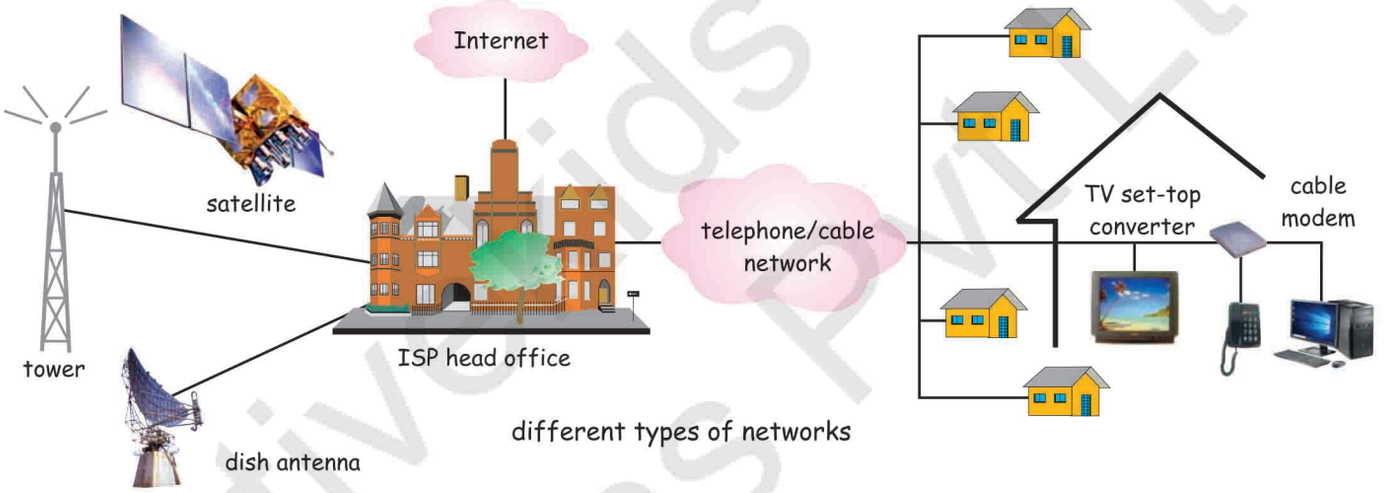
CHAPTER 1

COMPUTER NETWORKS

INTRODUCTION

A network is a group of devices connected to one another, allowing the exchange of data with each other. **Cable** networks, **television** networks and **telephone** networks are some examples of networks.

A network ties things together. When we create a network of different devices, it is called **networking. Networking** allows the inter-connection of various devices to share their resources.



different types of networks

COMPUTER NETWORK

A **computer network** is a collection of computers and peripheral devices (collectively known as network components) connected by communication links.

In order to establish a computer network, we need at least two or more computers and some other devices. These devices are inter-connected using a communication medium such as a wire.

