

**Operating System**

**Unit-2**

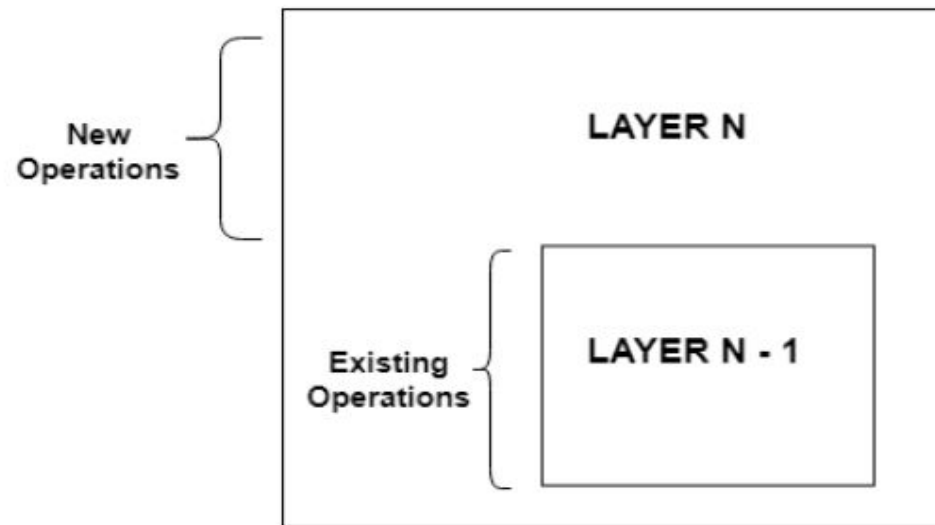
**Operating System Structure**

# Introduction to Operating System Structure

- A structure of an Operating System determines how it has been designed and how it functions.
- The structure of the OS depends mainly on how the various common components of the operating system are interconnected and melded into the kernel
- There are numerous ways of designing a new structure of an Operating system
- The most common structures of operating System are
  - **Layered system**
  - **Kernel system**
  - **Client-server model**
  - **Virtual machine**

# Layered System

- The operating system is divided into a number of layers (levels), each built on top of lower layers.
- The bottom layer (layer 0), is the hardware; the highest (layer N) is the user interface
- With modularity, layers are selected such that each uses functions (operations) and services of only lower-level layers.



Layered Structure of Operating System

- A layered design was first used in THE operating system. Its six layers are as follows

Layer	Function
5	The operator
4	User programs
3	Input/output management
2	Operator-process communication
1	Memory and drum management
0	Processor allocation and multiprogramming

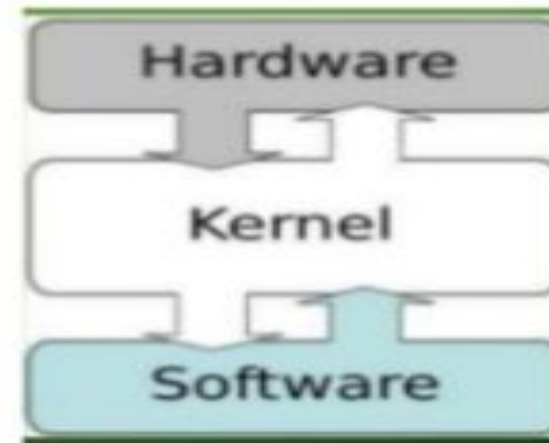
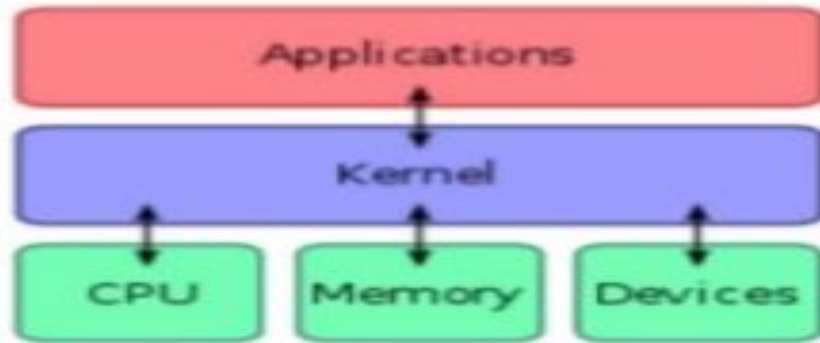
- **Layer 0** was responsible for the multiprogramming aspect of operating system. It decided which process was allocated to CPU.
- It dealt with interrupts and performed the context switch when process change was required.
- **Layer 1** was concerned with allocating memory to process.
- **Layer 2** deals with inter-process communication and communication between operating system and the console.

