

Unit I: Introduction to Computer – Computer Fundamentals and Application

Definition of Computer:

The word "computer" is derived from the Greek word "compute" which means "to calculate". A computer is an electronic device which can be reprogrammed to take input from the user, process them by using CPU "Central Processing Unit" and give output in the human readable and understandable form and even store the output for future use.

It can process both numerical and non-numerical (arithmetic and logical) calculations. The only language supported by computer system is "Binary System" or "Machine Language". The Machine Language is represented by 0's and 1's.

How A Computer Works?

A computer takes data input from real world by keyboard or mouse. The input data is converted into machine language before being processed. The CPU "Central Processing Unit" then processes the input data utilizing available resources.

The result thus obtained is converted to human readable form, which may be displayed on monitor or print hardcopy by printer or listen sound through speaker. The working principle of computer can be summarized as input, process and output cycle.

IPO Cycle:

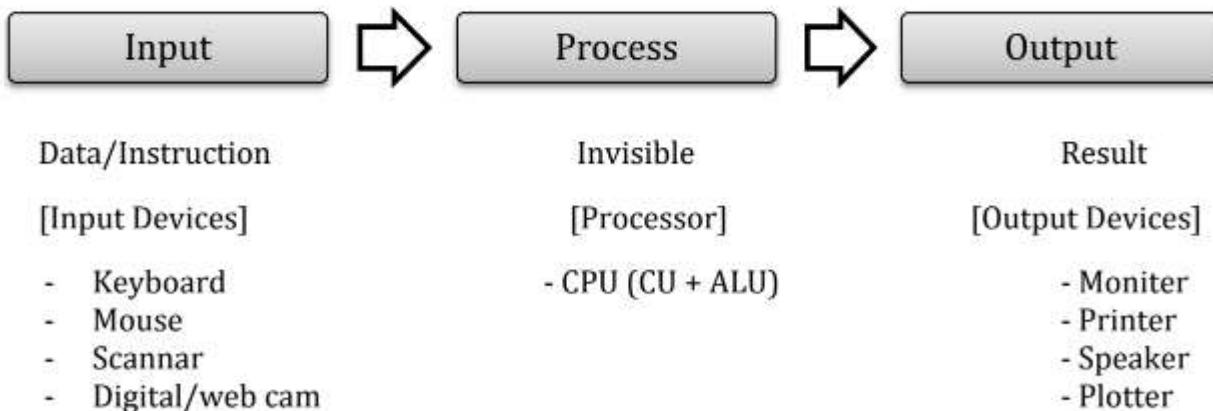


Fig: Computer working process

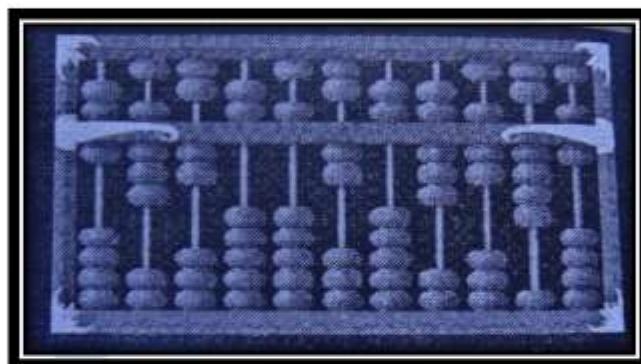
History of Computers:

The history of computer starts from 4000 years ago. History of computer means the gradual change in the concept over a long period of time. Around fifth century, Hindu philosophers developed a new method of counting from 0 to 9. Counting the numbers from 0 to 9 can be performed with the help of fingers. The development of counting started from the development of simple counting device called ABACUS.

Age of Mechanical Calculating Era:

1. Abacus:

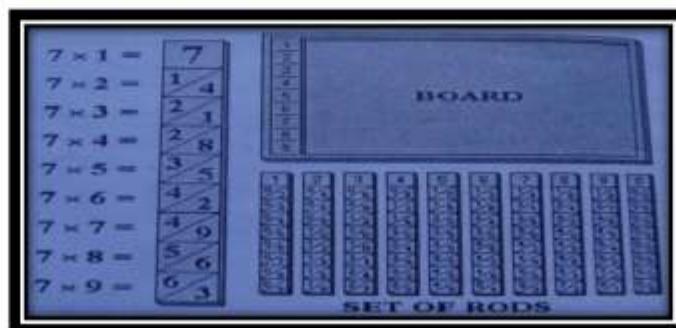
It is believed that abacus was the earliest counting device invented by human being. In fact, the oldest surviving abacus was used in 3000 B.C. by the Babylonians. The Chinese abacus was called 'suan pan' which means counting board.



An abacus consists of rectangular frames containing a number of rods or wire which is divided into two unequal parts called earth and heaven. The lower part contains 5 beads/rings and upper part contains 2 beads/rings in each wire. By moving the beads/rings, it is used for counting as well as to find addition and subtraction.

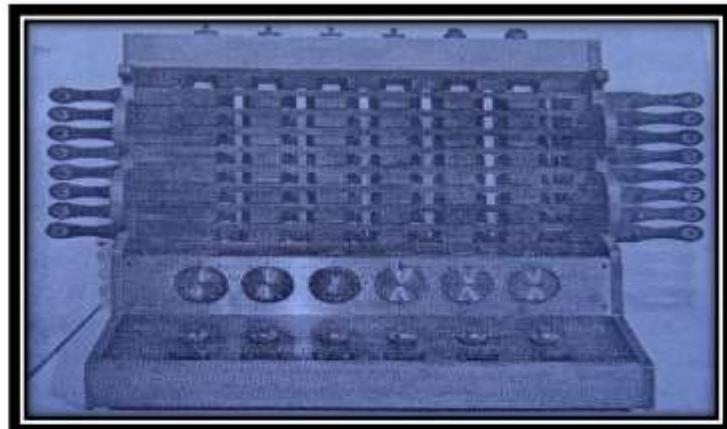
2. Napier's Bone:

John Napier was a great Scottish mathematician. He invented 'Principle of Logarithm' in 1614 A.D. then based on his own principle, he invented a simple device containing 10 rods made of ivory sticks marked with numbers in 1617 A.D. That device was called Napier's Bone and people can use it for faster multiplication and division.



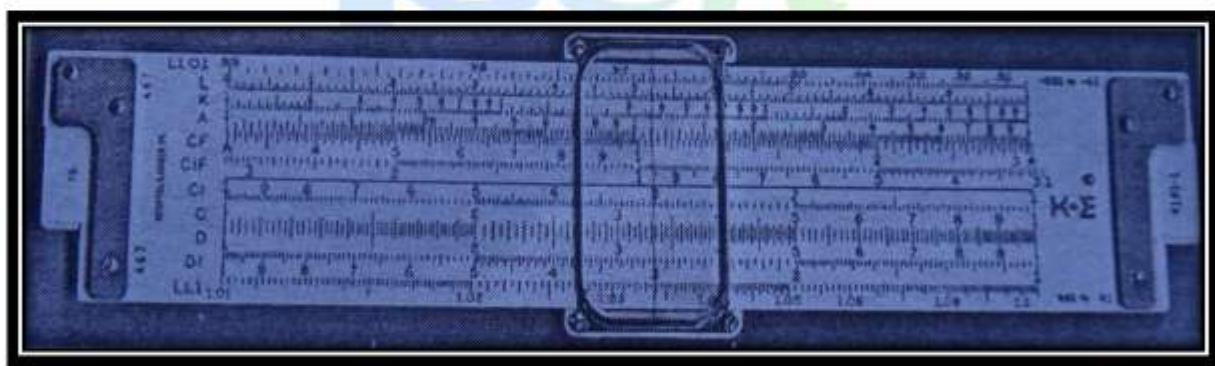
3. Schickard's Calculating Clock:

The first gear driven calculating machine was probably the calculating clock, named by its inventor, the German Professor Wilhelm Schickard in 1623 A.D. This device got little publicity because Schickard died soon afterward in the bubonic plague.



4. Slide Rule:

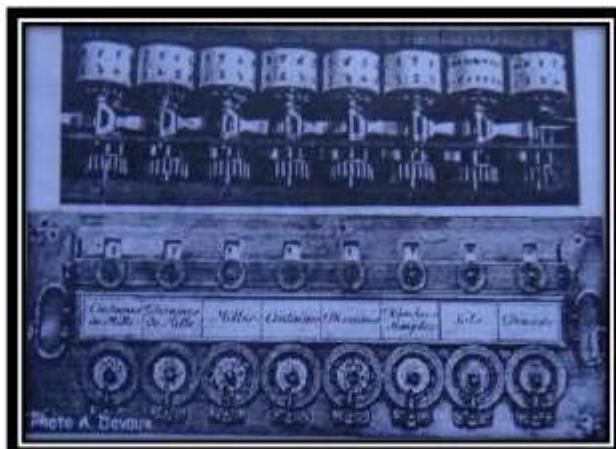
Based on the principle of John Napier (Principle of Logarithm), William Oughtred an English mathematician made a simple device called slide rule in 1624 A.D. People could use it for faster multiplication and division. It was used in the 1960's by the NASA engineers of the Mercury, Gemini and Apollo programs which landed men on the moon.



5. Pascaline:

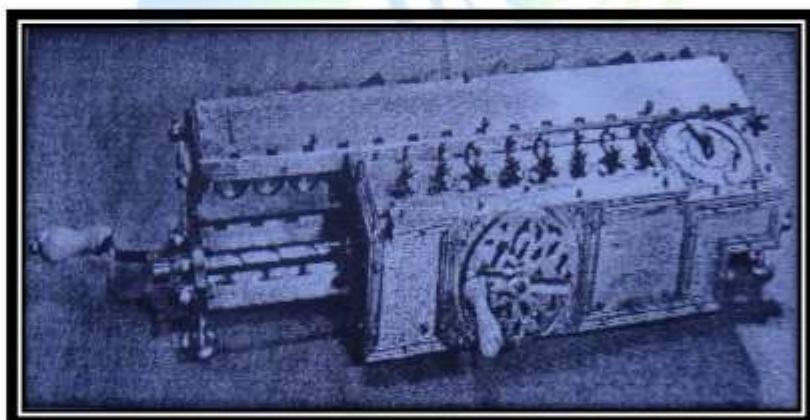
Pascaline was invented by Blaise Pascal in 1642 A.D. He invented pascaline to help his father who was tax collector. Pascaline had some cogs and gears rotating in complement to each other and it could do addition and subtraction up to 8 digits.

Multiplication and division were also done by repeated addition and subtraction respectively. The car speedometer used the very same mechanism. Later a computer programming language was called 'Pascal' to honor Blaise Pascal for his great contribution.



6. Stepped Reckoner:

Gottfried Wilhelm von Leibniz was a great German mathematician. He managed to build a four function (addition, subtraction, multiplication and division) calculator in 1671 A.D. on the basis of Pascaline.



He named that device "Stepped Reckoner" and he employed fluted drums having ten flutes arranged around their circumference in a stair-step fashion instead of gears. It could find square root too. Although the Stepped Reckoner employed the decimal number system, Leibniz was the first to advocate use of the binary number system which is fundamental to the operation of modern computers.

7. Jacquard's Loom and Punch Card:

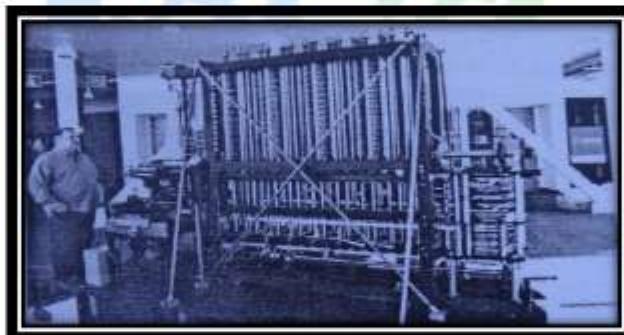
In 1801 A.D. Joseph Marie Jacquard invented a power loom that could base its wave upon a pattern and automatically read form punched wooden cards, held together in a long row by rope. Later the same punched card technology was used for computer programming. Hence, he is remembered even in the history of computer.

Jacquard's technology was a real boon to mill owners, but put many loom operators out of work. Angry mobs smashed Jacquard Looms and once attacked Jacquard himself.



8. Difference Engine and Analytical Engine:

Charles Babbage was a great mathematician of Cambridge University. He developed "Difference Engine" in 1822 A.D. which was equal to the size of a room. Difference Engine was his first invention and it was powered by steam. Charles Babbage obtained government funding for the development of Difference Engine, due to the importance of numeric tables in ocean navigation. By promoting their commercial and military navies, the British government had managed to become the earth's greatest empire.



Charles Babbage also designed another engine called Analytical Engine in 1833 A.D. but unfortunately he was unable to complete it. He also discovered the principle for the construction of general purpose programmable automatic mechanical computer on which modern electronic computer are based. Hence he is known as "Father of Computer."



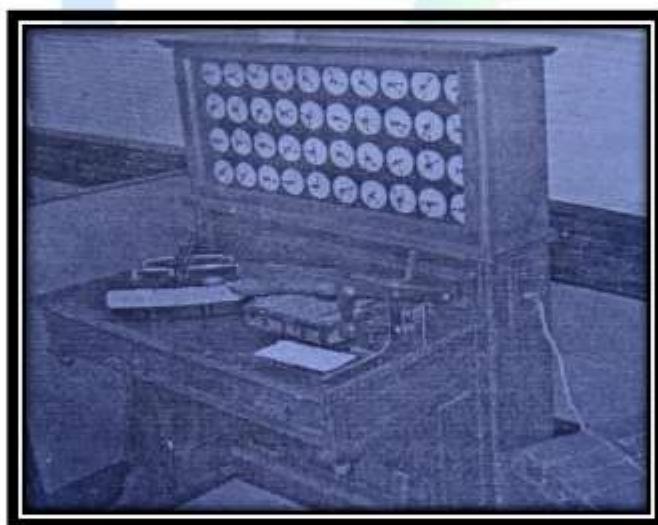
9. Lady Augusta Ada:

Lady Augusta Ada was the admirer and follower of Charles Babbage. She was fascinated by Babbage ideas. Through letters and meetings with Babbage, she learned enough about the design of the Analytical Engine. She suggested Babbage to use binary number system for computer program and data. She gave the concept of computer programming for the first time, so she is considered as "First Computer Programmer." She invented "Subroutine" and "Importance of Looping."

Later, a computer programming language was called "Ada" to honor her for her great contribution in computer programming.

10. Tabulating Machine:

The U.S. constitution states that a census should be taken of all U.S. citizens in every 10 years. The first census of 1790 A.D. had only required 9 months by 1880 A.D. the U.S. population had grown so much that the count for the 1880 A.D. census took 7.5 years. Then it was estimated that 1890 A.D. census may take 13 years due to increase in population of U.S. by immigration. This was not reliable because in U.S. census was taken in every 10 years but here the estimated time period was 13 years.

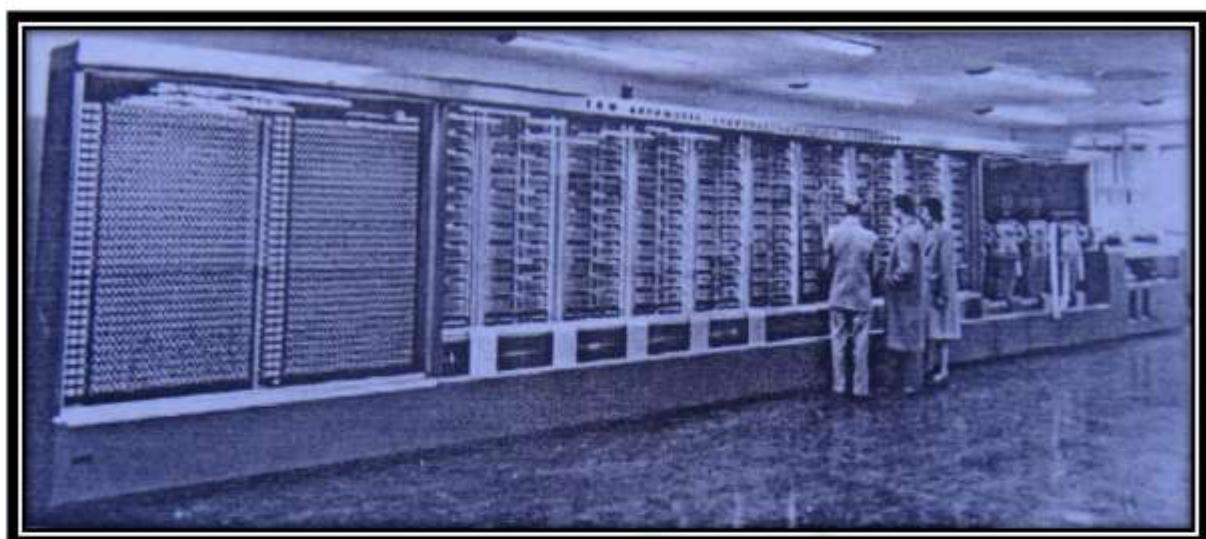


Then, by using the similar ideas of "Jacquard's Loom", Herman Hollerith made "Punch Card Tabulating Machine" in 1886 A.D. It could process on the punch cards and perform the census calculation faster and accurately. Hollerith's technique was successful and the 1890 A.D. census was completed in only 3 years at a saving of 5 million dollars. Herman Hollerith won prize by the census bureau for the invention of great census device.

In 1896 A.D. Herman Hollerith had established his own company called TMC "Tabulating Machine Company". Later, TMC joined other company and established IBM "International Business Machine" Company in 1923 A.D. IBM is the largest computer manufacturing company in the world. Punch Card technology was used in computers up to the late 1970's.

Age of Electro-Mechanical Computer Era:

1. Mark-I:



In 1937 A.D. Howard Aiken constructed an electro-mechanical computer named Mark-I, which was based on the principle of Charles Babbage. This invention was a joint partnership between IBM and Harvard University. It was also called IBMASCC "International Business Machine Automatic Control Calculator." This was the first programmable digital computer which works on binary format rather than decimal.

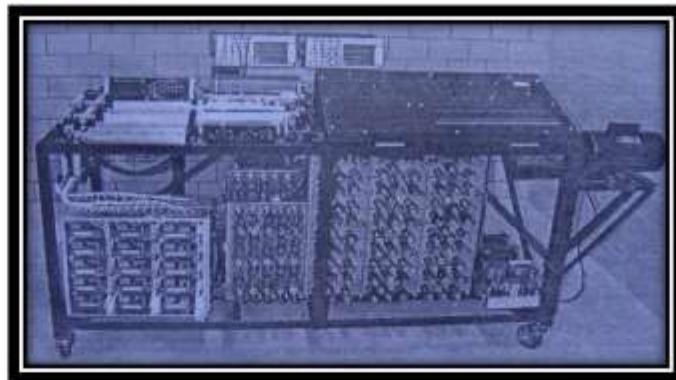
Mark-I was 51 feet long, 8 feet height and 3 feet wide using 18000 vacuum tubes with 7 lakhs 50 thousands parts and weighted approximately 32 tons. It uses 500 miles of wires to connect every parts of Mark-I and over 3000 electrically actuated switches to control operations. By using 5 horsepower electric motor, Mark-I used to rotate 50 feet rotating shaft.

Mark-I was capable of performing five basic arithmetic operations: addition, subtraction, multiplication, division and table reference on numbers as big as 23 digits. It takes approximately 0.3 seconds to add two numbers and 4.5 seconds for multiplication of two numbers. Grace Hopper was one of the programmer for the Mark-I. She found the first computer "bug."

2. ABC (Atanasoff-Berry Computer):

Dr. John V. Atanasoff Berry was a professor of physics and mathematics at Iowa State University. With the help of his graduate student Clifford Berry, he built a machine named ABC "Atanasoff Berry Computer" in 1938 A.D. which could solve different types of mathematical problems successfully.

This machine was the first to store data as charge on a capacitor, which is how today computer stores information in their main memory "RAM." It used 45 vacuum tubes for internal logic and capacitors for storage of electric charge.



Age of Electronic Computer Era:

1. Electronic Numerical Integrator and Calculator (ENIAC):

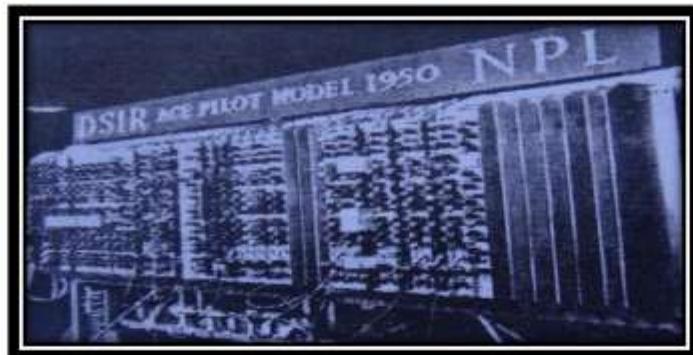
ENIAC stands for "Electronic Numerical Integrator and Calculator", which is the first electronic digital computer. It was built at the University of Pennsylvania between 1943 A.D. and 1946 A.D. by two professors John W. Mauchly and John Presper Eckert. It was built to meet the needs of US armed forces to use in world war. It was 300 times faster than any other devices of those days.



ENIAC filled a 20 by 40 feet room, weighted 30 tons, and more than 18000 vacuum tubes, produced more heat as it consumed 180 kilowatts of power and needed to be cooling system. It could add two numbers in 200 microseconds and multiply them in 2000 microseconds. ENIAC first task was to compute whether it was possible to build a hydrogen bomb.

2. Automatic Computing Engine (ACE):

ACE stands for "Automatic Computing Engine". Alan turning presented a detailed paper to the National Physical Laboratory Executive Committee giving the first reasonably complete design of a stored-program computer. Because of the strict and long lasting secrecy around his wartime work, he was prohibited from explaining that he knows his ideas could be implemented in an electronic device. ACE was the first true electronic computer using stored programs.



Unfortunately, due to wartime secrecy, the computer and his plans were destroyed with his suicide by injecting cyanide in 1954 A.D. Fifty five years after the death of Turing, on September 10, 2009 British Prime Minister Gordon Brown made an official public apology on behalf of the British government for the way in which Turing was treated after the war.

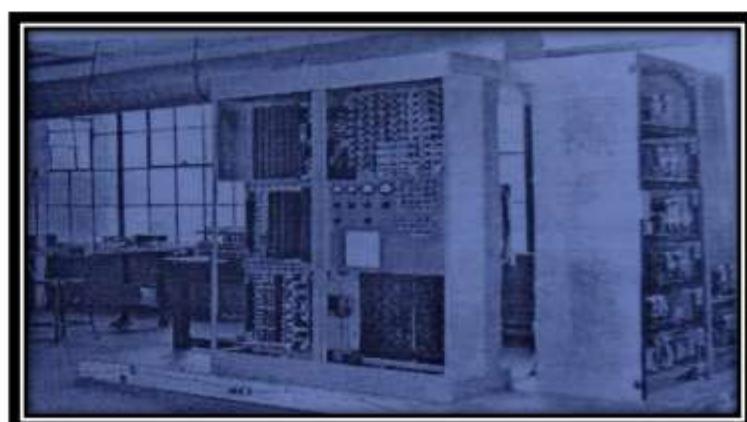
3. John Von Neumann:

John Von Neumann was a great mathematician and he discovered the "principle of stored program" concept in 1945 A.D. All the modern computers are based on his stored program technique. He is also called the "Father of Stored Program Technique".

Before his principle, program required for computers were integrated and written permanently in paper, tapes, and mechanical devices and in the circuit of vacuum tubes so modification of program was not possible. But after his discovery of stored program techniques, such programs were stored inside the computer in some storage media, so that modification will be easy and flexible.

4. Electronic Discrete Variable Automatic Computer (EDVAC):

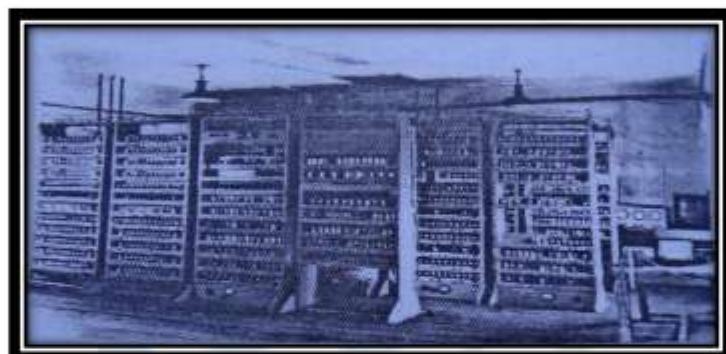
EDVAC stands for Electronic Discrete Variable Automatic Computer which was discovered by John W. Mauchly and John Presper Eckert in 1952 A.D. by applying the principle of stored program technique which was proposed by John Von Neumann in 1947 A.D. It also had vacuum tubes and some internal storage.



EDVAC was built for United States Army's Ballistics Research Laboratory by University of Pennsylvania's Moore School of Electrical Engineering. The computer had almost 6000 vacuum tubes, 1200 diodes and consumed 56 kilowatt of power. It covered 490 square foot space and weighted 7850 Kilogram. The machine requires 30 personnel to operate. This machine ran until 1961 A.D. at research laboratory.

