1 Network Communication and Mobile OS

SNAP RECAP

1. What is networking?
2. What are the different types of networks?
3. What is an operating system? Why do you need it?
4. Discuss the different types of operating systems.
5. State the various uses of a mobile phone.

LEARNING OBJECTIVES

You will learn about:

- a computer network and its components
- types of network
- network topology
- transmission channels
- mobile operating systems and its types

Computer networks

A network consists of two or more computers linked together for sharing resources such as printers and exchanging files, or allowing electronic communications. The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

Computers linked in a network

A large number of users belonging to the same area or organisation who are spread out at different places can communicate and share useful files, software programs and information, only when their computers are networked. This type of networking, specific to users in one organisation, is called an **intranet**. It is a network which is not open to all.

Advantages of a computer network

Networking of computers is a basic need of today's world. Let us study some advantages of computer networking.

1. **Centralised software management**: Software can be loaded on the main computer, the file server. This eliminates the need to spend time and energy in installing, updating and tracking files on independent computers throughout the same building.

FACT FILE

Extranet is another form of a network. It is private to an organisation with little external interference and is used for official purposes only. That is, it is any Intranet that also uses the Internet.

2. **Resource sharing**: Resources such as printers, fax machines, scanners and modems can be shared by connecting them on a network. This saves space and is also cheap.
3. **Speed**: Files can be sent and received quickly using a computer network. This method saves time, and is more convenient than manual delivery of data.
4. **Cost efficient**: Individually licenced copies of many popular software programs can be costly. Storing the software on a file server and making it available to other computers connected to it saves money.
5. **Security**: Sensitive files and programs on a network are protected by passwords. They can be made available as read only files, which helps to avoid copying of programs.

Disadvantages of a computer network

Some of the disadvantages of a computer network are:

1. When the server develops a fault, users may not be able to run the application programs and chances of data loss increase.
2. If the network stops operating, computers connected to the network cannot access the data/files stored on the network, which affects the entire system.
3. As traffic increases on a network the performance degrades unless it is designed properly.
4. It becomes difficult to manage when a large number of computers are connected to a network.
5. If the server is hacked or attacked by a virus, the security of data of all connected computers is at risk.

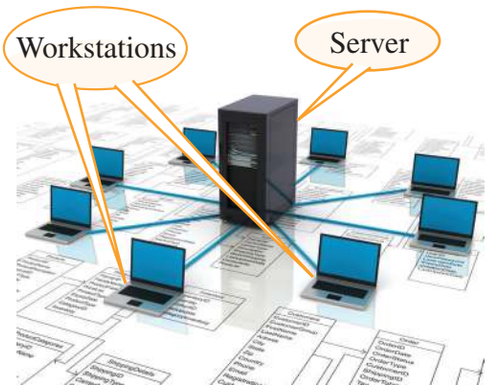
Basic components of a network

Computers are connected to a network using some special hardware devices called **network devices** or components of a computer network. Below are the different components of a computer network.

Server

A server is a computer that manages the network resources, software and files. It is normally dedicated to an allocated task and it performs no other task.

For example, a **file server** is a computer that manages storage and retrieval of files. A **print server** is a computer that manages one or more printers required on a network.



Workstations connected to a server

Workstation

A workstation is a computer intended for individual use in a networking environment. It is like a personal computer except that it is also connected to other computers and to the main computer, that is, the server.

Workstation

Network interface card

Network interface card

A network interface card (NIC) is a piece of hardware placed inside the system unit. It is part of the motherboard, the platform which connects all the different parts of a computer. It is designed to allow computers to communicate over a computer network. It provides physical access to a networking medium.

Hub

A hub is a device that connects multiple devices and makes them work as a single network segment. A hub has multiple ports. A specific cable connects the hub to the NIC. The NIC transfers the data on a computer to a hub, which then transfers it to the other connected computers.

Hub

Transmission channels

Each computer on a network is interconnected through transmission channels. These channels can be wired or wireless. Data is exchanged between two computers on a network using these channels.

FACT FILE

A **switch** is a smarter replacement of a hub. A hub transfers the data received from an NIC to all the computers; a switch transfers it to the specific computer.

The wired channels can be cables such as twisted pair, co-axial and fibre-optics. The wireless channels can work through satellites using microwaves or radio waves. You will learn more about the different types of transmission channels later in this chapter.

Types of network

A network can be categorised by geographical area:

Personal Area Network (PAN)

This is a network for communication among personal devices. The devices can include mobile phones, computers, cameras, laptops and tablets. These devices are connected through a wired or wireless 'Personal Area Network'. A PAN covers a short radius of only a few metres. It is used to share or transfer files, songs, etc. A USB cable is used to connect a wired PAN. Bluetooth and Wi-Fi are part of a wireless PAN.

Local Area Network (LAN)

When computers are interconnected within a limited geographical area, they form a 'Local Area Network'. For example, a network within a building, an office or a school. Such a network covers a radius of a few kilometres.

