Information Technology Institute

Computer Operating System Concepts

Chapter Three

OPERATING SYSTEM STRUCTURES

Table of Content

- System Components
- Operating System Services
- System Calls
- System Structure

SYSTEM COMPONENTS

System Components

- Process management
- Main memory management
- File system management
- I/O system management
- Secondary storage management
- Networking
- Protection
- Command interpreter

Process Management

- A process is a program in execution.
- A process needs certain resources, including CPU time, memory, files, and I/O devices, to accomplish its task.
- The operating system is responsible for the following activities in connection with process management.
  - Process creation and deletion.
  - process suspension and resumption.
  - Provision of mechanisms for:
    - process synchronization
    - process communication

Main-Memory Management

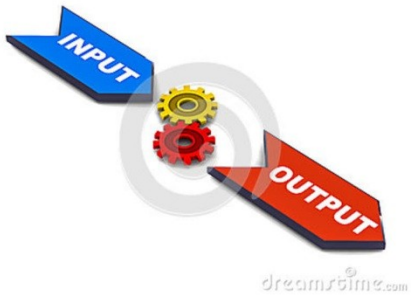
- Memory is a large array of bytes, each with its own address. It is a repository of quickly accessible data shared by the CPU and I/O devices.
- Main memory is a volatile storage device. It loses its contents in the case of system failure.
- The operating system is responsible for the following activities in connections with memory management:
  - Keep track of which parts of memory are currently being used and by whom.
  - Decide which processes to load when memory space becomes available.
  - Allocate and deallocate memory space as needed

File Management

- A file is a collection of related information defined by its creator. Commonly, files represent source and data.
- The operating system is responsible for the following activities in connections with file management:
  - File creation and deletion.
  - Directory creation and deletion.
  - Support of primitives for manipulating files and directories.
  - Mapping files onto secondary storage.
  - File backup on stable (non-volatile) storage media.

I/O System Management

- OS hide particularities of I/O devices
  - Device drivers
    - Input: retrieve block 12345
    - Output: hardware instructions for controller
- I/O subsystem
  - Drivers for specific hardware



Secondary-Storage Management

- Since main memory (primary storage) is volatile and too small to accommodate all data and programs permanently, the computer system must provide secondary storage to back up main memory.
- Most modern computer systems use disks as the principle on-line storage medium, for both programs and data.
- The operating system is responsible for the fc activities in connection with disk managemer
  - Free space management
  - Storage allocation

Networking (Distributed Systems)

- A *distributed* system is a collection processors that do not share memory or a clock. Each processor has its own local memory.
- The processors in the system are connected through a communication network.
- Communication takes place using a *protocol.*
- A distributed system provides user access to various system resources.
- Access to a shared resource allows:
  - Computation speed-up
  - Increased data availability
  - Enhanced reliability

Protection System

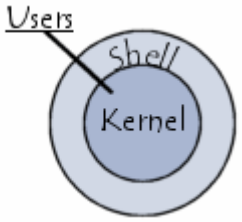
- *Protection* refers to a mechanism for controlling access by programs, or users to system resources.
- The protection mechanism must:
  - distinguish between authorized and unauthorized usage.

Command-Interpreter System

- Many commands are given to the operating system by control statements which deal with:
  - process creation and management
  - I/O handling
  - secondary-storage management
  - main-memory management
  - file-system access
  - Protection
  - networking

Command-Interpreter System Cont'd

- The program that reads and interprets control statements is called variously:
  - command-line interpreter
  - shell (in UNIX)
- Its function is to get and execute the next command statement.



OPERATING SYSTEM SERVICES

Operating System Services

- Program execution
  - System capability to load a program into memory and to run it.
- I/O operations
  - Since user programs cannot execute I/O operations directly, the operating system must provide some means to perform I/O.
- File-system manipulation
  - Program capability to read, write, create, and delete files.

Operating System Services Cont'd

- Communications
  - Exchange of information between processes executing either on the same computer or on different systems tied together by a network. Implemented via shared memory or message passing.
- Error detection
  - Ensure correct computing by detecting errors in the CPU and memory hardware, in I/O devices, or in user programs.

