

Types Of Operating Systems

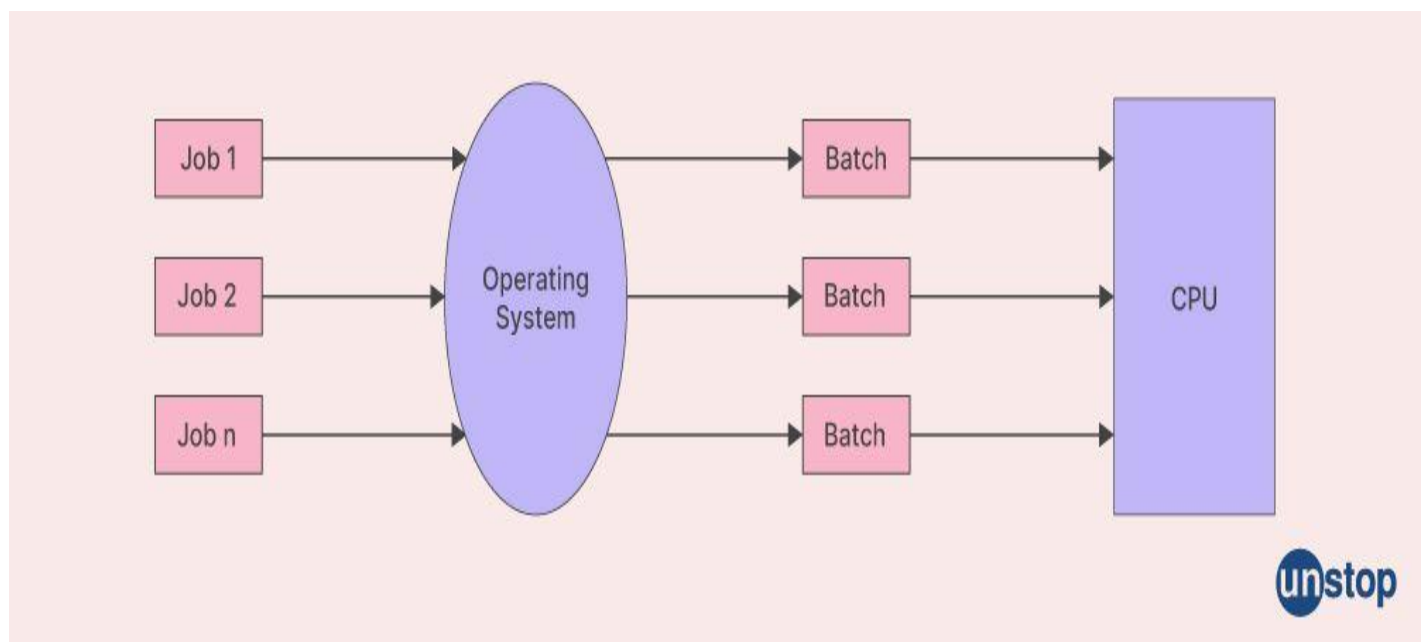
After what is the operating system and its components, let's look at the various types of OS. Here are the nine operating system types:

1. Batch Operating System

A batch operating system is a type of computerized operating system that processes and executes programs in batches rather than one at a time. This type of processing prevents users from interacting with the computer directly while running the program, as all jobs are handled by an automated process where input data files are pre-set before they start execution.

Batch systems processing can benefit large organizations that run high volumes of tasks concurrently since it reduces manual labor costs associated with managing multiple systems or simultaneously executing separate commands for each job request.

Examples include MS-DOS and DR-DOS.



Advantages of Batch Systems

- **Faster overall operation** since jobs can be set up to run automatically instead of requiring manual input.
- **Less chance for errors** introduced by user interaction during execution.
- **Reduced labour costs** associated with managing multiple systems or executing separate commands for each job request.

