

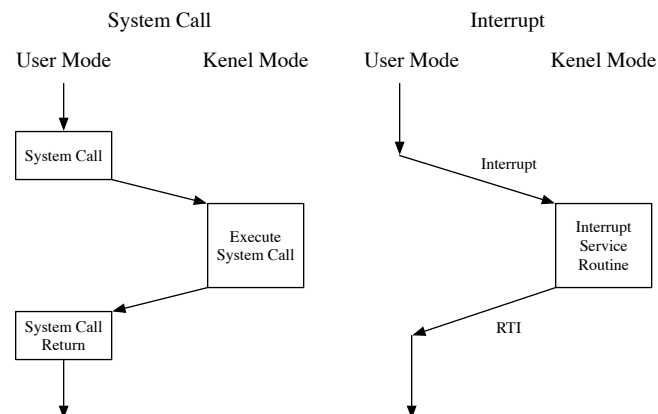
## Lecture Notes 1

### Operating Systems Function

- Resource Management
  - CPU
  - Memory
  - File System & I/O Devices
- User View
  - Ease of Use vs. Resource Utilization
  - Monitor, Keyboard & Mouse vs. Touchscreen vs. No HMI
- System View
  - Resource Allocator
  - Control Program
- Defining Operating Systems
  - Kernel
  - System Programs
  - Middleware

### Computer System Organization and Architecture

- Executable Programs
  - Bootstrap or Firmware – Initial program usually stored in NVM
  - Kernel – Core program that runs for duration after loading
  - System Processes or System Daemons – Run with kernel providing services
  - Interrupts – Signal the kernel that event has occurred (either from HW or SW)
    - System Call or Monitor Call – Special operation signaled through software generated interrupt
    - Interrupt Service Routine (ISR) – Specified in the Interrupt Vector for handling a specific HW interrupt.



- Memory
  - Primary Storage (Typically Volatile)
    - Register (Flip-Flops)
    - Cache (SRAM)
    - Main Memory (or RAM usually DRAM)
  - Secondary Storage (Typically Non-Volatile)
    - Solid-State Drive (SSD)
    - Hard-Disk Drive (HDD)
    - Optical Disk (CD, DVD, BluRay, etc.)
    - Magnetic Tape (TS1150, Sony 185TB, etc.)
- I/O Structure
  - Device Driver – Manages the device controller
  - Direct Memory Access (DMA) – Moves data in bulk between Device and Memory (and vice versa)
- Computer System Architecture
  - Single Processor Systems
  - Multiple Processor/Multi-core Systems
    - Asymmetric Multiprocessing
    - Symmetric Multiprocessing (SMP)
  - Clustered Systems – Loosely coupled that share storage and connected via LAN or similar network
    - Distributed Lock Management (DLM) – Provides synchronization between systems
    - Storage-Area Network (SAN) – Pool of storage shared by cluster

## Operating System Structure & Operations

- Multiprogramming – Maximizes CPU utilization
  - Time Sharing (Multitasking) – CPU switches between multiple jobs
  - Interactive (Response Time) – System needs to response quickly to user input
- Process (Job) – A program loaded into memory
  - Process Pool (or Job Pool) – Set of processes that can execute
  - Process or Job Scheduling (CPU Scheduling) – Decision of which process executes when
  - Swapping – Process is swapped completely in and out of main memory
  - Virtual Memory – Separates Logical from Physical memory to avoid need for swapping
- Interrupt or Trap – Signal to stop normal execution of instructions to give control flow back to OS
- Dual Mode (or Multimode) – Multiple modes of CPU operation
  - Kernel Mode (Supervisor, System or Privileged Mode) – Allowed to use all instructions/access all of memory
  - User Mode – Limited access to memory/instructions (usually virtually mapped memory)

- Virtualization Machine Management (VMM) – Usually allows for multiple modes to allow Virtual OS to be distinguished from Virtual User
- Timers – Timers are necessary to prevent user from getting stuck in infinite loop and locking up entire system

## Operating System Management

- Process Management
  - Process – Actively entity, it is a running program (passive entity)
  - Schedules Processes and Threads
  - Creates and Deletes Processes
  - Suspends/Resumes Processes
  - Provides Synchronization and Communication Mechanisms
- Memory Management
  - Maintain list of which parts are used and by which process
  - Decide which process are in and out of memory
  - Allocate and Deallocate memory as needed
- Storage Management
  - File System Management
    - Create/Delete files/directories
    - Support file/directory manipulation
    - Map file system to Mass-Storage
  - Mass-Storage Management
    - Free-space Management – Keep track of free space for later use
    - Storage Allocation – Allocate chunk when needed
    - Disk Scheduling – Decide when to read/write data in which order
  - Caching
    - What portions of Mass-Storage are stored in memory
    - When are the portions replaced
  - I/O Subsystem
    - Memory management – Buffer, caching, spooling, etc.
    - Device Driver Interface
    - Hardware Specific Drivers
- Security and Protection
  - Protection – Mechanism for controlling access of processes/users to resources
  - Security – Maintaining that unauthorized access is not permitted
  - Identifiers
    - User ID (UID)
    - Security ID (SID) – Windows
    - Group ID (GID) – Group identifier for allowing group wide access
    - Effective UID – Privileges can be escalated for a user temporarily