Chapter 3

OS Organization

Design of OS

- Factors influencing *design* of OS
  1. Performance
  2. Protection/Security
  3. Correctness
  4. Maintainability
  5. Commercial factors
  6. Standard & Open Systems

(1) Performance

- Functionality v/s Performance
  - More resource abstraction
  - Higher levels of resource abstraction
- Coding OS w.r.t. Performance
  - Assembly => Fast execution
  - BUT Assembly => Debugging ???
- Others?

(2) Protection & Security

- OS MUST NOT allow one process to interfere with the operations of another process
  - File access
  - Memory space
  - *Resources*
- Therefore, need to implement strategies that support *Isolation* & *Sharing*
- Challenge is:
  - If OS implements a policy, how to prevent <u>application</u> from changing it

(3) Maintainability & (4) Correctness

- Maintainability
  - Design and write systems to be maintainable

    => Sacrifice performance

- Correctness
  - Does the OS meet the requirements ?
  - Can we write valid set of requirements ?

(5) Commercial influence

- Commercial Influence
  - DOS => IBM-PC
  - UNIX => open platform

  - Commercial influence
    => machine nuances that hinder portability

    - UNIX => portable
    - MAC ???
    - Windows ???

(6) Standards & Open Systems

- Early systems: User tied to ONE vendor

- Desire: User gets pieces from ANY set of vendors
  => Need for Standards and Open Systems

- Open Systems
  => Network of heterogeneous systems
    =>Information flow [Big Endian v/s Little Endian]

(6) Standards & Open Systems

- Open systems achieved through
  - Application integration => common interface
  - Portability => more applications among hardware platforms
  - Interoperability
    - Standardize remote access facilities

      => All systems talk same language over the network

- POSIX = Open system
  - Standardize OS interfaces

Basic Functions of OS

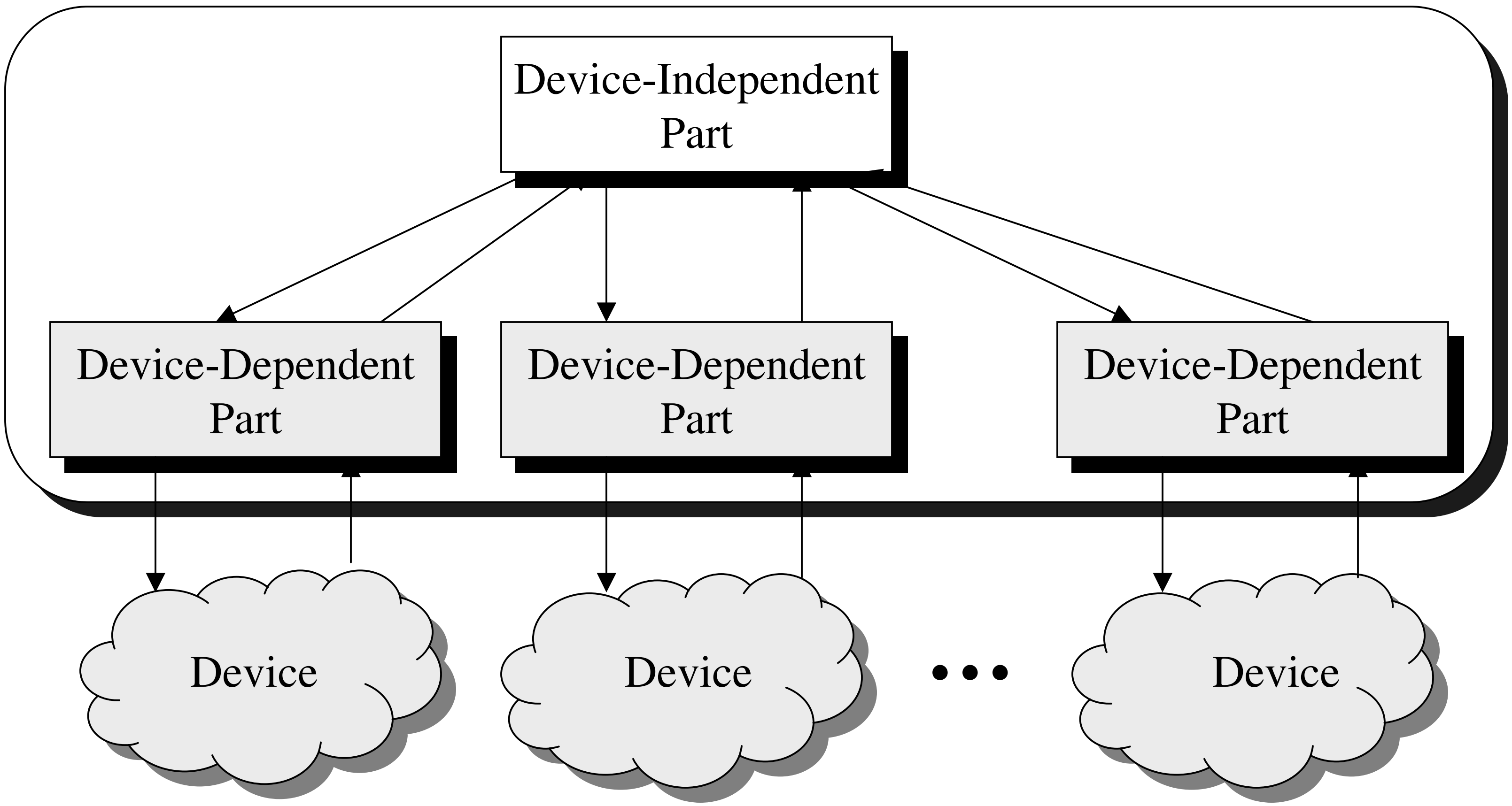
1. Device Management
2. Process / Resource Management
3. Memory Management
4. File Management

