Chapter – 7

Input Output Organization

External Devices:

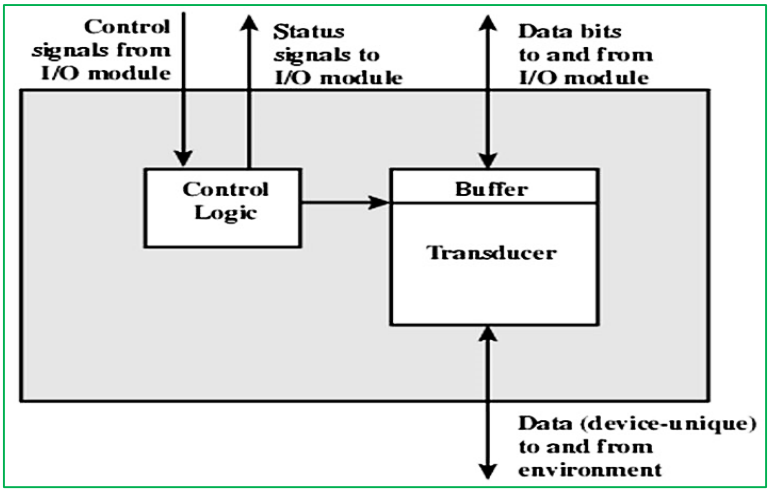


Fig: Block Diagram of an External Device

Input Output operations are accomplished through a wide range of external devices that provides a means of exchanging data between external environment and the computer. An external device is attached to the computer by a link to input/output module. The link is used to exchange control, status and data between input/output module and the external device. An external device connected to input/output module is known as peripheral device or simply a peripheral. The external devices can be classified as:

1. **Human Readable:** Suitable for communicating with the computer user. For example: Screen, Printer, etc.
2. **Machine Readable:** Suitable for communicating with equipment. For example: Magnetic Disk, Memory, etc.
3. **Communications:** Suitable for communicating with remote devices. For example: Modem, Network Interface Card (NIC).

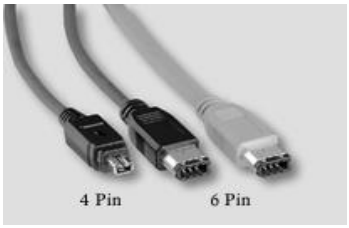
Examples:

1. **SCSI:**

- Acronym for small computer system interface.
- Pronounced "scuzzy," SCSI is a parallel interface standard used by Apple Macintosh computers, PCs, and many UNIX systems for attaching peripheral devices to computers.
- Provide for faster data transmission rates (up to 80 megabytes per second) than standard serial and parallel ports.
- Can attach many devices to a single SCSI port, so that SCSI is really an I/O bus rather than simply an interface.

- However, SCSI rarely in used because each piece of SCSI hardware has its own host adapter, and the software drivers for the device cannot work with an adapter made by someone else.
- Nearly all Apple Macintosh computers, excluding only the earliest Macs and the recent iMac, come with a SCSI port for attaching devices such as disk drives and printers.

2. **FireWire (IEEE 1394):**



- Fire Wire is Apple Computer's version of a standard, IEEE 1394, High Performance Serial Bus, for connecting devices to personal computer.
- Uses for devices that need to transfer high levels of data in real-time, such as video devices.
- Fire Wire provides a single plug-and-socket connection on which up to 63 devices can be attached with data transfer speeds up to 400 Mbps (megabits per second).
- Like USB, it also supports both Plug-and-Play and hot plugging, and also provides power to peripheral devices.

FireWire

3. **USB:**

- USB (Universal Serial Bus) is **a plug-and-play interface between a computer and add-on devices (such as mouse, scanners, and printers).**
- With USB, a new device can be added to computer without having to add an adapter card or even having to turn the computer off.
- USB 1.1 supports a data speed of 12 megabits per second. This speed will accommodate a wide range of devices.
- It is expected to completely replace serial and parallel ports.
- A single USB port can be used to connect up to 127 peripheral devices.

EXTERNAL INTERFACES:

The interface to a peripheral from an input/output module must be tailored to the nature and operation of the peripheral. One major characteristic of the interface is whether it is serial or parallel.

In a parallel interface, there are multiple lines connecting the input/output module and the peripheral, and multiple bits are transferred simultaneously, just as all of the bits of a word are transferred simultaneously over the data bus.

In a serial, there is only one line used to transmit data, and bits must be transmitted one at a time. A parallel interface has traditionally been used for higher speed peripherals, such as tape and disk, while the serial interface has traditionally been used for printers and terminals. With a new generation of high-speed serial interfaces, parallel interfaces are becoming much less common.

