended node reaches.

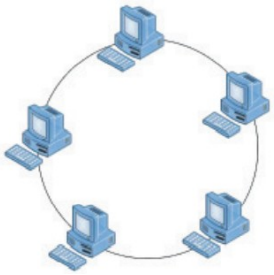

Fig 11.10 Ring topology

Characteristics of ring topology

1) No signal amplification is required as each node amplifies the signal.
2) Requires less cable length and hence is cost-effective.
3) If one node fails, the entire network will fail.
4) Addition of nodes to the network is difficult.

4) Mesh topology

- In mesh topology, every node is connected to other nodes.
- There will be more than one path between two nodes.
- If one path fails, the data will take another path and reach the destination.

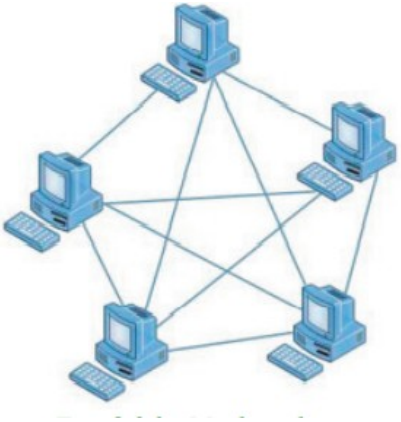

Fig 11.11 Mesh topology

Characteristics of mesh topology

1) Network will not fail even if one path between the nodes fails.
2) Expensive because of the extra cables needed.
3) Very complex and difficult to manage.

<u>Identification of Computers on a network</u>

1) Media Access Control (MAC) address:

i. A universally unique address (12 digit hexadecimal number) assigned to each NIC (Network Interface Card) by its manufacturer.
ii. MAC addresses are usually written in one of the following two formats:
iii. MM : MM : MM : SS : SS : SS or MM – MM – MM – SS – SS – SS
iv. The first half (MM:MM:MM) of a MAC address contains the ID number of the adapter manufacturer.
v. The second half (SS:SS:SS) of a MAC address represents the serial number assigned to the adapter (NIC) by its manufacturer.

eg. 00:A0:C9 : 14:C8:35

2) IP address:

i. An IP address is a unique 4 part numeric address assigned to each node on a network, for their unique identification.
ii. An IP address is a group of four bytes (or 32 bits) each of which can be a number from 0 to 255.

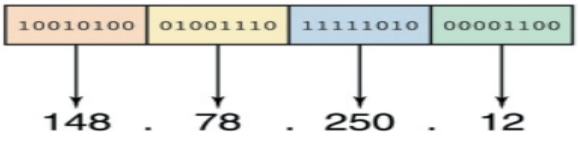

Fig 11.15 IP address

Questions

a) A---------- is a computer peripheral that allows you to connect and communicate with other computers via telephone lines.

b) In ----------topology, all devices are connected to a central hub/switch.

c) Explain any two advantages of computer networks.

d) There are many advantages in using networked computers instead of stand-alone computers. Write any four advantages of them.

e) Explain the functions of the network device **switch**.

f) Define the term, topology. Consider that, your principal has decided to network your computer lab. Which topology will you suggest? Justify your answer.

g) Compare ring topology and mesh topology.

h) Define following terms related to computer network

a) Bandwidth b) Noise c)Node