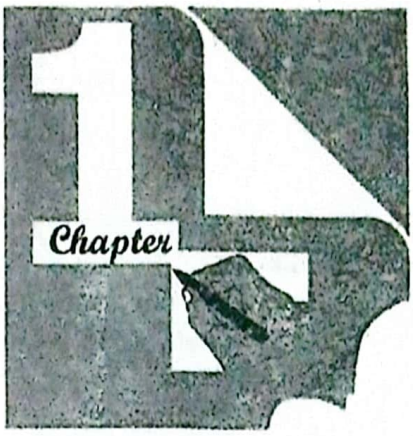


INTRODUCTION TO OPERATING SYSTEM

CHAPTER OUTLINE

After comprehensive study of this chapter, you will be able to:

- History, introduction and generation of Operating system
- Objectives (Resource Manager and Extended Machine)
- Types of Operating system
- Function of Operating system

INTRODUCTION

Computer has a great importance in today's world. Most of the things done today are because of computers. The computer is not only a bare hardware; it consists of proper combination of hardware and software. The one most important software required to run computer is operating system.

One or more processor, some main memory, disks, printers, keyboards, display, etc. are the major components of today's computer. As a whole today's computer is a complex system. These complex systems require running smoothly where as a record of every component should be kept every time a task is done, for these all an operating system is required.

WHAT IS OPERATING SYSTEM?

It is difficult for one to define operating system in a precise manner. We can say what an operating system does and what for operating system is? Though operating system can be defined as "an interface between users and hardware, which hides the complexities of hardware from users i.e. operating system performs the logical operations in machine language and displays it to user in a non-complex manner". In general Operating system is system software designed to run a computer's hardware and application programs.

For large systems, the operating system has even greater responsibilities and powers. It is like a traffic police, which makes sure that different program and users running at the same time do not interfere with each other. The operating system is also responsible for security, ensuring that unauthorized users do not access the system.

In other words, an operating system is a program that acts as an intermediary between a user of a computer and the computer hardware, to provide an environment in which a user can execute programs. The primary goal of an operating system is thus to make the computer system convenient to use. And to use the computer hardware in an efficient manner. In brief, an operating system is the set of programs that controls a computer.An operating system is an important part of almost every computer system. This can be divided roughly into four components: the hardware, the operating system, the application programs and the users.

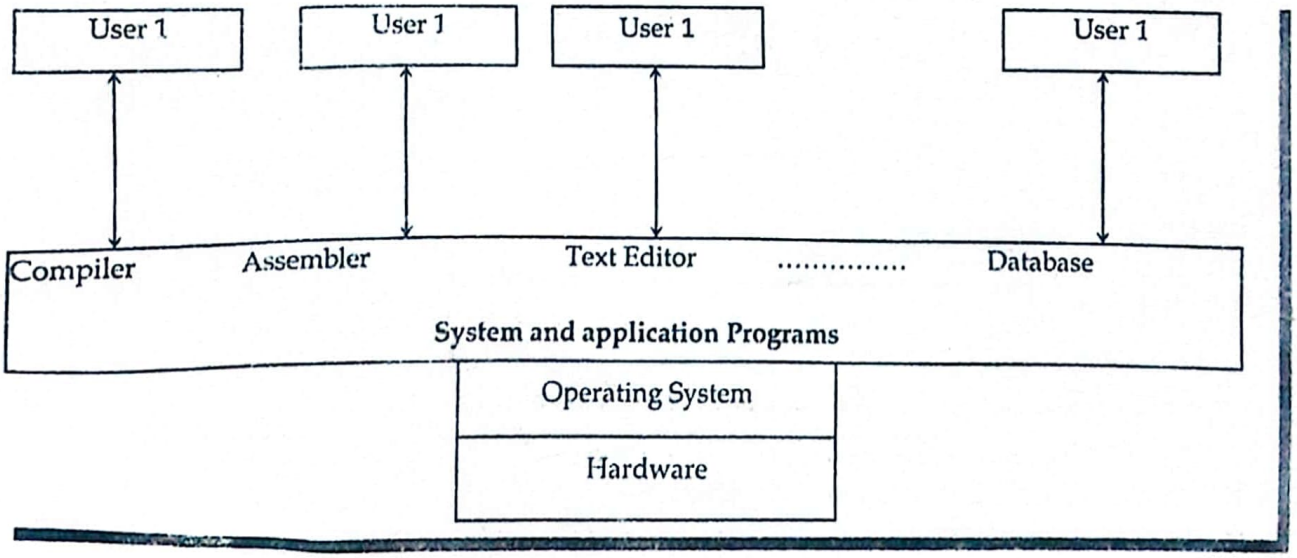


Fig 1.1: An overview of Complex System

Hardware, provides basic computing resources (CPU, Memory, I/O devices etc.) whereas Operating System controls and co-ordinates the use of the hardware among the various users. It is usually that portion of software that runs in kernel mode or supervisor mode. The application Programs define the way in which the system resources are used to solve the computing problems and users are the People, machine, other computers or processes.Some common operating systems are desktop operating system; network operating system; mobile operating system; embedded system operating system etc. Examples of operating system are Windows, Android, iOS, Mac OS, Linux, Chrome OS, and Windows Phone OS etc.

The advantage of using Operating System

- Allows you to hide details of hardware by creating an abstraction
- Easy to use with a GUI
- Offers an environment in which a user may execute programs/applications
- The operating system must make sure that the computer system convenient to use
- Operating System acts as an intermediary among applications and the hardware components
- It provides the computer system resources with easy to use format
- Acts as an intermediator between all hardware's and software's of the system

Disadvantages of using Operating System

- If any issue occurs in OS, you may lose all the contents which have been stored in your system
- Operating system's software is quite expensive for small size organization which adds burden on them. Example Windows
- It is never entirely secure as a threat can occur at any time

ASPECTS OF OPERATING SYSTEM (OBJECTIVES)

The aspect of operating system also called views or functions of operating system are generally covered in two parts.

- Operating system as an extended machine
- Operating system as a resource manager

Operating System as an Extended Machine

As we have discussed earlier today's computers comes with multiple components, we (users) are not interested on how these components work together to perform our task, all we need is our task needs to be completed with no complexity and overhead. We are no more interested about the read write commands performed during computing nor about the error and status list maintained by system.

Thus all we need is that the program should hide the truth about the hardware from the programmer and presents a nice, simple view of named files that can be read and written. This is the very primitive task of operating system. User is neither interested weather the file is written in CD or hard drive or some other device, nor about how it is stored? Contiguously or is broken into blocks. In this view, the function of the operating system is to present the user with the equivalence of an extended machine or virtual machine that is easier to program than the underlying hardware. To achieve it all, the operating system provides a variety of services that programs can obtain using special instructions called system calls.