5. Electronic Delay Storage Automatic Computer (EDSAC):

EDSAC stands for Electronic Delay Storage Automatic Computer which was discovered by Maurice V. Wilkes in 1949 A.D. using John Von Neumann stored program technique at Cambridge University Mathematical Laboratory. It also used Vacuum tubes. It runs its first program on May 6, 1949. EDSAC is able to do addition in 1500 microseconds and multiplication in 4000 microseconds. This machine was used to calculate a table of squares and a list of prime numbers.



Notes

6. UNIVersal Automatic Computer (UNIVAC):

UNIVAC stands for UNIVersal Automatic Computer which was discovered by John Presper Eckert and John W. Mauchly in 1951 A.D. after leaving the University of Pennsylvania over a dispute about who owned the patents for their invention. UNIVAC was the first commercial computer produced in large quantity.



UNIVAC was 25 feet by 50 feet in length, contained 5600 vacuum tubes, 18000 crystal diodes and 300 relays. It utilized a Mercury delay line, magnetic tape and typewriter output. UNIVAC was used for general purpose computing with large amounts of inputs and outputs.

UNIVAC processing speed was 0.525 milliseconds for arithmetic functions, 2.15 milliseconds for multiplication and 3.9 milliseconds for division. It was the first computer to come equipped with a magnetic tape unit and was the first computer to use buffer memory.

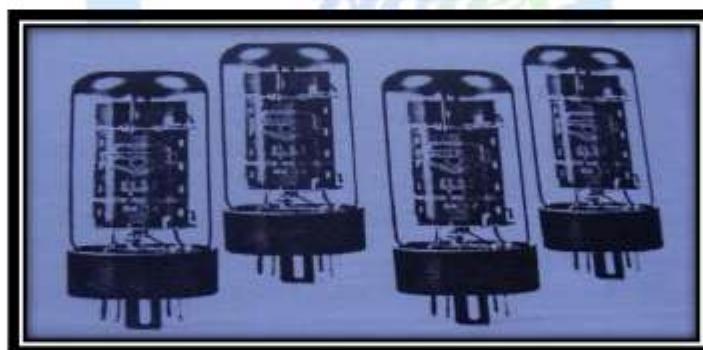
Generation of Computers:

If we see the computer in the past, then we find that they were not in similar shape, size, cost, functionality, technology, hardware and software to the modern digital computers. Computer generation is the classification of computers into different groups according to their manufacturing date, memory device other hardware and software technology used inside those computers.

Generation of computer is a step in advancing technology. It provides the framework for the growth and development of the more powerful and useful computer system. There are 5 generations of computer which are as follows.

First Generation of Computers:

The computers which were discovered approximately between 1942 A.D. and 1955 A.D. are classified as the First Generation of Computers. All the computers which were discovered during the first generation had "Vacuum Tubes" for their memory and processing devices. Vacuum tube was developed by Lee De Forest in 1908 A.D. and used later in computer system.



Vacuum tubes were a glass device, which used filaments as a source of electronics, could control and amplify electronic signals. It was the only high speed electronic switching device available in those days. The vacuum tubes required great amount of energy and generated much heat. Lots of space were required not only for the large number of vacuum tubes but also for housing special air-conditioning units to get rid of heat generated by vacuum tubes.

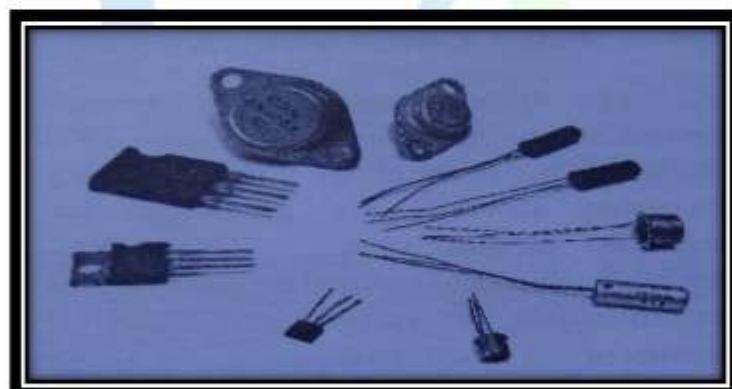
Features of First Generation of Computers:

- ❖ Vacuum tubes were used as main components.
- ❖ Processing speeds were measured in milliseconds.
- ❖ Punch Cards were used for input and output devices.

- ❖ Electro-mechanical types of computers.
- ❖ Vacuum tubes were used for primary memory devices.
- ❖ First punched cards later Magnetic drums were used for secondary storage devices.
- ❖ Computers operate manually because operating systems were not invented.
- ❖ Computers were not fully reliable and accurate.
- ❖ Machine Level Languages and Assembly Level Languages were used for Programming.
- ❖ Computers were very large and very expensive.
- ❖ Computers were available for military purpose and university research.
- ❖ Computers were not portable due to huge size.
- ❖ Computers consume lots of power and emit lots of heat.
- ❖ Examples: Mark-I, ENIAC, EDSAC, EDVAC, UNIVAC-I, ABC, IBM 701, IBM 700 Series, IBM 704, IBM 709, etc.

Second Generation of Computers:

The computers which were discovered approximately between 1955 A.D. and 1964 A.D. are classified as Second Generation of Computers. They have transistor and diodes for their memory and processing devices. Transistor was developed by three scientists John Braden, William Shockley and Walter Brattain in 1947 A.D. at Bell laboratory in United States and won the Nobel Prize in 1956 A.D. for it.



Transistors were made of solid materials principally called silicon and germanium semiconductor material rather than glass. Therefore they were cheap to produce. One transistor replaced the equivalent of 40 vacuum tubes. Transistors were found to conduct electricity faster and better than vacuum tubes.

They were also much smaller and gave off virtually no heat compared to vacuum tubes. Their use marked a new beginning for the computer. Transistors were highly reliable as compared to vacuum tubes, since they had no part like filament, which could burn out.

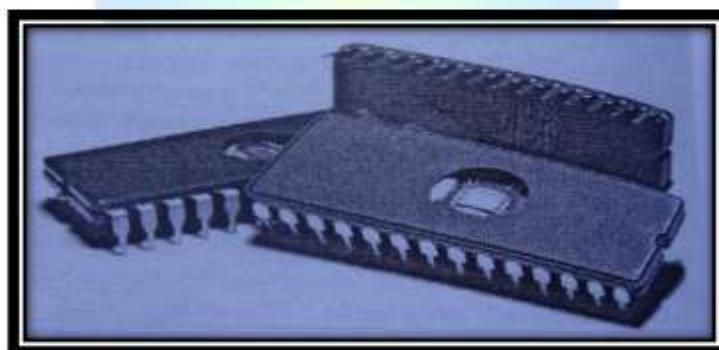
They could switch much faster (almost 10 times faster) than vacuum tubes. Transistor is the basic unit in radio, television and computer circuits. It is often used to amplify the current flowing from one circuit to another. Transistor consists three connecting parts: a base, an emitter and a collector.

Features of Second Generation of Computers:

- ❖ Transistors were used as main components.
- ❖ Processing speeds were measured in microseconds.
- ❖ Punch cards were used for input and output devices.
- ❖ Computers were electro-mechanical.
- ❖ Magnetic core (Ferrite) memories were used as primary memory devices.
- ❖ Magnetic tapes were used as secondary storage devices.
- ❖ Computers operate manually because operating systems were not invented.
- ❖ Computers were reliable and accurate than previous generation computers.
- ❖ Assembly level languages and high level languages such as FORTRAN, ALGOL, COBOL, SNOBOL, etc. were used for programming.
- ❖ Computers were smaller and cheaper than previous generation computers.
- ❖ Computers consume less power and emit less heat than previous generation computers.
- ❖ Computers were not portable.
- ❖ Example: IBM 7090, IBM 7094I, IBM 7094II, IBM 1620, IBM 1401 (first computer brought in Nepal on hire for National Census 2028), ICL 2950/10 (second computer brought in Nepal from England on 20 lakhs US dollar for National Census 2038), etc.

Third Generation of Computers:

The computers which were discovered approximately between 1964 A.D. and 1975 A.D. are classified as Third Generation of Computers. They have Integrated Circuits for memory and processing devices. Integrated Circuit was developed by Jack St. Clair Kilby and Robert Noyce in 1958 A.D.



An integrated Circuit (IC) also called a microchip, is an electronic circuit consisting of a large number of electronic components like transistors, resistors and capacitors placed on a single silicon chip, eliminating wired interconnection between components.

IC chips are much smaller in size, faster in operation, consumed much less power, high performance and more reliable than transistor and vacuum tubes. Initially, the integrated circuits contained only up to 100 components and the technology named as SSI (Small Scale Integration).

Later, with the advancement in technology for manufacturing ICs, it became possible to integrate from 100 to 3000 components on a single chip and this technology named as

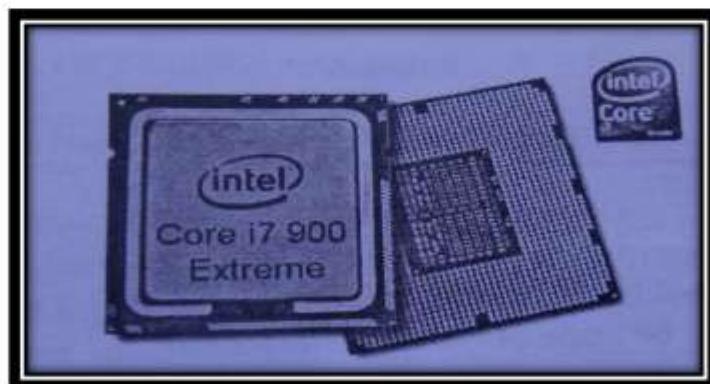
MSI (Medium Scale Integration). They function as timers, amplifiers, logic units, counters, calculators, temperature sensors, and radio receivers.

Features of Third Generation of Computers:

- ❖ Integrated Circuits (ICs) were used as main components.
- ❖ Processing speeds were measured into Nanoseconds.
- ❖ Keyboards and Monitors were introduced as input and output devices for the first time respectively.
- ❖ Computers were electronic.
- ❖ Semiconductor memories were used as primary memory.
- ❖ Magnetic disks were used as secondary storage device.
- ❖ Computers operate automatic and were multiprogramming.
- ❖ Computers were fully reliable and accurate.
- ❖ High level languages were used for programming.
- ❖ Computers were smaller and less expensive than previous generation computers.
- ❖ Computers were available for general purpose as well as for personal purpose.
- ❖ Computers consume less power and produce less heat than previous generation computers.
- ❖ Computers were portable because of the development of personal or desktop computer.
- ❖ Example: IBM system/360, ICL 1900, IBM 370 series, Honeywell 2200 series, CDC 7600, STAR-100, UNIVAC 9000, etc.

Fourth Generation of Computers:

The computers which were discovered approximately between 1975 A.D. and 1989 A.D. are classified as Fourth Generation of Computers. They have microprocessor as CPU "Central Processing Unit" with LSI "Large Scale Integration" and VLSI "Very Large Scale Integration" technology in ICs as memory and processing devices. Microprocessor was developed by Intel Corporation in 1971 A.D.



A microprocessor is a single chip in which millions of components like transistors are integrated together in different layers and it performs all the operations of the computers processor; since it is so small, it is called a microprocessor. It is a complete CPU built on a single chip by using LSI or VLSI technology.

Intel Corporation of USA developed the first microprocessor named "Intel 4004" in 1971 A.D. It contained about 1600 transistors. It was a 4-bit microprocessor and process only 4 bits of data at a time. Since then, the technology has increased by leaps and bounds.

The microprocessors available today are more powerful than many of the large computers of the past. They have become cheaper and more reliable too. The modern processors are available in 32, 64 or higher bits word length.

The important characteristics of a microprocessor are the width of address bus, data bus, clock speed and its instruction set architecture. Processors are also often classified as being either RISC "Reduced Instruction Set Computer" or CISC "Complex Instruction Set Computer".

Features of Fourth Generation of Computers:

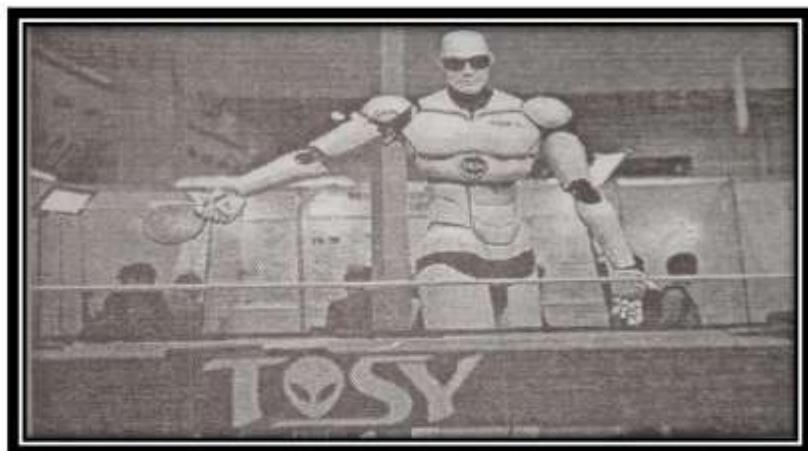
- ❖ Microprocessors were used as main components with LSI and VLSI technology.
- ❖ Processing speeds were measured into Picoseconds.
- ❖ Scanner, Touch screen, Printer, etc. were invented for input and output devices.
- ❖ Computers were electronic.
- ❖ Semiconductor memories with huge capacity were used as primary memory.
- ❖ Magnetic and Optical disks with large storage capacity were used as secondary storage devices.
- ❖ Multiprogramming, Multiprocessing, Multimedia and distributed operating system become possible.
- ❖ Computers were fully reliable and accurate.
- ❖ Computers use advanced high level language and fourth generation language for application and database programming.
- ❖ Computers were smaller and cheaper than previous generation computers.
- ❖ Computers were available for general purpose as well as special purpose.
- ❖ Computers use less power and produce less heat than previous generation computers.
- ❖ Computers were portable because of the development of personal or desktop computer, laptop, notebook, PDA, etc.
- ❖ Example: IBM PC, Apple/Macintosh, Wang Laser, Letron, Acer ASPIRE 5741, Apple MacBook Air, Dell Inspiron 1440, etc.

Fifth Generation of Computers:

The computers which were discovered approximately between 1989 A.D. and present are classified as Fifth Generation of Computers. In the fifth generation, VLSI "Very Large Scale Integration" technology became ULSI "Ultra Large Scale Integration" technology, resulting in the production of microprocessor chips having ten million electronic components. In fact, the speed of microprocessors and the size of main memory and hard disk doubled almost every 18 months.

This generation is based on parallel processing hardware and Artificial Intelligence "AI" software. Artificial Intelligence is an emerging branch in computer science, which interprets means and method of making computers think like human beings. All the high level languages like C and C++, Java, .Net, etc are used in this generation.

During fifth generation, there was tremendous outgrowth of computer networks which emerge the use of electronic mail and World Wide Web "WWW". Moreover, exciting applications like electronic commerce, virtual libraries, virtual classrooms, distance education, etc. emerged during the period.



Generally this generation computers are referred as Artificial Intelligence which includes:

- ❖ Robotics
- ❖ Neural Networks
- ❖ Game playing
- ❖ Expert Systems
- ❖ Understand natural languages such as Nepali, English, Hindi, etc.

Features of Fifth Generation of Computers:

- ❖ Computers will use ULSI "Ultra Large Scale Integration" technology with Artificial Intelligence.
- ❖ Computers will be more users' friendly interface with multimedia features.
- ❖ Computers will be capable of fully parallel processing.
- ❖ Computers will use super conductor memory like bio-chips so that the speed will be very fast.
- ❖ Computers will be intelligent and knowledge base because of Artificial Intelligence.
- ❖ Instead of high level languages, natural languages like English, Nepali, Hindi, etc. will be used to give instruction and making computer program.
- ❖ Computers will be large scale data processing on the basis of knowledge processing.
- ❖ The cost of hardware and software will decrease.
- ❖ Very powerful and compact computer will be available at cheaper rates.

Types of Computers:

Computers can be classified into various classes on the basis of how the computer works i.e. what types of data values a computer can process and give result.

On The Basis Of Working Principle:

1. Analog Computer:

The computer which work with the natural phenomena and physical values like frequency, earthquake, flow of water, speed of wind, weight, light, etc. are known as analog computers. The analog computers are based on continuous data and their output is also continuous in the form of graph.



It is especially used in scientific work, medical and industrial field. The analog computers are not built for general purpose but analog devices are broadly used in our daily life.

Examples of analog computers are Plesley, ELWAT, and AKAT-I and some other analog devices are speedometer, thermometer, seismograph, analog watch, etc. AKAT-I was the first transistor differential analyzer built by J. Karpinski in 1959 A.D. and was used to solve differential equations.

Characteristics Of Analog Computer Are As Follows:

- ❖ It works on continuous data. It is used to measure natural or physical values.
- ❖ It is specific to a particular task. Hence, it is not versatile.
- ❖ Accuracy of analog computer is not so high in comparison to digital computer.
- ❖ Generally, analog computer does not have storage capacity as it works on real time basis.
- ❖ It also gives the output in the form of curve line or graph so it may not be meaningful to all.

2. Digital Computer:

The computer which works on the digital values where 0 and 1 denotes OFF and ON state of electricity respectively is known as digital computer. The digital computer works by counting rather than measuring values. Digital computers work on the numerical problems of business and scientific field.

Examples of digital computers are IBM PC, Apple/Macintosh PC, Mercantile PC, Lenovo PC etc.



Characteristics Of Digital Computer Are As Follows:

- ❖ It works on discontinuous or discrete data.
- ❖ It works by counting the values rather than measuring.
- ❖ It is based on the principle of 0 and 1 which states ON and OFF of electricity.
- ❖ It is general purpose computer. Hence, it is versatile.
- ❖ The accuracy of digital computer is very high i.e. always 100%.
- ❖ It has large storage capacity.
- ❖ It is completely flexible computer and it can be easily reprogrammed according to the requirement of user.
- ❖ It has faster processing speed.

Different between Analog and Digital Computer:

| Analog Computer | Digital Computer |
|---|---|
| Analog computer is one which is designed to work on numerical data represented by physical quantity (i.e. rotation or displacement), electrical charge (voltage and charge), temperature, weight etc which varies continuously. | Digital computer is a computer which stores data in terms of digits (numbers) and proceeds in discrete steps from one state to another. |
| It is single problem oriented machine or not versatile. | It is general or versatile machine. |
| The accuracy of this computer is very low. It has low storage capacity. | The accuracy of this computer is very high. It has high storage capacity. |
| It is expensive. | It is cheaper. |
| It has fewer functions. | It has large number of functions. |
| It is faster in operation than digital computer. | It is slower in operation than analog computer. |
| Example of analog device is speedometer of an automobile. | Examples: IBM, IBM compatible, etc. |

3. Hybrid Computer:

Hybrid Computer is the combination of two distinct analog and digital computers. It can work on the physical and digital computers. It can work on the physical or continuous

data like analog computer and on the discontinuous values or discrete data like digital computer. Generally, hybrid computer is used in aeroplane, hospital, industries, etc. Examples of hybrid computers are MRI, CT scan, Ultra Sonogram, ELWAT, etc.



Characteristics Of Hybrid Computer Are As Follow:

- ❖ It works on continuous as well as discrete value.
- ❖ It is also specific to a particular work and not versatile machine.
- ❖ It converts the analog values to digital value and vice-versa.
- ❖ It is not easily reprogrammable computer.
- ❖ It is of very high cost.

On The Basis Of Size:

1. Super Computer:

Super Computer is physically the largest computer on size and it is the fastest, most expensive and most powerful computer. It can perform more than one trillion calculations per second as it has thousands of processors. It is especially made to process the complex and time consuming calculation. It has extremely large storage capacity than other computers.



Super Computer Can Be Used For The Following Applications.

- ❖ For forecasting the weather and global climate.
- ❖ For military research and defense system.

- ❖ For automobile, aircraft, and spacecraft designing.
- ❖ For encoding and decoding the sensitive information.
- ❖ For seismograph, plasma and nuclear research.
- ❖ For study of DNA and genetics engineering.

The speed of super computer is measured in FLOPS "Floating Point Operations per Second", commonly used with prefix such as TFLOPS, PFLOPS. Examples of super computers are CRAY XT5 Jugur, IBM Road runner, IBM Blue Gene/L, IBM Deep Blue, ASCI White, NEC Earth Simulator, etc.

2. Mainframe Computer:

Mainframe computer is also large computer which covers about 1000 sq. feet. It is a general purposed computer which has been designed for large scale data processing. It is also very expensive and high speed computer system.

It supports large numbers of computer terminal with separate input and output unit in each terminal so that 100 or more persons can work in this computer at a time. These computers are used in large organizations such as insurance company and banks, where many people frequently need to use the same data.



In traditional mainframe computers, each user accesses the mainframe's resources through a device called a terminal. There are two types of terminal: a dumb terminal and an intelligent terminal. A dumb terminal does not process or store data, it has simply input and output devices. An intelligent terminal can perform some processing operations, but usually does not have any storage.

IBM 7090, IBM 1401, ICL 2950/10, etc. are the example of mainframe computers.

3. Mini Computer:

Minicomputer is the medium-sized general purpose computer which was first released in 1960's. Minicomputer got its name because of small size in comparison to other computer of those days. The capacities of a minicomputer are somewhere between those of mainframe and personal computers. For this reason, minicomputer also called mid-range computers.



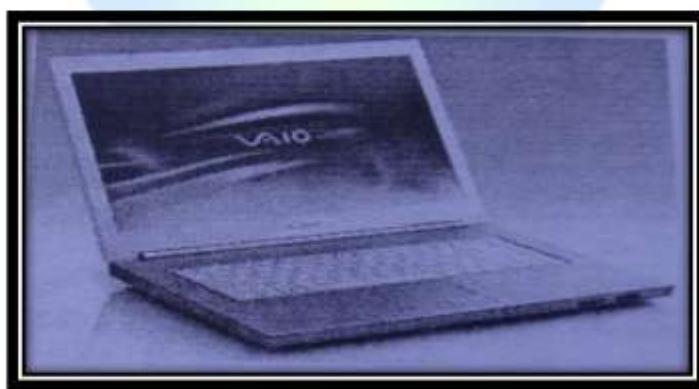
Minicomputer covers about 10 sq. feet. Its CPU can be connected up to 50 terminals so that up to 50 persons can work in this computer at a time. It is used in medium size organization and corporation like bank, insurance company, reservation center etc.

Prime series, AS/400, AP-3, etc. are example of minicomputer.

4. Micro Computer:

Microcomputer is the smallest purpose computer on the basis of size and it is called microcomputer because it has microprocessor as a central processing unit. Microprocessor is a small silicon chip which is made by integrating millions of components.

It is also called personal computer because it can be used only by a single person at a time. It is easy to handle so it is used in different application areas such as schools, colleges, home, cyber, etc. Desktop computer, laptop computer, notebook computer, palmtop computer, pocket PC etc. are some examples of microcomputer.



On The Basis Of Brand:

1. IBM PC:

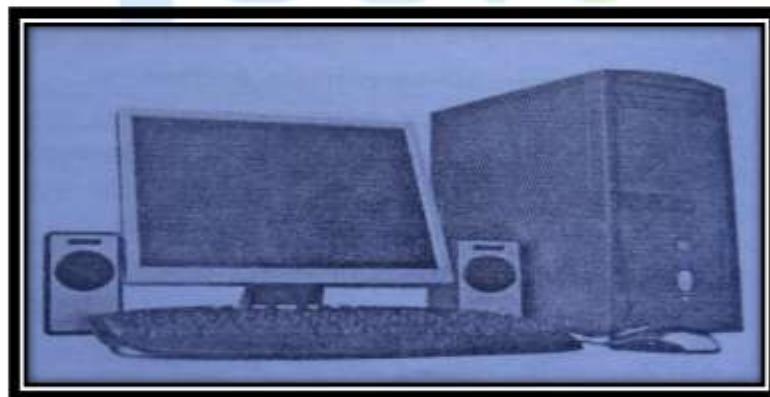
IBM PC stands for International Business Machine Personal Computer which is made by IBM Company which was established by Dr. Herman Hollerith in 1923 A.D. and it is the largest computer manufacturing company in the world even today.

It is leading the market of mainframe computer, minicomputer and microcomputer. IBM computers are more reliable, durable and they have higher processing capacity. It is also called IBM branded computer as its all parts are developed by IBM Company itself. Generally this computer is more expensive than other PCs. This company manufacture from smallest component like keyboard to advanced microprocessor.



2. IBM Compatible:

The word "compatible" means "able to exist" together and work successfully. In IBM Compatible computer, the parts of computers are developed by different companies and finally they are assembled as a computer system. It is also called assembled PC. Although the architecture of IBM Compatible computer is similar to IBM PC, it is less powerful, less expensive and less durable than IBM branded PC.



3. Apple/Macintosh:

Apple Corporation is also one of the largest computer manufacturing company of USA. It has made many PCs with good quality and user friendly environment and they are called Apple/Macintosh computer. The internal architecture of Apple computer is differently from IBM PC. Hence, the software made for Apple computer cannot be used in IBM PC or vice-versa.



On The Basis Of Processor Used:

1. XT (Extended Technology):

They are the early computers that used 8080, 8086, 8088 processors. They were very slow and have less storage capacity. This model refers to first-generation PCs which include the first floppy disk, hard disk and all compatibles.

