



OPERATING SYSTEM DESIGN

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OS Structures & Kernel Programming

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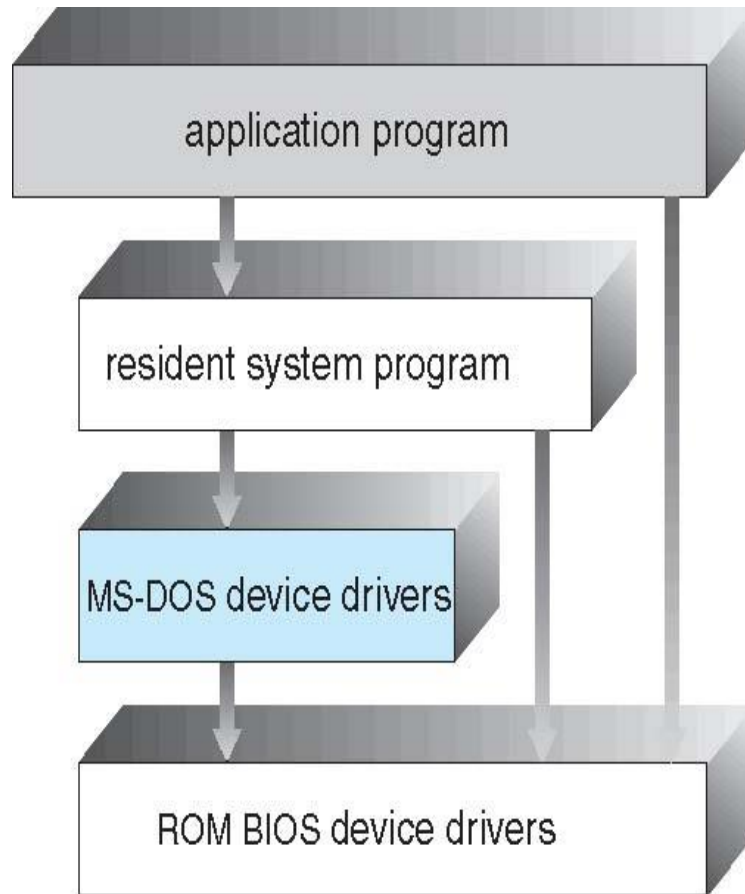
- It is easier to create an operating system in pieces
- Every segment is also a part of the operating system
- OS structure - strategy for connecting and incorporating various operating system components within the kernel
- Major Structures
 - Simple Structure
 - Monolithic Structure
 - Micro-Kernel Structure
 - Layered Structure
 - Modular Structure

Simple Structure

- These operating systems do not have well-defined structures
- They are small, simple, and limited
- The interfaces and levels of functionality are not well separated.
- Example: MS-DOS – written to provide the most functionality in the least space
- Not divided into modules
- Although MS-DOS has some structure, its interfaces and levels of functionality are not well separated

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OS Structure



Advantages

- Because there are only a few interfaces and levels, it is simple to develop.
- Because there are fewer layers between the hardware and the applications, it offers superior performance.

Disadvantages

- The entire operating system breaks if just one user program malfunctions.
- Since the layers are interconnected, and in communication with one another, there is no abstraction or data hiding.
- The operating system's operations are accessible to layers, which can result in data tampering and system failure.