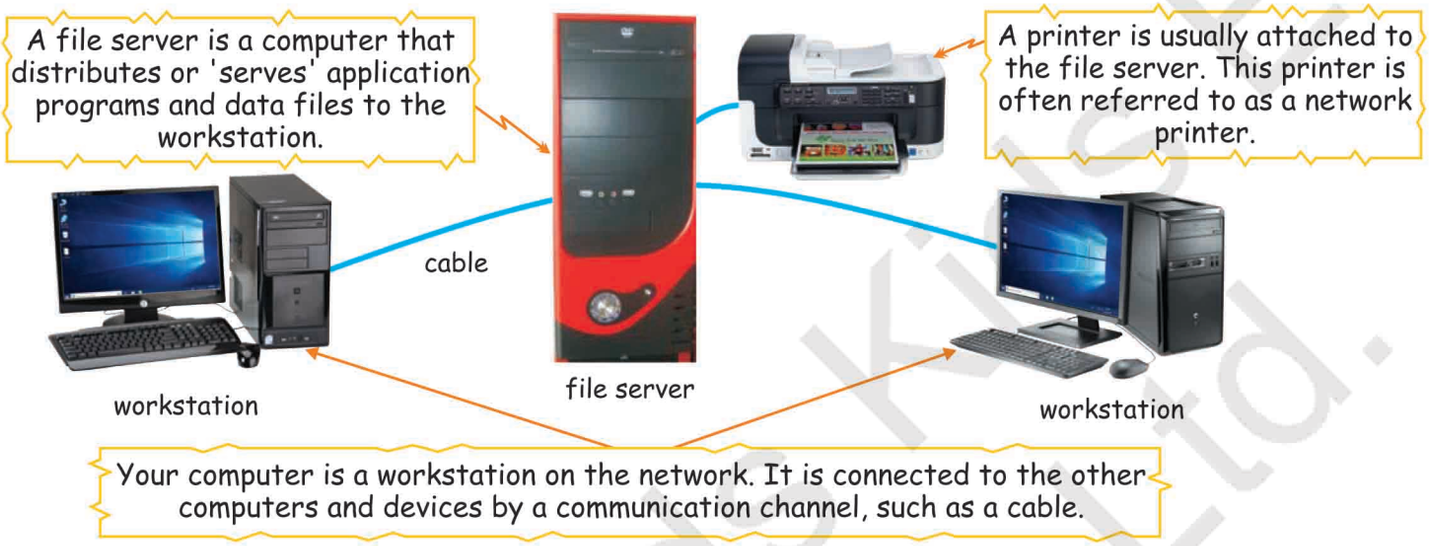
The communication mediums or links allow the network components to work together. The network components may be located at remote locations or within the same building.

Remember

1. A file server is a computer connected to a network, responsible for services or distributing files to the network users.
2. Network resources include disk storage space, printer and other peripheral devices available on a network.

CREATING A COMPUTER NETWORK

A network can be of any size. For example, a small network is created by connecting two computers for sharing files.



A network connects millions of computers all over the world to exchange information. Internet is the world's largest computer network.

Practice Time

(Experiential Learning)

1. Visit the computer lab in your school and closely examine the computer network there.
2. Prepare a list of the number of computers and other peripheral devices connected to the network.

COMPONENTS OF DATA COMMUNICATION

- **Message:** Message is the data that is exchanged between the sender and the receiver. It can be in the form of text, audio, video or a picture.
- **Sender:** While sending data or a message, there must be a machine that acts as a sender, that is generally a computer, mobile phone or a node that sends data in the network.
- **Receiver:** To receive a message sent by the sender, there must be a receiver. It can be a computer or a mobile phone.
- **Communication Medium:** It sets a link between the sender and the receiver. It is a physical path by which the message travels. It can be twisted pair cables, coaxial cables, optical fibre cables, radio waves or satellite.
- **Protocol:** Protocol is a set of rules that governs the data communication between the sender and the receiver.

Multiple Choice Questions

1. Computer network is a ..... .
   (a) group of computers linked to each other
   (b) collection of hardware components and computers
   (c) packet that distributes application programs
2. ..... is a physical path by which message travels.
   (a) Protocol (b) Network
   (c) Communication medium

NETWORK BENEFITS

It has been discovered that there are several benefits of connecting the computers together. The network benefits the users by increasing productivity, lowering the costs and much more.

Ease Of Access

The network stores most of the information on the **central computer**. Storing information on one or two central computers makes it easy for people to work with their files. It also helps people to manage their files.

A network allows people to access their information from other computers on the network.

Work From Home

The network has dedicated computers that allow people to connect to the company's network using a modem.

Once users are connected to the network, they work with any data available on the network. The network makes it easy for people to access office information from home.

Sharing Resources

The computers connected to a network, share equipments and devices including printers and hard drives. These equipments and devices are called **resources**. The ability to share resources **reduces the cost** of buying computer hardware.

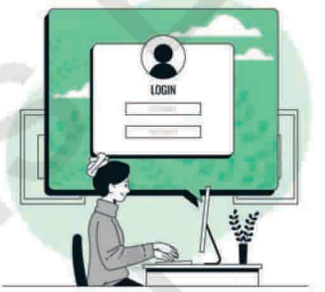
Sharing Information

You use a network to exchange information with other people. Information may be in any form of data, such as documents created in a word processing program or information provided by the school database. This also increases **productivity**.

