Unit	*INTRODUCTION TO*
09	*NETWORKS*

UNIT STRUCTURE

9.0 Learning Objectives :

In this unit, we will discuss about the computer networks :

➢ Learn What is network ? And advantages and disadvantages of networks.

➢ Understand how the computer networks can be classified.

➢ Know about types of networks.

➢ Understand various topologies of network.

9.1 Introduction :

Initially, when the computers were invented, they were used as standalone machines. Different computers were used for gathering of information, data

processing and obtaining information. Due to change in technology, and rapid growth in the area of information gathering and distribution, connection between computer devices become an essential need. In this unit we will define the term called 'network'. We will also discuss the advantages and disadvantages of it. We will see different types of network.

9.2 What is a Network ?

Two or more devices connected to each other using some media, to share the information (data transfer purpose) or to share resources (the hardware devices) is called network. Networking can be done of any devices. You may have observed that our telephones or mobiles are connected in the network called telephonic or mobile network. Our television sets are connected with the network so that we can view different channels in it. The connection(s) between two or more computing devices to share data or resources is called computer networks.

In order to meet various requirements and needs, different types of applications, different protocols, media and layout plans are used in the networking. Networks can be classified on the basis of its geographic coverage.

9.2.1 Advantages of Computer Networks :

We have defined the term computer networks as – Two or more computing devices are connected to each other to share data or resources is called computer network. But one question will come into your mind that why should we have to connect computing device ? What benefits are getting after connecting two or more computing devices ? So, here we have given a list of advantages to have a computer network.

1. **Data Sharing :** Computer networks are useful to share data or information from one machine to another. We can transfer the data whether it is an image, audio, video, text message or any type of files like document, PDF, spread sheet or presentation from one computer to another computer, if the machines are connected to each other in the network.

2. **Resource Sharing :** You can share the hardware resource like CD–ROM, Printer or hard disk drive of a one computer to another computer if both computers are in the network. You can give a printout from one terminal to the printer attached with another terminal if both terminals are connected with each other, and printer is shared in the network.

3. **Sharing Internet Connection :** With the help of network, you can also share an Internet connection of one machine to another machines.

4. **Increase Storage :** If the machines are connected with each other in the network, you can store your data on the hard drive of any machine.

5. **Reliability of Storage :** If the computers are connected in the network, it allows you to take back of the data of one system to any other system. So, if hard–drive of one machine goes out of order you can recover your data from another machine.

6. **Communication :** If the machines are connected in the network then users can communicate with each other by exchanging text messages (chat) or Email.

❑ **Check Your Progress – 1 :**

1. —————— is/are essential for computer networks.

   [A] Applications   [B] Protocols   [C] Media   [D] All of the above

2. From the given below, which not advantage of computer network ?

   [A] Data sharing   [B] Communication

   [C] Privacy   [D] Resource sharing

9.2.2 Limitation of Computer Networks :

Even though, computer network serves many advantages, there are some limitations are also there. The limitations of computer network are described below :

1. **Cost :** To create a computer network, we need to buy UTP (Unshielded Twisted Pair) cables, connectors, network adapters, Hub/Switches etc. Cost is involved in the purchase of all these essential networking devices.

2. **Privacy :** When computers are connected in the network, then Privacy of the user is the biggest issue. If the proper security is not maintained then someone can access your personal data without your permission.

3. **Needs Trained Employees :** Managing a large network is complicated. To manage such network and networking equipment trained staff is required.

4. **Viruses and Other Threats :** If the machines are connected in the network then it is essential to implement proper security. If security concerns are implemented properly then hacker can hack the system and damage the system or data. If any one machine of the network is virus infected, then it may infect other machines of the network.

9.3 Classification of Networks :

As we have seen, two of more computing devices are connected with each other will make computer network. Depending up its geographic coverage network can be divided into three main categories.

   [1]   LAN : Local Area Network

   [2]   MAN : Metropolitan Area Network

   [3]   WAN : Wide Area Network

9.3.1 LAN : Local Area Network :

A Local area network is privately owned, relatively smaller network. The span of the Local Area Network is maximum 10 km. It is used to provide local connectivity within premises or building in a small geographic area. Local Area Network connects two or more computing devices using Ethernet or Wi–Fi technologies. Computers connected within a building or premises or nearby buildings are examples of LAN.