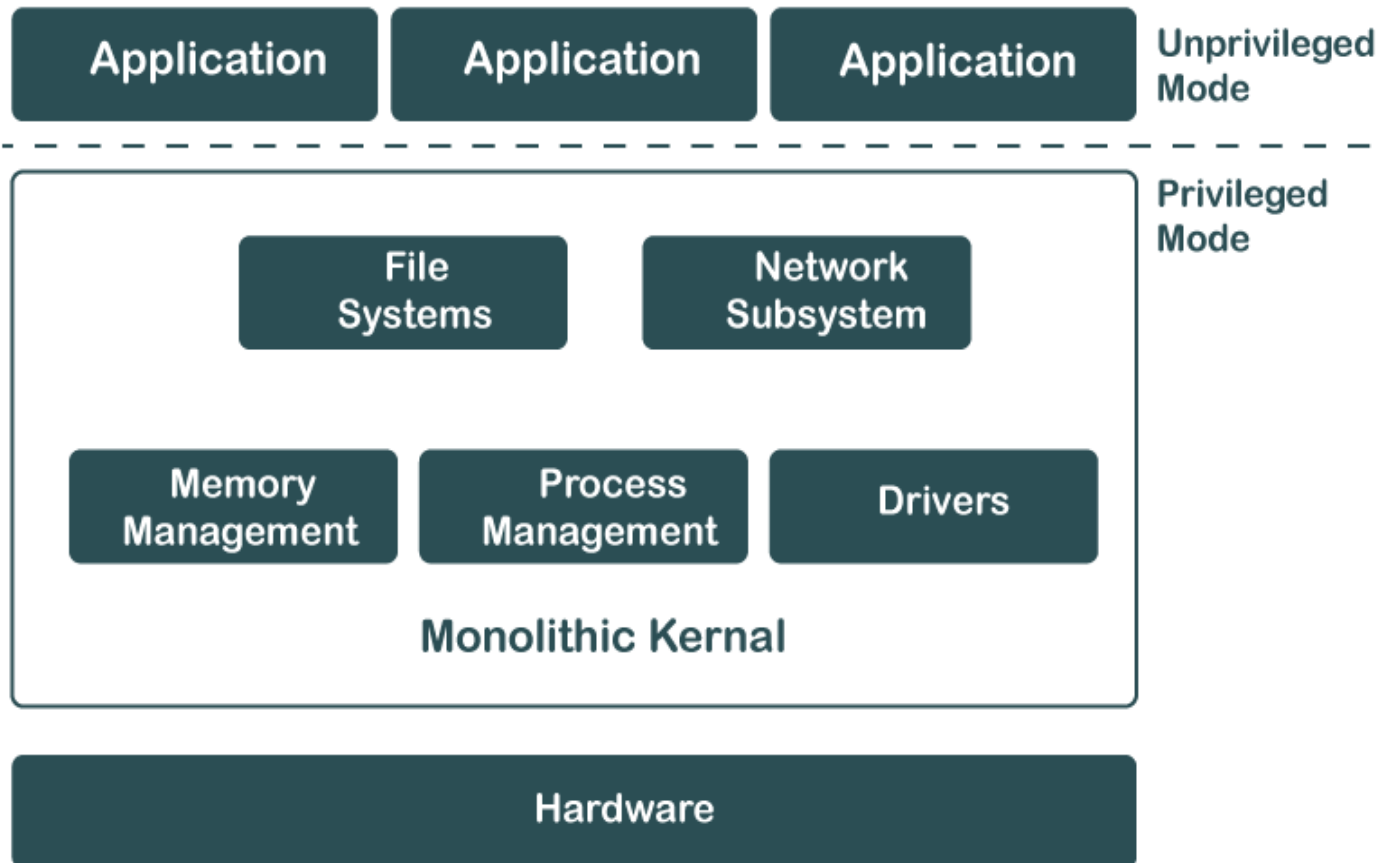
Monolithic Structure

- Kernel implemented as an only one process
- All the functional components of the kernel have access to all of its internal data structures and routines
- Example: UNIX. Comprises of two separable parts : Shell, Kernel
- Shell : Command interpreter, includes system libraries and compilers
- Kernel - Consists of everything below the system-call interface and above the physical hardware
- Provides the file system, CPU scheduling, memory management, etc a large number of functions as one level