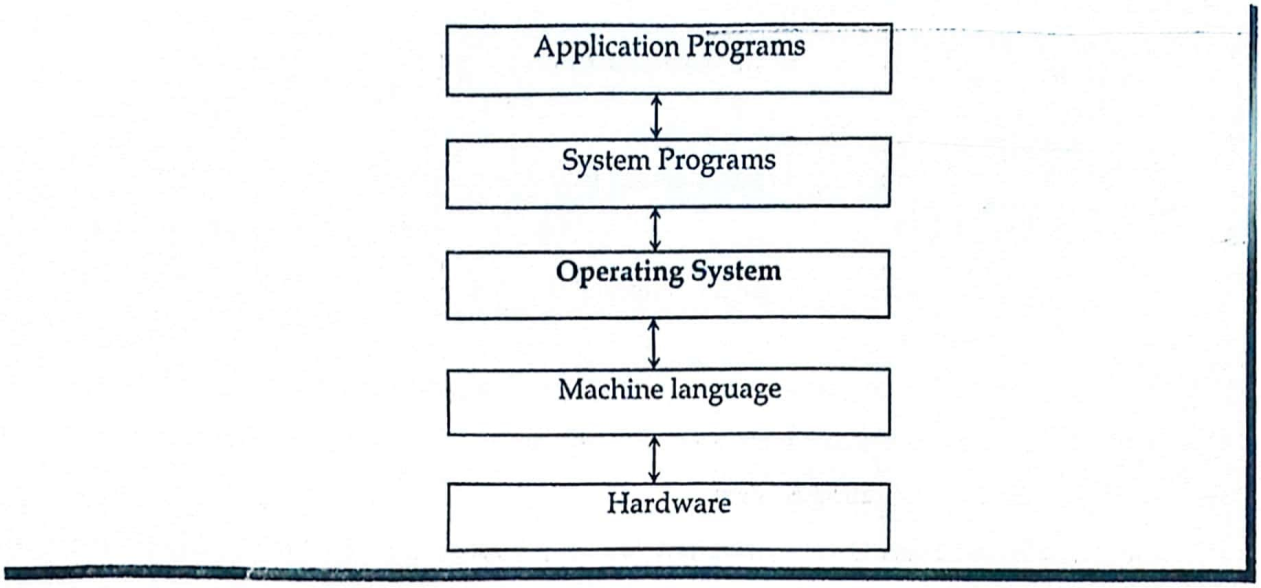


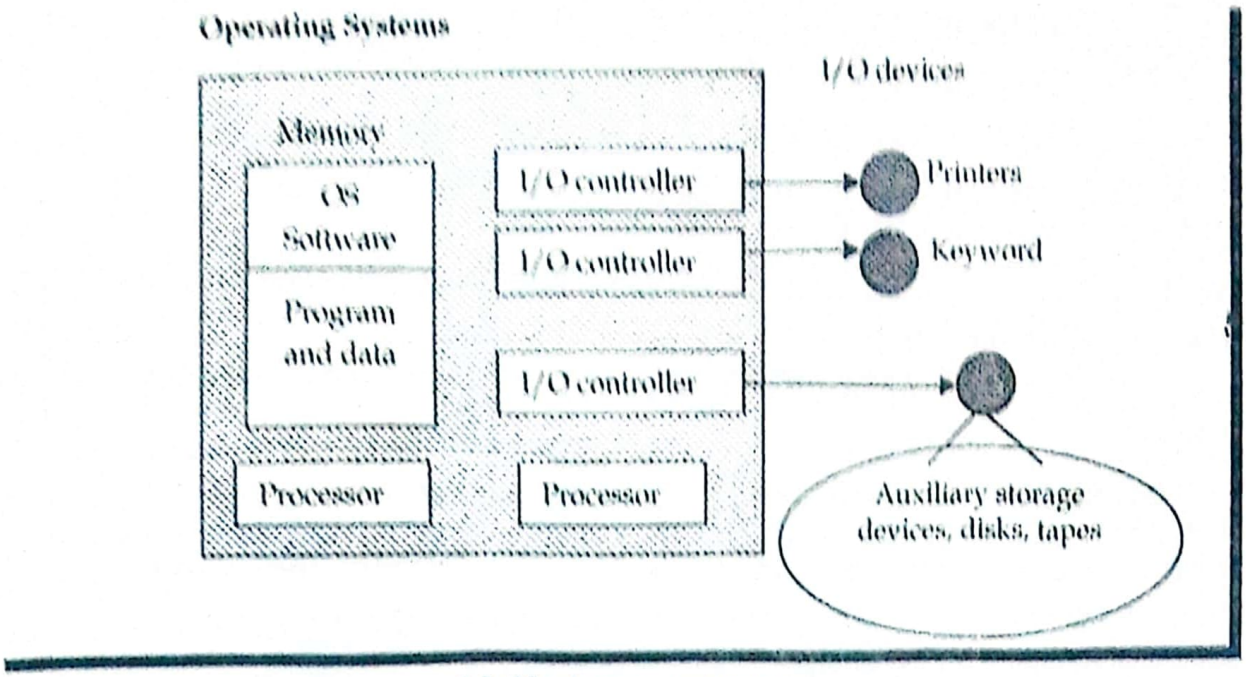
Fig 1.2: OS act as extended machine

The Operating System as a Resource Manager

No matter what kind of machine you have constructed, its major function is how resources are managed. For example, we have constructed a system which provides all necessary banking operations, one need to deposit amount in one account meanwhile another user requires to print statement regarding to the account details i.e. first user requires to access the database while the second one too requires to access database as well as printer. As we have discussed earlier users are interested in getting their job done. But the problem occurs with the system how to manage these requests. The process of managing all these (resources) is resource management, and this is done by resource manager. Now let's think about complex system (computer).

- What happens if three programs try to print their output on the same printer at the same time?
- What happens if two network users try to update a shared document at same time?

The primary function is to manage all pieces of a complex system i.e. provide all necessary resources to the process asking for it.



1.3: OS act as resource manager

EVOLUTION OF OPERATING SYSTEM

Operating systems have been evolving through the years. The first true digital computer was designed by the English mathematician Charles Babbage (1792-1871). Babbage spent most of the life trying to build his "analytical engine." He was unsuccessful because of the technology of those days could not produce the necessary parts required like wheels, gears, and cogs to the high precision for his machine. Needless to say, the analytical engine did not have an operating system. Babbage realized that he would need software for his analytical engine, so he hired a young woman named **Ada** Lovelace. The programming language **Ada** is named after her.

The First Generation (1945-55) Vacuum Tubes

The early computers of the late 1940s had no operating system. Every program that ran on these early systems had to include all of the code necessary to run the computer, communicate with connected hardware, and perform the computation the program was actually intended to perform. This situation meant that even simple programs were complex. As computer systems diversified and became more complex and powerful, it became increasingly impractical to write programs that functioned as both an operating system and a useful application.

Human operators scheduled jobs for execution and supervised the use of the computer's resources. Because these early computers were very expensive, the main purpose of an operating system in these early days was to make the hardware as efficient as possible. Now, computer hardware is relatively cheap by comparison with the cost of the personnel required to operate it, so the purpose of the operating system has evolved to encompass the task of making the user as efficient as possible.

Features of first generation OS

- **Speed:** 50 multiplications/sec
- **Input/output:** cards, punchedtape

- **Memory type:** punched tape,vacuum tubes, relays
- **Technology:** 20,000 relays,12,500 vacuum tubes
- **Floor space:** 25 feet by 40 feet
- Use vacuum tubes to build calculatingengines.
- All programming was done in machinelanguage, often by wiring up plug boards tocontrol the machine's basic functions.
- Need to sign up for a block of time, comedown to the machine room, insert plug boardsand wait for calculation

The Second Generation (1955-65) Transistors and Batch Systems

In 1950s transistor were introduced and for the first time, there was a clear separation between designers, builders, operators, programmers, and maintenance personnel. These machines (now called mainframes) were locked in air conditioned rooms, with professional operators to run them. To run a job, a programmer would first write the program on paper (in FORTRAN or assembler), then punch it on cards. When the computer finished whatever job it was currently running, an operator would go over to the printer and tear off the output and carry it over to the output room, so that the programmer could collect it later. Then he would take one of the card decks that had been brought from the input room and read it in. If the FORTRAN compiler was needed, the operator would have to get it from a file cabinet and read it in. Much computer time was wasted while operators were walking around the machine room.