Device Management

- Isolation
- Allocation
- Share

- Need device drivers
  - Must be able to configure into OS without re-compiling OS (no Source Code)

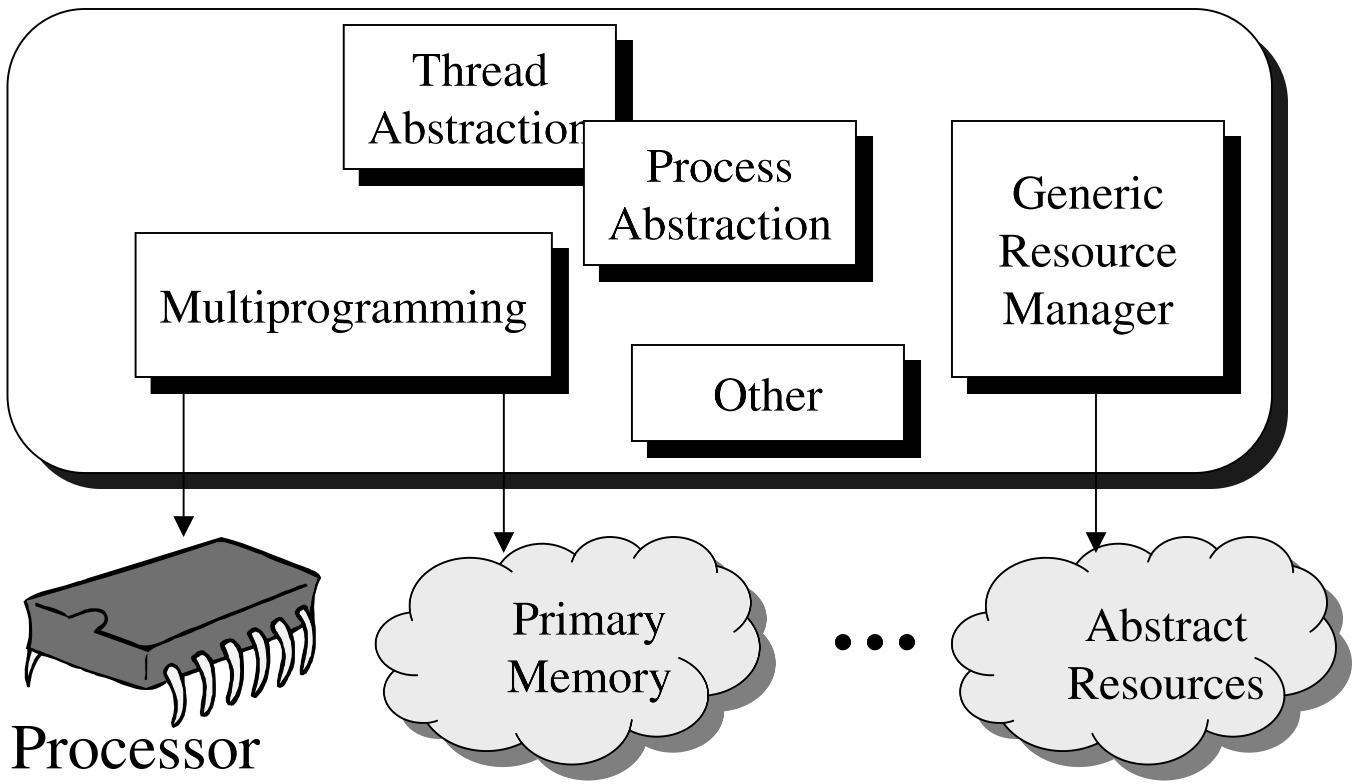
Device Management



Process/Thread/Resource Management

- Process
  - Creating
  - Destroying
  - Blocking
  - Running
- Resource
  - Isolation
  - Sharing

