Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

Fundamentals of Hardware

People matter, results count.

Computer

- A computer is an electronic machine that manipulates data according to a set of instructions.

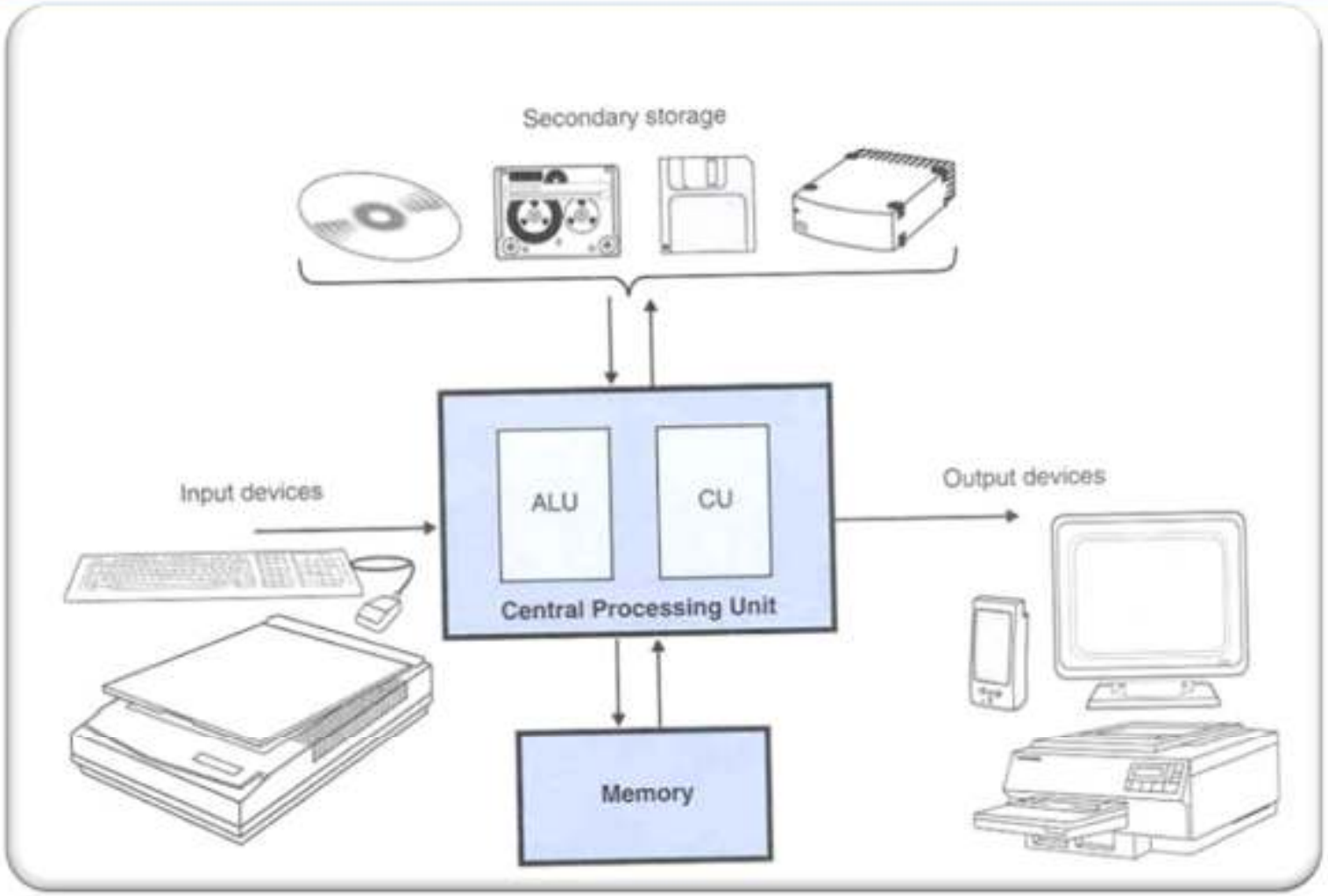
➢ **Software**

- The instructions and data are called software.

➢ **Hardware**

- The components which works according to the instruction are called hardware.

Block Diagram of Computer



Computer Input / Output Devices

Input / Output Devices	
Input	**Output**
Keyboard	Monitor
Mouse	Printers (all types)
Trackballs	Audio Card
Touch pads	Plotters
Pointing Sticks	LCD Projection Panels
Joysticks	Computer Output Microfilm (COM)
Pen Input	Facsimile (FAX)
Touch Screen	Speaker(s)
Light Pen	.
Digitizer	.
Graphics Tablet	.
Scanner	.
Microphone	.
Electronic Whiteboard	.
Video Cards	.
Audio Cards	.

Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

Input Devices

Keyboard

- Key board is an input device that enables you to enter data into a computer.

Mechanical Keyboard

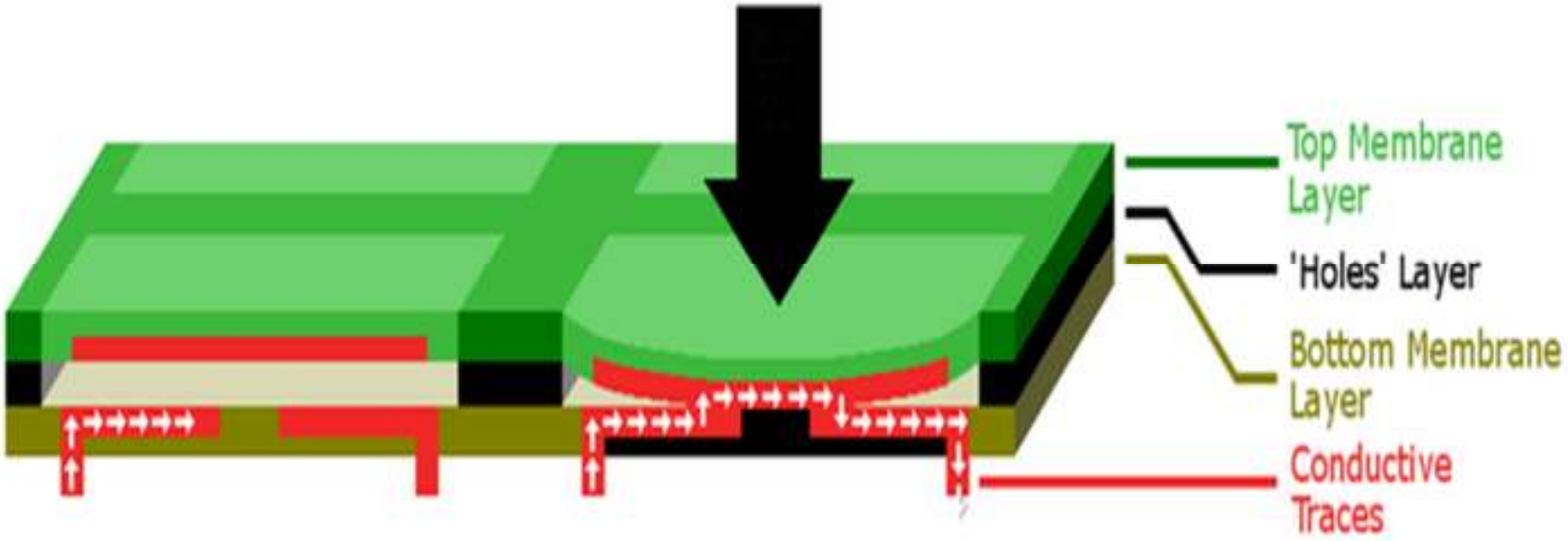
- Enables to enter the data & changes to ASCII codes.
- It has it's own processor and circuits.
- The switch technology is incorporated for their operation.
- The choice of switch technology affects key response
- There are many keyboards incorporated with the modern technology.

Membrane keyboard

- These types of keyboards have pressure pads, that have letters, numbers & symbols printed on the flat flexible surface.
- Membrane keyboards, which work by electrical contact between the keyboard surface and the underlying circuits when key top areas are pressed .

Capgemini

Working Principle of Membrane keyboard



Multimedia Keyboard

- A multimedia keyboard is designed to make it one-touch simple for the user to access often-used programs. There are special keys used to access the Internet, music, and other frequently used programs such as email.

- A typical multimedia keyboard contains buttons that control various computer processes, such as turning on the computer's power, putting the CPU to sleep, and waking it up again.

- The web browser keys on a multimedia keyboard should be familiar to most Internet users. Back, forward, stop, and refresh buttons are usually present on such keyboards.

- Volume control is another handy function that multimedia keyboards possess.

- Multimedia keyboards come in various connection formats, including PS/2, USB, and wireless.

- Example - **NEXUS IT-DUO606**

Input Devices

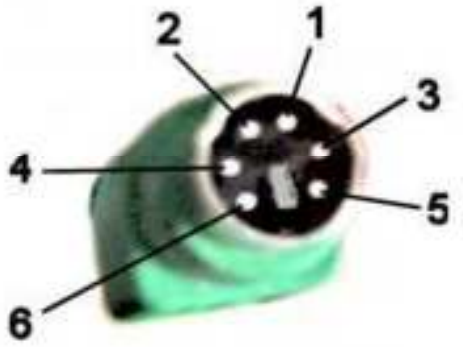
Keyboard connectors:

AT keyboard connector (DIN5)

Connector Pin #	Purpose
Pin 1	KBDCLK (clock)
Pin 2	KBDAT (data)
Pin 3	KBRST (reset, not used)
Pin 4	GND
Pin 5	VCC (+5V)

PS/2 keyboard connector (MINI-DIN6)

Connector Pin #	Purpose
Pin 1	KBDAT (data)
Pin 2	not used
Pin 3	GND
Pin 4	VCC (+5V)
Pin 5	KBDCLK (clock)
Pin 6	not used



Input Devices

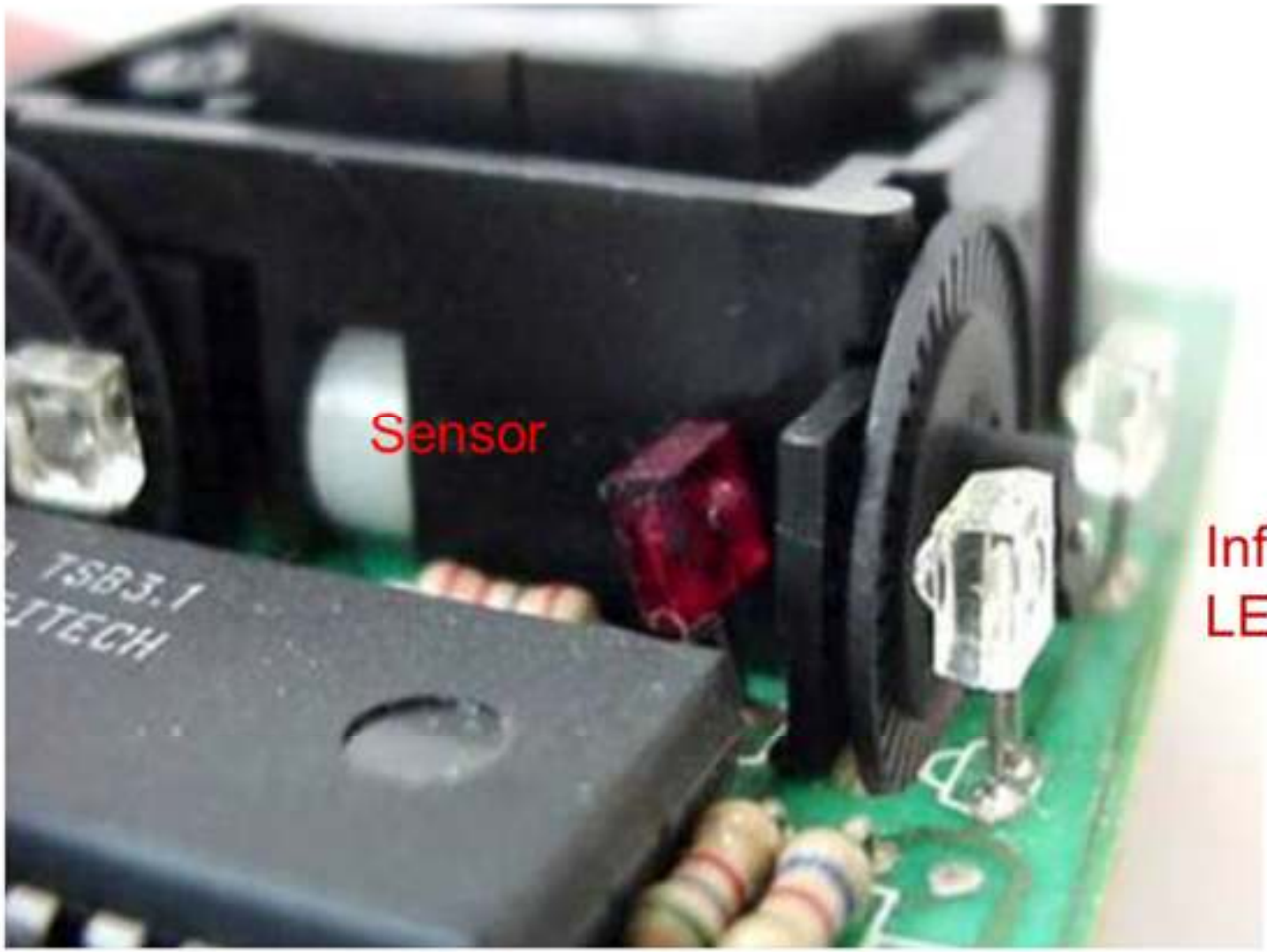
Optical mouse:

Components of Optical Mouse:

- Inbuilt optical sensor.
- High speed camera which can take 1000 pictures at a time.
- LED.

Working:

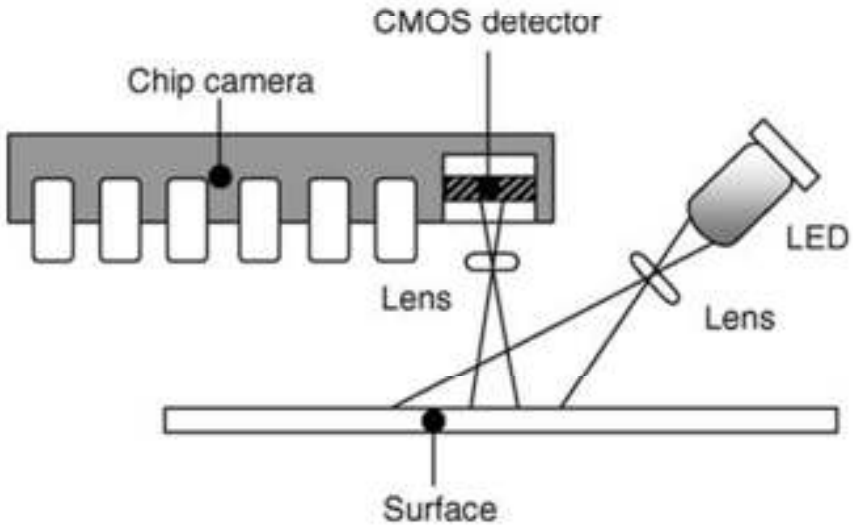
- The optical sensor reads the movements of the optical mouse (moved by the user) with the help of the light rays which comes out from the bottom (The area in which a light glows).
- When the user moves the optical mouse, the LED (Light Emitting Diode) present inside the mouse emits the light according the minute movements. These movements are send to the camera as light rays.
- The camera captures the difference in light rays as images. When the camera captures the images, each and every pictures and compared to one another with the digital technology.



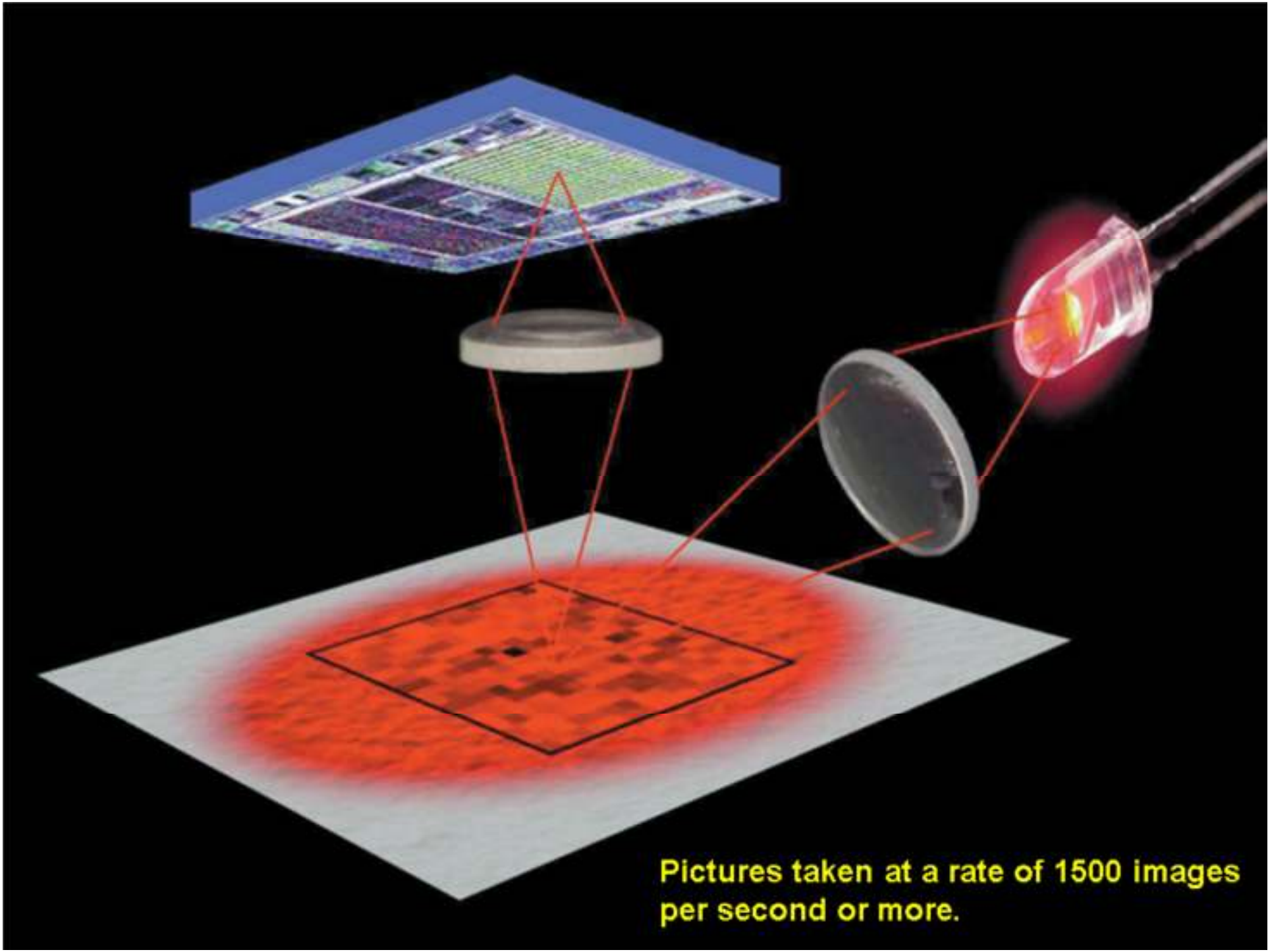
Input Devices

Optical mouse working:

- A single light emitting diode (LED) illuminates the surface at an angle.
- A lens is used to image the surface of the mouse pad onto a CMOS sensor located in the camera chip.



- The Light which reflected from the surface is captured by CMOS Detector and the corresponding pulses were given to Mouse Controller


Pictures taken at a rate of 1500 images
per second or more.

Input Devices

Mouse connector:

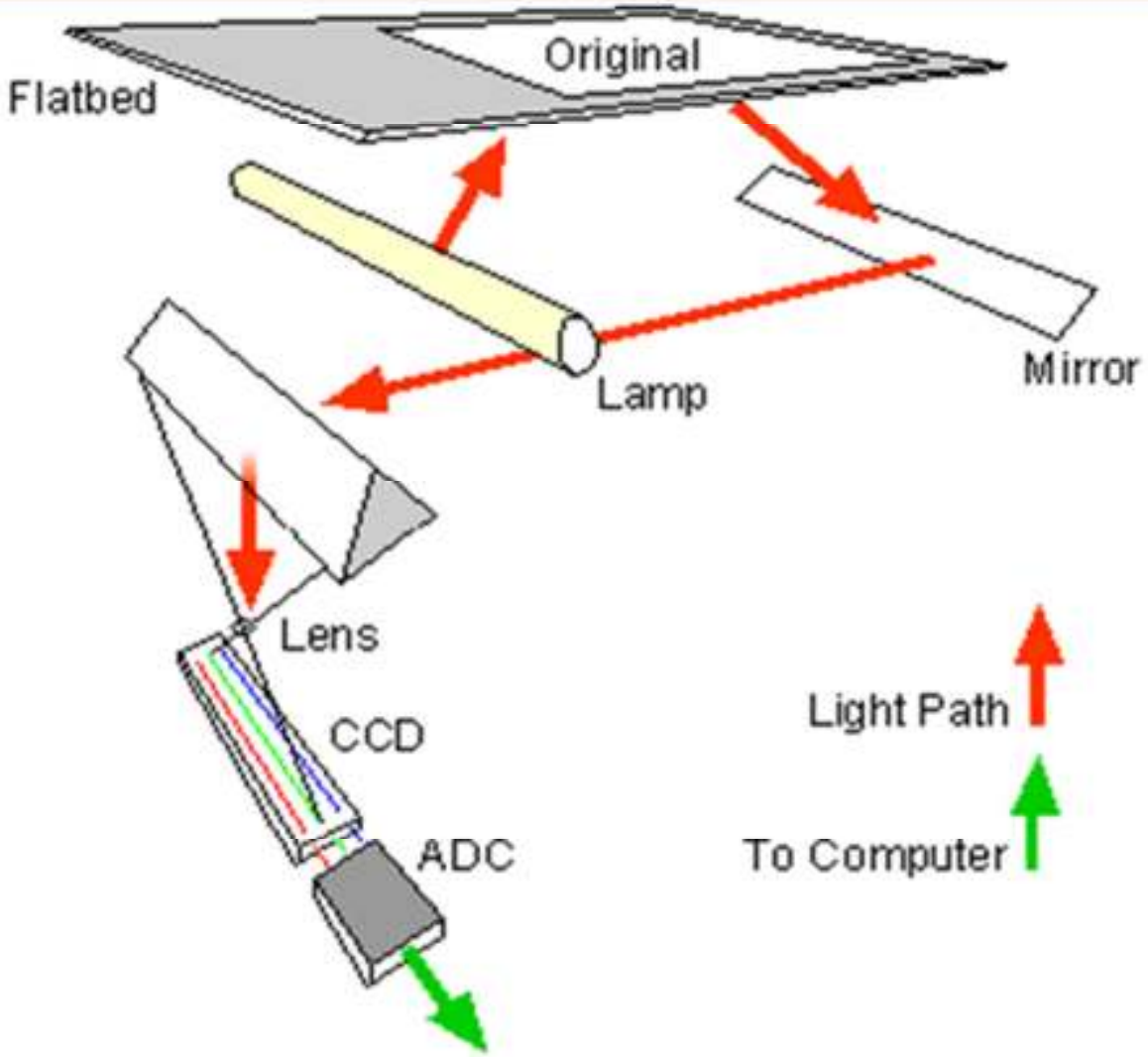
Pin 1 Data
Pin 2 Not connected
Pin 3 GND Ground
Pin 4 Vcc +5 V DC at 100 mA
Pin 5 +CLK Clock
Pin 6 Not connected

Input Devices

Scanner:

- A scanner is to analyze an image and process it in some way. Image and text capture (optical character recognition or OCR) allow you to save information to a file on your computer. You can then alter or enhance the image, print it out or use it on your Web page.

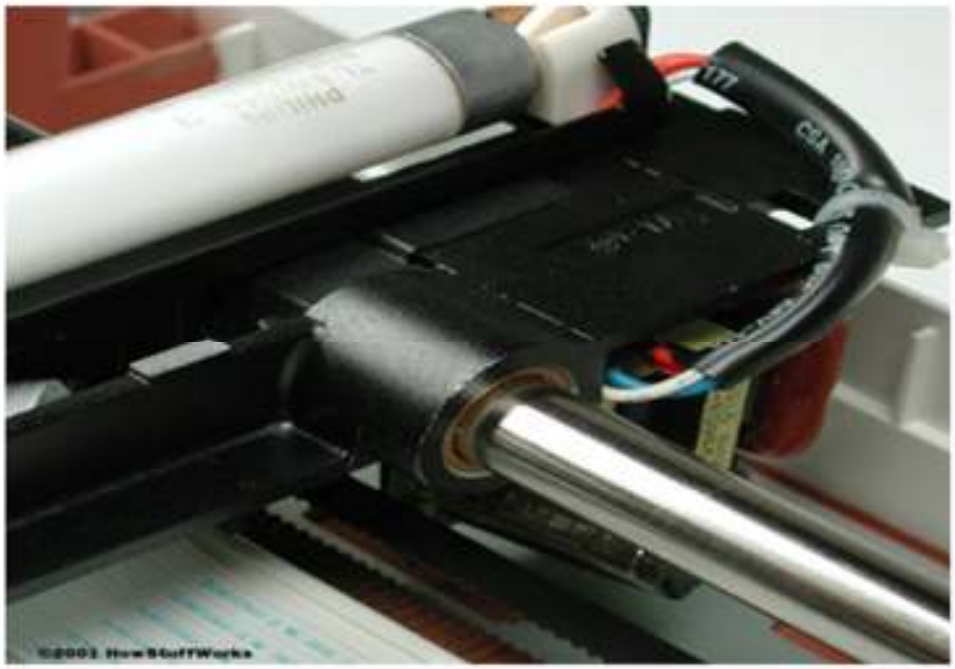
Scanning Process



Lamp

In the image above, you can see the fluorescent lamp on top of the scan head.