To speed up processing, jobs with similar needs were batched together and were run through the computer as a group, which was introduced in the same generation. These computers used batch operating systems, in which the computer ran batches of jobs without stop. Programs were punched into cards that were usually copied to tape for processing. When the computer finished one job, it would immediately start the next one on the tape. Professional operators, not the users, interacted with the machine. Users dropped jobs off, and then returned to pick up the results after their jobs had run. This was inconvenient for the users, but the expensive computer was kept busy with a steady stream of jobs.The definitive feature of a batch system is the lack of interaction between the user and the job while that job is executing. In this execution environment, the CPU is often idle. The problems with Batch Systems are as follows:

- Lack of interaction between the user and the job.
- CPU is often idle, because the speed of the mechanical I/O devices is slower than the CPU.
- Difficult to provide the desired priority.

Features of second generation OS

- Transistor was invented in the mid-1950s. Computer becomes more reliable since vacuum tubes are replaced by transistors –mainframes.

- IBM's 7000 series mainframes were the company's first transistorized computers. Significantly faster and more dependable than vacuum tube machines.
- Write the program on paper and Punch it on cards

The Third Generation (1965-1980) ICs and Multiprogramming

The period of third generation was from 1965-1980. The computers of third generation used Integrated Circuits (ICs) in place of transistors. A single IC has many transistors, resistors, and capacitors along with the associated circuitry. This development made computers smaller in size, reliable, and efficient. In this generation remote processing, time-sharing, multiprogramming operating system was used. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation. During this generation several advancements were done in computer operating system like multiprogramming, time sharing, Real time operating systems were introduced.

Major feature of the third generation operating system

- IBM System/360 was the first major computer to use IC(integrated circuit)
- Uses multiprogramming technique to save CPU time.
- **Uses spooling technique** – The process in which information to be printed is stored temporarily in a file, the printing being carried out later. It is used to prevent a relatively slow printer from holding up the system at critical times, and to enable several computers or programs to share one printer.
- Uses timesharing system to share CPU time between users using terminal.

The Fourth Generation (1980-Present) Personal Computers

With the development of LSI (Large Scale Integration) circuits, chips containing thousands of transistors on a square centimeter of silicon, the age of the personal computer dawned, personal Computers were easy to. These were chips containing thousands of transistors on a square centimeter of silicon. Because of these, microcomputers were much cheaper than minicomputers and that made it possible for a single individual to own one of them.

The advent of personal computers also led to the growth of networks. This created network operating systems and distributed operating systems. The users were aware of a network while using a network operating system and could log in to remote machines and copy files from one machine to another.

Major feature of the fourth generation operating system

- The development of LSI (Large Scale Integration) circuits (containing thousands of transistors) reduces the price of computer, which make it possible to build personal computer.
- A group of two or more computer systems linked together.
- User type in commands from the keyboard

BRIEF HISTORY OF OS

- Operating systems were first developed in the late 1950s to manage tape storage
- The General Motors Research Lab implemented the first OS in the early 1950s for their IBM 701
- In the mid-1960s, operating systems started to use disks
- In the late 1960s, the first version of the Unix OS was developed
- The first OS built by Microsoft was DOS. It was built in 1981 by purchasing the 86-DOS software from a Seattle company
- The present-day popular OS Windows first came to existence in 1985 when a GUI was created and paired with MS-DOS.

TYPES OF OPERATING SYSTEMS

An Operating System performs all the basic tasks like managing file, process, and memory. Thus operating system acts as manager of all the resources, i.e. resource manager. Thus operating system becomes an interface between user and machine. Some of the widely used operating systems are as follows:

- Batch Operating System
- Multiprogramming Operating System
- Multiprocessor Operating System
- Time-Sharing Operating Systems
- Real-Time Operating System
- Distributed Operating System
- Network Operating System

Batch Operating System

Early computers were large machines run from a console with card readers and tape drives as input devices and line printers, tape drives, and card punches as output devices. The user did not interact directly with the system; instead, the user prepared a job, (which consisted of the program, data, and some control information about the nature of the job in the form of control cards) and submitted this to the computer operator. The job was in the form of punch cards, and at some later time, the output was generated by the system. The output consisted of the result of the program, as well as a dump of the final memory and register contents for debugging.

To speed up processing, operators batched together jobs with similar needs and ran them through the computer as a group. For example, all FORTRAN programs were compiled one after the other.

The major task of such an operating system was to transfer control automatically from one job to the next. Such systems in which the user does not get to interact with his jobs and jobs with similar needs are executed in a "batch", one after the other, are known as batch systems. Digital Equipment

Eg. Payroll, forcasting.

In the batch environment, it requires the grouping of similar jobs, which consists of programs, data and system commands. It is also known as offline processing.

Corporation's VMS is an example of a batch operating system. Examples of Batch based Operating System: Payroll System, Bank Statements etc.

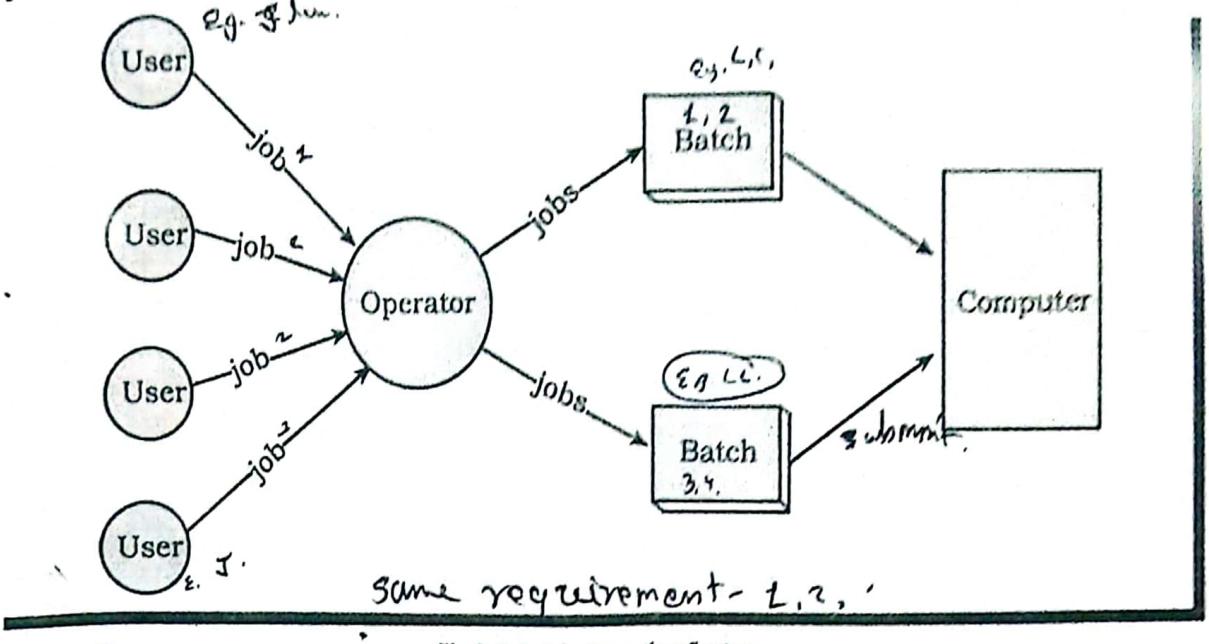


Fig 1.4: Batch Operating System

Advantages of Batch Operating System

- It is very difficult to guess or know the time required by any job to complete. Processors of the batch systems know how long the job would be when it is in queue
- Multiple users can share the batch systems
- The idle time for batch system is very less
- It is easy to manage large work repeatedly in batch systems

Disadvantages of Batch Operating System

- The computer operators should be well known with batch systems
- Batch systems are hard to debug
- It is sometime costly
- The other jobs will have to wait for an unknown time if any job fails

