

INTRODUCTION TO COMPUTER HARDWARE

- Computer Hardware refers to the physical components of the computer.
- This is the tangible part of the computer you can see and touch.
- Microcomputer hardware can be classified into the several functional units.
- Each Functional unit is composed of several hardware devices that perform specific function



Computer system

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MAIN FUNCTIONS OF A COMPUTER SYSTEM

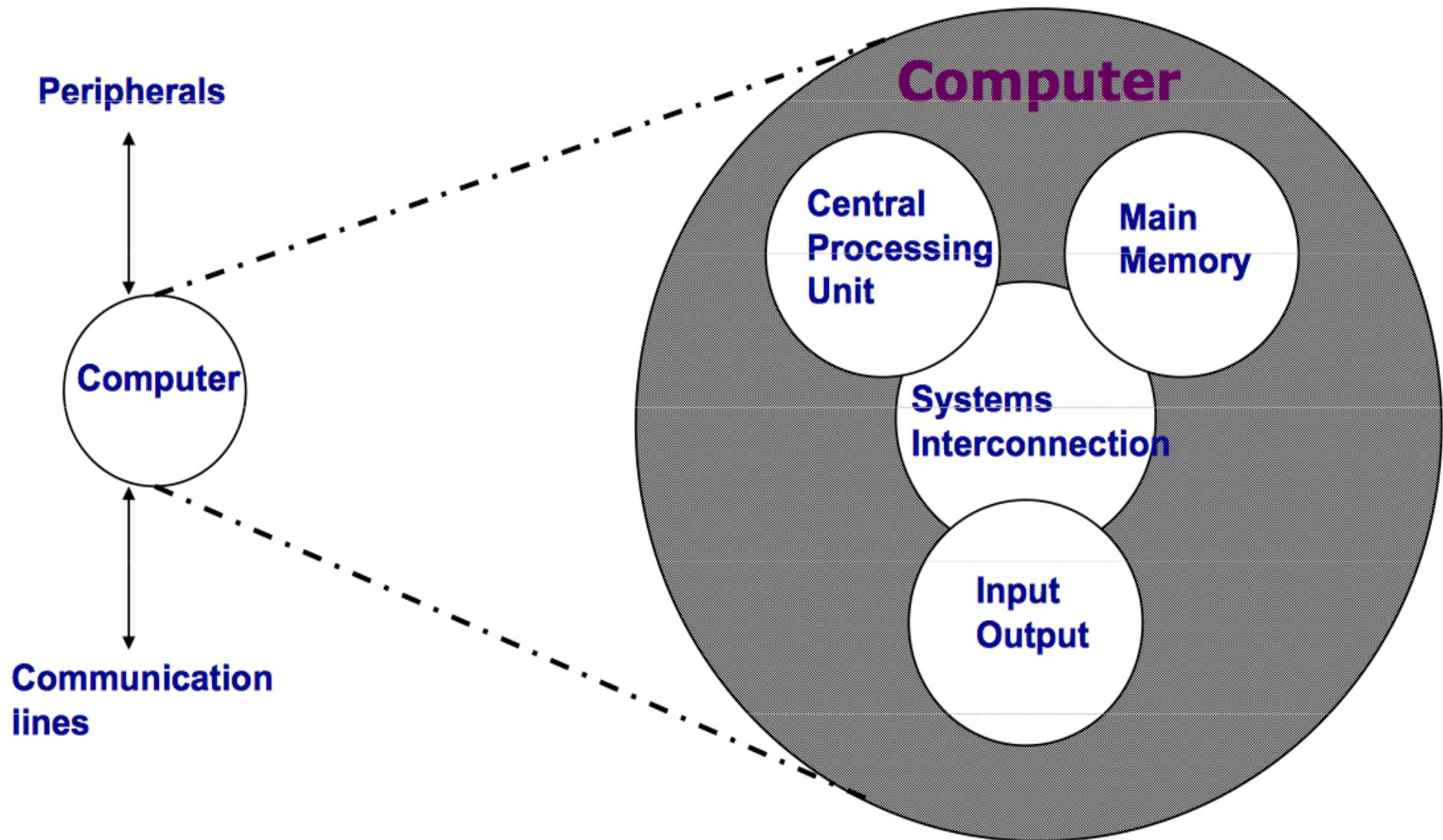
Four main functions of the computer system include:

- ❖ Data processing
- ❖ Data storage
- ❖ Data movement(I/O)
- ❖ Control

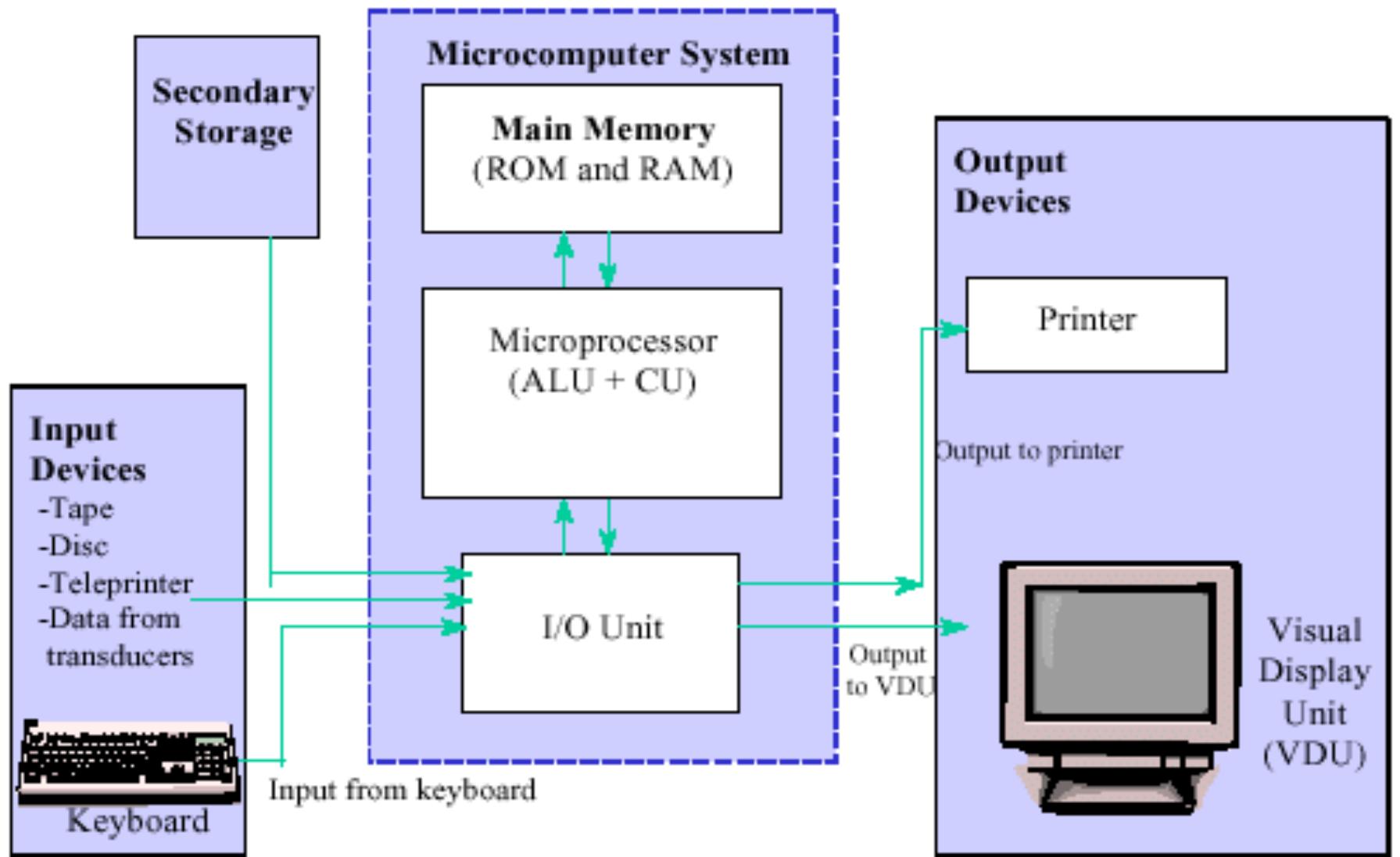
FUNCTIONAL COMPONENTS OF A COMPUTER SYSTEM

The functional units of the computer system include;

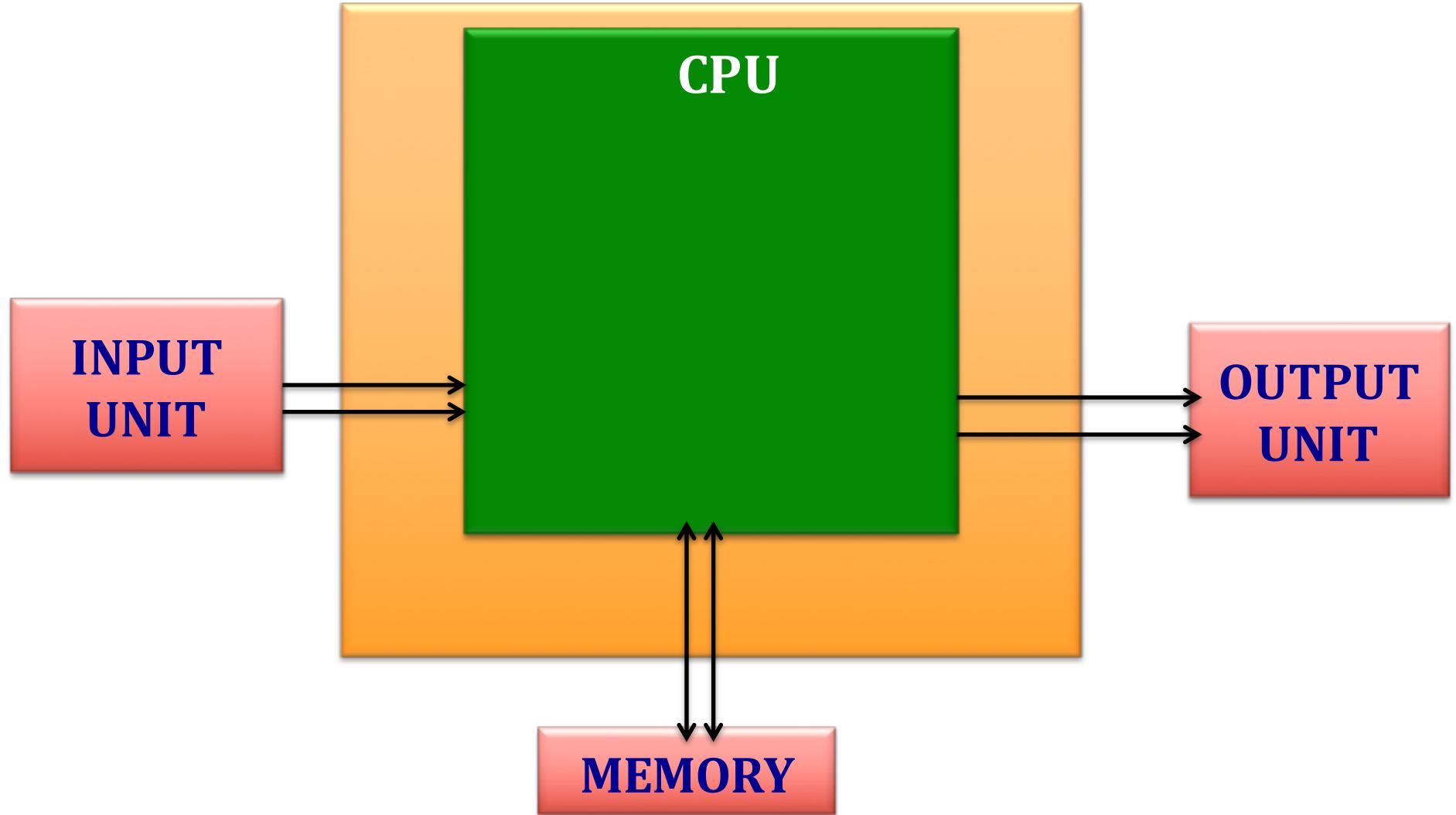
- Central Processing Unit (CPU)
- Storage Unit
- Input / Output Unit (I/O)
- System Interconnection



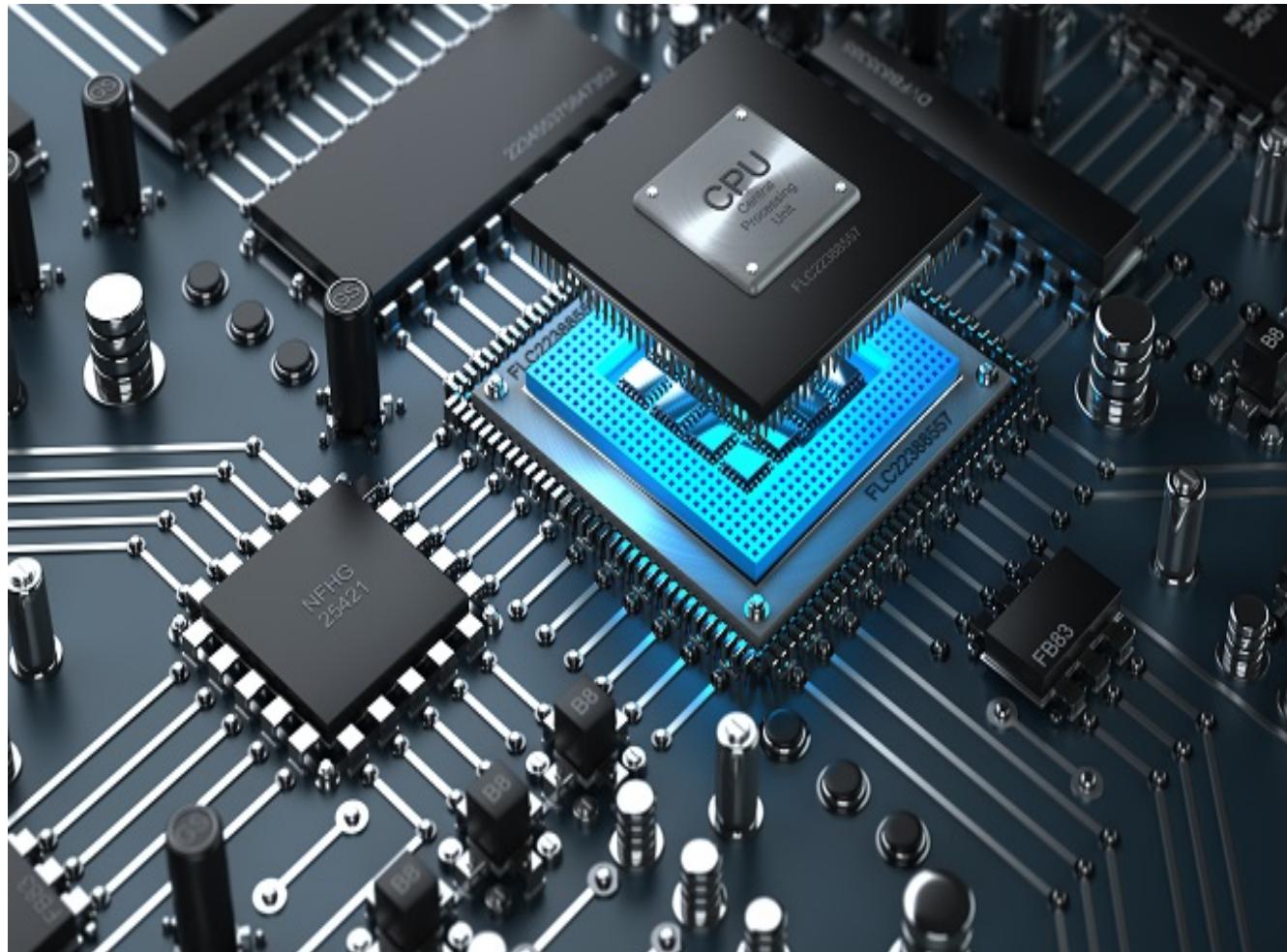
TOP LEVEL STRUCTURE OF COMPUTER



COMPONENTS OF THE COMPUTER



PHYSICAL COMPONENTS OF THE COMPUTER



Central Processing Unit

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THE CPU

- ❖ Central Processing Unit (CPU) is also known as the processor or microprocessor.
- ❖ This chip is regarded as the brain of the computer.
- ❖ It performs the basic operations of the computer, such as arithmetic, logical and I/O
- ❖ CPU performs all types of data processing operations.
- ❖ It controls the operation of all parts of computer

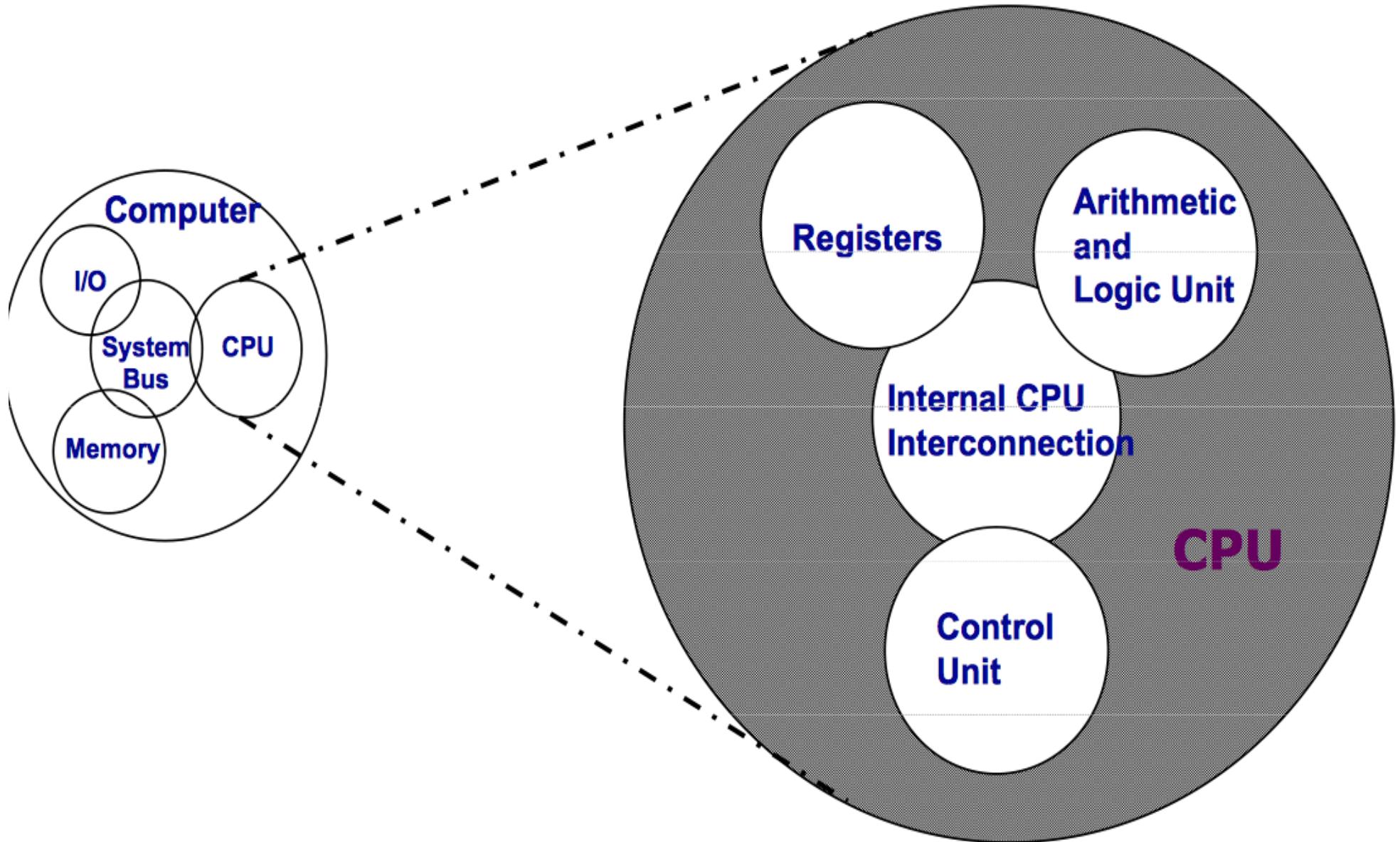
COMPONENTS OF THE CPU

- ❖ The CPU is made up of the following component;
 - Arithmetic Logic Unit (ALU)
 - Control Unit (CU)
 - Registers
 - Cache



CPU CORE FROM INTEL

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COMPONENTS OF THE CPU

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COMPONENTS OF THE CPU

ARITHMETIC LOGIC UNIT (ALU):

- An arithmetic logic unit (**ALU**) is a digital circuit component of the CPU.
- This is the fundamental building block of the CPU.
- It performs arithmetical and logical operations such as addition, subtraction, multiplication, division, etc.
- The unit also perform comparison or logical operation such as comparing numbers, letters, or special characters.

REGISTERS

This is a collection of high-speed storage locations.

Registers are temporary storage areas which are responsible for holding the data that is to be processed by the CPU

They store instructions and data in a processor and provide fast access because of their proximity to the ALU.

Different types of registers exist to handle different operations within the CPU

They can be classified as general purpose or special purpose.

Example of registers

This category of registers is used for performing specific operation. They include

- Accumulator(AC),
- Data Register(DR),
- Address Register(AR),
- Program Counter(PC),
- Memory Data Register (MDR),
- Memory Buffer Register(MBR).