2. AT (Advanced Technology):

They are 80286, 80386, 80486, etc processors. They are faster and have large storage capacity than XT computers. This model refers to advanced machine in the PC and featured a new keyboard, 1.2 MB floppy disk and 16 bit data bus.

3. PS/2 (Personal System/2):

They used the improved architecture and system design of AT computers that make them faster, reliable, and efficient having more functions. They are specially designed for laptop and other PCs that use the Pentium processors. They generally use OS/2 or UNIX as operating system.

Characteristics of Modern Computers:

1. Speed:

The computers in the past were not very reliable and did not have very fast processing speed due to the lack of advanced technology. After the invention of microprocessor, computers became very fast and can perform billions of calculation within fraction of a second.

The processing speed of computer is measured in the unit of Hertz such as Hertz (Hz), Kilo Hertz (KHz), Mega Hertz (MHz), Giga Hertz (GHz) and Tera Hertz (THz).

Measuring Units Of Computer Speed Are:

| Units | Symbols | Fraction of a second |
|-------------|---------|--|
| Millisecond | ms | 1/1000 th of a second (10^{-3}) |
| Microsecond | μ s | 1/1000000 th of a second (10^{-6}) |
| Nanosecond | ns | 1/1000000000 th of a second (10^{-9}) |
| Pico second | ps | 1/1000000000000 th of a second (10^{-12}) |

2. Storage Capacity:

A modern computer can store large amount of data, information and program in its secondary devices like magnetic disks, optical disks, hard disks, floppy disks, etc. for present and future reference. The storing capacity of computer is expressed in Bits, Bytes, Kilobyte, Megabytes, Gigabytes, Terabytes, etc. Normally one byte stores one character of data.

Measuring Units Of Computer Storage Capacity Are:

| | | |
|---------------------|---|-----------------|
| 0 or 1 | = | 1 Bit |
| 4 Bits | = | 1 Nibble |
| 8 Bits | = | 1 Byte |
| 1 Byte | = | 1 Character |
| 1024 Bytes | = | 1 Kilobyte (KB) |
| 1024 Kilobytes (KB) | = | 1 Megabyte (MB) |
| 1024 Megabytes (MB) | = | 1 Gigabyte (GB) |
| 1024 Gigabytes (GB) | = | 1 Terabyte (TB) |

3. Accuracy:

Accuracy means correctness. Computer never does any mistakes if the instructions, input data and hardware devices are correct. It always performs each and every task with 100% accuracy. But sometimes we get the wrong output due to the fault in the data, instructions or programs. That's why the phrase "GIGO" (Garbage-In-Garbage-Out) is true to the computer.

4. Diligence:

Unlike the human beings, a computer is free from monotony, tiredness and lack of concentration. It can continuously work for hours without creating any error and without grumbling. Hence, computers score over human beings in doing routine type of jobs that require great accuracy. If ten million calculations have to be performed; a computer will perform the last one with exactly the same accuracy and speed as the first one.

5. Versatility:

Modern computer can perform various types of jobs efficiently as it is a versatile machine. A computer has ability to communicate with other systems and adopt several modes like audio-visual, graphics, etc. For example, at one movement a computer is used to prepare results of an examination, at next movement it is busy preparing electricity bill and in between it may be helping an office secretary to trace an important letter in seconds. This is the reason to say computer as versatile machine.

6. Automatic:

Computers are automatic machines because once started on a job, they carry out the job (normally without any human assistance) until it is finished. However, computers being machine cannot start themselves and cannot go out and find their own problems and solutions. We need to instruct a computer using coded instructions that specify exactly how it will do a particular job. After getting instruction computer automatically complete the tasks.

7. Non-Intelligence:

Although the modern computer is much more fast, reliable, accurate and diligent than human being. It's an artificial machine; it does not have commonsense and intelligence. As a result, computer cannot think and decide like human being. Many man-made programs have to be installed in computer to do various kinds of tasks. Hence, this device is a non-intelligence machine.

8. No-feeling:

Based on our feeling, taste, knowledge and experiences we often make certain judgments in our day to day life whereas computers cannot make such judgments on their own as it is a machine. Computer makes judgments based on the instructions given to them in the form of programs that are written by human.

Application of Computers:

1. Education:

Computer has been used in education sector to help the students in their study and the teachers to organize and prepare their teaching materials from the internet. Due to the availability of e-book in CD, DVD, and in internet, computer has been very useful for students and teachers for their better education. Educational institute uses computers for keeping the students records, preparing the result sheet, examination process, accounting and printing different documents, etc.

2. Office:

In offices, computers are used in preparing the reports, letters, notice, salary sheet, income and expenditure reports, etc. to improve employee's efficiency. Generally Microsoft office and accounting package are used in an office to handle the daily works.

3. Health and Medical Field:

Computers have played a vital role in medical field to diagnosis diseases, getting information about patient and drugs. CT scan machine, eye testing machine and many other computerized machines are used for experiment and diseases diagnosis. Surgeon also uses the computerized device to get the correct information about the condition of patient.

4. Bank:

Computerized technology has brought revolution in bank. A computer is also used to maintain ledger, to provide the online service to the customers who need services from their home to transfer amount etc. For these purposes, there is a central computer called server in bank, mostly in head office, which stores all the necessary information centrally. Due to the computer with network facility, nowadays banks also provide ATM service to customers.



5. Industries:

Computers have been used in industries for various purpose such as keeping the employees records, income and expenditure records, salary sheet, measurement and display of physical quality, quality control of production etc. The different tasks which are risky for human being are done by computerized robots in industries so that human's life will not be at risk.

6. Weather Forecasting:

Weather forecasting is not an easy task as it is done after the analysis of the images, temperature, wind speed, humidity, etc. of different places, which is sent by the satellite. Computer analyzes the direction of the wind, cloud structure, past data and many other factors to forecast the weather. Due to the use of specific computers, we can see that BBC, CNN, and other news channels predict the weather forecasting for the coming 5 days in all over the world.

7. Military:

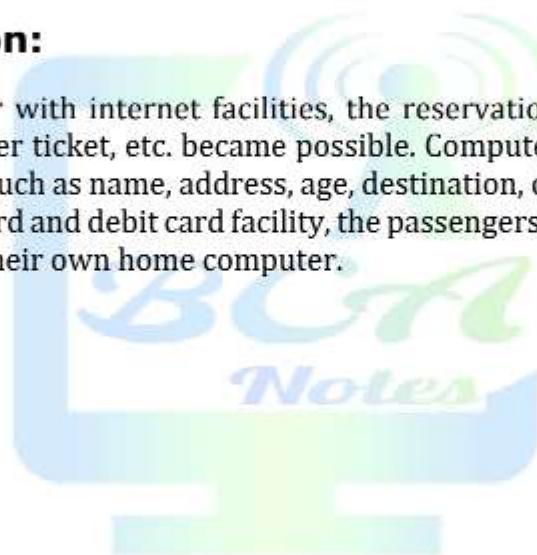
At present, computers have been heavily used by the armed force. Modern weapon like tanks, torpedoes, missiles, etc. employ computerized control system having microprocessor. The pilot-less fighter planes can carry missile and drop at the pin-point area by the use of computerized system.

8. Communication:

Due to the invention of the internet, modern computers are massively used for fast, reliable and cheap communication all over the world. Text, photo, animation, email, voice, etc. can be exchanged between the computers through the internet. Due to the services like WWW, email, voicemail, chat, internet phone, etc. communication has been fast, reliable and cheaper.

9. Reservation:

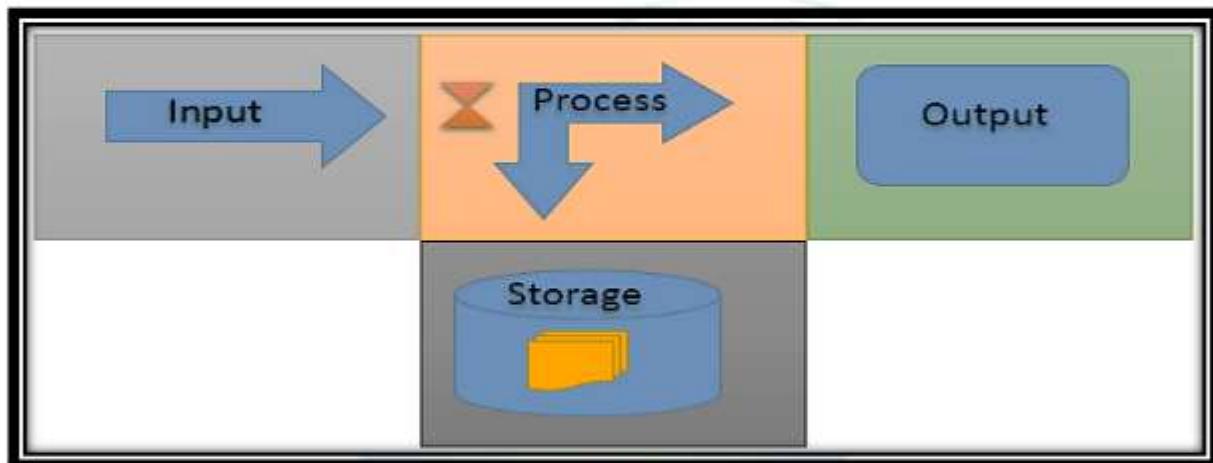
By using the computer with internet facilities, the reservation for the air ticket, train ticket, bus ticket, theater ticket, etc. became possible. Computer also stores information regarding passengers such as name, address, age, destination, date of journey, class, fare, etc. Due to the credit card and debit card facility, the passengers can reserve and purchase the tickets even from their own home computer.



Unit II: Basic Organization of Computer – Computer Fundamentals and Application

Basic Function of Computer:

Even though the size, shape, performance, reliability, and cost of computers have been changing over the years, the basic logical structure (based on the stored program concept), as proposed by John Von Neumann, has not changed. No matter what shape and size of computer we are talking about, all computer systems perform the following four basic operations for converting raw input data into useful information and presenting it to a user:



- Inputting:** Inputting is the process of entering data and instructions into a computer system.
- Storing:** Storing is the process of saving data and instructions to make them readily available for initial or additional processing as and when required.
- Processing:** Performing arithmetic operations (add, subtract, multiply, divide, etc.) or logical operations (comparisons like equal to, less than, greater than, etc.) on data to convert them into useful information.
- Outputting:** Outputting is the process of producing information or results for a user, such as printed report or visual display.

A computer's components or devices are used to do these tasks. Typically, computer components are only built to execute one of these four purposes. Some specialized components or gadgets, on the other hand, are intended to accomplish two, three, or even all four roles. A hard drive, for example, may fulfill three functions: input (when data are read), storage (when files are saved), and output (when files are written) (when files are written).

Input devices, output devices, storage devices, and processing devices are the four primary categories of computer components or devices, based on the function for which they are employed. For example, a component is known as the processing device if it processes the provided instructions. The output device, on the other hand, is a device that displays the processed data.

Basic Functional Organization of Computer:

Most computer systems from the embedded computerized controller found in automobiles, micro-oven, personal computer, mini and micro frame have the same basic organization. The basic computer organization has four main components:

- ❖ The CPU
- ❖ The Memory Subsystem
- ❖ The Input Subsystem
- ❖ The Output Subsystem

The general organization of these components is shown in the adjacent figure below:

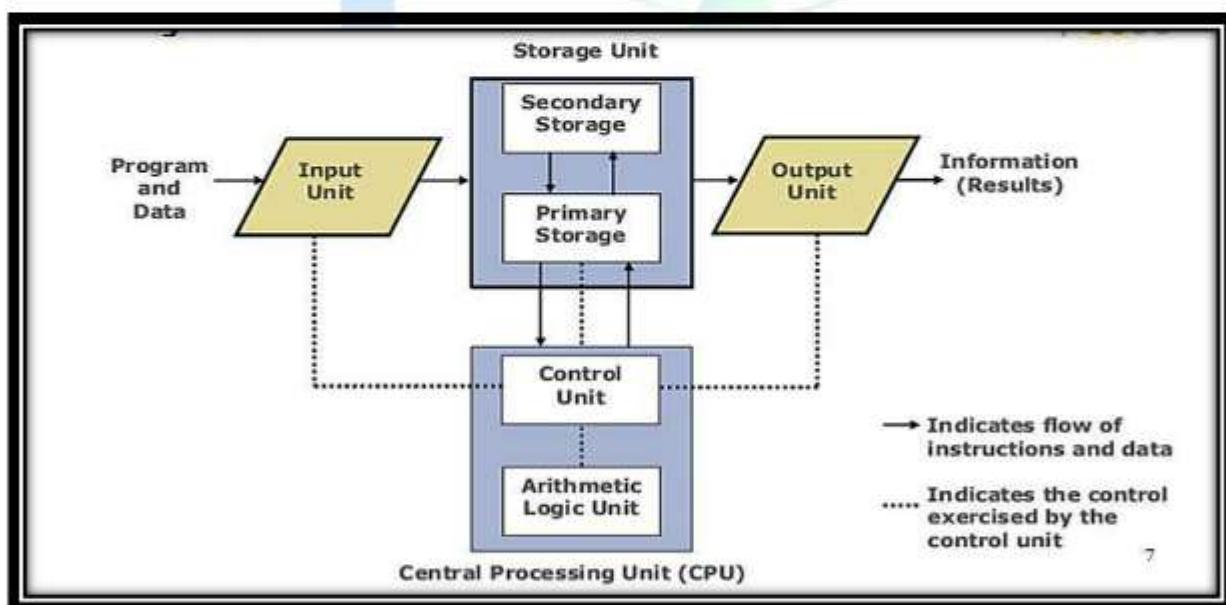


Fig: Basic Organization of a Computer System

Input Unit:

Input means data and instructions given to the computer in the various forms such as text, numbers, sound, picture, video, etc. The unit which is used to give input to the computer system is called input unit and it is formed by the various input devices attached to the computer such as keyboard, mouse, joystick, trackball, light pen, touch screen, etc.

It is mainly responsible for taking input and converting it into computer understandable form i.e. binary code. The input unit establishes the communication links between the user and the computer system. The computer scientists are also trying to design such system which can accept human voice, handwriting, any gesture and other symbols directly as input to the computer.

Processing Unit:

Processing unit is also called CPU "Central Processing Unit" and it is the control center for a computer. It guides directs and governs all operations and components inside the computers. It is considered as a brain of the computer. It is linked with various peripherals equipment including input/output devices, secondary storage and memory unit. It performs mathematical computation, logical comparison, executes instructions and transfer information between all parts of computer. CPU consists of ALU, CU and Registers.

1. Control Unit (CU):

The control unit of the microprocessor coordinates and controls the various operations and initiates the appropriate sequence of micro-operations for each task. It controls and guides the interpretation, flow and manipulation of all data. It is responsible for executing the instruction of the program and fetching the data required for the next instruction from memory. It also control and coordinates the functions of all other units of the computer and ensures smooth operation.

2. Arithmetic and Logic Unit (ALU):

It is responsible for doing all type of arithmetic operation like addition, subtraction, multiplication, and division on integer and real operands. It also can perform the logical operation or comparison like equal to, greater than, less than, etc. between two operands. It receives its operands from the register section of the CPU and stores its results back in the register section.

3. Register:

Registers are electronic memory chips made from transistors and flip-flops which serve as temporary storage location in the CPU. The instructions execution is performed in the CPU by taking data from registers. Registers quickly accept, hold and transfer the data and instruction which are being executed currently. The size and number of these registers determine the overall speed of the computer. Registers size and types vary from one CPU to others.

Storage Unit:

The memory is the computer's storing area. This is the place where our data and programs get stored before processing and the result also gets stored before its output. Data and instructions are stored in memory in the binary form. Storage unit provide space for storing data and instructions, intermediate results and results for output. Storage unit of all computers is categorized into two parts.

1. Primary Memory:

Primary storage of a computer, is also known as its main memory, which is used to hold pieces of program instructions and data, intermediate results of processing and recently produced results of those jobs on which the computer is currently working. Primary memories are also two types:

A. RAM (Random Access Memory):

RAM stands for "Random Access Memory" and is often called primary/main memory because it is made up of semiconductor chips. It is the working space used by the computer to hold the program that is currently running along with the necessary data and instructions. It is fast and expensive memory which allows the computer to access the data and instructions very quickly.

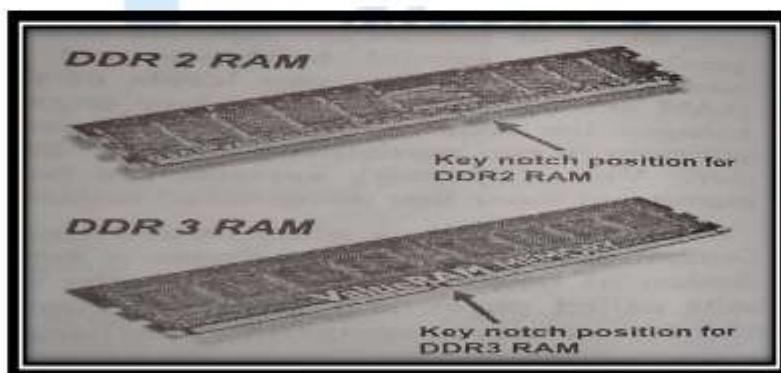


Fig: Random Access Memory

We can read from RAM as well as write into it. Hence it is also called "Read-Write" memory. The main drawback of RAM is that it is volatile memory so the contents of RAM are lost when the computer is switched off. It is made of millions of microscopic cells which are distinctly numbered so that each cell can be identified and located. Each cell can be electrically charged or not. The charged cell represents 1 and not charged cell represents 0 in binary format.

RAM is also of two types:

❖ DRAM (Dynamic Random Access Memory):

DRAM stands for "Dynamic Random Access Memory". It is made up of capacitors which is capable of storing the electric charge. Due to the leakage of charges, the capacitors discharge gradually and the memory cells lose their contents. So, to recharge the capacitors to retain its memory contents it has to be refreshed periodically. DRAM is slower than SRAM but it is dense, consumes less electricity, smaller in size and less expensive.

Synchronous Dynamic Random Access Memory "SDRAM" is DRAM that has a synchronous interface which is widely used in present computers. Traditionally, DRAM has a synchronous interface, which means that it control inputs. SDRAM has a synchronous interface, meaning that it waits for a clock signal before synchronized with the computers system bus. **Example:** DDR "Dual Data Rate", DDR2, DDR3, EDO DRAM, SDRAM, RIMM, etc.

❖ SRAM (Static Random Access Memory):

SRAM stands for "Static Random Access Memory" and is made up of transistors. It is called static because it can remember or retain its memory contents without being refreshed or recharged as long as there is power. SRAM is faster than DRAM but more expensive, lesser in density and bigger in size and consumes more electricity.

B. ROM (Read Only Memory):

ROM stands for "Read Only Memory" and it is called ROM because only read operation can be performed on it. The binary information stored in ROM is written permanently by the manufacturer and it cannot be altered. ROM is necessary to store such software which enables the computer to boot up because booting instructions does not need modification.

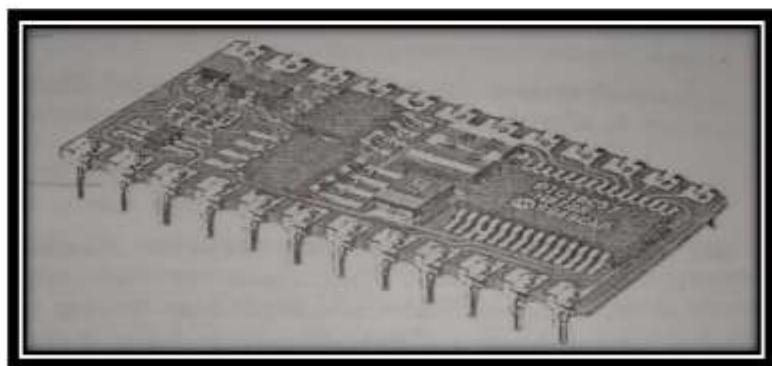


Fig: Read Only Memory

ROM is non-volatile memory because it can retain its contents even after the computer is turned off. It is also made semiconductor chips. The program stored permanently in ROM

is called firmware. Hence, firmware is immediately available when a device is powered on to start up the PC or other electronic equipment like mobile, PDA and others. ROM is of three types:

❖ PROM:

PROM stands for "Programmable Read Only Memory". Initially it is the blank chip which can be written or programmed only one time by using a special machine called ROM programmer or ROM burner. Once the PROM is written, it cannot be modified and becomes ROM.

❖ EPROM:

EPROM stands for "Erasable Programmable Read Only Memory". It is a special chip which can be re-programmed to record different information. The data and information are erased by exposing it to intense ultra violet light for about 20 minutes. These types of memory are used in product development and experimental projects.

❖ EEPROM:

EEPROM stands for "Electrically Erasable Programmable Read Only Memory". These types of chips can be erased and re-programmed repeatedly with special electrical pulses. It does not require a special device to write into it. EEPROM can be re-programmed without removing it from the computer. It also has limited life span i.e. the number of times it can be re-programmed is limited to tens or hundreds or thousands of times.

Differentiate between RAM and ROM:

| RAM | ROM |
|---|--|
| RAM stands for Random Access Memory. RAM is volatile memory, if power fails data and information will be lost. | ROM stands for Read Only Memory. ROM is inherently non-volatile memory, if power fails data and information will not be lost. |
| RAM is used for currently running programs of computer system. | ROM is used to store firmware of computer system and system software for embedded system. |
| RAM is read/write memory. The cost of RAM is higher than ROM. There are two types of RAM: SRAM and DRAM. | ROM is read only memory. The cost of ROM is lower than RAM. There are three types of ROM: PROM, EPROM and EEPROM |

Differentiate between DRAM and SRAM:

| DRAM | SRAM |
|---|---|
| DRAM stands for Dynamic Random Access Memory. | SRAM stands for Static Random Access Memory. |
| DRAM is made up of capacitors. | SRAM is made up of transistors. |
| DRAM is high density RAM. In one chip larger memory can be constructed. | SRAM is low density of RAM. In one chip small memory can be constructed. |
| Power consumption of DRAM is higher than SRAM. | Power consumption of SRAM is lesser than DRAM. |
| DRAM need to be periodically refreshed. (System automatically refreshed the RAM cells.) | SRAM does not need to be periodically refreshed. |
| The cost of DRAM is lower than SRAM. | The cost of SRAM is higher than DRAM. |
| The data access time is larger than SRAM, typically requires larger than 40 nanoseconds. Hence they are slow. | The data access time is smaller than DRAM, typically less than 30 nanoseconds. Hence they are fast. |
| DRAM is generally used for low cost high capacity memory for computers. | SRAM is generally used to create memory of critical section like cache memory. |
| Example: DDR, DDR2, DDR3 (Dual Data Rate), EDO DRAM, SDRAM, RIMM, etc. | Example: cache memory of microprocessor. |

2. Secondary Storage:

As we know that we cannot store any data and instructions into ROM because modification is unavailable and RAM cannot hold any information after the computer is shut down. To overcome this problem of the primary memory, the computer has a separate memory place and it is called secondary storage. It is also called auxiliary or backing storage. The secondary storage is used to permanently store system programs, application program, large data files, etc.

Only those programs, data and instructions which are currently needed by the processor are stored in the main memory and all other information is stored in the secondary storage and is transferred to main memory when needed. The secondary memory has huge storage capacity up to Gigabytes and Terabytes. It is much slower than primary memory but it is less expensive and it is non-volatile in nature. Hence, storage devices are mainly used to store the data, program and information permanently in computer and transfer them from one PC to another PC.

Output Unit:

Output is the processed data which is very useful and meaningful to us and we get it from computer in the form that we want. The unit which is used to provide output is called output unit. It is always formed by the various output devices such as monitor, printer,

plotter, speaker, etc. attached to the computer. The output coming from the CPU is in the form of binary code and it needs conversion in some form which can be easily understood by human i.e. character, number, graphics, audio or video. The output unit is responsible for the conversion of data into human understandable/readable form. Computer output can be classified into two forms:

1. Soft Copy Output:

A soft copy output is the unprinted digital document file. It can usually be viewed through an appropriate editing program, such as word processing programs, database programs or presentation software depending on the file type. It can be transported from one computer to another through email or through USB drives and other disk drives.

2. Hard Copy Output:

A hard copy output is a permanent reproduction or copies of softcopy output in the form of a physical object of any media suitable form direct use by a person, displayed or for transmit data. Fax pages, photo prints, etc are some example of hard copy output.

Differentiate between Hardcopy output and Softcopy output:

| Hardcopy output | Softcopy output |
|--|--|
| Hardcopy output refers to recording letters, graphics or pictures on the permanent medium such as paper. The output can be read later as the user's requirement. | Softcopy output refers to the output displayed on the screen. The output on the screen is lost when the computer is turned off. |
| The most commonly used hardcopy output devices are printers and plotters. | The most commonly used softcopy output device is monitor. Sound produced by voice output device (speaker) is also softcopy output. |
| Hardcopy cannot be edited or modified. | Softcopy output can be edited. |
| Generally hardcopy output can be submitted everywhere for their assignment or thesis or any other purpose. | Generally, the data, programs stored in the form of soft copy can be submitted in software for their assignment. |
| Hardcopy can be touched. | Softcopy cannot be touched. |
| Hardcopy can be seen when computer is switched off or person is not using computer. | Softcopy output cannot be seen when person is not using computer. |

The System Concept:

A system is group of integrated parts that have a common purpose of achieving some objective(s). Hence, a system must have the following three characteristics:

1. It must have a more than one element.
2. All its elements must be related logically.
3. All its elements must be controlled in a manner to achieve the system goal.

