

LEARNING MATERIAL

On

COMPUTER HARDWARE AND MAINTENANCE

(For 5th semester CSE)

PREPARED BY:

NALINI KANTA MOHAPATRA

GOVT . POLYTECHNIC , DHENKANAL

COMPUTER CENTRE MANAGEMENT

NEED FOR MANAGEMENT IN COMPUTER CENTRES:-

Now a days with growing need of computers in every aspect of life, the computer centres have become a place of interest for everybody. The need for a sound management for a computer centre is therefore can't be ruled out. A good management is essential in a busy computer centre in order to provide convenience to the users of the centre in the following fields.

- The management is responsible for providing the required time slots to each user/user group that there is no overlapping.
- The management takes responsibility to distribute the computer stationary present in the computer centre according to the priority of the users.
- The management is responsible for maintaining the computer room environment, such as temperature, humidity etc.
- The management takes care of the system and peripherals present inside the centre when it starts malfunctioning. This job is accomplished by the management, either by employing a dedicated staff for this purpose or by employing a third party maintenance company for this purpose.
- The management assign the jobs to each individual staff of the centre, so that the centre is fully utilised and well maintained.

Thus in absence of a proper management in a computer centre, the resources available at the centre may be misutilised or under utilized.

TYPES OF JOB CARRIED OUT IN AN ORGANISATION:-

The various types of jobs carried out in an organisation which involve computers are as follows.

- Data processing : This is accomplished by using any data processing/ DBMs package in computer. This involves collecting various data as input to the package and process them to get a required result.
- Word Processing : This involves letter drafting, leaflets etc. This is performed through

any word processors available in the market.

- Scientific Purpose : This type of job involves complex calculations, which are accomplished by using various high level languages available for this purpose. This job involves extensive programming by expert programmers.
- Industrial equipment control : Sophisticated instruments are interfaced to computer and can be controlled by sitting in front of a computer and issuing commands through the computers.
- Data communication : This type of job is carried out by connecting two or more computers through cables or satellite link and sending digital data through the cable.

These are few types of job that are carried out by using a computer.

DUTIES AND RESPONSIBILITY OF PERSONNEL INVOLVED:

The duties and responsibility of the personnel involved in a computer centre can be divided into the following categories, depending on their group.

- ✓ Marketing group : This group of professionals possess an average idea of how computer can be useful in different aspect of life. Therefore they are responsible for creating a general awareness between the common man about the use of computers. Thus this group of professional are responsible for creating a sound market for computers.
- ✓ Internal training group : This group is responsible for planning and conducting the training of professionals within the organisation so as to help them in self development and career advancement. For this purpose the group carries out a comprehensive survey of qualification and on job experiences of all the professional of the organisation.
- ✓ System software group : This group is responsible for providing system programming support to the computer centre and help the professionals within the division. For this purpose, the group take up system generation work for the system software available on the computer. Apart from this, they also design other system software to provide an easy platform to application programmers.
- ✓ Hardware consultancy group : This group provides all the hardware support to the computer centre. They are responsible for minimising the system down time in the computer centre. They also help in interfacing of different peripherals to different system as and when required.
- ✓ Program operation group : This group is responsible for providing the necessary information about the on going project, to the programming staff. Thus this group is the field group, who actually realise the needs, limitation, usability etc. of the project and passes the same to the programming group.
- ✓ Programming group : This group is responsible for providing the end product to the customer. They take support from various groups and code them in same programming language.

HIERARCHICAL POSITION OF DIFFERENT LEVELS:

An average organisation, must have three levels of managers viz strategic, medium and operational. The managers of strategic level are responsible for long run planning of the organisation. Apart from this, the managers of this level are also responsible for setting up the objective, target etc. for the lower level managers. Then this is the top most level of an organisation as far as hierarchy of different levels are concerned.

The medium level managers are responsible for short term planning, task setting for lower level employees, etc. This level managers take help of a management information system in order to expertise their job, while the strategic level managers use decision support system for the purpose.

The employees of operational level, actually perform the jobs following the direction of medium level managers. Fig 1.1 represents a pictorial view of these different levels, which depicts their hierarchical position. The possible employees are mentioned by assuming that the organisation has a computer division.

Management level	Possible employee	Jobs performed by them
Level – 1	General Manager	Objective setting, cost benefit analysis, policy making audit, overall administration
Level – 2	System Manager, EDP In-charge, System analyst	System design, user interaction, resource allocation, Feasibility study, system maintenance, stock verification etc.
Level – 3	Programmer, System Operator	Coding, testing, installing etc.

NEED FOR TRAINING OF STAFF:

With the rapid developments in computers, computer education has become an inevitable activity of the employees of any organisation which uses computers. Though the need for training of staffs in computers can be classified into three groups depending on the level of management, but the basic objective is one i.e. to update the knowledge of the staff to make them aware to the recent development in hardware and software fields.

In top management level the objective of computer training again depends on the type of job that is to be handled by the organisation. For example if it is an EDP organisation then the need for computer training will be as follows:-

- To study the recent generation computer concepts, in terms of hardware and software.
- To provide intensive training in the design, development and implementation of computer based system.
- To provide tensile training in relevant programming language/ package.
- To expose the participants to operation research techniques relevant to their specific operation.
- To expose to the capability of computers.
- Strategy for an orderly change in the work culture.
- To become conversant with top management role in planning.

Similarly it the organisation is handling any other type of job apart from EDP like, computerised control of production, marketing policy through computers etc. then the top management level need to be thoroughly trained in the processes by which all these works are being performed.

In management level which lies in between top and bottom, the need of staff training are as follows.

- To get an exposure in recent computer concepts.
- To get an exposure in management information system concepts.
- To get an exposure in updated software package, that are used at their level.
- To get an awareness of numerical methods, including simulation, linear programming etc.

The lower management level need to be trained in the following fields.

- Training in computer concepts.
- Training in programming methods.
- Training in application software.
- Training on various operating platform.

Basically the need for staff training in an organisation can be concluded under the following points.

- To get an understanding of managerial decision making process and to evolve an interdisciplinary approach for the planning, analysis, design and implementation of computer based information system.
- To develop an understanding and knowledge of tools and techniques in the design of software systems for implementing computer based information system.
- To expose participants to updated computing systems.
- To develop an understanding of advanced analytical techniques and their applications in management information systems.

IDEA ABOUT VARIOUS COMPUTER MAKES AND INSTALLATIONS IN INDIA:

Since the advent of personal computer IBM corp. of USA dominated the market and almost all other computer manufactures follow the IBM architecture and are known as IBM PC clones. Apart from IBM corp. Another international giant in personal computer manufacturer is Apple computers, of UK Most Indian manufactures follow the IBM PC architecture to manufacture PCs, in India. Now a days few companies are there in India who are pushing Apple products into the Indian market.

Following is an extensive list of Indian computer hardware manufacturers.

- HCL Ltd.
- Pertech computers limited (PCL)
- Wipro InfoTech.
- International computer Indian Manufacturer (ICIM)
- Unicorp Industries Ltd.
- Blue star computer Ltd.
- Zenith Computers Ltd.
- Modi Ollevietee Ltd.

Following is a list of major computer installations in India and the type of service they provide.

- National Informatics Centre (NIC) – Provide services and consultancy
- C-DAC – carry out extensive research, on recent technical advancements.
- Army head quarters – Military computerisation.
- Indian Institute of Technology – Research purpose.
- Council of Scientific and Industrial research – Research purpose (CSIR)
- Department of Electronics (DOR) – Research purpose.
- World health organisation (WHO) – Research purpose.
- Public sector undertakings – EDP work and CNC controls

Apart from these almost all offices in India now a days are opting for computerisation.

FIRMS DEALING IN COMPUTERS –

Computer being a flourishing business, now a days there are a number of firm dealing in computers. In international market flowing firms are worth mentioning.

- IBM Corp., USA
- Apple computers, UK
- Compaq Corp. Germany
- Dell Machines Germany
- Casio Corp. Japan
- Sony Corp., Japan
- NEC Corp., Japan

All these firms deal in hardware. Flowing are some firms which deal in software.

- Microsoft Corp., USA
- Novel Inc., USA
- Aldus INC, USA
- Macromedia Corp, USA
- AT&T bell Lab., USA
- SCO, USA

Now with the rapid computerisation in every field in India many firms are already into this hi-tech business. Followings are some firms in India who deal in computer hardware.

- HCL HP Ltd.
- PCL Computers
- Wipro Infotech
- Unicorp Industries
- Altos India
- Sterling computers
- ICIM
- Modi ollivitte
- Zenith computers
- TVSE
- IDM computer

Similarly in the software and services field following are few Indian companies which are worth mentioning.

- NIC
- C-DAC
- NIIT
- TCS
- Tata Unisys
- Binary Semantics
- Oricom
- Fifth Generation software

Apart from these are many other software firms which undertake export oriented projects.

SITE PREPARATION & INSTALLATION

PLANNING COMPUTER ROOM LAYOUT:-

Site layout is very important for proper use of various resources. Several points must be considered to achieve an idea layout. The major factors which influence the layout are –

- System configuration
- Shape of the room
- Number of computer users.

If the systems are compact systems then the layout of the room is simple as the terminal data entry system, processing unit, input-output unit, all are attached to each other in a compact way on the other hand if these various units are separate from each other then the lay out of the computer room will be different so as to accommodate each individual unit in separate parts.

Similarly shape of the room affects the layout greatly. Normally a square size room is ideal for computer room, as in this case all the space can be fully utilised.

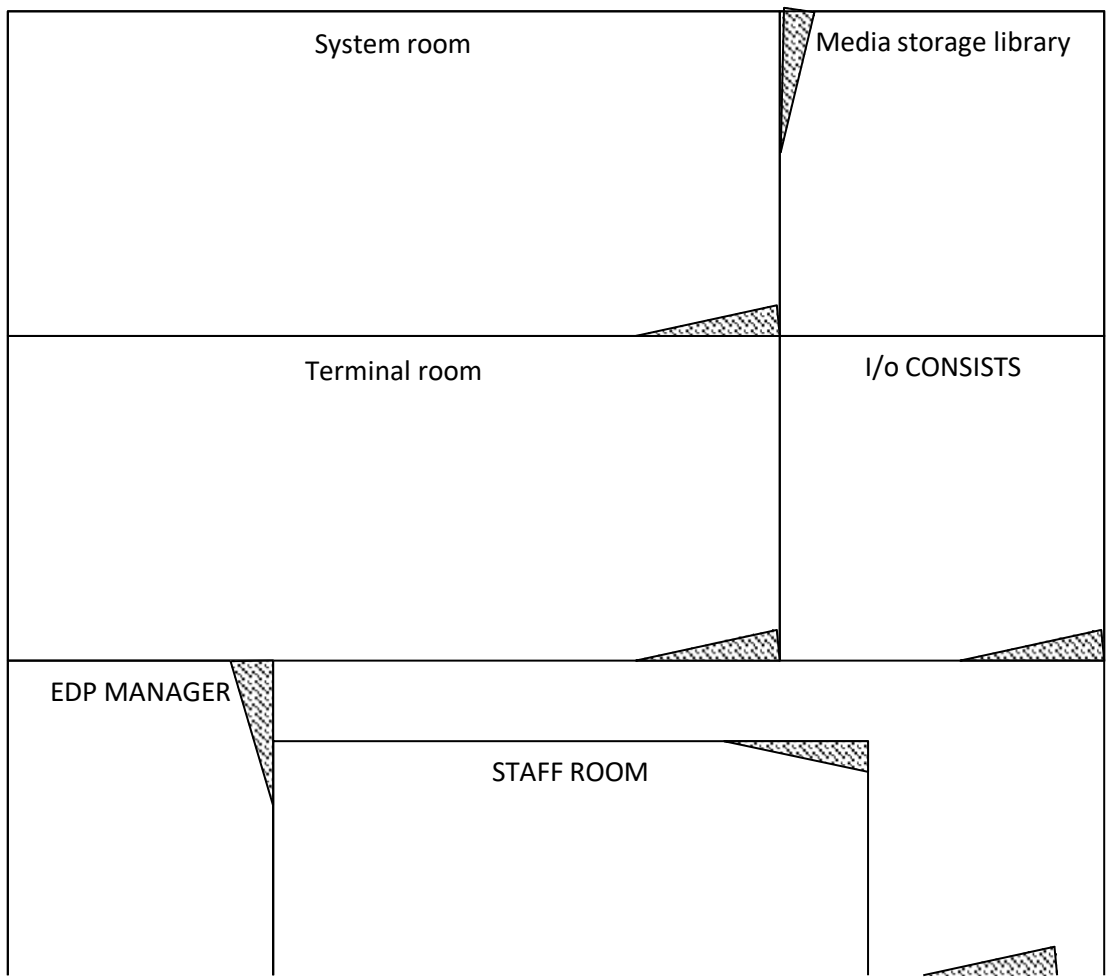
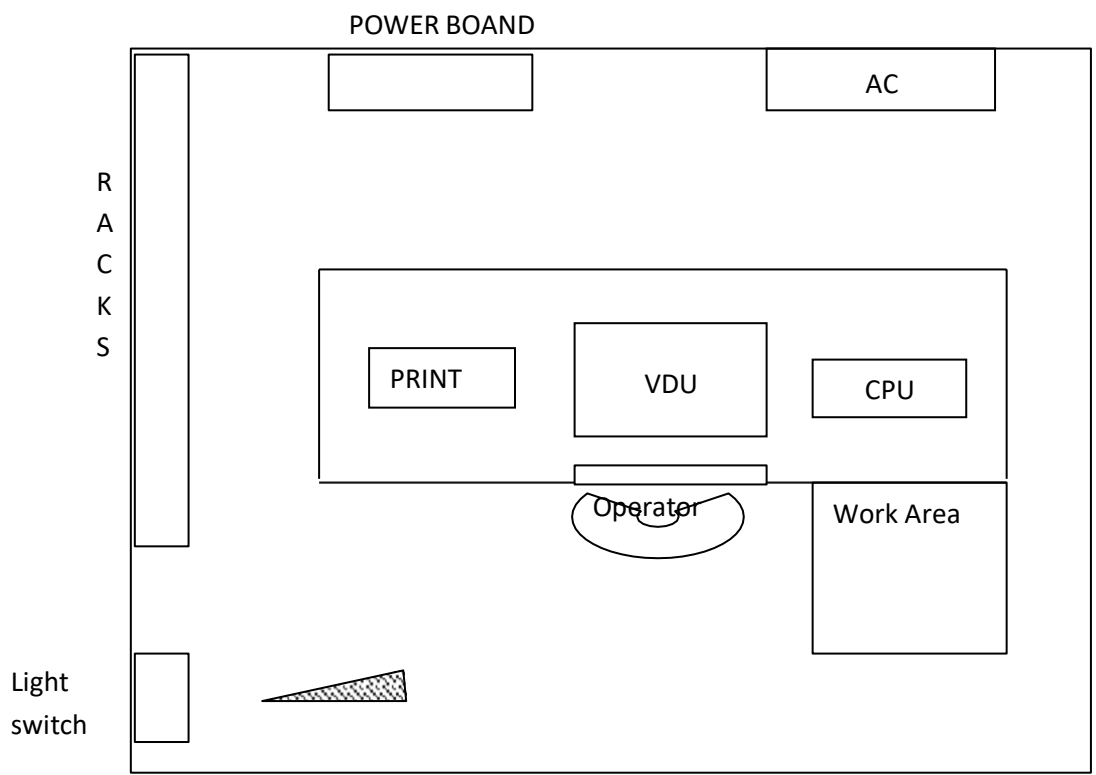
Number of users who are allowed at a time to use the computer, again is major criteria for layout reparation. Very often the fabricators charge their fees on this basis.

A typical lay out for a stand alone system as shown below, this requires a room of size 3m x 3m.

A multi terminal system with large external memory requirement, may need special attention in terms of locations of various units. It is always advisable to divide the equipment area into three working areas as follows.

- ⇒ Main computer system.
- ⇒ Terminals and data entry devices.
- ⇒ Media and consumable library

A typical layout for a multi terminal system rook is shown below



In earlier days the input-output devices were bulky and were occupying a lot of space. Therefore then a separate room was necessary for these I/O devices. However now a days these I/O devices are compact and area kept beside the systems in the system room itself. The staff strength of such a computer centre is quite large for which we need a separate room for staff and for the EDP manager. The room for EDP manager may be outside the computer centre. Similarly a small room for the media storage should be available. This should be adjacent to the system room as shown in the above figure.

Apart from this there are various other factors which can be taken into account while preparing the computer room are as discussed below.

False flooring and false roofing:-

Computer system with a number of peripherals together with power supply may employ a lot of inter connecting cables which might not only look untidy but can lead to very confusing wiring. False flooring helps in running the cables beneath the false floor.

Similarly false roofing is used to hide the air conditioning ducts and lighting cables. False roofing also reduce the room height then decreasing the volume of air to be air conditioned.

Air-conditioning:-

Although the modern computers are far more robust and less sensitive to their environment than their predecessors, some precautions are essential to protect the magnetic media and to improve the reliability. This can be achieved by properly maintaining the room temperature and humidity.

High temperature or rapid change in temperature can accelerate the deterioration of equipment, magnetic media etc.. Similarly excess humidity leads to moisture absorption and affect the magnetic disks. Apart from this, due to excess temp. and low humidity, static electricity is developed which can cause damage to the memory and processing circuitry.

All these drawbacks can be overcome by air conditioning. The size of the air conditioner depends on the volume of the room, the total heat dissipation inside the room, the no. of users expected to work inside the room at a time, environmental condition of the room etc.

Dust proofing:-

This is another important factor to be considered while designing the computer room. For this the no. of windows and doors into the room should be minimised. Each door should be provided with automatic door closure and the human entry into the room should be restricted to the minimum.

Apart from this the room should be provided with fire alarms and fire extinguish.

POWER SUPPLY

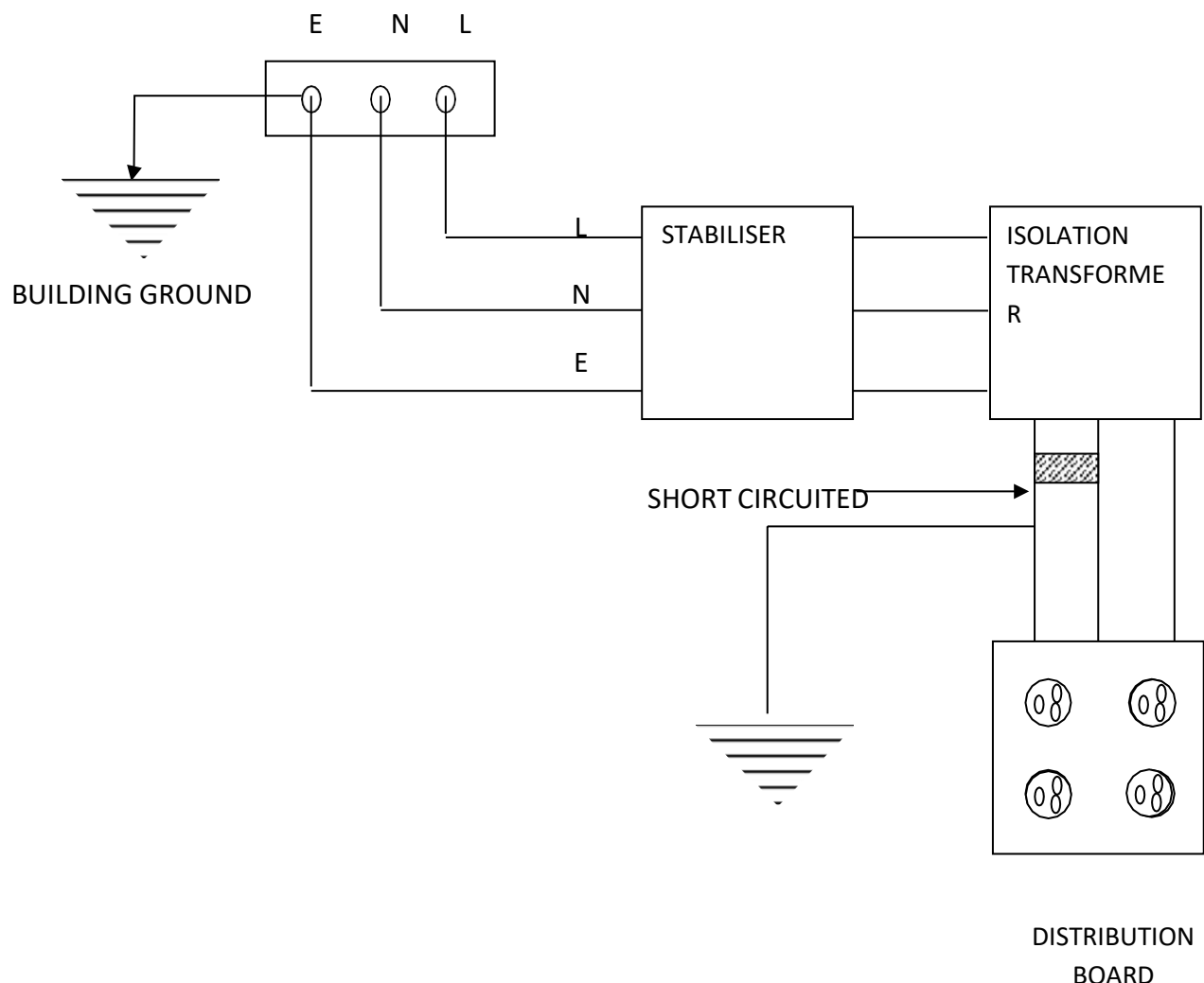
POWER REQUIREMENT FOR COMPUTER ROOM:-

In a typical computer room, the current input may vary from 5 amp to 30 amp depending on the type of configuration, but voltage and frequency fluctuation are dangerous for the operation of system. Maximum voltage and frequency range are $230\text{ v} \pm 5\%$ & $50\text{ hz} \pm 4\%$ hz.

