CONTENTS

PC TROUBLE SHOOTING AND MAINTENANCE

SYLLABUS

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UNIT II

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UNIT I

LESSON

1

BASIC MICROCOMPUTER SYSTEM

CONTENTS

1.0 AIMS AND OBJECTIVES

After studying this lesson, you will be able to:

- Explain the basic microcomputer system
- Discuss microprocessor subsystem
- Describe the I/O subsystem configuration
- Identify the IBM PC system
- Discuss the bus subsystem
- Explain the memory subsystem

1.1 INTRODUCTION

The basic microcomputer (Computers)! A wonderful machine! We are living in the computer age today and most of our day-to-day activities cannot be accomplished without using computers. Sometimes knowingly and sometimes unknowingly we use computers. Whether we have to withdraw money from the ATM (Automated Teller Machines retranslated as Any Time Money), publish a newsletter, drive a motorbike, design a building or even a new dress, go to a grocery shop and buy from cookies to tires for our car — all involve computer in one way or the other.

We are breathing in the computer age. Computer has become such a dire necessity of life that it is difficult to imagine life without it. Computer is affecting every sphere of our life - be it government, business, education, legal practice, entertainment, defense or home. Computer has become an indispensable tool.

Whereas super computers can forecast weather, embedded computers make smart devices like washing machines that beep when washing is complete or the automobiles that give you warning before breaking down.

In this lesson we will see the basic microcomputer system, I/O subsystem, bus subsystem, memory subsystem and the task associated with them.

1.2 THE BASIC MICROCOMPUTER SYSTEM

The smallest computers are termed as microcomputers. The CPU of a microcomputer is located on a single small chip of silicon or germanium. Such chips are known as microprocessors. It is because of this that such computers are called microcomputers.

There are a number of different types of microcomputers available today and many more are being constructed with each passing day.

A microcomputer is also referred to as personal computer. A personal computer (PC) is usually owned by single individual for personal purposes. This is why it is called personal computer or simply PC. You must have seen personal computers at many places. This is the most popular type of computer.

A few characteristics of microcomputers are listed below.

- *Size:* The size is very small compared to computers mentioned above.
- *Speed:* They are slower than computers mentioned.
- *Storage capacity:* Their storage capacity is smaller than those of computers mentioned above.
- *Cost:* They are cheapest of all the computers.
- *Number of users:* They are single-user computers.
- *Applications:* They are mostly found in offices and households.
- *Examples:* IBM PC, Apple etc.

Some of the most common microcomputers are mentioned below.

1.2.1 Desktop Microcomputers

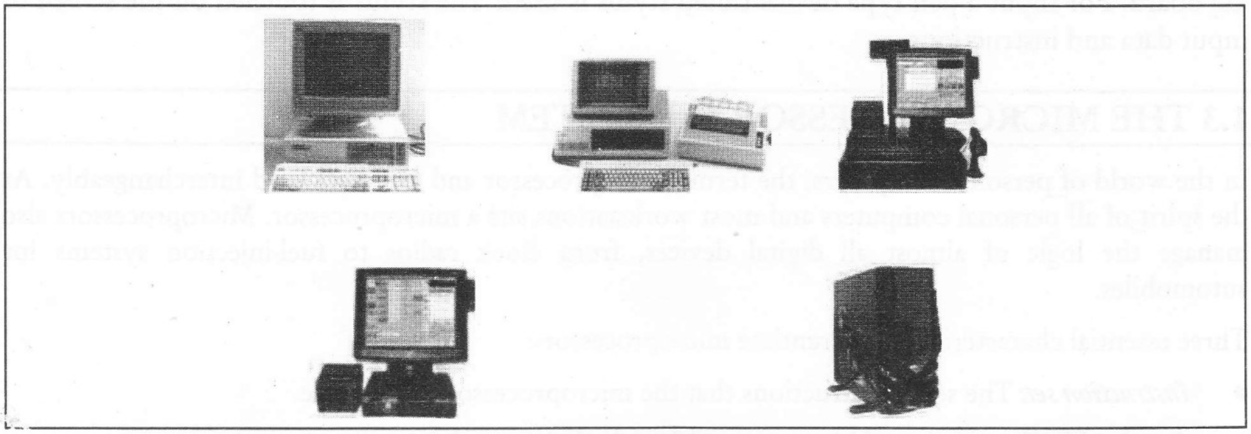


Figure 1.1: Desktop Computers

These computers must look familiar to you. These are desktop computers. They are so called because usually they are placed on the top of a table or desk.

1.2.2 Laptop Microcomputers

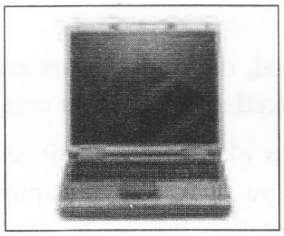


Figure 1.2: Laptop Computer

The computer shown in Figure 1.2 is a laptop computer or a notebook. Its small size enables you to carry it just like a small suitcase. You can place it on your lap and work wherever you want to sit and work. They have in-built rechargeable batteries for power supply. These computers are most suitable for sales executives and managers who have to travel a lot.

1.2.3 Palmtop Microcomputers

The computer shown in Figure 1.3 is a pocket computer. It is also called Personal Digital Assistant (PDA) or pocket computers for obvious reasons. You can carry this type of computer in your pocket.

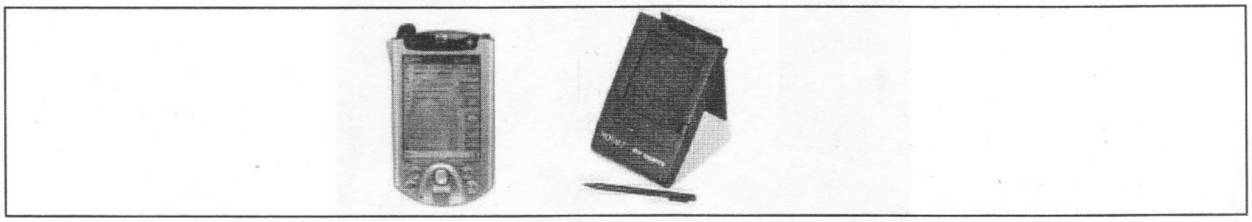


Figure 1.3: Palmtop Computer

This is a palmtop computer. It is small enough to fit onto your open palm. It does not have a keyboard. For input a pen type device called stylus is used. The stylus is touched on the screen to input data and instructions.

1.3 THE MICROPROCESSOR SUBSYSTEM

In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the spirit of all personal computers and most workstations sits a microprocessor. Microprocessors also manage the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Three essential characteristics differentiate microprocessors:

- *Instruction set:* The set of instructions that the microprocessor can execute.
- *Bandwidth:* The number of bits processed in a single instruction.
- *Clock speed:* Specified in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

In both cases, the superior the value, the more powerful the CPU. For example, a 16-bit microprocessor that runs at 50MHz is more powerful than an 8-bit microprocessor that runs at 25MHz.

In totaling to bandwidth and clock speed, microprocessors are classified as being any CISC (complex instruction set computer) or RISC (reduced instruction set computer).

The microprocessor enclose all, or most of, the Central Processing Unit (CPU) functions and is the "engine" that goes into action when you turn your computer on. A microprocessor is planned to perform arithmetic and logic operations that utilize the small number-holding areas called *registers*. Distinctive microprocessor operations comprise of adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the consequence of a set of instructions that are part of the microprocessor design.

After your computer is turned on, the microprocessor gets the first instruction from the Basic Input/Output System (BIOS) that arrive with the computer as part of its memory. After that, either the BIOS, or the operating system that BIOS loads into computer memory, or a function program is "driving" the microprocessor, giving it instructions to perform.

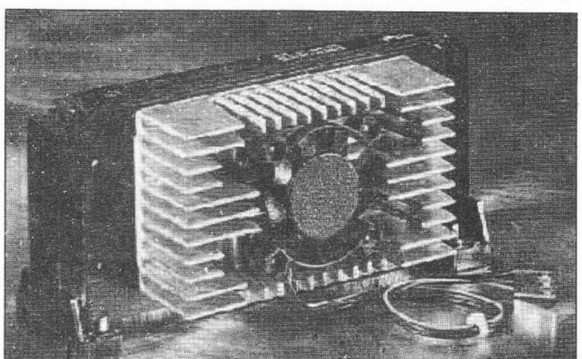


Figure 1.4: A Slot 1 Processor with Heat Sinks and a Fan

The microprocessor, (or CPU), is the mind of the computer. The Figure 1.4 shows a slot 1 processor with heat sinks and a fan, which avoid it from overheating. Figure 1.5 shows the processor without the heat sinks and fan, being introduce into a slot 1 motherboard connection. Slot 1 processors have the microprocessor and level 2 cache memory mounted on a circuit board, (or card), which is enclosed inside of a defensive shell.

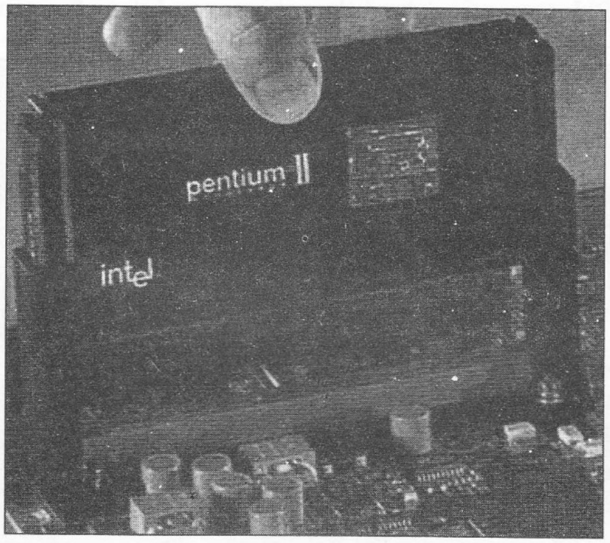


Figure 1.5: The Processor without the Heat Sinks and Fan

The surrounded slot 1 processor card enclose the central processing unit, (or CPU), with its level 1 cache memory. The central processing unit also contains the control unit and the arithmetic/logic unit, both working mutually as a team to process the computer's commands. The control unit controls the flow of events within the processor. It obtains instructions from memory and decodes them into commands that the computer can understand. The arithmetic/logic unit handles all of the math calculations and logical assessment. It takes the commands from the control unit and executes them, accumulate the results back into memory. These 4 steps, (fetch, decode, execute, and store), are known as the "machine cycle" of a computer. These 4 basic steps are how the computer runs each and every program. The microprocessor's level 1 cache memory is memory that is contained within the CPU itself. It stores the most often used instructions and data. The CPU can access the cache memory much earlier than having to access the RAM, (or Random Access Memory). Figure 1.6 shows the picture of Pentium 3 processor. The control unit, arithmetic/logic unit, and level 1 cache are controlled within the center CPU chip. Level 2 cache memory is noticeable on the right-hand side of the processor card.

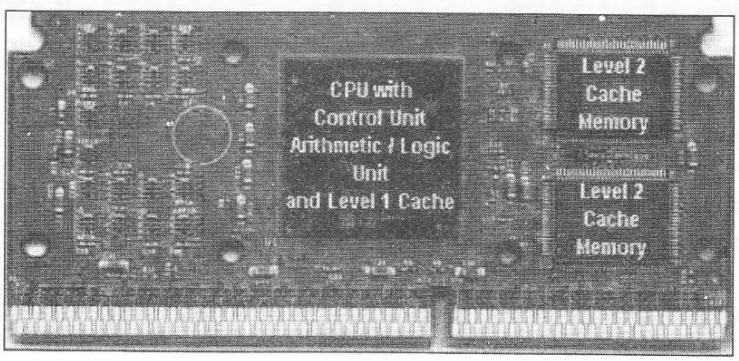


Figure 1.6: Pentium 3 Processor

Level 1 cache memory is memory that is built-in inside of the CPU itself. It is typically smaller and faster than level 2 cache memory. Level 2 cache memory is memory among the RAM and CPU. It is used when the level 1 cache memory is full or is too small to clutch the intended data. The Figure 1.6 shows level 2 cache memory on the processor card, beside the CPU. Figure 1.7 shows the two CPU. The figure on the bottom is a view of the CPU chip from the outside. The figure on the top is a large map of the inside of the CPU, presenting the different areas and their function.

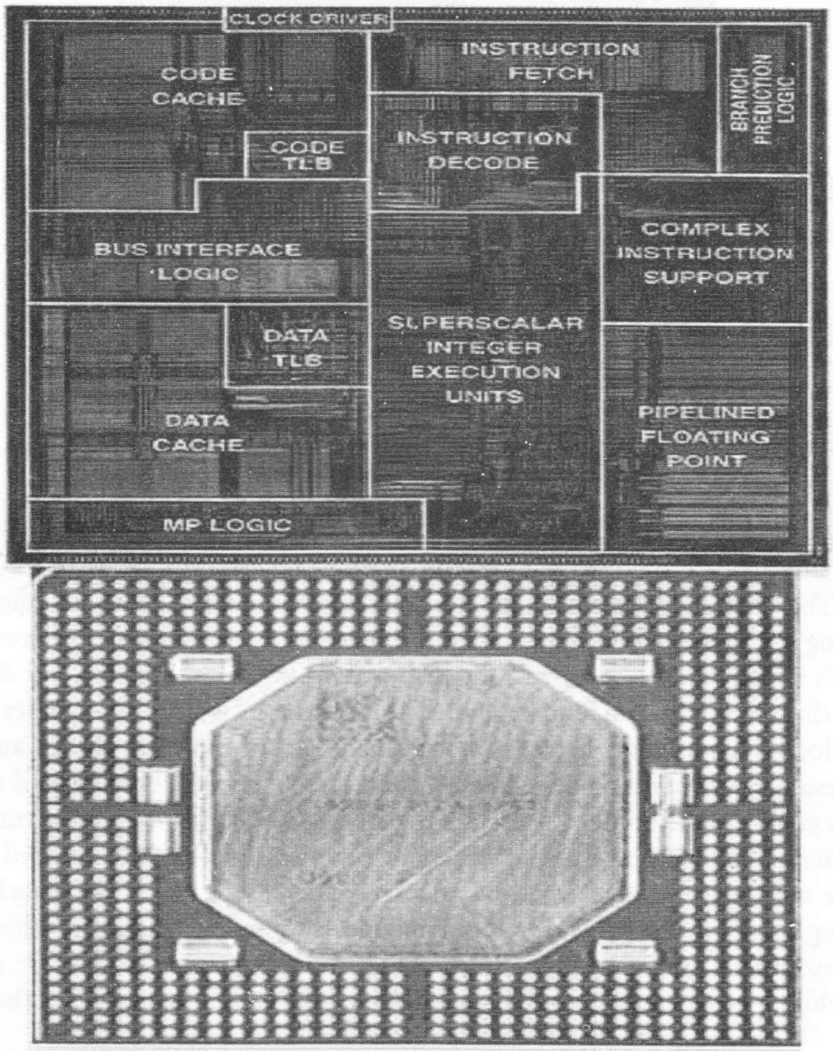


Figure 1.7: CPU

At the top of the Figure 1.7 you can also see the clock driver. The clock driver sets the pace, for the computer. CPUs are rated according to the speed of the clock. Each machine cycle consists of two beats. With each beat the control unit fetches and decodes data, which is called the "instruction cycle." At the same time the arithmetic/logic unit executes and stores data, which is called the "execution cycle." The speed of a clock is rated by how many beats per second it can achieve. 1 billion beats per second is referred to as 1 GHz. For every beat, (except the very first), a machine cycle is finished. Common CPUs are obtainable today perform at 3 GHz and faster. This means that a 3 GHz CPU can execute 3,000,000,000 instructions in a single second!

1.4 I/O SUBSYSTEM CONFIGURATION

Input-output interface gives a method for transferring information between internal memory and I/O devices. Peripherals connected to a computer require special communication links for interfacing them with the central processing unit. The purpose of the communication link is to resolve the differences that exist between the central computer and each peripheral.

The major differences are:

1. Peripherals are electromechanical and electromagnetic devices and their manner of operation is different from the operation of the CPU and memory, which are electronic devices. Therefore a conversion of signal values may be required.
2. The data transfer rate of peripherals is usually slower than the transfer rate of the CPU.
3. Data codes and formats in peripherals differ from the word format in the CPU and memory.
4. The operating modes of peripherals are different from each other.

1.4.1 I/O Bus and Interface Modules

A communication link between the processor and several peripherals is represented the following Figure 1.8. The I/O bus is made of data lines, address lines and control lines. The magnetic disk, printer and terminal are used in any general-purpose computer. The magnetic tape is used in computers for backup storage. Each peripheral device associated with it by interface unit. Each interface decodes the address and control received from the I/O bus, interprets them for the peripheral and provides signals for the peripheral controller. It also synchronizes the data flow and supervises the transfer between peripheral and processor. Each peripheral has its own controller that operates the particular electromechanical device. For example, the printer controller controls the paper motion, the print timing and the selection of printing characters. A controller may be housed separately or may be physically integrated with the peripheral. The I/O bus from the processor is attached to all peripheral interfaces. To communicate with a particular device, the processor places a device address on the address lines. Each interface attached to the I/O bus contains an address decoder that monitors the address lines. When the interface detects its own address, it activates the path between the bus lines and the device that it controls. All peripherals whose address does not correspond to the address in the bus are disabled by their interface.

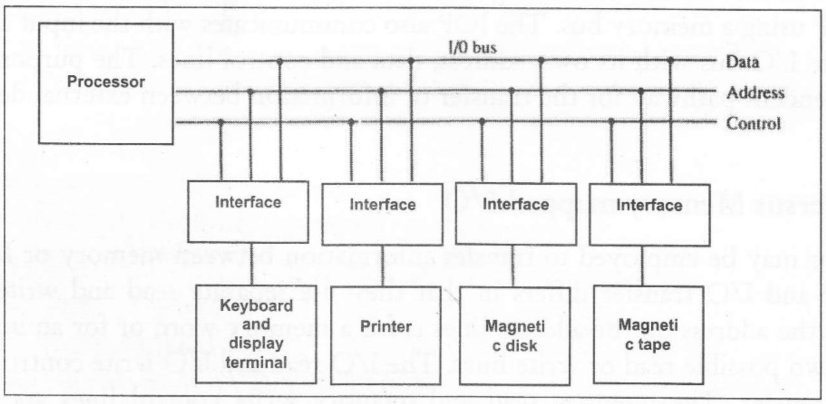


Figure 1.8: Connection of I/O Bus to Input-Output Devices

The address is made available in the address lines and the processor provides a function code in the control lines. The interface selected responds to the function code and proceeds to execute it. The function code is referred to as an I/O command and is in essence an instruction that is executed in the interface and is attached in the peripheral unit. The interpretation of the command depends on the peripheral that the processor is addressing. There are four types of commands that an interface may receive. They are classified as control, status, data output and data input.

We issue a control command to activate the peripheral. The particular control command issued depends on the peripheral. Each peripheral receives its own distinguished sequence of control commands, depending on its mode of operation.

We use a status command to test various status conditions in the interface and the peripheral. For example, the computer may wish to check the status of the peripheral before a transfer is initiated. During the transfer, one or more errors may occur which are detected by the interface.

A data output command causes the interface to respond by transferring data from the bus into one of its registers. Consider an example with a tape unit. The computer starts the tape moving by issuing a control command. Now the processor monitors the status of the tape by means of a status command.

By giving the data input command the interface receives an item of data from the peripheral and places it in its buffer register. The processor checks if data are available by means of a status command and then issues a data input command. The interface places the data on the data lines, and the processor accepts data.

1.4.2 I/O versus Memory Bus

To communicate with I/O, the processor must communicate with the memory unit. The memory bus contains data, address and read/write control lines. There are three ways to use computer buses to communicate with memory and I/O:

1. Use two separate buses, one for the memory and the other for I/O.
2. Use one common bus for both memory and I/O but have separate control lines for each.
3. Use one common bus for memory and I/O with common control lines.