Multiprogramming Operating System

To overcome the problem of underutilization of CPU and main memory, the multiprogramming was introduced. The multiprogramming is interleaved execution of multiple jobs by the same computer. In multiprogramming system, when one program is waiting for I/O transfer; there is another program ready to utilize the CPU. So it is possible for several jobs to share the time of the CPU. But it is important to note that multiprogramming is not defined to be the execution of jobs at the same instance of time. Rather it does mean that there are a number of jobs available to the CPU (placed in main memory) and a portion of one is executed then a segment of another and so on. A simple process of multiprogramming is shown in figure:

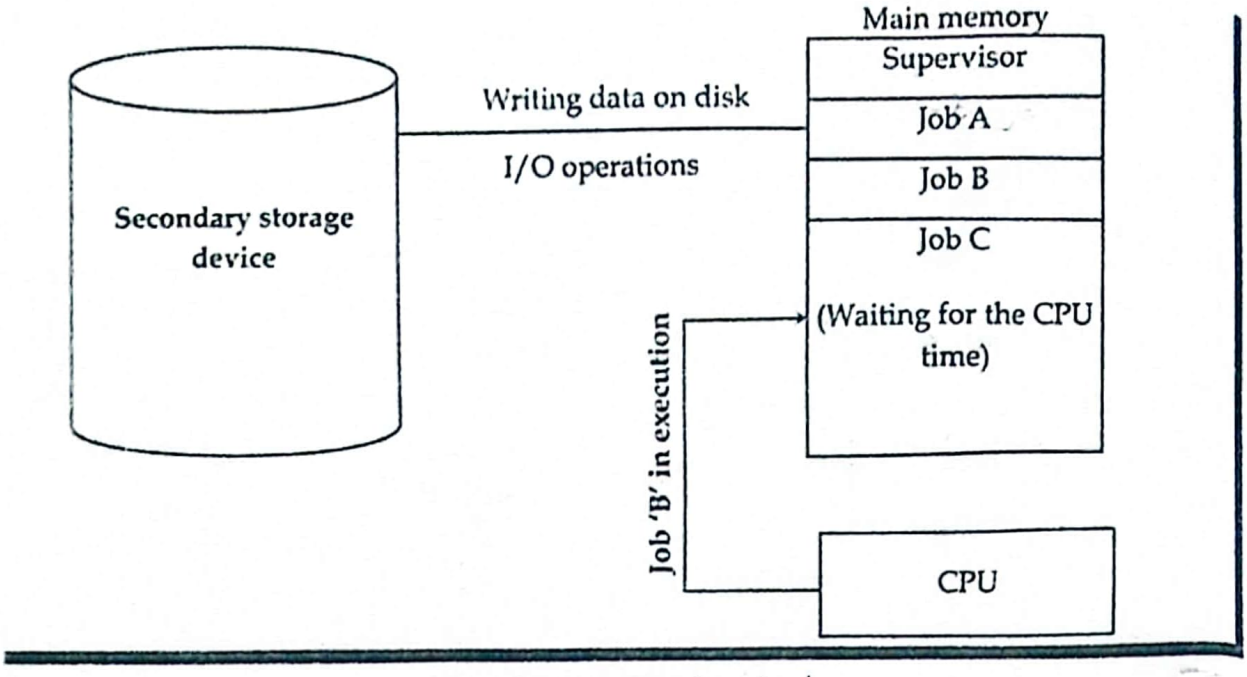


Fig: 1.5 Multi-programming OS

As shown in fig, at the particular situation, job' A' is not utilizing the CPU time because it is busy in I/O operations. Hence the CPU becomes busy to execute the job 'B'. Another job C is waiting for the CPU for getting its execution time. So in this state the CPU will never be idle and utilizes maximum of its time.

Multiprocessor Operating Systems

Multiprocessor Operating System refers to the use of two or more central processing units (CPU) within a single computer system. These multiple CPUs are in a close communication sharing the computer bus, memory and other peripheral devices. These systems are referred as tightly coupled systems. Multiplicity of the processors and how they do act together are transparent to the others.

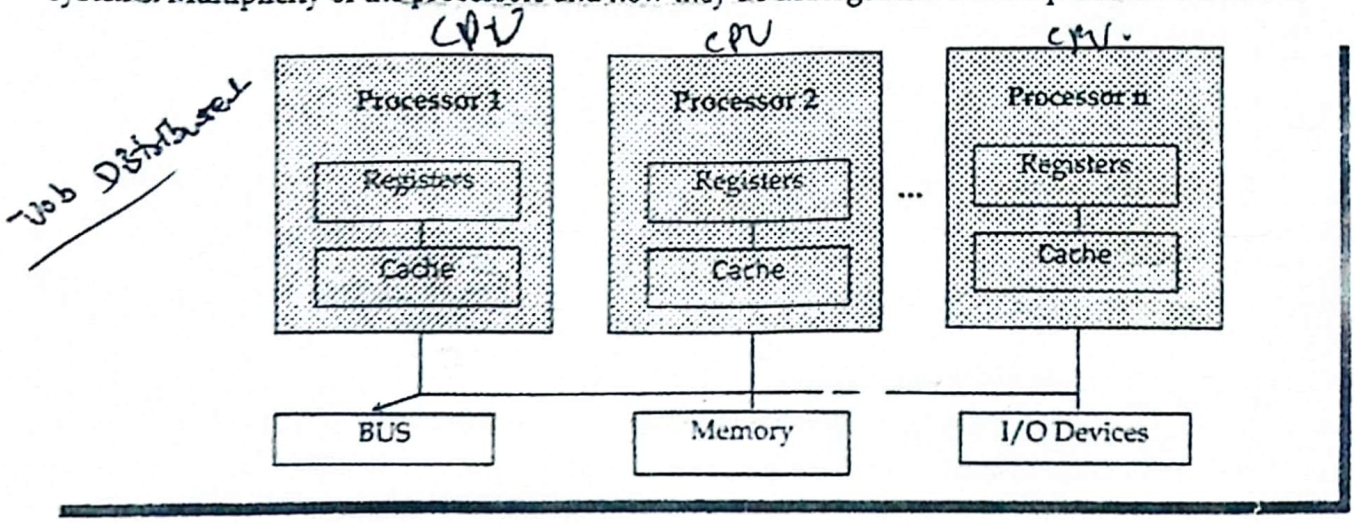


Fig 1.6: Multiprocessor Operating System

Advantages of Multiprocessor Systems

- Enhanced performance
- Execution of several tasks by different processors concurrently, increases the system's throughput without speeding up the execution of a single task.

- If possible, system divides task into many subtasks and then these subtasks can be executed in parallel in different processors. Thereby speeding up the execution of single tasks.

Time-Sharing Operating Systems

These are multi-user and multi-process systems. Multi-user means system allows multiple users simultaneously. In this system, a user can run one or more processes at the same time. Examples of time-sharing systems are UNIX, Linux, Windows server editions.

Each task is given some time to execute, so that all the tasks work smoothly. Each user gets time of CPU as they use single system. These systems are also known as Multitasking Systems. The task can be from single user or from different users also. The time that each task gets to execute is called quantum. After this time interval is over OS switches over to next task.