There are various instruments which are provided to save the system from voltage and frequency fluctuation, they are:-

- i) Voltage stabiliser
- ii) Frequency stabiliser
- iii) Overload protection devices
- iv) Isolators

It should be remembered that the capacity of power line and voltage stabiliser should be fixed at a minimum 50 percent higher than the total power requirement. Apart from this the leakage current/ voltage should be kept at the minimum ($<3\text{v}$). Similarly proper earthing should be provided to the main line in which the system are connected. The following figure represents the wiring scheme for a single desktop computer.



VOLTAGE STABILIZER

Voltage stabilisers are the devices by using which, the voltage is maintained at a constant level. There are various types of voltage stabilisers, which can be broadly clarified into two types i.e. manually controlled stabiliser and automatic voltage stabilisers. As far as the use of stabilisers in computer room are concerned, automatic stabilisers are used.

There are two types of automatic voltage stabilisers depending on its control mechanism i.e. discontinuous control and continuous control. Both these types of voltage stabilisers consists of two block i.e. sensing/ measuring unit and regulating unit. The measuring unit compares the output voltage or the controlled variable with a steady reference and given an output proportional to their difference. The regulating unit is driven by this error signal derived from the measuring unit, and given the stabilised voltage.

In the discontinuous type control, the measuring unit is such as to produce no error signal so long as the voltage is within certain limits. This period during which no signal is generated is known as dead zone. When the voltage goes outside this dead zone, a signal is produced by the measuring unit, until the voltage again enters into dead zone. Normally voltage sensitive relay are used for the purpose. As the stabiliser functions discontinuously, it is known as automatic discontinuous voltage stabiliser.

In continuous types the measuring unit produces a signal whose amplitude is proportional to the difference between the fixed reference and the controlled voltage. The output of measuring unit is zero when the controlled voltage is equal to the reference voltage. An example of this type of measuring unit is the voltage sensitive bridge. The regulating unit associated with a continuous type stabiliser, given a connecting voltage proportional to the output of measuring unit. For more sophisticated use this continuous type is preferred over the discontinuous type.

OVERLOAD PROTECTION DEVICES:-

Computer being sophisticated electronic devices, have a constant voltage and current input specification. These specification are fixed deepening on the power tolerance of the IC's used in the system. If by any means the voltage or current in the input power supply cross this tolerance level, it may damage the system. This is known as over load to the system. There are devices to protect the system from this overload. This extra voltage is known as serge voltage. These serge voltage occur due to extra inductive load in the supply line or sudden blowing of certain fuses. Different overload protection devices are used to protect the system from this overload. Basically there are two circuit for protecting the system from AC surge and DC surge.

The inductance 'L' is used in input circuit to neutralise the extra inductance resulting due to leakage transformer and other loads.

Selenium cell can be used as a overload protection device for restricting DC surge voltage. A single selenium cell can withstand reverse voltage rated between 20v – 30v. Thus if the surge voltage increases it blows off and the system is protected from surge voltage.

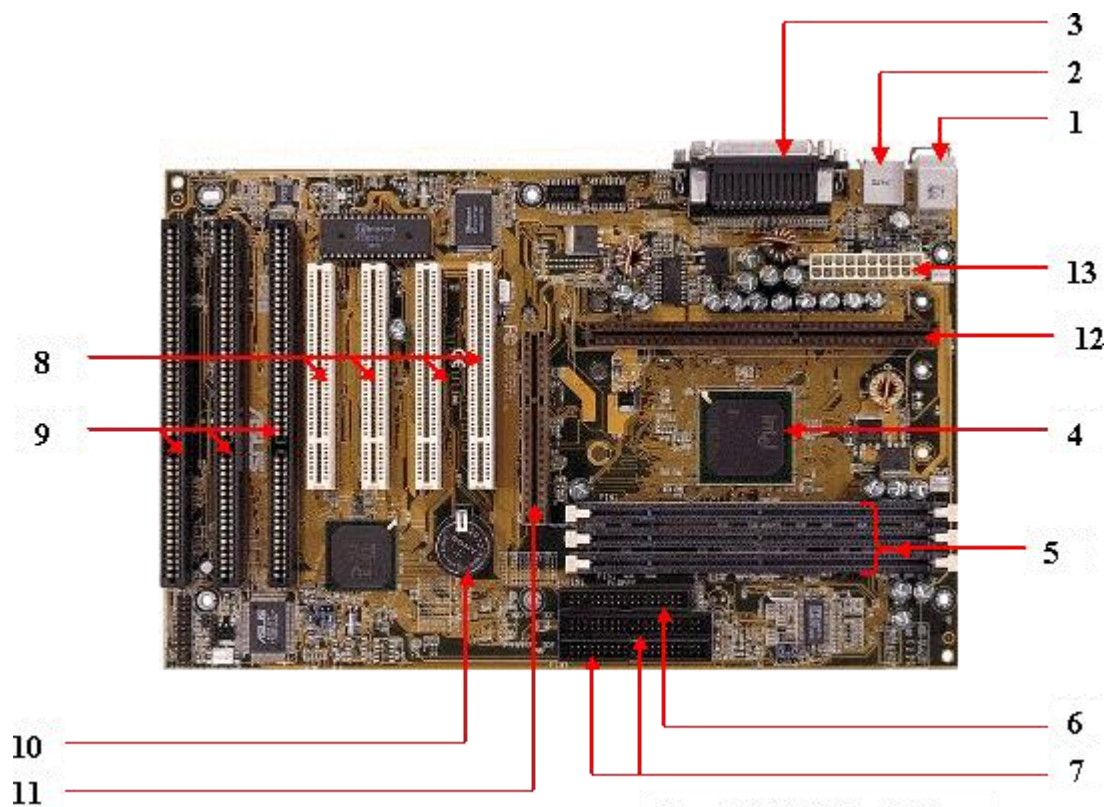
EARTHING AND ISOLATION TECH:-

This is another major requirement of system power supply. For proper functioning of the system, the power line should have minimum leakage voltage i.e. the voltage between the ground and neutral lines should be minimum. To achieve this, the ground wire should be properly earthed. There are various ways to achieve proper earthing. For this a plate is inserted into ground to which an iron rod is connected. The surrounding of this plate and rod are filled with salt and coke as they are very good conductors of electricity. The ground wire is connected to this iron rod.

There are various circuits to isolate the system from main power supply in case of any abnormal voltage or current. Mainly silicon controlled rectifier are used for this isolation circuit. Apart from this there are also isolation transformations which are now used by the stabiliser which perform both stabilizing and isolation of the power supply.

Mother Board and Components

Computer Motherboard Components



1. Mouse & keyboard
2. USB
3. Parallel port
4. CPU Chip
5. RAM slots
6. Floppy controller
7. IDE controller
8. PCI slot
9. ISA slot
10. CMOS Battery
11. AGP slot
12. CPU slot
13. Power supply plug in

1. Mouse & keyboard: Keyboard Connectors are two types basically. All PCs have a Key board port connected directly to the motherboard. The oldest, but still quite common type, is a special DIN, **(DIN connectors are round, with pins arranged in a circular pattern. This type of connector was used widely for PC keyboards are usually 5 pin)** and most PCs until recently retained this style connector. The AT-style keyboard connector is quickly disappearing, being replaced by the smaller mini DIN PS/2-style keyboard connector.**(The PS/2 port is a 6-pin mini-DIN connector used for connecting keyboards and mice to a PC)**

You can use an AT-style keyboard **(5 PIN)** with a PS/2-style socket (or the other way around) by using a converter. Although the AT connector is unique in PCs, the PS/2(**personal system**)-style mini-DIN is also used in more modern PCs for the mouse. Fortunately , most PCs that use the mini-DIN for both the keyboard and mouse clearly mark each mini-DIN socket as to its correct use. Some keyboards have a USB connection, but these are fairly rare compared to the PS/2 connection keyboards.

2. USB (Universal serial bus): USB is the General-purpose connection for PC. You can find USB versions of many different devices, such as mice, keyboards, scanners, cameras, and even printers. a USB connector's distinctive rectangular shape makes it easily recognizable.

USB has a number of features that makes it particularly popular on PCs. First, USB devices are hot swappable. You can insert or remove them without restarting your system.

3. Parallel port: Most printers use a special connector called a parallel port. Parallel port carry data on more than one wire, as opposed to the serial port, which uses only one wire. Parallel ports use a 25-pin female DB connector(**D-subminiature, but many people call it "D-sub" or just "DB".**) (**DB 9 holes connector**). Parallel ports are directly supported by the motherboard through a direct connection or through a dangle.

4. CPU Chip : The *central processing unit*, also called the *microprocessor* performs all the calculations that take place inside a pc. CPUs come in Variety of shapes and sizes. Modern CPUs generate a lot of heat and thus require a cooling fan or heat sink. The cooling device (such as a cooling fan) is removable, although some CPU manufactures sell the CPU with a fan permanently attached.

5. RAM slots: Random-Access Memory (RAM) stores programs and data currently being used by the CPU. RAM is measured in units called bytes. RAM has been packaged in many different ways. The most current package is called a 168-pin DIMM (Dual Inline Memory module).(**168-pin for D-RAM, SD-RAM**)(**Synchronous Dynamic Random Access Memory**)

6. Floppy controller: The floppy drive connects to the computer via a 34-pin *ribbon cable*, which in turn connects to the motherboard. A *floppy controller* is one that is used to control the floppy drive.

7. IDE controller: Industry standards define two common types of hard drives: EIDE (**Enhanced Integrated Drive Electronics**) and SCSI (**Small Computer System Interface**). Majority of the PCs use EIDE drives. SCSI drives show up in high end PCs such as network servers or graphical workstations. The EIDE drive connects to the hard drive via a 2-inch-wide, 40-pin ribbon cable, which in turn connects to the motherboard. *IDE controller* is responsible for controlling the hard drive.

(Technically, there are Parallel ATA(**Advanced Technology Attachment**) (PATA) and Serial ATA (**SATA**), which are both variants of the **IDE** hard drive interface. However, the term **IDE** is typically used for a Parallel ATA drives. You can tell **IDE** from **SATA** by looking at the hard drive connectors)

8. PCI slot: Intel introduced the *Peripheral component interconnect* bus protocol. The PCI bus is used to connect I/O devices (such as NIC or RAID controllers) to the main logic of the computer. PCI bus has replaced the ISA bus.

9. ISA slot: (Industry Standard Architecture) It is the standard architecture of the Expansion bus. Motherboard may contain some slots to connect ISA compatible cards. (**Video Cards**)

10. CMOS Battery: To provide CMOS (**Complementary metal–oxide–semiconductor**) with the power when the computer is turned off all motherboards comes with a battery. These batteries mount on the motherboard in one of three ways: the obsolete external battery, the most common onboard battery, and built-in battery.

11. AGP slot: If you have a modern motherboard, you will almost certainly notice a single connector that looks like a PCI slot, but is slightly shorter and usually brown. You also probably have a video card inserted into this slot. This is an Advanced Graphics Port (AGP) slot.

12. CPU slot: To install the CPU, just slide it straight down into the slot. Special notches in the slot make it impossible to install them incorrectly. So remember if it does not go easily, it is probably not correct. Be sure to plug in the CPU fan's power.

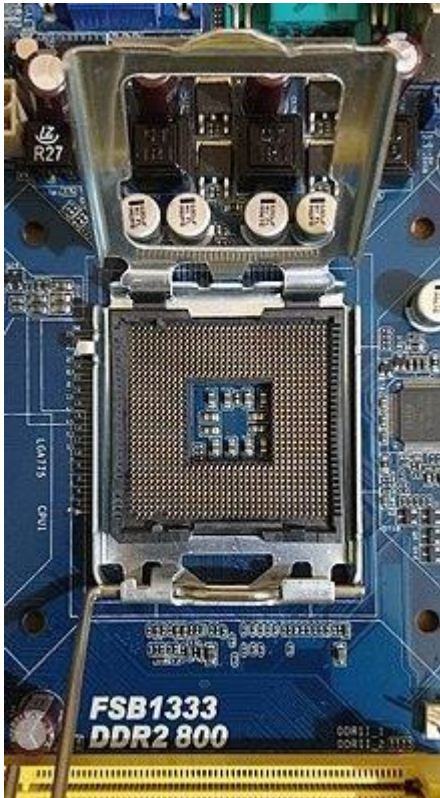
13. Power supply plug in: The Power supply, as its name implies, provides the necessary electrical power to make the pc operate. the power supply takes standard 110-V AC power and converts into 12-Volt, 5-Volt, and 3.3-Volt DC power.

Microprocessor

Also known as the microprocessor or the **processor**, the CPU is the computer's brain. It is responsible for fetching, decoding, and executing program instructions as well as performing mathematical and logical calculations

The processor chip is identified by the processor type and the manufacturer. This information is usually inscribed on the chip itself. For example, Intel 386, Advanced Micro Devices (AMD) 386, Cyrix 486, Pentium MMX, Intel Core 2Duo, or iCore7.

If the processor chip is not on the motherboard, you can identify the processor socket as socket 1 to Socket 8, LGA 775 among others. This can help you identify the processor that fits in the socket. For example, a 486DX processor fits into Socket 3



Memory

Random Access Memory, or RAM, usually refers to computer chips that temporarily store dynamic data to enhance computer performance while you are working.

In other words, it is the working place of your computer, where active programs and data are loaded so that any time the processor requires them, it doesn't have to fetch them from the hard disk.

Random-Access Memory is volatile, meaning it loses its contents once power is turned off. This is different from non-volatile memory, such as hard disks and flash memory, which do not require a power source to retain data.

When a computer shuts down properly, all data located in RAM is returned to permanent storage on the hard drive or flash drive. At the next boot-up, RAM begins to fill with programs automatically loaded at startup, a process called booting. Later on, the user opens other files and programs that are still loaded in memory.



Chip-sets

A chipset is a group of small circuits that coordinate the flow of data to and from a PC's key components. These key components include the CPU itself, the main memory, the secondary cache, and any devices situated on the buses. A chipset also controls data flow to and from hard disks and other devices connected to the IDE channels.

A computer has got two main chipsets:

- The NorthBridge (also called the memory controller) is in charge of controlling transfers between the processor and the RAM, which is why it is located physically near the processor. It is sometimes called the GMCH, for Graphic and Memory Controller Hub.
- The SouthBridge (also called the input/output controller or expansion controller) handles communications between slower peripheral devices. It is also called the ICH (I/O Controller Hub). The term "bridge" is generally used to designate a component which connects two buses

Cache Memory

Cache memory is a small block of high-speed memory (RAM) that enhances PC performance by pre-loading information from the (relatively slow) main memory and passing it to the processor on demand.

Most CPUs have an internal cache memory (built into the processor) which is referred to as Level 1 or primary cache memory. This can be supplemented by external cache memory fitted on the motherboard. This is the Level 2 or secondary cache.

In modern computers, Levels 1 and 2 cache memory are built into the processor die. If a third cache is implemented outside the die, it is referred to as the Level 3 (L3) cache.

BIOS (Basic Input/Output System)

BIOS, also called system BIOS, PC BIOS or ROM BIOS, is firmware that is used to perform hardware initialization during the booting process; and to provide runtime services for operating system and programs. The BIOS firmware is the first software to run when powered on; it is re-installed on a PC's system board.

BIOS stands for Basic Input/Output System. BIOS is a "read-only" memory, which consists of low-level software that controls the system hardware and acts as an interface between the operating system and the hardware. Most people know the term BIOS by another name—device drivers, or just drivers. BIOS is essentially the link between the computer hardware and software in a system.

All motherboards include a small block of Read Only Memory (ROM) which is separate from the main system memory used for loading and running software. On PCs, the BIOS contains all the code required to control the keyboard, display screen, disk drives, serial communications, and a number of miscellaneous functions.

The system BIOS is a ROM chip on the motherboard used during the startup routine (boot process) to check out the system and prepare to run the hardware. The BIOS is stored on a ROM chip because ROM retains information even when no power is being supplied to the



computer.

CMOS Battery

Motherboards also include a small separate block of memory made from CMOS RAM chips which are kept alive by a battery (known as a CMOS battery) even when the PC's power is off. This prevents reconfiguration when the PC is powered on.

CMOS devices require very little power to operate.

The CMOS RAM is used to store basic Information about the PC's configuration for instance:-

- Floppy disk and hard disk drive types
- Information about CPU
- RAM size
- Date and time
- Serial and parallel port information
- Plug and Play information
- Power Saving settings

Other Important data kept in CMOS memory is the time and date, which is updated by a Real Time Clock (RTC)



I/O Controller

Input/output controllers receive input and output requests from the central processor, and then send device-specific control signals to the device they control. They also manage the data flow to and from the device. This frees the central processor from involvement with the details of controlling each device. I/O controllers are needed only for those I/O devices that are part of the system.

Often the I/O controllers are part of the electronics on the main circuit board (the *mother board*) of the computer. Sometimes an uncommon device requires its own controller which must be plugged into a connector (an expansion slot) on the mother board.

I/O controllers are sometimes called **device controllers**. The software that directly interacts with a device controller is called a **device driver**. When you install a new device on your computer (say, a new graphics board) you must also install a device driver for it.

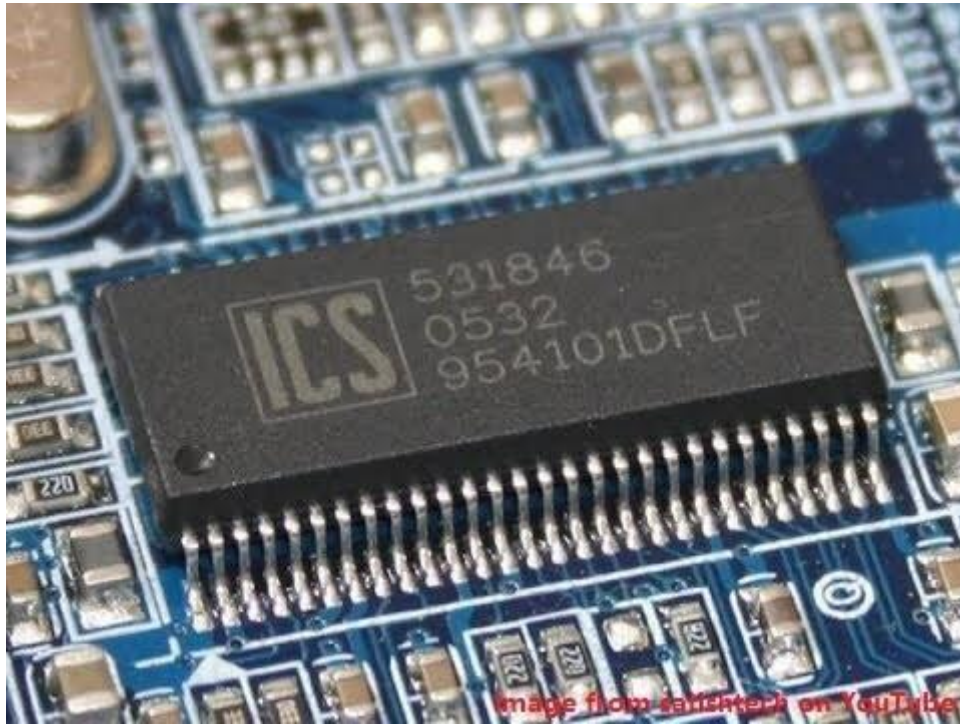
Clock generator

The CPU clock synchronizes the operation of all parts of the PC and provides the basic timing signal for the CPU. Using a quartz crystal, the CPU clock breathes life into the microprocessor by feeding it a constant flow of pulses.

For example, a 200 MHz CPU receives 200 million pulses per second from the clock. A 2 GHz CPU gets two billion pulses per second. Similarly, in any communications device, a clock may be used to synchronize the data pulses between sender and receiver.

A "real-time clock," also called the "system clock," keeps track of the time of day and makes this data available to the software. A "time-sharing clock" interrupts the CPU at regular intervals and allows the operating system to divide its time between active users and/or applications

A clock generator is an electronic oscillator (circuit) that produces a clock signal for usage in synchronizing a circuit's operation. The clock signal ranges between high and low frequencies, thus creating a metronome for the coordination of actions.



