Computer Fundamentals

Basic Computer Science

Learning Objectives

By the end of this lesson, you will be able to:

- Elaborate Computer Fundamentals
- Elaborate Operating System
- Classify Network Fundamentals
- Explain Computer Security

Computer Fundamentals

Computer Fundamentals

- A computer is an electronic device that accepts data and processes it into useful information.
- There are two main aspects of the computer:

Input:

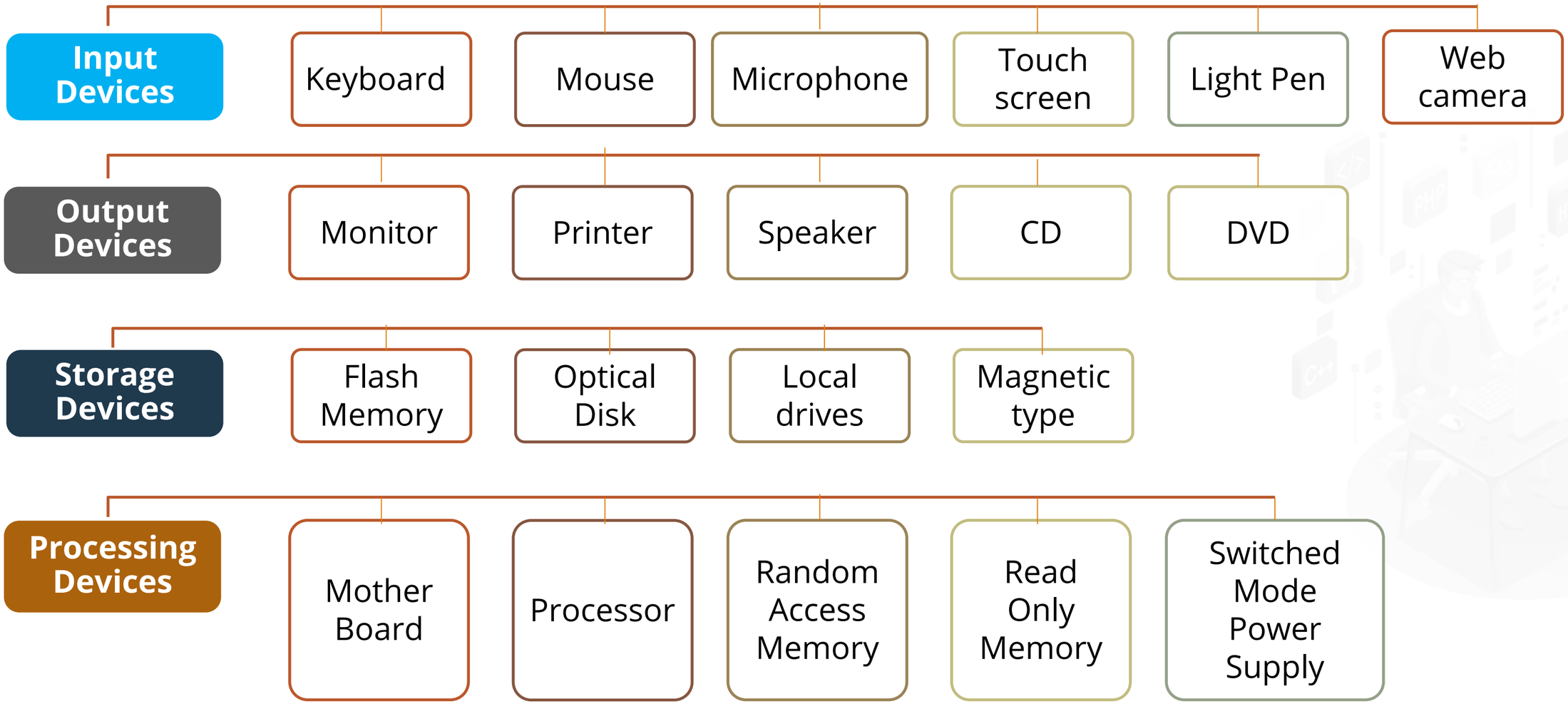
  - The data entered into a computer is called the input.
  - Inputs are raw facts for which the system processes and gives results.

Output:

  - The output is the result that the computer provides in return of the raw data entered.

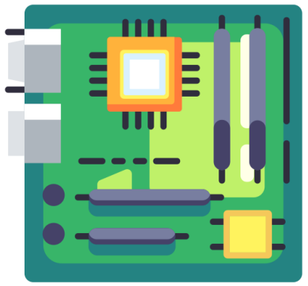
Computer Fundamentals

Computer Devices

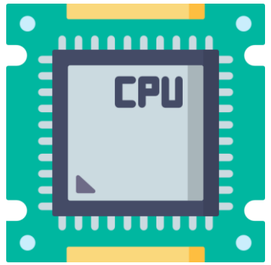


Computer Components

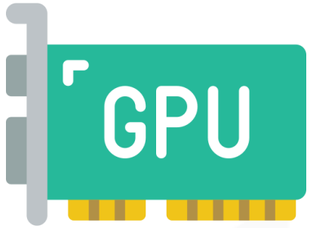
The five main components that make up a typical, present-day computer include:



Motherboard

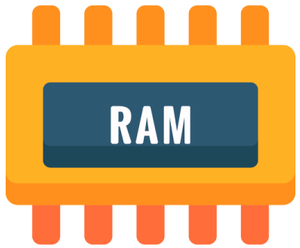


Central Processing Unit (CPU)



Graphics Processing Unit (GPU)

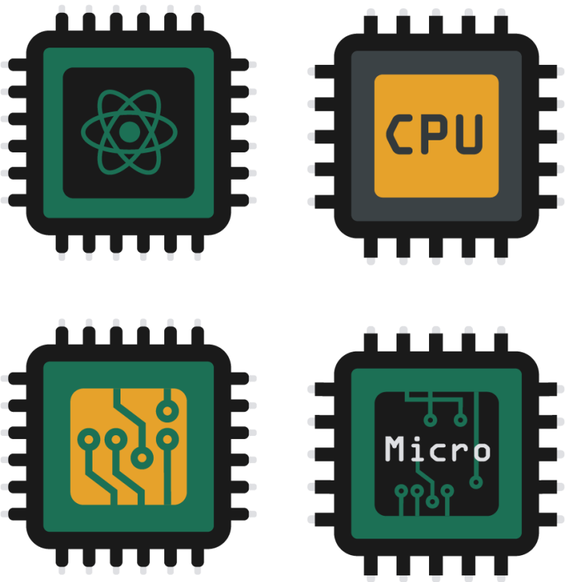
Solid State Drive (SSD)



Random Access Memory (RAM)

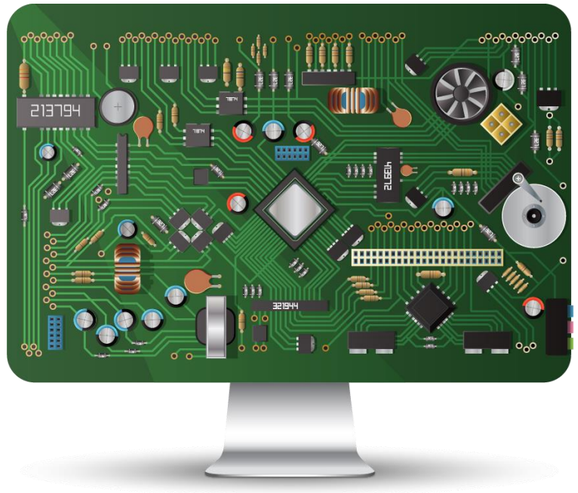
Computer Memory

The performance of a computer system depends upon the memory and CPU. A CPU is capable of storing only instructions required to operate the computer. Therefore, it is mandatory to have the memory to run a computer properly.



