UNIT-1

PC HARDWARE AND ITS COMPONENTS

CHAPTER OUTLINE

1.1 PC HARDWARE AND SOFTWARE

Now a days we can not imagine our world without Personal Computer. PCs are occupying place in almost all the offices and even in homes also. Computer consists of two major components referred as *hardware* and *software*.

1. **Hardware :** Hardware of a computer is defined as something which we can touch and feel in a computer. Hardware of a computer minimally comprises of monitor, mouse, keyboard, speakers etc., which we can see, touch and feel.

2. **Software :** Software of a computer comprises of set of programs which enable all the hardware components of a computer to work together. Software cannot be touched but what makes all the components of a computer together is software. What all you see on the monitor is provided by software called as **Operating system.**

   A computer without software is like a car without driver.

   Software is often Divided into Two Categories :

   - **Systems Software :** Includes the operating system and all the utilities that enable the computer to function. The purpose of the system software is to improve the performance of the system.
   - **Applications Software :** The software designed for a specific application is application software. The programs we develop comes under this category. For example, word processors, spreadsheets, and database management systems fall under the category of applications software.

   Differences Between Hardware and Software : There are several differences between computer hardware and software.

S.No.	Hardware	Software
1.	Physical parts of the computer are called hardware.	A set of instructions given to the computer is Called software.
2.	You can touch, see and feel hardware.	You cannot touch and feel software.
3.	Hardware is constructed using physical materials or components.	Software is developed by writing instructions in programming language.
4.	Computer is hardware, which operates under the control of a software.	The operations of computer are controlled through software.
5.	If hardware is damaged, it is replaced with new one.	If software is damaged or corrupted, its backup copy can be reinstalled.
6.	Hardware is not affected by computer viruses.	Software is affected by computer viruses.

7.	Hardware cannot be transferred from one place to another electronically through network.	Software can be transferred from one lace to another electronically through network.
8.	User cannot make new duplicate copies of the hardware.	User can make many new duplicate copies of the software.
9.	Computer monitor or the mouse you're using to navigate is considered computer hardware.	Software like Microsoft Windows, an operating system that allows you to control your computer and other programs that run on it.

1.2 IMPORTANCE OF BIOS

BIOS refers to Basic Input Output System. It is software program a PC's microprocessor uses to start a computer when you turn it on. It is the first software that runs on a PC when you turn it on. It mainly manages data flow between the computer's operating system and attached devices such as the hard disk, keyboard, Video adapter, mouse and printer.

This program is made accessible to the microprocessor on an Erasable Programmable Read-Only Memory (EPROM) chip. When you turn on your computer, the microprocessor passes control to the BIOS program and executes it..

1. Check the CMOS Setup for custom settings.
2. Load the interrupt handlers and device drivers.
3. Initialize registers and power management.
4. Perform the power-on self-test (POST).
5. Display system settings.
6. Determine which devices are bootable.
7. Initiate the bootstrap sequence.

1.3 BIOS HARDWARE INTERACTION

BIOS program runs in the computer every time you turn it on. It checks all the hardware connected to the computer whether they are connected properly, their functionality, their drivers and their connection etc. it reports to the user with a beep code if any malfunction occurs with any of the hardware device. This is check is very important for a computer and user to work with the PC after operating system is loaded.

1.4 BIOS FUNCTIONS (I) POST, (II) BOOTSTRAP LOADING

BIOS Function POST : **POST** stands for Power on Self Test. It is a process performed by BIOS with help of software routines immediately after a computer device is powered on

The principal duties of the main BIOS during POST are as follows :

- Verify CPU registers.
- Verify the integrity of the BIOS code itself.
- Verify some basic components like DMA, timer, interrupt controller.
- Verify system main memory.
- Initialize BIOS.
- Identify, organize, and select which devices are available for booting.

Bootstrap Loading : It is done by boot strap loader which is a computer program that loads operating system software for the computer after completion of the Power-On Self-Testprocess :

- It is the loader for the operating system itself.
- It runsafter completion of all self-tests, then loads and runs the OS software.
- A boot loader is loaded into main memory from persistent memory such as a hard disk.
- The boot loader then loads and executes the processes that complete the boot process.
- Now the computer will be ready touse with operating system ready to interact with the user.
- If the operating system could not found or if there exist any errors of missed volumes in the operating system, the booting process fails and reports about the problem in the operating system and suggests diagnosing it.
- The bootstrap loader has been replaced in computers that have an Extensible Firmware Interface (EFI) and is now part of the EFI BIOS.

1.5 CONFIGURATION OF A GENERAL PURPOSE COMPUTER

Configuration of a computer represents the characteristics of most important ones of it such as its processor, hard disk, memory, peripherals connected, its operating system,

etc. Any software you install on a computer mentions the minimal configuration that your computer should support in order to successfully run it. Configuration of a computer represents the characteristics and capability of the following components of a computer.

- Processor.
- Operating system.
- RAM capacity.
- Storage (Hard disk) capacity.
- Other peripherals such as Key Board, Mouse, Webcam, Speakers, Wi-Fi etc.
- CD-ROM.
- Monitor type.
- Network adapter.
- Graphic card.

The minimal configuration of a Pentium-IV computer will be like the following.

- **Processor (CPU) :** Pentium-IV.
- **Operating System :** Microsoft Windows-7 or above.
- **Memory :** 4 GB RAM.
- **Storage :** 500 GB internal hard drive.
- **Monitor/Display :** 21.5" LCD monitor.
- **Other :** Dual-band Wi-Fi, LAN card, Graphic card, Speakers, Key board, Mouse.

1.6 IDENTIFICATION OF VARIOUS COMPONENTS ON THE MOTHERBOARD

Following is the diagram of a typical mother board which maps components on it.

Mother board is the most important component in any personal computer. It is heart of the computer. Mother board contains almost every important component of the computer.

Motherboard provides the framework upon which the every other component builds. Motherboard contains most of the circuitry of the computer. Every device in the computer system connects either directly or indirectly to motherboard.

The motherboard is the main circuit board inside the PC which holds the processor, memory and expansion slots and connects directly or indirectly to every part of the PC. It's made up of a chipset, ROM and the various interconnections or buses.

A motherboard, also known as main board, system board, or logic board.

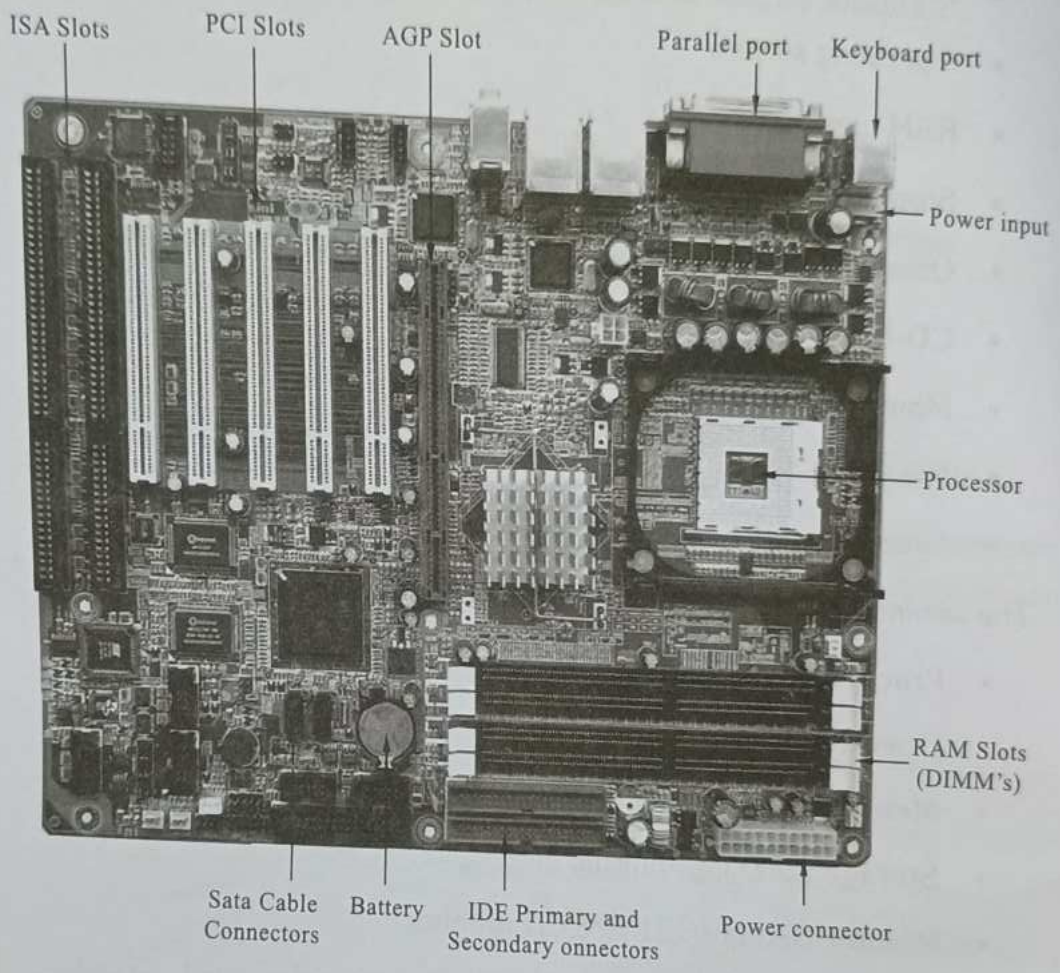
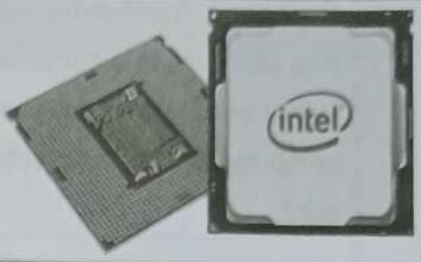


FIG 1.1 : Identification of Various Components on the Motherboard

Basic Features of Motherboard :

- Motherboard provides base upon which other components can reside.
- Mother board provides the logic.
- Motherboard provides the electrical connection between various components in the system.
- Motherboard provides CPU interface with other peripherals.
- Mother board provides interface for various add on cards such as 3 D graphics cards, sound cards, network interface cards etc.
- Mother board provides CMOS battery driven real time clock.
- Supports ports like serial, parallel, USB and Infrared etc.