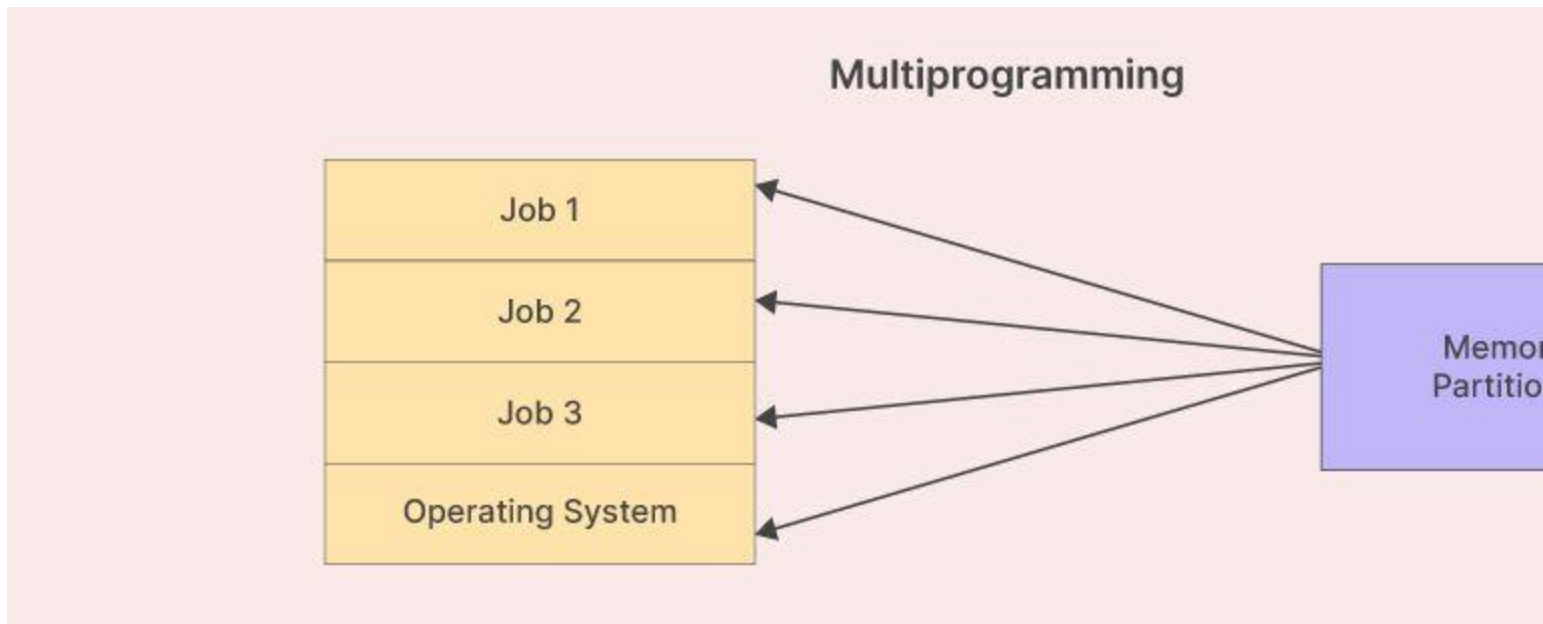
Disadvantages of Batch Systems

- **Limited flexibility and inability to respond in real-time** as some tasks may take longer than others due to the batch approach. This means users have no control over how quickly their requests are fulfilled if they're partaking in a batch process queue.
- **Poor scalability**, especially at higher load levels, compared to interactive operating system environments that allow more direct user control.

2. Multi-Programming Operating System

A multi-programming operating system is a computer operating system that enables multiple programs to run simultaneously, effectively utilizing the hardware available. It does so by simultaneously maintaining several instances of the same or different programs and scheduling them depending on their priority and the resources required. This way, each program can be allocated its time slice in which it works and gets done with its operations before yielding control for some other application or process to use those resources.

Examples of multiprogramming OS include Unix/Linux (multi-user) systems like Solaris, HP-UX, AIX, etc., and Windows XP/Vista/7 & 8 for desktop computing.



Advantages of Multi-programming

- It helps to **increase the efficiency** of a system by allowing multiple applications and programs to run on one machine at any given time, thus utilizing all available resources. This results in **increased speed and improved performance** as compared to non-multiprogramming systems.
- It can also help **save memory** since instances of different application programs do not need their copy; instead, they share the same memory pool for running processes.

