Chapter No. 1 Motherboard & its Components

What is Motherboard?

- The main circuit board of a microcomputer.
- The motherboard contains the connectors for attaching additional boards.
- It contains the CPU, BIOS, memory, mass storage interfaces, USB, SATA, serial & parallel ports, expansion slots, & all controllers required to control standard peripheral devices, such as the display screen, keyboard, & the disk drive.
- CPU is the main component on the motherboard or computer system. **CPU is the brain of the computer.**
- All these chips that reside on the motherboard are known as the motherboard's chipset.
- It also known as a mainboard, system board or logic boards.

Types of motherboards

- There are two types of motherboards

1. Non-integrated motherboards.
2. Integrated motherboards.

1. **Non-integrated motherboards** :-(it means old motherboards) have assemblies such as the I/O port connectors (serial & parallel ports), hard drive connectors, floppy controllers & connectors, joystick connections, network interface card (NIC) etc. installed as expansion boards.
2. **Integrated motherboards**: -it also called as all in one motherboard.

- Integrated system board has multiple components integrated into the board itself. These may include the CPU, video card, sound card, and various controller cards.

- These types of motherboards has all I/O ports other peripheral connectors on the motherboard such as network RJ45 connectors, USB port, audio jack,& SATA HDD connector, DVD ROM connector, etc. all connect directly to the motherboard.

Motherboard form factors:

Q. What is form factor? List any two form factors of the motherboard

- The shape & layout of motherboard are called the form factor.
- It refers to the physical dimensions (size & shape) as well as certain connecters, screw hole & other position of that the board will fit.
- FF is related to the configurations of the pc.

Types of form factors:-

There are 12 official form factors.

PC/XT, AT, BabyAT, ATX, Mini-ATX, Micro-ATX, FlexATX, LPX, Mini LPX, NLX, BTX, PicoBTX, Micro-BTX.

Components of motherboard (List):-

1. CPU(processor)
2. System clock
3. Chipset(north bridge & south bridge)
4. ROM BIOS
5. RAM & RAM cache(memory)
6. ATX power connector
7. PCI & PCI express slot
8. USB slot
9. SATA/IDE connector

Components	Details
Serial ATA	Serial advanced technology attachment connector Supports up to 6 eSATA ports.
IDE connector	(Integrated drive electronics HDD)Connects to older hard disks & optical drives for data transfer.
SATA connector	Connects to modern hard disk drives.
CMOS Battery	Supplies power to store BIOS settings & keep the real time clock running.
RAM Slots	Insert RAM here. Supports DDR3 800/1066/1333.
Front panel USB & Audio Connector	Connects to USB & Audio ports.
Back panel Connectors & Ports	Connectors & ports for connecting the computer to external devices such as display ports, Audio , USB, Ethernet, PS/2 ports etc.

Components	Details
CPU Socket	Supports Land grid array1155/1156 socket
Chipset	It contains north & south bridge supports H67 or P67 express chipset platform.
PCI slot	Peripheral component interconnect Older expansion cards such as sound cards, network cards, connector cards
PCI Express X1 slots	Modern expansion cards such as sound cards, network cards(wi-fi, Ethernet, Bluetooth),connector cards(USB, Firewire, eSATA) & low end graphics cards.
PCI Express X16 slot	Discrete graphics cards.
ATX 12V Power connector	Connects to 4 pin power cable of a power supply to CPU.
ATX Power connector	Connects to the 24 pin ATX power cable of a power supply to the motherboard.

1. CPU Internal Structure

- The CPU was first developed at Intel with the help of Ted Hoff in the early 1970's.
- It is also called as processor, Computer Processor, Microprocessor, central processor, & "thebrains of the computer."
- It is responsible for interpreting & executing most of the commands from the computer's hardware& software.
- The major CPU manufacturers are Intel, Motorola, IBM, Advanced Micro Devices(AMD), & Cyrix

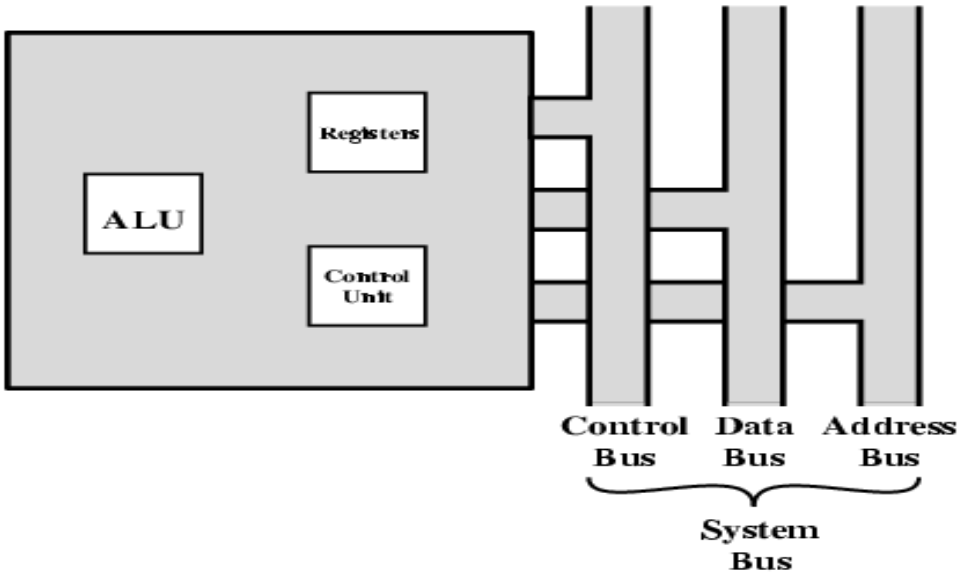


Fig. CPU Internal Structure

System Bus

1. Address Bus:-

- A collection of wires connecting the CPU with main memory that is used to identify particular locations (addresses) in main memory.
- It is a unidirectional bus means data travels only one way, from the CPU to memory.
- Modern PCs have 36 address lines.