In addition to operating in a limited space, LANs are also typically owned, controlled and managed by a single person or organisation. A LAN which is created with the help of Wi-Fi, without using cables, is called a WLAN.

Wide Area Network (WAN)

When a network is spread across cities, countries or even continents, covering a large geographical area, it becomes a 'Wide Area Network'. The internet is the largest WAN, covering the world.

Metropolitan Area Network (MAN)

When computers are interconnected within the same geographical area, for example in different branches of an organisation in one city, it becomes a 'Metropolitan Area Network'. Local libraries or different divisions of the same school in a city are examples.

A MAN spans over a larger physical area than a LAN but smaller than a WAN. It is typically owned and operated by a single entity such as a bank, government body or large corporation.

FACT FILE

There is another type of network connecting multiple LANs confined within a campus. This is known as a **Campus Area Network** (CAN). This network is smaller than a **MAN**.

For example, different colleges connected in the same university campus or branches of the same office in a specific region.

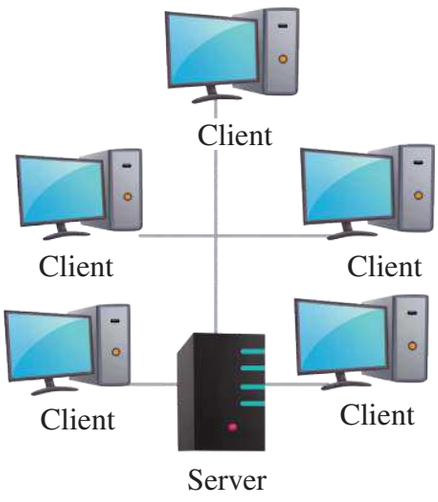
Computer networks may also be classified according to the functional relationships that exist among the elements of the network. For example, client server and peer-to-peer (workgroup) architecture.

Client-Server architecture

Client-Server architecture is defined as a specific type of network which consists of a single powerful computer acting as a **server**, usually connected to multiple computers called **clients**.

Generally one server supports many clients. The server has powerful central processors, added memory, and larger disk drives in comparison to the clients. A server device typically stores files and databases including more complex applications like websites. The client contains the software programs based on the requirements of its users. Network clients make requests to a server by sending messages, and servers respond to their clients by acting on each request and returning results.

A client-server network can be used by desktop computers and laptops, as well as other mobile devices that are properly equipped.



Client-Server architecture

An example of a client-server is when you try to access your bank account from a computer. A client program on your computer forwards the request to a server program at the bank. The server accesses the data of that specific account and sends the request back with the account details to the client computer.

Advantage: The centralised handling of data provides increased security. For example, password protection which ensures that the data is only available to qualified individuals.

Disadvantage: It runs the risk of system overload. If too many different clients attempt to reach a shared network at the same time, there may be a failure or slowing down of the connection.

Peer-to-peer architecture

Peer-to-peer architecture is a type of network in which each workstation has equivalent capabilities and responsibilities.

The workstations are connected to each other but do not have a server. Files can be shared among workstations, and a printer connected to one workstation can be also accessed by other workstations.

Peer-to-peer architecture

Peer-to-peer networks can be set up among only a few computers within an office or single room. Such a network is much simpler to set up in comparison to client-server networks.

Advantage: It supports distributed processing, so the increased load does not affect the system overall.

Disadvantage: It does not support centrally managed security, nor does it provide data backup.

FACT FILE

There are sets of rules that govern data communication in a networking environment, known as protocols. A few of them are given below:

- Hyper Text Transfer Protocol (HTTP)
- Simple Mail Transfer Protocol (SMTP)
- File Transfer Protocol (FTP)
- Transmission Control Protocol/Internet Protocol (TCP/IP)

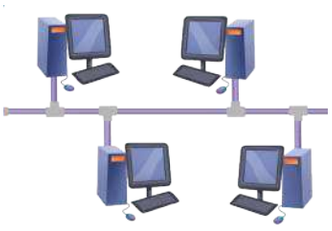
Network topology

The physical arrangement of cables, computers and other peripheral devices to form a network is known as a topology.

A few examples of network topologies are described below.

Bus topology

A bus topology is made up of a main single cable with terminators at both ends. It is a shared communication medium that makes the backbone of the system. Computers and other devices including the server are connected to this linear cable for communication.



Bus topology

Advantages

- It is easy to install.
- It does not require much cabling, so it is very cost effective.

Disadvantages:

- If the backbone cable fails, the entire network stops working.
- In the case of an entire network shut-down, it becomes very difficult to locate the problem area.

FACT FILE

The data delivered on a network is divided into small packets. Each packet is given a sequence number. The first packet has a destination address followed by the next packet number.

The last packet has an end-of-file pointer that helps the destination computer to know that the number of packets are complete. Any data loss during data transmission on a network can be found by tracing the missing packet number.

Star topology

Star topology is the most commonly used topology. In such a setup all the workstations are connected to a central connection point called a **hub**. Any data that is sent first goes to the central hub and is redirected from there to the destination computer.

