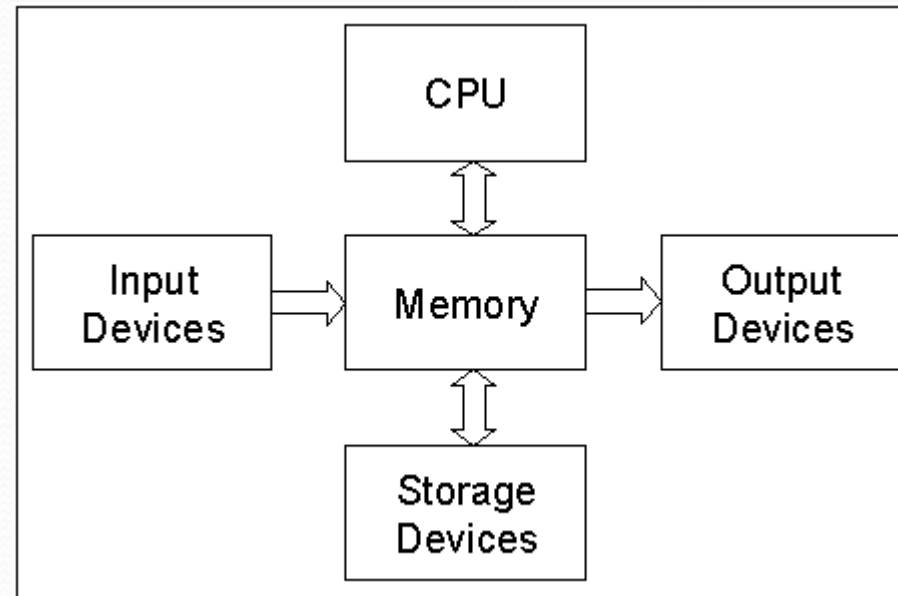
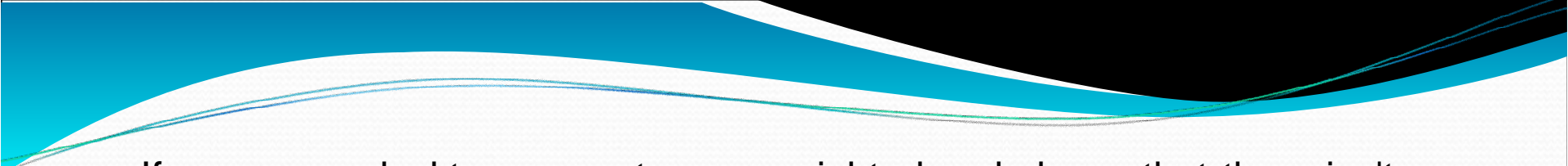



Components of a computer

Components of a personal computer



- Computer systems ranging from a controller in a microwave oven to a large supercomputer contain components providing five functions.
- A typical personal computer has hard, floppy and CD-ROM disks for storage, memory and CPU chips inside the system unit, a keyboard and mouse for input, and a display, printer and speakers for output. The arrows represent the direction information flows between the functional units.

- 
- If you use a desktop computer, you might already know that there isn't any single part called the "computer." A computer is really a system of many parts working together. The physical parts, which you can see and touch, are collectively called **Hardware**.
 - **Software**, on the other hand, refers to the instructions, or programs, that tell the hardware what to do.



A typical personal computer should have the following main components:

- Monitor
- Motherboard
- Central processing unit or CPU
- Memory
- Cables and connectors
- Peripherals, such as mouse, keyboard, printer, scanner, etc

