UNIT-1

- Computer system architecture – single processor systems , multiprocessor systems , clustered systems. Operating system operations- dual mode and multimode operation. Process management, Memory management, Storage management. Computing Environments- Traditional computing, Mobile computing, Distributed systems, Client Server computing, Peer-to-Peer computing, Virtualization, Cloud computing, Real-time embedded systems.
- System structures - Operating system services , System calls , Types of system calls ,Operating system structure-Simple structure, Layered approach, Microkernals ,Modules, Hybrid systems.

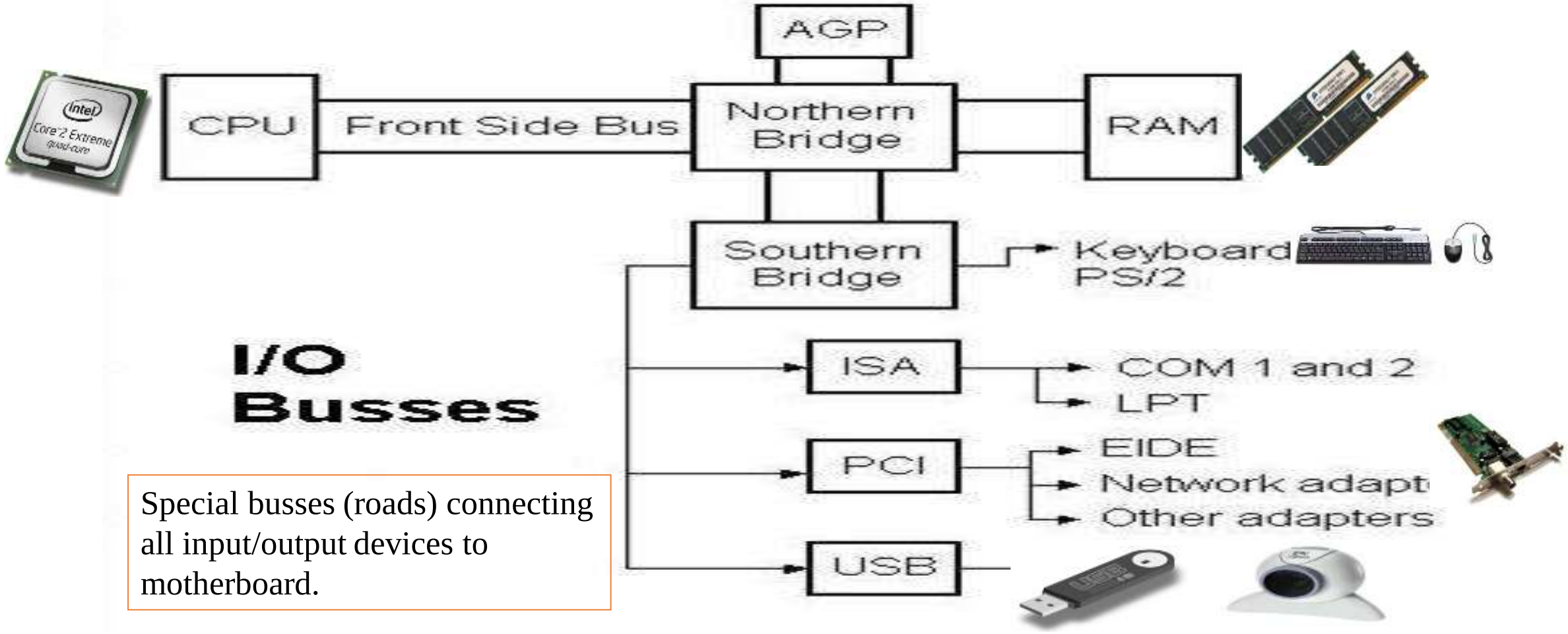
Operating System

- An operating system is the most important software that runs on a computer. It manages the computer's memory and processes, as well as all of its software and hardware.

Computer system architecture

- Computer architecture refers to the end to end structure of a computerThe organization that determines how its components interact with each other in helping to execute the machines purpose.