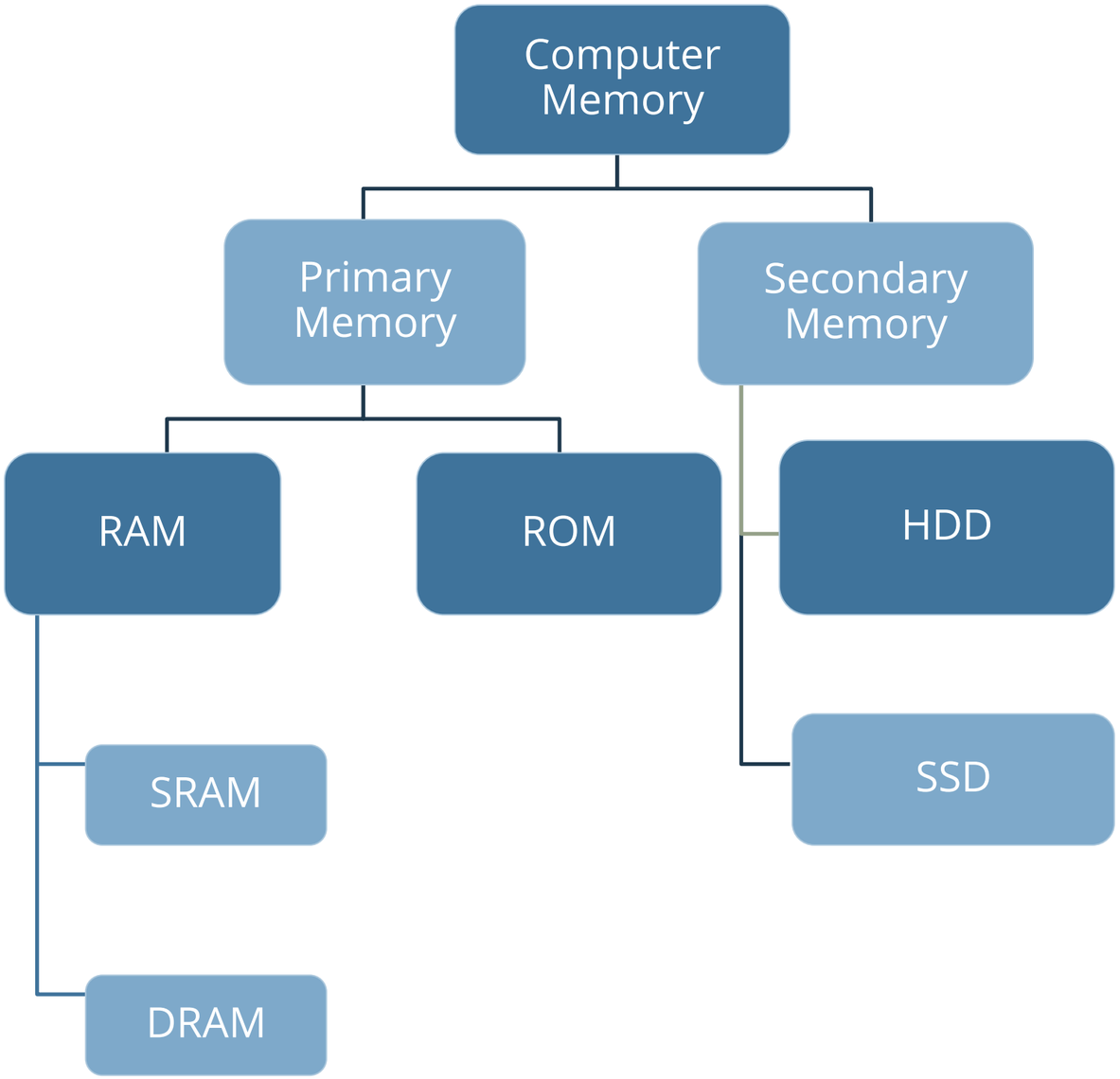
Computer Memory

Memory is a set of memory cells known as the building block of memory. Each memory cell has a unique index number or identification number known as the unique address of the specific memory cell.



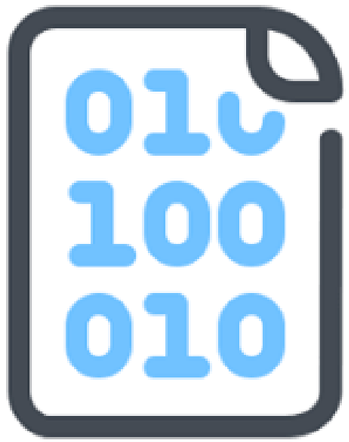
A computer system is built using a combination of these types of computer memory, and the configuration can be optimized to produce the maximum data processing speed, the minimum cost, or some compromise between these two.

Computer Memory Hierarchy



Number System

The **number system** is the technique to represent numbers in the computer system architecture. Every value that a user is saving into or getting from computer memory has a defined number system.



Computer architecture supports following number systems:

- Binary number system (Base – 2)
- Octal number system (Base – 8)
- Decimal number system (Base – 10)
- Hexadecimal (hex) number system (Base – 16)

Number System

Computer architecture supports following number systems:

Number system	Base	Used digits	Example	Language assignment
Binary	2	0, 1	$(11110000)_2$	int val=0b11110000;
Octal	8	0, 1, 2, 3, 4, 5, 6, 7	$(360)_8$	int val=0360;
Decimal	10	0, 1, 2, 3, 4, 5, 6, 7, 8, 9	$(240)_{10}$	int val=240;
Hexadecimal	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F	$(F0)_{16}$	int val=0xF0;

Operating System

What Is an Operating System?

An operating system is a unit of system software that manages a computer's resources, such as hardware and software.

It is a piece of software that serves as a link between the user and the computer hardware.

What Is an Operating System?

Any software or application in a computer system must run on at least one operating system. An application, such as Microsoft Word, Chrome, or games, requires an environment in order to execute and fulfill its duties.

What Is an Operating System?

With the help of an operating system, communication between devices and applications may be done easily with the computer without learning computer languages.

Any computer or smartphone device cannot operate without an operating system.

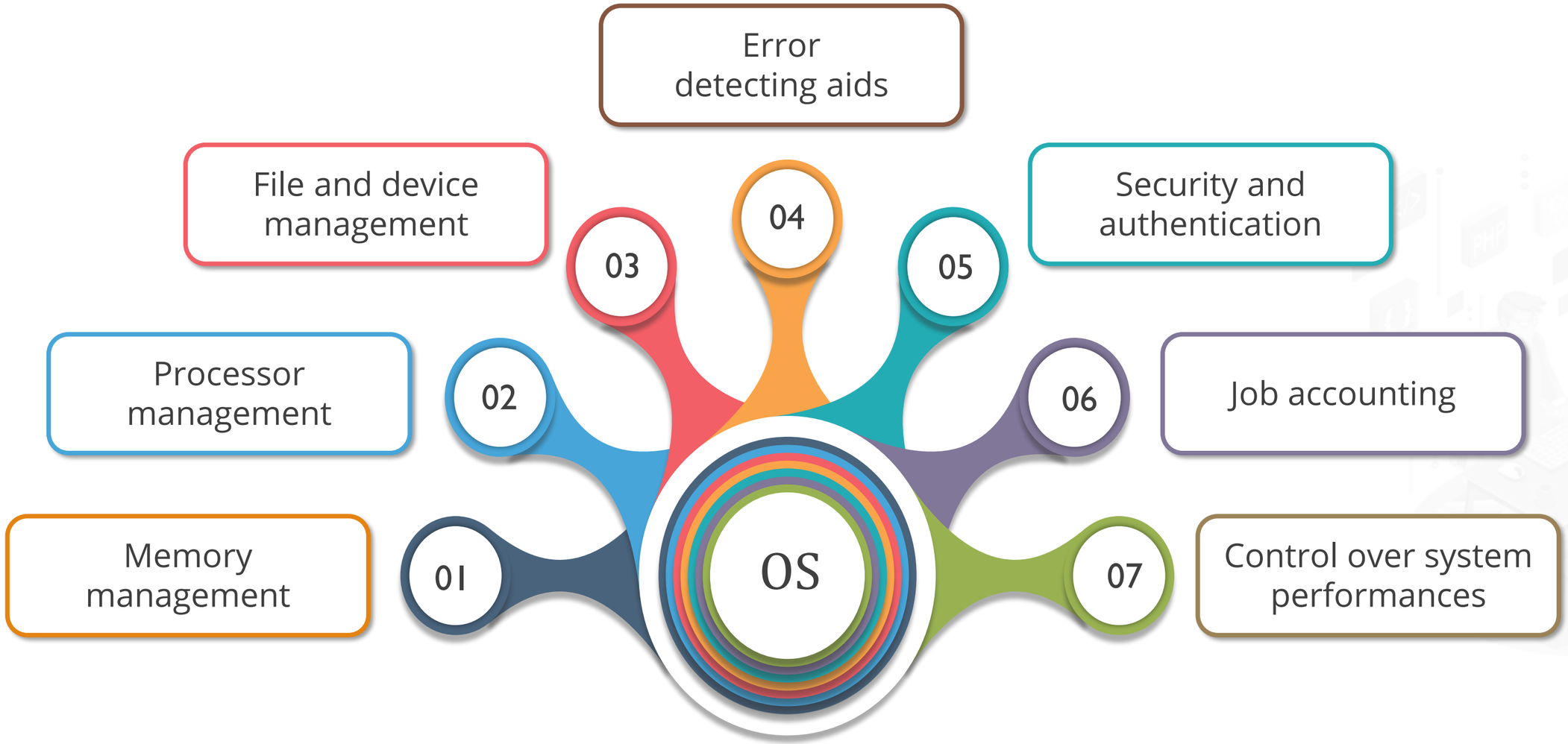
Operating System

The devices for communication are :

Objectives of an Operating System

1. The operating system offers an **appropriate interface** to use the computer system.
2. It helps in hiding the information related to the **hardware resources** from the users.
3. It provides the **sharing of resources among users and programs** in an efficient way.
4. The operating system helps us to **manage the computer system resources**.
5. The operating system offers **convenient & impartial sharing of resources** between the users & programs.
6. The operating system is useful to **monitor and handle the execution of other programs**.