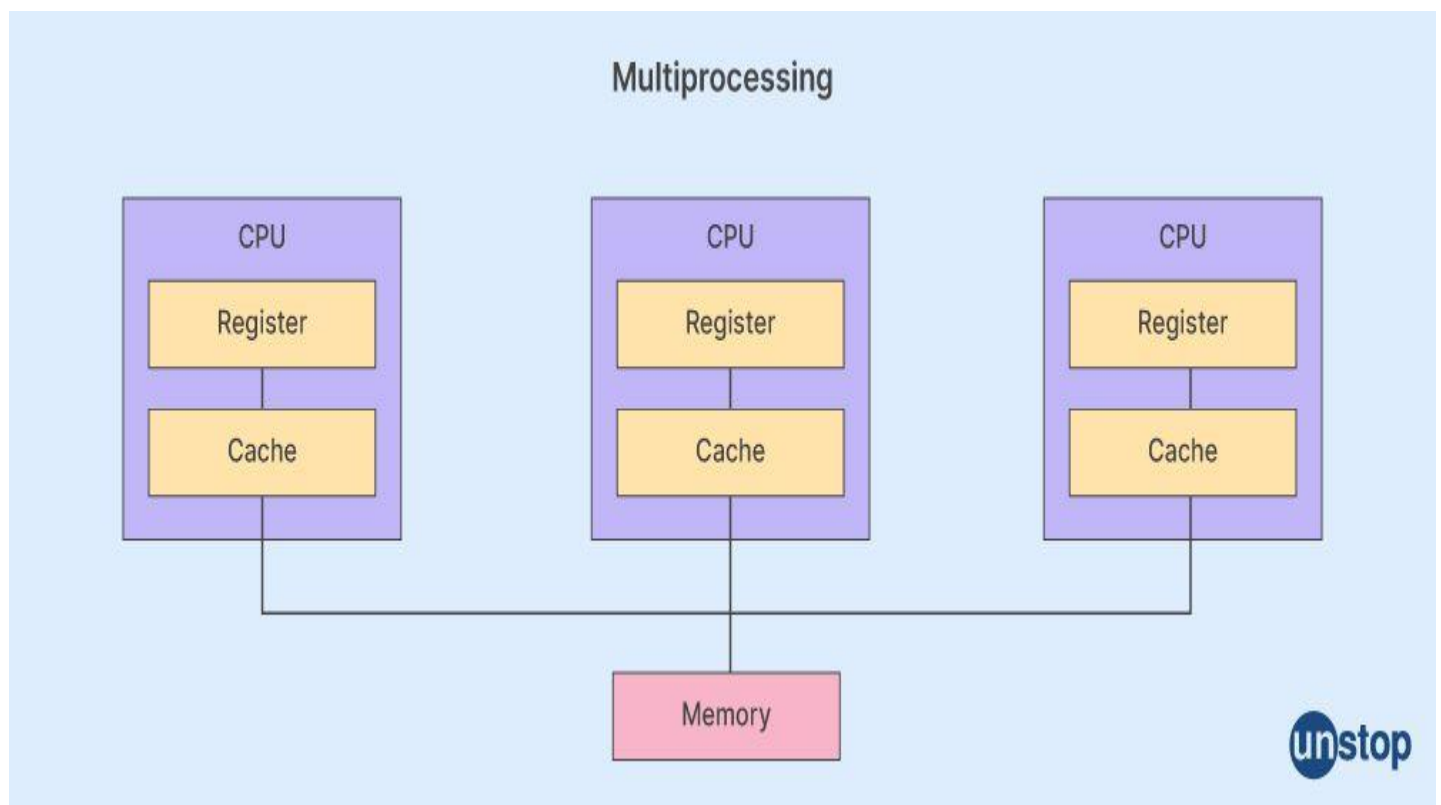
Disadvantages of Multi-programming

- Multi-programming can lead to issues if two or more competing tasks try to access shared resources simultaneously because these could cause conflicts among them, resulting in errors or slower response times due to **contention for CPU cycles known as thrashing**.
- As we add new software, it may become a **difficult and time-consuming process** to manage a large amount of hardware and applications with associated data used by each program within an operating system.

3. Multi-Processing Operating System

Multi-Processing Operating System is a type of operating system that utilizes multiple processing elements, including processors, memory and other components, to execute tasks. These systems can be used in single and multi-user environments as they allow more than one user to access the same hardware resources at any time.

Examples of Multi-Processing Operating Systems include Windows Server (MS), Linux/Unix-based distributions (Red Hat Enterprise Linux), or macOS.



Advantages of Multi-Processing OS

- **Increased Efficiency:** Utilizing multiple processors for various tasks helps make the system more efficient as each processor can handle separate processes and execute instructions

concurrently or simultaneously. This helps reduce the overall workload of a single computer, allowing it to do more in less time.

- **Improved Reliability:** Multi-processing operating systems tend to be more reliable than those running on single-process systems since they are better equipped and designed to handle several different types of applications simultaneously without any noticeable effect on performance due to errors in individual components or programs.
- **Better Security:** Many multi-processing operating systems have built-in security features that help protect sensitive data from unauthorized access, malware attacks, etc., helping businesses remain secure against potential cyber threats.

Disadvantages of Multi-Processing OS

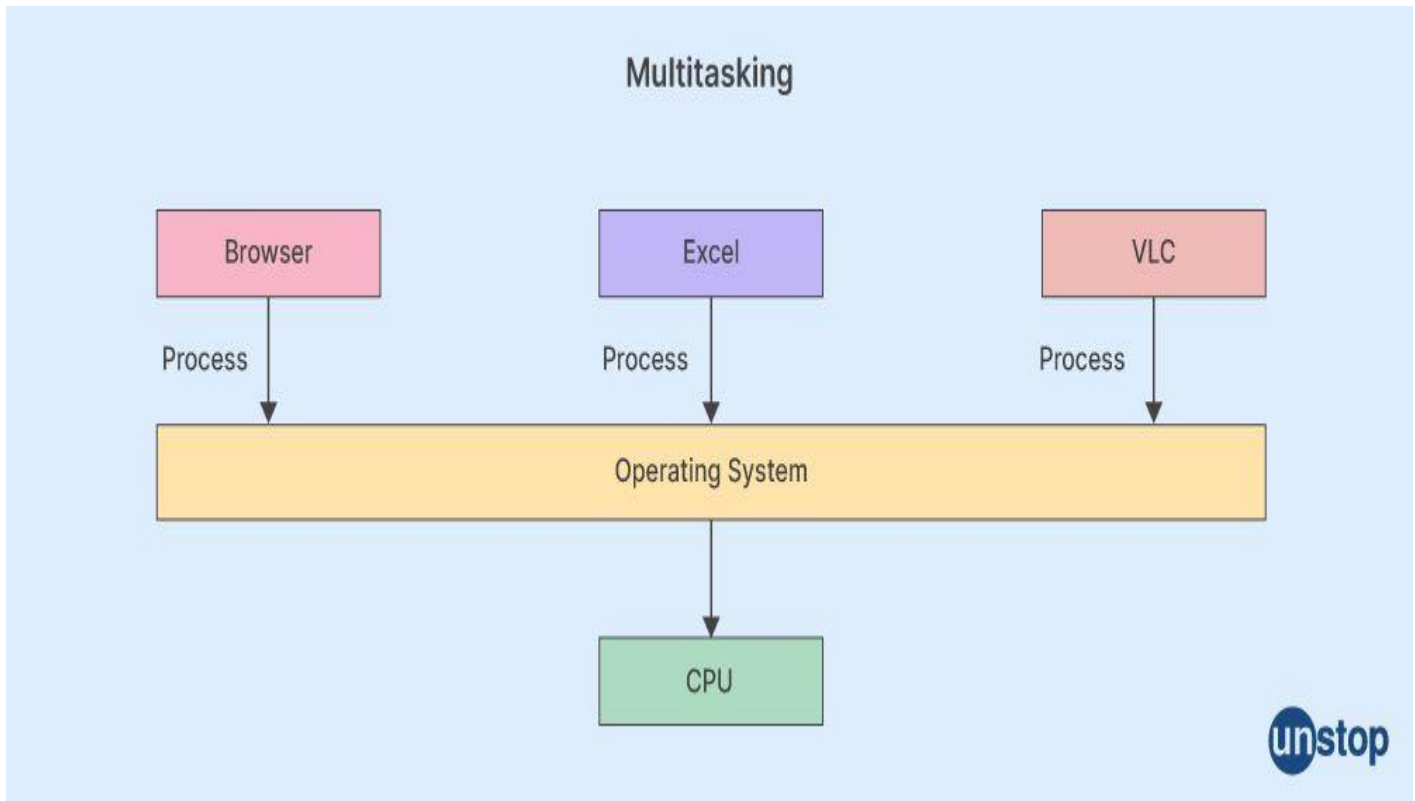
- **Expensive Upkeep:** The cost associated with setting up and maintaining a multi-processing operation system may not be worth the investment depending upon business needs.
- **Inconsistent Performance:** Depending on how intensively certain programs are being run, there could potentially be issues with performance inconsistencies when running them across multiple processors.
- **Not All Applications Are Compatible:** Certain applications cannot fully utilize every advantage afforded by these types of systems.

