Chapter 2.3 [Input output organization](https://lms.cuchd.in/mod/resource/view.php?id=814230)

*Input/output (I/O) organization is the method of controlling the flow of data between input/output devices and the CPU of a computer system. Asynchronous data transfer is a method of data transfer where data is transferred without the use of a fixed clock signal.*

**Source Initiated**

* *In source-initiated data transfer, the input/output device controls the transfer of data and signals the CPU when the transfer is complete.*
* *The CPU sends a command to the input/output device to transfer data, and the input/output device transfers data to the CPU when ready.*
* *This method is suitable for low-speed devices and devices that have a simple interface.*

***Example 1:*** *A mouse sending data to the CPU only when it has new data available to send.*

***Example 2:*** *A digital camera transferring data to a computer only when the user initiates a transfer.*

**Destination Initiated**

* *In destination-initiated data transfer, the CPU initiates the transfer of data and signals the input/output device when ready to receive data.*
* *The input/output device waits for a signal from the CPU indicating that it is ready to receive data, and then transfers data to the CPU.*
* *This method is suitable for high-speed devices and devices that have a complex interface.*

***Example 1:*** *A disk controller initiating data transfer only when the CPU signals that it is ready to receive data.*

***Example 2:*** *A sound card initiating the transfer of audio data to the CPU only when the CPU is ready to process the data.*

**Handshaking**

* *Handshaking is a method of asynchronous data transfer where the input/output device and the CPU exchange signals to control the transfer of data.*
* *In this method, the input/output device sends a signal to the CPU indicating that it is ready to transfer data, and the CPU responds with a signal indicating that it is ready to receive data.*
* *The input/output device then transfers data to the CPU, and the CPU sends a signal indicating that the data has been received.*
* *This method is suitable for devices that require data transfer control.*

***Example 1:*** *A serial communication device waiting for the CPU to signal that it is ready to receive data before sending data.*

***Example 2:*** *A printer waiting for the CPU to signal that it is ready to receive data before printing a document.*

**Programmed I/O**

* *Programmed I/O is a method of data transfer where the CPU controls the transfer of data by reading and writing data directly to and from the input/output device.*
* *The CPU uses a series of input/output instructions to transfer data to and from the input/output device.*
* *This method is suitable for devices that have a simple interface and low-speed devices.*

***Example 1:*** *Reading data from a keyboard using an input instruction and writing data to a printer using an output instruction.*

***Example 2:*** *A microcontroller reading sensor data from an ADC and storing it in memory using input/output instructions.*

**Interrupts**

* *Interrupts are a method of data transfer where the input/output device interrupts the CPU when it is ready to transfer data.*
* *The input/output device sends an interrupt signal to the CPU, and the CPU saves its current state and starts processing the interrupt request.*
* *The input/output device then transfers data to the CPU, and the CPU resumes its previous task.*
* *This method is suitable for devices that require fast and efficient data transfer.*

***Example 1:*** *A network card interrupting the CPU when a packet has been received and needs to be processed.*

***Example 2:*** *An audio card interrupting the CPU when it has finished playing a sound.*

**DMA**

* *DMA (Direct Memory Access) is a method of data transfer where a DMA controller transfers data directly between the input/output device and main memory without the intervention of the CPU.*
* *The CPU sets up the DMA controller to transfer data, and the DMA controller handles the transfer of data between the input/output device and main memory.*
* *This method is suitable for devices that require high-speed data transfer and devices that need to transfer large amounts of data.*

***Example 1:*** *A hard disk controller transferring data from the hard disk to main memory using a DMA controller.*

***Example 2:*** *A graphics card transferring large amounts of image data from its memory to main memory using a DMA controller.*

**IOP**

* *IOP (Input/Output Processor) is a dedicated processor that controls the transfer of data between input/output devices and main memory.*
* *The IOP communicates with the CPU to transfer data between input/output devices and main memory.*
* *This method is suitable for devices that require high-speed data transfer and devices that need to transfer large amounts of data.*

***Example 1:*** *A RAID controller managing multiple hard disks and handling the storage and retrieval of data on its own.*

***Example 2****: A network controller that manages packet processing, including checksum calculation and packet routing.*