In the first method, the computer has independent sets of data, address and control buses, one for accessing memory and the other for I/O. This is done in computers having a separate I/O Processor (IOP) in addition to the Central Processing Unit (CPU). The memory communicates with both the CPU and the IOP using a memory bus. The IOP also communicates with the input and output devices through a separate I/O bus with its own address, data and control lines. The purpose of the IOP is to provide an independent pathway for the transfer of information between external devices and internal memory.

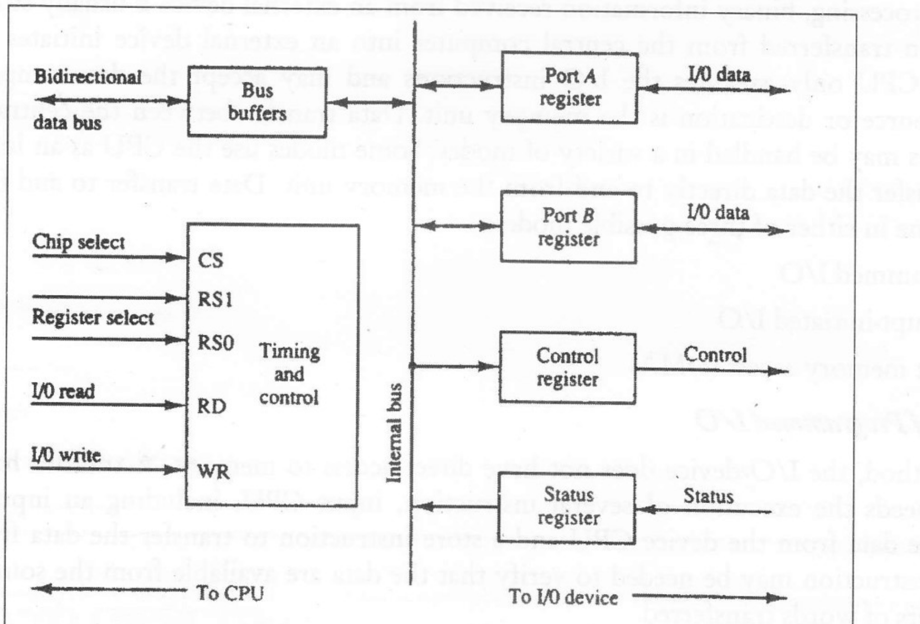
1.4.3 Isolated versus Memory-mapped I/O

One common bus may be employed to transfer information between memory or I/O and the CPU. Memory transfer and I/O transfer differs in that they use separate read and write lines. The CPU specifies whether the address on the address lines is for a memory word or for an interface register by enabling one of two possible read or write lines. The I/O read and I/O write control lines are enabled during an I/O transfer. The memory read and memory write control lines are enabled during a memory transfer. This configuration isolates all I/O interface addresses from the addresses assigned to memory and is referred to as the isolated I/O method for assigning addresses in a common bus.

Example of I/O Interface

Figure 1.9 shows an example of an I/O interface unit is shown in block diagram. It has two data registers called ports, a control register, a status register, bus buffers, and timing and control circuits. The interface communicates with the CPU through the data bus. The chip select and register select inputs determine the address assigned to the interface. The I/O read and write are two control lines that specify an input or output, respectively. The four registers communicate directly with the I/O device attached to the interface.

The input-output data to and from the device can be transferred into either port A or port B. The interface may operate with an output device or with an input device, or with a device that requires both input and output. If the interface is connected to a printer, it will only output data, and if it services a character reader, it will only input data. A magnetic disk unit is used to transfer data in both directions but not at the same time, so the interface can use bi-directional lines. A command is passed to the I/O device by sending a word to the appropriate interface register. In a system like this, the function code in the I/O bus is not needed because control is sent to the control register, status information is received from the status register, and data are transferred to and from ports A and B registers. Thus the transfer of data, control, and status information is always via the common data bus. The distinction between data, control, r status information is determined from the particular interface register with which the CPU communicates.



CS	RS1	RS0	Register selected
0	×	×	None: data bus in high-impedance
1	0	0	Port *A* register
1	0	1	Port *B* register
1	1	0	Control register
1	1	1	Status register

Figure 1.9: Example of I/O Interface Unit

The control register gets control information from the CPU. By loading appropriate bits into the control register, the interface and the I/O device attached to it can be placed in a variety of operating modes. For example, port A may be defined as an input port and port B as an output port, A magnetic tape unit may be instructed to rewind the tape or to start the tape moving in the forward direction. The bits in the status register are used for status conditions and for recording errors that may occur during the data transfer. For example, a status bit may indicate that port-A has received a new data item from the I/O device.

The interface registers uses bi-directional data bus to communicate with the CPU. The address bus selects the interface unit through the chip select and the two register select inputs. A circuit must be provided externally (usually, a decoder) to detect the address assigned to the interface registers. This circuit enables the Chip Select (CS) input to select the address bus. The two register select-inputs RSl and RSO are usually connected to the two least significant lines of the address bus. Those two inputs select on of the four registers in the interface as specified in the table accompanying the diagram. The content of the selected register is transfer into the CPU via the data bus when the I/O read signal is ended. The CPU transfers binary information into the selected register via the data bus when the I/O write input is enabled.

1.4.4 Mode of Transfer

For later processing, binary information received from an external device is usually stored in memory. Information transferred from the central computer into an external device initiates in the memory unit. The CPU only executes the I/O instructions and may accept the data temporarily, but the ultimate source or destination is the memory unit. Data transfer between the central computer and I/O devices may be handled in a variety of modes. Some modes use the CPU as an intermediate path; others transfer the data directly to and from the memory unit. Data transfer to and from peripherals may be done in either of three possible modes:

1. Programmed I/O
2. Interrupt-initiated I/O
3. Direct memory access (DMA)

Example of Programmed I/O

In this method, the I/O device does not have direct access to memory. A transfer has I/O device to memory needs the execution of several instruction, input CPU, including an input instruction to transfer the data from the device CPU and a store instruction to transfer the data from the CPU to memory instruction may be needed to verify that the data are available from the source and to count the numbers of words transferred.

Figure 1.11 shows data transfer from an I/O device through an interface into the CPU. The device transfers bytes of data one at a time, as they are available. When a byte of data is available, thedevice places it in the I/O bus and enables its data valid line. The interface accepts the byte into its data register and enables the data accepted line. The interface sets a bit in the status register that we will refer to as a "flag" bit. The device can now disable the data valid line, but it will not transfer another byte until the data accepted line is disabled. This is according to the handshaking procedure established in Figure 1.10

A program is written to check the flag in the status register to determine if a byte has been placed in the data register by the I/O device. This can be done by reading the status register into a CPU register and checking the value of the flag bit. If the flag is equal to 1, the CPU reads the data from the data register. The flag-bit is then cleared to 0 by either the CPU or by the interface, depending on how the interface circuits are designed. Once the flag is cleared, the interface disables the data accepted line and the device can then transfer the next data byte. A flowchart of the program is shown in Figure 1.11 It is assumed that the device is sending a sequence of bytes that must be stored in memory. The transfer of each byte needs three instructions:

1. Read the status register.
2. Check the status of the flag bit and branch to step I if not set or to step if set.
3. Read the data register.

A CPU register read each byte and then transferred to memory with a store instruction. I/O programming task is to transfer a block of words from an I/O device and store them in a memorybuffer.

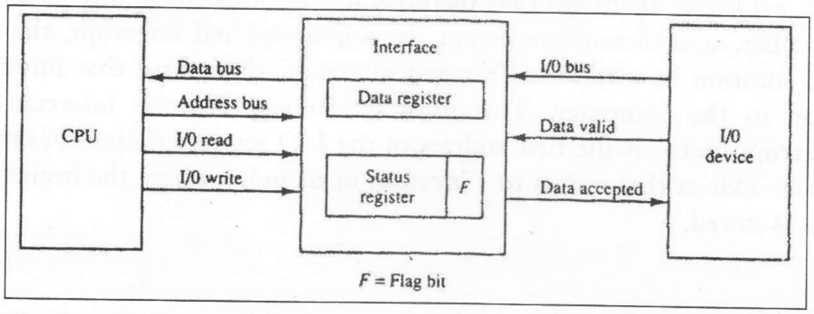


Figure 1.10: Data Transfer from I/O Device to CPU

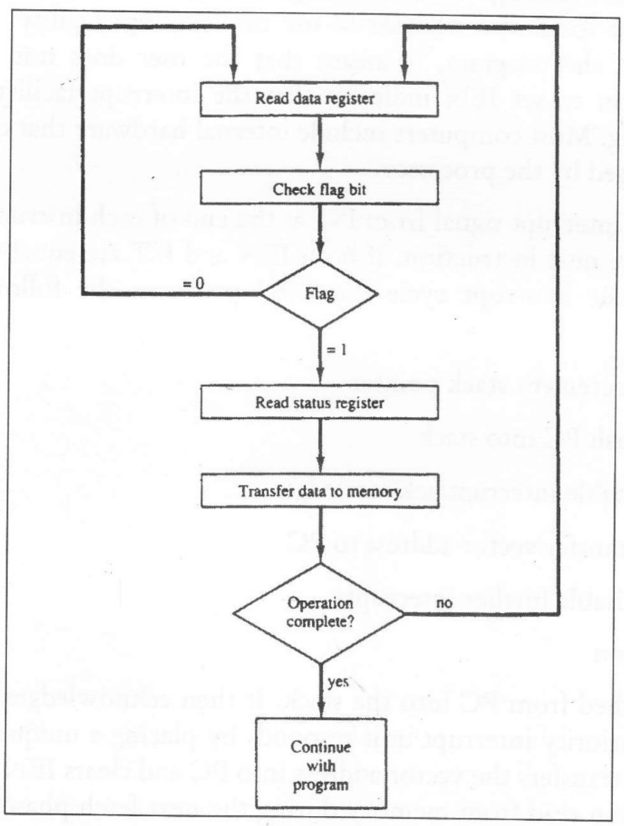


Figure 1.11: Flowchart for CPU Program to Input Data

This method is used in small low-speed computers or in systems that are dedicated to monitor a device continuously. The difference in information transfer rate between the CPU and the I/O device makes this type of transfer inefficient. Another way of constantly monitoring the flag is to let the interface inform the computer when it is ready to transfer data. This mode of transfer uses the interrupt facility. While the CPU is running a program, it does not check the flag. However, when the flag is set, the computer is momentarily interrupted from proceeding with the current program and is informed of the fact that the flag has been set. The CPU deviates from what it is doing to take care of the input or output transfer.

The CPU responds to the interrupt signal by storing the return address from the program counter into a memory stack and then control branches to a service routine that processes the required I/O transfer. The way that the processor chooses the branch address of the service routine varies from one unit to another. In principle, there are two methods for accomplishing this. One is called vectored interrupt and the other, non-vectored interrupt. In a non-vectored interrupt, the branch address is assigned to a fixed location in memory. Vectored interrupt, the source that interrupts supplies the branch information to the computer. This information is called the interrupt vector. In some computers the interrupt vector is the first address of the I/O service routine. In other computers the interrupt vector is an address that points to a location in memory where the beginning address of the I/O service routine is stored.

Interrupt Cycle

The interrupt makes flip-flop IEN so that can be set or cleared by program instructions. When IEN is cleared, the interrupt request coming from 1ST is neglected by the CPU. The program-controlled IEN bit allows the programmer to choose whether to use the interrupt facility. If an instruction to clear IEN has been inserted in the program, it means that the user does not want his program to be interrupted. An instruction to set IEN indicates that the interrupt facility will be used while the current program is running. Most computers include internal hardware that clears IEN to 0 every time an interrupt is acknowledged by the processor.

CPU checks IEN and the interrupt signal from IST at the end of each instruction cycle the. If either 0, control continues with the next instruction. If both IEN and IST are equal to 1, the CPU goes to an interrupt cycle. During the interrupt cycle the CPU performs the following sequence of micro-operations:

SP← SP – 1	Decrement stack pointer
M [SP] ←PC	Push PC into stack
INTACK ←1	Enable interrupt acknowledge
PC←VAD	Transfer vector address to PC
IEN←0	Disable further interrupts

Go to fetch next instruction

The return address is pushed from PC into the stack. It then acknowledges the interrupt by enabling the INTACK line. The priority interrupt unit responds by placing a unique interrupt vector into the CPU data bus. The CPU transfers the vector address into PC and clears IEN prior to going to the next fetch phase. The instruction read from memory during the next fetch phase will be the one located at the vector address.

Direct Memory Access (DMA)

We can transfer data direct to and from memory without the need of the CPU. The transfer of data between a fast storage device such as magnetic disk and memory is often limited by the speed of the CPU. Removing the CPU from the path and letting the peripheral device manager the memory buses directly would improve the speed of transfer. This transfer technique is called Direct Memory Access (DMA). During DMA transfer, the CPU is idle and has no control of the memory buses. A DMA controller takes over the buses to manage the transfer directly between the I/O device and memory.

The CPU may be in an idle state in a variety of ways. One common method extensively used in microprocessors is to disable the buses through special control signals. Figure 1.12 shows two control signals in the CPU that facilitate the DMA transfer. The bus-request-input (BR) is used by the DMA controller to request the CPU to relinquish control of the buses. When this input is active, the CPU terminates the execution of the current instruction and places the address bus, the data bus, and the read and write lines into a high-impedance state. The high-impedance state behaves like an open circuit, which means that the output is disconnected and does not have logic significance. The CPU activates the bus-grant-output (BG) to inform the external DMA that the buses are in the high-impedance state. The DMA that originated the bus request can now take control of the buses to conduct memory transfers without processor intervention. When the DMA terminate the transfer, it disables the bus request line. The CPU disables the bus grant, takes control of the buses, and returns to its normal operation.

DMA communicates directly with the memory, when it takes control of the bus system,. We can transfer in several ways. In DMA burst transfer, a block sequence consisting of a number of memory words is transferred in a continuous burst while the DMA controller is master of the memory buses. This mode of transfer is needed for fast devices such as magnetic disks where data transmission cannot be stopped or slowed down until an entire block is transferred. An alternative technique called cycle stealing allows the DMA controller to transfer one data word at a time, after which it must return control of the buses to the CPU. The CPU merely delays its operation for one memory cycle to allow the direct memory I/O transfer to "steal" one memory cycle.

DMA Controller

The DMA controller requires the usual circuits of an interface to communicate with the CPU and an I/O device. It also needs an address register, and count register, and a set of address lines. The address register and address line are used for direct communication with the memory. The word count register specifies the number of words that must be transferred. The data transfer may be done directly between the device and memory under control of the DMA.

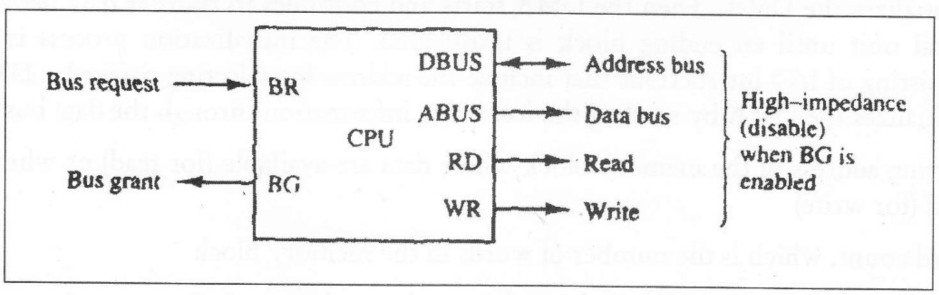


Figure 1.12: CPU Bus Signals for DMA Transfer

Figure 1.13 shows a DMA controller. The unit can communicate with the CPU via the data bus and control lines. The registers in the DMA are selected by the CPU through the address bus by enabling the DS (DMA select) and RS (register select) inputs. The RD (read) and WR (write) inputs are bi-directional. When the BG (bus grant) input is 0, the CPU can communicate with the DMA registers through the data bus to read from or write to the DMA registers. When BG = 1, the CPU has relinquished the buses and the DMA can communicate directly with the memory by specifying an address in the address bus and activating the RD or WR control. The DMA communicates with the external peripheral through the request and acknowledge lines by using a prescribed handshaking procedure.

The DMA controller consists of three registers namely an address register, a word count register, and a control register. The address register contains an address to specify the desired location in memory. The address bits go through bus buffers into the address bus. The address register is incremented after each word that is transferred to memory. The word count register holds the number of words to be transferred. This register is decremented by one after each word transfer and internally tested for zero. The control register specifies the mode of transfer. All registers in the DMA appear to the CPU as I/O interface registers. Thus the CPU can read from or write into the DMA registers under program control via the data bus.

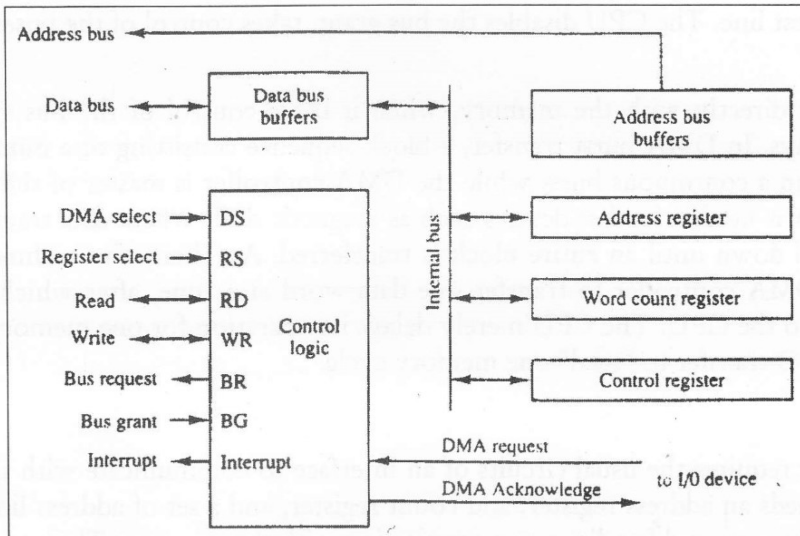


Figure 1.13: Block Diagram of DMA Controller

CPU first initializes the DMA. Then the DMA starts and continues to transfer data between memory and peripheral unit until an ending block is transferred. The initialization process is essentially a program consisting of I/O instructions that include the address for selecting particular DMA registers. The CPU initializes the DMA by sending the following information through the data bus:

1. The starting address of the memory block where data are available (for read) or where data are to be stored (for write)
2. The word count, which is the number of words in the memory block
3. Control to specify the mode of transfer such as read or write
4. A control to start the DMA transfer.

The starting address is stored in the address register. The word count is stored in the word count register, and the control information in the control register.

DMA Transfer

Figure 1.14 shows the position of the DMA controller among the other components in a computer system. The CPU communicates with the DMA through the address and data buses as with any interface unit. The DMA has its own address, which activates the DS and RS lines. The CPU initializes the DMA through the data bus. Once the DMA receives the start control command, it can start the transfer between the peripheral device and the memory.

The DMA controller activates the BR line, when the peripheral device sends a DMA request, informing the CPU to relinquish the buses. The CPU responds with its BG line, informing the DMA that its buses are disabled. The DMA then puts the current value of its address register into the address bus, initiates the RD or WR signal, and sends a DMA acknowledge to the peripheral device. Note that the RD and WR lines in the DMA controller are bi-directional. The direction of transfer depends on the status of the BG line. When BG =0, the RD and WR are input lines allowing the CPU to communicate with the internal DMA registers. When BG = 1, the RD and WR are output lines from the DMA controller to the random-access memory to specify the read or write operation for the data.

When the peripheral device gets a DMA acknowledge, it puts a word in the data bus (for write) or receives a word from the data bus (for read). Thus the DMA controls the read or write operations and supplies the address for the memory. The peripheral unit can then communicate with memory through the data bus for direct transfer between the two units while the CPU is momentarily disabled.