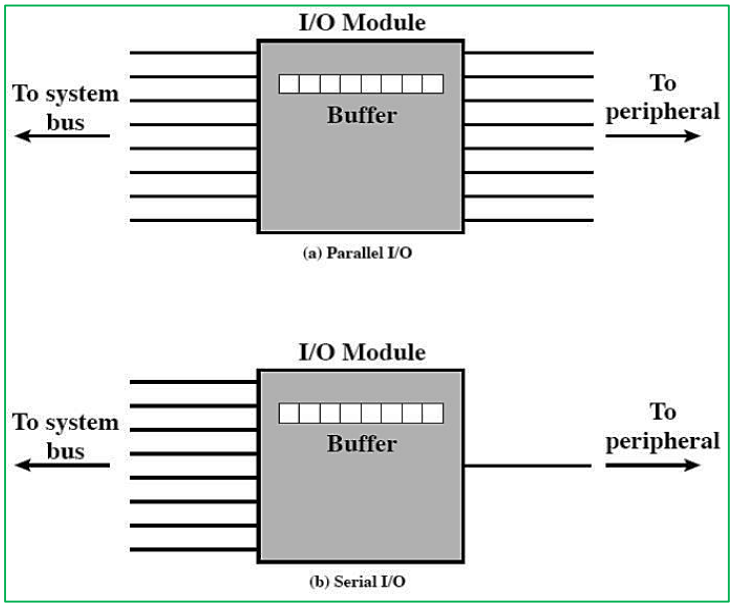


Fig: Parallel and Serial IO

In either case, the input/output module must engages in a dialogue with the peripheral. In general terms, the dialogue for a write operation is as follows:

- The input/output module sends a control signal requesting permission to send data.
- The peripheral acknowledges the request.
- The input/output module transfers data (one word a block depending on the peripheral).
- The peripheral acknowledges receipt of the data.

A read operation proceeds similarly.

Key to the operation of an input/output module is an internal buffer that can store data being passed between the peripheral and the rest of the system. This buffer allows the input/output module to compensate for the differences in speed between the system bus and its external lines.

INPUT OUTPUT MODULE STRUCTURE:

It is an entity with in a computer that is responsible for the control of one or more external devices and for the exchange of data between those devices and main memory or CPU. The input/output memory must have:

a. Interface to CPU and memory
b. Interface to one or more peripheral

The major function or requirement of input/output module falls into following categories:

a. Control and Timing
b. CPU communication
c. Device communication
d. Error detection

Similarly, CPU might involve in sequence of operations like:

a. Check the input/output module device status.

b. Returns device status
c. If ready CPU request data transfer
d. Input/output modules gets data to CPU, etc.

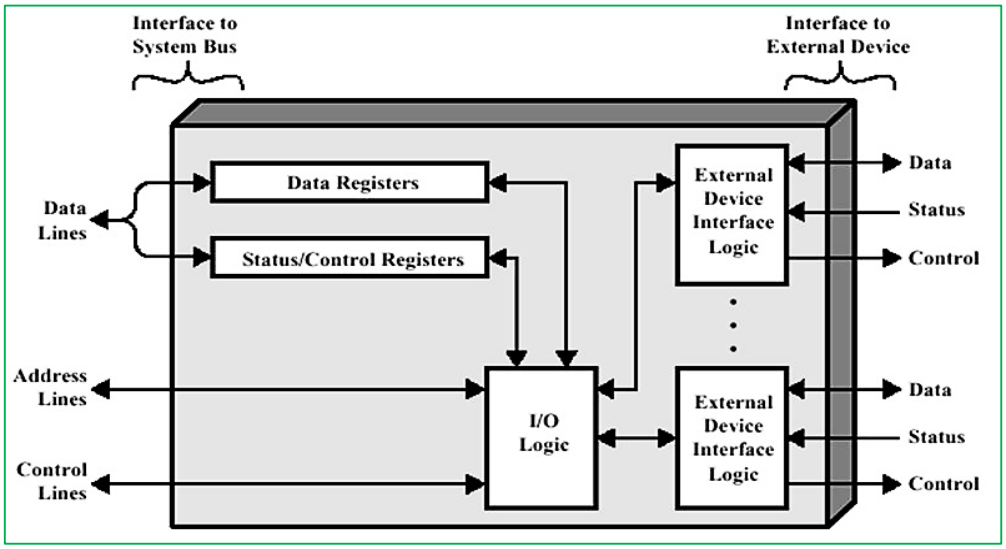


Fig: Block Diagram of Input/output Module

INPUT OUTPUT DATA TRANSFER TECHNIQUES:

There are 3 different types of data transfer techniques:

1. PROGRAMMED INPUT OUTPUT:

With programmed input/output, data are exchanged between CPU and input/output module. The CPU execute a program that gives it direct control of the input/output operation, including sensing the device status, sending a read/write command and transferring the data. When CPU issues a command to input/output module, it must wait until input/output operation is completed.