4. Multi-Tasking Operating System

A multi-tasking operating system is a computer operating system that allows different applications to run concurrently on the same hardware platform. It enables multiple tasks or processes to be executed simultaneously, each with its own address space and memory resources.

Multi-Tasking Operating System (MTOS) can also refer to real-time systems designed for hard real-time multimedia processing. They offer higher levels of control over process scheduling and access control methods such as segmentation fault prevention when using virtual memory management capabilities built into these kernels.

The most common example of this type of OS is Microsoft Windows 10, which uses pre-emptive multi-tasking, allowing programs to run in the background while other applications are active on the desktop for increased efficiency and productivity.



Advantages of Multi-Tasking OS

- It **improves system performance** by making multi-tasking easier and faster. This means that more programs can run simultaneously, resulting in **higher productivity**.
- Multi-tasking OS has **built-in features** like virtual memory management, segmentation fault prevention when dealing with multiple processes, and access control options such as passwords for added security measures.
- These operating systems are much **better at handling hardware device interruptions** than single-tasking systems. This is very useful for controlling complex I/O operations or other jobs requiring real-time response times from the system.

Disadvantages of Multi-Tasking OS

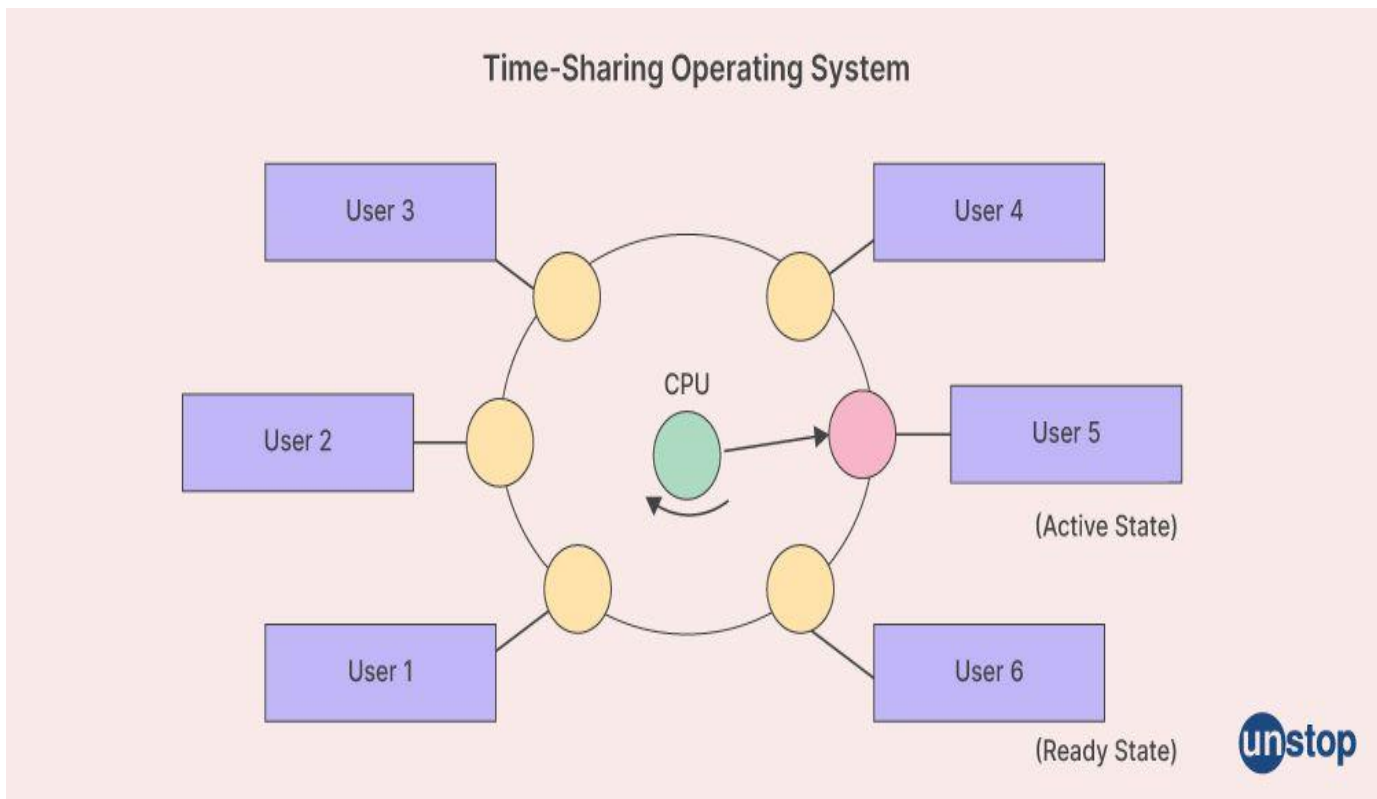
- Multi-tasking Operating Systems tend to be **less efficient** than their Single Tasking counterparts (especially where there is no support for Virtual Memory). As each process needs its own address space to execute within, it will consume a portion of RAM.
- Multi-tasking Operating System **vulnerabilities include potential deadlocks** due to resource contention between tasks sharing common resources, as well as **race conditions** caused by timing inconsistencies arising during inter-phase communications across different partitions to pass data around effectively.