9.3.2 MAN : Metropolitan Area Network :

A MAN is defined for the geographic area which is lesser than 50km. It provides regional connectivity typically within a city or between two cities. Cable TV is an example which connects television sets of a city is a good example of Metropolitan Area Network. MAN covers more geographic area compare to LAN. Companies may create MAN to connect, various LANs of different departments.

9.3.3 WAN : Wide Area Network :

Wide Area Network does not restrict to any geographic boundaries. A WAN provides transmission of data, voice, image and video information at a very long distance. Internet is an example of Wide Area Network which cover entire globe. WANs may utilize public, leased or private communication devices usually in combination and span unlimited number of miles.

Now a days another term called PAN becomes popular. PAN stands of Personal Area Network. In a Local Area Network Wi–Fi (Wireless Fidelity) technology may be used, which is based on Radio transmission. But if you connect two devices with the help of Bluetooth technology to transfer data from one computing device to another, then is called Personal Area Network. Bluetooth produces very short–range signals, which may used to connect your wireless ear buds, wireless neck band, wireless headphones or fitness band with your mobile devices. Using PAN, you can connect your mobile phone with your friend's mobile phone to transfer any file using Bluetooth technology.

❑ **Check Your Progress – 2 :**

1. _____ is a smallest network, uses Bluetooth technology to transfer data.

   [A] LAN   [B] MAN   [C] WAN   [D] PAN

2. A _____ is a small network, connect all computing devices of a building or premises.

   [A] LAN   [B] MAN   [C] WAN   [D] PAN

3. Internet is an application of _____.

   [A] LAN   [B] MAN   [C] WAN   [D] PAN

9.4 Types of Networks :

There are mainly two types of networks based on that network contains any switching elements or not. These types are : [1] Point–to–Point network and [2] Broadcast network.

9.4.1 Point–to–Point Network :

Point–to–Point is a simplest type of network where two computers or two routers or computer and routers are directly (without any host or networking device) connected. To send the packets from source machine to destination machine, a packet on point–to–point network must have to first visit one or more intermediate machine or router. When the packet is sent by the source machine to the destination machine, each intermediate router between source and destination machine stores the packet. Intermediate routers keep packets into their local memory till the outgoing line towards the destination doesn't becomes free. When the outgoing line towards the destination becomes free, router transmits the packets stored in the memory on a proper outgoing line. In a point–to–point network router transmit the packet on single optimal outgoing line towards the destination and not forward the packets on all outgoing lines. A subnet using this principle is called point–to–point or packet switched network.
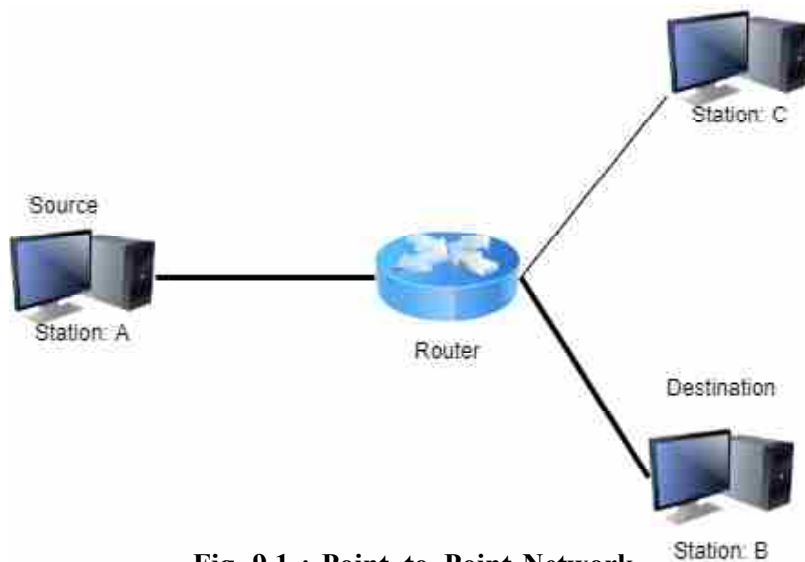
Fig. 9.1 : Point–to–Point Network

In the Figure 9.1 suppose Station : A is a source and it want to transmit the data to Station : B (Destination). When packet arrives from Source : A to the Router, Router will redirect the packet on particular outgoing line which is connected with Station : B. Here, Station : C will not receive any packet, but packets will be propagated from Station : A to Router, and then Router to Station : B in point–to–point manner.