Computer Architecture



Special busses (roads) connecting all input/output devices to motherboard.

CPU – Central Processing Unit

- This is the brain of your computer.
- It performs all of the calculations.
- In order to do its job, the CPU needs commands to perform, and data to work with.
- The instructions and data travel to and from the CPU on the system bus.
- The operating system provides rules for how that information gets back and forth, and how it will be used by the CPU.

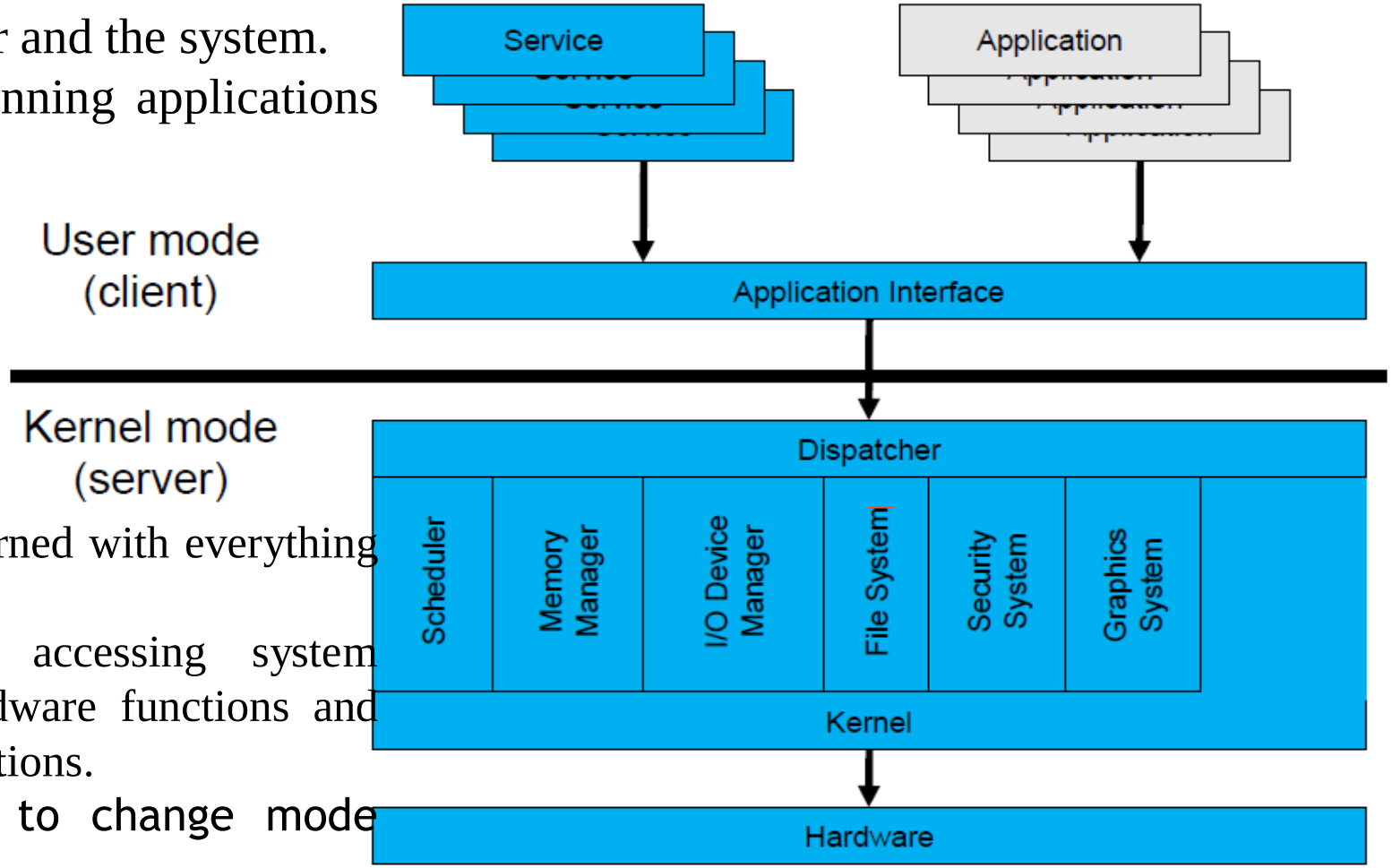
RAM – Random Access Memory

- This is like a desk, or a workspace, where your computer temporarily stores all of the information (data) and instructions (software or program code) that it is currently using.
- Each RAM chip contains millions of address spaces.
- Each address space is the same size, and has its own unique identifying number (address).
- The operating system provides the rules for using these memory spaces, and controls storage and retrieval of information from RAM.
- Device drivers for RAM chips are included with the operating system.

Problem: *If RAM needs an operating system to work, and an operating system needs RAM in order to work, how does your computer activate its RAM to load the operating system?*

Operating System Mode

- The *User Mode* is concerned with the actual interface between the user and the system.
- It controls things like running applications and accessing files.



- The *Kernel Mode* is concerned with everything running in the background.
- It controls things like accessing system resources, controlling hardware functions and processing program instructions.
- System calls are used to change mode from User to Kernel.

single processor systems

- **Single-Processor Systems**

  Single-processor system, there is one main CPU capable of executing a general-purpose instruction set, including instructions from user processes.
- Almost all systems have other special-purpose processors as well. They may come in the form of device-specific processors, such as disk, keyboard, and graphics controllers; or, on mainframes,