RTC

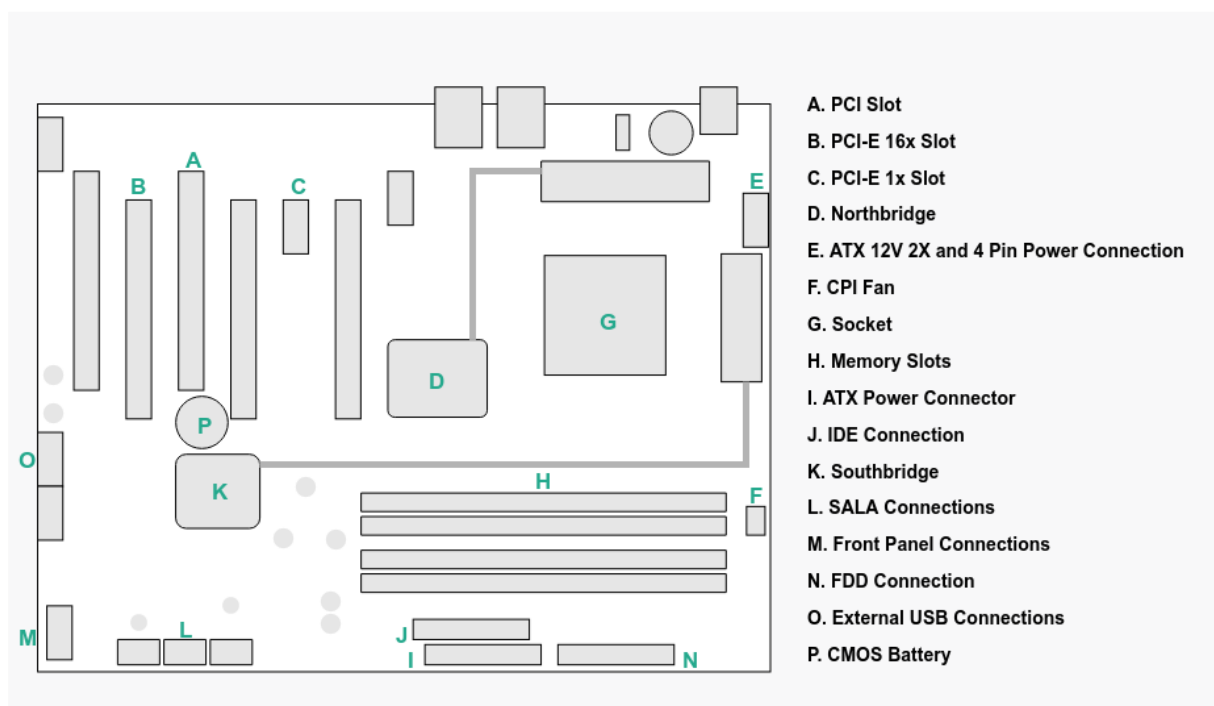
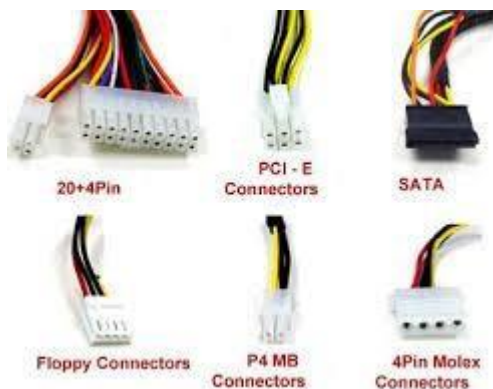
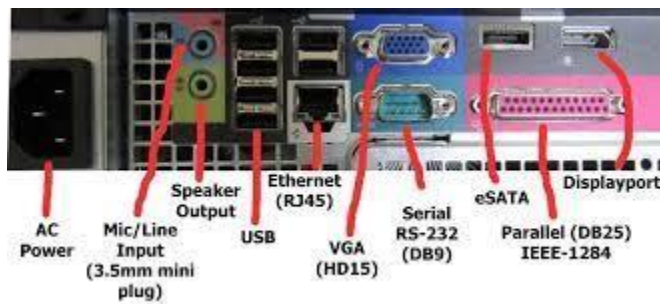
Short for **real-time clock**, **RTC** is an **integrated circuit** on a computer's **motherboard** that is powered by the **CMOS** battery. The RTC provides an accurate date and time, in addition to allowing a computer to regulate the timing and speed of all its functions.

Jumpers

- **DIP** (Dual In-line Package) switches are small electronic switches found on the circuit board that can be turned on or off just like a normal switch. They are very small and so are usually flipped with a pointed object, such as the tip of a screwdriver, a bent paper clip, or a pen top. Take care when cleaning near DIP switches, as some solvents may destroy them. Dip switches are obsolete and you will not find them in modern systems.
- **Jumper pins** are small protruding pins on the motherboard. A jumper cap or bridge is used to connect or short a pair of jumper pins. When the bridge is connected to any two pins, via a shorting link, it completes the circuit and a certain configuration has been achieved.
- **Jumper caps** are metal bridges that close an electrical circuit. Typically, a jumper consists of a plastic plug that fits over a pair of protruding pins. Jumpers are sometimes used to configure expansion boards. By placing a jumper plug over a different set of pins, you can change a board's parameters

ATX Power Connector:

This is the second of two power connections. This is the main power connection for the motherboard, and comes from the Power Supply.



(PCIe (peripheral component interconnect express) is an interface standard for connecting high-speed components. Every desktop PC **motherboard** has a number of PCIe slots you can use to add **GPUs** (aka video cards aka graphics cards), **RAID cards**, Wi-Fi cards or **SSD** (solid-

state drive) add-on cards. The types of PCIe slots available in your PC will depend on the [motherboard you buy](#).)

Motherboard: Definition

A motherboard is one of the most essential parts of a computer system. It holds together many of the crucial components of a computer, including the central processing unit (CPU), memory and connectors for input and output devices. The base of a motherboard consists of a very firm sheet of non-conductive material, typically some sort of rigid plastic. Thin layers of copper or aluminum foil, referred to as *traces*, are printed onto this sheet. These traces are very narrow and form the circuits between the various components. In addition to circuits, a motherboard contains a number of sockets and slots to connect the other components.

Parts of a Motherboard

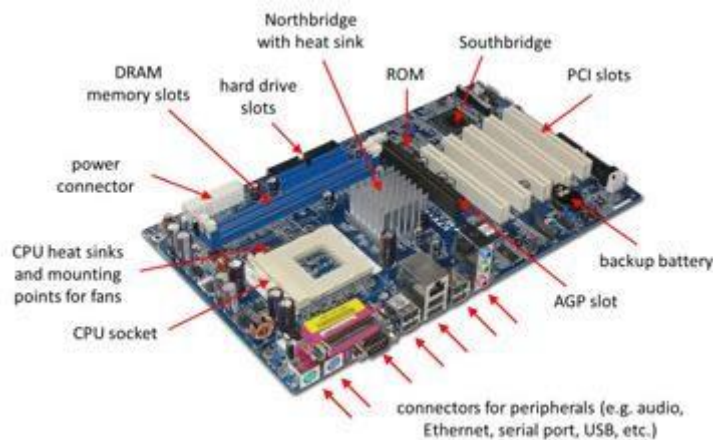
If you were to open up your computer and take out the motherboard, you would probably get pretty confused about all the different parts. Depending on the make and model of your computer, it might look something like this.



To understand how computers work, you don't need to know every single part of the motherboard. However, it is good to know some of the more important parts and how the motherboard connects the various parts of a computer system together. Here are some of the typical parts:

- A CPU socket - the actual CPU is directly soldered onto the socket. Since high speed CPUs generate a lot of heat, there are heat sinks and mounting points for fans right next to the CPU socket.
- A power connector to distribute power to the CPU and other components.
- Slots for the system's main memory, typically in the form of DRAM chips.
- A chip forms an interface between the CPU, the main memory and other components. On many types of motherboards, this is referred to as the Northbridge. This chip also contains a large heat sink.

- A second chip controls the input and output (I/O) functions. It is not connected directly to the CPU but to the Northbridge. This I/O controller is referred to as the Southbridge. The Northbridge and Southbridge combined are referred to as the *chipset*.
- Several connectors, which provide the physical interface between input and output devices and the motherboard. The Southbridge handles these connections.
- Slots for one or more hard drives to store files. The most common types of connections are Integrated Drive Electronics (IDE) and Serial Advanced Technology Attachment (SATA).
- A read-only memory (ROM) chip, which contains the firmware, or start up instructions for the computer system. This is also called the BIOS.
- A slot for a video or graphics card. There are a number of different types of slots, including the Accelerated Graphics Port (AGP) and Peripheral Component Interconnect Express (PCIe).
- Additional slots to connect hardware in the form of Peripheral Component Interconnect (PCI) slots.



Photograph of a typical motherboard with the most important parts labeled

There are certainly a lot of acronyms to get used to! Don't worry too much about trying to remember all the parts and their acronyms. The key is to remember that the **motherboard contains the central processing unit, the memory, and all the connectors to the rest of the hardware of the computer system. The board is the 'mother' of all components - that's where it gets its name.**

Types

A processor can have multiple cores. (In summary, a **core** is a small **CPU** or **processor** built into a big **CPU** or **CPU** socket. It can independently perform or process all computational tasks. From this perspective, we can consider a **core** to be a smaller **CPU** or a smaller **processor** within a big **processor**) A core is capable of independently executing a single thread or process while the other cores may be idle or executing a completely different process simultaneously. The more cores a processor has, the better it is able to multitask programs without having to divide up the available time between them as much it would with a single core for executing all processes. In early computers, most had only a single core due to the expense of building the processor. Processor manufacturers have turned towards multiprocessors (i.e. multiple cores) as a means of continuing to improve performance in the face of the growing limits in other areas. However, making effective use of multiple cores requires programmers to effectively make use of parallelism and asynchronous programming techniques that keep multiple cores busy simultaneously. Within the processor, the individual cores generally have a small amount of cache memory not shared with the other cores, and a larger quantity of cache shared between all cores. They will also all share the portions of the processor responsible for external access to memory and other peripherals.

Most processors today are [multi-core](#), which means that the IC contains two or more [processors](#) for enhanced performance, reduced power consumption and more efficient simultaneous processing of multiple tasks (see: [parallel processing](#)). Multi-core set-ups are similar to having multiple, separate processors installed in the same computer, but because the processors are actually plugged into the same socket, the connection between them is faster

A **processor core** (or simply “**core**”) is an individual **processor** within a **CPU**. Many computers today have multi-**core processors**, meaning the **CPU** contains more than one **core**. For many years, computer CPUs only had a single **core**. ... In the mid-2000s, dual-**core** and quad-**core** CPUs began replacing multi-**processor** configurations.

A **core IS a processor**. If a **processor is** a quad-**core**, that means that it has 4 **cores** in one chip, if it **is** an Octa-**core** 8 **cores** and so on. ... There are even **processors**(shortened as **CPU**, Central Processing Unit) with 18 **cores**, The Intel **core** i9. And one **with a** astonishing 72 **cores**

Modern CPUs have between two and 64 cores, with most processors containing four to eight. Each one is capable of handling its own tasks. In most cases these days, you'll want at least **four cores**--or at least four threads

Although many day-to-day tasks don't require much more than a Dual **Core**, there are benefits of a **Quad Core processor** are a little more tangible. Not only is it faster, and more powerful when it comes to highly intensive tasks, the **Quad Core processor** may also give you more bang **for** your buck in the long run.

Windows 10 supports a maximum of two physical CPUs, but the number of logical processors or cores varies based on the processor architecture. A maximum of **32 cores** is supported in 32-bit versions of Windows 8, whereas up to **256 cores** are supported in the **64**-bit versions

******(To find how many cores your current computer is running, for Windows users, simply pull up the Windows Task Manager by pressing the Ctrl + Alt + Delete keys and clicking on the Task Manager button. Next click on the performance tab. The number of cores is listed on the bottom right. This particular set of instructions is for those using Windows 10. Those with other versions may have some variations)

The Intel **Core 2 Duo** (also known as **Core2 Duo**) notebook **processor** is a 64 bit dual**core processor**. This **means** two **processor** cores work inside a **Core 2 Duo** in parallel. ...

Each **core** is based on the Pentium M micro architecture. Intel **Dual Core processors** are downgraded version of **Core 2 Duo**

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

An **i5** is cheaper **than** a **quad core** because it only has 2 **cores**. A **quad core** is more expensive but while give you a **better** experience. If you are using you computer for general school work, you are **better** off with a **i5**. If you plan on heavy gaming **or** video editing, you need at least a **quad core**

Advanced Micro Devices, Inc. (**AMD**) is an American multinational semiconductor company based in Santa Clara, California, that develops computer **processors** and related technologies for business and consumer markets. **AMD** is able to offer lower prices by thinking that even though the margins are lower, the amount of CPUs sold should make up for the difference -

at least somewhat. ...**AMD** is **cheaper** because of brand name (recognition) in the CPU department, and **cheaper** in the GPU department because of a worse product.

AMD and **Intel** don't share the same **CPU** architecture, its like if two machines could fold clothes, but one can do 30 shirts at a time and another could do 60 **AMD** chips do more things per cycle but fewer cycles per second (GHz) while **Intel** increases the cycles/second (GHz) but does less in each cycle. **A10** is a family of 64-bit quad core mid-class microprocessors developed by **AMD** and introduced in 2012

A **Xeon processor** is an Intel CPU designed and manufactured primarily for use in high-end military and industrial servers and workstations. **Xeon** CPUs tend to have a lot more built-in, business-critical technology. For example, they support error-correcting code (ECC) memory, which prevents data corruption and system crashes

AMD's new 2990WX is now the world's fastest CPU, with some caveats. AMD's Threadripper 2990WX has finally launched, and it is officially the fastest CPU in the world. With 32 cores, 64 threads, and an all **core** frequency of 3.4 GHz, it's a monstrous CPU

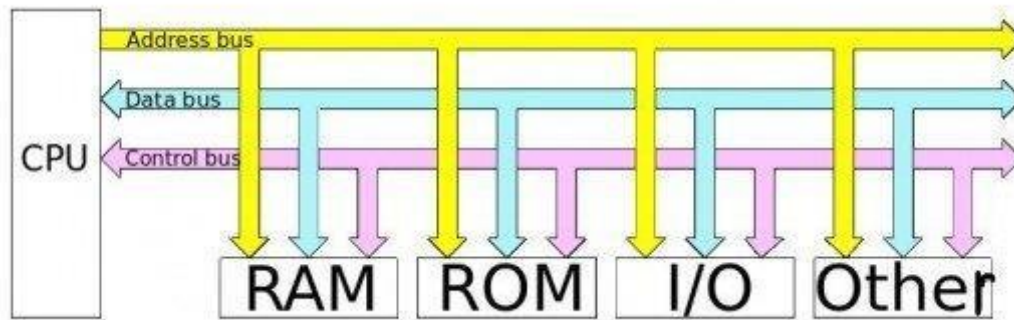
(**Snapdragon** 865 Plus has an Adreno 650 GPU (graphics processing unit) for graphics, whose speed is 10 percent more than before. Its CPU speed is from 2.84GHz to 3.1GHz, which is claimed to be the fastest speed ever. Samsung has launched the new 5G **Exynos** processor. This processor will be used in mid-range smartphones)

.Types of Buses in Computer Architecture

Inside computers, there are many internal components. In order for these components to communicate with each other, they make use of wires that are known as a '**bus**'.

A **bus** is a **common pathway** through which information flows from one computer component to another. This pathway is used for communication purpose and it is established between two or more computer components. We are going to check different **computer bus architectures** that are found in computers.

Different Types of Computer Buses



The Computer Buses | Source

Functions of Buses in Computers

Summary of functions of buses in computers

1. **Data sharing** - All types of buses found in a computer transfer data between the computer peripherals connected to it.

The buses transfer or send data either in the serial or parallel method of data transfer. This allows for the exchange of 1, 2, 4 or even 8 bytes of data at a time. (A byte is a group of 8 bits). Buses are classified depending on how many bits they can move at the same time, which means that we have 8-bit, 16-bit, 32-bit or even 64-bit buses.

2. **Addressing** - A bus has address lines, which match those of the processor. This allows data to be sent to or from specific memory locations.

3. **Power** - A bus supplies power to various peripherals connected to it.

4. **Timing** - The bus provides a **system clock** signal to synchronize the peripherals attached to it with the rest of the system.

The expansion bus facilitates easy connection of more or additional components and devices on a computer such as a TV card or sound card.

There are a lot of cables involved when getting a computer connected and ready to run. Also there are many different types of connection ports for the cables. Some cables can be made at home with the right connectors, So I will show pin-outs for these connectors so you will know which pin gets soldered to where.

PCI - A **Peripheral Component Interconnect Bus** (PCI bus) connects the CPU and expansion boards such as modem cards, network cards and sound cards. These expansion boards are normally plugged into expansion slots on the motherboard. **Peripheral Component Interconnect (PCI)** is one of the latest developments in bus architecture and is the current standard for PC expansion cards. Intel developed and launched it as the expansion bus for the Pentium processor in 1993. It is a local bus like VESA, that is, it connects the CPU, memory, and peripherals to a wider, faster data pathway.

PCI supports both 32-bit and 64-bit data width; it is compatible with 486s and Pentiums. The bus data width is equal to the processor, such as a 32-bit processor would have a 32 bit PCI bus, and operates at 33MHz.

PCI was used in developing Plug and Play (PnP) and all PCI cards support PnP. This means a user can plug a new card into the computer, power it on and it will “self-identify” and “self-specify” and start working without manual configuration using jumpers.

Unlike VESA, PCI supports **bus mastering** that is, the bus has some processing capability and thus the CPU spends less time processing data. Most PCI cards are designed for 5v, but there are also 3v and dual-voltage cards. Keying slots used help to differentiate 3v and 5v cards and also to make sure that a 3v card is not slotted into a 5v socket and vice versa

AGP (Accelerated Graphics Port)

is heavily based on [PCI](#), and in fact the AGP bus is a **superset of the conventional PCI bus**, and AGP cards must act as PCI cards. The primary advantage of AGP over PCI is that it provides a dedicated pathway between the slot and the processor rather than sharing the PCI bus. The need for high quality and very fast performance of video on computers led to the development of the **Accelerated Graphics Port (AGP)**. The AGP Port connects to the CPU and operates at the speed of the processor bus. This means that video information is sent more quickly to the card for processing.

The AGP uses the main PC memory to hold 3D images. In effect, this gives the AGP video card an unlimited amount of video memory. To speed up the data transfer, Intel designed the port as a direct path to the PC's main memory.

Data transfer rate ranges from 264 Mbps to 528mbps, 800 Mbps up to 1.5 Gbps. AGP connector is identified by its brown colour

A Universal Serial Bus (USB)

is basically a newer port that is used as a common interface to connect several different types of devices such as: This is an external bus standard that supports data transfer rates of 12 Mbps. A single USB port connects up to **127 peripheral devices**, such as mice, modems, and keyboards. The USB also supports hot plugging or insertion (ability to connect a device without turning the PC off) and plug and play (You connect a device and start using it without configuration).

We have two versions of USB:-









- Keyboards.
- Printers.
- Media devices.
- Cameras.
- Scanners.

Color-coding scheme for connectors and ports

Most computers today follow a common color code for the device ports located in the rear of your computer. But not all devices follow this color scheme, so this Computer Connection Diagram will help you to identify what devices go to each connection point. Granted, some devices are made to obviously go to a unique port but some are common to one another and may be inserted into the wrong ports

Perhaps the most end-user visible and lasting impact of PC 99 was that it introduced a [color code](#) for the various standard types of plugs and connectors used on PCs.^[2] As many of the connectors look very similar, particularly to a novice PC user, this made it far easier for people to connect peripherals to the correct ports on a PC. This color code was gradually adopted by

almost all PC and [motherboard](#) manufacturers. Some of the color codes have also been widely adopted by peripheral manufacturers.

	Color	Function	Connector on PC
User input			
	Green	PS/2 mouse / pointing device	6-pin mini-DIN female
	Purple	PS/2 keyboard	6-pin mini-DIN female
	Gold	Game port / MIDI	15-pin D female
General input/output			
	White	USB 1 low speed and full speed	USB Type A receptacle
	Black	USB 2.0 high speed	USB Type A receptacle
	Sky blue	USB 3.0 SuperSpeed	USB Type A SuperSpeed receptacle
	Yellow	USB 3.0 SuperSpeed Always On even if the PC is turned off	USB Type A SuperSpeed receptacle
	Red	High-power USB (more than 500 mA current available)	USB Type A receptacle

	<u>Grey</u>	IEEE 1394 (FireWire)	6-pin FireWire 400 or 9-pin FireWire 800
	<u>Burgundy</u>	Parallel port	25-pin D female
	<u>Teal or turquoise</u>	Serial port	9-pin D male
<u>Video</u>			
	<u>Blue</u>	Analog monitor	15-pin VGA female
	<u>White</u>	Digital monitor	DVI female (Digital Visual Interface)
	<u>Yellow</u>	S-Video	4-pin mini-DIN
	<u>Yellow</u>	Composite video	RCA jack
	<u>Black</u>	Digital audio/video	HDMI or DisplayPort female
<u>Audio</u>			
	<u>Pink</u>	Analog microphone audio input (mono or stereo)	3.5 mm TRS (TRS stand for Tip, Ring, and Sleeve)
	<u>Light blue</u>	Analog line level audio input	3.5 mm TRS
	<u>Lime green</u>	Analog line level audio output, front stereo (speakers or headphones)	3.5 mm TRS
	<u>Black</u>	Analog line level audio output, rear stereo (surround speakers)	3.5 mm TRS

<u>Orange</u>	Analog line level audio output, center and <u>subwoofer</u> (surround speakers)	3.5 mm <u>TRS</u>
<u>Silver</u>	Analog line level audio output, side stereo (surround speakers)	3.5 mm <u>TRS</u>
<u>Orange</u>	Digital audio output (coaxial S/PDIF)	<u>RCA connector</u> (Radio Corporation of America)

MEMORY AND I/O DEVICE

1. **Primary Memory / Volatile Memory.**
2. **Secondary Memory / Non Volatile Memory.**

1. Primary Memory / Volatile Memory– Primary memory is internal memory of the computer. It is also known as main memory and Temporary memory .Primary Memory holds the data and instruction on which computer is currently working. Primary Memory is nature volatile. It means when power is switched off it lost all data. The **memory** devices used for **primary memory** are semiconductor **memories**. **Primary memory** is also known as Main **memory** or Internal **memory**.

Types of Primary Memory– Primary memory is generally of two types.

1. **RAM**
2. **ROM**

1. RAM (Random Access Memory) – It stands for Random Access Memory.RAM is known as read /writes memory. It generally refereed as main memory of the computer system. It is a temporary memory. The information stored in this memory is lost as the power supply to the computer is switched off. That's why RAM is also called "**Volatile Memory**". **Types of RAM–** RAM is also of two types:

a) Static RAM- Static RAM also known as SRAM ,retain stored information as long as the power supply is ON. SRAM are of higher cost and consume more power .They have higher speed than Dynamic RAM

b)Dynamic RAM– Dynamic RAM also known as DRAM, its stored information in a very short time (a few milliseconds) even though the power supply is ON. The Dynamic RAM are cheaper and moderate speed and also they consume less power.

2. ROM (Read Only Memory) – It stands for Read Only Memory.ROM is a Permanent Type memory. Its content are not lost when power supply is switched off. Content of ROM is decided by the computer manufacturer and permanently stored at the time of manufacturing. ROM cannot be overwritten by the computer. It is also called “**Non-Volatile Memory**”.

Type of ROM: ROM memory is three types names are following-

1. **PROM(Programmable Read Only Memory)**-PROM chip is programmable ROM. it is PROM chips to write data once and read many. once chip has been programmed ,the recorded information cannot be changed. PROM is also nonvolatile memory.
2. **EPROM (Erasable Programmable Read Only Memory)**- EPROM chip can be programmed time and again by erasing the information stored earlier in it. Information stored in EPROM exposing the chip for some time ultraviolet light .
3. **EEPROM (Electrically Erasable Programmable Read Only Memory)**-The EEPROM is programmed and erased by special electrical waves in millisecond. A single byte of a data or the entire contents of device can be erased.