9.4.2 Broadcast Networks :

In a broadcast network a single channel is shared by all the stations (machines) of the network. Packets are sent by any station are sent to all other stations. Destination machine when receive the packet it will accept it and rest of the machines are also receiving the same packets but they will simply ignore it as the packet is not intended to them.

There will be address fields are there in the packet. Before transmitting the data, source machine specifies the addresses of source and destination machine. When the packet is broadcasted, then it will all other stations will receive the broadcasted packet. Every station then matches their addresses with the destination address placed by a sender node. Destination machine will accept the packet as its address match with destination address field of packet. Other machines will simply ignore the packet.

Usually when the networking device HUB is used, it broadcast the packet arrived from a source machine, to all the ports. Compare to point–to–point, Broadcast is less secure.
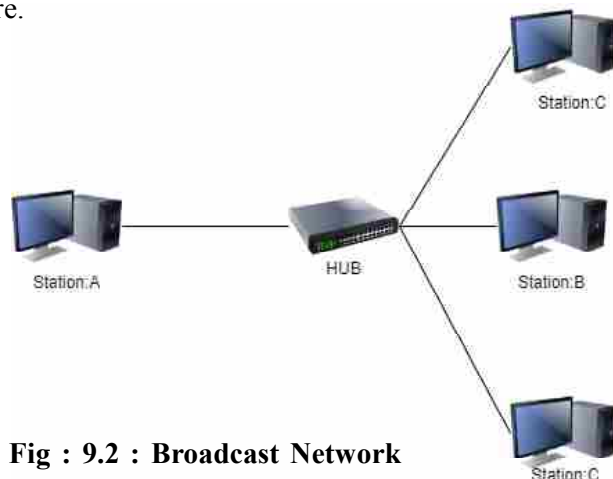
Fig : 9.2 : Broadcast Network

As shown in the Fig. 9.2 if station : A transmits the data for station : B, HUB will accept the packets from station : A. HUB then now forward the data to all the stations. Station : B, will accept the data and other stations will ignore the data packets.

❑ **Check Your Progress – 3 :**

1.   Networking device HUB use, _____ data transmission method.

[A] Unicast   [B] Broadcast

[C] Point–to–Point   [D] None of the above

2.   In a Point–to–Point network, data packets transmitted by source machine, will be forwarded to all the machines of the Network [True / False].

3.   _____ networking device is used for Point–to–Point data transmission.

[A] Router   [B] HUB

[C] Both [A] and [B]   [D] None of the above

9.5 Topologies :

Network topology is a method of arranging networking devices physically or logically into the network. Topology defines how the network devices are arranged into the network, or we can say it is a physical layout of the network. Different topologies are suggested for the network. In this section we will discuss each topology in detail.

9.5.1 Star Topology :

In a start topology each device has a dedicated point–to–point link, with the central controller. The central controller can be either HUB or Switch. In star topology if one machine transmits the data to the other machine, then the data must pass through HUB or switch placed between them. If one or two machines are out of order, it doesn't make any change in the network. Other machines can function in the network in a natural way. If the central controller goes out of order then, obvious entire network will stop functioning. More cabling is needed in the star topology, as there is dedicated cable has to be installed from each machine to central controller. Start topology you can find in the computer laboratories.
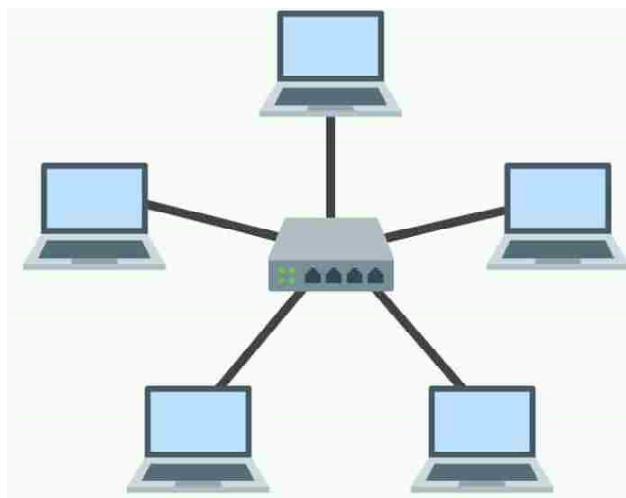
Fig. 9.3 : Star Topology

