Unit-2

Operating System

(e) Definition of Operating System :- An Operating System (OS) is a system software that acts as an interface between the user and computer hardware, managing all hardware and softwa resources, and providing services for application programs.

The operating system is :-

(i) the middleman - acts as a friendly interpr , taking your requests (like open this document) and telling the hardware what to do. It also takes the hardware's responses and shows them to you in a user-friendly wa

(ii) the resource boss - The OS is incharge of dividing up the resources fairly and efficiently among all the programs you're running.

(iii) the traffic cop - OS manages the flow of data and instructions keeping everything running smoothly and preventing chaos.

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(ii) Functions of Operating System :

(i) Process Management : manages running programs, schedules CPU time, and ensures smooth execution.

(ii) Memory Management : Allocates memory to programs, keeps track of used and free memory.

(iii) File Management : Manages files and directories on storage devices

(iv) Device Management : Controls input / output devices like keyboard, mouse, printer and monitors.

(v) Security & Access Control : Protects data and resources from unauthorized access

(vi) User Interface (UI) : Provides interface for users to interact with the computer

(vii) Networking : Manages network connections and data communication between computers.

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(a) Types of Operating System :- An operating system (OS) can be classified into several types based on how it handles tasks, users, and resources.

(i) Batch Operating System - In a Batch Operating System similar jobs are collected (batched) together and executed one after another without user interaction.

How it works :
- Users submit their jobs to an operator.
- The operator groups similar jobs into batches.
- The system executes each batch automatically.

Ex :- Early IBM mainframe systems.

Advantages :- • Efficient for large, repetitive tasks
• Reduces idle time of CPU.

Disadvantages :- • No interaction between user and computer during execution.
• Debugging errors is difficult.

(ii) Multiprogramming OS - A multiprogramming OS allows multiple programs to reside in memory at the same time, sharing CPU resources.

How it works :
- When one program waits for I/O, the CPU executes another program.
- Increases CPU utilization.

Ex :- UNIX, Linux (early versions)

Advantages : • Efficient CPU utilization
• Increased throughput

Disadvantages : • Requires large memory
• Complex to manage

(iii) Multitasking / Time Sharing Operating System :-
A time-sharing OS allows multiple users or tasks to use the CPU at the same time by quickly switching between them.

How it works :
• CPU time is divided into small units called time slices.
• Each task gets a time slice, creating the illusion of simultaneous execution.
Ex :- Windows, macOS, Linux

Advantages : • Multiple users can interact with the system at once.
• Minimizes CPU idle time.

Disadvantages : • Requires high processing power
• security and data integrity issues may arise.

(iv) Real-Time OS :- A real time OS is designed to process data and respond to inputs immediately or within a fixed time limit.
Types of RTOS :
(i) Hard Real-Time OS : Response must occur within strict deadline. Ex - Airplane control system
(ii) Soft Real-Time OS : Delays are acceptable but should be minimal. Ex - online transcation system.

(v) **Distributed Operating System** :- A distributed OS manages a group of independent computers and makes them appear as a single system to the user.

How it works :
- Tasks are distributed among different connected computers (nodes)
- Each node communicates through a network.

Advantages : • Resource sharing and faster processing
• High reliability (if one node fails, others continue)

Disadvantages : • complex to design
• Security and synchronization issues.

(vi) **Network Operating System (NOS)** :- A network OS manages data, users, and applications over a network of computers.

How it works :
- Provides network services like file sharing, printing, communication, and security.
- Each computer runs its own OS but can access shared resources.

Advantages : • centralized management of data & security
• Easy communication between systems.

Disadvantages : • Expensive setup and maintainance
• Server dependency (if server fails, network may stop

(vii) Mobile Operating System :- A mobile OS is designed specifically for smartphones, tablets, and handheld devices with touch-based interfaces. Ex:- Android, iOS etc.

Advantages :-
- Optimized for mobility, sensors, and low power used
- Provides GUI and supports apps easily

Disadvantages :-
- Limited multitasking
- Hardware-dependent

(v) Classification of Operating System :- The Operating System can be classified based on how it handles users, tasks, and resources.