Since a computer comprises of integrated components (input unit, output unit, storage unit, and CPU) that work together to perform the steps called for in a program, it is a system. Its input and output units cannot function until they receive signals from the CPU. Similarly, the storage unit of the CPU alone is of no use. Hence, the usefulness of each unit depends on other units and is realizable only when all units are put together (integrated) to form a system.



Unit III: Computer Software – Computer Fundamentals and Application

Introduction to Hardware and Software:

Hardware:

Hardware is best described as a device, such as a hard drive, that is physically connected to the computer or something that can be physically touched. Most of the hardware cannot be seen as they are covered by casing. Every component in a computer is interconnected with a platform, known as motherboard to make all components work together for common task.



Fig: Hardware

A CD-ROM, monitor, printer, video card, etc. are some example of computer hardware. Without any hardware, a computer would not function, and software would have nothing to run on. Hardware and software interact with each other. Software tells hardware which tasks it needs to perform.

Software:

In contrast to hardware, software is a non-physical entity defined by sets of rules and instructions that tell the hardware how to perform a task. In general term, software is described as a collection of computer programs, procedures and documentation that perform some task on a computer system.

Without software, a computer cannot do anything and becomes only a dead machine. Software is necessary for a computer system to work at the optimum level. Software is typically programmed with a user-friendly interface that allows humans to interact more and more efficiently with a computer system.

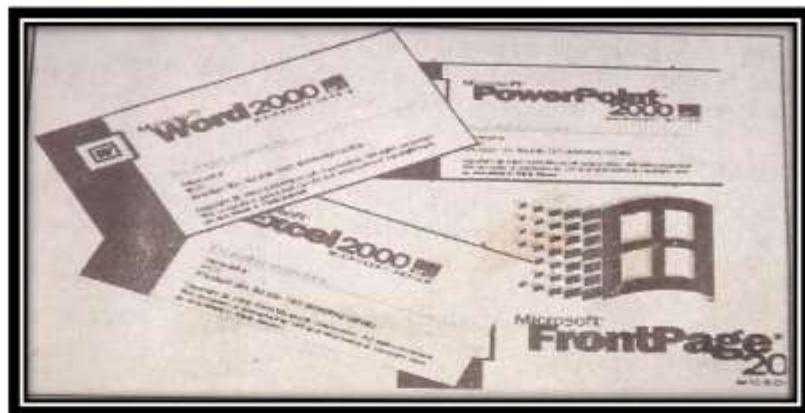


Fig: Software

Software is also called a computer program. It is written by using programming language which the computer can understand. Software can be divided into two major categories:

- ❖ System Software
- ❖ Application Software

Difference between Hardware and Software:

| Hardware | Software |
|--|---|
| Hardware is described as a device, such as a hard drive, that is physically connected to the computer or something that can be physically touched. | Software is described as a collection of computer programs, procedures and documentation that perform some task on a computer system. |
| Hardware can be touched and seen. | Software cannot be touched and seen. |
| According to the function, there are different types of hardware devices like input, output, memory and processor. | There are two types of software i.e. system software and application software. |
| Hardware failure is random. Hardware has increasing failure rate. | Software failure is systematic. Software does not have increasing failure rate. |
| Hardware cannot function until software is loaded. | Software does not work until it has appropriate hardware. |
| Changing hardware takes greater skill and is usually a more expensive endeavor. | Software can be easily created, changed or deleted. |
| Hardware is physical in nature. | Software is logical in nature. |
| Hardware firewalls are typically in broadband routers. | Software firewalls are installed on the computer (like any software) and can be customized to suit individual user's security needs. |
| Hardware wears out overtime (expiry date). | Software does not wear out over time. However, bugs are discovered in software as time pass. |
| CD-ROM, monitor, printer, video card, scanners, label makers, routers, modems are some examples of hardware. | QuickBooks, adobe acrobat, internet explorer, Microsoft office are some example of software. |

Logical System Architecture:

Today's application like desktop application, mobile application and web application are sophisticated and provides different instructions to the computer to understand. These applications are built in Fourth Generation Programming Languages "4-GL" that are more natural and human readable than those of First Generation Programming Languages "1-GL" and Second Generation Programming Languages "2-GL".

Moreover, to make "4-GL" understandable by machine, the languages are translated into assembly languages or binary languages by using following tools:

Compiler:

Compiler translates high-level languages codes to low level code that any system or machine can understand. It translates whole pages of code into machine code at a time.

Interpreter:

Interpreter translates high-level languages into machine level language. It translates the codes written in a page line by line into machine code. While translating, the objects are not created.

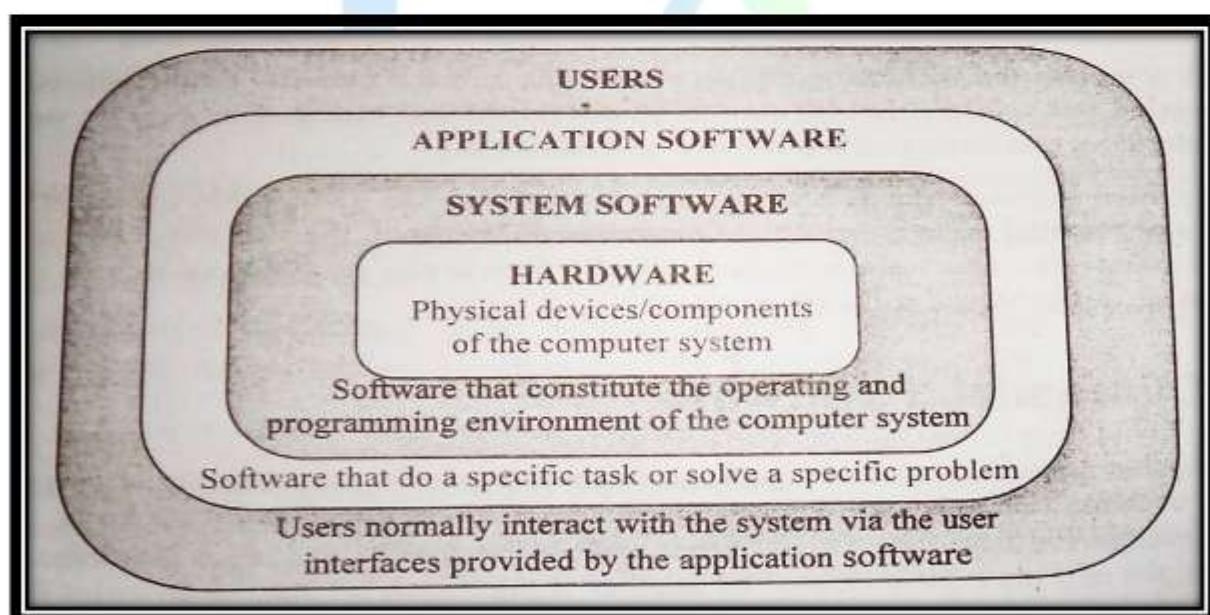


Fig: System Logical Architecture

Since, the operating system plays a vital role for the interface between application and hardware. The objects or instructions passed by any applications are converted into binary language by operating system. After binary conversion, operating system plays major role in instruction implementation by utilizing the local hardware resources. Operating system passes the instructions and data to specific hardware components for further processing of that particular instruction and data.

As data and instructions are reached to hardware components in binary format CPU "Central Processing Unit" control them. The CPU passes the control signals to respective hardware components like storage devices, memory units, etc and provide the result to operating system in binary format. The result thus received is sent to desired application in high-level language or human readable format.

Thus, it can be said that instructions and different set of rules provided by programming language plays vital role to make whole working system.

Types of Software:

Software is the set of instructions which control what a computer does. The software enables the hardware to operate. Without software, a computer cannot do anything and becomes only a dead machine.

Software consists of series of instructions and decision rules that instruct the computer in executing a given task. Software is also called a computer program. It is written by using a programming language which the computer can understand. Software can be divided into two major categories. They are:

1. System Software:

The software which is designed to operate, control and manage the actual operation of the computer hardware is called system software. Being an artificial machine, a computer does not know how to do even a small task. It requires instructions for each and everything it does.

These instructions are given to the computer through system software. The system software controls internal computer operations like reading data from input devices, sending processed information to the input device, checking system components, converting data/instruction to computer understandable (binary) form etc.

Some common known types of system software are:

A. Operating System:

Operating system is a program which acts as an interface between the user, application program and hardware. Without operating system, we cannot start the computer and run other programs.

It is loaded at first into computer by booting program then it controls the execution of computer program like scheduling, debugging, input/output control, compilation, storage, supervision and management of data, etc. Although it is invisible to the user, it is a link between the user and hardware. Windows 7, Linux, MS –DOS, etc. are some example of operating system.

B. Translating Program:

Being an electronic machine, a computer can understand the given instructions written only in machine language i.e. binary language in the form of 0 and 1. But it is very difficult and tedious for us to give instructions in a combination of 0's and 1's.

To overcome this difficulty, translating program is used to transform instructions written in human understandable or readable language like VB, .NET, C, ASP.NET, JAVA, etc. to machine language which the computer can understand. There should be one translating programs for each programming languages. The translating is done by assembler, compiler, and interpreter.

C. Utility Software:

It is designed to help analyze, configure, optimize and maintain the computer. These software usually focus on how the computer resources (software and hardware) efficiently used. Due to this focus utility software are often technical and targeted to advanced level of computer user.

Most utilities are highly specialize and designed to perform only a single task or a small range of tasks. Most major operating system comes with several pre-installed utilities software. For example: anti-virus, disk defragmentation, disk cleanup, backup, recovery, etc.

2. Application Software:

The program which is designed to do only specific task is called application software. The application software made for one purpose cannot do another task. For example: software that can perform ticket reservation function of "Makalu Bus Service" cannot prepare the result sheet for a school or college.

Some of the tasks performed by the application software are word processing, inventory control, financial accounting, result preparation, railway reservation, etc. It can be further divided into two categories. They are:

A. Customized or Tailored Software:

The software which is designed to meet the specific requirement of a particular person or an organization is called customized software. It is written according to the demand of a person or an organization. It serves only a person or an organization.

The tailored software made for one organization cannot be used in another organization. It is written using a high level programming language such as C, C++, VB, JAVA, etc. Payroll, Sales Ledger, Salary Sheet, etc. are the example of tasks done by customized software.

B. Packaged Software:

As we know there are numerous requirements of different people and organization which can be done by computer, but it is not possible to design software to fulfill the requirement of each of them individually.

Some general purpose software are designed that may be used by all the users and organization as if the program has been designed to suit their needs and requirements. Packaging of general purpose software is called package software. It is also called universal software as it can be used by users and organizations all over the world.

Some popular types of packaged software are:

1. Word Processing Software:

The software which is designed to create, edit and format matter like letter, application, thesis, newsletter, newspaper, book, etc. is called word processing software. It has all kind of word processing facilities like to create, edit, format, save and print document, to check spellings and grammar, to search for synonyms and antonyms, to work with newspaper columns, tables, to add footnotes and endnotes, page number, special symbols, bookmarks, comments, to insert the picture, table of contents and index, etc.

2. Electronic Spreadsheet Software:

It is a program that organizes data into rows and columns and allows user to perform calculation on it and express the result in report. It is also used to generate bar-diagram and pie-chart to show the report more vividly (brightly).

3. Presentation Software:

The software which is used to create professional presentation is called presentation software. A presentation program (presentation graphics) is a computer software package used to display information, normally in the form of slide show. It typically includes three parts: the text editor for insertion and formatting, manipulating graphics, and a slide show system to display the content.

4. Database Management System:

Database is an organized collection of related data in a tabular format. It is a set of programs that enable us to create a database, maintain it, add, delete, and update it, organize its data in desired fashion. For example: sort its record alphabetically name-wise and selectively retrieve useful information from it.

Similarly, queries such as get the telephone number of the person named Kashyap Rana from the address database, or get the names of all currently enrolled students whose birthdays fall today from the student database can be handled easily.

5. Graphics Package:

Graphics package enables us to use a computer system to create, edit, view, store, retrieve and print designs, drawings, pictures, graphs and anything else that can be drawn in traditional manner. Today's graphics packages normally support the features such as: draw designs, present graphs, paint drawings and pictures, drag and drops objects, import objects, screen capture, etc.

6. Personal Assistance Package:

Personal assistance packages allow individuals to use personal computers to store and retrieve their personal information, as well as to plan and manage their schedules, contacts, finances and inventory of important items. It supports the features such as: calendar, to-do list, address book, investments book, inventory book, etc.

7. Education Software:

Education software allows a computer to be used as a teaching and learning tool. A few examples of such software include those used for teaching mathematics, grammar, language, or any other subject.

8. Entertainment Software:

Entertainment software allows a computer to be used as an entertainment tool. Computer video games belong to this category of software.

9. Desktop Publishing Package:

The software that handles page layout by combining the functions of a traditional typesetter and a layout artist is known as desktop publishing software. Desktop publishing packages are basically used for composing the text, its layout, line drawing, charts and graphs etc. so by using desktop publishing package, the design and layout of a complete book, magazine or newspaper can be achieved very easily.

Difference between System software and Application software:

| System Software | Application Software |
|--|--|
| System software is a group of programs, languages which allow the user to communicate with computer equipment. | Application software is designed to fulfill user's requirements. |
| System software creates the suitable environment to run application software. | Application software depends on system software to run. |
| A special kind of training is required in specific sector for its construction. | A special training is enough for its construction. |
| Example: LINUX, UNIX, Windows, etc. | Examples: Word, Excel, etc. |

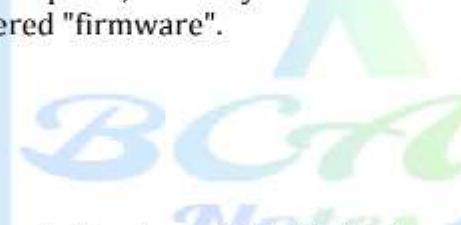
Firmware:

Firmware is a program for hardware to make it work. It is an embedded code for the hardware. Every device has inbuilt firmware. For example: BIOS "Basic Input Output System". It contains the special program to make a computer system work. Other hardware components for PCs have their own sets of firmware. Firmware are stored on special chip called ROM "Read Only Memory".

Initially, only system software was supplied in the form of firmware. However, today even application programs are also supplied in firmware. Dedicated applications are also programmed in this fashion and made available in firmware. Because of the rapid development in memory technology, firmware are frequently a cost-effective alternative to wired electronic circuits, and its use in computer design has been gradually increasing. In fact, the increased use of firmware has today made it possible to produce smart machines of all types. These machines have microprocessor chips with embedded software.

However, the division between firmware and software is not always completely clear. A computer BIOS might be on a reprogrammable device. This reprogramming is not normally enabled so that it can't be changed by accident. But, a computer BIOS normally can be "flashed" to change it, so that the BIOS may be updated. Because this is not part of the normal operation of a computer, and may users will never have occasion to change the BIOS, this is still considered "firmware".

Middleware:



Middleware is defined as a set of tools and data that helps applications use networked resources and services. It is a separate software layer that acts as "glue" between the client and server parts of an application and provides a programming abstraction as well as masks the heterogeneity of underlying networks, hardware, and operating system from application programmers. The middleware technology includes web servers, application servers, and similar tools that support application development and delivery. Middleware is especially integral to modern information technology based on XML, SOAP, Web services and service-oriented architecture.

Middleware software sits between application software and the underlying different operating system. It is similar to the middle layer of three-tier single system architecture, except that it is spread across multiple systems or applications. Examples include database system, telecommunications software, transaction monitors, and messaging and queuing software.

The distinction between operating system and middleware functionality is, to some extent arbitrary. While core kernel functionality can only be provided by the operating system itself, some functionality previously provided by separately sold middleware is now integrated in the operating system. A typical example is the TCP/IP stack for telecommunication, nowadays included in virtually every operating system.

In simulation technology, middleware is generally used in the context of the high level architecture (HLA) that applies to many distributed simulations. It is a layer of software

that lies between the application code and the run-time infrastructure. Middleware generally consists of a library of functions and enables a number of applications simulations or federates in HLA terminology to page these functions from the common library rather than re-create them for each application.

Different Types of Middleware:

1. Remote Procedure Call:

Clients make calls to procedures running on remote system. It can be asynchronous or synchronous.

2. Message Oriented Middleware:

Message sent to the client are collected and stored until they are acted upon, while the client continues with other processing.

3. Object Request Broker:

These types of middleware make it possible for application to send objects and request services in an object-oriented system.

4. SQL-oriented Data Access:

DBMS "Database Management System" uses SQL "Standard Query Language" statements to manipulate the data on client.

5. Embedded Middleware:

Communication services and integration interface software/firmware that operates between embedded applications and the real time operating system.

Unit IV: Accessories (Devices) and Data Handling – Computer Fundamentals and Application

Input Accessories (Devices):

An input device is an electromechanical device that accepts data from outside world and translates them into a form, which a computer can interpret. They act as an interface between the computer and the user. Modern computer system can take input in the various forms such as text, number, sound, picture, video, etc. The various types of input devices used in modern computer system are as follows:

1. Keyboard:



Keyboard is considered as the main input device in a computer system. Keyboard is just like a type-writer. Keyboard is attached to the computer system with the help of a cable. Each key of the keyboard, when pressed, sends a different signal to the processor. The keyboard has many types of keys. They are categorized as:

- ❖ **Function Keys:** These keys are command keys that provide pre-defined instructions, when pressed. The function keys are from F1-F12.
- ❖ **Main Keys:** These keys are the alphanumeric keys with some special keys having instructions.
- ❖ **Numeric Keys:** The keyboard also consists the group of keys that provides easy numerical calculations.
- ❖ **Additional Keys:** There are many other keys for different functionalities like Esc, Shift, Alt, Arrow keys, PrntScr, Home, End and so on.

2. Pointing Devices (Point and Draw Devices):

Pointing devices are the input devices that are generally used for moving the cursor to a particular location to point an object on the screen. With the help of pointing devices, we can easily select the icons, menus, windows, etc. on the Graphical User Interface (GUI).

Thus, the users can easily interact with a computer system by means of a pointing device. We can simply change the position of the objects displayed on the screen by first pointing at the object and then dragging it to the desired position. Some of the commonly used pointing devices are:

Commonly Used Pointing Devices:

A. Mouse:

Mouse is a small hand-held pointing input device, which is used to point to a place or icon on the monitor and to give input to the computer. When the mouse is rolled over a flat surface, the cursor on the screen also moves in the direction of the mouse movement.

It is very useful for GUI based programs because we can simply point to an option or icon and click a mouse button. It is also useful for computer designing programs like CAD. The first mouse was manufactured by Xerox Corporation. The most commonly used types of mouse are as follows:

a. Mechanical Mouse:

A mechanical mouse consists of three buttons: left button, right button, and scroll button. Inside the plastic coating of the mouse, there is a ball which is rolled over flat surface corresponding to which the cursor moves on the display screen.

The left button on the mouse helps in selecting the icons, folders and text on the display screen. The right button on the mouse helps in displaying the shortcut menu, whereas the scroll button helps in moving the cursor up and down in the screen by scrolling it.

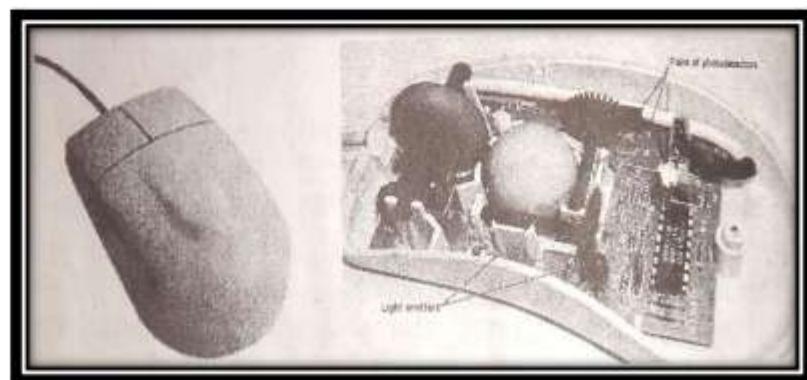


Fig: Mechanical Mouse

b. Optical Mouse:

An optical mouse is a pointing input device in which the reflected light determines the movement of the cursor on the displayed screen. The upper portion of the mouse is similar to that of the mechanical mouse. The lower portion of the optical mouse consists of Light Emitting Diodes (LEDs), an optical sensor and a Digital Signal Processor (DSP).

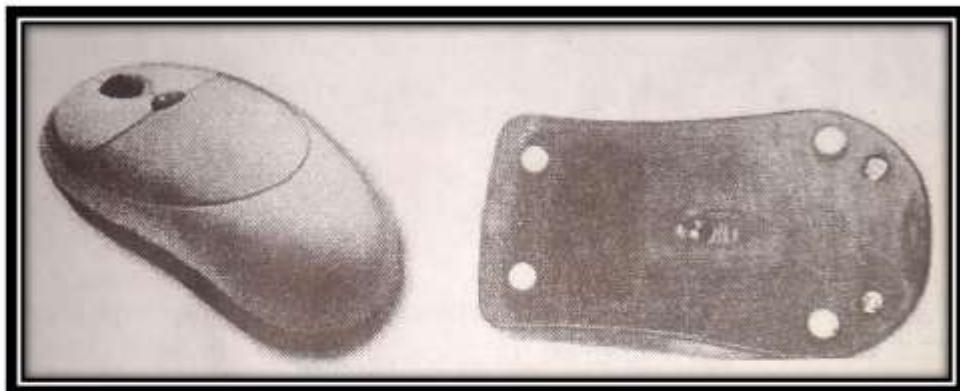


Fig: Optical Mouse

B. Trackball:

A trackball is a pointing device similar to a roller ball mouse. It is like an upside-down mouse. A trackball requires less space than a mouse for operation and is often attached to or built into the keyboard. To move the graphics cursor at a desired position on the terminal screen, the ball is rolled with hand. In designing, trackball is preferred because hand movement is mostly sufficient to move the graphical cursor and does not require any movement of equipment.

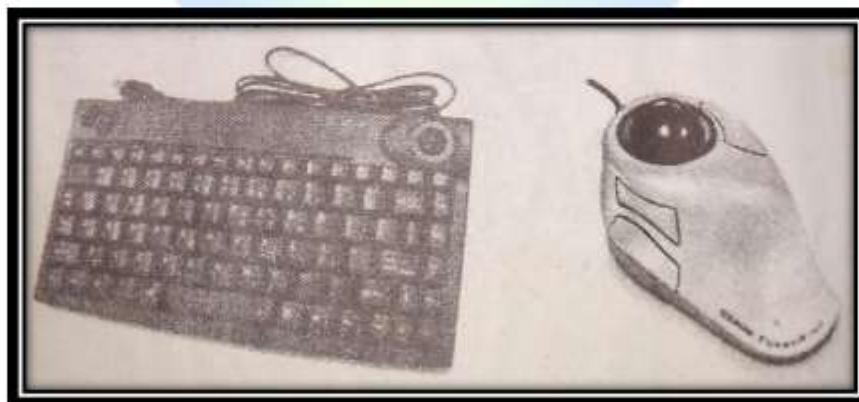


Fig: Trackball

C. Light Pen:

Light pen is an electro-optical pointing device that is used for selecting the objects on the display screen with the help of a light sensitive pen. The pen contains a light-sensitive diode, which helps in pointing the objects displayed on the screen.

Using a light pen, we can directly draw the objects on the screen by holding it on our hand. When the tip of the light pen is brought in contact with the screen, the light coming from the screen causes a pulse to be generated in the pen which in turn causes the processor to identify the position pointed to by the pen.

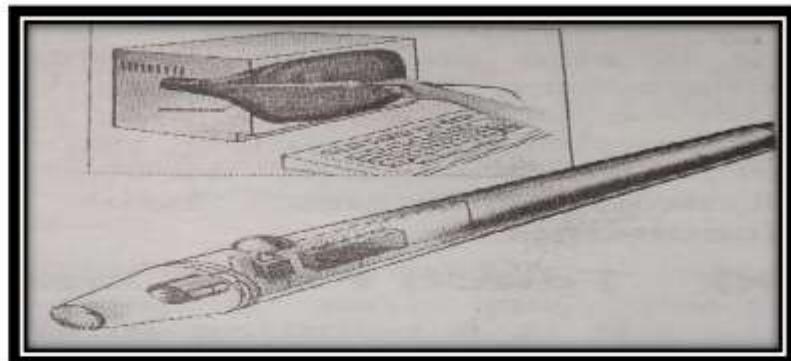


Fig: Light Pen

D. Joystick:

A joystick is a pointing device that works on the same principle as a trackball. A user moves the spherical ball by the attached stick with his/her hand. The stick can be moved forward or backward, left or right, to move and position the graphics cursor at the desired position.

On most joysticks, a button on the top is provided to select the option currently pointed to by the cursor. The button is clicked to make the selection. Typical uses of a joystick include video games, flight simulators, training simulators and remote control of industrial robots.