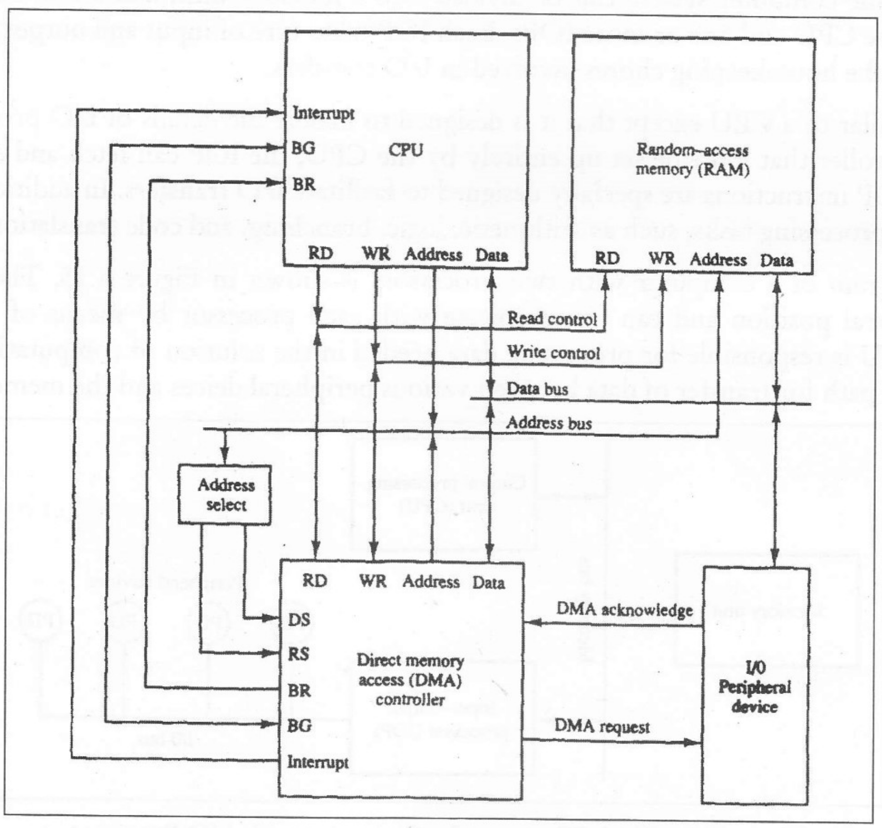


Figure 1.14; DMA Transfer in a Computer System

The DMA increments its address-register and decrements its word count-register, for each word that is transferred. If the word count does not reach zero, the DMA checks the request line coming from the peripheral. For high-speed device, the line will be active as soon as the previous transfer completed. A second transfer is then initiated, and the process continues until the entire block is transferred. If the peripheral speed is slower, the DMA request line may come somewhat later. In this case the DMA disables the bus request line so that the CPU can continue to execute its program. When the peripheral requests a transfer, the DMA requests the buses again.

If the word count register reaches zero, the DMA stops any further transfer and removes its bus request. It also informs the CPU of the termination by means of an interrupt. When the CPU responds to the interrupt, it reads the content of the word count register. The zero value of this register indicates that all the words were transferred successfully. The CPU can read this register at any time to check the number of words already transferred.

DMA transfer is very useful. It is used for fast transfer of information between magnetic disks and memory. It is also useful for updating the display of the terminal is kept in memory, which can be updated under program control.

1.4.5 Input-Output Processor (IOP)

A computer may incorporate one or more external processors and assign them the task of communicating directly with all I/O devices. An Input-Output Processor (IOP) may be classified as a processor with direct memory access capability that communicates with I/O devices. In this configuration, the computer system can be divided into a memory unit, and a number of processors comprised of the CPU and one or more IOPs. Each IOP takes care of input and output tasks, relieving the CPU from the housekeeping chores involved in I/O transfers.

The IOP is similar to a CPU except that it is designed to handle the details of I/O processing. Unlike the DMA controller that must be set up entirely by the CPU, the IOP can fetch and execute its own instructions. IOP instructions are specially designed to facilitate I/O transfers. In addition, the IOP can perform other processing tasks, such as arithmetic, logic, branching, and code translation.

The block diagram of a computer with two processors is shown in Figure 1.15. The memory unit occupies a central position and can communicate with each processor by means of direct memory access. The CPU is responsible for processing data needed in the solution of computational tasks. The IOP provides a path for transfer of data between various peripheral deices and the memory unit.

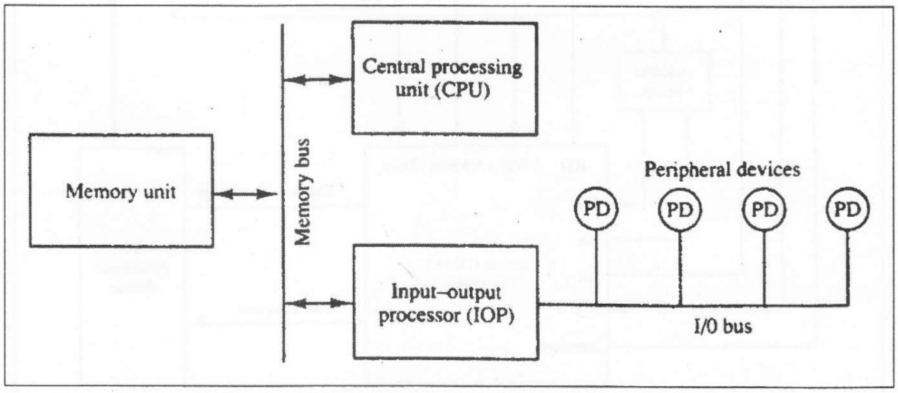


Figure 1.15: Block Diagram of a Computer with I/O Processor

The data formats of peripheral devices differ from memory and CPU data formats. The IOP must structure data words from many different sources. For example, it may be necessary to take four bytes from an input device and pack them into one 32-bit word before the transfer to memory. Data are gathered in the IOP at the device rate and bit capacity while the CPU is executing its own program. After the input data are assembled into a memory word, they are transferred from IOP directly into memory by "stealing" one memory cycle from the CPU. Similarly, an output word transferred from memory to the IOP is directed from the IOP to the output device at the device rate and bit capacity.

The communication between the IOP and the devices attached to it is similar to the program control method of transfer. The way by which the CPU and IOP communicate depends on the level of sophistication included in the system. In most computer systems, the CPU is the master while the IOP is a slave processor. The CPU is assigned the task of initiating all operations, but I/O instructions are execute in the IOP. CPU instructions provide operations to start an I/O transfer and also to test I/O status conditions needed for making decisions on various I/O activities. The IOP, in turn, typically asks for CPU attention by means of an interrupt. It also responds to CPU requests by placing a status word in a prescribed location in memory to be examined later by a CPU program. When an I/O operation is desired, the CPU informs the IOP where to find the I/O program and then leaves the transfer details to the IOP.

1.4.6 CPU-IOP Communication

There are many form of the communication between CPU and IOP. These are depending on the particular computer considered. In most cases the memory unit acts as a message center where each processor leaves information for the other. To appreciate the operation of a typical IOP, we will illustrate by a specific example the method by which the CPU and IOP communicate. This is a simplified example that omits many operating details in order to provide an overview of basic concepts.

The sequence of operations may be carried out as shown in the flowchart of Figure 1.16. The CPU sends an instruction to test the IOP path. The IOP responds by inserting a status word in memory for the CPU to check. The bits of the status word indicate the condition of the IOP and I/O device, such as IOP overload condition, device busy with another transfer, or device ready for I/O transfer. The CPU refers to the status word in memory to decide what to do next. If all is in order, the CPU sends the instruction to start I/O transfer. The memory address received with this instruction tells the IOP where to find its program.

The CPU can now continue with another program while the IOP is busy with the I/O program. Both programs refer to memory by means of DMA transfer. When the IOP terminates the execution of its program, it sends an interrupt request to the CPU. The CPU responds to the interrupt by issuing an instruction to read the status from the IOP. The IOP responds by placing the contents of its status report into a specified memory location.

The IOP takes care of all data transfers between several I/O units and the memory while the CPU is processing another program. The IOP and CPU are competing for the use of memory, so the number of devices that can be in operation is limited by the access time of the memory.

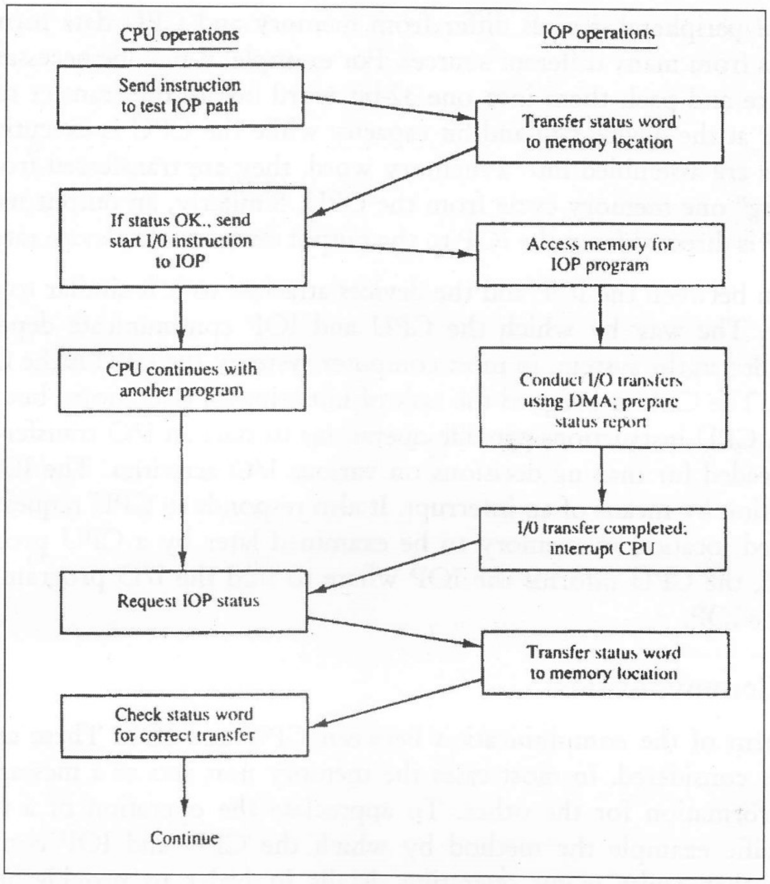


Figure 1.16: CPU-IOP Communication

Check Your Progress

Fill in the blanks:

1. The totality of all the physical parts that are tangible (i.e., which can be seen and touched) is referred to as ....
2. Microprocessors also control the logic of almost all .... devices, from clock radios to fuel-injection systems for automobiles.
3. Input-output interface gives a method for .... information between internal memory and I/O devices.
4. To .... with I/O, the processor must communicate with the memory unit.

1.5 LET US SUM UP

Broadly speaking, computer can be said to be made up of hardware and software. The totality of all the physical parts that are tangible (i.e., which can be seen and touched) is referred to as hardware. Software is the collection of all the instructions that makes the computer hardware produces the desired result. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles. Input-output interface gives a method for transferring information between internal memory and I/O devices. Peripherals connected to a computer require special communication links for interfacing them with the central processing unit.

1.6 KEYWORDS

IPOS: Input Processing Output Storage

IOP: Input Output Processor

CPU: Central Processing Unit

DMA: Direct Memory Access

1.7 QUESTIONS FOR DISCUSSION

1. List four peripheral devices that produce an acceptable output for a person to understand.
2. What is the difference between isolated I/O and memory mapped I/O? What are the advantages and disadvantages of each?
3. What is the need of I/O processor? Give block diagram of CPU with I/O processor.
4. What is the advantage of using interrupt - initiated data transfer over transfer under program control without an interrupt?
5. How does DMA enhance memory access operations?

Check Your Progress: Model Answers

1. Hardware
2. Digital
3. Transferring
4. Communicate

1.8 SUGGESTED READINGS

William Stallings, *Computer Organization and Architecture*, 6th edition, Pearson Education, 2002.

A.S.Tannenbaum, *Structured Computer Organization*: Prentice-Hall of India, 1999.

R. P. Beales, *PC Systems, Installation and Maintenance*, Second Edition.

Ron Gilster, *PC Upgrade and Repair Black Book.*

Peter Norton's, *Inside the PC.*

LESSON

2

THE IBM PC SYSTEM

CONTENTS

2.0 AIMS AND OBJECTIVES

After studying this lesson, you will be able to:

- Explain the IBM PC system
- Discuss the bus subsystem
- Describe the significance memory subsystem

2.1 INTRODUCTION

The IBM Personal Computer, normally known as the IBM PC, is the unique version of the IBM PC compatible hardware platform. It is IBM model number 5150, and was initiated on August 12, 1981. It was produced by a team of engineers and designers under the direction of Don Estridge of the IBM Entry Systems Division in Boca Raton, Florida.

In this lesson we will learn the IBM PC, the bus subsystem and memory subsystem.

2.2 INSIDE THE IBM PC SYSTEM

Earlier than 1980s computers were obtainable only to large business enterprise and organizations. Due to high cost and less user-friendliness computers were not popular with common man.

Though, in the year 1981 IBM manufactured personal computers and nowadays they are found everywhere. Later on many companies started manufacturing the IBM design. These computers are recognized as IBM compatibles or PC clones.

IBM proposes the PCs. Microprocessor chip itself is manufactured by Intel amongst many other companies. The initial microprocessor chip used in PCs was Intel's 8088. As many microprocessors have been designed each more powerful than the previous ones. It has taken around 25 years for this development. The list of the microprocessors that Intel manufactured has been given below.

- *Intel 8088:* This was the primary microprocessor to be used in a computer. It had 8-bit word-size.
- *Intel 8086:* This microprocessor is alike to 8088 except that it has 16-bit word-size.
- *Intel 80186:* IBM used these chips as embedded computers in other machines.
- *Intel 80286:* IBM employs this chip in AT (advanced technology) computers.
- *Intel 80386:* This was the first accurate 32-bit processor used on the PC platform. It was modified into many other close such as 80386SX and 80386DX. The 80386SX chip was used in the first little notebook computers.
- *Intel 80486:* This processor was much faster and powerful than all the previous microprocessors. Other clones of this chip are – 80486SX-, 80486DX-50, 486DX2-66 etc.

Pentium chip was launched in 1995. It is a 64-bit microprocessor. It is approximately equivalent to two 80486 processors in capability and performance. Other duplicate of this chip are - Pentium MMX, Pentium-Pro, Pentium-II, Pentium-III, Pentium-IV and Pentium-V.

Beside "microcomputer" and "home computer", the term "personal computer" was already in use before 1981. It was used as early as 1972 to distinguish Xerox PARC's Alto. However, because of the achievement of the IBM Personal Computer, the term PC came to mean more purposely a microcomputer compatible with IBM's PC products.

Built into the unique IBM PC ROM (Read Only Memory) was its POST (Power on Self Test), BIOS (Basic Input Output System) and the BASIC program language. This was an absolute built in operating system that allows the user to write, save, load, print and run BASIC programs. It maintained loading and saving programs from diskette and cassette tape, keyboard input, video display, printing, and ASYNC communications. The POST and BIOS code was written by IBM and the BASIC predictor was provided by Microsoft.

The next operating system was provided by Microsoft and of course was DOS (Disk Operating System). As there was a DOS version 1.0 supplied by Microsoft, it was so full of bugs that clients did not see it. The first real release was DOS version 1.1 that offers the basic A:\ prompt still used today.

There were further OS's available soon after the IBM PC came out, like Digital Research's DR DOS, but these were not used by many customers.

The achievement of the IBM computer led other companies to develop IBM Compatibles, which in turn led to brandings like diskettes being in IBM format, or systems irritable about no ROM-BASIC on booting. In spirit, during the immensity of the 1980s and early 1990s, the main machines that were talked about in the press and in how-to guides, were IBM ones.

To a great scope one could build an IBM clone with off-the-shelf parts, but the BIOS required some reverse-engineering. Corporation like American Megatrends, Award, and others achieved workable replica of this, allowing companies like DELL, Compaq, HP et al, to produce PCs that worked like IBM ones. These did not have a ROM-BASIC, so when ROM-Basic was probable to load in the absence of a boot device, a message might appear saying no ROM BASIC was found.

Figure 2.1: IBM PC System

The IBM Micro Channel Architecture [MCA] bus was launched around 1987 working on the Intel 286 processor, then shortly on the 386 series of processors within the IBM PS2 series of computers. The MCA bus was an IBM proprietary interface. The MCA (Micro Channel Architecture) bus was used as a PC development bus, allowing expansion cards to be plugged into MCA slots on the Mother Board. The MCA bus is outdated; running at a 10MHz bus speed using whichever a 16 or 32 bit wide data bus. With bus improves the speed reaches to 80MBps, using clock doubling. The MCI bus only emerges on IBM PS2 series of computers which have been off the market for many years now.

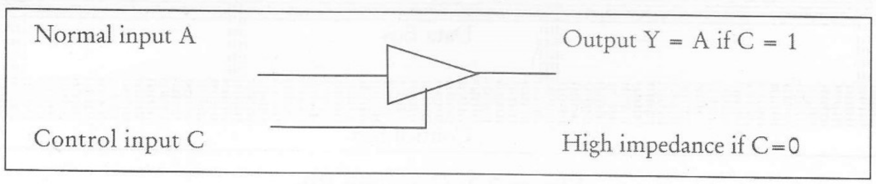
The MCA bus was not backwards compatible with the unique ISA bus, and was only formed by IBM; though the proprietary MCA bus was licensed to a few other companies. The MCA bus was in opposition with the EISA bus, but was rendered obsolete by the introduction of the PCI bus. The MCA interface is outdated and should not be used for new designs. However, legacy systems may still include MCA boards.

2.3 THE BUS SUBSYSTEM

A typical digital computer has many registers and paths must be provided to transfer information from one register to another. The number of wires will be excessive if separate lines are used between each register and all other registers in the system. A more efficient scheme for transferring information between registers in a multiple-register configuration is a common bus system. A bus structure consists of a set of common lines, one for each bit of a register, through which binary information is transferred one at a time. Control signals determine which register is selected by the bus during each particular register transfer.

One way of constructing a common bus system is with multiplexers. The multiplexers select the source register whose binary information is then placed on the bus. In general, a bus system will multiplex registers of a bit each to produce an n-line common bus. The number of multiplexers needed to construct the bus is equal to n, the number of bits in each register. The size of each multiplexer must be $K \times 1$ since it multiplexes k data lines. A bus system can be constructed with 'three-state gates' instead of multiplexers. A three-state gate is a digital circuit that exhibits three states. Two of the states are signals equivalent to logic 1 and 0 as in a conventional gate. The third state is a high impedance state. The high-impedance state behaves like an open circuit, which means that the output is disconnected and does not have logic significance. The one most commonly used in the design of a bus system is the buffer gate.

The graphic symbol of a three state buffer gate is shown in Figure 5.1. The control input determines the output. When the control input is equal to 1, the output is enabled and the gate behaves like any conventional buffer, with the output equal to the normal input. When the control input is 0, the output is disabled and it goes to high-impedance state, regardless of the value in the normal input.



Different components of a computer may be interconnected in many different ways. Certain ways of connection may have advantages over other ways of connection. The manner in which these components are interconnected is referred to as the computer's **architecture**. Architecture may be applicable to any level of integration, viz., chip-level, inter chip-level or intra-chip-level.

On macro unit-level, several computer architectures are possible. One of the simplest architectures is the Common Bus Architecture outlined below. Bus is a collection of connecting lines. Computers designed under this architecture may have separate buses for data and instructions (Figure 2.2) or may have a single bus for both data and instruction (Figure 2.3). The signals flow through the bus under control of a bus controller.

