ADVANCED OPERATING SYSTEMS

OS objectives

Mode of operation

Components

Architecture

Linux

Windows XP

What Is an Operating System?

- Computer = set of able resources
  - processor(s), memory, I/O & communication devices
- OS
  - enables use of resources
  - manages resources
- resources not limited to hardware
- shift from:
  - pure efficient use of resources
    to
  - enhance user experience

Mode of operation

- Kernel:
  - substance, core, center, essence, gist, heart, heart and soul, inwardness, marrow, meat, nub, pith, sum, nitty-gritty
- pieces of software that perform OS tasks
- has privileged access to resources

Terminology

- kernel mode or kernel space
- user mode or user space
- system call:
  - user mode program invokes kernel mode functionality

Operating System Components

- Processor scheduler
- Memory manager
- I/O manager
- Interprocess communication manager
- File system manager

Operating System Architectures

- Operating systems tend to be complex
  - Provide many services
  - Support variety of hardware and software
  - Operating system architectures help manage this complexity
    - Organize operating system components
    - Specify privilege with which each component executes

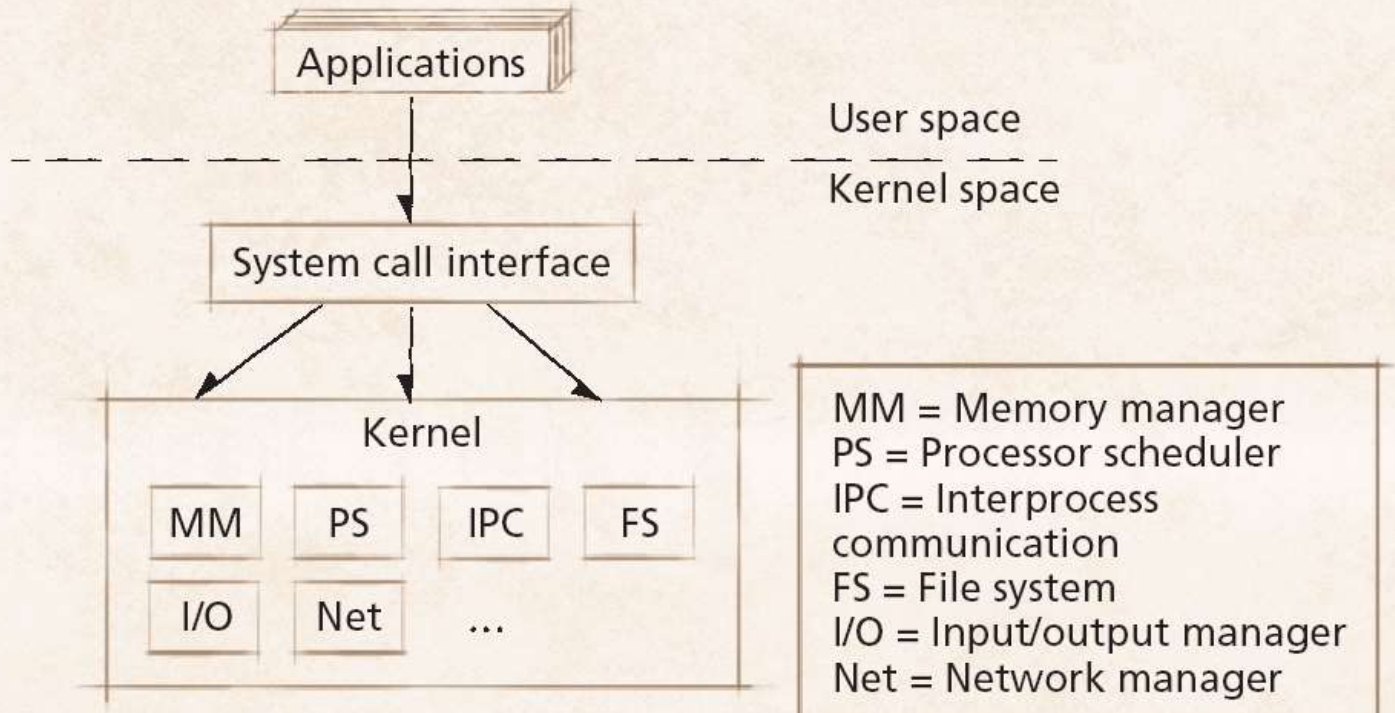
Operating System Architectures

- monolithic
- layered
- micro-kernel
- distributed

Monolithic Architecture

- Monolithic operating system
  - Every component contained in kernel
    - direct communication among all elements
    - highly efficient
  - Problems:
    - complexity
    - new devices, emerging technologies
      - enabling, protection