- They may come in the form of more general-purpose processors, such as I/O processors that move data rapidly among the components of the system.
  All of these special-purpose processors run a limited instruction set and do not run user processes. Sometimes they are managed by the operating system, in that the operating system sends them information about their next task and monitors their status

Multiprocessor Systems

- **Multiprocessor Systems**

Multiprocessor systems (also known as **parallel systems** or **tightly coupled systems)** are growing in importance. Such systems have two or more processors in close communication, sharing the computer bus and sometimes the clock, memory, and peripheral devices.

2/8/2015

4 Comments

Multiprocessor systems have three main advantages:

- **1. Increased throughput.** By increasing the number of processors, we expect to get more work done in less time.
- **2. Economy of scale.** Multiprocessor systems can cost less than equivalent multiple single-processor systems
- 3. **Increased reliability.** If functions can be distributed properly among several processors, then the failure of one processor will not halt the system, only slow it down.

- **The multiple-processor systems are of two types.**

  · **Asymmetric multiprocessing,** which each processor is assigned a specific task.
  · **Symmetric multiprocessing (SMP),** The most common systems use in which each processor performs all tasks within the operating system

Clustered Systems

- **Clustered system** is an another type of multiple-CPU system. Clustered systems differ from multiprocessor systems, however, in that they are composed of two or more individual systems coupled together.
- The definition of the term *clustered* is not concrete;
- The generally accepted definition is that clustered computers share storage and are closely linked via a **local-area network (LAN)** or a faster interconnect

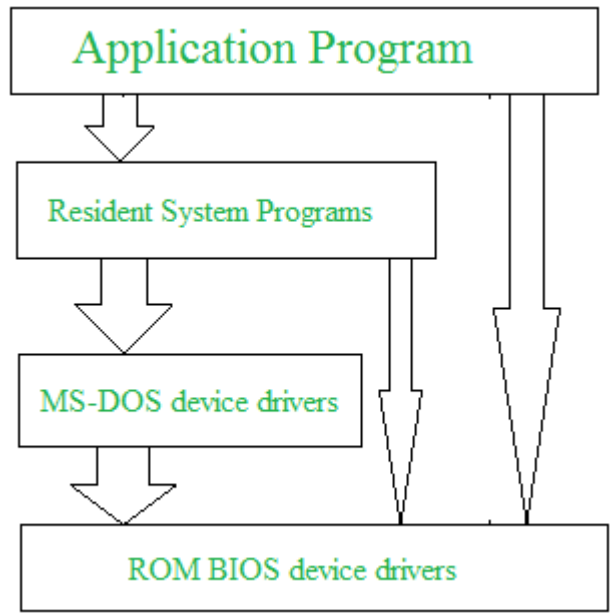
Operating-System Structure-Simple/Monolithic

operating system is a design that enables user application programs to communicate with the hardware of the machine.

