

# Unit 1: Generalize Operating System

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## Unit Structure

- 1.1 Learning Objectives
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- 1.3 Types of Generalize Operating System
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- 1.5 Check Your Progress
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## 1.1 LEARNING OBJECTIVE

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After studying this unit, a student should be able to understand:

- Definition of generalize operating system (OS)
- Need of operating system
- Objectives of operating system
- Functions and views of operating system
- Multi-Tasking operating system
- Network operating system
- Distributed operating system
- Real Time operating system
- Embedded operating system
- Differences of operating systems

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## 1.2 INTRODUCTION

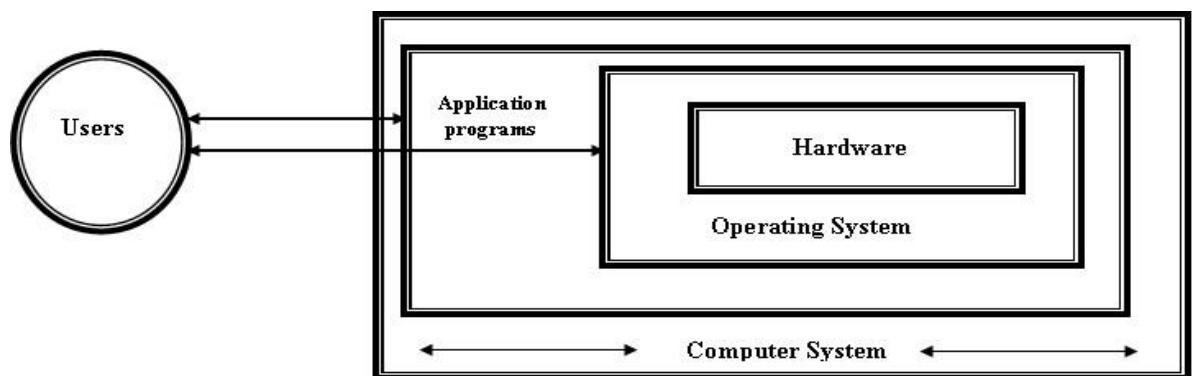
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In the last two decade the power of computing has changed. Now a day, computers are becoming more powerful. The storage capacity and computing speed are extremely fast. Today's computer applications are becoming user friendly with fast processing capability. In this information age, everyone is concerned with the computer and its performance. Now a day computer with good speed is a basic necessity of people. People do majority of their work with the help of computer. They use computer for the online shopping, booking a railway/air ticket, account management, storing files and many more. Have you ever thought how all these works are done? How does the computer manage all the work given by the user without any errors? How does the computer manage all the attached devices or hardware with the help of user?

In the beginning of computer era, the tasks to be performed by user where directly given to hardware. This made the user of computers difficult as user had to know the architecture of computer system. Later on various software were designed to assist the users. The software minimized the interaction of user with hardware, thus allowing users to perform all functionalities easily. This software that operates the computer system is known as Operating System (OS). An Operating System

which runs on computer is called Generalize Operating System. Now on wards in this block we will use the terms “Operating System” or “OS” for the “Generalize Operating System”.

An Operating System is the first program that is loaded into computer by a boot program; it manages all the applications runs on the computer. An Operating System acts as a layer between the user or application and the hardware. It works in background, without letting us know who is managing all the hardware and application on computer.



**Figure-1 Layers of Operating System**

As shown in the Figure-1, An Operating System plays a role of inter mediator between applications and hardware. Here, User gives input to the application/s, based on that OS perform processing and get result with the help of hardware and transmit it back to application for delivering the same to user.

An Operating System can also be defined in the following ways:

- “It is an integrated set of specialized programs used to manage overall resources and operations of the computer.”
- “A software that acts as an interface between the users and hardware of the computer system”
- “A software that provides working environment to the user’s applications”
- “A resource manager that manages the resources needed for all the applications in the background”
- “It is specialized software that controls and monitors the execution of all other applications that reside in the computer.”