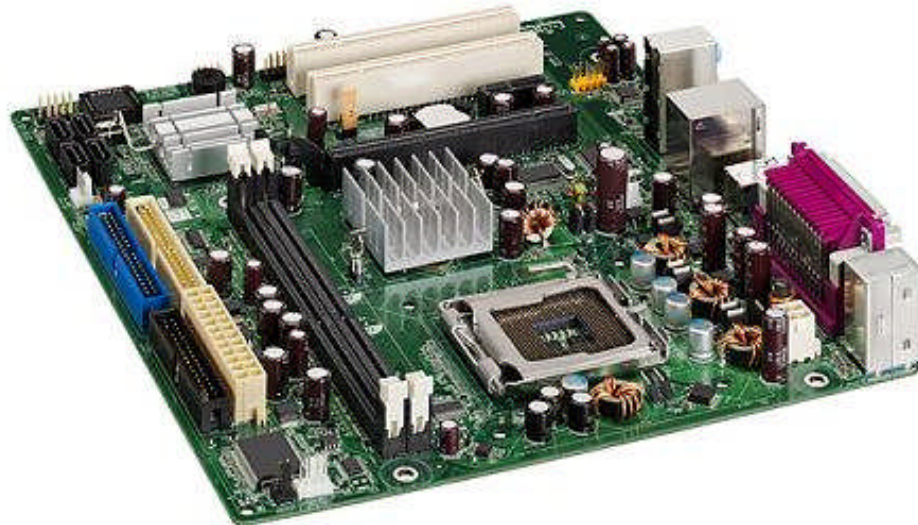
Monitor

- Displays information in visual form, using text and graphics.
- The portion of the monitor that displays the information is called the screen. Like a television screen, a computer screen can show still or moving pictures.
- There are two basic types of monitors: CRT (cathode ray tube) monitors and LCD (liquid crystal display) monitors.
- Both types produce sharp images, but LCD monitors have the advantage of being much thinner and lighter. CRT monitors, however, are generally more affordable.



Motherboard

- Also known as mainboard, mobo (abbreviation), MB (abbreviation), system board, logic board
- Serves as a base platform to connect all of the parts of a computer together. The CPU, memory, hard drives, optical drives, video card, sound card and other ports and expansion cards all connected to the motherboard directly or via cables.



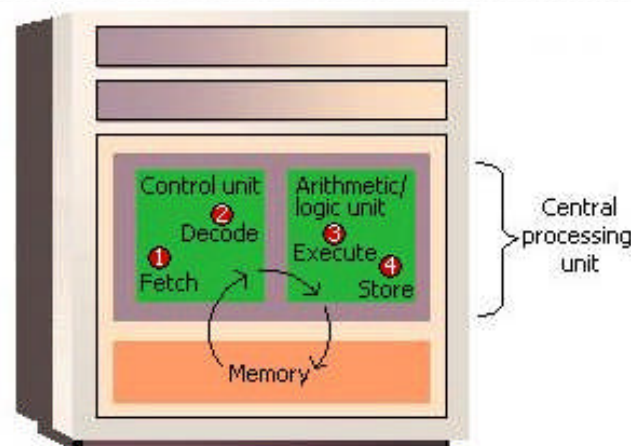
Central Processing Unit

What is the central processing unit (CPU) ?

- Also called as a processor, microprocessor, central processor, "the brains of the computer", the CPU is the heart of any computer system. It interprets and carries out basic instructions that operate a computer.
- Central Processing Unit itself consists of three main subsystems; first is the Control Unit, the second is Registers, and the third is Arithmetic and Logic Unit(ALU).

How the CPU Executes Program Instructions

- Before an instruction can be executed, program instructions and data must be placed into memory from an input device or a secondary storage device. Once the necessary data and instruction are in memory, the central processing unit performs the following four steps for each instruction:
 1. The control unit fetches (gets) the instruction from memory.
 2. The control unit decodes the instruction (decides what it means) and directs that the necessary data be moved from memory to the arithmetic/logic unit. These first two steps together are called instruction time, or I-time.
 3. The arithmetic/logic unit executes the arithmetic or logical instruction. That is, the ALU is given control and performs the actual operation on the data.
 4. The arithmetic/logic unit stores the result of this operation in memory or in a register. Steps 3 and 4 together are called execution time, or E-time.



Control Unit

- The control unit of the CPU contains circuitry that uses electrical signals to direct the entire computer system to carry out, or execute, stored program instructions.
- The control unit does not execute program instructions; rather, it directs other parts of the system to do so. The control unit must communicate with both the arithmetic/logic unit and memory.

Arithmetic Logic Unit (ALU)

- Arithmetic logic unit (ALU) is a digital circuit that performs arithmetic and logical operations.
- An ALU loads data from input registers, an external Control Unit then tells the ALU what operation to perform on that data, and then the ALU stores its result into an output register. The Control Unit is responsible for moving the processed data between these registers, ALU and memory.
- Arithmetic/logic unit (ALU) performs execution part of the machine cycle. The execution consists of Arithmetic (addition, subtraction, multiplication, and division), Comparison (greater than, equal to, or less than) and Logical (AND, OR, NOT).