Star topology

Advantages:

- It is easy to add and remove workstations by upgrading the hub.
- It is easy to install.

Disadvantages:

- It requires more cable length.
- Failure in the central hub will break down the entire network.

Ring topology

In a ring topology, every workstation has two neighbours for communication purposes. All messages travel through a ring in the same direction either clockwise or anticlockwise.

Ring topology

Advantages:

- It is easier to detect faults in the network.
- Fewer cable wires are required.

Disadvantages:

- A failure in any cable or device breaks the loop, leading to breakdown of the entire network.
- Adding or removing a device/workstation requires rewiring and re-routing all the existing cables.

Types of transmission channels

The medium used for transmission of data between the nodes in a network is called a transmission channel. This channel can be wired or wireless.

Wired transmission channels

Wired transmission channels help in the transmission of data over a wire-based network. A few examples of wired channels are explained here.

Coaxial cable

Coaxial cable: This is one of the cheapest and the most commonly used wire-based networking mediums. This type of cable is suitable for transmitting low-powered signals over a small distance. It is widely used in small networks, cable TV, etc.

Twisted pair cable: This consists of two independently insulated wires, twisted around one another. The twisting stops the disruption of signals due to adjacent pairs or other sources.

Twisted pair cable

FACT FILE

There are generally two types of twisted pair cables. These are Shielded Twisted Pair (STP) and Unshielded Twisted Pair (UTP).

Fibre-optic cable: This is made up of optical fibres that use the concept of light for transmission of data. High speed data can be made to travel over a long distance with less damage. It is steadily replacing copper wire as an appropriate means of communication through signal transmission.

Fibre-optic cable

Wireless transmission channels

Wireless communication is the transfer of information over a distance without use of wires. It is the fastest growing segment of the communication industry today. The distances involved may be short, that is, a few metres as in the case of a television remote control. They may also be long, as in the case of thousands or millions of kilometres for radio communications. There are many types of wireless networks that make data communication possible, both over long range and short range. All of these networks operate at different frequencies.

Some examples of wireless communication are:

- Remote controls for electronic devices
- Bluetooth
- Mobile phones
- Wireless networking
- Wireless computer devices like mouses and keyboards
- Satellite televisions
- Radio waves

FACT FILE

Wi-Fi (Wireless Fidelity) is a wireless LAN technology that enables laptops, PCs and other devices to connect easily to the internet.

There can be various channels for wireless transmission. A few are explained here:

Radio waves: Radio waves are generally used for long-distance wireless communication. Signals can pass through thick objects such as non-metallic substances. Radio waves are used in radio communication (AM/FM), communication satellites, radars, computer networks, etc.

Infrared: Infrared is one of the oldest forms of wireless communication. It is an electromagnetic radiation. It is suitable for short-distance communication. For example, a television and a remote control connect to each other using infrared rays. The signals travel in a straight line and cannot go through walls.

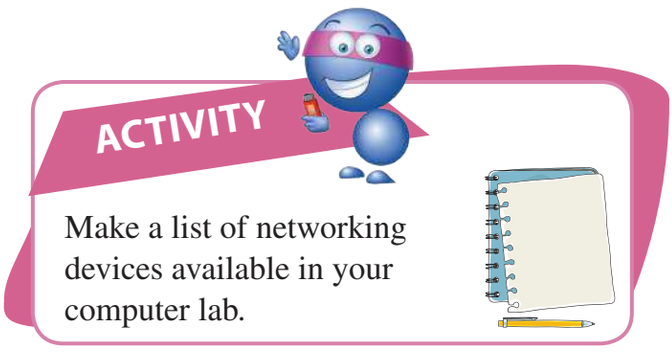
Microwave: Microwave is the most commonly used wireless transmission medium, which is spread widely across the world. Most of the wireless access points and wireless devices work on microwave communication. This communication medium is not only cost effective, it is also extensively used in cellular communication.

Bluetooth: Bluetooth is another wireless communication medium operating over short distances. It has a normal range of approximately 3–300 feet depending on the connected devices. These devices can be mobile phones, personal computers, laptops, digital cameras, MP3 players, etc. Bluetooth enabled devices form a small network. In Bluetooth technology, eight devices can be connected to each other at the same time. Bluetooth can also be found in headsets, hands-free kits, wireless keyboards and mouses. Bluetooth uses radio wave technology which is not very expensive and has low power consumption.

A Bluetooth device

Mobile operating systems

Initially, when mobile phones were introduced in the late 90s, they were just designed to support making and receiving calls and sending simple text messages. Usage of mobile phones has increased drastically over the last few years, which has brought a huge revolution in the features of mobile handsets.



Modern mobile phones are just like a compact computer loaded with basic applications. These mobile applications can be designed and uploaded easily. Wireless establishment of connections can be achieved through Bluetooth and infrared technologies. Mobile phones like this are called **smartphones**.