# Module 7

Input/Output Management

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▼ Examples of I/O devices?

- Readable devices can be used to communicate with a user. Examples include printers, keyboards, and video displays.
- Machine Readable devices communicate with the computer. Examples include disk drives and controllers.
- Communication devices are used for communicating with remote devices. Examples include modems and digital line drivers.

▼ What is programmed I/O?

when, on behalf of a process, the processor issues the I/O command to an I/O module

▼ What is interrupt-driven I/O?

when, on behalf of a process, the processor issues an I/O command after checking to see whether the instruction is blocking or nonblocking

▼ What is direct memory access (DMA) I/O?

when data is exchanged between main memory and an I/O module

▼ What is generality?

The ability of the operating system to handle all devices in a uniform manner.

▼ What is buffering?

Performing input transfers in advance of requests being made, and performing output transfers some time after the request is made

▼ What is a block-oriented device?

- Stores information in block of a fixed size
- Transfers one block at a time
- Data can be referenced by block number
- Examples are disk and USB secondary storage

▼ What is a stream-oriented device?

- No block structure
- Data is transferred as a stream of bytes
- Devices that are NOT used for secondary storage—printers, pointing devices, terminals

▼ What is a single buffer scheme?

- In this simplest type of buffering, the operating system assigns a buffer in the system portion of main memory to the operation.
- Data comes in as a block from the I/O device and stays in the buffer in memory until the user process is ready for it.
- This technique does usually speed up overall processing time, but also makes the OS work harder at keeping track of the assignment of system buffers to user processes.
- Examples
  - For stream-oriented I/O, data comes in a line at a time or a byte at a time.
  - Line-at-a-time buffering is appropriate for older scrolling (dumb) terminals and line printers.
  - Byte-at-a-time buffering is used for forms-mode terminals where each keystroke is significant, and for many other peripherals.

▼ What is a double buffer scheme?

- Assigning two system buffers to an operation makes a significant improvement over the single buffer scheme.
- Buffer swapping: a process can then transfer data to or from one buffer while the OS is emptying or filling the other buffer.
- This technique works well for block-oriented transfer, and can many times ensure that the process will not have to wait on I/O. It does, however, cost more in terms of increased complexity and work on the part of the operating system.
- For stream-oriented input, double buffering improves the efficiency of line-at-a-time I/O since the process does not need to be suspended for input or output.

▼ What is a circular buffer scheme?

When more than two buffers at a time

▼ What determines the speed of an I/O device?

access and transfer time

▼ What is access time comprised of?

- Seek time: the amount of time it takes to move a moveable head to the correct spot on the disk, or to position a fixed head at the correct spot.
- Rotational delay: the amount of time required for the beginning of the sector to reach the head.

▼ What is transfer time?

The time it takes to transfer (read or write) the data as the sector moves under the head. It occurs once the disk head is in position.

▼ What is the redundant array of independent disks (RAID)?

a set of physical disk drives viewed by the OS as a single logical drive

▼ What is a disk array?

A disk array is a group of disks in which each disk works independently but in parallel. This allows data to be distributed across multiple disks.

▼ What is striping?

data can be distributed across the physical disks are an array

▼ What is redundant disk capacity used for?

to store parity information, which is used to guarantee data recovery in case of a disk failure

▼ What is a disk cache?

- A buffer in main memory for disk sectors
- When a process sends an I/O for data in a particular sector, a quick check is made to determine whether that sector is in memory. If so, the request is quickly satisfied via the cache in memory. If not, the sector is accessed on the disk.
- Disk caching can improve performance as long as the correct sector is often found in memory.

▼ How do Unix and Linux deal with I/O?

- Each I/O device is associated with a special file, which is managed by the file system like user data files, which provides a uniform interface for users and processes.
- There are two types of I/O—buffered (like a disk cache) and unbuffered (DMA only).
- Recognized devices include:
  - Disk drives
  - Tape drives
  - Terminals
  - Communication lines
  - Printers

▼ How does Windows deal with I/O?

- It uses the Windows I/O Manager to manage and control all I/O for the operating system and to provide a uniform interface that all types of drivers can

use. Components include:

  - Cache manager handles file caching for all file systems.
  - File system drivers act as device drivers that route I/O requests for file system volumes to the appropriate software drivers.
  - Network drivers provide integrated networking capabilities and support for remote file systems.
  - Hardware device drivers control peripheral devices.
- There are two types of I/O operations—asynchronous and synchronous.
- Supports Software RAID and Hardware RAID.