If CPU is faster than input/output module then there is wastage of CPU time.

Using programmed input/output, the input/output module will perform the requested actions and then set appropriate bits in status register. It is the responsibility of CPU to periodically check the status of the input/output module until it finds that the operation is completed.

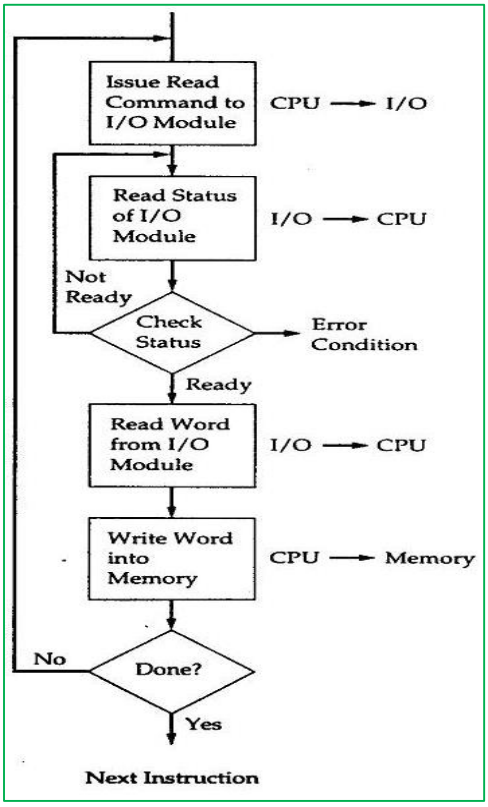


Fig: Programmed IO

2. Interrupt Driven Input Output:

Using programmed control input/output technique there is wastage of the time of CPU, which is overcome by interrupt driven input/output technique. Here, CPU issues read command and when input/output module gets data from peripheral device then it interrupts CPU. After that, CPU request data and input/output module transfer data. The CPU reads data and store it in main memory.

Advantages:

a. Less wastage of the time of CPU.
b. Speed is comparatively faster than programmed input/output technique.

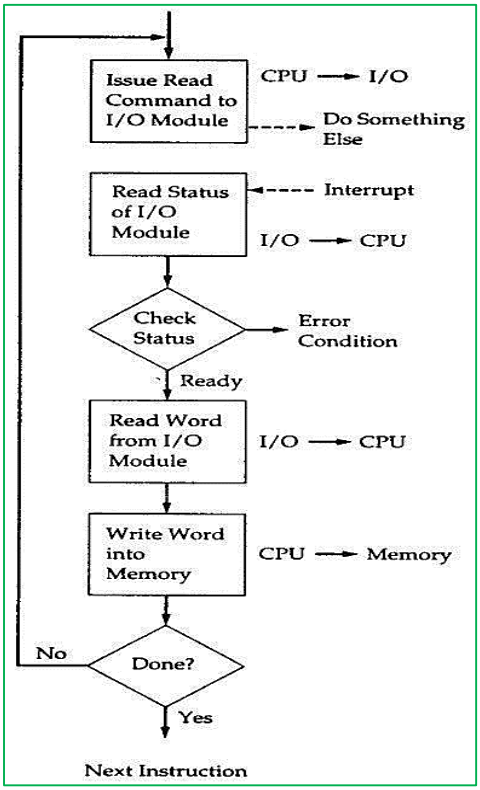


Fig: Interrupt Driven IO

3. Direct Memory Access (DMA):

DMA is the technique, which allows data to be send directly from an attached device to the memory and vice-versa. Usually a specified portion of memory is designated as an area to be used for DMA.

Here, the microprocessor is freed form involvement with the data transfer. Thus, speeding up overall computer operation. As shown in diagram at right side, whether a read or write is requested, there is use of control lines between input/output devices and memory. The address of the input/output device is communicated on the data-lines.

The overall operation for the data transfer is controlled through DMA controller.