Sharing Programs

Most of the people who are connected to a network, use a central computer to work with different programs such as word processors and spreadsheets. The network makes installing programs simpler as only one copy of a program needs to be installed on a central computer.

Security



Before accessing information on a network, users must enter a **username** and a **password**. This ensures that only authorised people use the information stored on the network. Username and password allow the network administrator to keep track of everyone who uses the computer on a network.

NETWORKING MEDIA

Networking media is also known as **transmission media** through which data is transferred. There are two types of networking media:

Wired Media

The wires connect computers and resources with a network. Different kinds of cables are used, depending on the type and size of the network. The type of cable used, often determines the speed of the network, i.e., how quickly the information travels through the network to reach its destination. Some networks may require several miles of cables.

Some of the wired media are: **Twisted pair cable**, **Coaxial cables**, **Optical fibre cables**.

twisted pair cable

coaxial cable

optical fibre cable

Wireless Media

Wireless means there is no physical path for the signals (data) to move. Wireless communication is one of the biggest contributions to humankind. It involves sending and receiving information over a distance without using wires or cables. It is also known as **unguided media**.

Some of the wireless media are: **Bluetooth**, **Infrared** and **WiFi (Wireless Fidelity).**

TYPES OF NETWORKS

There are various types of computer networks. Generally, the following types of networks are used:

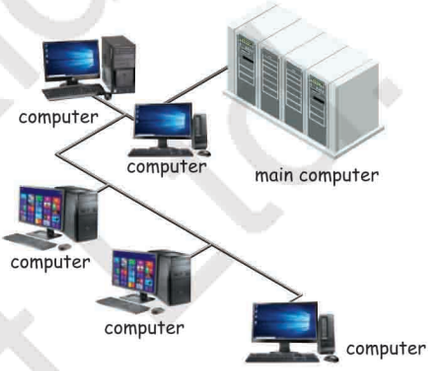
Personal Area Network (PAN)

A **Personal Area Network** is a computer network that communicates among various electronic devices such as the personal computers and mobile phones in a close range. The area of a PAN is typically a few meters.

Personal Area Network

Local Area Network (LAN)

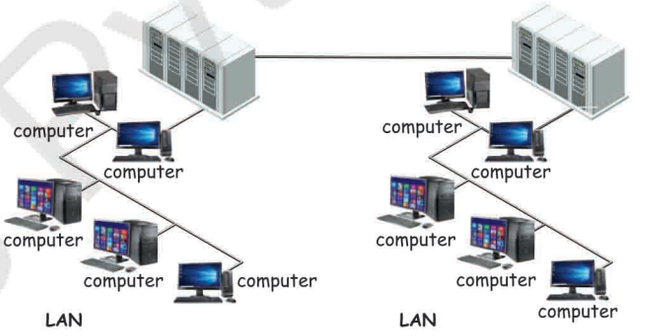
A **Local Area Network** is the most common type of network. A LAN connects computers and devices located close to one another, such as many computers in one building. Usually, this type of network does not consist of more than 100 computers. For example, computers connected in an office.



Local Area Network

Campus Area Network (CAN)

A **Campus Area Network** is a computer network made of an inter-connection of two or more Local Area Networks (LANs) within a limited area. This type of network is larger than a Local Area Network but smaller than a Wide Area Network (WAN).



Campus Area Network

Metropolitan Area Network (MAN)

A **Metropolitan Area Network** is also a collection of Local Area Networks. It connects computers located in the same geographical area such as a city or a town. For example, branches of a local bank in a city.

Metropolitan Area Network

Wide Area Network (WAN)

A **Wide Area Network** connects LAN and MAN together. The networks that make up a Wide Area Network, may be located throughout a country or even around the world. For example, Internet and ATM facility.

Wide Area Network

NETWORK TOPOLOGY

The art of connecting different computers in a network is known as **topology**. The term **network topology** refers to the way in which the nodes (computer or other devices that need to communicate) of a network are linked together. It determines the data paths, that may be used between any pair of nodes in the network.