CPU

Memory Data Register (**MDR**)

Program Counter (**PC**)

Current Instruction Register (**CIR**)

Accumulator (**ACC**)

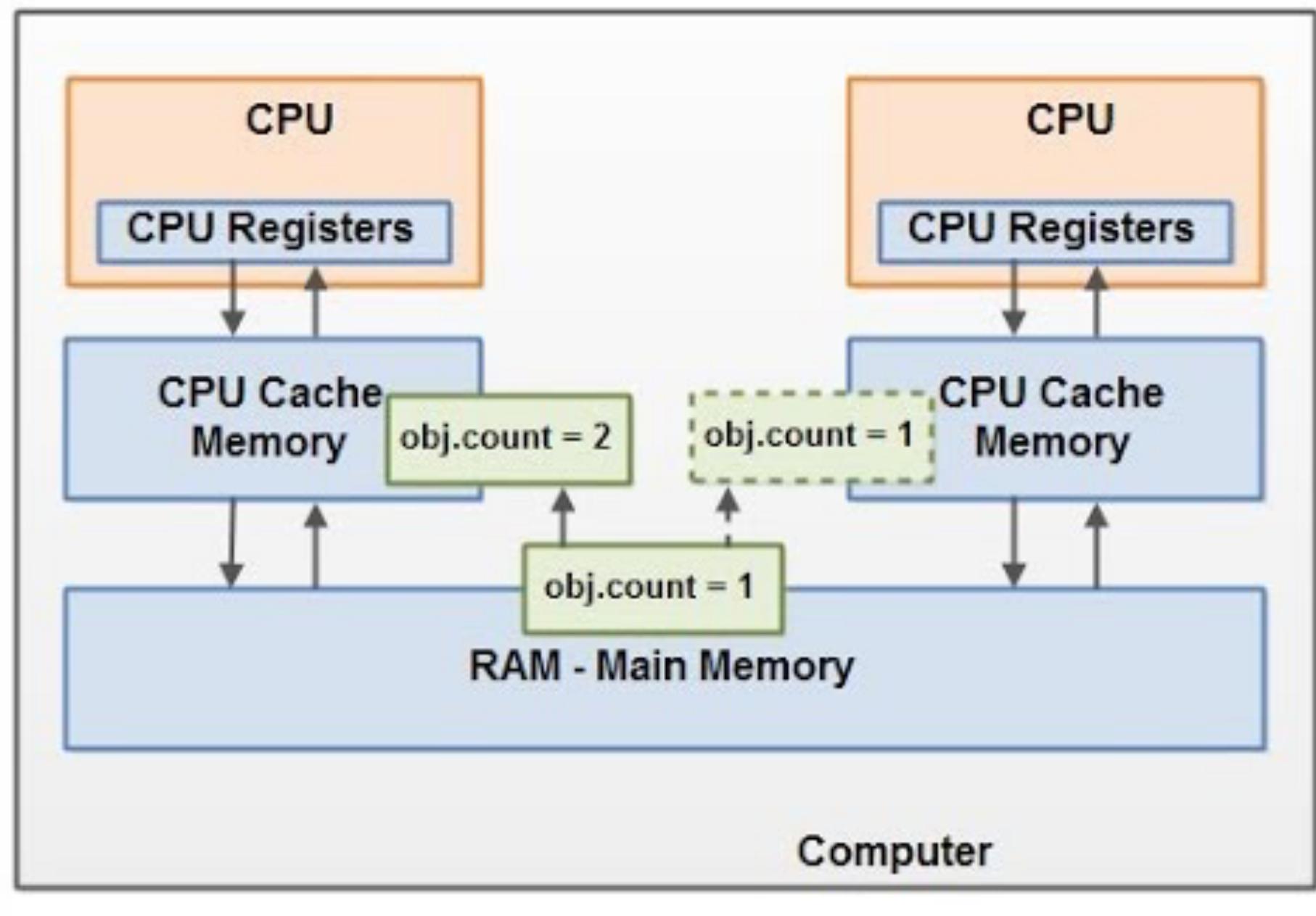
General purpose registers

(Quite a few of them)

.....

Memory Address Register (**MAR**)

REGISTERS



CPU CACHE

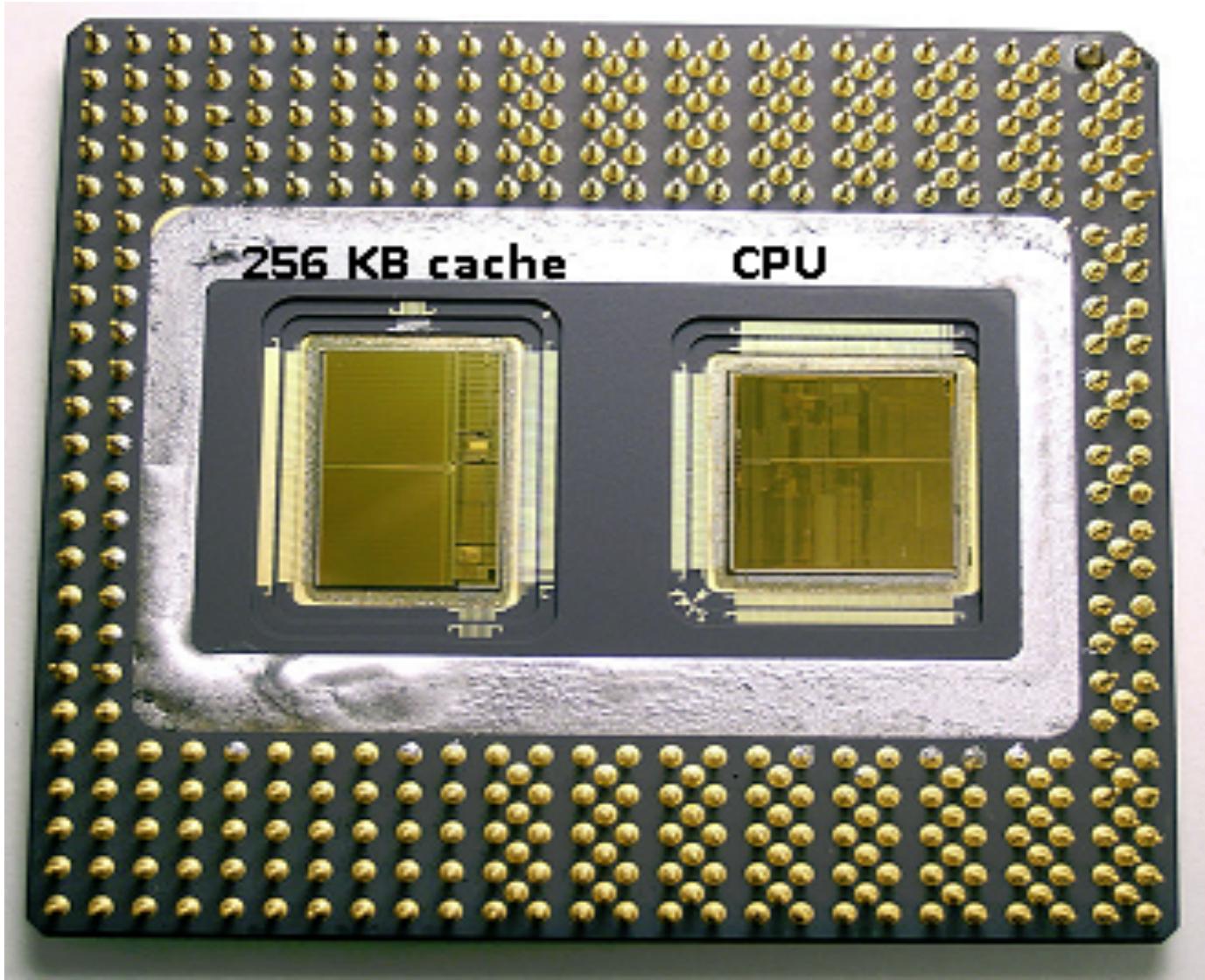
The CPU cache is one of the most commonly used types of cache memory.

Found on modern day CPUs, it holds data and program instructions that are likely to be needed by the CPU in the near future.

It enables storing and providing access to frequently used programs and data.

The cache is slower than registers, but provides more storage space and faster than the main memory

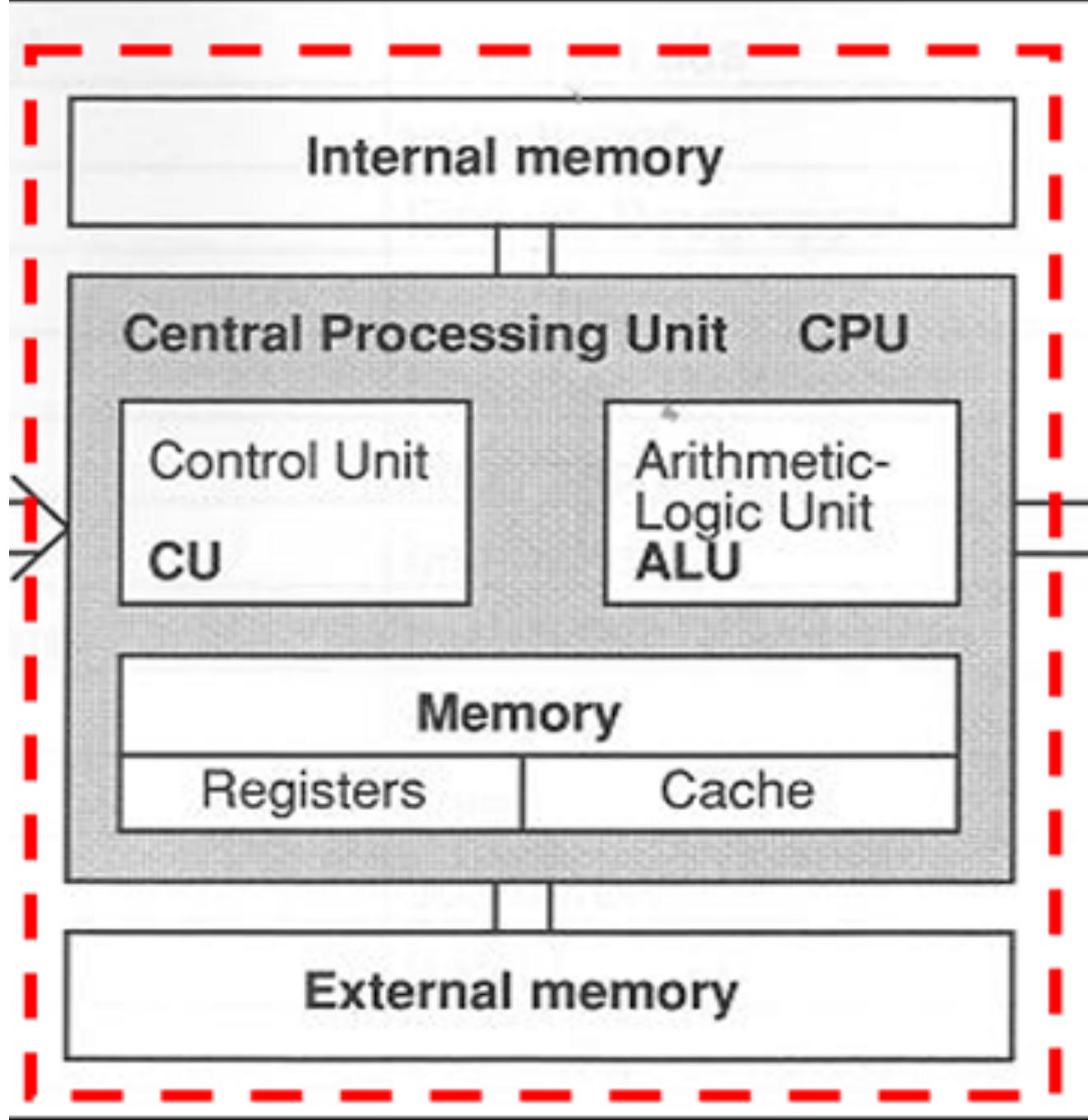
The CPU cache is embedded directly on the processor, while some are also installed close to the CPU

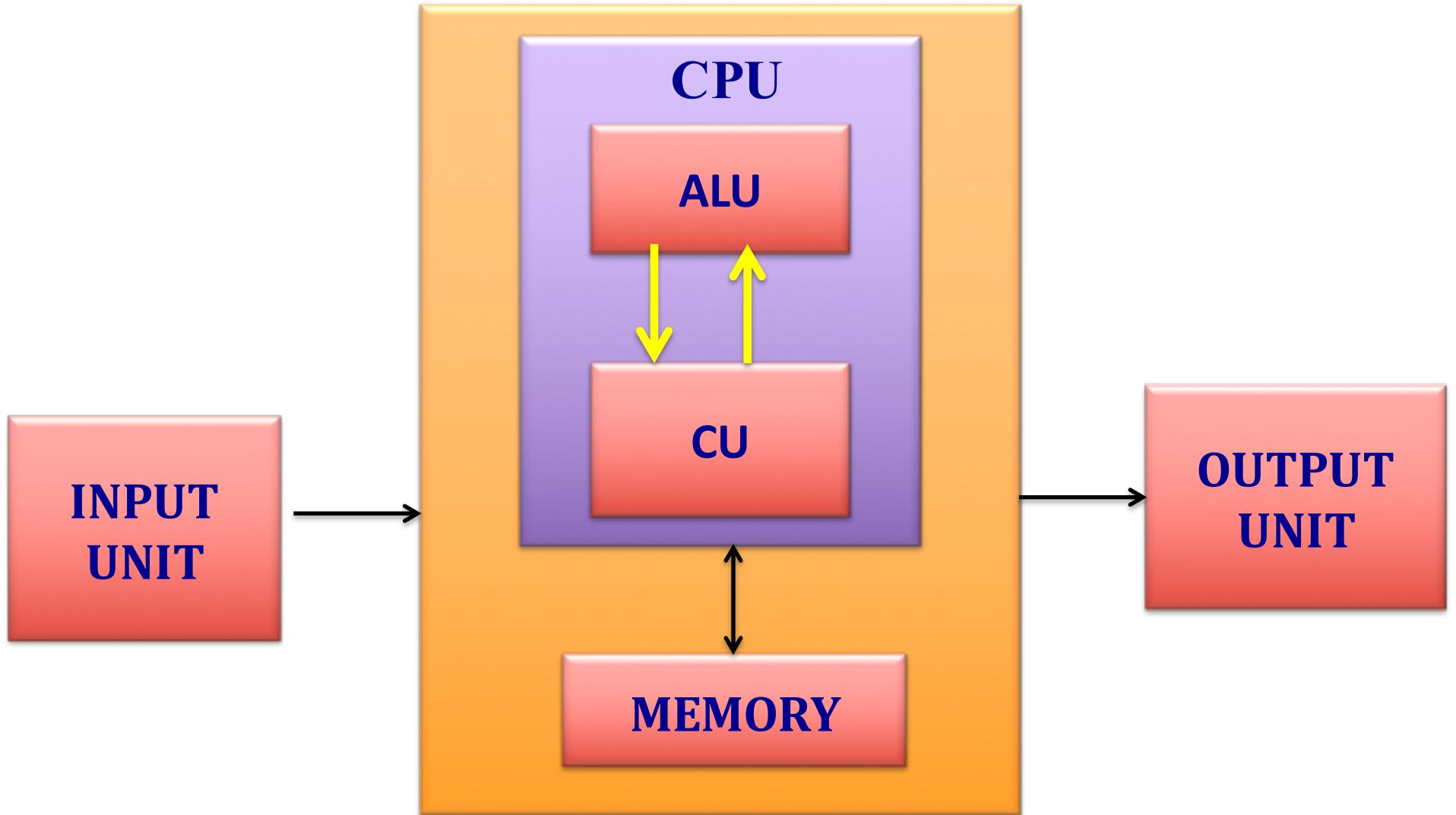


CPU CACHE

CONTROL UNIT

- The control Unit of the CPU controls and directs the operation of the entire system.
- It implements instructions required to be executed by the CPU .
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer; thus It performs fetch, decode, execute and store operations for the CPU
- It communicates with Input/output devices for transfer of data or results from storage.





CPU VENDORS

- The most popular CPU manufacturers, as of 2014, are AMD and Intel.
- Other popular vendors supporting the industry include *IBM, NVIDIA, SUN, TI, VIA, QUALCOMM*
- Initially, a CPU contained only one processor; then, Intel came up with the dual-core processor, a CPU containing two processors
- As of August 2014, both Intel and AMD have continued to develop and produce multiple core processors



IMAGES OF CPU

STORAGE ELEMENTS

- ❖ These are hardware devices used to store and retrieve data or instructions for future use.
- ❖ Storage devices could be internal or external relative to the computer system.
- ❖ It can hold and store information both temporarily and permanently.
- ❖ Storage elements can be classified into two:
 - Primary storage
 - Secondary storage

THE STORAGE ELEMENT

PRIMARY STORAGE DEVICE

- ❖ Primary storage is alternatively referred to as internal memory, main memory or primary memory
- ❖ Primary memory device is a medium that holds data for short periods of time while a computer is running or hold permanent data for the computer system
- ❖ Primary storage memory connects directly to the computer's CPU and could be volatile or non-volatile
- ❖ Primary storage devices have much faster access time
- ❖ They are however very costly

TYPES OF PRIMARY STORAGE

- ❖ The primary memory is embedded with two types of memory technologies;
 - RAM (Random Access Memory)
 - ROM (Read Only Memory)
- ❖ Aside the RAM and ROM, two other primary storage areas can be found;
- ❖ These are on the CPU itself;
 - Processor registers
 - Processor cache.

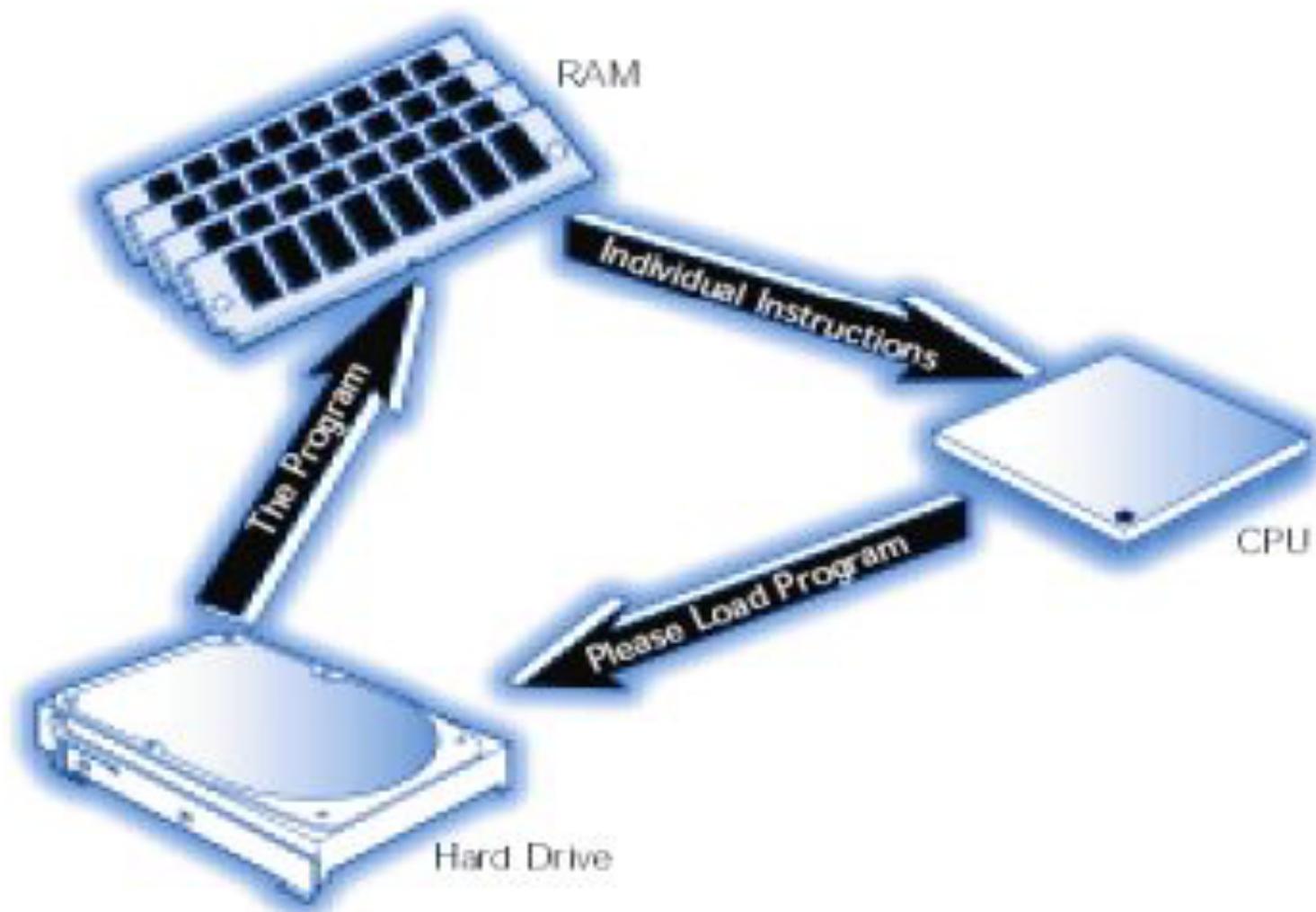
THE RAM CHIP

- ✧ RAM is acronym for Random Access Memory
- ✧ It is a primary storage device of the computer system
- ✧ RAM is used to store intermediate data temporarily while the CPU is processing the data.
- ✧ RAM is the most common type of memory found in computers and other devices, such as printers
- ✧ RAM is used to stores data and instructions that will be executed by the CPU
- ✧ Access to data on the RAM is faster

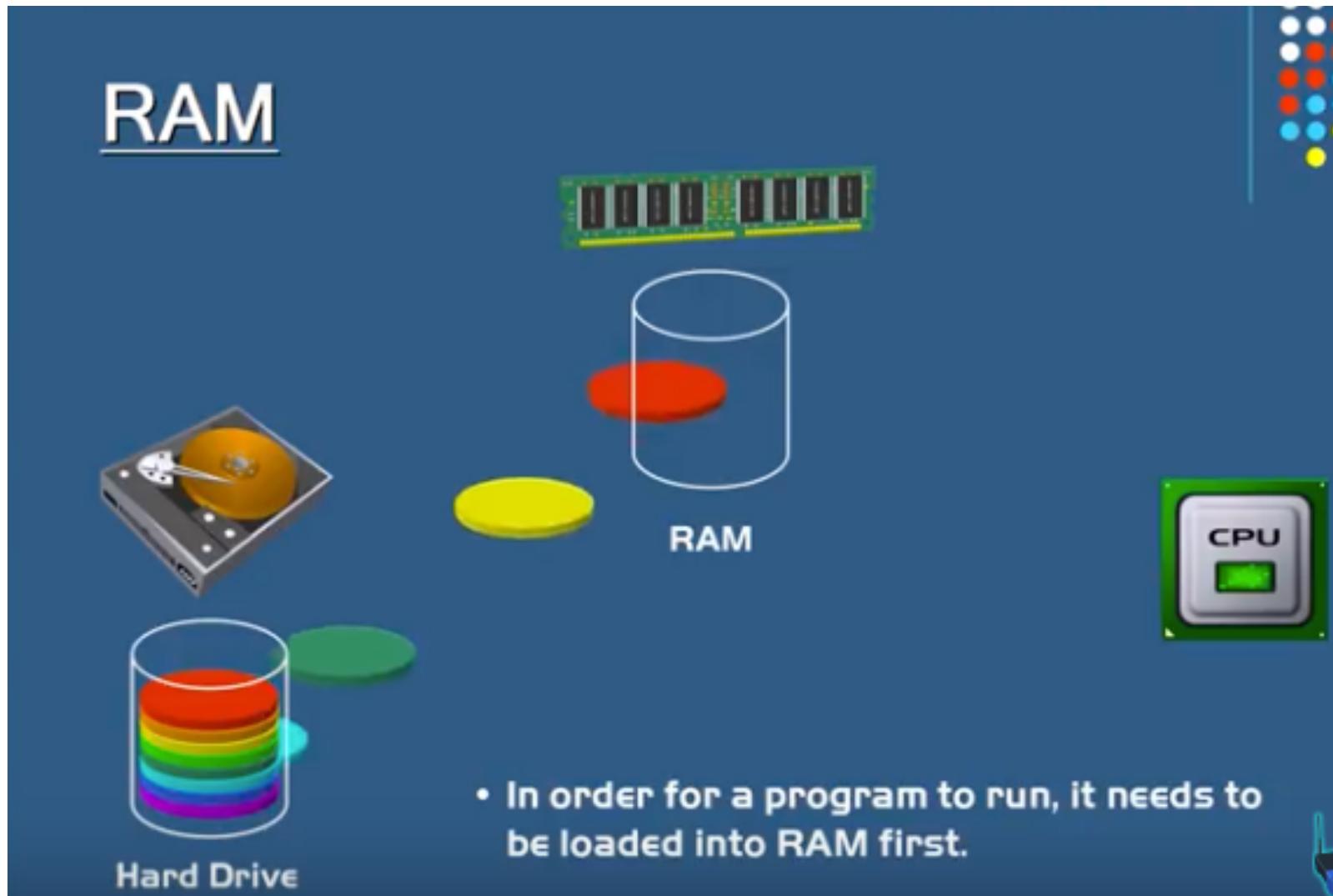
THE RAM

- Data stored on the RAM is volatile hence is lost when the computer system goes off.
- RAM data can be modified and updated.
- RAM is accessed randomly; any byte of memory can be accessed without touching the preceding bytes.
- RAMs are installed on the motherboard in modules.
- Different modules exist; SIMM, RIMM, DIMM, SO DIMM