Chipset : A Chipset is a group of ICs that are designed to work together and are usually marked as a single product. A chipset controls communication between processor and external devices.	
SMPS : It can call a power house of a computer. It supply power to other components, like Motherboard, Hard drive, CD rom/DVD rom etc., It reduces the amount of voltage.	
Disk Drives : A disk drive is a physical drive in a computer capable of holding and retrieving information.	
Mouse : A computer mouse is a hand held hardware input device that controls a cursor in a GUI and can move and select text, icons, files, and folders.	
Keyboard : A computer keyboard is one of the primary input devices used with a computer that looks similar to those found on electric typewriters, but with some additional keys. Keyboards allow you to input letters, numbers, and other symbols into a computer that can serve as commands or be used to type text.	
Monitor : A monitor is an output device that displays video images and text. A monitor is made up of circuitry, a screen, a power supply, buttons to adjust screen settings, and casing that holds all of these components.	
Printer : A printer is an external hardware output device that takes the electronic data stored on a computer or other device and generates a hard copy of it. Printers are one of the most popular computer peripherals and are commonly used to print text and photos.	

Speaker : A computer speaker is a hardware device that connects to a computer to generate sound. The signal used to produce the sound that comes from a computer speaker is created by the computer's sound card.

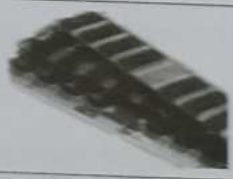
Modem : A Modem or Broadband Modem is a hardware device that connects a computer or router to a broadband network. For example, a Cable Modem and DSL Modem are two examples of these types of Modems.

USB Ports : Short for Universal Serial Bus, USB is a plug-and-play interface that allows a computer to communicate with peripheral and other devices. USB connected devices cover a broad range; anything from keyboards and mice, to music players and flash drives. USB may also be used to send power to certain devices, such as smartphones and tablets, as well as charge their batteries.

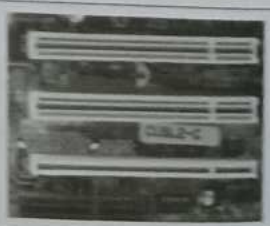
Parallel Port : A **parallel port** is a type of socket found on personal computers for interfacing with various peripherals. It is also known as a printer port or Centronics port.

Serial Port : A serial port is a serial communication physical interface through which information transfers in or our one bit at a time.

RAM : RAM stands for Random Access Memory. It is a hardware device that allows information to be stored and retrieved on a computer.



PCI : Peripheral Component Interconnect, PCI was introduced by Intel in 1992. The PCI bus came in both 32-bit (133 MBps) and 64-bit versions and was used to attach hardware to a computer.



ISA : Industry Standard Architecture, ISA is an 8-bit or 16-bit parallel bus system that allowed up to 6 devices to be connected to a PC.

REVIEW QUESTIONS

Part-A

1. What is Hardware?
2. What is Software?
3. What is BIOS?
4. What is POST?
5. Which function does POST belong to?
6. When will BIOS be run on a system?
7. Write any four components of configuration.
8. Where is a Motherboard placed in a computer?
9. Name any two components of Motherboard.
10. What is the main role of BIOS?
11. Is it important to run BIOS on a system?

Part-B

1. Define the terms hardware and software with examples.
2. What are the important functions of BIOS?
3. What is the importance of POST?
4. What is Bootstrap loading?
5. What does configuration of a computer represent?

Part-C

1. Explain the configuration of a computer with an example.
2. List and explain various components on a Mother board.
3. Explain the function of BIOS in detail.

UNIT-2

SYSTEM BOARD, PROCESSORS, MEMORIES AND MASS STORAGE DEVICES

CHAPTER OUTLINE

2.1 MOTHER BOARD

A **motherboard**, also known as a **main board**, **system board**, or **logic boards** is the central or primary circuit board making up a complex electronic system, such as a modern computer. Mother board is the most important component of the computer. Mother board ties all the components of the computer.

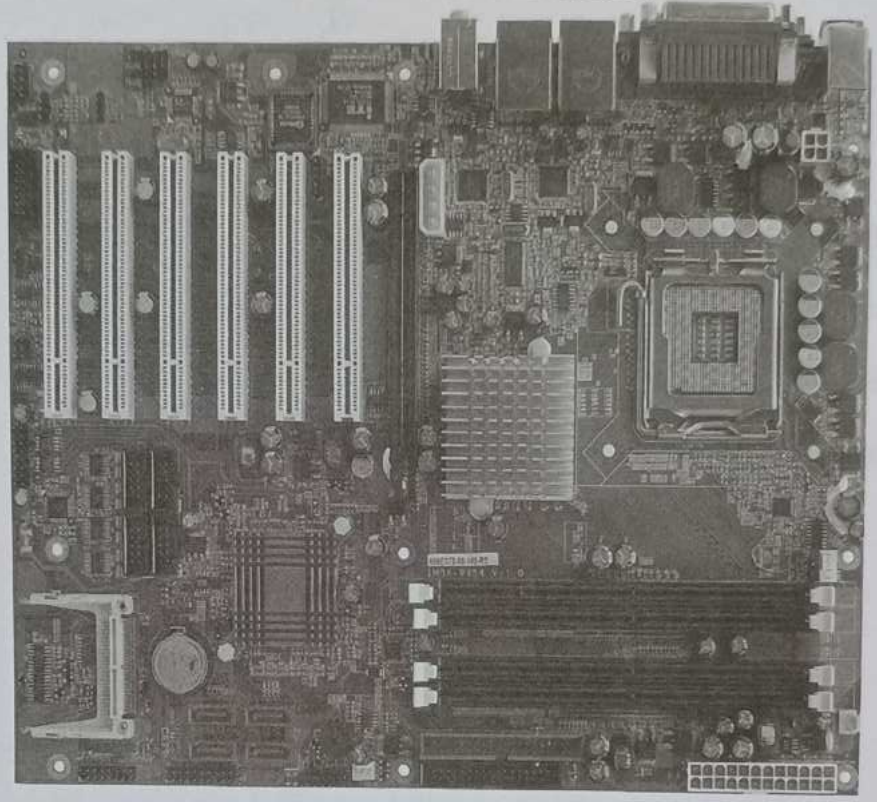


FIG 2.1 : Mother Board of a CPU

As shown in the above Fig. 2.1 the main components on a system board are :

- CPU,
- ROM BIOS,
- RAM,
- Jumpers and DIP switches,
- Power supply connections.
- System clock,
- CMOS configuration chip and its battery.
- System bus with expansion slots,
- Ports,

A typical computer is built with the microprocessor, main memory, and other basic components on the motherboard. Other components of the computer such as external storage, control circuits for video display and sound, and peripheral devices are typically attached to the motherboard.

In the initial days of computing, a computer was built in a case or Mainframe with a series of wired together connectors called a ***backplane*** into which the CPU, memory

and I/O on separate cards was plugged. With the arrival of the microprocessor, it became more cost-effective to place the backplane connectors, processor and logic onto a single *'mother'* board, and have the video, memory and I/O on *'child'* cards - hence the terms *'Motherboard'* and Daughterboard.

2.1.1 *Motherboards based on the form Factor : Such as AT, ATX, micro ATX, mini ATX, Baby AT, BTX, NLX etc.,*

Form factor is the specification of a motherboard like the dimensions, power supply type, location of mounting holes, number of ports on the back panel, etc. Specifically, in the IBM PC compatible systems, standard form factors are practised so that parts are interchangeable across different vendors and different generations of technology.

Below are various types of mother boards depending on their form factors.

Form Factor	Origin by-in	Size	Description
AT (Advanced Technology)	IBM 1984	12 × 11-13 inches	Very popular standard developed by IBM for Intel 80286 Processor.
ATX (Advanced Technology extension)	Intel 1996	12 × 9.6 inches	Became most popular form factor for commodity mother boards since 1995 till 2007.
Micro ATX	1996	9.6 × 9.6 inchses	A variant of the ATX form factor (25% shorter). Compatible with most ATX cases, but has fewer solts than ATX, with a smaller power supply unit.
Mini ATX	AOpen 2005	5.9 × 5.9 inches	Mini-ATX is slightly smaller than micro-ATX. These were designed with MoDT (Mobile on Desktop Technology) which adapt mobile CPUs for lower power requirement, less heat generation and better application capability.
Baby AT	IBM 1985	8.5 × 10-13 inches	Functionally equivalent to the AT, it became popular due to significantly smaller size.
BTX (Balanced Technology)	Intel 2004	12.8 × 10.5 inches	A standard proposed by intel, according to intel the layout has better cooling. BTX boards are flipped in comparison to ATX Boards. The RAM slots and the PCI slots are parallel to each other.
NLX	Intel 1999	8-9 × 10 inches	A low-profile design 13.6 released in 1997. It also incorporated a riser for expansion cards, and never became popular.

2.1.2 *Various Components on Motherboard*

Mother board is a PCB (Printed Circuit Board) on which CPU, Chip set, memory buses and peripheral connectors are mounted. Mother board is referred to as mother of all components attached to it, it comprises of all components needed by a computer to work. It connects all components of a computer together and makes their working possible in a sophisticated manner.