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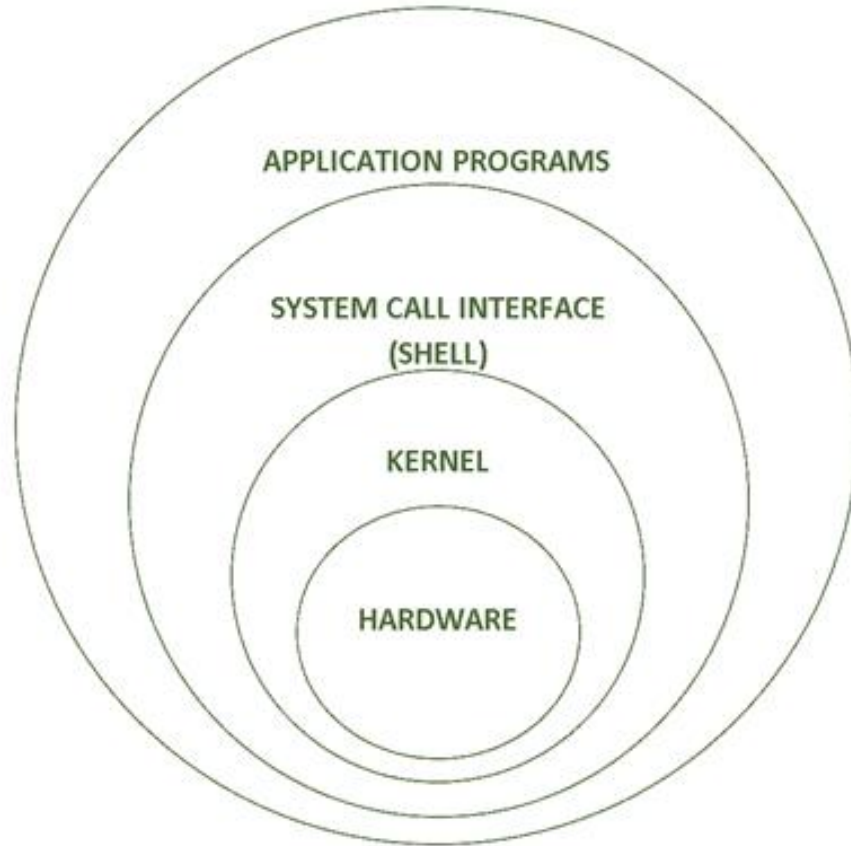
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Monolithic Kernel System