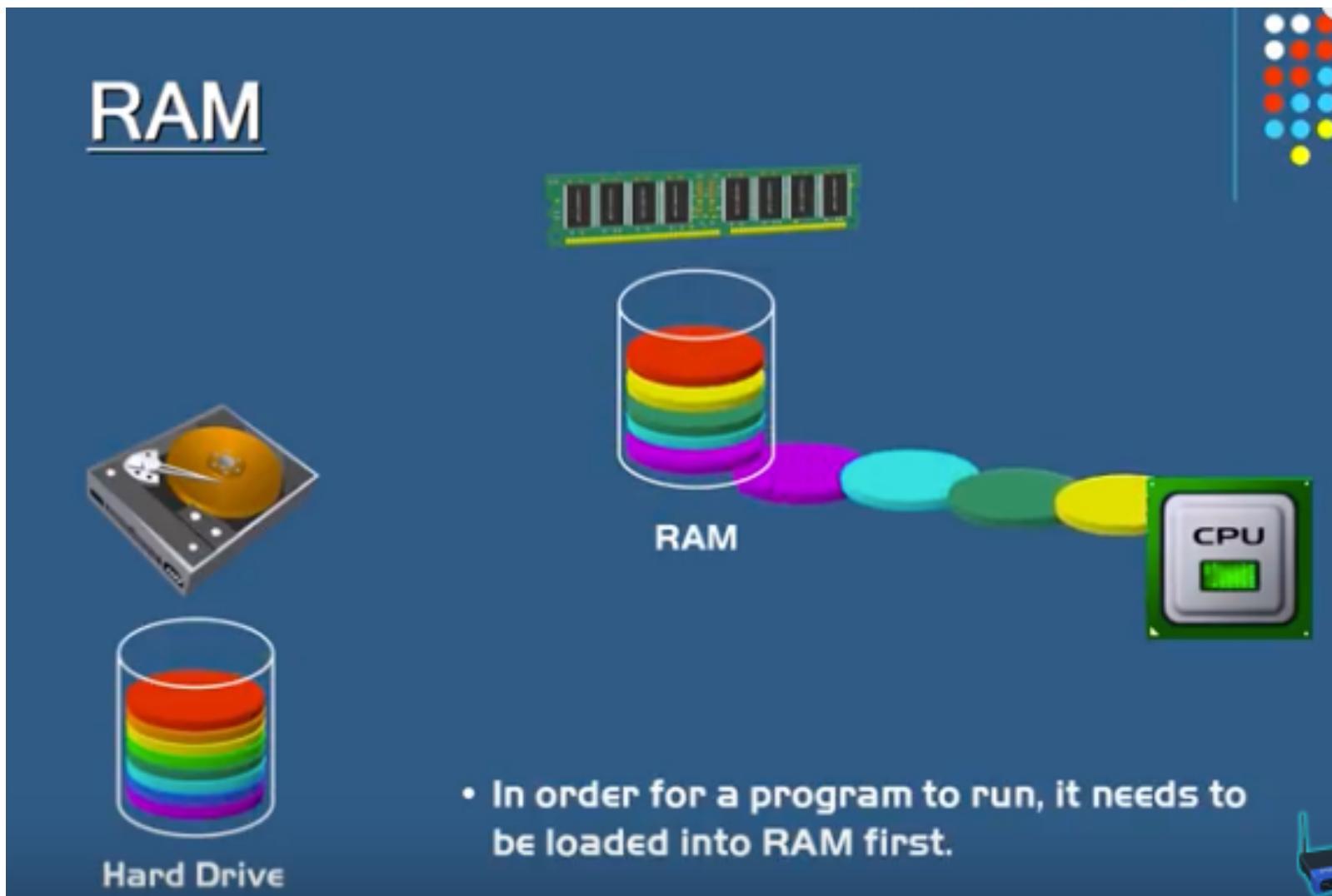
THE RAM



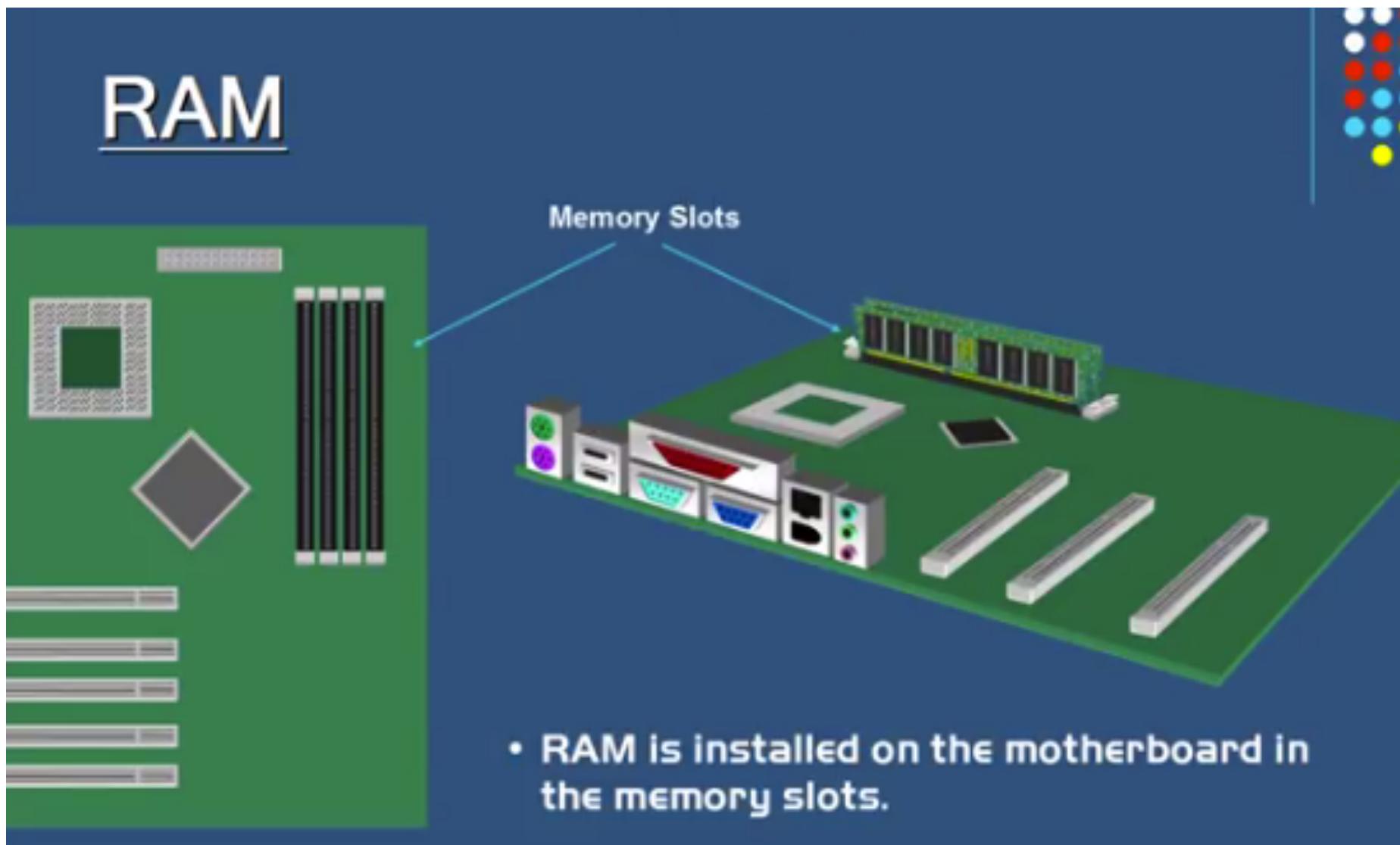
THE RAM



THE RAM



THE RAM



DIMM vs. SIMM vs. RIMM

- DIMM and SIMM are two major types of random-access memory standards for personal computers.
- The naming of each type of RAM refers to the specific way in which the memory is packaged.
- DIMM stand for Dual -Inline Memory Module
- SIMM stand for Single-Inline Memory Module
- RIMM stand for Rambus-Inline Memory Module
- SO DIMM stand for small Outlined DIMM
- DIMM and SIMM are manufactured with pins which enable them to connect to the PC's motherboard.
- Typical SIMM has 72 pins while DIMM has 168 pins
- SIMM pins supports 32-bit whiles DIMM support 64-bits
- RIMM has 16-bit with 184 pins and 32-bit with 232 pins

SIMM



30 pin SIMM

SIMM

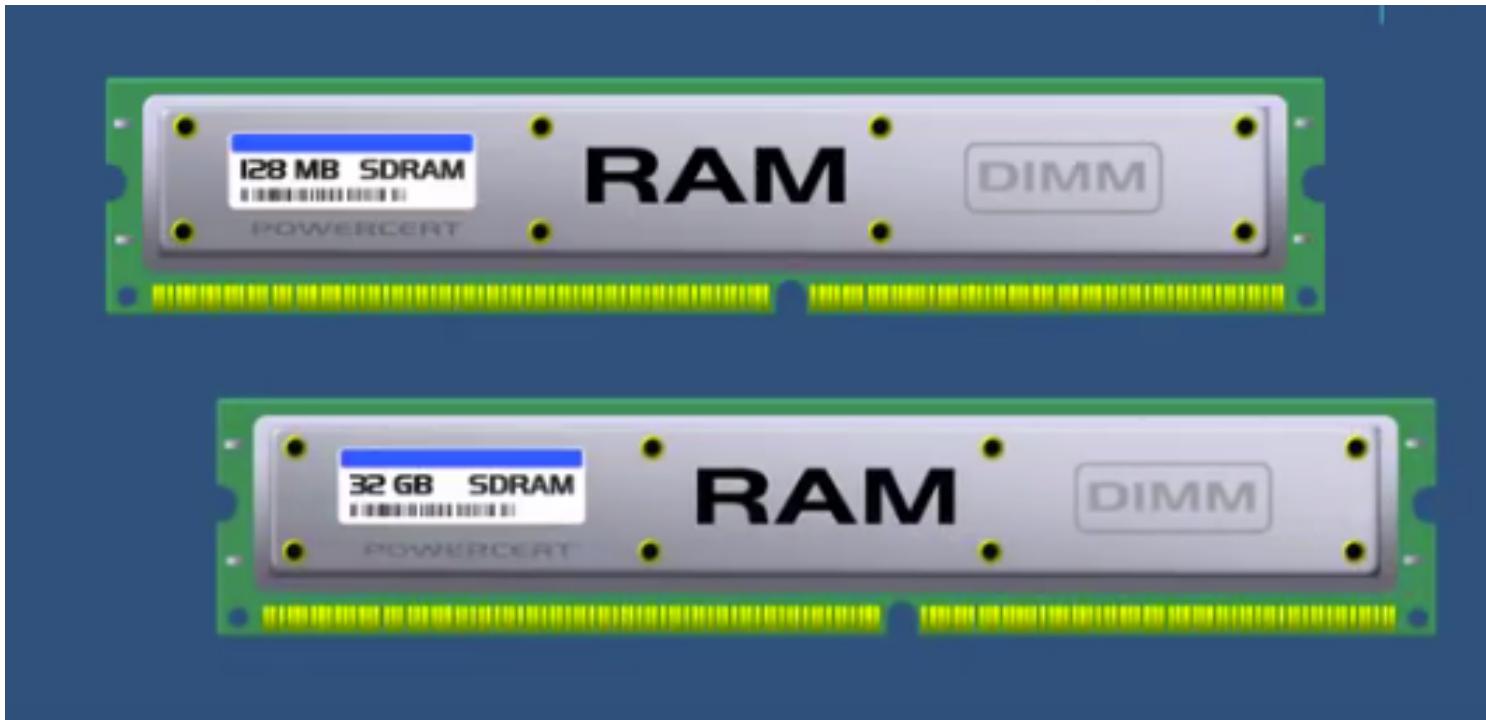


4 MB 72-Pin SIMM

ComputerHope.com

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DIMM



TYPES OF RAM

There are two types of Random Access Memory or RAM;

They are:

- Static RAM----SRAM
- Dynamic RAM----DRAM

DRAM: DYNAMIC RAM

- ❖ DRAM requires data to be refreshed periodically in order to retain the data.
- ❖ DRAM is slower and less desirable; average access time is 60 nanoseconds
- ❖ DRAM consumes much power; due to frequent refresh
- ❖ It is relatively cheaper ; gigabyte of DRAM costs \$20-\$75
- ❖ DRAM has become the mainstream in computer main memory
- ❖ DRAM has large storage capacity
- ❖ DRAM require one transistor and one capacitor to store 1 bit of data

TYPES OF DRAM

- ❖ ADRAM

Asynchronous DRAM

- ❖ SDRAM

Synchronous DRAM

- ❖ SDR RAM

This moves data one in every clock cycle

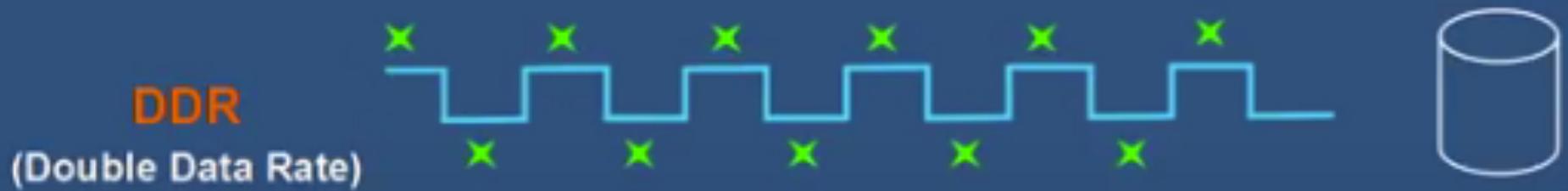
- ❖ DDR RAM

This moved data twice in a single clock cycle

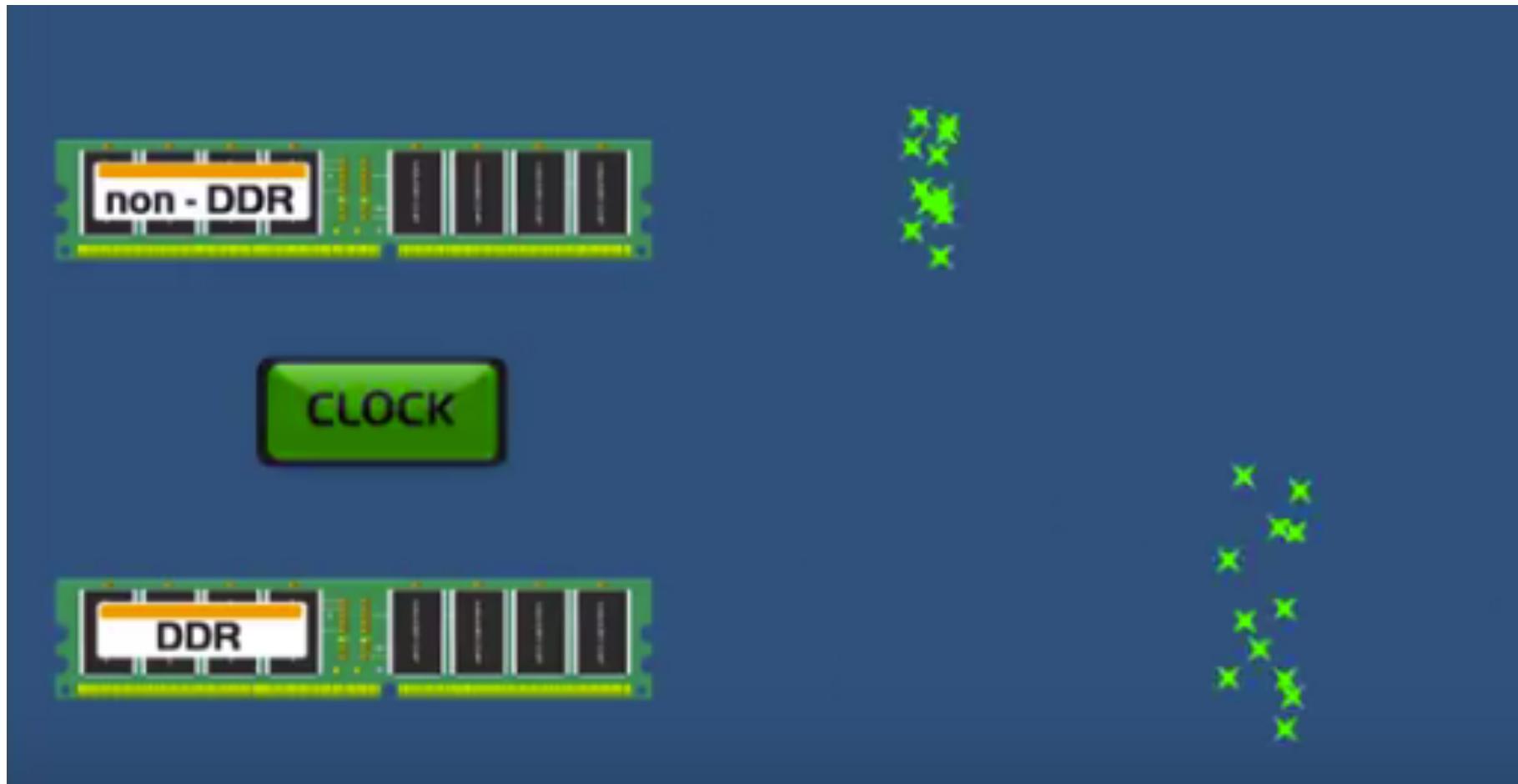
SDR vs. DDR

DDR - Double Data Rate

- Sends double the amount of data in each clock signal.



SDR vs. DDR



TYPES OF DDR

❖ DDR

100-200 MHz, 184 pins

❖ DDR2

200-533 MHz, 240 pins

❖ DDR3

400-1066 MHz, 240 pins

❖ DDR4

1066-2133 MHz, 288 pins

SRAM

- ❖ SRAM does not need to be refreshed, as the transistors inside would continue to hold the data as long as the power supply is not cut off.
- ❖ SRAM provides faster access to data; average access time is less than 10 nanoseconds
- ❖ SRAM consumes less power
- ❖ It is however expensive; gigabyte of SRAM cache costs around \$5000,
- ❖ SRAM has less storage capacity
- ❖ The most prominent use of SRAM is in the cache memory of processors where speed is very essential (L1 , L2 cache)
- ❖ SRAM is made up of flip flop
- ❖ SRAM use 6 transistor for each bit of data

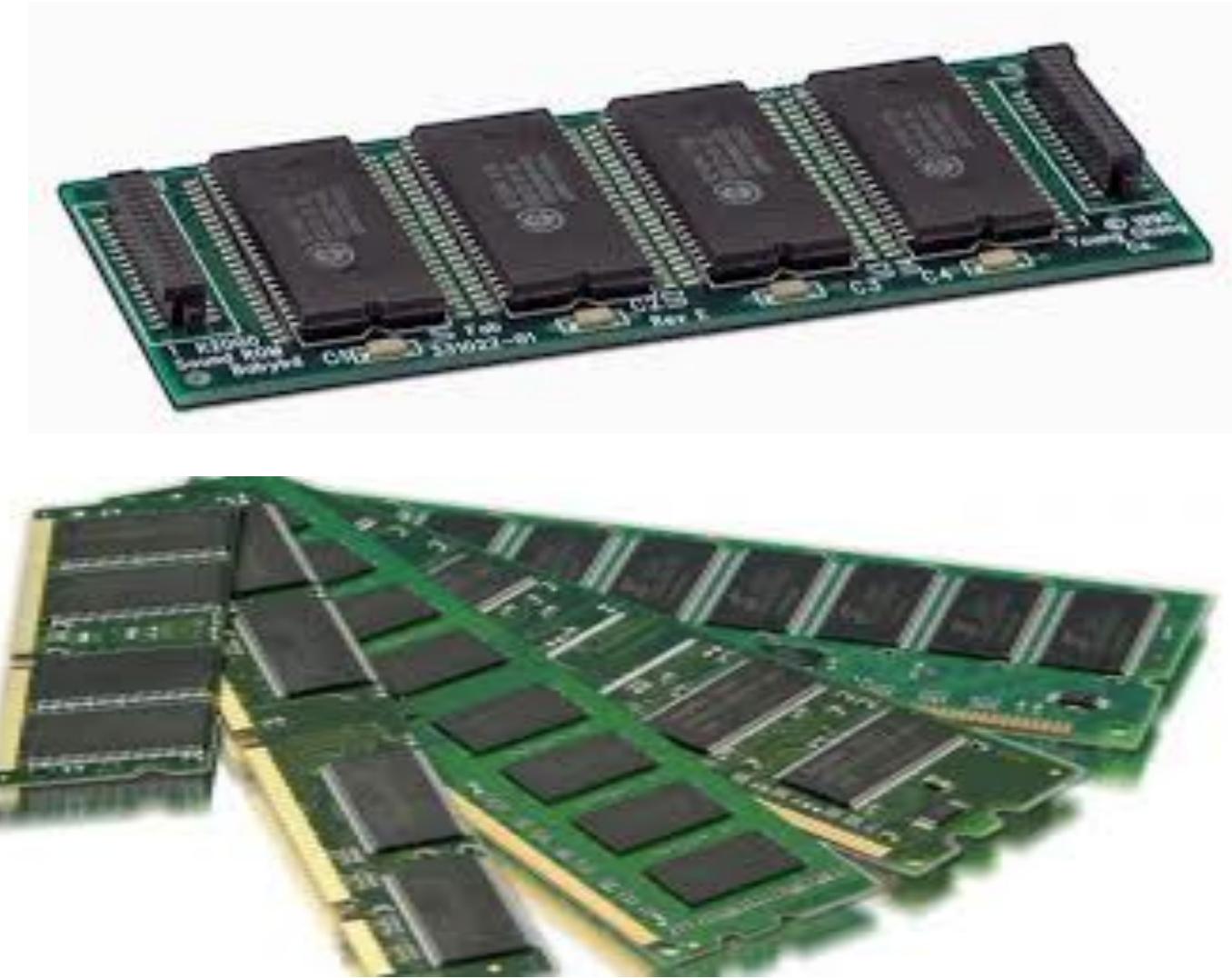


IMAGE OF RAM CHIPS

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THE ROM CHIP

- ❖ ROM (Read Only Memory) is a memory that stores permanent instruction that cannot be erased.
- ❖ ROM is a non-volatile primary storage device
- ❖ Data stored on the ROM is permanent
- ❖ ROM data cannot be modified or updated by the user
- ❖ ROM contains special instructions that boot and performs diagnostics on the computer system
- ❖ ROMs operate at a much slower speed than RAM.