Stabilizer bar



The stabilizer bar is very durable and tightly secured to the body of the scanner.

The Position of the Mirrors

Input Devices

Scanning process:

- The document is placed on the **glass plate** and the **cover** is closed.
- The inside of the cover in most scanners is flat white, although a few are black. The cover provides a uniform background that the scanner software can use as a reference point for determining the size of the document being scanned

Input Devices

Scanning process:

- A lamp is used to illuminate the document. The lamp in newer scanners is either a cold cathode fluorescent lamp (CCFL) or a xenon lamp, while older scanners may have a standard fluorescent lamp

- The entire mechanism (mirrors, lens, filter and CCD array) make up the scan head.

- The scan head is moved slowly across the document by a belt that is attached to a stepper motor. The scan head is attached to a stabilizer bar to ensure that there is no wobble or deviation in the pass. Pass means that the scan head has completed a single complete scan of the document.

Input Devices

Scanning process:

- The image of the document is reflected by an angled mirror to another mirror. In some scanners, there are only two mirrors while others use a three mirror approach. Each mirror is slightly curved to focus the image it reflects onto a smaller surface.

- The last mirror reflects the image onto a lens. The lens focuses the image through a filter on the CCD array.

Input Devices

Scanning process:

- Scanners use the single pass method. The lens splits the image into three smaller versions of the original. Each smaller version passes through a color filter (either red, green or blue) onto a discrete section of the CCD array.

- The scanner combines the data from the three parts of the CCD array into a single full-color image. Another imaging array technology that has become popular in inexpensive flatbed scanners is contact image sensor (CIS).

- CIS replaces the CCD array, mirrors, filters, lamp and lens with rows of red, green and blue light emitting diodes (LEDs).

- The image sensor mechanism, consisting of 300 to 600 sensors spanning the width of the scan area, is placed very close to the glass plate that the document rests upon. When the image is scanned, the LEDs combine to provide white light. The illuminated image is then captured by the row of sensors

Input Devices

Resolution and interpolation:

- Flatbed scanners have a true hardware resolution of at least 300x300 dots per inch (dpi).

- The dpi is determined by the number of sensors in a single row (x-direction sampling rate) of the CCD or CIS array by the precision of the stepper motor (y-direction sampling rate).

Input Devices

Scanner types:

- Flatbed scanners also called desktop scanners, are the most versatile and commonly used scanners.
- Sheet-fed scanners are similar to flatbed scanners except the document is moved and the scan head is immobile. A sheet-fed scanner looks a lot like a small portable printer.
- Handheld scanners use the same basic technology as a flatbed scanner, but rely on the user to move them instead of a motorized belt. This type of scanner typically does not provide good image quality. However, it can be useful for quickly capturing text.
- Drum scanners are used by the publishing industry to capture incredibly detailed images. They use a technology called a **photomultiplier tube** (PMT). In PMT, the document to be scanned is mounted on a glass cylinder. At the center of the cylinder is a sensor that splits light bounced from the document into three beams. Each beam is sent through a color filter into a photomultiplier tube where the light is changed into an electrical signal.

Capgemini

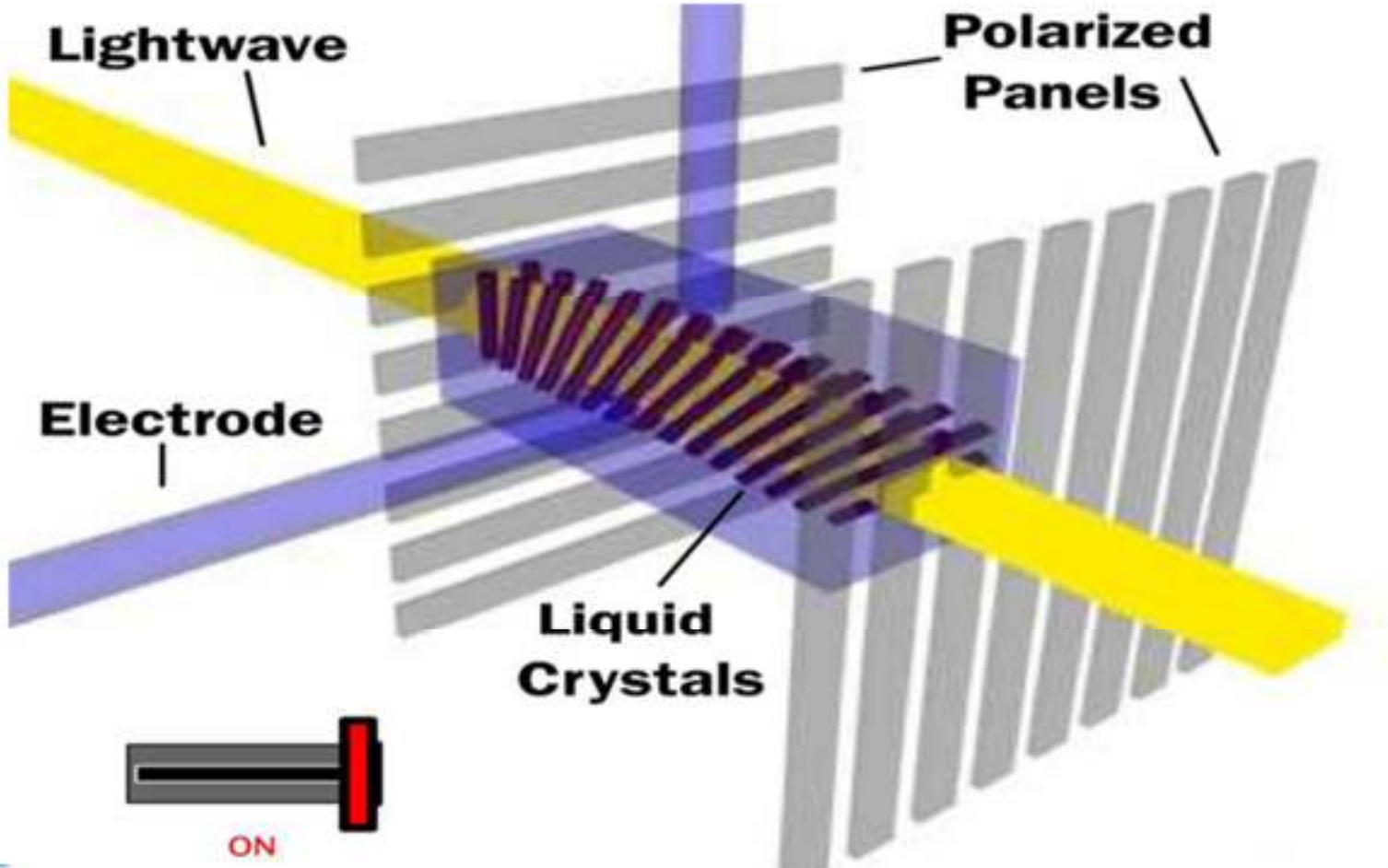
CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

LCD MONITORS

Output Devices

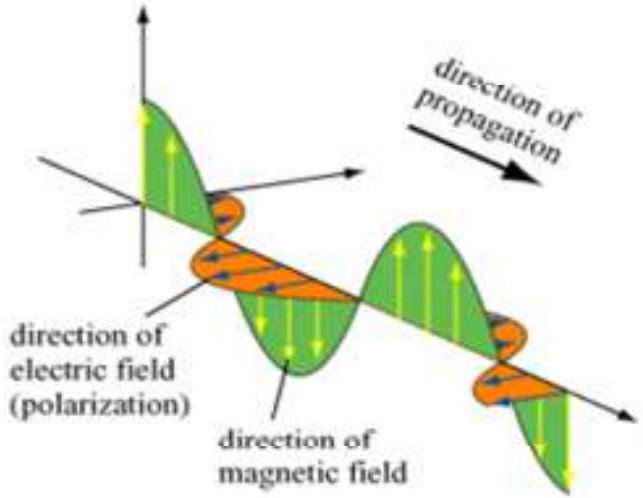
LCD – Monitor:



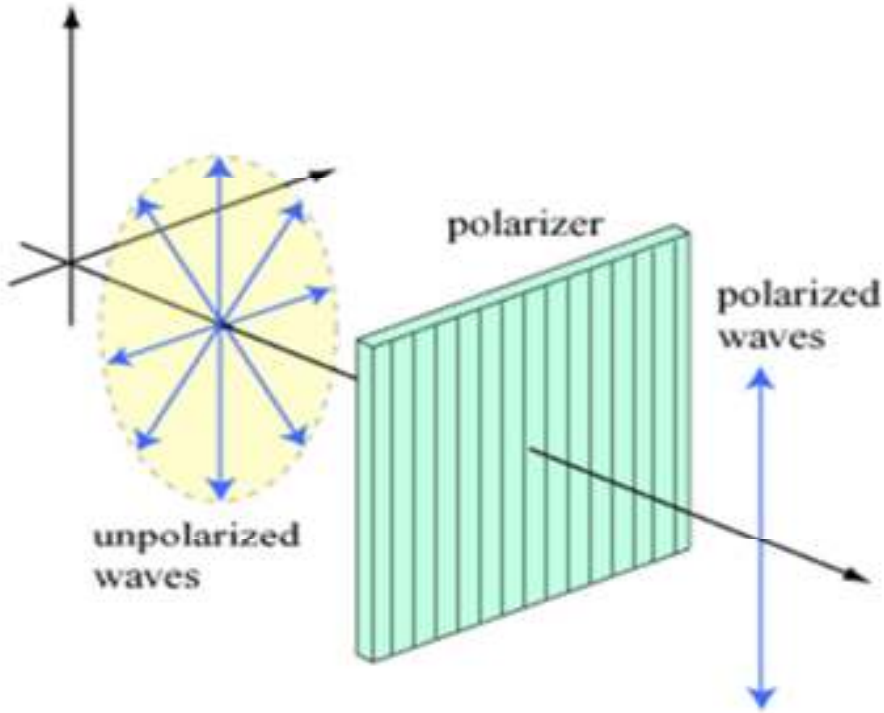
Output Devices

Polarizer:

Electromagnetic wave

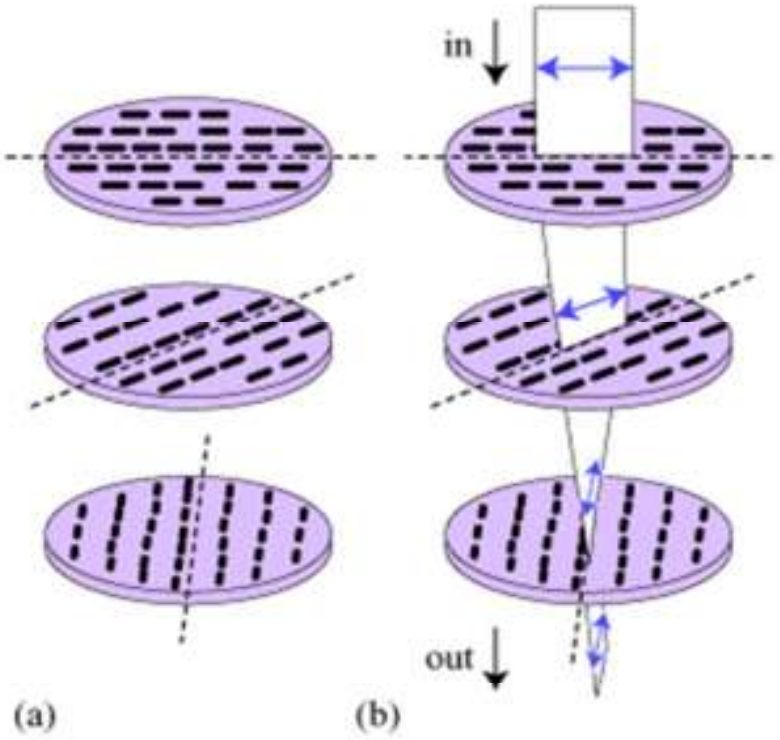


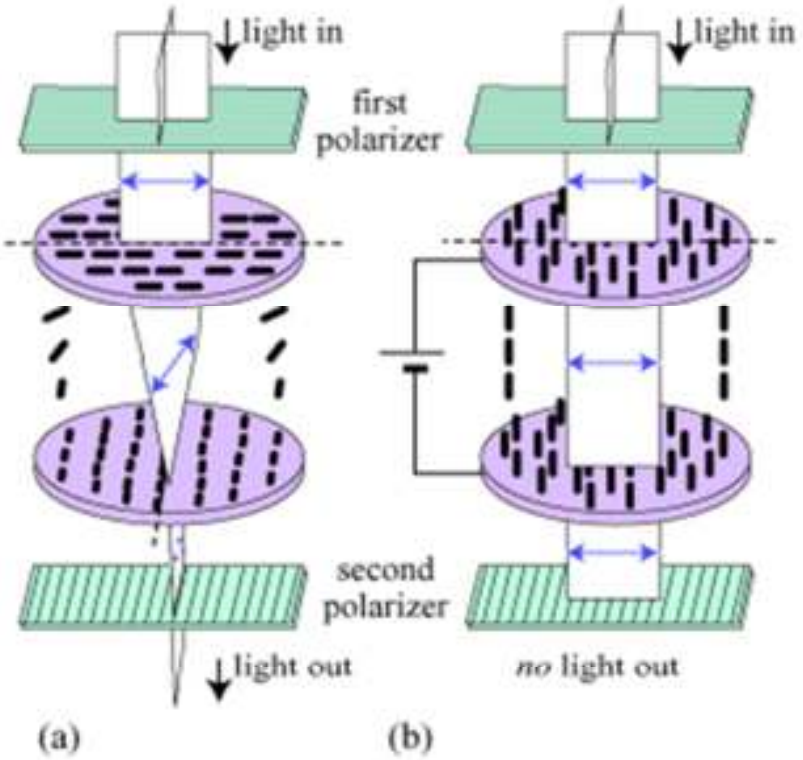
Polarizer



Output Devices

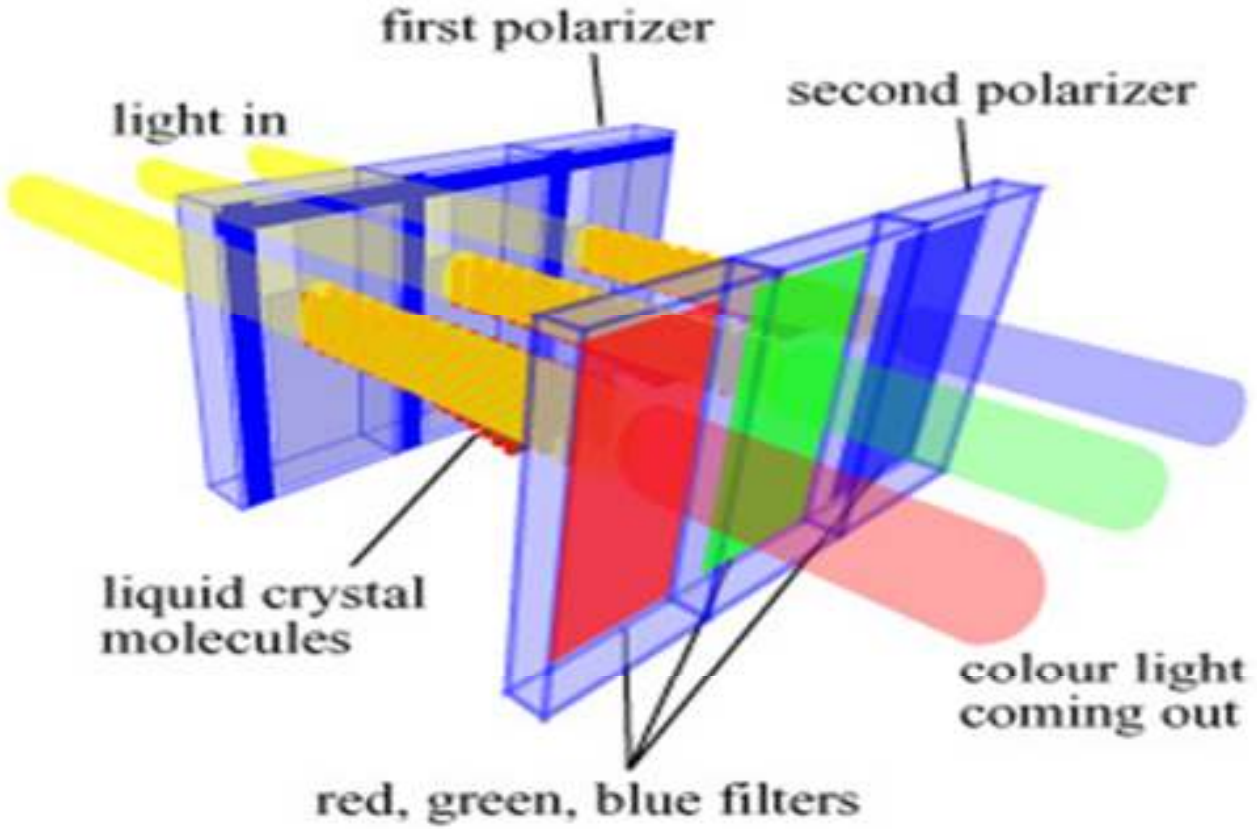
Liquid crystal – layers:





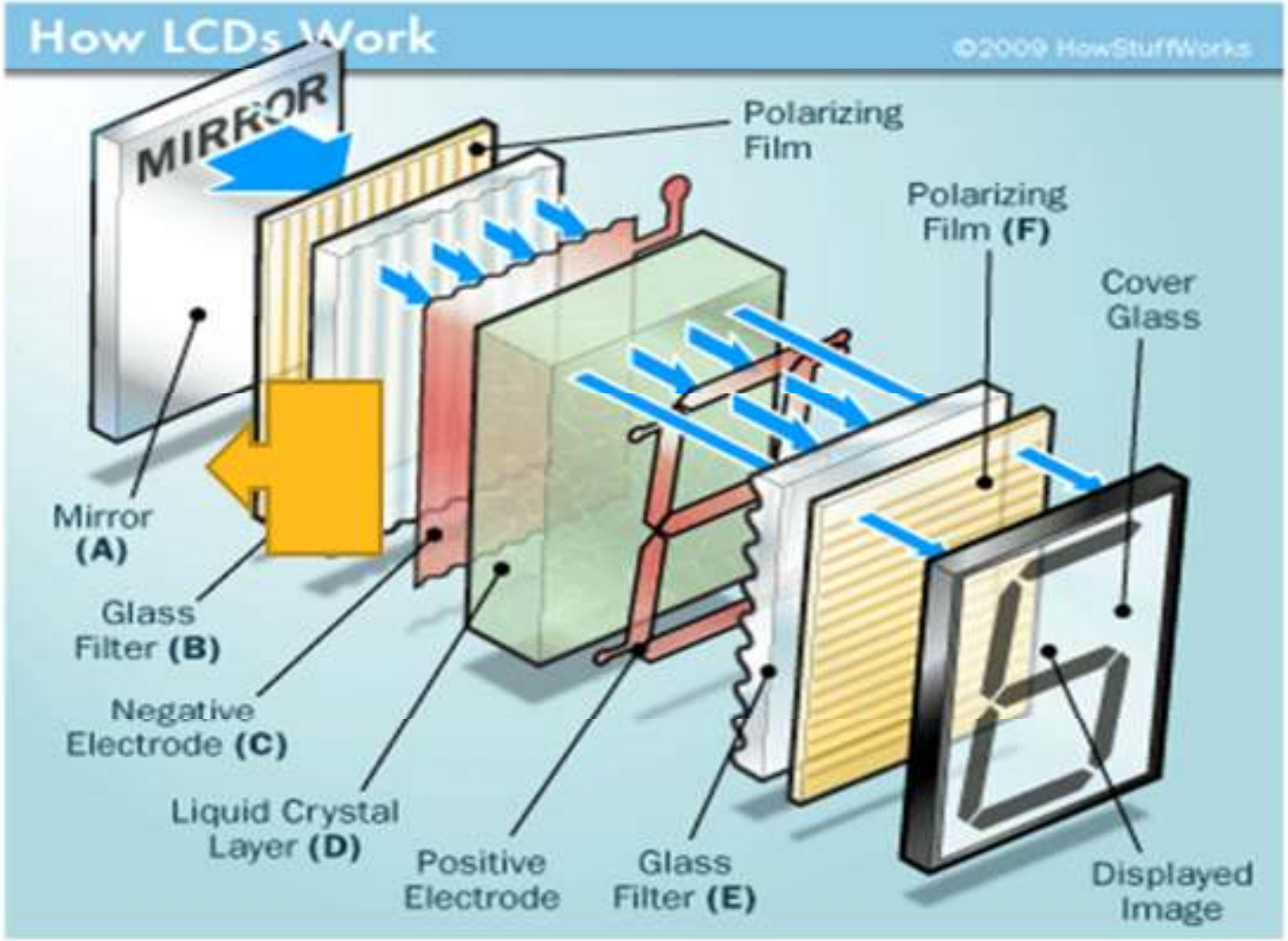
Output Devices

LCD - Display Unit:



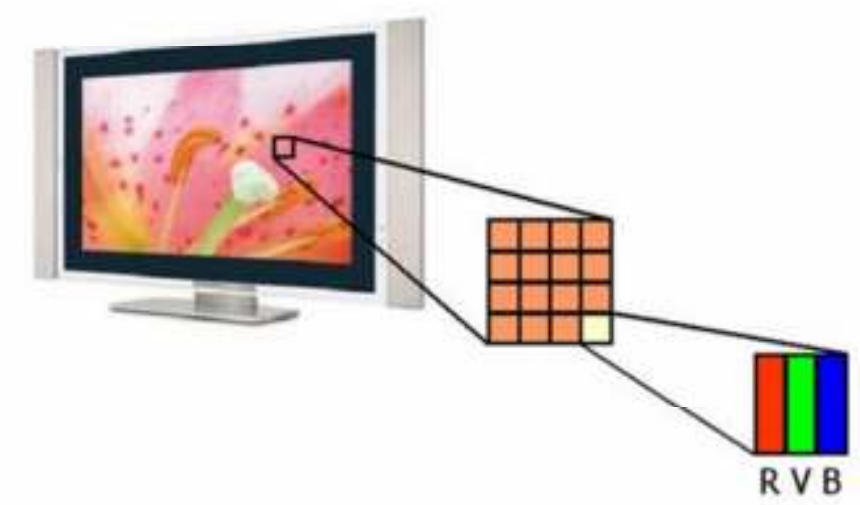
Output Devices

Working Principle of LCD:



Plasma Display

- A digital image is produced by a rectangular array of picture elements (pels or pixels). Each pixel in the display panel is made of three sub-pixels for the three additive primary colors: red, green and blue. All shades of colors from bright white to pitch black are produced from the mixture of these colors.

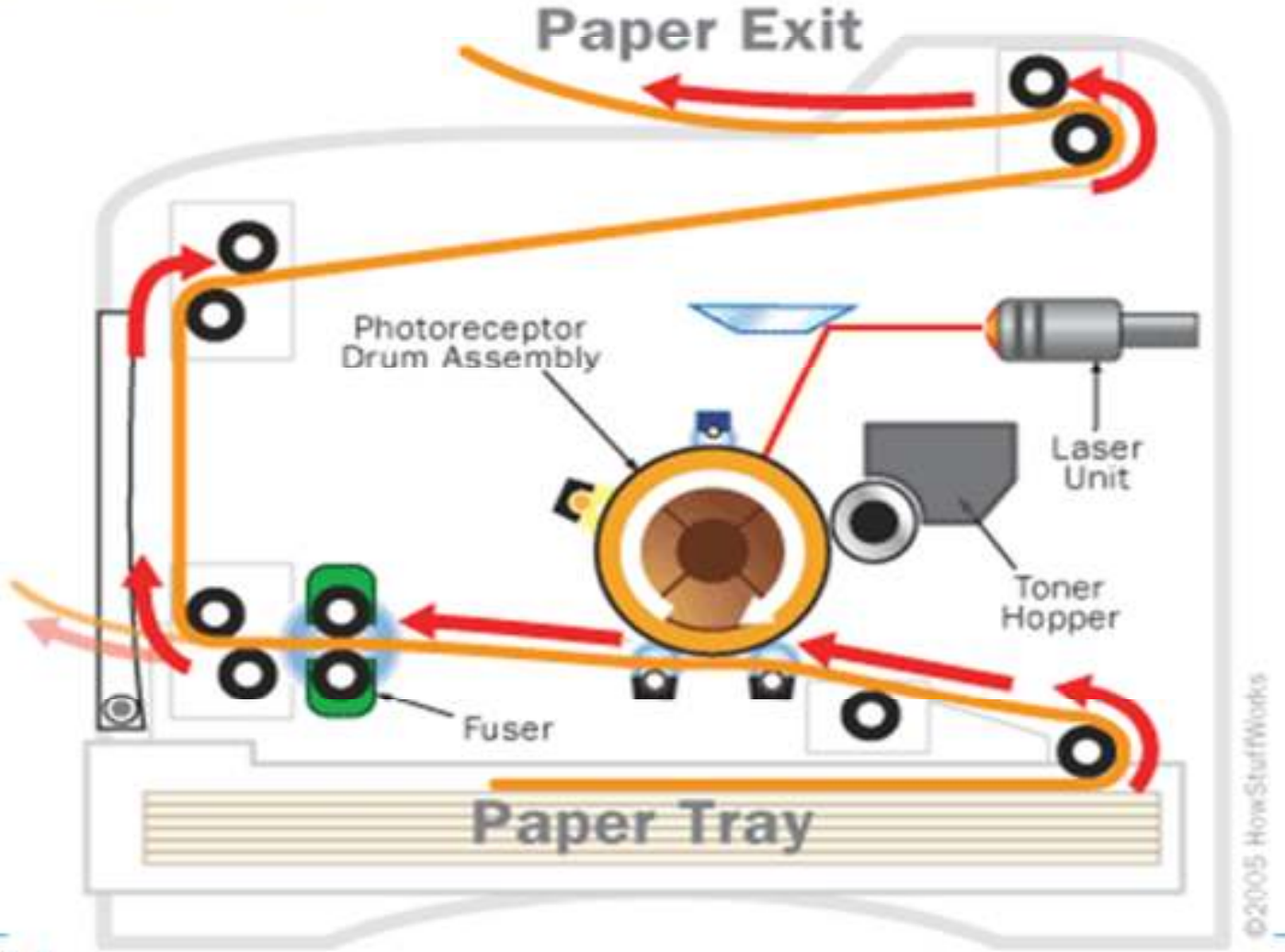


Working Principle of Plasma

- Plasma display consists of two transparent glass panels sandwiching a thin layer of pixels.
- Each pixel is made of three gas filled cells.
- The gas used is a mixture of inert gases neon and xenon.
- A grid of tiny electrodes supplies electric current to these sub-pixels, as a result of which the gas ionizes to plasma state.
- This ionized gas emits high frequency UV rays, stimulating the cell's phosphors to glow to the desired color.