2. Secondary Memory / Non Volatile Memory– Secondary Memory is external memory of the computer. It is also known as Auxiliary memory and permanent memory. It is used to store the different programs and the information permanently. Secondary Memory is nature non volatile. It means data is stored permanently even if power is switched off. The **secondary memory** devices are magnetic and optical **memories** **Secondary memory** is also known as External **memory** or Auxiliary **memory**.

There are three main types of secondary storage in a computer system:

- solid state storage devices, such as USB memory sticks.
- optical storage devices, such as CD, DVD and Blu-ray discs.
- magnetic storage devices, such as hard disk drives

The secondary storage devices are:

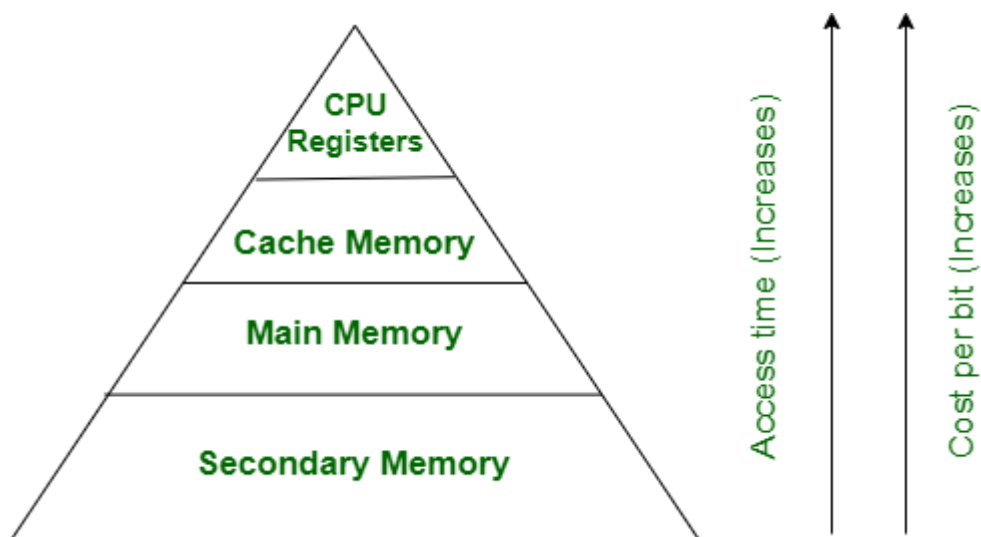
1. Floppy Disks
2. Magnetic (Hard) Disk
3. Magnetic Tapes
4. Pen Drive
5. Optical Disk(CD,DVD)
6. Solid State Drive provides a persistent flash memory. It's very fast compared to Hard Drives. Frequently found in Mobile phones, its rapidly being adopted in PC/Laptop/Mac

Difference between Primary and Secondary Memory

Computer Memories store data and instruction. Memory system can be divided into 4 categories:

- CPU register
- Cache memory
- Primary / Main memory
- Secondary Memory / Mass Storage

They can be represented in an hierarchical form as:



1. Primary / Main memory:

Primary memory is the computer memory that is directly accessible by CPU. It is comprised of DRAM and provides the actual working space to the processor. It holds the data and instructions that the processor is currently working on. The main features of **primary memory**, which distinguish it from secondary **memory** are – It is accessed directly by the processor. It is the fastest **memory** available. Each word is stored as well as. It is volatile, i.e. its contents are lost once power is switched off.

2. Secondary Memory / Mass Storage:

The contents of the secondary memory first get transferred to the primary memory and then are accessed by the processor, this is because the processor does not directly interact with the secondary memory. **Secondary memory** refers to storage devices, such as hard drives and solid state drives. It may also refer to removable storage media, such as USB flash drives, CDs, and DVDs For example, a computer may have a one terabyte hard drive, but only 16 gigabytes of RAM

Now, Let's see the difference between Primary memory and Secondary memory:

SR.NO.	PRIMARY MEMORY	SECONDARY MEMORY
1.	Primary memory is temporary.	Secondary memory is permanent.
2.	Primary memory is directly accessible by Processor/CPU.	Secondary memory is not directly accessible by the CPU.
3.	Nature of Parts of Primary memory varies, RAM- volatile in nature. ROM- Non-volatile.	It's always Non-volatile in nature.
4.	Primary memory devices are more expensive than secondary storage devices.	Secondary memory devices are less expensive when compared to primary memory devices.
5.	The memory devices used for primary memory are semiconductor memories.	The secondary memory devices are magnetic and optical memories.

SR.NO.	PRIMARY MEMORY	SECONDARY MEMORY
		Secondary memory is also known
	Primary memory is also known as	as External memory or Auxiliary
6.	Main memory or Internal memory.	memory.
	Examples: RAM, ROM, Cache	
	memory, PROM, EPROM, Registers,	Examples: Hard Disk, Floppy Disk,
7.	etc.	Magnetic Tapes, etc.

Memory access time. Access time is the amount of time it takes the processor to read data, instructions, and information from memory.

A computer's access time directly affects how fast the computer processes data.

The time a program or device takes to locate a single piece of information and make it available to the computer for processing. *DRAM (dynamic random access memory)* chips for personal computers have access times of 50 to 150 nanoseconds (billionths of a second). *Static RAM (SRAM)* has access times as low as 10 nanoseconds. Ideally, the access time of memory should be fast enough to keep up with the CPU. If not, the CPU will waste a certain number of clock cycles, which makes it slower.

Note, however, that reported access times can be misleading because most memory chips, especially DRAM chips, require a pause between back-to-back accesses. This is one reason why SRAM is so much faster than DRAM, even when the reported access times are equivalent; SRAM doesn't require any refreshes, so there is no pause between back-to-back accesses. A more important measurement of a chip's speed, therefore, is its cycle time, which measures how quickly two back-to-back accesses can be made.

Access time is also frequently used to describe the speed of disk drives. Disk access times are measured in milliseconds (thousandths of a second), often abbreviated as *ms*. Fast hard disk drives for personal computers boast access times of about 9 to 15 milliseconds. Note that this is about 200 times slower than average DRAM.

The access time for disk drives includes the time it actually takes for the *read/write head* to locate a sector on the disk (called the *seek time*). This is an average time since it depends on how far away the head is from the desired data.

Access time in a computer memory is the time required to Both locate and retrieve the data. Cycle time is the time, usually measured in nanosecond s, between the start of one random access memory (RAM) access to the time when the next access can be started. Access time is sometimes used as a synonym. Memory access time is how long it takes for a character in memory to be transferred to or from the CPU. In a PC or Mac, fast RAM chips have an access time of 70 nanoseconds (ns) or less. SDRAM (**Synchronous Dynamic Random Access Memory**) chips have a burst mode that obtains the second and subsequent characters in 10 ns or less.

DRAM (dynamic random access memory) chips for personal computers have access times of 50 to 150 nanoseconds (billionths of a second). Static RAM (SRAM) has access times as low as 10 nanoseconds. Ideally, the access time of memory should be fast enough to keep up with the CPU.

Memory speed

The speed rating of your RAM module is an expression of its data transfer rate. The faster the number, the faster your computer can store and retrieve the data stored in local memory. The formula for the exact speed rating changes slightly based on the version of DDR memory your computer is using (see below). It's no longer simply

Random Access Memory is an integrated circuit chip made from millions of transistors and capacitors. Each pair of transistor and capacitor make up a cell, and these cells are where the data is stored.

These cells hold and release electrical charges to write, rewrite, and erase data. This allows data to regularly change much faster than your traditional mechanical drive (HDD) that uses platters and actuator arms. Even [SSD's](#) can't compete with the speeds RAM provides.

RAM is also **volatile**, meaning that any data that is held within its cells will be lost when it loses power. This is why we don't permanently write data to our RAM modules.

The **Random Access** part of Random Access Memory comes from the fact that data can be written to any cell in any order, and can be read from any cell as long as the physical location of the cell containing the data is known

Finding the *real* speed of your RAM comes down to a couple of factors, and has been embodied in a handy little formula. However, before we show you the formula, let's understand the different factors to consider when finding your RAM speed.

The first factor is the RAM clock speed; let's take 3200Mhz as an example.

The next factor relates to what RAM you have. For example, DDR (Double Data Rate) transfers data on both sides of the clock cycle. Meaning, it transfers data twice in one cycle.

And lastly, your RAM CL Timing, which is the first of the four numbers that make up the RAM timing. We'll use (14-15-15-39) for this example.

Those are the factors, so let's put them into an equation to work out the exact RAM speed.

(On Windows 10, [use the Task Manager](#). Right-click your taskbar and select "Task Manager" or press Ctrl+Shift+Esc to open it. Click the "Performance" tab and select "Memory" in the left pane. If you don't see any tabs, click "More Details" first.)

Several factors affect your PC's performance. The central processing unit (CPU), or processor, is an important and obvious one – it's clear that the faster the CPU, the faster your PC will perform. Storage is another, with solid-state drives (SSDs) performing much faster than old-school spinning hard disk drives (HDDs). Another important performance factor is RAM, or memory, speed. Not all RAM is created equal, with some being much faster than others. The difference won't be apparent to the typical user mainly browsing the web, but if you're a gamer or creative professional, then RAM speed could be important.

This guide will introduce you to the idea of RAM speed and provide a basic overview of how it affects PC performance.

RAM Parameters

The first component of RAM speed, and the most cited, is its data transfer rate. This is simply the amount of data that the RAM can pass to and from your CPU. Today, most RAM is called Double Data Rate (DDR) RAM with a number after the acronym that shows its generation. For example, DDR4 for the fourth and current generation. After that, there is a number that

designates the speed it can perform at measured in Megahertz (MHz), or millions of cycles per second.

As this guide is being written, RAM speeds vary from DDR4-1600 (or a 1,600MHz data rate) to [DDR4-3200](#) (or a 3,200MHz data rate). You'll also see RAM written as a PC4 specification, which is the data rate times eight. So, DDR4-1600 might also be called PC4-12800, and DDR4-3200 might also be called PC4-25600.

With all of that said, the faster the data rate, the faster the RAM. That much is simple enough. Modern RAM runs best when it's installed in matched memory module pairs – that's the "Double Data Rate" part of DDR4. If just a single memory module is installed, or mismatched modules are used, then the data rate will be half of the specification. For example, DDR4-3200 would run at just 1,600MHz.

The next component of RAM speed that you might find listed for a memory module is the timing or latency rate. This can get extremely complicated, so we won't be covering it in detail here, but you'll see numbers formatted like 7-8-8-24 when reading RAM specifications. These four numbers refer to the time it takes the RAM to perform certain functions. Basically, the smaller these numbers the faster the RAM will perform.

What it means for your PC

As we said before, the faster your RAM, the more data can be fed to and from your CPU, storage, and in the case of integrated graphics that use system RAM, the graphical processing unit (GPU) every second. A discrete [GPU](#) will have its own memory, designated as some generation of Video RAM or VRAM; for example, video RAM currently tops out at GDDR6.

While RAM speed is important, it's better to have more RAM than faster RAM. If you're configuring your PC and have budget constraints, then you might find it economical to buy more RAM that's rated at a slower speed than fewer, faster modules. If you're wondering how much RAM to buy, then check out our other RAM guide.

Faster RAM is better, but not vital

To stress the point, it's always better to have faster components – if you can afford it. But RAM speed is less important for most people than CPU, GPU, and storage performance, and again, it's better to have more RAM than faster RAM. If you're looking to upgrade your PC to make it faster, then spending your money on extra RAM modules, a faster CPU, more powerful GPU, or an SSD instead of an HDD, will give you more bang for your buck.

Prior to SDRAM, speed was expressed in terms of **nanoseconds** (ns). This measured the amount of time it takes the module to deliver a data request. Therefore, the lower the

nanosecond speed, the faster. Typical speeds were 90, 80, 70 and 60ns. Older 486 machines may have 80 or 90. More recent Pentiums will have 60 or 70.

HARD DISK

A hard disk, also referred to as a disk drive or hard drive, is a magnetic disk for storing computer data. It uses magnetic storage to store and retrieve digital data using one or more rigid, rapidly rotating platters coated with magnetic material. The platters are paired with magnetic heads that read and write data to the platter surfaces. Data is randomly accessed, meaning individual blocks of data can be retrieved and stored in any order. Hard disks contrast with floppy disks, as they are faster and hold more data than floppy disks.

Hard disk (hard drive) construction

Hard disks are rigid platters, composed of a substrate and a magnetic medium. The substrate – the platter's base material – must be non-magnetic and capable of being machined to a smooth finish. It is made either of aluminum alloy or a mixture of glass and ceramic. To allow data storage, both sides of each platter are coated with a magnetic medium – formerly magnetic oxide, but now, almost exclusively, a layer of metal called a thin-film medium. This stores data in magnetic patterns, with each platter capable of storing a billion or so bits per square inch (bps) of platter surface.



Platters vary in size and hard disk drives come in two form factors, 5.25in or 3.5in. The trend is towards glass technology since this has the better heat resistance properties and allows platters to be made thinner than aluminum ones. The inside of a hard disk drive must be kept as dust-free as the factory where it was built. To eliminate internal contamination, air

pressure is equalised via special filters and the platters are hermetically sealed in a case with the interior kept in a partial vacuum. This sealed chamber is often referred to as the head disk assembly (HDA).

Typically two, three or more platters are stacked on top of each other with a common spindle that turns the whole assembly at several thousand revolutions per minute. There's a gap between the platters, making room for magnetic read/write head, mounted on the end of an actuator arm. This is so close to the platters that it's only the rush of air pulled round by the rotation of the platters that keeps the head away from the surface of the disk – it flies a fraction of a millimeter above the disk. On early hard disk drives this distance was around 0.2mm. In modern-day drives this has been reduced to 0.07mm or less. A small particle of dirt could cause a head to crash, touching the disk and scraping off the magnetic coating. On IDE and SCSI drives the disk controller is part of the drive itself.

There's a read/write head for each side of each platter, mounted on arms which can move them towards the central spindle or towards the edge. The arms are moved by the head actuator, which contains a voice-coil – an electromagnetic coil that can move a magnet very rapidly. Loudspeaker cones are vibrated using a similar mechanism.

The heads are designed to touch the platters when the disk stops spinning – that is, when the drive is powered off. During the spin-down period, the airflow diminishes until it stops completely, when the head lands gently on the platter surface – to a dedicated spot called the landing zone (LZ). The LZ is dedicated to providing a parking spot for the read/write heads, and never contains data.

A **hard disk drive (HDD)**, **hard disk**, **hard drive**, or **fixed disk**^[b] is an electro-mechanical data storage device that stores and retrieves digital data using magnetic storage and one or more rigid rapidly rotating platters coated with magnetic material. The platters are paired with magnetic heads, usually arranged on a moving actuator arm, which read and write data to the platter surfaces.^[2] Data is accessed in a random-access manner, meaning that individual blocks of data can be stored and retrieved in any order. HDDs are a type of non-volatile storage, retaining stored data even when powered off.^{[3][4][5]}

Introduced by IBM in 1956,^[6] HDDs were the dominant secondary storage device for general-purpose computers beginning in the early 1960s. HDDs maintained this position into the modern era of servers and personal computers, though personal computing devices

produced in large volume, like cell phones and tablets, rely on flash products. More than 224 companies have produced HDDs historically, though after extensive industry consolidation most units are manufactured by Seagate, Toshiba, and Western Digital. HDDs dominate the volume of storage produced (exabytes per year) for servers. Though production is growing slowly (by exabytes shipped, sales revenues and unit shipments are declining because solid-state drives (SSDs) have higher data-transfer rates, higher areal storage density, better reliability,^[8] and much lower latency and access times.

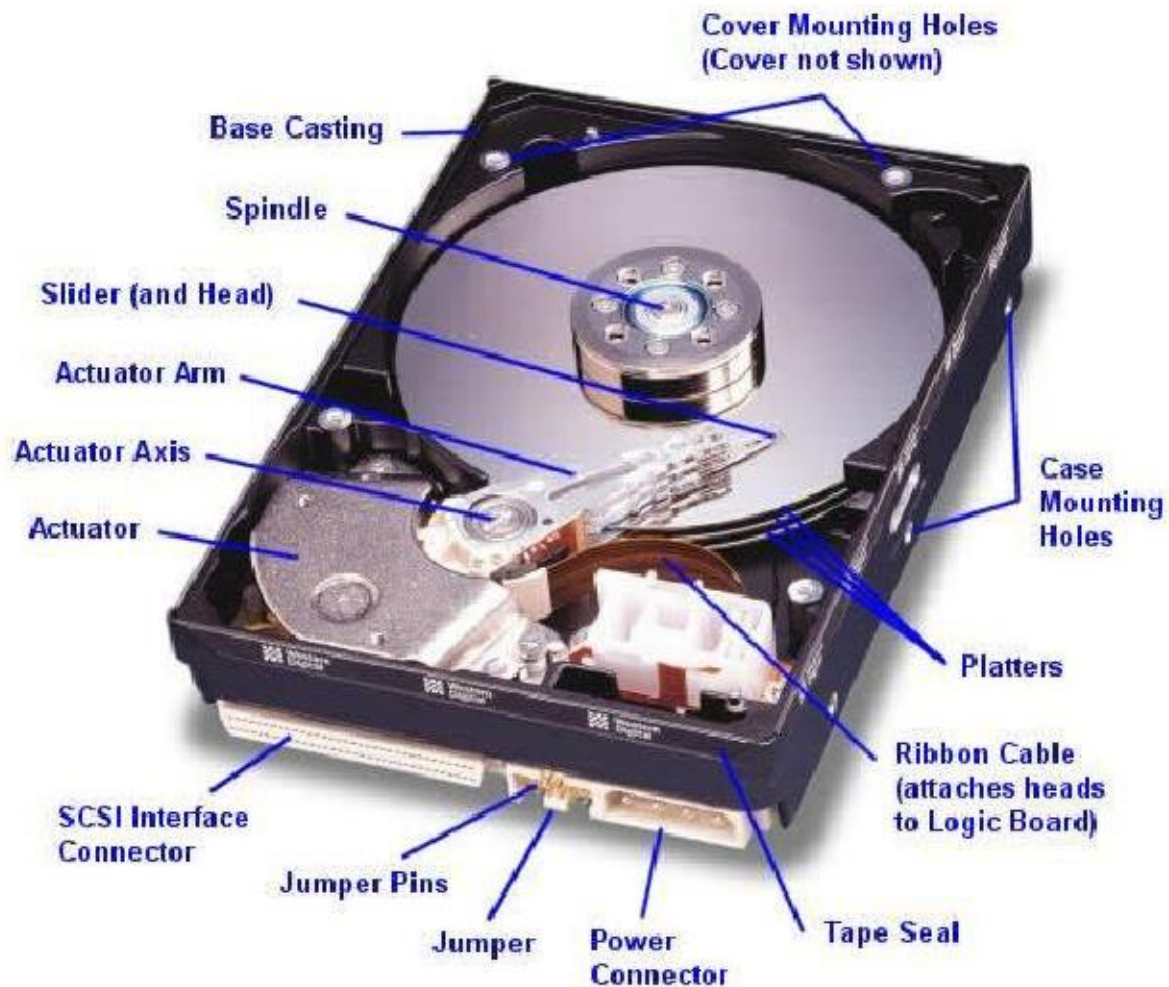
The revenues for SSDs, most of which use NAND, slightly exceed those for HDDs. Flash storage products had more than twice the revenue of hard disk drives as of 2017.^[14] Though SSDs have four to nine times higher cost per bit,^{[15][16]} they are replacing HDDs in applications where speed, power consumption, small size, high capacity and durability are important.^{[11][12]} Cost per bit for SSDs is falling, and the price premium over HDDs has narrowed.^[16]

The primary characteristics of an HDD are its capacity and performance. Capacity is specified in unit prefixes corresponding to powers of 1000: a 1-terabyte (TB) drive has a capacity of 1,000 gigabytes (GB; where 1 gigabyte = 1 billion bytes). Typically, some of an HDD's capacity is unavailable to the user because it is used by the file system and the computer operating system, and possibly inbuilt redundancy for error correction and recovery. Also there is confusion regarding storage capacity, since capacities are stated in decimal Gigabytes (powers of 10) by HDD manufacturers, whereas some operating systems report capacities in binary Gibibytes, which results in a smaller number than advertised. Performance is specified by the time required to move the heads to a track or cylinder (average access time) adding the time it takes for the desired sector to move under the head (average latency, which is a function of the physical rotational speed in revolutions per minute), and finally the speed at which the data is transmitted (data rate).

The two most common form factors for modern HDDs are 3.5-inch, for desktop computers, and 2.5-inch, primarily for laptops. HDDs are connected to systems by standard interface cables such as PATA (Parallel ATA), SATA (Serial ATA), USB or SAS (Serial Attached SCSI)

To many people, a hard disk is a "black box" of sorts—it is thought of as just a small device that "somehow" stores data. There is nothing wrong with this approach of course, as long as all you care about is that it stores data. If you use your hard disk more than just a place to "keep stuff", then you want to know more about your hard disk. It is hard to really understand the factors that affect performance, reliability and interfacing without knowing how the drive works internally. Fortunately, most hard disks are basically the

same on the inside. While the technology evolves, many of the basics are unchanged from the first PC hard disks in the early 1980s



How a hard drive works

In your computer's hard drive, there aren't really any iron nails. There's just a large shiny, circular "plate" of magnetic material called a **platter**, divided into billions of tiny areas. Each one of those areas can be independently magnetized (to store a 1) or demagnetized (to store a 0). Magnetism is used in computer storage because it goes on storing information even when the power is switched off. If you magnetize a nail, it stays magnetized until you demagnetize it. In much the same way, the computerized information (or data) stored in your PC hard drive or iPod stays there even when you switch the power off.