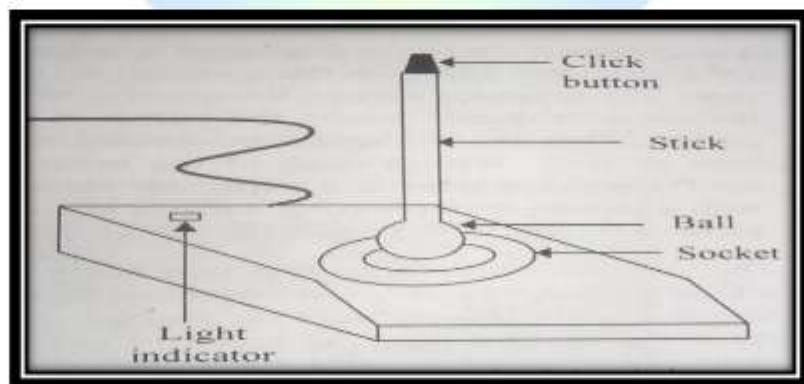


Fig: Joystick

E. Touch Screen:

Touch screen is a pointing device that enables us to enter data such as text, pictures and images by directing touching the screen. The touch screen is the display monitor with which the user can directly interact with the computer system by touching the screen.

These devices do not make use of the keyboard and the mouse for inputting the data into the computer system. The touch screen is used in a variety of applications, such as cell phones, ATM's, PDA's and games.



Fig: Touch Screen

Types of Touch Screen:

a. Surface WAVE Technology:

This technology generally makes use of ultrasonic waves, which are absorbed when they are passed through the touch screen panel.

b. Capacitive Technology:

This technology makes use of indium tin oxide material, which is coated on the touch screen for providing continuous electric charge.

3.Data Scanning Devices:

Data scanning devices are input devices, which are used for direct data entry into the computer system from source documents. Some of the data scanning devices are also capable of recognizing marks or characters. Data scanning devices typically have the following characteristics:

- ❖ They eliminate some of the duplication of human effort required to get data into the computer. Human beings do not have to manually enter the data.
- ❖ The reduction in human intervention improves data accuracy, and can increase the timeliness of the information processed.
- ❖ Since scanners are direct data entry devices, they demand high quality of input documents. Documents that are poorly typed or have strike overs or erasures are normally rejected.
- ❖ With these devices, form design and ink specification may become more critical than is the case when people key in the data from the forms.

- ❖ Data scanning devices are of many types. Some of the commonly used Data scanning devices are described below

Commonly Used Data Scanning Devices:

A. Image Scanner:

An image scanner is an input device that translates paper documents into an electronic format that can be stored in a computer. The input documents may be typed text, pictures, graphics or even handwritten material. A copy of a document stored in a computer will never deteriorate in quality and can be displayed, printed, altered and manipulated, whenever desired.

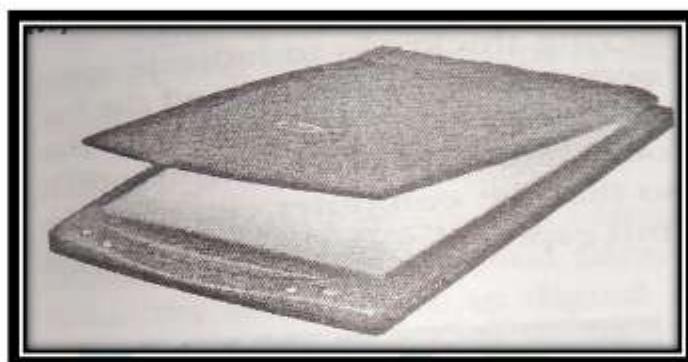


Fig: Image Scanner

There are two types of image scanner commonly used. They are:

a. Flatbed Scanner:

Flatbed scanners consist of a flat surface composed of glass pane on which the documents are kept for scanning. The object to be scanned is put inside down on the glass pane and the cover is lowered. The scanning is done from left to right horizontally, line by line and the procedure is repeated until all the lines are scanned. It takes about 20 seconds to scan a document of size 21cm x 28cm.

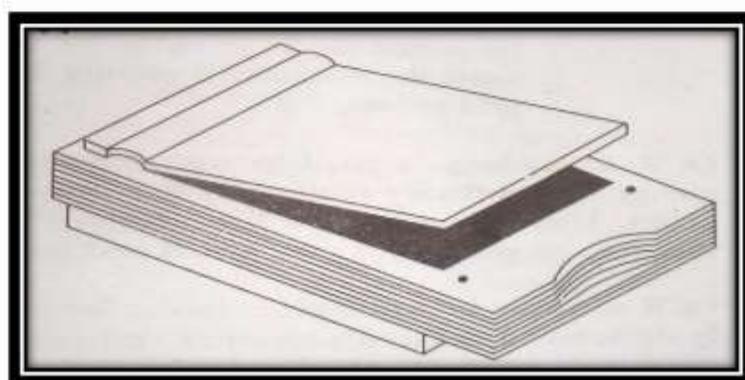


Fig: Flatbed Scanner

b. Hand Held Scanner:

Hand held scanners are the scanning devices that are generally used for digitizing the images into bitmap, which is a matrix of 0's and 1's. The sizes of these scanners are small and are suitable for scanning small images. They are generally used for identifying the bar-code level of the products. These scanners are also known as half page scanners, as they can scan maximum up to 5 inches at a time.

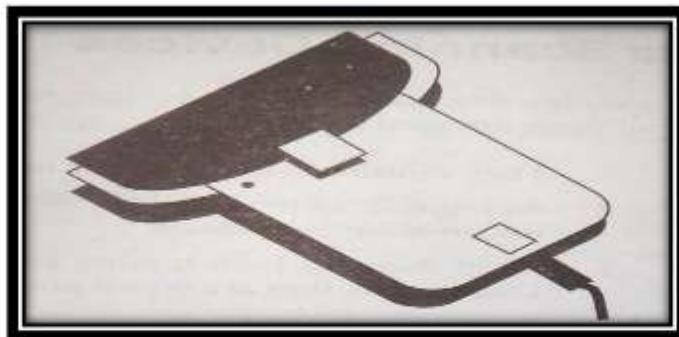


Fig: Hand Held Scanner

B. Optical Character Recognition (OCR) Device:

OCR is a type of scanner and used as an input device of computer. It is used to read character form the paper printed in special type of font and converts the characters into ASCII form which the computer can process. It uses the light and sensor system to determine which character is being examined and convert into electric signal.

OCR can understand the characters of only a few special fonts. Because of the OCR, we do not need intermediate keyboard to type data; we can give data directly to computer for processing. It is widely used in Airlines, Banks, Postal Offices, etc.



Fig: Optical Character Recognition

C. Optical Mark Reader (OMR):

OMR is an input device which can detect the presence of the mark of dark pencil made in the boxes of special pre-printed forms. Then OCR converts the marks into electrical

pulses and transmitted to the computer for processing. It is widely used for the following purposes:

- ❖ To check objective type answer paper in examinations.
- ❖ Various types of surveys where responses can be made restricted to one or more out of a few possibilities.
- ❖ Order forms containing a small choice of items.

The main advantage of OMR is that the information is entered at its source and no further translation is required.

D. Bar Code Reader:

Bar code reader is the scanner that usually reads bar code, which is used to label the items in the supermarkets, retail stores, books numbering in library, etc. The bar code is the computer readable code representing vertical lines of different widths.

The bar code reader basically consists of a scanner decoder and cable. The scanner is used for scanning the bar code, which is later converted into numbers or letters using decoder. The patterns of bar-code are standardized by code named "Universal Product Code".

The bar code is scanned with the help of the bar code reader, which directs the light beam over the bar code. A part of the beam is reflected back from the bar code by the sensor. Then, this light energy is converted into electrical energy by the bar code scanner. Finally, the electrical energy is transformed into data and forwarded to the computer system.

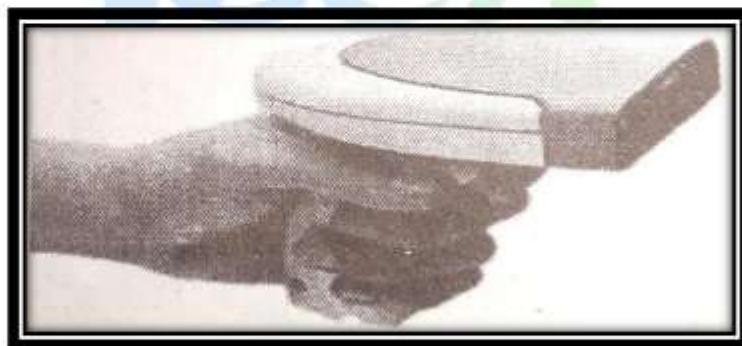


Fig: Bar Code Reader

E. Magnetic-Ink Character Recognition (MICR):

MICR devices are the special device used for recognizing the characters written with magnetic ink consisting developed for the banking operations. The details on the bank cheque, such as cheque number, bank and branch code are written with the magnetic ink. If a copy of the cheque is made with the help of colored photocopy scanning machine then the characters written with the magnetic ink will simply not respond. This provides an extra level of security in the banks for the protection of the cheque from illegal copying. The MICR scanner consists of MICR toner, which produces magnetic charge for reading the MICR line.

4. Digitizer:



Fig: Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored on a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at. Digitizer is also known as Tablet or Graphic Tablet because it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for doing fine works of drawing and image manipulation applications.

5. Electronic Card Reader:

Electronic cards are small plastic cards having encoded data appropriate for the application for which they are used. An electronic card reader, normally connected to a computer, is used to read the data encoded on an electronic card and transfer it to the computer for further processing. The numbers of input devices are common in association with cash transactions. The most common are ATMs and POS terminals.

A. ATM (Automated Teller Machines):

Automated Teller Machines are interactive input/output devices that enable people to make bank transactions from remote locations. ATMs utilize screen input as well as magnetic and POS terminal.

B. POS (Point of Sale):

Point of Sale: terminals are computerized cash registers that also often incorporate touch screen technology and bar-code scanners. These devices allow the input of numerous data such as item sold, price, method of payment, name or Zip code of the buyer, and so on. Some inputs are automated; others may be entered by the operators.

6. Speech Recognition Devices:

Speech recognition devices are input devices that allow a person to input data to a computer system by speaking to it. Hence, they make computers much easier to use.

However, as a data input device, currently speech recognition systems have limited success because correct interpretation by a machine of the large number of words in the vocabulary of a language is difficult.

The major difficulties are the people speak with different accents (pronounce differently) and intonations (with different tone or pitch of the voice), and the fact that the meaning of words can vary depending on the context in which they are used.

Hence, today's speech recognition systems are limited to accepting few words within a relatively small domain and can be used to enter limited kinds and qualities of data only.

Although in its infancy, speech recognition systems are already used for a wide range of applications. Some of its applications are:

- ❖ For data input to a computer system by a person in situations where his/her hands are busy or his/her eyes must be fixed on a measuring instrument or some other object. For example, doctors in an operation room can request certain information about a patient while operating.
- ❖ For data input by dictation of long text or passage for later editing and review.
- ❖ For authentication of a user by a computer system based on speech input.
- ❖ For limited use of computers by individuals with physical disabilities.

7. Vision Input System:

A vision input system allows a computer to accept input by seeing an object. Input data in this case is normally an object's shape and features in the form of an image. The idea is to simulate the capability of a human vision system in a limited sense.

A computer with a vision input device consists of a digital camera. Following steps are taken to recognize a given object:

- ❖ The camera is focused on the input object to take its picture.
- ❖ The camera creates an image of the object in digital form (in 0's and 1's) so that it can be stored and interpreted by the computer.
- ❖ The digitized image of the object is matched against similarly formed pre-stored images in the computer's image database.
- ❖ Depending on whether a match is found or not, the system takes appropriate icon.

Vision input devices are used mainly in factories for designing industrial robots used for quality control and assembly processes. For example, a robot used for quality control may inspect objects and separate those not meeting certain quality-control specifications. Another robot may be used to inspect shapes of objects and separate objects of different shapes in different bins.

Output Accessories (Devices):

Output devices receive information from the computer and provide them to the users. Output Devices are the electromechanical device which converts the machine readable information into human readable form. The output devices display the processed information by converting them into human readable forms such as graphical, alphanumeric or audio visual forms.

There are two types of outputs i.e. hardcopy output and softcopy output. Certain devices which act as both input as well as output devices like touch sensitive screen, magnetic disks and tapes are actually input/output devices.

1. Monitor or VDU (Video Display Unit):

Monitors are the most popular output devices used today for producing softcopy output. They display the generated output on a television like screen. A monitor is associated usually with a keyboard and together they form a Video Display Terminal "VDT". A VDT is the most popular input/output device used with today's computers. It serves as both an input and output device.

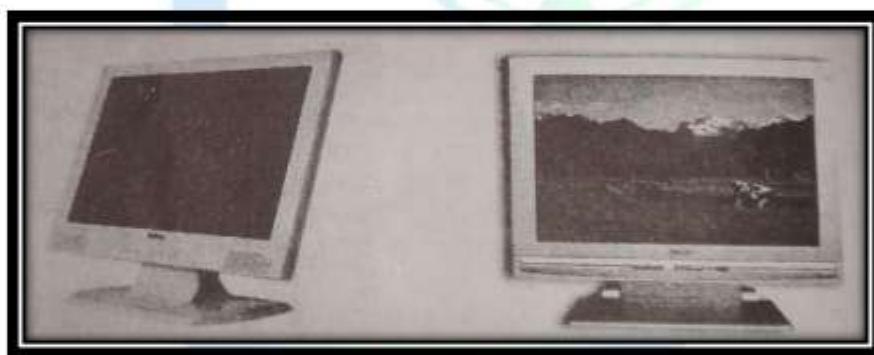


Fig: Monitor

Types of Monitor:

A. CRT Monitor:

CRT stands for "Cathode Ray Tube" and it is the most common type output device of modern digital computer. It has an electron gun located at the back of a tube which produces the electron beams. The screen has a layer of phosphor which emits light when it is struck by light beam.

The monitor is composed of a number of dots arranged in rows and columns. Each dot is called a pixel. A picture is displayed on the screen by brightening or darkening the selected pixel. The number of pixel per square inch or whole screen is called screen resolution. The high resolution monitor has more pixels per square centimeter or inch. The higher resolution generates greater and fine picture quality the details which can be displayed.

The CRT screen can be classified into two types in term of color capabilities.

❖ Monochrome:

The monitor which displays only in two colors i.e. one for background and the other for foreground are called monochrome monitors. These monitors are also called black and white or gray scale monitors.

❖ Color:

The screen which can display output in more colors by striking red, green and blue electron beam in the color screen are called color monitors. It is also called RGB monitor. These monitors are capable of displaying colored images on the screen.

B. LCD Monitor:

LCD stands for "Liquid Crystal Display" and it is a flat panel screen especially used in portable computer like laptops, notebooks, etc. because they are not heavy and bulky like CRT monitors. They are light-weighted monitor. A special liquid is sandwiched between two plates.

The top plate is transparent and bottom plate is reflective. LCDs do not emit their own light hence it does not harm our eyes. The liquid crystal layer is used to block and allow polarized light from its source. And, polarized filter is used to filter and display appropriate color to particular pixel.

Difference between CRT Monitor and LCD Monitor:

| CRT Monitor | LCD Monitor |
|--|---|
| CRT stands for "Cathode Ray Tube". | LCD stands for "Liquid Crystal Display". |
| CRT uses vacuum tube and electron guns. | This type of monitor is not harmful for eyes. |
| Picture quality of CRT monitor is high. | Picture quality of LCD monitor is low. |
| The cost of CRT monitor is low. | The cost of LCD monitor is high. |
| CRT monitor require more power to operate. | LCD monitor require less power to operate. |
| It occupies large space. | It occupies small space. |
| CRT is weighted, bulky and large in size. | LCD is light, compact and thin in size. |
| Screen is flicking. | Screen is not flicking. |
| CRT monitor is slowly getting outdated. | LCD monitor is becoming popular day by day. |

C. Plasma Displays:

Plasma display is a type of flat-panel display that works by sandwiching a neon/xenon gas mixture between two sealed glass plates with parallel electrodes deposited on their surfaces. The plates are sealed so that the electrodes form right angles, creating pixels. When a voltage pulse passes between two electrodes, the gas breaks down and produces weakly ionized plasma, which emits Ultra violets "UV" radiation. The UV radiation activates color phosphors and visible light is emitted from each pixel.

Today, plasma displays are becoming more and more popular. Compared to conventional CRT displays, plasma displays are about one-tenth the thickness around 4", and one-sixth the weight under 67 pounds for a 40" display. They use over 16 million colors and have a 160 degree viewing angle. Plasma displays are manufactured by companies such as Panasonic, Fujitsu, and Pioneer.

D. Light Emitting Diode(LED) displays:

An LED "Light Emitting Diode" is a flat panel display, which uses an array of light-emitting diodes as pixels for a video display. Their brightness allows them to be used outdoors in store signs and billboards, and in recent years they have also become commonly used in destination signs on public transport vehicles.

LED displays are capable of providing general illumination in addition to visual display, as when used for stage lighting or other decorative purpose. LED uses 7-segment display for digit, hexadecimal letter and 18-segment for alphabets or dot matrix. In dot-matrix display particular dots can be switched on to display any alphanumeric characters.

2. Printer:

Printer is an output device of a computer, which is used for producing hardcopy output like text and graphics on the paper. So, the printers provide information in a permanent readable form. Printers can be classified into different groups on the basis of different factors:

Types Of Printer On The Basis Of How They Print:

A. Impact Printer:

Impact printers use the electromechanical mechanism. They print by striking the printer head or pin against an inked ribbon and paper. Dot-matrix printer, daisy wheel printer, line printer etc. are example of impact printers. Impact printers are noisy printer because they produce sound while printing. Impact printers can print multiple copies of output at a time by using carbon between the papers. They are slow and print quality is also not so high.

B. Non-Impact Printer:

The printers which do not make the mechanical contact between the print head and paper are called non-impact printers. Ink-Jet, Laser, etc. are the example of non-impact printers. They print on the paper by using ink-jet, thermal, and electrostatic or laser beam technology. They are faster and less noisy than impact printers and they also provide better print quality. The main disadvantage of non-impact printer is that they cannot produce multiple copies of text at a time.

Difference between Impact Printer and Non-Impact Printer:

| Impact Printer | Non-Impact Printer |
|---|--|
| Electromechanical printers which print by pressing or striking against paper are called Impact Printer. | Printer which print without touching or striking on the paper are called Non-Impact Printer. |
| These printers use inked-ribbon for writing characters. | These printers use cartridge or toner to print characters. |
| The quality of Impact Printer is low. | The quality of Non-Impact Printer is high. |
| These printers are noisy, slow and used for only text. | These printers are less noisy, fast and used for text as well as pictures. |
| Generally, these printers are character or line printer. | Generally, these printers are page printers. |
| These printers can be used for printing multiple copies at a time by using carbon paper. | These printers cannot be used to print multiple copies at a time. |
| The printing per-page is low. | The printing per-page is high. |
| Impact Printers are generally used in small organizations. | Non-Impact Printers are generally used in big organizations. |
| Example: Dot-Matrix, Fax Printer, Daisy Wheel and Type writer. | Example: Canon 2900, Photocopies, HP Laser shoot and Inkjet Printers. |

Types of Printer On The Basis Of Printing Speed:

A. Character Printer:

The printer that prints one character of text at a time is called character printer. It is very slow for printing and its printing quality is not so high. Dot-Matrix Printer, Daisy Wheel Printer, etc. are example of Character Printer.

B. Line Printer:

The printer which can print one line of text at a time is called line printer. It is faster than character printer. Drum Printer, Chain Printer, etc. are the example of Line Printer.

C. Page Printer:

The printer which can print one page of text or image at a time is called Page Printer. They are fastest printer and printing quality is very high. Laser Printer is the example of Page Printer.

Types of Printer:

A. Dot-Matrix Printer:

Dot-Matrix Printer is a kind of printer which prints a character by printing a selected number of dots from a matrix of dots. It has a print head containing a number of pins. Then it prints by striking the head on the inked ribbon and paper. It does not have fixed character font so it can print any type of font or alphabets. Its printing speed is very slow and does not provide high print quality.



Fig: Dot-Matrix Printer

B. Ink-Jet Printer:

Ink-Jet Printer is a type of Non-Impact Printer which prints one character of text at a time. It prints text and graphics by spraying ink from a nozzle onto the paper. The ink cartridge contains a column of tiny heaters. They heat the ink near the nozzle to very high temperature for a fraction of second. This heating process causes the ink to boil and form vapor bubble.

As the vapor bubble expands, it pushes a drop of ink through the nozzle and forces it on the paper. It is faster, less noisy and provides higher print quality than impact printers but its printing cost is higher. It can be used for printing even graphics. It is flexible font type of printer so it can print any alphabets of different fonts.

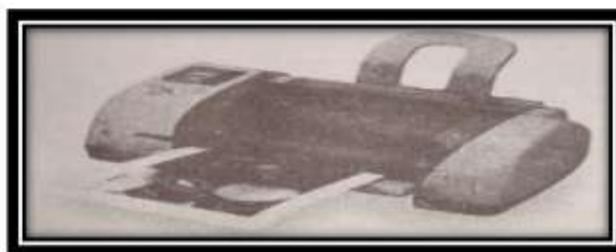


Fig: Ink-Jet Printer

C. Thermal Printer:

Thermal Printer is a type of Non-Impact printer which prints a character at a time. It has special heat sensitive ribbon and a print head consisting of number of pins. It prints text and graphics by pushing electrically heated pins against the ribbon. It also uses the Dot-Matrix approach to print a character. It prints a character which is made of dots. It is faster, less noisy and provides better print quality than impact printers and it can be used for printing graphics also.

D. Laser Printer:

Laser Printer is a Non-Impact high resolution printer which uses the photocopy principle and prints text and image of a complete page at a time. It uses the laser beam to produce an image of the page on a photosensitive drum. The drum is coated with negatively charged photoconductive material.

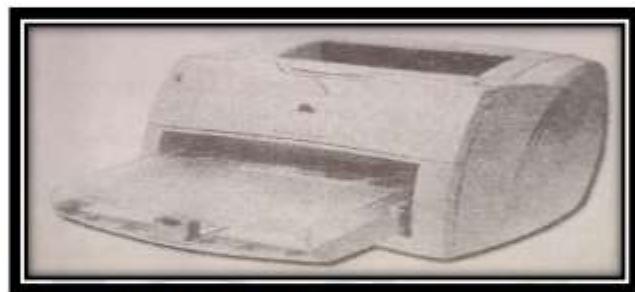


Fig: Laser Printer

When the laser beam is exposed, it converts the negative charge of the drum into positive charge. Then the drum is rolled through the toner and only the laser-exposed areas of the drum attract the toner. Then finally, the toner is transferred to the paper through the combination of heat and pressure.

Laser printer is capable of printing extremely high quality text and graphics in a fast speed. The low speed laser printer prints 8-10 pages per minute and high speed laser printer can prints about 200 pages per minute. Laser printer is more expensive in comparison to other printer.

E. Drum Printer:

Drum Printers are line printers that print an entire line at time. It consist of a solid cylindrical drum with characters embossed (raised characters) on its surface in the form of circular bands. Each band consists of all the printing characters supported by the printer in its character set. The drum of a Drum Printer rotates at a high speed and has to complete one full revolution to print each line of output.

In drum printer all the characters on a line are not printed at exactly the same time, but the time required to print an entire line is so fast that it appears as if one line is printed at a time. The drum of a drum printer is expensive and cannot be changed often. Drum

printers do not have ability to print any shape of characters, different sized of print, and graphics such as charts and graphs.

Drum printers are impact printers because they print by hammering on a paper and inked ribbon against the characters embossed on the drum. Hence, they can be used to produce multiple copies by using carbon paper or its equivalent. Due to impact printing, drum printers are noisy in operations and often use a cover to reduce the noise level. Printing speed of drum printers are in the range of 300 to 2000 lines per line.

F. Chain/Band Printer:

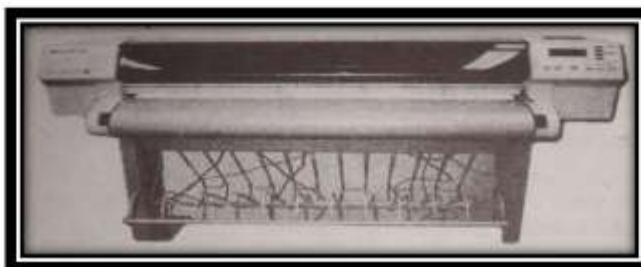
Chain/Band printers are line printers that print one line at a time. It consists of a metallic chain/band on which all characters of the character set supported by the printer are embossed. A standard character set may have 48, 64, 96 characters. In Chain/Band printers, the character set are repeated several time on the chain/band, it is not necessary to wait for the chain/band to make a complete revolution to position the desired character in the correct print position.

Unlike the drum of a drum printer, the chain/band of a chain/band printer can be changed easily. This allows use of different fonts (styles of characters) and different scripts (languages) to be used with the same printer. Like drum printers, chain/band printers can print only pre-defined sets of characters embossed on the chain/band used with the printer. Chain/Band printers, therefore, do not have the ability to print any shape of characters, different sizes of print, and graphics such as charts and graphs.

Chain/Band printers are impact printers because they print by hammering on a paper and inked ribbon against the characters embossed on the chain/band. Hence, they can be used to produce multiple copies by using carbon paper or its equivalent. Due to impact printing, chain/band printers are noisy in operations and often use a cover to reduce the noise level. Printing speeds of chain/band printers are in the range of 400 to 3000 lines per minute.