Output Devices

Printer - Laser Printer:



Output Devices

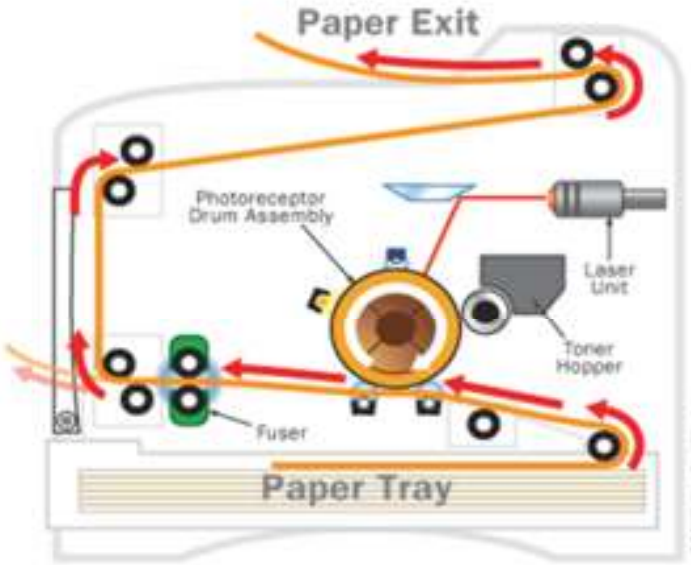
Laser printer:

Principle : Static electricity

- Static electricity is simply an electrical charge built up on an **insulated object**, such as a balloon or your body. Since oppositely charged atoms are attracted to each other, objects with opposite static electricity fields cling together.

➢ The core component of this system is the photoreceptor, typically a revolving drum or cylinder.

➢ The drum assembly is made out of highly photoconductive material that is discharged by light photons.

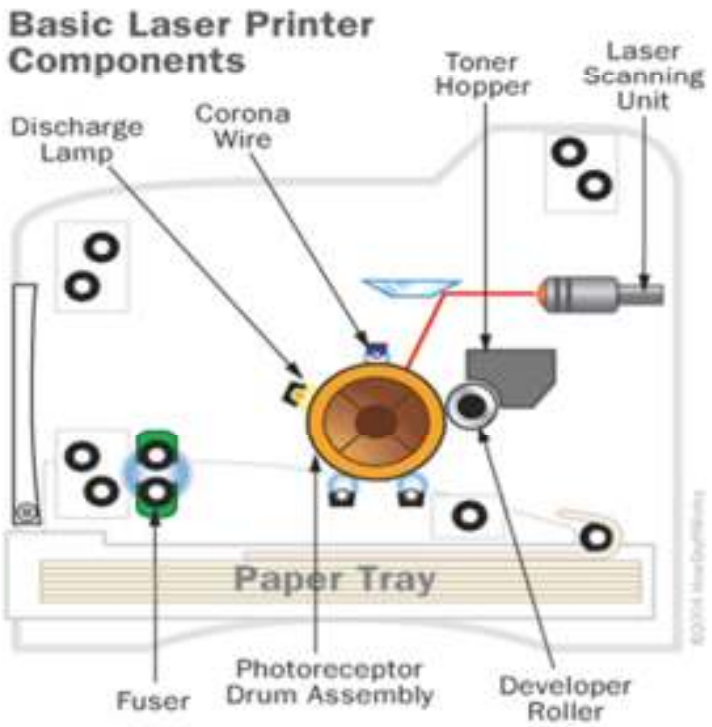


Output Devices

Laser printer:

Drum:

- Initially, the drum is given a total **positive charge** by the **charge corona wire**, a wire with an electrical current running through it.
- As the drum revolves, the printer shines a tiny laser beam across the surface to discharge certain points.
- The laser "draws" the letters and images to be printed as a pattern of electrical charges an **electrostatic image**
- The system can also work with the charges reversed -- that is, a positive electrostatic image on a negative background.
- After the pattern is set, the printer coats the drum with positively charged **toner** a fine, black powder.



Output Devices

Laser printer:

- A positive charge, the toner clings to the negative discharged areas of the drum, but not to the positively charged background.
- The flour only sticks to the glue-coated part of the can, so you end up with a message written in powder.
- With the powder pattern affixed, the drum rolls over a sheet of paper, which is moving along a belt below. Before the paper rolls under the drum, it is given a negative charge by the **transfer corona wire** .
- Since it is moving at the same speed as the drum, the paper picks up the image pattern exactly.

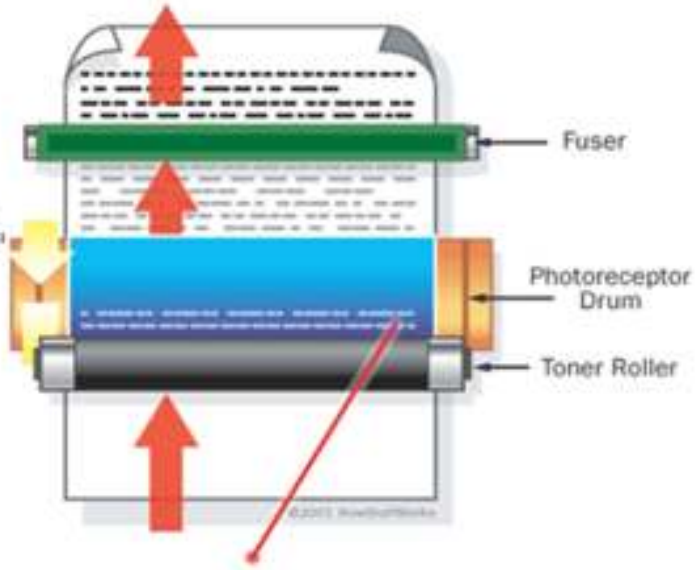
Fuser unit:

- When the printer passes the paper through the **fuser**, a pair of heated rollers. As the paper passes through these rollers, the loose toner powder melts, fusing with the fibers in the paper.
- The fuser rolls the paper to the output tray, and you have your finished page.

Output Devices

Laser printer:

- The fuser also heats up the paper itself, of course, which is why pages are always hot when they come out of a laser printer or photocopier.
- After depositing toner on the paper, the drum surface passes the **discharge lamp**. The bright light exposes th entire photoreceptor surface, erasing the electrical image.
- The drum surface then passes the charge corona wire, which reapplies the positive charge.



The controller:

- The printer controller is the laser printer's main onboard computer. It talks to the host computer through a communications port, such as a parallel port or USB port.

Output Devices

Laser printer:

- It talks to the host computer through a communications port, such as a parallel port or USB port.
- At the start of the printing job, the laser printer establishes with the host computer how they will exchange data.
- The controller may have to start and stop the host computer periodically to process the information it has received.

Output Devices

Laser printer components:

- **Toner cartridge:**

- A hopper filled with toner. Toner is a fine powder composed of plastic, iron and carbon particles.
- An EP drum covered with photosensitive coating that holds a static charge until exposed to light.
- A blade to remove used toner from the drum.
- A corona charging assembly, which applies a static to the drum after an image has been printed.

Output Devices

Laser scanning assembly

Contains the following components:

Laser - Shines on the drum and creates an electrostatic image of what's printed. Creates areas of negative charge on the positively charged drum.

Mirror - Reflects the laser beam.

Lens - Focuses the laser beam. Multiple lenses maybe used to focus the laser beam on the various areas of the drum: the areas being closer to or farther away from the mirror and laser beam.

Power supplies:

A high voltage power supply (HVPS) converts 120 volt, 60 Hz AC current into high voltage electricity used by EP process. A DC supply (DCPS) is used to power components that don't require high voltages.

Output Devices

- Paper control and transport assembly:

  Paper moved through the printer by a series of rollers. Some of the rollers simply guide the paper from one location to another and some rollers function to apply pressure to printed page to fuse the toner.

- Transfer corona assembly:

  The HVPS applies a high voltage charge to the corona wire. The wire then charges the paper so that the toner from the drum can be transferred onto the paper as it passes under the drum. After the paper passes the drum, the static charge eliminator strip drains charges from the paper so that it doesn't adhere to the toner cartridge and create a paper jam.

- Fusing assembly:

  The fusing assembly is composed of rollers and a heating lamp. It applies heat and pressure to adhere the toner permanently to the page.

- Electronic control package:

  Also known as the printer control circuitry or the main logic assembly. This component is responsible for communicating with the internal printer memory, the control panel and the computer from which the print job is being received.

Output Devices

Steps in the laser printing process:

- Charging or conditioning:

  The primary corona wire applies a negative charge of approximately -600volts to the EP drum.

- Writing or exposing:

  The laser beams reduces the negative charge to about -100 volts on the EP drum in the areas that become the image to be printed.

- Developing:

  Areas of the drum that were written to by the laser attract toner.

- Transferring:

  A positive charge of about +600volts is applied to the paper by transfer corona wire.

- Fusing:

  Pressure and heat set the toner to the paper. A 350 deg F fusing roller melts the toner, and squeezing the paper through a set of rollers presses the toner into the paper.

- Cleaning and erasing:

  A rubber blade clears the excess toner from the drum. Another corona wire removes the charges from the drum.

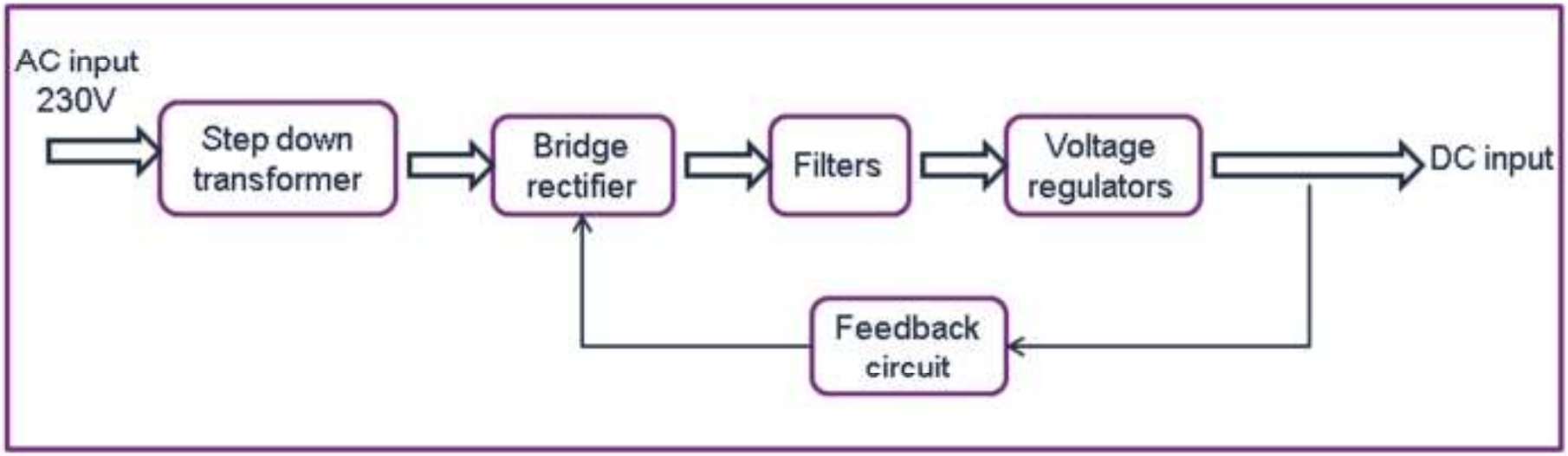
Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

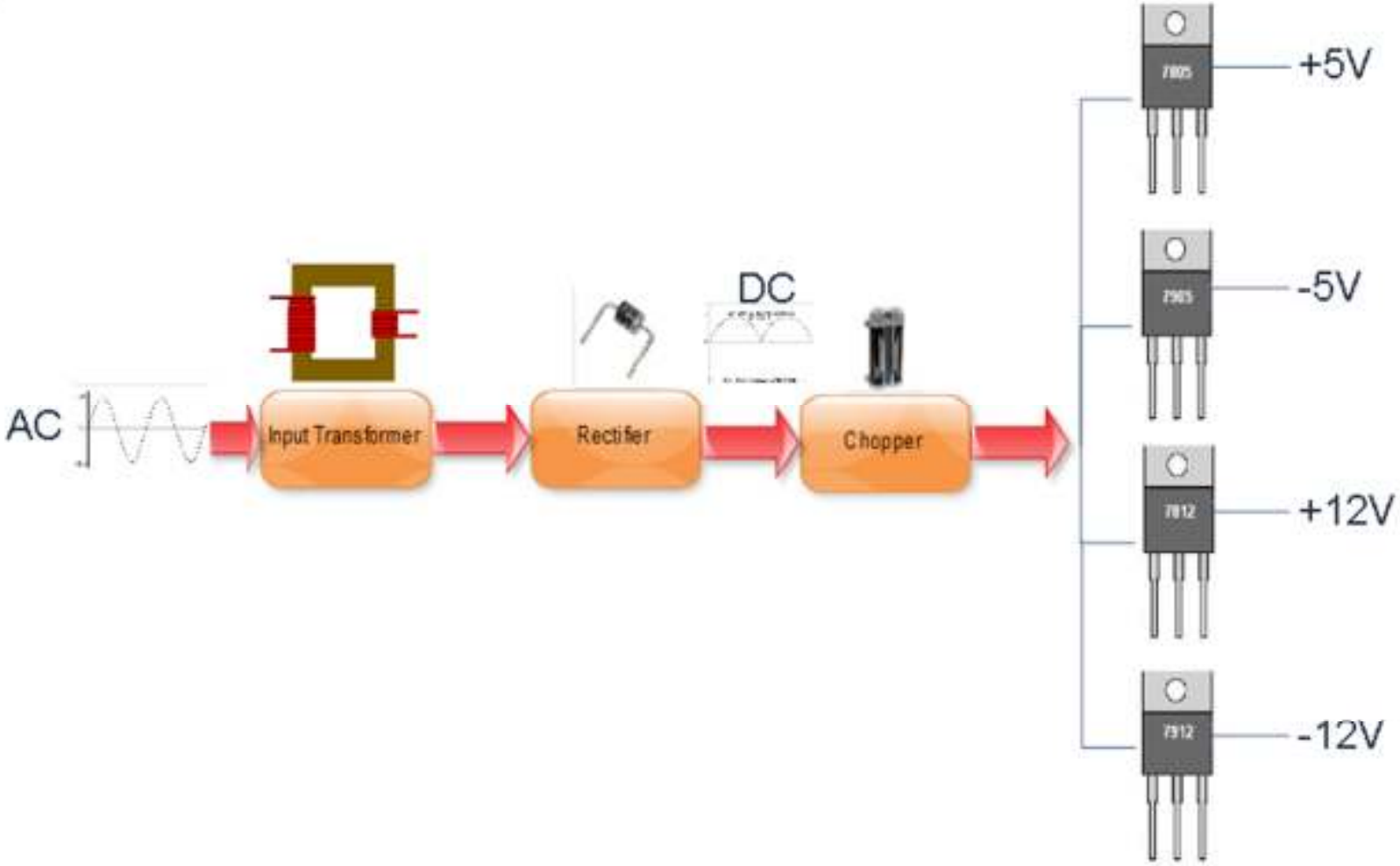
People matter, results count.

SMPS – Switched Mode Power Supply

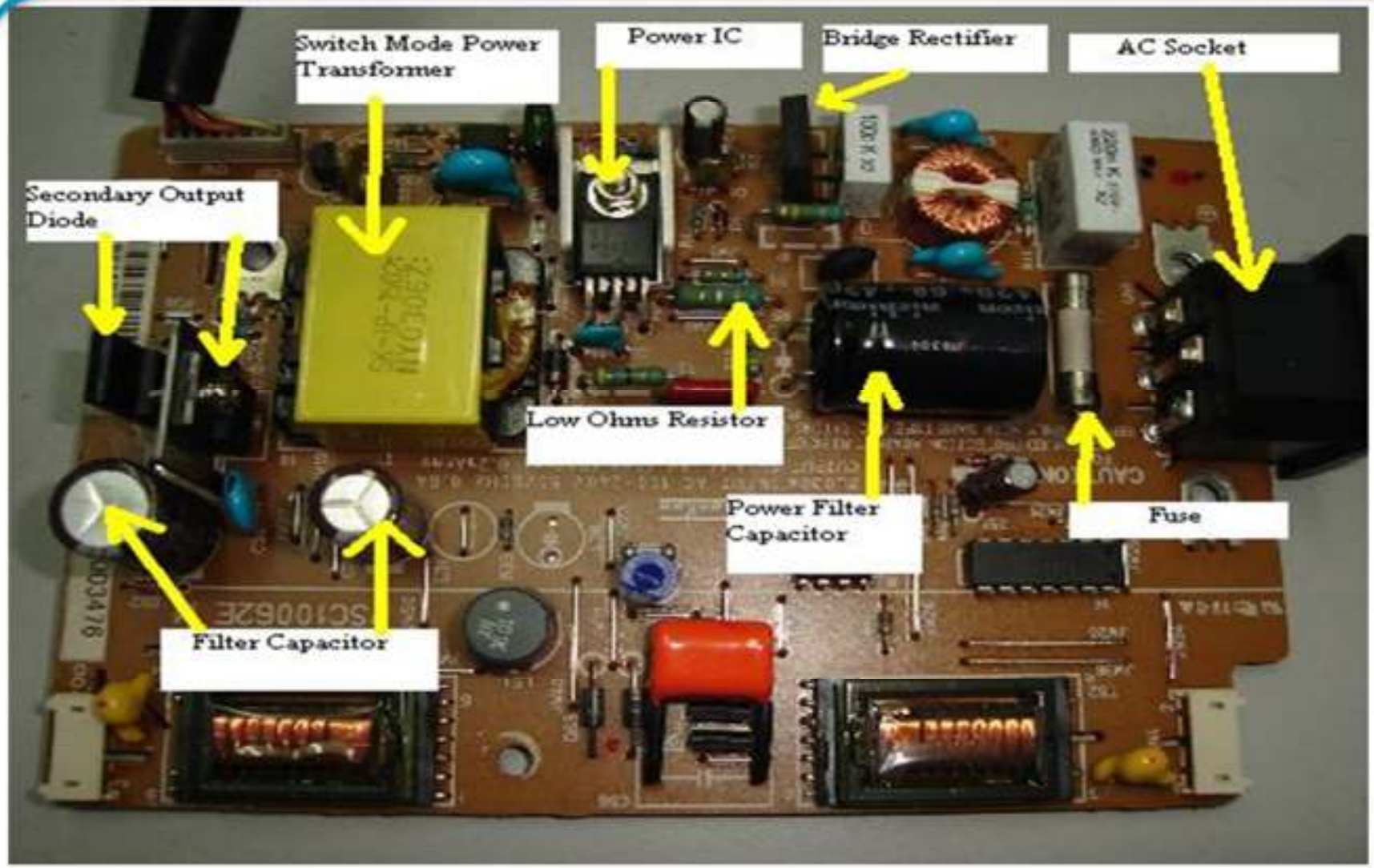
- Rectifies AC – DC
- Feedback control, which controls the voltage
- Output transformer for constant current output.
- Various voltages can be obtained by IC voltage regulators



SMPS – Switched Mode Power Supply

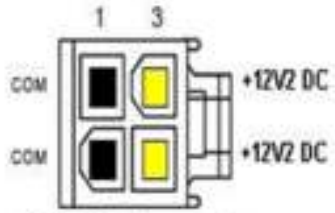


Internal circuit of SMPS

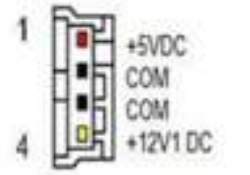


SMPS – Switched Mode Power Supply

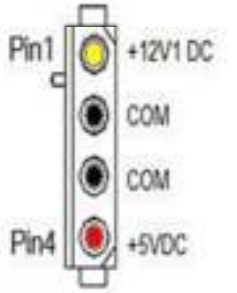
Connectors:



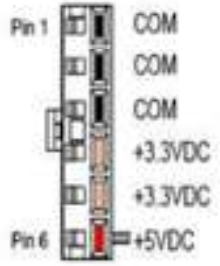
+12V2 DC Connector



Floppy Drive Connector



Peripheral Connector



Aux Power Connector
(ATX12V v.1)

SMPS – Switched Mode Power Supply

24-pin ATX12V 2.x power supply connector
(20-pin omits the last four: 11, 12, 23 and 24)

Color	Signal	Pin	Pin	Signal	Color
Orange	+3.3 V	1	13	+3.3 V	Orange
				+3.3 V sense	Brown
Orange	+3.3 V	2	14	-12 V	Blue
Black	Ground	3	15	Ground	Black
Red	+5 V	4	16	Power on	Green
Black	Ground	5	17	Ground	Black
Red	+5 V	6	18	Ground	Black
Black	Ground	7	19	Ground	Black
Grey	Power good	8	20	No connection	
Purple	+5 V standby	9	21	+5 V	Red
Yellow	+12 V	10	22	+5 V	Red
Yellow	+12 V	11	23	+5 V	Red
Orange	+3.3 V	12	24	Ground	Black

The three shaded pins (8, 13, and 16) are data signals, not power.

Pin 20 used to provide -5VDC (white wire) in ATX and ATX12V versions 1.2 and earlier. Version 1.2 allowed the omission of this pin and versions 1.3 and beyond prohibited this pin.

The right-hand pins are numbered 11 through 20 in the 20-pin version.

Earthing:

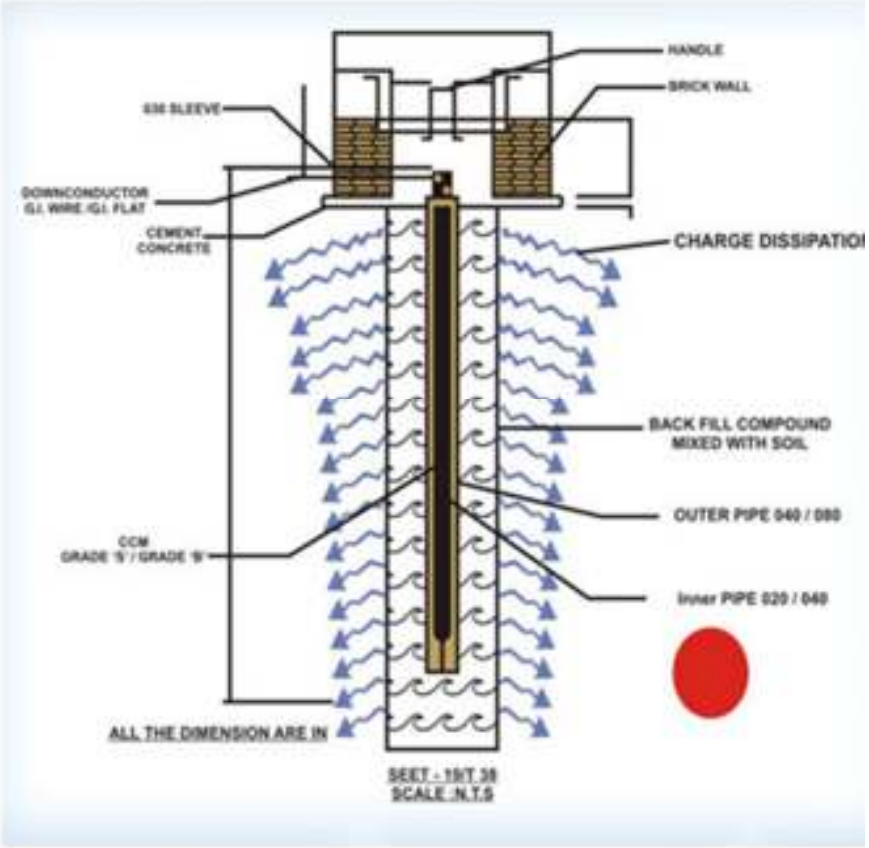
- In electricity supply systems, an **earthing** system defines the electrical potential of the conductors relative to the Earth's conductive surface.
- The choice of earthing system can affect the safety and electromagnetic compatibility of the power supply, and regulations can vary considerably among countries.