TYPES OF ROM

ROM - Read Only Memory

PROM - Programmable Read Only Memory

EPROM - Erasable Programmable Read Only Memory

EEPROM - Electrically Erasable Programmable Read Only Memory

ROM

- ❖ The way a ROM chip works necessitates the programming of complete data when the chip is created.
- ❖ You cannot reprogrammed or rewrite a standard ROM chip.
- ❖ If it is incorrect, or the data needs to be updated, you have to throw it away and start over
- ❖ They use very little power, are extremely reliable and, in the case of most small electronic devices, contain all the necessary programming to control the device.

PROM

- ❖ Creating ROM chips totally from scratch is time-consuming and very expensive in small quantities.
- ❖ For this reason, developers created a type of ROM known as programmable read-only memory (PROM).
- ❖ Blank PROM chips can be bought inexpensively and coded by the user with a programmer.
- ❖ PROMs can only be programmed once.
- ❖ They are more fragile than ROMs.

EPROM

- ❖ Working with ROMs and PROMs can be a wasteful business.
- ❖ Even though they are inexpensive per chip, the cost can add up over time.
- ❖ Erasable programmable read-only memory (EPROM) addresses this issue.
- ❖ EPROM chips can be rewritten many times.
- ❖ Erasing an EPROM requires a special tool that emits a certain frequency of ultraviolet (UV) light.
- ❖ EPROMs are configured using an EPROM programmer

EEPROM

- ❖ changes cannot be made incrementally to an EPROM; the whole chip must be erased.
- ❖ Electrically Erasable Programmable Read-Only Memory (EEPROM) chips remove the biggest drawbacks of EPROMs.
- ❖ In EEPROM, chip does not have to remove to be rewritten.
- ❖ The entire chip does not have to be completely erased to change a specific portion of it.
- ❖ Instead of using UV light, you can return the electrons in the cells of an EEPROM to normal with the localized application of an electric field to each cell.
- ❖ This erases the targeted cells of the EEPROM, which can then be rewritten.

ROM

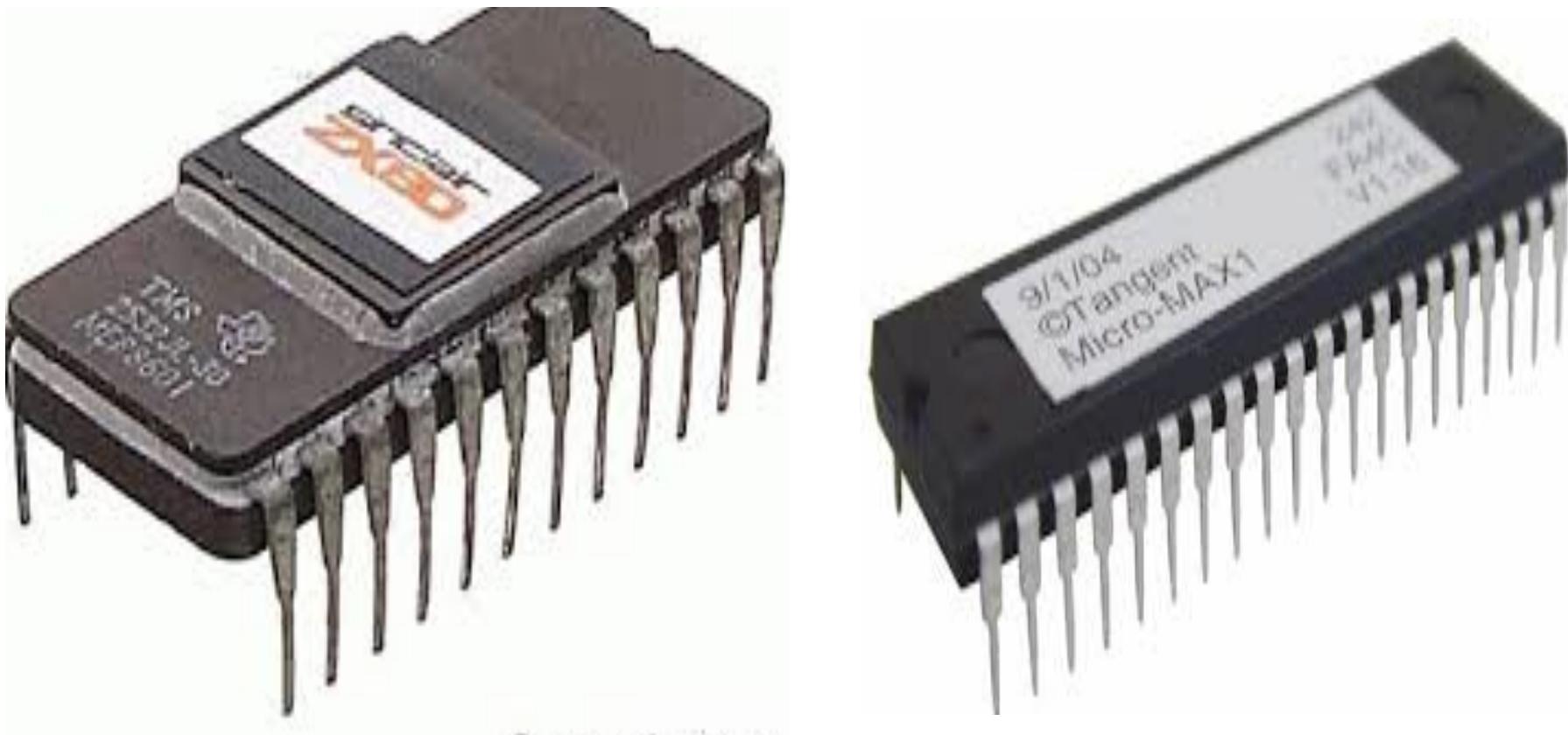


IMAGE OF ROM CHIPS

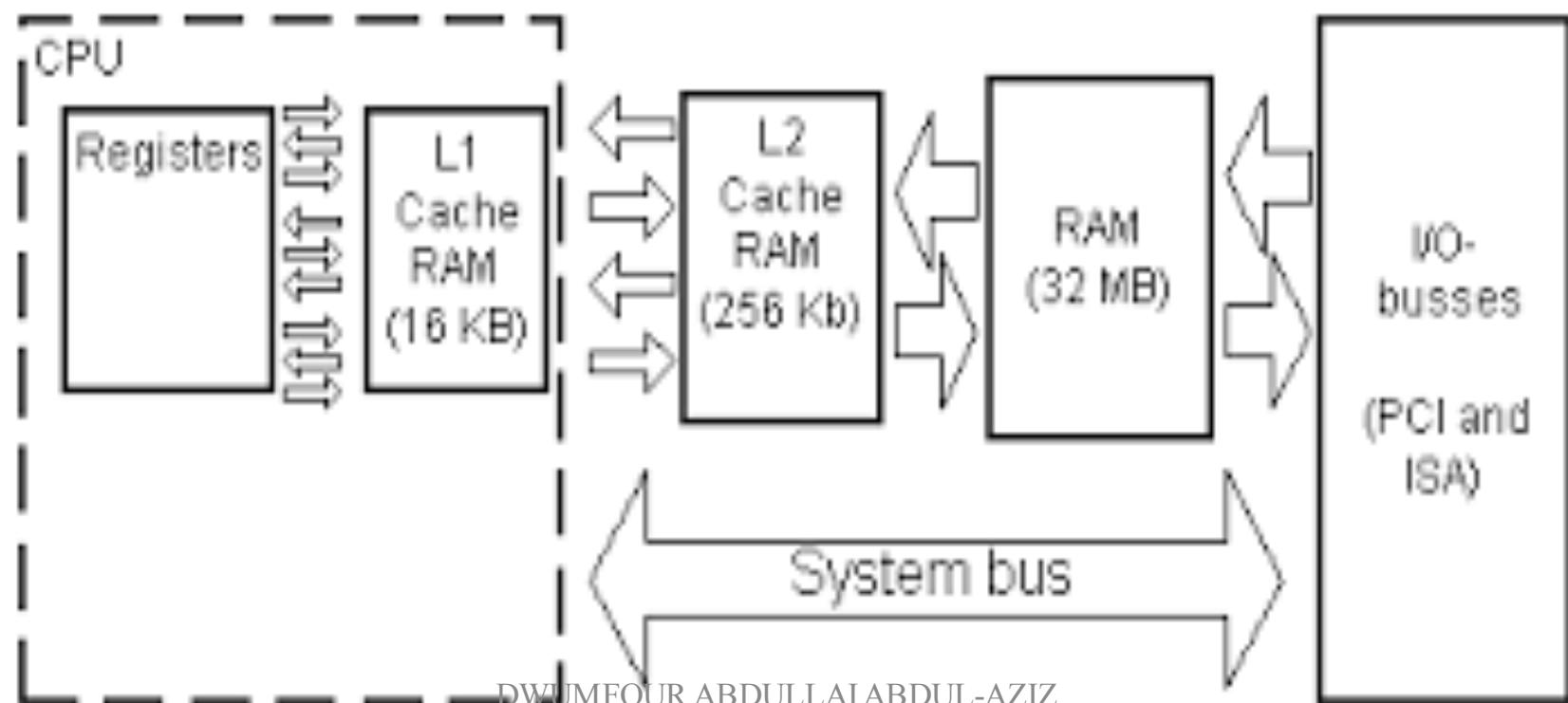
TYPES OF STORAGE

THE PROCESSOR CACHE

- ❖ Processor cache on the other hand is used by the CPU for reducing the time it takes to access the main memory.
- ❖ It stores data coming from the most frequently used applications of the CPU.
- ❖ During normal operations, the CPU checks the processor cache before checking the main memory, making the processing time faster.

THE PROCESSOR CACHE

- ❖ The type of memory used in the processor cache is on the same die as the processor and far more expensive to produce than normal RAM.
- ❖ Processor cache is substantially faster than the system RAM and contains information that the processor will be immediately and repeatedly accessing



SECONDARY STORAGE

- ❖ Secondary storage device also referred to as auxiliary storage , secondary memory or external memory refers to non-volatile storage that is internal or external to the computer
- ❖ Unlike primary memory, Secondary storage is not directly accessed by the CPU.
- ❖ It store permanent data for the computer system
- ❖ It stores almost all programs and applications that reside on the computer

SECONDARY STORAGE

- ❖ They have large storage capacity at a lesser cost per byte compared to primary storage
- ❖ Secondary storage allows for storage of data ranging from some megabytes to terabytes and beyond
- ❖ When power goes off, data stored on secondary memory is retained (is not lost)
- ❖ Storage devices are created using either magnetic or optical media.
- ❖ Storage devices are less expensive than semiconductor memory.

Storage Technologies

Storage devices are created using the following technologies

- ✓ Magnetic coated technology
- ✓ Optical technology
- ✓ Solid state technology

Magnetic Storage technology

A magnetic disk is a storage device that uses a magnetization process to read and write data. It is covered with a magnetic coating and stores data in the form of tracks and sectors.

Advantages of Magnetic Storage technology

- ✧ Inexpensive storage
- ✧ Very fast access to data
- ✧ Direct access on any part of the drive
- ✧ Very large amounts of storage space

Disadvantages of Magnetic storage technology

- ✧ Data can be altered by magnetic fields, dust, mechanical problems
- ✧ Gradually lose their charge over time - data lost
- ✧ Hard disks eventually fail which stops the computer from working
- ✧ The surface of the disk, can lose data within sectors with regular crashes
- ✧ Cannot transfer the disk to another computer easily

Examples of magnetic storage devices

- Hard disk
- Floppy disk
- Tape drive



Optical Storage Technology

An optical disc is an electronic data storage medium that can be written to and read using a low-powered laser beam. These drives use **Lasers** (light) to **read** information from disks and in some cases **write** information to disks.

Optical drives include CD's, DVD's and Blu-ray disks and they all use a lens to read and write data.

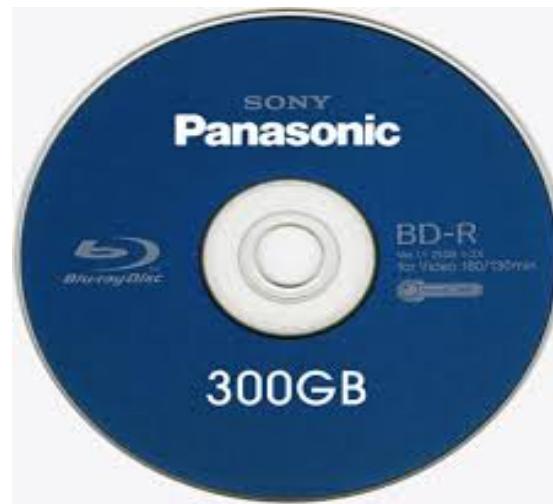
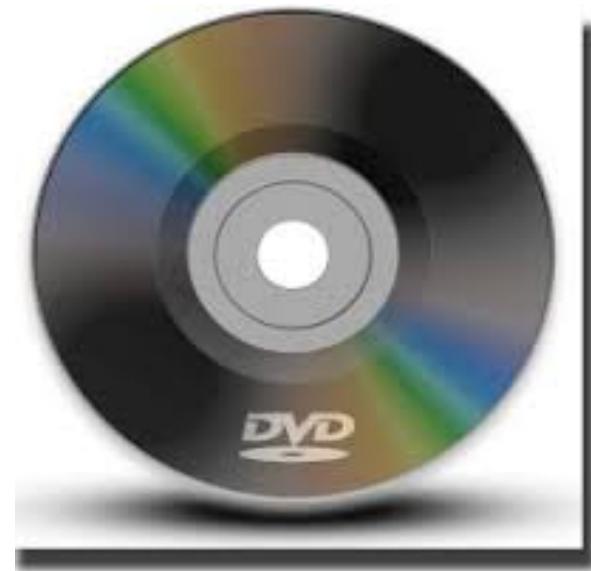
CD-R, DVD-R, BD-R can be written to once and are then Read only, while CD-RW, DVD-RW, BD-RW are Read Write so they can be written many times.

Advantages of Optical Storage Devices

- ✧ Optical discs are portable and can be read on many different devices
- ✧ Very inexpensive
- ✧ Memory is retained even when the power is turned off
- ✧ Durable and last longer
- ✧ Archived data cannot be overwritten on read only CD-R, DVD-R, BD-R formats
- ✧ Can random access data no matter where or when it was stored

Disadvantages of Optical Storage Devices

- ✧ Require special drives to read/write.
- ✧ Compared to other storage devices they have little storage
- ✧ Can be expensive per GB/TB
- ✧ There are compatibility issues with different drives
- ✧ Lack of standards for grading quality and for longevity tests
- ✧ You can write once on read only CD-R, DVD-R, BD-R formats



Solid State Storage Technology

Solid state drives use flash memory to store non-volatile data. Solid state devices have *no moving parts* and so are called 'solid state'. Instead, they use a special kind of *programmable ROM memory chip(flash memory)* on which data is stored.

Advantages of Solid State Storage Devices

- ✧ Startup faster due to no spin-up and they are faster than magnetic hard drives
- ✧ They have faster launch times
- ✧ They last longer and some are waterproof
- ✧ All data stored can be scanned quickly for security purposes

Disadvantages of Solid State Storage Devices

- ✧ Solid State Storage devices are expensive
- ✧ Vulnerable to abrupt power loss, magnetic fields, and electrical and static charges
- ✧ Larger erase blocks make random write speeds slow

Example of SSD storage devices

- ✧ USB flash drive
- ✧ Memory card
- ✧ SSD drive



SSD

INPUT/OUTPUT DEVICES

INPUT DEVICES

- ❖ Input devices are used to send data or command into the computer system for necessary actions to be taken.
- ❖ Common input devices of the computer system include; Mouse, keyboard, scanner, light pen, touch screen, joystick, track ball, digital camera, microphone, stylus etc.

INPUT DEVICES



Mouse



scanner



trackball



keyboard



joystick

INPUT DEVICES



Light pen



Light pen



microphone



stylus

OUTPUT DEVICES

- Output devices are used to display the results of process data for the user to see.
- Common output devices include; Monitor, printer, projector, plotter, speaker etc.

OUTPUT DEVICES



Printer



Monitor



Plotter

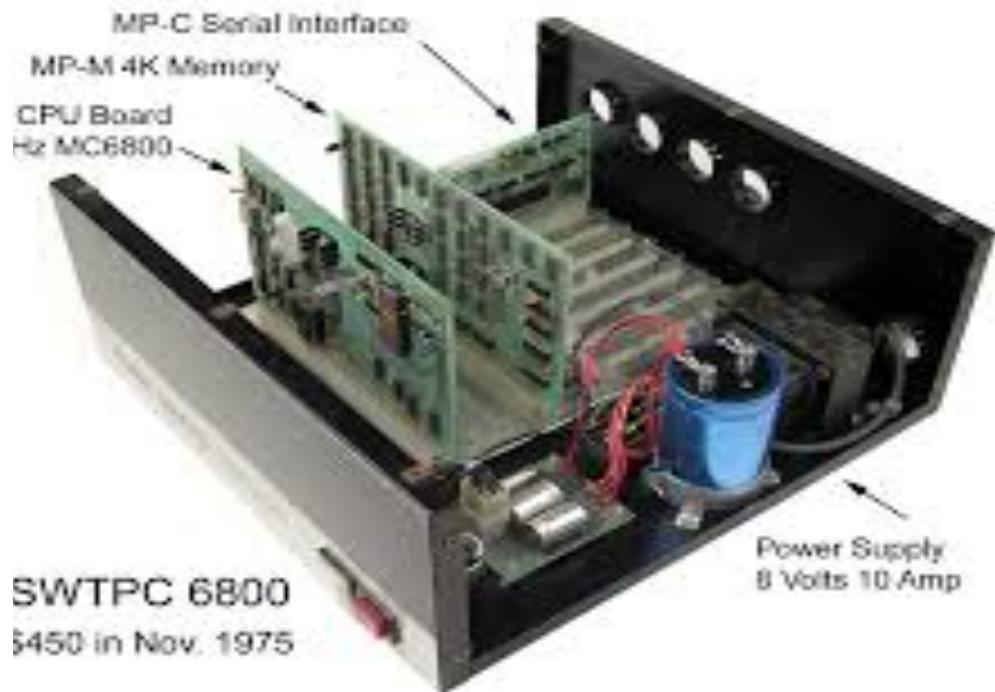


Projector

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THE SYSTEM UNIT

- ❖ The system unit is a rectangular box that contains different hardware components.
- ❖ It serves as a rectangular encasing, which protects other hardware devices found inside it.
- ❖ The basic components found inside the system unit include:
 - Power supply
 - Mother board
 - Expansion slots
 - Hard disk
 - RAM chip
 - ROM chip
 - CPU chip
 - Ports
 - VGA
 - BIOS
 - CMOS
 - Cooling Fan
 - GPU
 - Cables



SWTPC 6800
\$450 in Nov. 1975

SYSTEM UNIT

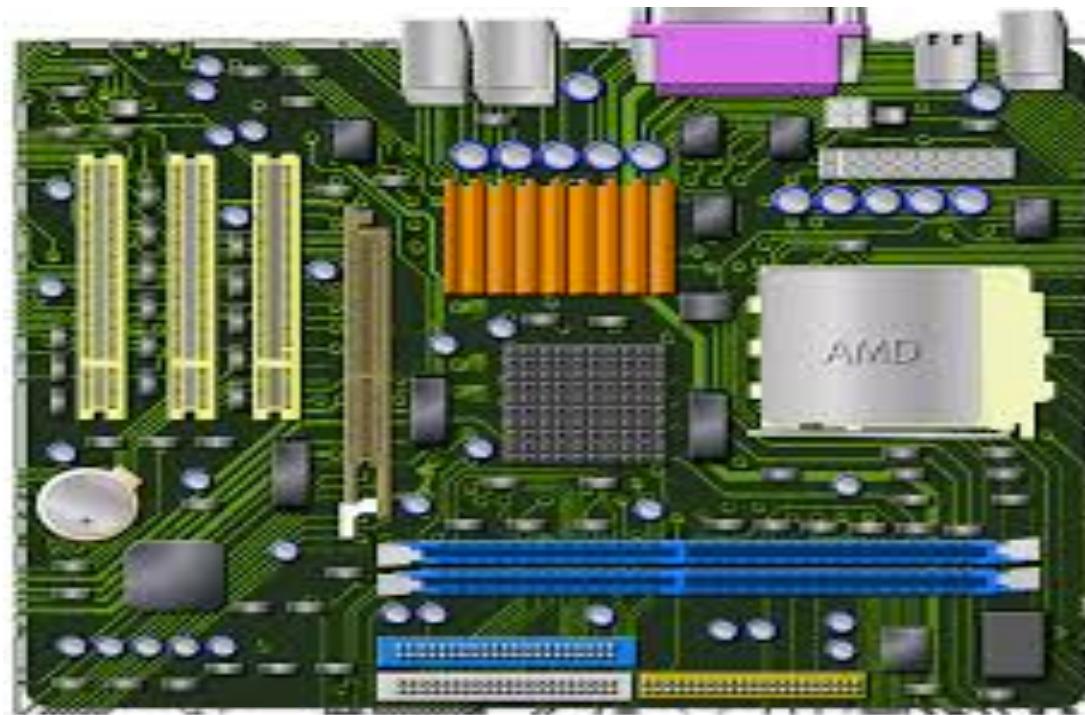


SYSTEM UNIT

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THE MOTHER BOARD

- This is the main circuit board inside the system unit.
- It is a flat board at the bottom of the system unit on which most components are mounted.



POWER PACK

- This is a device that converts AC to DC to run the computer.
- It is the main source of power to the computer system.



POWER PACK

VGA

- Short for Video Graphics Array, VGA is a standard display hardware developed by IBM in 1987.
- VGA connector is provided on video cards, projectors, computer monitors, laptop computers, and new televisions.