### **1.2.1 NEED OF GENERALIZE OPERATING SYSTEM**

To understand the need of operating system, we need to answer the questions raised here. Often while working with computer system we might take faced questions like:

- While storing the data on file, who is allocating memory to the file?
- Who is mapping logical path of file to the physical location of file on hard disk?
- Today's computer can open and manage multiple windows at a time, who is managing all windows?
- Who protect user's data to unauthorized access by another users?
- While print command is given, who is transferring the data from file to printer?
- When any request is sent for the data from the network, who transfers data within network?
- Who provides the mechanism to transfer data between two applications?
- Who manages CPU and make sure that it is not sitting idle or busy forever?
- Who schedules the processes for the CPU execution?
- Who manages the memory (RAM) and how it is allocated as and when it is demanded by the processes?

Well, the answer of all the questions raised here is "Operating System". An Operating System has a responsibility to manage all the resources and applications in the computer system and provides friendly environment to the users.

### **1.2.2 OBJECTIVE OF GENERALIZE OPERATING SYSTEM**

In the journey of Operating System development, the central theme is to keep in mind the convenience of the user.

The objectives of the Operating System are:

➤ **Convenience**

Main goal of the Operating System is to provide convenience to its user. Operating System hides the complex mechanism of hardware handling from the user and provides a user friendly GUI (Graphical User Interface) to its users.

➤ **Efficiency**

Operating System makes the computer system convenient to its user in an efficient manner. Operating System effectively manages all the resources such as printer, hard disk, RAM, CPU. Operating System makes arrangement that each running application can get resources as and when it is demanded. OS uses scheduling algorithm, so each application utilizes computer system resources at its optimal level. OS keeps track of who is using which resource, granting resource requests, and mediating conflicting requests from different programs and users.

➤ **Ability to Evolve**

An operating system should be constructed in such a way as to permit the effective development, testing, and introduction of new system functions without interfering with existing service

### **1.2.3 FUNCTIONS OF GENERALIZE OPERATING SYSTEM**

We have understood the need of Operating System. Now it is time to discuss various functions of Operating System. The function can be divided into two parts namely user view functions and system view functions.

#### **1.2.3.1 User View Functions**

The user view is a top – down view function. It allows execution the of user's task on the computer system without knowing the complex hardware details of the computer system. It provides a simple interface between application and the hardware.

The user view functions are as follow:

➤ **Error Detection**

A variety of errors can occur while a computer system is running. These include internal and external hardware errors, such as a memory error, or a device failure or malfunction; and various software errors, such as division by zero and inability of the OS to grant the request of an application. Operating System traces the errors and prompts the error messages to the user. It also provides methods for debug and error-detection.

➤ **Coordination Between Applications and Users**

The OS acts as coordinator between various kinds of applications and its users. It coordinates assignment of compilers, interpreters, assemblers, and other software to various users of the computer systems.

➤ **Software Development and Execution**

The OS provides a variety of services for the new software, such as various kinds of editors and debuggers that help user to develop software efficiently and speedily. All software work on specific set of instructions, OS helps in fetching and execution of there instructions.

➤ **Access to I/O devices**

The input output (I/O) device has own set of instructions and control signals for operation. The OS converts the I/O device specific set of instructions and signals to uniform interface so that users can access such I/O devices in simple way.

➤ **File Access Mechanism**

The OS provides a file access matrix. Each file has specific rights of Read, Write for its users. The OS maintains the file access rights by various mechanisms to provide access to its users. In the case of a system with multiple users, the OS may provide protection mechanisms to control access to the files.

➤ **System access**

The OS provides a protection method to its resources and data from unauthorized users and solves conflicts for resource dispute. The OS has control access as a whole and specific resource also.

### 1.2.3.2 System View Functions

The OS performs the most of functionalities in background which is called system view function. Managing the hardware, allocations of CPU, memory management are done in background without the users knowledge. Therefore, from the computer system's point of view, the OS is specialized program that controls the allocation and retentions of all the resources in the computer system. The system view functions are as follow:

➤ **Memory Management**

Each running software on computer system demands memory dynamically. The OS provides functionality for the memory management. The OS keeps track of the primary memory like what part of it is in use by whom, what part is not in use, etc. and allocates the memory when software requests it.

➤ **Processor Management**

Each running software acts as a process at machine level. At a time many processes stand in queue to execute set of instructions. The OS provides scheduling mechanisms to allocate the processor (CPU) to process and retain the processor when it is no longer required.

➤ **Device Management**

The OS keeps track of all the devices attached with the computer system. Through the virtual machine manager (Drives), OS provide instructions to the device and receives output for the device.