(i) Based on Number of Users :

(a) Single-User Operating System - Allows only one user to operate the computer at a time. Ex- MS-DOS, older versions of Windows.

(b) Multi-User Operating System - Allows multiple users to access the computer simultaneously through different terminals. Ex - UNIX, Linux, modern Windows Server.

(ii) Based on Number of Tasks :

(a) Single-Tasking OS - can run only one program at a time. Ex - MSDOS

(b) multi-Tasking OS - can run multiple programs at the same time by sharing CPU time. Ex - Windows, macOS, Linux

(iii) Based on Processing :

(a) Batch Processing OS - executes jobs in batches without user interaction

(b) Real-Time OS - responds to inputs immediately or within fixed deadlines.

(c) Time-sharing OS - Provides CPU time slices to multiple users for simultaneous access.

(d) Distributed OS - Runs on multiple interconnected computers and manages resources collectively.

(iv) Based on Mode of Operation :

(a) Network OS - Manages and controls network resources and communication between connected computers.

(b) Mobile OS - specifically designed for mobile devices with touch interface and sensors.

(a) ▶ Elements of Command-based and GUI-based OS

Operating systems provide different ways for users to interact with the computer - mainly through command-line Interface (CLI) or Graphical User Interface (GUI). Each has its own elements that help users perform operations.

(i) Command-Based Operating System (CLI)

A command-based operating system (or command-line interface) allows users to type textual commands to perform tasks such as file management, program execution, and system control.

Main elements of CLI :

(a) Command Prompt :- The text-based interface where the user types commands.
Example :- C:\> in MS-DOS

(b) Commands :- Specific words or keywords given to perform operations
Example :- DIR, COPY, DEL, MKDIR

(c) syntax :- The proper format or structure that must be followed for commands.
Example :- COPY source destination

(d) Switches / Parameters :- Modifiers added to commands to change their behaviour.
Example :- DIR /P

(e) File System Navigation :- Commands to move between directories or drives.
Example - CD, DIR, CLS

(f) Error Messages :- Text messages shown when a command fails.

(g) Batch Files :- A group of commands stored in a file and executed sequentially.

Example - .BAT files.

Examples of Command Line Interface :-
• MS-DOS • UNIX (shell) • Linux Terminal

(ii) GUI - Based Operating System :-
A GUI Based operating system allows users to interact using graphical elements such as windows, icons, menus, and buttons instead of typing commands.

Main Elements of GUI :-

(a) Desktop :- The main screen containing icons, shortcuts and background.
Ex - Windows desktop

(b) Icons :- Small graphical symbols representing files, folders, or applications.

(c) Windows :- Rectangular areas where applications and files open.
Ex- Word Document Window.

(d) Menus :- List of options or commands displayed to perform actions.
Ex - File → Open, Save, Exit

(e) Taskbar / Dock :- Shows running applications and system shortcuts.
Ex- Windows Taskbar

(f) Buttons :- Clickable controls to perform actions.
Ex - OK, Cancel, Close (X).

(g) Dialog Boxes :- Popup windows that asks for user input or confirmation.
Ex - save file

(h) Pointer / Cursor :- Controlled by mouse or touchpad for selecting items.

(i) Control Panel / Settings :- Area to configure system hardware and software.
Ex - Display settings, Wi-Fi setup.

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Ans Difference b/w Command Based OS and GUI-Based OS

Feature	Command Based	GUI Based
User Interface	Text-Based	Graphical
Ease of use	Difficult for Beginners	Very user-friendly.
Input Method	Keyboard Commands	Mouse, keyboard, Touch
Speed	Fast for experts	Slower due to graphics
Examples	MS-DOS, UNIX	Windows, macOS, Android.

Computer Network

- Definition of computer Network :- A computer network is an interconnected collection of computers and other devices that communicate with each other to share resources such as data, files, printers, and internet services.