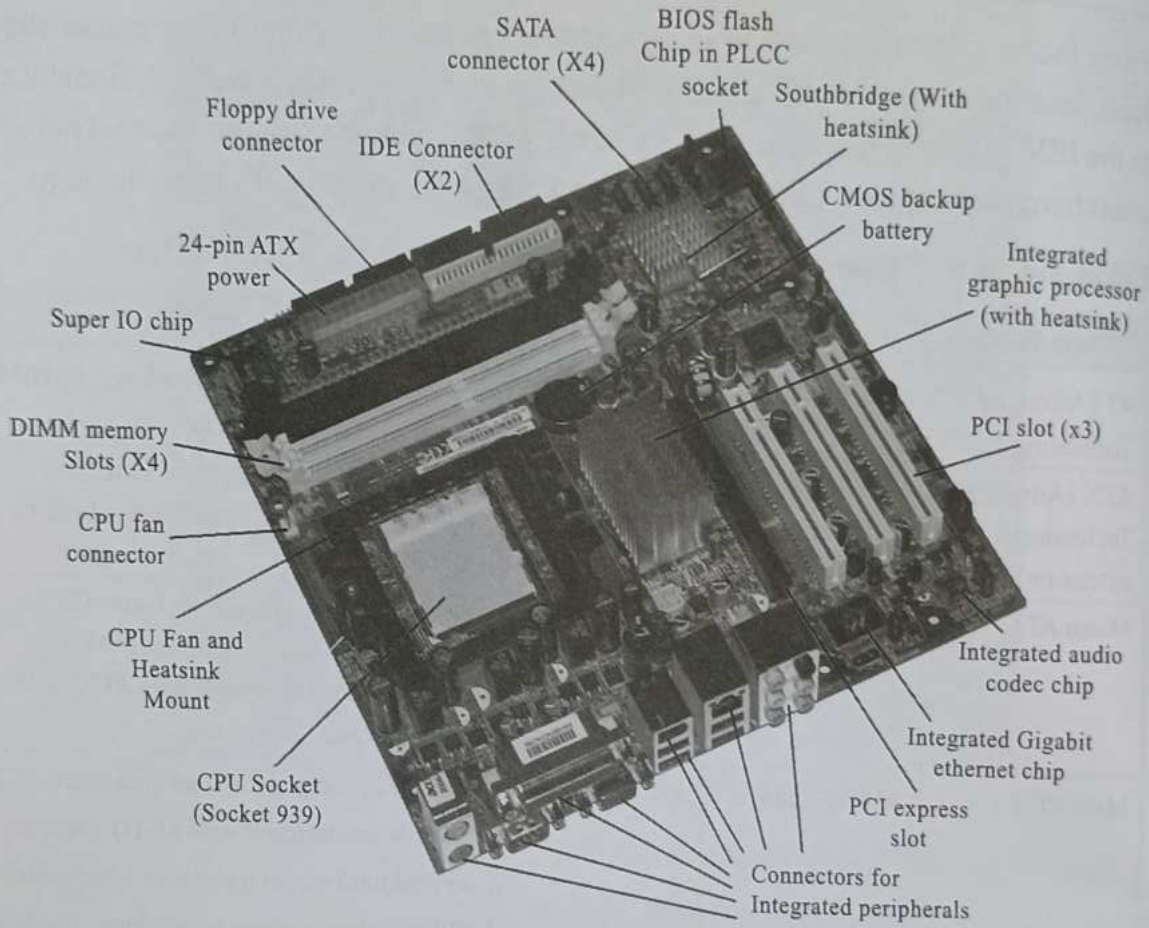


FIG 2.2 : Components of a Mother Board

Motherboard Mainly Comprise of Following Components :

- Socket to facilitate a microprocessor to be mounted.
- Slots into which the system's main memory is to be mounted.
- A chipset which is an interface between the CPU's front-side bus, main memory and peripheral buses.
- Non-volatile memory chips which contains the system's BIOS
- A clock generator which produces the system clock signal to synchronize all components.
- Slots for expansion cards.

- Power connectors, which receive electrical power from the computer power supply and distribute it to the CPU, chipset, main memory, and expansion cards.
- Connectors for hard drives.

2.1.3 Various I/O Ports Available on Motherboard

There are several I/O ports available on the motherboard to facilitate peripherals to be connected to the computer. I/O ports available on the motherboard are as follows.

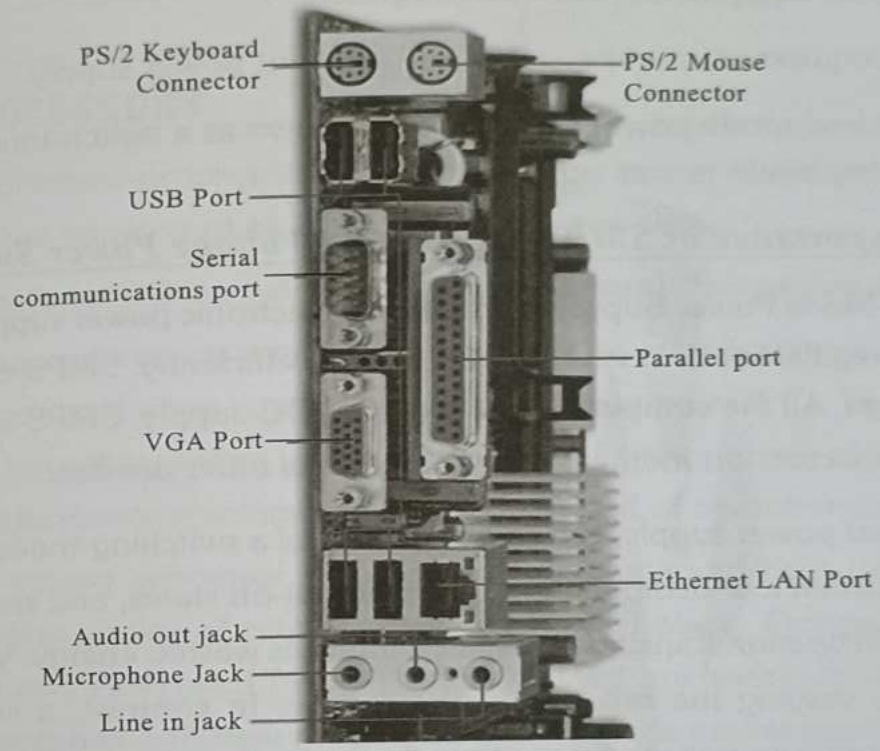


FIG 2.3 :

- **PS/2Mouse Connector :** To connect mouse.
- **PS/2 Keyboard Connector :** To connect keyboard.
- **USB (Universal Serial Bus) Ports :** To connect plug-n-play devices.
- **Serial Communication Port :** To connect serial devices such as MODEMs or switches.
- **Parallel Port :** To connect printer.
- **VGA Port :** To connect monitor.
- **LAN Port :** To connect computer to a network.
- **Audio out-Line in :** To connect speakers.
- **Microphone :** To connect microphone.

2.1.4 SMPS

A Switched-Mode Power Supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state.

- Switching power supplies have high efficiency and are widely used in a variety of electronic equipments, such as computers
- These equipment require stable and efficient power supply.
- A switched-mode power supply is also known as a switch-mode power supply or switching-mode power supply.

2.1.5 Importance of SMPS over Linear Voltage Power Supply

A **S**witched-**M**ode **P**ower **S**upply (SMPS) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. SMPS converts AC voltage to DC voltage. All the computer parts work on DC supply. SMPS supplies DC voltage through connectors on motherboard and various other devices.

Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor.

Advantages of SMPS over Linear Power Supply :

1. Low weight.
2. Smaller size.
3. Higher efficiency.
4. Lower power dissipation.
5. Wide a.c. input voltage range.
6. Reduces costs.

2.1.6 Connectors from SMPS and Voltage Levels of each Wire in various Connectors based on the Standard color of the Wire

Connectors from SMPS : SMPS uses 220 V as the input and at the out it gives DC current with different values used by different components of the computer such as + 5 V used by keyboard LED, + 12 V used by SMPS cooling fan and + 12 V for processor cooling fan. The out cable from SMPS comprises basically of six colors.

Different color wires from SMPS represent different voltage.

Orange power signal identify.

Standard Colour	Voltage
Yellow	+ 12 V
Red	+ 5 V
Black	GND
Blue	12 V
White	5 V

2.2 PROCESSORS

A processor or micro-processor is the **'brain'** of a computer system. It is the processor that controls the working of all of the hardware and software.

The processor is sometimes referred to as the **Central Processing Unit (CPU).**

There are many processors available and processor specification is usually one of the first things considered when buying a new personal computer (PC). The type of processor and its speed have the greatest impact on the overall performance of a computer system. Processor performance is related directly to its speed of operation and its architecture.

Competition among processor manufacturers is fierce and because of this there is a wide and diverse choice of processors in the market place. Processor manufacturers, such as Intel and Advanced Micro Devices (AMD) are continually developing more advanced processors and new models are released within the space of months rather than years. This is in stark contrast to earlier processor developments, such as the 8086, 80286 and 80386 which were released years apart.

I. INTEL P4, CELERON, XEON, ITANIUM PROCESSORS, AMD ATHLON

A processor is a large logic circuitry that responds to and processes each and every instruction of a computer. Processor is also meant for Central Processing Unit (CPU). The processor in a personal computer or in small devices is often called a **microprocessor.** There are several microprocessors brought into the market by different companies. There is a magnificent change in the development of microprocessors since its inception.

Some of the Processors are :

1. **Intel P4 :**
   - (Pentium 4) is developed by Intel which is a line of single-core desktop central processing units (CPUs) on November 20, 2000.

FIG 2.4 :

- They incorporated a seventh- generation x86 micro architecture called NetBurst in it which has a very deep instruction pipeline to achieve very high clock speeds.
- Latest Pentium architecture started out with a 400 MHz system bus and 256 KB L2 cache later increased to 800 MHz and 2 MB.
- Intel's first Pentium 4 chipset was the 850 and supported only Rambus memory (RD RAM), but subsequent chipsets swtiched to DDR SDRAM.

2. **Celeron :**

- It is a name of a variant given by Intel to IA-32 and x86-64 computer microprocessor models which are aimed as budget models.
- Celron is a range of x86 CPUs from Intel targeted at budge/value personal computers.
- These processors can run all IA-32 computer programs comparative to other processors of its family but their performance is less when compared to with higher-priced Intel CPU brands.

FIG 2.5 :

- The Celeron brans will often have less cache memory, or have advanced features purposely disabled. These missing features have had a variable impact on performance.