9.5.2 Bus Topology :

Bus topology is multipoint configuration–based topology. One long, thick cable will act as a backbone of the entire network. All other devices are connected with this backbone cable directly using special connectors. The main advantage of this topology is, it uses less cabling and hence it is cost effective. The problem with this topology is : It is less reliable. If the problem occurs with the backbone cable then entire network goes out of order. Another drawback of this topology is that, data will be transmitted from source to destination only though backbone cable, therefore the speed will be reduced as in heavily loaded network much congestion will occur in the backbone cable. Bus topology is less secure as data transmitted by one machine will be broadcasted to all other machines of the network.
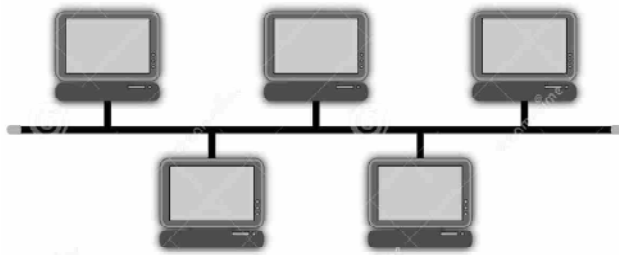

Fig. 9.4 : Bus Topology

❑ **Check Your Progress – 4 :**

1. _____ topology is used in the computer laboratory of your study centre.

   [A] Star   [B] Ring   [C] Mesh   [D] Bus

2. In _____ topology minimum cable is used.

   [A] Star   [B] Ring   [C] Mesh   [D] Bus

3. In _____ topology hub or switch is used.

   [A] Star   [B] Ring   [C] Mesh   [D] Bus

9.5.3 Ring Topology :

Ring topology is similar to the bus topology, in which each device has a dedicated point–to–point connection. A signal is passed in the ring (a ring–shaped backbone cable) in one direction from machine to machine, until it reaches to its destination machine. Each machine in the ring also works as a repeater (which is strengthen the weaker signal). When a receiver machine finds that the packet is for some another machine, they will regenerate the same fresh and strong signals and passes to its neighbour. A ring topology is easy to install and reconfigure. Each machine is linked to its immediate neighbours.
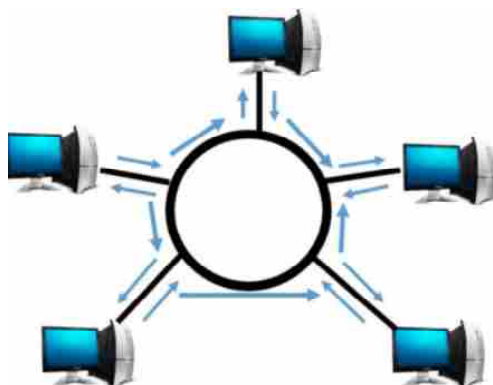

Fig. 9.5 : Ring Topology

IBM (International Business Machines) company has proposed ring topology. Token passing mechanism is used in the ring topology to transmit the data. The advantages of ring topology are, it is cost effective and use less cabling. The disadvantages are, the traffic will move only in one direction through a backbone cable. It is less secure as all the intermediate machines between sender and receiver can access the transmitted data.