Examples :
- Two computers connected using a LAN cable
- Internet (the largest network in the world)
- Wi-Fi connection between a laptop and a mobile phone.

- Main Objectives of Computer Networking :-

(i) Resource sharing - sharing printers, files, software, and storage among users.

(ii) Communication - Sending emails, instant messages and video calls.

(iii) Data sharing - Accessing and exchanging data between systems

(iv) Centralized Data Management - Storing and managing information in one central location.

(v) Backup and Recovery - Ensures data safety through network-based backups.

- **Components of a Computer Network:**

(i) **Computers (Nodes)** :- Devices like PCs, laptops, or servers connected in the network.

(ii) **Network Devices** :- Hardware like routers, switches, hubs and modems.

(iii) **Transmission Medium** :- The medium used for data transfer - cables (wired) or radio waves (wireless)

(iv) **Network Interface Card (NIC)** :- Hardware that connects a computer to the network.

(v) **Protocols** :- Set of rules that govern communication

(vi) **Network Software** :- OS and programs used for managing and controlling the network.

(ii) Types of Computer Network :- A computer network is classified based on its geographical area, size, and purpose.
The main types are PAN, LAN, MAN, WAN.

(i) PAN (Personal Area Network)
- coverage area is very small (a few meters)
- Connects personal devices around a single person
- Example :- Bluetooth connection, Hotspot sharing
- Transmission is mostly wireless
- Devices used are: laptop, smartphone, smartwatch, printer.

(ii) LAN (Local Area Network)
- coverage area is small such as building, office, or school.
- connects multiple computers for sharing data and devices like printers.
- Transmission is either wired or wireless.
- Devices used are switch, Router, Hub, ethernet cable.
- speed is high.

Example :- All computers connected within a school's computer lab.

(iii) MAN (Metropolitan Area Network) :-

- covers a city or large campus
- connects several LANs together within a metropolitan area.
- Transmission type is wired or fibre optic cable
- Devices used are routers, switches, modem
- Speed is medium to High.

Example : cable TV or citywide WiFi network.

(iv) WAN (Wide Area Network)

- covers large geographical areas like countries or continents.
- Purpose is to connect multiple LANs and MANs together.
- Transmission Type is satellite links, fibre optics, telephone lines.
- Devices used are routers, Modems, Firewalls
- Speed is lower due to distance.

example : Internet

(v) Other modern Networks :-

- CAN (campus area network) - connects multiple LANs within a campus or university.
- SAN (storage area network) - High speed network for connecting data storage devices
- VPN (Virtual Private Network) - creates a secure network over the internet.
- WLAN (Wireless LAN) - A LAN without physical

Q) Data Communication & Data communication is the exchange of digital or analog data between two or more devices via a transmission medium such as wires, fiber optics, or wireless channels.

Key elements of Data Communication :-

1.) Sender - The device or computer that sends the data.

2.) Reciever - The device or computer that receives the data.

3.) Medium / Channel - The physical path or communication medium through which data travels.
Ex - Copper cable, fibre optics, air.

4.) Message / Data - The actual information that is transmitted. It can be text, audio, video, or other digital data.

5.) Protocol - A set of rules that control data transfer and reception.

Types of Data communication / Transmission Modes :-

- Types :-

(i) Simplex :- Data flows in one direction only
Sender → Receiver
Ex :- Keyboard → Computer , TV Broadcast

(ii) Half Duplex :- Data flows in both directions, but one at a time.
Ex :- Walkie-talkie , CB radio

(iii) Full Duplex :- Data flows simultaneously in both directions.
Ex :- Telephone , Internet chats

- Modes :-

(i) Serial Transmission - data is sent one bit at a time over a single channel

(ii) Parallel Transmission - multiple bits are sent simultaneously over multiple channels.

- Transmission Media :-

(i) Wired / Guided - physical medium such as coaxial cable , twisted pair , or fibre optic cable.