VGA CABLE



VGA PORT

THE BIOS

- The Basic Input Output System, usually referred to as BIOS, is a ROM chip on the motherboard that contain program which instructs the computer on how to perform a number of basic functions such as booting
- BIOS is also used to identify and configure the hardware in a computer such as the hard drive, floppy drive, optical drive, CPU, memory
- It include instructions on how to load basic computer hardware
- It performs a test called POST (Power On Self Test), which helps to verify if the computer meets requirements to boot up

FUNCTION OF THE BIOS

POST

This test the computer hardware and ensure no error exist before loading the operating system

BOOTSTRAP LOADER

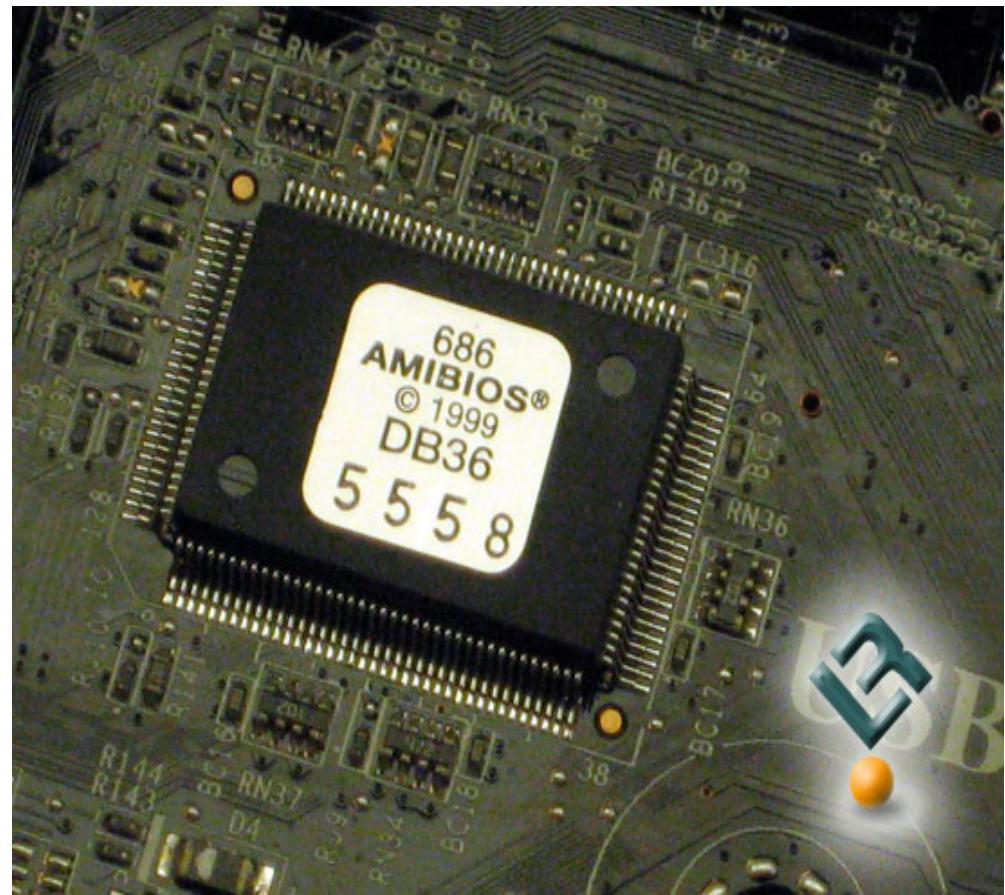
This locate the operating system and load it into memory

BIOS DRIVER

Low level drivers that give the computer basic operational control over the computer hardware

CMOS

Configuration program that allows you to configure hardware settings including system settings such as password, time and date



BIOS



CMOS

CMOS Battery



GPU

- Acronym for Graphics Processing Unit, GPU is an electronic circuit used to speed up the creation of both 2D and 3D images.
- GPUs could be integrated into computer's CPU or motherboard,
- they could also be dedicated to a separate piece of hardware known as a video card.
- By dedicating a separate processor, the GPU allows the computer's CPU resources to be used for other important tasks.

SYSTEM INTERCONNECTION

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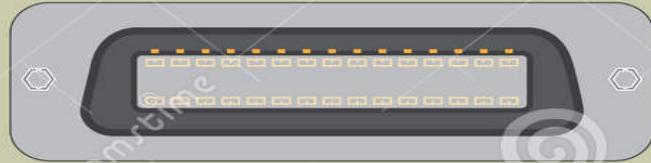
PHYSICAL COMPONENTS OF CONNECTIVITY

System interconnection is a mechanism used to connect different hardware components within the computer system

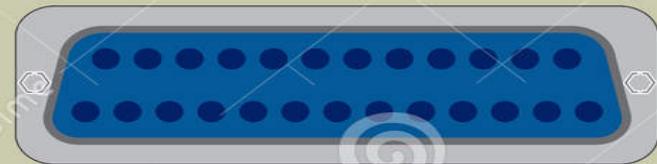
- Port
- Cable
- Buses

HARDWARE PORT

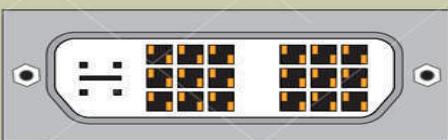
- Port is a socket designed to allow peripheral devices to be attached to the computer
- A port is usually located at the external part of the computer's system unit
- Ports serve as an interface for connecting external devices to the computer system
- Ports are designed to enable computer systems to share data and signals with other peripherals
- Common ports include: USB port, Ethernet port, VGA port, Audio port, PS/2, firewire port, game port, DVI Port, HDMI, thunderbolt



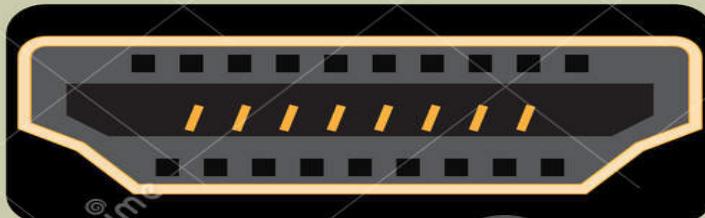
Centronics Parallel



Parallel Port



DVI-I



HDMI



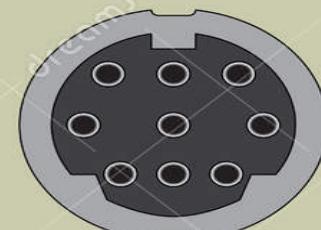
Dual-link DVI



Optical Audio Toslink



USB 2.0



Serial port



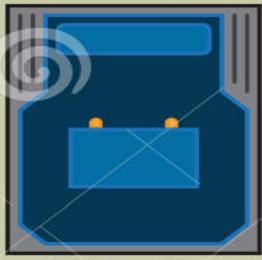
Composite audio/video



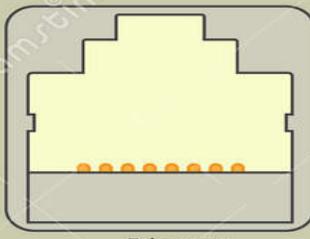
S-Video



Component Video



3.0 Type B Jack



Ethernet



VGA



Fire Wire 400



CABLES

Cables are hardware devices used to connect different peripherals to the computer system.

Common cables include:

- ❖ Integrated Drive Electronic (IDE) Cable
- ❖ Video Graphic Array (VGA) Cable
- ❖ Digital Visual Interface (DVI) Cable
- ❖ Serial Advance Technology Attachment (SATA) Cable
- ❖ High Definition Multimedia Interface (HDMI) Cable
- ❖ Universal Serial Bus (USB) Cable
- ❖ Ethernet Cable
- ❖ Firewire Cable
- ❖ Power Cable
- ❖ Thunderbolt Cable

CABLES

IDE Cable

IDE cables were used to connect storage devices to a motherboard.

VGA Cable

Connect computer system to Monitor, projector etc.

DVI Cable

Successor of VGA and used to connect computer , Monitor, Projector etc.

SATA Cable

was designed to succeed ATA.

SATA ports is used for newer hard disk over ATA ports.

Compared to ATA, SATA provides higher data transfer speeds.

CABLES

HDMI Cable

Successor to DVI and found in New computers, Projectors, High Definition TV set

USB Cable

Used to connect all USB compatible device to the computer

Ethernet Cable

Ethernet cables are used to set up local area networks

Firewire Cable

The purpose of FireWire is similar to that of USB: high speed data transfer for computer peripherals. E.g. printers and scanners

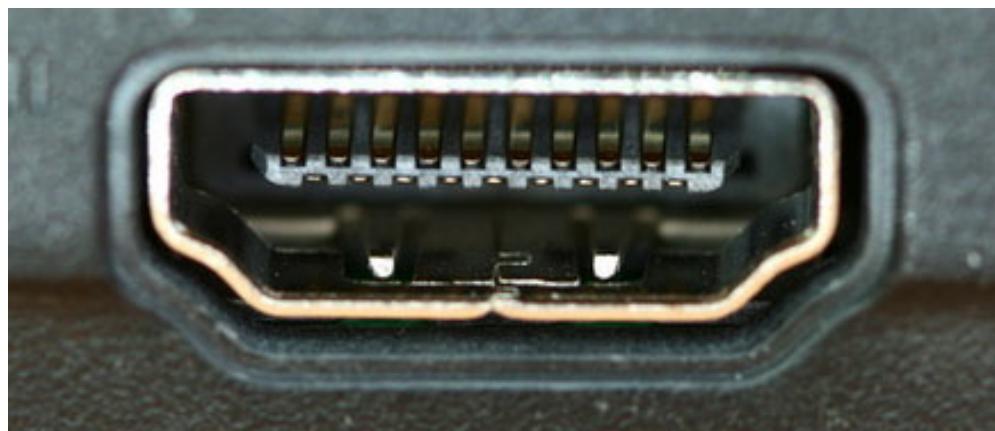
Power Cable

Use to connect the computer system to a power external power source

HDMI CABLE



HDMI PORT

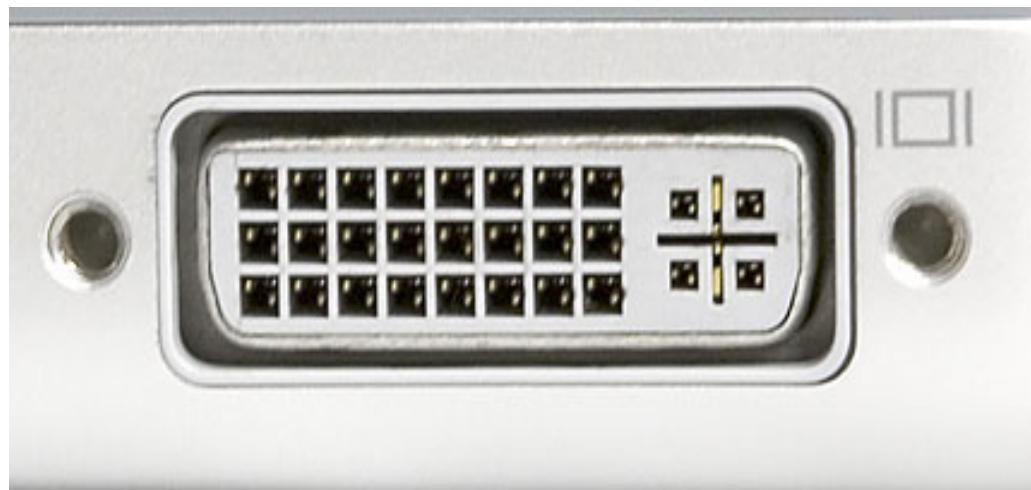


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DVI CABLE



DVI PORT

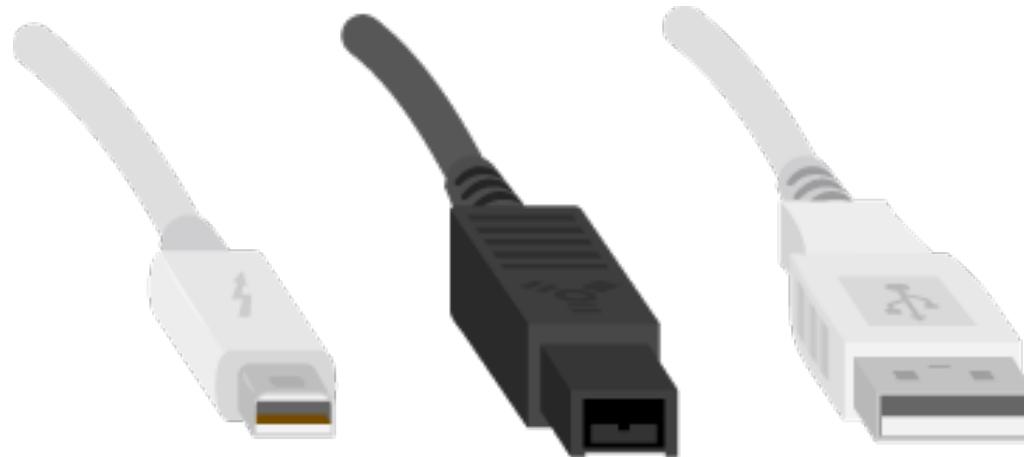


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Thunderbolt cable and port



Thunderbolt , Firewire and USB



80 seconds
Thunderbolt



1,026 seconds
FireWire 800



4,444 seconds
USB 2.0



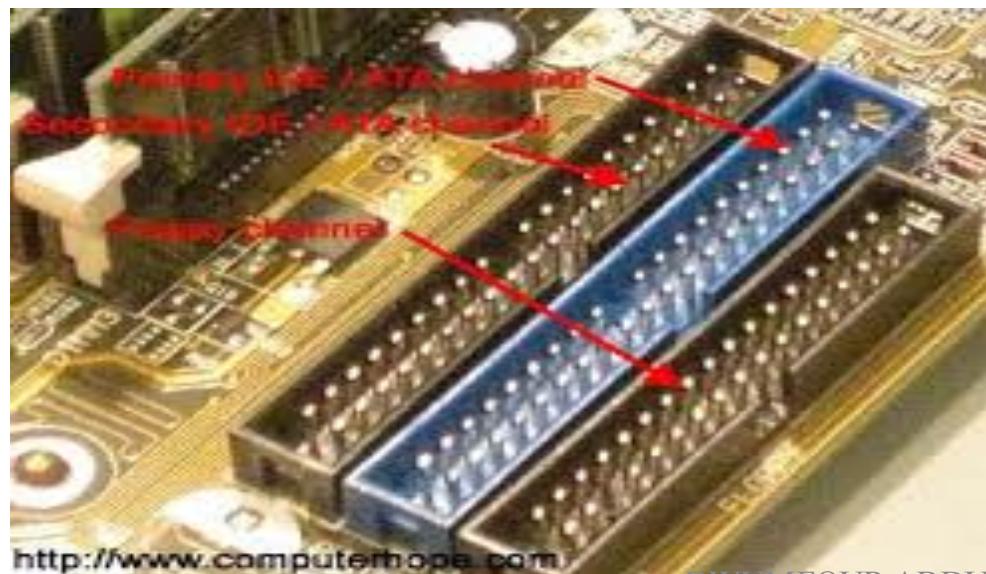
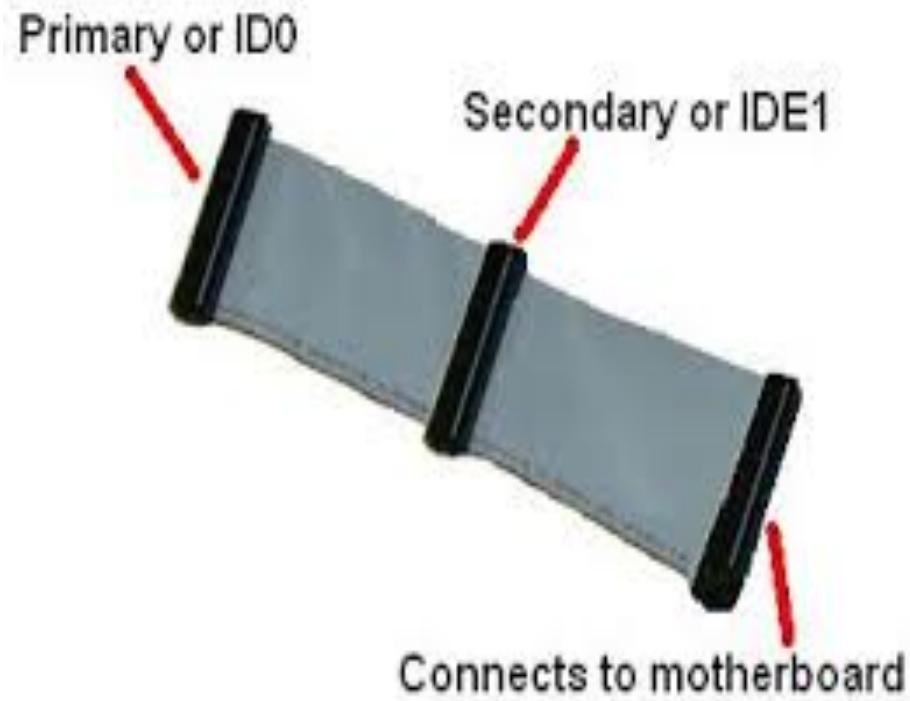
Firewire port and cable





SATA CABLE

SATA DRIVE



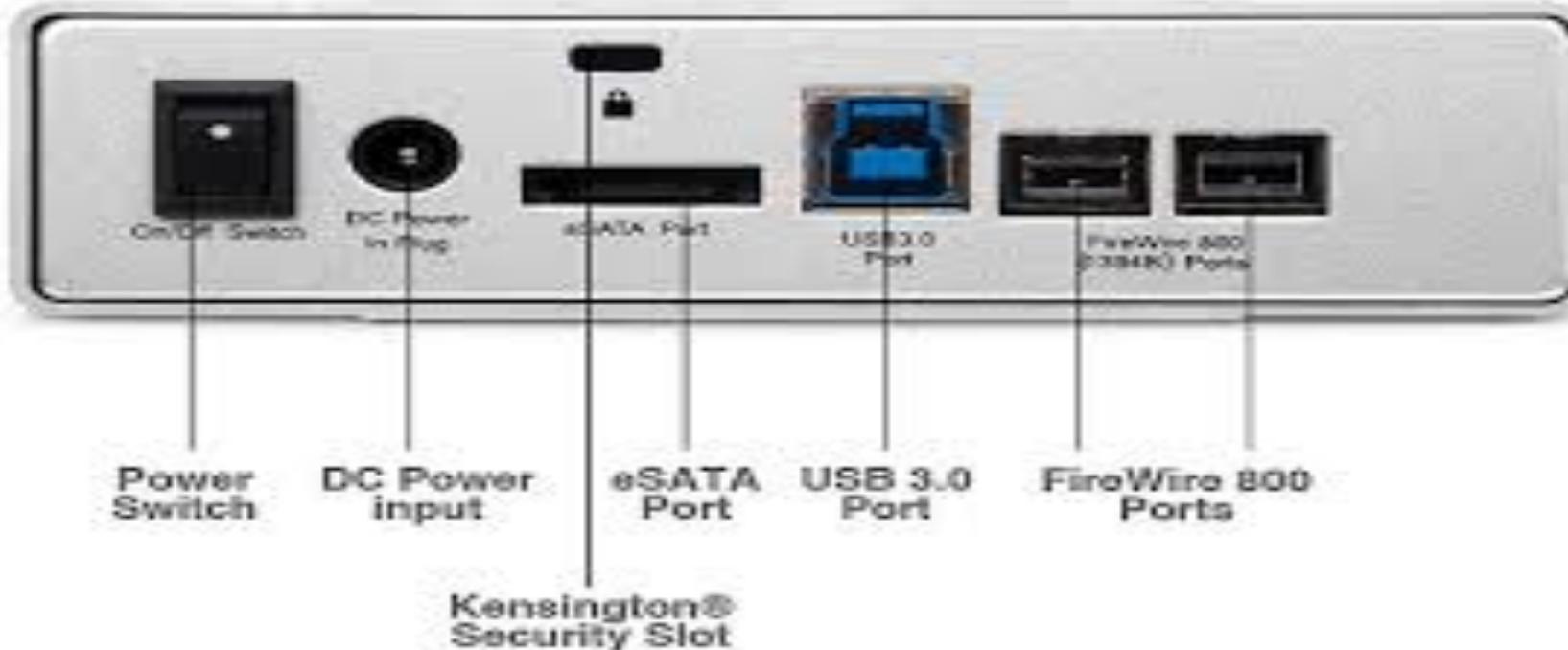
IDE CABLE AND PORT

USB CABLE AND PORT



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USB 3.0 + FireWire 800 + eSATA



FIREWIRE CABLE/PORT

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ETHERNET CABLE AND PORT



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POWER CABLE



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BUS CONNECTIVITY

A **bus**, in computing, is a set of physical connections (cables, printed circuits, etc.) which can be shared by multiple hardware components in order to communicate with one another.

The purpose of buses is to reduce the number of "pathways" needed for communication between the components, by carrying out all communications over a single data channel.