Features of an Operating System



Features of an Operating System

Main memory stores data and programs that can be lost when the system is turned off. It is also known as Versatile Memory.

Main Memory

A processor is defined as an integrated electronic circuit which performs the job of calculations in the computer.

Processor

The system bus is responsible for communication between the processors, input-output modules, and main memory.

System Bus

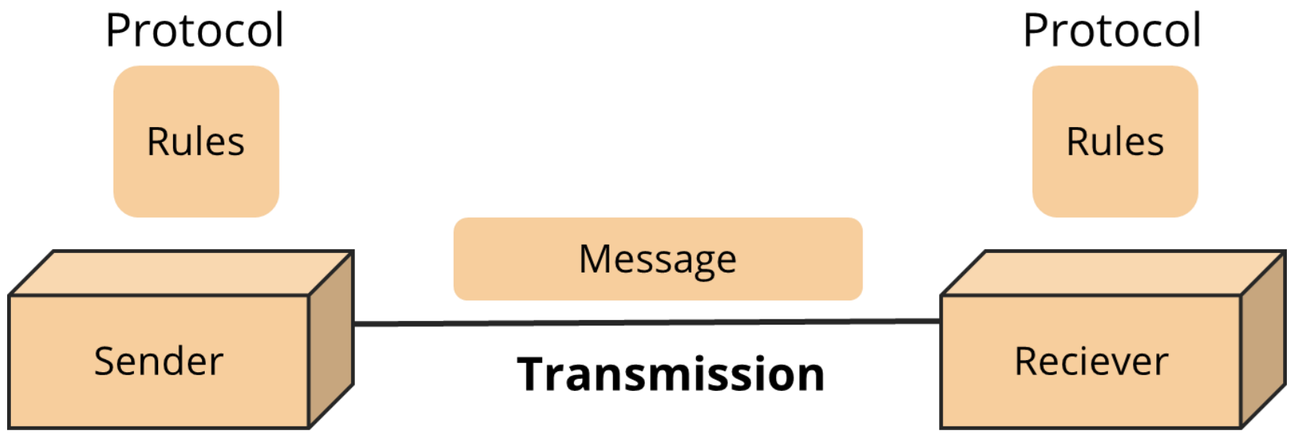
The task of I/O modules is to move the data within the computer to its peripheral external environment.

I/O Modules

Network Fundamentals

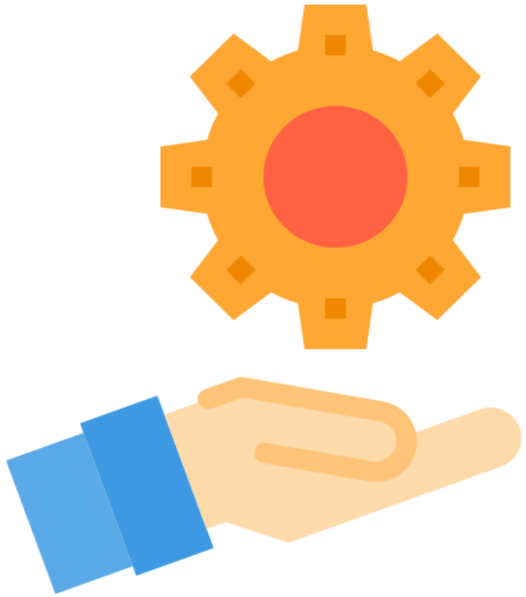
Introduction to Computer Networks

A computer network is a group of devices, such as computers, printers, scanners, that are connected to each other via wires, cables, and so on. These devices are also known as nodes.



It helps in sending and receiving data stored in devices over the network.

Computer Networks Features



1. Performance
2. Data Sharing
3. Backup
4. Reliable
5. Security
6. Scalability
7. Software/Hardware Compatibility

Computer Networks

Some techniques to assess performance are:

- Transit time: The time it takes for a message to go from one device to another
- Response time: The time elapsed between an inquiry and a response

Performance can also be measured in other ways:

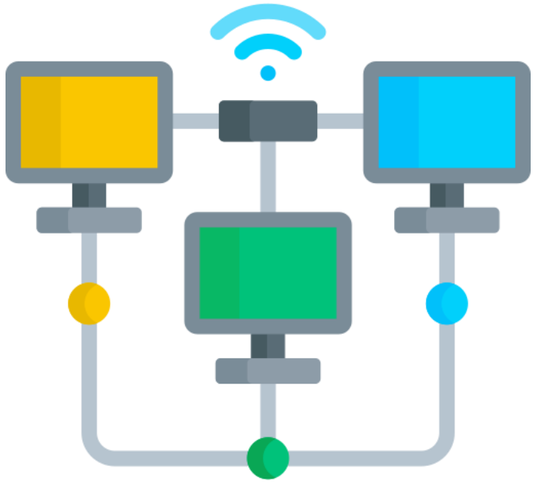
- Number of users
- Efficacy of software
- Connected hardware's capabilities

Communication Model

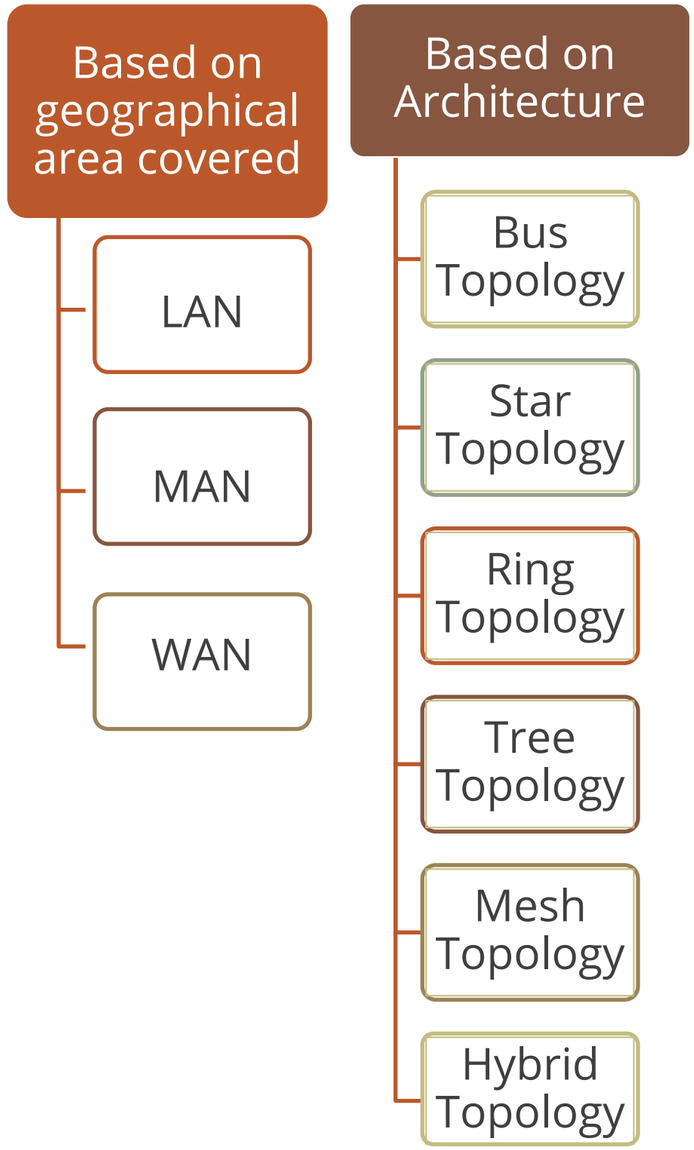
Model	Description
Source	Data to be transmitted is generated by devices such as telephones, personal computers, and so on.
Transmitter	It transforms and encodes data in a way that electromagnetic waves or signals are produced.
Transmission System	The transmission system is as simple as a single line or as complicated as a complex network that connects source and destination.
Receiver	It accepts signals from the transmission system and translates them into a format that the destination can understand.
Destination	The receiver's data is delivered to the destination.

Network Topology

Network topology is the configuration of a network that includes nodes and connecting lines via sender and receiver.