How to Test Earthing?

Portable Appliance Tester or "PAT":

The PAT is specifically designed to test electrical safety and does all the different tests necessary to ensure the electrical safety of the appliance and makes testing easy.

The difference between using a Millimeter and a PAT is that a Millimeter does a Continuity Test where as a PAT does an Earth Bond or Earth Integrity Test.

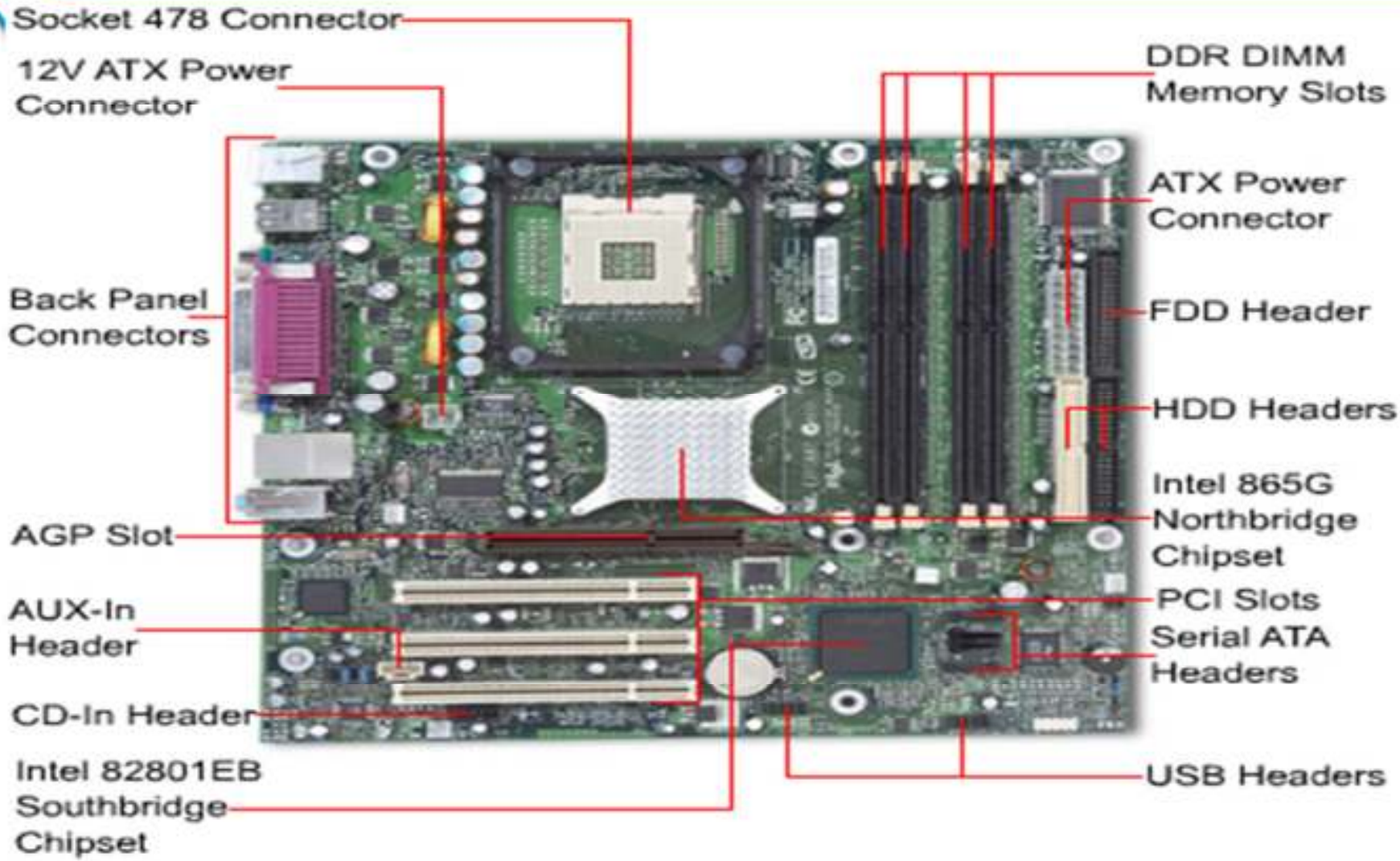


Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

Motherboard



Motherboard

- PCB which is used to integrate all the components.
- It contains slots, socket, chipsets and ports.
- Chipset is the major part of the motherboard.

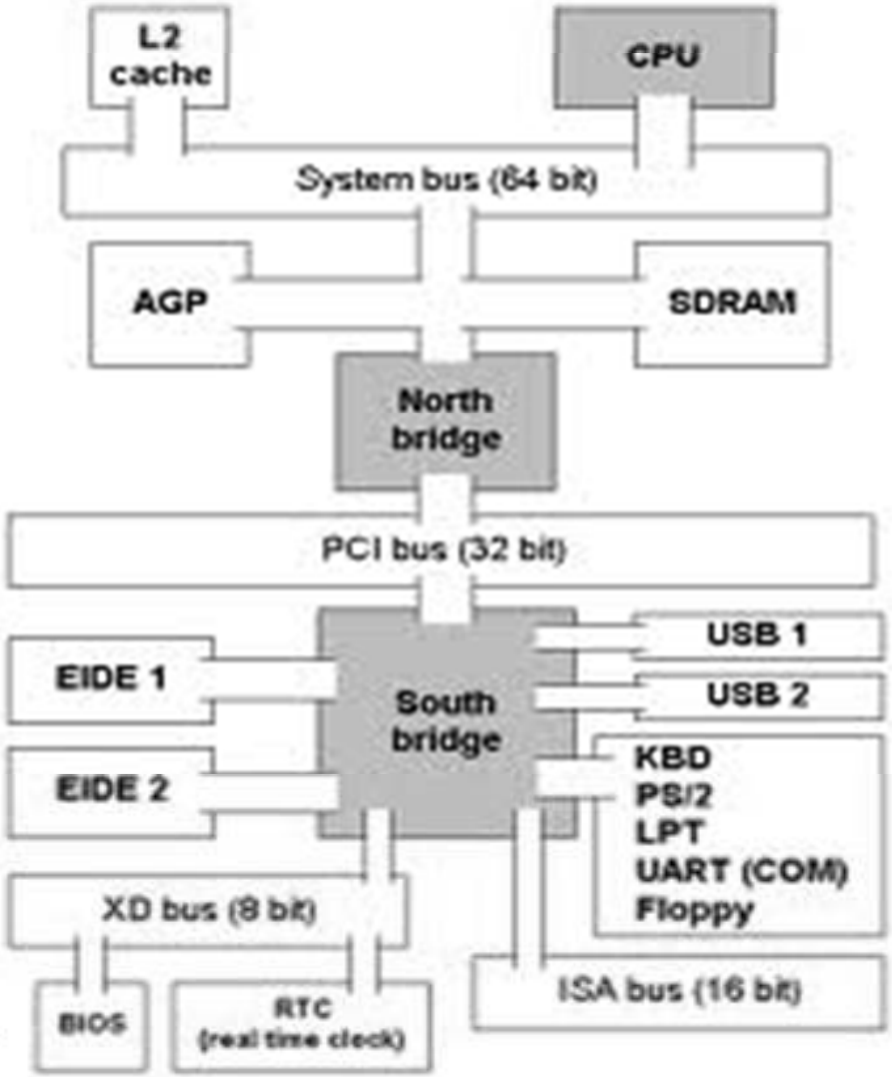
- **North bridge:**

  - Memory controller Hub
  - Communicates among CPU,RAM ,AGP,PCI
  - Calculates Speed, Type of CPU ,Type of RAM
  - Handles transactions for the Front side bus

- **South bridge:**

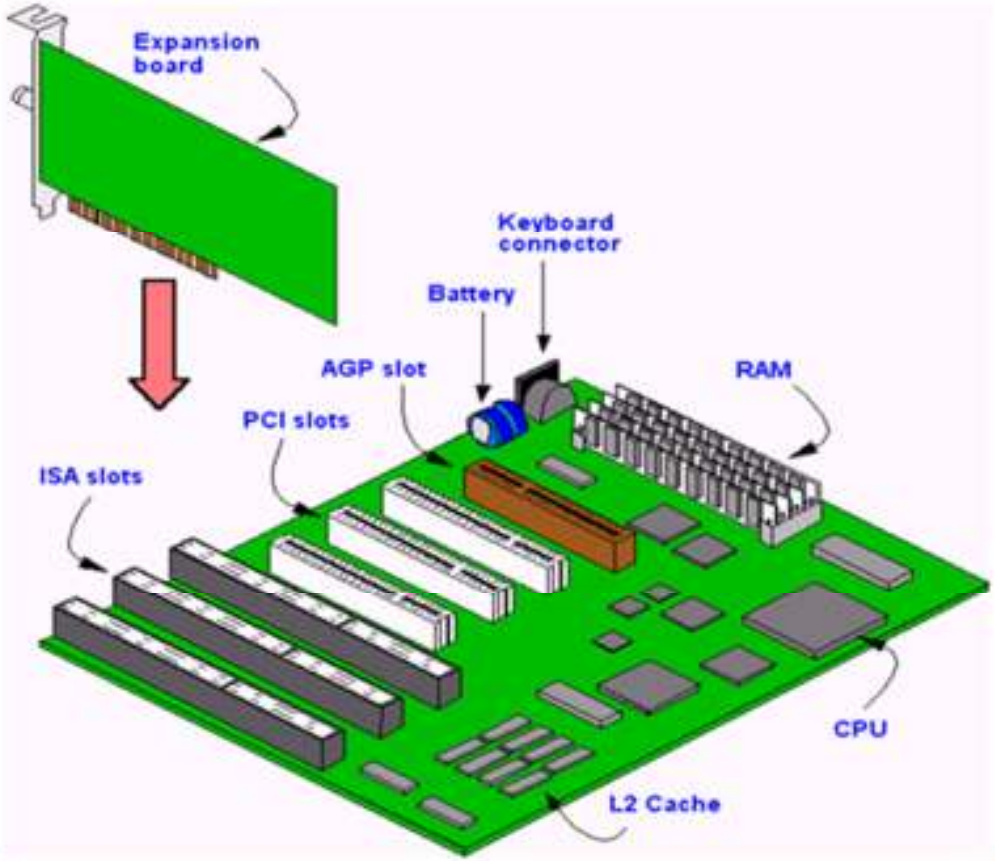
  - I/O controller Hub
  - North bridge ties the Southbridge to the CPU
  - Controls BIOS, IDE,USB, Legacy control

North and South bridge:

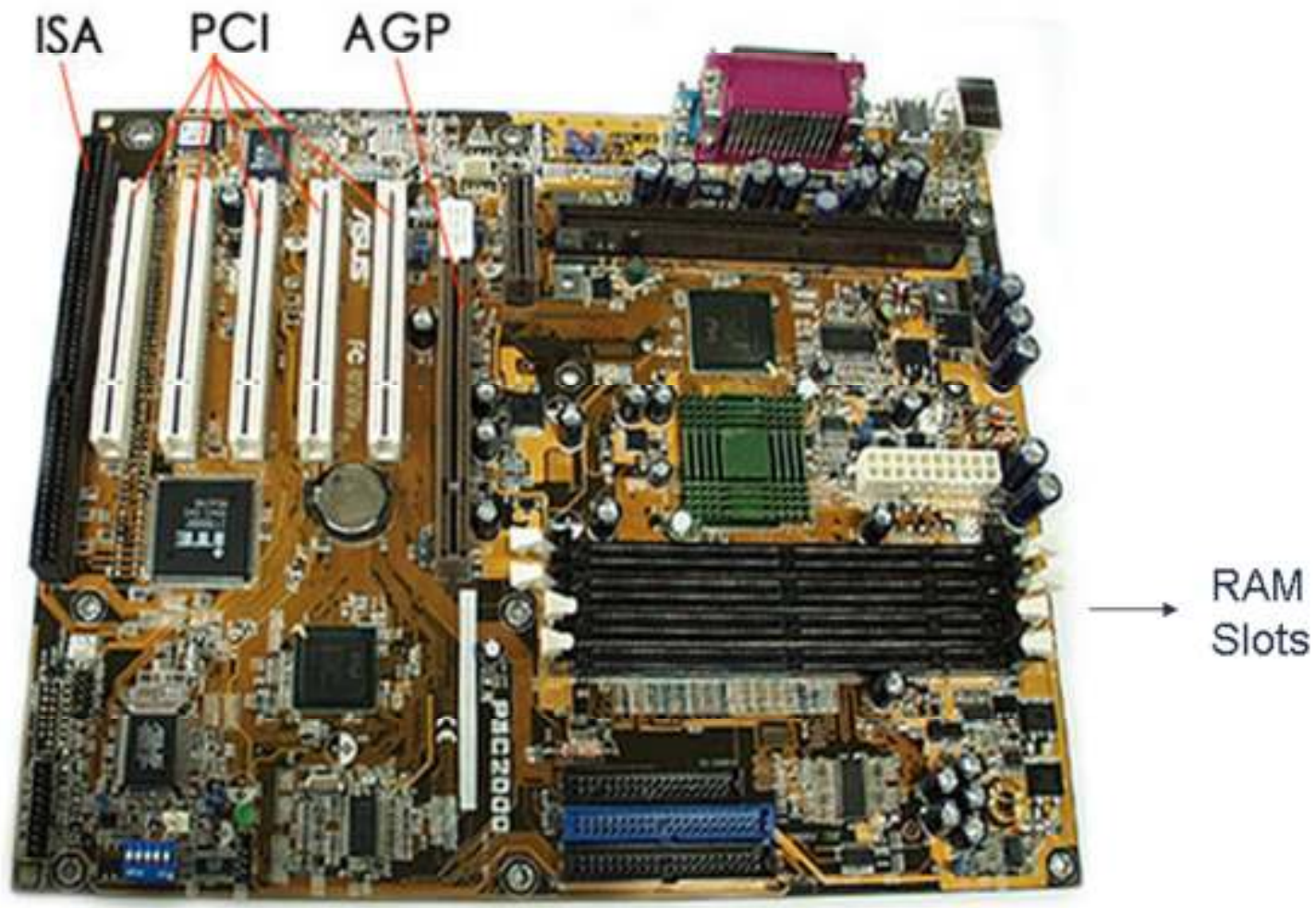


Slots:

- ISA (Industrial Standard Architecture)
- EISA (Extended Standard Architecture)
- PCI (Peripheral Component Interface)
- PCI Express



Slots:

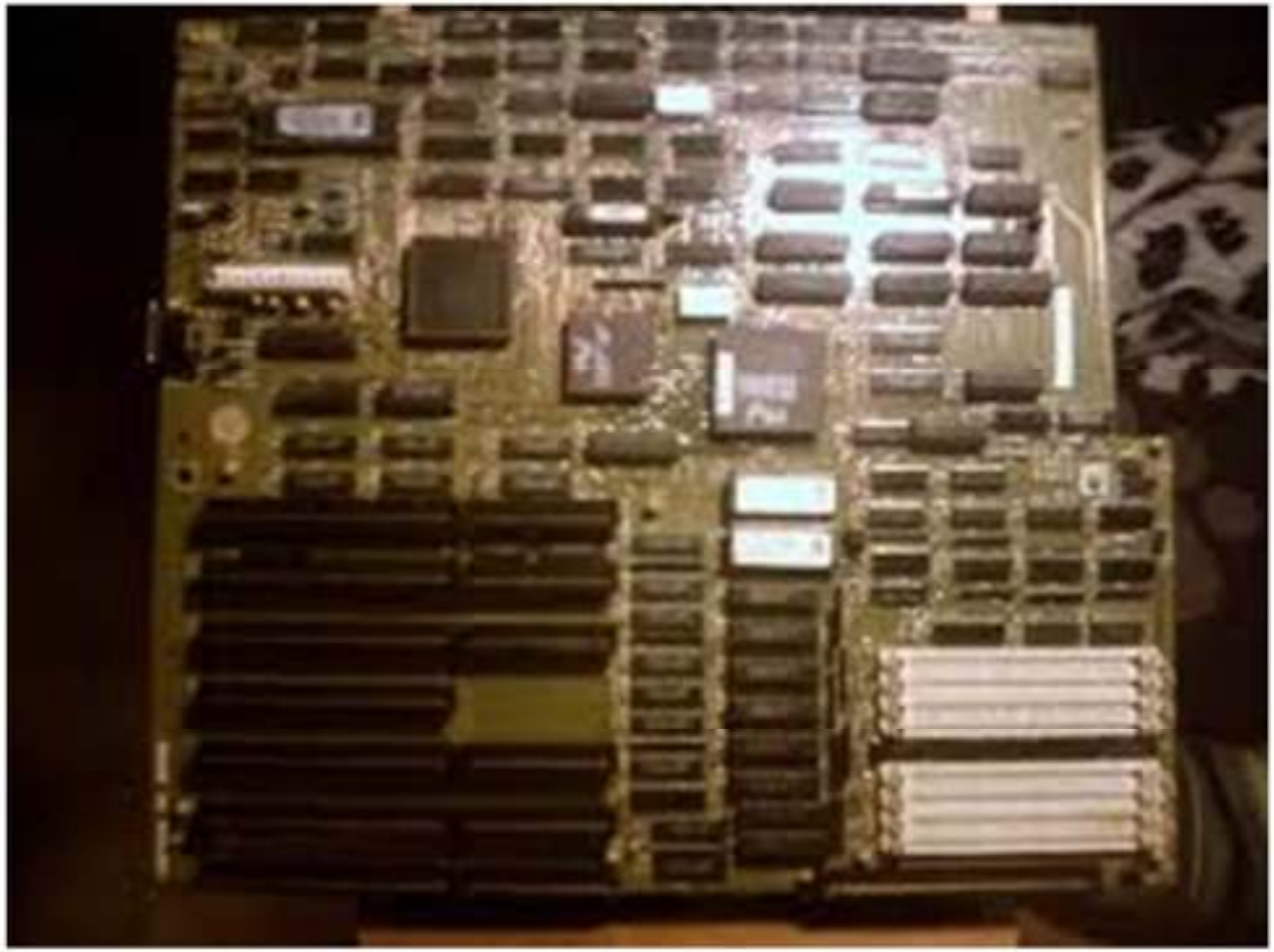


Motherboard

Motherboard

Types of Motherboard:

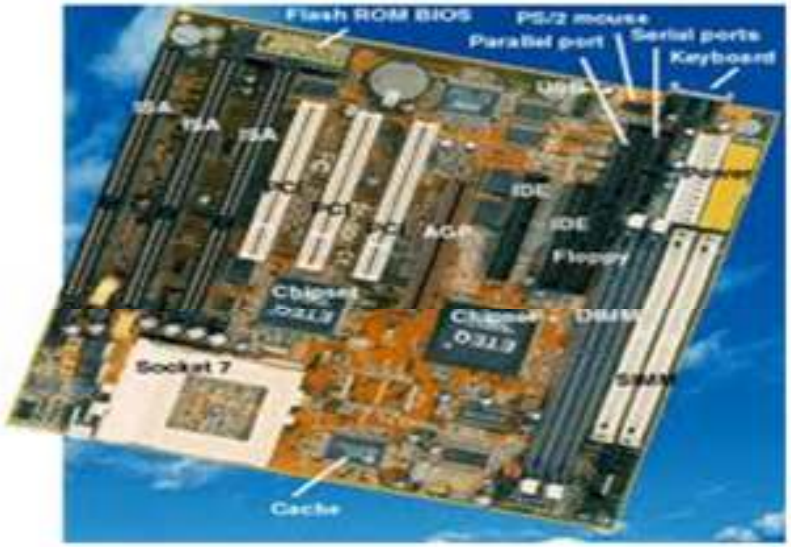
Full AT:



Width =12 inches
Length =11 inches

Baby AT:

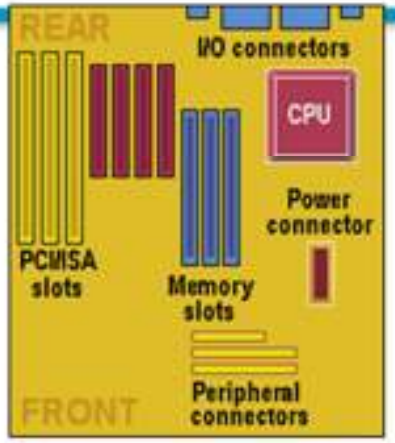
- To overcome the problem created by AT Form factor, the Baby AT form factor was introduced.
- Baby AT is designed to hold the peripheral devices like keyboard, video and mouse.
- It could not accommodate the combination of processor, heat sink and fan.

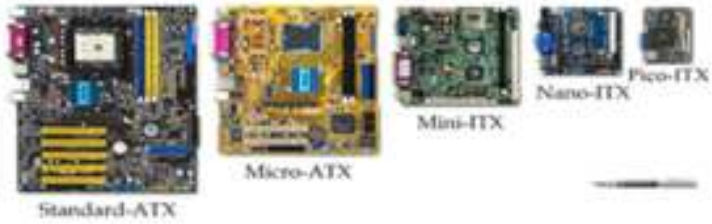


Form Factor:

ATX:

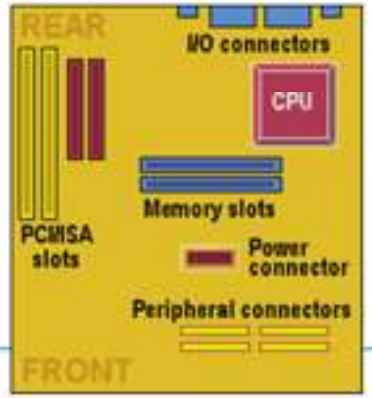
- More I/O Connectors on the rear end when compared to at and baby at form factor
- Here expansion slots were placed on separate riser cards.



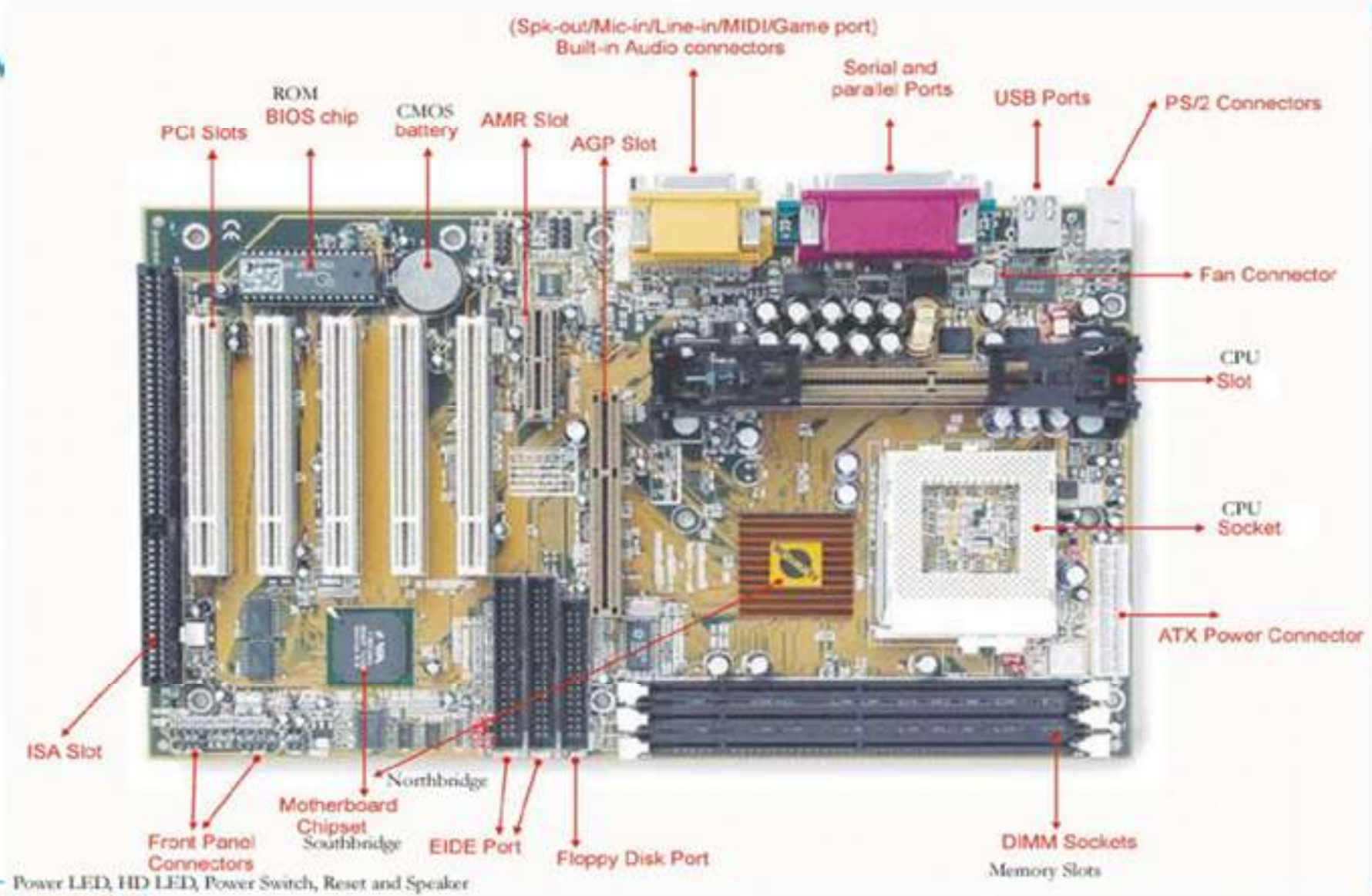


Micro ATX form factor:

- Small in dimension when compared to ATX
- More space for Peripheral connectors was provided at the rear end.