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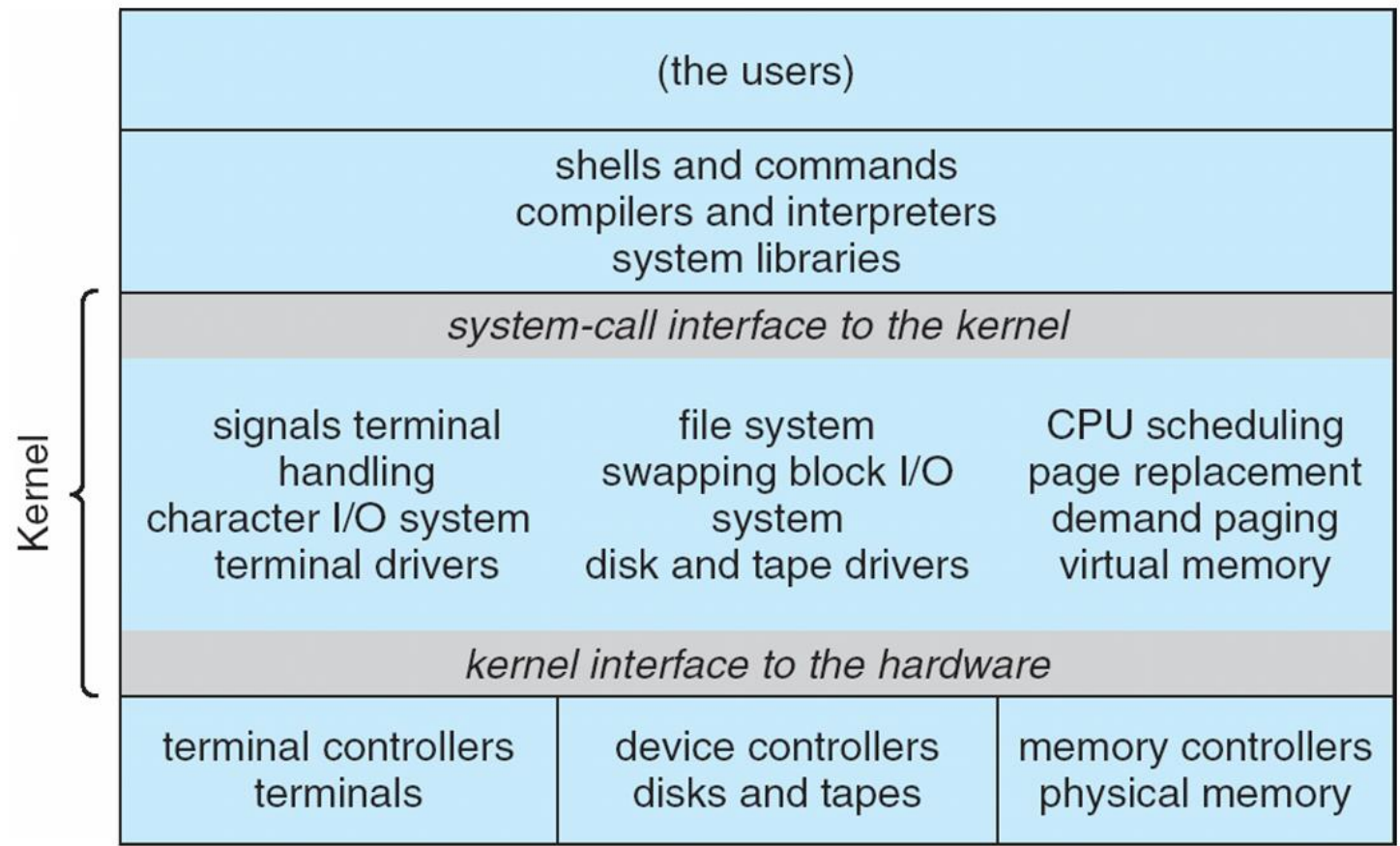
OS Structure