5. Time-Sharing Operating Systems

Time-sharing operating systems are computer operating systems that allow multiple users to interact with a single computer system simultaneously. They enable multiple users or processes to access the same computer resources, including memory and CPU time.

Time-sharing enables people with different platforms on different computers to share computing power simultaneously without waiting for each other's processes to complete before beginning another task altogether, as it would be if only one user were using the system exclusively at any given moment.

Examples of such systems include Windows Server 2019, Linux (Ubuntu), macOS High Sierra 10.13, IBM OS/360 Multiprogramming System, etc.



Advantages of Time-Sharing OS

- **Increases Efficiency:** Time-sharing operating systems allow multiple users and processes to use the same computer resources simultaneously, making these computers far more efficient than single-user machines. This eliminates the need to wait for a process or task to finish running on one machine before another can begin using it.
- **Reduces Cost:** Time-sharing also reduces costs because many tasks can be done simultaneously with fewer data centers and less hardware required per user/process compared to individual workstations with exclusive access rights and dedicated resource requirements like memory.
- **Increased Security:** Each user's sessions are separated from other users within a given environment due to its multi-user approach. This provides additional security measures against malicious activities such as data leakage (like hacking) since they operate in separate partitions (areas).

Disadvantages of Time-Sharing OS

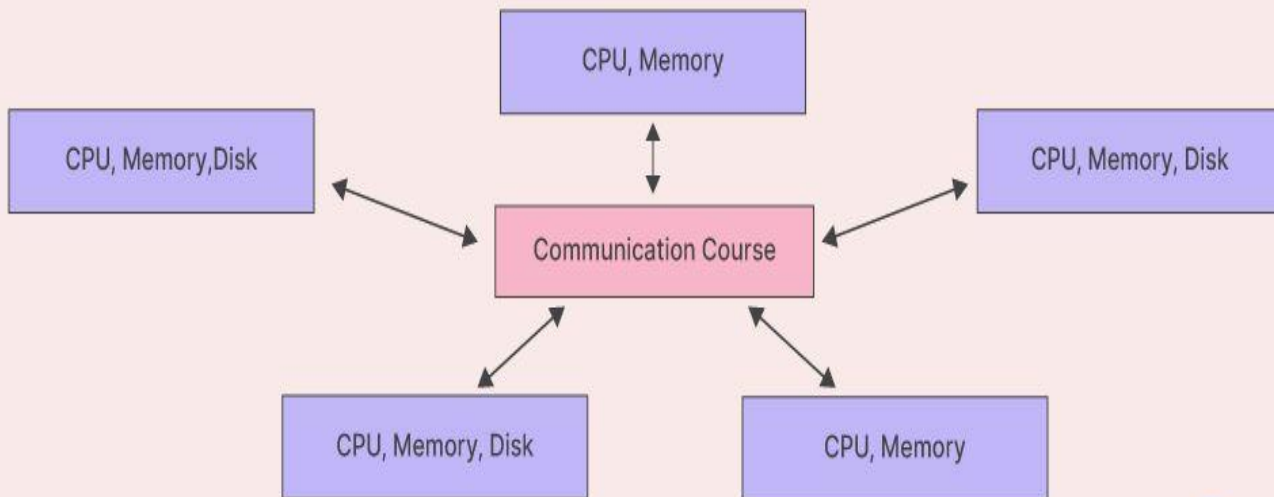
- **System Overload:** A system overload occurs when too many simultaneous requests take up concurrent resources, slowing down the time-sharing system.
- **Limited Resources:** With more users utilizing shared resources, there is less available for each user or process to consume independently within their dedicated area of responsibility.
- **Difficulty in Maintenance:** Time-sharing systems can be difficult to maintain due to their complexity regarding access rights and other security measures implemented on various platforms like Windows Server/Linux.

6. Distributed Operating System

A distributed OS allows two or more computers to share resources and communicate over a network. It runs on each computer, allowing all machine users to access information from any other machine in the cluster. This can help share files, applications, memory storage space and data processing power across multiple devices within an organization.

Examples of distributed operating systems include Windows Server 2019 Datacenter Edition, Red Hat Enterprise Linux 8, VMware ESXi 6 at Cisco UCS B-Series Servers, and Kubernetes clusters running CoreOS distributions.

Architecture of Distributed OS



Advantages of Distributed OS

- **Increased Flexibility:** As many computers are connected and used together, the system can be adapted more quickly to changing demands. Single-node systems require modifications or upgrades that could take significantly longer since they have a single point of failure risk.
- **Improved Reliability:** Since distributed operating systems are composed of multiple machines working in tandem, failures occur much less frequently than in single-node systems due to redundancy built into the architecture. This means users can continue using parts of the system even when one component fails as long as another machine runs correctly.
- **Better Scalability:** Distributed computing allows organizations to scale up their operations by increasing resources like RAM or storage space without having to purchase an entirely new node each time additional infrastructure is needed. This can save money over time while allowing companies to increase productivity and efficiency within their organization at an overall quicker rate than normal hardware expansions would allow them to achieve alone.