- **Layer 3** manages all I/O between device attached to the computer.  
This included buffering information from the various devices.
- **Layer 4** The programs used by the user are operated in this layer, and they don't have to worry about I/O management, operator/processes communication, memory management, or the processor allocation.
- **Layer 5** The system operator process is located in the outer most layer.
- This system operator controls overall of the system.

# Kernel System

- Kernel is core component of Operating system without which OS can not work.
- Kernel is nervous system of OS
- It is central component of operating system that manages operation of computer and hardware.
- It basically manages operation of memory and CPU time.
- Kernel acts as a bridge between applications and data processing performed at hardware level using inter-process communication and system calls.
- Kernel uses the system call to prepare all its function like CPU scheduling, memory management etc.

- The main function of kernel are:
  - It provides mechanism for creation and deletion of processes.
  - It provides CPU scheduling, memory management and I/O management.
  - It provides mechanism for inter-process communications



A kernel connects the application software to the hardware of a computer.

# Types of kernel

- There are mainly two types of kernel.
  - **Monolithic/Macro kernel**
  - **Micro / Exo-kernel**

## **Monolithic/Macro kernel:**

- It is traditional or older approach of kernel design.
- In monolithic kernel every basic system services like process and memory management, interrupt handling and I/O communication, file system run in kernel space.
- Every component of operating system is contained in the kernel and can directly communicate with each other by using function call.
- Kernel typically executes with unrestricted access to the computer system
- This approach provides rich and powerful hardware access.
- Ex: Linux, UNIX, open VMS etc.

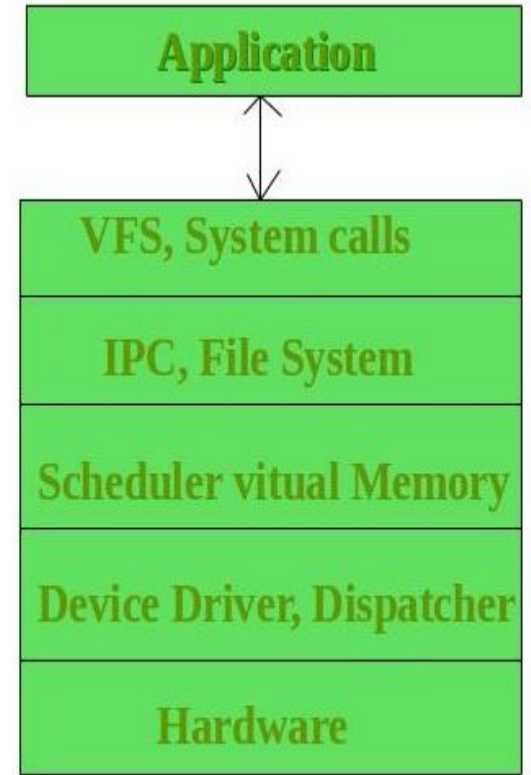


## Advantage:

- The execution of monolithic kernel is quite fast.
- Smaller in source and compile forms.
- System call are used to do operation
- Less code generally means fewer bugs and security problem is also less.

## Disadvantage:

- Coding in kernel space is hard.
- Debugging is harder.
- Monolithic kernel must be written for each new architecture that the OS to be used.