3. Plotter:

Plotter is an output device of computer which is used to produce precise and good quality graphics or drawings such as pie-chart, bar graph, map, etc. on a paper. It uses ink pen or jet to draw graphics or drawing. It is mainly used for architects, engineers, city planners and others, who need to routinely generate high-precision, hard-copy, graphic output of widely varying sizes.



Types of Plotters:

A. Drum Plotter:

A drum plotter is a pen plotter that wraps the paper around a drum with a pin feed attachment. The drum then rotates the paper as pens move across it and draw the image. It was the first output device used to print graphics and large engineering drawings. There are two types of drum plotters, external and internal. With external drum plotter, the paper is wrapped around its external surface, while the internal drum plotter uses a sheet of paper wrapped around its internal surface.

B. Flat-Bed Plotter:

A flat-bed plotter is a mechanical drafting device used with many CAD "Computer Aided Design" programs for designers. The paper remains stationary on a flat surface while a pen moves across it horizontally and vertically. This plotter may use several different pen colors to create the graphics. The size of the graphic is limited to the size of the flat-bed plotter's surface.

C. Ink-jet Plotter:

The ink-jet plotter creates an image by spraying small droplets of ink on to paper. A popular choice for advertising agencies and graphic designers, ink-jet plotters are used generally for large outputs, such as banners and billboards and large signs often seen along roadsides.

They are available in thermal or piezoelectric models. Thermal ink-jet plotters use heat to apply droplets of ink, while piezoelectric plotters use charged crystals to apply the ink. Ink-jet plotters typically produce better quality graphics than other plotter types.

D. Cutting Plotter:

The Cutting Plotter is a large scale cutting device that produces ready-cut Mylar or vinyl lettering and graphics. Automated plotter knives cut into a sheet of the material lying on the plotter's flat surface area curving out the attached computer. Used for sign making billboard advertising and vehicle graphics, the devices offer far greater speed and precision than can be achieved with the traditional method of creating sign lettering and logos by hand.

4. Computer Output Microfilm (COM):

Computer Output Microfilm is a system that converts stored data directly to microfilm or microfiche. It was used in 1960s to 1980s, till used today, mostly by organizations that need to store payroll, accounting, insurance, inventory, or employee data. Yet because

most of these organizations have outputted the Computer Output Microfilm to microfiche, they have to manually search for a record and use a reader printer to save out a particular file.

A more feasible option is to convert Computer Output Microfilm to digital image via Generation Imaging's microfiche scanning services. Generation Imaging specializes in microfiche to PDF "Portable Document Format", TIFF "Tagged Image File Format", or JPEG "Joint Photographic Experts Group" conversions.

Using high quality/high production microfiche scanners, we convert the COM microfiche to digital. Generation Imaging provides this COM fiche scanning service to end users as well as other service bureaus. Clients can choose from Adobe PDF "Portable Document Format" format, Group 4 TIFF (Tagged Image File format), or greyscale JPEGs. PDFs and TIFFs can be wrapped in a multi-page file. Generation Imaging offers an optional OCR (Optical Character Recognition) image processing and other indexing services (by folder or filename).

The end result of this entire process is a digital image which you could easily search the file containing records by name, account number, date, and/or social security number. Obviously this saves time and efficiency.

5. Screen Image Projector:

Screen Image Projector is an input/output device that is used to enlarge image of computer, television or other resources on the screen so that a group of people can view it simultaneously. It is very useful for making presentations to a group of people with direct use of a computer. Screen Image Projector can be categories as LCD "Liquid Crystal Display" and DLP "Digital Light Processing".

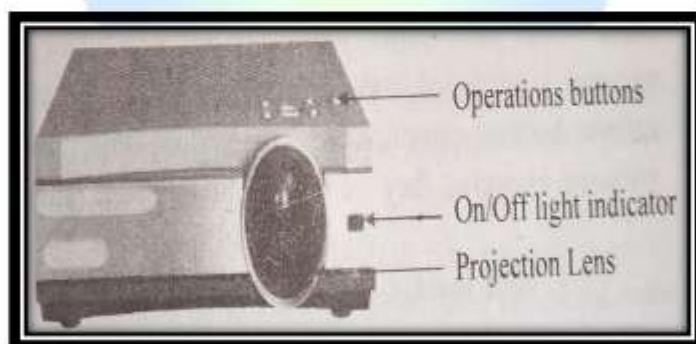


Fig: Projector

Screen Image Projectors have become common presentation equipment today. They are used commonly with portable notebook computers to setup a modern presentation facility quickly at any place with great ease. Like Monitors, Screen Image Projectors provide a temporary, soft-copy output.

Voice Response Systems:

A voice response system enables a computer to talk to a user. A voice response system has an audio-response device that produces audio output which is temporary, soft-copy output. Voice response systems are of two types: Voice Reproduction System and Speech Synthesizer.

Voice Reproduction System:

A voice reproduction system produces audio output by selecting an appropriate audio output from a set of pre-recorded audio response. The set of pre-recorded audio responses may include words, phrases, or sentences spoken by human beings, music or alarms generated by musical instruments, or any other type of sound.

The actual analog recordings of the pre-recorded sounds are converted into digital data first and then stored on a computer's disk or in its memory chip permanently. When audio output is to be produced, the computer selects the appropriate sound from the set of pre-recorded sounds.

The selected sound is converted back into analog form and then routed to a speaker to produce the audio output. Voice reproduction systems are very useful in a wide range of application such as:

- ❖ Audio help for guiding how to operate a system
- ❖ Automatic answering machines
- ❖ Talking alarm clocks
- ❖ Talking toys and home applications also use a voice reproduction system.
- ❖ Often personal computers with audio facility are used for automated multimedia presentations during exhibitions.
- ❖ Video games are made exciting and interesting by playing an event-based sound from a set of pre-recorded sounds.

Speech Synthesizer:

A Speech Synthesizer converts text information into spoken sentences. To produce speech, these devices combine basic sound units called Phonemes. From a given text information, sequence of words are combined into phonemes, amplified, and output through a speaker attached to the system.

Speech synthesizers are still in their infancy because currently they can produce only limited unique sounds with only limited vocal inflections and phrasing. However, they are useful in a wide range of applications such as:

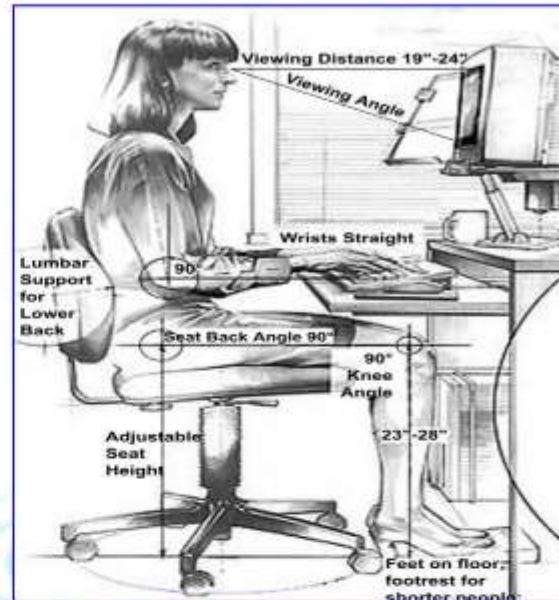
- ❖ For reading out text information to blind persons
- ❖ For allowing those persons who cannot speak, to communicate effectively
- ❖ For translating systems that convert an entered text into spoken words in a selected language

Ergonomically Designed Devices:

The devices or equipment design to maximize the productivity by reducing operator fatigue and discomfort is called ergonomically designed device.

The Devices Are:

- ❖ Office Chairs
- ❖ Document Holder
- ❖ Pointing Devices (Mouse Devices)
- ❖ Wrist Rests/ Forearm Supports
- ❖ Keyboard/Mouse Platforms
- ❖ Workstations
- ❖ Telephone Accessories
- ❖ Slant boards and Book lifts
- ❖ Monitor Blocks
- ❖ Mouse Deck
- ❖ Anti-Glare Lighting
- ❖ Footrests



Physical ergonomics: The science of designing user interaction with equipment and work place to fit the user.

How To Buy A Computer (Detailed Configuration):

Buying a new laptop or desktop PC can be quite confusing. Many people find it difficult to compare prices, features, processor types, etc. to find the right choice in accordance with their requirements. In this post we will tell you the top 10 things to consider before buying a PC.

The List Of Things That Should Be Considered While Buying The Computer Are:

1. Usability:

It is important to first consider the tasks that we will be performing on our PC. So, if we wish to buy a computer for simply browsing the internet and using some online services than it might be better to buy a single core computer which satisfies our minimum requirements. On the contrary if we require using it for heavy video editing and professional work, then it might be better to buy a system that has enhanced multimedia options.

2. Price:

This brings us to our next consideration of price. There might be some very fancy features that everybody wants in their new PC. The price should be considered and the computer should be chosen according to the price.

3. Operating System Type:

Users with minimum requirements may be better off buying a Windows Starter or Home Premium version e.g. of Windows 7. For users who wish to take advantage of more enhanced features and require more effective tools such as connecting their PC to a domain are naturally better off buying a Professional or Ultimate Edition.

4. Size:

Some people prefer buying larger laptops for a better display screen, whereas other prefers smaller and more portable sizes. Whereas, the people with weak eye sights a laptop with a larger display screen might be worth the price.

5. Peripherals:

Peripheral devices such as printers, scanners, etc. can significantly increase or reduce our price for buying a new PC. It might be better off buying a system with a DVD combo drive if we do not require writing data to DVDs.

6. Brand:

Some brands offer better warranties, whereas others offer software packages that come with the system. For example: A Dell laptop with the same specifications may be cheaper than a Sony. The reason is that Sony provides many of its own software with their laptops which save the users cost for buying software. (Example: A DVD burning).

However, if we already have many such licensed or freeware software available, then it might be better to go for a cheaper brands. ACER for instance is known for its low cost laptops that provide more enhanced specs like hard disk space and RAM as compared to its competitors.

7. Hard Disk:

Hard Disk considerations might not mean much to a lay user; nevertheless, having the right amount of disk space and disk type might be the necessary for the efficient management of regular tasks for a professional. A common user may merely have to decide between buying a 120 GB or 320 GB hard disk system.

8. RAM:

It is obvious that for more professional tasks and to run a Xeon Server there will be more RAM required than for merely using a PC for browsing the internet. Moreover, the RAM type may matter more than many people might consider. For example: there are not many applications currently available that can take advantages of DDR3 RAM types, one may be better of saving some dimes by buying a system with a DDR3 RAM.

9. Processor:

The processor is one of the most important part of a system and can mean the difference between a system that frequently hangs and the one that runs smoothly. Some people might think that going for the low cost single core or dual core processor is a good idea but I would not recommend either of them for anyone who requires using a system for more than basic usage.

Moreover, one might be better off buying a Corei3 system instead of Core2 Duo as the later might be more expensive and less efficient than the former. A Corei3 can cost up to \$113 whereas, a Core2 Duo can cost \$130. For more demanding professionals, it might be better to buy a Corei5 (if not a Corei7), as the core i5 Turbo Boost technology other than Hyper Threading.

10. Warranty:

Warranty makes up the most important consideration for people when buying a system. Having one covered with the right kind of hardware warranty is essential and should be unconditional. I still remember when Sony had to recall several laptops due to a battery fault because of which their laptops caught fire. I'm sure none of us would like to have a laptop that we can fry omelets on without the guarantee of replacement.

Computer Network:

A group of autonomous computer and associated devices are connected together by wire or wireless in order to:

- ❖ Share resources (files, data, hard drives, CD-ROM, software, etc.),
- ❖ Allow electronic communication (e-mail, messenger, VOIP, Facebook, etc.),
- ❖ Increase productivity

is called computer network. The computer devices include palmtop to mainframe, networking devices includes repeaters to gateways and other components like telephone, mobile, etc. may include to form a computer network.

Advantages of Computer Network:

1. Resources Sharing:

We can share different hardware and software resources like file, printer, operating system, scanner or computer peripheral devices in the network. A single file can be shared and used between multiple users at the same time.

2. Communication Medium:

It is very fast and cheap to communicate long distance through computer networking. We communicate via computer networking by sending text, listening online FM stations, e-commerce, Facebook, etc.

3. Centralized Computing:

All the computers and other components of a network are managed and controlled by a central computer which is known as the server. For the security measure, server data can be protected easily and then data can be transferred to all clients. It is easy and convenient to manage and troubleshoot all the clients through server rather than individually. Hence, the centralized computing is the best advantage of computer network. Without computer network, client and server cannot share data and information between them.

4. Simultaneous Access:

A network server is a central computer with a large storage capacity and other resources that all users can share. If server stores data files for user to access it is commonly called a file server. The business can store data file on the server that user can access whenever they want. Then, if one user modifies it other user will see the change when they use the file.

5. Backup and Recovery:

Server is the main component of the computer network so it is kept in a secured place and good security mechanism has been implemented to keep the data and files safe. In networking environment, all the data and files are centralized in a server. If any data or files are lost in the clients, it is possible to restore them from the server.

Disadvantages of Computer Network:

1. Increase Expenses:

The networking process requires devices, technical manpower and operating cost. These devices cost more and increases expenses of organization. The commonly used devices

such as hubs, cable, NIC "Network Interface Card", modem, etc. These devices increase the cost of the organization.

2. Possibility of Leakage and Corruption of Data:

The networking server manages and controls all the other computer nodes in the networks. The data server transmits data by implementing some security mechanism. The data transmission in between the nodes may be hacked and used by third parties. This causes the data corruption and leakage in networking. Similarly, the hackers and computer viruses are the great threat to the computers in the networks. Even a virus theft personal data from one computer and send it to other.

3. Need Special Technical Knowledge:

To work in the networking environment, the organization needs very high skilled manpower to install and operate. In Nepal, there is still lack of technical manpower. The absence of technical manpower causes shutdown of network. There are others technical issues like availability of devices lack of teaching institution etc.

Types of Networks:

The classification of network is based on the distance covered, geographical area and bandwidth of the data transmission. This type of network has specific features on its own types. Some of the mostly used network types are as follows:

1. Personal Area Network (PAN):

A PAN is a computer network used to communicate among electronic devices, including phones, television, personal digital assistance, etc. The range of these devices bounds within a room, ranging up to a few meters. The PAN can be used to communicate among personal devices themselves.



Fig: Personal Area Network (PAN)

Personal area networks may be wired or wireless in nature. Infrared communication (Remote Controller), Bluetooth, Z-Wave and ZigBee are the common example of wireless personal area network. Printer cable, HDMI cable, USB extension cord, computer-mobile data cables and external hard disk connector are the common examples of wired personal area network.

Advantages of PAN:

- ❖ It has high bandwidth.
- ❖ It is easy to troubleshoot because minimum devices are used.
- ❖ It has low cost in comparison to other network types.
- ❖ It has minimum chance of hacking or data lost.

Disadvantages of PAN:

- ❖ It cannot be used for general purpose.
- ❖ The transmission generally has one to one communication.

2. Local Area Network (LAN):

A computer network which is limited to a small area such as a room, office, building, campus and university is known as Local Area Network. Its speed is the fastest among other networks as it uses only one type of transmission media such as coaxial or twisted pair but never both. It is limited to maximum 5 kilometers or less. It connects workstations, personal computers, printers and other devices. All these resources are normally physically connected via cables.

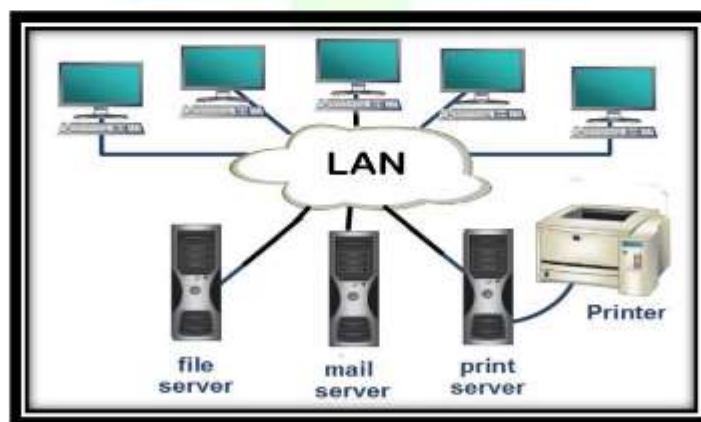


Fig: Local Area Network (LAN)

Advantages of LAN:

- ❖ It provides high bandwidth for resources sharing.
- ❖ It provides cheaper and reliable communication medium.

- ❖ It provides a great deal of design flexibility, easy maintenance and cost efficiency.
- ❖ It can support centralized data storage.

Disadvantages of LAN:

- ❖ Large number of nodes cannot handle efficiently.
- ❖ Fault on network can lost data and information.
- ❖ One time installation cost is high.
- ❖ Very limit coverage.

3. Metropolitan Area Network (MAN):

Metropolitan Area Network is a high speed network that can carry voice, data, video and image up to 512 mbps or faster over distances up to 75 km. A MAN can include one or more LANs as well as telecommunication equipment, microwave relay stations and satellite base stations.

Big companies, banks and many organizations use MAN to connect with their branches or sub offices for communicating data and information. A MAN is larger than LANs and smaller than WAN and operates at high speed. MAN is operated by either public or private owned companies. The coverage area of a MAN is around a city. That can be used to share resources among different computers or devices within a city. Cable Television, Cable Internet, Wireless Internet, Telephone exchange station, Bank Networking within city are the most common examples of Metropolitan Area Network.

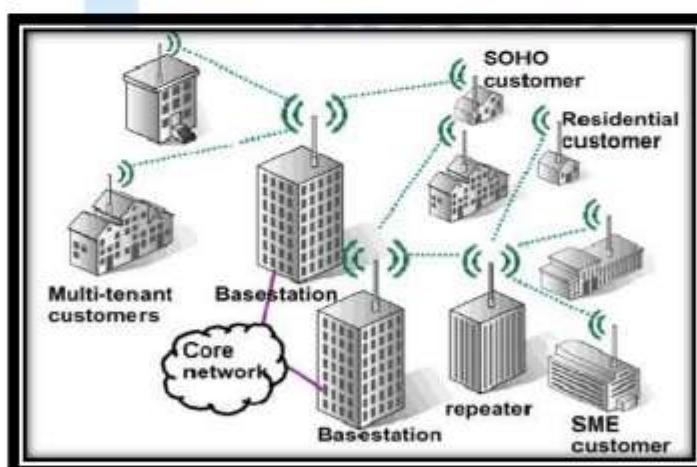


Fig: Metropolitan Area Network (MAN)

Advantages of MAN:

- ❖ It provides a good backbone for a large network and provides greater access to WANs.
- ❖ MAN uses hybrid, mesh, and tree topologies to connect multiple LAN's.
- ❖ Error's during data transmission is less than WAN.

- ❖ It mainly used Fiber Optical Cable which helps in fast data transmission.
- ❖ Generally it covers a city or a town.
- ❖ It supports voice communication.
- ❖ It may be used in guided (wired) or unguided (wireless) medium.

Disadvantages of MAN:

- ❖ More cable required for a MAN connection from one place to another.
- ❖ The large network becomes difficult to manage.
- ❖ It is difficult to make the system secure from hackers.
- ❖ Installation costs are high.
- ❖ Breaching of data is possible.

4. Wide Area Network (WAN):

A geographical widespread network capable for communicating and sharing all types of data and information all over the world is called WAN. WAN is a large network also called network of networks and consists large number of LANs and MANs.

The span of WAN is in 1000 km around the world connecting countries and continents. The bandwidth is lesser in comparison to the LANs and MANs. The operator of the WAN is by Internet Service Provider (ISP) or by a telephone company. In most WAN, there are two distinct components:

- ❖ Transmission Lines
- ❖ Switching Nodes

Transmission line is the communication channels between the computers. These may be copper wire, optical fiber or even radio frequencies. Switching nodes are the computers that share and communicate via transmission lines. The switching nodes may be the intermediate devices like repeaters, hubs, routers and gateways or computer itself.

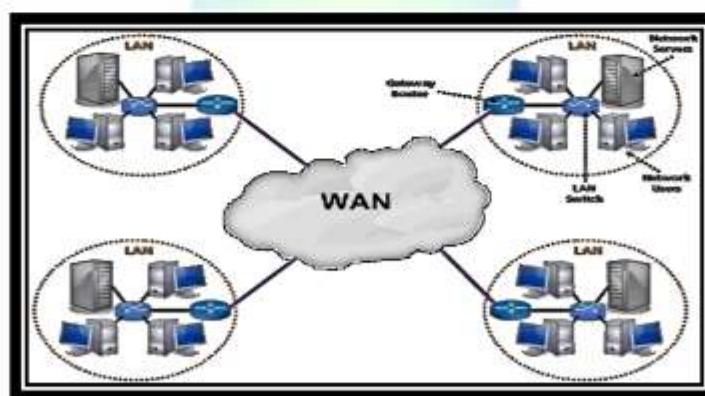


Fig: Wide Area Network (WAN)

Advantages of WAN:

- ❖ Covers a large geographical area so long distance businesses can connect on the one network.

- ❖ Shares software and resources with connecting workstations.
- ❖ Messages can be sent very quickly to anyone else on the network. These messages can have pictures, sounds, or data included with them (called attachments).
- ❖ Expensive things (such as printers or phone lines to the internet) can be shared by all the computers on the network without having to buy a different peripheral for each computer.
- ❖ Everyone on the network can use same data. This avoids problems where some users may have older information than others.
- ❖ Share information/files over large area.

Disadvantages of WAN:

- ❖ They are expensive and slow.
- ❖ Need a good firewall to restrict outsiders from entering and disrupting the network.
- ❖ Setting up a network can be an expensive and complicated experience. The bigger the network the more expensive it is.
- ❖ Security is a real issue when many different people have the ability to use information from other computers. Protection against hackers and viruses adds more complexity and expense.
- ❖ Information may not meet local needs or interests.
- ❖ Chances of occurring error during data transmission are high due to the use of wireless communicational medium which are highly suffered by external node.

5. Campus Area Network:

A network which is bigger than LANs but smaller than MANs and WANs such as on a University or a Local Business Campus is known as Campus Area Network (CAN). It consists of multiple LANs. A CAN is also known as a Corporate Area Network (CAN).

A CAN made up of an interconnection of LAN within a limited geographical area. CAN includes "Switches, Routers" and transmission medium "Optical Fiber, Copper Plant, Cat5, Cat6 Cabling, etc. CAN are owned by the campus tenant/owner, an enterprise, University, Government, etc.

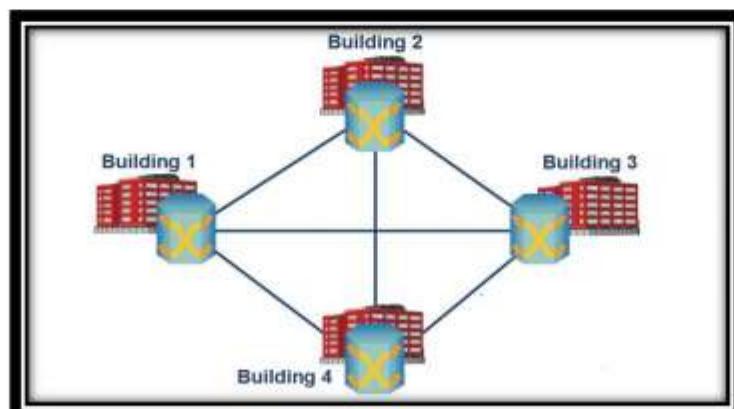


Fig: Campus Area Network (CAN)

Advantages of CAN:

- ❖ It provides high bandwidth for resources sharing.
- ❖ It provides cheaper and reliable communication medium.
- ❖ It provides a great deal of design flexibility, easy maintenance and cost efficiency.
- ❖ It can support centralized data storage.

Disadvantages of CAN:

- ❖ Large number of nodes cannot handle efficiently.
- ❖ Fault on network can lost data and information.
- ❖ One time installation cost is high.
- ❖ Very limit coverage.

Network Topologies:

Topology of a network refers to the way in which the network's node (computers or other devices that need to communicate) are linked together. It determines the various data paths available between pair of nodes in the network.

Most of all network topology is used to create Local Area Network (LAN) and connect two distinct LANs between computer and computer related components. Hence, topology refers to the shape of a network. How different nodes in a network are connected to each other and how they communicate with each other is determined by the Network Topology.

Hence, topologies are also called LAN topology. Choice of a topology for a computer network depends on a combination of factors such as:

- ❖ Desired performance of the system.
- ❖ Desired reliability of the system.
- ❖ Size (number of nodes and their geographical distribution) of the system.
- ❖ Expandability of the system.
- ❖ Cost of components and services required to implement the network.
- ❖ Availability of communication lines.
- ❖ Delays involved in routing information from one node to another.

1. Bus Topology:

Bus Topology consists of a single cable (bus or backbone) as a transmission medium, on which all the devices of the network such as clients, servers, printer, etc. are connected. If anyone device wants to communicate with any other devices, then it puts the request on the bus. If the bus is free then the request is accepted, processed and services is provided to the requesting device otherwise the device has to wait. The position of the server is not fixed in this topology. The server can be anywhere on the network.

It can be at the end or in the middle anywhere. The signal passes through the bus in both directions and can be received by all other nodes. All nodes on the bus topology have equal access to the bus and there is no discrimination.