A hard drive has only a few basic parts. There are one or more shiny silver platters where information is stored magnetically, there's an arm mechanism that moves a tiny magnet called a **read-write head** back and forth over the platters to record or store information, and

there's an [electronic](#) circuit to control everything and act as a link between the hard drive and the rest of your computer.

After a hard-drive crash last year, I was left with an old drive that no longer worked. I took a peek inside, and here's what I found...



1. Actuator that moves the read-write arm. In older hard drives, the actuators were [stepper motors](#). In most modern hard drives, **voice coils** are used instead. As their name suggests, these are simple electromagnets, working rather like the moving coils that make sounds in [loudspeakers](#). They position the read-write arm more quickly, precisely, and reliably than stepper motors and are less sensitive to problems such as temperature variations.
2. Read-write arm swings read-write head back and forth across platter.
3. Central spindle allows platter to rotate at high speed.
4. Magnetic platter stores information in binary form.
5. Plug connections link hard drive to circuit board in personal computer.
6. Read-write head is a tiny magnet on the end of the read-write arm.
7. Circuit board on underside controls the flow of data to and from the platter.
8. Flexible connector carries data from circuit board to read-write head and platter.
9. Small spindle allows read-write arm to swing across platter

The platters are the most important parts of a hard drive. As the name suggests, they are disks made from a hard material such as [glass](#), [ceramic](#), or [aluminum](#), which is coated with a thin layer of metal that can be magnetized or demagnetized. A small hard drive typically has only one platter, but each side of it has a magnetic coating. Bigger drives have a series of platters stacked on a central spindle, with a small gap in between them. The platters

rotate at up to 10,000 revolutions per minute (rpm) so the read-write heads can access any part of them.

There are two read-write heads for each platter, one to read the top surface and one to read the bottom, so a hard drive that has five platters (say) would need ten separate read-write heads. The read-write heads are mounted on an electrically controlled arm that moves from the center of the drive to the outer edge and back again. To reduce wear and tear, they don't actually touch the platter: there's a layer of fluid or air between the head and the platter surface.

Reading and writing data

The most important thing about memory is not being able to store information but being able to *find it* later. Imagine storing a magnetized iron nail in a pile of 1.6 million million identical nails and you'll have some idea how much trouble your computer would get into if it didn't use a very methodical way of filing its information.

When your computer stores data on its hard drive, it doesn't just throw magnetized nails into a box, all jumbled up together. The data is stored in a very orderly pattern on each platter. Bits of data are arranged in concentric, circular paths called **tracks**. Each track is broken up into smaller areas called **sectors**. Part of the hard drive stores a map of sectors that have already been used up and others that are still free. (In Windows, this map is called the **File Allocation Table** or **FAT**.) When the computer wants to store new information, it takes a look at the map to find some free sectors. Then it instructs the read-write head to move across the platter to exactly the right location and store the data there. To read information, the same process runs in reverse.

How does an electronic computer manipulate all the mechanical nitty gritty in a hard drive? There is an interface (a connecting piece of equipment) between them called a **controller**. This is a small circuit that operates the actuators, selects specific tracks for reading and writing, and converts parallel streams of data going from the computer into serial streams of data being written to the disk (and vice versa). Controllers are either built into the disk drive's own circuit board or part of the computer's main board (motherboard).

With so much information stored in such a tiny amount of space, a hard drive is a remarkable piece of engineering. That brings benefits (such as being able to store 500 CDs on your iPod)—but drawbacks too. One of them is that hard drives can go wrong if they get dirt or dust inside

them. A tiny piece of dust can make the read-write head bounce up and down, crashing into the platter and damaging its magnetic material. This is known as a **disk crash** (or **head crash**) and it can (though it doesn't always) cause the loss of all the information on a hard drive. A disk crash usually occurs out of the blue, without any warning. That's why you should always keep backup copies of your important documents and files, either on another hard drive, on a [compact disc \(CD\) or DVD](#), or on a flash memory stick.

WORKING PRINCIPLE

The disk, when new, does not contain anything on it. It is just like a plain paper and there is no parts or lines or anything on which the data can be written or arranged. Partitioning of the drive is a process in which the drive space is physically divided into pieces called volumes or partitions. They can be accessed by different letters like C, D, E etc. Actually still the disk is one but you have made limits for storing data in various parts or volumes. The DOS's FDISK command is used for drive partitioning. The format of drive/disk which is made first to store data is also known as disk geometry. It includes sides, Tracks, Cylinders and Sectors

FILE SYSTEM

Computers use particular kinds of file systems to store and organize data on media, such as a [hard drive](#), the CDs, DVDs, and BDs in an [optical drive](#) or on a [flash drive](#).

A file system can be thought of as an index or database containing the physical location of every piece of data on the hard drive or another storage device. The data is usually organized in folders called directories, which can contain other folders and files.

Any place that a computer or other electronic device stores data employs some type of file system. This includes your Windows computer, your Mac, your smartphone, your bank's ATM—even the computer in your car!

File Systems

A file system is the *method* used to organise data on a disk. It controls the allocation of disk space to files, and associates each file with a filename, directory, permissions, and other information.

A file system is a structure used for storing and managing data. It includes a boot, file and directory structures. A file system also needs to..

- track free and used space
- maintain file and directory names
- record where each file is located on disk

The choice of file system is an important one since it affects performance, recovery from errors, compatibility with other operating systems, limitations on partition and file sizes, and so on. Common file systems are:-

<i>File System</i>	<i>OS</i>	<i>Accessible by</i>
FAT 16	DOS, Win3.1, Win95	Win98/NT/2000/ ME/XP/Linux
FAT 32	Win95 (2nd release), Win98, ME, 2000,	Win98/NT/2000/ ME/XP/Linux <i>not DOS, Win3.1, Win95(1st release)</i>
NTFS	WinNT, 2000, XP	WinNT, 2000, XP <i>not DOS, Win3.1, Win95, Win98, read-only for Linux</i>
EXT2 or EXT3	Linux	Linux or Unix <i>not DOS or Windows</i>
Netware	Novell Netware	Netware <i>not DOS, Windows, Linux or Unix</i>

FAT is characterized by the use of a **File Allocation Table** and **clusters**. A cluster is a small fixed number of sectors and are the smallest unit of data storage. FAT records which clusters are allocated, which are free and where files are stored within clusters.

The FAT table also has a root directory that records information about each sub-directory. Each sub-directory entry contains information about files in the form of file name, creation date, the first cluster used by the file and file attributes, (hidden, read-only, etc.)

FAT 16

FAT16 was the standard partition type up to Windows 95 - used by DOS, Windows 3.1 and Windows 95 (1st release). Although FAT16 partitions are supported by all versions of Windows, FAT16 partitions are limited to a maximum of 2Gb.

FAT 32

FAT32 is supported by Windows95 second edition onwards, including Windows 2000 but not WinNT. FAT32 partitions are the standard with Windows 98.

FAT32 is based on 32-bit file allocation table entries rather than 16-bit entries used by FAT16. As a result, FAT32 supports larger disks or partition sizes than FAT16. Although the theoretical maximum size for FAT32 is 2 TB, Windows98's scandisk only supports 128Gb, and Windows 2000 does not permit the creation of FAT32 disks larger than 32Gb.

Unlike file systems such as NTFS (WinNT, 2000, XP) and EXT (Linux), FAT file systems are unable to hold information on **file ownership** and **permissions**. Since Linux supports both reading from, and writing to FAT16 and FAT32 partitions, quite often FAT partitions are used to allow file sharing between Linux and Windows on a dual-boot system.

NTFS

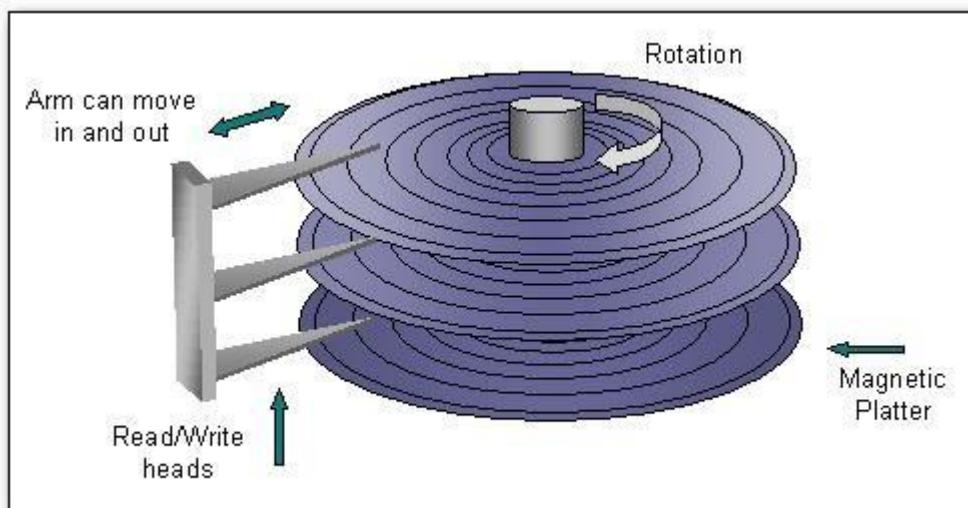
NTFS (new technology file system) is a file system introduced with Windows NT v4.0. Windows 2000 and XP also use NTFS. Linux, installed on another partition or

disk, can only access an NTFS partition in read-only mode. NTFS partitions are not accessible from Windows 95 or 98.

Like FAT 16 and FAT32, NTFS uses clusters, but a cluster size of 512 bytes can be specified which reduced file fragmentation and wasted disk space. So NTFS performs well on large disks. Unlike FAT systems, NTFS supports the holding of information on **file ownership** and **permissions**.

Physical Formatting

A magnetic disk is physically **formatted** (also call a low-level format) into a **tracks**, **sectors** and **cylinders**, usually by the manufacturer. Physical formatting divides the disk into basic elements so that data can be read from the disk.



After formatting, the magnetic quality of the surface may gradually deteriorates. the read-write heads may find it difficult to read the magnetic properties of sectors. Any sector that becomes impossible to read is marked as a **bad sector** and is ignored by the computer.

Logical Formatting

After physical formatting, the disk must be logically formatted. This process places a **file system** on disk and allows an operating system to store and retrieve files. Different operating systems (Windows 9x, NT, Linux etc.) use different file systems. So a disk must be formatted using the correct file system for the operating system that you plan too install.

Do you know the type of file system commonly used by the operating systems listed below?

After a disk is formatted using a particular file system, you are usually limited to installing one operating system. However, it is possible to logically format a disk using more than one file system using a technique called **partitioning**.

Partitioning effectively divides up your hard disk into different parts, allowing you to logically format each part separately, using different file systems and installing *different* operating systems, if you choose.

Partitioning

After a disk has been physically formatted and normally before it is logically formatted, a disk can be sectioned up into discrete units called partitions. Effectively, each partition is separate from another partition and can be logically formatted with a file system different from file systems on other partitions.

This is tremendously useful for:-

- installing more than one operating system onto a disk. You can just give each OS its own partition.
- Separating data

Once a partition is logically formatted it is called a **volume** and you can give this volume a name if you like, to help identify it.

The picture below shows a disk partitioned into two volumes. The first volume has an NTFS file system and the volume label is *WinXP*. The second volume has a FAT32 file system and the volume label is *MYFILES*.

Disk	Partition	Type	Size MB	Used MB	Unused MB	Status	Pri/Log
1	C:WinXP	NTFS	9,993.5	8,106.5	1,887.0	Active	Primary
1	*:MYFILES	FAT32	28,168.7	14,730.4	13,438.2	None	Primary

Now, there are three types of partitions, primary, extended and logical.

Primary Partitions

A primary partition can contain an operating system and/or data files. There is a **limit** to the number of primary partitions a disk can have. A disk can be sectioned up into **at most** four primary partitions.

One of the partitions must be set as the **active** partition. The active partition is the one used at boot up time and so it should contain an operating system. You can change the active partition at any time to another primary partition using a utility such as DOS's **fdisk**.

Only one primary partition can be active at any one time.

Extended Partitions

Extended partitions are used to overcome the four-partition limit on primary partitions. Effectively, an extended partition is a container for logical partitions and it can contain an unlimited number of them. This is useful for further partitioning of the disk.

For example, say you wish to have five partitions. You could create three primary partitions with one of the primary partitions containing an extended partition containing two logical partitions.

Extended partitions in themselves do not hold data, they just hold logical partitions.

Logical Partitions

Logical partitions can contain an operating system and/or data files, just like primary partitions. However, you should be aware that not all operating systems can boot from a logical partition.

The picture below shows a disk that has been partitioned into three primary partitions, one of which is really an extended partition. Inside this extended partition there are four logical partitions

formatting

In general, Windows built-in tools Disk Management and Diskpart can format drive to exFAT easily. However, in Disk Management, you'll find that [there is no exFAT option](#) when you

right-click the partition that you need to format and choose “Format Partition” if the partition is on an internal or external hard drive. Then, let’s see how to format a drive with exFAT using Diskpart utility.

PS.: Formatting will delete all data on the partition. It is advised to backup important data on the partition before formatting.

Removable Storage-

A Removable storage is an external media device that is used by a computer system to store data, and usually these are referred to as the Removable Disks drives or the External Drives. Removable storage is any type of storage device that can be removed/ejected from a computer system while the system is running. Examples of external devices include CDs, DVDs and Blu-Ray disk drives, as well as diskettes and USB drives. Removable storage makes it easier for a user to transfer data from one computer system to another. In a storage factors, the main benefit of removable disks is that they can provide the fast data transfer rates associated with storage area networks (SANs)

Types of Removable Storage:

- Optical discs (CDs, DVDs, Blu-ray discs)
- Memory cards
- Floppy disks
- Magnetic tapes
- Disk packs
- Paper storage (punched tapes , punched cards)

<https://www.backblaze.com/blog/history-removable-computer-storage/>

Compact disc



Compact disc (CD) is a digital optical disc data storage format that was co-developed by Philips and Sony and released in 1982. The format was originally developed to store and

play only digital audio recordings (CD-DA) but was later adapted for storage of data (CD-ROM). Several other formats were further derived from these, including write-once audio and data storage (CD-R), rewritable media (CD-RW), Video CD (VCD), Super Video CD (SVCD), Photo CD, PictureCD, Compact Disc-Interactive (CD-i), and Enhanced Music CD. The first commercially available audio CD player, the Sony CDP-101, was released October 1982 in Japan.

DVD



DVD (abbreviation for **Digital Versatile Disc** or **Digital Video Disc**)^{[8][9]} is a digital optical disc storage format invented and developed in 1995 and released in late 1996. The medium can store any kind of digital data and is widely used for software and other computer files as well as video programs watched using DVD players. DVDs offer higher storage capacity than compact discs while having the same dimensions.

Memory Stick

Memory Stick is a removable [flash memory card](#) format, originally launched by [Sony](#) in late 1998.^[1] In addition to the original Memory Stick, this family includes the **Memory Stick PRO**, a revision that allows greater maximum storage capacity and faster file transfer speeds; **Memory Stick Duo**, a small-form-factor version of the Memory Stick (including the **PRO Duo**); the even smaller **Memory Stick Micro (M2)**, and the **Memory Stick PRO-HG**, a

high speed variant of the PRO to be used in [high-definition video](#) and still cameras.



USB flash drive

USB flash drives are often used for storage, data back-up and transferring of computer files. Compared with [floppy disks](#) or [CDs](#), they are smaller, faster, have significantly more capacity, and are more durable due to a lack of moving parts. Additionally, they are immune to [electromagnetic interference](#) (unlike floppy disks), and are unharmed by surface scratches (unlike CDs). Until about 2005, most desktop and laptop computers were supplied with floppy disk drives in addition to USB ports, but floppy disk drives became obsolete after widespread adoption of USB ports and the larger USB drive capacity compared to the "1.44 megabyte" (1440 [kibibyte](#)) 3.5-inch floppy disk.

A flash drive consists of a small [printed circuit board](#) carrying the circuit elements and a USB connector, insulated electrically and protected inside a plastic, metal, or rubberized case, which can be carried in a pocket or on a key chain, for example. The USB connector may be protected by a removable cap or by retracting into the body of the drive, although it is not likely to be damaged if unprotected. Most flash drives use a standard type-A USB connection allowing connection with a port on a personal computer, but drives for other interfaces also exist. USB flash drives draw power from the computer via the USB connection. Some devices combine the functionality of a [portable media player](#) with USB flash storage; they require a battery only when used to play music on the go.



Solid State Drive (SSD)

Solid state refers to electronic circuitry that is built entirely of semiconductors. The term was originally used to define those **electronics**, such as a transistor radio that used semiconductors rather than vacuum tubes in its construction.

Most electronics today are built around semiconductors and chips. A solid state drive uses, as its primary storage medium, semiconductors rather than the magnetic platters of a conventional hard drive.

Solid state drives and **USB flash drives** use the same type of non-volatile memory chips that retain information when there is no power. The difference is in the form factor and capacity of the drives. While a flash drive is designed to be external to the computer system, an SSD is designed to reside inside the computer in place of a more traditional hard drive.

Many SSDs on the outside look almost identical to a conventional hard drive. This design allows the SSD drive to be put into a laptop or desktop computer in place of a hard drive. To do this, it needs to have the same standard dimension as a 1.8-inch, 2.5-inch, or 3.5-inch hard drive. It also uses the common **SATA interface** so that it can easily be placed into any PC as a hard drive would. There are several new form factors such as **M.2** that look more like a memory module.



KEYBOARD

Computer keyboards are nothing new in the world of Technology and we use our computer keyboard to accomplish almost every task from logging in to our computers, typing, playing games and everything else you can think of. Even if you are not doing any specific tasks on your computer, you can use your computer without any mouse at all, and depend completely on the keyboard for everything. When it comes to using our computer keyboard, we can find different types of keyboards at different prices to get more convenience while typing or doing our specific task. But when it comes to keys on the keyboard you can also find a multimedia keyboard that has additional keys to trigger different system activities.

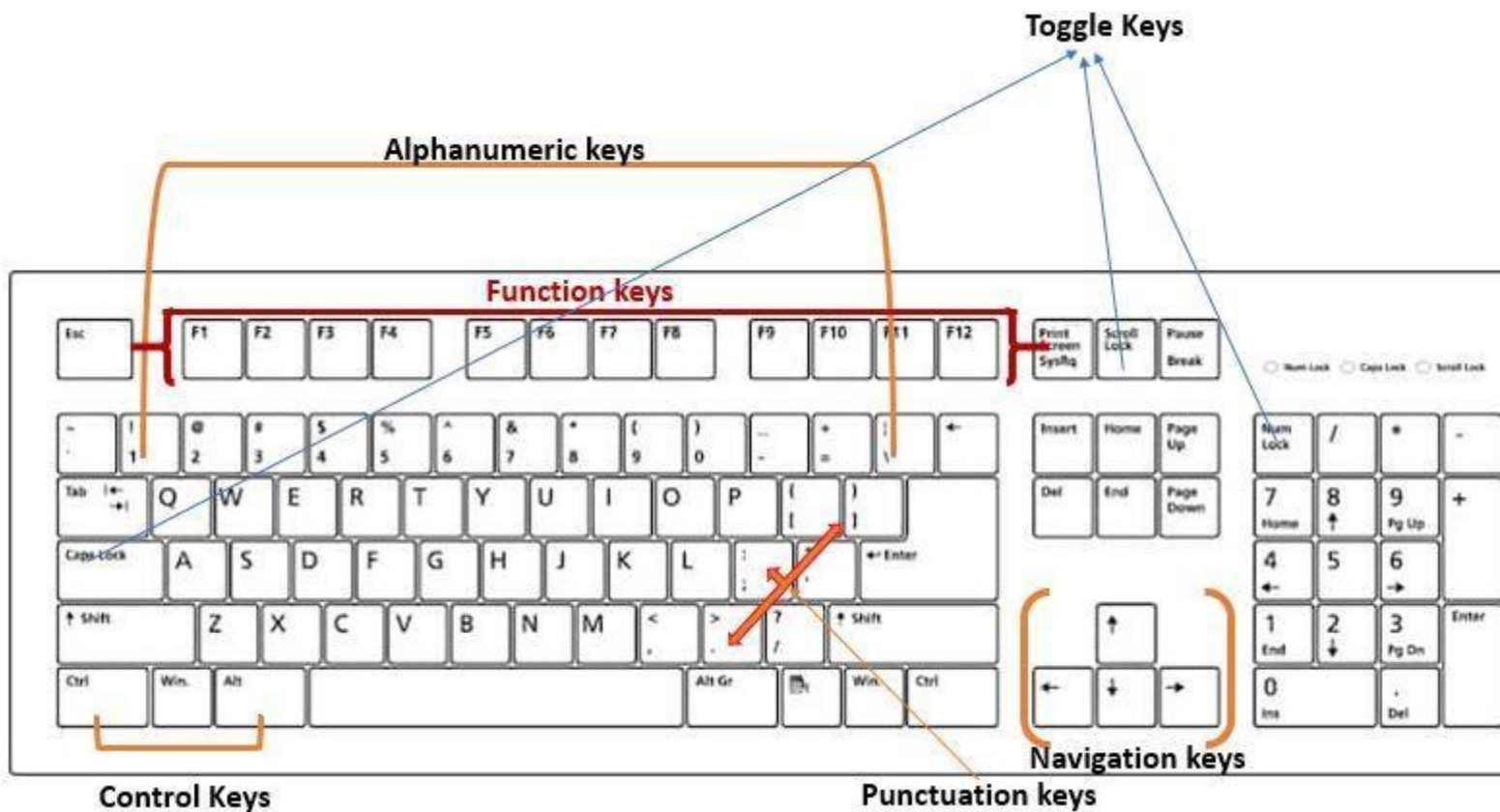
No matter, whether you are using a simple or multimedia keyboard the keys that you can find on the keyboard are there for a purpose and depending upon the functionality of each set of keys on the keyboard keys, they can be classified into different types, which you should know about if you want to go deep into the world of computers, or just a normal user who wants to explore the fun world of computers. So, today I will talk about the different types of keys that you can find a normal keyboard, or all the keyboard that you can find, for all the computer operating systems that you can find.