➤ **File Management**

The Files require physical memory (Secondary Memory) in the computer system. The OS allocates and retains the physical memory as file needs to be saved on hard disk. It also provides the method to retrieve the data from the physical location when needed.

➤ **System Performance**

The OS keeps eye on the performance of various attached devices. It records the delay between the request for a service and response from the system.

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## **1.3 TYPES OF GENERALIZE OPERATING SYSTEMEM**

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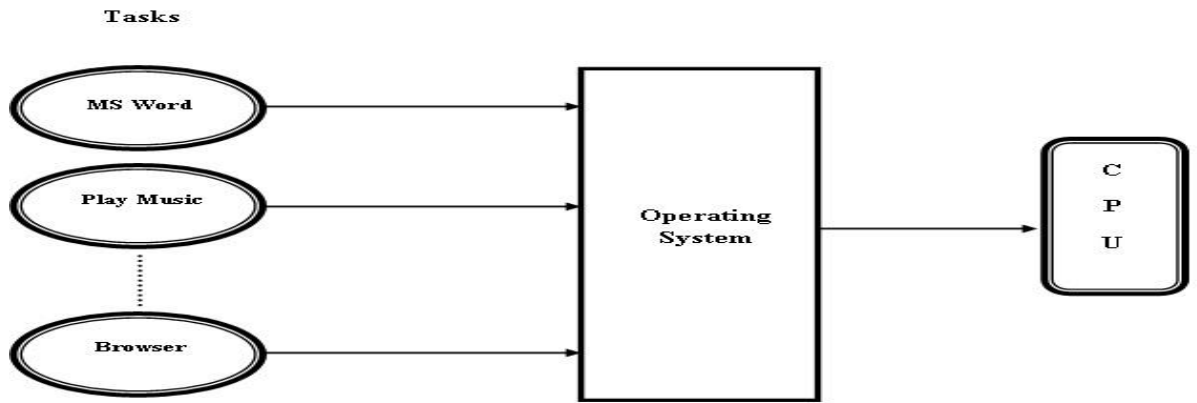
We have seen the basic function and architecture of generalize operating system. Today, a variety of Operating Systems exist. For the day to day uses we have Window, Linux, and Ubuntu Operating System. Network OS is used to handle several computers on network. Embedded OS is used to manage mobile devices. Real time Operating System (RTOS) like RTLinux is used to handle real time tasks without time delays. Thus, depending on the requirement and project types, an appropriate Operating System is used.

### **1.3.1 MULTI -TASKING OPERATING SYSTEM**

Today's most modern Operating Systems are multitasking. As name itself suggests, multiple tasks (here task may be process / thread / programs) are stored in main memory and executed at a time. If we can play MP3 music, write a text on text editor, search data on internet simultaneously then the OS is called Multi-Tasking OS (MOS). All the modern generalize operating systems are Multi-Tasking OS, functions of MOS is the same as functions of generalize OS.

Multi –Tasking OS is useful when the user wants to open and works on the multiple applications simultaneously on computer system. Microsoft Window, Linux, Ubuntu are the modern multi-tasking OS.





**Figure-2 Multi-Tasking OS**

Multi-Tasking OS works on time sharing and context switching concept. Here in a time sharing system, each process is assigned some specific quantum of time for which a process is meant to be executed. For example there are three processes P1, P2, P3 ready to execute. So each of them are assigned some time quantum for which they will execute e.g time quantum of 10 nanoseconds (10 ns). As one process begins execution (say P1), it executes for that quantum of time (10 ns). After 10 ns the CPU starts the execution of the other process (say P2) for the specified quantum of time, after 10 ns, the CPU starts the execution of the other process (Say P3) for the next 10ns. At the end of the time quantum OS removes one process (say P1) from the CPU and send second process (say P2) in the CPU for execution, is called context switching. Here time quantum is too small and context switching happens very fast, a user cannot feel the interrupts in the process execution. This way, the user is given the illusion that multiple-tasking are being executed simultaneously, But actually only one task is executing at a particular instance of time.

### **1.3.1.1 Advantages of Multi-Tasking Operating System**

- The Multi-Tasking OS works on fixed time quantum, is able to provide quick response on request.
- The multi-tasking OS makes optimal CPU utilization at maximum, resulting in less CPU idle time.
- As it allocates fixed time quantum to each process, hence each process gets an equal opportunity of execution.
- All tasks run smoothly without a glitch in performance.