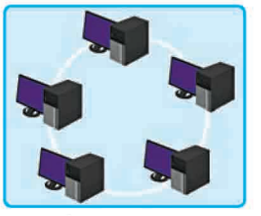
There are four basic network topologies: **star topology**, **ring topology**, **bus topology and mesh topology**.

Star Topology

In a **star topology**, all nodes are connected to a central system called **switch**. It forwards data towards its final destination. The switch controls the communication on the network.

Advantages Of Star Topology	Disadvantage Of Star Topology
❖ It has minimal line cost. ❖ If any of the local computers fails, the remaining portion of the network remains unaffected.	❖ The system entirely depends on the central switch. If it fails, the entire network goes down.

Ring Topology

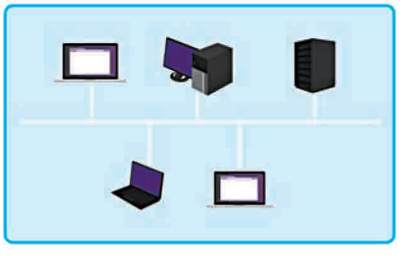


In a **ring topology**, all nodes are connected in a closed loop so that each device is connected to two other devices, one on either side. The computers in a ring topology are connected in the shape of a **closed ring**.

Data travels only in one direction in a ring topology. Each computer passes the data to the next one on the line automatically.

Advantages Of Ring Topology	Disadvantages Of Ring Topology
❖ It works well where there is no central-site computer system. ❖ It is more reliable than the star topology.	❖ It requires more complicated control software. ❖ Failure of one node results in the failure of the entire network.

Bus Topology



In a **bus topology**, all the nodes are connected to a central cable called **bus**. In this topology, a bus is a single continuous cable. Transmission from any node travels the length of the bus in both directions and is received by all the other nodes in the network. The bus has **terminators** at either end that absorbs the signal, removing it from the bus.

Advantages Of Bus Topology	Disadvantages Of Bus Topology
❖ It is quite easy to set up. ❖ Failure of one node does not affect the rest of the network.	❖ It offers limited flexibility for change. ❖ A signal on the bus must be strong enough to reach the receiver.

Mesh Topology

In a **mesh topology**, all nodes are interconnected with one another, allowing each node to have a direct connection with other nodes in the network.

Advantages Of Mesh Topology	Disadvantages Of Mesh Topology
❖ Failure of one node does not affect the rest of the network. ❖ Communication is very fast between any two nodes. ❖ Changes in the network are done easily without interrupting other nodes.	❖ It is the most expensive network as there are many redundant connections. ❖ Maintenance of this network is very difficult.

Multiple Choice Question

In a ..... topology, all nodes are interconnected with one another, allowing each node to have a direct connection with other nodes in the network.

(a) star ☐ (b) ring ☐ (c) mesh ☐

Remember

1. A node is a computer or any other device on a network that communicates with other devices.
2. The way in which the nodes of a network are linked together is called topology.

NETWORKING DEVICES

For the smooth functioning of networks, many devices play an important role. Let us discuss a few of them.

MODEM: A MODEM (Modulator-Demodulator) is an electronic device that enables a computer to transmit data over telephone lines. This device converts the digital signals into analog signals and vice versa.

modem

Hub: A hub is a hardware device that is used to connect several computers together. It provides a central connection point for cables from nodes, servers and peripherals. When a hub receives the data packet, it transmits those data packets to all the connected devices.

hub

Switch: A switch also connects computers on a network like hub. But, it sends the data packets only to the intended receiver.

switch

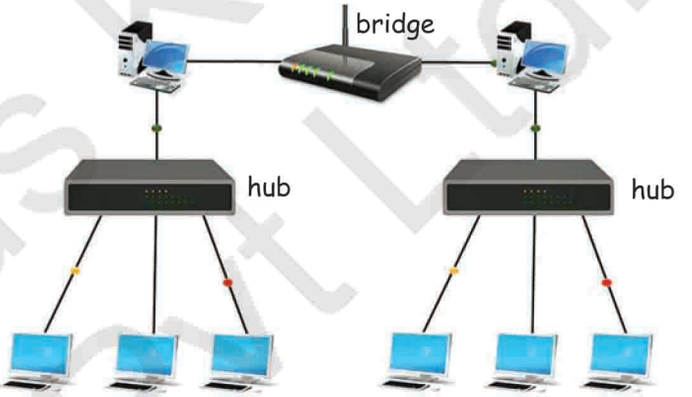
Router: A router is a communication device that is used to connect two networks, such as two LANs. It is used to forward data packets from the source machine to the destination machine by using the shortest path.