Network Topology

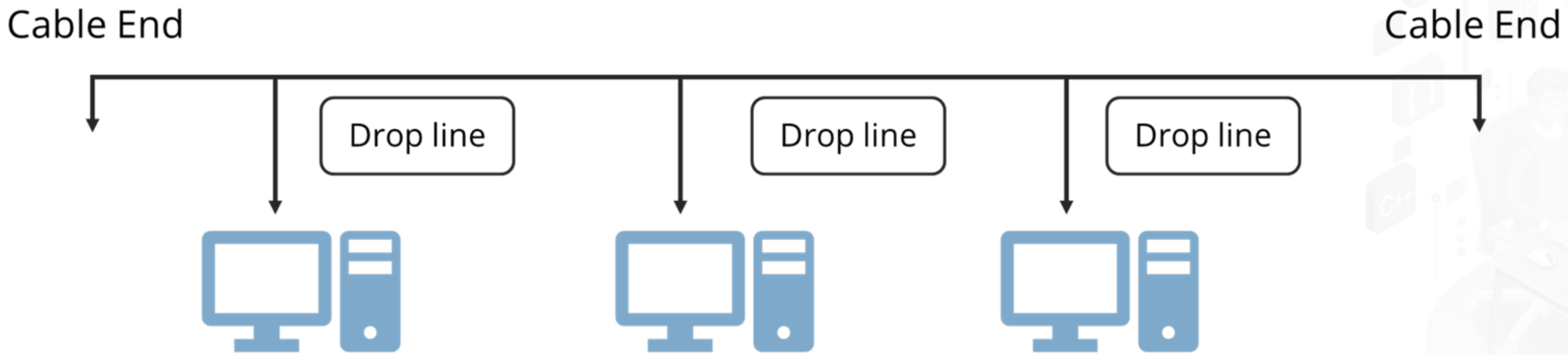


They are divided into two categories:

- Geographical areas covered
- Network architecture

Bus Topology

Bus topology is a network type in which every computer and network device is connected to single cable. When it has exactly two endpoints, then it is called Linear Bus topology.



Bus Topology

The advantages and disadvantages of bus topology are:

Advantages

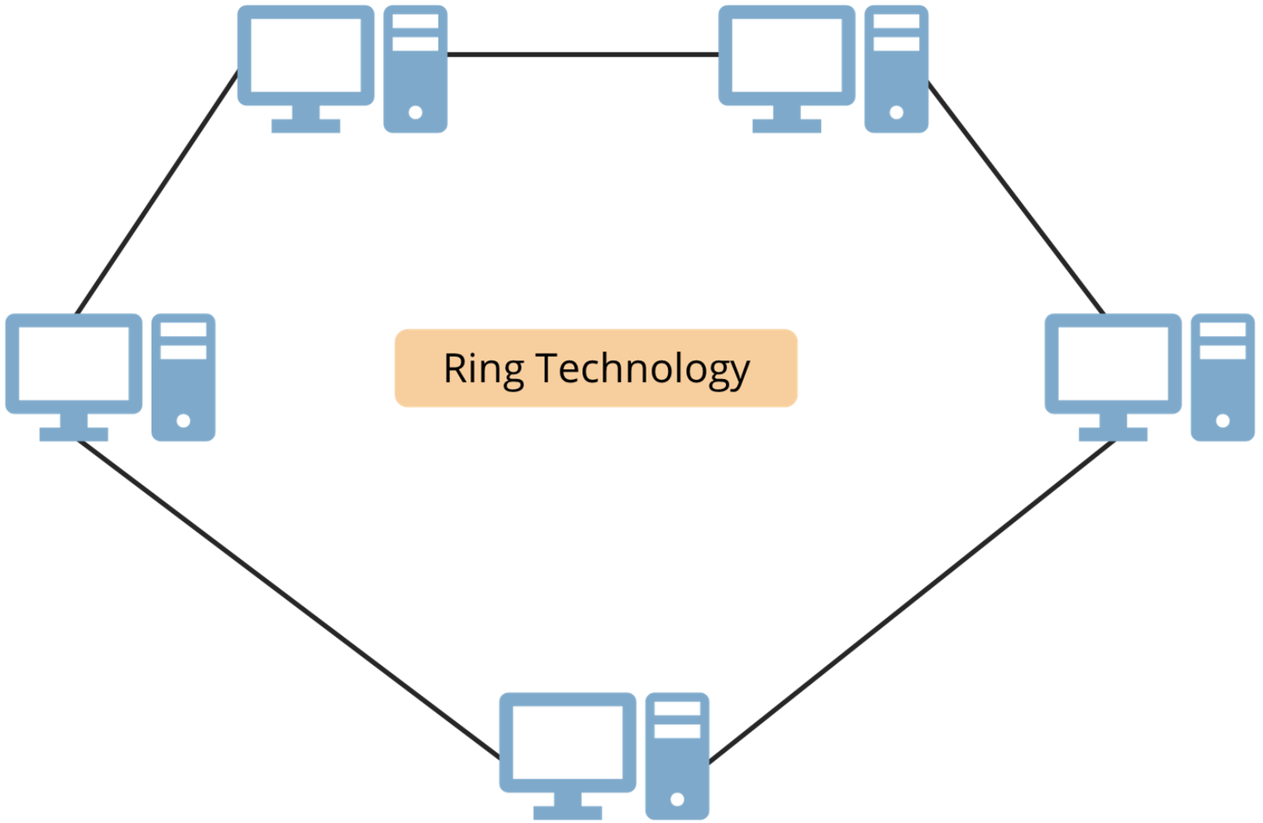
- It is easy to set up.
- The bus uses less cabling than the mesh, star, and tree topologies.

Disadvantages

- Reconfiguring and isolating errors is difficult.
- All communication is disrupted when a bus cable malfunctions or breaks.

Ring Topology

Ring topology is called so because one computer connected to another, with the final one being connected to the first. Each device has exactly two neighbors.



Advantages and Disadvantages

The advantages and disadvantages of ring topology are:

Advantages

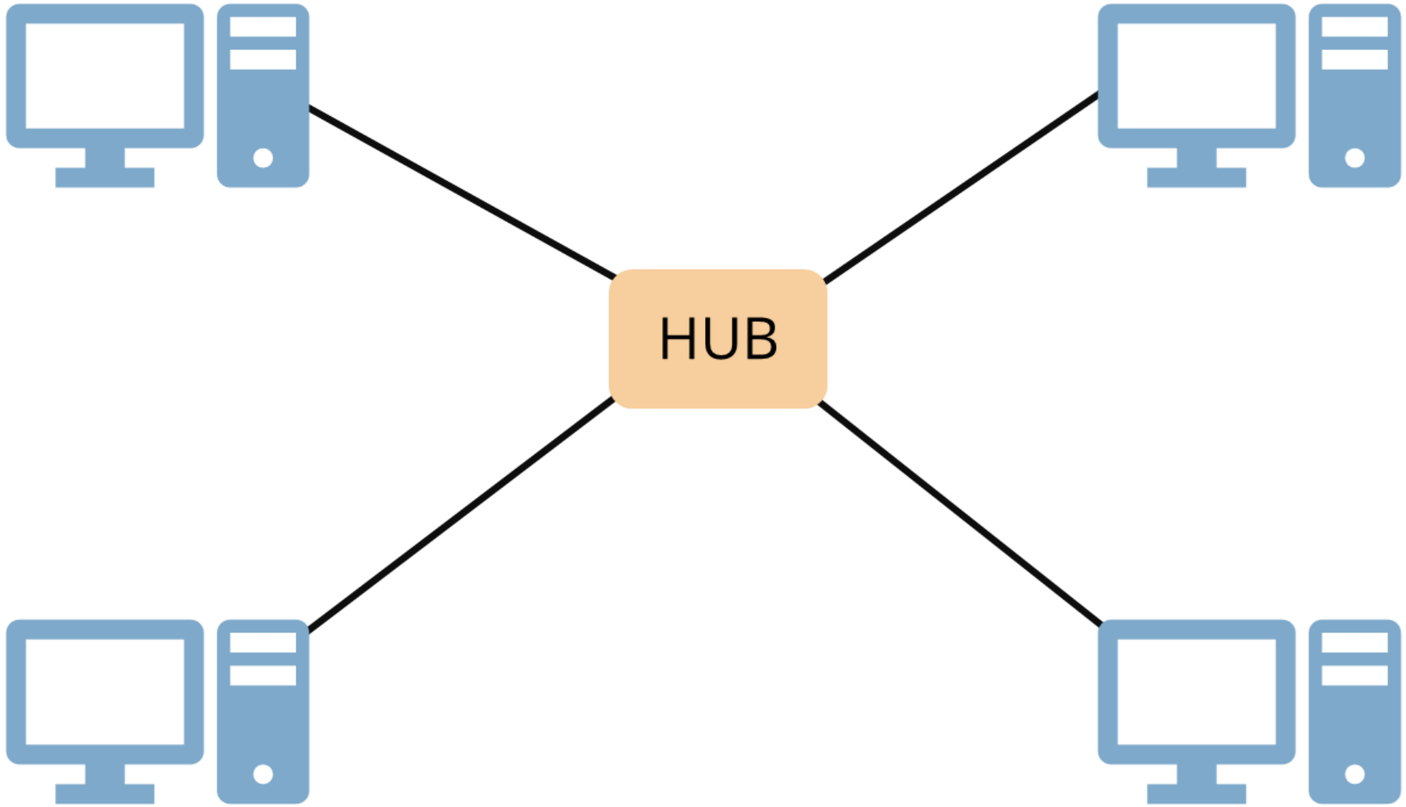
- Although packets only move in one direction, data transmission is comparatively simple.
- A central controller is not required to manage communication between nodes.

Disadvantages

- A data packet in a unidirectional Ring must pass through all nodes.
- For computers to communicate with one another, they must all be turned on.