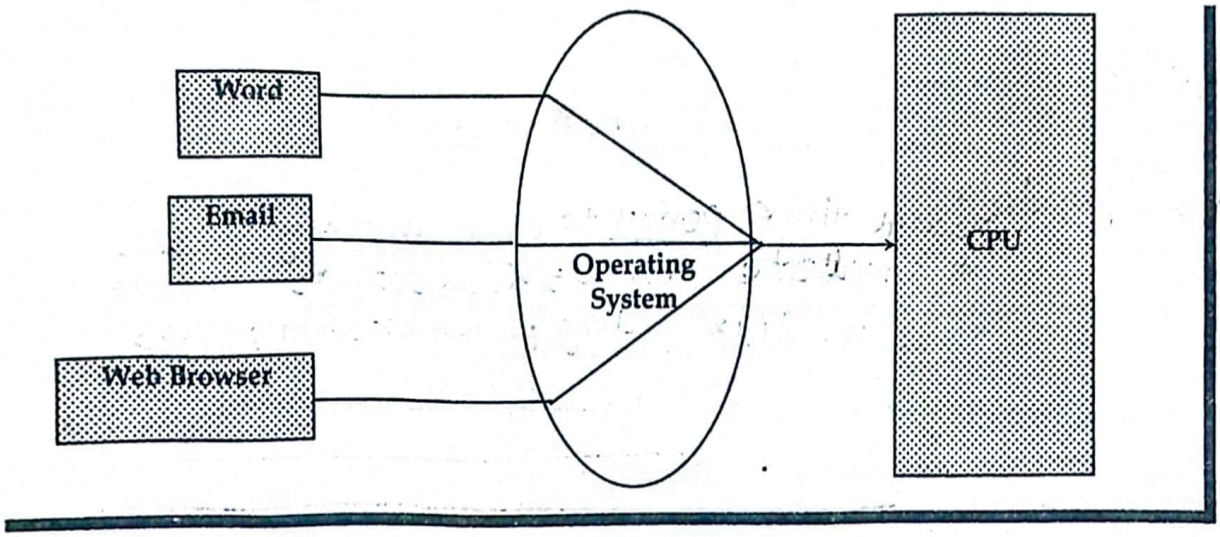


Fig1.7: Time sharing Operating System

Advantages of Time-Sharing OS

- Each task gets an equal opportunity
- Less chances of duplication of software
- CPU idle time can be reduced

Disadvantages of Time-Sharing OS

- Reliability problem
- One must have to take care of security and integrity of user programs and data
- Data communication problem

Real-Time Operating System - quick response.

A real-time operating system (RTOS) is an operating system (OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays. Processing time requirements (including any OS delay) are measured in tenths of seconds or shorter in :ements of time.

A real-time operating system is an important type of operating system used to provide services and data processing resources for applications in which the time interval required to process & respond to input/output should be so small without any delay real-time system. For example, real-life situations governing an automatic car, traffic signal, nuclear reactor or an aircraft require an immediate response to complete tasks within a specified time delay. Hence, a real-time operating system must be fast and responsive for an embedded system, weapon system, robots, scientific research & experiments and various real-time objects.

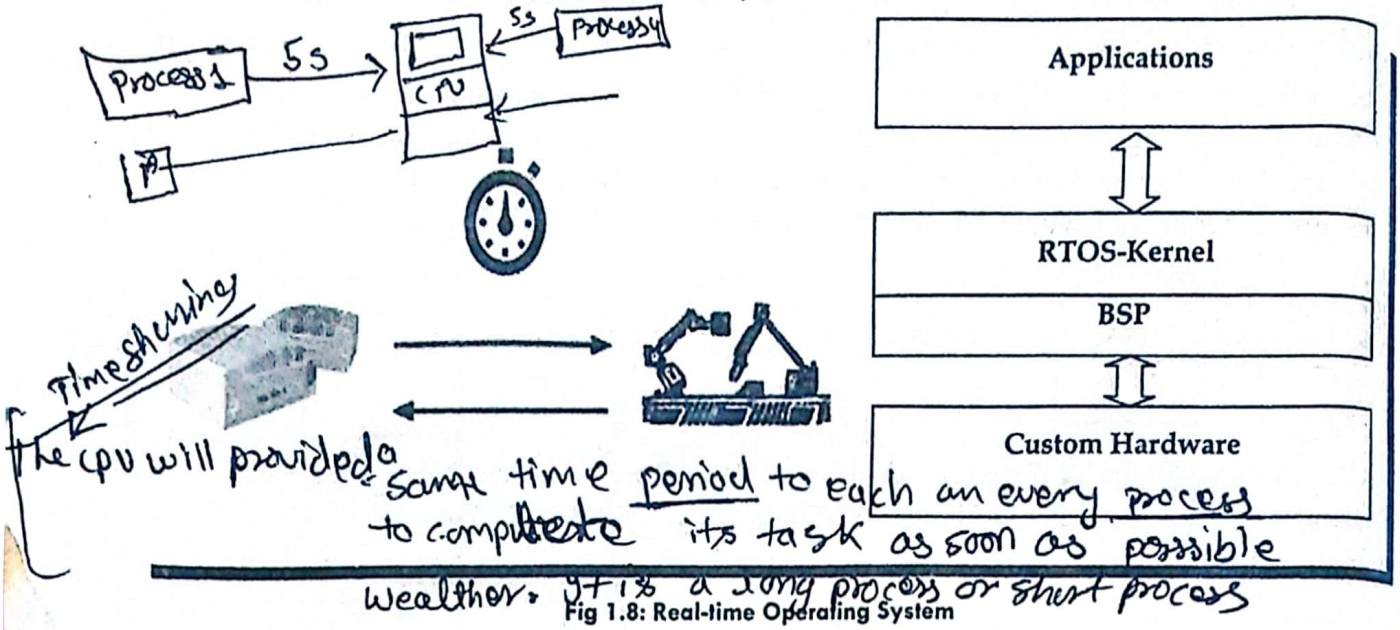


Fig 1.8: Real-time Operating System

Types of Real-Time Operating System (RTOS)

There are three different types of RTOS which are following

- Soft real-time operating system
- Hard real-time operating system
- Firm real-time operating system

a. Soft real-time operating system

Soft Real time RTOS, accepts some delays by the Operating system. In this type of RTOS, there is a deadline assigned for a specific job, but a delay for a small amount of time is acceptable. So, deadlines are handled softly by this type of RTOS. Example: Online Transaction system and Livestock price quotation System.

b. Hard Real Time

These OSs are meant for the applications where time constraints are very strict and even the shortest possible delay is not acceptable. These systems are built for saving life like automatic parachutes or air bags which are required to be readily available in case of any accident. Virtual memory is almost never found in these systems. **Example:** Medical critical care system, Aircraft systems, etc.

c. Firm Real time

These types of RTOS also need to follow the deadlines. However, missing a deadline may not have big impact but could cause undesired affects, like a huge reduction in quality of a product. **Example:** Various types of Multimedia applications.

Features of Real time Operating System

Here are important features of RTOS:

- Occupy very less memory
- Consume fewer resources
- Response times are highly predictable
- Unpredictable environment
- The Kernel saves the state of the interrupted task ad then determines which task it should run next.
- The Kernel restores the state of the task and passes control of the CPU for that task.

Applications of Real Time Operating System

Real-time systems are used in:

- Airlines reservation system.
- Air traffic control system.
- Systems that provide immediate updating.
- Used in any system that provides up to date and minute information on stock prices.
- Defense application systems like RADAR.
- Networked Multimedia Systems
- Command Control Systems
- Internet Telephony
- Anti-lock Brake Systems
- Heart Pacemaker

Advantages of RTOS

- **Maximum Consumption:** Maximum utilization of devices and system, thus more output from all the resources
- **Task Shifting:** Time assigned for shifting tasks in these systems are very less. For example in older systems it takes about 10 micro seconds in shifting one task to another and in latest systems it takes 3 micro seconds.
- **Focus on Application:** Focus on running applications and less importance to applications which are in queue.
- **Real time operating system in embedded system:** Since sizes of programs are small, RTOS can also be used in embedded systems like in transport and others.
- **Error Free:** These types of systems are error free.
- Memory Allocation: Memory allocation is best managed in these type of systems.