2. Data Bus:-

- It is group of electrical wires used to send data back & forth between two or more components. i.e. the connections between & within the CPU, memory,& peripherals used to carry Data.
- It is bidirectional bus.
- Data bus to carry actual data or information, an address bus to determine where it should be sent.

3. Internal Registers:-

- There are 16 general, control & system registers in the CPU.
- Program counter, stack pointer, Accumulator (A), index register, flag register.

CPU/Processor Modes (Q. What is processor mode?)

- It also called CPU modes or CPU privilege level.
- All modern CPUs can run in different modes of operation.
- The mode of operation determines how the CPU manages applications & memory.
- The processor modes are used by processor to create an operating environment for itself.
- There are 3 different modes of operation

1. Real Mode
2. Protected Mode
3. Virtual Real Mode.

1. Real Mode (Q. Describe real mode processor?)

- Real mode, also called real address mode, is an operating mode of all x86compatible CPUs.
- Real mode is characterized by a 20-bit segmented memory address space (giving exactly 1 MB of addressable memory).
- Real mode provides no support for memory protection, multitasking, or code privilege levels.
- In real-mode, only the first 1 M bytes of memory can be addressed with the typical segment: offset logical address. Each segment is 64K bytes long.
- Real mode is of course used by DOS & standard DOS applications.

2. Protected Mode (Q. Describe protected mode of processor?)

- This mode was first introduced with the 80286 processor.
- The differences between this mode and real address mode are Protection and a larger address space.
- This is much more powerful mode of operation than real mode, & used in all modern multitasking operating system.
- An address line has 24 bits on an 80286 CPU, limiting the available address space to 16 megabytes.
- Used: - Window 9X, OS/2, Linux. Even DOS.
- **Advantages:-**

1. Full access to all system memory. There is no 1MB limit in protected mode.
2. Ability to multitask –meaning execution of multiple programs simultaneously.
3. Support for virtual memory.
4. Faster (32 bit) access to memory &faster 32 bit drivers to do input or outout transfers.

3. Virtual Real (8086) Mode (Q. Describe Virtual Real (8086) mode of processor?)

- Also called virtual 8086 mode
- It is an additional capability, an enhancement, of protected mode.
- There is often a desire to be able to run DOS programs under Windows, to solve this problem this mode is used.
- It emulates real mode from within protected mode allowing DOS programs to run.
- A protected mode operating system such as Windows can in fact create multiple virtual real mode machines, each of which appear to the software running them.
- Each virtual machine gets its own 1MB address space, an image of the real hardware BIOS routines, everything.

Q. Compare Real Mode & Protected mode

SN	Real Mode	Protected mode
01	It this mode processor works as 8086/8088.	It this processor works in full capacity
02	It has only 1MB memory addressing capability	It has more than 1MB to few GB memory addressing capability
03	It handles only one task.	It handles multiple tasks at a time.
04	In this memory address translation not required.	In this memory address translation required.
05	It directly communicate with ports & devices.	It directly communicate with ports & devices through OS.
06	This mode not supports memory management.	This mode supports memory management.
07	It supports less addressing modes & instructions.	It supports more addressing modes & instructions.
08	This mode is for backward capability to support 8086/8088.	This mode processor works in its real power.

Process Technologies:-

- It used to improve the performance of the processor.
- The design complexity of CPUs increased as various technologies facilitated building smaller & more reliable electronic devices.
- 1st such improvement came with the advent of the transistor.
- Operating speed & power requirements are affected by transistor size.
- There are two types of technologies are used.

1. The Dual Independent Bus (DIB) architecture.
2. Hyper Threading Technology.

Processor Socket & Slots

- Processor socket is a connection that allows computer processors to be connected to a motherboard.
- A CPU socket or CPU slot is a mechanical component that provides mechanical & electrical connections between a microprocessor & a printed circuit board (PCB).
- It is the connector that interfaces between a computers motherboard & processor itself.

Chipset Architecture

- Chipset is a collection of several intelligent controllers & programmable chips.
- Use of chipset simplifies the motherboard design.
- In pc, the chipset represents the connection between the processor & everything else.
- It controls the features & abilities of the motherboard.

- Chipset usually contains the processor bus interface called Front-side bus (FSB), memory controller, bus controller, I/O controller & more.
- Two types of Chipset architecture

1. North/south bridge architecture
2. Hub architecture

1. North/South Bridge Architecture: [W-09,S-13]

- Intel's earlier chipset were broken into multi-tiered architecture known as North Bridge and South Bridge components as well as Super I/O chip.
- **North Bridge:** it is the connection between the high speed processor bus and the slower AGP & PCI buses.
- **South Bridge:** it is the bridge between PCI bus and even slower ISA bus.
- **Super I/O chip**: contains commonly used peripheral items all combined in single chip.