Registers: Temporary Storage Areas

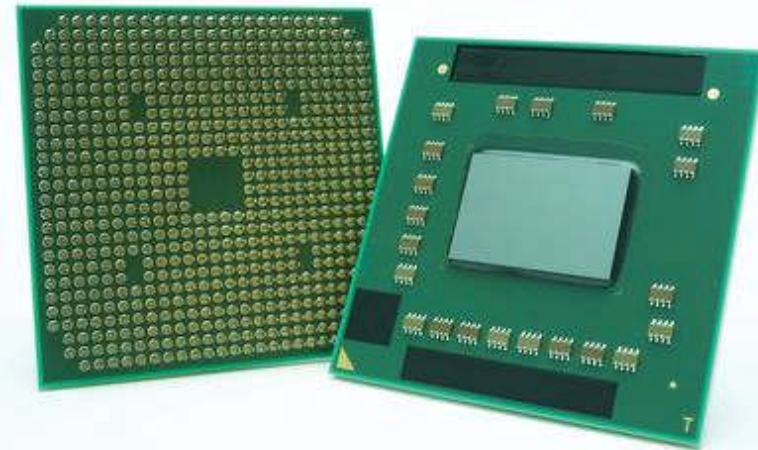
- Registers are temporary storage areas for instructions or data. They are not a part of memory; rather they are special additional storage locations that offer the advantage of speed.
- Registers work under the direction of the control unit to accept, hold, and transfer instructions or data and perform arithmetic or logical comparisons at high speed. The control unit uses a data storage register the way a store owner uses a cash register-as a temporary, convenient place to store what is used in transactions.

Memory

- Memory is also known as primary storage, primary memory, main storage, internal storage, main memory, and RAM (Random Access Memory); all these terms are used interchangeably by people in computer circles.
- Memory is the part of the computer that holds data and instructions for processing. Although closely associated with the central processing unit, memory is separate from it. Memory stores program instructions or data for only as long as the program they pertain to is in operation.

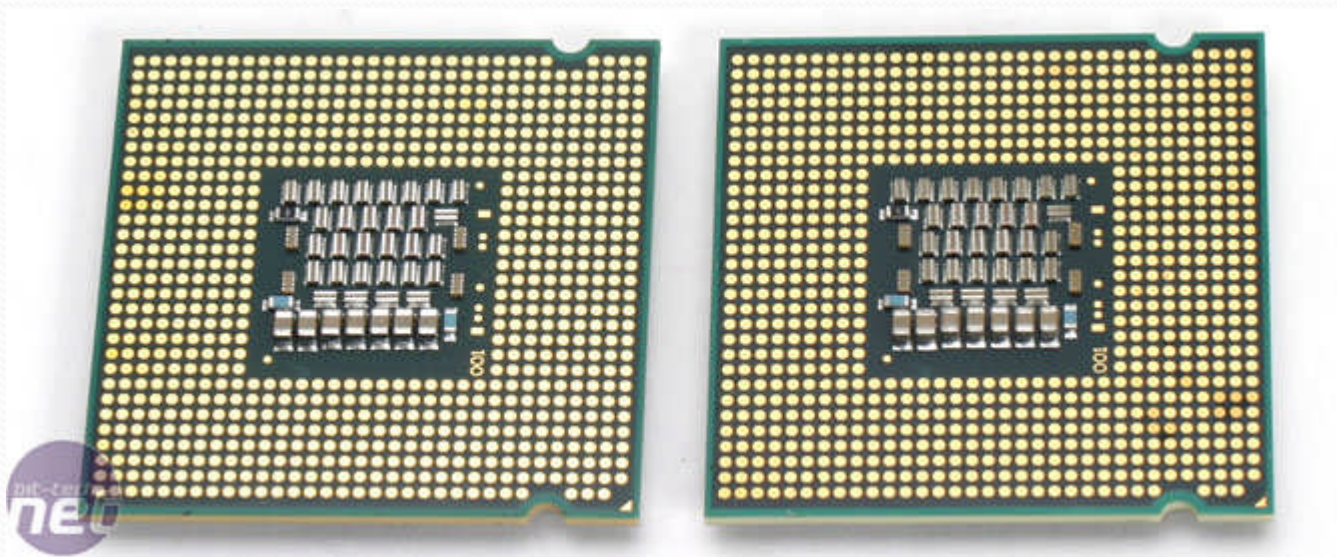
L1 cache

- L1 cache is a small, fast memory cache that is built in to a CPU and helps speed access to important and frequently-used data.
- L1 cache is typically smaller and faster than L2 cache.
- L1 cache is an abbreviation of *Level 1 cache*.