Motherboard



Serial Connectors:

Standard Serial Connector - This connector has been about in PCs since they first appeared. It was initially located on ISA expansion type cards. Nowadays it is an essential part of latest motherboards. It is a 9- pin, D-shell connector that agrees to you to connect external devices with serial ports to your PC. The maximum data rate is 115 KB/s.

USB - Universal Serial Bus -This is a comparatively new serial bus. Formerly specific as low speed, 1.2 Mb/s, it was improved to full speed, 12Mb/s. The latest version 2.0 is specified as high speed of more than 400 MB/s.

One day the USB will finally change the standard serial connector that has been the workhorse serial port in previous computers. At present USB are the average connectors on all the latest motherboard available in the market.

Not like the serial and parallel ports, the USB port is designed to power devices connected to it. The devices must be low power devices and must be able to reduce their current draw to less than 0.5uAmps when commanded to do so by the PC.

Parallel Connectors:

Centronix or Standard Parallel - This connector has been about in computers since they first emerged. It has 37-pins and is now included on recent motherboards. It is frequently used to attach your printer to the PC and moves data at speed of about 1MB/s.

SCSI – The SCSI is being termed as Small Computer System Interface which sends the data at a maximum speed of up to 80Mb/s. It not included into most computer motherboards. It can be installed in a computer in a form of Expansion card. With the help of this card the user can connect around seven hard drives in one computer.

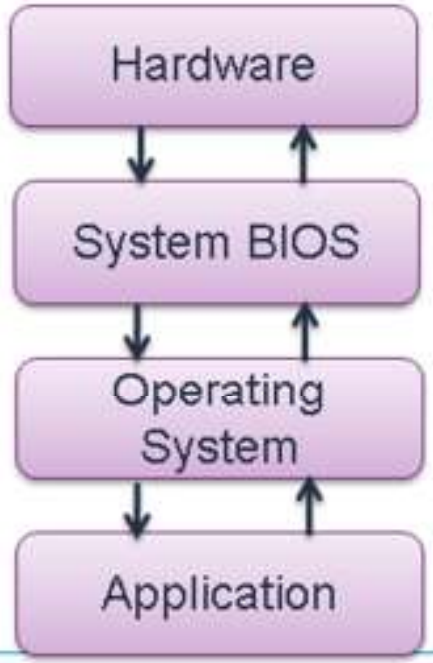
Expansion Card Connectors - The CPU is being connected to expansion card connectors through one of the chip set ICs mentioned above. They are situated on the motherboard near the back of the computer. These connectors permit special utility cards to plug into and work with the computer.

Before motherboards incorporated the serial and centronix connectors were found on expansion boards that plugged into ISA slots.

BIOS:

The BIOS is special software that interfaces the major hardware components of your computer with the operating system. It is usually stored on a Flash memory chip on the motherboard, but sometimes the chip is another type of ROM. When you turn on your computer, the BIOS does several things. This is its usual sequence:

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



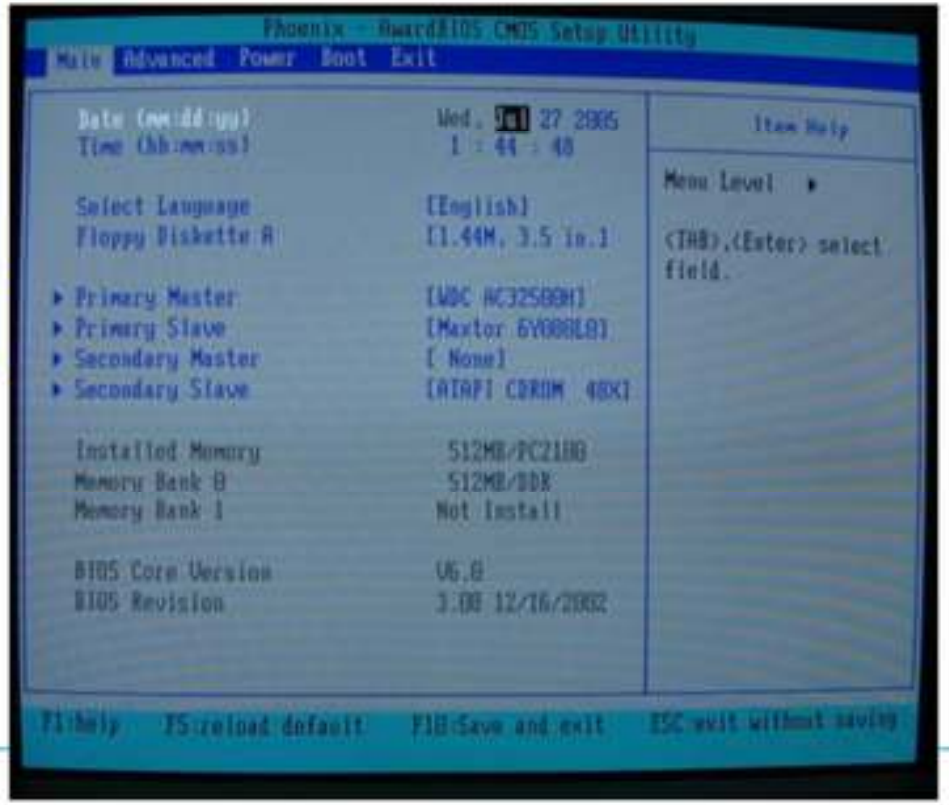
BIOS Settings:

- BIOS checks the CMOS Setup for custom settings. Here's what you do to change those settings.

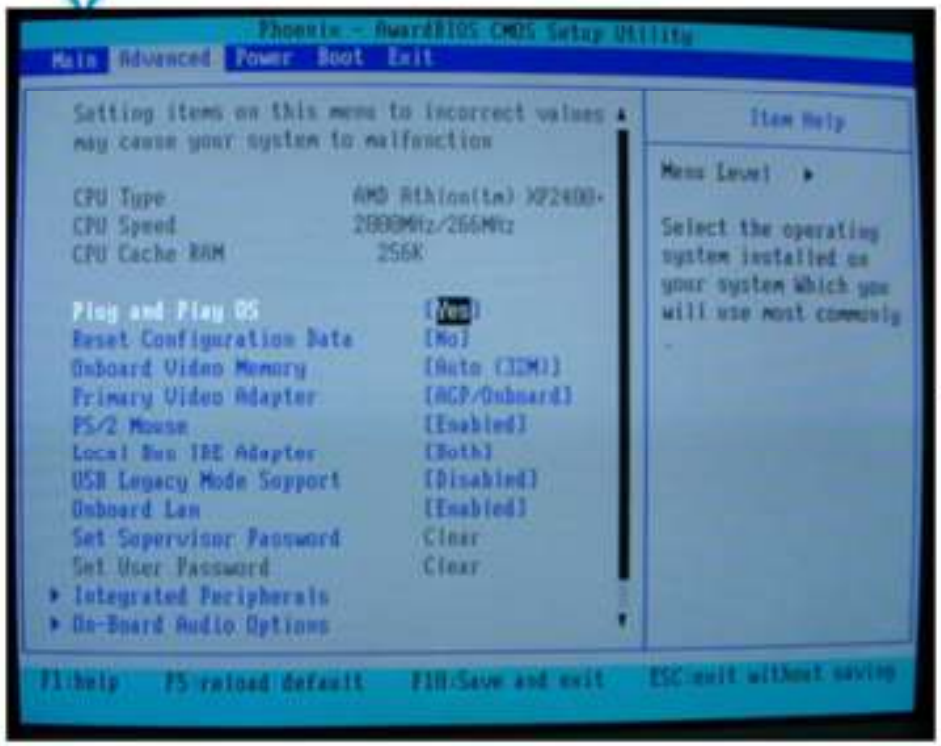
- To enter the CMOS Setup, you must press a certain key or combination of keys during the **initial startup sequence**. Most systems use "Esc," "Del," "F1," "F2," "Ctrl-Esc" or "Ctrl-Alt-Esc" to enter setup.Common options include:

- **System Time/Date** - Set the system time and date
- **Boot Sequence** - The order that BIOS will try to load the operating system
- **Plug and Play** - A standard for auto-detecting connected devices; should be set to "Yes" if your computer and operating system both support it
- **Mouse/Keyboard** - "Enable Num Lock," "Enable the Keyboard," "Auto-Detect Mouse"...
- **Drive Configuration** - Configure hard drives, CD-ROM and floppy drives
- **Memory** - Direct the BIOS to shadow to a specific memory address
- **Security** - Set a password for accessing the computer
- **Power Management** - Select whether to use power management, as well as set the amount of time for **standby** and **suspend**
- **Exit** - Save your changes, discard your changes or restore default settings

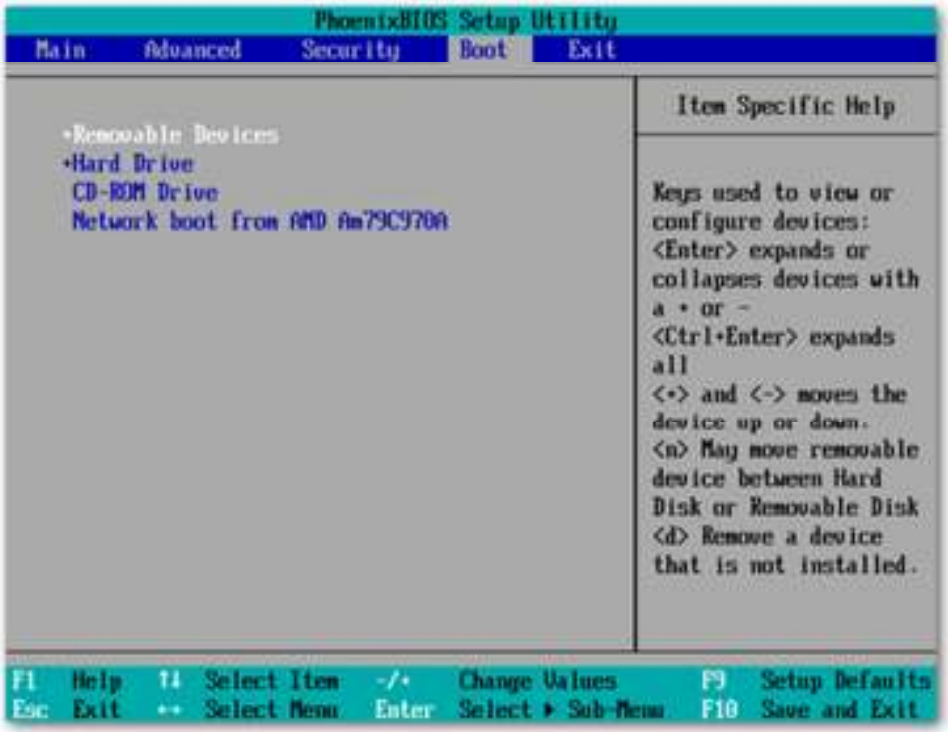
BIOS Settings:

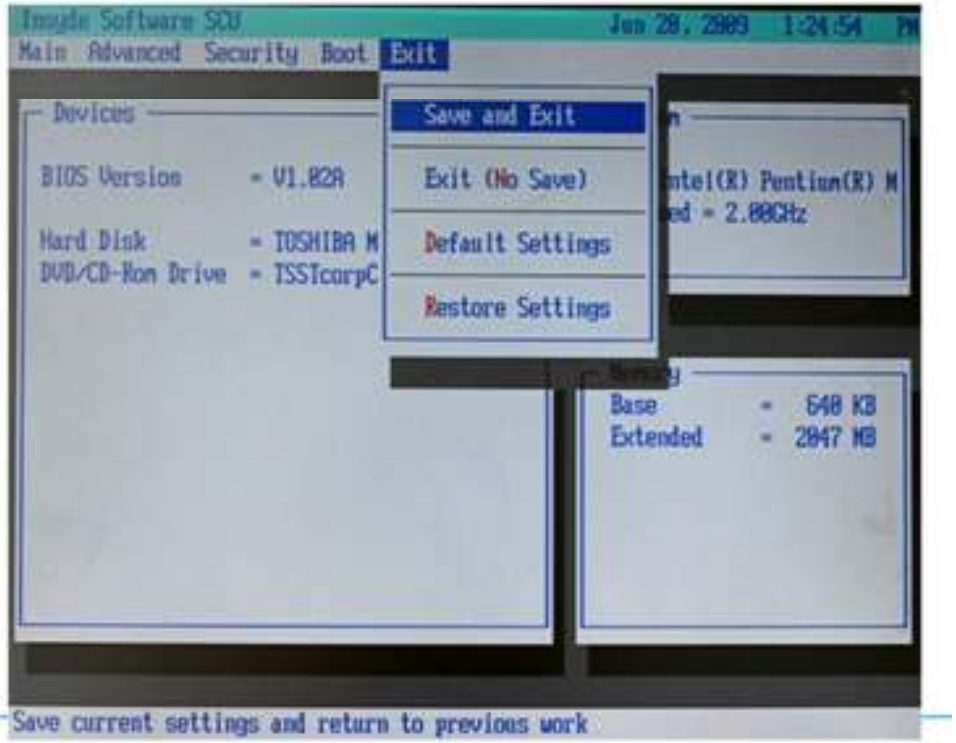


BIOS Settings:



BIOS Settings:





Memory Modules

Memory Sets

SIMM:

A **SIMM**, or **single in-line memory module**, is a type of memory module containing random access memory used in computers.

Types :

30 - pins 256 KB

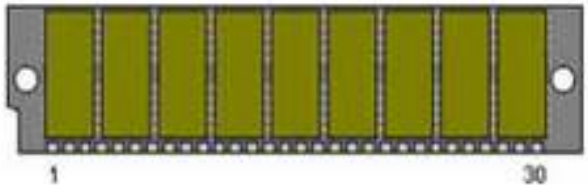
72 - pins 128 MB

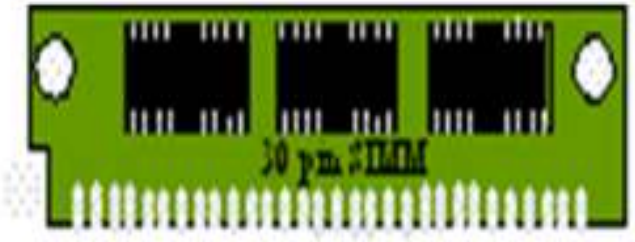
30 Pin SIMM

72 Pin SIMM

30 Pin

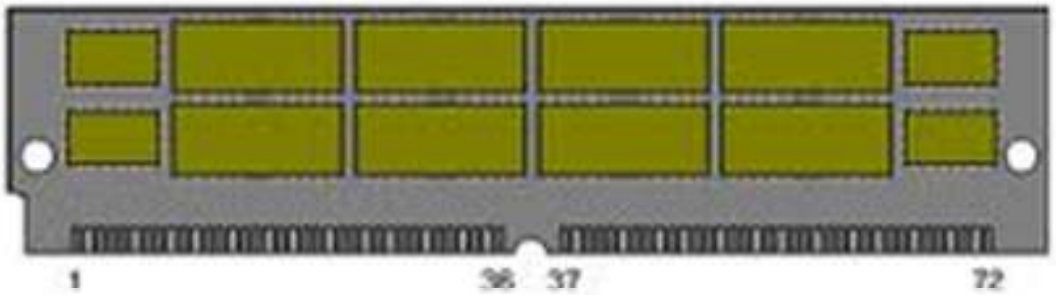
- 30 pins on each side of memory board
- 30 pin SIMMs used only an 8-bit data bus perhaps 9-bits using ECC
- 30-pin SIMMs had an access time of 60ns





The approximate board size. 3.5" x 0.75"

72 pin SIMM



The approximate board size. 4.25" x 1.0"

DIMM

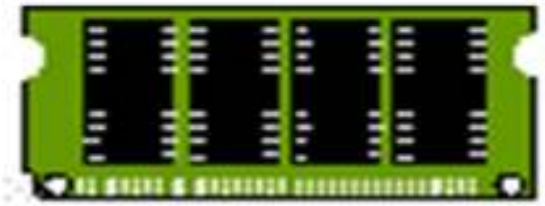
A DIMM has a 168-pin connector and supports 64-bit data transfer

DDR 1

DDR 2

DDR 3

SO DIMM



The approximate board size. 2.375" x 1.0"

➢ **SO-DIMM** memory is normally found in portable Computers; Notbooks, Laptops, and Moble Workstations.

SO-DIMM modules are an enhanced version of DIMM modules. 72-pin SO-DIMM's are about half the size as 72-pin DIMM modules

Memory sets (DIMM & DDR)

- DDR SDRAM modules for computers, commonly called DIMMs, have 184 pins.
- Double Data Rate synchronous dynamic random access memory (or also known as DDR SDRAM) is a class of memory integrated circuits used in computers .
- Compared to the preceding single data rate (SDR) SDRAM, the DDR SDRAM interface makes higher transfer rates by control of the timing of the electrical data and clock pulses.
- Ex : With data being transferred 64 bits at a time,
- - DDR SDRAM gives a transfer rate of (memory bus clock rate) × 2 (for dual rate) × 64 (number of bits transferred) / 8 (number of bits/byte). Thus, with a bus frequency of 100 MHz, DDR SDRAM gives a maximum transfer rate of 1600 MB/s.

Memory Sets

RIMM:

- Rambus In-line Memory Module (RIMM), technically DIMMs but called RIMMs due to their proprietary slot.
- Run at 2.5 volts.
- Contains 184 pins.
- Arrived in 3 flavors of PC600, PC700, PC800.
- Designed with multiple channels.
- Failed because of high cost of manufacture and licensing fees

Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

Processor

- Brain of your computer
- It performs all the tasks according to the set of instructions.
- Two types,

  CISC (Complex Instruction Set Computing)

  - Few registers, more memory references
  - More than one cycle to perform single instruction.
  - X86

CISC processors have more internal instructions than its RISC counterpart allowing a more diverse set of operations. Although this may sound the best option, CISC processors are generally slower due to the complexity of the instructions. Some people think the benefit of having more complex instructions built-in outweigh the performance lose, but it would depend on the applications that the processor is going to run.

Processor

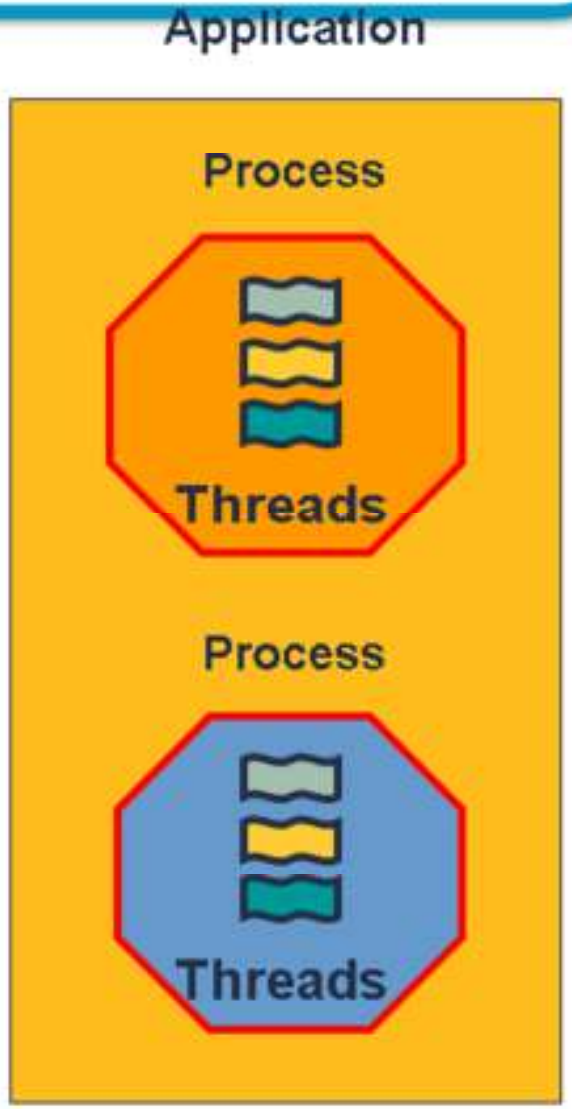
RISC (Reduced Instruction Set Computing)

- More registers and cache
- Multiple instructions in one cycle.
- Sparc

RISC processors, as the name suggests, have fewer built-in instructions, this can add to the overall speed of the processor due to the simplicity of the instructions, but again the performance would depend on the type of applications the processor was to be used for.

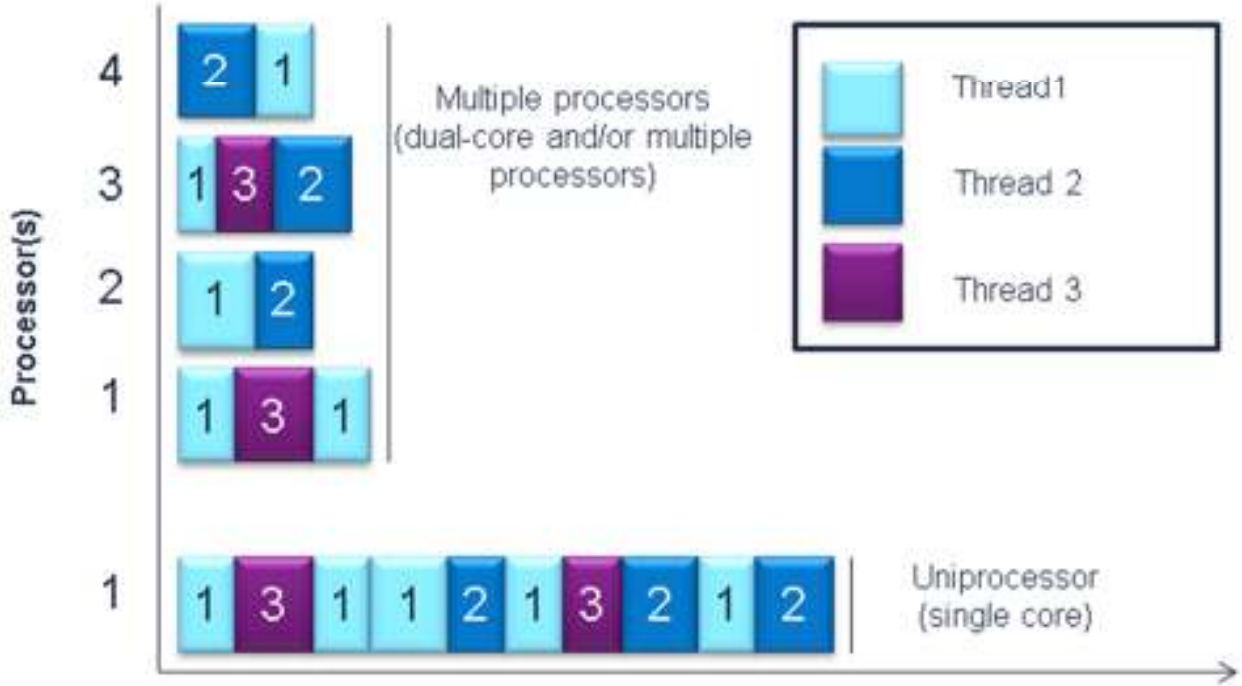
Processor

- **Multiprogramming:** A method of executing two or more programs concurrently using the same computer. The CPU executes only one program but can service the input/output needs of others at the same time.
- **Multitasking:** The multiprogramming capability of primarily single-user operating systems, such as those for older PCs.
- **Time sharing:** The sharing of computer resources by many users simultaneously by having the CPU spend a fixed amount of time on each user's program before proceeding to the next.
- **Multiprocessing:** An operating system feature for executing two or more instructions simultaneously in a single computer system by using multiple central processing units.