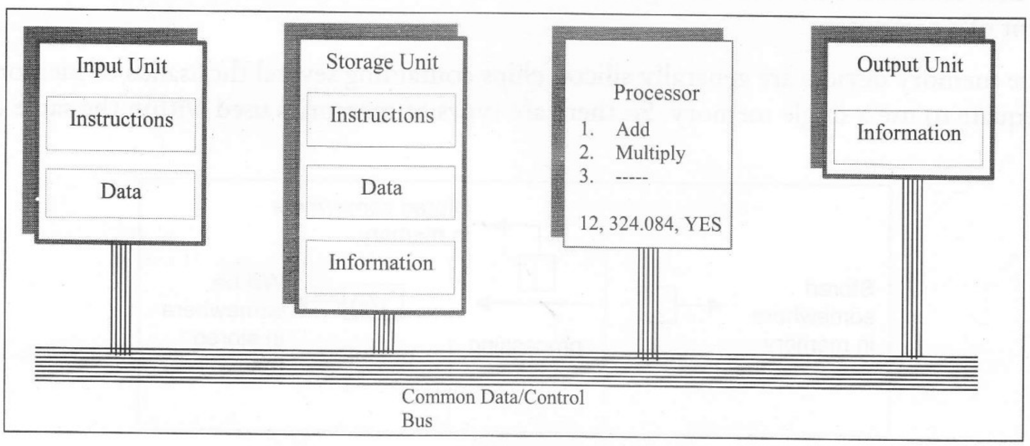


Figure 2.2: Common Data/Control Bus

Simplicity of design and cost are its advantages. However, it does not have very good performance in terms of speed and efficiency because of the frequent switching of the bus between data and control.

Another architecture that provides for separate buses for data and control is shown below. The performance of this architecture is many times better than the previous one, however, at an increased cost.

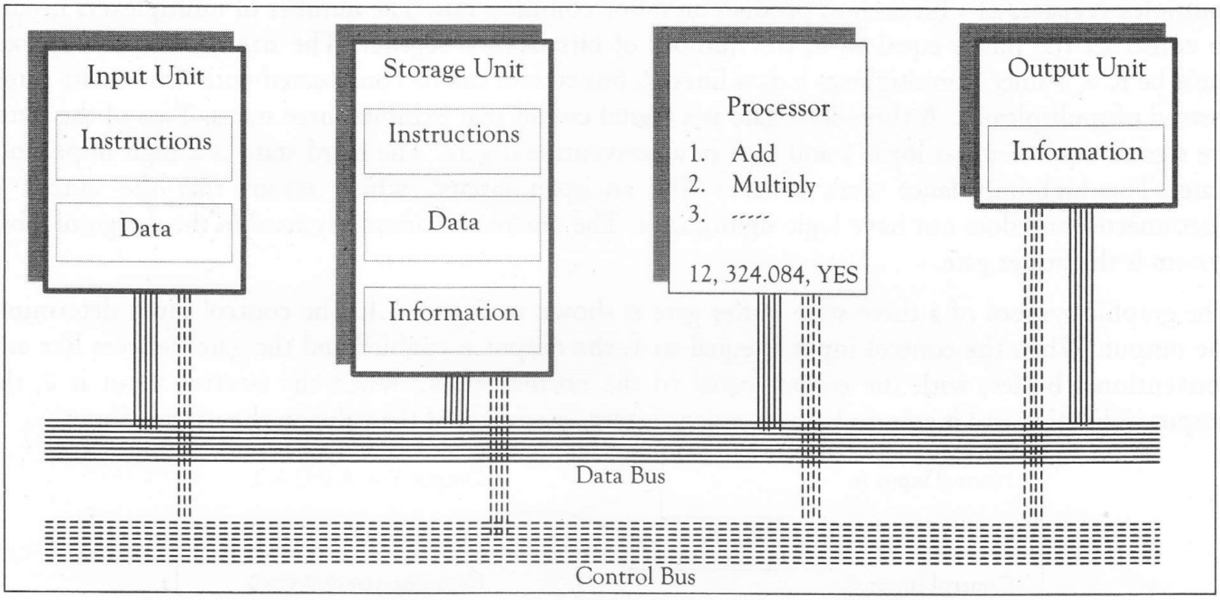


Figure 2.3: Common Bus

Please note that there are many computer architectures available today and many more are being designed with each passing day.

2.4 MEMORY SUBSYSTEM

Computers can process data only when it is available in main memory. This makes memory unit is an essential part of any digital computer. For example, if computer has to compute f(x) = sinx for a given value of x, then first of all x is stored in memory somewhere, then a routine is called that contains program that calculates sine value of a given x. So it seems plausible that memory is an indispensable component of a computer.

Since these memory devices are generally silicon chips containing several thousands of memory cells, it is not adequate to use a single memory. So there are types of memories used within the same computer system.

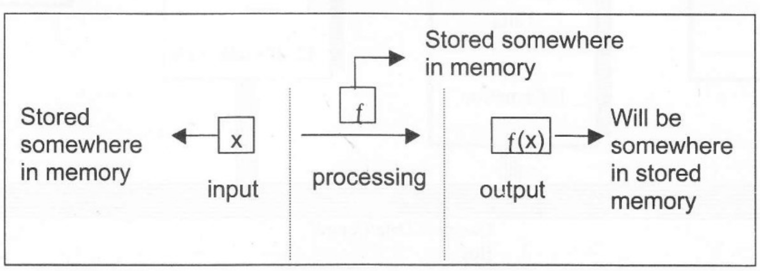


Figure 2.4: Significance of Memory in Computer System

Main Memory

Also known as primary memory, It is comparatively faster memory. CPU directly communicates with main memory. Main memory contains all the data that's currently being processed by CPU. Its cost is higher than secondary memories because production of high speed memory employs sophisticated designing techniques.

Main memory is also known as primary memory. It is a faster memory. CPU directly communicates with main memory. Main memory contains all the data that's currently being processed by CPU. It's cost is higher than secondary memories because production of high speed memory employs sophisticated designing techniques.

The main memory of the computer is also known as RAM, standing for Random Access Memory. It is constructed from integrated circuits and needs to have electrical power in order to maintain its information. When power is lost, the information is lost too! It can be directly accessed by the CPU. The access time to read or write any particular byte are independent of whereabouts in the memory that byte is, and currently is approximately 50 nanoseconds (a thousand millionth of a second). This is broadly comparable with the speed at which the CPU will need to access data. Main memory is expensive compared to external memory so it has limited capacity. The capacity available for a given price is increasing all the time. For example many home Personal Computers now have a capacity of 16 megabytes (million bytes), while 64 megabytes is commonplace on commercial workstations. The CPU will normally transfer data to and from the main memory in groups of two, four or eight bytes, even if the operation it is undertaking only requires a single byte.

Secondary Memory

Apart from main memory there is secondary memory too, which works slower than the main memory and is used to provide a backup. It is also called auxiliary memory. The main memory gathers the data required currently for processing and CPU uses this data.

Cache Memory

This is the smallest and fastest memory component in memory hierarchy of a digital computer. It increases the speed of processing. It is placed between the main memory and CPU.

It stores the data in advance, for processing in CPU. This way it increases the inflow of data to CPU which is fast inherently.

2.4.1 Types of Memory

Mainly there are two types of primary memories:

1. Random Access Memory
2. Sequential Access Memory

The basic difference between the 2 memories is that first is random in nature, that is, the access of particular memory location doesn't depend upon the sequence, i.e., access time is small. But in sequential memory the access of a particular data depends upon the location where it is stored.

For example, if a data is stored at XX40F then in sequential access the locations XX00 to XX40F all will be accessed, but in random access it takes same amount of time for each access.

Types of RAM

RAMs are of two types:

- *Static RAM:* Here refresh signal is not required. Data stored is lost as soon as power is switched off.
- *Dynamic RAM:* Here data stored may be lost even when power is on, so to maintain data one has to give refreshing signals.

Auxiliary Memory

Auxiliary memory is where programs and data are kept on a long-term basis. Common secondary storage devices are the hard disk and floppy disks.

- The hard disk has enormous storage capacity compared to main memory.
- The hard disk is usually contained in the systems unit of a computer.
- The hard disk is used for long-term storage of programs and data.
- Data and programs on the hard disk are organized into files--named sections of the disk.

A hard disk might have a storage capacity of 40 gigabytes. This is about 300 times the amount of storage in main memory (assuming 128 megabytes of main memory.) However, a hard disk is very slow compared to main memory. The reason for having two types of storage is this contrast:

Primary memory	Auxiliary memory
Fast	Slow
Expensive	Cheap
Low capacity	Large capacity
Connects directly to the processor	Not connected directly to the processor

Floppy disks are mostly used for transferring software between computer systems and for casual backup of software. They have low capacity, and are very, very slow compared to other storage devices.

Apart from main memory there is secondary memory too, which works slower than the main memory and is used to provide a backup. It is also called auxiliary memory. The main memory gathers the data required currently for processing and CPU uses this data.

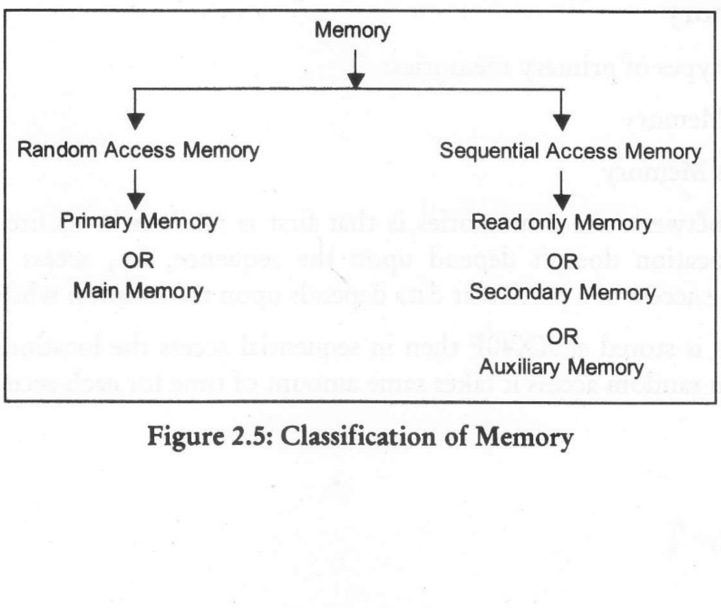


Figure 2.5: Classification of Memory

Memory Hierarchy

Memories vary in their design as also in their capacity and speed of operation. A typical computer can have all types of memories. According to their nearness to the CPU, memories form a hierarchy structure as shown below:

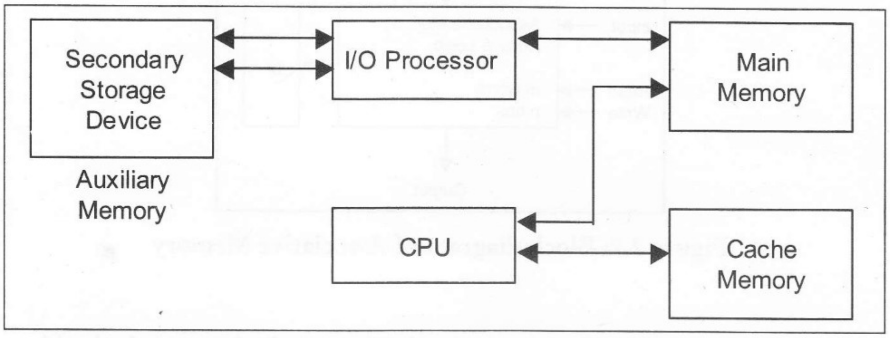


Figure 2.6: Memory Hierarchy in a Computer System

2.4.2 Associative Memory

The access time to find an item can be reduced significantly if stored data can be identified for access by the content of the data itself rather than by an address.

A memory unit accessed by content is called an associative memory or Content Addressable Memory.

An associative memory is more costly than a RAM because each cell must have storage capability as well as logic circuits for matching its contents with an external argument. Associative memories are used in applications where the search time is very critical and essentially short, because it performs parallel searches by data association; moreover searches can be done on an entire word or on a field within a word. This memory can also find the unused data location to store the word. When a word is to be read by such a memory, the content/part of the word is specified.

Whenever a word is written in this memory, no address is to be given.

Hardware Organization of Associative Memory

It consists of:

1. A memory array and logic for m words within bits per word.
2. There is an n-bit argument register one for each bit of word.
3. There is an n-bit key register one for each bit of word.
4. There is an m-bit match register one for each memory word.

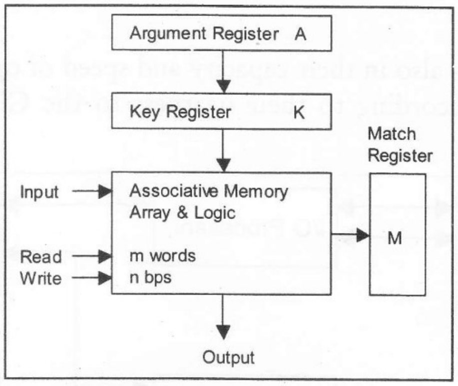


Figure 2.7: Block diagram of Associative Memory

Functioning

Content of argument register and word are compared. The words that match the bits of the argument register set a corresponding bit in match register. After matching, the bits in match register that are set indicate the fact that their corresponding words have been matched. Reading is done by sequential access to memory for those words whose corresponding bits in the match register have been set.

The key register provides a mask for choosing a particular field or key in the argument word. The entire argument is compared with each memory word if key register contains all 1's, else only those bits in argument that have 1's in their corresponding position of key are compared.

So key register provides information about how the reference to memory is made.

RAM is also called Read / Write memory.

ROM: It is the memory in which data is stored for permanent use. Data cannot be written in or deleted from this type of memory.

CDROM is a common example.

Building Large Memories: Given a particular RAM chip of specified capacity and some decoders, it is possible to extend memory by using similar types of chips with decoders.

An example:

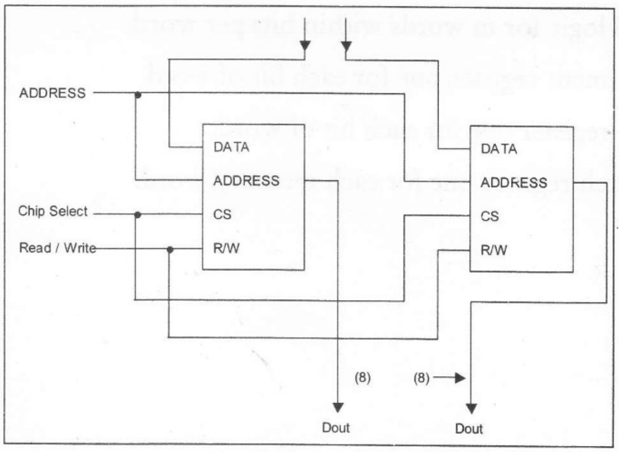


Figure 2.8: Block Diagram of 1K*16 RAM with 1K*8 RAMS (Parallel Connection)

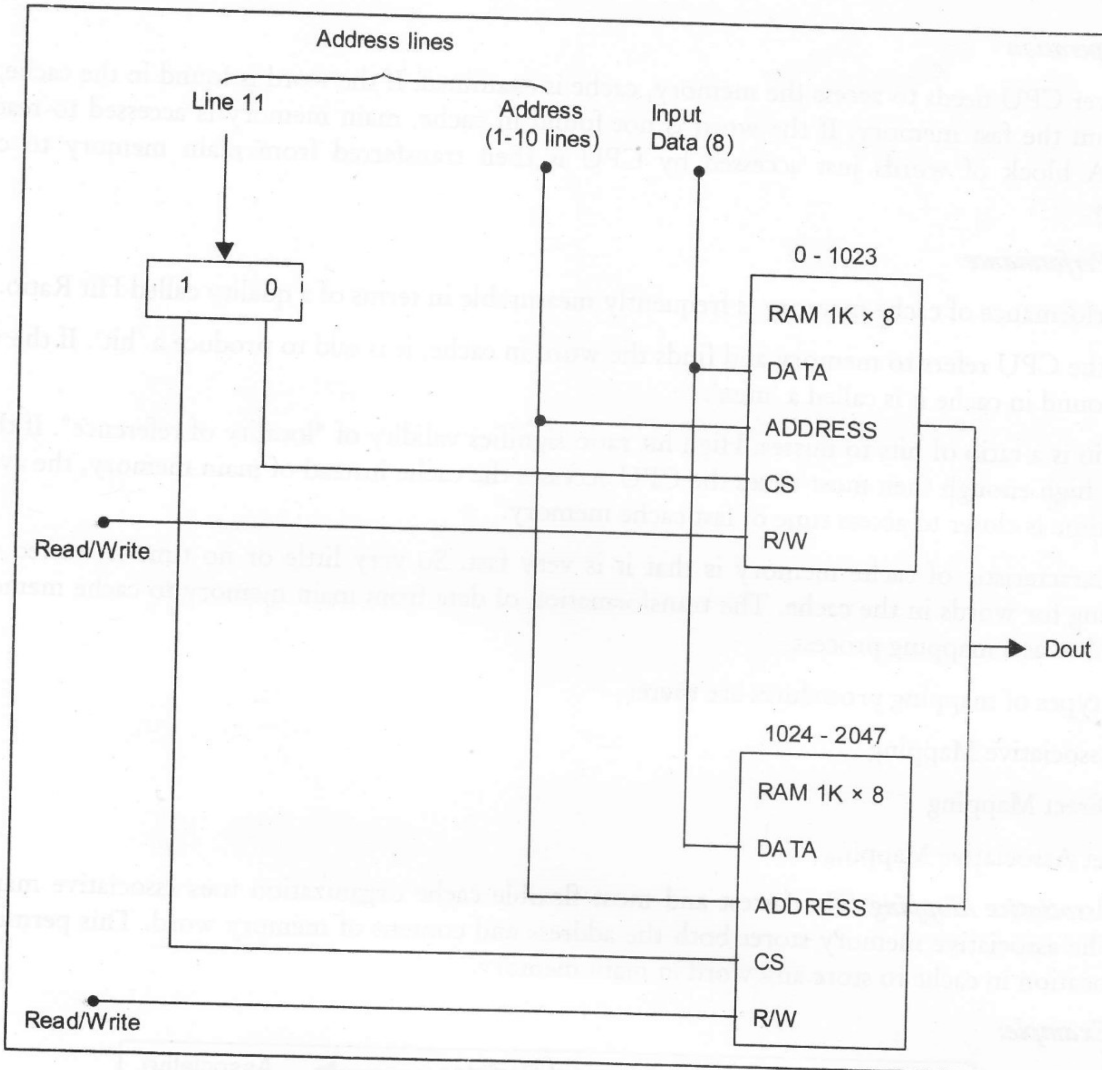


Figure 2.9: Block Diagram of a 2K*8 RAM (Series Connection)

2.4.3 Cache Memory

This phenomenon states that at a particular time interval, references to memory tend to be confined within a few localized areas in memory. Its illustration can be given by making use of control structure like 'loop'.

Whenever a loop is executed in a program CPU executes the loop repeatedly, the same subroutine is called repeatedly. Thus loops and subroutines tend to localize the references to memory for fetching instructions. To a lesser degree, memory references to data also tend to be localized. Table lookup procedure repeatedly refers to that portion in memory, where the table is stored. Iterative procedures refer to common memory locations and array of numbers are confined within a local portion of memory. The result of these observations is locality of reference property.

The fundamental idea of cache organization is that by keeping the most frequently accessed instructions and data in the fast cache memory, the average memory access time will reach near to access time of cache.

Basic Operation

Whenever CPU needs to access the memory, cache is examined. If the word is found in the cache, it is read from the fast memory. If the word is not found in cache, main memory is accessed to read the word. A block of words just accessed by CPU is then transferred from main memory to cache memory.

Cache Performance

The performance of cache memory is frequently measurable in terms of a quality called Hit Ratio.

When the CPU refers to memory and finds the word in cache, it is said to produce a 'hit'. If the word is not found in cache it is called a 'miss'.

Hit ratio is a ratio of hits to misses. High hit ratio signifies validity of "locality of reference". If the hit ratio is high enough then most times the CPU accesses the cache instead of main memory, the average access time is closer to access time of fast cache memory.