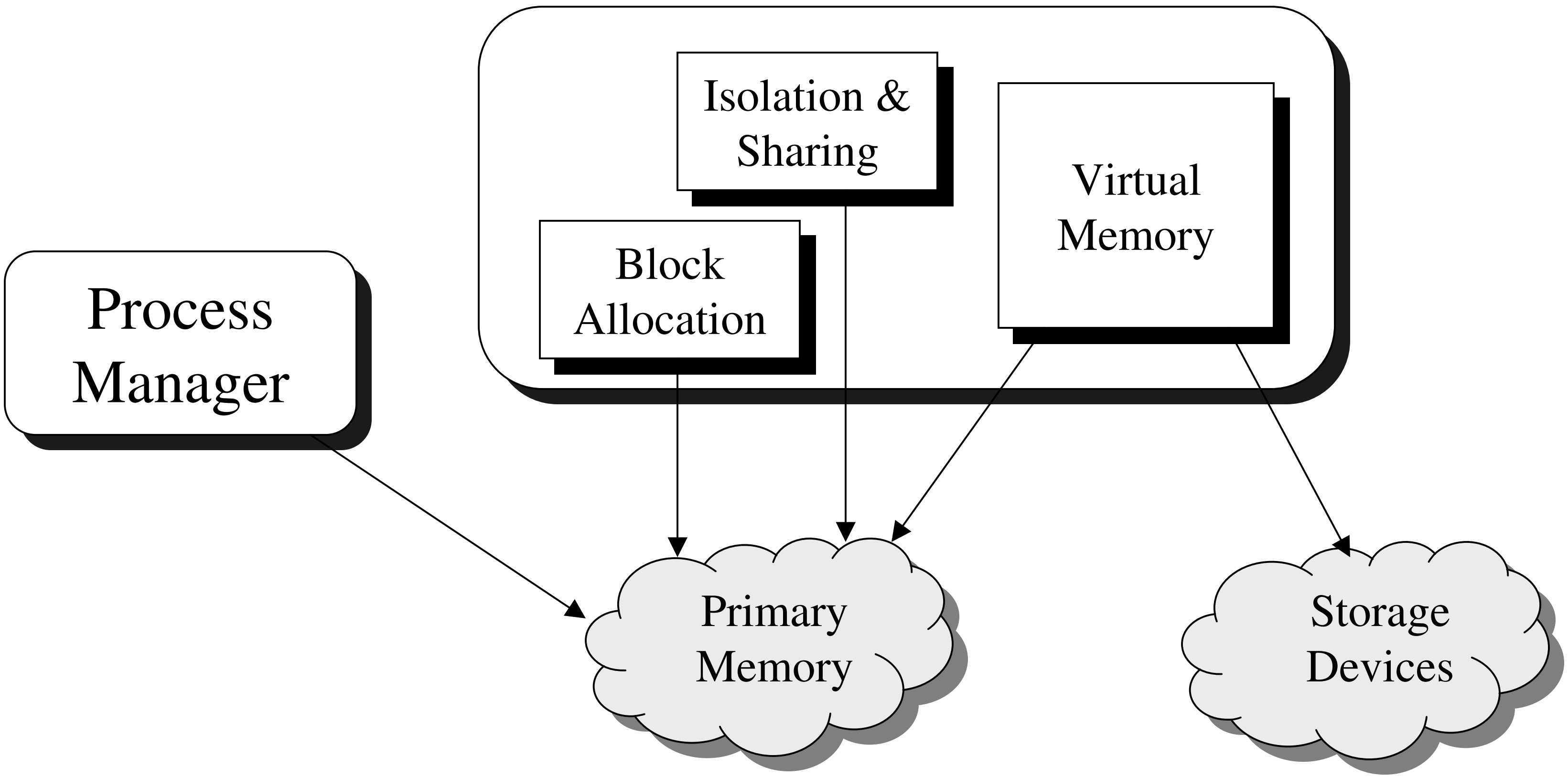
Process/Thread/Resource Management



Memory Management

- Allocation & use of main memory
  - Isolation & Protection
  - Sharing
- Virtual Memory
  - Main memory & storage devices
  - Reference ‘memory’ on storage devices
- Segmented VM – viable approach
  - Block & Offset