So, without any further delay, let's get started with the different types of keys or the classification of the keys on a computer keyboard.

There are several ways of connecting a keyboard to a system unit (more precisely, to its keyboard controller) using cables, including the standard AT connector commonly found on motherboards, which was eventually replaced by the PS/2 (personal System) and the USB connection. Prior to the iMac line of systems, Apple used the proprietary Apple Desktop Bus for its keyboard connector.

Wireless keyboards have become popular for their increased user freedom. A wireless keyboard often includes a required combination transmitter and receiver unit that attaches to the computer's keyboard port. The wireless aspect is achieved either by radio frequency (RF) or by infrared (IR) signals sent and received from both the keyboard and the unit attached to the computer. A wireless keyboard may use an industry standard RF, called Bluetooth. With Bluetooth, the transceiver may be built into the computer. However, a wireless keyboard needs batteries to work and may pose a security problem due to the risk of data

“eavesdropping” by hackers. Wireless solar keyboards charge their batteries from small solar panels using sunlight or standard artificial lighting.



The Alphanumeric keys

The alphanumeric keys are those keys on the keyboard, which can type in letters or numbers in the editor, which includes all the alphabetical keys from A to Z and the number keys above that. The number keys can not only type numbers, but they can also double up as a symbol keyboard, which can be used to type in different symbols which include the \$, %, @ and a set of other useful symbols. You can also find another numeric keypad on the right side of the keyboard, however, it depends upon the keyboard model and in some concise keyboards meant for laptops, a dedicated numeric keypad might be absent to reduce the overall size of the keyboard.

Computer mouse

To transmit their input, typical cabled mice use a thin electrical cord terminating in a standard connector, such as RS-232C, PS/2, ADB or USB. Cordless mice instead transmit data via

infrared radiation or radio (including Bluetooth), although many such cordless interfaces are themselves connected through the aforementioned wired serial buses.

While the electrical interface and the format of the data transmitted by commonly available mice is currently standardized on USB, in the past it varied between different manufacturers. A bus mouse used a dedicated interface card for connection to an IBM PC or compatible computer.

Mouse use in DOS applications became more common after the introduction of the Microsoft mouse, largely because Microsoft provided an open standard for communication between applications and mouse driver software. Thus, any application written to use the Microsoft standard could use a mouse with a Microsoft compatible driver (even if the mouse hardware itself was incompatible with Microsoft's). An interesting footnote is that the Microsoft driver standard communicates mouse movements in standard units called "mickeys", as does the Allegro library.

Serial interface and protocol

Standard PC mice once used the RS-232C serial port via a D-subminiature connector, which provided power to run the mouse's circuits as well as data on mouse movements. The Mouse Systems Corporation version used a five-byte protocol and supported three buttons. The Microsoft version used a three-byte protocol and supported two buttons. Due to the incompatibility between the two protocols, some manufacturers sold serial mice with a mode switch: "PC" for MSC mode, "MS" for Microsoft mode.

PS/2 interface and protocol

With the arrival of the IBM PS/2 personal-computer series in 1987, IBM introduced the eponymous PS/2 interface for mice and keyboards, which other manufacturers rapidly adopted. The most visible change was the use of a round 6-pin mini-DIN, in lieu of the former 5-pin connector. In default mode (called stream mode) a PS/2 mouse communicates motion, and the state of each button, by means of 3-byte packets.

A Microsoft IntelliMouse relies on an extension of the PS/2 protocol: the ImPS/2 or IMPS/2 protocol (the abbreviation combines the concepts of "IntelliMouse" and "PS/2"). It initially operates in standard PS/2 format, for backwards compatibility. After the host sends a special command sequence, it switches to an extended format in which a fourth byte carries

information about wheel movements. The IntelliMouse Explorer works analogously, with the difference that its 4-byte packets also allow for two additional buttons (for a total of five).

Mouse vendors also use other extended formats, often without providing public documentation. The Typhoon mouse uses 6-byte packets which can appear as a sequence of two standard 3-byte packets, such that an ordinary PS/2 driver can handle them. For 3-D (or 6-degree-of-freedom) input, vendors have made many extensions both to the hardware and to software. In the late 1990s Logitech created ultrasound based tracking which gave 3D input to a few millimetres accuracy, which worked well as an input device but failed as a profitable product. In 2008, Motion4U introduced its “OptiBurst” system using IR tracking for use as a Maya (graphics software) plugin.

USB

The industry-standard USB (Universal Serial Bus) protocol and its connector have become widely used for mice; it’s currently among the most popular types.

Cordless or wireless

Cordless or wireless mice transmit data via infrared radiation or radio (including Bluetooth). The receiver is connected to the computer through a serial or USB port, or can be built in (as is sometimes the case with Bluetooth). Modern non-Bluetooth wireless mice use USB receivers. Some of these can be stored inside the mouse for safe transport while not in use, while other, newer mice use newer “nano” receivers, designed to be small enough to remain plugged into a laptop during transport, while still being large enough to easily remove.



A computer mouse with the most common features: two buttons (left and right) and a scroll wheel (which also functions as a button).



A typical wireless computer mouse

A **computer mouse** (plural **mice** or **mouses**) is a hand-held **pointing device** that detects **two-dimensional** motion relative to a surface. This motion is typically translated into the motion of a **pointer** on a **display**, which allows a smooth control of the **graphical user interface** of a **computer**.

The first public demonstration of a mouse controlling a computer system was in 1968. Mice originally used a ball rolling on a surface to detect motion, but modern mice often have optical sensors that have no moving parts. Originally wired to a computer, many modern mice are cordless, relying on short-range radio communication with the connected system.



Apple mouse

In addition to moving a cursor, computer mice have one or more **buttons** to allow operations such as selection of a menu item on a display. Mice often also feature other elements, such as touch surfaces and **scroll wheels**, which enable additional control and dimensional input

Computer printer



A Lexmark printer

A **computer printer** is a piece of hardware for a computer. It allows a user to print items on paper, such as letters and pictures. Mostly a printer prints under the control of a computer. Many can also work as a copying machine or with a digital camera to print directly without using a computer.

Types of printers

Today, the following types of printers are in regular use:

- Inkjet printers, also sometimes called *bubble jet printers* throw colored ink onto a paper.
- Plotters are large format inkjet printers, or printers that use special pens.
- Laser printers transfer tiny particles of toner onto the paper. Most do not print colors.
- Dye sublimation printers produce very high quality images. Three colors are used. Cyan, Magenta and Yellow. Each color is printed one at a time from cellophane sheets. The image is then sealed with a clear top layer. Some small photographic printers made by Kodak and Canon use this process.
- Thermal printer is an inexpensive printer that works by pushing heated pins against heat-sensitive paper. Thermal printers are widely used in calculators and fax machines. Many 20th century computer printers worked this way.
- Impact printers worked by striking the paper with an inked ribbon. They were noisy.
 - Dot-matrix printers are now almost extinct. There were models with 9 pins and models with 24 pins.
 - Daisy Wheel printers were a typewriter printer. Results looked hand-typed. They had no real graphics and were very loud. Few were made in the 21st century.
 - Line printers contain a chain of characters or pins that print an entire line at one time. Line printers are very fast, but produce low-quality print.

How to Troubleshoot Printer Problems on a Windows PC

Check the Paper

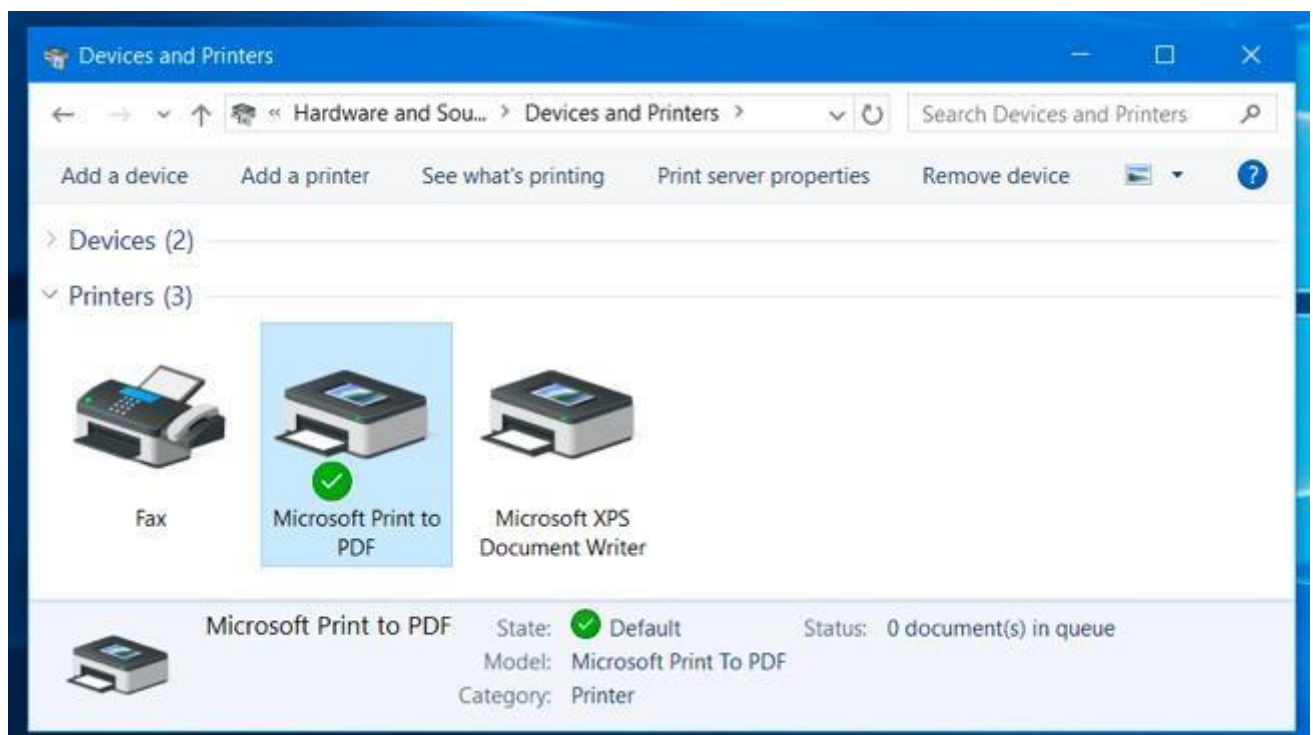
First, ensure your printer is in proper working state. Verify that the printer has paper loaded if it isn't printing. Even if you've loaded paper, you may need to properly align the paper so the printer can use it. Check the inside of the printer to ensure there isn't a paper jam preventing the printer from working. If there is, you may need to manually remove the jammed paper and clear things up.

Check the Ink or Toner

Of course, you'll need enough [ink](#) (if it's an inkjet printer) or toner (if it's a laser printer) before you can print. Even if you're just printing in black-and-white, some inkjet printers may refuse to print at all until you refill their color ink.

To check your printer's ink levels on Windows, open the Devices and Printers window in Windows. You can do so by opening the Control Panel and clicking "View devices and printers" under Hardware and Sound. You may be able to select a printer by clicking it and view this information at the bottom of the window, or right-click a printer, select "Properties", and look for the ink or toner levels.

Many printers report that sort of information here, although not all do — it depends on the printer and its drivers. You may also be able to see this information on the printer itself, if it has a built-in status display.



Check the Print Queue Dialog

Problems with printing could also be caused by issues with Windows. To ensure nothing is going wrong, open the print queue dialog in Windows. You can open a printer's queue by right-clicking that printer in the Devices & Printers window and selecting "See what's printing". If you see an older document that can't print with an error, right-click the document here and remove it. If a printer job is paused, you can resume it from here.

You should also click the “Printer” menu here and verify that “Use printer offline” isn’t enabled. If this option is checked, remove the checkmark to disable it.

Install, Update, or Reinstall Your Printer Drivers

You may need to install, update, or reinstall the printer drivers if it isn’t working properly. Printers should ideally “just work” and have their drivers automatically installed by Windows, but this doesn’t always work. To do this, visit your printer manufacturer’s website, download their driver package, and run the driver installer. It’ll walk you through installing the printer drivers and detecting your printer.

Use the Printer’s Diagnostics

You might need to use a diagnostic function that will clean the printer’s heads or nozzles, or realign them. This option will be in a slightly different place in each printer, depending on the printer’s software. On Windows, open the Devices and Printers window, right-click a printer, select “Properties”, and examine the options here to see what options are available for your particular printer. These options are provided by your printer drivers, and you may find them somewhere else — for example, in a printer configuration utility located in your Start menu.

This can help fix problems with poor print quality, too.

Set Your Default Printer

[Windows 10’s “November update”](#) changed the way default printers work on Windows. By default, every time you print to a printer, Windows will automatically make it your default printer. This would be inconvenient if you wanted to leave one particular printer as your default one and occasionally print to another one.

To disable this, open the Settings app from the Start menu or Start screen, select “Devices”, select “Printers & scanners”, and disable the “Let Windows manage my default printer” option.

You can then select a default printer by clicking or tapping it in this window and clicking “Set as default”. You can also right-click a printer in the Devices and Printers window and select “Set as Default Printer”.

If your printer has a physical control panel with buttons on it, you may need to press the “OK” button one or more times if it’s displaying a status message. Some printers may just not print until you press “OK” and verify you’ve seen a displayed status message. This control panel may also display more detailed error message that will point you in the right direction and give you something to search for if it isn’t working properly.

Lots of things can go wrong with a printer, and some printers — especially older ones — may display confusing error messages. If your printer shows a particular error message and you’re not sure what it means, you should try searching the web for that particular error message.

Four Types of Scanners

SCANNER TYPES

There are a number of different types of scanners available. Each type has its own defining feature, usually obvious by its name. Make sure you understand the differences between them, so you can choose the one that is right for you.

Flatbed Scanners



A flatbed scanner captures an image of any size or material, whether it's a single sheet, a page of a book, or even an object like a flower or jewelry. You place the object on the glass plate and the scanning head comes down on top of it.

Slide, Film and Transparency Scanners

These allow you to digitize film negatives, slides or transparencies. You can add a film and slide adapter to a flatbed scanner, and some have one built-in already.



Sheet-Fed Scanners

These scanners automatically feed your documents for continuous scanning, allowing you to scan a high volume of loose pages quickly and easily.

Simplex & Duplex Scanners

Most scanners are Simplex scanners, meaning that the scanner will capture a single side of a document. Duplex scanners simultaneously capture the front and back of a document.

Card Scanners

Card scanners are smaller and are expressly used to quickly scan business or ID cards.



Mobile Scanners

Bigger than card scanners but smaller than traditional flatbed scanners, mobile scanners are an excellent solution for those who need a way to scan documents while traveling or on the go.

- Flatbed Scanners. The most common type of scanner, flatbed scanners have a large glass surface and a lid. These scanners...
- Production Scanners. Production scanners operate similarly to flatbed scanners, but offer far faster operation and the...
- Hand Scanners. Hand scanners or handheld scanners are small wand-shaped devices. You use a hand scanner by slowly...
- Sheetfed Scanner. Sheetfed scanners scan loose papers placed in a tray by pulling them across a static scanning lens.

How to Troubleshoot the Scanner

What to Do

Step 1

Check the power. Almost everyone has missed this easy fix at least once. Make sure all power switches are on, all cords are plugged in and any indicator lights are showing green.

Step 2

Eliminate the chance for operator error by refreshing your memory on the operating instructions. If you discover that you have been missing a step in the scanning process, highlight the relevant step in the operating manual and try to scan again.

Step 3

Verify the correct positioning of the document you want to scan, which is face down on the scanner bed glass. Spot clean the glass if necessary with a damp cloth.

Step 4

Double-check your scan optimization settings. Some printers allow you to refine their settings for print only, image only or mixed documents. Make sure you have the right one selected.

Step 5

Make sure you have the right computer destination selected in a network. If you are not in a network, examine the cables that connect your all-in-one printer to your computer.

Step 6

Keep the device's task manager on while scanning. Some all-in-one printers need their task manager in the toolbar to function properly.

Step 7

Pull up the troubleshooting menu for the printer on your computer for more system-specific remedies.

Scanners Problems and Solutions	
Problem	Solution

<p>The computer does not recognize a scanner has been connected to it, and therefore is unresponsive.</p>	<ul style="list-style-type: none"> • Verify the cables are connected properly to the back of the scanner. • If the scanner is a parallel port scanner, it likely has two available connections on the back of the scanner. Verify that the cable coming from the computer is connected to the "Computer In" port. • Make sure the scanner is receiving power. Push the power button, which can be located on the top or on the side. • Check to see if the scanner appears in My Computer. If it does not appear, it is possible the scanner, scanner software, or scanner driver (TWAIN) was not installed properly. Contact your technology coordinator. (Click here)
<p>You receive an error message similar to "Scanner Initialization failed", "Scanner not found" or the TWAIN_32 error (Click here), when trying to use the scanner.</p>	<ol style="list-style-type: none"> 1. You will need to reset the scanner. 2. Close any Scanner software. 3. Disconnect the cable that connects the scanner to the computer. 4. Turn the power switch on the back of the scanner to OFF. 5. Turn the computer off, wait 60 seconds, and then turn the computer on again. 6. Turn the power switch on the back of the scanner to ON. 7. Reconnect the cable that connects the computer and the scanner. 8. The scanner should be working again. If not you may need to contact your technology coordinator.
<p>Scanner has stopped working properly. (If the scanner stops scanning, complete the following steps, in the presented order. After each step, start a scan to see if the scanner is working again. If the problem persists, proceed with the next step.)</p>	<ol style="list-style-type: none"> 1. A cable might be loose. Ensure that both the USB cable and power cable are securely connected. 2. Unplug the power cable from the power source, wait 60 seconds, and then plug it back in. 3. Reboot your computer. 4. A software conflict might exist on your computer. You might need to uninstall and then reinstall the scanner software via Control Panel's Add/Remove Programs. (Click here) 5. Reinstall the software. If the problem persists, you may need to contact your technology coordinator.
<p>The scanned documents, both written text and images have smudges.</p>	<ul style="list-style-type: none"> • Check to see if the glass has smudges on them from repeated and prolonged use. (Click here) • Check your original document. It is possible this is the way the original appeared. • Try scanning again and see if the cleaning fixed the issue. If necessary repeat the cleaning process.

The Light Bar Flashes or Blinks on the Scanner. ([Click here](#))

- When the light bar flashes or blinks, the built-in diagnostics are reporting the hardware is not functioning as expected.
- Turn off the computer that is connected to the scanner
- Disconnect power cord and USB cable from the back of the scanner.
- Unlock the Transport Lock several times, if necessary. Make sure it is opened. ([Click here](#))
- Wait 60 seconds before reconnecting the USB Cable and the power cord to the scanner.
- Turn on the computer and rescan to test.
- If problem persists, contact your technology coordinator.

Display, Power Supply and BIOS

Graphics card

A graphics card is a type of display adapter or video card installed within most computing devices to display graphical data with high clarity, color, definition and overall appearance. A graphics card provides high-quality visual display by processing and executing graphical data using advanced graphical techniques, features and functions.

A graphics card is also known as a graphics adapter, graphics controller, graphics accelerator card or graphics board.

DISPLAY

A display is a computer output surface and projecting mechanism that shows text and often graphic images to the computer user, using a cathode ray tube (CRT), liquid crystal display (LCD), light-emitting diode, gas plasma, or other image projection technology. The display is usually considered to include the screen or projection surface and the device that produces the information on the screen. In some computers, the display is packaged in a separate unit called a monitor . In other computers, the display is integrated into a unit with the processor and other parts of the computer. (Some sources make the distinction that the monitor includes other signal-handling devices that feed and control the display or projection device.

However, this distinction disappears when all these parts become integrated into a total unit, as in the case of notebook computers.) Displays (and monitors) are also sometimes called *video display terminals (VDTs)*. The terms *display* and *monitor* are often used interchangeably.

CRT

Cathode Ray Tube is the old style 'chunky TV' (and monitor). The reason it's so bulky is because the box has to house a screen and a projector gun. An image is created by firing electrons through this 'gun' onto a screen, exciting the particles on it. These TV formats have been on the fall since the early 2000's with the introduction of far smaller LCD screens.

LCD

LCD's are thin displays, normally used in laptop computers and TV screens. The term 'LCD' stands for 'Liquid Crystal Display'.

A liquid crystal display is a special flat panel that can block light, or allow it to pass. The panel is made up of segments with each block filled with liquid crystals. The colour and transparency of these blocks can be changed by increasing or reducing the electrical current.

LCD crystals do not produce their own light, so an external light source like a florescent bulb is needed to create an image.

LED

Contrary to popular belief, LED TV's are not a completely new format of TV- Instead they are simply an updated version of the previous LCD generation. LED use the same technology as an LCD TV, but instead of being illuminated by a florescent bulb from behind, they are lit by an array of LEDs (light emitting diodes). These are far more efficient and smaller in size, meaning the TV can be narrower.

LED can be broken up into two further major categories Direct (Back-lit) LED and Edge-lit LED:

Direct LED

These displays are backlit by an array of LEDs directly behind the screen. This enables focused lighting areas – meaning specific cells of brightness and darkness can be displayed more effectively.

Edge-lit LED

As the name suggests have lights set around the television frame. Edge-lit models reflect light into the centre of the monitor, and are the thinnest, lightest models available. Since they have fewer lights in the centre of the screen.

LED is the most popular format of TV on the market now due to its cost, size and versatility, although it is not the highest quality image available.

PLASMA

Plasma screens are made of 2 sheets of glass with a mixture of gases stored between the layers. These gases are injected and sealed in plasma form during the manufacturing process, hence why we have the name 'Plasma TV'.

When charged with electricity, the gases react and cause illumination in the pixels across the screen.

Plasma, is arguably superior to LCD & LED in terms of contrast and colour accuracy. However the format, due to costs, is restricted to larger screen sizes, usually 40-inch +. In these larger screen sizes, buying the Plasma option tends to work out cheaper. It is also used in the super-sized 80-inch+ screens as the plasma screens are easier, and more cost effective, to produce over a larger size.