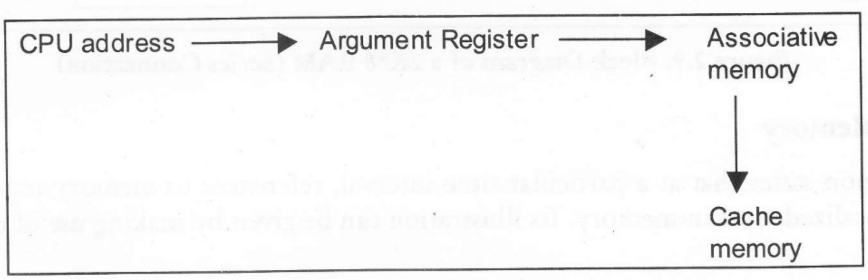
The characteristic of cache memory is that it is very fast. So very little or no time is wasted when searching for words in the cache. The transformation of data from main memory to cache memory is referred to as a mapping process.

Three types of mapping procedures are there:

1. Associative Mapping
2. Direct Mapping
3. Set Associative Mapping

- ***Associative Mapping:*** The fastest and most flexible cache organization uses associative mapping. The associative memory stores both the address and content of memory word. This permits any location in cache to store any word in main memory.

  Example:



  CPU address is first placed in argument register and then associative memory is searched for the match of the above address. If address is found in it somewhere, it has to be placed in cache memory immediately.

  If cache memory has no vacant space for storage of new information, in such a case vacancy is created using page replacement policy.

- ***Direct Mapping:*** Associative memories are expensive compared to RAMs because of added logic associated with each cell.

In general case, there are 2^K words in cache memory and 2^n words in main memory. The n-bit memory address is divided into two fields. K bits for index field and n-k bits for long field. The direct mapping cache organization uses n-bit address to access main memory and k-bit index to access the cache. Each word in cache consists of data word and its associated tag.

When a new word is first brought into cache, the tag bits are stored alongside the data bits. When CPU generates a memory request, the index field is used for the address to access cache. The tag field of CPU address is compared with the tag in word read from the cache. If the two tags match, there is a hit and the desired data word is in cache. If there is no match, there is a miss and the required word is read from main memory. It is then stored in cache together with the new tag, replacing the previous value.

Disadvantage of Direct Mapping: The disadvantage of direct mapping is that the hit ratio can drop considerably if two or more words whose addresses have the same index but different tags are accessed repeatedly.

- ***Set Associative Mapping:*** It is a more general method that includes pure associative and direct mapping as special cases. It is an improvement over the direct mapping organization in that each word of cache can store two or more words of memory under the same index address.

  Each data word is stored together with its tag and the number of tag data items in one word of cache is said to form a set.

2.4.4 Virtual Memory

Virtual memory is a concept used in some large computer systems that permits the user to construct programs as though a large memory space is available.

Each address that is referenced by the CPU goes through an address mapping from the so-called virtual address to a physical address in main memory.

Virtual Address	:	Address used by a user.
Physical Address	:	Address in main memory.
Address Space	:	Set of virtual addresses.
Memory Space	:	Set of locations in main memory.

Paging

In paging the physical memory is broken into groups of equal size called "blocks" which may range from 64 to 4096 words each.

- "Page" means groups of address space of same size.
- "Block" is sometimes referred to as 'page frame'.

The mapping from address space to memory space is facilitated if each virtual address is considered to be represented by two numbers (this makes mapping easier)

1. Page number (as is in a book)
2. Line number (as is in a page of a book)

Now suppose there are 2^n words per page when 'n' number of bits are used to specify line address and rest high order bits used for page number.

Let a virtual address have 14 bits.

Since $2^{10} = 1$ K words per page are there of each containing 10 bits which indicate line address.

Rest of (14-10) = 4 bits used for specifying $2^4 = 16$ pages.

Note that line address in additional space and memory space is the same; the only mapping required for mapping a page number to a block number. Consider a computer with an additional space of 16K and memory space of 4K.

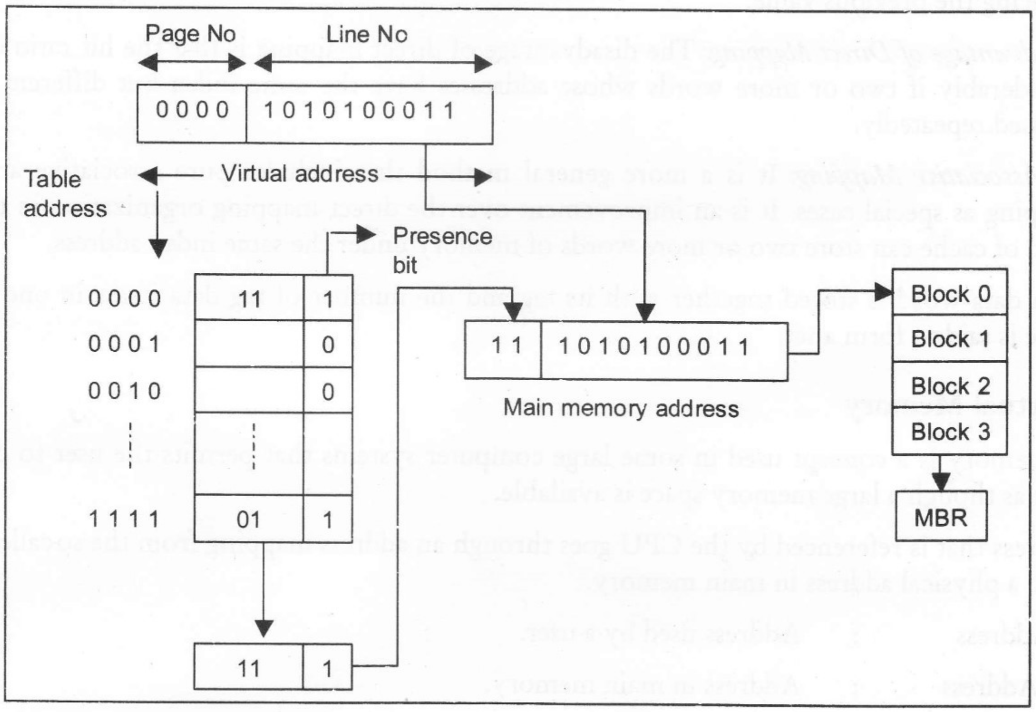


Figure 2.10: Memory Page Table

The four most significant bits of virtual address give page number. This page number is searched in page table. If data is found in that particular page number which is indicated by presence bit, then the content of this page is transferred into memory table buffer register.

10 less significant bits indicate line number. This line number is added with page content to give block address.

Page Replacement

For efficient utilization of memory space, memory management software system handles all the software operations. It must make decisions about:

1. When page is to be transferred from auxiliary memory to main memory.
2. Which page should be removed from main memory.
3. Where the new page is to be placed in main memory.

Page Fault

- When a program starts, execution pages are to be transferred from auxiliary to main memory.
- When the required page is not in main memory, page fault occurs. Until the required page is brought into memory, the process is suspended.

Page Replacement Algorithm

- *FIFO (First In First Out):* According to this policy that page is replaced with a new page (obviously when memory is full) which had entered the memory first.
- *LRU (Last Recently used):* According to this policy the page that has taken a long time for not being used and lying in cache.

Segmentation

Segmentation is a technique to handle problems with respect to program size and logical structure of programs.

It is easier to divide programs and data into logical parts called segments.

A segment is a set of logically related data elements associated with a given name.

The address generated by a segmented program is called a "logical address". This is similar to a virtual address except that logical address space is associated with variable length segments rather than fixed length pages.

The function of the memory management unit is to map logical addresses into physical addresses similar to the virtual memory mapping concept.

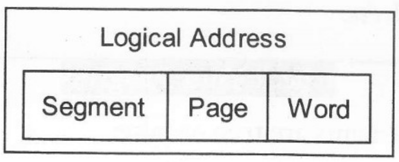


Figure 2.11: Logical Address

Segmented Page Mapping

Segmented Page Mapping is mapping of logical address to physical address.

A logical address can be divided into three parts.

1. Segment
2. Page
3. Word

Segment field specifies a segment number.

Page field specifies a page within a segment. A page field of 'P' bits can have maximum number oWord field specifies a specific word in the page.

The length of segment is variable and varies according to number of pages assigned to it.

The mapping of logical address to physical address requires two tables.

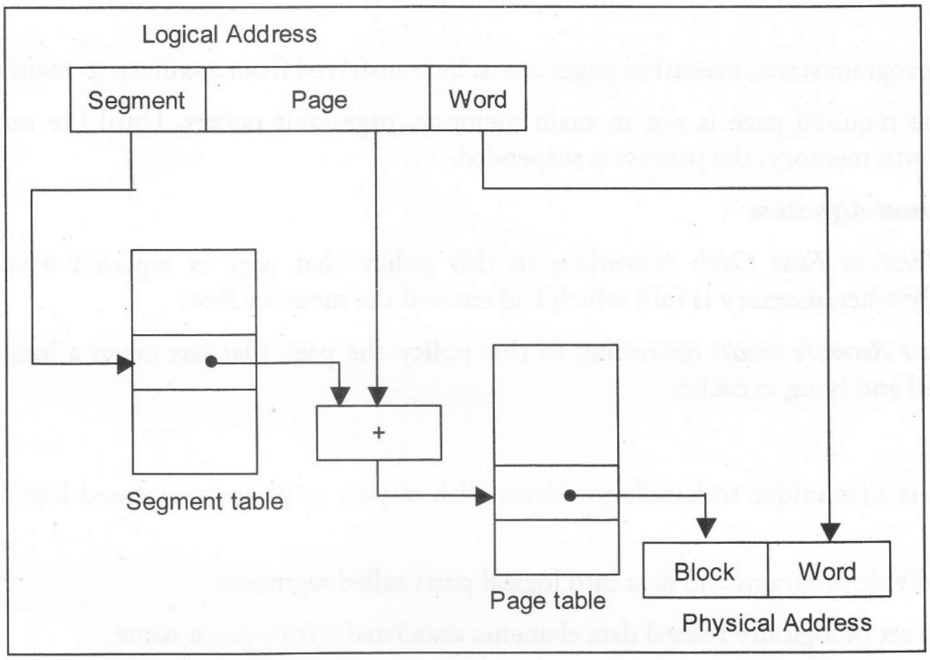


Figure 2.12: Mapping of Logical Address to Physical Address

The segment address is like a pointer to page table base address. The page table base is added to the page number given in the logical address. The sum is pointer address to an entry in page table. The value found in page table provides the block number in physical memory. The concatenation provides the block number in physical memory. The concatenation of the block field with the word field produces final physical mapped address.

Check Your Progress

State weather the following statements are true or false:

1. The MCA bus was an IBM proprietary interface.
2. The high-impedance state behaves like an open circuit, which means that the output is disconnected and does not have logic significance.
3. Main memory does not contains all the data that's currently being processed by CPU.
4. The words that match the bits of the argument register set a corresponding bit in match register.
5. Associative memories are inexpensive compared to RAMs because of added logic associated with each cell.

2.5 LET US SUM UP

Alongside "microcomputer" and "home computer", the term "personal computer" was already in use before 1981. It was used as early as 1972 to characterize Xerox PARC's Alto. However, because of the success of the IBM Personal Computer, the term PC came to mean more specifically a microcomputer compatible with IBM's PC products. On macro unit-level, several computer architectures are possible. One of the simplest architectures is the Common Bus Architecture outlined below. Bus is a collection of connecting lines. An associative memory is more costly than a RAM because each cell must have storage capability as well as logic circuits for matching its contents with an external argument.

2.6 KEYWORDS

ROM: Read Only Memory

POST: Power on Self Test

BIOS: Basic Input Output System

RAM: Random Access Memory

MCA: Micro Channel Architecture

2.7 QUESTIONS FOR DISCUSSION

1. Explain the bus system?
2. What is the difference between associative and virtual memory?
3. What is memory unit? How memory unit can be broadly classified?

Check Your Progress: Model Answers

1. True
2. True
3. False
4. True
5. False

2.8 SUGGESTED READINGS

William Stallings, *Computer Organization and Architecture*, 6th edition, Pearson Education, 2002.

A.S.Tannenbaum, *Structured Computer Organization*: Prentice-Hall of India, 1999.

R. P. Beales, *PC Systems, Installation and Maintenance*, Second Edition.

Ron Gilster, *PC Upgrade and Repair Black Book*.

Peter Norton's, *Inside the PC*.

UNIT II

LESSON

3

MEMORY PERIPHERALS

CONTENTS

3.0 AIMS AND OBJECTIVES

After studying this lesson, you will be able to:

- Discuss magnetic tape, magnetic disk, etc.
- Understand floppy disk, optical disk
- Discuss magnetic record fundamentals

3.1 INTRODUCTION

Memory is an essential component of a digital computer. It is a storing device. It stores programs, data, results, etc. At present the following two kinds of memory are commonly used in modern computers.

- Semiconductor memory
- Magnetic memory

The semiconductor memory is faster, compact and lighter. It consumes less power and is a static device, i.e. there is no rotating part in it. The magnetic memory is cheaper than static memory. It is in the form of magnetic disk or magnetic tapes. The semiconductor memory is employed as the main memory or primary memory of the computer. It stores programs and data, which are currently needed by the CPU and hence is directly connected to the CPU. The magnetic memory is used as secondary memory or auxiliary memory.

Computers main memory 'Random Access Memory (RAM)', is a 'volatile memory'. Whenever power supply is switched off, everything stored inside it is completely washed off and lost forever. As we use computers to keep many important records, it should have some facility to keep the data permanently – without any loss. Magnetic storage devices are the most popular means of storing data permanently and are also the main source of transferring data between different computers. The most common magnetic storage devices are magnetic tape and magnetic disk. These storage devices are extensively used for input as well as output and commonly termed as Auxiliary storage device or Secondary storage device. In this chapter we will study the functioning of two most important auxiliary storage devices: magnetic tape and magnetic disks.

Secondary storage is also known as Auxiliary Memory or External Memory. It supplements the primary memory. Secondary storage is used to store data/information permanently. Its storage capacity is virtually unlimited because a large database can be stored across a number of floppy disks/tapes. Data cannot be processed directly from secondary devices hence we need main memory also. Thus a secondary storage device cannot, in any way, replace the primary memory of the computer system. Commonly used secondary storage devices are hard disks, magnetic disks, magnetic tapes, floppy disks, optical disks, etc.

3.2 MEMORY PERIPHERALS

Before discussing the various peripherals, we will first discuss the characterstics of secondary storage devices. The characterstics of secondary storage devices are given below:

- *Non-volatile:* Unlike primary memory, data stored in these devices is retained even after power supply is withdrawn. The data stored in the secondary storage devices is non-volatile.

- ***Mass Storage:*** Secondary storage devices can store hundreds of giga byte on them in a very small place. Nowadays hard disks of capacity 20 to 30 GB are also available.
- ***Cost-Effective:*** Unlike the semiconductor memory, this magnetic media is cheaper and cost-effective. Hence cost of storage per mega byte is relatively very small with secondary storage devices.
- ***Reusability:*** The secondary storage devices can be reused again and again which means obsolete information can be erased from these devices and new information stored.

Storage devices are classified into two parts according to their working and the method provided to access the information stored in it; serial access storage devices and direct access storage devices.

- ***Serial Access Storage Devices:*** These devices provide only serial access to the information stored. This means that all the previous records need to be read to access the next record - one cannot directly access a particular record. In a serial access storage device simultaneous reading and writing cannot be done in the file. Magnetic tape is an example of serial access storage device.
- ***Direct Access Storage Devices (DASD):*** In a direct access storage device there is no need to read all the previous records to access a particular record. The record can be accessed directly. In DASD the data stored can also be accessed sequentially, if need be. Reading and writing can be done simultaneously in the file in a DASD floppy disk and magnetic disks. CD ROMs are also direct access storage devices.

3.3 MAGNETIC TAPE SYSTEMS

Magnetic tapes are used as external storage device to keep back-up copies of precious software and data. It is a serial access storage device and provides sequential access only. Tape is a plastic ribbon that is coated on one side with a magnetic material (iron-oxide). Information is stored using binary code in the form of magnetized or non-magnetized spots. An electro-magnetic head arranges these magnetic particles to store data. These particles are interpreted when we read from the tape and are then converted back to information. They come in the range of 12.5 mm to 25 mm width and 500 meters to 1200 meters length.

3.3.1 Recording Data on Magnetic Tapes

Magnetic tapes have their own coding system. Information is recorded on the tape in the form of tiny invisible magnetized and non-magnetized spots (representing 1's and 0's). Tape is divided into vertical columns called frames and horizontal rows called tracks. Only one character is recorded per frame. Data is recorded in two coding formats - BCD (Binary Coded Decimal) which is 7 bit format (6 bit BCD and 1 bit for parity checking), EBCDIC (Extended Binary Coded Decimal Interchange Code) which is 9 bit format (8 bit EBCDIC code and 1 bit for parity checking). A parity or check bit is used to detect errors that may occur due to loss of a bit from a string of 6 bit BCD or 8 bit EBCDIC format during input or output operation.

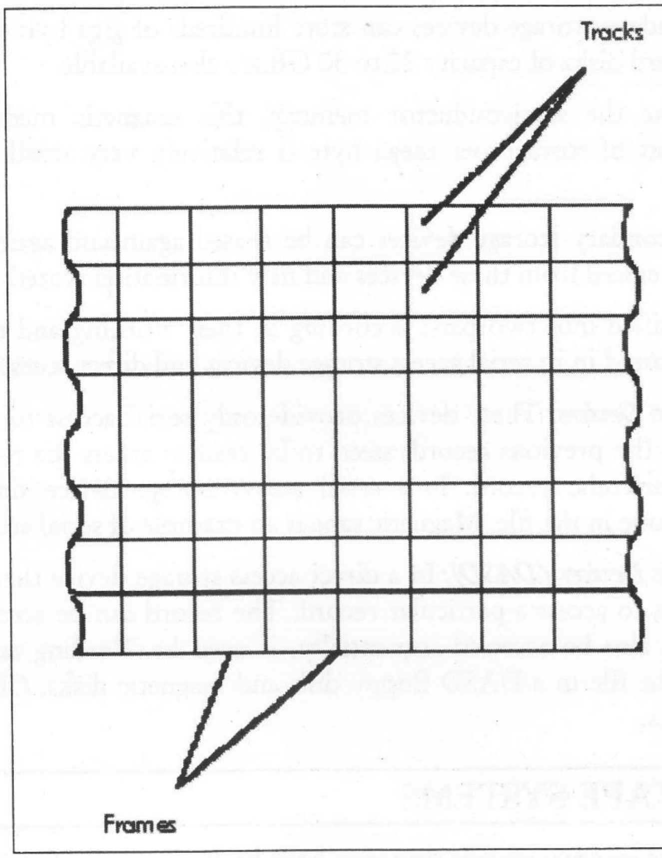


Figure 3.1: Track Magnetic Tape

3.3.2 Fixed and Variable Length Records

The data is normally stored on a tape in blocks. On some tapes, the block is of fixed length. It may vary in length for others. In fixed length record block, the data size cannot exceed a predetermined maximum numbers of characters. In variable length record block, there is no such limitation on number of characters and the record may contain any number of characters.

3.3.3 Advantages of Magnetic Tapes

- Magnetic tapes provide virtually unlimited storage. Number of tapes can be used as per requirement for storing of data.
- A magnetic tape provides high data density. A typical tape can store 6250 characters per inch. So a tape of 28,800 inches can store 180 million characters.
- Magnetic tapes are economical to use – their cost is very low.
- Rapid data transfer rate is about one million bytes per second.
- Magnetic tapes and cartridges are very easy to handle and use.
- Tape is a convenient way of carrying large volumes of information from one place to another.
- It can be erased and reused many times.

3.3.4 Limitations of Magnetic Tapes

One of the main limitations with magnetic tapes is that they lack direct access to records and are susceptible to environmental disturbances. Also they require human intervention for operation. The data transmission in magnetic tapes is slow as compared to disks. There is variability or tape drives, i.e. different types of tape drives are available and there is no standardization, which makes it difficult to recover from parity errors.