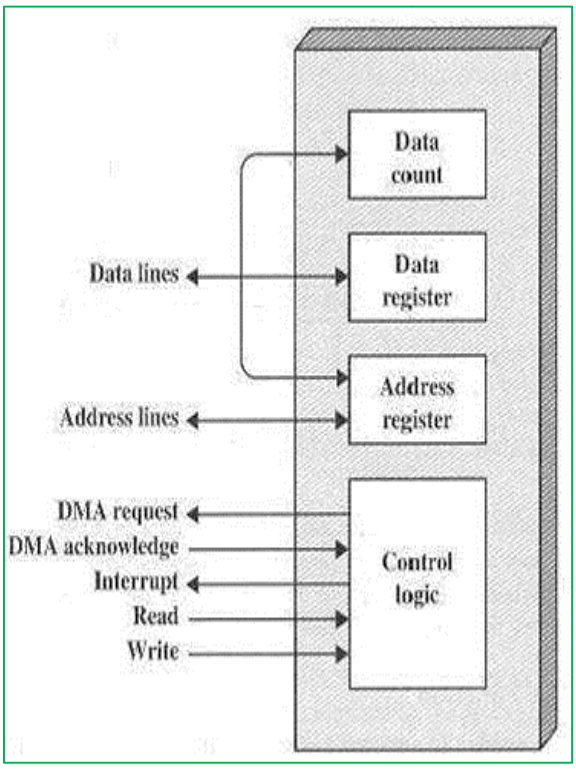


Fig: Block Diagram of DMA

INPUT OUTPUT CHANNELS AND PROCESSOR:

As computer systems has evolved, there is a pattern of complexity and sophistication of individual components. There are different characteristics of input/output channels for accomplishing complicated tasks. It has an ability to execute input/output instructions, which gives it complete control over input/output operations.

Some tasks are:

- Instructions are stored in main memory to be executed by a special purpose processor.
- A selector channel controls multiple high speed devices and at any time.
- The input/output channel selects one device and effects the data transfer.
- Similarly, a multiplexer channel can handle with multiple devices at the same time.
- For low speed devices a byte multiplexer accepts or transmits characters as fast as possible to multiple devices.

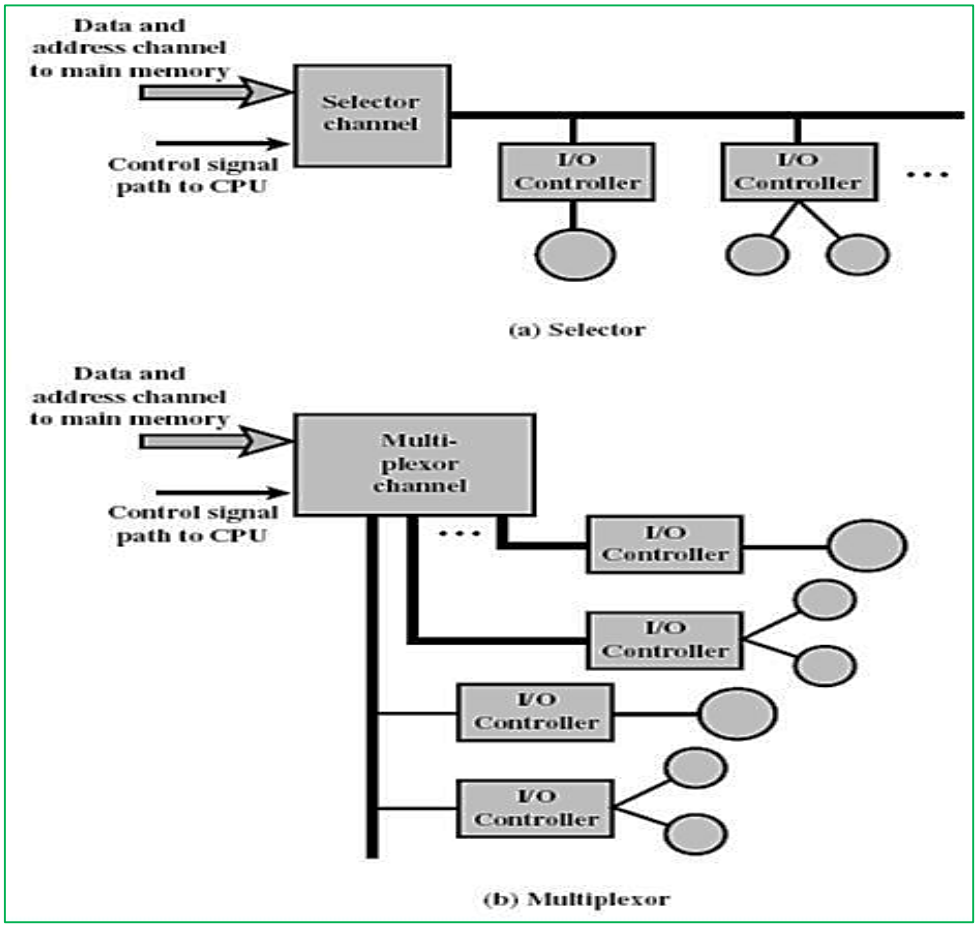


Fig: Input/output Channel Architecture