- User can run a single task or multiple tasks, with ease on computer system.
- Computer resources like RAM, Processor, I/O devices and hard drive are superlatively managed by OS.

### **1.3.1.2 Disadvantages of Multi – Tasking Operating System**

- The Multi-Tasking OS shares the computer resources among the multi tasks that raise reliability issues for the MOS.
- In the Multi-Tasking OS, multiple tasks exist in main memory at a time, at times it may cause shortage of memory.
- If the processor in the computer system is slow then it may take long time to process programs.
- Sharing computer resources at a time raise a question of security and data integrity of user tasks.

## **1.3.2 NETWORK OPERATING SYSTEM**

Network Operating System (NOS) is a specialized operating system that has special function to connect and manage autonomous computers in the local area networks. The main purpose of NOS is to allow users to share resources across the computer network. They can share data files or network devices such as printer, DVD drive or other electronic devices. The most widely used network operating systems are Microsoft Window Server, Microsoft NT, Novell Open Enterprise Server.

All modern NOS have following functions additional to generalize operating system:

- Managing the computer and peripheral devices attached in network.
- Creating and managing the network user account.
- Controlling access to network resources.
- Providing efficient communication service in the network.
- Monitoring and troubleshooting of the network.
- Providing network routing features.
- Providing interface to users for remote access of data files and devices across network.

The NOS is deployed on network server to administrate network resources such as storage device, network prints, computer nodes and communication services. The Network Operating System has two types:

➤ **Peer-to-peer NOS**

The Peer-to-Peer (P2P) NOS allow user to share their resources and files located on their computer and also can access resources located on other network computer. In P2P NOS all users have the same level of right to access the resources. The data in P2P NOS is stored on different computers within network. The P2P NOS basically used for small and medium local area network. Figure-3 shows the layout of peer to peer network OS.

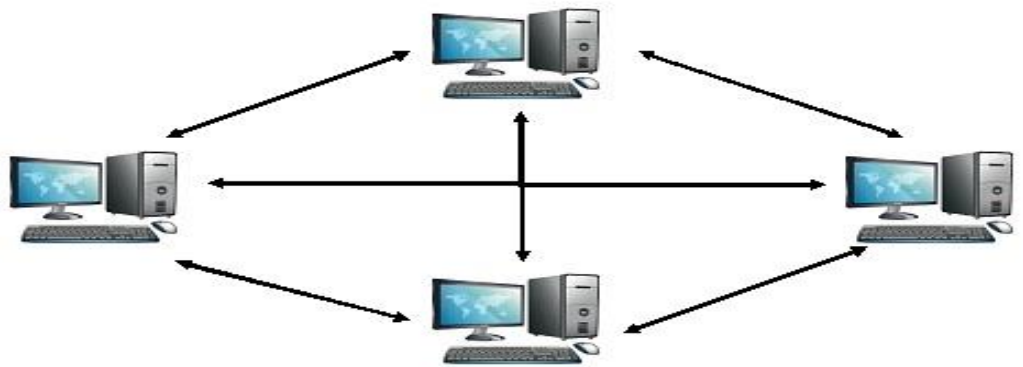
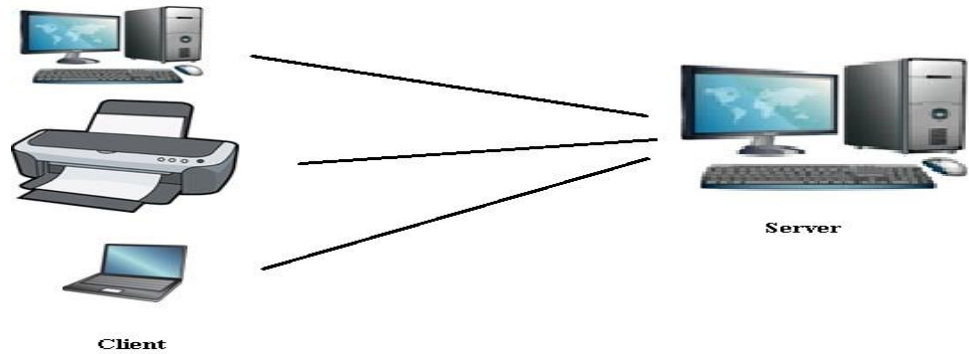


Figure-3 P2PNetwork OS

➤ **Client / Server NOS**

The Client / Server network operating system allows network to store data at central location called server. The computer node in the network called client, accesses this data through the network. Here Server acts as a heart of the entire network system. Server manages users, network resources, access rights and security. To access the data client, need to connect with server. Figure-4 shows the client server network OS.