3. **Xeon :**

- It is a brand of x86 microprocessors designed and manufactured by Intel Corporation, which are aimed to work for workstation, server, and embedded system computers.

FIG 2.6:

- The Xeon CPUs generally have more cache and more multiprocessing capabilities than desktop computers.
- Xeon processors are based on the same architecture as regular desktop-grade CPUs.
- Xeon have some advanced features such as support for ECC memory, higher core counts, support for larger amounts of RAM.
- They are often capable of safely continuing execution where a normal processor cannot due to these extra RAS features, depending on the type and severity of the machine-check exception (MCE)

4. **Itanium :**

- It is a processor from a family of 64-bit Intel microprocessors that implement the Intel Itanium architecture (IA-64).
- These processors are for enterprise servers and high-performance computing systems.
- The Itanium architecture originated at Hewlett-Packard (HP).

FIG 2.7 :

- Itanium was the fourth-most deployed microprocessor architecture for enterprise-class systems, behind x86-64, Power ISA, and SPARC.
- One feature of Itanium is its use of a "smart compiler " to optimize how instructions are sent to the processor. This approach allows Itanium and future IA-64 microprocessors to process more instructions per clock cycle (IPCs).

- (IPCs can be used along with clock speed in terms of megahertz (MHz) to indicate a microprocessor's overall performance).

5. **AMD Athlon :**

- It is the brand name applied to a series of x86-compatible microprocessors manufactured by Advanced Micro Devices (AMD).
- AMD is the world;s second largest manufacturer x86 architecture processors.
- AMD solutions allow you to interact with technology in your way.
- 4 our of first 5 supercomputers of the world Today, use AMD technology.
- The original Athlon was the first of seventh-generation x86 processor. This was the first desktop processor to reach 1GHz speed.

II. DUAL CORE AND CORE 2 DUO

1. **Dual Core :**

- A Dual core is the generic name given to processors that have 2 cores on the same chip.
- Core 2 Duo is the second line of dual core processors incorporated.
- The two identical processor are manufactured so they reside side by side on the same die.
- ***Some Popular Dual Core Processors are :*** AMD A4-3300, Intel Core Duo, AMD X2.

FIG 2.8 :

Features of Dual Core :

- Execute two complete instructions at the same time.
- Integrates two processors in a single package.
- Support hyper threading technology.
- Capable of 64-bit instructions.
- Maultitasking and multithreading capability.
- Its desing is well tested and reliable.

2. **Core 2 Duo :**
   - All Core 2 Duo processors are dual core but not all dual core processors are Core 2 Duo.

FIG 2.9 :

- The Intel Core 2 Duo (also known as Core2 Duo) processors is a 64 bit dual core processor. This means two processor cores work inside a Core 2 Duo in parallel.
- Basically, the difference between dual core processors and the Core 2 Duo processors is just in the semantics as Core 2 Duo is simply a name given to a more recent family of dual core processors.
- If we translate this to the single core processors, we can say that Core Duo is Pentium 1 while Core 2 Duo is Pentium 2, while AMD has their own processors with different names; but all these are still single core processors. We can therefore say that Core 2 Duo is simply a subset of all the dual core processors that are out in the market today.

Features of Core 2 Duo :

- 64 bit support.
- Dual core processor with shared level 2 cache.
- Execute disable bit.
- Partially Intel Virtualization Technology (VT).
- Socket M (starting form santa Rosa socket P).
- 291 million transistors.

III. QUAD CORE AND I-SERIES (I3, I5 AND I7)

1. **Quad Core :** A quad-core processor is a chip with four independent units called cores that read and execute central processing unit (CPU) instructions such as add, move data, and branch. Within the chip, each core operates in conjunction with other circuits such as cache, memory management, and input/output (I/O) ports.

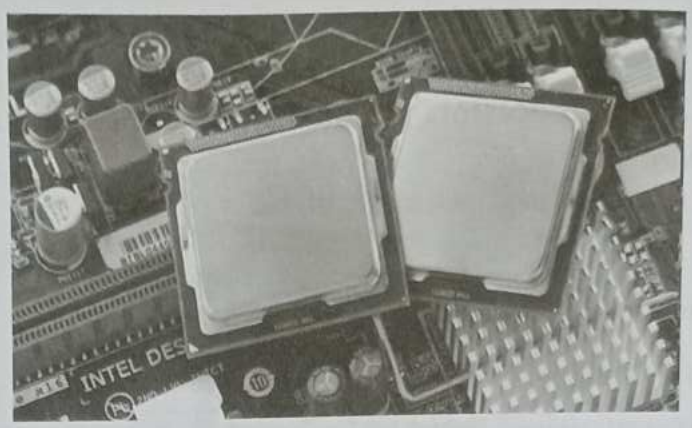


FIG 2.10 :

2. **i-Series :** Typically, the Core i3 series has only dual-core processors, while the Core i5 and Core i7 series have both dual-core and quad-core processors. Quad-cores are usually better than dual-cores.

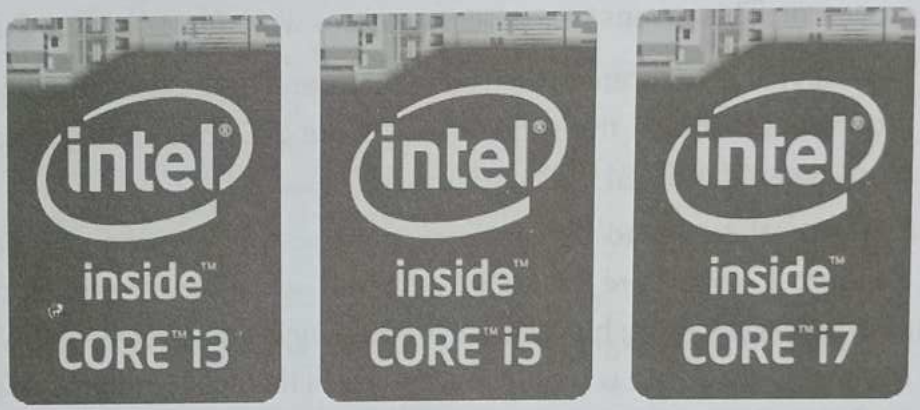


FIG 2.11 :

Intel Hyper Threading Technology is available on i3, i5 and i7 processors (i stands for Intel). This feature uses processor resources more efficiently, enabling multiple threads to run on each core. As a performance feature, Intel HT Technology also increases processor throughput, improving overall performance on threaded software. You can find the i3 processors with 2 cores and 4 threads. In the other hand, the i5 processors can be found with 4 cores and 4 threads. The more the number of cores and number of threads handled increases the processor speed.

- An Intel Core i3 to provide adequate performance for basic tasks.
- An Intel Core i5 to provide good performance for most tasks.
- An Intel Core i7 to provide great performance for the most demanding of tasks.
- Intel Core i9 processors offer higher performance because they have more cores, higher frequencies, more cache and draw more power. I9 gives highest performance with single-threaded or multithreaded workloads.

2.2.1 Chipset

I. INTEL CHIPSETS 915, 945, 955, 965, 975, AMD CHIPSETS

Definition : A chipset is a group of microchips that are designed to work with one or more related functions that were first introduced in 1986 when Chips and Technologies introduced the 82C206.

Chipset is a set of electronic components mounted on an integrated circuit that facilitates the data flow between the processor, memory and peripherals of a computer. It is mounted on the motherboard. Chipset is one of the important components of a mother board because it controls communications between the processor, peripherals and external devices and also determines system performance. Examples of chipset manufacturers include ALi, AMD, Intel, NVidia, SiS, and VIA. These chipsets can include instructions that help control the CPU, PCI, ISA, or USB hardware.

Chipest	Intel 915	Intel 945	Intel 965	Intel 975	AMD
Introduction	2004	2005	2006	2009	2009
Socket	LGA 775	LGA 775	LGA 775	FCLGA1366	AM3+
Processor	Pentium 4	Pentium 4,Pentium	Core2, Athlin.	Pentium 4	Phenom
Support	Celeron Pentium D	4, Pentium D, Celeron D	Sempron	Celeron D	
System Speed FSB1006	FSB533, FSB800, FSB1006	FSB533, FSB 800,	FSB533, FSB800,	3.33GHz	4.8 GT/s
Memory Controller	Dual DDR400 DDR2-533	Dual DDR2-667	Dual DDR-2-800	DDR3 Triple-channel	x4 DDR3
Graphics Interface	PCI Express x16	PCI Express x16	PCI Express × 16		32 Mb AMI UEFI Legal BIOS with GUI support
Max. Memory	4 GB	8 GB	8 GB	8 GB	32 GB
South bridge (8280 1FB)	ICH6 -652	ICH7 (82801-GB) -652 balls	ICH8(82801-HB) controller with two ports each	for USB 2.0 controller with two ports each	AMD SB 950
Ultra ATA/100	2 channels	1 channels	1 channel	2 channel	2 channels
Raid Support	RAID0,1 (ICH6-R)			Eeight Serial ATA channels	RAID,0, RAID1 and RAID5 RAID 10), NCQ AHCI and "Hot Plug"

Serial ATA ATA/150	4 × Serial ATA/300	4 × Serial ATA/300	6 × Serial	SATA compatible	x2 eSATA
Audio	HD Audio	HD Audio	HD Audio	HD Audio	HD Audio
Networking Express	via PCI Express emeFX X-Fi	via PCI GbE	interated LAN, Super	Via LAN cable	x1 Gigabit 7.1 Au

2.2.2 *Processor Sockets Like ZIF, SEC, LGA, PGA, BGA*

The CPU socket locks the central processing unit into place, preventing it from moving or being damaged. It also establishes the connection between the CPU and mother board so that data can transfer to the CPU for processing and return. Different models and types of computers require different types of CPU sockets, because not all CPUs are compatible with every socket.

1. **ZIF** : Zero Insertion Force socket is an extension of a PGA socket, with pins on the CPU. With a ZIF socket, you don't have to press down on the CPU to lock it in place. Instead, you simply place the CPU into the socket, and then lock it in using a lever or slider on the side of the socket. This results in less risk of you damaging the CPU when misplaced.