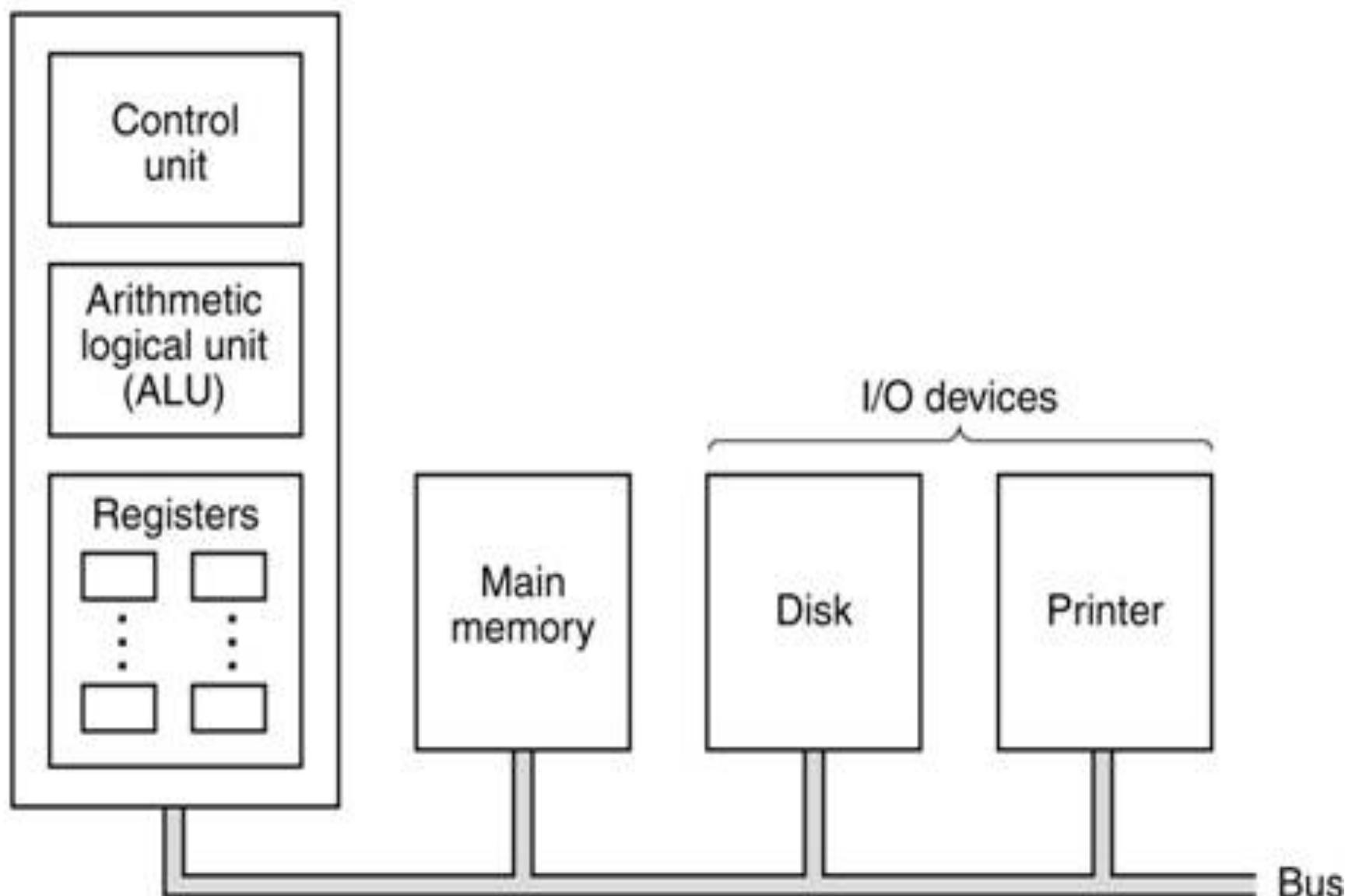
There are basically three primary category of buses

Internal bus

External bus

Expansion bus

Central processing unit (CPU)



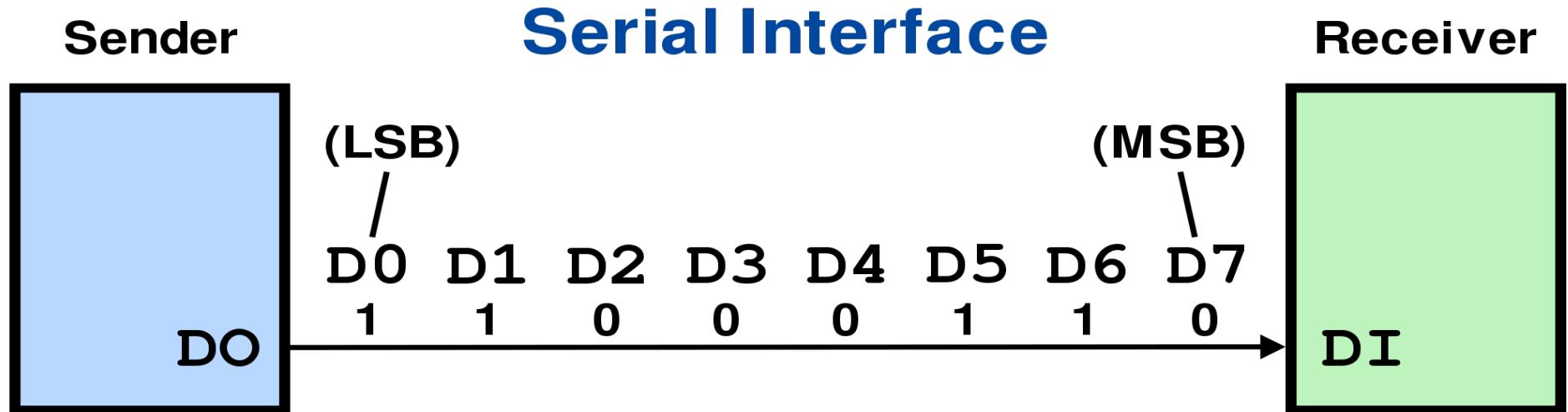
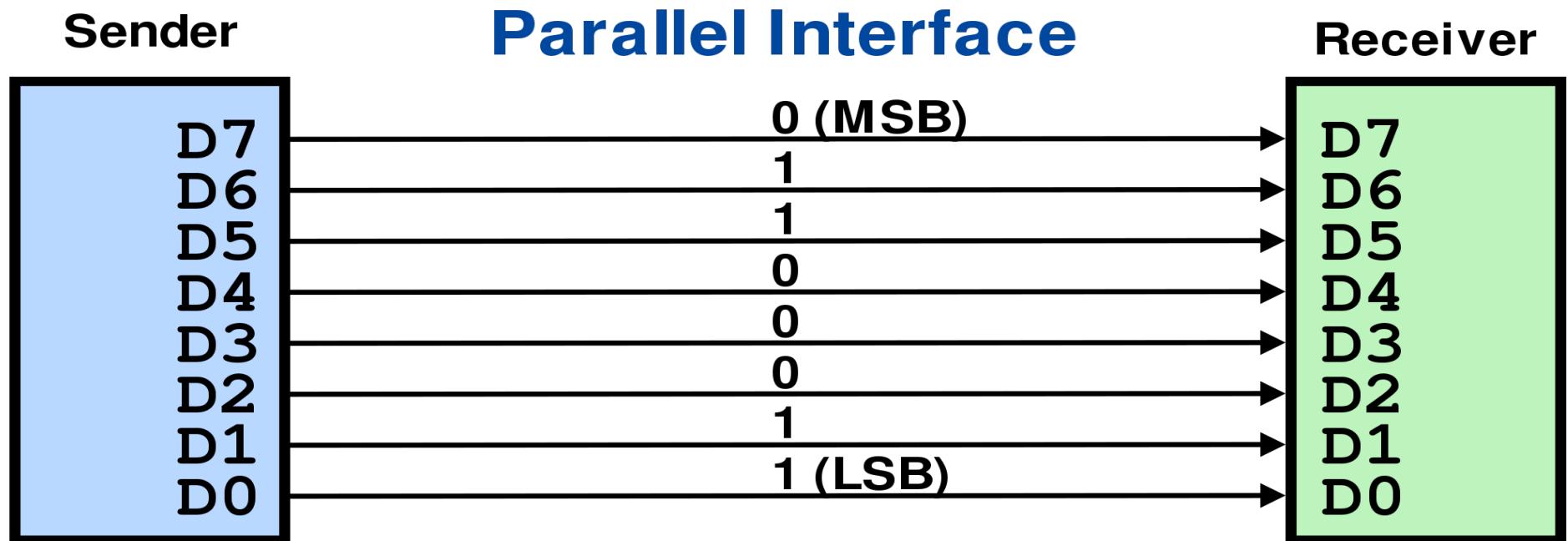
TYPES OF BUS COMMUNICATION

Bus communication is achieved by sending bits (control, data, and address) of data between devices.

These bits are transmitted through the bus in either of the following ways:

- **Serially:** Bits are transmitted sequentially along a single path. This transmission can be unidirectional or bidirectional.
- **parallel:** Bits are transmitted along multiple paths simultaneously. Parallel can also be bidirectional.

Example transfers of 01100011



INTERNAL BUS

The internal **bus**, also known as internal data **bus**, memory **bus**, system **bus** or Front-Side-Bus, connects all the internal components of a computer, such as CPU and memory, to the motherboard.

Internal data **buses** are also referred to as a local **bus**, because they are intended to connect to local devices.

Internal bus can be classified into three

- ✓ Data bus
- ✓ Address bus
- ✓ Control bus

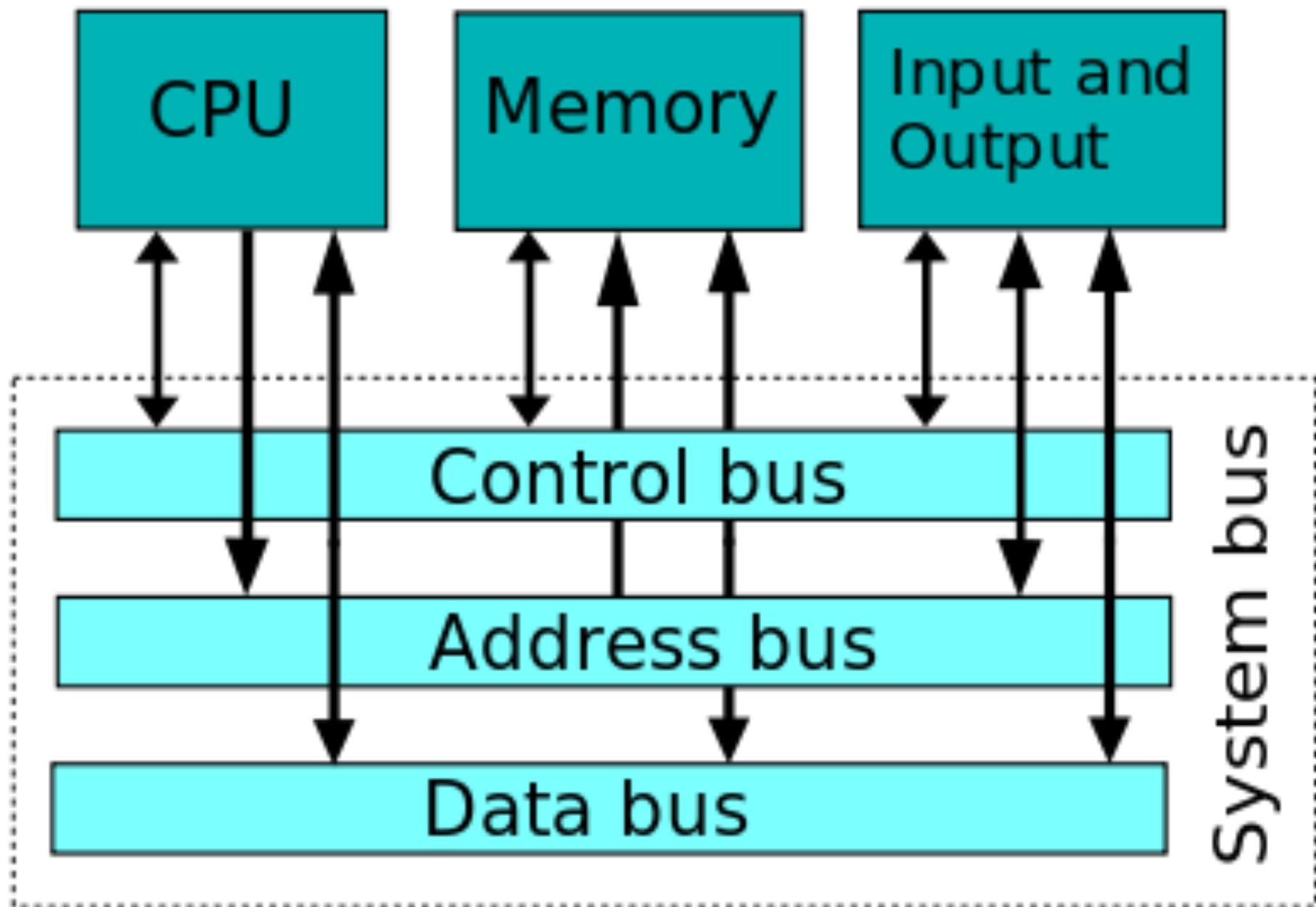
Address bus (sometimes called the *memory bus*) transports memory addresses which the processor wants to access in order to read or write data. It is a unidirectional bus.

Data bus transfers instructions coming from or going to the processor.

It is a bidirectional bus.

Control bus (or *command bus*) transports orders and synchronization signals coming from the control unit and travelling to all other hardware components.

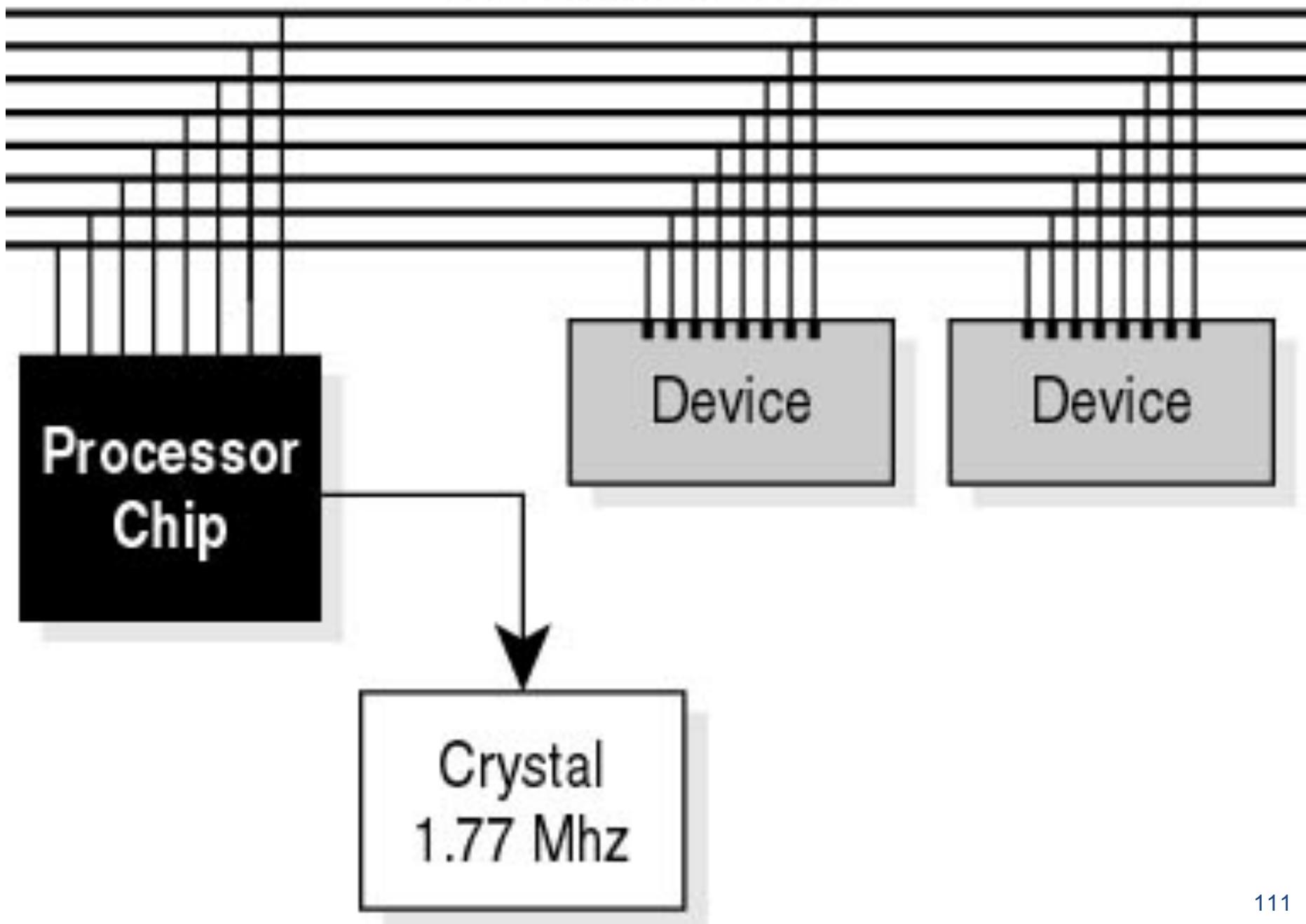
It is a bidirectional bus, as it also transmits response signals from the hardware.

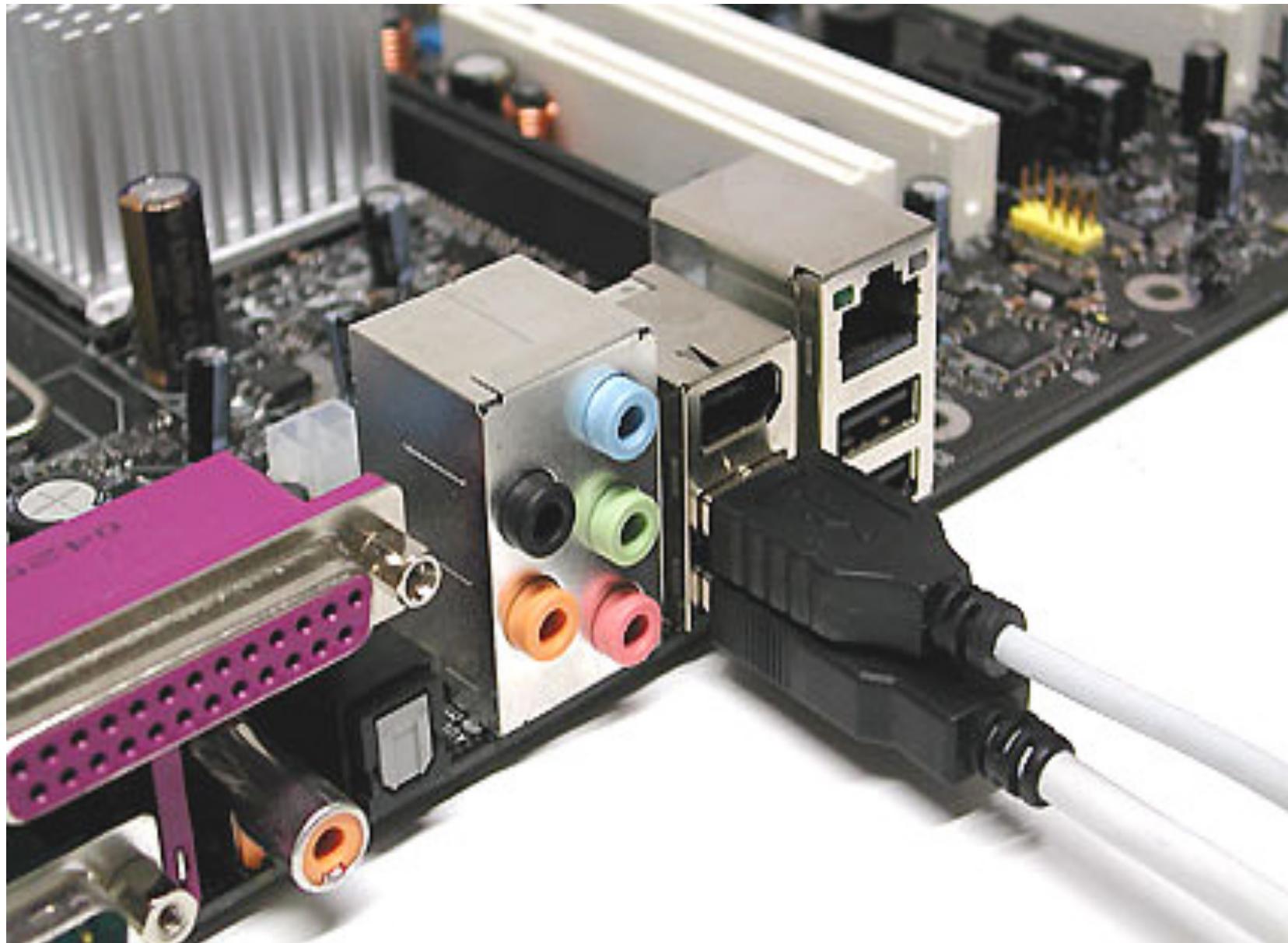


External bus

- ✧ The **External Bus Interface**, usually shortened to EBI, is a computer **bus** for interfacing small peripheral devices like flash memory with the processor.
- ✧ It is used to expand the internal **bus** of the processor to enable connection with **external** memories or other peripherals.

External data bus





EXPANSION BUS

- An expansion bus is a computer bus which allow communication between the internal hardware of a computer system with the CPU and Memory
- It is a collection of tiny wires and protocols that allows computer to expand its functionalities.
- Expansion bus allows communication when expansion card is inserted into expansion slots on the computer's motherboard

EXPANSION BUS TYPES

ISA - Industry Standard Architecture by IBM

MCA - Micro Channel Architecture, successor of ISA

EISA - Extended Industry Standard Architecture

VESA - Video Electronics Standards Association

PCI - Peripheral Component Interconnect

PCMCIA - Personal Computer Memory Card Industry Association (Also called PC bus)

AGP - Accelerated Graphics Port

Peripheral component interconnect

- ✧ PCI is a local bus specification by Intel that standardizes how PCI expansion cards, such as network cards, modems, video card, exchange information with the CPU.
- ✧ The PCI bus came in both 32-bit and 64-bit
- ✧ PCI provides the interconnection between the CPU and attached devices.
- ✧ The plug-and-play functionality of PCI enables the host to easily recognize and configure new cards and devices
- ✧ The number of PCI slots depend on the manufacturer and model of the motherboard.
- ✧ To connect a PCI card to a computer, the motherboard must have a PCI slot

Peripheral component interconnect

PCI standard encompasses the following

PCI bus

Is a local bus standard that allows PCI compliant to communicate with the CPU

PCI slot

Is used to expand the capabilities of the computer system by allowing devices to be plug into it

PCI device

A **PCI device** is any piece of computer hardware that plugs directly into a PCI slot on a computer's motherboard

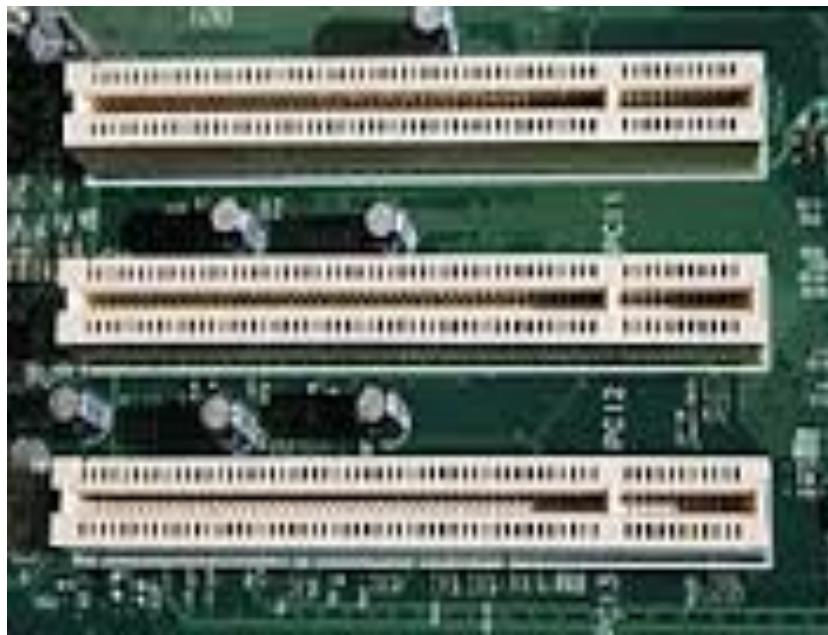
PCI device driver

Is an interface software that allow the device controller to communicate with the host

EXPANSION SLOT

- An **expansion slot** is an engineered approach used to create a port on the motherboard where expansion cards or adapters are inserted to add capabilities to the computer
- Most desktop computers come with a set of expansion slots which ensure that the computer has room for expandability in the future.