L2 Cache

- L2 cache is a set of memory circuits designed to speed access to important and frequently used data.
- Early L2 cache designs involved fast static RAM memory chips placed near the CPU. Modern L2 caches involve RAM built directly into the CPU.
- L2 cache is typically larger but slower than L1 cache.
- L2 cache is an abbreviation of *Level 2 cache*.



RAM (Random Access Memory)

- Random-access, commonly known as RAM or simply memory, provides space for your computer to read and write data to be accessed by the CPU (central processing unit). When people refer to a computer's memory, they usually mean its RAM.
- The strength of the RAM determines, at random, how fast a piece of data can be pulled and returned.
- Regardless of where the data is on a drive or whether it is at all related to any previous bit of data is irrelevant; RAM pulls it back at a constant time.
- RAM is volatile, so data stored in RAM stays there only as long as the computer is running. As soon as the computer is switched off, the data stored in RAM disappears.



- There are two different types of RAM: DRAM (Dynamic Random Access Memory) and SRAM (Static Random Access Memory).

- There are two types of RAM:

SRAM (Static Random Access Memory)

- SRAM is a type of memory that is faster and more reliable than the more common DRAM (dynamic RAM). The term static is derived from the fact that it doesn't need to be refreshed like dynamic RAM.
- Uses multiple transistors, typically four to six, for each memory cell but doesn't have a capacitor in each cell.
- It is volatile i.e. they lose their contents when the power is turned off
- It is used primarily for cache.

DRAM (Dynamic Random Access Memory)

- It has memory cells with a paired transistor and capacitor requiring constant refreshing.
- The advantage of DRAM is its structural simplicity: only one transistor and a capacitor are required per bit, compared to six transistors in SRAM. This allows DRAM to reach very high densities.
- It is volatile i.e. they lose their contents when the power is turned off
- DRAM is used in main memory .

ROM (Read-Only Memory)

- Read-Only Memory or ROM is an integrated-circuit memory chip that contains configuration data.
- ROM is commonly called firmware because its programming is fully embedded into the ROM chip. As such, ROM is a hardware and software in one.
- Because data is fully incorporated at the ROM chip's manufacture, data stored can neither be erased nor replaced. This means permanent and secure data storage.
- Data stored in ROM is nonvolatile - it is not lost when your computer is turned off.
- Data stored in ROM is either unchangeable or requires a special operation to change.
- Examples of ROM are: Programmable ROM (PROM), Erasable Programmable ROM (EPROM) and Electrically Erasable Programmable ROM (EEPROM).



Ports

- A port serves as an interface between the computer and other computers or peripheral devices through which data is sent and received.
- Physically, a port is a specialized outlet on a piece of equipment to which a plug or cable connects.
- Electronically, the several conductors making up the outlet provide a signal transfer between devices.
- Hardware ports can almost always be divided into two groups based on the signal transfer:
 - A **serial port** transmits one bit of data at a time and is used to connect slow-speed devices, such as mouse, keyboard, mode.
 - A **parallel port** connects devices that can transfer more than one bit at a time, such as a printer.

Parallel Port

- A parallel port is a type of interface found on computers (personal and otherwise) for connecting various peripherals.
- In computing, a parallel port is a parallel communication physical interface.
 - Printers
 - Scanners
 - CD burners
 - External hard drives
 - Iomega Zip removable drives
 - Network adapters
 - Tape backup drives



- When using a parallel port, the computer sends the data 1 byte at a time (8 bits in parallel, as opposed to 8 bits serially as in a serial port). With each byte sent out, it sends a handshaking signal so the printer can latch the byte.
- If you want to accept data from a parallel port, all you really need is an 8-bit latch and a little glue logic.