Monolithic Kernel

## **Micro / Exo-kernel**

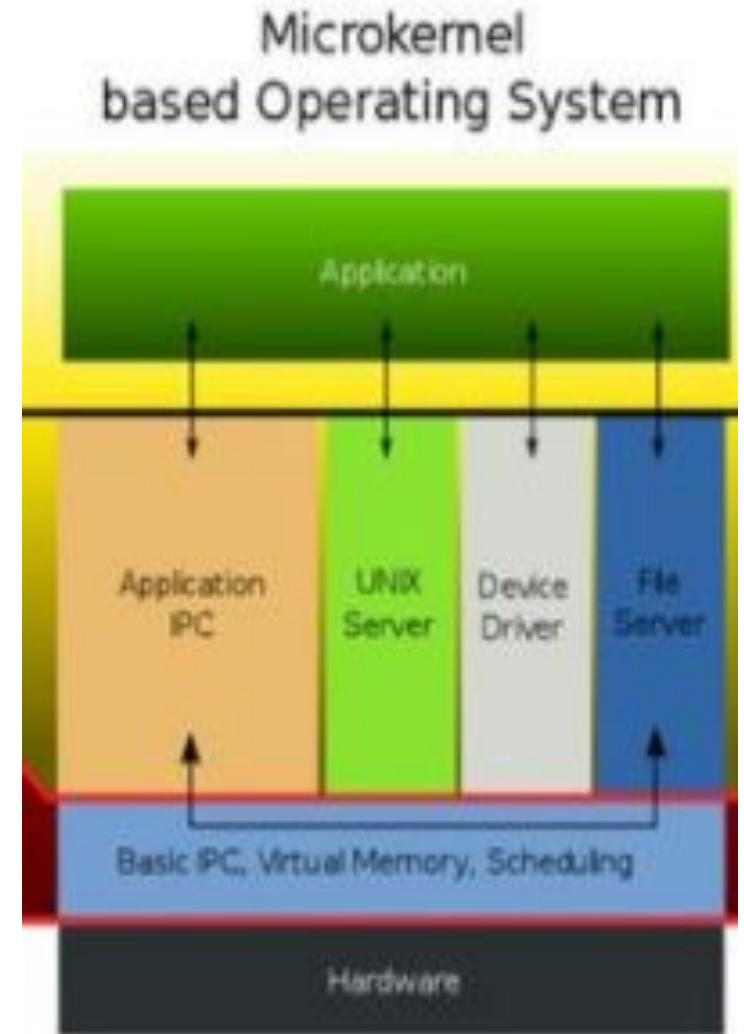
- In a microkernel, the kernel provides basic functionality such as IPC, memory management and scheduling etc that allows execution of server and separate program.
- The kernel is broken into separate processes known as server. Some of server run in user space and some in kernel space.
- The communication in microkernel is done via message passing. The server communicate through Interprocess communication.
- Server invoke “services” from each other by sending message.
- If a service fails , the rest of OS work fine.

## Advantage:

- Smaller in size.
- Easy to maintain
- New services can be added easily.
- Portable.
- Crash resistant.

## Disadvantage

- Service provided by microkernel is expensive.
- Execution is slow.