Unix Structure

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OS Structure



Unix Structure

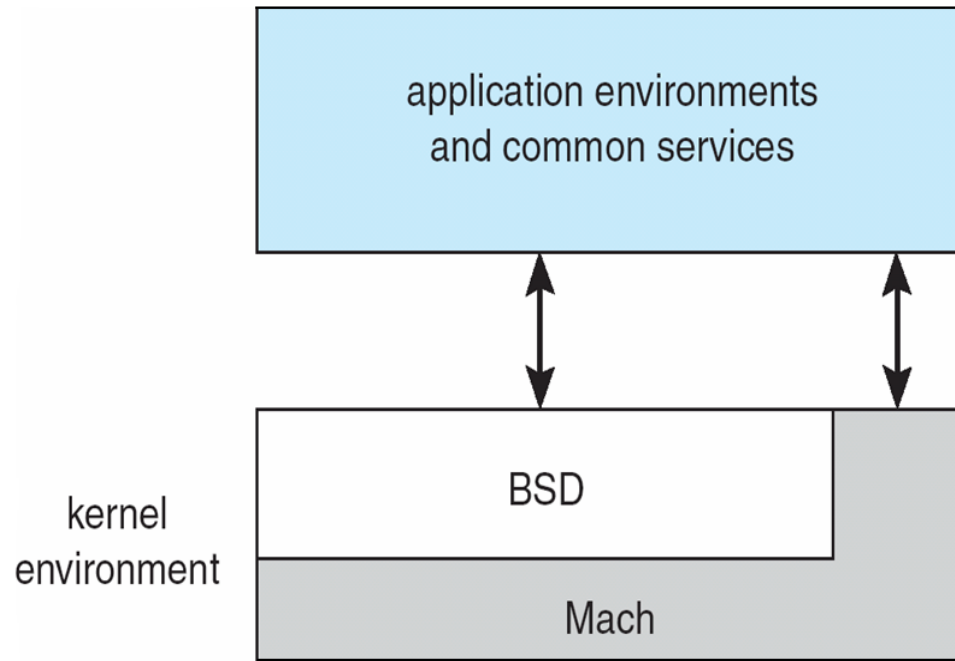
Microkernel

- First introduced by Mach in mid 1980's
- Moves as much from the kernel into “*user*” space
- i.e, removing all non-essential components from the kernel and implementing them as system and user programs
- Communication takes place between user modules using message passing

- Advantages
 - Easier to extend a microkernel
 - Easier to port the operating system to new architectures
 - More reliable (less code is running in kernel mode) & More secure
- Disadvantages
 - Performance overhead of user space to kernel space communication

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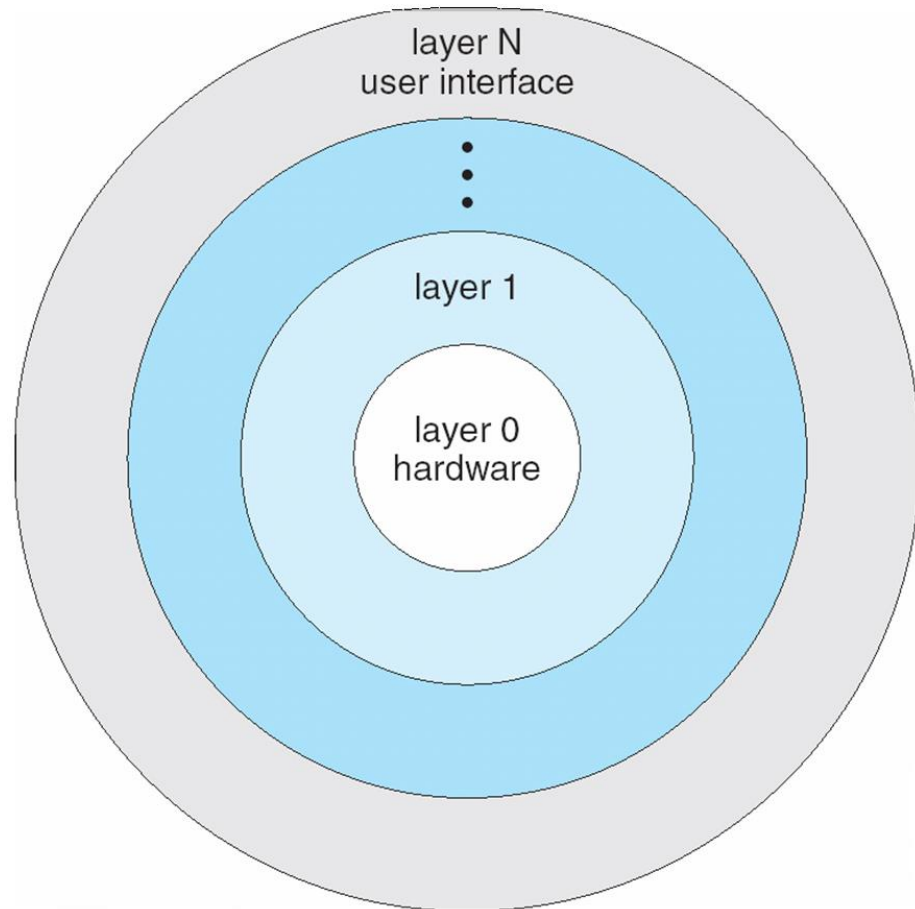
OS Structure