- Simple/Monolithic Structure
- Micro-Kernel Structure
- Hybrid-Kernel Structure
- Exo-Kernel Structure
- Layered Structure
- Modular Structure
- Virtual Machines

Simple/Monolithic Structure

- The monolithic operating system is a very basic operating system in which file management, memory management, device management, and process management are directly controlled within the kernel. The kernel can access all the resources present in the system.


Application Program
Resident System Programs
MS-DOS device drivers
ROM BIOS device drivers

- **Advantages of Simple/Monolithic structure**
- It delivers better application performance because of the few interfaces between the application program and the hardware.
- It is easy for kernel developers to develop such an operating system.
- **Disadvantages of Simple/Monolithic structure**
- The structure is very complicated, as no clear boundaries exist between modules.
- It does not enforce data hiding in the operating system.

Micro-kernel Structure

- This structure designs the operating system by removing all non-essential components from the kernel and implementing them as system and user programs.
- **Advantages of Micro-kernel structure**
- It makes the operating system portable to various platforms.
- As microkernels are small so these can be tested effectively.
- **Disadvantages of Micro-kernel structure**
- Increased level of inter module communication degrades system performance

Hybrid-Kernel Structure

- Hybrid-kernel structure is nothing but just a combination of both monolithic-kernel structure and micro-kernel structure.
- **Advantages of Hybrid-Kernel Structure**
- It offers good performance as it implements the advantages of both structure in it.
- It supports a wide range of hardware and applications.
- It provides better isolation and security by implementing micro-kernel approach.
- It enhances overall system reliability by separating critical functions into micro-kernel for debugging and maintenance.
- **Disadvantages of Hybrid-Kernel Structure**
- It increases overall complexity of system by implementing both structure (monolithic and micro) and making the system difficult to understand.
- The layer of communication between micro-kernel and other component increases time complexity and decreases performance compared to monolithic kernel.

Layered structure

- An OS can be broken into pieces and retain much more control over the system. In this structure, the OS is broken into a number of layers (levels).
- The bottom layer (layer 0) is the hardware, and the topmost layer (layer N) is the user interface.
- These layers are so designed that each layer uses the functions of the lower-level layers.
- This simplifies the debugging process, if lower-level layers are debugged and an error occurs during debugging, then the error must be on that layer only, as the lower-level layers have already been debugged.
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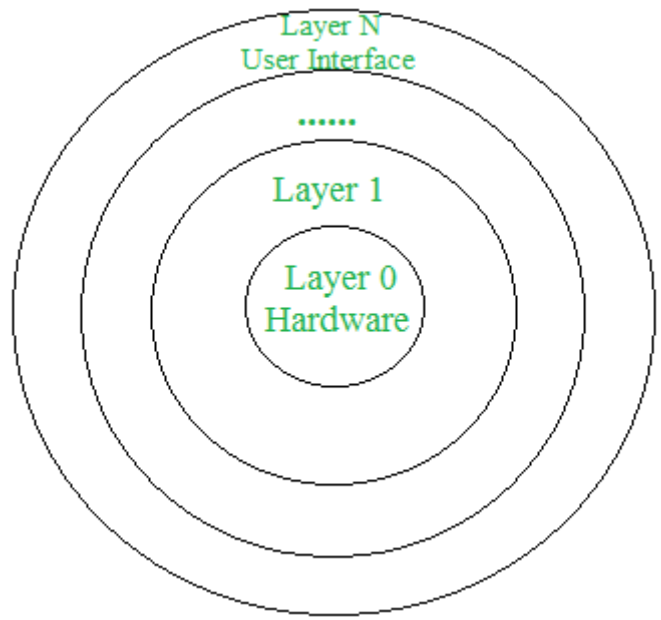