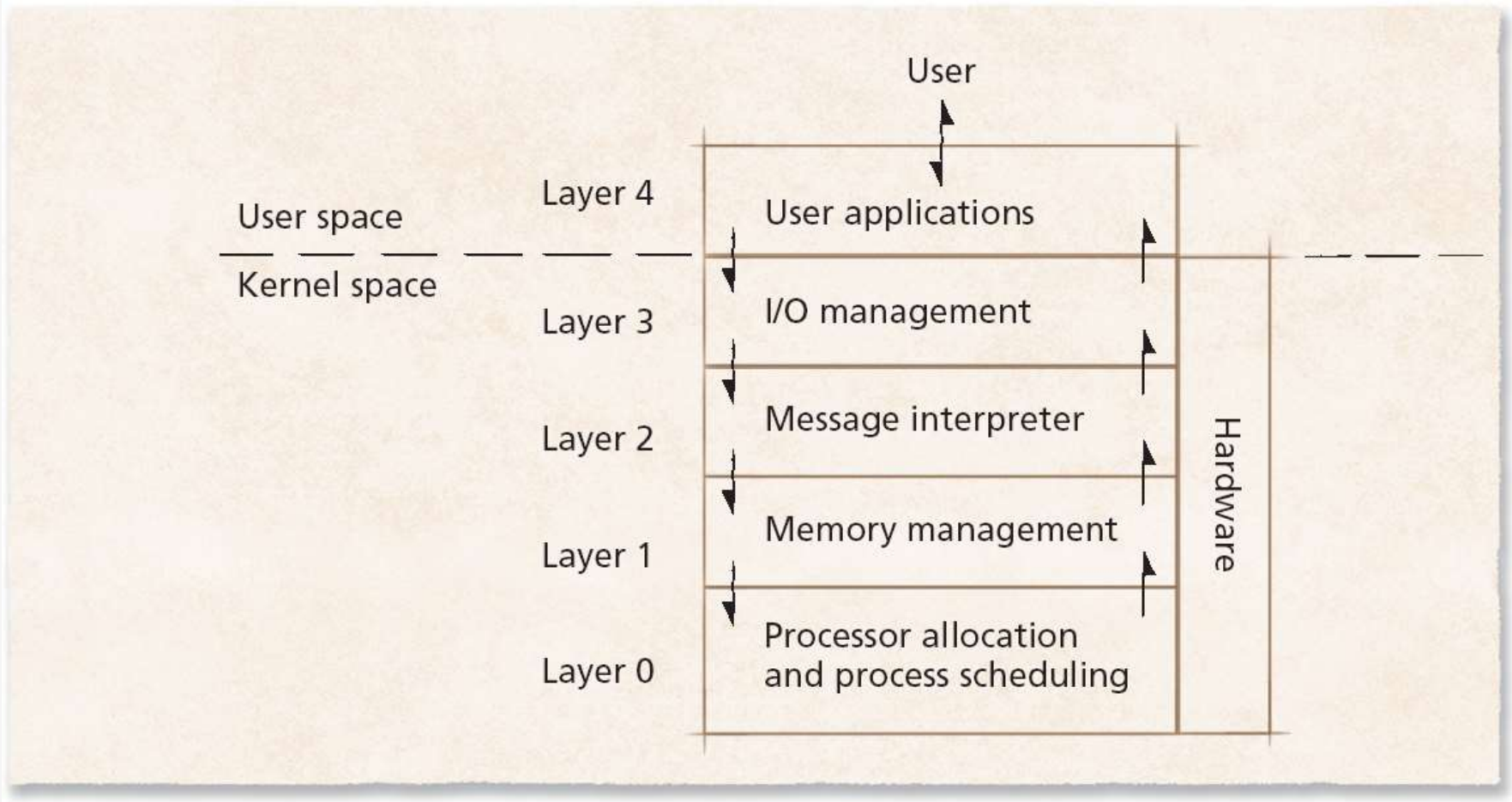
Monolithic Architecture



Layered Architecture

- Groups components that perform similar functions into layers
- Each layer communicates only with adjacent layer
- System calls might pass through many layers before completion