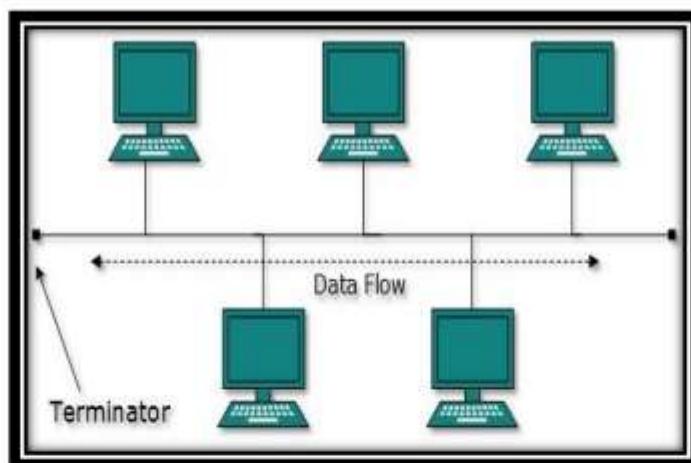


Fig: Bus Topology

Advantages of Bus Topology:

- ❖ Installation is cheap and easy.
- ❖ Addition of nodes/new connection is easily made.
- ❖ Less cable is required.
- ❖ If one computer goes down it does not affect the network.
- ❖ Terminator resistors at the end do not allow data to escape.
- ❖ It is not expensive as it requires least amount of cables.

Disadvantages of Bus Topology:

- ❖ It is used only for small network.
- ❖ Fault identification is difficult.
- ❖ A single fault in cable disturbs network transmission.
- ❖ It depends upon a single cable (bus), if the cable fails the whole network fails.
- ❖ As the number of computers are added, its performance decreases.

2. Star Topology:

A topology in which all workstations and servers are connected to a centrally-located device called hub/switch in the form of a star is known as Star Topology. It is not always necessary that they should form a star. The message first goes to the central device and then transmits to its destination.

Adding and removing computers is fairly easy in this topology. This design provides an excellent platform for reconfiguration and troubleshooting. A break in the medium is easy to isolate and doesn't affect the rest of the network.

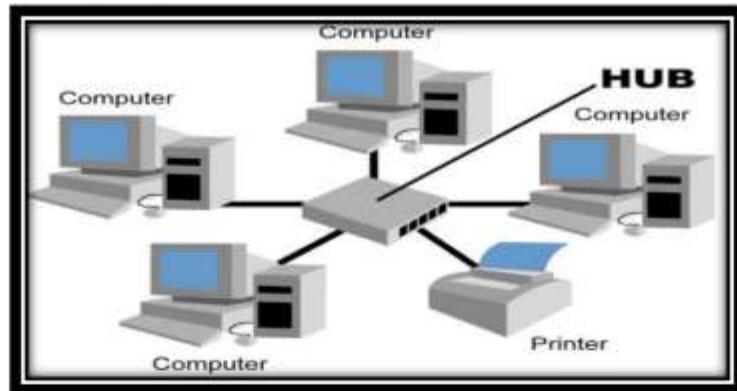


Fig: Star Topology

Advantages of Star Topology:

- ❖ Installation and configuration of network is easy.
- ❖ Less expensive when compare to Mesh Topology.
- ❖ Fault in the network can be easily tracked.
- ❖ Expansion and modification of Star Topology is easy.
- ❖ Single computer failure does not affect the network.
- ❖ It supports multiple cable type like STP, UTP, telephone cable, etc.
- ❖ It is easy to add and remove computers in this topology.

Disadvantages of Star Topology:

- ❖ Failure of central hub brings the entire network fail.
- ❖ More cabling is required in comparison to tree, bus, or ring topology.
- ❖ It is expensive as a lot of cables and other controlling devices are required.

3. Ring Topology:

A computer arrangement in which all the computers of network are connected to a single cable or trunk in a circular way is known as Ring Topology. In this topology, the first and last computers are also connected with each other. Here, each computer acts like a repeater that boosts an incoming signal before passing it to the next computer.

Data travels from one computer to another in a clockwise or anticlockwise direction. Each packet of data sent by fixing its destination address, when data arrives in one computer it simply checks destination address is same as its own.

If both address matches then it accepts the data otherwise it sends the data to other workstation in the ring. When the workstation is powered off, it disconnects from the ring and allows the information to bypass to other workstations. When the workstation is powered on, it connects itself to the ring and starts accept, reject and forward data on the ring.

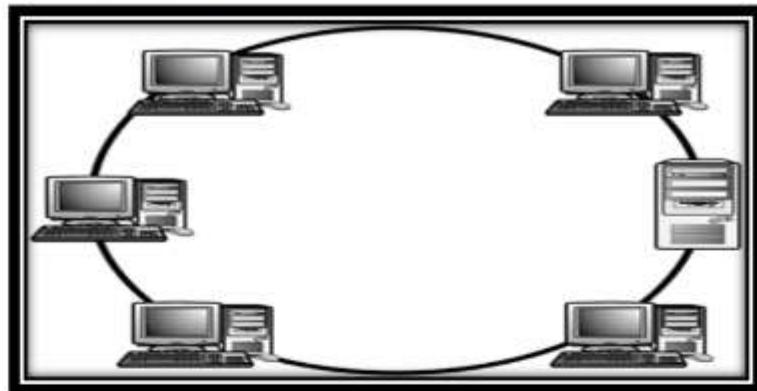


Fig: Ring Topology

Advantages of Ring Topology:

- ❖ It is easy to install and modify the network.
- ❖ The fault isolation is simplified.
- ❖ No signal/data loss in ring topology.
- ❖ Speed is high as data travels in only one direction.
- ❖ Each node on the ring has repeater, so it can be expanded to a greater distance.
- ❖ All stations have equal access.

Disadvantages of Ring Topology:

- ❖ Adding and removing computers disturbs the entire network.
- ❖ A break in the ring can stop transmission in the network.
- ❖ It cannot use for large scale network.
- ❖ Changing network structure is very difficult.
- ❖ It cannot cover a large geographical area.
- ❖ It is very difficult to detect any fault or errors.

4. Tree Topology:

Tree Topology is a LAN topology in which only one path exists between any two nodes on the network. The pattern of the connection branching further and construct tree. The top most devices form where roots are generated is called root of the network. The last ending point of the network which does not have further nodes is called leaf nodes. It is a hybrid topology forming after multiple star topologies.

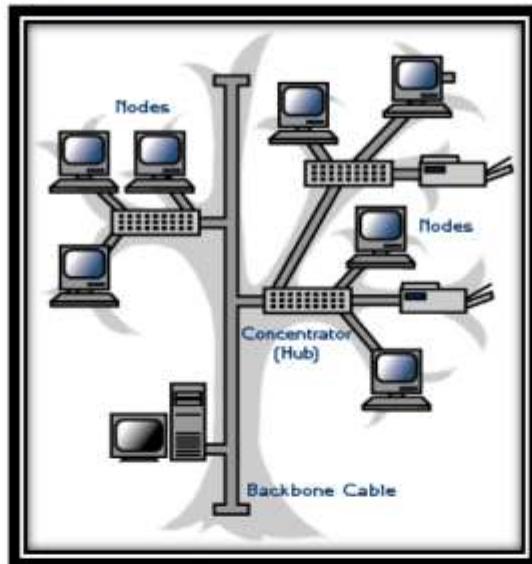


Fig: Tree Topology

Advantages of Tree Topology:

- ❖ Installation and configuration of network is easy.
- ❖ The fault can be easily tracked.
- ❖ Expansion of the network is easy.
- ❖ It supports for multiple cable type.

Disadvantages of Tree Topology:

- ❖ Failure of root brings communication breakup.
- ❖ The more cable required for interconnection.
- ❖ More devices are needed to interconnect topology.

5. Mesh Topology:

A topology in which all computers are connected with one another, forming a mesh (network) is called Mesh Topology. In this topology, several star topologies are connected together with linear bus topology. It is the only true point-to-point design. This design is not very practical because of its excessive waste of transmission media. This topology is difficult to install and reconfigure. Moreover, as the number of devices increase, the difficulty of installation increases geometrically.

A fully connected Mesh network has $n*(n-1)/2$ physical links between n devices. To connect these devices on the network must have $(n-1)$ input/output ports.

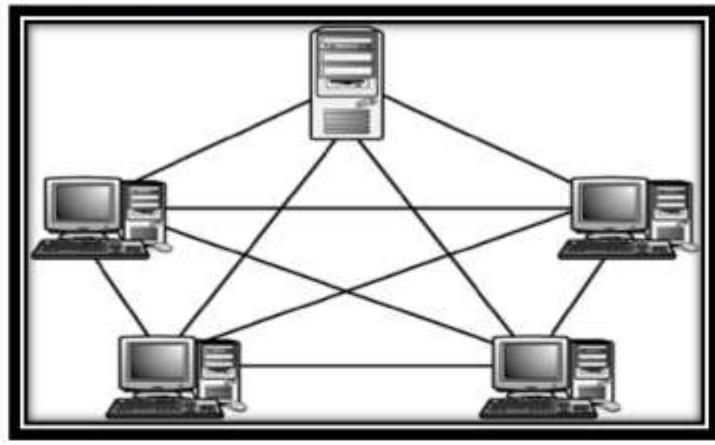


Fig: Mesh Topology

Advantages of Mesh Topology:

- ❖ Use of dedicated links eliminates traffic problems.
- ❖ Failure in one of the computer does not affect the entire network.
- ❖ Point-to-point link makes fault isolation easy.
- ❖ It is robust.
- ❖ Privacy between computers is maintained as messages travel along dedicated path.

Disadvantages of Mesh Topology:

- ❖ The length of cabling required is high.
- ❖ A large number of input/output ports are required.
- ❖ Cost of the networking is high because of cable and ports.
- ❖ Because of its complex nature, it is not popular or practical.
- ❖ It is difficult to install and reconfigure especially as the number of devices increases.

6. Cellular Topology:

Cellular Topology divides the area into cells. In wireless media, the range or geographical area of wireless device within certain boundary is called cell. Each cell represents the network area to communicate between devices. All the devices communicate via the central hub called access point. Multiple access points create a broader range of network to share among devices. This topology is applicable only in wireless devices, in case of wired medium is not accessible.

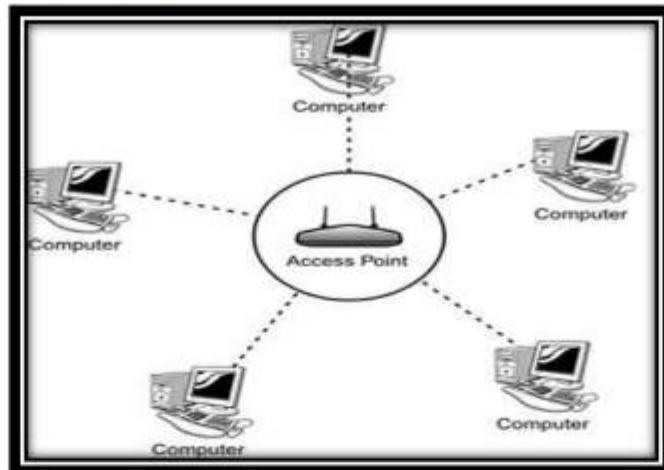


Fig: Cellular Topology

Advantages of Cellular Topology:

- ❖ Troubleshooting is easy.
- ❖ Cost is low because wire is not used.
- ❖ Good looking network topology because on wire is used.

Disadvantages of Cellular Topology:

- ❖ If Access Point (Wireless Hub) is fails all services are affected.
- ❖ Generally, the bandwidth is less than Star Topology.

Introduction of Internet:

The internet is a worldwide collection of interconnected computer networks and released devices that use standard internet protocol suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business and government networks of local and global that is linked by electronic and optical networking technologies.

The heart of the internet is backbone of high speed optical fiber connected to the major junction point all around the globe. The internet carries a vast amount of information resources and services that are inter-linked hypertext documents of the World Wide Web (WWW) and support for electronic mail via these backbones.

Today, the internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the internet uses a portion of the total resources of the currently existing public telecommunication networks.

Technically, what distinguishes the internet is its use of a set of protocols called TCP/IP (Transmission Control Protocol/Internet Protocol). For many users, electronic mail (e-mail) has practically replaced the postal services by short written transactions. Electronic

mail is the most widely used application on the internet. We can also carry on live conversations with other computer users, using Internet Relay Chat (IRC) and Voice over Internet Protocol (VoIP).

In 1990, Tim Berners Lee, contractor at the European Organization for Nuclear Research, had built all the necessary tools for working on the internet. These tools are Hyper Text Transfer Protocol (HTTP), Hyper Text Markup Language and the first web browser and web editor named World Wide Web. The first HTTP server software was known as CERN httpd. The first web server is <http://info.cern.ch/> and web pages that described the project worked by him.

Using the web, we can access to millions of pages of information. Web browsing or net surfing is accessed by a web browser with internet connection. The most popular web browsers are Microsoft Internet Explorer, Mozilla Firefox and Netscape Navigator. The appearance of a particular web site may vary slightly depending on the browser we use. Also, later versions of a particular browser are able to make efficient for browsing with animation, virtual reality, sound and music files than earlier versions.

Services Provided By the Internet:

1. On-line Communication:

The electronic mail service on the internet is extensively used today by computer users around the world of communication with each other with this facility, internet has provided to be a rapid and productive communication tool for millions of users.

2. On-line Shopping:

The internet also has facilitated the introduction of a new market concept which consists of virtual shopping. They provide information about products or services for sale through www servers. Using the internet, customers submit specific product queries and request specific sales quotes.

3. Video Conferencing:

Internet allows a group of users located around the globe to talk and interact with each other as if they were sitting and discussing in single room. The parties interacting can see each other talking on their computer screen and can hear each other's voice through a special audio device fixed in their computers.

4. Software Sharing:

The internet provides access to a large number of shareware software development tools and utilities. A few examples of such available shareware tools are compilers, code libraries, mail servers and operating systems. A collection of such shareware tools are available via FTP (File Transfer Protocol) from the internet site sunsite.unc.edu.

5. IRC:

Internet Relay Chat (IRC) the other method for internet conversation is less common than talk because someone must set up the chat before others can join in. Chat sessions allow many users to join in the same free-form conversation, usually centered on a discussion topic. When users see a topic that interests them, they type a command to join and then type another command to choose a nickname. Nicknames allow people in the session to find you in IRC networks or channels.

6. Usenet:

Usenet is the bulletin board service which provides the knowledge of more than 4000 subjects.

Advantages of Internet:

1. Communication:

One of the main goals of the internet is to connect people. With social media, emails, chats and other avenues you can instantly communicate and get to know people from all over the world. This has aided the world in beginning to bridge the culture gap that exists.

2. Information:

Anything you could ever want to know can be found on the internet, and comically simply. Search engines such as Google and Yahoo have given people the access to all of the information in the world. This is greatly beneficial for students, researchers, and anybody seeking to gain knowledge on a subject.

3. Entertainment:

Entertainment is becoming a growing focus for internet users. You can use the internet to play games, stream videos, listen to music and even read books. This may be why everyone is so glued to the screens.

4. Comfort:

The internet makes everything convenient. You can purchase just about anything and communicate with people without having to leave your bedroom.

5. New Economic Methods are Made:

Another big thing the internet has changed is business. It has become the biggest marketing tool ever. People can also make purchases on the internet meaning that anyone can be a business owner.

Disadvantages of Internet:

1. Personal Information Compromised:

Every computer on the web is connected to each other's. Some people can access to our computer to misuse our personal information. This information may be name, bank account, ATM number, credit card number, etc.

2. Pornography:

There are no limits of what can be put on the internet; it is a tool that is open to anybody and everybody. Very violent, sexually explicit, and other illegal things can be easily accessed for viewing using the internet.

3. Addiction:

Social media, online games, and other time consuming things are beginning to take over the youth. They spend more time in their virtual life than they do in their real ones.

4. Wide Spread Audience:

While this may seem like a pro to many, I consider it a major con. Things can travel astoundingly quickly on the internet. This provokes people to purposefully danger themselves or other in order to gain some viral fame.

5. Virus Threat:

Virus is nothing but a program which disrupts the normal functionality of our computer systems. Computers attached to internet are more prone to virus attacks and can crash whole hard disk, erase files and folder, and convert files to unreadable format. Some Backdoors, Trojan horse, Rabbits seem unthreatened to computer system but secretly steals information from our computer and send to other computer.

Introduction of E-mail:

Email short form of "electronic mail" is one of the most widely used features of the internet, along with the web. It allows us to send and receive messages to and from anyone with an email address, anywhere in the world.

An electronic mail message consists of two parts: the message header and the message body. The header consists those information which are needed to deliver email message from one address to others these includes email address, domain, types of email, security system implemented on email (encrypted), attached files information and one or more

recipient addresses. The body part consist the digital message delivered from source address to destination addresses these may include files attached to email and email message.

Email uses multiple protocols within the TCP/IP (Transmission Control Protocol/Internet Protocol) suite. For example, SMTP (Simple Mail Transfer Protocol) is used to send messages, while the POP (Post Office Protocol) or IMAP (Internet Mail Access Protocol) protocols are used to retrieve messages from a mail server. When we configure an email account, we must define our email address, password and the mail servers used to send and receive messages.

Fortunately most webmail services configure our account automatically, so we only need to enter our email address and password. However, if we use an email client like Microsoft Outlook or Apple mail, we may need to manually configure each account. Besides the email address and password, we may also have to enter the correct port numbers for each one.

The original email standard only supported plain text messages. Eventually, email evolved to support rich text with custom formatting. Today, email supports HTML (Hyper Text Markup Language), which allows emails to be formatted the same way as websites. HTML email messages can include images, links and CSS (Cascading Style Sheet) layouts.

We can also send files or "EMAIL ATTACHEMENTS" along with messages. Most mail servers allow sending multiple attachments with each message, but they limit the total size. In the early days of email, attachments were typically limited to one megabyte. But now many mail servers supports email attachments that are 20 megabytes in size or more.

Uses of Email:

1. Information Exchange:

Messages are sent via internet through email system. Email messages can include a wide variety of information that can be sent as attached files. Email software makes this feature quick and simple. We can send email message directly to individuals or small group of people.

2. Group Work:

Group of people can work on the same topic via email and generate one common document together. Suppose the study group has a question about the material in a class to be solved. Problem can be solved by the existence email service. Getting all the related people together will be very difficult because of the geographical regions and time. Experts can share the view and thoughts on the common matter to come in one conclusion. That will be possible because of the email service.

3. Record Keeping:

The email messages and files which are sent via internet can be saved on the mail server computer. By saving a copy of sent and receive messages we can keep track all the messages for the further use as record keeping. The number of emails saved on the email server can vary from different email service provider. These email service provider have different facilities these may be picture managing facilities, files and folders managing facilities and others.

4. Staying in Touch:

Email functions are and increasingly common way to keep track of recent developments and current trends. People are not discriminate by the cast, race or tradition. All people can share their view and feelings via common platform on the Internet i.e. email. Similarly, people are not bounded by the geographical regions. If someone has access to the internet can access the email account to stay in touch to the family and friends.

Advantages of Email:

- 
- 1. Low Cost (Cheap):** Email is cheaper than postal mail. Letters can be sent by Email for the cost of one local call.
 - 2. Speed (fast):** Email is a very fast means of communication. And Email (letter) can be sent at any part of the world within few seconds.
 - 3. Multimedia:** Besides text, Email supports pictures, sound and even video as an attachment (sound, images, video, even computer software can be sent by Email).
 - 4. Easy to use:** It is easy to send an Email. We don't have to write it many times, find and envelope, go to the corner to buy a stamp and find a mailbox (i.e. can be sent to large number of people at the same time).

Disadvantages of Email:

1. Cannot send physical things like money, book, floppy, etc.
2. Hardware requirements: We need a computer with Email facilities to send or receive the Email (can't see without computer).
3. Brings virus: data would be lost automatically (crash the computer system)
4. Sometimes the messages get lost or reach to another location. (The private information sent by the remote user gets lost).
5. Telephone line busy.

Unit V: Mastering DOS and Windows – Computer Fundamentals and Application

Introduction of Operating System:

An operating system is an essential component of a computer system. The primary objective of an operating system is to make the computer system convenient of use and to utilize computer hardware in efficient manner. An operating system is system software which may be viewed as an organized collection of software consisting of procedures to operate a computer and to provide an environment for execution of programs. Moreover, it acts as an interface between computers, users and the resources of the computer system. The resource may be hardware, software, files or folders stored in computer system.

Operating system is a large collection of software, which manages the resources of the computer system such as memory, processor, file system and input/output devices. It keeps track the status of all resources and decides which process will have control over computer resources for how long and when.

Hardware is the physical part of the computer system. Kernel is a part of operating system which directly interacts with the hardware system. The aim of the kernel is to make the rest of the operating system machine independent and hiding all the low-level details. Kernel provides mechanism for creation and deletion of processes, processor, scheduling, memory management, input/output management, synchronization of processors and interprocess communication. The UNIX operating system is based on Kernel approach. Some version of windows operating systems are also built on the Kernel based approach.

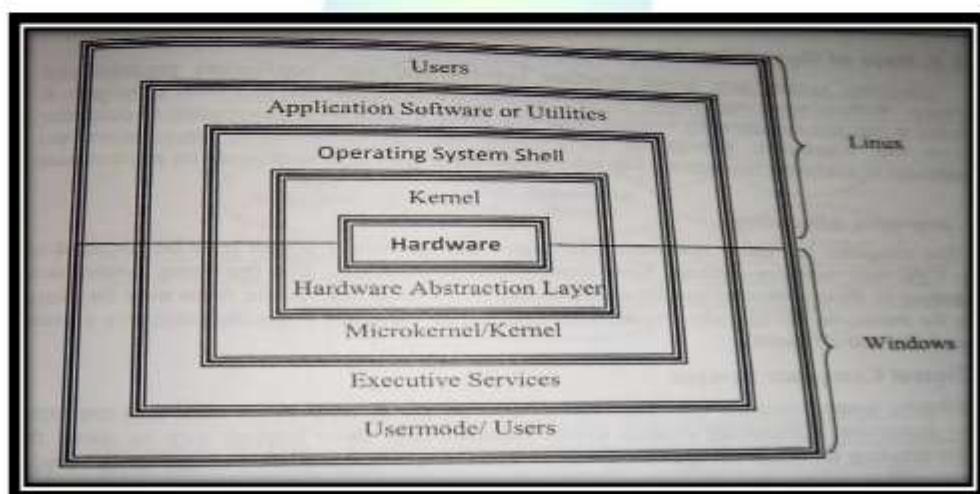


Fig: Architecture of Operating System

In a computer system, there are four main components: Hardware, Kernel, Operating System and Application Software or Utilities. The users use these components internally

through operating system and externally with the help of application software or utilities. The hardware provides basic physical computing resources. The application software or program defines the way in which these resources are used to solve the computing problems of the users. The operating system controls and coordinates the use of hardware among various system programs and application programs for various users.

Significance/Importance of an Operating System:

- ❖ Users interacts with the computer through the operating system in order to accomplish his/her task. Hence operating system called the primary interface between the users and the computer.
- ❖ Operating system provides a platform and mechanism for execution of program. Hence, it is platform provider.
- ❖ To fulfill the needs of utilizing advance technology of computer or digital devices can only manipulated through the operating system.
- ❖ Operating system helps to understand the inner functions of a computer very closely.
- ❖ It provides general concepts to use resources and interface for easy and handy interaction.
- ❖ It provides some techniques have genera applicability in other application and operating system as well.

Functions of Operating System:

1. Process Management:

Currently executing program or program segment inside a CPU "Central Processing Unit" is called the process. The CPU executes a large number of processes simultaneously. Process management main concern is the execution of user programs and system activities. These activities are called process. The process has the main five stages: New, Ready, Running, Waiting and End.

New state is the starting of any new program or applications which wants microprocessor time. Ready process is the state lined (queue) for microprocessor time. Running state indicates the job is being executing in the microprocessor. Waiting state mentions pausing of the process execution on microprocessor. End state indicates the process has no longer exists on the microprocessor for execution.

2. Memory Management:

Memory is a large collection of bytes; each byte has its own address. In simple words, memory is a space which can store data and information on computer system. Data and information can be achieved through random read or write process on specific memory address. The operating system manages all the memory devices like primary memory (RAM and ROM).

3. Storage Management:

Storage devices are also called secondary memory. Storage devices are large collection of space where all data, information and program exists. The computer system provide secondary storage device to backup data and information. Modern computer system uses magnetic disk as storage device. All programs stored on disk before loading it in memory during execution and then use the disk as source or destination after processing. Hence, the proper management of secondary storage is main importance to a computer system.

4. Input/output Management:

Input/output devices work in different speed, usage, functioning and design. Hence, operating system plays a vital role for the management of input/output devices. Operating system also manages its buffer management, queuing of jobs like printing reading, copying files one source to others. The operating system is responsible for the manipulation of input devices like keyboard, mouse, light pen, etc. and output devices like monitor, printer, plotter, etc.

5. Files and Folders Management:

A unit of information stored inside a computer is called file. Hence, a file is a collection of related information defined by its creator. Commonly, files represent programs and data. Operating system also organizes the files and folders in systematic manner. Files and folders management is one of the most visible services of operating system.

6. Protection and Security Management:

The protection is the process of securing the data and information from unauthorized users. The users may be a person, group of hackers or some types of software like viruses. The user may delete, alter or update information, which may harm the owner. For protection of data and information various mechanisms can be used to ensure that the files, memory segment and other resources operated only by those processes that have gained proper authorization from operating system.