Star Topology

All the PCs in this configuration are connected to a single hub through a cable. This hub stands as the central node, with all other nodes connecting to it.



Advantages and Disadvantages

The advantages and disadvantages of star topology are:

Advantages

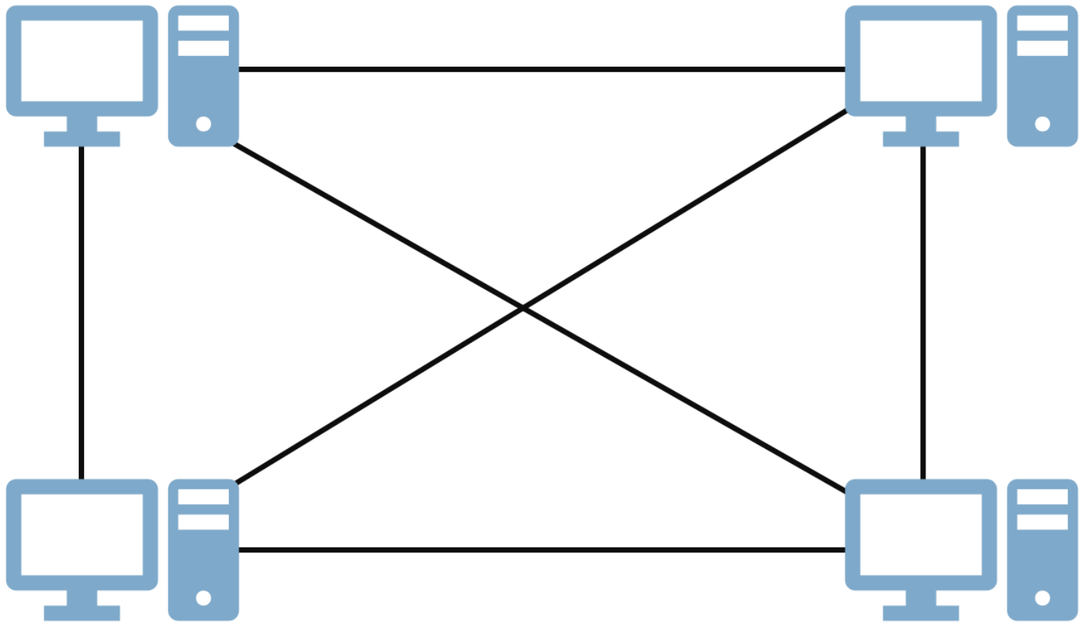
- There are no network interruptions when connecting or disconnecting devices.
- It is easy to install and configure.
- The process of identifying and isolating defects is straightforward.

Disadvantages

- If the hub, switch, or concentrator fail, the nodes attached to them are considered failed.
- It is more expensive than linear bus topologies due to the cost of the hubs.

Mesh Topology

It is a connection between two nodes or devices, which is point-to-point. All the network nodes are linked. To connect n devices, Mesh has n(n-1)/2 physical channels.



Advantages and Disadvantages

The advantage and disadvantages of mesh topology are:

Advantages

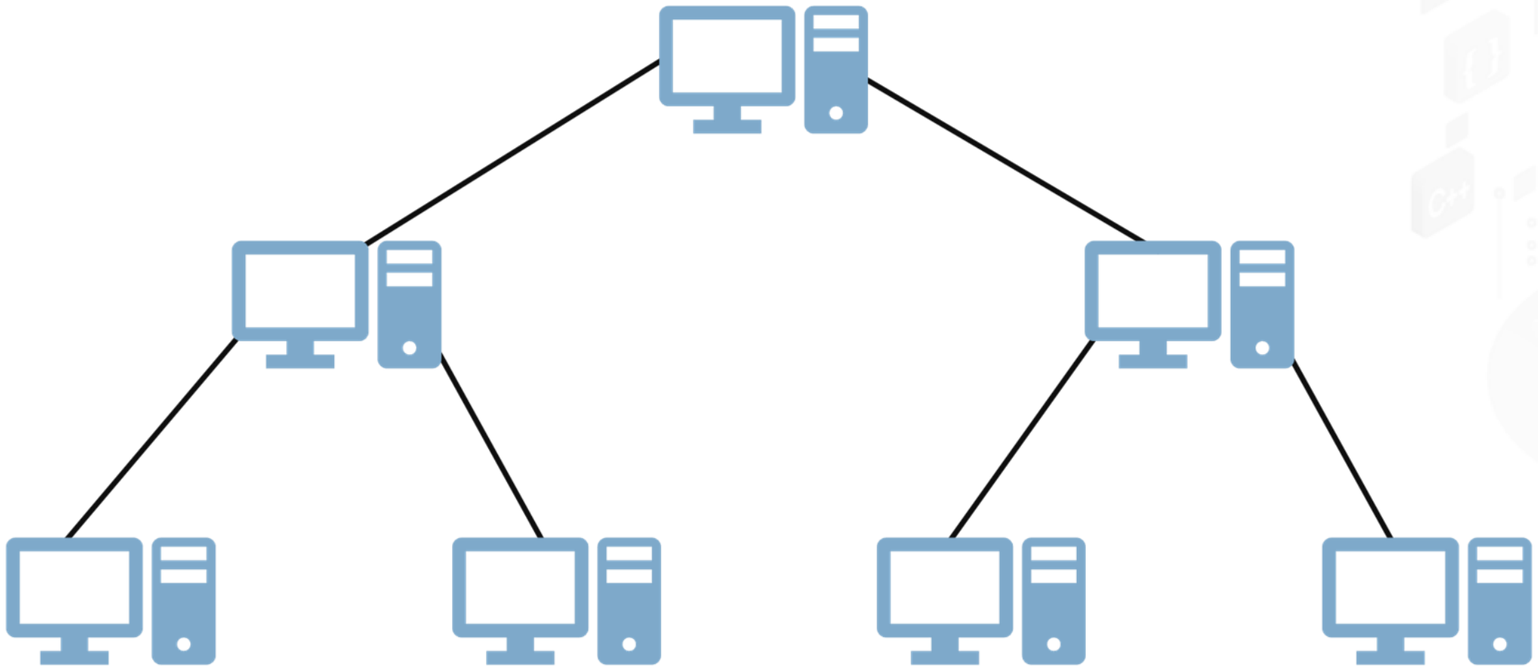
- Various devices can transmit data at the same time. This topology can handle a large amount of traffic.
- Even if one of the connections fails, there is always a backup connection. Data transmission is unaffected as a result.

Disadvantages

- A huge amount of cabling and the number of I/O ports is required.
- It is challenging to set up and customize.

Tree Topology

It does have a cluster center that is linked to all other nodes, creating a hierarchy. It is also known as Hierarchical topology. The hierarchy should have at least three tiers.



Advantages and Disadvantages

The advantage and disadvantages of tree topology are:

Advantages

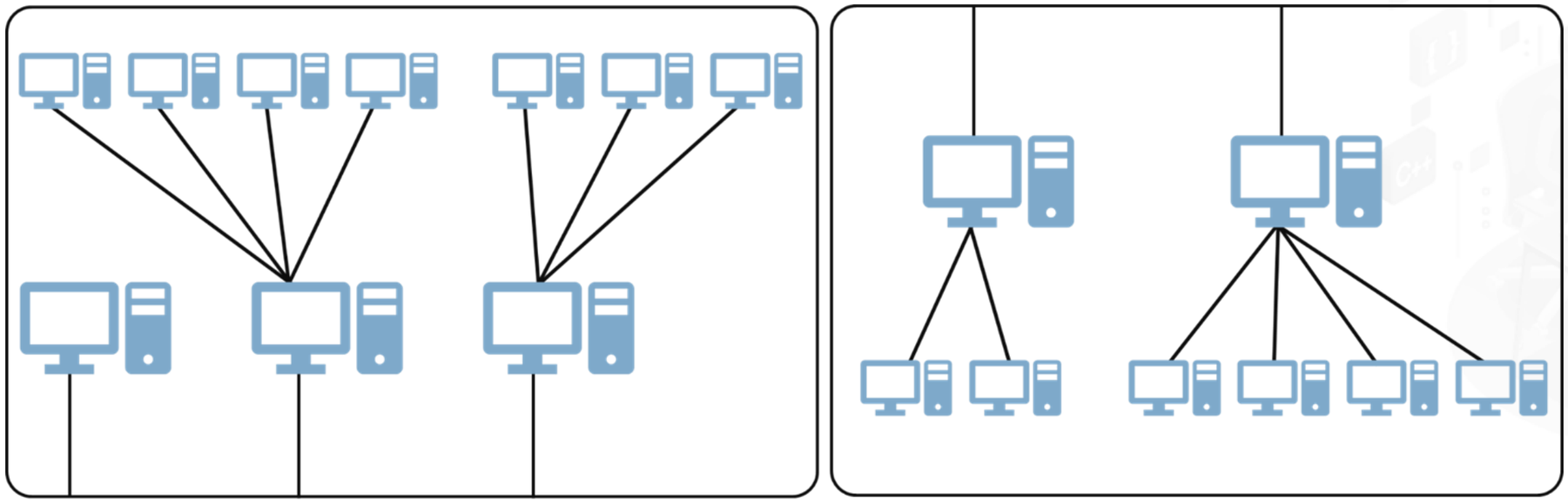
- Expansion of the network is both possible and simple.
- We divide the network into smaller portions (star networks) to make it easier to operate and maintain.
- If one section is damaged, the others are untouched.