(ii) Wireless / Unguided :- no physical medium, uses radiowaves , microwaves , infrared ,

Digital Data :- Digital data is information represented in discrete (binary) form, usually 0s and 1s.
- Can be easily stored, processed, and transmitted by computers.
- Less prone to noise and distortion
- easy to encrypt and secure.

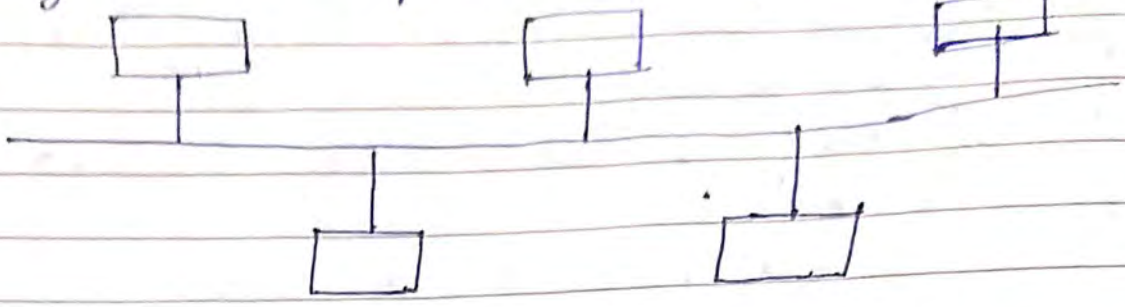
Analog Data :- Analog data is information represented in continuous form that can take any value in a range.
- Continuous signals that vary smoothly over time
- Prone to noise and distortion
- Example - Human voice in telephone, Radio signals.

Network Topologies :- Network Topology refers to the arrangements or layout of different elements in a computer networks.
It shows how computers, printers, and other devices are connected and how data flows between them

- **Types of Network Topologies :-**

(i) Bus Topology - All devices are connected to a single central cable called the backbone.
Data travels in both directions.
Advantage :- • easy to install
• requires less cable
Disadvantage :- • Network fails if backbone fails
• difficult to troubleshoot

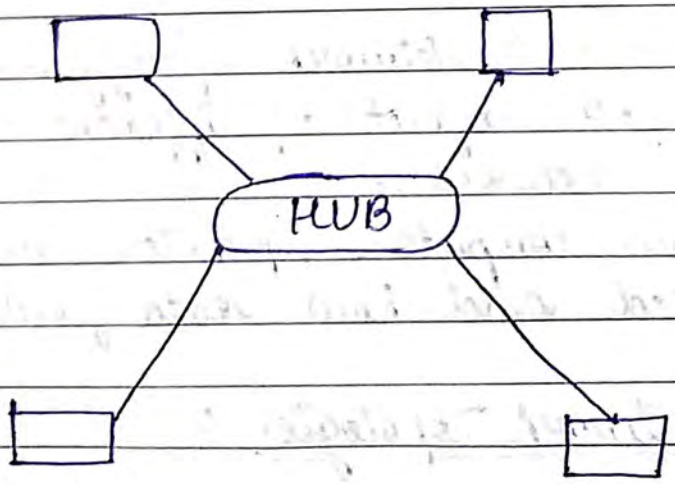
Diagrammatic representation of Bus topology:



(ii) Star Topology :- All devices are connected to a central hub, switch or router.

Advantage:
- Easy to install and manage
- Failure of one device doesn't affect others