Serial Port

- A serial port is a serial communication physical interface through which information transfers in or out one bit at a time.
- Data transfer through serial ports connected the computer to devices such as terminals and various peripherals.
- While such interfaces as Ethernet, FireWire, and USB all send data as a serial stream, the term "serial port" usually identifies hardware more or less compliant to the RS-232 standard, intended to interface with a modem or with a similar communication device.



Cables and Connectors

1. Computer and Monitor Power Cable

- This is the power cable that connects the computer with the wall socket. Computer monitors also use this cable.
- Computer power cable connects to the back of your computer on the power supply unit.



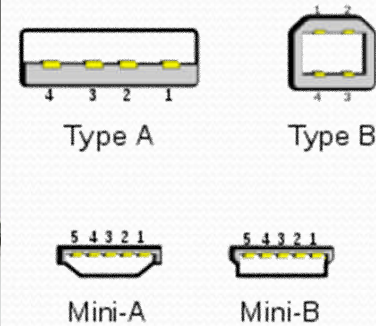
2. USB (Universal Serial Bus) Cables

What are USB cables used for?

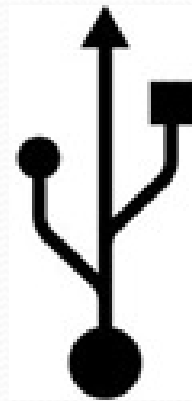
- A “plug and play” technology, a USB can be “hot-plugged” (connected or disconnected) while the computer is on.
- It is the most common interface for connecting external and peripheral devices to your computer including flash memory sticks, portable media players, internet modems and digital cameras.



- USB has effectively replaced a variety of interfaces such as serial and parallel ports.



- Additionally, USB cables are also used for charging a variety of gadgets including mobile phones or for transferring data from one computer to another.



3. VGA (Video Graphic Array) Cable

- VGA cable is one of the most common video connectors which connect computers with monitors or television sets.
- A standard VGA connector has 15-pins and other than connecting a computer to a monitor, a VGA cable can also be used to connect a laptop to a TV screen or a projector.
- It transmit analog video data that supports standard 640 x 480 resolution and wide screen displays.
- A VGA only transfers video signals, not audio signals.



4. DVI (Digital Visual Interface) Monitor Port

- A DVI cable implement the DVI video interface standard in order to enable high visual quality displays on LCD flat panel and digital projector displays.
- It supports both analog and digital data transfer of video signals. Digital video resolutions range from 1920 x 1200 and higher when using DVI cables.
- It uses pins to send DVI-native digital video signals to display devices. It has 29 pins, though some connectors may have less pins depending on their configuration.
- DVI's video signal is compatible with HDMI, so a simple converter can allow a DVI monitor to receive input from an HDMI cable.
- Additionally, DVI to VGA converters are also available for connect your new graphics card to old monitor that supports only VGA mode.
- The letter that follows the DVI label indicates the type of connection it is, for example, DVI-D (digital connections), DVI-A (Analog connections), DVI-I (Integrate digital and analog connections).



5. HDMI (High Definition Multimedia Interface) Cables

- HDMI is the new standard that provide both audio and video transmission through a single cable.
- It is a compact 19-pin plug and cable for connecting High-Definition video and multi-channel audio-capable
- HDMI is an uncompressed, all-digital signal audio/video interface with 5 Gbps of available bandwidth.



- The primary use of the HDMI wire is to transmit digital signals from a compatible digital audio/video source such as a cable set top box, DVD player, A/V receiver or satellite receiver to a compatible digital audio and/or video monitor such as a high definition television.
- In addition to carrying uncompressed video, HDMI carry 8-channels, of 192kHz, 24-bit uncompressed audio.



- HDMI eliminates the complexity of using several multiple cables since it combines audio and video onto a single cable.