# Client server Model

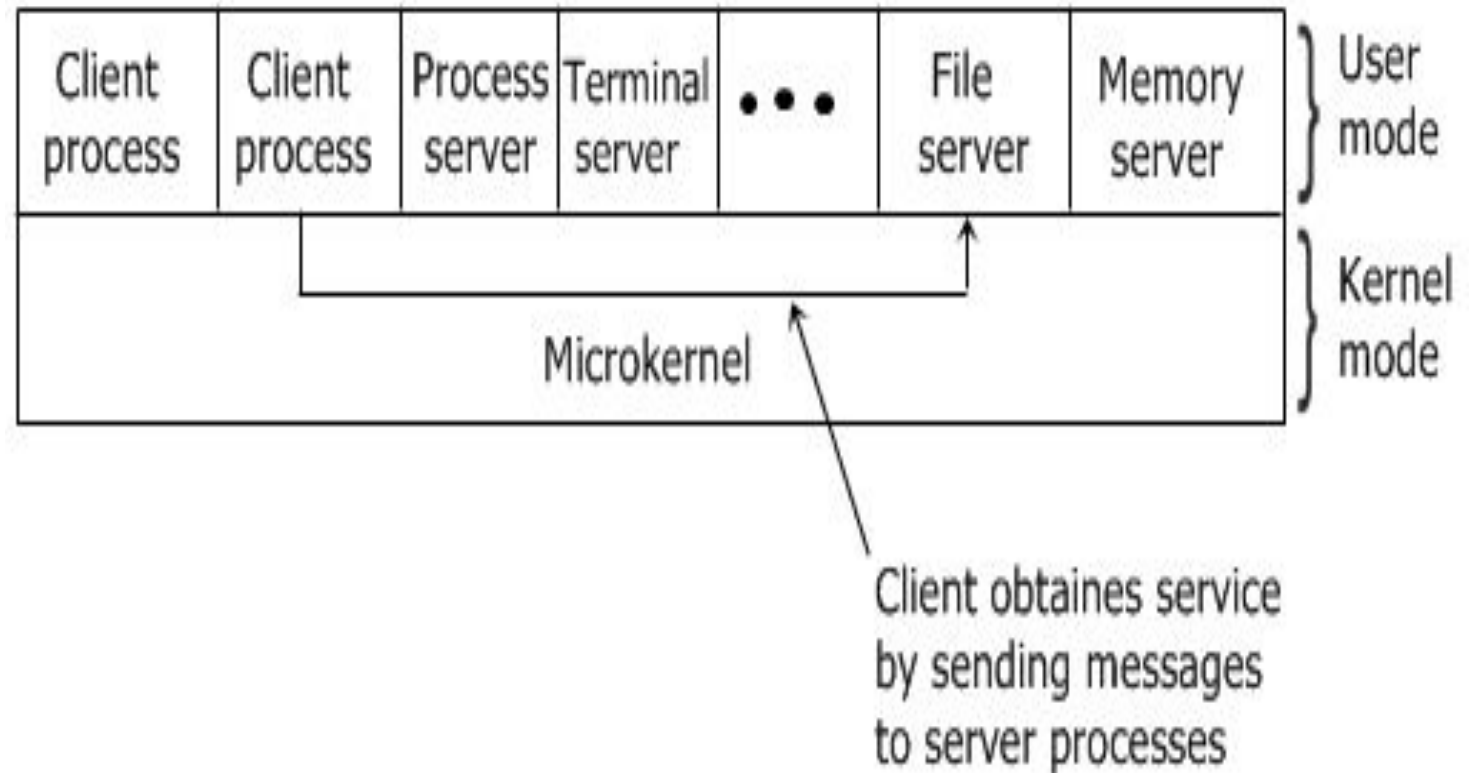
- One of the recent advances in computing is the idea of a client/server model .
- A server provides services to any client that requests it.
- This model is heavily used in distributed systems where a central computer acts as a server to many other computers.
- In this model, kernel handles the communication between the client and servers.
- operating system (OS) is splitting up into parts, each of which only handles one fact of the system, such as file service, terminal service, process service, or memory service, each part becomes small and manageable.

## **Advantage:**

- It can result in a minimal kernel.
- it's adaptability to user in distributed system
- Crash resistant.