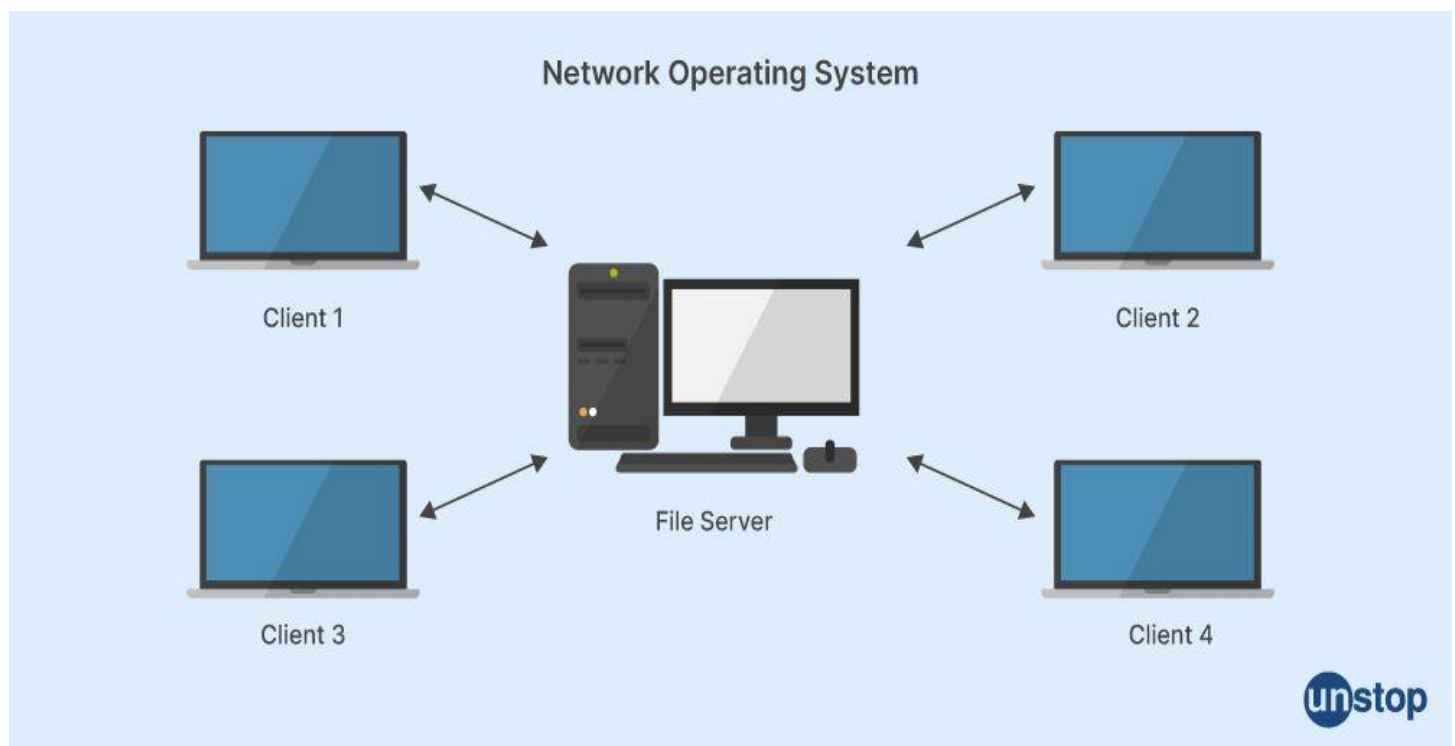
Disadvantages of Distributed OS

- **Rising Maintenance Cost:** Because there's no need for expensive dedicated hardware such as server racks, networking switches, etc., building out a distributed compute environment costs substantially less compared to traditional large IT setups, albeit its maintenance costs may rise over time depending upon how often changes made across its multiple components.
- **Reduced Security:** With so many different machines connected at once, it can be difficult to prevent cyber-attacks or malicious code from affecting the entire system as each node may have different security protocols in place - this could create gaps for intruders to easily exploit and breach networks.

7. Network Operating System

A Network Operating System (NOS) facilitates the communication and coordination of activities between networked computers. It helps manage sharing resources such as files, printers, memory, and other peripherals across networks.

Some examples of popular NOSs include Microsoft Windows Server 2008 R2/2016, Linux RedHat Enterprise Edition 7+, FreeBSD 10+, and Apple Mac OS X El Capitan 10+.



Advantages of NOS

- **Ease of administration:** An NOS enables administrators to make changes quickly and efficiently across the network, reducing the overall workload required.
- **High performance:** With an optimized system design, these OSs can often provide higher performance levels than traditional operating systems on stand-alone machines.