Memory Management

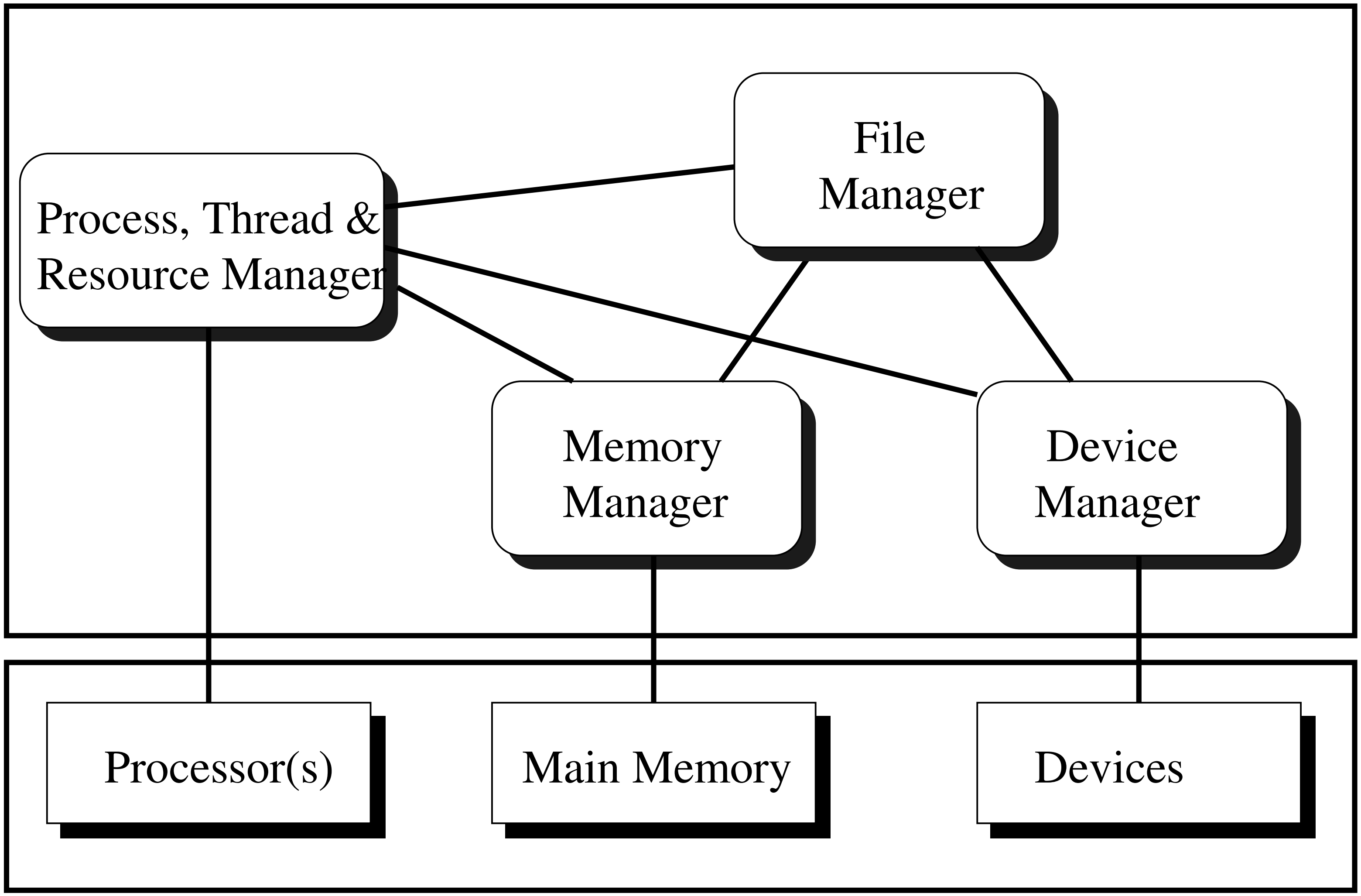


File Management

- Transfer from main memory to file
  - Code (VM)
  - Data (VM)
  - Editors

- Different file management strategies
  - Sequential
  - Indexed
  - Direct access
  - Networked

Basic OS Organization



Implementation Considerations

- Process Modes
- Kernels
- Method of requesting system services

Processor Modes

- Supervisor mode
  - Can execute any instruction
  - Can reference all memory locations