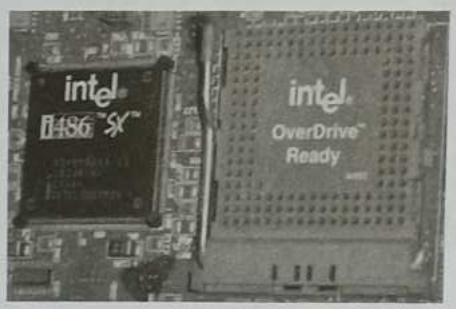


FIG 2.12 :

The following table summarizes the Zero Insertion Force (ZIF) socket characteristics for different Intel processors.

Socket	Pins	Layout	Processor (s)	Voltage
0	168	Inline	486 DX	5 V
1	169	Inline	486 DX, SX 5	V
2	238	Inline	486 DX, SX, DX2	5 V
3	237	Inline	486 DX, SX, DX2, DX4	3V or 5 V
4	273	Inline	60 or 66 MHz Pentium	5 V
5	320	Staggered	Pentium	3 V
6	235	In line	486 DX4	3 V
7	321	Staggered	Pentium	3 V
8	387	Staggered	Pentium Pro	3 V

2. SEC : Single Edge Contact Cartridge is a central processing unit (CPU) component designed to hold certain Intel microprocessors such as Pentium II and Pentium III, Pentium Pro and Celeron. The SECC is also known as Slot 1 because it is inserted into Slot 1 on the motherboard and it is used by Intel Pentium II and III processors. The card was easily inserted into Slot 1 and eliminated the chance of pins being broken or bent as with older socket versions. The processor, along with several L2 cache chips, is mounted on a small circuit board, which is then sealed in a metal and plastic cartridge.

FIG 2.13 :

3. LGA : The LGA (Land Grid Array) is a socket whose assembly is in packaging for integrated circuits. In these types of sockets, the needles are located in the CPU socket, and there are metallic points of contact in the lower area of the processor. The LGA can be electrically connected to a motherboard through a connector or by soldering the board directly. Since the socket has the pins on the motherboard instead of on the microprocessor, the microprocessor contains holes in its lower part where they insert; this prevents the microprocessor pins from being damaged, and it is the most current of all sockets.

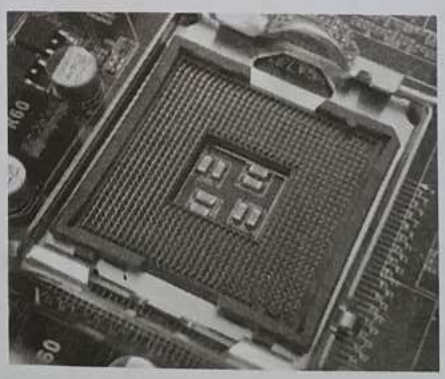


FIG 2.14 :

4. PGA : Pin Grid Array socket is usually a square package made up of a number of holes in an array. The CPU itself has the pins that insert into the socket. The arrangement of pins on the CPU must correspond to the slots on the socket; if not, the CPU will not connect properly to the board and if you do not line up the pins properly, you may bend or damage them. PGA is a chip where the connecting pins are located on the bottom. The bottom of the processor chip in this example is covered by several pins, each of these pins are plugged into a socket on a circuit board.

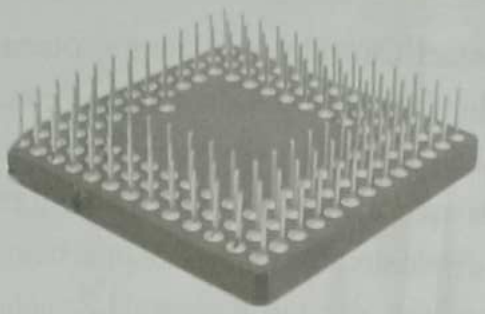


FIG 2.15 :

5. **BGA :** BGA is not as famous as other types of sockets. BGA (Ball Grid Array) socket is not technically a socket because its main characteristic is that the microprocessor are **permanently mounted in this socket.** In this case, instead of pins, some copper balls are soldered directly to the motherboard. This eliminates any possibility of upgrading or replacing the microprocessor.

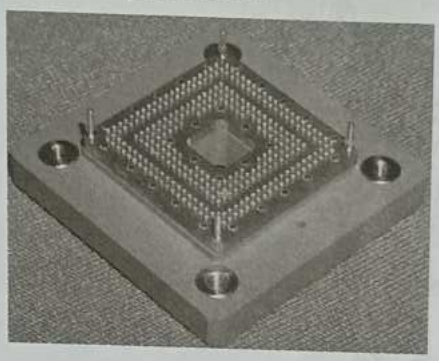


FIG 2.16 :

2.3 MEMORIES

Computer memory is any physical device capable of storing information temporarily or permanently. For example, Random Access Memory (RAM), is a volatile memory that stores information on an integrated circuit used by the operating system, software, and hardware.

Below is an example picture of a 512 MB DIMM computer memory module. This memory module connects to the memory slot on a computer motherboard.

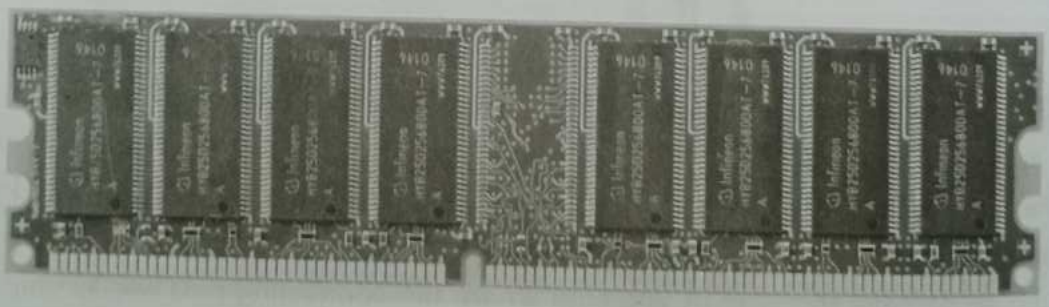


FIG 2.17 :

There are Two Basic Types of Memories (RAM). They are :

1. Static RAM.
2. Dynamic Ram.

2.3.1 *Static and Dynamic RAM*

SRAM (Static RAM) : Static RAM is a type of RAM that keeps the data fed to it. It never has to be refreshed. This type of memory maintains data in storage as long as it is powered. Static RAM is faster and more reliable and expensive than DRAM.

SRAM is most often used as cache memory. The most common type of SRAM today is pipeline burst SRAM, which can operate at higher bus speeds.

In static RAM, a form of flipflop holds each bit of memory. A flip-flop for a memory cell takes four or six transistors along with some wiring, but never has to be refreshed.

This makes static RAM significantly faster than dynamic RAM. However, because it has more parts, a static memory cell takes up a lot more space on a chip than a dynamic memory cell. Therefore, you get less memory per chip, and that makes static RAM a lot more expensive.

Static RAM is fast and expensive, and dynamic RAM is less expensive and slower. Static RAM is used to create the CPU's speedsensitive cache, while dynamic RAM forms the larger system RAM space.

DRAM (Dynamic RAM) : DRAM is called dynamic because it must constantly be refreshed and lose the data in very short time. DRAM stores each bit of data in a separate capacitor within a integrated circuit.

This type of RAM retains its data by being continuously rewritten every few milliseconds. Like SRAM, the data in storage is volatile, meaning it is lost when the system is not powered. DRAM is the most common type of expandable company memory in workstations and servers today, but there are several different types of DRAM.

In the most common form of computer memory, Dynamic Memory Cell, represents a single bit of data. The capacitor holds the bit of information – a 0 or a 1. The transistor acts as a switch that lets the control circuitry on the memory chip read the capacitor or change its state. A capacitor is like a small bucket that is able to store electrons. To store a 1 in the memory cell, the bucket is filled with electrons.

To store a 0, it is emptied. The problem with the capacitor's bucket is that it has a leak. In a matter of a few milliseconds a full bucket becomes empty. Therefore, for dynamic

memory to work, either the CPU or the Memory Controller has to come along a recharge all of the capacitors holding it before they discharge. To do this, the memo controller reads the memory and then writes it right back. This refresh operation happe automatically thousands of times per second.

2.3.2 *RAM types - SDRAM (Synchronous DRAM), Asynchronous DRA DDR1, DDR2, DDR3 and DDR4 (1-4) RAM, Rambus RAM*

1. **SDRAM (Synchronous Dynamic Random Access Memory):** "Synchronous" te about the behaviour of the DRAM type. In late 1996, SDRAM began to appear systems. Unlike previous technologies, SDRAM is designed to synchronize itself wi the timing of the CPU.

2. **SDRAM** (Synchronous DRAM) is the standard type of memory for PCs because it used in the front-side bus clock in your system. SDRAM and the bus execute instructio at the same time rather than one of them having to wait for the other. As bus speed have increased beyond 100 MHz, this will improve the system performance.

3. **DDR-1 SDRAM (Double Data Rate) :** The next generation of SDRAM is DDR, whic achieves greater bandwidth than the preceding single data rate SDRAM by transferrin data on the rising and falling edges of the clock signal (double pumped). Effectively, doubles the transfer rate without increasing the frequency of the clock. The transfe rate of DDR SDRAM is the double of SDR SDRAM without changing the internal clock DDR SDRAM, as the first generation of DDR memory, the prefetch buffer is 2bit, whic is the double of SDR SDRAM. The transfer rate of DDR is between 266~400 MT/s DDR266 and DDR400 are of this type.

4. **DDR-2 SDRAM (Double Data Rate Two SDRAM) :** Its primary benefit is the abilit to operate the external data bus twice as fast as DDR SDRAM. This is achieved by improved bus signal. The prefetch buffer of DDR2 is 4 bit(double of DDR SDRAM) DDR2 memory is at the same internal clock speed (133~200MHz) as DDR, but the transfer rate of DDR2 can reach 533~800 MT/s with the improved I/O bus signal DDR2 533 and DDR2 800 memory types are on the market.