9.5.4 Mesh Topology :

In Mesh topology each machine is connected with all other machines via dedicated point–to–point line. Therefore, huge amount of cabling is needed in the mesh topology. Each machine needs n–1 ports, if the network has n number of machines. For example, in a mesh topology network, if 6 machines are there, then in each machine 5 network IO ports are needed. It is very costly as more hardware are needed to implement mesh topology. There is no central controller is available in the mesh topology. In fact, it is not possible to implement mesh topology because of high cost and hardware required in its implementation, it has many advantages. It is faster as each pair of machines are communicating with their dedicated link. It is more reliable as one or two links goes down; the machines can communicate via some other intermediate machines. It is highly secure as the data of source machine is directly transmitted to the recipient machine, without any intermediate machine.
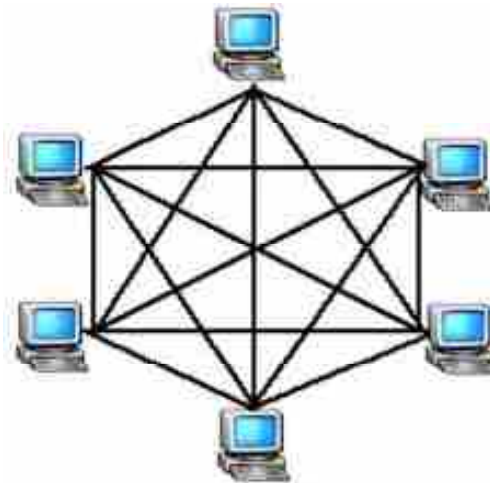
Fig. 9.6 : Mesh Topology

9.5.5 Hybrid Topology :

Hybrid topology is actually a mixture of any two or three topology discussed above. Suppose, in a building separate LANs are there in a star topology in each floor. Now if all star topology network we connect with a single backbone cable, then it will be a mixture of bus topology and star topology. Such type of topology in which we have used two or more different topologies is called Hybrid topology.

❑   **Check Your Progress – 5 :**

1.   _____ topology has been proposed by IBM.

   [A] Star   [B] Ring   [C] Mesh   [D] Bus

2   _____ topology is costly but more reliable, faster, highly secure.

   [A] Star   [B] Ring   [C] Mesh   [D] Bus

3. In _____ topology data is transmitted using token passing mechanism.

   [A] Star   [B] Ring   [C] Hybrid   [D] Mesh

4. _____ topology is a combination of two or more topologies.

   [A] Star   [B] Ring   [C] Bus   [D] Hybrid

9.6 Let Us Sum Up :

In this chapter we have discussed the term 'Network' and 'Computer Network'. We have seen the advantages and disadvantages of network. We have learnt how networks are classified into PAN, LAN, MAN and WAN. Then we have seen, that network can be of type : [1] Point–to–Point and [2] Broadcast. After discussing different types of networks, we have seen various topologies of the network. Topologies represents physical and logical layout of network. We have discussed Star, Bus, Ring, Mesh and Hybrid topologies with their advantages and disadvantages.

9.7 Glossary :

PAN : Personal Area Network. It a smallest network in which computing devices are connecting with each other using Bluetooth wireless technology.

LAN : Local Area Network. It is a small network spread within campus, or building or two nearby buildings. It uses either Ether or Wi–Fi technology.

MAN : Metropolitan Area Network. It can cover city or nearby two cities.

WAN : Wide Area Network. It can cover a county, region or entire world. Internet is an application of WAN.

Wi–Fi : Wireless Fidelity. It is a wireless data transfer technology of network, which uses high frequency of Radio signals to transmit the data.

9.8 Suggested Answers For Check Your Progress :

❑   **Check Your Progress 1 :**

   1. [D]   2. [C]

❑   **Check Your Progress 2 :**

   1. [D]   2. [A]   3. [C]

❑   **Check Your Progress 3 :**

   1. [B]   2. False   3. [A]

❑   **Check Your Progress 4 :**

   1. [A]   2. [D]   3. [A]

❑   **Check Your Progress 5 :**

   1. [B]   2. [C]   3. [B]   4. [D]

9.9 Assignment :

1. Write a short note on Network Classification.

2. What is topology ? Explain following topologies in brief.

   • Bus topology

   • Star topology

   • Ring topology

- Mesh topology
- Hybrid topology

3. Explain Point–to–Point network and Broadcast network in detail.

9.10 Activity :

1. Define the following terms :

- Sender
- Recipient
- Message
- Media
- Protocol

9.11 Case Study :

Make a small note OSI layer mode of computer networks. Make a list of all 7 layers and write the functionality performed by each OSI layer in details.

9.12 Further Reading :

1. Computer Fundamentals by P.K.Sinha and Priti Sinha.

2. Discovering Computers 2016 by Shelly Cashman Series. CENGAGE publications.

3. Computer Fundamentals by Pearl Software, Khanna Book Publishing.

4. Computer Networks by Tanenbaum, Prentice–Hall India Publications.