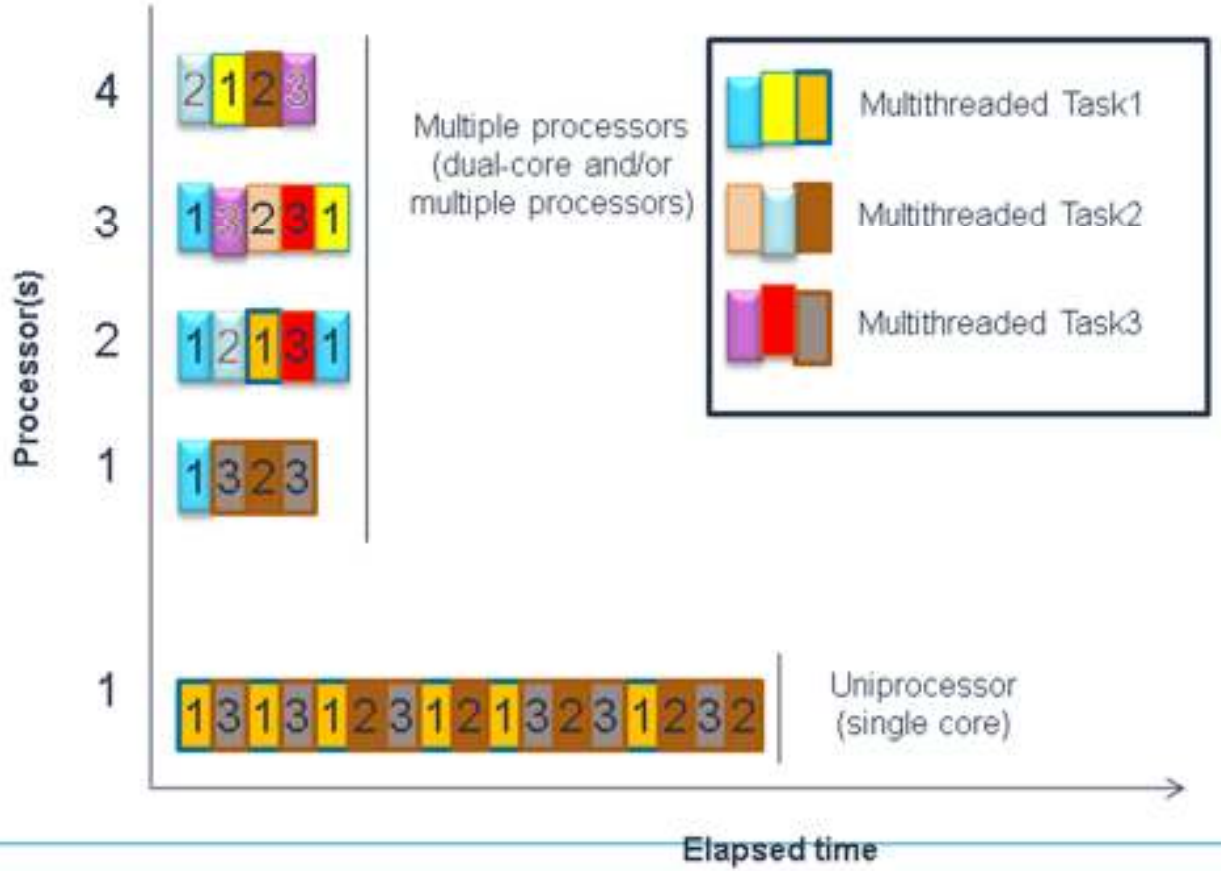
Multithreading:

- The ability of an operating system to execute different parts of a program, called threads, simultaneously. The programmer must carefully design the program in such a way that all the threads can run at the same time without interfering with each other. . Multithreading can not make a single processor to process two task in a single clock cycle, but the performance can be improved by utilizing the idle time of the processor.



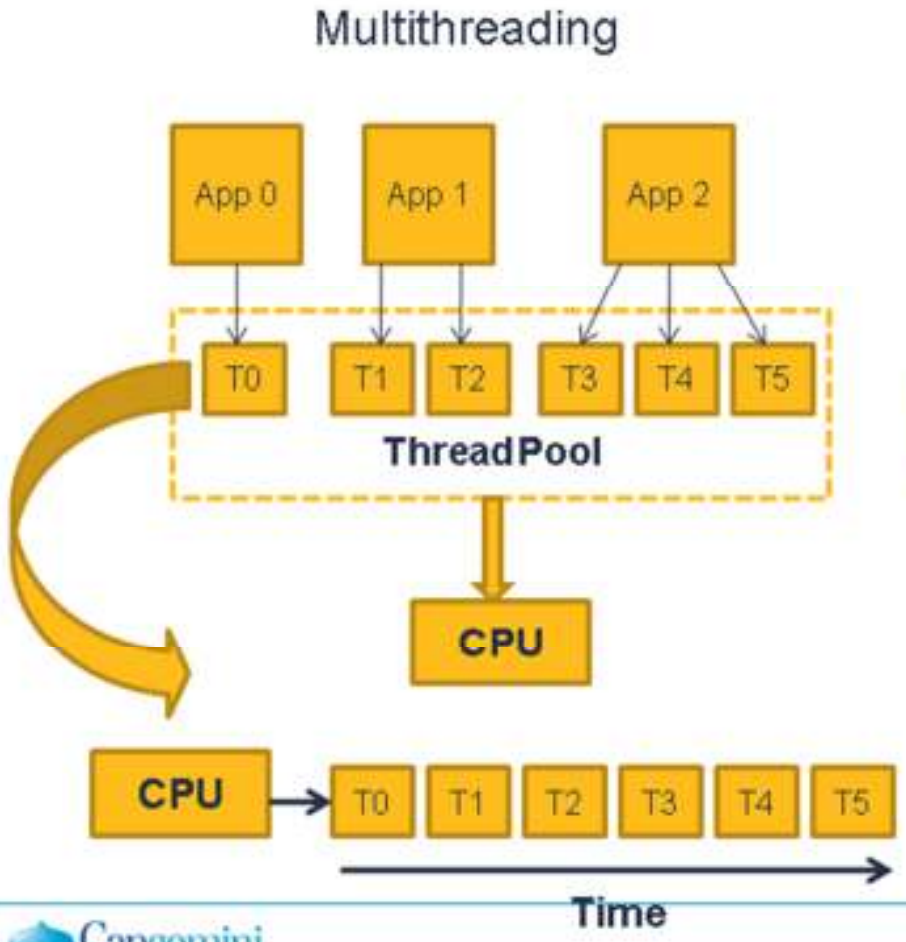
Multiprocessing:

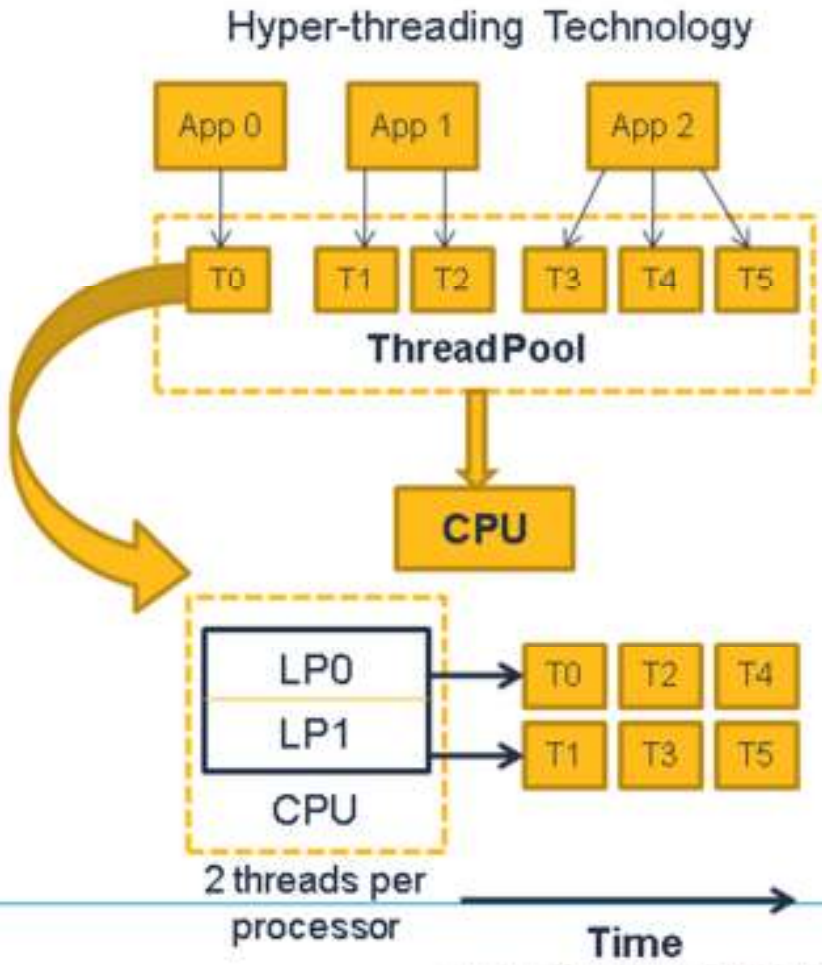
- Multiprocessing is the use of two or more central processing units (CPUs) within a single computer system. The term also refers to the ability of a system to support more than one processor and/or the ability to allocate tasks between them.



Hyper threading:

Hyper-Threading enables different parts of the CPU to work on different tasks concurrently. In this way, a CPU with Hyper-Threading appears to be more than one CPU.



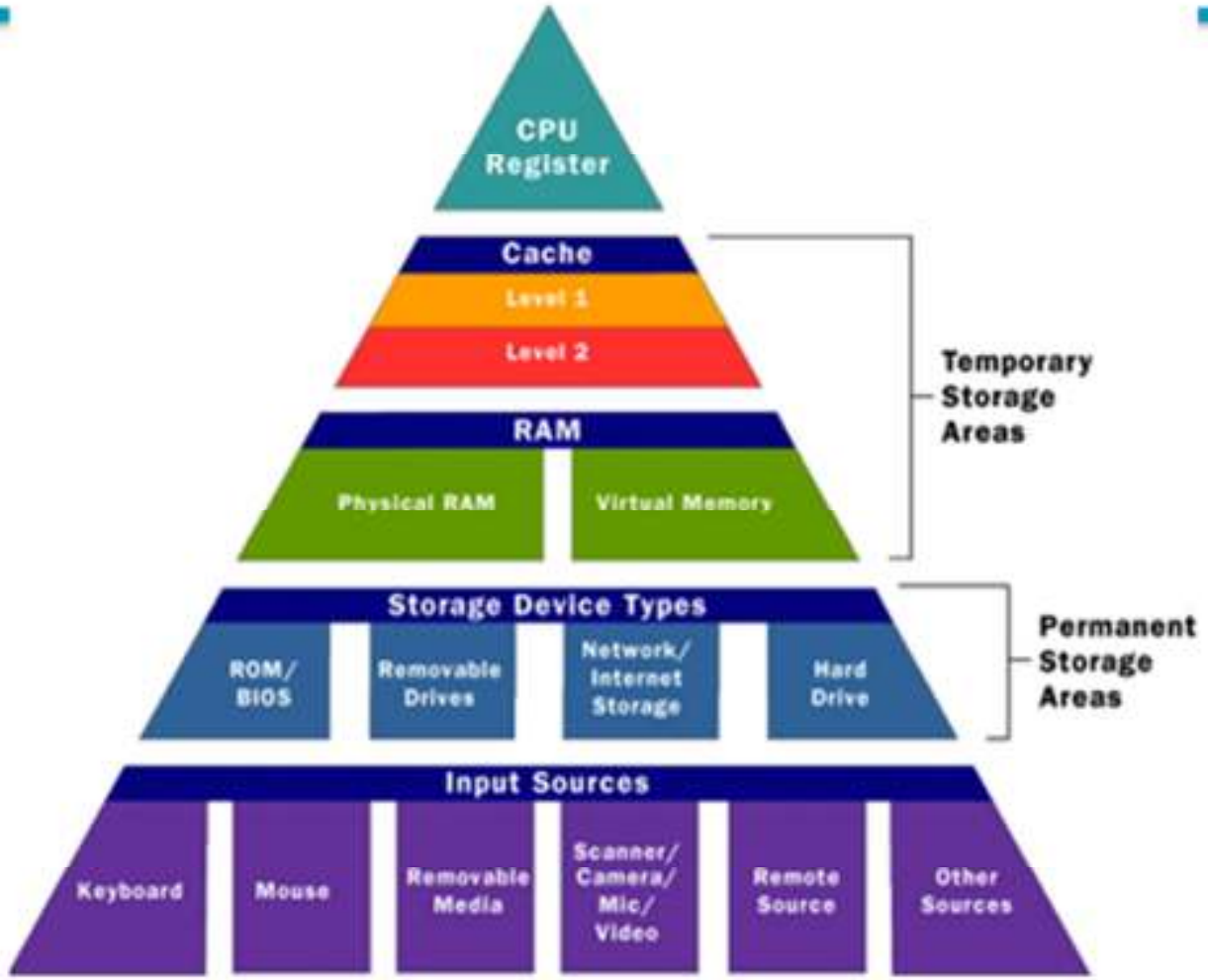


Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

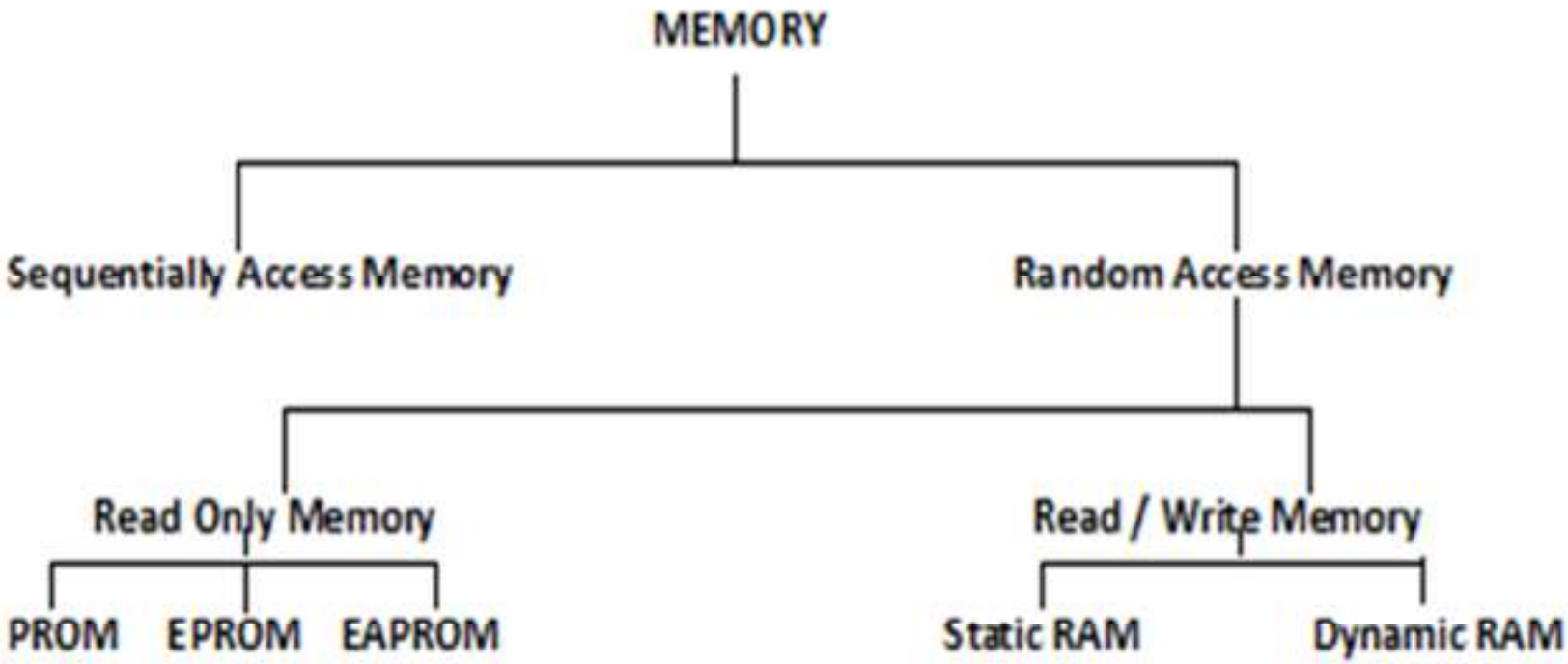
Memory



Memory

- Data and instructions are stored as BITS (binary digits). Everything from our world is translated into a computer recognizable format called binary (zeros or ones)
  - The combination of binary digits represents our letters or numbers. One character represented is equal to a byte.
- Memory capacity is measured in bytes. Today's most common measurement is megabytes
  - Kilo = 1,000 (KB) Thousand
  - Mega = 1,000,000 (MB) Million
  - Giga = 1,000,000,000 (GB) Billion
- Bytes are composed using either the ASCII coding system (7 bits = character) or EBCDIC (8 bits = character)

Memory



Memory

Sequentially Accessed Memory:

- Memory Locations were accessed in a serial form
- Time taken to read / write operations differs

  Ex : Shift Registers, CCD

Random Access Memory:

- Memory Locations were accessed in a Random Fashion
- Time taken to read / write operations take place with speed.

  Ex : Flip Flop, MOS RAM

Memory

Read Only Memory

- Semiconductor chip used to store the permanent information.
- Chips were made by Bipolar technology or MOS technology.

- **PROM:**
  - Electrically Programmable Memory. After fabrication it is programmed by PROM Programmer.
  - Reprogramming is not possible.

- **EPROM:**
  - Non Volatile Memory.
  - Reprogramming is possible.
  - Uses MOS Transistors.
  - Uses Electrical signal to read and ultraviolet rays to erase the data.

- **EEPROM:**
  - Non Volatile Memory.
  - Reprogramming is possible.
  - Uses Electrical signals to Read / Write program.
  - Uses MOSFET.
  - The exact location of memory can be reprogrammed.

SRAM

- Uses Flip-flop to store every bit
- 1 flip-flop = 6 transistors
- No Refreshing
- Fast and Expensive
- It is used primarily for cache.

DRAM

- A Transistor and a capacitor are paired to create a memory cell
- The capacitor holds the bit of information -- a 0 or a 1
- This refresh operation is where dynamic RAM gets its name

Memory

Synchronous DRAM:

- Run at 3.3 volts.
- Contains 168 pins.
- SDRAM's can scale up to 133 MHz officially and 180 MHz unofficially.

Double Data Rate Synchronous DRAM:

- Run at 2.5 volts.
- Contains 184 pins.
- DDR SDRAM's can scale up to 333MHz.

Memory

Read Write Memory - Memory SRAM:

- **Static RAM** uses a completely different technology. In static RAM, a form of flip-flop holds each bit of memory.
- A flip-flop for a memory cell takes four or six transistors along with some wiring, but never has to be refreshed. This makes static RAM significantly faster than dynamic RAM.
- Since it has more parts, a static memory cell takes up a lot more space on a chip than a dynamic memory cell due to this we get less memory per chip, and that makes static RAM a lot more expensive.

Memory

Cache:

- **L1 cache** - Memory accesses at full microprocessor speed (10 nanoseconds, 4 kilobytes to 16 kilobytes in size)
- **L2 cache** - Memory access of type SRAM (around 20 to 30 nanoseconds, 128 kilobytes to 512 kilobytes in size)
- **Main memory** - Memory access of type RAM (around 60 nanoseconds, 32 megabytes to 128 megabytes in size)

Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

Storage

Storage is the place where data is held Temporarily or Permanently for later use.

Types of storage:

- Magnetic Storage
  - Diskettes
  - Hard Disk
  - Cartridges
  - Magnetic Tapes
- Optical Storage
  - CD
  - DVD
  - Blue Ray

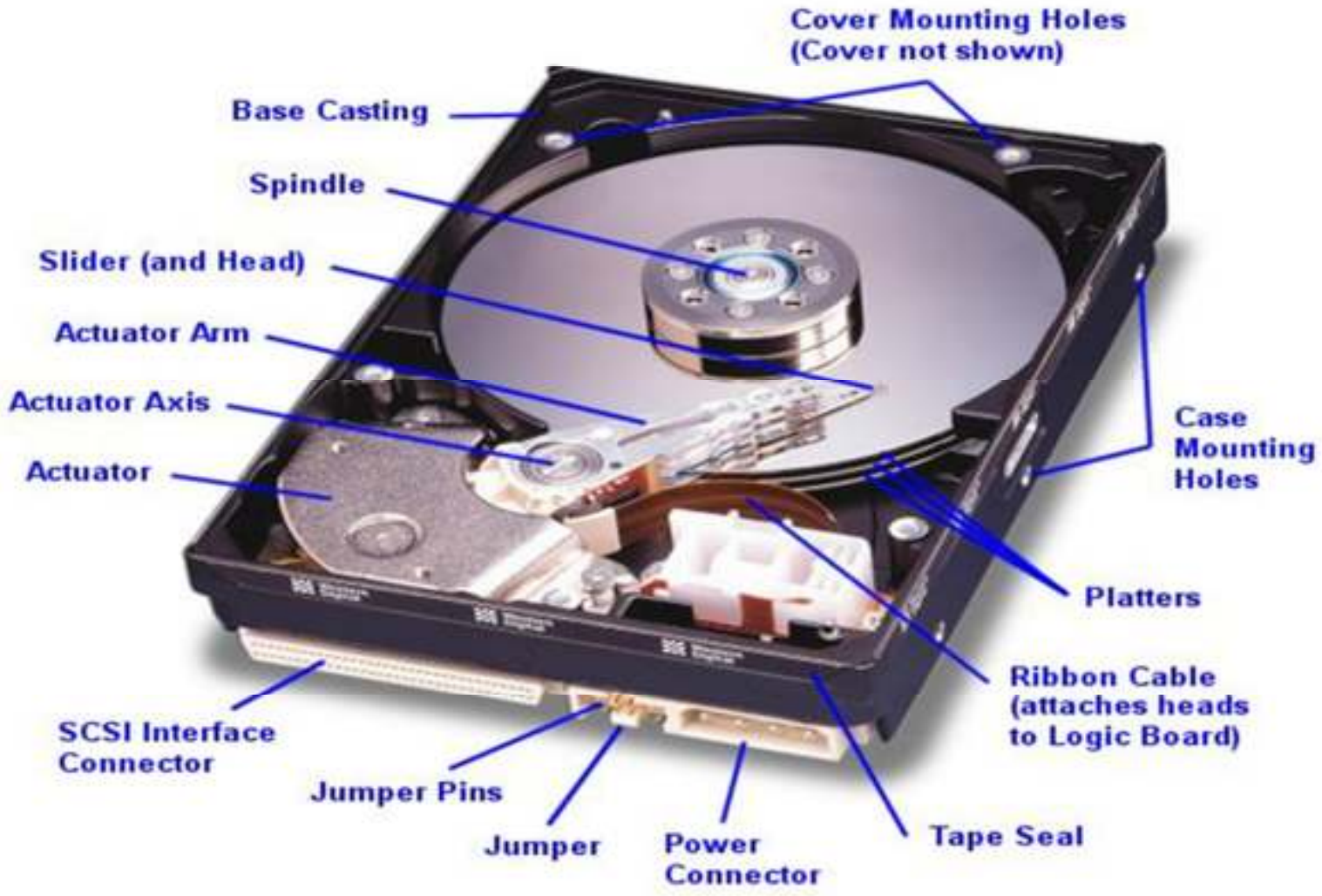
Storage

Types of storage - Magnetic Storage:

OVER COAT	Layer of Carbon and thin layer of lubrication
MAGNETIC COAT	Ferromagnetic material of 50 – 100 nm thickness
UNDER COAT	Ni – P layer
SUBSTRATE	Aluminum Layer coated with reactive binder that reduces corrosion

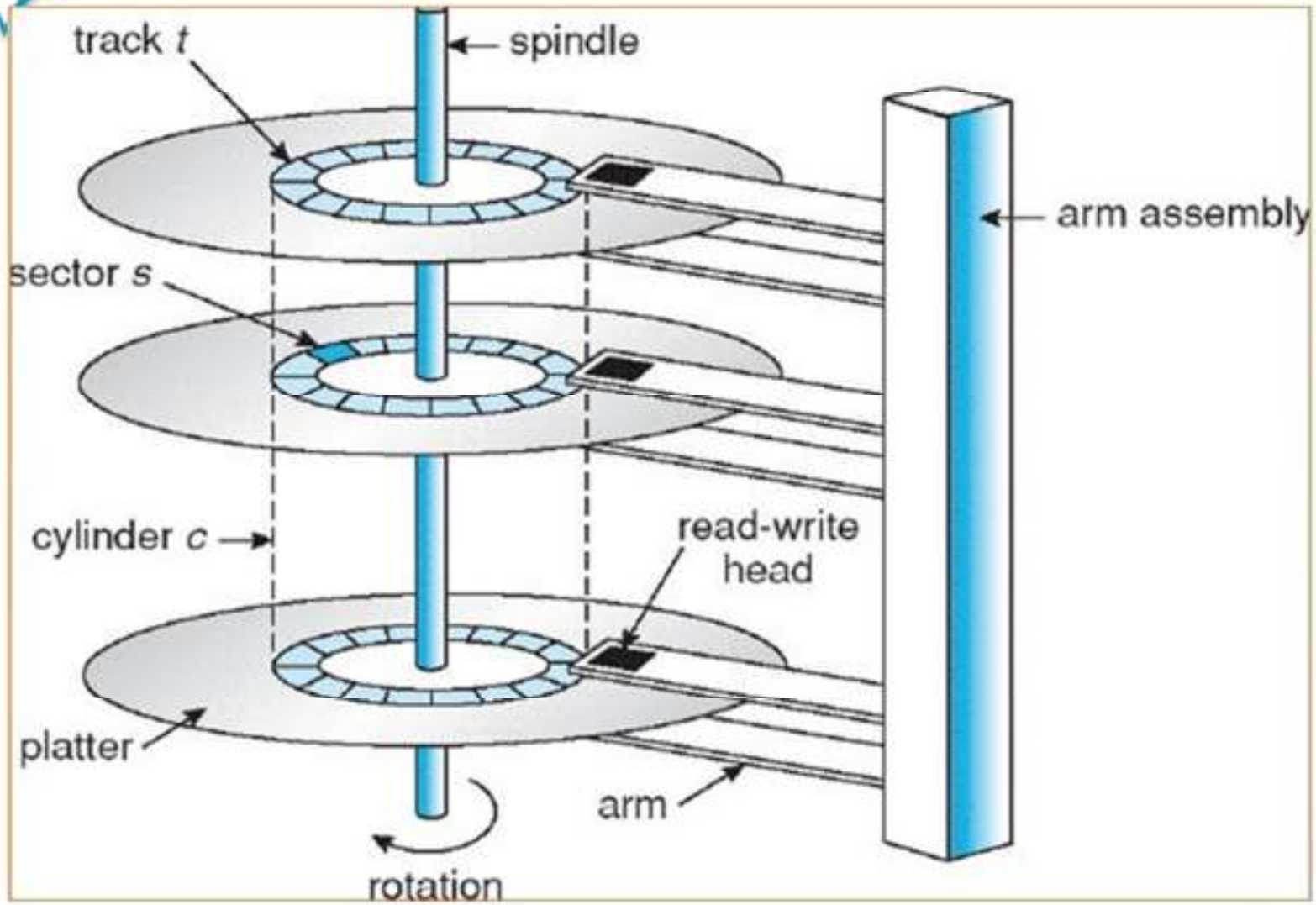
Storage

Types of storage - Hard Disk (Magnetic Storage):