PCI SLOT ON THE MOTHERBOARD



EXPANSION CARD

- An expansion card or interface card or adapter is an circuit card/board that is designed to provide expanded functionality to a computer.
- It is plugged into one of the computer's expansion slot on the motherboard of a computer.
- Cards may come in one of two sizes designed to match standard slot dimensions.

Example of adapters include:

- Video card
- Sound card
- Modem
- Network card

PCI DEVICES



PCI ETHERNET
CARD

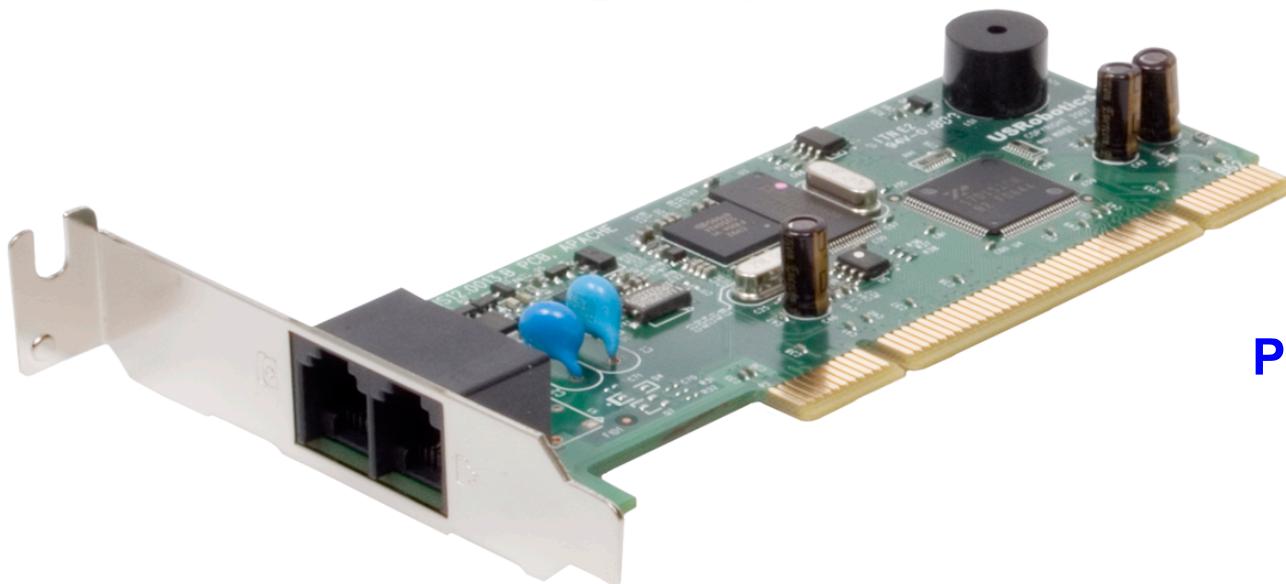


PCI SOUND
CARD

PCI DEVICES



PCI VIDEO CARD



PCI MODEM



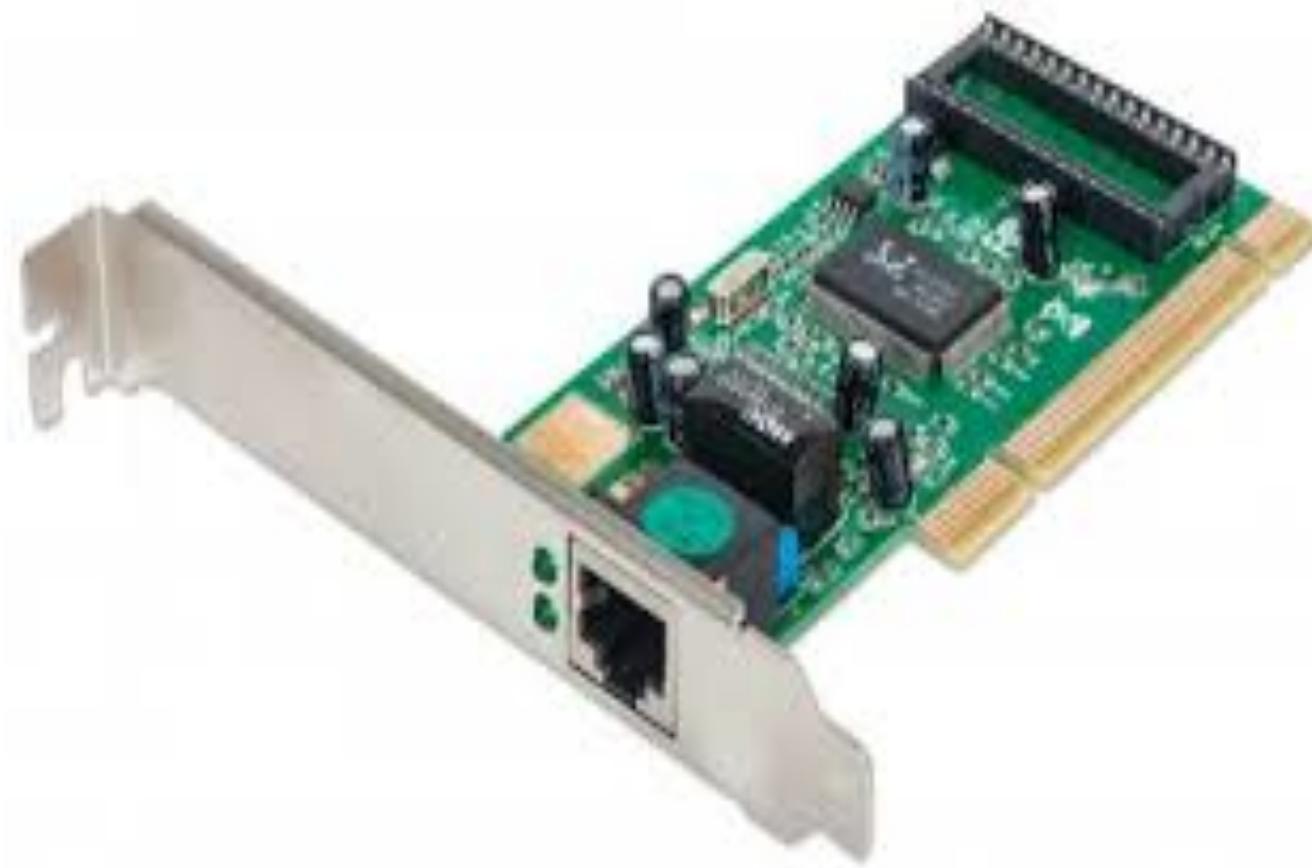
VIDEO INTERFACE ADAPTER

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SOUND INTERFACE CARD

DWUMFOUR ABDULLAI ABDUL-AZIZ



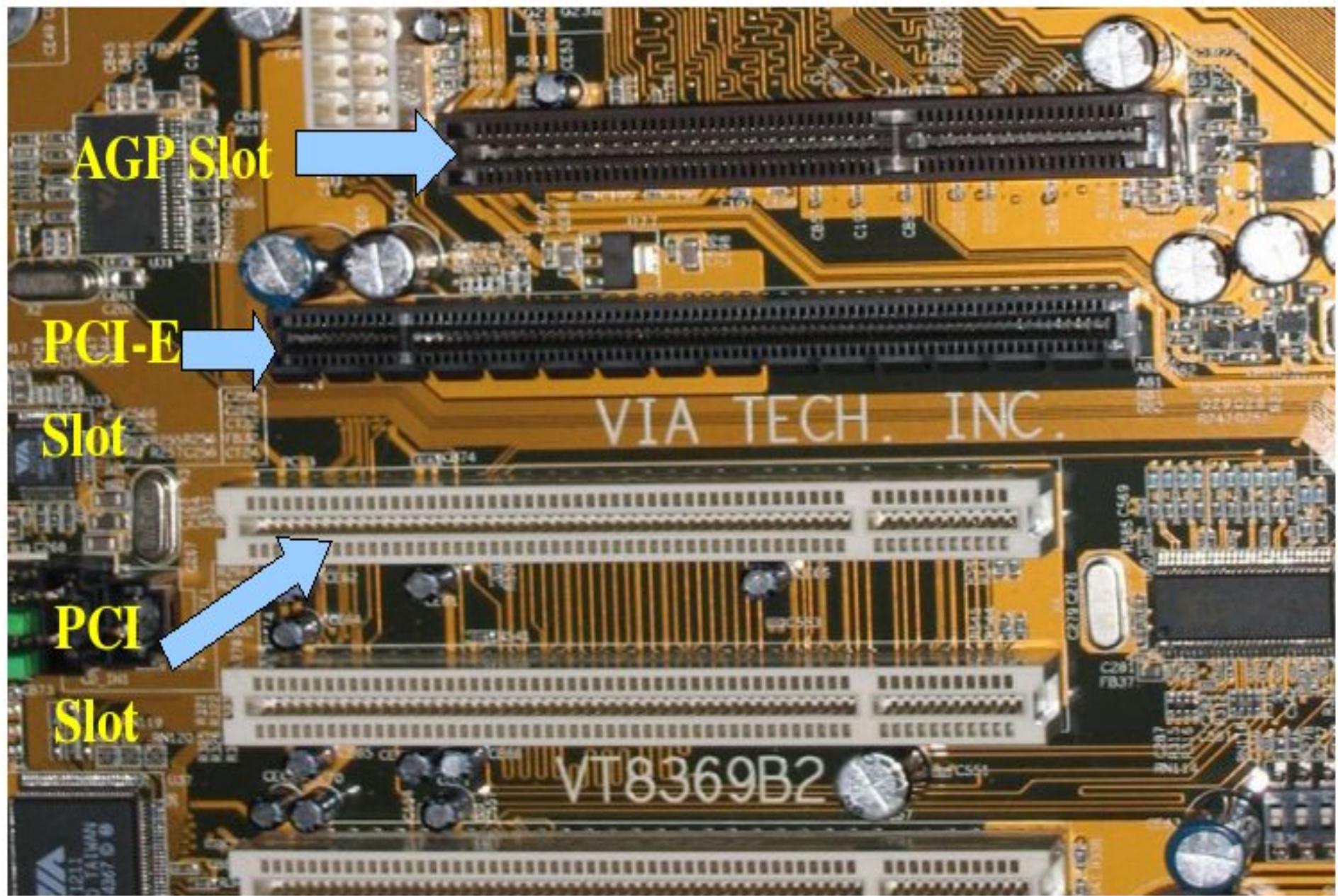
NETWORK INTERFACE ADAPTER

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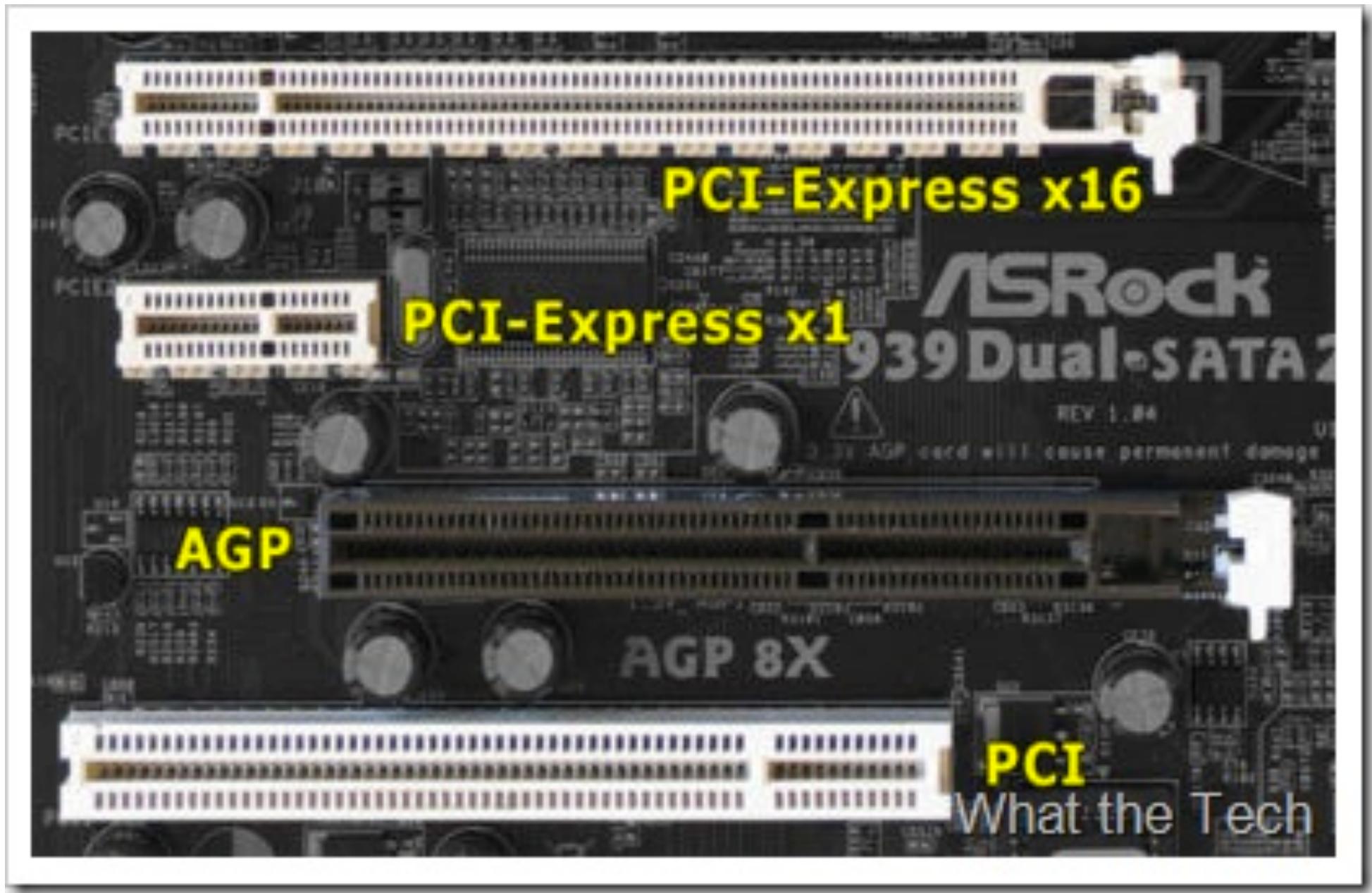
PCI EXPRESS

- PCI used parallel expansion standard
- Peripheral Component Interconnect Express (PCIe or PCI-E) is a serial expansion bus standard for connecting a computer to one or more peripheral devices.
- It is a high-speed serial computer expansion bus standard, designed to replace the older PCI, PCI-X, and AGP bus standards.

PCI-E SLOT



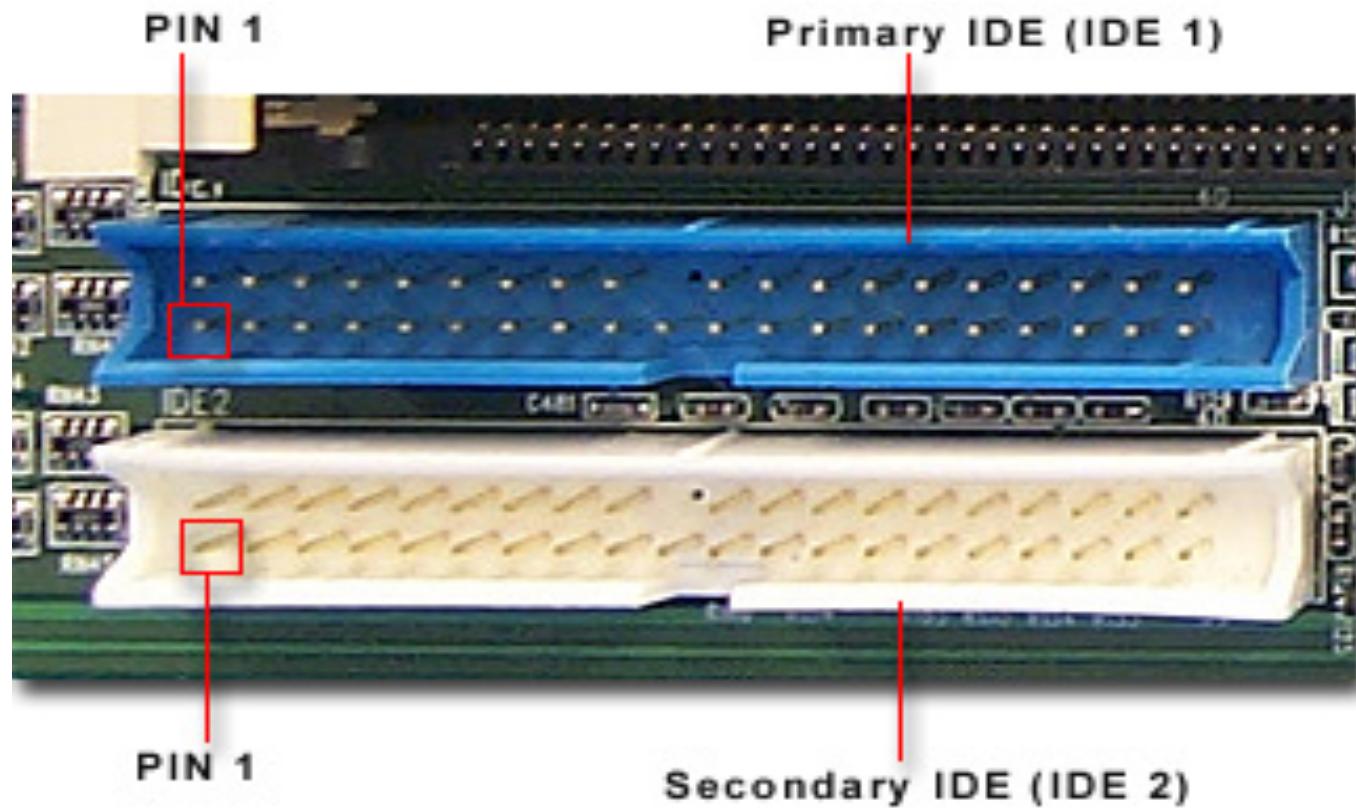
PCI-E SLOT



IDE/ATA INTERFACE TECHNOLOGIES

- ✧ This stands for Integrated Drive Electronics/ Advance Technology Attachment
- ✧ IDE (Integrated Drive Electronics) is a standard electronic interface developed by IBM used between a computer motherboard's data paths or bus and the computer's disk storage devices.
- ✧ IDE was adopted as a standard by ANSI and named it Advanced Technology Attachment (ATA).
- ✧ With IDE the interface electronics or disk controller is built into the drive and is not a separate board.
- ✧ The primary purpose of the hard disk controller, or interface, is to transmit and receive data to and from the drive.
- ✧ ATA is a 16-bit parallel interface, meaning that 16 bits are transmitted simultaneously down the interface