OLED

OLED is a massive leap forward in screen technology. Unlike its name suggests, OLED is nothing like LED.

OLED stands for 'Organic Light Emitting Diode' and uses 'organic' materials like carbon to create light when supplied directly by an electric current. Unlike LED/LCD screens, an OLED TV doesn't require a backlight to illuminate the set area. Without this restriction of an external light source, OLED screens can be super thin and crucially, flexible.

As the individual areas can be lit up directly and not via an external backlight, the colours and contrasts are much better on OLED TV's.

On the whole, OLED is thinner, more flexible, faster at processing images, creates deeper colours and more crisp in contrast. It is, however, still very expensive and will not be seen on consumer TV's at an 'affordable price' for at least another year.

TFT

The benefit of thin-film transistor technology is the separate, tiny transistor for each **pixel** on the display. Because each transistor is so small, the amount of charge needed to control it is also small. This allows the screen to refresh very quickly, as the image is re-painted or refreshed several times per second.

A TFT monitor uses thin-film **transistor** technology in an LCD display. LCD monitors, also called flat panel displays, are replacing the old-style cathode ray tubes (CRTs) in both televisions and computer displays. Nearly all LCD monitors today use TFT technology.

SMPS: Basics & Working of Switched Mode Power Supply

Switch mode power supplies (SMPSs) are used in a range of applications as an efficient and effective source of power. This is in major part of their efficiency. For anybody still working on a desktop, look for the fan output in the central processing units (CPU). That's where the SMPS is.

SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of electronics gadgets. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching "on" and "off" with high frequency.

Basic working concept of an SMPS

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

BIOS

A BIOS (*Basic Input/Output System*) Short for **ROM** is boot firmware program that a computer uses to successfully start operating. The BIOS is located on a chip inside of the computer and is designed in a way that protects it from disk failure.

When you turn on a PC, the BIOS first conduct a basic hardware check, called a Power-On Self Test (POST), to determine whether all of the attachments are present and working. Then it loads the operating system into your computer's random access memory, or RAM. The BIOS also manages data flow between the computer's operating system and attached devices such as the hard disk, video card, keyboard, mouse, and printer. The BIOS stores the date, the time, and your system configuration information in a battery-powered, non-volatile memory chip,

called a CMOS (Complementary Metal Oxide Semiconductor) after its manufacturing process.

The main functions of the BIOS are:

Functions of BIOS

(i) BIOS Power on Self Test (POST): It is a built-in diagnostic program. This self test ensures that the computer has all of the necessary parts and functionality needed to successfully start itself, such as use of memory, a keyboard and other parts. Then additional tests are done during booting. If errors are detected during the test, the BIOS instruct the computer to give a code that reveals the problem. Error codes are typically a series of beeps heard shortly after startup.

The BIOS also works to give the computer basic information about how to interact with some critical components, such as drives and memory that it will need to load the operating system. Once the basic instructions have been loaded and the self-test has been passed, the computer can proceed with loading the operating system from one of the attached drives. Computer users can often make certain adjustments to the BIOS through a configuration screen on the computer. The setup screen is typically accessed with a special key sequence during the first moments of startup. This setup screen often allows users to change the order in which drives are accessed during startup and control the functionality of a number of critical devices. Features vary among individual BIOS versions.

We can also use flash-memory cards to hold BIOS information. This allows users to update the BIOS version on computers after a vendor releases an update. This system was designed to solve problems with the original BIOS or to add new functionality. Users can periodically check for updated BIOS versions, as some vendors release a dozen or more updates over the course of a product's lifetime. Mother board (System) BIOS, Video adapter firmware (BIOS), Drive controller firmware (BIOS), Modem Card firmware (BIOS), Network adapter board BIOS, SCSI adapter BIOS. The mother board BIOS provides routines to support motherboard features. BIOS ROM chips for major sub systems of computer such as video and drive control must also be included.

Actually BIOS can be placed in between the computer and external devices as its name tells it is used for reading the keystroke, displaying values on screen, Reading and writing to and from floppy and hard disks etc.

The keyboard is assigned the port number 60, which is known to BIOS. BIOS read this port and data from keyboard goes to computer.

(ii) Bootstrap Loader: To boot the operating system. The BIOS contains a program known as bootstrap loader whose responsibility is to search and start the operating system boot program. Then the boot program of operating system controls the computer system and boots the operating system.

(iii) BIOS Setup Utility Program: A non volatile memory (NVRAM) is used to store information about the computer system. During installation of a system, the user run BIOS setup program and enter the correct parameters. The settings of memory, disk types and other settings are stored in NVRAM and not in BIOS chip itself. To construct NVRAM, the material required is CMOS (Complementary metal oxide semiconductor). These CMOS chips are very efficient storage devices as they store and maintain data on very low values of current. The system's configurations therefore are also termed as CMOS settings, which we can set using BIOS set up program. The BIOS reads the parameters from CMOS RAM as and when required.

POST

Short for **power-on self-test**, the **POST** is a test the computer must complete verifying all hardware is working properly before starting the remainder of the boot process. The POST process checks computer hardware, like RAM (random access memory), hard drive, CD-ROM drive, keyboard, etc., to make sure all are working correctly.

If all hardware passes the POST, the computer continues the boot up process and may generate a single beep sound as well. If POST is unsuccessful, it generates a **beep code** to indicate the error encountered and the computer will not boot up. All POST errors are relating to hardware issues with one of the components in the computer.

The POST (power on self-test) is a set of procedures that a computer runs through each time it is turned on. It ensures that all of the system's hardware is working properly before trying to load the operating system. If the computer does not pass POST, it will not boot.

Remove new hardware

If any new hardware was recently added to the computer, remove that hardware to make sure it is not causing your issue. If your computer works after removing the new hardware, it

can mean a few things. Either the new hardware is not compatible with your computer, a system setting needs to be changed, or the new hardware is defective.

Remove any disks or USB devices

Remove any disks, CDs, or DVDs that are in the computer. If any USB devices (iPods, drives, phones, etc.) are connected, disconnect all of them as well. Reboot the computer and see if anything changes.

Disconnect external devices

Remove everything from the back of the computer, except the power cable. Turn on the computer and see if it beeps normally. If the computer has never beeped, keep the monitor or display connected to see if any change occurs.

Reconnect and check power cords

If the computer is not getting enough power or the power is getting interrupted, the computer can encounter problems. Disconnect your power cables from any power strip or UPS (uninterruptible power supply) and connect the computer directly to a known good wall outlet.

Identify beep code

If you are receiving a sequence of beeps, see the beep code page for a listing of different beep codes and their explanation. You can also check your motherboard or computer documentation for information on the beep codes. These beep codes are meant to help identify which computer component is failing or bad. If your beep code is not listed, continue troubleshooting.

Check all fans

Make sure all fans are running on the computer. If a fan has failed (especially the heat sink fan for the CPU), your computer could be overheating or detecting the fan failure, causing the computer not to boot.

Check all cables

Verify all the cables are securely connected to the computer and that there are no loose cables by firmly pressing in each cable.

- All disk drives should have a data cable and power cable connected to them.
- Your power supply should have at least one cable going to the motherboard. Many motherboards may also have additional cables connected to them to supply power to the fans.

Disconnect all expansion cards

If the above recommendations still have not resolved the irregular POST, disconnect the riser board (if applicable) and each of the expansion cards. If this fixes the problem or allows the computer to POST, connect one card at a time until you determine which card is causing the problem.

Disconnect all drives

If you cannot diagnose the problem by the beep code (or you do not hear a beep code), power off the computer. Then, disconnect any IDE, SATA, SCSI, or other data cables from the motherboard. When they are disconnected, try booting the computer again.

If this resolves your irregular POST or generates error messages, reconnect each device until you determine which device or cable is causing the issue. In some situations, it can also be a loose cable connection that causes the issue.

Remove the RAM

If you continue to experience the same problem with all the above hardware removed, remove the RAM from the motherboard and turn on the computer. If the computer has a different beep code or was not beeping but is now, turn off your computer and try the suggestions below. Make sure to turn off the computer before adding and removing the memory and then turning it back on to see if the suggestion resolves the issue.

1. Re-insert the memory into the same slot.
2. If you have more than one stick of memory, remove all but one stick of memory and try rotating through each stick.

3. Try one stick of memory in each slot.

If you can get the computer to boot with one or more of the sticks of memory installed, you are likely dealing with some bad memory. Try to identify which stick of memory is bad and replace it.

If you can get the memory to work in one slot but not another slot, the motherboard is likely defective. You can either workaround the issue by running the memory in a different slot that does work or replace the motherboard.

Power cycle the computer

In some situations, a computer may have power related issues often caused by either the power supply or the motherboard. To help determine if this is the issue, try turning the computer on, off, and back on as fast as possible, making sure the computer power light goes on and off. In some situations, you may be able to temporarily get the computer to boot.

MAINTENANCE AND TROUBLE SHOOTING

BASIC MAINTENANCE CONCEPTS:-

As far as computer maintenance is considered it is divided into three categories i.e. preventive maintenance, corrective maintenance and on line maintenance.

Preventive maintenance is performed at regular time interval and significantly contribute to increase the reliability of the system. It usually involves performance measurement, checking mechanical wear outs, cleaning, review of system diagnostic log etc. The frequency of preventive maintenance depends on the system's operating environment, period of use etc. very often the frequency of the preventive maintenance is fixed by the manufacturer.

Corrective maintenance is performed on receiving the customer's call while the system fails. In many cases the diagnostic log indicates the need for corrective maintenance.

Online maintenance employees online diagnostic tests stored in the secondary memory. These tests are automatically run by the operating system, to verify the various units of the system.

Another major concept in computer maintenance is maximum down time, which is the time for which the system will be down at the most. Several steps are taken care of to minimise this maximum down time. Which are as follows.

- Minimise the time to organise maintenance personnel, test equipment etc.
- Minimise the time to diagnose
- Minimise the time to access the faulty part.
- Minimise the time to replace or repair the faulty item.

IMPORTANT FACTORS AFFECTING COMPUTER MAINTENANCE:-

There are several factor which affects computer maintenance

Diagnostic tests and aids:-

As the computers become more advanced, they also grow in complexity. Thus the tools for testing this also become more sophisticated. Diagnostic tests are the testing software, which are either resident in the system or the user has to load them manually into the system. In fact now a days most of the systems are coming with self-testing s/w loaded into it. Thus whenever the system is powered on these diagnostic tests are automatically run to test the correctness of the hardware. Another very important aid to diagnostic is the early warning system which is a bulletin service provided by the manufacturer giving details of any abnormal faults, noticed in the same model, anywhere else.

Spare part management:-

Selection of a maintenance policy determines the locations at which stocks of spares for replacement and repair are required. Spare part inventory is divided in the following hierarchy.

- Site kit : This kit contains low value,, fast moving spares like LEDs, fuses, bolts, switches etc.
- Branch office Kit: The inventory at branch office level would normally consists of more expensive parts like canals, mechanical assembly, motors etc.
- Country kit: This kit contains the expensive parts like, large PCB, expensive chips, memory etc.

The spare part at site level should be able to satisfy almost 80% of the site requirements immediately and the branch office and country kit should contribute the rest 20%

Information for maintenance activity:-

It is essential to develop a suitable management information system (MIS) to keep track of the system performance. The basic input to this MIS is the site report of the visiting engineers. For every activity undertaken the engineers have to report relevant data giving details of machine serial number, total time spent on the equipment, travel time, equipment down, time, activity type etc.. These data are then processed to generate several reports like

- Exception report – This report gives the number of calls and maintenance hours for a particular machine.
- System log – This is a history of all the works done on the equipment along with the comments by the attending engineers. This log is kept with the user.
- System availability – This report is used to evaluate the efficiency of the system.

$$\text{System availability} = \frac{\text{CPU process clock}}{\text{CPU process clock and down time}}$$

DIFFERENT TYPES OF MAINTENANCE:-

As far as computer maintenance is concerned it can be divided into three types i.e. preventive maintenance, corrective maintenance and online maintenance.

The preventive maintenance is performed at a fixed interval and is helpful in preventing the system from any malfunctioning. Corrective maintenance is performed when the system gives any problem. This is performed only when a customer calls for it. The online maintenance is performed online to the system. For this some diagnostic software are loaded into computer memory, which does the self-tests and rectifies the problem. The computer virus problem is very often rectified by this online maintenance.

Importance of preventive maintenance:-

As we know that preventive or remedial maintenance is performed to prevent the system from malfunctioning. Following are some of the problems, which may arise if the preventive maintenance is improper.

Problem-1: Reliability problem due to corrosion of connectors and PCB edge contact.

Cause – Corrosion

P.M. – Frequent cleaning and controlling humidity.

Problem-2: Cause malfunctioning of circuits.

Cause – Electrical noise.

P.M. – Shielding cables, isolating system power from other load, antistatic measures stabilised power supply etc.

Problem-3: Causes head crash of HDD, damage floppy disk drive head, causes failure of chips.

Cause – Dust

P.M. – Frequent cleaning of the room and equipment.

Problem-4: Affects data recorded in HDD & FD.

Cause – Magnetic field.

P.M. – Keeping PC away from magnetic substance.

Problem-5: Causes unreliable operation, damage electronic components.

Cause – AC power fluctuation.

P.M. – Use CVT/UPS and isolators.

Problem-6: Disk data loss, problem in electronic circuits etc.

Cause – High temperature.

P.M. – Provide sufficient cooling and air circulation.

Problem-7: Improper functioning of FDD

Cause – FDD head dust

P.M. – Cleaning of FDD head with head cleanings diskette.

Problem-8: - Improper function of printer.

Cause – Friction in mechanical assembly.

P.M. – Oiling the mechanical part of printer.

Problem-9: Improper functioning of keyboard.

Cause – Non contact in key.

P.M. – Cleaning the contact point of the keys.

NATURE OF FAULT:

Computer faults can be clarified into two types based on the frequency of occurrence of the problem.

Permanent fault – When the computer gives the same problem, any time it is run, then the fault is a permanent fault. Thus with the occurrence of permanent fault the computer give problem consistently.

Intermittent fault – When the computer misbehavior for a period of time and then works properly or the nature of the fault changes each time we switch on the computer then the type of fault is intermittent fault.

SYSTEM TROUBLESHOOTING:-

Basically there are two ways followed for system troubleshooting.

- i) Adhoc troubleshooting
- ii) Systematic troubleshooting

Adhoc troubleshooting method doesn't follow any logical approach. This method is based on the historical factor of that system and experience of the hardware engineer. However this approach is often followed by expert hardware engineer for quick troubleshooting.

The systematic troubleshooting has a logical approach to system problem. It is divided into the following four steps.

- i) Symptom observation
- ii) Symptom analysis
- iii) Fault diagnosis
- iv) Fault rectification.

Symptom observation:

This is the first thing an engineer should do before rectifying the problem. The symptoms of the problem should be carefully listened from the customer and noted down on a piece of paper. Many engineers possess a symptom sheet which they provide to the customer on facing a problem. Apart from this the engineer should carefully observe the POST sequence and its messages. Many times the fault is mentioned during the POST routine execution.

Symptom Analysis:-

This is another vital step of system trouble shooting. After carefully observing the symptom, it is essential to analyse them. Many time more than one symptoms of fault are observed. In this case it is very help full of the engineer to analyse them properly and establish some relationship between them. Sometime it is necessary to analyse the same fault a number of times especially in case of intermitted faults. Thus the engineer should carefully analyse all the symptoms to draw some cancelation about the faulty part/ area of the system.

Fault Diagnosis:-

This is the process in which the engineer actually find out the fault in the system. For this the engineer should have a sound idea on the system and he should have presence of mind and analytical skill. For this step the engineer should adopt a multidimensional approach in four direction.

- i) Architecture
- ii) Organisation
- iii) Engineering layout
- iv) Environment

For a successful fault diagnosis, the engineer should have a good idea on the system architecture. By this he will be able to distinguish between the hardware and software faults. When there is a confusion, it is always advisable to verify the software properly by loading a fresh copy of the software before reaching for any hardware faults.

Before going for the fault diagnosis the engineer should be aware of the special organisational aspects of that particular system if any. This includes the timing relationships between the various subsystems of the computer. Though it is not necessary to remember all the details of the organisation, it becomes essential to grasp the conceptual parts of the organisation for an efficient fault diagnosis.

Certain problems are caused by physical layout facts. Some of the common faults due to this one.

- Faulty cable
- Loose connection
- Open wire
- Track short
- In connect jumper setting etc.

To counter these, the engineer should possess the layout of that particular system which often accompanies the system.

The engineer should also approach the fault from environment point of view, which may be caused due to one of the following.

- High temperature
- Dust
- Supply voltage fluctuation
- Magnetic field
- Humidity etc.

Fault rectification :

This is the last step for trouble shooting. After fault diagnosis, the engineer has to rectify it by performing one or more of the followings, depending on the type/ nature of the fault.

- Replacing defective IC or other components
- Replacing defective PCB
- Cleaning R/W head
- Soldering broken wires
- Changing the software
- Mechanical adjustments
- Replacing key switch.
- Isolating other electrical load
- Controlling temperature or humidity

- Correcting the jumper setting etc.

TROUBLESHOOTING TOOLS:-

All the tools that are used for system troubleshooting can be divided into two types i.e.

- i) Nodal tester
- ii) System tester.

Nodal testers are simple equipment used for testing the system by selecting some test points known as nodes. Some of the popular nodal testers are as follows:

Logic Probe :-

This is used to find out the logic state of any node in a circuit including steady states and pulses. The circuit of a logic probe is powerful enough to detect very narrow pulses.

Logic Pulser :-

This is a device used to inject pulse into any logical equipment for testing. A single pulse or a stream of pulse can be issued at different frequencies according to user's choice.

Current Tracer :-

This is a hand held tool used for detecting current flow in electronic circuits. It is useful for detecting short circuit, components etc.

Oscilloscope:-

This is a relatively expensive device but can test almost all parts of a computer. It is used.

- ⇒ To test logic levels.
- ⇒ To measure signal characteristics such as frequency, pulse width, rise/ fall time, noise etc.
- ⇒ To measure the timing relationship between two or more signals.

The system testers are sophisticated test equipments which are useful to quickly isolate the faulty subsystem. It includes emulators, functional testers, signature analyser, logic analyser etc.

COMMON FAULTS:-

All the common faults that occurs in a computer can be divided into following types.

- i) Motherboard faults
- ii) Keyboard faults.
- iii) FDD problem
- iv) HDD problem
- v) Display problem
- vi) Printer problem

MOTHER BOARD FAULTS:-

Some non-motherboard fault creates a confusion of being motherboard problem. Therefore before diagnosing the mother board, these problems should be verified. They are :-

- a) No dc power supply
- b) Abnormal dc power supply
- c) Missing ground in SMPS
- d) Defective reset switch on front panel
- e) Defective keyboard/ keyboard cable
- f) Faulty speaker/ speaker connection
- g) Defective power on LED/ LED connector.

Besides there the motherboard problem are mainly of following types.

- Fault in address bus
- Fault in data bus
- Fault in control bus
- Fault in power supply pins
- Fault in RAM logic
- Fault in ROM logic
- Fault in I/O port logic
- Fault in interrupt logic.

The faults in address and data base can be detected by injecting pulse through each bit of the bus. If some bit is struck then the bus may be faulty.

The fault in control bus can be detected by observing whether the four control signal MEMB, MEMW, IOR and IOW are working properly or not. The exact fault will be detected by examining all the relevant units like bus controller, DMA controller etc.

The power supply pins, of the chips should be verified to determine whether the chips are getting power supply or not. A digital multi meter should be used to measure the exact voltage.

Following are some possible faults in RAM logic.

- Improper decoding
- One or more address / data input bad.
- Chip select i/p bad
- R/W control i/p bad
- IC socket problem
- IC internal fault

Following are some possible faults in ROM logic.

- Improper decoding
- Address i/p bad
- Chip select i/p bad
- Internal fault in IC chip
- IC socket problem

Following are some possible fault in I/O port logic and interrupt logic.

- Address input bad
- Chip select input bad
- R/w input bad
- Internal problem in IC
- IC socket problem

KEYBOARD FAULT:-

The keyboard problem can be of following types.

- Faulty keyboard connector
- Fault in keyboard decoding logic
- Mechanic faults in key board.

FDD PROBLEM:-

All the FDD problems can be categorised into following three types.

- Electromechanical problem
- Computability problem
- FDC problem

HDD PROBLEM:-

The HDD problems can be the following types.

- Electrical failure.
- Drive is powered, but shows no sign of function
- Failure in spindle motor
- Mechanical failure
- Lead crash due to dust.
- Head crash due to physical shock
- Electronic failure
- Data failure
- Bad spot on platter
- Dust on platter surface
- Dust on R/W head.

Display Problem:-

- Display No Image
- Displays only a thin horizontal line or a pinpoint at the center
- Flashes one color intermittently, even when the screen is blanked
- Displays some colors incorrectly or not at all
- Image rolls or a horizontal line scrolls constantly down the screen
- Image displays rectilinearly, but is incorrectly sized or aligned on screen

Printer Problem:-

- Printing takes too long
- Paper jams
- Really bad looking prints
- Print Jobs Stuck in Print Queue
- Stop Printing Because Ink Is Low
- A Print Image Is Being Superseded Over Another

NETWORKING DEVICES AND THEIR INTERFACES

A network interface card (NIC) is a circuit board or [card](#) that is installed in a computer so that it can be connected to a network.

A network interface card provides the computer with a dedicated, full-time connection to a network. Personal computers and workstations on a local area network ([LAN](#)) typically contain a network interface card specifically designed for the LAN transmission technology

Short for **Network Interface Card**, the **NIC** is also referred to as an **Ethernet card** and **network adapter**. It is an [expansion card](#) that enables a [computer](#) to connect to a network; such as a home network, or the Internet using an [Ethernet cable](#) with an [RJ-45](#) connector.

Due to the popularity and low cost of the Ethernet standard, most new computers have a network interface build directly into the [motherboard](#).

How does a computer with a network card connect to a network?