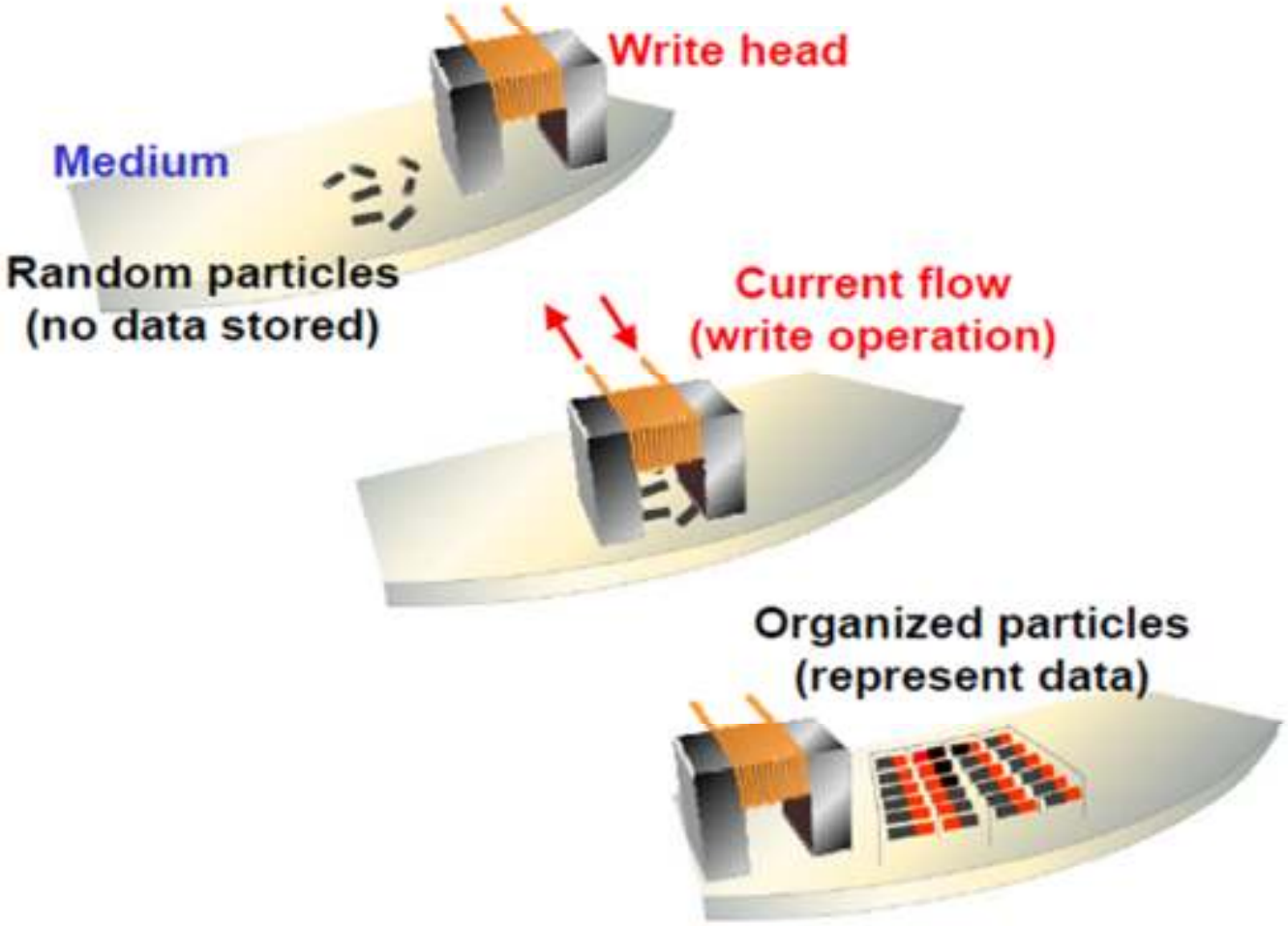


Storage

Magnetic Storage-Hard disk(Contd…)

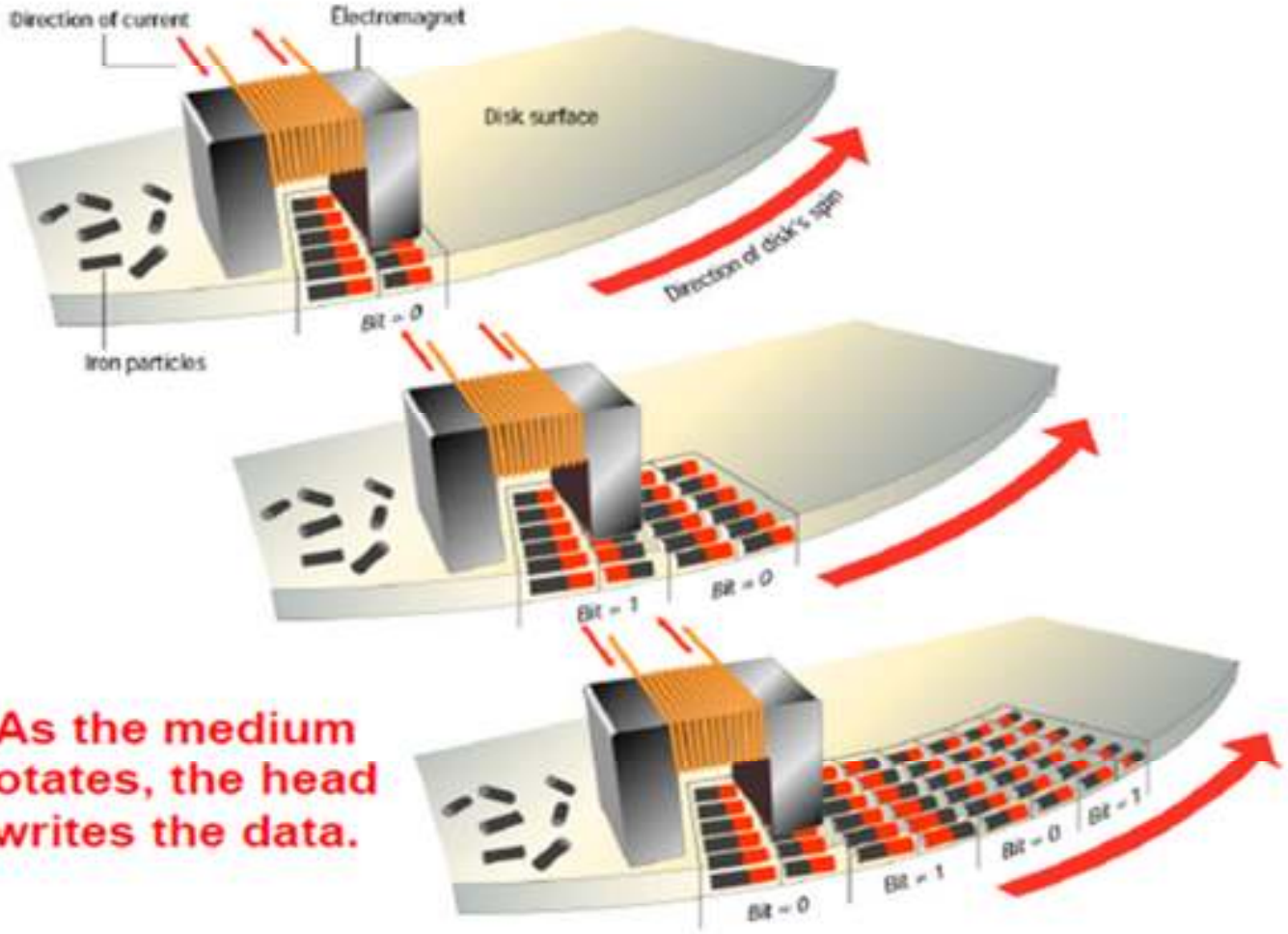


Magnetic Storage - How it works ?



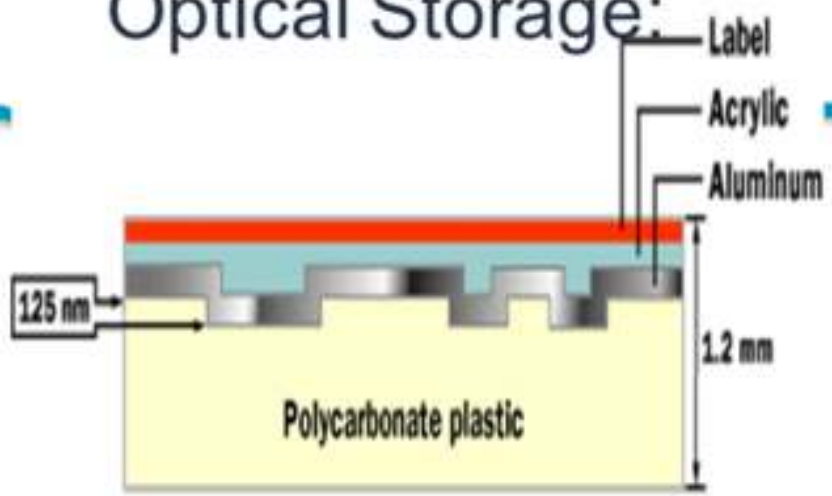
Storage Technology

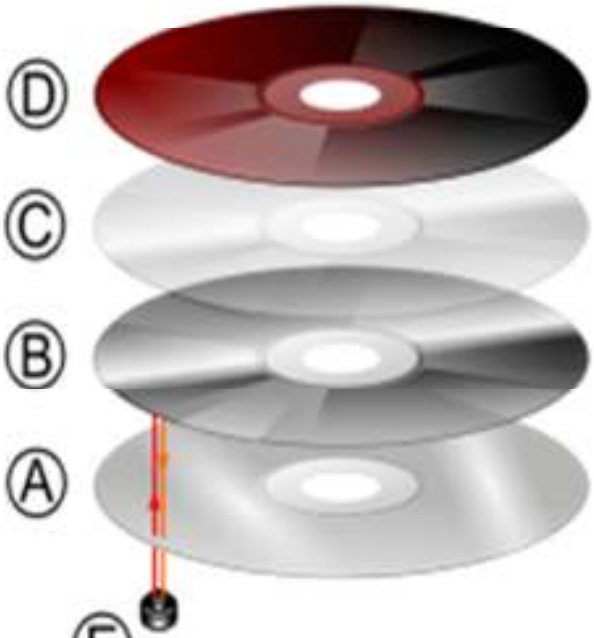
Magnetic Storage - How it works ?



As the medium rotates, the head writes the data.

Optical Storage:

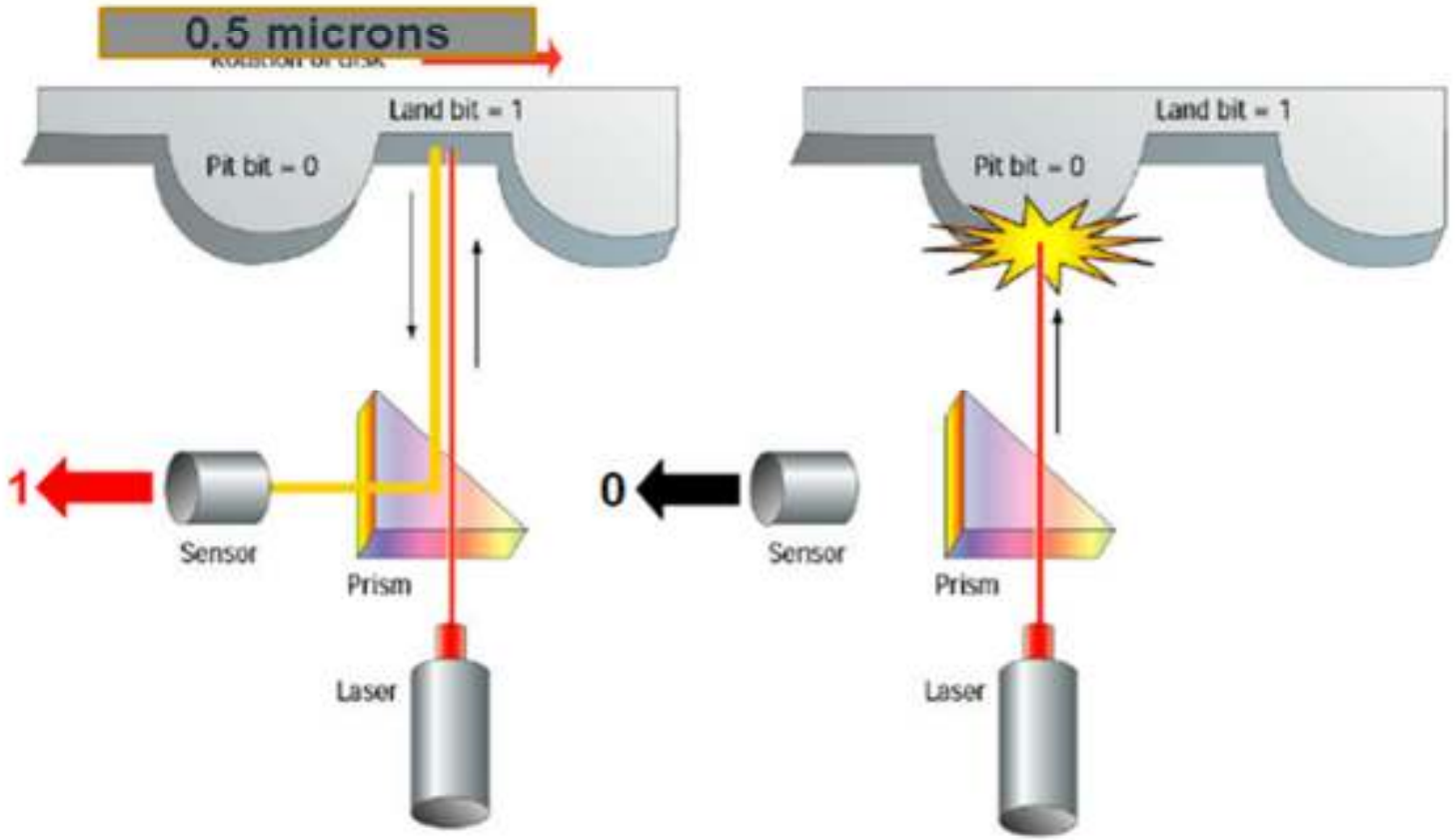




A – Polycarbonate disc layer coated with aluminum has the data encoded by using pits and lands
B – Shiny Layer reflects the laser
C – Layer of Lacquer protects the shiny layer
D – Artwork (screen printed) on top of disk
E -- Laser Beam reads the CD and reflected back to sensor.

Unwinding the CD Track would extend out to 3.5 miles (5 km)

Optical Storage - Optical disk:

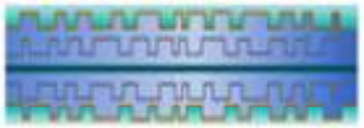


Optical Storage - DVD Disk:

Single-sided, single layer (4.7GB)

Single-sided, double layer (8.5GB)

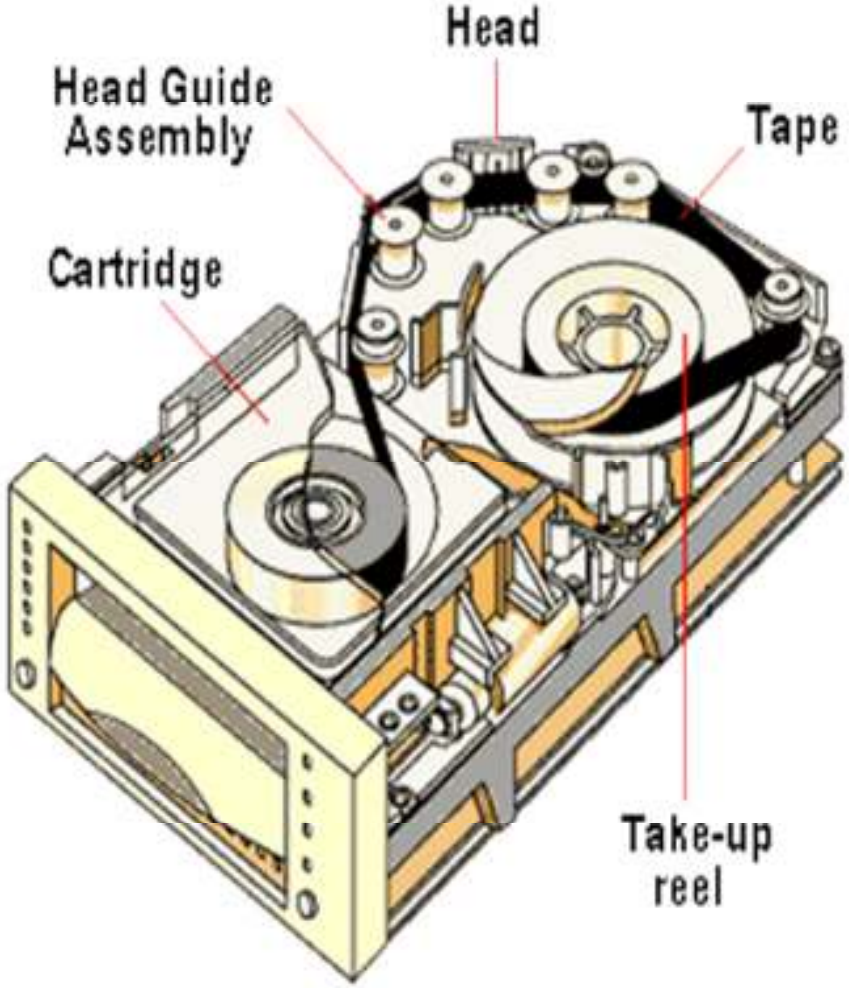
Double-sided, double layer (17GB)



- Base Layer - Polycarbonate Plastic
- Aluminum coating over the polycarbonate plastic
- Clear Protective acrylic Coating
- Semi Reflective and Fully reflective layers

Magnetic Storage - Magnetic Tape:

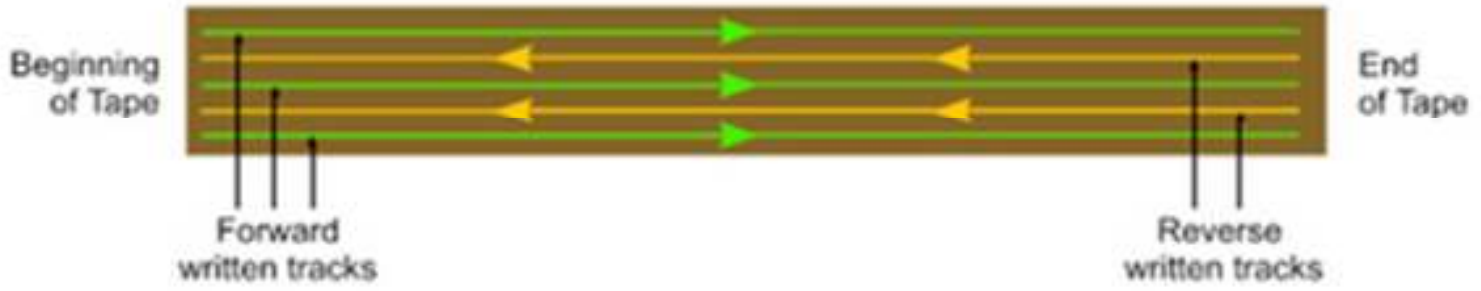
- Sequential storage
- Backup storage
- Tape Drive



Magnetic Storage - Recording Technology:

Helical Scan Recording

Linear Serpentine Recording



Storage

Types of Tapes - Linear Tape Open:

LTO or Linear Tape Open is a magnetic tape data media that was initiated and developed by IBM, Seagate and Hewlett-Packard

There were two forms of LTOs: Accelis and Ultrium.

- The Accelis form of LTO tapes was developed in 1997 for fast data access.
- The LTO form Ultrium is a half-inch magnetic tape with a single reel (contrasting with the 8mm double reel Accelis).
- LTO Ultrium tape uses a single reel to maximize storage capacity and thus is better suited for archival use.
- An Ultrium LTO drive is also backward compatible and contains a strong error correction algorithm that makes data recovery possible when lost data is within one track or up to 32 mm of the tape medium
- The LTO Ultrium is very popular and LTO in common usage usually refers to the LTO Ultrium as the LTO Accelis are no longer commercially available

Storage

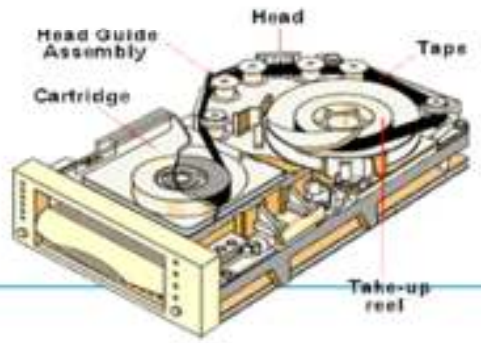
Types of Tapes - Digital Linear Tape:

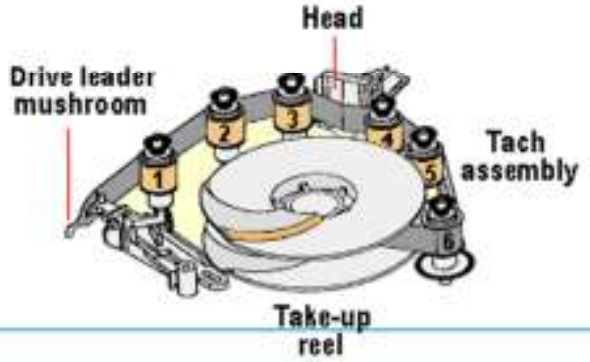
- The origins of Digital Linear Tape date back to the mid-1980s.
- The first true DLT system emerged in 1989 and the technology was later acquired by Quantum Corporation in 1994.
- A number of OEMs have subsequently licensed the technology primarily for the purpose of manufacturing automated tape libraries.
- Effectively, DLT is an adaptation of the old reel to reel magnetic recording method where the tape cartridge performs as one reel and the tape drive as the other.

Storage

Types of Tapes - Digital Linear Tape(DLT):

- DLT uses linear serpentine recording with multiple tracks on half-inch (12.7 mm) wide tape.
- The cartridges contain a single reel and the tape is pulled out of the cartridge by means of a leader tape attached to the take-up reel inside the drive.
- The drive leader tape is buckled to the cartridge leader during the load process.
- Tape speed and tension are controlled electronically via the reel motors;
- The tape is guided by 4 to 6 rollers that touch only the back side of the tape.
- The prime advantages DLT retains are higher storage capacity, higher data transfer rates, and higher reliability, mainly because the media does not physically touch the head in the drive





Tapes - virtual storage library:

- Virtual tape is an archival storage technology
- VTL makes it possible to save data as if it were being stored on tape although it may actually be stored on hard disk or on another storage medium.
- Benefits of virtual tape systems include better backup and recovery times and lower operating costs.
- The shift to VTL also eliminates streaming problems that often impair efficiency in tape drives as disk technology does not rely on streaming and can write effectively regardless of data transfer speeds.

Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.