Disadvantages of RTOS

- **Limited Tasks:** Very few tasks run at the same time and their concentration is very less on few applications to avoid errors.

- **Use heavy system resources:** Sometimes the system resources are not so good and they are expensive as well.
- **Complex Algorithms:** The algorithms are very complex and difficult for the designer to write on.
- **Device driver and interrupt signals:** It needs specific device drivers and interrupt signals to response earliest to interrupts.
- **Thread Priority:** It is not good to set thread priority as these systems are very less prone to switching tasks.

Difference between in General-Purpose Operating System (GPOS) and Real-Time Operating System (RTOS)

Here are important differences between GPOS and RTOS:

General-Purpose Operating System (GPOS)	Real-Time Operating System (RTOS)
It used for desktop PC and laptop.	It is only applied to the embedded application.
Process-based Scheduling.	Time-based scheduling used like round-robin scheduling.
Interrupt latency is not considered as important as in RTOS.	Interrupt lag is minimal, which is measured in a few microseconds.
No priority inversion mechanism is present in the system.	The priority inversion mechanism is current. So it cannot modify by the system.
Kernel's operation may or may not be preempted.	Kernel's operation can be preempted.
Priority inversion remain unnoticed	No predictability guarantees

Distributed Operating System

Distributed systems use multiple central processors to serve multiple real-time applications and multiple users. Data processing jobs are distributed among the processors accordingly.The processors communicate with one another through various communication lines (such as high-speed buses or telephone lines). These are referred as loosely coupled systems or distributed systems. Processors in a distributed system may vary in size and function. These processors are referred as sites, nodes, computers, and so on.

The motivation behind developing distributed operating systems is the availability of powerful and inexpensive microprocessors and advances in communication technology. These advancements in technology have made it possible to design and develop distributed systems comprising of many computers that are inter connected by communication networks.

when many computer are interconnected to each other through a network for the purpose of sharing their task them it is called Distributed O/S.

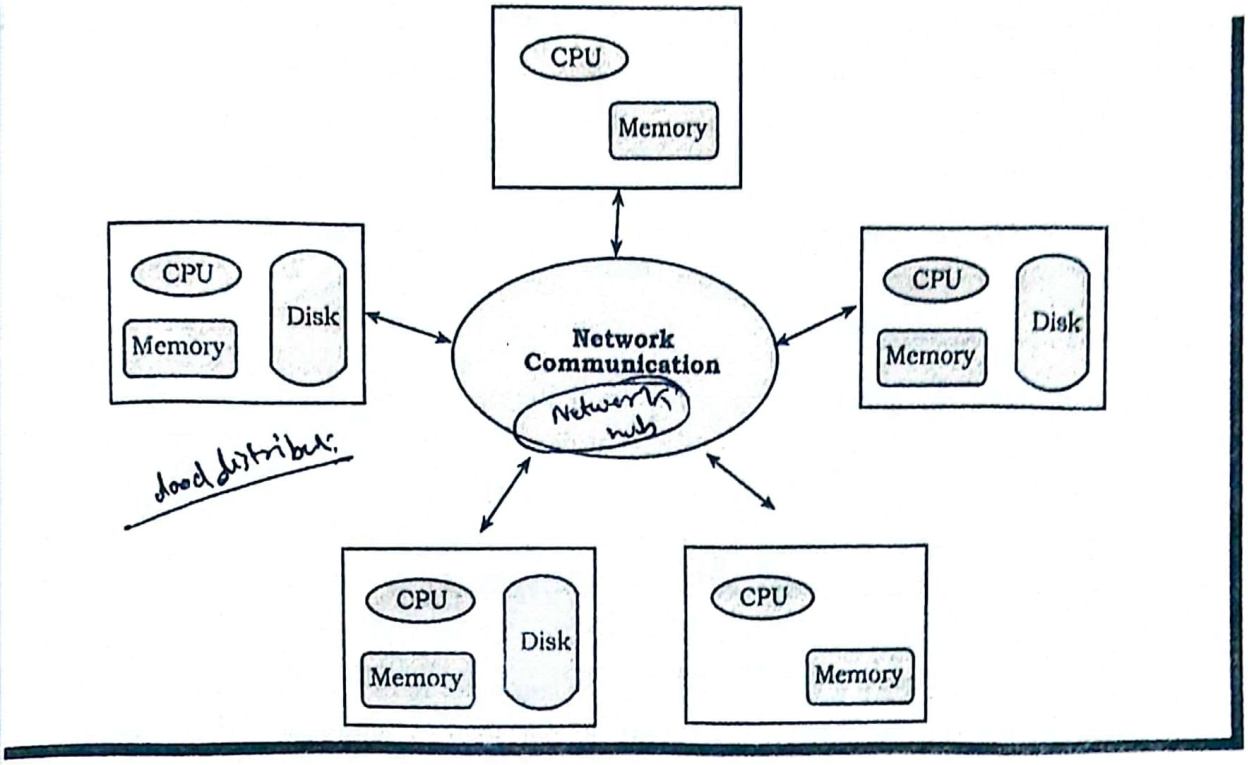


Fig1.9: Distributed Operating System

The advantages of distributed systems are as follows

- With resource sharing facility, a user at one site may be able to use the resources available at another.
- Speedup the exchange of data with one another via electronic mail.
- If one site fails in a distributed system, the remaining sites can potentially continue operating.
- Better service to the customers.
- Reduction of the load on the host computer.
- Reduction of delays in data processing.

Types of Distributed Operating Systems

Following are the two types of distributed operating systems used:

- Client-Server Systems
- Peer-to-Peer Systems

1. Client-Server Systems

Centralized systems today act as server systems to satisfy requests generated by client systems. The general structure of a client-server system is depicted in the figure below:

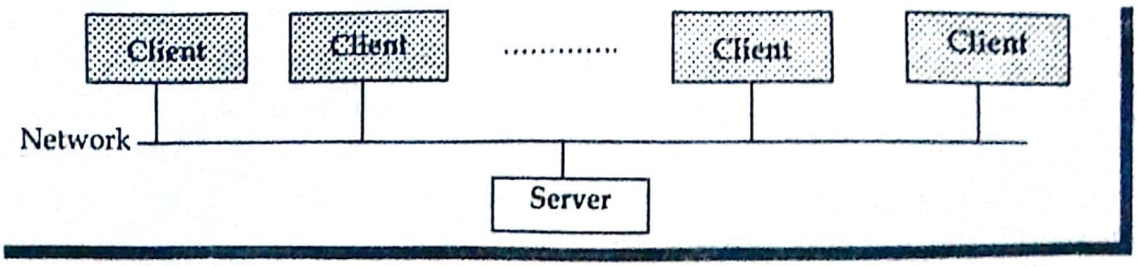


Fig 1.10: Client-Server Systems

Server Systems can be broadly categorized as: Compute Servers and File Servers.

- Compute Server systems, provide an interface to which clients can send requests to perform an action, in response to which they execute the action and send back results to the client.
- File Server systems, provide a file-system interface where clients can create, update, read, and delete files.

b. **Peer-to-Peer Systems**

The growth of computer networks - especially the Internet and World Wide Web (WWW) - has had a profound influence on the recent development of operating systems. When PCs were introduced in the 1970s, they were designed for personal use and were generally considered standalone computers. With the beginning of widespread public use of the Internet in the 1990s for electronic mail and FTP, many PCs became connected to computer networks.