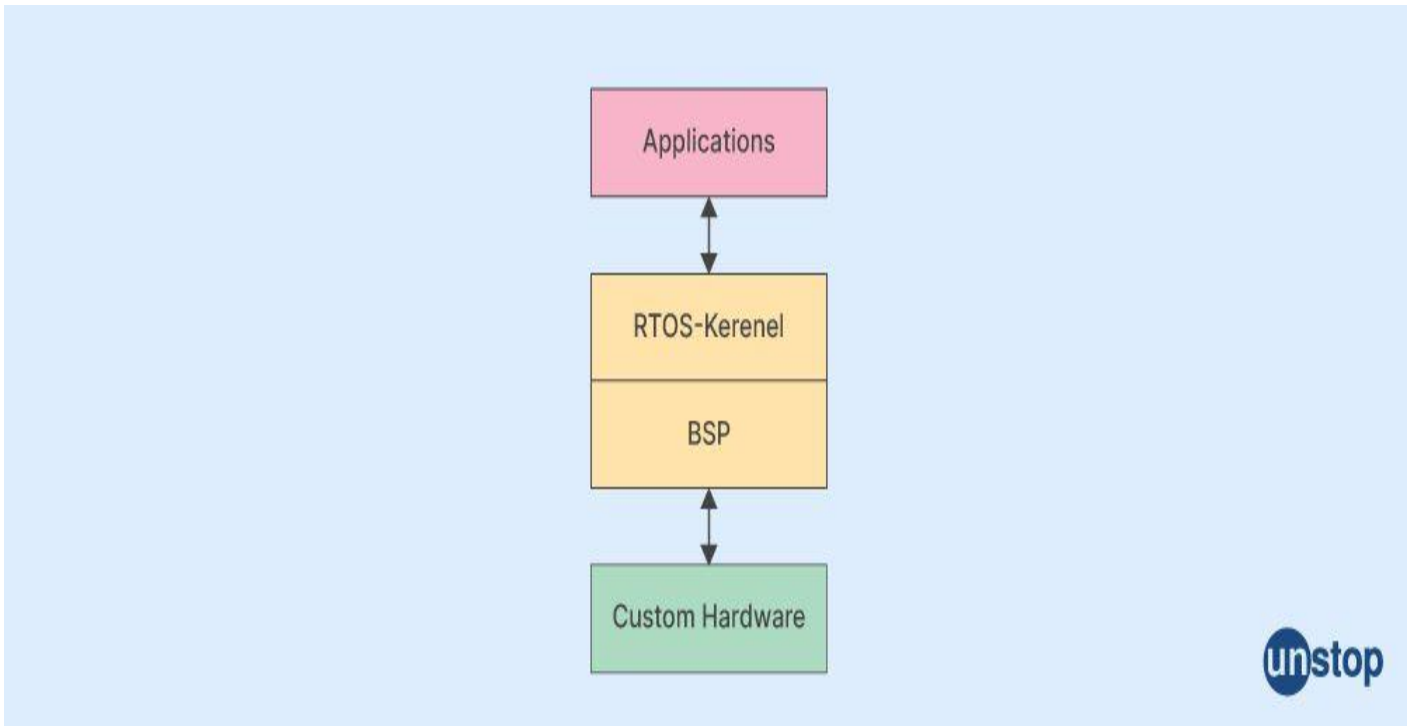
Disadvantages of NOS

- **Cost:** Although free versions are available, such as Linux RedHat Enterprise Edition 7+, most commercial offerings come with some associated costs. This is because they generally require more powerful hardware and involve greater support costs than a regular operating system would need for a single-machine setup.

8. Real-Time Operating System

Real-Time Operating System (RTOS) is designed to serve real-time applications that process data as it comes in, typically without buffer delays. This makes the system more predictable and reliable since unpredictable processing times are eliminated.

Examples of RTOSs include FreeRTOS, eCos, VxWorks, INTEGRITY, and QNX Neutrino.



Advantages of RTOS

- **Guaranteed execution time:** The biggest advantage of a Real-Time Operating System is its guaranteed response time which ensures that all application processes or tasks are complete within a certain specific amount of time before being put back on hold until the next task starts again.
- **Faster Response Time:** Another benefit associated with using an RTOS for your applications is its faster response time due to reduced buffering delays. This allows for quicker decision-making at run-time by the microcontrollers running these relevant programs or code snippets attached to them directly from their memory storage locations.
- **High Reliability and Accuracy:** One major plus point about opting for an RTOS over another kind of OS, such as Windows XP/7, etc., is their high reliability & accuracy when executing a programmed code, especially if there's no user interface involved between us and our hardware components like LEDs, motors, Buzzers, etc.

