

# IO Systems

## The Role of Operating Systems in IO Systems

The operating system is responsible for managing IO systems, the hardware and software necessary to handle input and output devices on a computer.

## IO Devices

IO, or input/output, devices are physical, electronic devices that can receive and produce signals between a computer and the outside world.

## IO Device Categories

IO devices can be categorized into three categories:

- human-readable
- machine-readable
- communication

## Device Drivers Definition

Driver devices provide support to both CPUs and IO devices so that they may communicate effectively with one another.

## Types of Device Drivers

There are two types of device drivers:

- Kernel-mode drivers allow for basic functionality on a CPU. They even contribute to the start-up of an operating system when we turn on our computers.
- User-mode drivers are necessary when a user adds additional hardware to their computer which requires its own set of drivers that need to be installed.

## Blocking

Blocking refers to the method in which an application stops all other execution and waits for the current IO request to be completely executed.

## Non-blocking

Non-blocking refers to the method in which requests get placed into a queue when they are waiting for IO requests to be completed so that the CPU may allocate its resources to continue processing other requests.

## Interrupts

Interrupts are a hardware mechanism that sends a signal to the CPU whenever an IO device needs the CPU's attention

## Interrupt Handler

The interrupt handler is a pool or queue of interrupts being sent to the CPU.

## DMA Controller

DMA controllers are hardware devices that allow IO devices to transfer data to/from memory while bypassing the CPU.

## Memory-mapped IO

Memory-mapped IO allows for an IO device and the main memory of a computer to share address space in their transfer of data

## Reading/Writing on IO Devices

The three methods used by IO devices to read/write data are the character method, block method, and network method.

- The character method of reading/writing data looks like a sequential series of bytes and each byte is accessed one at a time.
- The block method of reading/writing data allows for random access as memory is designed to store data in blocks of a fixed size.
- The network method of reading/writing data is designed to use different types of interfaces (such as a socket interface) to access multiple devices over a network.

## IO Software

The role of IO software is to receive signals from physical devices, interpret them, and then perform tasks accordingly through the operating system.

## User-space vs. Kernel-space

The user-space is the place in memory in which user processes run. The kernel-space is the place in memory in which the kernel functions and manages system calls.

## Kernel-space

The kernel-space is the place in memory where the kernel performs its functionality. The kernel manages the scheduling of tasks, buffering (storing data in memory when transferring between a computer and IO devices), spooling (holding output data for an IO device), and more.

## IO Software Layers

IO software consists of the following layers:

- User-level IO software or user processes
- Device-independent software
- Device Drivers
- Interrupt handlers
- Hardware

## Device Drivers IO Software

Device drivers are device-specific code that is added to a computer so that a device may interact with a computer.

## Device Independent Software

Device independent software refers to the software components that handle functions that are not specific to any single IO device.