**Figure-4 Client Server Network OS**

### **1.3.2.1 Advantages of Network Operating System**

- NOS has centralized server that is highly stable.
- Security issues are handled easily at server.
- Due to network connectivity, remote access is possible.
- New technology and hardware can easily be upgraded and integrated to the network.
- Less requirement of hardware as it is sharable.
- Data can be stored at central location, it becomes easy to access it from network.

### **1.3.2.2 Disadvantages of Network Operating System**

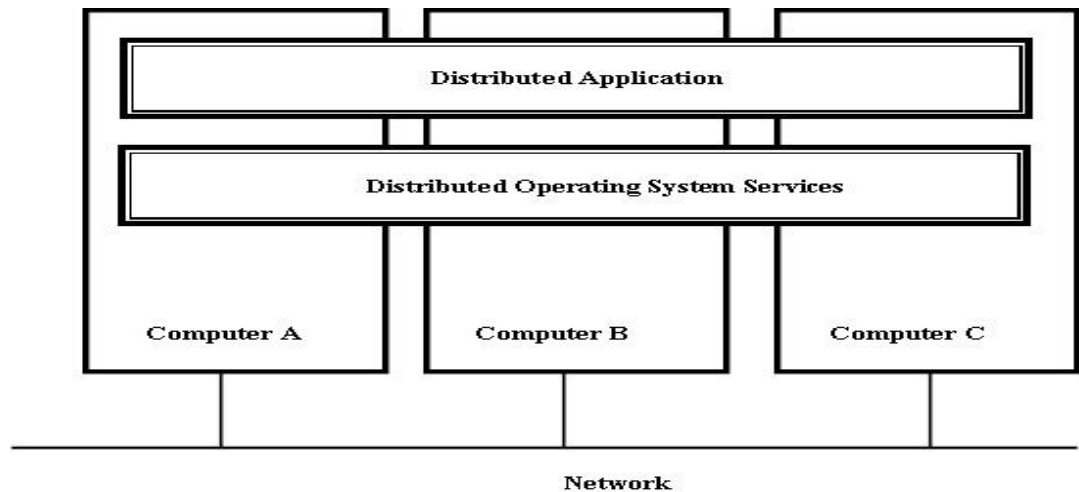
- NOS's Servers are costly.
- Network systems are highly dependent on Server.
- Users are mostly dependent on server for their data.
- Maintenance and updatation is required regularly
- It has less security compared to stand alone computer system.

## **1.3.3 DISTRIBUTED OPERATING SYSTEM**

Distributed operating system is multi-processors system to serve multiple applications and users in distributed manner. Here each node in network works as complete computer system. Using this multiple node data processing is done in distributed manner. It works on wide area network (WAN).

Resources sharing and fast processing is the main purpose of distributed OS. It is not possible to take advantage of thousands of processors on single board, but

the multiple processor are realized as single powerful machine in a network system, this machine is called distributed system. UNIX based IRIX operating system, DYNIX, AIX based on IBM RS/6000 are some of the distributed operating system. Figure-5 show the working layer of distributed operating system.



**Figure-5 Distributed OS**

By the distributed OS, it makes possible to make partitioning a computation into some sub computations which are distributed and run concurrently on various node of network, resulting process execution becomes fast.

All modern distributed OS has following functions additional to generalize operating system:

- It provides mechanism to run regular program in distributed fashion.
- It provides easier mechanism to user for accessing network resources.
- Processes may execute on any network node, Distributed OS needs to manage processes by efficient way as compared to generalize OS's process management.
- Multiple processes run on different network node, synchronization and inter process communication methods are provided by the distributed OS.
- Distributed OS provide one interface to all resources in the network, the user feel as if work is done on single OS.