Mac OS Structure

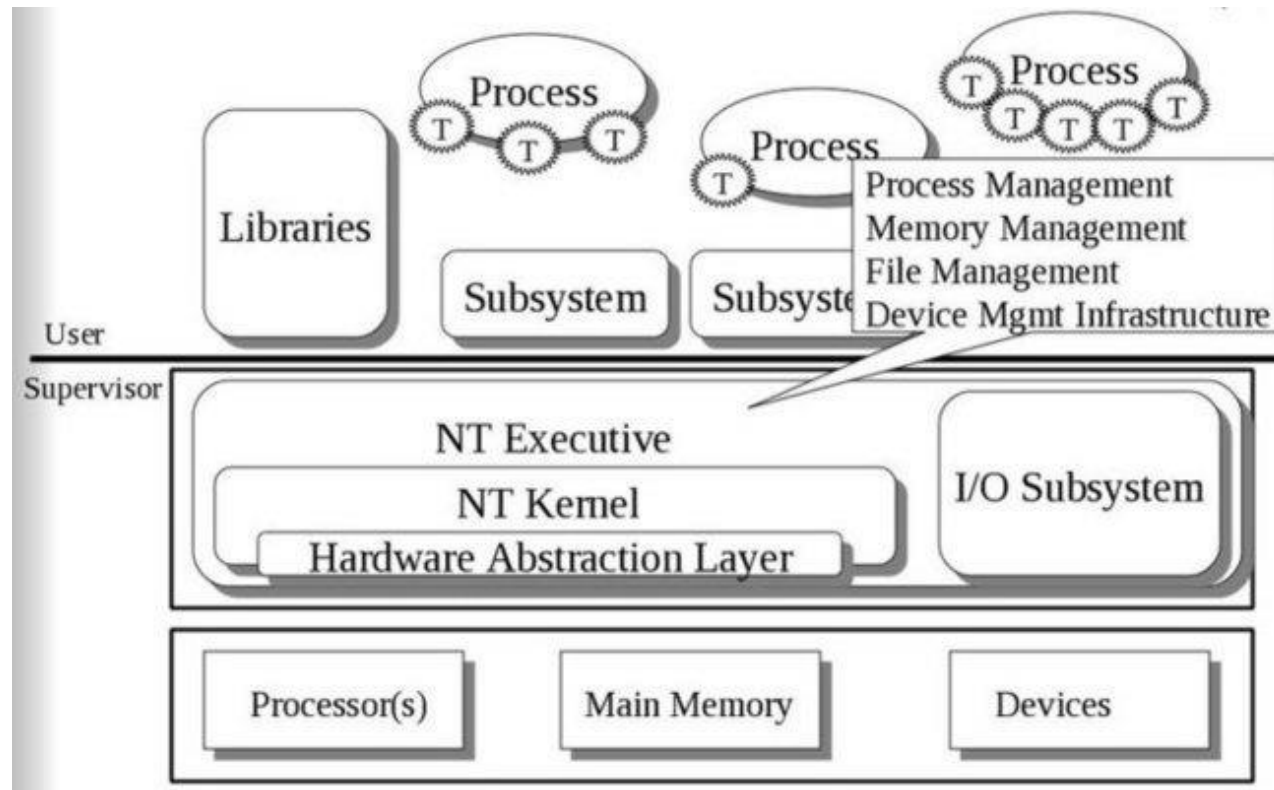
Layered Approach

- 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 layer uses functions (operations) and services of only lower-level layers
- Advantage: Simplicity of Construction and Debugging
- Disadvantage: fails if appropriate planning not done. Each layer adds overhead to the lower layers