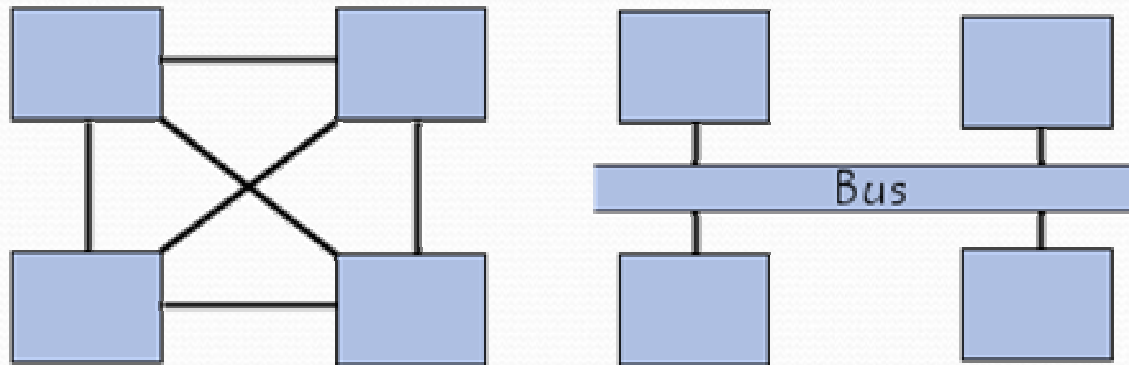
6. Firewire

- Firewire, also known as IEEE 1394 and i.Link, is a high speed serial bus.
- It is a faster alternate to USB and is commonly used for connecting digital camcorders and external hard drives to a computer.
- Digital camcorders and external hard drives often have firewire ports.
- Firewire typically has 6 pins in its connector, though a 4 pin variety is common as well.



Bus

- In order for multiple hardware components to communicate with one another, a bus is used to transmit the data from one part of a computer to another.
- A bus is a collection of wires through which data is transmitted from one part of a computer to 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.



Characteristics of a bus

- The size of a bus, known as its *width*, is important because it determines how much data can be transmitted at one time.
- For example, a 16-bit bus can transmit 16 bits of data, whereas a 32-bit bus can transmit 32 bits of data.
- Additionally, the bus speed is also defined by its **frequency** (expressed in Hertz), the number of data packets sent or received per second.
- Each time that data is sent or received is called a **cycle**.
- To find the maximum **transfer speed** of the bus, the amount of data which it can transport per unit of time, by multiplying its width by its frequency.
- Example: A bus with a width of 16 bits and a frequency of 133 MHz, therefore, has a transfer speed equal to:

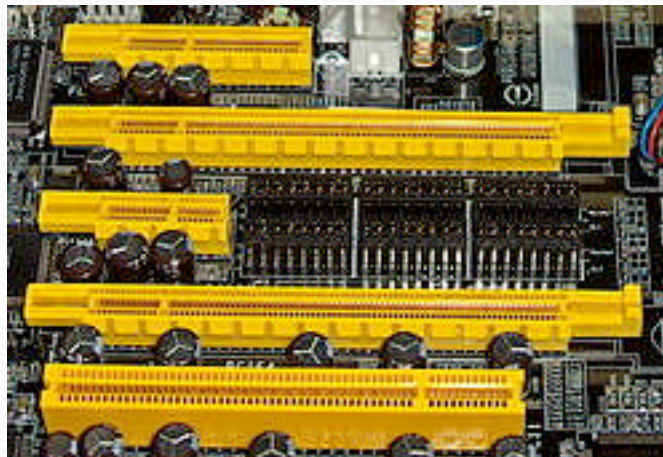
$$16 * 133.10^6 = 2128 * 10^6 \text{ bit/s,}$$