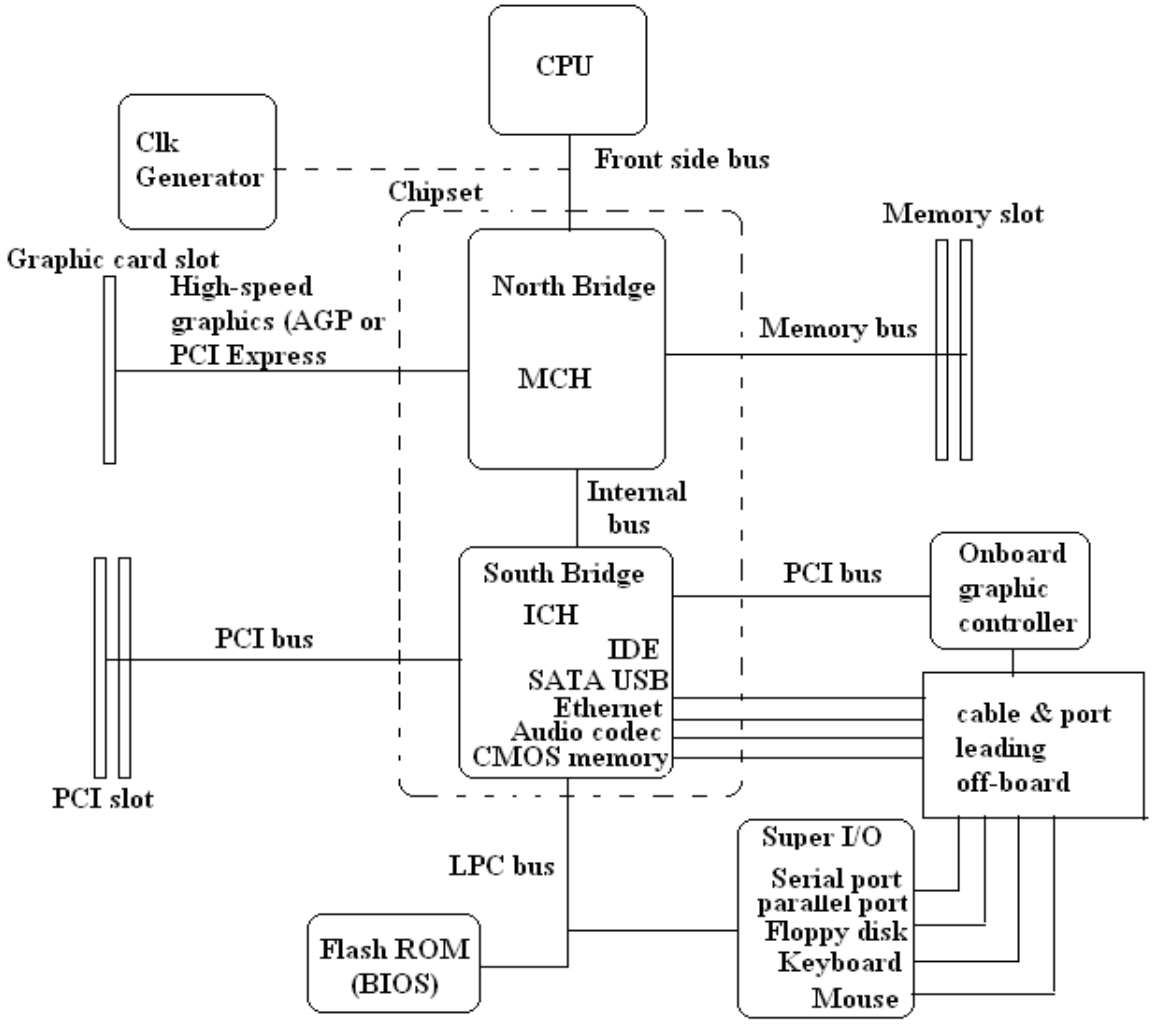


Fig.North/South Bridge Architecture

North Bridge

Northbridge is also referred to as PAC (PCI-AGP) controller is the main component of the motherboard and only motherboard circuit (besides the processor) that runs at the full motherboard speed. It serves as the four way connection between CPU, Memory, Video card and south bridge.

South Bridge

The Southbridge is the lower speed component of the chipset. The south bridge connects to the 33MHz PC and contains the interface to ISA bus. It also contains dual ATA/IDE hard disk controller interfaces, one or more USB interfaces, CMOS RAM, real time clock functions, interrupt controller, DMA controller.

- Super I/O chip contains serial port, floppy controller, keyboard & mouse interface.

Functions of South Bridge

- It is a chip on the motherboard.
- It is also known as I/O controller hub (ICH).
- It incorporates a number of different controller functions.
- It looks after the transfer of data to and from the hard disk and all the other I/O devices, & passes this data into the link channel which connects to the north bridge.
- It connects to the 33 MHz PCI bus & contains the interface or bridge to the 8 MHz ISA bus.
- It also contains dual ATA/IDE hard disk controller interfaces, one or more USB interfaces.
- It also contains DMI (Direct Memory Interface), Matrix storage, audio, AC97 modem, Ethernet.

Function of North Bridge

- It is also knows as memory controller hub (MCH).
- It is a controller which controls the flow of data between the CPU (processor) & RAM, & to the AGP port.
- AGP (Accelerated Graphics Port) is I/O card used for the video card.
- In new motherboards in replacement of AGP the PCI Express x16 port is used.