Disadvantages

- For its basic form, tree topology relies heavily on the main bus wire, and if it breaks, the entire network is hampered.
- When more nodes and segments are introduced, maintenance becomes more difficult.

Hybrid Topology

It is a mixture of two or more topologies. For example, in an office, if one department uses ring topology and another uses star topology, connecting these topologies will result in Hybrid Topology (ring topology and star topology).



Advantages and Disadvantages

The advantage and disadvantages of hybrid topology are:

Advantages

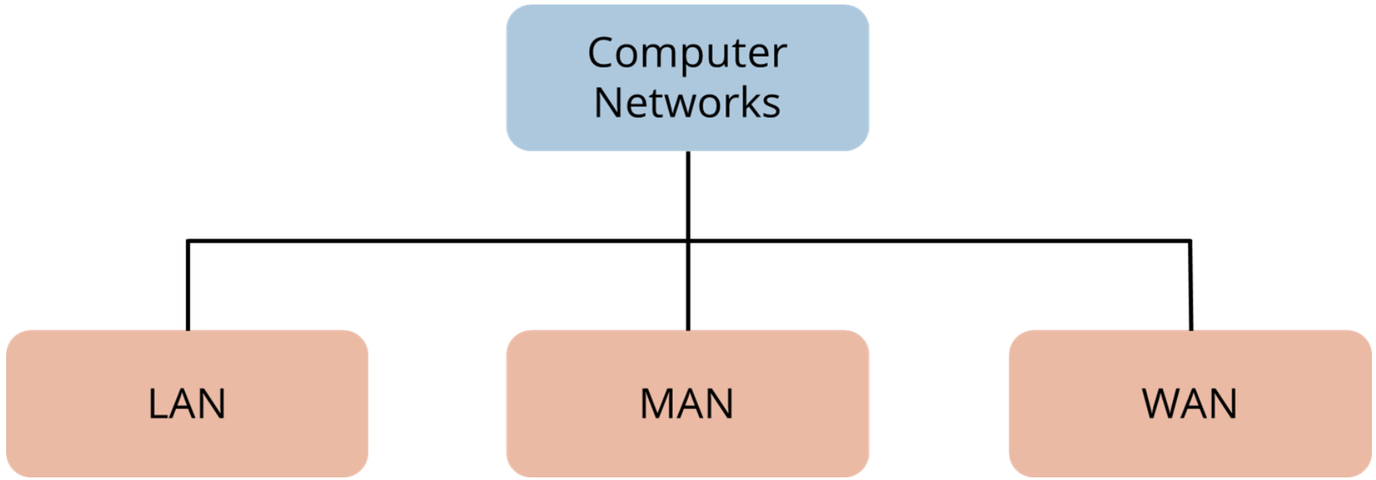
- This form of topology integrates the advantages of various topologies into a single topology.
- It is quite dependable.
- It is highly adaptable as hybrid networks are built in such a way that new hardware components can be easily integrated.
- It is simple to spot errors and troubleshoot them.

Disadvantages

- It is a high-priced network type.
- The creation of a hybrid network is a difficult task.
- In order to link one topology to another, hardware must be changed.
- Hybrid architectures are typically larger in scale, necessitating a high number of wires during the installation procedure.

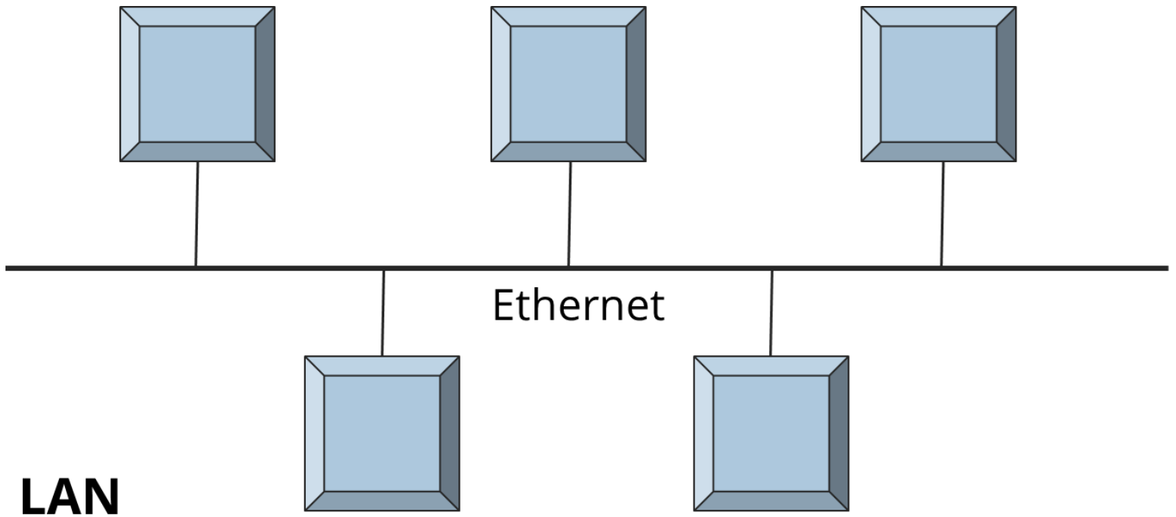
Computer Network Types

- A computer network is a group of computers connected with each other through a transmission medium such as cable, wire, and so on.
- A computer network can be categorized by its size and is mainly of three types:



LAN (Local Area Network)

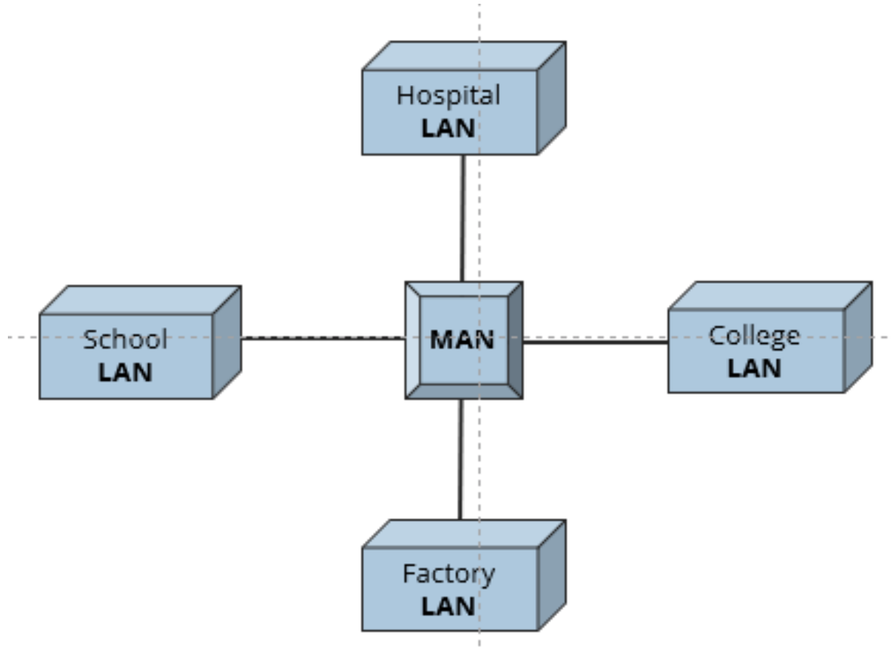
- LAN is a group of computers connected with each other in small places and is best suited for schools, hospitals, apartments and so on.
- Due to its small size, LAN works faster, with its speed between 10 to 100 Mbps. It can transfer data with a speed ranging from 4 to 16 Mbps.