A network card can communicate with each other over the same [network](#) using a network [switch](#) or if only two computers a direct connection. If computers on your network need to connect to a different network (e.g. the [Internet](#)) they must be eventually connected to a [router](#) that allows networks to communicate with each other.

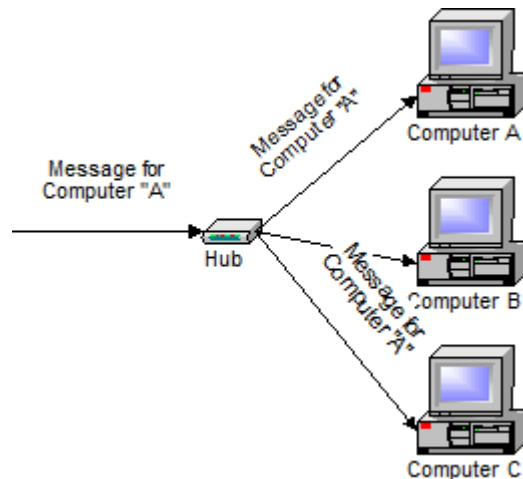
What's the difference between a Ethernet hub, a switch, and a router?

Ethernet hubs, switches, and routers are all devices that let you connect one or more computers to other computers, networked devices, or even other networks. Each has two or more connectors called ports into which you plug in the cables to make the connection. Varying degrees of magic happen inside the device and therein lies the difference. I often see the terms misused, so let's clarify what each one really means.

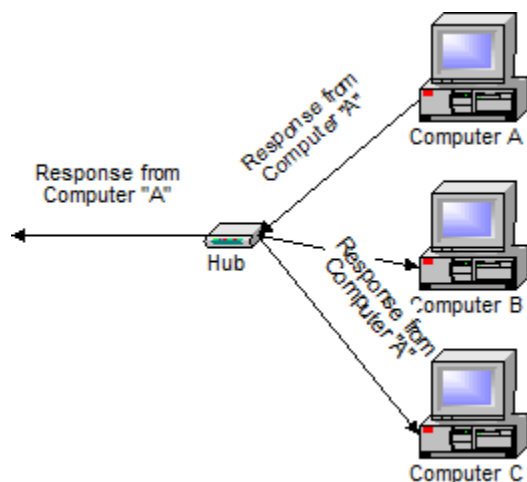
Ethernet hub

A Ethernet hub is typically the least expensive, least intelligent, and least complicated of the three. Its job is very simple – anything that comes in one port is sent out to the others.

If a message comes in for computer “A”, that message is sent out all the other ports, regardless of which one computer “A” is on:



And when computer “A” responds, its response also goes out to every other port on the hub:



Every computer connected to the hub “sees” everything that every other computer on the hub sees. The computers themselves decide if they are the targeted recipient of the message and when a message should be paid attention to or not.

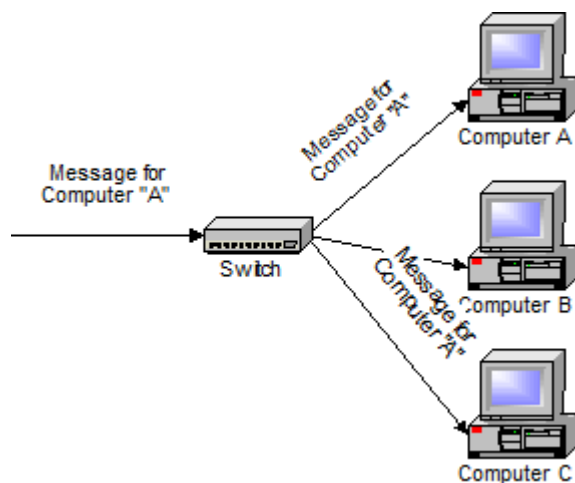
The hub itself is blissfully ignorant of the data being transmitted. For years, simple hubs have been quick and easy ways to connect computers in small networks.



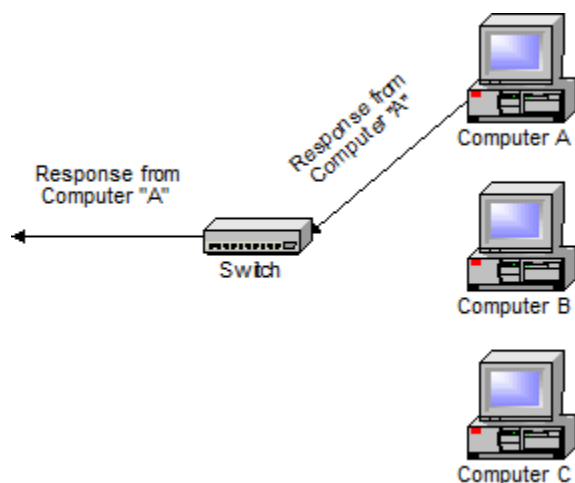
Switches

A switch does essentially what a hub does, but more efficiently. By paying attention to the traffic that comes across it, it can “learn” where particular addresses are.

Initially, a switch knows nothing and simply sends on incoming messages to all ports:

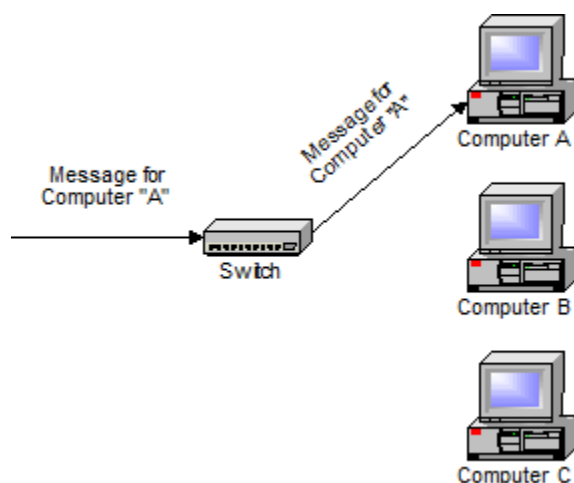


Even accepting that first message, however, the switch has learned something – it knows on which connection the sender of the message is located. Thus, when machine “A” responds to the message, the switches only need to send that message out to the one connection:



In addition to sending the response through to the originator, the switch has now learned something else – it now knows on which connection machine “A” is located.

That means that subsequent messages destined for machine “A” need only be sent to that one port:

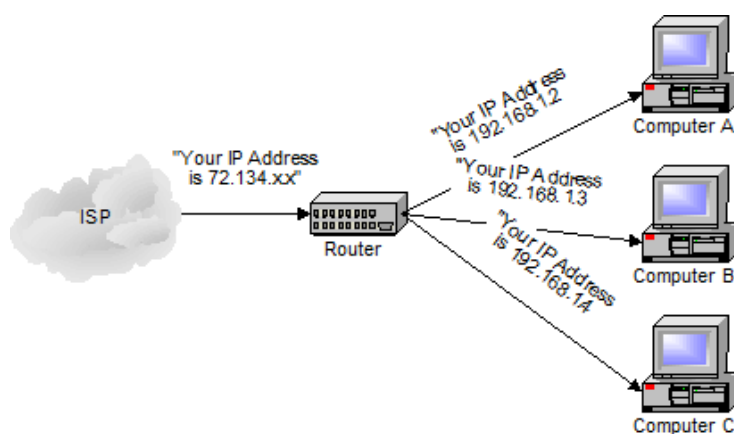


Switches learn the location of the devices that they are connected to almost instantaneously. The net result is that most network traffic only goes where it needs to rather than to every port. On busy networks, this can make the network significantly faster.

Routers

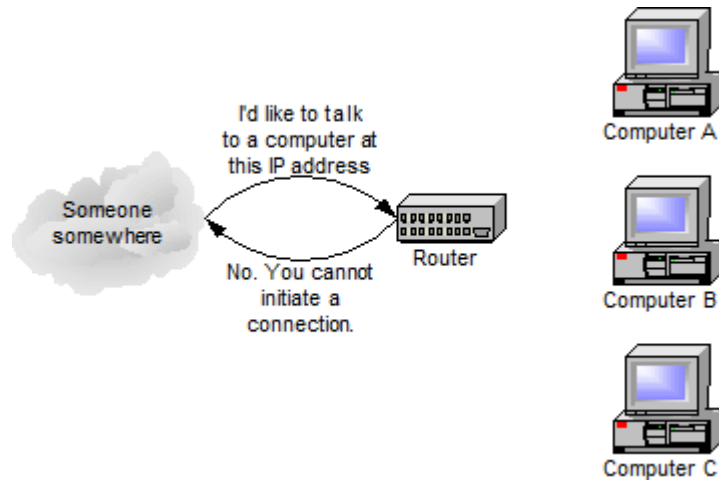
A router is the smartest and most complicated of the bunch. Routers come in all shapes and sizes – from the small, four-port broadband routers that are very popular right now to the large industrial strength devices that drive the internet itself.

A simple way to think of a router is as a computer that can be programmed to understand, possibly manipulate, and route the data that it's being asked to handle. Many routers today are, in fact, little computers dedicated to the task of routing network traffic. As far as simple traffic routing is concerned, a router operates exactly as a switch, learning the location of the computers on its connections and routing traffic only to those computers. Consumer grade routers perform at minimum two additional and important DHCP – Dynamic Host Configuration Protocol – is the way dynamic IP addresses are assigned. A device asks for an IP address to be assigned to it from “upstream” and a DHCP server responds with an IP address assignment. A router connected to your ISP-provided internet connection will typically ask your ISP's server for an IP address; this will be your IP address on the internet. Your local computers, on the other hand, will ask the router for an IP address and these addresses are local to your network.



NAT – Network Address Translation – is the way that the router translates the IP addresses of packets that cross the internet/local network boundary. When computer “A” sends a packet out, the IP address that it’s “from” is that of computer “A” – 192.168.1.2 in the example above. When the router passes that on to the internet, it replaces the local IP address with the internet IP address assigned by the ISP. It also keeps track, so that if a response comes back from somewhere on the internet, the router knows to do the translation in reverse – replace the internet IP address with the local IP address for machine “A” and then send that response packet on to machine “A”.

A side effect of NAT is that machines on the internet cannot initiate communications to local machines – they can only respond to communications initiated by those local machines. The net effect is that the router then also acts as a firewall:



What that means is that malware that might spread by trying to independently connect to your computer over the network cannot.

All routers include some kind of user interface for configuring how the router will treat traffic. The really large routers include the equivalent of a full-blown programming language to describe how they should operate as well as the ability to communicate with other routers to describe or determine the best way to get network traffic from point A to point B.

There are three main devices that work to connect one computer to another computer. A network hub, switch, and router can all perform this function. It can sometimes be confusing when trying to figure out what device is currently being used on a computer network, without knowing what each device does.

Cables

Despite advances in wireless technologies, many computer networks in the 21st century still rely on cables as a physical medium for devices to transfer data. Several standard types of **network cables** exist, each designed for specific purposes.

Coaxial Cables

Invented in the 1880s, "coax" was best known as the kind of cable that connected television sets to home antennas. Coaxial cable is also a standard for 10 [Mbps Ethernet cables](#).

When 10 Mbps Ethernet was most popular, during the 1980s and early 1990s, networks typically utilized one of two kinds of coax cable - **thinnet** (10BASE2 standard) or **thicknet** (10BASE5). These cables consist of an inner copper wire of varying thickness surrounded by insulation and another shielding. Their stiffness caused network administrators difficulty in installing and maintaining thinnet and thicknet.

Twisted Pair Cables

Twisted pair eventually emerged during the 1990s as the leading cabling standard for [Ethernet](#), starting with 10 Mbps (**10BASE-T**, also known as Category 3 or **Cat3**), later followed by improved versions for 100 Mbps (100BASE-TX, **Cat5**, and **Cat5e**) and successively higher speeds up to 10 Gbps (10GBASE-T). Ethernet twisted pair cables contain up to eight (8) wires wound together in pairs to minimize electromagnetic interference.

Two primary types of twisted pair cable industry standards have been defined: **Unshielded Twisted Pair (UTP)** and **Shielded Twisted Pair (STP)**.

Modern Ethernet cables use UTP wiring due to its lower cost, while STP cabling can be found in some other types of networks such as *Fiber Distributed Data Interface (FDDI)*.

Fiber Optics

Instead of insulated metal wires transmitting electrical signals, [fiber optic network cables](#) work using strands of glass and pulses of light.

These network cables are bendable despite being made of glass. They have proven especially useful in [wide area network \(WAN\)](#) installations where long distance underground or outdoor cable runs are required and also in office buildings where a high volume of communication traffic is common.

Two primary types of fiber optic cable industry standards are defined – **single-mode** (100BaseBX standard) and **multimode** (100BaseSX standard). Long-distance telecommunications networks more commonly use single-mode for its relatively higher [bandwidth](#) capacity, while local networks typically use multimode instead due to its lower cost.

USB Cables

Most [Universal Serial Bus \(USB\)](#) cables connect a computer with a peripheral device (keyboard or mouse) rather than to another computer. However, special [network adapters](#) (sometimes called [dongles](#)) also allow connecting an Ethernet cable to a [USB port](#) indirectly. USB cables feature twisted pair wiring.

Serial and Parallel Cables

Because many PCs in the 1980s and early 1990s lacked Ethernet capability, and USB had not been developed yet, serial and parallel interfaces (now obsolete on modern computers) were sometimes used for PC-to-PC networking. So-called [null model cables](#), for example, connected the [serial ports](#) of two PCs enabling data transfers at speeds between 0.115 and 0.45 Mbps.

Crossover Cables

Null modem cables are one example of the category of [crossover cables](#). A crossover cable joins two network devices of the same type, such as two PCs or two [network switches](#).

The use of Ethernet crossover cables was especially common on older home networks years ago when connecting two PCs directly together. Externally, Ethernet crossover cables appear nearly identical to ordinary (sometimes also called *straight-through*), the only visible difference being the order of color-coded wires appearing on the cable's end connector. Manufacturers typically applied special distinguishing marks to their crossover cables for this reason.

Nowadays, though, most home networks utilize routers that have built-in crossover capability, eliminating the need for these special cables.

Connector types and its properties

Along with the cables that are widely used nowadays have evolved over time, so have the connectors that are used for connecting them. Some of these connectors have superseded their earlier version because of their new and enhanced characteristics like durability, reliability and easy to operate features etc. Many of these connectors have also been used for creating the patch cables and terminating internal cable running at data centers and wall plates. The other advantage of using a connector is that they are inter changeable from one connector type to the other as per requirement whereas in case of a copper cable, they have a particular set of requirements to be made by connectors. Twisted pair along with coaxial cables leaves us no choice for connector but fiber cables overcome this disadvantage. It can be generally said that most of the connectors perform more or less the same operation of joining two ends of the core filament mutually such that the light pulses have no difficulty in travelling from one point to another. Another characteristic of most of the connectors are that they are spring loaded such that the cores can be pressed mutually and firmly. It remains with the user now to select which type of connector to go for seeing the compatibility and requirements of the same as there are tones of such connectors available in the market. Some of the most widely used connectors these days have been discussed in detail below.

Fiber



The fiber optic connectors may be classified according to the requirement of the individual as single mode or multi mode fiber optic cable connector. The fiber optic cable connectors have also been used extensively recently and will also have an increase in their demand in the near future also because of its characteristics of strength and durability etc. Some of the basic features for a good connector are reliability and low cost, high return and low insertion losses, easy to operate and install and low sensitivity for environmental conditions. These connectors also help in quicker disconnection and connection and align at the cores to allow light to pass through it. Depending on the fiber optic cable you are using and according to the purpose and need of the connection, the appropriate connector may be chosen from a wide range of connectors. However, it is mandatory to have general awareness of the physical appearance and the basic purpose for each of the different type of connectors. Some of the fiber optic connectors have been discussed in detail below:

ST: The ST or a straight tip fiber optic connector makes use of a bayonet type and half twisted lock which allows it to hold in the place strongly. This type of connectors generally found their use with the single mode fiber optic cables which is responsible for transmitting data at larger distances. These connectors strongly resemble a little BNC connector but the ingredient by which it is made of is generally hard plastic. This type of connector is easier to insert and have a diameter of 2.5 mm. It also has features like ceramic ferrule which helps in minimizing the back reflections. This was among the first type of connectors that was implemented in a fiber optic application. These connectors have been in business for many years now but now they are facing the risk of elimination with the smaller, newer and denser connections for the installation. They are generally rated for duration of 500 mating cycles. The insertion loss or attenuation for a typical connector of this type is around 0.25 db.

SC: The SC or the standard connector is one of the most basic types of a fiber optic connector. It makes use of a push and pull configuration mechanism which you may have encountered in common video and audio plugs or jacks. This type of connectors finds its extensive use in combination to multi mode fiber optic cables which forms the basis of any local area connection or network. They are able to hold a single fiber with the diameter of 2.5 mm. This type of push pull configuration mechanism is also easier to use than the original twist style mechanisms and easier to operate in tighter places. It is also known as subscriber connector which was developed by a Japanese company named NTT. The body of this type of connector is generally square shaped such that the 2 SC connectors have been held together with the help of plastic clip and this connection is termed as duplex connection.

LC: The LC or the local connector is the fiber optic cable type connector which has a body built just like a RJ jack style. These types of connector find their extensive use for making local connections that are generally seen in the network closet or the telecom room of the organization. One of the most popular forms of connector is small form factor connector and that is also LC type connector. This connector design was developed by Lucent Technologies and it makes use of retaining tab design which is very similar to a phone. The squarish shape of the connector means it resembles the shape of the SC connector. The diameter of the LC connector is 1.25 mm and generally held together with the help of plastic clip which is also termed as the duplex connection as described earlier.

MTRJ: The MTRJ connector or the mechanical transfer registered jack connector is quickly becoming more and more popular these days because of its small size and high durability. It looks more or less like the RJ - 45 connector and makes use of two fibers which are stationed just next with each other. It was originally designed keeping in mind to replace the basic SC connector. That is why, it is almost half the size of SC connector when it provides 2 connected fibers instead of being just one. This form of connectors is also one of the forms of the small form factor connectors and was developed by Corning and AMP/Tyco. A modular plug of RJ - Style resembles closely to it and that is where this connector got a part of its name from. There is a duplex connection for holding the two connectors together and generally makes use of the plastic or elastic component for their body.

Copper

Enough is been said about the fiber optic connectors. Not all of the connectors are optic fiber cable type. There are many connectors which makes use of copper as a raw material for their construction. Copper connectors are still widely used for many of the networks even today. Some of these connectors may have lost their value overtime and were unable to survive the test of time but they surely find an important place in many of the applications in today's world. The fiber end needs to be properly cemented followed by polishing, so that maximum light can pass through it. The whole process also requires a lot more manual effort but they are easy to install and operate. Heavy end duty press is then used for compressing the ends of several layers to finally make it into a copper ferrule and then punching takes place to dig in a hole for the connection.



RJ - 45: These type of connectors are the most common and basic type of all the network connectors. These can mainly be found used for connecting network interface card with the hubs or switches. These also have found consistent use in connecting various network devices collectively for better communication and better control of the device. The RJ - 45 type of connectors contains and can be used to connect four different pairs of wires, although they are generally used for connecting only 2 pairs. This is the 8 conductor and 8 position modular connectors which also find use in data networks like Ethernet. These connectors have a physically wider appearance and can also connect a patch cable to a network router. It also makes use of a keyed variety to prevent the occurrence of mating along with the other connectors.

RJ - 11: There are a lot of chances that you have encountered this type of connector in your everyday life since they are extensively used in all forms of telephonic connections in almost all the countries. These types of connectors are meant to have and join two different pairs of wires. While operating a computer also, you will be using this type of connector for connection between modem and the telephonic line unless you are still in the era of a dial - up connection. This makes use of a modular connector 6 - position and looks to be identical to RJ - 14 and RJ - 25 connectors except for the fact of different number of contacts in the connector. These types of connectors are capable to make use of 2 conductor configuration but instead 4 conductor configurations is generally used with major 4 wires connecting to a central box junction. Two contacts are used to connect tip and ring and the remaining two are unused then.

BNC: BNC connector type is very rarely used these days in any form of networks. These found extensive use in their era during older times and for connection of an old network. The BNC connector is made to push in and then makes a lock on to the connection to hold the place securely while also connecting the two core wires and is abbreviated as Bayonet Neill Concelman connector and is a type of coaxial cable which still is operated in radio frequency operations.

F - Connector: The F - connector is coaxial type cable connector which finds its use in the field of cable TV or cable modems. It makes use of an attachment through RG - 6 or RG - 59 connector cable in its older versions and provides a solid foundation for facilitating the data transmission or the TV or modem signals. It also use is satellite communications as well and is one of the oldest connectors (discovered in 1950) known. Its inexpensive characteristics and good impedance matching features makes it an ideal choice for this type of connections.

DB - 9 (RS - 232): The standard 232 or the RS - 232 also known as the DB - 9 connector is a cable data transmission standard and is profoundly used in serial data communication and transmission between the data terminal and communication equipment like the one is used to connect serial port of computer to the external modem. It is not used quite frequently in today's world as it used to be in the past. The advancement of technology in this field such as USB connectors etc. is quietly superseding these standard DB - 9 connectors. This also has the lowest footprint in all the D - miniature connectors and is also used for data connectivity.

Patch panel: a patch panel is more or less a wall mounted or a rack structure that is the home of cable connections. This generally makes use of plugging into the front side and the back side holding the connection that was punched down for a stable, longer and permanent use. This type of connection has an added incentive that it also offers the administrator to change the signal path whenever required. A damaged cable can be easily replaced by simply changing the connection of the two patch cables.

110 block (T568A, T568B): This is a newer and most recent type of wiring connectors and distribution points termed as a 110 block which has already replaced most of the telephonic wires and installations and is also found being implemented in the computer network. Wires are made to punch down from one side and on the other side are connected RJ - 11 for phones and RJ - 45 for networking connections. This type of connector comes in many different sizes ranging from 25 wire pairs to above 500 pairs. When these are used in collaboration to CAT 6 cables, they can also carry 1 Gbps connections.