5. **DDR-3 SDRAM (Double Data Rate Three SDRAM) :** DDR3 memory reduces 40% power consumption compared to current DDR2 modules, allowing for lower operating currents and voltages (1.5 V, compared to DDR2's 1.8 V or DDR's 2.5 V). The transfer rate of DDR3 is 800~1600 MT/s. DDR3's prefetch buffer width is 8 bit, whereas DDR2's is 4 bit, and DDR's is 2 bit. DDR3 also adds two functions, such as ASR (Automatic Self-Refresh) and SRT (Self-Refresh Temperature). They can make the memory control the refresh rate according to the temperature variation.

Rambus DRAM (Rambus Memory DRAM) send less information on the data bus (which is 18 bits wide as opposed to the standard 32 or 64 bits) but it sends data more frequently. It also reads data on both the rising and falling edges of the clock signal, as DDR does. As a result, Rambus memory is able to achieve effective data transfer speeds of 800 MHz and higher.

2.3.3 SIMM and DIMM

Single In-Line Memory Modules (SIMM) is that the little circuit boards having notches wherever the RAM chips are fixed. SIMM connectors and therefore the slot situated on the motherboard are created of metal(gold or tin). In SIMM, Pins present in either facet are connected. There are two type of SIMM presents, one with 30 pins and another one is with 72 pins.

Dual In-Line Memory Module (DIMM), additionally has metal connectors almost like SIMM, however either of the perimeters of the connective doesn't admit the opposite. DIMM supports 64 bit channel for data transferring while SIMM supports only maximum of 32 bit channel. There are three type of DIMM presents which are used by modern motherboard, one with 168 pins and second one is with 184 pins and third one is 240 pins.

SIMM have just one usable aspect because of having only one set of the instrumentality whereas DIMM have completely different signal pins at either side that square measure usable and doesn't believe the opposite side.

Differences between SIMM and DIMM :

Sl.No.	SIMM	DIMM
1.	In SIMM, Pins present in either facet are connected.	DIMM pins are freelance.
2.	SIMM supports 32 bit channel for data transferring.	DIMM supports 64 bit channel for data transferring.
3.	SIMM consumes 5 volts of power.	DIMM consumes 3.3 volts of power.
4.	SIMM provides the storage 4 MB to 64 MB.	DIMM provides the storage 32 MB to 1 GB.
5.	The classic or most common pin configuration of the SIMM module is 72 pins.	The foremost common pin configuration of the DIMM module is 168 pins.
6.	SIMMs are the older technology.	DIMMs are the replacement of the SIMMs.

2.3.4 RAM Slots

- RAM slots are often found in pairs and are sometimes color-coded for identification.
- A RAM module is rectangular and has a connector on one of the long sides.
- RAM slots or sockets on a PC motherboard are long channels, generally located close to the CPU.
- There are clasps on each end of the socket, which will snap tight around the edge of the RAM when plugged in.
- Pressing the RAM into the socket will engage these clasps, so they must be disabled before you can remove the currently installed RAM.
- You usually push the clasps away from the memory module, and they help disconnect the module from the motherboard.

2.3.5 Procedure to Upgrade RAM Capacity of the System by Adding Additional RAMs

RAM upgrade is done if your present RAM is not capable of handling the softwares and run out of space occurs.

- Shut down the computer.
- Power off the computer.
- Open the computer cabinet.
- Observe the mother board identify RAM sockets in it.
- open the latches at each end of the RAM socket by gently pushing them down.
- Line up the notch at the bottom of the memory stick with the corresponding bump in the memory socket.
- Touching the top edge of the module, gently push the piece down into the socket the latches at either end should rise and lock.
- Gently press each latch toward the edge of the RAM module to confirm that it is completely closed.
- Close the computer case.
- Power on the computer.
- Start the computer.
- Check whether the new RAM has been identified or not.
- If not, place the memory stick properly and start the computer again.

2.3.6 Cache Memory and Explain how it Improves the Performance of Memory

Cache Memory : The Cache is a fast memory which lies in between the CPU and RAM. The frequently used data is placed in the cache memory. CPU can access the cache memory at very fast rate than RAM. So cache memory is to improve the performance of the system.

The Cache Memory is attached for storing the input which is given by the user and which is necessary for the CPU to Perform a Task. But the Capacity of the Cache Memory is too low in compare to Memory and Hard Disk.

Importance of Cache Memory : The cache memory lies in the path between the processor and the memory. The cache memory therefore, has lesser access time than memory and is faster than the main memory. Cache memory has an access time of 100 ns, while the main memory may have an access time of 700 ns. The cache memory is very expensive and hence is limited in capacity. Earlier cache memories were available separately but the microprocessors contain the cache memory on the chip itself. The need for the cache memory is due to the mismatch between the speeds of the main memory and the CPU.

How cache memory can improve system performance ? Cache is a small amount of memory which is part of the CPU which is physically closer to the CPU than RAM is. The more cache there is, the more data can be stored closer to the CPU.

Cache Memory is Beneficial Because :

- Cache memory holds frequently used instructions/data which the processor may require next and it is faster access memory than RAM, since it is on the same chip as the processor.
- This reduces the need for frequent slower memory retrievals from main memory, which may otherwise keep the CPU waiting.

The more cache the CPU has, the less time the computer spends accessing slower main memory and as a result programs may run faster.

2.3.7 L1, L2 and L3 Cache and their Locations

L1 and L2 are levels of **cache memory** in a computer. These cache is usually located on the computer processor chip and not on the motherboard.

If the computer processor can find the data it needs for its next operation in cache memory, it will save time compared to having to get it from **random access memory.**

L1 is "level-1" cache memory, usually built onto the microprocessor chip itself. For example, the Intel **MMX** microprocessor comes with 32 thousand bytes of L1.

L2 (level-2) cache memory is on a separate **chip** (possibly on an expansion **card**) that can be accessed more quickly than the larger **"main"** memory. A popular L2 cache memory size is 1,024 kilobytes (1 MB). L1 is placed on the microprocessor itself and L2 is placed on the mother board.

L3 : (Level 3 cache) A memory bank built onto the motherboard or within the CPUmodule. The L3 cache feeds the L2 cache, and its memory is typically slower than the L2 memory, but faster than main memory. The L3 cache feeds the L2 cache, which feeds the L1 cache, which feeds the processor. The common L3 cache is slower but much larger, which means it can store data for all the cores at once.

2.4 MASS STORAGE DEVICES

A Mass Storage Device (MSD) is any storage device that makes it possible to store and port large amounts of data across computers, servers and within an IT environment. MSDs are portable storage media that provide a storage interface that can be both internal and external to the computer. What is the most common mass storage device?

Hard drives are amongst the most common types of mass storage devices. Most computers have a hard disk drive already built into them, and they can offer a large amount of memory which can be accessed easily by the user.

2.4.1 Different Mass Storage Devices

There are several different types of mass storage devices.

- Hard drives
- Solid state drives
- Optical disks
- Floppy disks
- Flash drives etc.

2.4.2 Constructional Details and Working of a Hard Disk Drive

Hard Disk Drive : A hard disk drive (HDD) is a data storage device used for storing and retrieving digital information using one or more rapidly rotating disks (platters) coated with magnetic material. The platters are paired with magnetic heads arranged on a moving actuator arm, which read and write data to the platter surfaces. Data is accessed in a random-access manner, meaning that individual blocks of data can be stored or retrieved in any order rather than sequentially. HDDs retain stored data even when powered off.

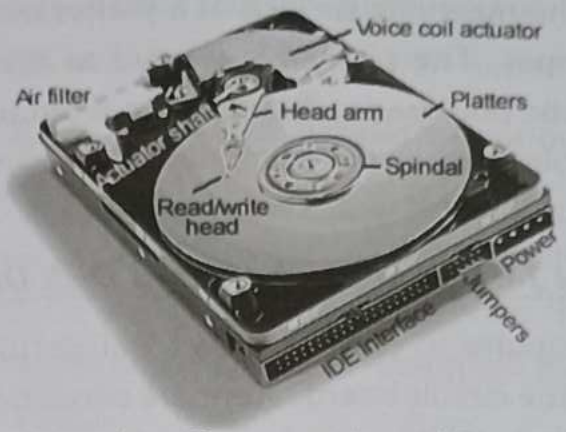
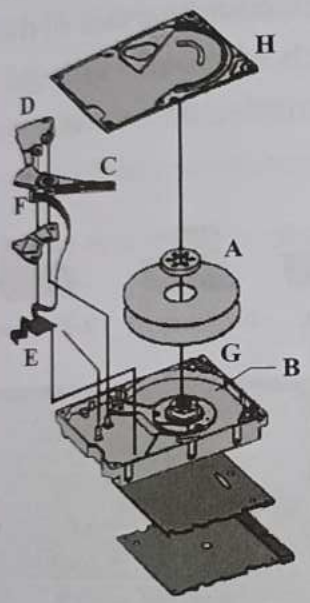


FIG 2.18 : Various Components and Their Functions.



A – Platter : Stores the data

B – DC Spindle Motor : Spins the platter

C – Head : Reads or writes data from or to the platter

D – Actuator : Causes the arm to move

E – Printed-circuit Cable : Connects arm and head to electronics

F – Arm : Moves across the disk, positioning the head

G – Chassis : Cast metal base on which other components are mounted

H – Protective Cover : Seals the mechanism against dust

J – Logic Circuits : Handle address translation, data buffering and I/O requests

Components of a HDD are :

- Actuator that moves the read-write arm. They position the read-write arm more quickly, precisely, and reliably than stepper motors and are less sensitive to problems such as temperature variations. Read-write arm swings read-write head back and forth across platter.
- Central spindle allows platter to rotate at high speed.
- Magnetic platter stores information in binary form.
- Plug connections link hard drive to circuit board in personal computer.
- Read-write head is a tiny magnet on the end of the read-write arm.
- Circuit board on underside controls the flow of data to and from the platter.
- Flexible connector carries data from circuit board to read-write head and platter.
- Small spindle allows read-write arm to swing across platter.