LAN

MAN (Metropolitan Area Network)

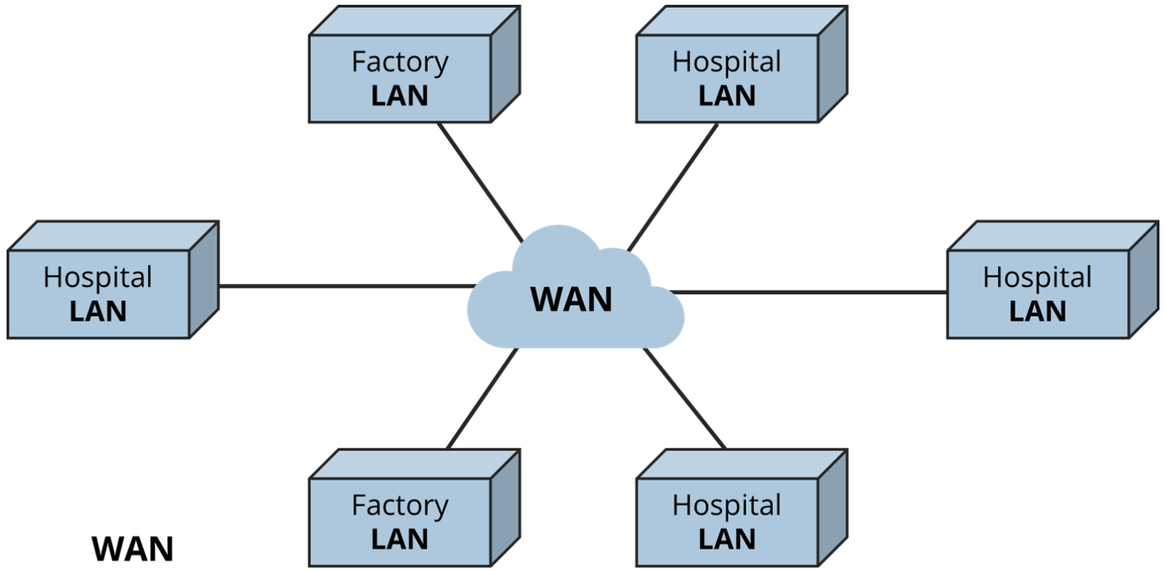
In MAN, various LANs are connected to each other through telephone lines. It is mainly held and operated by a single private or public company.



The size of the MAN is larger than LANs and smaller than WANs. A MAN covers the larger area of a city or town that is around 50 Kms.

WAN (Wide Area Network)

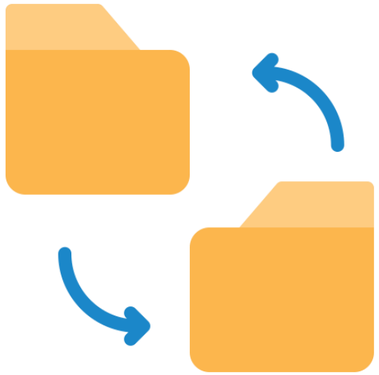
- WAN provides long distance transmission of data, and its size is larger than LAN and MAN. It can cover a country, continent, or even the whole world
- The medium of communication used by WAN is PSTN or Satellite links.
  Some examples are Internet and Broadband Mobile Connections, such as 3G or 4G.



WAN

Transmission Modes

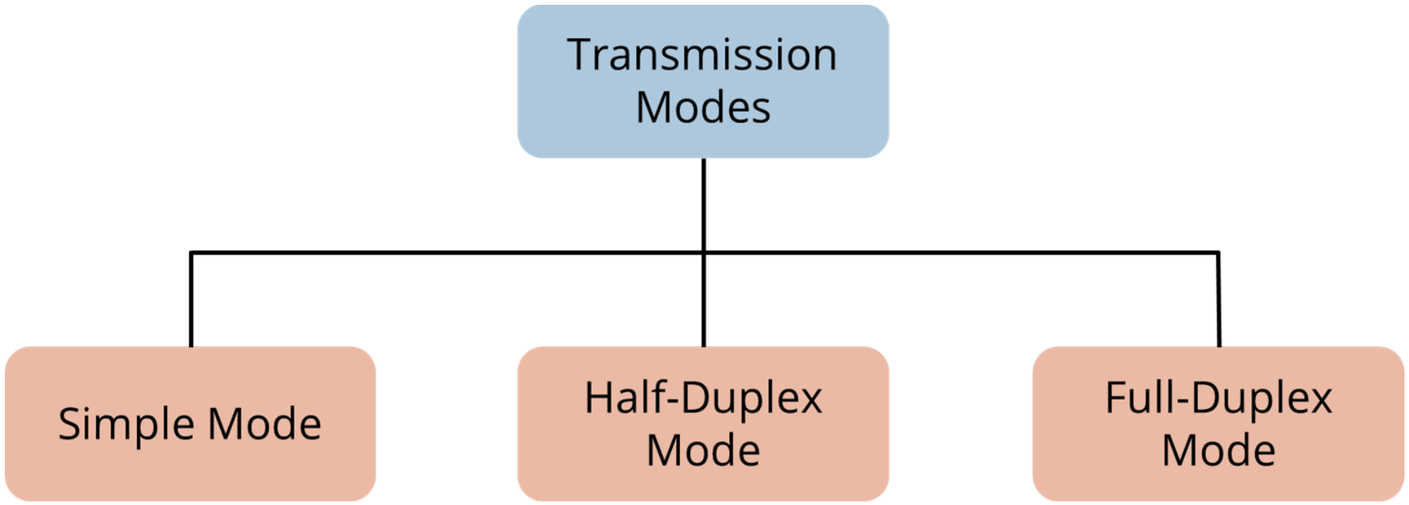
A transmission mode is a mechanism of transferring the data between two devices. These devices or nodes must relate or connect to each other.



It is also called communication mode. The modes direct the direction of the flow of information. The transmission mode is defined in the physical layer.

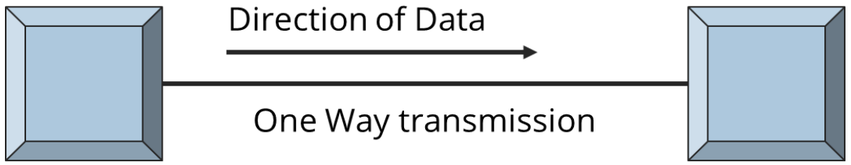
Transmission Modes

The transmission mode is divided into three categories:



Simplex Transmission Mode

The features of simplex transmission mode are:

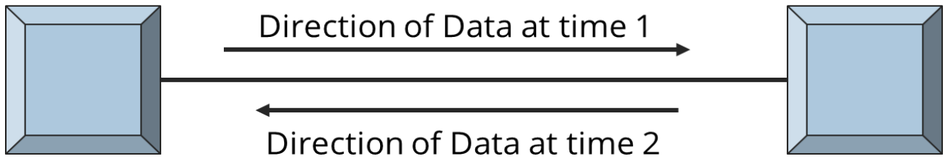


Simplex Mode

- In simplex mode the data transmits in one direction only.
- This transmission mode is also known as unidirectional transmission.
- The sender device can only send data and cannot receive it, whereas the receiver device can only receive the data and cannot send it.
- For example, a television demonstrates simplex mode.

Half-Duplex Transmission Mode

The features of simple transmission mode are:

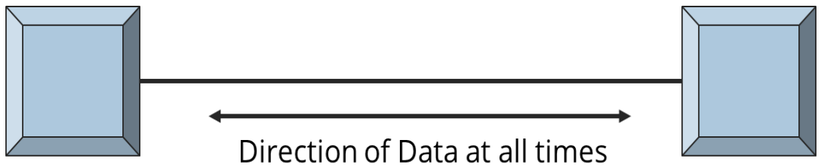


Half-Duplex Mode

- In half-duplex mode, transmission can be done both ways.
- Two connected devices can send and receive data at different times.
- An example of a half-duplex is a **walkie-talkie** in which one message is sent at a time, but multiple messages are sent in both directions.

Full-Duplex Transmission Mode

The features of simple transmission mode are:



Full-Duplex Mode

- In this mode, data can be sent in both directions at the same time.
- There is no delay in communication as both can send and receive data simultaneously.
- An example of a Full Duplex is a Telephone Network, that is, communication between two persons by a telephone line, using which both can talk and listen at the same time.

Internet

Internet

The Internet is a global system of interconnected computer networks. It uses a standard Internet Protocol (IP) suite to link several devices.

- It is an international network of network, linked by optical, wireless, and electronic networking technologies.
- It consists of business, public, educational, and government networks.

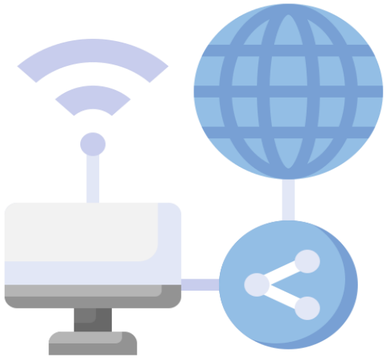
Internet

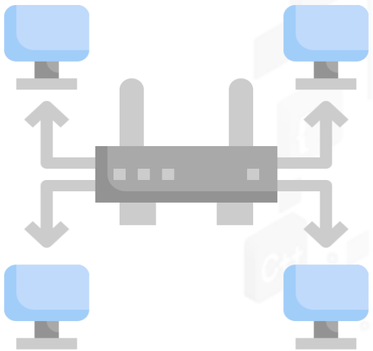
It carries an extensive range of information resources and utilizes:

- IP Addressing Scheme
- Transmission Control Protocol (TCP)
- Peer2Peer (P2P) networks for file sharing

Intranet

An intranet is a private network that is contained within an enterprise.
It consists of interlinked LAN and uses WAN for network connectivity.