In contrast to the Tightly Coupled systems, the computer networks used in these applications consist of a collection of processors that do not share memory or a clock. Instead, each processor has its own local memory. The processors communicate with one another through various communication lines, such as high-speed buses or telephone lines. These systems are usually referred to as loosely coupled systems (or distributed systems). The general structure of a Peer to Peer system is depicted in the figure below:

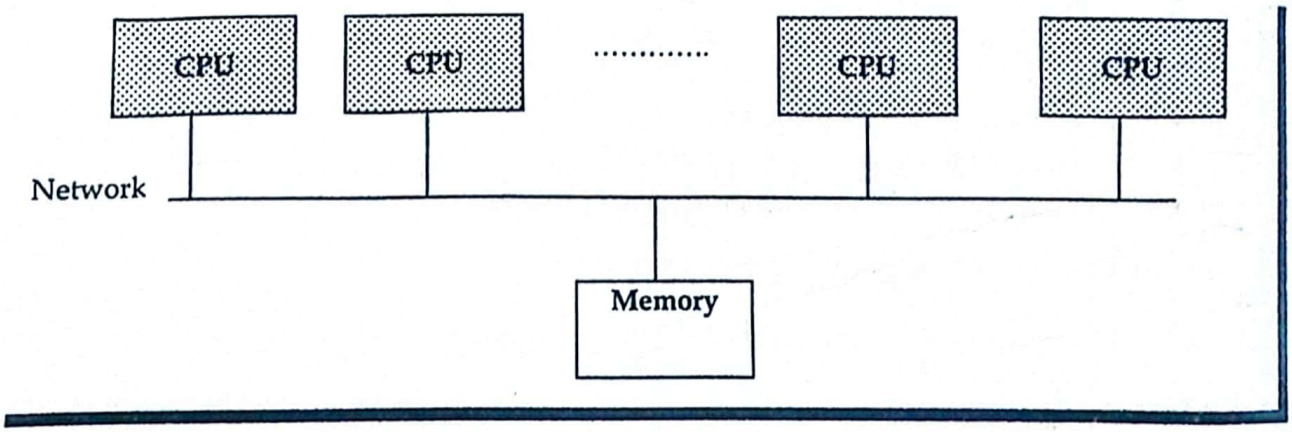


Fig 1.11: Peer to Peer Operating system

Network Operating System

Network Operating System runs on a server and provides the server the capability to manage data, users, groups, security, applications, and other networking functions. The primary purpose of the network operating system is to allow shared file and printer access among multiple computers in a network, typically a local area network (LAN), a private network or to other networks. Examples of network operating systems include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD.

Network o/s have a server that connects many other client computers. so, we can easily share own files, resources and many more from the server machine to all the machine which are connected through a server.

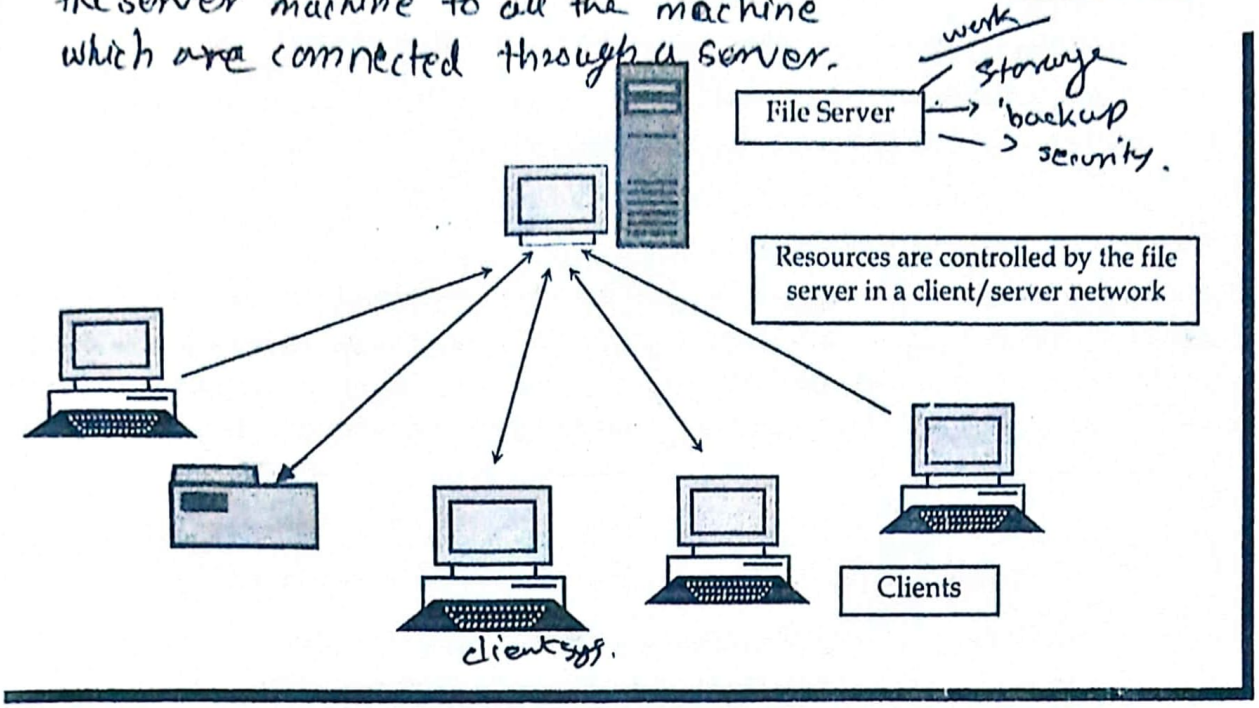


Fig1.12: Network Operating system

The advantages of network operating systems are as follows

- Centralized servers are highly stable.
- Security is server managed.
- Upgrades to new technologies and hardware can be easily integrated into the system.
- Remote access to servers is possible from different locations and types of systems.

The disadvantages of network operating systems are as follows

- High cost of buying and running a server.
- Dependency on a central location for most operations.
- Regular maintenance and updates are required.

Handheld Operating Systems

Handheld operating systems are small devices that perform basic tasks such as email, web browsing and scheduling. Since the unit is much smaller than a traditional computer, it has a smaller memory, a slower processing system and a smaller display. Some handheld devices may use wireless technology such as Blue Tooth, allowing remote access to e-mail and web browsing. Cellular telephones with connectivity to the Internet fall into this category. Their use continues to expand as network connections become more available and other options such as cameras and MP3 players expand their utility.

Handheld operating systems are also designed to work with different types of hardware than standard desktop operating systems. Following are the most popular handheld operating systems:

- Android OS (Google Inc.)
- Bada (Samsung Electronics)
- BlackBerry OS
- iPhone OS / iOS (Apple)
- MeeGo OS (Nokia and Intel)
- Palm OS (Garnet OS)

FUNCTION OF OPERATING SYSTEM

An Operating System acts as a communication bridge (interface) between the user and computer hardware. The purpose of an operating system is to provide a platform on which a user can execute programs in a convenient and efficient manner.

The main task an operating system carries out is the allocation of resources and services, such as allocation of: memory, devices, processors and information. The operating system also includes programs to manage these resources, such as a traffic controller, a scheduler, memory management module, I/O programs, and a file system.Important functions of an operating System:

- **Security**

  The operating system uses password protection to protect user data and similar other techniques. It also prevents unauthorized access to programs and user data.

- **Control over system performance**

  Monitors overall system health to help improve performance. Records the response time between service requests and system response to have a complete view of the system health. This can help improve performance by providing important information needed to troubleshoot problems.

- **Job accounting**

  Operating system keeps track of time and resources used by various tasks and users, this information can be used to track resource usage for a particular user or group of user.

- **Error detecting aids**

  Operating system constantly monitors the system to detect errors and avoid the malfunctioning of computer system.

- **Coordination between other software and users**

  Operating systems also coordinate and assign interpreters, compilers, assemblers and other software to the various users of the computer systems.