router

Gateway: A gateway is a device that connects dissimilar networks.

gateway

Bridge: A network bridge is a computer networking device that creates a single aggregate network from multiple communication networks.



a network bridge

Laughter Time

Arun : Why do you think Jack and Jill went up the hill?

Tia : I think they went in search of a better WiFi.

NETWORKING TERMINOLOGY

Intranet

An Intranet is a set of interconnected networks forming the internal network within a company or an organisation. For example, the people of Indian Railways are connected to a network that cannot be accessed by someone outside the network.

Internet

Internet is a network of networks. It consists of millions of smaller networks worldwide. It is publicly accessible and transmits data using the standard Internet Protocol (IP).

Bandwidth

Bandwidth is defined as the amount of data that can be transmitted in a fixed amount of time. The bandwidth is usually expressed in bits per second (bps), bytes per second (Bps), kilobytes per second (kbps) and megabytes per second (mbps).

Internet Service Provider (ISP)

ISP is a company that provides services for using Internet. You have to pay a monthly fee in order to use Internet.

Website

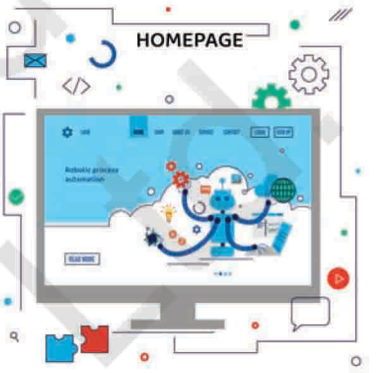
It is a collection of related web pages to provide information about many things such as a person, business organisation, education or games. A website is like a book that contains many pages.

Web Portal

A web portal is a specially designed website that brings information from different sources like e-mails, forums and search engines, together in a uniform way. Examples of a web portal are Yahoo, Lycos and Microsoft Network.

Web page

It is a part of a website. It is stored in an electronic form on a computer connected to Internet.



Home Page

Every website has a main page. This is the first page that appears when you open a website. This main page is called the home page.

Link

A link in data communication is the medium of connecting one location to another for the purpose of transmitting and receiving digital information.

Hyperlink

A web page contains many things besides text and pictures. It also contains hyperlinks. A hyperlink can be an image, audio, video, graphics or text that connects one web page to another web page. It is also used to connect two sectors within the same web page.

Practice Time (*Experiential Learning*)

Open the website of your school. List any five hyperlinks.

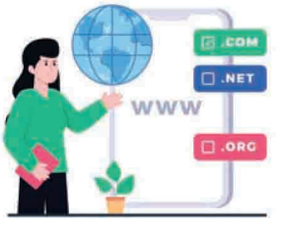
Hypertext

Hypertext is a text that includes text and hyperlinks to related texts. The term Hypertext was coined by Ted Nelson.

Uniform Resource Locator (URL)

A URL (Uniform Resource Locator) is an address you type in a web browser to access a particular resource.

For example, creativekidssolutions.com/Virtual/Tutor



Number Addressing System/IP Address

Number Addressing System is the system where a unique number is used to designate the address of a website. This unique number address is known as the IP address. The IP addresses can be directly used to access the web pages instead of typing the letter name.

Letter Addressing System/Domain Name System

The Letter Addressing System is an addressing system where unique identification names are given to website. This is also called the **Domain Name System (DNS)**. The DNS relates various information to their domain names; it serves as the dictionary for Internet. DNS translates the domains into correspondence **IP addresses**. For example, the domain name www.example.com might translate to 199.79.62.152.

PROTOCOL

A **network protocol** defines the rules for communication between network devices.