### **1.3.3.1 Advantages of Distributed Operating System**

- Distributed OS provides resource sharing in a way that user at one location can be use resources located on the other location.
- Distributed OS provides a distributed computing for speedy execution of process.
- If one of the computer system in a network fails still computing will be done with the use of remaining node in network.
- Using Distribute OS, fast, better and effective service can be provided to user.
- Less load on the host computers.
- Data exchange can be fast in network.
- Resource can be added and utilized easily in network.

### **1.3.3.2 Disadvantages of Distributed Operating System**

- Failure of network will stop entire communication.
- Distributed OS is very expensive.
- Security issues may rise due to resource sharing in network.
- Message / Data Packet can be lost in network that effects on distributed computing.
- High bandwidth is required in network for large data transmission.
- To provide and maintain common interface for network resource is big challenge.

### **1.3.4 REAL TIME OPERATING SYSTEM**

As we have discussed earlier in this unit that all the generalized Operating Systems work on time sharing. Time sharing systems have some drawback, if there is more load on the OS then response time is more and may increase if load increases. In some computation processes this kind of delay cannot be allowed. Such delay can cause system failure or disaster. For example any OS which needs to control the temperature of nuclear reactor 24\*7, 365 days, if the OS fails to control the same for a minute, it may result in blast at nuclear plant. So in 1980 new kind of Operating system was developed that works on small response time. The time taken

by the system to respond to an input and display of required updated information is termed as the response time.

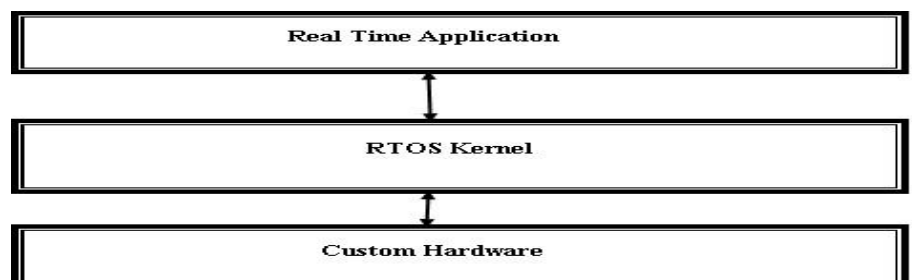
A Real-Time Operating System (RTOS) is a system in which the time required to process and respond to input is so small that it controls the environment. Here response time is too small as compared to other generalize operating system. RTOS responses immediately to user / application's request or within a fixed time frame, is known as Real –Time Processing. RTOS are used when there are very strict time requirements on the operation of a processor. Scientific applications, weapon control systems, nuclear control systems, Air Traffic Control Systems, image processing applications, voice / video calling applications and industrial control systems use Real-Time OS. Real-Time systems are two types:

➤ **Hard Real Time System**

In Hard Real Time System, processes should be executed in given time quantum. Processes cannot cross the time limit. Hard real time system gives guarantee that critical tasks are completed on time. All the weapons control systems are example of hard real time.

➤ **Soft Real Time System**

In Soft Real Time System, processes may not be executed in given time quantum. It may cross the time limit without harming the system. A critical real-time task gets priority over other tasks and retains the priority until it is completed. A voice / video calling applications, image processing applications are the example of soft real time. Figure-6 shows view of RTOS.



**Figure-6 Real Time OS**

All Real-Time OS has following functions additional to generalize operating system:

- RTOS works based on event driven switching, higher priority tasks are allocated CPU services first as compared to lower priority tasks.
- RTOS needs to work on fixed time sharing (quantum) manner.
- To manage the processor and other resources in such a way that it meets the requirement of real time applications.
- To synchronize with the system events.
- To respond quickly to any request that needs to manage RAM in efficient manner.
- To provide exclusive access to the computer resource.

#### **1.3.4.1 Advantages of Real Time Operating System**

- RTOS is developed to handle critical applications, thus the performance of applications is very high.
- RTOS uses its resources at maximum, thus more output from the resources.
- RTOS has efficient fault toleration technique, so we can say it is error free operating system.
- Memory management is best compared to generalize operating system.
- RTOS can be best used for any applications which run 24 hours and 7 days because it does less task shifting and gives maximum output.

#### **1.3.4.2 Disadvantages of Real Time Operating System**

- RTOS handles limited tasks. Very few tasks can run at the same time.
- RTOS uses very heavy system resources thus it is expensive operating system.
- Algorithm runs on RTOS is complex and difficult. It is very difficult to write that algorithm for a designer.
- It needs specific device drivers and interrupts signals to respond earliest to the interrupts.