Data is recorded onto the magnetic surface of a platter in exactly the same way as it is on floppies or digital tapes. The surface is treated as an array of dot positions, with each domain' of magnetic polarisation being set to a binary 1 or 0. These binary digits itself represent the whole data in the computer. Read/write head in HDD reads the binary digits already existing and writes new data into it.

2.4.3 *Importance of Jumper Settings of Hard Disk Drive and give Details of it*

Jumpers allow the computer to close an electrical circuit, allowing the electricity to flow certain sections of the circuit board. Jumpers consist of a set of small pins that can be covered with a small plastic box (jumper block) as shown in the illustration to the right. Below the illustration, is a picture of what the jumpers may look like on your motherboard. In this example, the jumper is the white block covering two of the three gold pins. Next to the pins is a silkscreen description of each of the pin settings. In the picture jump pins 1-2 for Normal mode, 2-3 for config mode, and when open the computer is in recovery mode.

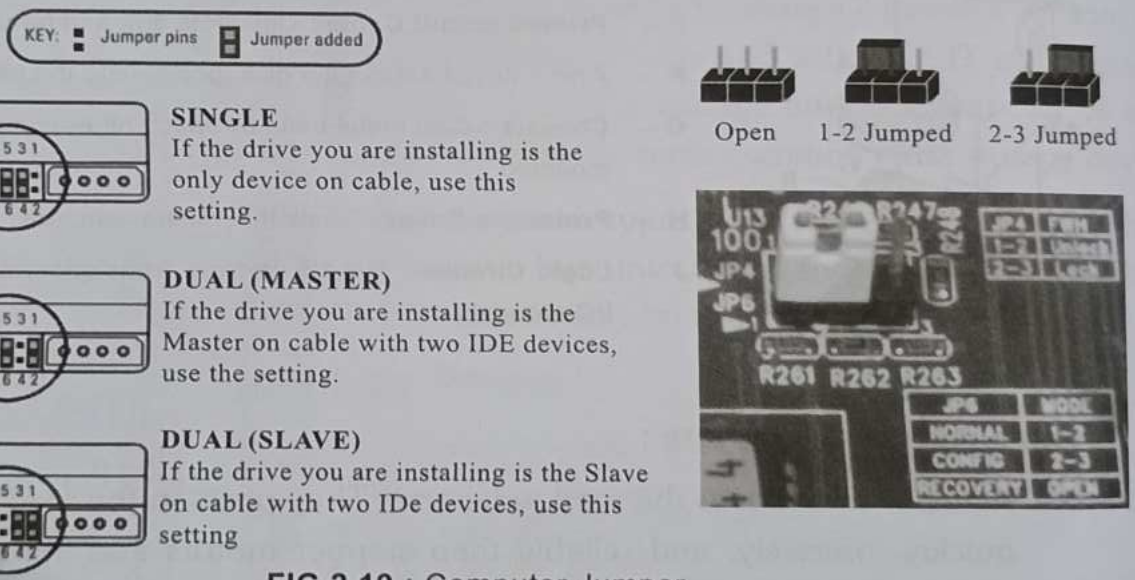


FIG 2.19 : Computer Jumper

Jumpers are used to configure the settings for computer peripherals such as the motherboard, hard drives, modems, sound cards, and other components. For example, if your motherboard supported intrusion detection, a jumper can be set to enable or disable this feature.

2.4.4 *Familiarize with Hard Disk Interfacings Standards like IDE/SCSI / SATA / PATA*

There are a few ways in which a hard disk can connect/interface with, which are IDE, ATA Advanced Technology Attachment also known as IDE, ATAPI and Parallel ATA, Serial ATA, SCSI.

1. **Integrated Drive Electronics (IDE)** : Integrated Drive Electronics IDE is more commonly known as ATA or Parallel ATA (PATA).

IDE (Integrated Drive Electronics) is a standard electronic interface used between a computer motherboard's data paths or bus and the computer's disk storage devices.

The IDE interface is based on the IBM PC Industry Standard Architecture (ISA) 16-bit bus standard, but it is also used in computers that use other bus standards. IDE was adopted as a standard by the American National Standards Institute (ANSI) in November 1990.

IDE is different from the Small Computer Systems Interface (SCSI) and Enhanced Small Device Interface (ESDI) because its controllers are on each drive, meaning the drive can connect directly to the motherboard or controller. IDE and its updated successor, Enhanced IDE (EIDE), are the most common drive interfaces found in IBM compatible computers today.

Below is a picture of the actual IDE connector and cable.

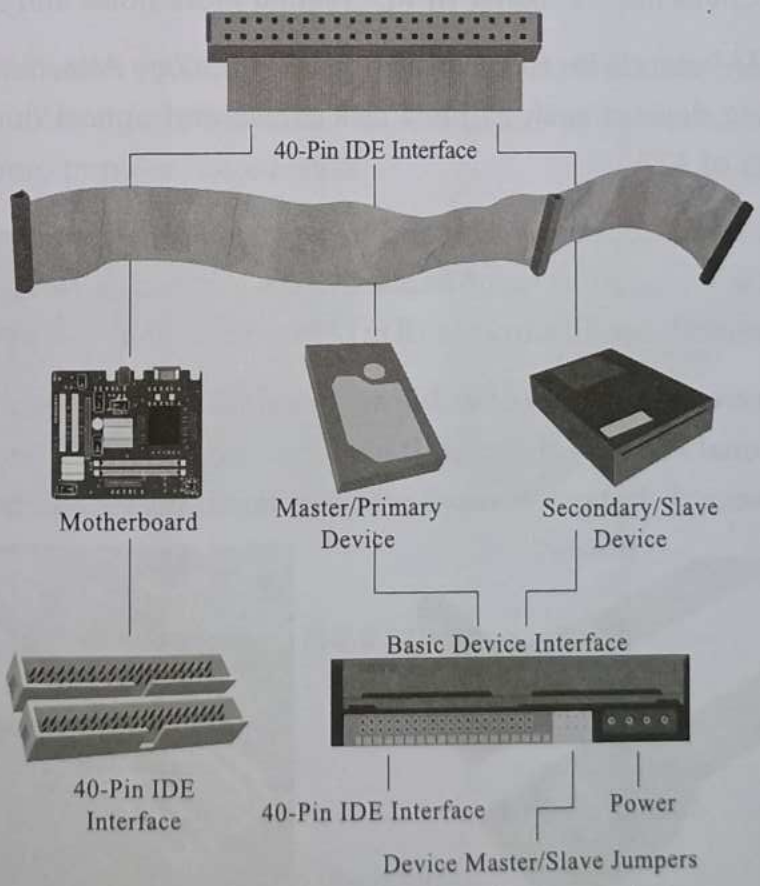


FIG 2.20 : 40 Pin IDE Interface Components

2. **SCSI** : "SCSI" stands for Small Computer System Interface and is a standard for communication between a sub-system of peripherals and the system bus. SCSI is like

a small LAN inside a computer. SCSI is a kind of bus. The SCSI bus can contain up to 15 devices. The number of devices the SCSI bus can support depends on the type of SCSI being used.

SCSI is commonly used in servers, and more in industrial applications than home uses.

Advantages :

- Faster.
- Wide range of applications.
- Better scalability and flexibility in Arrays (RAID).
- Better for storing and moving large amounts of data.
- Reliability.

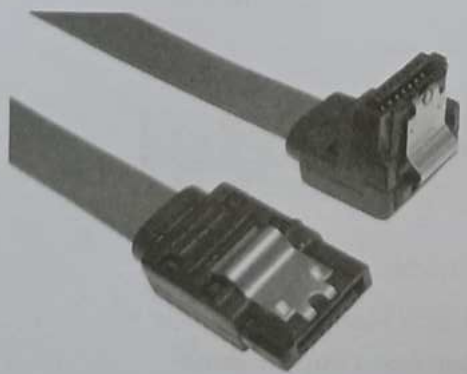
Disadvantages

- Costs.
- Not widely supported.
- SCSI drives have a higher RPM, creating more noise and heat.

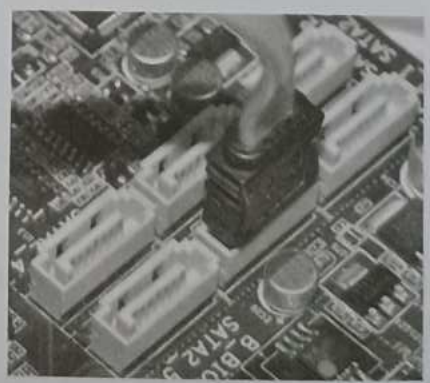
3. **SATA :** "SATA" stands for **S**erial **A**dvanced **T**echnology **A**ttachment, is a bus interface for connecting devices such as hard disk drives and optical drives. It is basically an advancement of ATA.

SATA is a standard for connecting and transferring data from hard disk drives (HDDs) to computer systems. As its name implies, SATA is based on serial signaling technology, unlike Integrated Drive Electronics (IDE) hard drives that use parallel signaling.

SATA cables are thinner, more flexible and less massive than the ribbon cables required for conventional PATA hard drives. It also reduced cable-bulk and cost (reduced from 80 wires to seven), faster and more efficient data transfer, and hot swapping.



Sata Cable



Sata Ports on a Motherboard

FIG 2.21 : SATA Cables

Advantages :

- Low costs.
- Large capacity.
- Faster transfer rates.
- Smaller cables for better heat dissipation.

Disadvantages :

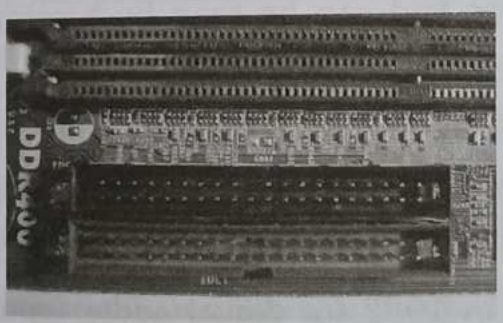
- Slower transfer rates compared to SCSI.
- Not supported in older systems without the use of additional components.

4. **PATA :** PATA, short for Parallel ATA, is an IDE standard for connecting storage devices like hard drives and optical drives to the motherboard.

