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**OPERATING SYSTEM**

An **operating system** (**OS**) is system software that manages hardware, software resources, and provides common services for computer programs.

The application programs make use of the operating system by making requests for services through a defined application program interface (API).

In addition, users can interact directly with the operating system through a user interface, such as a command-line interface (CLI) or a graphical UI (GUI).

**Why use an operating system?**

An operating system brings powerful benefits to computer software and software development. Without an operating system, every application would need to include its own UI, as well as the comprehensive code needed to handle all low-level functionality of the underlying computer, such as disk storage, network interfaces and so on.

Without the OS desktop computer, mobile phone, network switch, server, smart TV etc became hard to function.

**Operating system types**

*General purpose operating system*: - Examples could be Windows, Linux, Mac, Unix

*Mobile operating system*: - Examples could be Apple iOS and Google Android.

*Embedded operating system*: - A huge assortment of dedicated devices -- including home digital assistants, automated teller machines (ATMs), airplane systems, retail point of sale (POS) terminals and internet of things (IoT) devices -- includes computers that require an operating system. The principal difference is that the associated computing device only does one major thing, so the OS is highly stripped down and dedicated to both performance and resilience.

*Network operating system*: - is another specialized OS intended to facilitate communication between devices operating on a local area network.

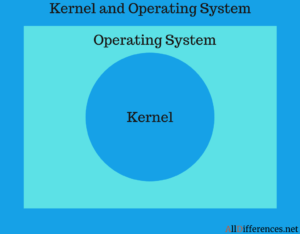
*Real time operating system*: - When a computing device must interact with the real world within constant and repeatable time constraints, the device manufacturer may opt to use a real-time operating system. E.g FreeRTOS and VxWorks.

**Kernel**

A Kernel is a computer program that is the heart and core of an Operating System. The Kernel is responsible for low-level tasks such as disk management, memory management, task management, etc. It provides an interface between the user and the hardware components of the system.

**Functions of a Kernel**

* **Access Computer resource:** A Kernel can access various computer resources like the CPU, I/O devices and other resources. It acts as a bridge between the user and the resources of the system.
* **Resource Management:** It is the duty of a Kernel to share the resources between various processes in such a way that there is uniform access to the resources by every process.
* **Memory Management:** Every process needs some memory space. So, memory must be allocated and deallocated for its execution. All these memory management is done by a Kernel.
* **Device Management:** The peripheral devices connected in the system are used by the processes. So, the allocation of these devices is managed by the Kernel.



**Kernel Types**

**Monolithic Kernel: -** Here, the OS and Kernel both run in the same memory space and suitable where security is not a significant concern.

**Microkernel**: -is operating systems that outsource the traditional operating system functionality to ordinary user processes while providing them with mechanisms requisite for implementing it.

**Hybrid Kernel: -**They are a mix of Monolithic Kernel and Microkernel. It moves out drivers but keeps system services inside the Kernel

Nano Kernel, Exo Kernel etc.

**Types of Microkernel**

Microkernel-based operating systems come in many different flavors, each having a distinctive set of goals, features and approaches.

Some of the most often cited reasons for structuring the system as a microkernel is flexibility, security, and fault tolerance.

Many microkernels can take on the role of hypervisor too.

**Escape**: -A UNIX like microkernel operating system, that runs on X86, X86\_64, ECO32 and MMIX.

**MINIX 3**: - A free, open-source, operating system designed to be highly reliable, flexible, and secure. It is based on a tiny microkernel running in kernel mode with the rest of the operating system running as a number of isolated, protected, processes in user mode

**seL4**

A high-assurance, high-performance microkernel developed, maintained and formally verified by NICTA and owned by General Dynamics C4 Systems. It is a member of the L4 family of microkernels, and is the world's most advanced, highest-assured operating-system microkernel.

F9, M3, Fuchsia, Genode etc.

**Focus Area**

In this documentation, we will focus mainly on kernels related to general purpose operating system with x86 CPU architecture.

Dictionary

Retrofit: - A component or accessory added to something after it has been manufactured