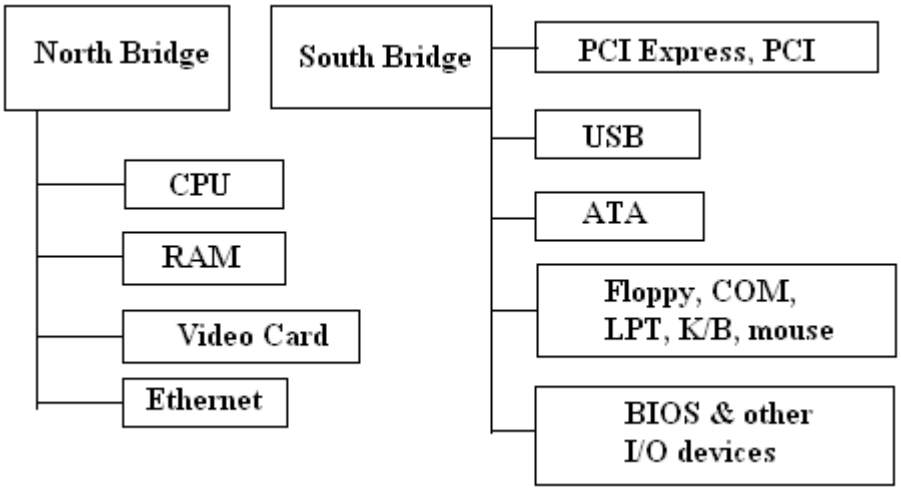


Fig: Connection of North/South Bridge

1. Hub Architecture: [W-08]

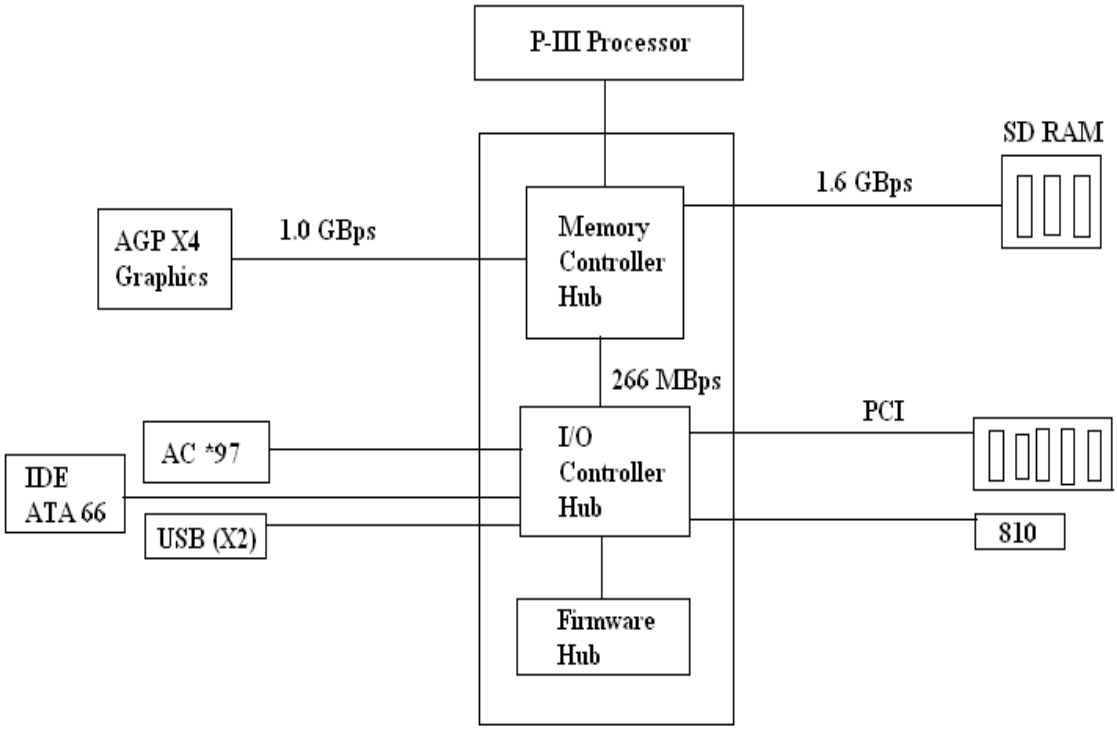


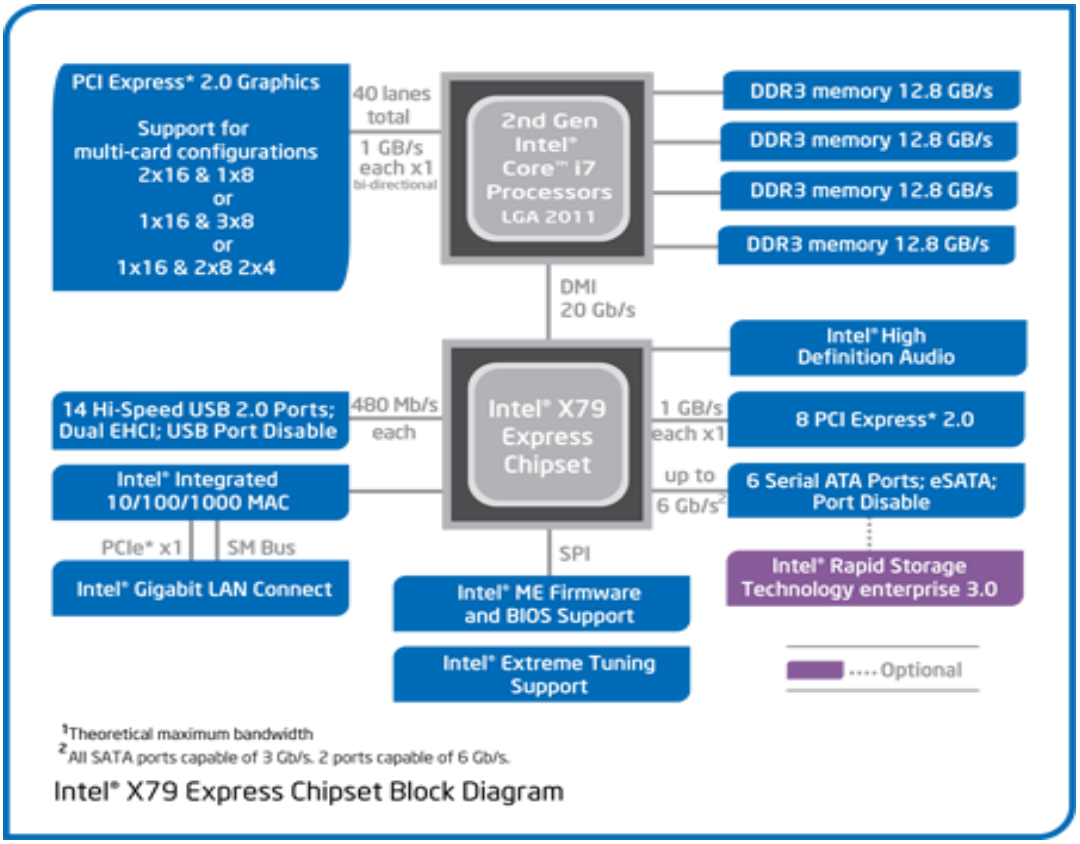
Fig. Hub Architecture

- Intel Hub Architecture (IAH) is also known as Accelerated Hub Architecture.
- It is Intel's architecture for the 8xx family of chipsets.
- In fig, the Memory controller hub (MCH) is connected to I/O controller hub (ICH) via 266 MB/s bus.
- This connection is called Direct Media Interface (DMI).
- MCH chip Provides connectivity for memory & AGP.
- ICH chip provides connectivity for PCI, USB, sound, IDE/ATA & LAN