- **Memory Management**

  The operating system manages the primary memory or main memory. Main memory is made up of a large array of bytes or words where each byte or word is assigned a certain address. Main memory is a fast storage and it can be accessed directly by the CPU. For a program to be executed, it should be first loaded in the main memory.An Operating System performs the following activities for memory management:

  It keeps tracks of primary memory, i.e., which bytes of memory are used by which user program. The memory addresses that have already been allocated and the memory addresses of the memory that has not yet been used. In multi programming, the OS decides the order in which process are granted access to memory, and for how long. It allocates the memory to a process when the process requests it and de-allocates the memory when the process has terminated or is performing an I/O operation.

- **Processor Management**

  In a multi programming environment, the OS decides the order in which processes have access to the processor, and how much processing time each process has. This function of OS is called process scheduling. An Operating System performs the following activities for processor management.

  - Keeps tracks of the status of processes
  - Allocates the CPU that is processor to a process
  - De-allocates processor when a process is no more required.

- **Device Management**

  An OS manages device communication via their respective drivers. It performs the following activities for device management.

  - Keeps tracks of all devices connected to system
  - Designates a program responsible for every device known as the Input/output controller.
  - Decides which process gets access to a certain device and for how long.
  - Allocates devices in an effective and efficient way
  - De-allocates devices when they are no longer required.

- **File Management**

  A file system is organized into directories for efficient or easy navigation and usage. These directories may contain other directories and other files. An Operating System carries out the following file management activities.

  It keeps track of where information is stored, user access settings and status of every file and more. These facilities are collectively known as the file system.

Laboratory Works

Learn basic LINUX Commands

Navigation

Linux filesystems are based on a directory tree. This means that you can create directories (or folders") inside other directories, and files can exist in any directory.

- To see what directory you are currently active in:

  Pwd

  This stands for "print working directory", and will print the path to your current directory.

- To see other files and directories that exist in your current working directory:

  ls

  This will give you a list of names of files and directories.

- To navigate into a directory, use its name:

  cd<name of directory>

  This will change your new current working directory to the directory you specified.

- We can also create new directories in our current working directory. For example, to create a new directory called bar:

  mkdir bar

- We can also delete bar if we no longer find it useful:
  rm -d bar
- Will only delete empty directories.
  rm -d

File Manipulation

- We can view files. Say we have a file test in our current directory:
  cat test
  This will print out the entire contents of **test** to the terminal.
- With long files, this is impractical and unreadable. To paginate the output:
  less test
  This will also print the contents of test, but one terminal page at a time, beginning at the start of the file. Use the spacebar to advance a page, or the arrow keys to go up and down one line at a time. Press q to quit out of less.
- To create a new file called csit:
  touchcsit
  This creates an empty file with the name csit in your current working directory. The contents of this file are empty.
- It is also possible to copy a file to a new location. If we want to bring back csit, but keep bca too:
  cpbcacsit
- To edit text into test:
  nano test
  This will open up a space where you can immediately start typing to edit test. To save the written text, press "Ctrl-X"
- To delete the empty cdcsit:
  rmcdcsit
- **sudo**, that's an essential yet potentially dangerous command. Whenever you're getting a Permission denied, Authorization failed or something like that use sudo.
  sudotouch csit
- **shoutdown –h now**: to power off immediately
- **shoutdown–h +10**: to shout down after 10 minutes
- **reboot**: to reboot the machine immediately

Using the Visual Editor

An editor is the program that is used to edit source code. There are many text editors available for Linux, but the two most widely used are Visual Editor Improved (VIM) and Emacs. Here we discuss VIM editor.

Creating and opening file

- **$ vi<filename>** - opens file if it is already exist, otherwise creates new file.
- **$ vi** - opens VIM editors, without filename.

Save Changes and Exit the Visual Editor (normal mode operation.)

- :w - write (save) the file.

- :q - quit if saved
- :wq - save and quit. Or :x or ZZ
- :wq filename - save file with filename.
- :q! - Quit without saving any changes.
- :e! - Abandon the changes and reload the last saved file

Compiling with GCC

A compiler turns human-readable code into machine readable object code that can actually run. The compilers of choice on Linux systems are all part of the GNU compiler collection, usually known as gcc. It supports the ANSI standard syntax for C. Compile, link and run the program.

- $ gcc -o <exefile><sourcefile>
- $ ./<exefile>

Example

- $ gcc -o hello hello.c
- $ ./hello

EXERCISE

Multiple Choice Questions

1. Which of the following is an example of a real-time operating system?
   a. Lynx b. MS-DOS
   c. Windows XP d. Process Control
2. Which of the following operating system does not implement the multitasking truly?
   a. Windows 98 b. Windows NT
   c. Windows XP d. MS-DOS
3. Which of the following operating system do you choose to implement a client-server network?
   a. MS-DOS b. Windows
   c. Windows 98 d. Windows 2000
4. Which of the following Operating systems is better for implementing a Client-Server network?
   a. MS-DOS b. Windows 95 c. Windows 98 d. Windows 2000
5. Which of the following is not an operating system?
   a. DOS b. Linux c. Windows d. Oracle
6. ..... is the program run on a computer when the computer boots up.
   a. System software b. Operating system
   c. System operations d. None

7. Multi-processor system gives a.....
   a. Small system
   b. Tightly coupled system
   c. loosely coupled system
   d. Macro system
8. Multiprocessor system has advantage of.....
   a. Increased Throughput
   b. Expensive hardware
   c. operating system
   d. Both a and b
9. Multiprogramming of computer system increases.....
   a. memory
   b. storage
   c. CPU utilization
   d. Cost of computation
10. Example of open source operating system is.....
   a. UNIX
   b. Linux
   c. windows
   d. both a and b

Subjective Questions

1. Explain why all modern systems have cache memory in addition to main memory.
2. Explain the term "multiprogramming". Explain why a system which is not multi-programmed does not need secure multiplexing of resources. Suggest what functions an operating system might still be used for on such a system.
3. What is an Operating System? Explain their features.
4. Explain Brief History of Operating Systems.
5. What are the functions of operating system?
6. List out types of operating system and explain any three types of OS in brief.
7. What are the objectives of OS? Explain.
8. Operating system acts as resource manager. Explain in detail.
9. What do you mean by distributed operating system? Explain.
10. Differentiate between multiprocessing and multi-tasking system with suitable example.
11. What is real time operating system? Explain types of real time OS with suitable example.
12. Differentiate between soft real time system and hard real time system.
13. What is batch operating system? Explain in detailed.
14. What is network operating system? Explain in detailed.
15. What is Time sharing operating system? Explain in detailed.
16. Describe structure of OS with suitable example.
17. Describe two aspects of OS with suitable example.
18. What is Batch OS? Describe their advantages and disadvantages.
19. What are the advantages and disadvantages of operating system? Explain.
20. What is Mobile operating system? List out most popular hand held operating systems.

ANSWERS KEY

1. (d)	2. (d)	3. (d)	4. (d)	5. (d)	6. (b)	7. (b)	8. (a)	9. (c)	10. (b)

□□□

Unit-1 Introduction to Operating System.

① Define operating system? Describe the types of operating system.

⇒ An operating system is a program that acts as an interme-diary between a user of a computer and computer Hardware, to provide an environment in which a user can execute programs. The primary goal of an operating system is thus to make the computer system convenient to use. And to use the computer hardware in an efficient manner. An operating system is software which performs all the basic tasks like file management, memory management, process management, handling input and output and controlling peripheral devices such as disk drives and printers.

Examples of O/S are windows, Android, iOS, Mac OS, Linux, Chrome OS, VMS, OS/400, AIX, z/OS, windows Phone OS etc.

An operating system is an important part of almost every computer system. This can be divided into four Component. the hardware, the operatingsystem, the application program and the users.