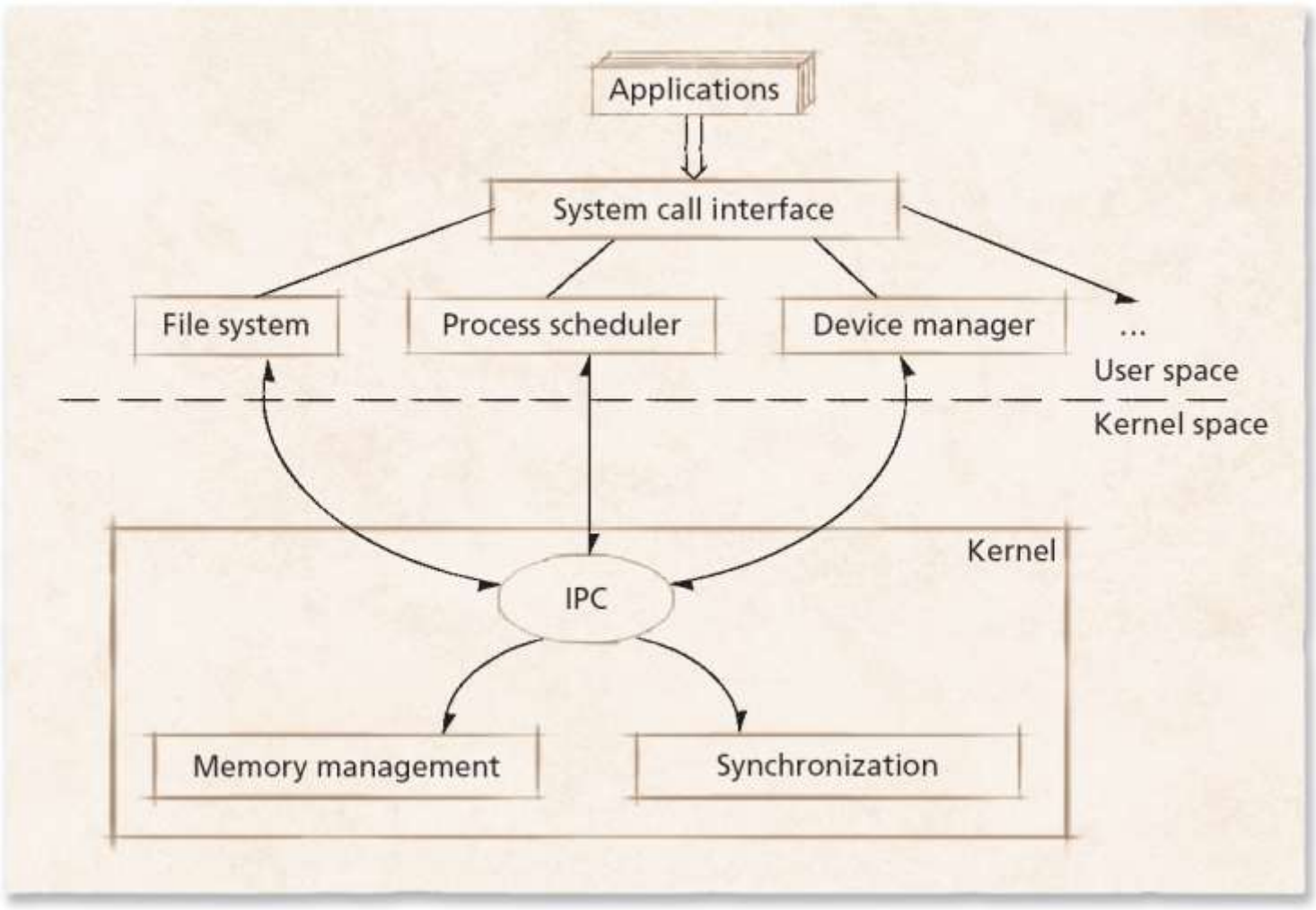
Layered Architecture



Microkernel Architecture

- Microkernel
  - provides only small number of services
  - attempt to keep kernel small and scalable
- High degree of modularity
    - Extensible, portable and scalable
- Increased level of inter-module communication