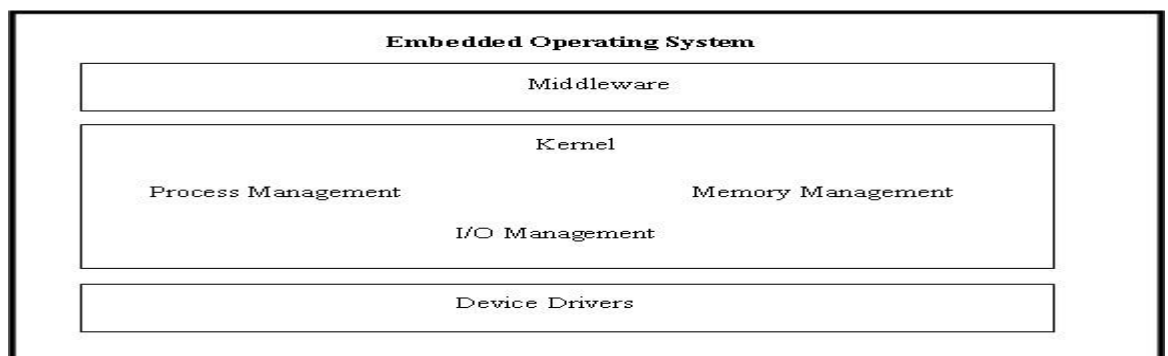


- RTOS is low multi-tasking. RTOS runs few tasks so multi-tasking is done few times.

### 1.3.5 EMBEDDED OPERATING SYSTEM

Embedded operating system is the system which is made for specific tasks. An embedded system is a combination of computer hardware and software, it define for specific functions within a system. Embedded system has an operating systems but it is not generalized operating system. Embedded OS performs all the basic functions of OS like initialization, task management, memory management, process scheduling etc. but with little or no user interface. Embedded OS has limited tasks related to specific environment. ATM Machines, High-end cars, Mobile devices, digital television have embedded operating system.

Embedded operating system has three main components: Hardware, Software and RTOS. Here RTOS supervises applications software and provides mechanism to handle the process. It sets the rules during the execution of applications. Here we should note that small scale embedded system may not have RTOS. So we can define an embedded system as a Microcontroller based, software driven, reliable and real-time control system. Figure-7 shows a view of Embedded OS.



**Figure-7 Embedded OS**

Mobile OS is a part of Embedded Operating System. Now a day various kinds of Mobile Operating Systems are available in market. An android, iOS and window phone are the most popular Mobile Operating System, on the other hand black berry, symbain, bada, palm, webOs and meeGo are also Mobile Operating Systems.

As the book scope is restricted to Mobile Operating System, here we will learn Embedded Operating system in the concern with Mobile Operating System.

All Embedded OS has following functions in addition to generalize operating system:

- An embedded OS works on small scale devices. Power management is primary function of embedded work.
- An embedded OS has technique to manage tasks with limited memory.
- An embedded OS must work on a microcontroller or microprocessor.
- An Embedded system is inbuilt with hardware and software where the hardware is used for security and performance and Software is used for more flexibility and features.

#### **1.3.5.1 Advantages of Embedded Operating System**

- Embedded OS is combination of hardware and software thus it is easy to customize.
- Generally Embedded OS is small in size so can be loaded fast.
- Requires low cost to develop.
- Can work on low power.
- Can execute task with limited processing power.
- Works for the predefine task, thus performance is good.

#### **1.3.5.2 Disadvantages of Embedded Operating System**

- Embedded OS cannot be powerful multi-tasking.
- Troubleshooting is difficult.
- Difficult to transfer data from one system to other.
- It is difficult to update embedded OS.

#### **1.3.6 COMPARATIVE STUDY OF TYPES OF OSs**

We have seen the types of operating systems with their functions, advantages and disadvantage in the previous section. The Table-1 here shows that the applicability of OS to applications.