Internet Protocol (IP)

It is a protocol that is used to send data from one computer to another on Internet. Each computer on Internet has at least one IP address that uniquely identifies and differentiates it from all other computers on Internet. When you send or receive data, the message gets divided into **packets**. These packets contain both the sender's and the receiver's IP address. The Internet Protocol just delivers them.

Transmission Control Protocol (TCP)

It is the protocol that puts the packets back in the right order.

Hypertext Transfer Protocol (HTTP)

It is a set of rules for transferring files (text, graphic images, sounds, videos and other multimedia files) on the World Wide Web. As soon as a user opens a web browser, he/she is indirectly making use of the HTTP.

HTTP is an application protocol that runs on top of the **TCP/IP** protocols.

Do You Know

- The Transmission Control Protocol and the Internet Protocol are together known as TCP/IP.
- **Abhay Bhushan**, a student of the Indian Institute of Technology (Kanpur) and the Massachusetts Institute of Technology (USA), designed and published the **File Transfer Protocol** (FTP) in 1971.
- **Robert Elliot Kahn** and **Vinton Gray Cerf** developed TCP/IP in 1978.


Abhay Bhushan


Robert Elliot Kahn


Vinton Gray Cerf

Practice Time

(Experiential Learning)

1. Draw a diagram of a network that includes attached systems and devices.
2. Collect information about the latest developments in the field of wireless communication technologies and create a PowerPoint presentation on the same.

Key Points

- A network is a group of devices connected to one another.
- A computer network is a collection of computers and peripheral devices connected by communication links.
- A file server is a computer that distributes application programs and data files to the workstation.
- Your computer is a workstation on the network.
- A network improves your work efficiency by increasing productivity, lowering the costs and much more.
- The art of connecting different computers in a network is called topology.
- A network protocol defines the rules for communication between the network devices.
- Networking media is also known as transmission media, through which data is transferred.

EXERCISES

According To NEP Guidelines

A. Multiple Choice Questions

1. Inter-connection of various devices are called ..... .
   (a) chatting ☐ (b) networking ☐ (c) Internet ☐
2. Peripheral devices connected to the network are called ..... .
   (a) servers ☐ (b) workstations ☐ (c) resources ☐
3. Cable television is an example of ..... .
   (a) LAN ☐ (b) MAN ☐ (c) WAN ☐
4. City School has four branches in the same city. The school wants to build a network across all branches. Which geographical network should the school prefer?
   (a) LAN ☐ (b) CAN ☐ (c) PAN ☐

B. Fill in the blanks.

1. A ..... is an electronic device that connects the digital signal into analog signal and vice versa.
2. Your computer is a ..... on the network.
3. A ..... is a device that connects dissimilar networks.
4. A ..... is a collection of Local Area Network within a city.
5. A ..... topology has a minimal line cost.

C. Write the full forms of the following.

1.	URL	2.	PAN	3.	LAN	4.	MAN
5.	WAN	6.	HTTP	7.	TCP/IP	8.	WiFi

D. Very Short Answer Questions

1. Who developed TCP/IP in 1978?
2. Name two types of wired media. Which of them is more durable?

E. Short Answer Questions

1. What is topology?
2. Write two differences between LAN and WAN.
3. How do you think networking helps Indian Railways?

F. Long Answer Questions

1. Write the advantages and disadvantages of the following:
   (a) star topology (b) mesh topology
2. Write a note on the hardware parts required to establish a network.
3. How does information sharing work in a closed group like your computer laboratory?
4. How will you bring your photographs from mobile to computer without using Internet?

G. Computer In Everyday Life (Application-based Questions)

1. The Principal of a school wants to connect all the computers and devices within the school building. Which network should he/she use to do the same and why?
2. Navleena is interested in transferring a few songs from her mobile phone to her father's mobile phone. Suggest to her the simplest wireless option for doing the same.

TECH ZONE

A. Project

(*Creating*)

Collect the information about hubs and switches using Internet. Prepare a chart to describe the difference between them.

B. Group Discussion

(*Collaborative Learning*)

Discuss in class: 'Benefits of a computer network'

Know More

To know more about computer networks, click on the given link:
https://www.youtube.com/watch?v=VwN91x5i25g&list=PLBlnK6fEyqRgMCUAG0XRw78UA8qnv6jEx