Latest Chipset for PC

- Intel X79, Z87, H87 chipset will be the latest & greatest Chipset available until the second quarter 2014.

1. Intel X79 Express Chipset:-



Feature:-

1. Processor
2. Storage Technology
3. Protection Technology
4. PCI Express 2.0 interface
5. High definition audio
6. USB
7. SATA- 6 GBPS, eSATA
8. Green Technology

Motherboard Buses:-

- Bus is a shared linear pathway that connects multiple devices on M/B.
- Bus provides communication Bi-directionally.
- Processor, cache, RAM, expansion cards, disks, & other communicate using one or more buses that exist in the computer.
- The external bus is also referred to as the expansion bus.

- **The common types of buses are ISA, PCI, AGP, USB and IDE/SATA.**

1. **PCI (Peripheral Component Interconnect)**

- PCI specifies a computer bus for attaching peripheral devices to a computer motherboard.
- PCI bus adds another tier to the interface between CPU & I/O devices.
- It is high speed bus that connects high performance peripherals like video adaptors, disk adaptors & network adaptors to the chipset processor & memory.
- **Specifications of PCI:-**
  - **Speed:-**33.33MHz.
  - **Data transfer Speed**:-133mb/s for 32 bit, 266mb/s for 64 bit.
  - **Bus size Supported**: - 32 bit or 64 bit.
  - 5V/ 3.3V signaling.
  - Supporting of multi-processor systems.

- **Features of PCI Bus**
  - **Extremely high-speed data transfer**:-133mb/s for 32 bit, 266mb/s for 64 bit.
  - **Plug & Play Facility**:-PCI board inserted in any PCI slot is automatically detected & required I/O & memory resources are allotted by system.
  - It can work with 32 bit or 64 bit bus width.
  - It uses 3.3V or 5V for operations.
  - It is device independent which means it can be used to connect different types of devices such as hard disk controllers, sound cards, multimedia controllers, LAN cards etc.
  - **Full multi-master capability**:-this allows any PCI master to communicate directly with other PCI master/slave.

2. **PCI-X(Peripheral Component Interconnect Extended)**

- PCI-X (Peripheral Component Interconnect Extended) is a computer bus & expansion card standard designed to supersede PCI.
- It is essentially faster version of PCI, running at twice the speed.
- PCI-X was developed jointly by IBM, HP, & Compaq.
- **Features of PCI-X:-**
  - 1. Up to 133MHz bus Speed.
  - 2. 64 bit bandwidth.
  - 3. 1GB/s throughput.
  - 4. More efficient bus operation for easier interface.
  - 5. Backwards compatibility.

3. **PCI-E (Peripheral Component Interconnect Express) or PCIE**

- It is a computer expansion card interface format.
- It was designed to replace PCI, PCI-X &AGP (graphics card interface).
- PCI-E as newer motherboards & computers being made today are supporting this new connection.

- PCI-E is a point to point topology.
- It increases the available bandwidth from 133 MB/s to 8 GB/s.
- It provides each device with its own dedicated data pipeline.
  - **Advantages:-**
  - Software compatibility with old version.
  - High throughput (up to >4GB/s)
  - Scalable bandwidth.
  - Dedicated bandwidth per slot.
  - Peer to peer communication
  - Long life (20 + yrs).

Accelerated graphics port (AGP)

- It is also called as advanced graphics port.
- AGP designed by Intel & introduced in august 1997. It uses dedicated point to point channel that allows the graphics controller card to direct access to s/m memory
- It is a high-speed point-to-point channel for attaching a graphics card to motherboard.
- Primarily to assist in the acceleration of 3D computer graphics.
- It is currently being phased out in favor of PCI Express.
- It is designed to accept an AGP video card.
- It transfers are 32 bit wide.
- Clock speed 66.66 MHz.
- AGP 1x transferred 1 bit per data line per clock cycle yielding 266.66 Mb/s.
- AGP 2x & 4x transferred 2 & 4 bits per data line per clock cycle yielding 533.33 & 1066.66Mbps respectively.
- AGP 8x transfers 8 bits per line per clock cycle yielding 2133.28 Mbps.
- AGP 8x is used in graphics intensive applications like video editing, 3-dimensional mapping, etc.