3.4 MAGNETIC DISK

Magnetic disks are used as an input, output or external storage device. They are a popular medium for Direct Access Storage Devices (DASD). It is a thin, circular metal plate/platter coated on both sides with a magnetic material. It usually comes in the form of a disk pack, also known as hard disk. All the disks in the disk pack rotate at a very high speed of 700 or 3600 rpm. They come in two varieties according to the operations of the read-write mechanism - fixed head and moving head. Disk packs also come in two configurations - fixed disk pack, removable disk pack.

3.4.1 Storage of Information

Information is stored on both the surfaces of each disk platter except the upper surface of the top platter and lower surface of the bottom platter. Each disk platter is divided into concentric circles known as tracks. A set of corresponding tracks in all the surfaces of a disk pack is called a cylinder. Data is stored in one cylinder first and then the head moves to the next cylinder. This saves time wasted in moving the head track by track for a particular disk. Information is recorded as a series of magnetized (signifying a 1-bit) or non-magnetized (signifying a 0-bit) spots. Each track contains equal number of characters. Information can be erased from anywhere on the disk and new data can be recorded on it. Normally there are 200 tracks on a disk surface numbered 0 to 199. Each track is divided into 8 or 12 equal sectors. Sectors are used to store information - about 512 bytes can be stored per sector.

3.4.2 Addressing of Records

The heads are attached to access arms, which are moved in and out over the spinning disk. The heads can thus be quickly located over any track to read or write data. These tracks begin at the outer edge and continue towards the center. Each track has a unique number (000-199).

3.4.3 Accessing of Data

Data is recorded on the tracks of the spinning disk surface and read from this surface by one or more read/write heads. There are two basic types of disk systems - the moving head system and the fixed head system. Accessing of data is different for both.

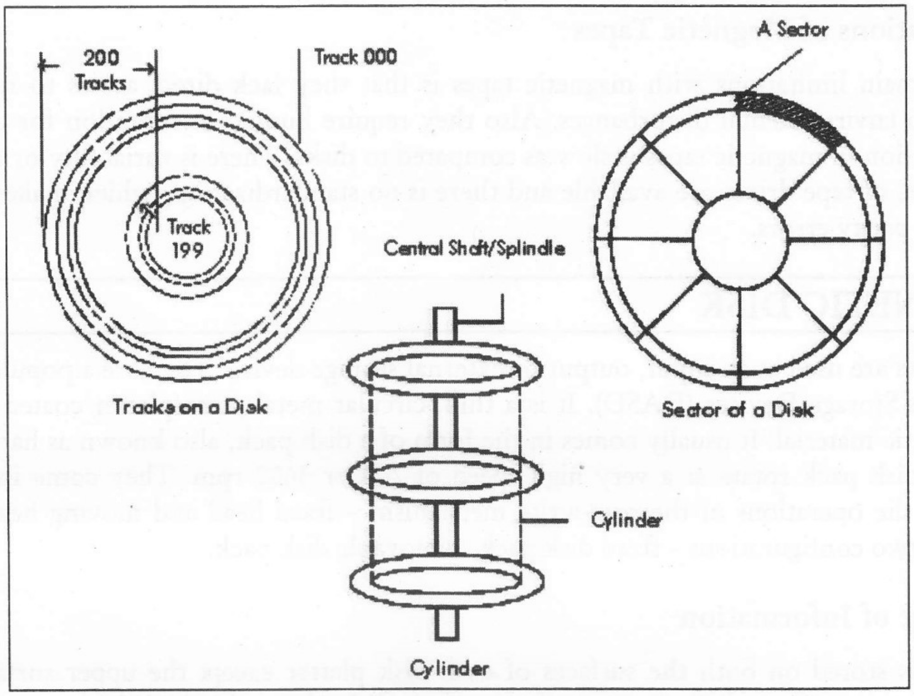


Figure 3.2: Tracks and Sectors

3.4.4 Moving Head System

Moving head system consists of one read-write head for each disk surface mounted on an access arm, which can be moved in and out. Each read-write head moves horizontally across the surface of the disk. Every surface of disk pack has its own head and all heads move together. One cylinder is accessed simultaneously by the set of read-write head. Then the head moves for the next cylinder.

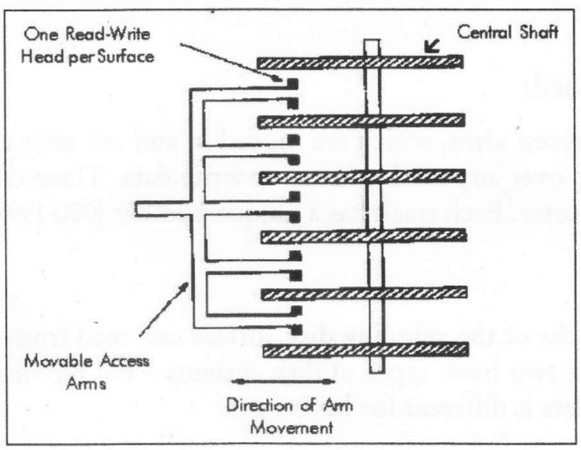


Figure 3.3: Moving Head Disk

3.4.5 Fixed Head System

In a fixed head system the access arm is non-movable and a number of heads are attached on this arm. These read-write heads are distributed over the disk surface, one head for each track. As a result no head movement is required and information is accessed more quickly. Because of the space required for the additional read-write heads, fixed head disks have less capacity and cost more per byte of data stored.

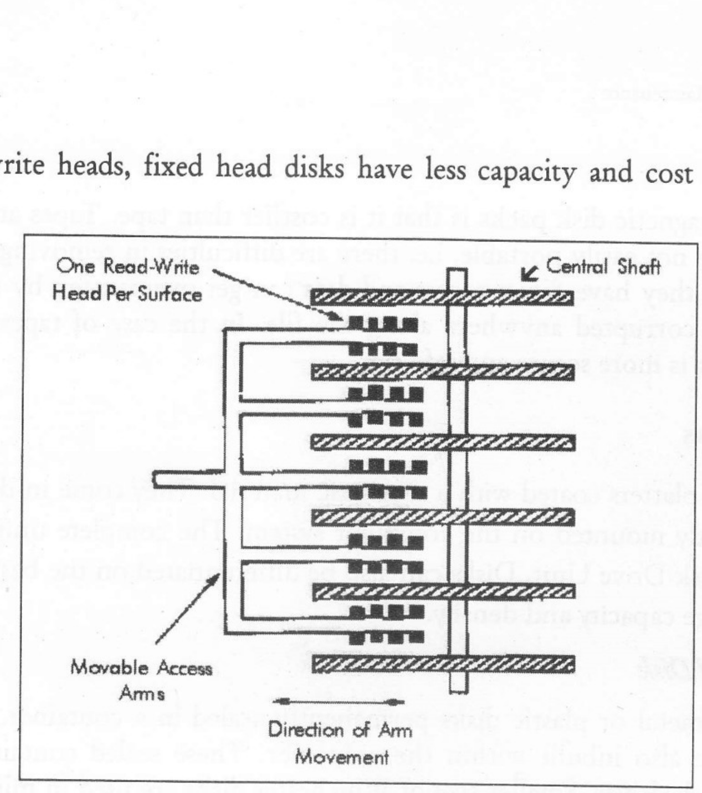


Figure 3.4: Moving Arm Disk

3.4.6 Access Time

Information is accessed from the disk by referencing the disk address. Disk address is specified in terms of surface number, track number and sector number. Access time in any disk system is made up of three components – Seek Time, Latency Time and Data Transfer Time.

- *Seek Time:* Time required to position the head over the proper track is called the seek time, normally measured in milliseconds. For fixed head system, seek time is always zero.
- *Latency Time:* Time required to rotate the disk pack to bring the correct sector under the read-write head is known as latency time. Average latency time is of the order of 8-10 ms.
- *Data Transfer Time:* Time required to read or write the actual data on the disk is called data transfer time.

3.4.7 Storage Capacity

The storage capacity of a magnetic disk largely depends upon the number of disks in the disk pack and the number of tracks per inch and bits per inch of track. Total number of bytes that can be stored in a disk pack = (Number of cylinders × Tracks per cylinder × sectors per track × Bytes per sector). Storage capacity of a disk pack is in the range of 200 to 10000 megabytes (Mbytes).

3.4.8 Advantages of Magnetic Disks

Magnetic disks are DASD devices, i.e. time taken to locate a particular record is independent of the position of that record. Disk storage is more durable than that of tape storage. Magnetic disks support on-line processing because of its direct accessing property. In a nutshell the advantages of magnetic disks are: easy accessibility, durability, reusability, compactness and providing sequential as well as direct access.

3.4.9 Disadvantages

The disadvantage of magnetic disk packs is that it is costlier than tape. Tapes are more economical to use. The disk packs are not easily portable, i.e. there are difficulties in removing a diskpack. Also they are less secure because they have direct access and data can get overwritten by mistake any where on the disk or it can get corrupted anywhere along the file. In the case of tapes, since all of it is not exposed for accessing it is more secure and safe.

3.4.10 Types of Disks

All magnetic disks are platters coated with a magnetic material. They come in different sizes. They are portable or permanently mounted on the computer system. The complete unit to read and write on these disks is called Disk Drive Unit. Disks can also be differentiated on the basis of their size, sectors, number of sides, storage capacity and density.

Winchester Disk/Hard Disk

It is a group of large metal or plastic disks permanently sealed in a container. Read-write heads and access mechanisms are also inbuilt within the container. These sealed containers are not generally removed from their disk drives. Smaller size of Winchester disks are used in mini computers and PCs. Winchester disks minimize contamination by prohibiting the circulation of outside air between the disk. In operation, the disk is rotated at a high speed on the spindle. There is one read-write head for each surface. The heads can move to and fro to select desired track position. During operation, heads don't touch the magnetic surface, a thin cushion of air is maintained between a rotating disk and read-write head. To store or retrieve data, the system finds the disk address used to contain the data by moving the read/write head to the appropriate track where it waits until the desired sector passes by. The capacity of hard disks is very high compared to other disks. Nowdays hard disks of capacity 4.3 GB and 8 GB are available. Although hard disks are fixed in PC, porting of disks from one place to another is more secure than before because all the disks are safely packed inside a protective covering.

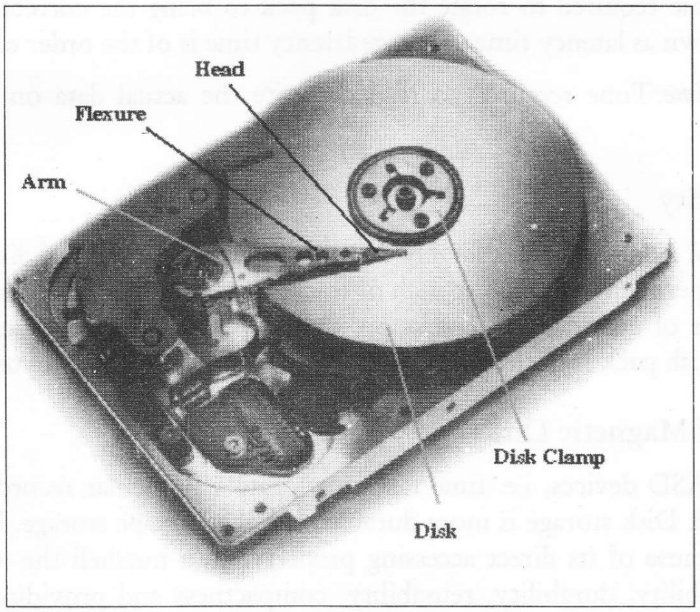
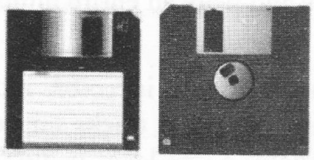


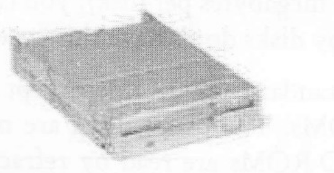
Figure 3.5: Hard Disk

Floppy Diskette

Hard disks are costly and unfit to transfer data from one place to another so floppy diskettes of low capacity are used. These diskettes are economical and very flexible to use and are fixed inside the computer system. The diskette can be frequently taken out and inserted in the disk drive unit. During operation, floppy disk drive heads actually touch the surface of the magnetic disk. This results in quick wear and tear of the disks and the read-write heads. These diskettes are made up of plastic and have a magnetic coating. The disk is covered in a protective sheath with opening for editing and writing. A typical 3.5 inches diameter 1.44 MB floppy disk is shown below.



Floppy Disk



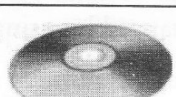
Floppy Drive

Optical Disk

CD-ROM works much like the compact discs used in CD players. Just as CDs have revolutionized the music industry, optical disks have the potential to change secondary storage media. Based on the same laser technology as CDs, optical disks offer a medium capable of storing extremely large amounts of data. The three main types of optical disks are CD-ROM, WORM CD, and MO technology.

The most popular and least expensive type of optical disk is Compact Disk Read–Only Memory (CD-ROM). As the name indicates, these disks come prerecorded and cannot be altered; CD-ROM is, in other words, a read-only storage medium. Still, CD-ROM provides an excellent way to distribute large amounts of data at low cost. CDs can store up to 650 MB of data, yet they can cost as little as a dollar per disk.

To use a CD-ROM, you must have a computer equipped with a CD-ROM drive. Double-speed drives achieve the minimum level of retrieval speed for multimedia applications. (A double–speed drive is slower than a floppy drive). Eight–speed drives are decreasing in cost and becoming common in new computer systems, and Ten-speed drives are available at a larger cost. CD-ROM towers, containing as many as 256 CD-ROM drives, are frequently attached to CD servers so that all the computers on a network can share what is stored on the CD-ROMs.



CD

CD Drive

A WRITE ONCE, READ MANY COMPACT DISCS (WORM CD) is purchased blank from the manufacturer and encoded using special equipment. The disks can't be altered after they are encoded and can't be easily duplicated because the encoding process does not actually pit the disk. Many businesses use WORM CDs to store old data files. This practice, known as archiving, enables old files to be deleted from the hard disk, thus freeing space for new files. WORM CDs are used most frequently for document processing with complete image processing, including replication of photos, graphics, text and even signatures.

Until recently, recording on a CD-ROM required separate, very expensive equipment. Now drives that can write to and read a CD, called CD-Recordable (CD-R) drives, are available for less than Rs. 900, and prices are going down rapidly. A blank disk costs about Rs. 10. CD-R is a WORM process. Any standard CD-ROM unit can read the disks.

If you want to create a multimedia presentation and then play it back on any available computer equipped with a CD-ROM drive, CD-R is the tool you have been looking for. With large capacity of CD-R (roughly 600 megabytes per disk), you can create and store an entire multimedia presentation on a single disk. (Floppy disks don't have this capacity).

CD-Rs look like standard CD-ROMs except that they are gold in color, rather than the silver of "mastered" CD-ROMs. The blank disks are made with the spiral tracks impressed on the recording surface. Because CD-ROMs are read by refraction of light, a dye layer is discolored in the recording process, which causes the area either to reflect light or to disperse it.

The technology to make **CD-Erasable (CD-E)** disks recently became available. CD-E enables users to store, access and reuse disks in the same way that floppy disks can be used. Because of the large storage capacity of CDs, they will in all likelihood make magnetic tape, and perhaps floppy disks, a thing of the past.

Magneto-optical (MO) Disks

These disks are erasable and combine the magnetic principles used on tape and disk with new optical technology. MO disks measure storage capacity in gigabytes; they are removable, portable and durable. One of the newest MO systems—Orray produced by Pinnacle Micro—uses a storage method similar to that of RAID (Redundant Array of Inexpensive Disks). Optical disks have a thirty-year shelf life and are ideal for graphics and audio-visual applications that require large storage capacity.

Advantages and Limitations of Optical Disk

The main advantage of these disks is that unlike the magnetic storage media, if these disks are kept properly, the stored information on these disks will last forever. These CD-ROMs are not susceptible to electrical and magnetic field disturbances because whatever is stored is permanent and it is not in the form of electrical charge or magnetic polarity of particles. Another big advantage of the CD-ROM disk is its high storage capacity. One CD-ROM can store 600 MB of data. The only demerit associated with it is that it is read only storage device and data cannot be changed by using a normal CD-ROM drive.

One of the most common applications of the CD-ROM is entertainment software such as video games, etc. Many types of educational software encyclopedia requiring lot of space are nowadays available on CD-ROMs. They are also being used extensively for multimedia application.

3.5 MAGNETIC RECORD FUNDAMENTALS

Secondary storage devices with magnetic storage media have a thin magnetic coating on the recording surface. The read-write head records the information on the media by setting the magnetic polarity of the particles. Recording takes place by inducing a magnetic field in the coil present inside the read-write head. For reading, read-write head senses the polarity of magnetic particles as 0's and 1's and signal is transmitted to the CPU as given in the Figure 3.6.

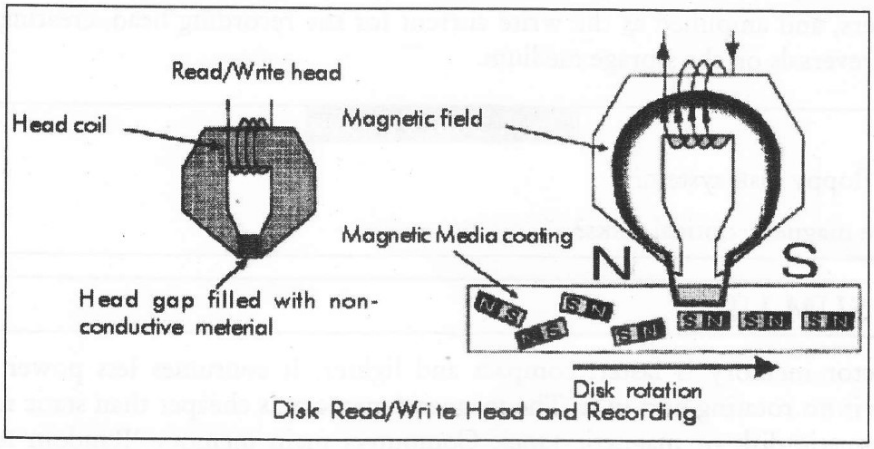
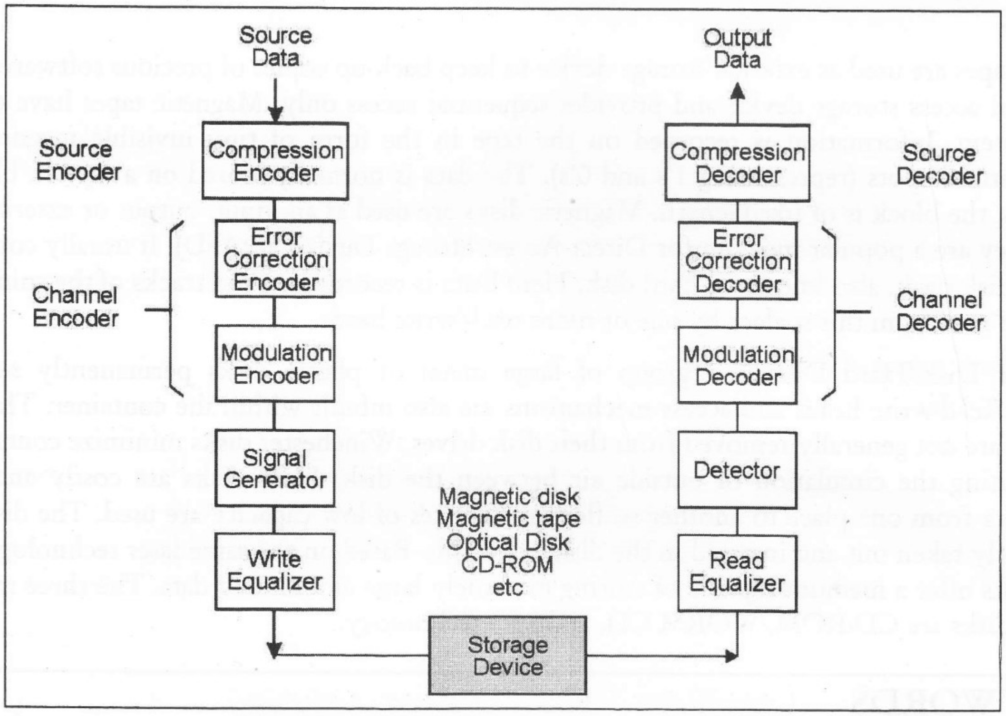


Figure 3.6: Disk Read/Write Head and Recording

3.5.1 Digital Magnetic Recording



Source: http://www.lintech.org/comp-per/07MAGREC.pdf

Figure 3.7: Digital Recording Channel

Magnetic Digital recording systems can be measured as communications channels. It includes an input signal and an output signal which acts as a changed and loud edition of the input. Above figure shows the block diagram of the digital read/write channel. The source data to be recorded or saved is prepared by The CPU prepares the source data which is to be recorded or saved, and CPU also provides the storage appliance with information regarding the address of the storage locations. Compression before the data passes into the channel encoder which adds error-correcting bits and converts the data stream into a form appropriate for recording. This signal is passed through the equalization filters, and amplified as the write current for the recording head, creating the pattern of magnetic fluxes reversals on the storage medium.