- User mode
  - Subset of instructions
  - Can only reference a subset of memory locations

In UNIX:

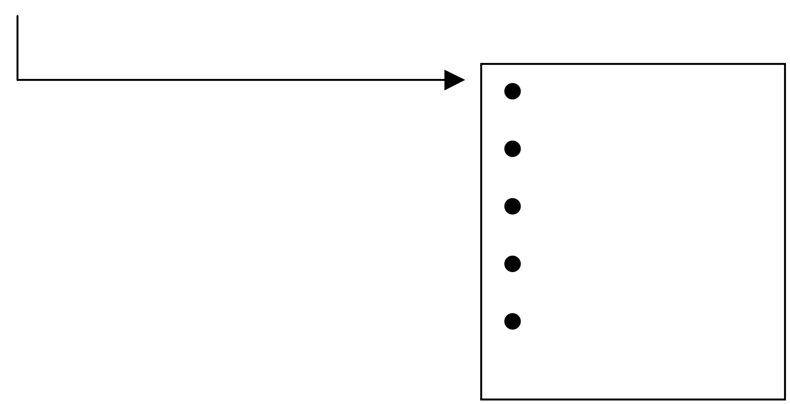
What can root execute that application cannot ?

- renice : OS call
- chown : OS call
- IOCTL (OS call) – if user interleaves output on printer
- Memory accesses

Kernel

- Trusted part of the OS
- Executes in Supervisor mode
- Generally, memory resident
- OS extension run in User mode
  - Example: Drivers

- Kernel functions are invoked by "trap"