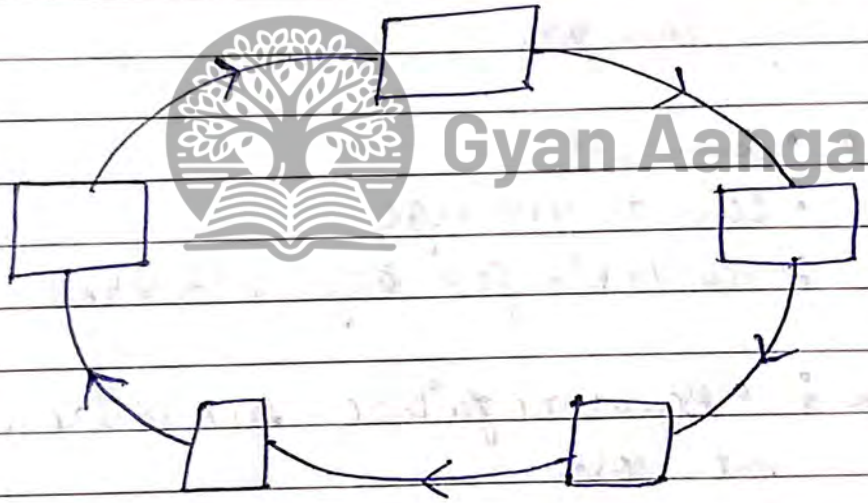
Disadvantage :-
- central hub failure affects entire networks.
- Requires more cable.



(iii) Ring Topology :- Each device is connected to exactly two other devices, forming a ring. Data travels in one direction.

Advantage :-
- easy to install
- Data packets move in a predictable path

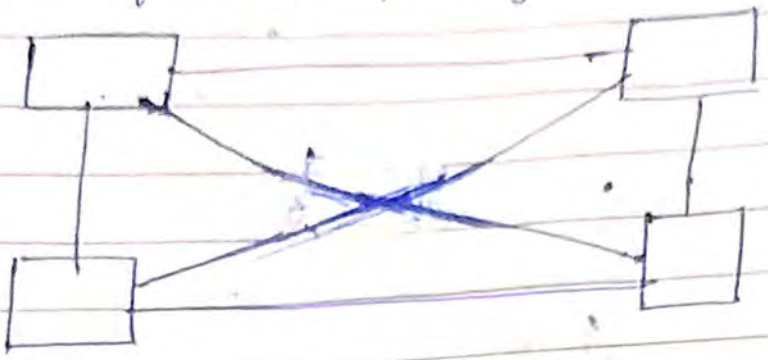
Disadvantage :-
- Failure of one device can break the network
- Troubleshooting is difficult.



(iv) Mesh Topology :- Every device is connected to every other device directly.

- Advantage :-
  - High reliability
  - failure of one device does not affect network
  - fast data transmission
- Disadvantage :-
  - Expensive
  - Requires a lot of cables
  - complex to install

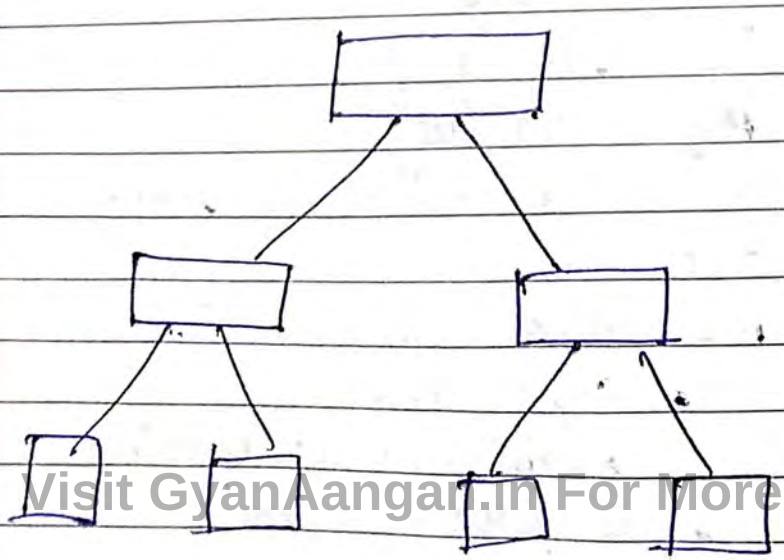
Diagram of mesh topology :-



(v) Tree Topology :- Hierarchical topology combining star and bus topologies. Groups of star networks are connected to a central backbone.

Advantage :- • Scalable
• Easy to manage
• Suitable for large networks

Disadvantage :- • Backbone failure can collapse the network
• Expensive



(vii) **Hybrid topology** : Combination of two or more topologies.