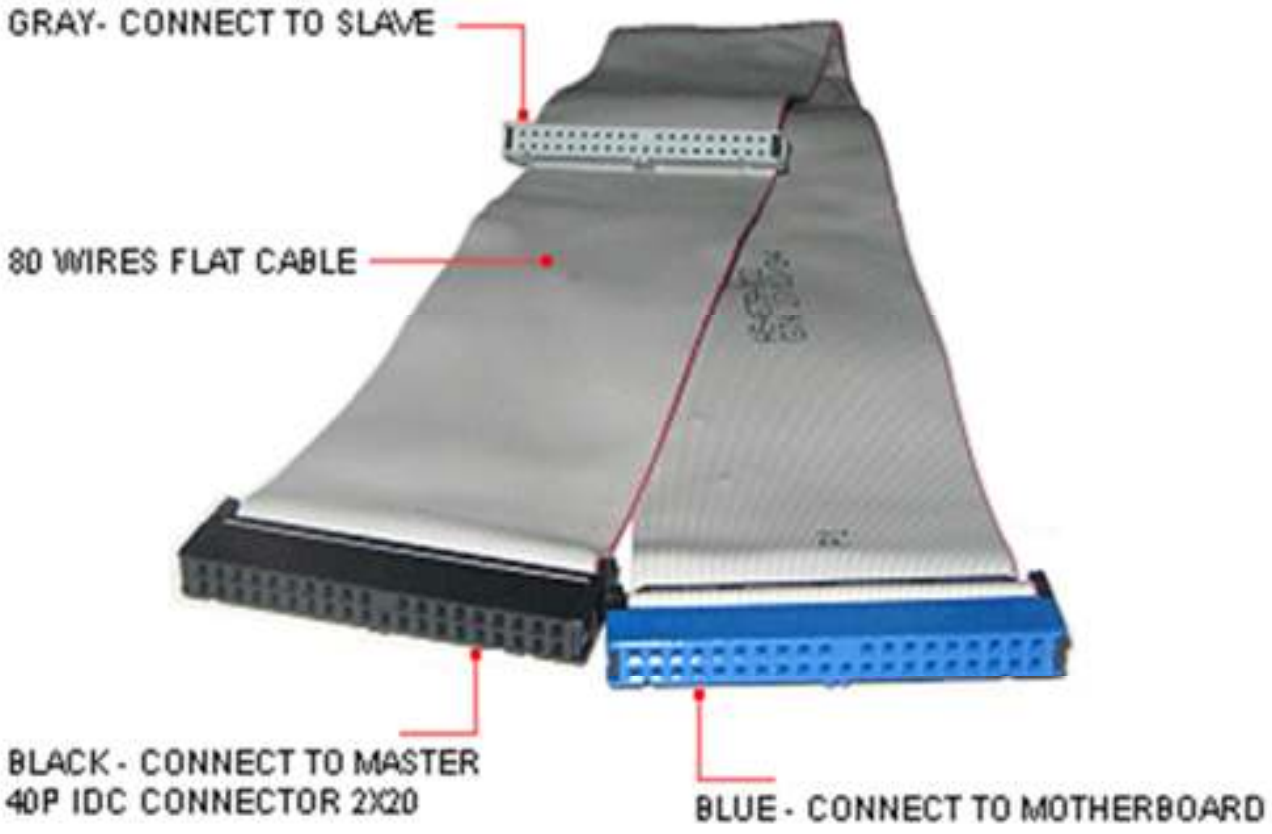
Interface Types

Types of Hard Disk Interface

- IDE
- SCSI
- SATA

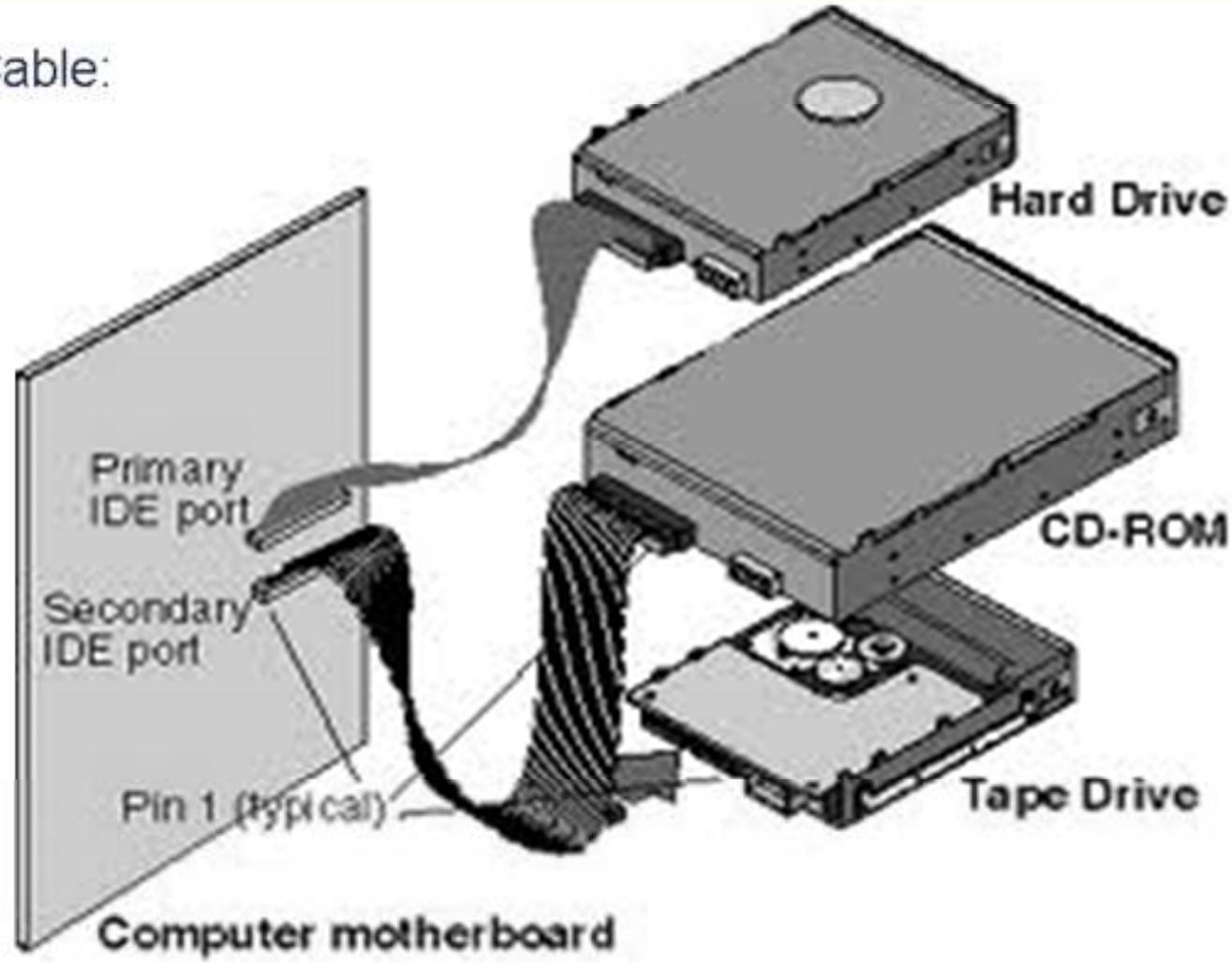
Interface Types

IDE Cable:



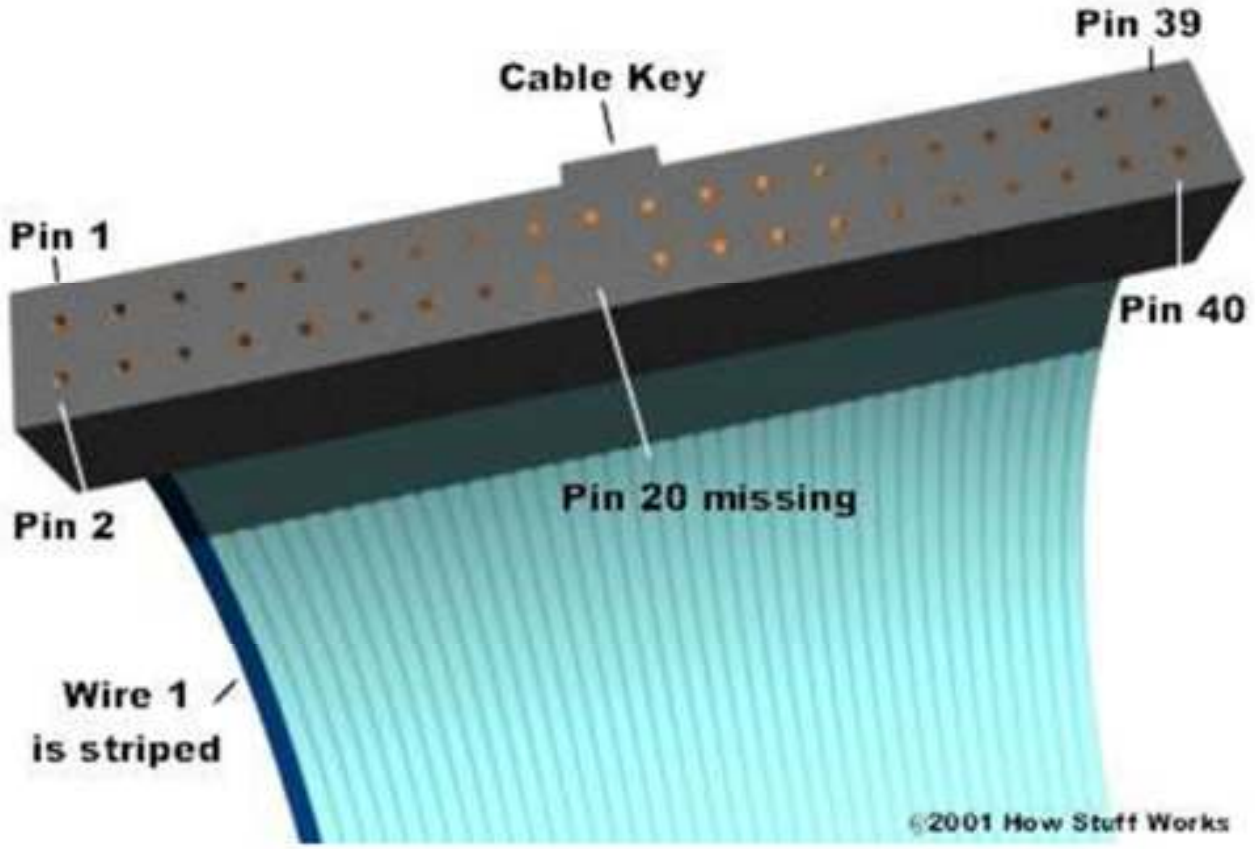
Interface Types

IDE Cable:



Interface Types

IDE Connector:



Pin	Description	Pin	Description
1	Reset	23	-IOW
2	Ground	24	Ground
3	Data Bit 7	25	-IOR
4	Data Bit 8	26	Ground
5	Data Bit 6	27	I/O Channel Ready
6	Data Bit 9	28	SPSYNC: Cable Select
7	Data Bit 5	29	-DACK3
8	Data Bit 10	30	Ground
9	Data Bit 4	31	RQ 14
10	Data Bit 11	32	-IOCS 16
11	Data Bit 3	33	Address Bit 1
12	Data Bit 12	34	-PDIAG
13	Data Bit 2	35	Address Bit 0
14	Data Bit 13	36	Address Bit 2
15	Data Bit 1	37	-CS1FX
16	Data Bit 14	38	-CS3FX
17	Data Bit 0	39	-DA/SP
18	Data Bit 15	40	Ground
19	Ground	41	+5 Volts (Logic) (Optional)
20	Cable Key (pin missing)	42	+5 Volts (Motor) (Optional)
21	DRQ 3	43	Ground (Optional)
22	Ground	44	-Type (Optional)

Interface Types

SCSI:

- Standard SCSI
- Wide SCSI

SCSI Identifiers:

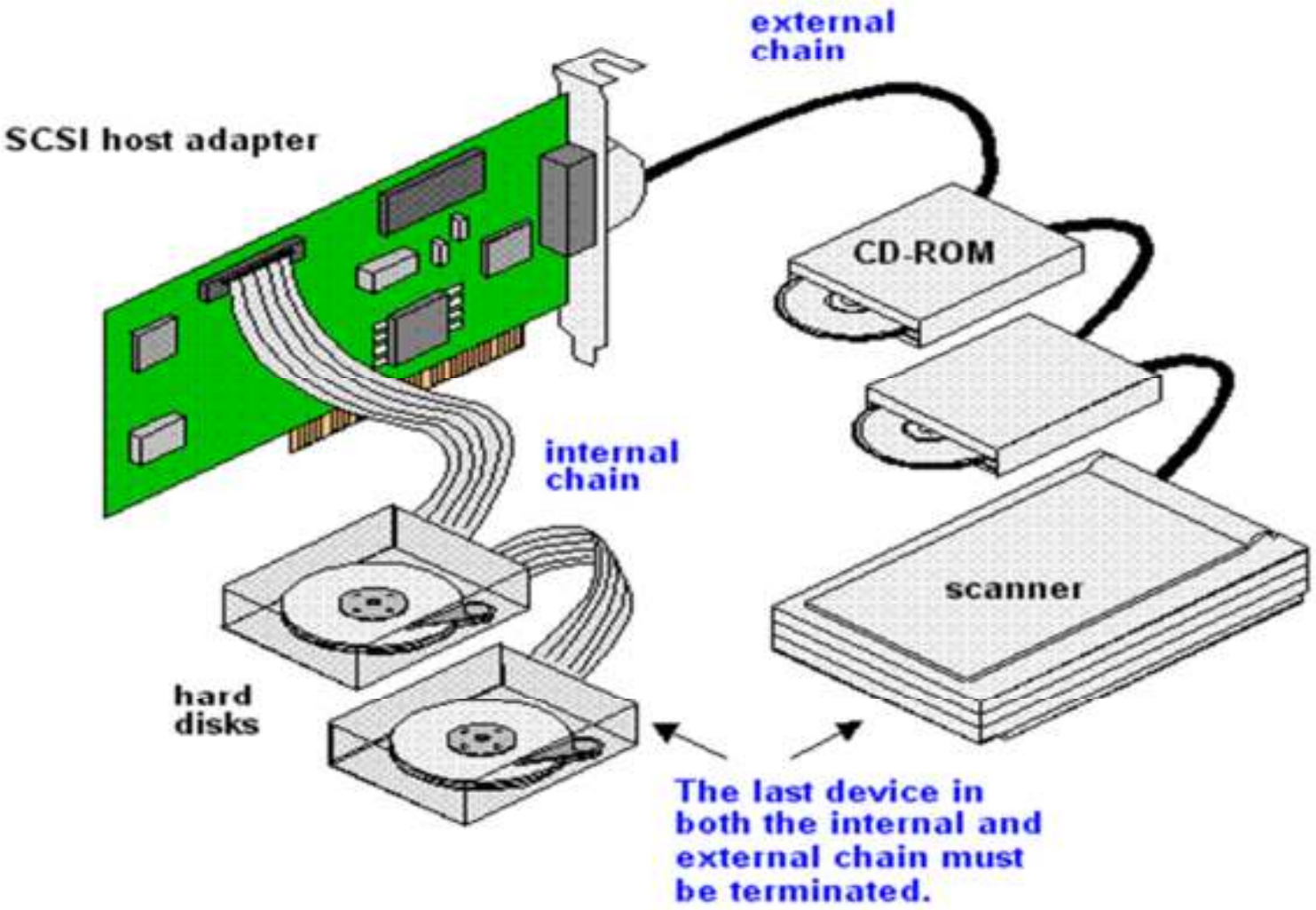
- Controller
- Device
- Cable
- Connectors

Interface Types

SCSI Controller:

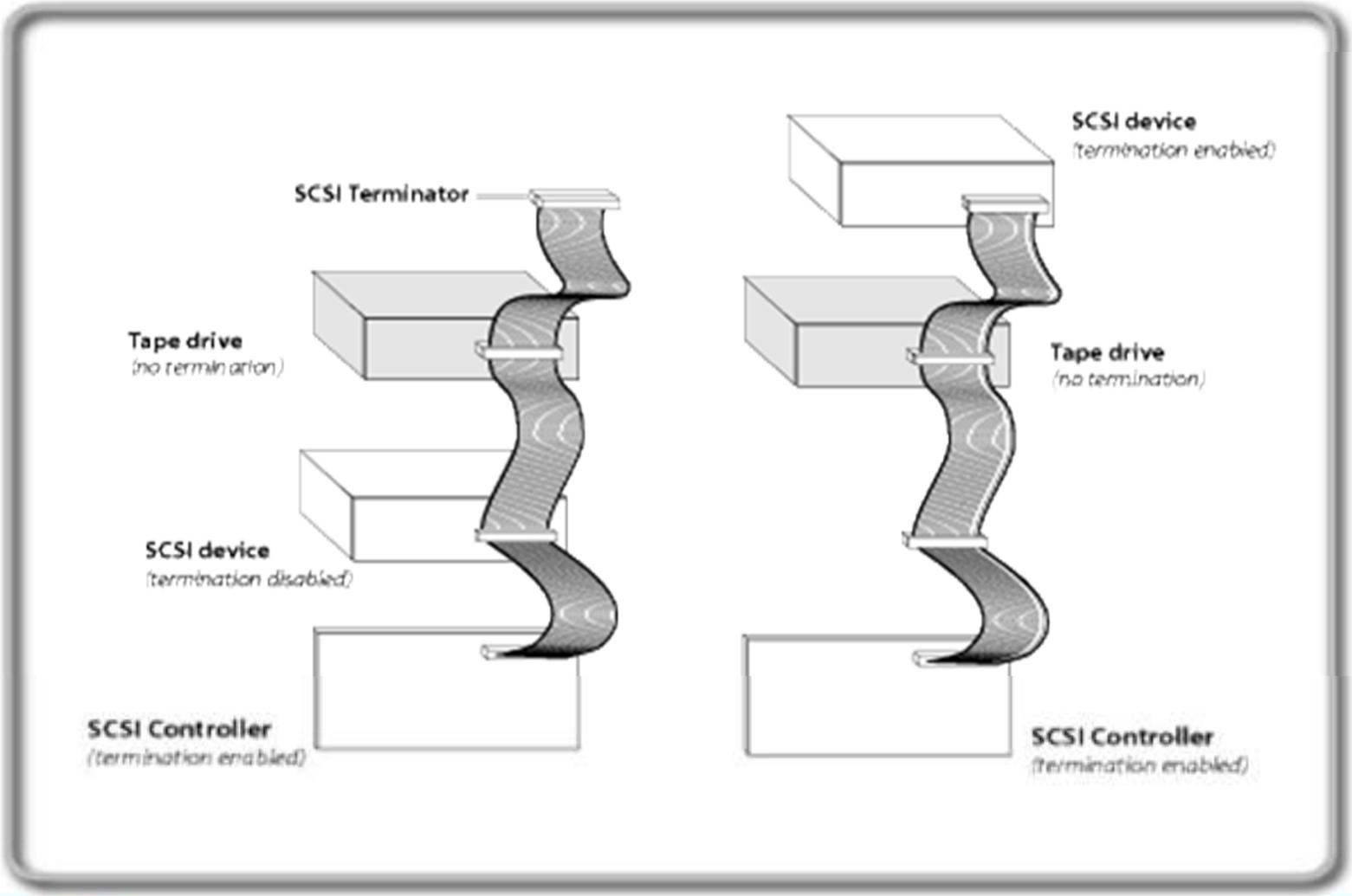
Interface Types

SCSI Device:



Interface Types

SCSI Terminator:



Interface Types

SCSI Cable:

Interface Types

SCSI Connectors:

SCSI 50 Pin Connector

SCSI 68 Pin Connector

SCSI 80 Pin Connector

Interface Types

SCSI Types:

- SCSI-1
- SCSI-2
- SCSI-3

Name	Specification	# of Devices	Bus Width	Bus Speed	MBps
Asynchronous SCSI	SCSI-1	8	8 bits	5 MHz	4 MBps
Synchronous SCSI	SCSI-1	8	8 bits	5 MHz	5 MBps
Wide	SCSI-2	16	16 bits	5 MHz	10 MBps
Fast	SCSI-2	8	8 bits	10 MHz	10 MBps
Fast/Wide	SCSI-2	16	16 bits	10 MHz	20 MBps
Ultra	SCSI-3 SPI	8	8 bits	20 MHz	20 MBps
Ultra/Wide	SCSI-3 SPI	8	16 bits	20 MHz	40 MBps
Ultra2	SCSI-3 SPI-2	8	8 bits	40 MHz	40 MBps
Ultra2/Wide	SCSI-3 SPI-2	16	16 bits	40 MHz	80 MBps
Ultra3	SCSI-3 SPI-3	16	16 bits	40 MHz	160 MBps
Ultra320	SCSI-3 SPI-4	16	16 bits	80 MHz	320 MBps

Interface Types

SATA:

- Hot plugging
- Native command queuing

SATA Revisions:

- SATA revision 1.0 (1.5 Gbit/s)
- SATA revision 2.0 (3 Gbit/s)
- SATA revision 3.0 (6 Gbit/s)

Interface Types

SATA Cables:

- Data Connector
- Power Connector
  - Standard
  - Slim Line
- ESATA

Interface Types

SATA Data Connector:

PIN#	FUNCTION
1	GROUND
2	A+ (transmit)
3	A- (transmit)
4	GROUND
5	B- (receive)
6	B+ (receive)
7	GROUND

Interface Types

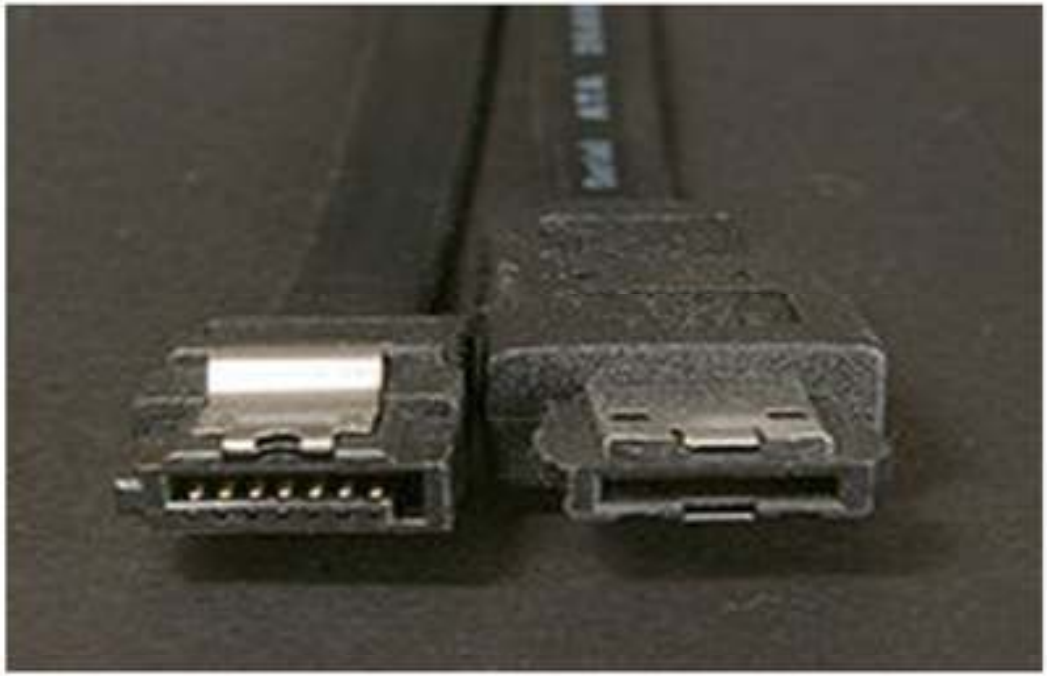
Power Connector:

STANDARD

SLIM LINE

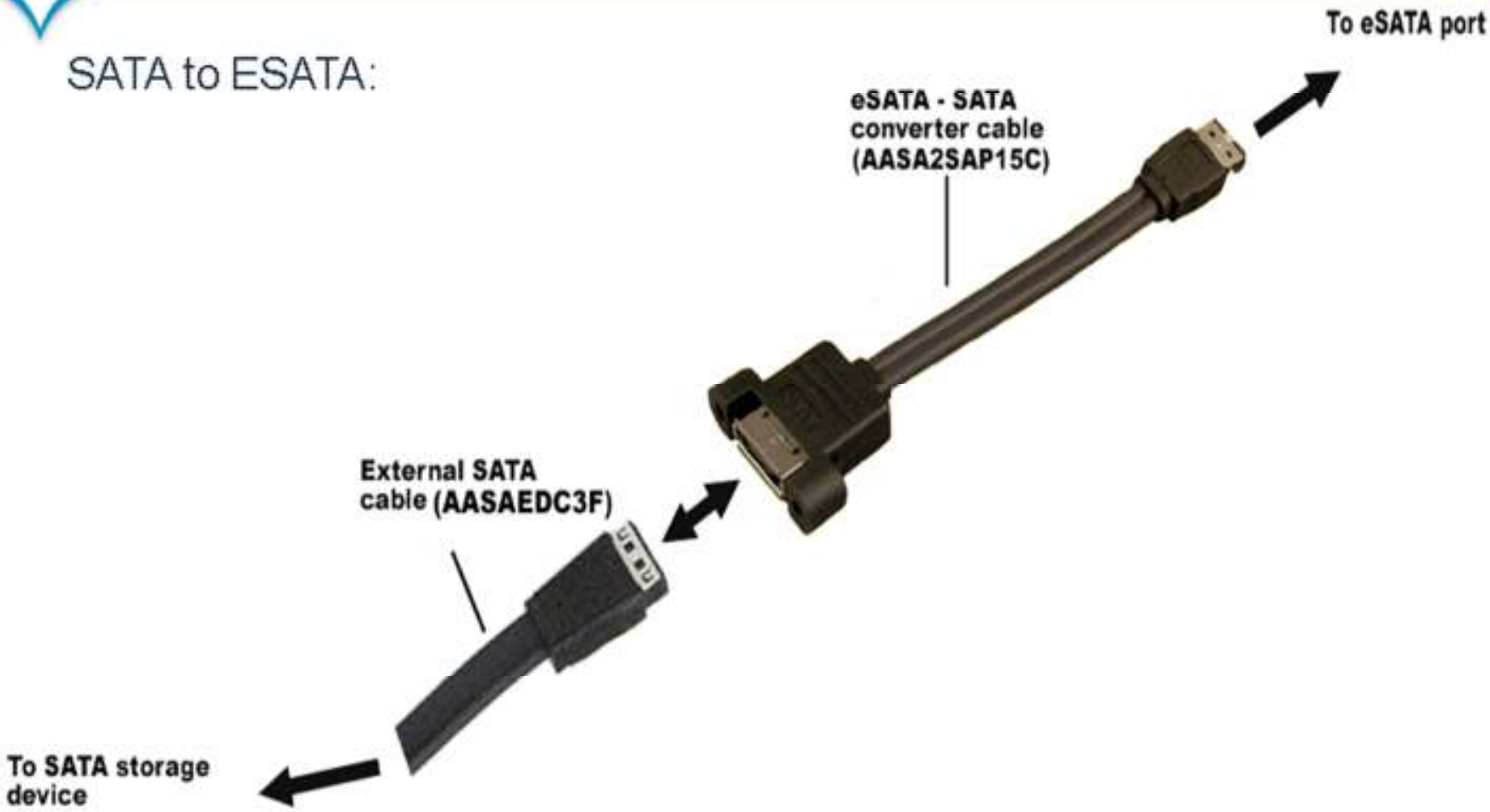
Interface Types

ESATA:



Interface Types

SATA to ESATA:



Capgemini

CONSULTING.TECHNOLOGY.OUTSOURCING

People matter, results count.