Logical Memory Organization

- My PC has 512 MB of memory.
- The system memory in the PC it is often referred to as single number is in fact broken into several different areas.
- 1. Conventional Memory
- 2. Extended Memory
- 3.Expanded Memory

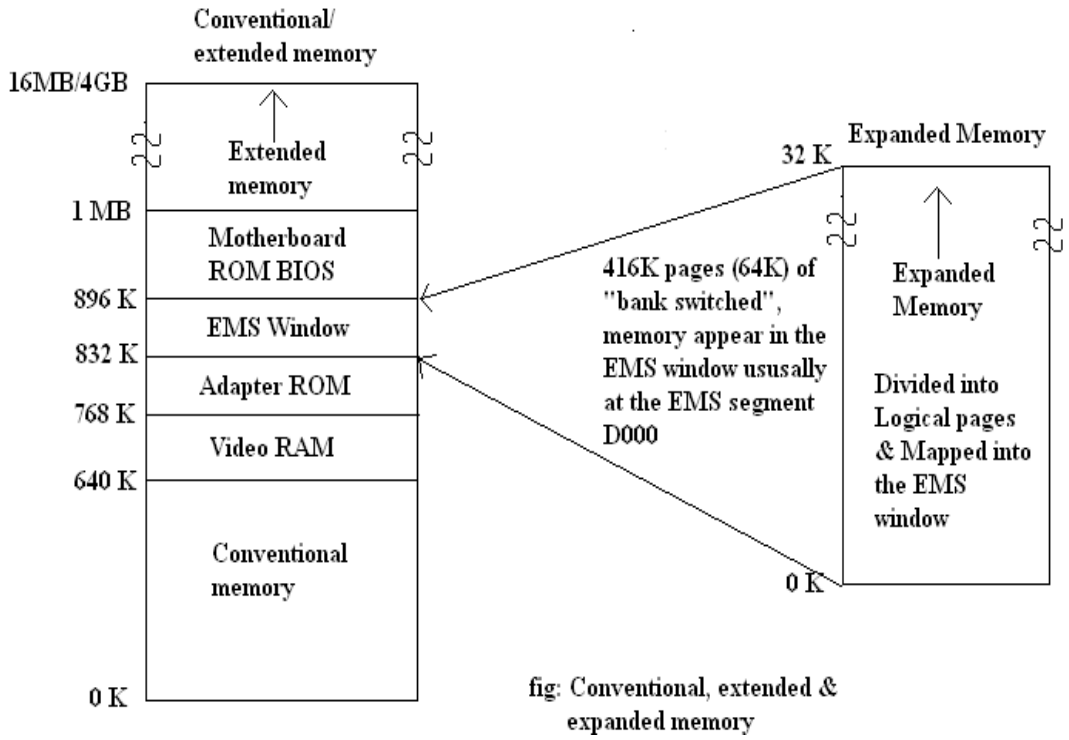


Fig. Logical memory organization

1. Conventional Memory

- First 640 kb of system memory is called conventional memory.
- This area is available for use by standard DOS programs, device drivers, command.com, and interrupt vector.
- It available to all PCS.
- Limited to 640 kb.
- Virtually every program can use this memory.
- By default DOS, device drivers, in conventional memory.
- Originally this was the only place that programs could run.
- Conventional memory occupies addresses 00000h to 9FFFFh.

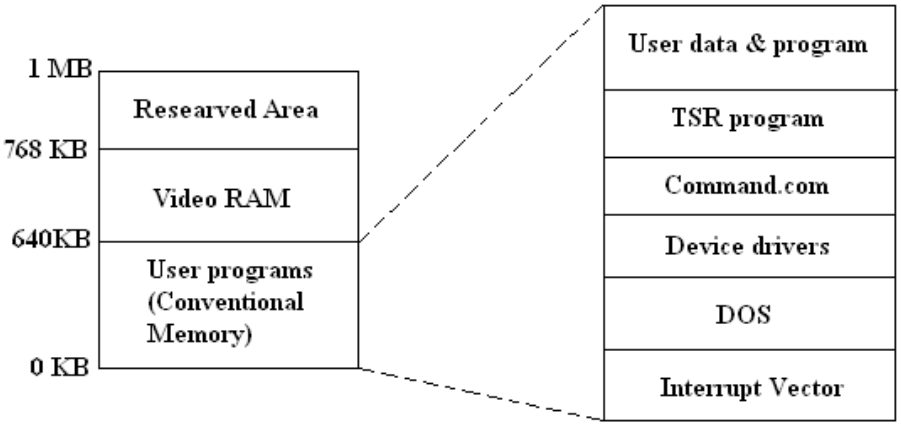


Fig: Conventional Memory

2. Extended Memory

- All of the memory above 1MB is called extended memory.
- This is all the memory above the high memory area until the end of system memory.
- It is used for programs & data when using an OS running.
- It is found from address 10FFF0h to the last address of system memory.
- The most commonly used manager is HIMEM.SYS, which sets up extended memory according to the extended memory specification (XMS).
- XMS is the standard that PC programs use for accessing extended memory.

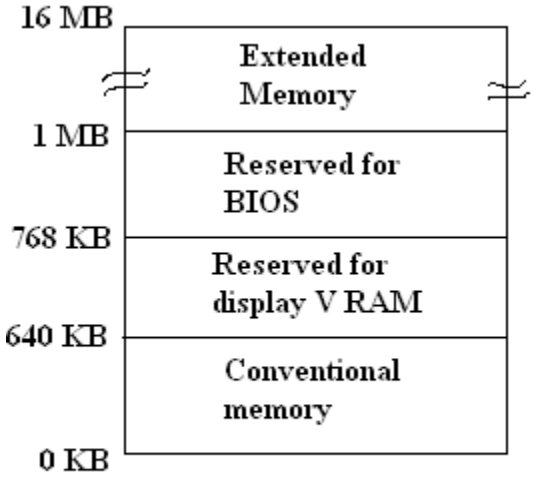


Fig: memory map with extended memory

3. Expanded Memory

- An older standard for accessing memory above 1 MB which is called expanded memory.
- It uses a protocol called the expanded memory specification or EMS.
- EMS was originally created to overcome the 1MB addressing limitations of the 8088 & 8086 CPUs.
- Expanded memory is not directly addressable by the processor.
- Instead, it can only be accessed through a small 64K window established in upper memory area.
- Expanded memory is a segment or bank switching scheme in which custom memory adapter has large number of 64K segments on board combined with special switching & mapping hardware.
- Expanded memory specification developed by Lotus, Intel & Microsoft (LIM).

