Modern Operating Systems

- Microkernel architecture
  - Assigns only a few essential functions to the kernel
    - Address spaces
    - Interprocess communication (IPC)
    - Basic scheduling

- Multithreading
  - Process is divided into threads that can run concurrently
    - Thread
      - Dispatchable unit of work
      - executes sequentially and is interruptable
    - Process is a collection of one or more threads
Modern Operating Systems

• Symmetric multiprocessing (SMP)
  – There are multiple processors
  – These processors share same main memory and I/O facilities
  – All processors can perform the same functions

Multiprogramming and Multiprocessing

1 processor multiprogramming

2 processors multiprocessing

Figure 2.12  Multiprogramming and Multiprocessing
Modern Operating Systems

• Distributed operating systems
  – Provides the illusion of a single main memory space and single secondary memory space

Modern Operating Systems

• Object-oriented design
  – Used for adding modular extensions to a small kernel
  – Enables programmers to customize an operating system without disrupting system integrity
Windows Architecture

- Modular structure for flexibility
- Executes on a variety of hardware platforms
- Supports application written for other operating system
Operating System Organization

- Modified microkernel architecture
  - Not a pure microkernel
  - Many system functions outside of the microkernel run in kernel mode
- Any module can be removed, upgraded, or replaced without rewriting the entire system

Kernel-Mode Components

- Executive
  - Contains base operating system services
    - Memory management
    - Process and thread management
    - Security
    - I/O
    - Interprocess communication
- Kernel
  - Consists of the most used components
Kernel-Mode Components

- Hardware abstraction layer (HAL)
  - Isolates the operating system from platform-specific hardware differences
- Device drivers
  - Translate user I/O function calls into specific hardware device I/O requests
- Windowing and graphics systems
  - Implements the graphical user interface (GUI)

Windows Executive

- I/O manager
- Cache manager
- Object manager
- Plug and play manager
- Power manager
- Security reference monitor
- Virtual memory manager
- Process/thread manager
- Configuration manager
- Local procedure call (LPC) facility
User-Mode Processes

• Special system support processes
  – E.g.: logon process and the session manager
• Service processes
• Environment subsystems
• User applications

Client/Server Model

• Simplifies the Executive
  – Possible to construct a variety of APIs
• Improves reliability
  – Each service runs on a separate process with its own partition of memory
  – Clients cannot directly access hardware
• Provides a uniform means for applications to communicate via LPC
• Provides base for distributed computing
Threads and SMP

- Operating system routines can run on any available processor
- Different routines can execute simultaneously on different processors
- Multiple threads of execution within a single process may execute on different processors simultaneously
- Server processes may use multiple threads
- Share data and resources between process

Windows Objects

- Windows relies heavily on object oriented design
  - Encapsulation
    - Object consists of one or more data items and one or more procedures
  - Object class or instance
    - Create specified instances of an object
  - Inheritance
    - Support to some extent in the Executive
  - Polymorphism
UNIX

- Hardware is surrounded by the operating system software
- Operating system is called the system kernel
- Comes with a number of user services and interfaces
  - Shell
  - Components of the C compiler

Figure 2.14: General UNIX Architecture
UNIX Kernel

Fig. 2.15

Modern UNIX Kernel

Fig. 2.16
Some UNIX Systems

- System V Release 4 (SVR4)
- Solaris 10
- 4.4BSD
- Linux
- OS X