Layer N
User Interface
.....
Layer 1
Layer 0
Hardware

- **Advantages of Layered structure**
- Layering makes it easier to enhance the operating system, as the implementation of a layer can be changed easily without affecting the other layers.
- It is very easy to perform debugging and system verification.
- **Disadvantages of Layered structure**
- In this structure, the application’s performance is degraded as compared to simple structure.
- It requires careful planning for designing the layers, as the higher layers use the functionalities of only the lower layers

Modular Structure

- It is considered as the best approach for an OS.
- It involves designing of a modular kernel.
- The kernel has only a set of core components and other services are added as dynamically loadable modules to the kernel either during runtime or boot time.
- It resembles layered structure due to the fact that each kernel has defined and protected interfaces, but it is more flexible than a layered structure as a module can call any other module.

VMs (Virtual Machines)

- Based on our needs, a virtual machine abstracts the hardware of our personal computer, including the CPU, disc drives, RAM, and NIC (Network Interface Card), into a variety of different execution contexts, giving us the impression that each execution environment is a different computer.
- An operating system enables us to run multiple processes concurrently while making it appear as though each one is using a different processor and virtual memory by using CPU scheduling and virtual memory techniques.

OPERATING-SYSTEM OPERATIONS

- Interrupt-driven nature of modern OS requires that erroneous processes not be able to disturb anything else.
- Dual-Mode and Multimode Operation
- Dual-mode operation is designed to provide a layer of protection and stability to computer systems by separating user programs and the operating system into two modes: user mode and kernel mode. User mode restricts access to privileged resources, while kernel mode has full access to these resources
- User mode when executing harmless code in user applications
- Kernel mode (a.k.a. system mode, supervisor mode, privileged mode) when executing potentially dangerous code in the system kernel.
- Certain machine instructions (privileged instructions) can only be executed in kernel mode.
- Kernel mode can only be entered by making system calls. User code cannot flip the mode switch.
- Modern computers support dual-mode operation in hardware, and therefore most modern OSes support dual-mode operation.

Multimode

- The concept of modes of operation in operating system can be extended beyond the dual mode. This is known as the multimode system. In those cases the more than 1 bit is used by the CPU to set and handle the mode.
- **Advantages:**
- It helps in the sharing of data and information among different users.
- It also helps in the sharing of hardware resources such as printers.
- It avoids disruption if any one computer fails it does not affect any other computer present on that network.
- Users can share their work with other users

Process management

- Process management refers to the activities involved in managing the execution of multiple processes in an operating system. It includes creating, scheduling, and terminating processes, as well as allocating system resources such as CPU time, memory, and I/O

Memory management

- Memory management is a form of resource management applied to computer memory. The essential requirement of memory management is to provide ways to dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed.

Storage Management

- **Storage Management** is defined as it refers to the management of the data storage equipment's that are used to store the user/computer generated data. Hence it is a tool or set of processes used by an administrator to keep your data and storage equipment's safe. Storage management is a process for users to optimize the use of storage devices and to protect the integrity of data for any media on which it resides and the category of storage management generally contain the different type of subcategories covering aspects such as security, virtualization and more, as well as different types of provisioning or automation, which is generally made up the entire storage management software market.