RAM (Random Access Memory)

- Random-access memory, or RAM, provides large quantities of temporary storage in a computer system.
- Remember the basic capabilities of a memory:
  - It should be able to **store a value**.
  - You should be able to **read the value** that was saved.
  - You should be able to **change** the stored value.

- There are two basic types of RAM

1. Static RAM (SRAM)
2. Dynamic RAM (DRAM)

Dynamic Memory

- Dynamic memory is built with capacitors.
  - A stored charge on the capacitor represents a logical 1.
  - No charge represents logic 0.
- However, capacitors lose their charge after a few milliseconds. The memory requires constant refreshing to recharge the capacitors. (That's what's "dynamic" about it.)
- Dynamic RAMs tend to be physically smaller than static RAMs.
  - A single bit of data can be stored with just one capacitor and one transistor, while static RAM cells typically require 4-6 transistors.
  - This means dynamic RAM is cheaper and denser—more bits can be stored in the same physical area.

Types of RAM

- **Static RAM (SRAM)**
  - Each cell stores bit with a six-transistor circuit.
  - Retains value indefinitely, as long as it is kept powered.
  - Relatively insensitive to disturbances such as electrical noise.
  - Faster (8-16 times faster) and more expensive (8-16 times more expensive as well) than DRAM.
- **Dynamic RAM (DRAM)**
  - Each cell stores bit with a capacitor and transistor.
  - Value must be refreshed every 10-100 ms.
  - Sensitive to disturbances.
  - Slower and cheaper than SRAM.

1. **SDRAM**

- **Synchronous DRAM (SDRAM)** SDRAM replaced DRAM, FPM (fast page mode), and EDO (extended data o/p).
- SDRAM is an improvement because it synchronizes data transfer between the CPU and memory.
- SDRAM allows the CPU to process data while another process is being queued.
- **Features of SDRAM:-**
- 1. All SDRAM chips for desktop Pcs have 168 pins.
- 2. Speed of SDRAM is 100 MHz & 133 MHz.
- 3. generally available in size 32mb, 64mb, 128mb,256mb, 512mb,1GB etc.
- 4. Operating voltage 3.3V.
- 5. The architecture used synchronous.
- 6. Operation Max temperature -85 degree c.
- 7. It pre fetches 1 bit at a time.

2. **DDR(Double Data Rate SDRAM)**

- **Double data rate synchronous dynamic random-access memory** (**DDR SDRAM**) is a class of memory integrated circuits used in computers.
- It basically doubles the rate of data transfer of standard SDRAM by transferring data on the up & down tick of a clock cycle.
- DDR memory operating at 333 MHz actually operates at 166 MHz * 2.

DDR (double data rate synchronous dynamic RAM)

- **Features of DDR:-**
- 1. All DDR RAM chips have 184 pins.
- 2. DDR RAM comes different speeds. i.e. 100mhz, 133mhz, 166mhz, 200mhz.
- 3. DDR RAM is twice as fast as SDRAM.
- 4. Operating voltage 2.5V.
- 5. The architecture used source-synchronous.
- 6. Operation Max temperature -85 degree c.
- 7. It pre-fetches 2 bits at a time.

DDR2 (double data rate two synchronous dynamic RAM)

- **Features of DDR2:-**
- 1. All DDR2 chips have 240 pins.
- 2. DDR2 RAM to operate at data rates of 400 MHz, 533 MHz, 667 MHz, & above.
- 3. Higher bandwidth.
- 4. Lower power 1.8V.
- 5. The architecture used source-synchronous.
- 6. Operation Max temperature 95 degree c.
- 7. It pre-fetches 4 bits at a time.

DDR3 (double data rate three synchronous dynamic RAM)

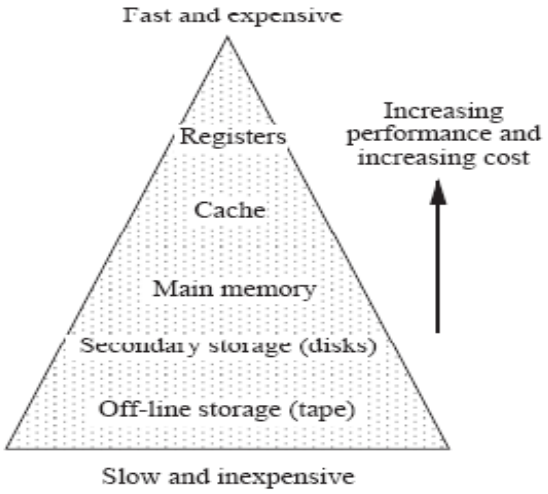
- DDR3 (double data rate three synchronous dynamic RAM is a RAM technology used high speed storage of the working data of computer.
- **Features of DDR3:-**
- 1. Introduction of asynchronous RESET pin.
- 2. Support of system level flight time compensation.
- 3. On- DIMM mirror friendly DRAM pin out.
- 4. DDR3 RAM to operate at data rates of 800 MHz, 1066 MHz, 1333 MHz, 1600 MHz & above.
- 5. READ & WRITE calibration.
- 6. It works on lower power 1.5V.
- 7. It pre-fetches 8 bits at a time.

Concept of cache memory

- Processor does all memory operations with cache.
- It is a high speed memory kept in between the processor & RAM to increase the data execution speed. It is kept near to the processor.
- It is smaller, faster memory which stores copies of data from the most frequently used main memory locations.
- When the processor needs to read from or write to a location in main memory, it first checks whether a copy of that data is in cache.
- CPU uses cache memory to store instructions that are repeatedly required to run programs, improving overall system speed.
- Advantages of cache memory is that CPU does not use the motherboard system bus for data transfer.