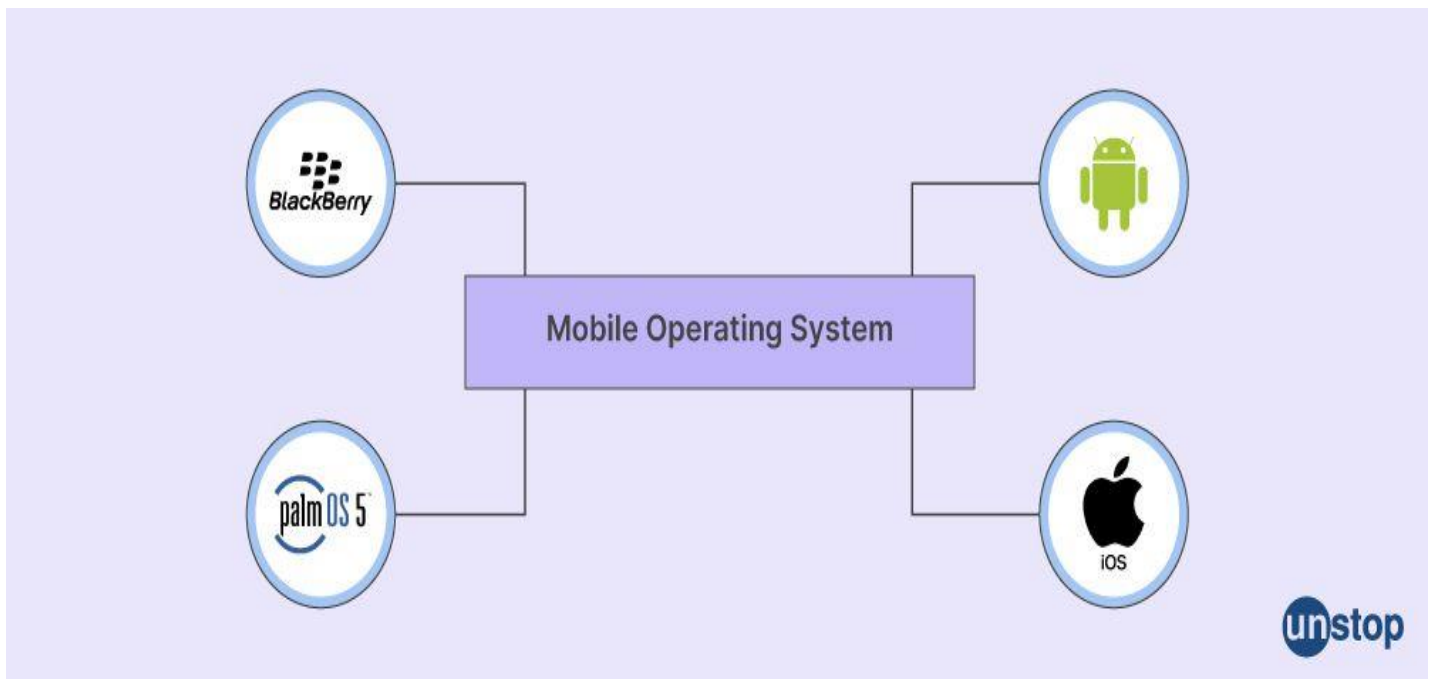
Disadvantages of RTOS

- **Costly to Develop & Maintain:** RTOS is by and large relatively new compared to other desktop/laptop OS existing since the past decade, such as Microsoft Windows & UNIX. They often utilized specialized software and hardware and thus, can be costlier than a traditional OS.
- **Complexity:** Due to their often heavily coded programming structures, they are more complex and less flexible than a traditional OS. Moreover, since they're often specially designed, modifying RTOS for new features is difficult and time-consuming.

9. Mobile OS

Tablets and smartphones use the mobile operating system (Mobile OS). It manages these devices' hardware and software resources, allowing users to access various features, including making phone calls, browsing the web, playing music files or videos, sending and receiving emails or messages, taking photos, or recording video clips.

Examples of mobile operating systems include Android, iOS, HarmonyOS, KaiOS, and Samsung Tizen.



Advantages of Mobile OS

- Mobile OS provides **optimized performance** for small-screened handheld devices due to its scalability.
- Most mobile operating systems provide **robust security** so that personal data stored can be kept safe from unauthorized access.
- They allow users to **install applications** written specifically for their platform, which adds **extra functionality** beyond what is provided by the manufacturer's out-of-the-box options like games, etc.

Disadvantages of Mobile OS

- **Updates may not always be released regularly** or quickly enough when vulnerabilities arise, putting users at risk if they don't take precautions against attack vectors.
- Users have **less control over how their device behaves** compared with traditional desktop-based solutions where more powerful tools are accessible.
- Certain modifications aren't possible without extensive coding knowledge.

What's New! Officially launched in August 2019 by Huawei, HarmonyOS is a relatively new player in the market. It's a distributed operating system designed for various devices, including smartphones, tablets, smart TVs, and wearables. While it hasn't achieved the widespread adoption of Android or iOS yet, it's actively being developed and could become a major player in the future. Compared to established players like Windows 11 (late 2021) or potentially iOS 17 (mid-2023), HarmonyOS has an earlier official launch date (August 2019).

Popular Operating Systems in the Market

Let's take a look at some of the most popular OSs currently existing in the market:

- **Microsoft Windows:** This is the most popular operating system in the world, with a market share of around 90%. It works on both desktop computers and laptops.
- **Apple macOS:** Apple's proprietary OS runs its Mac line of desktops, laptops, and mobile devices like iPhones and iPads. It has a small portion of the global OS market (around 8%).
- **Linux:** An open-source platform free from numerous vendors, Linux runs millions of servers worldwide that power everything from supercomputers to web hosting services to consumer electronics such as a Raspberry Pi board or Amazon Fire TV Stick streaming device. About 2% of users globally use it on their PCs at home or workstations.
- **Chrome OS:** Primarily associated with inexpensive Chromebooks released by Google, this lightweight operating system boasts easy setup time due to being tied into Google's ubiquitous cloud-based services suite Gmail, Docs, etc. Its overall usage rate remains low compared to other leading systems but continues to grow steadily each year.
- **iOS:** Developed by Apple exclusively for its mobile devices, including the iPhone and iPad, it is the most popular OS within that category, with around 14% overall usage rate (as of 2019). It offers a robust environment for productivity and entertainment on the go and access to Apple's App Store containing over 1 million applications.

To conclude, Operating Systems are essential software that manages and controls all machine's hardware components. They enable users to interact with their computers using user-friendly interfaces such as GUIs or command-line systems. Popular operating systems include Windows Server 2019, Linux (Ubuntu), macOS High Sierra 10.13, IBM OS/360 Multiprogramming System, etc. These offer different memory management techniques like paging and segmentation for better resource utilization while incorporating essential security features like authentication enforcement policies based on RBAC models to protect confidential data stored within them from unauthorized access attempts by malicious actors around us today, more commonly known as viruses and malware families infecting online connections worldwide currently.