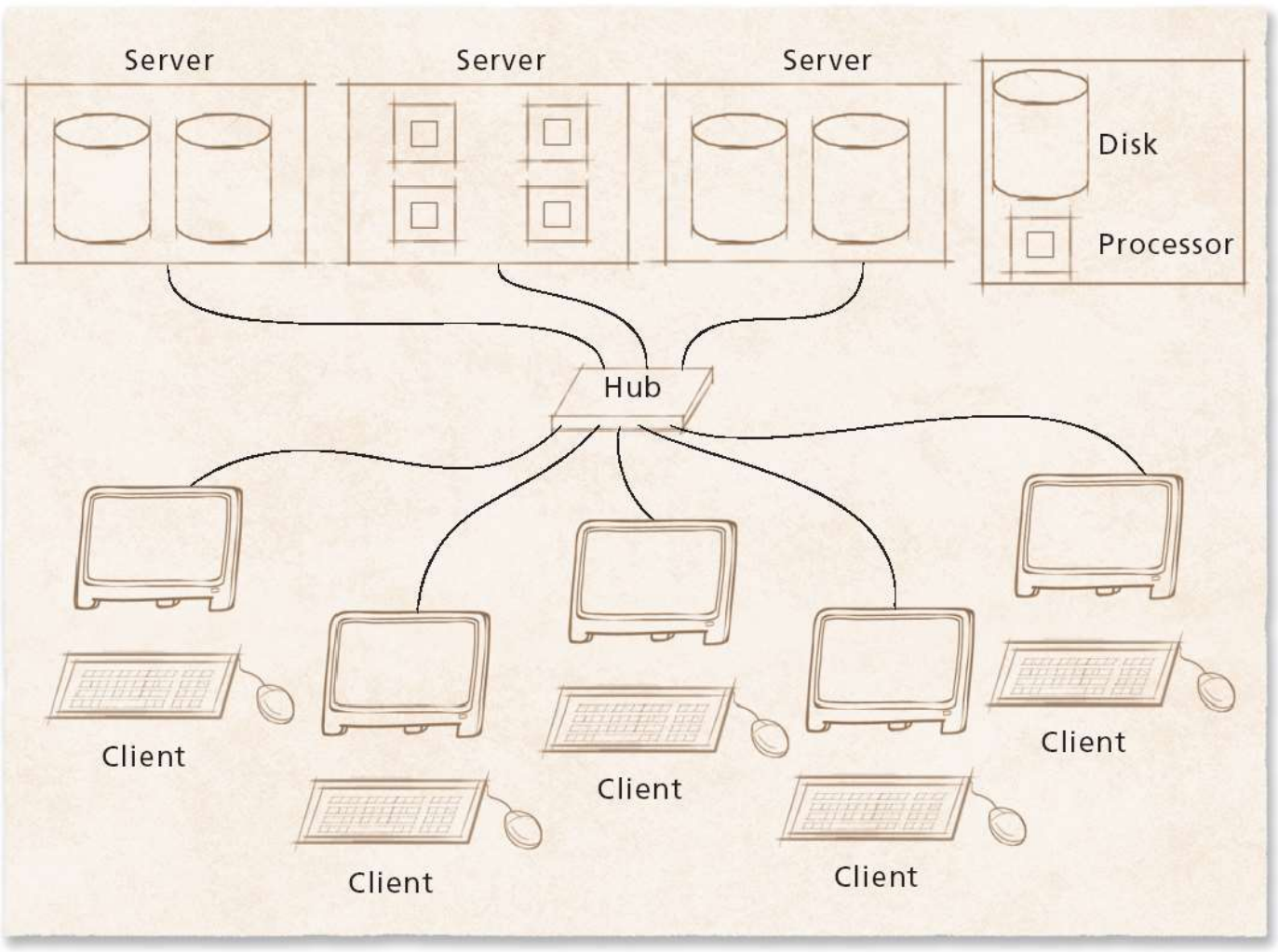
Microkernel Architecture



Distributed Operating Systems

- Network operating system
  - Runs on one computer but allows its processes to access remote resources
- Distributed operating system
  - Single OS manages resources on more than one computer