Need of cache memory

- When a program executes, the cache memory is searched first.
- To increase the speed of processes to store frequently accessed memory location in cache so that the CPU can access immediately.
- It is directly accessible memory to CPU or processor.
- It is a fastest memory as compared to all other memory.
- It increases the speed of the CPU or processor.



Level of cache memory or types of cache or Cache Hierarchy

There are different levels of cache:-

1. L1 cache or internal cache
2. L2 cache or external cache
3. L3 cache or shared cache

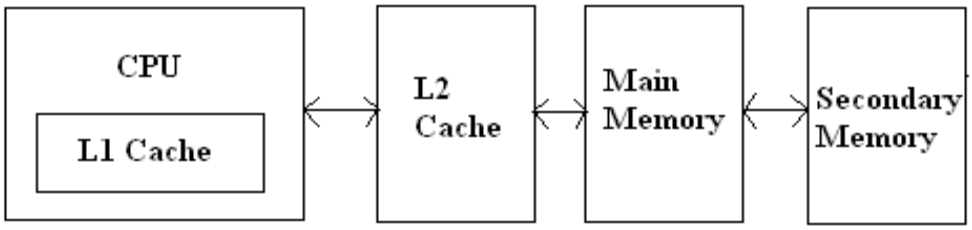


Fig: Memory Hierarchy

L1 Cache or Internal Cache

- Cache built into CPU itself is referred to as level 1 (L1) cache or Internal cache.
- It is a small, high speed cache incorporated right into the processor chip.
- L1 cache typically ranges in size from 8kb to 64kb & uses the high speed SRAM(static RAM) .

L2 Cache or External Cache

- Cache that resides on a separate chip next to CPU is called Level 2(L2) cache or external cache.
- L2 cache is between main memory & CPU.
- It provide higher data bandwidth interface between the L2 cache & processor core.

L3 Cache or Shared Cache

- L3 cache has come into trend with the advent of multi-core CPUs.
- These chips will have both L1 & L2 caches for each separate core, there is a common fairly large L3 shared by all cores.
- It is usually the size of all other caches combined or few multiples of all other caches combined.
- **Advantages:**

1. Speed of system or improving performance.
2. It lies on the same chip the access time is very small.
3. It is intelligent memory.
4. It reduces wait state or no wait states.

- **Disadvantages:**

1. Size is very small.
2. Cost is very high.

Q. Compare between internal & External cache

Sr. No.	L1 or Internal Cache	L2 or External Cache
1	Cache built into chipset itself	Cache that resides on separate chip next to the CPU
2	Directly accessible to processor	Resides between processor & RAM
3	Small in size	Bigger in size
4	Faster than external	Slower cache
5	Cost is more	Cost is less

6	Waiting delay is less	Waiting delay is more

Features of Intel Processor

1) Features of Pentium processor

- **Superscalar architecture** – Pentium has two data paths (U & V pipelines) that allow it to complete more than one instruction per clock cycle.
- It is RISC processor Design
- **64–bit data path** – This doubles the amount of information pulled from the memory on each fetch.
- Clock speed of Pentium available in 75, 90, 100, 120, 133, 150, 166, 200 & 233MHz.
- **32-bit microprocessor** – 32-bit addressing
- Pipelined Floating Point Unit
- Separate code (8K) & data (8K) cache
- Advance Design Features: Branch Prediction 237-pin PGA package

What is BIOS ? (Basic Input Output System)? [W-08, W-10, S-11]

- It is also called as ROM BIOS, PC BIOS, System BIOS.
- It is software program that tests the computer hardware components.
- Serves as a standardized communication interface between the computer's hardware and the operating system.
- Is a small ROM chip on the PC's motherboard.
- A basic software program containing all BIOS functions is permanently stored in the ROM.
- This software functions as a basic operating system.
- Is responsible for starting the PC.
- This hardware integrated with software is also referred to as firmware.

Functions of the BIOS

- When you first turn on your PC
  - Your PC requires information
    - to detect PC components
    - To find the operating system(floppy disk, hard drive, or a CD-ROM)
  - This information is stored in the BIOS
- To give **instructions for the POST** (power-on self test).
- This self test ensures that the computer has all of the necessary parts & functionality needed to successfully start itself, such as use of memory, a keyboard & other parts.
- If errors are detected during the test, the BIOS instruct the computer to give a code that reveals the problem.
- Error codes are typically a series of beeps heard shortly after startup.
- The BIOS also works to give the computer basic information about how to interact with some critical components, such as drives & memory that it will need to load the OS.

Motherboard Selection Criteria [S-10, S-11]

- **Processor:** A Pentium motherboard should use as minimum the second-generation 3.3v Pentium processor with 296-pin socket 5 or 7 configuration.
- **Processor Socket:** Pentium motherboard should have at least one ZIFF socket that follows the Intel Socket 7 specification. VRM (Voltage Regulator Module) socket will allow the best selection of future Pentium processors.
- **Motherboard speed:** Pentium motherboard speeds are start from 66MHz onwards.
- **Cache memory:** All Pentium motherboards should have 256K to 512K or more of L2 cache on-board.
- **SIMM/DIMM memory:** All Pentium or Pentium Pro motherboards should use either 72 pin SIMMs or 168 pin DIMMs. Today all motherboard use DIMM type of memory.
- **Bus type:** Today on the motherboard PCI Express bus is used.
- **Form Factor:** Different types of form factors are like AT for 80286 onwards, ATX for P-IV motherboards onwards, NLX improvement over ATX.
- **Built-in interfaces:** A motherboard should contain as many built-in standard controllers & interfaces (FDC, HDC, UART, LPT, PS/2, USB, and SCSI) as possible (except video).
- **Motherboard Chipset:** Different types of chipset are Intel Triton II (430HX), Orion (450 KX & 450 GX), and Natoma (440FX).
- **Plug & Play**
- **Power management**