Computing environment

Computing environment

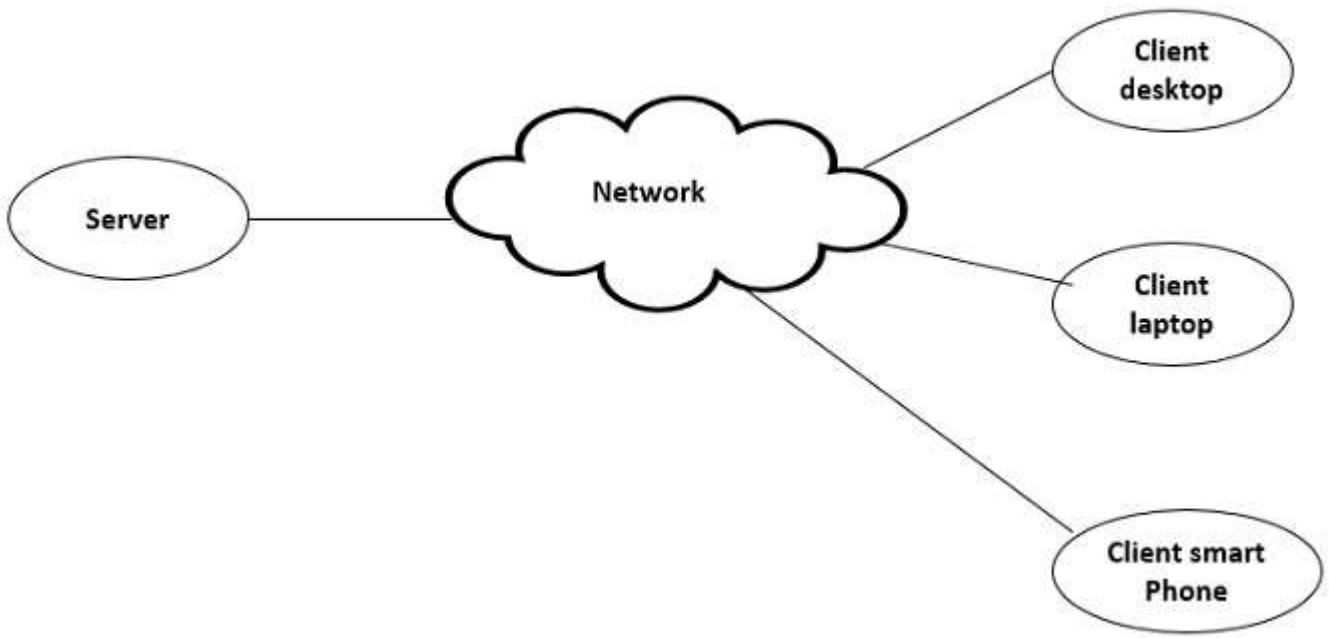
- In computers there are different types of computing technologies and all are different from each other. By using this we are finding output based on the input given by the user.
- In a computing environment the user can use a particular computing technology and it is responsible for all the types of input and output given by the computer
- **1. Traditional computing**
- In traditional computing the user can use a traditional method like static memory allocation and it is mainly useful in single user operating systems.
- In this technique there will be a particular operating system that is going to perform all tasks to that particular computer system.
- It is like one task is performed by the CPU at a given time and the CPU utilizes the memory that is used only for one task.

Mobile computing

- It refers to the smart phones and tablets and these types of devices having different features.
- According to mobile computing they can be recognized with the help of storage size, memory size and the service available by the company.
- When a process is working on a mobile system and it uses some memory space with the help of RAM then the calculation regarding the memory space and connection is known as mobile computing.

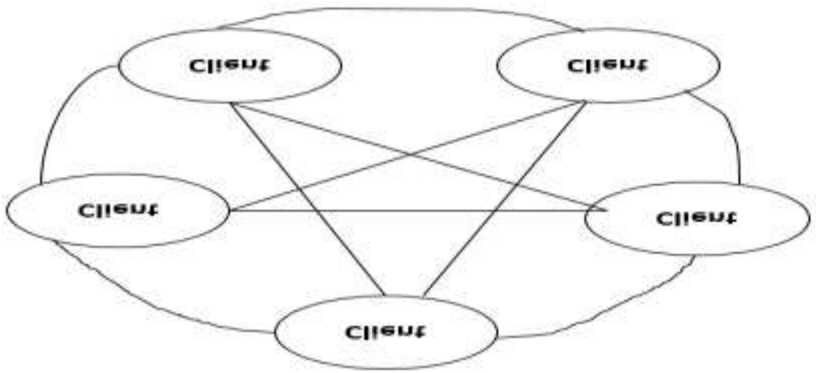
Client-server computing

- In client-server computing there is a technology available by using a client and server that are connected with each other with the help of a network.
- When some process or program transfers from client to server or server to client then the memory and I/O calculations is called client-server computing.
- Basically in the internet the user can use this technology and a network is used to connect the server with the client. So, that the client and server are connected with each other for client-server computing.