Distributed Operating Systems

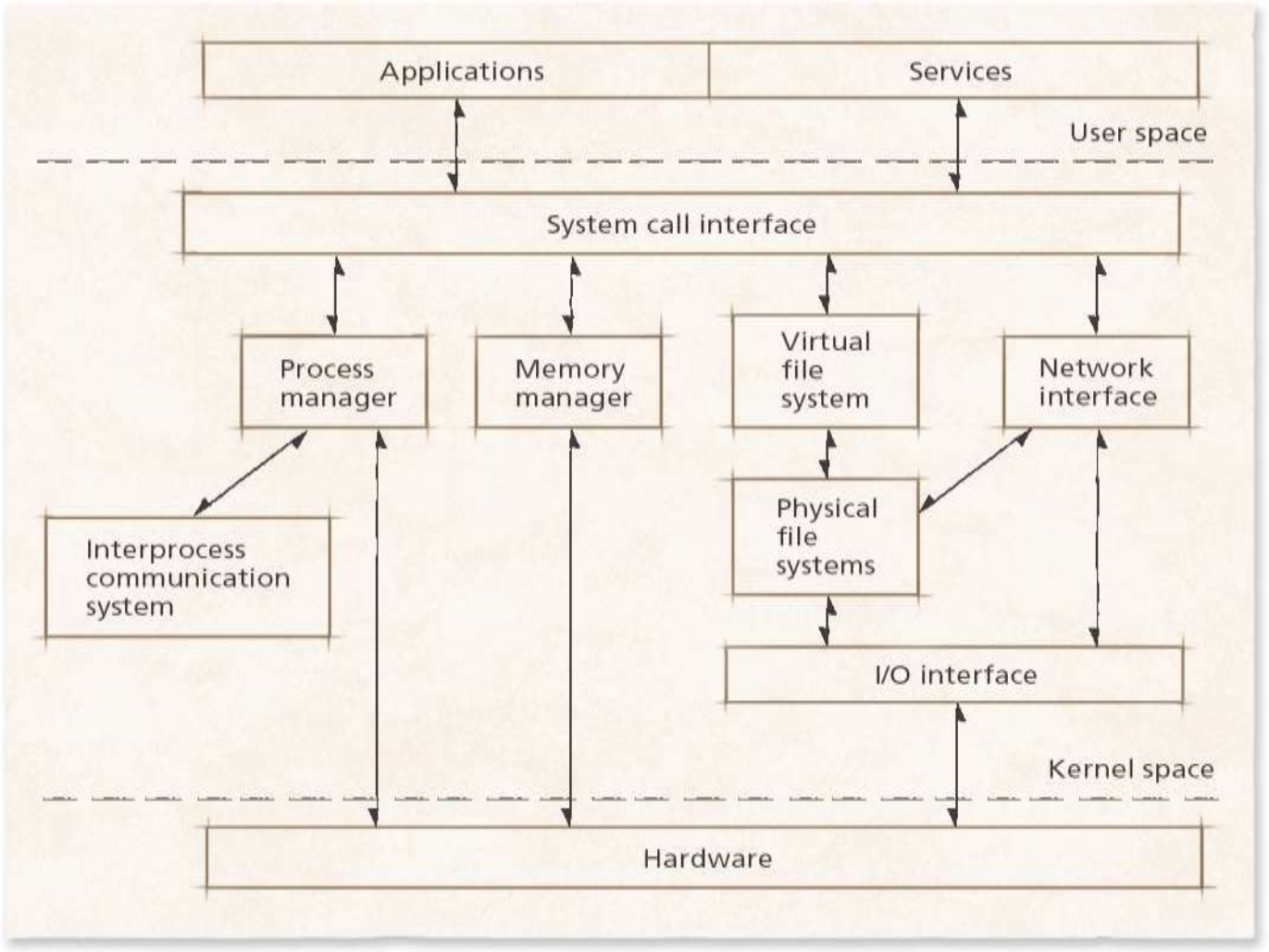


Linux Kernel Architecture

- Monolithic kernel:

  Contains modular components
  - Process management
  - Interprocess communication
  - Memory management
  - File system management
    - VFS: provides a single file system interface
  - I/O management
  - Networking