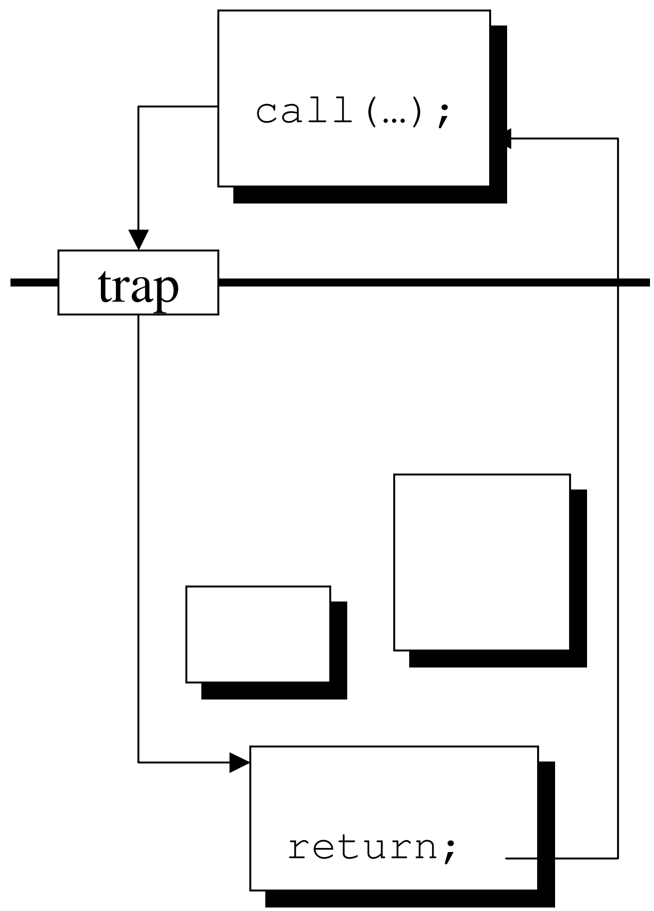


Interrupt Handler

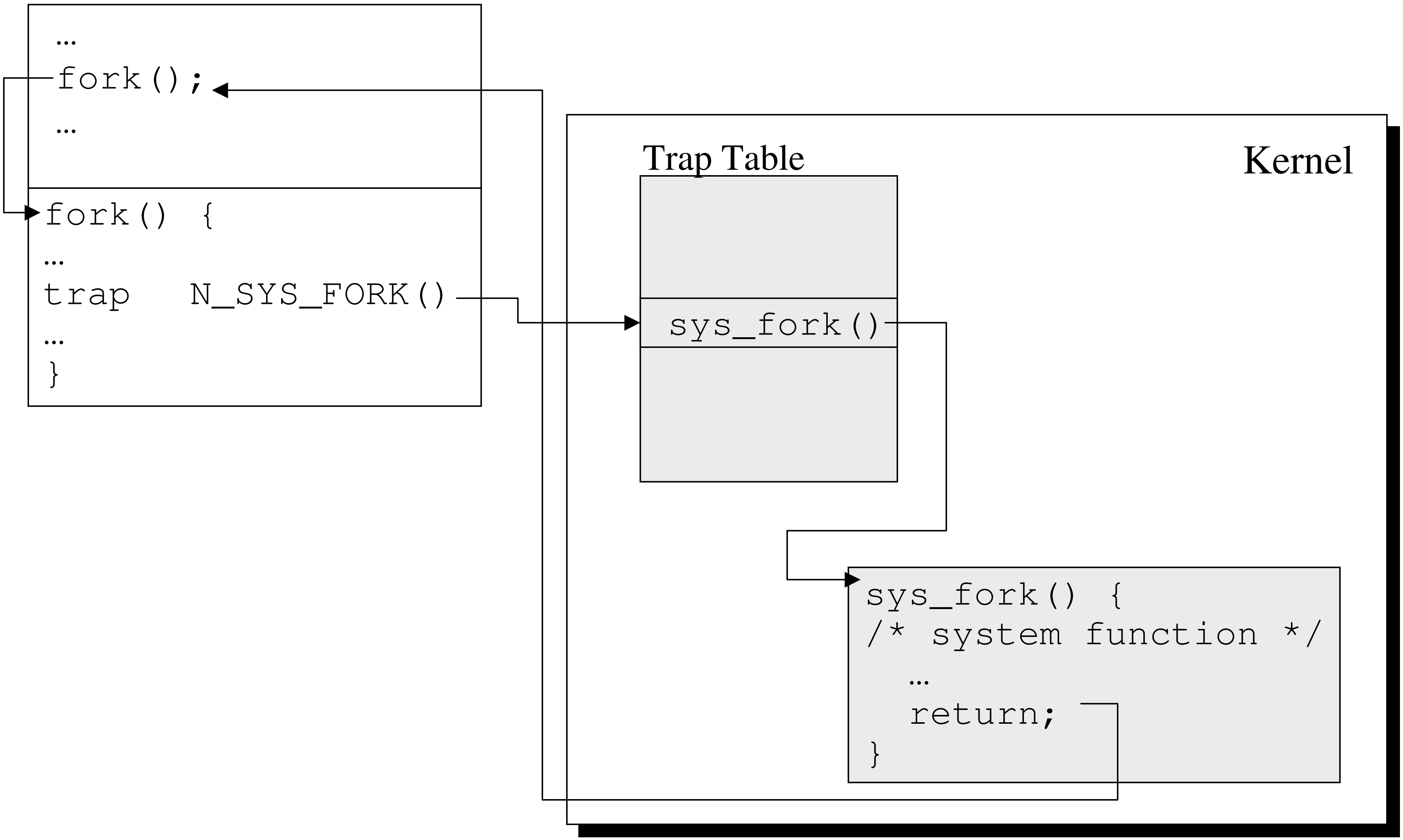
Requesting Service from OS

- System call
  - Process traps to OS Interrupt Handler
  - Supervisor mode set
  - Desired function executed
  - User mode set
  - Returns to application

Requesting Svc: System Call



System Call Using the trap Instruction



Message Passing

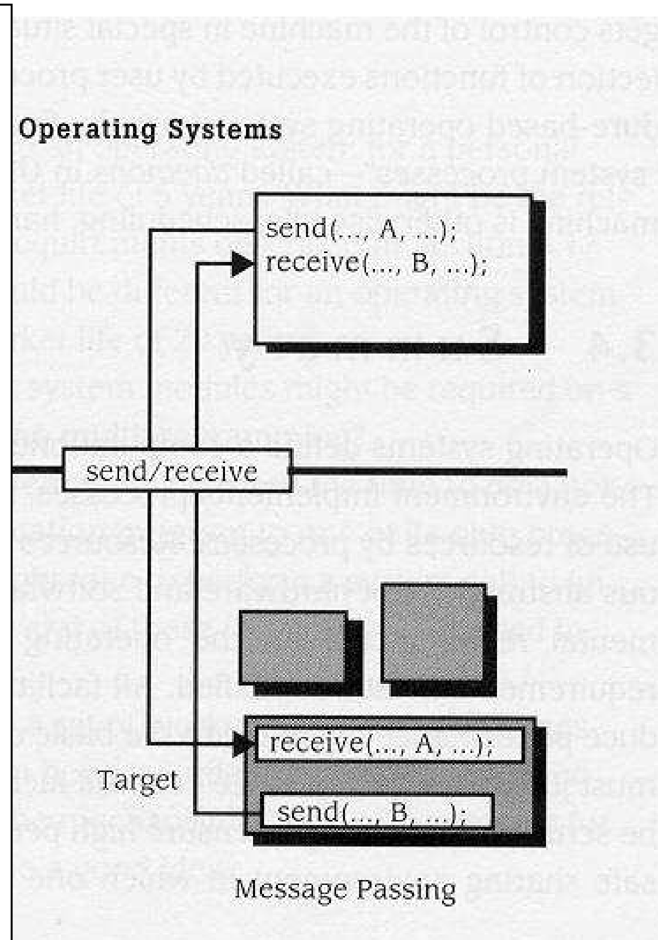
- User process constructs message indicating function (service) needed
- Invokes send to pass message to OS
- Process blocks

  ……….
- OS receives message
- OS initiates Function execution
- Upon Function completion, OS Returns (“OK”)
- Process un-blocks

  ……….

Send and *Receive* analyze message for proper format, etc.

Requesting Svc: Message Passing



Message Passing…

- System call are more efficient

    BUT

    they also unduly tie the Application to specifics of the OS

- Tradeoffs ???