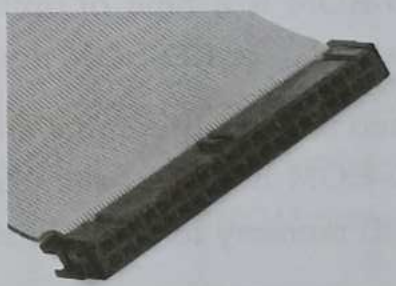
PATA is also advancement of ATA but this works in a parallel procedure. PATA generally refers to the types of cables and connections that follow this standard.

It's important to note that the term Parallel ATA used to simply be called ATA. ATA was retroactively renamed to Parallel ATA when the newer Serial ATA (SATA) standard came into being.

Even though PATA and SATA are both IDE standards, PATA (formally ATA) cables and connectors are often referred to simply as IDE cables and connectors. It's not a correct usage but it's very popular nonetheless.



ATA Motherboard Sockets



ATA Connector

FIG 2.22 :

Advantages :

- Low costs.
- Very faster transfer rates.
- Smaller cables for better heat dissipation.

Disadvantages :

- Not supported in older systems without the use of additional components.

2.4.5 *Various Optical Disk Drives Like CD-ROM, CD-RW, Combo Drive, DVD-ROM, DVD-RW, and Blu-ray Drives*

- An optical drive is an internal or external computer disk drive that uses laser beam technology to read and write data.
- Optical disk drives are associated with compact discs, DVD and Blue-Ray technology.
- Optical drives work by rotating the inserted disc at a constant speed, calculated in revolutions per minute (RPM).
- The rotating disc in an optical drive is read with a laser beam using a lens embedded within the optical drive's head.
- Optical drives mainly use an Advanced Technology Attachment (ATA) bus or a Serial ATA (SATA) bus, along with Small Computer System Interface (SCSI) to send and receive data from a computer.

CD-ROM :

- CD-ROM is an acronym for Compact Disc-Read Only Memory and is a type of compact disc that has read-only data, meaning that once data has been recorded onto the disc, it can only be read or played and cannot be altered or erased.
- A CD-ROM is a type of optical disc and can be read by a computer with an optical drive, or CD-ROM drive, and a DVD/Blu Ray Drive.
- It's used to store programs and files that require large amounts of data storage. A CD-ROM holds between 650-700 megabytes (MB) of data, meaning it has enough memory to store approximately 300,000 pages of text.
- The compact disc was introduced in 1982 for digital audio reproduction. But because a compact disc can hold any type of digital information, the disc was adapted by the computer industry in the mid-1980s for a low-cost storage solution for large computer programs, graphics, and databases.
- As the storage capacity was considered large, it quickly replaced the floppy disk, which has a maximum capacity of 1.4 MB.

CD-RW :

- Short for *CD–ReWritable disk*, a type of CD disk that enables you to write onto it in multiple sessions.

- One of the problems with CD-R disks is that you can only write to them once. With CD-RW drives and disks, you can treat the optical disk just like a floppy or hard disk, writing data onto it multiple times.
- The first CD-RW drives became available in mid-1997. They can read CD-ROMs and can write onto today's CD-R disks, but they cannot write on normal CD-ROMs.
- This means that disks created with a CD-RW drive can only be read by a CD-RW drive. However, a new standard called *MultiRead*, developed jointly by Philips Electronics and Hewlett-Packard, will enable CD-ROM players to read disks create by CD-RW drives.

Combo Drive :

- A combo drive refers to optical drives that are capable of recording and/or reading two or more types of optical media.
- As DVD drives were introduced, combo drives referred to those optical disk drives that combined CD media read and write capabilities with the capability to read DVD media.
- As the popularity of DVD media grew, the definition of what makes a drive a combo drive also changed.
- In CD and DVD media, the term now usually describes a DVD drive that also includes CD media read and write capabilities. Before combo drives, consumers needed to choose between a CD burner or a DVD-ROM drive.
- Combo drive is also a term which can be used to describe disc players capable of playing one or more media formats. For example, a combo drive that is capable of playing both HD-DVD and Blu-ray discs would be a combo drive.

DVD-ROM :

- DVD-ROM is a read-only compact disc that can hold a minimum of 4.7GB (gigabytes), enough for a full-length movie.
- The DVD-ROM specification supports disks with capacities of from 4.7GB to 17GB and access rates of 600 KBps to 1.3 MBps.

- One of the best features of DVD-ROM drives is that they are backward-compatible with CD-ROMs.
- This means that DVD-ROM players can play old CD-ROMs, CD-I disks, and video CDs, as well as new DVD-ROMs. Newer DVD players can also read CD-R disks.
- DVD-ROMs use MPEG-2 to compress video data.

DVD-RW :

- Short for ***DVD-ReWritable***, a re-recordable DVD format similar to CD-RW or DVD + RW.
- The data on a DVD-RW disc can be erased and recorded over numerous times without damaging the medium. DVD-R, DVD-RW and DVD-RAM are supported by Panasonic, Toshiba, Apple Computer, Hitachi, NEC, Pioneer, Samsung and Sharp.

Blu-ray Drives :

- Blu-ray is an optical disc format like CD and DVD.
- Blu-ray discs can hold more information than other optical media, because of the blue lasers that the disc drives use.
- A single Blu-ray disc can hold up to 25GB of data.

2.4.6 *Process of Reading and writing of Data on Various Disk Drives like CD- ROM, CD- Writer, DVD Drive and Blu-Ray Disk Drive etc.*

All CD-ROM, CD- Writer, Combo drive, DVD Drive are called **optical storage devices** because they work with light energy such as a laser beam.

1. A beam of light energy is emitted from an infrared laser diode and aimed toward a reflecting mirror. The mirror is part of the head assembly, which moves linearly along the surface of the disk.
2. The light reflects off the mirror and through a focusing lens, and shines onto a specific point on the disk.
3. A certain amount of light is reflected back from the disk. The amount of light reflected depends on which part of the disk the beam strikes: each position on the disk is encoded as a one or a zero based on the presence or absence of ***"pits"*** in the surface of the disk.
4. A series of collectors, mirrors and lenses accumulates and focuses the reflected light from the surface of the disk and sends it toward a photo detector.

5. The photo detector transforms the light energy into electrical energy. The strength of the signal is dependent on how much light was reflected from the disk.

Combo drive is a drive which can read and write CD as well as DVD. The reading and writing process in both CD and DVD will be the same.

2.4.7 Working Principle of a Pen Drive

USB Flash Drives or commonly called as **Pen Drives** are popular removable storage media having a storage capacity up to 256 GB. They are preferred over the other conventional storage devices like floppy disks or CD ROMs as they are faster, smaller and have a longer life span. The devices like memory card, hard disk, pen drive etc with high data storage capacity fall under the category of Mass Storage Devices. In order to communicate data with devices falling under this category the USB has defined a set of protocols. The operating system provides inbuilt libraries to handle such devices thereby preventing the need of any external drivers to be installed before using these devices.

The internal circuitry of the pen drive draws power from the computer for its operation. They have an integrated USB interface to communicate with the computer. The important parts of the pen drive are USB connector, crystal oscillator, memory chips and a controller to interact with the PC. The controller IC can interface with all kind of NAND EEPROM. The data is stored in memory cells of the EEPROM, known as ***"Floating gate transistors"*** – a regular metal-oxide field effect transistor (M0SFET) consisting three terminals – source, gate and drain. Take an example of the storage capacity of this memory is 2GB. There is another similar chip with storage capacity of 2GB on the other side of the PCB, thereby making the total capacity of the pen drive to be 4GB.The second memory chip, a crystal oscillator and a number of surface mount components are soldered which are required for the operation of the pen drive.

2.4.8 Solid-State Drives (SSD)

- An SSD, or solid-state drive, is a type of storage device used in computers.
- This non-volatile storage media stores persistent data on solid-state flash memory.
- SSDs replace traditional hard disk drives (HDDs) in computers and perform the same basic functions as a hard drive.
- A solid-state drive (SSD) is a new generation of storage device used in computers.
- SSDs use flash-based memory, which is much faster than a traditional mechanical hard disk.
- Upgrading to an SSD is one of the best ways to speed up your computer.

- SSDs store data permanently on an integrated circuit, which is a collection of electronic circuits embedded within a silicon semiconductor cell.
- Sometimes referred to as semiconductor storage devices, SSDs are more commonly known as solid-state drives, because they don't have the moving parts found in hard-disk drives (HDD).

REVIEW QUESTIONS

Part-A

1. What is a form factor?
2. What are the different form factors?
3. What is an I/O port?
4. What is SMPS?
5. Name any four processors.
6. What is a chipset?
7. What are the different processor sockets?
8. What is memory?
9. What are the different types of RAMs?
10. What is SIMM?
11. What is Cache memory?
12. What is a SATA cable?
13. What is L1 cache?
14. What are the different types of mass storage devices?
15. What is a hard disk?
16. What amount of data a CD can hold?
17. What is the main principle of Combo drive?
18. What is an SSD?

Part-B

1. Explain any four important components of Motherboard.
2. Explain the need of SMPS.
3. Explain about ZIF socket to insert a processor.
4. Explain about static and dynamic RAMs.

5. What are the advantages of DIMM over SIMM?
6. What is the concept of Cache memory?
7. What is the need of Mass Storage device beyond computer's memory?
8. Why is a CD-R/W used?
9. What are Blu-ray drives?

Part-C

1. Detail the importance of SMPS over linear voltage power supply.
2. Explain SMPS connectors.
3. What are the various I/O ports available on Motherboard?
4. Explain color coding of SMPS connector.
5. Explain about any 3 processor sockets.
6. How to insert RAM chip into RAM slots?
7. Explain the procedure to be followed to upgrade RAM capacity.
8. Explain the importance of L1, L2 and L3 cache.
9. Explain the constructional details of HDD.
10. Give the different jumper settings of Hard disk Drive.
11. Explain about Hard disk interfacings.
12. Explain the working principle of a Pen Drive.
13. Explain about Solid State Drive and their importance.