<b>Type of Operating System</b>	<b>Applicable to which type of application</b>
Multi Tasking OS	When a user wants to open and work simultaneously on many windows on the single system.
Network OS	When user want to remote login to a system, transfer a file or share resource on the network.
Distributed OS	When computational speed and resource sharing is required.
Real Time OS	Applicable to systems which require time bounded responses.
Embedded OS	Specialized systems with memory, power and processing restrictions. Used in consumer electronic items, mobile phone etc.

**Table-1 Applicability of OS to applications**

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## **1.4 LET US SUM UP**

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In this unit we learnt about the working methodology of generalized operating systems. Let's quickly review the main points of the unit.

- An operating system is software that acts as an interface between the user and hardware of the computer systems.
- An operating system is a resource manager that in background manages the resources needed for all the applications run on it.
- We learnt main functions of generalized operating system. It is divided in two views: User view functions and System view functions.
- Multi - Tasking operating system work on time sharing concept. The switching between the processes is too fast so it seems like a Multi-Tasking.
- Network operating system used to manage network resources like computer nodes, printer and other devices.
- Distributed operating is used to serve multiple applications and users through multiprocessor.

- To handle the on time situation and give immediate response, we used Real Time operating system.
- Embedded operating system is system which is made to handle specific tasks.

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## 1.5 CHECK YOUR PROGRESS

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**Give the answer of the following MCQ.**

1. When a user wants to open and work simultaneously on many windows on his system, \_\_\_\_\_ OS is chosen.
 

A. Real time	B. Batch
C. Multi user	D. Multi tasking
2. When computational speed and resource sharing is required and implemented through combining multiple computer system in a network, \_\_\_\_\_ OS should be chosen.
 

A. Real time	B. Distributed
C. Networking	D. Embedded
3. Symbian OS is used in \_\_\_\_\_ types of applications.
 

A. Real time	B. Batch
C. Networking	D. Embedded
4. \_\_\_\_\_ OS should be chosen on systems that require time bound response.
 

A. Real time	B. Batch
C. Networking	D. Embedded
5. \_\_\_\_\_ OS should be chosen in consumer electrics items, mobile phone, smart cards, etc.
 

A. Real time	B. Batch
C. Networking	D. Embedded
6. User Interface is a function of \_\_\_\_\_.
 

A. User View	B. System View
C. Both	D. None
7. Two types of Real time system are \_\_\_\_\_ and \_\_\_\_\_.
 

A. Hard and Soft	B. Soft and Tight
C. Hard and Tight	D. None of These

8. A software that acts as an interface between the users and hardware of the system is called \_\_\_\_\_.
  - A. Operating system
  - B. Multi tasking system
  - C. Multi programmed system
  - D. Time sharing system
9. The software that operates computer is known as \_\_\_\_\_.
  - A. MS office
  - B. Compiler
  - C. Operating System
  - D. None of these
10. RTOS stands for \_\_\_\_\_.
  - A. Random Transfer Open Stack
  - B. Real Transform Open Schedule
  - C. Random Transform Office
  - D. Real Time Operating System Schedule
11. \_\_\_\_\_ is an example of Embedded Operating System
  - A. MS Windows
  - B. DOS
  - C. ANDROID
  - D. UNIX
12. When a user wants to remotely log on a network system to transfer a file, \_\_\_\_\_ OS is chosen.
  - A. Real time
  - B. Batch
  - C. Networked
  - D. Embedded

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## 1.6 CHECK YOUR PROGRESS: POSSIBLE ANSWERS

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- |       |       |       |
|-------|-------|-------|
| 1. D  | 2. B  | 3. D  |
| 4. A  | 5. D  | 6. A  |
| 7. A  | 8. A  | 9. C  |
| 10. D | 11. C | 12. C |

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## 1.7 FURTHER READING

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- Naresh Chauhan (2014), Principals of Operating System, Oxford.
- "Introduction to OS", <https://nptel.ac.in/courses/106106144/2>.
- "Embedded System", <https://nptel.ac.in/courses/108102045/20>.

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## 1.8 ASSIGNMENTS

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### **Write answers of the following Questions**

1. What is the need of an operating system?
2. What are the functions of operating system from user's view point?
3. What are the functions of operating system from system's view point?
4. Explain the work of Multi-Tasking OS with advantages and disadvantages of it.
5. What are the functions of Network operating systems?
6. Explain the Distributed operating system.
7. What is Hard Real Time and Soft Real Time.
8. Explain the work of Embedded system along with advantages and disadvantages.