Operating System Services Cont'd

- Additional functions exist not for helping the user, but rather for ensuring efficient system operations.
  - Resource allocation
    - Allocating resources to multiple users or multiple jobs running at the same time.
  - Accounting
    - Keep track of and record which users use how much and what kinds of computer resources for account billing or for accumulating usage statistics.
  - Protection
    - Ensuring that all access to system resources is controlled.

SYSTEM CALLS

System Calls

- System calls provide the interface between a running program and the operating system.
  - Generally available as assembly-language instructions.
  - Languages defined to replace assembly language for systems programming allow system calls to be made directly (e.g., C, C++)

Copy Program Example

- Variable initialization
- open (file1)
- create (file2)
- read (file1)
- write (file2)
- close (file1)
- close (file2)

Types of System Calls

- Process control
- File management
- Device management
- Information maintenance
- Communications

Process Control System Calls

- end, abort
- load, execute
- create, terminate
- get attributes, set attributes
- wait for time
- wait event
- allocate & free memory

File Management System Calls

- create file, delete file
- open, close
- read, write, reposition
- get file attributes, set file attributes

Device Management System Calls

- request device, release device
- read, write
- get device attributes, set device attributes
- logically attach or detach device

Information Maintenance Calls

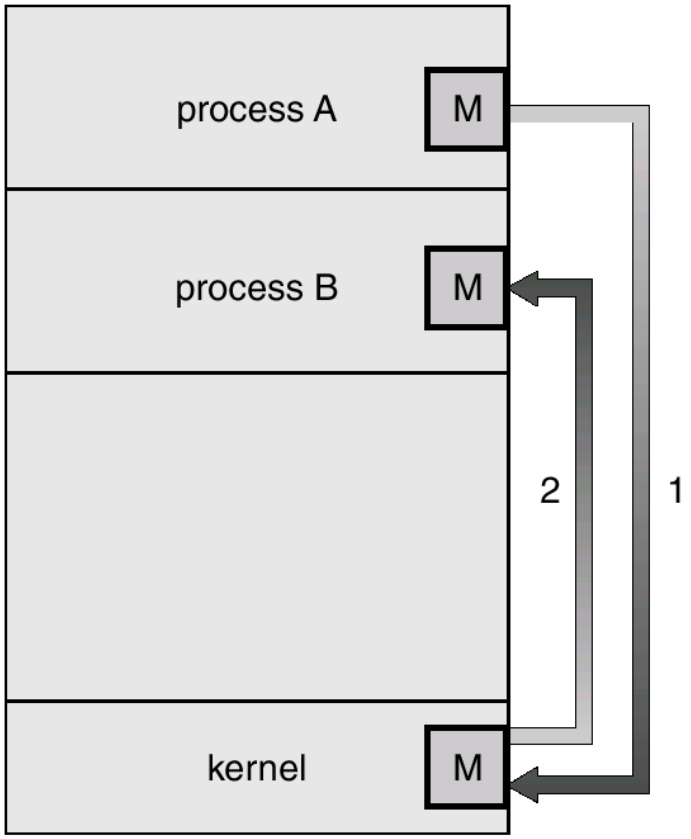
- get time or date, set time or date
- get process, file, or device data
- set process, file, or device data

Communication System Calls

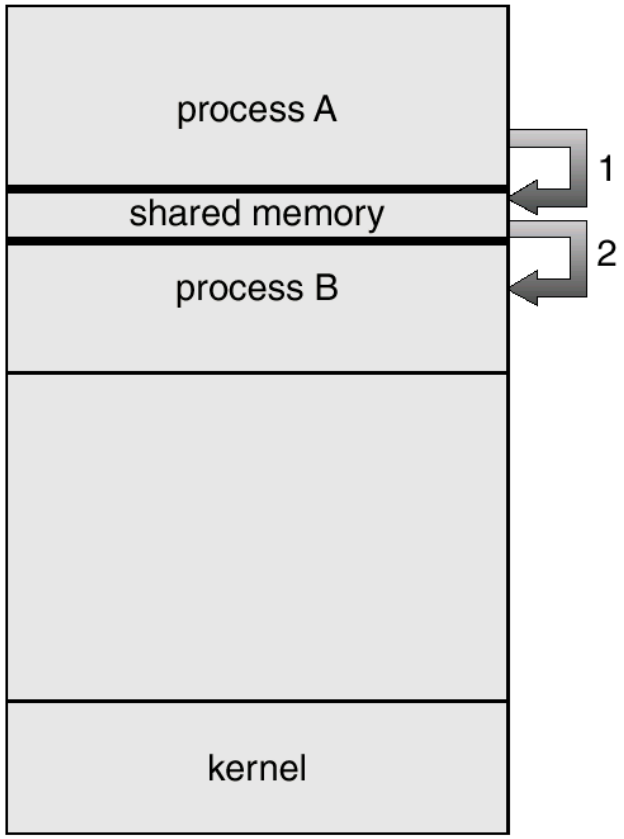
- create, delete communication connection
- send, receive messages
- transfer status information
- attach or detach remote device