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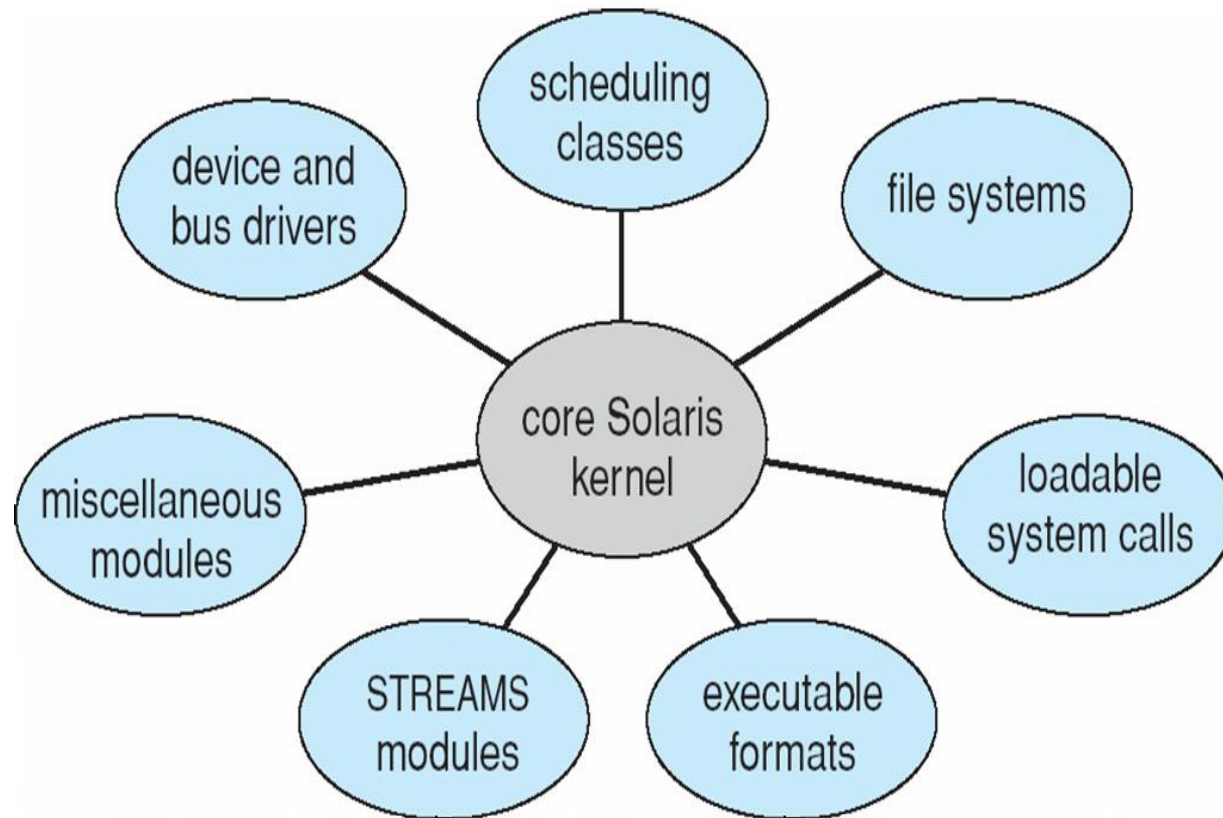
OS Structure



Windows NT Structure

Modules

- Most modern operating systems implement kernel modules
 - Uses object-oriented approach
 - Each core component is separate
 - Each talks to the others over known interfaces
 - Each is loadable as needed within the kernel
- Overall, similar to layers but with more flexibility



Solaris Structure

- Other Structures
 - Hybrid-Kernel Structure
 - Exo-Kernel Structure
 - Virtual Machines
- Hybrid Kernel Structure
 - Hybrid-kernel structure is nothing but just a combination of both monolithic-kernel structure and micro-kernel structure.
 - It implement speed and design of monolithic and modularity and stability of micro-kernel structure

- Exo-kernel Structure
 - Exokernel is an operating system developed at MIT
 - provide application-level management of hardware resources
 - Use abstractions as little as possible
- Virtual Machines
 - 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
 - Example: virtual Box



THANK YOU

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