Check Your Progress

1. What is floppy disk system?
2. What are magnetic optical disks?

3.6 LET US SUM UP

The semiconductor memory is faster, compact and lighter. It consumes less power and is a static device, i.e. there is no rotating part in it. The magnetic memory is cheaper than static memory. It is in the form of magnetic disk or magnetic tapes. Computers main memory 'Random Access Memory (RAM), is a 'volatile memory'. Whenever power supply is switched off, everything stored inside it is completely washed off and lost forever. Magnetic storage devices are the most popular means of storing data permanently and are also the main source of transferring data between different computers.

Magnetic tapes are used as external storage device to keep back-up copies of precious software and data. It is a serial access storage device and provides sequential access only. Magnetic tapes have their own coding system. Information is recorded on the tape in the form of tiny invisible magnetized and non-magnetized spots (representing 1's and 0's). The data is normally stored on a tape in blocks. On some tapes, the block is of fixed length. Magnetic disks are used as an input, output or external storage device. They are a popular medium for Direct Access Storage Devices (DASD). It usually comes in the form of a disk pack, also known as hard disk. Here Data is recorded on the tracks of the spinning disk surface and read from this surface by one or more read/write heads.

Winchester Disk/Hard Disk is a group of large metal or plastic disks permanently sealed in a container. Read-write heads and access mechanisms are also inbuilt within the container. These sealed containers are not generally removed from their disk drives. Winchester disks minimize contamination by prohibiting the circulation of outside air between the disk. Hard disks are costly and unfit to transfer data from one place to another so floppy diskettes of low capacity are used. The diskette can be frequently taken out and inserted in the disk drive unit. Based on the same laser technology as CDs, optical disks offer a medium capable of storing extremely large amounts of data. The three main types of optical disks are CD-ROM, WORM CD, and MO technology.

3.7 KEYWORDS

Memory: .It is a storing device which stores programs, data, results, etc.

Magnetic Tape: Magnetic tapes are used as external storage device to keep back-up copies of precious software and data.

Magnetic Disks: Magnetic disks are used as an input, output or external storage device.

Winchester Disk/Hard Disk: It is a group of large metal or plastic disks permanently sealed in a container.

3.8 QUESTIONS FOR DISCUSSION

1. What is Magnetic tape? How recording is performed in magnetic field?
2. Discuss advantages and disadvantages of magnetic tape.
3. What is Magnetic disk? Discuss how data is stored in magnetic disk.
4. Discuss addressing of records in magnetic disk.
5. Discuss advantages and disadvantages of magnetic disk.
6. What are different types of disks? Discuss.

Check Your Progress: Modal Answers

1. Hard disks are costly and unfit to transfer data from one place to another so floppy diskettes of low capacity are used. These diskettes are economical and very flexible to use and are fixed inside the computer system. The diskette can be frequently taken out and inserted in the disk drive unit. During operation, floppy disk drive heads actually touch the surface of the magnetic disk. This results in quick wear and tear of the disks and the read-write heads. These diskettes are made up of plastic and have a magnetic coating. The disk is covered in a protective sheath with opening for editing and writing.
2. Magneto-optical (MO) Disks are erasable and combine the magnetic principles used on tape and disk with new optical technology. MO disks measure storage capacity in gigabytes; they are removable, portable and durable. One of the newest MO systems—Orray produced by Pinnacle Micro—uses a storage method similar to that of RAID (Redundant Array of Inexpensive Disks).

3.9 SUGGESTED READINGS

William Stallings, *Computer Organization and Architecture*, 6th edition, Pearson Education, 2002.

A.S.Tannenbaum, *Structured Computer Organization*: Prentice-Hall of India, 1999.

R. P. Beales, *PC Systems, Installation and Maintenance*, Second Edition.

Ron Gilster, *PC Upgrade and Repair Black Book.*

Peter Norton's, *Inside the PC.*

LESSON

4

CLEANING AND PREVENTIVE MAINTENANCE

CONTENTS

4.0 AIMS AND OBJECTIVES

After studying this lesson, you will be able to:

- Discuss cleaning computer and peripherals
- Describe cleaning equipments
- Identify ESD (Electrostatic) precaution and procedure
- Explain hard disk maintenance

4.1 INTRODUCTION

Prevention is always better than cure. It's a universal law and also very much applicable to IT Equipments, personnel and Industry. Our PC's two mortal enemies are heat and moisture. Excess heat accelerates the deterioration of the delicate circuits in our system. The most common causes of overheating are dust and dirt: Clogged vents and CPU cooling fans can keep heat-dissipating air from moving through the case, and even a thin coating of dust or dirt can raise the temperature of our machine's components.

Any dirt, but particularly the residue of cigarette smoke, can corrode exposed metal contacts. That's why it pays to keep our system clean, inside and out.

If your PC resides in a relatively clean, climate-controlled environment, an annual cleaning should be sufficient. But in most real-world locations, such as dusty offices or shop floors, our system may need a cleaning every few months.

All we need are lint-free wipes, a can of compressed air, a few drops of a mild cleaning solution such as Formula 409 or Simple Green in a bowl of water, and an antistatic wrist strap to protect our system when we clean inside the case.

By Definition, Preventive maintenance (PM) has the following meanings:

"The care and servicing by workers for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects."

Maintenance, including tests, capacity, adjustments, and parts replacement, performed specifically to prevent faults from happening.

4.2 CLEANING COMPUTER AND PERIPHERALS

Cleaning your computer, components and peripherals helps keep the components and computer in good working condition and helps keep the computers from spreading germs. To the right is an example image of how dirty the inside of your computer case can get. This example is a dirty computer case fan.

The frequency of how often you should clean your computer varies on several different factors. Further, it is suggested that we should thoroughly clean each and every components of our computer once in every 11 months.

Below is a listing of general tips that should be taken when cleaning any of the components or peripherals of a computer as well as tips to help keep a computer clean.

- Never spray any type of liquid onto any computer component. If a spray is needed, spray the liquid onto a cloth and then use that cloth to stroke down the components.
- End Users can use a vacuum to suck up dirt, dust, or hair around their computer on the outside container and on their keyboards. However,do not use a vacuum for the inside of your computer as it generates a lot of static electricity that can damage the internal components of your computer. If you need to use a vacuum to clean the inside of your computer, use a portable battery powered vacuum designed to do this job.
- When cleaning a component and/or the computer, turn it off before cleaning. Never get any component inside the computer or any other circuit board moist.
- Be very cautious when using any type of crackdown solvents; some individuals may have allergic reactions to chemicals in cleaning solvents and some solvents can even damage the case. Try to always use water or a highly diluted solvent.
- When cleaning, be careful not to accidentally adjust any knobs or controls. In addition, when cleaning the back of the computer, if anything is plugged in, make sure not to disconnect any of the plugs.
- When cleaning fans, particularly the smaller fans within a moveable computer, it's suggested that you either hold the fan or place something in-between the fan blades to stop it from rotating. Spraying compressed air into a fan or cleaning a fan with a vacuum may cause damage to some fans or in some cases cause back voltage.
- Try to avoid eating or drinking around the computer.

4.2.1 Cleaning Tools

Although many companies have created products to help improve the procedure of cleaning your computer and peripherals, end users can also use household items to clean their computers and peripherals. Below is a listing of items you may need or want to use even as cleaning your computer or computer peripherals.

Keep in mind that some components in your computer may only be able to be cleaned using a product designed for cleaning that component; if this is the case, it will be mentioned in the cleaning tips.

- ***Cloth:*** A cloth is the best tool used when rubbing down a component; although paper towels can be used with most hardware, we recommend using a cloth whenever possible.
- ***Water or rubbing alcohol:*** When moistening a cloth, it is best to use water or rubbing alcohol. Other solvents may be bad for the plastics used with your computer.
- ***Portable Vacuum:*** Sucking the dust or similar particles out of a computer can be one of the best methods of cleaning a computer. Over time, these items can restrict the airflow in a computer and cause circuitry to rust.
- ***Cotton scrub:*** Cotton swaps moistened with rubbing alcohol or water are excellent tools for wiping hard to reach areas in your keyboard, mouse, and other peripherals.
- ***Foam swabs:*** It is better to use lint-free swabs such as foam swabs.

4.2.2 Case Cleaning

It gives or keeps appearance of the computer looking new? During cleaning, if airing locations are found, these can be cleaned helping the case keep a stable airflow to the computer, keeping machinery cool and in good working state.

The plastic case that houses the PC workings can be cleaned with a lint-free cloth that has been slightly dampened with water. For determined stains, add a little family detergent to the cloth. It is recommended that you never use a solvent cleaner on plastics.

Make sure all vents and air holes are hair and lint free by rubbing a cloth over the holes and vents. It is also helpful to take a vacuum around each of the hole, vents, and crevices on the computer. It is safe to use a standard vacuum when cleaning the outside vents of a computer; however, if you need to clean the inside of the computer, use a portable battery powered vacuum to prevent static electricity.

4.2.3 CD-ROM/Disc Cleaning

A dirty CD-ROM drive or other disc drive can cause read errors with CD discs. These read errors could cause software installation issues or issues while running the program.

To clean the CD-ROM drive we recommend purchasing a CD-ROM cleaner from your local retailer such as a local Radio Shack. Using a CD-ROM cleaner should adequately clean the CD-ROM laser from dust, dirt, and hair.

In addition to cleaning the drive with a special disc intended to clean drives users can also use a cloth moistened with water to clean the tray that ejects from the drive. Make sure however that after the tray has been cleaned that it completely dry before putting the tray back into the drive.

4.2.4 CD/DVD Cleaning

Dirty CDs can cause read errors and/or cause CDs to not work at all.

Cleaning CDs and DVDs should be done with a cleaning kit but can also be done with a normal clean cotton cloth or shirt. When doing this with a clean cotton cloth or shirt, wash against the tracks, starting from the middle of the CD or DVD and wiping towards the outer side as shown in the below picture. It is highly recommended when cleaning a CD that water is used. However, if the substance on a CD cannot be removed using water, pure alcohol can also be used.

4.2.5 Floppy Drive Cleaning

Dirty read/write heads on the floppy drive can cause errors during the reading and/or writing process. The floppy drive can be cleaned by two different ways. The first method of cleaning a floppy drive, and our suggested method, is to purchase a kit at your local retail store designed to clean the read/write heads on your floppy drive.

The second method of cleaning the floppy drive is only recommended for experienced computer users. Open the floppy drive casing and physically swab the read/write heads with a lint-free foam swab soaked in pure alcohol, or trichloroethane. While performing these steps, be extremely careful when cleaning the heads to ensure that you do not lock them out of position causing the floppy drive to not work. To help prevent the heads from becoming out of alignment, use a dabbing motion lightly putting the swab on the head and removing it; do not perform a side-to-side motion with the swab.

4.2.6 Hard Disk Drive Cleaning

While hard drives cannot be cleaned physically, they can be cleaned with various utilities on the computer to help it run fast and more professionally. Utilizing these utilities will prevent the hard drive from slowing down.

4.2.7 Headphones Cleaning

If the headphones being used are plastic and/or vinyl, moisten a cloth with warm water and rub the head and earpieces of the headphones. As mentioned earlier in our cleaning tips, it is recommended that if your headphones are being used for a library or school that you do not use any type of disinfectant or cleaning solvent as users may have allergic reactions to the chemicals they contain.

Headphones that have cushions also have the easiness of usages having the cushions replaced. Replacing these cushions can also help keep the headphones clean.

4.2.8 Keyboard Cleaning

The Computer keyboard is often the most germ infected substance in your home or office; often it will contain more bacteria than your toilet seat. Cleaning it can help remove any dangerous bacteria. Dirt, dust and hair can also build up causing the keyboard to not function correctly.

Prior to cleaning the keyboard first turn off the computer or if you're using a USB keyboard simply unplug it. Not unplugging the keyboard can result in causing other computer problems as you may press keys that cause the computer to perform a task you don't want it to do.

Many people clean the keyboard by turning it upside down and shivering. A more effective method is to use dense air. Compressed air is pressurized air contained in a can with a very long needle. Simply aim the air between the keys and blow away all of the dust and debris that has gathered there. A vacuum cleaner can also be used, but make sure the keyboard doesn't have loose "pop off" keys that could possibly be sucked up by the vacuum.

If you wish to clean the keyboard more widely you'll need to remove the keys from the keyboard. After the dust, dirt, and hair has been removed. Put a disinfectant onto a cloth. As mentioned in our general cleaning tips, never spray any type of liquid onto the keyboard.

Something Unwanted Spilt into the keyboard

If the keyboard has anything spilt into it (e.g. cola, Pepsi, Coke, milk, juice etc.), not taking the proper steps can cause the keyboard to be destroyed.

Below are a few recommendations to help thwart a keyboard from becoming bad once a substance has been split within it.

If anything is spilt onto the keyboard turn the computer off immediately or at the very least disconnect it from the computer. Once done quickly flip the keyboard over helping to prevent the substance from penetrating circuits. While the keyboard is upside down, shake the keyboard over a surface that can be cleaned later. While still upside down, use a cloth to help clean out what can be reached. After cleaned to the best of your ability leave the keyboard upside down for at least one night allowing it to dry. Once dry, continue cleaning the keyboard with any remaining substance.

4.2.9 LCD Cleaning

Dirt, dust, and finger prints can cause the computer screen to be difficult to read.

Unlike a computer monitor, the LCD/flat-panel display is not made of glass, therefore requires special cleaning procedures.

When cleaning the LCD screen it is important to remember to not spray any liquids onto the LCD directly, press gently while cleaning, and do not use a paper towel as it may cause the LCD to become scratched.

To clean the LCD screen we recommend that you use a non-rugged microfiber cloth, soft cotton cloth. If a dry cloth does not completely clean the monitor, you can apply rubbing alcohol to the cloth and wipe the screen with the moist cloth. Rubbing alcohol is in fact used to clean the LCD before it leaves the factory.

4.2.10 Monitor Cleaning

This part is for computer monitors if you have a LCD or flat-panel. Dirt, dust, and fingerprints can cause the computer screen to be difficult to read.

The glass monitor screen can be cleaned with ordinary household glass cleaner. Switch off power from the monitor and spray the cleaner onto a lint free-cloth so the fluid doesn't leak into the electrical components inside the monitor. Vacuum off any dust that has settled on top of the monitor, and make sure no books or papers have been placed on the air vents. Thwarted monitor vents can cause the monitor to overheat or even catch on fire.

We suggest using a cloth dampened with water when cleaning monitor on a screen that is not made of glass or has any type of anti-glare protection on the screen. Using ordinary household glass cleaner on special screens, particularly cleaners with ammonia can remove anti-glare protection and/or other special surfaces.

Other Cleaning Solutions

- Micro fiber Towels
- Swifter Dusters

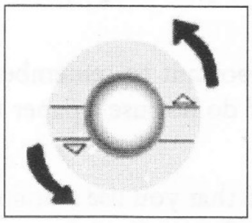
4.2.11 Motherboard Cleaning

Dust and specially particles of cigarette smoke can build up and oxidize circuitry causing various problems such as computer lockups. Alternative solution to compressed air is to use a portable battery powered vacuum that can efficiently remove the dust, dirt, and hair from the motherboard completely and stop it from getting attentive within the box. However, do not use a standard electricity powered vacuum as it can cause a lot of static electricity that can damage the computer. When using the vacuum it is vital that you stay a couple inches away from the motherboard and all other components to help prevent contact as well as to help prevent anything from being sucked into the vacuum. Ensure that you do not remove any small components with the vacuum such as jumpers.

When cleaning the inside of the case also look at any fans and/or heat sinks. Dust, dirt, and hair collect around these components the most.

4.2.12 Mouse Cleaning

A dirty optical-mechanical mouse (mouse with a ball) can cause the mouse to be difficult to move as well as cause strange mouse movement.



To clean the rollers of an optical-mechanical mouse, you must first remove the bottom cover of the mouse. To do this, examine the bottom of the mouse to see which direction the mouse cover should be rotated. As you can see in the below illustration, the mouse cover must be moved counter clockwise. Place two fingers on the mouse cover and push the direction of the arrows.

Once the cover has rotated about an inch, rotate the mouse into its normal position, covering the bottom of the mouse with one hand and the bottom should fall off including the mouse ball. If this does not occur, attempt to shake the mouse gently.

Once the bottom cover and the ball are removed, you should be able to see three rollers located within the mouse. Use a cotton swab, your finger, and/or fingernail and move in a horizontaldirection of the rollers. Usually, there will be a small line of hair and or dirt in the middle of the roller, remove this dirt and/or hair as much as possible.

Once you have removed as much dirt and hair as possible, place the ball back within the mouse and place the cover back on.

To help keep a mouse clean and germ free it can be helpful to clean the mouse.

Use a cloth moistened with rubbing alcohol or warm water and rubs the surface of the mouse and each of its buttons.

4.2.13 Palm Pilot Cleaning

Dirty touch screens can cause difficult routing.

To clean the Palm Pilot Screen, uses a soft cloth moistened with rubbing alcohol and rub the screen and the casing of the palm pilot. It is not recommended to use glass cleaner as it could damage plastics over time.

4.2.14 Printer Cleaning

Cleaning the outside of a printer can help keep the printer's manifestation looking good; and in the case of a printer that is used by many different people, keep the printer clean of germs.

First, make sure to turn off the printer before cleaning it. Dampen a cloth with water or rubbing alcohol and wash the case and each of the buttons or knobs on the printer. As mentioned earlier, never spray any liquid directly onto the printer. With some printers it may be necessary to clean the inside of the printer to help keep the printer running smoothly.

Because of numerous types of printers, different steps in cleaning printers, and printer manufacturer policies on cleaning the inside of the printer, we recommend you obtain the printer cleaning steps from your printer manufacturer.

4.2.15 Scanner Cleaning

Flatbed scanners usually become dirty with dust, fingerprints, and hair. When a scanner is dirty, the images may have distortions.

Clean a flatbed scanner's surface by spraying a window cleaner onto a paper towel or cotton cloth and wash the glass until clean. As mentioned earlier, never spray a liquid directly onto the components.

To clean the outside of the scanner, the same towel or cotton cloth can be used.

4.2.16 Super Disk/LS120 Cleaning

It is recommended that the Super Disk / LS120 drive be cleaned regularly to prevent drive heads from becoming dirty.

Purchase the Super Disk cleaning kit available through simulation. Using any other method will void the warranty on your drive.