## **Disadvantage:**

- Security problem
- overloading



# Virtual machine

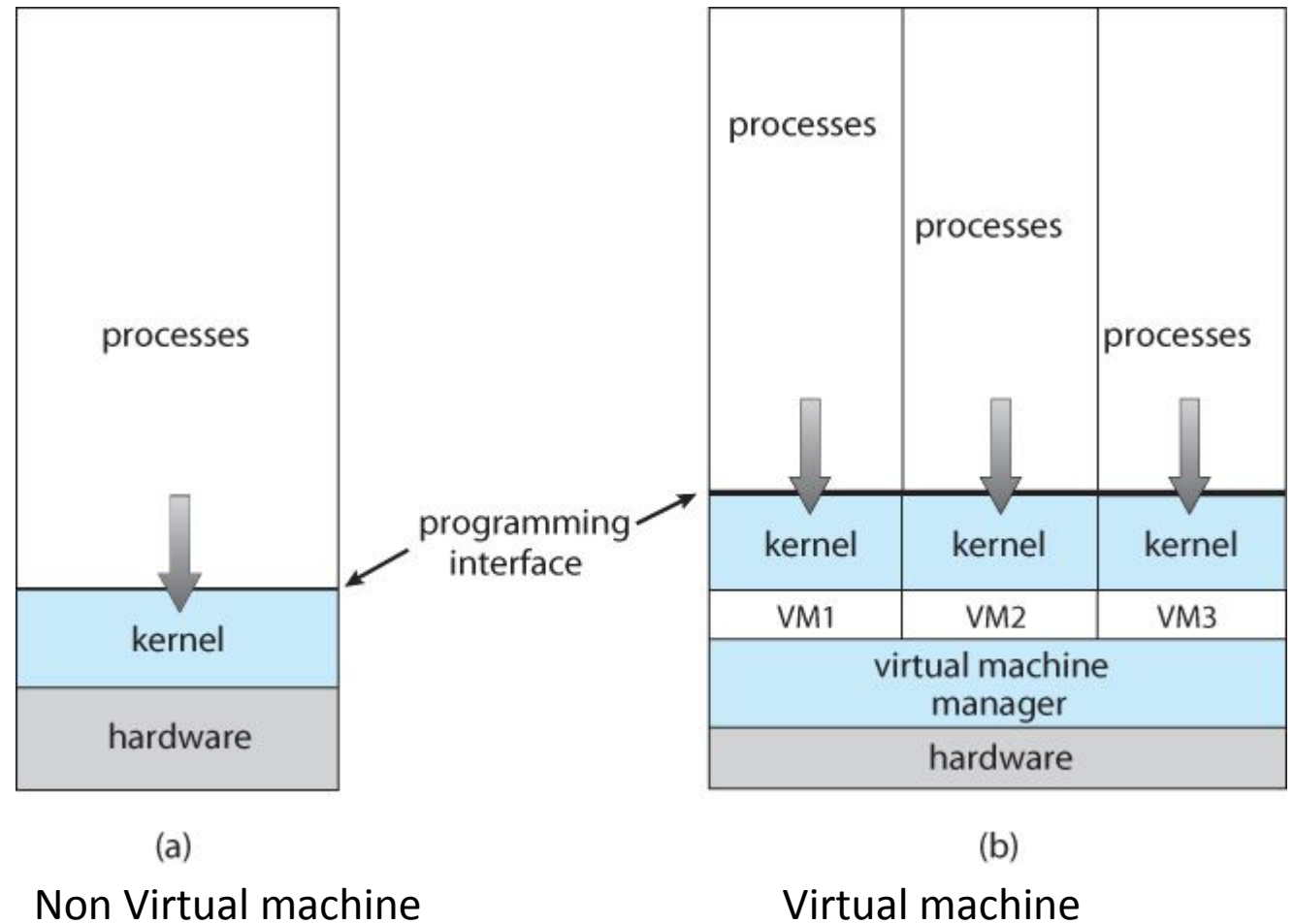
- Virtual machine is an illusion of a real machine.
- It is created by a real machine operating system, which make a single real machine appears to be several real machine.
- Actually, virtual machine can run several operating systems at once, each of them on its virtual machine.
- A virtual machine provides an interface identical to underlying bare hardware.
- The operating system creates illusion of multiple processes, each executing on its own processor with its own memory.
- The resource of the physical computer are shared to create virtual machine.

## Advantage:

- Provides a robust level of Security.
- Allows multiple OS to run On same machine at same Time
- Easier to system upgrade.

## Disadvantage:

- Less efficient.
- Difficult in sharing of hard drives



# Shell

- Shell is outer layer of an operating system.
- It is part of operating system that interface with the user
- A shell is a user interface for access to an operating system's services
- Most often the user interacts with the shell using a command-line interface
- It is interface to which accepts, interpret, and then executes command from user
- There are two types
  - **Command line interpreter(CLI)**
  - **Graphical user interface(GUI)**