40 PIN- IDE PORT ON THE MOTHERBOARD



IDE/ATA HARD DISK



Jumper Setting

Back Panel

Power Supply Connector

IDE Connector

SimulationExams.com

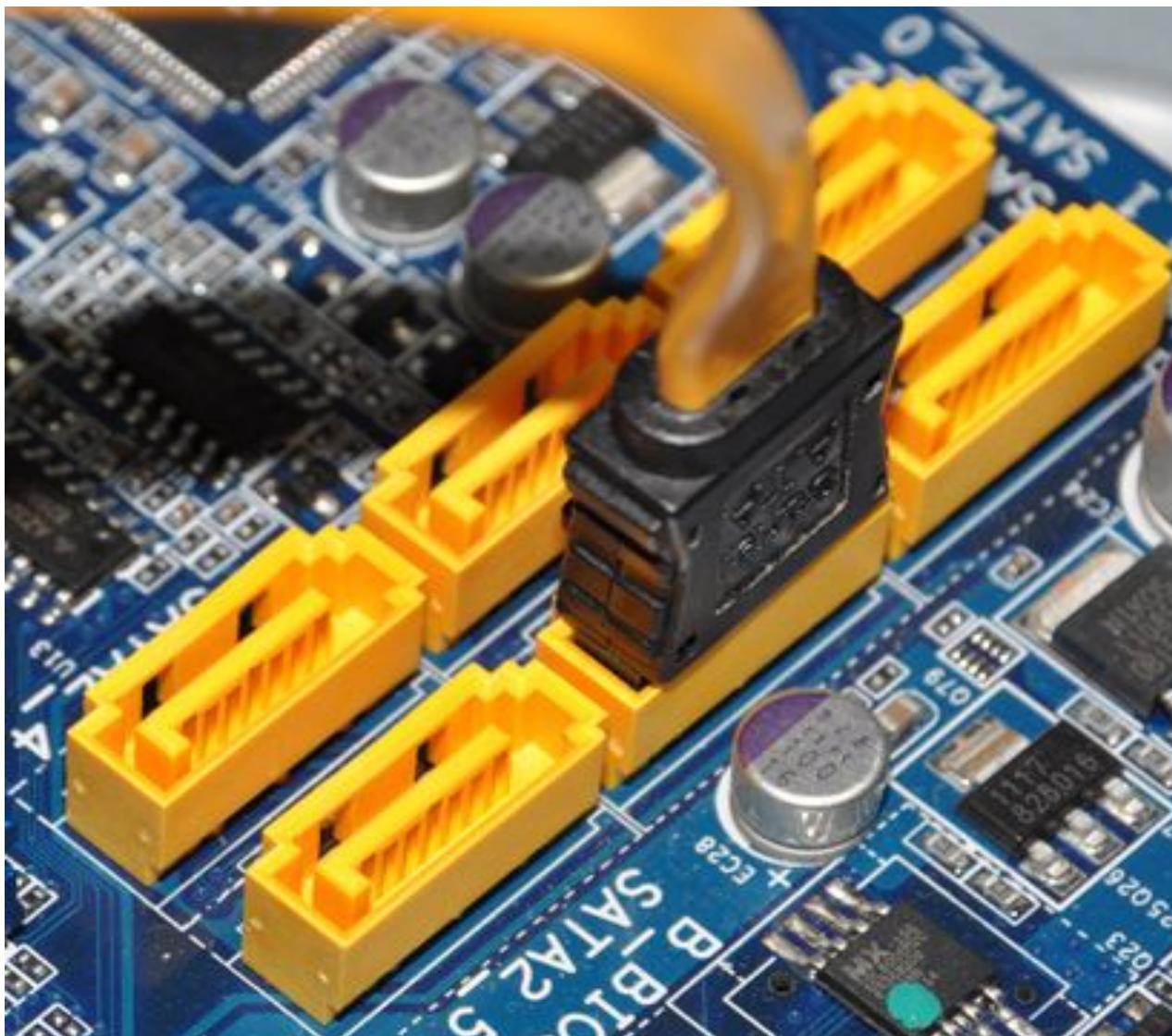
IDE/ATA CD DRIVE

SATA: SERIAL ATA

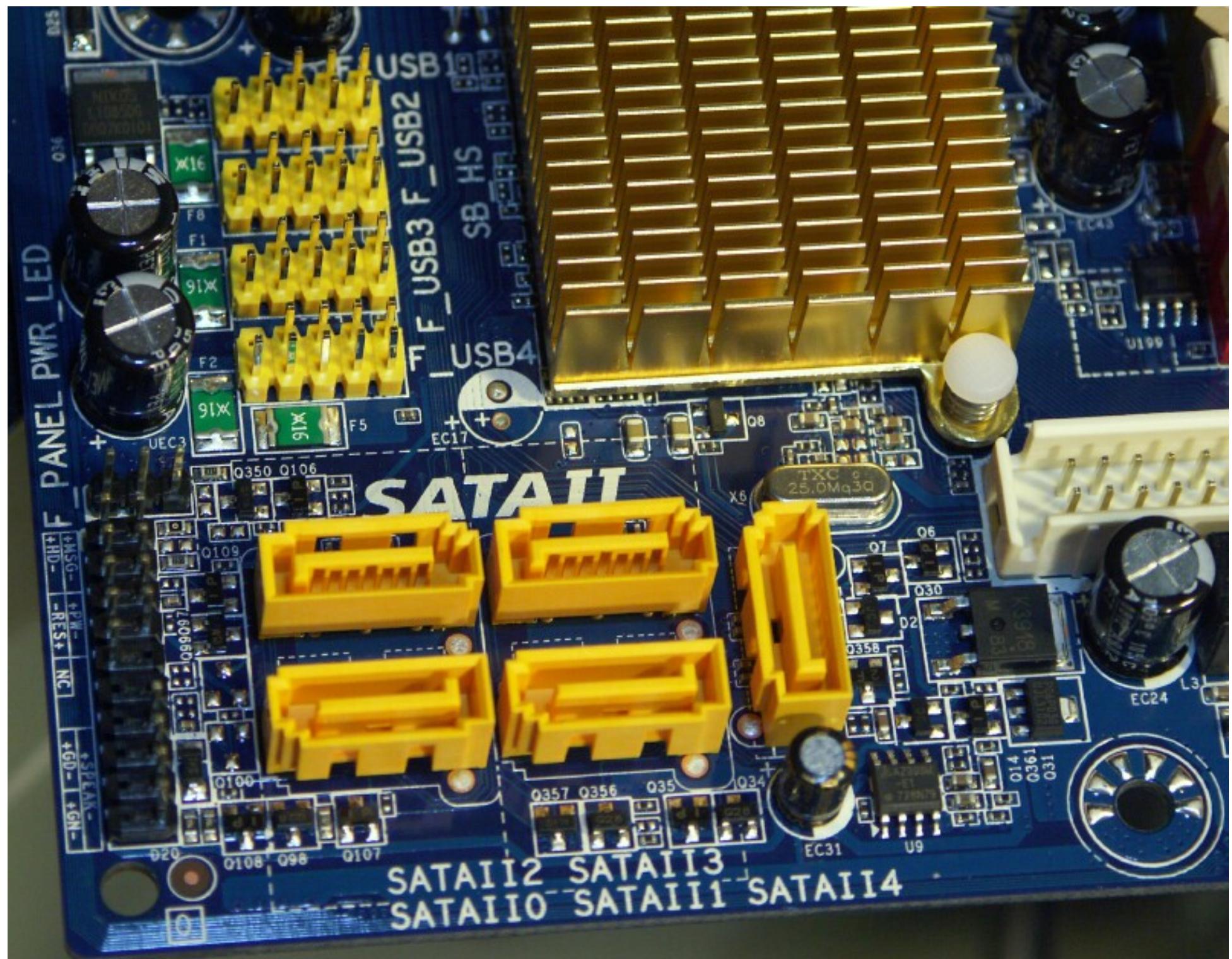
- ✧ This is a standard hardware interface for connecting hard drives, solid state drives (SSDs) and optical drives (DVD drives, CD drives) to the computer.
- ✧ SATA is the faster serial version of the parallel ATA (PATA) interface.
- ✧ Both SATA and PATA are "integrated drive electronics" (IDE) devices, which means the controller is in the drive, and only a simple circuit is required on the motherboard.
- ✧ SATA storage devices can transmit data to and from the rest of the computer over twice as fast as an otherwise similar PATA device.
- ✧ Serial ATA also has the benefit of cheaper cable costs and the ability to hot swap devices.

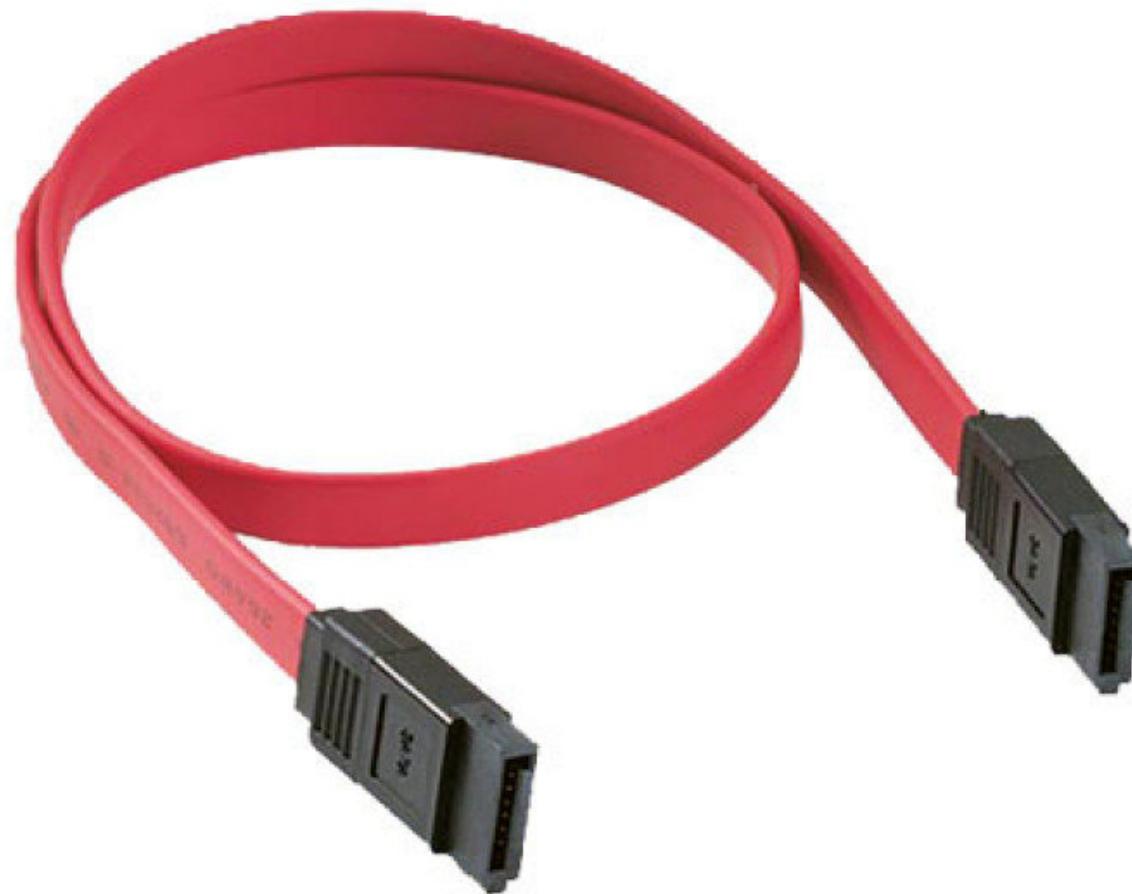
SATA: SERIAL ATA

- ✧ SATA transfer speeds are more than twice as fast as PATA.
- ✧ 133 MB/s is the fastest transfer speed possible with PATA devices, whereas SATA maxes out at 600 MB/s.
- ✧ Even SATA's slowest speed is 150 MB/s, which is still faster than the maximum speed that can be accomplished through PATA.



SATA PORT ON THE MOTHERBOARD

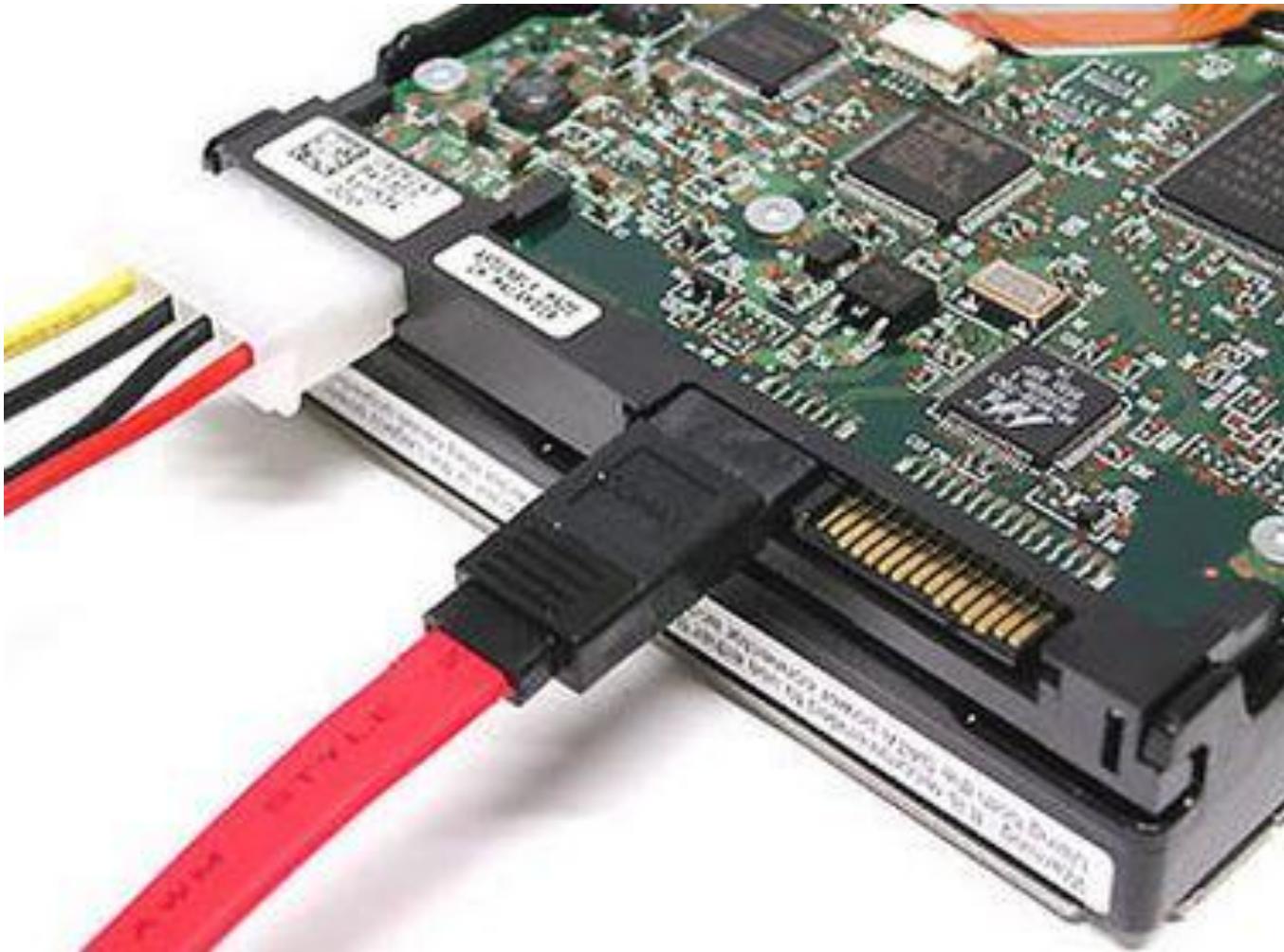




SATA CABLES



SATA HARD DISK

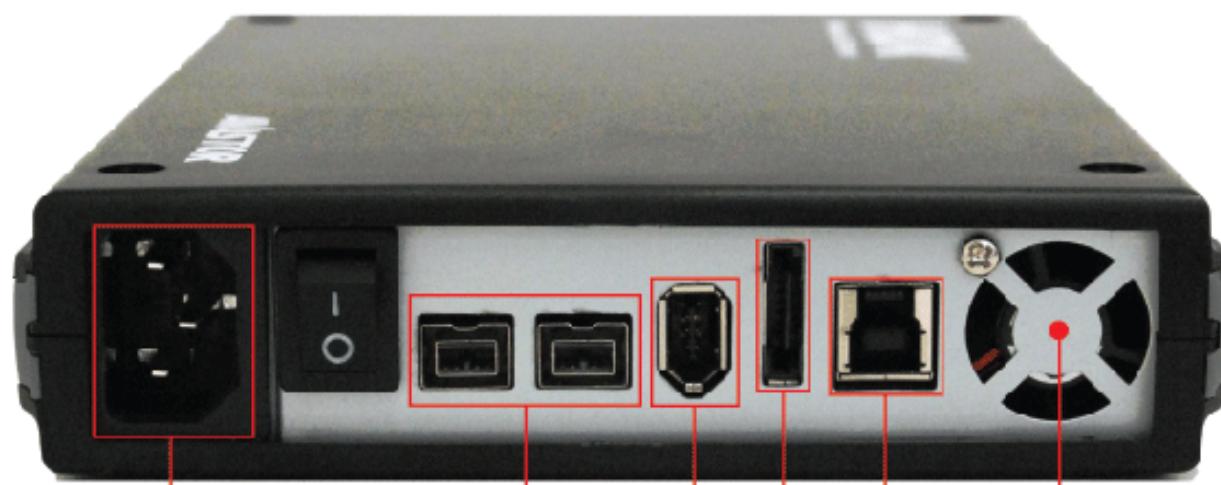


SATA HARD DISK

E-SATA (EXTENDED SATA)

- ✧ External serial advanced technology attachment (eSATA) is a bus interface for connecting external storage devices.
- ✧ It is an extension of the serial advanced technology attachment (SATA or serial ATA) standard.
- ✧ It is designed to enable the SATA drive to be attached





100/240 VAC 50/60Hz
Internal Power Supply
IEC 3-Prong Power Cord

FireWire 800

FireWire 400

eSATA

USB 3.0

Ultra Quiet Fan

USB+ESATA



对SATA 22Pin



eSATA to eSATA cable





SMALL COMPUTER SYSTEM INTERFACE(SCSI)

- ✧ The Small Computer System Interface (**SCSI**) is a parallel interface standards developed by ANSI used to attach peripherals to computers
- ✧ It's a fast bus that can connect lots of devices to a computer at the same time, including hard drives, scanners, CD-ROM/RW drives, printers and tape drives.
- ✧ One of the benefits of SCSI interfaces is that multiple devices could be chained together to a single port.
- ✧ It is capable of supporting up to 7 or 15 devices.

Serial Attached SCSI (SAS) is a point-to-point serial protocol that has replaced the older Parallel SCSI

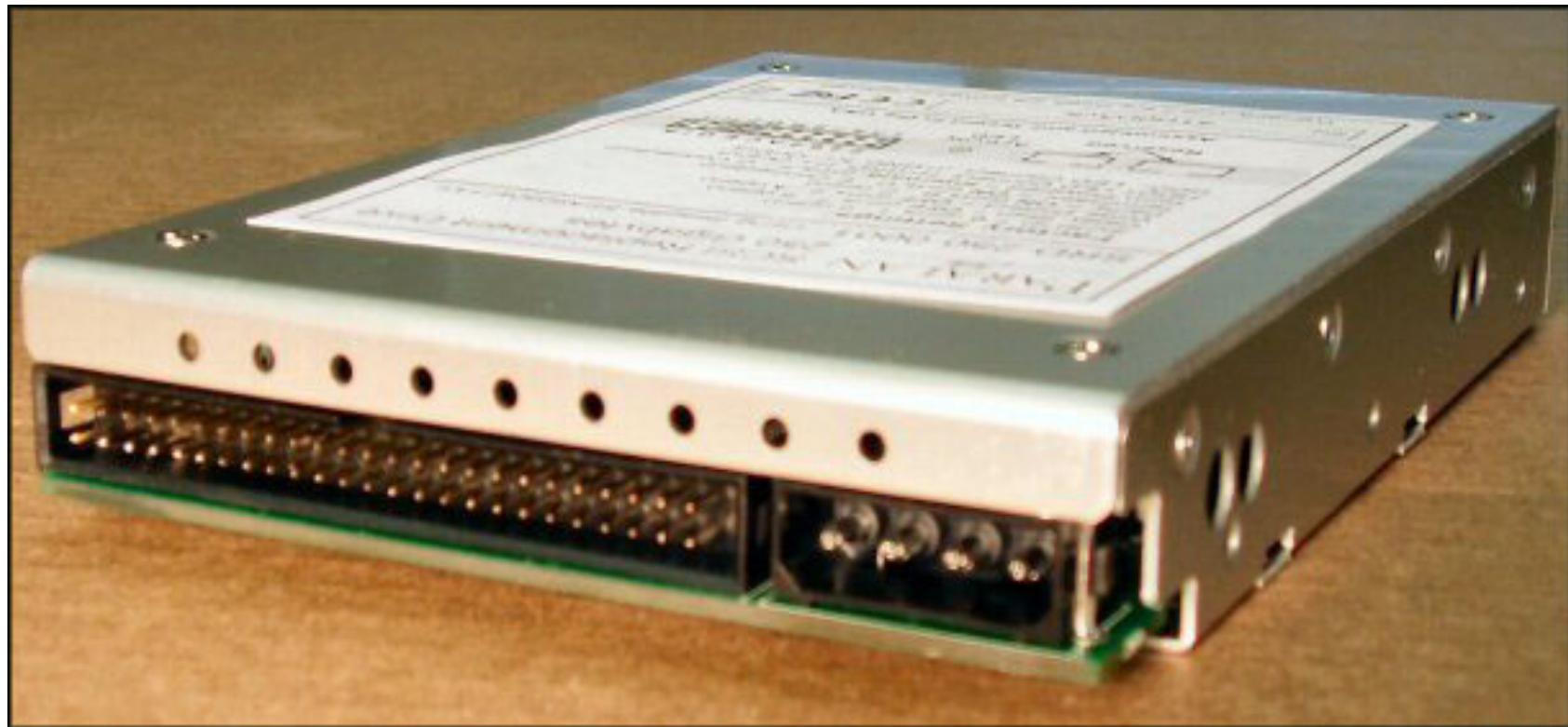


SCSI CABLE

INFORMATION STORAGE &
MANAGEMENT TECHNOLOGIES



SCSI CABLE



SCSI DISK

INFORMATION STORAGE &
MANAGEMENT TECHNOLOGIES



SCSI PORT

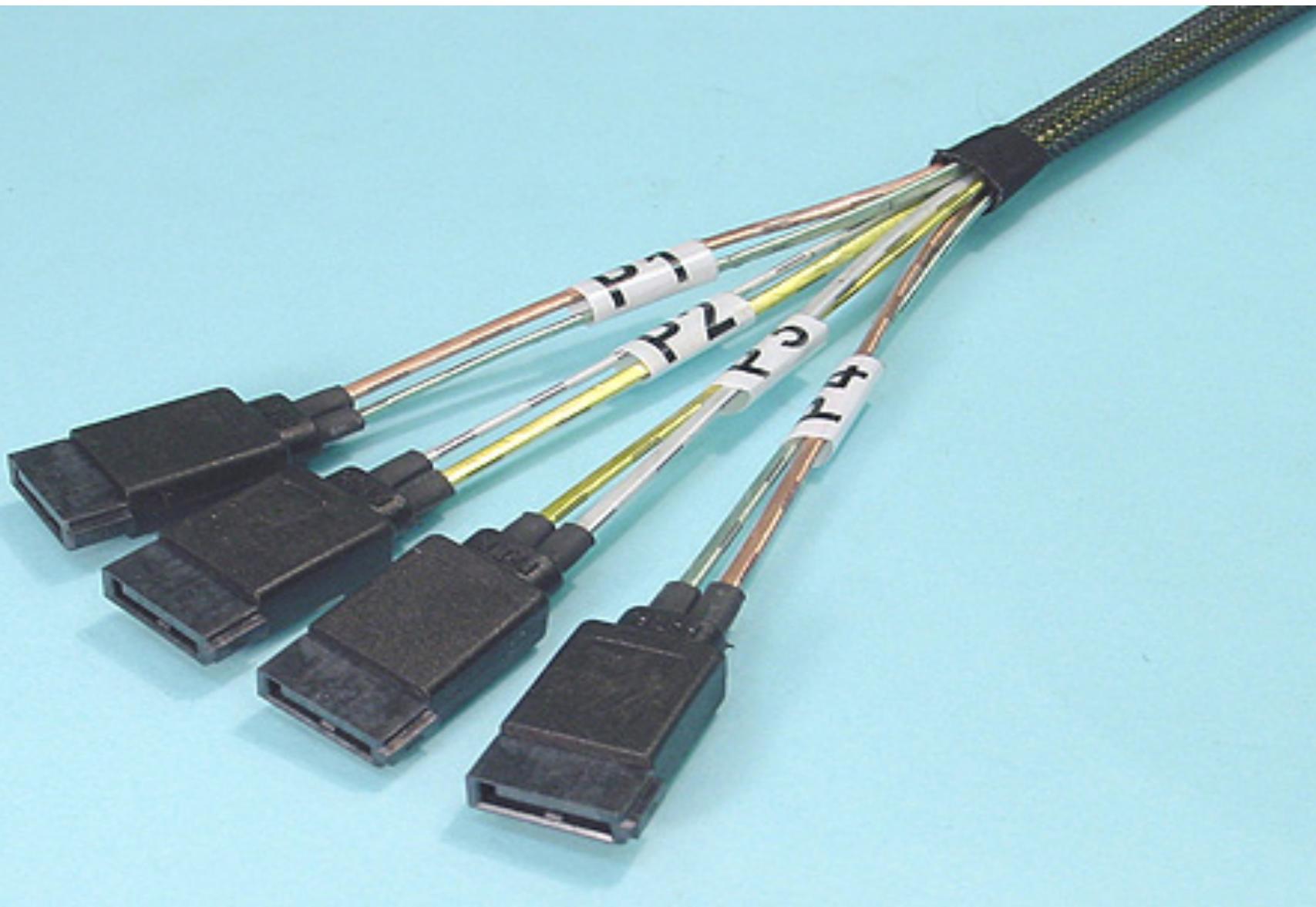
INFORMATION STORAGE &
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SCSI adapter card



<http://www.computerhope.com>

SCSI PORT



SCSI CABLE

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