Linux Kernel Architecture



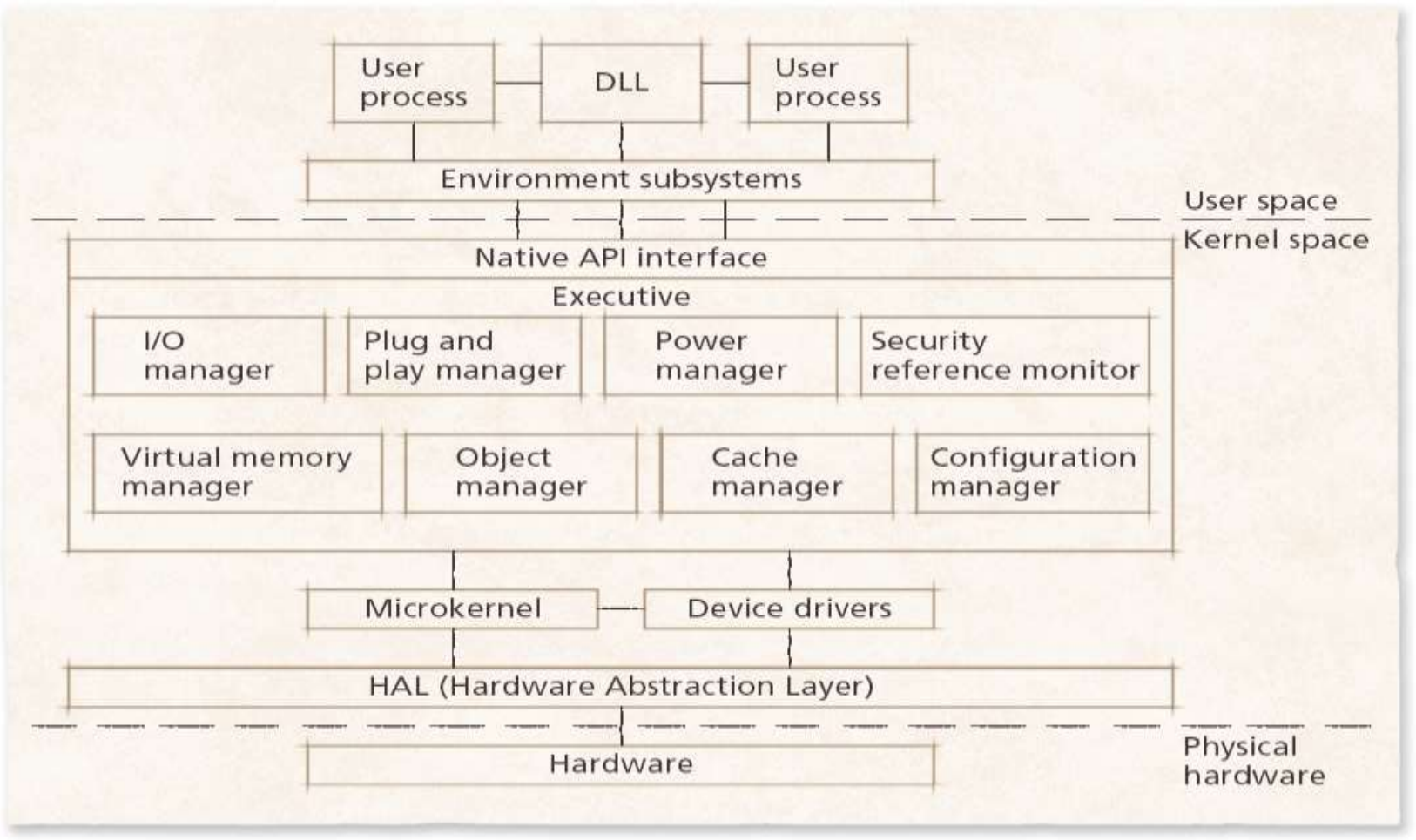
Loadable Kernel Modules

- Enables code to be loaded on demand
  - Reduces the kernel's memory footprint
  - *Kmod*: a kernel subsystem that manages modules without user intervention
    - Determines module dependencies and loads and unloads them on demand
  - Problem: kernel and module versions

Windows XP Kernel Architecture

- Modified microkernel
  - has layers
  - has modular components within layer
  - Microkernel
    - Basic system mechanisms
    - Thread scheduling, interrupt dispatching, etc.
    - Abstracts hardware specifics that differ between architectures

Windows XP Kernel Architecture



Windows XP Kernel Architecture

- Executive
  - main operating system subsystems
- Environment subsystems
  - Provide a specific computing environment for user-mode processes:
  - Examples: Win32, SFU, WOW64