$$\text{or } 2128 * 10^6 / 8 = 266 * 10^6 \text{ bytes/s or}$$

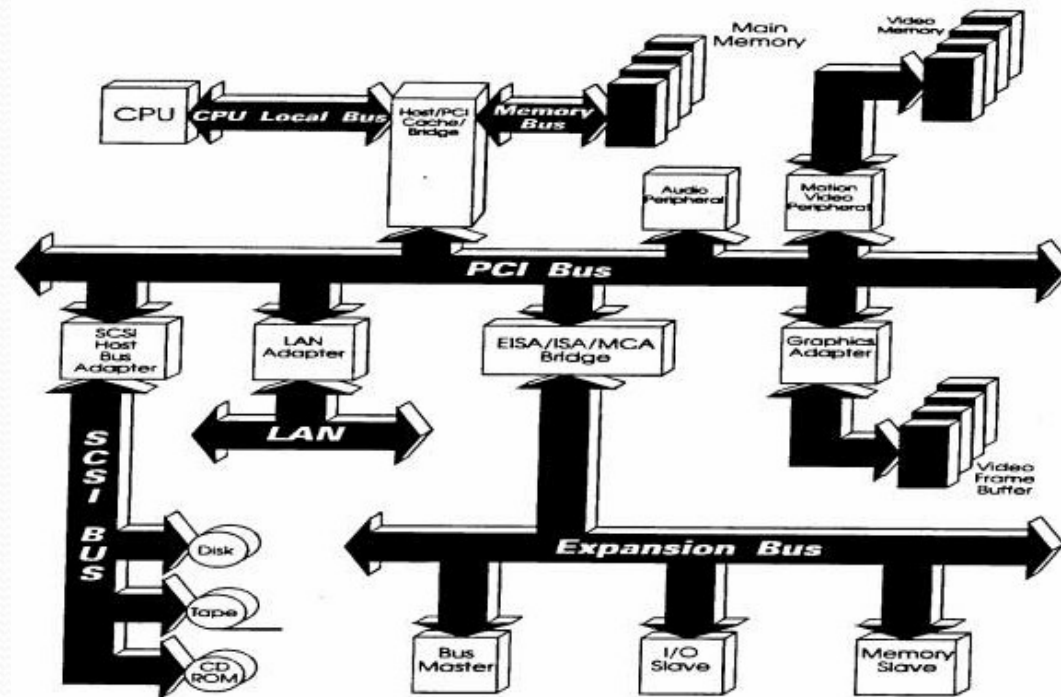
$$266 * 10^6 / 1000 = 266 * 10^3 \text{ KB/s}$$

$$\text{or } 259.7 * 10^3 / 1000 = 266 \text{ MB/s}$$

- A bus is generally constituted of 50 to 100 distinct physical lines, divided into three subassemblies:
- The **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.
- The **data bus** transfers instructions coming from or going to the processor. It is a bidirectional bus.
- The **control bus** (or *command bus*) transports orders and synchronisation 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.



- There are generally two buses within a computer:
 - **Internal bus** (sometimes called the *front-side bus*, or *FSB* for short). The internal bus operates only within the internal circuitry of the CPU, allowing the processor to communicate with the system's central memory (the RAM).
 - **External bus** (sometimes called the *input/output bus*) allows various motherboard components (USB, serial, and parallel ports, cards inserted in PCI connectors, hard drives, CD-ROM and CD-RW drives, etc.) to communicate with one another.



Peripheral Devices

- Peripheral devices are computer devices that are connected to the computer externally such as printer, scanner, keyboard, mouse, tape device, microphone and external modem or internally such as CD-ROM or internal modem and external as the scanner, printer and Zip drive.
- Peripheral devices can be classified according to their functions.
 - **Input**
 - Input devices are the type of the computer devices that are used to provide the control signals to the computer. Keyboard and the Mouse are the examples of the input devices.
 - **Output**
 - Output devices are the devices that are used to display the results. Printer, scanner, speaker and the monitor are the examples of the output devices.
 - **Storage**
 - A storage device is a device that is used to store the information such as hard disk drive, flash drive, floppy disk and the tape drive.

REFERENCES:

- http://www.webopedia.com/DidYouKnow/Hardware_Software/2002/FiveGenerations.asp
- http://library.thinkquest.org/o8aug/01795/Website/generations_of_computer.html
- http://www.cs.cmu.edu/~fgandon/lecture/uk1999/computers_types/
- http://www.plyojump.com/classes/hardware_components.html
- http://www.associatedcontent.com/article/341565/definition_and_history_of_the_computer.html?cat=15
- http://98.158.195.207/definition/Digital_computer
- <http://www.labnol.org/gadgets/visual-guide-to-computer-cables-connectors/10694/>
- <http://www.buy-a-new-computer.com/types-of-computer-cables/>
- http://www.ehow.com/about_5403549_types-computer-connectors.html
- <http://www.tech-faq.com>
- <http://www.pcguide.com/ref/ram/typesROM-c.html>

Exercise : Identify main components of a personal computer

1. What are the functions of the following computer components:
 - CPU:
 - Hard Disk:
 - Memory RAM:
 - Motherboard:
 - Video Graphic Card:
2. Name a few components present in an integrated motherboard.
3. If a computer is powered off, what happens to data in a:
 - Memory RAM
 - Hard disk
 - ROM