4.2.17 Cleaning Equipments

For cleaning or protecting our computer device/s, we should have following items:

- Anti Static Wrist Strap
- Compressed Air
- Non-Static Vacuums
- Phillips Screwdriver
- Soft (lint-free) cloth
- Rubbing Alcohol (Isopropyl)

Anti-Static Wrist Strap: Worn to protect your fragile computer components from static electricity damage. (Note: Electrostatic Discharge (ESD) is the term used to describe the transfer of static electricity from one object to another. As we go about our daily lives, we gather certain amounts of electrostatic accuse. This happens mostly in low dampness areas; in winter and in dry seasons. Our bodies also produce static electricity which is caused by excess electrons (negatively charged particles) being formed especially when we walk on carpeting. Your computer components inside your case (especially your hard drive) are prone to being affected by Electrostatic Discharge. It is very likely for you to be damaging your responsive electronic components inside your case from Electrostatic Discharge without knowing it. If you felt a discharge, it possibly was more than 2,000 volts. A discharge as low as 200 volts can destroy your computer chip. It is possible that this damage might not be noticeable right away. Your components might just start a deprivation process that slowly kills your computer parts. You could (for example) start getting irregular breakdowns until your computer stops functioning properly)

Compressed Air: This will discharge air to blow away dust and debris from hard-to-reach areas of your computer such as your motherboard, memory cards and fan blades.

Use a small screw driver to 'jam' fan blades to avoid them from rotating when using dense air since there is a possibility of regenerative electricity that could damage receptive electronics.

Non-Static Vacuums: Common household dust kills PCs. Throw in some dog and cat hair and you might as well call a priest right now. A dust buildup can cause dreaded static and can cause your components to overheat and become useless. When removing dust buildup from your keyboard, inside your computer's case, and from your components, use a non-static vacuum. Many hand-held vacuums are designed specifically for use on PCs. Note that you should definitely not use a common household vacuum cleaner. These create static electricity and can toast your PC!

Computer Vacuum Cleaner: This will be handy to suck out dirt, dust and other particles from your computer. Do not use household vacuum cleaners and shop vacuums.

Phillips Screwdriver: To open your computer case.

Soft (lint-free) cloth: To clean off your components and the exterior of your computer.

Rubbing Alcohol (Isopropyl): Alcohol is the only solvent that I would recommend since others might not work well with the plastic that makes up your computer.

Isopropyl Alcohol is a high quality rubbing alcohol that can be found in most drug stores and is excellent for cleaning off thermal compounds.

Water: To help to clean the exterior of your computer.

Lint-free cotton swabs (tips): Used to clean areas of your computer that are hard-to-reach.

4.3 ESD (ELECTROSTATIC) PRECAUTION AND PROCEDURE

ESD is the discharge of built up static electricity. Electrostatic discharge however, should not be taken lightly when working with computers. ESD has the capability of causing enough damage to the components inside your computer to render it completely inoperable. It's important to use an anti-static strap and/or a grounding mat whenever working on the inside of your computer. Being aware of ESD precautions can significantly reduce the chance of damage to your computer due to static electricity.

Avoid carpets in cool, dry areas. Leave PC cards and memory modules in their anti-static packaging until ready to be installed.

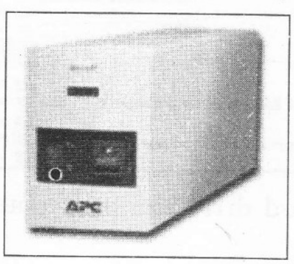
Dissipate static electricity before handling any system components (PC cards, memory modules) by touching a grounded metal object, such as the system unit unpainted metal chassis.

If possible, use antistatic devices, such as wrist straps and floor mats.

- Always hold a PC card or memory module by its edges. Avoid touching the contacts and components on the memory module.
- Take care when connecting or disconnecting cables. A damaged cable can cause a short in the electrical circuit.
- Prevent damage to the connectors by aligning connector pins before you connect the cable. Misaligned connector pins can cause damage to system components at power-on.
- When disconnecting a cable, always pull on the cable connector or strain-relief loop, not on the cable itself.

4.3.1 Uninterruptible Power Supply

A UPS helps in blackout situations, during which the electricity cut offs completely for a period of time, and brownouts, during which the electrical supply sags well below the level needed to run your PC. Every UPS has batteries that provide backup power, thus enabling you to save your work and shut down your PC properly. A UPS is thus sometimes called a battery backup. Note that a UPS does not provide unlimited power so you can keep working while the city lights are out. What it does provide you is a short window of a couple of minutes to save and shut down. UPS come in two main varieties, Standby Power System (SPS) and online UPS. Both of these will protect your system in the event of a power outage or sag, but they work differently and provide different levels of protection.



Standby Power Systems

An SPS has a battery that begins generating power as soon as the unit detects a sag in the supply of electricity. It takes a split second for the SPS to come online, however, and therein lies the main disadvantage to using an SPS. The brief lapse of time could result in your files being damaged before the UPS has kicked in.

Online UPSs

An online UPS, in contrast to an SPS, provides electricity to the PC all the time, using the electricity from the AC outlet simply to recharge its batteries. If you have an electrical brownout or blackout, your PC does not even flinch, and you'll have plenty of time to save and shut down properly. As an added bonus, most online UPS boxes act as power conditioners that help your PC run better. Electricity coming from the power company does not come in a single stream of electrons at constant pressure, but rather in gentle fluctuations. Because the online UPS runs the PC from its batteries, the UPS can provide a much smoother flow of electricity that the typical wall socket. An online UPS costs more than an SPS, but in the long run its benefits justify the expense.

4.4 HARD DISK MAINTENANCE

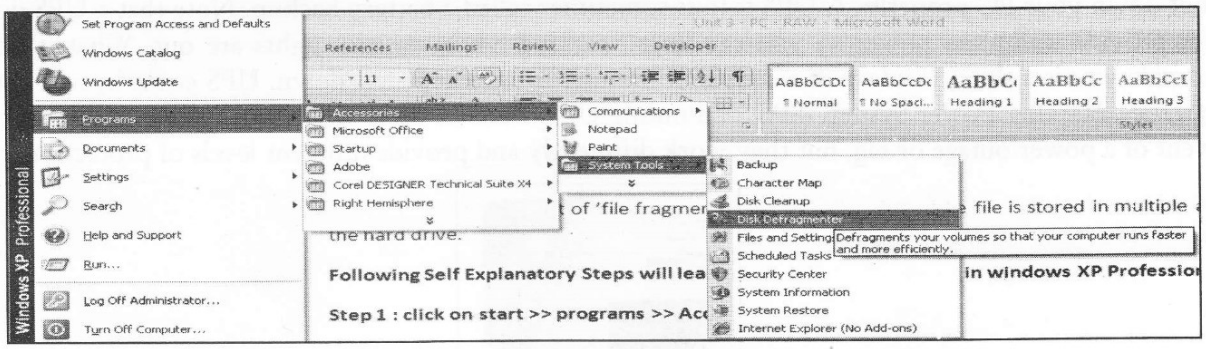
Since hard drives are one of the key system components in your computer, it's a good idea to keep it in good working order. There are several things you can do from your operating system to help things out. Further, it will increase the probability of our data storage life, speed, and net efficiency or turnaround time.

De-fragmentation

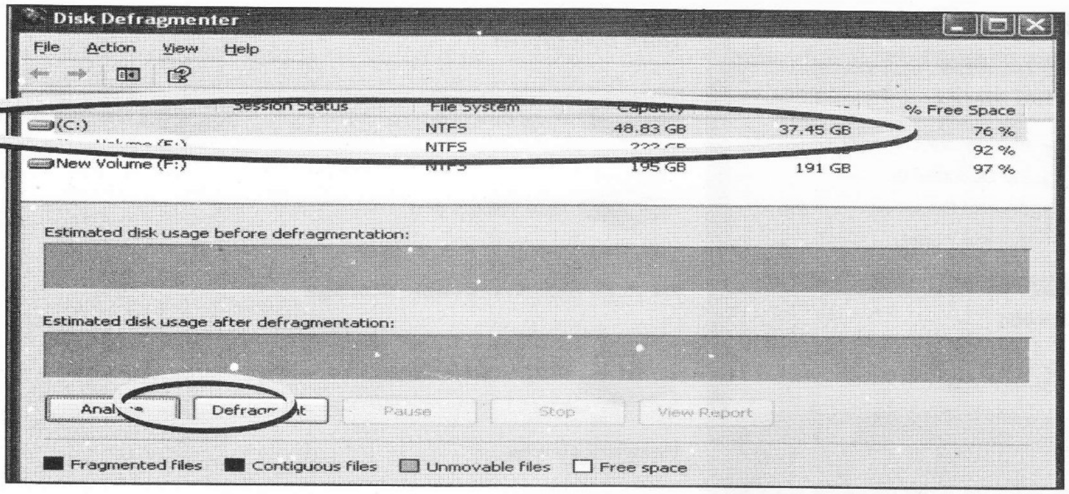
A 'defrag' as it's known in the business, is a simple process used to create harmony out of disorder on your hard drive. Files stored in your hard drive aren't placed in any logical order. The hard drive doesn't come with any advanced algorithms to place files for a program in the same area. As you delete, download, and install programs, gaps will inevitably open up and get filled with different information. The concept of 'file fragmentation' occurs when a single file is stored in multiple areas of the hard drive.

Following Self Explanatory Steps will lead to defrag your hard drive in windows XP Professional

Step 1: click on start > > programs > > Accessories > > System tools > > Disk Defragmenter



Step 2: It will ask you to select a hard drive and once opted this conclude the process with task Summary.



When files become fragmented, it takes longer for the disk to seek, read, and send the data to the CPU. With increasing amounts of fragmentation across the entire hard drive, you'll begin to feel a serious performance hit. Luckily, Windows comes with a defrag applet that is assessable through your hard drive's tools in the property menu. Just make sure you defrag your disks when it tells you that it needs it (the defrag program will automatically analyze your HD) and you'll be better off afterwards. On average, you should only need to defrag every few weeks, and the entire operation could take between 10-30 minutes, depending on the size and percentage of fragmentation on your hard drive.

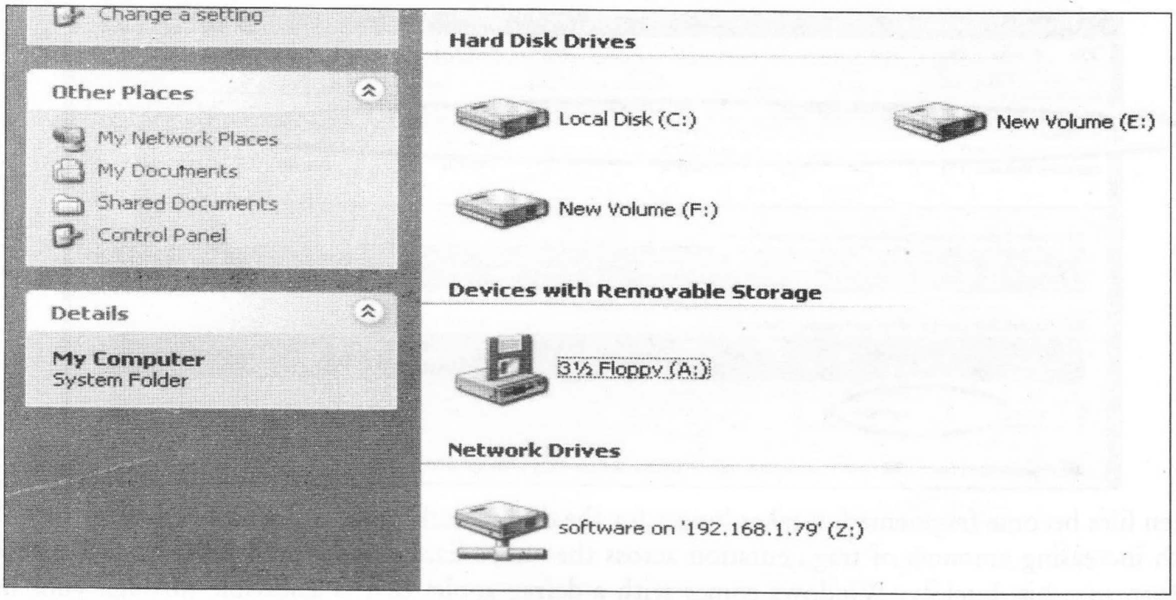
Scandisk

Sometimes a hard drive will accumulate a number of file errors that could lead to serious problems on your computer. However, most modern hard drives have 'smart' features that automatically monitor the performance of your disk. It's not so important these days to run 'scandisk' from Windows. Try to run it from time to time (maybe every month) to make sure there's nothing seriously wrong with your hard drive.

Partitioning

One advanced method of managing your hard drive is to 'partition' it into virtual drives. For instance, you could partition a 100-gigabyte hard drive into two partitions of 30 gig and 70 gig sizes. The 30-gig one would be assigned the 'C:' while the 70-gig would get 'D:'—In this way, you could use the 30-gig partition for your operating system and critical system applications, while you use the bigger 70-gig partition for games, movies, music, and miscellaneous applications. In the event that you need to re-install your OS or reformat, you can just do it for C: while all of your documents, music, and precious files are left alone on D:! Read online documents for proper instructions on how to partition your hard drive.

Like in following screenshot we have c drive with 50 GB of space and it is only reserved for Operating system and related files. But, Drive E has 200 GB of space , could be used for Application software specific files and drive F also has 200 GB of space and we are using this as a repository of all dump software's.

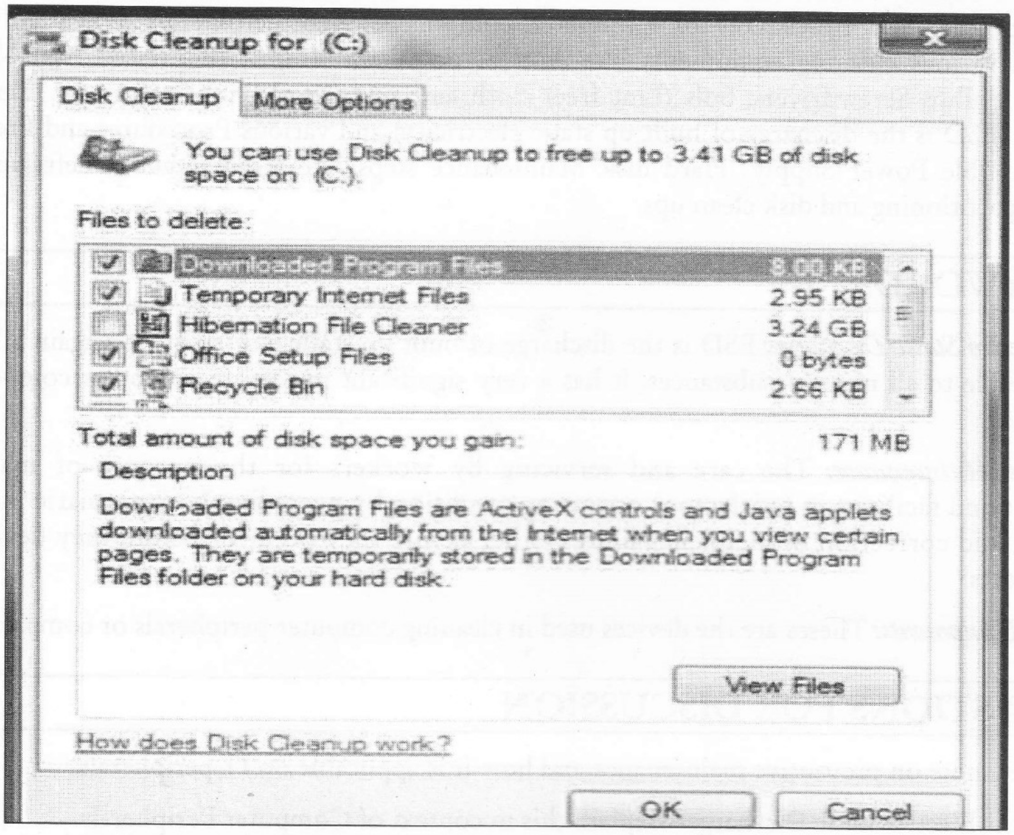


Disk Clean Up

Disk Cleanup (cleanmgr.exe) is a computer maintenance utility included in Microsoft Windows designed to free up disk space on a computer's hard drive. The utility first searches and analyzes the hard drive for files that are no longer of any use, and then removes the unnecessary files. There are a number of different file categories that Disk Cleanup targets when performing the initial disk analysis:

- Compression of old files
- Temporary Internet files
- Temporary Windows file
- Downloaded Program files
- Recycle Bin
- Removal of unused applications or optional Windows components
- Setup Log files
- Offline files

The above list, however, is not comprehensive. For instance, 'Temporary Remote Desktop files' and 'Temporary Sync Files' may appear only under certain computer configurations, differences such as Windows Operating System and use of additional programs such as Remote Desktop. The option of removal hibernation data may not be ideal for some users as this may remove the hibernate option.



Aside from removing unnecessary files, users also have the option of compressing files that have not been accessed over a set period of time. This option provides a methodical compression scheme. Infrequently accessed files are compressed to free up disk space while leaving the frequently used files uncompressed for faster read/write access times. If after file compression, a user wishes to access a compressed file, the access times may be increased and vary from system to system. In addition to the categories that appear on the Disk Cleanup tab, the More Options tab offers additional options for freeing up hard drive space through removal of optional Windows components, installed programs, and all but the most recent System Restore point or Shadow Copy data in some versions of Microsoft Windows.

Check Your Progress

How will you clean the following Components or Peripherals?

1. Monitors
2. Keyboards

4.5 LET US SUM UP

Prevention is always better than cure. It's a universal law and also very much applicable to IT Equipments, personnel and Industry. Our PC's two mortal enemies are heat and moisture. Excess heat accelerates the deterioration of the delicate circuits in our system. Cleaning your computer and your computer components and peripherals helps keep the components and computer in good working condition and helps keep the computers from spreading germs. We have elaborated various applicable cleaning process and procedures of Computer components and peripherals .Then enlisted and elaborated various cleaning equipments like Anti Static Wrist Wrap, Compressed Air, Non Static Vacuums, Philips Screwdrivers, Soft (Lint free) cloth and rubbing alcohol (Isopropyl). Electrostatic Discharge (ESD is the discharge of built up static electricity) and various Procedures and Precautions. Uninterruptible Power Supply. Hard disk Maintenance steps like fragmentation, defragmentation, Scandisk, partitioning and disk clean ups.

4.6 KEYWORDS

ESD – Electro Static Discharge: ESD is the discharge of built up static electricity. It's again a Universal law applicable to all matters/substances. It has a very significant impact on computer components or peripherals.

Preventive Maintenance: The care and servicing by workers for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.

Cleaning Equipments: Theses are the devices used in cleaning computer peripherals or components.

4.7 QUESTIONS FOR DISCUSSION

1. Make a note on preventive maintenance and how it is applicable on IT peripherals.
2. What is Electro Static Discharge? Explain this in context of Computer Peripherals.
3. What are the various equipments used in Preventive Maintenance of peripherals?
4. What do you think cleaning computer components or peripherals will give any results? Explain your Choice.
5. What are the various steps involved in hard disk maintenance? Elaborate each step.
6. What are the various usages of following equipments:
   (a) Anti Static Wrist Wrap
   (b) Compressed Air
   (c) Non Static Vacuums
   (d) Philips Screwdriver
   (e) Soft Cloth
   (f) Rubbing Alcohol.

Check Your Progress: Modal Answers

1. The glass monitor screen can be cleaned with ordinary household glass cleaner. Vacuum off any dust that has settled on top of the monitor, and make sure no books or papers have been placed on the air vents. We suggest using a cloth dampened with water when cleaning monitor on a screen that is not made of glass or has any type of anti-glare protection on the screen. Using ordinary household glass cleaner on special screens, particularly cleaners with ammonia can remove anti-glare protection and/or other special surfaces. Other Cleaning Solutions which are used for monitor are Micro fiber Towels and Swifter Dusters
2. Many people clean the keyboard by turning it upside down and shivering. A more effective method is to use dense air. Compressed air is pressurized air contained in a can with a very long needle. Simply aim the air between the keys and blow away all of the dust and debris that has gathered there. A vacuum cleaner can also be used, but make sure the keyboard doesn't have loose "pop off" keys that could possibly be sucked up by the vacuum.

4.8 SUGGESTED READINGS

William Stallings, *Computer Organization and Architecture*, 6th edition, Pearson Education, 2002.

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Peter Norton's, *Inside the PC.*

UNIT III