Its purpose is to share company information among employees. It is usually created and maintained by a private organization, and the content is intended for the members of the organization only.

Extranet

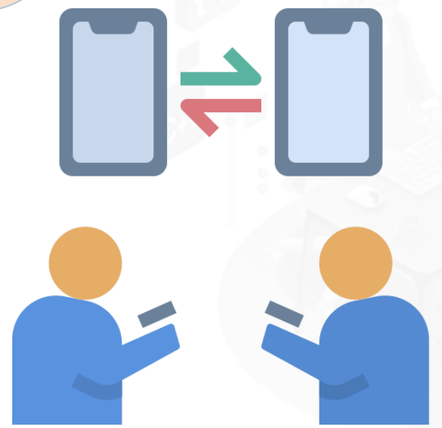
Extranet uses internet protocols to link intranet over the public internet. It is a part of a company's intranet that is extended to users outside the company, such as suppliers, vendors, partners, customers, and so on.

Some examples are placing of purchase order to registered vendors, billing & invoices, payments related activities, joint venture related activities, product brochures for partners, discounted price lists for partners, and so on.

Extranet

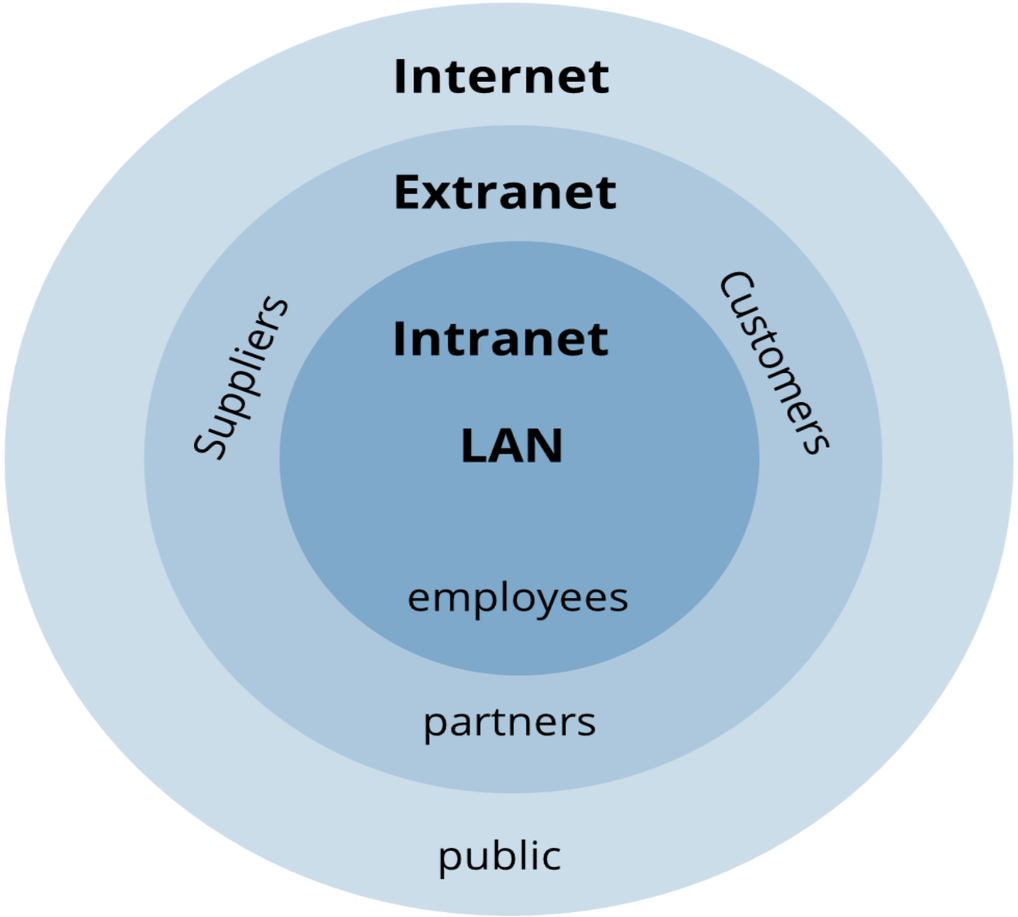
Extranet can be used to:

- Exchange large volume of data
- Collaborate with partners & Peers
- Share Product Catalogs



Internet, Intranet, and Extranet

The subset of internet, intranet and extranet is:



Email

Email is a way to send and receive messages across the Internet. Each user of email is assigned a unique name for their email account.

- An email address is generally written as username@domainname.
- For example, king.kochhar@abc.com is an email address.
- The username and the domain name are separated by @ (at) symbol.
- Email addresses are not case sensitive. Spaces are not allowed in email address.

Email

The advantages of email are :

Productivity Tools	Email is usually packaged with a calendar, address book, instant messaging, and so on for convenience and productivity.
Access to Web Services	To sign up for an account like Facebook or services like Amazon, a user will need an email address to be safely identified and contacted.
Easy Mail Management	Email service providers have tools that allow users to file, label, prioritize, find, group, and filter their emails for easy management. They can even control spam or junk emails.

Email

The advantages of email are :

Communication with People	A user can send an email to multiple people at once, with an option to include as few or as many people required in the conversation.
Anywhere Anytime	A user does not have to be at home to get the email. They can access it from any computer or cell phone that has an Internet connection.

WebMail Providers

The top three webmail providers are Yahoo!, Outlook.com, and Google's Gmail. These providers allow you to access your email account from anywhere.

There are several email service providers available in the market with their enabled features, such as sending, receiving, drafting, storing an email, and so on.

Computer Security

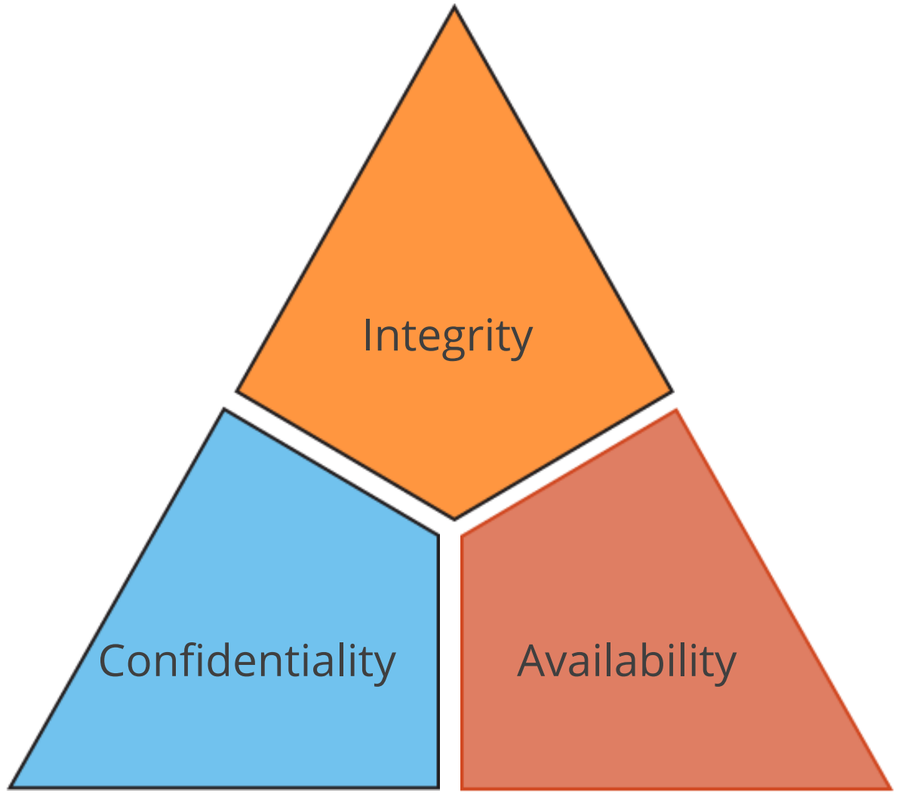
What Is Computer Security?

Computer security is the protection of computer systems and information from unauthorized use, which allows a user to use the computer while keeping it safe from threats.

It secures the personal information and the overall health of the computer. Adequate computer security helps prevent viruses and malware, allowing programs to perform faster and more smoothly.

CIA Triad in Security

Since the first mainframes, the industry standard for computer security has been Confidentiality, Integrity, and Availability.



CIA Triad in Security

Confidentiality:

Ensuring that data is unavailable to unauthorized parties, usually using encryption, IDs, and passwords

Integrity:

Preventing unauthorized parties from altering information and systems and guaranteeing that the protected data is correct and reliable

Availability:

Ensuring that authorized persons have access to information when they need it, keeping them up to date on upgrades, and employing backups to prevent disruptions or data loss among other things

Key Takeaways

- Computer Fundamentals has three main aspects: Input, Output, and Computer Memory.
- An Operating System is a unit of system software that manages a computer's resources, such as hardware and software.
- A computer network is a group of devices connected to each other.
- Computer security allows a user to use the computer while keeping it safe from threats.

Thank you