Communication Models

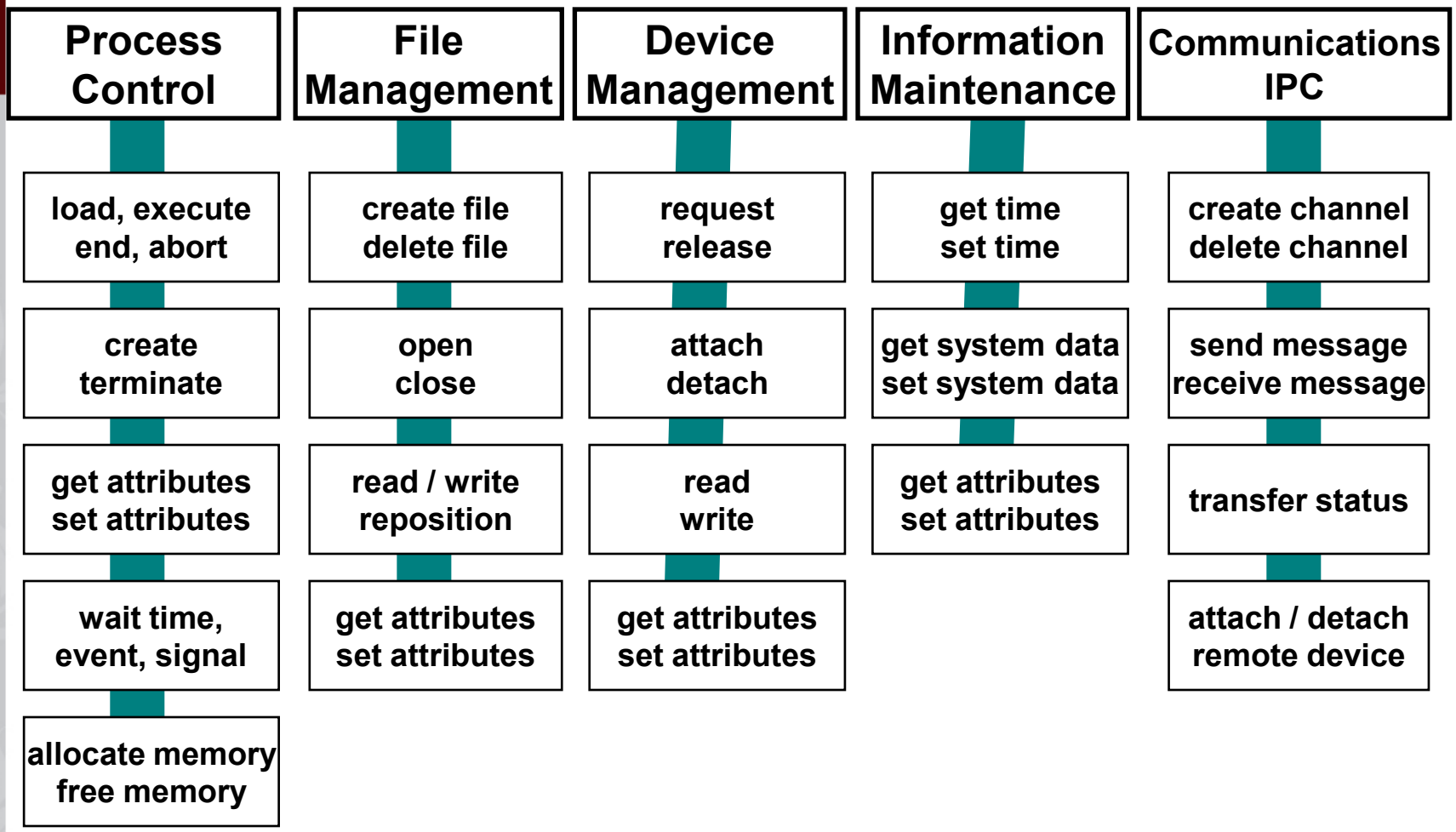
- Message Passing



Shared Memory



System Calls Types

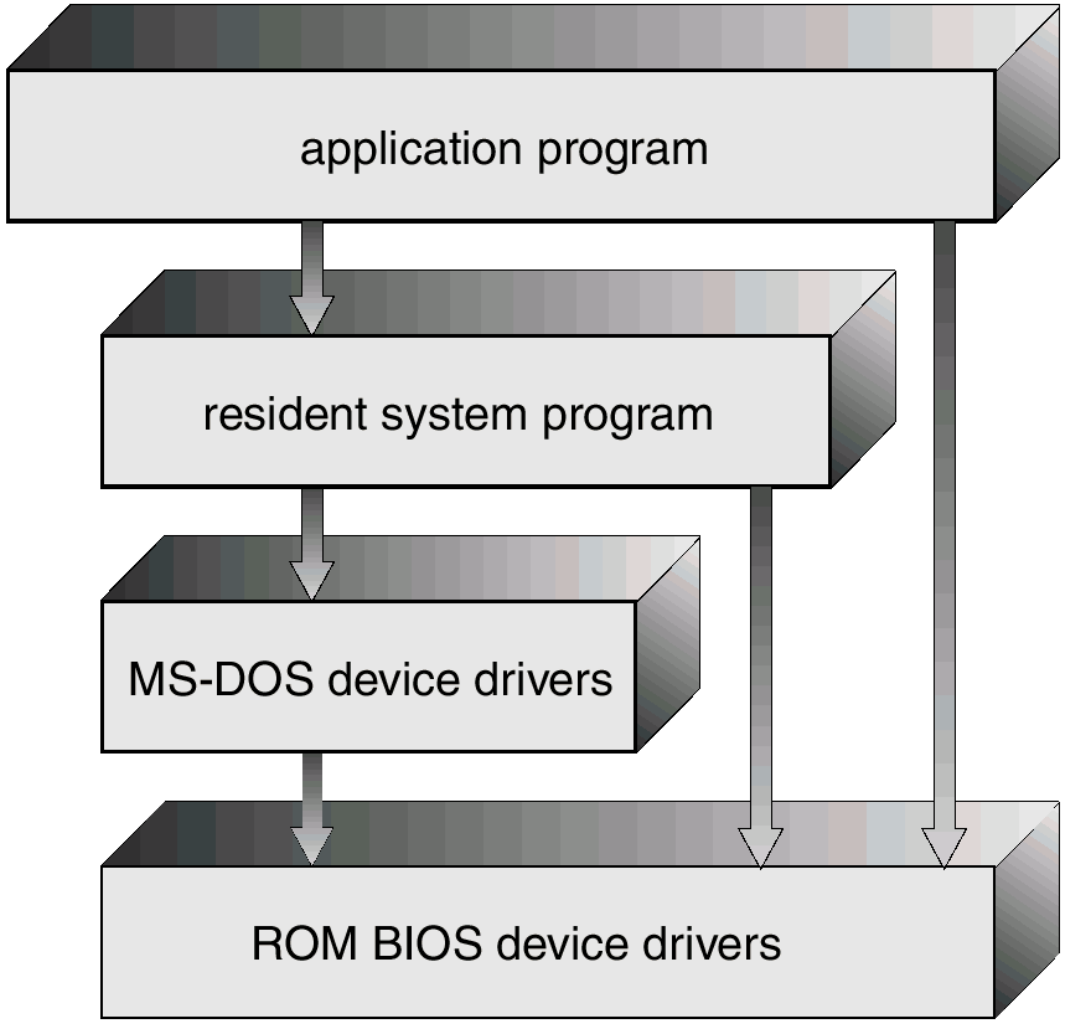


SYSTEM STRUCTURE

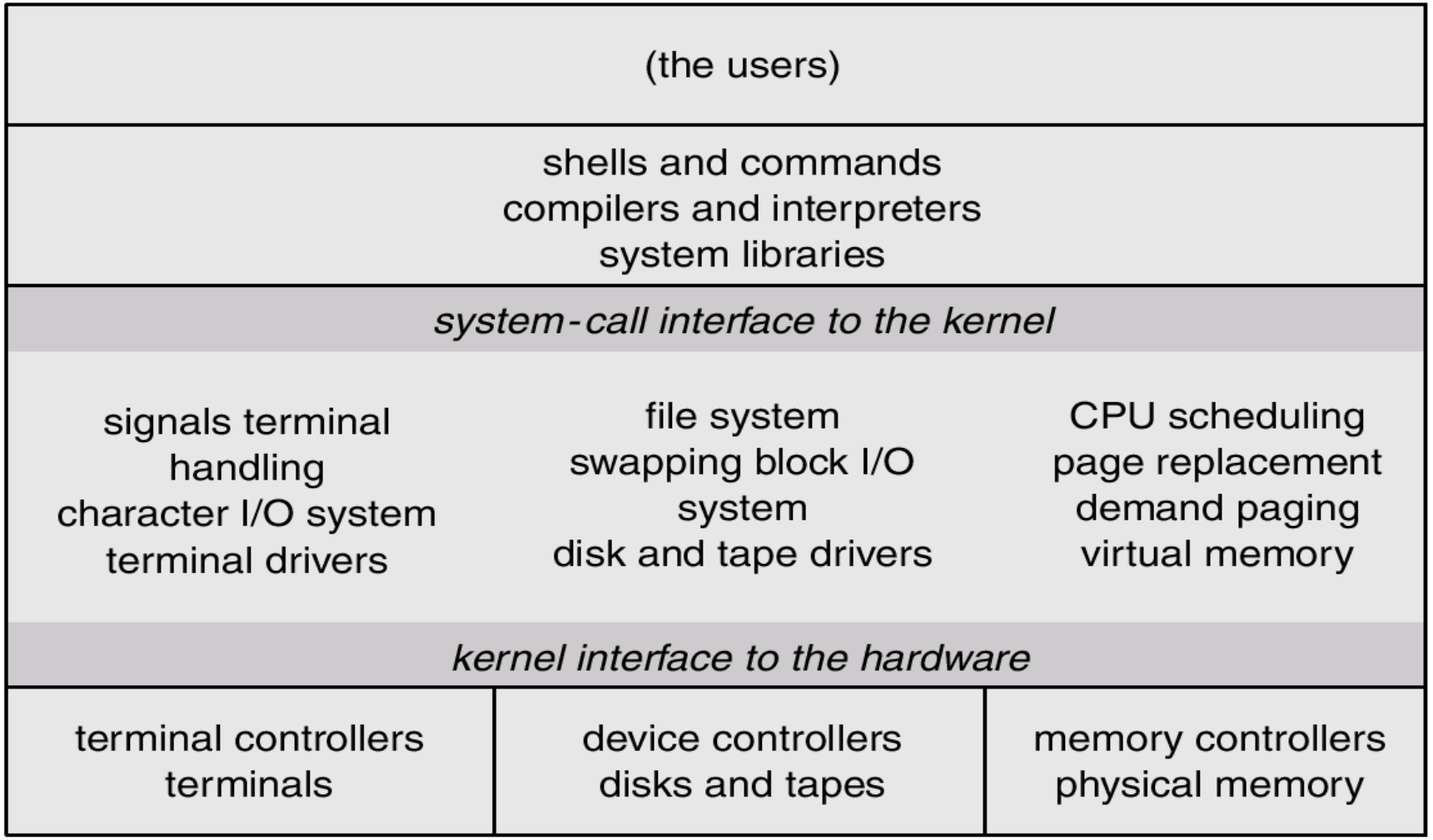
OS System Design Structure

- Simple structure
- Layered approach

MS-DOS Structure



UNIX System 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 uses functions (operations) and services of only lower-level layers.

Layered Approach Cont'd

- Advantage:
  - Modularity
  - Debugging
  - Modification
- Disadvantage:
  - Layering overhead to the system call
  - Layers Order

OS/2 Layer Structure