Server
Network
Client desktop
Client laptop
Client smart Phone

Peer to peer network

- In Peer to Peer computing a node first joins the network and a number of nodes are directly connected to the network, so every single node has a direct connection with all the other nodes and this type of computing is called Peer to Peer computing.
- The Peer to Peer network is a network which is based on specific tasks and it is a centralized service where one single node will be connected to all the other nodes just like our computer where CPU is connected to all resources to perform operation.


Client
Client
Client
Client
Client

Cloud computing

- Cloud computing is a type of computing which delivers computing storage and services across the network.
- All the data is stored in cloud computing because it can be used by different servers to store their data and use whenever they want.
- In cloud computing different types of servers are used and storage manager is used to manage the computing and there will be cloud management service through which different companies are directly connected with it and store their data.

Embedded or real time computing

- In real time embedded system computing the real time OS is used and in this computing technique the OS that is used is real time OS.
- When the real time system has defined the time that is fixed and processing must be done within that defined time

System Calls in Operating System

- A system call is a way for a user program to interface with the operating system.
- The program requests several services, and the OS responds by invoking a series of system calls to satisfy the request.
- A system call can be written in assembly language or a high-level language like **C** or **Pascal**.
- System calls are predefined functions that the operating system may directly invoke if a high-level language is used

- A system call is a method for a computer program to request a service from the kernel of the OS on which it is running. A system call is a method of interacting with the operating system via programs. A system call is a request from computer software to an operating system's kernel.
- A computer software needs to access the operating system's kernel, it makes a system call. The system call uses an API to expose the operating system's services to user programs. It is the only method to access the kernel system.
- A system call function may create and use kernel processes to execute the asynchronous processing.
- A system call has greater authority than a standard subroutine. A system call with kernel-mode privilege executes in the kernel protection domain.
- System calls are not permitted to use shared libraries or any symbols that are not present in the kernel protection domain.
- The code and data for system calls are stored in global kernel memory.

How System Calls Work

- The Applications run in an area of memory known as user space. A system call connects to the operating system's kernel, which executes in kernel space. When an application creates a system call, it must first obtain permission from the kernel. It achieves this using an interrupt request, which pauses the current process and transfers control to the kernel.
- If the request is permitted, the kernel performs the requested action, like creating or deleting a file. As input, the application receives the kernel's output. The application resumes the procedure after the input is received. When the operation is finished, the kernel returns the results to the application and then moves data from kernel space to user space in memory.

Types of System Calls

- There are commonly five types of system calls. These are as follows
- **Process Control**
- **File Management**
- **Device Management**
- **Information Maintenance**
- **Communication**

- Process Control
- Process control is the system call that is used to direct the processes. Some process control examples include creating, load, abort, end, execute, process, terminate the process, etc.
- File Management
- File management is a system call that is used to handle the files. Some file management examples include creating files, delete files, open, close, read, write, etc.
- Device Management
- Device management is a system call that is used to deal with devices. Some examples of device management include read, device, write, get device attributes, release device, etc.
- Information Maintenance
- Information maintenance is a system call that is used to maintain information. There are some examples of information maintenance, including getting system data, set time or date, get time or date, set system data, etc.
- Communication
- Communication is a system call that is used for communication. There are some examples of communication, including create, delete communication connections, send, receive messages, etc.
-

Process	Windows	Unix
Process Control	CreateProcess() ExitProcess() WaitForSingleObject()	Fork() Exit() Wait()
File Manipulation	CreateFile() ReadFile() WriteFile() CloseHandle()	Open() Read() Write() Close()

Services of Operating System

- Program execution
- Input Output Operations
- Communication between Process
- File Management
- Memory Management
- Process Management
- Secuirity and Privacy
- Resource Management
- User Interface
- Networking
- Error handling
- Time Management
-