7. Networking Management:

A collection of autonomous computer system is called computer network. Autonomous means each computer has its own local resources. These computers can communicate through any medium. The files or data sharing mechanism, network security and resources management are managed by operating system. The operating system uses protocols for the communication on the network. Such operating system which manages networking facilities is called network operating system.

8. Command Interpretation:

One of the most important functions of an operating system is its command interpretations. The command is an input signal for the computer, on the basis of this command computer produces its output. Hence, command interpretation is the primary interface between users and the rest of the system. When a new job is started, a program which reads and interprets control statements and do that job(s).

9. Virtual Memory Management:

The operating system manages the workable space by combining secondary storage device and primary memory is called virtual memory. This memory does not exist longer as the computer system is shutdown. If the computer has less amount of primary memory, which is not capable for running large sized programs. The operating system creates and manages the virtual memory to run program on it. Then virtual memory and physical memory (RAM) jointly provide for running programs.

10. Backup and Recovery:

Backup is the process of storing data and information in the drive. The drive may be internal or external devices. This process is used for protection of data and information. Recovery is the process of generating information from the stored devices. Even though, these are the most important function of operating system. Backup and recovery ensures form the loosing data and provide facilities to come back previous recovery point.

Types of Operating Systems:

1. Batch Processing Operating System:

The batch processing operating systems are capable of executing only one job at a time. The jobs or the programs submitted by different users are grouped into batches and one batch of jobs is provided as input to the computer at a time. The jobs in the batch are processed on the first-come-first-serve basis.

After getting an appropriate command from the operator, the batch processing operating system starts executing the job one-by-one. The execution of a particular job generally involves three major activities, which are reading the job from the input device, executing the job by the system and printing the calculated result on to the output device.

After the execution, one job is complete; the operating system automatically fetches the next job from the batch without any human intervention.

2. Multitasking/multiprogramming Operating System:

Any operating system which supports two or more active task or running programs (music, do work on office, create presentation, etc.) simultaneously is called multitasking operating system. The number of tasks or processes that can be processed simultaneously in these types of operating system depends upon various factors, such as the speed of the CPU, the capacity of the memory, and the size of the programs.

These types of operating system are also called multiprogramming/multiprocessing operating systems. Multitasking Operating System is divided into two types: Preemptive multitasking operating system. UNIX, LINUX, Windows 2000, Windows XP, etc. are some example of Multitasking Operating System.

3. Time Sharing Operating System:

Time Sharing Operating System is a kind of multiprogramming operating system, which operates in an interactive mode with quick response time. The user request to the computer and get response on the user terminal. Hence this operating system is also called Online Operating System.

A time sharing operating system allows many users to share the computer resources simultaneously. Since, each action or command in a time sharing operating system takes a very small fraction of time, only a little CPU time is needed for each user to share computer's resources. CP/CMS is the example of time sharing operating system.

4. Real Time Operating System:

The Real Time Operating systems are similar to multitasking operating systems in their functioning. However, these operating systems are specially designed and developed for handling real time applications or embedded applications. The real time applications are those applications that are required to be executed within a specific period of time. Therefore, time is the major constraint for these applications.

The real time operating systems can be of two different types: hard real time operating system and soft real time operating system. In the hard time operating system, it is necessary to perform a task in the specified amount of time. In the soft real time operating system, a task can be performed even after its allocated time has elapsed. Industrial robots, spacecraft, industrial control applications and scientific research equipment are some example of real time operating system.

5. Multiprocessing Operating System:

Any Operating System which is capable of handling more than one processor and its resources efficiently is called multiprocessing operating system. The multiprocessor operating system allows the use of multiple CPUs in a computer system for executing multiple processes at the same time.

By using more than one CPU, the processes are executed in a faster manner as compared to the computer systems performing multiprocessing with a single CPU. Windows 7 with dual-core is an example of multiprocessing operating system.

6. Single Processing Operating System:

These types of Operating Systems are capable of handling only one process at a time. Since, the system has limited resources for the execution of instructions, these instructions uses the resources by sharing their time and space. For this purpose different types of interrupts are used.

Though, the process sharing the resources at the time of execution, it doesn't seem like as single processing operating system. Such, types of Operating Systems can be of two types. Those are: single processing single tasking operating system like DOS and single processing multi-tasking operating system like Windows XP.

7. Distributed Operating System:

It manages a group of independent computer and makes them appear to be a single computer. The networked computers that could be linked and communicated gave raise to distributed computing. These operating systems are mostly used on servers that share the resources of different systems to act as single computer.

8. Single user Operating System:

The Operating System which allows exactly one user at a time to operate the computer system at a time is called single user operating system. This types of operating system is designed to fulfill the requirements of one user mostly used in personal computer, PDA, and others mobile computing.

The single user operating systems are of two types: An operating system that allows a single user to perform just one task at a time like MS-DOS is called single user single tasking operating system. Again, if one operating system that allows single user to perform two or more tasks at a time like Windows XP, vista, Windows 7, etc. are called single user multitasking operating system.

9. Multiuser Operating System:

An operating system that allows multiple users to use one single computer resources simultaneously on a single network server is called multiuser operating system. Multiuser operating system is based on terminal server (which serves along the network) and terminal client (which request the resources).

In multiuser operating system environment, all or most of the computing occurs at the server whereas client terminal provides interface for connecting users to the server and

mechanism for forwarding and displaying user request. UNIX, LINUX, VMS, and MVS are some example of multiuser operating system.

10. Embedded Operating System:

The embedded operating systems are some-what similar to real-time operating systems. The embedded operating system is installed on an embedded computer system, which is primarily used for performing computational tasks in electronic devices.

These operating systems provide limited functionality that is required for the corresponding embedded computer system. The other common functions that a usual operating system supports are not found in these operating systems. Palm operating systems, Windows CE are some example of embedded operating system.

Operating System On The Basis Of User Interface:

1. Character User Interface/ Textual User Interface:

If the primary method of communication with the computer system is command or text based system then this type of operating system is called Character User Interface/ Textual User Interface. The user has to learn a large set of commands to run program, application and manipulation of other resources.

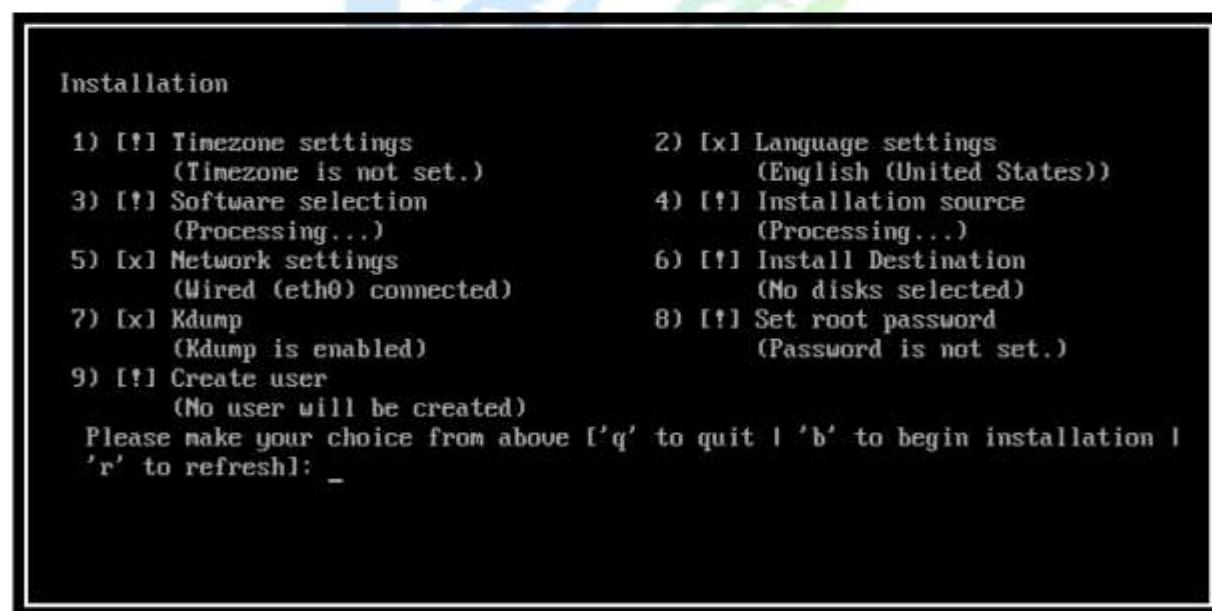


Fig: A Red Hat Linux based CUI

The output is also displayed in character or text form. The users cannot view any graphics, pointing device like mouse and icons facilities are not available. It is extremely difficult and boring for the general users to work in "CUI" based operating system. DOS, UNIX, LINUX are some example of CUI based operating system.

Advantages Of CUI Based Operating System:

- ❖ It is efficient in program execution than GUI based operating system.
- ❖ Faster in execution. Hence, it is used in mission critical server system.
- ❖ Burden for CPU is less because it executes commands only not graphics.
- ❖ CUI based operating system can run on simple configuration or old computer too.
- ❖ CUI based operating system are cheap or available free on the web.

Disadvantages Of CUI Based Operating System:

- ❖ It is difficult to use for general users because number of commands should be memorized.
- ❖ Pointing device cannot be used for selection and manipulation of commands.
- ❖ Absent of pleasant looks and feel, it simply display black or white background and text on it.

2. Graphical User Interface:

A visual computing environment that represents programs, files and options with graphical images such as icons, menus, and dialog boxes on the screen is called Graphical User Interface. A small image displayed on the screen to represent an object that can be manipulated by the user is called an icon.

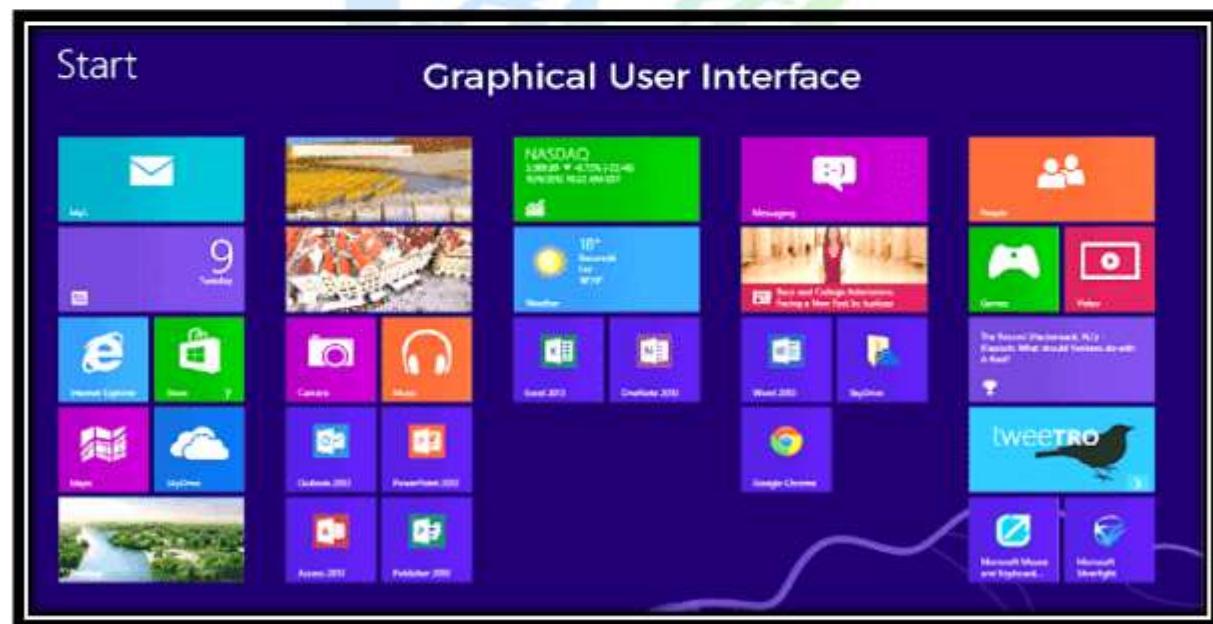


Fig: Windows based GUI

User can select and activate these options by pointing and clicking with the mouse or by keyboard. GUI provides a framework to use scroll bar, pointing arrow for mouse, select criteria by highlighting on it to handle user's action. Because of the user friendliness, it is popular among computer users. Mac Operating System, MS-Windows (2003 server, XP, vista, 7, etc.) are some example of GUI Operating System.

Advantages Of GUI Based Operating System:

- ❖ It is easy to use. Hence, it is built for general users to the advance user.
- ❖ User can be easily familiar with this operating system and can run simple programs with some mouse clicking.
- ❖ Every programs and files, data and information or icons and metaphors are represents in terms of graphical images, icons or images hence identification is easy.
- ❖ It is broadly used personal operating system because of user friendliness.

Disadvantages Of GUI Based Operating Systems:

- ❖ It is slower than GUI based operating system because of graphics.
- ❖ It cannot run on old computer system, it has hardware and software compatibility.
- ❖ Most of the GUI based operating systems are expensive; users have to pay for license or to buy it.

Differentiate between GUI "Graphical User Interface" and CUI/TUI "Character User Interface/Textual User Interface:

| Graphical User Interface | Character User Interface |
|---|--|
| GUI takes instruction by using some menu command and graphical icon, etc. | TUI takes instruction by keyboard using some textual commands. |
| GUI has graphical icons so users haven't to memorize all commands. | CUI has initial text command for every operation. So, users have to memorize all commands. |
| Pull down menu is available in GUI. | Pull down menu is not available in CUI. |
| Icons are available in GUI. | Icons are not available in CUI. |
| Multimedia is functional in GUI. | Multimedia is not functional in CUI. |
| GUI depends on graphical icons and menus. | CUI depends on text. |
| In GUI use of mouse is possible. | In CUI use of mouse is not possible. |
| GUI is user's friendly because it is easy to handle. | CUI is not user's friendly because it is complex to handle. |
| Networking/internet is functional in GUI. | Networking/internet is not functional in CUI. |
| Windows 98/ME/XP/VISTA/7 etc. are some example of GUI. | MS-DOS, UNIX, etc. are some example of CUI. |

Booting System And Its Types:

When we start our computer then there is an operation which is performed automatically by the computer which is called booting. In the booting, system will check all the

hardware and software those are installed or attached with the system and this will also load all the files those are needed for running a system.

In the booting process all the files those are stored into the ROM chip will also be loaded for running the systems. In the booting process the system will read all the information from the files those are stored into the ROM chip. After booting, the system will automatically display all the information which is stored inside the ROM. The instructions those are necessary to start the system will be read at the time of booting.

Types of Booting:

1. Warm Booting:

A warm boot is also called a soft boot. It is a process of restarting a computer without actually turning the computer off. It is usually performed when there is a problem such as a frozen computer program or a web page is not responding. Warm boot erase everything in the RAM then restart the computer while it is still turned on.

There are a couple of different ways to perform a warm boot. Firstly we can restart the computer by choosing restart option from shut down menu, which will restart in the initial state it was in.

Next we can do is by pressing **CTRL +ALT+DEL** simultaneously. This will open task manager and by clicking on "application" tab we can end the program that is causing the computer to freeze up.

2. Cold Booting:

A cold boot is also called a hard boot. It is a process of starting up a computer that is turned off completely. It is often used in contrast to a warm boot, which refers to restarting a computer once it has been turned on. A cold boot is typically performed by pressing the power on the computer system.

While a warm boot and cold boot are similar, a cold boot performs a more complete reset of the system than a warm boot. Therefore, if we are troubleshooting our computer, we may be asked to turn off our computer completely and perform a cold boot. This make sure all temporary data is wiped form our system, which may help to eliminate issues affecting our computer.

MS-DOS "Microsoft-Disk Operating System":

MS-DOS was developed and introduced by Microsoft in 1980 A.D. It is a single user and single tasking operating system developed computer. MS-DOS was specifically designed for the family of Intel 8086 microprocessor. This operating system provides a command line user interface, which means that a user needs to type a command at the command

line for performing a specific task. The CLI "Command Line Interface" of MS-DOS is more commonly known as DOS prompt. The user interface of MS-DOS is very simple to use but not very user-friendly because of its non-graphical nature. The user has to issue a command to carry out even a simple task. DOS was used in two versions: Microsoft version called MS-DOS and IBM version called PC-DOS.

Some of the system files, which are used in MS-DOS for the manipulation of computer resources, are as follows:

1. IO.SYS:

It is an important hidden and read only system file of MS-DOS that is used to start the computer system. It is also responsible for the efficient management and allocation of the hardware resources through the use of appropriate device drivers.

2. MSDOS.SYS:

It is another hidden and read only system file that is executed immediately after the execution of IO.SYS file is finished. MS-DOS.SYS acts as the kernel of MS-DOS. It is responsible for managing the memory, processors and the input/output devices of the computer system.

3. CONFIG.SYS:

It is a system file that is used to configure various hardware components of the computer system so that they can be used by the various applications.

4. COMMAND.COM:

It is the command interpreter that is used to read and interpret the various commands issued by the users. It is responsible for setting up the system by running the AUTOEXEC.BAT configuration file and being the ancestors of all processes.

5. AUTOEXEC.BAT:

It is a batch file consisting of a list of commands that is executed automatically as the computer system starts up. It is most often used to set environment variables such as keyboard, sound card, printer and temporary file locations.

Some of the Common Problems of MS-DOS:

- ❖ It supports only one user and one program at a time.
- ❖ It cannot support GUI and other pointing devices.
- ❖ It can handle less amount of memory (only 655360 bytes, type memo on DOS).
- ❖ Largest executable program size will be less than 619 Kilobytes.
- ❖ It supports only 16 bits programs.
- ❖ It cannot take advantages of modern 32 bits or 64 bits processors and multi-core processors.

Internal DOS Commands:

1. MD (Making Directory):

It is used to make or create directory.

Syntax: MD <directory.name> ↴

Example: C :\> MD Pokhara ↴

Example: C :\> MD D:\ Pokhara ↴

2. RD (Removing Directory):

It is used to remove a directory that is empty.

Syntax: RD <directory.name> ↴

Example: C :\> RD Pokhara ↴

3. CD (Changing Directory):

It is used to change the current directory/path.

Syntax: CD <path_name> ↴

Example: C :\> CD D :\Songs ↴ ⇒ D:\songs>

- ❖ CD...

To change the current directory path to one level up.

Example: D:\songs> CD... ↴ ⇒ D :\>

- ❖ CD/

It is used to set current directory path to the current disk drive.

Example: D:\songs\nepali\old\>CD/\> ⇒ D:\

4. DIR (Directories):

It is used to view the list of directories or files.

Syntax: DIR ↴

Example: C:\> DIR ↴

- ❖ /W: wide format with details
- ❖ /P: page wise listing
- ❖ /S: to display system files.

5. Date:

It is used to display the current date and prompt to change the current date.

Syntax: Date ↴

Example: C :\> Date ↴

6. Time:

It is used to change the current time.

Syntax: Time ↴

Example: C :\> Time ↴

7. Vol:

It is used to display the serial/volume of drive.

Syntax: Vol ↴

Example: C:\> Vol ↴

8. VER:

It is used to display the version of DOS.

Syntax: VER ↴

Example: C :\> VER ↴

9. ATTRIB:

It is used to change the attributes of files and folders. Attributes use different parameters to assign or revoke the attribute of files and folders. The parameters are:

- ❖ R: (read only):
To make files read only.
- ❖ H: (hidden):
To make the files hidden or not.
- ❖ S: (system files):
To apply the files as system files or to handle system files.
- ❖ "+" symbol is for assigning the attributes.
- ❖ "-" symbol is for revoking the attributes.

Syntax: Attrib<space> +/ - r, +/ - h, +/ - s <space> <file.name> or <directory.name> ↴

Example: C :\> attrib<space> +h <space> maya.mp3 ↴

10. REN (Rename):

It is used to rename files or directories.

Syntax: REN<space> <old.name><space> <new.name> ↴

Example: C:\> REN <space> Pokhara <space> Kathmandu ↴

11. Copy:

It is used to copy file from one location to another.

Syntax: Copy <source_file> <destination_file> ↴

Example: C :\> Copy D:\maya.mp3 C:\ ↴

12. DEL (Delete):

It is used to delete file.

Syntax: DEL<space> <file_name> ↴

Example: C:\> DEL<space> D:\maya.mp3 ↴

13. Move:

It is used to move a file from one location to another.

Syntax: move <source_file> <destination_location> ↴

Example: C :\> Move D:\ maya.mp3 C:\ ↴

14. COPY CON:

It is used to create a new file with content. To save the file we use Ctrl+z or F6.

Syntax: COPY CON <file_name> ↴ Content Ctrl+z ↴

Example: C :\> COPY CON Pokhara.txt ↴

This is one of the tourism spot place.

Ctrl + Z ↴

15. Type:

To view the content of a text file.

Syntax: Type<space> <file_name> ↴

Example: C:\> Type<space> Pokhara.txt ↴

External DOS commands:

1. CHKDSK (Check Disk):

It is used to check the disk sectors for errors and tries to fix those errors by using "/f".

Syntax: CHKDSK<space> /f <space> <drive_name> ↴

Example: C :\> CHKDSK <space> /f <space> D:\ ↴

2. Edit:

It helps to edit the content of a file.

Syntax: Edit <space> <file_name> ↴

This command has blue background with white text. It also has the menu.

Example: C :\> Edit <space> Pokhara.txt ↴

3. DELTREE:

It deletes all the files and directories inside the given path recursively. This command is not found in windows 7 and above.

Syntax: DELTREE <space> <file_name/directory_name> ↴

Example: C :\> DELTREE <space> D:\songs\nepali\old ↴

4. XCOPY:

It copies all the files and folders from one location to another.

Syntax: XCOPY <space> <source_path> <space> <destination_path> ↴

Example: C :\> XCOPY <space> D:** C\ ↴
** ⇒ any file with any extension
*txt ⇒ any filename with text extension
text * ⇒ text filename with any extension.

5. FORMAT:

It helps to format the drive while formatting "/s" is used to copy system files to the drive.

Syntax: FORMAT<space> <drive> ↴
Example: C :\> FORMAT <space> D: ↴

6. Tree:

It displays directories and its subdirectories structures and its relation with previous and next directories.

Syntax: Tree ↴
Example: C :\> tree ↴

7. SCANDISK:

It checks the status of disk drive and fixes the errors if it finds it.

Syntax: SCANDISK ↴
Example: C :\> SCANDISK ↴

8. Label:

It is used to create, rename or delete a name of disk drive.

Syntax: label <drive_name> ↴
Example: C :\> label D: Pokhara, rename D: Kathmandu ↴

Windows Operating System:

Microsoft Windows, usually known as Windows or Windows OS, is a personal computer operating system (OS) developed by Microsoft Corporation (PCs). The Windows operating system, which included the first graphical user interface (GUI) for IBM-compatible PCs, quickly dominated the PC industry. Windows is installed on around 90% of personal computers.

The original version of Windows, introduced in 1985, was only a graphical user interface (GUI) added to Microsoft's existing disk operating system, MS-DOS. Windows for the first time allowed DOS users to visually navigate a virtual desktop, opening graphical "windows" displaying the contents of electronic folders and files with the click of a mouse button, rather than typing commands and directory paths at a text prompt, based in part on licensed concepts used by Apple Inc. for its Macintosh System Software.

Later versions included more features, such as native Windows File Manager, Program Manager, and Print Manager applications, as well as a more dynamic user interface. Microsoft also created specific Windows products for enterprises, such as networkable Windows for Workgroups and high-powered Windows NT. Windows 95, released in

1995 as a consumer product, combined Windows and DOS and had built-in Internet capability, including the World Wide Web browser Internet Explorer.

Microsoft unified its numerous Windows products under a single umbrella with the release of Windows XP in 2001, offering multiple editions for consumers, corporations, multimedia developers, and others. Windows XP replaced the long-used Windows 95 kernel (core software code) with a more powerful code base, enhanced program and memory management, and a more user-friendly interface. In late 2006, the very popular XP standard was followed by Windows Vista, which had a rocky launch and faced significant market opposition, soon earning a reputation for being a huge, sluggish, and resource-intensive system. In response to Vista's low adoption rate, Microsoft produced Windows 7, an operating system with a similar interface to Vista that was praised for its substantial performance improvements and low system requirements.

In 2012, Microsoft released Windows 8, which included a start screen that displayed apps as tiles on a grid and the ability to synchronize settings so that users could log on to another Windows 8 system and utilize their chosen settings. Microsoft unveiled Windows 10 in 2015, which included Cortana, a digital personal assistant similar to Apple's Siri, as well as Microsoft Edge, a web browser that replaced Internet Explorer. Microsoft also stated that Windows 10 would be the final version of Windows, implying that customers would continue to get frequent updates but that no major changes would be made.

Main Features of Microsoft Windows:

1. Common Look and Feel:

All the windows application has the same basic looks. Once we learn one windows application, it is easy to use or learn other one.

2. Multitasking:

Windows provide multitasking environment for the execution of more than one program at a time.

3. Device Independent:

Windows represent a device independent interface to applications. Windows application is not bound to the underlying hardware such as mouse, pen drive, keyboard, monitor and some printers, windows API (Application Program Interface) manipulate, recognize and make them plug and play devices.

4. Data sharing:

Windows allow data transfer between applications and various users on the network.

5. Memory Management:

Windows provides memory management to break the limitation of RAM 640 KB of MS-DOS. An application has the ability to use the extended memory, share data segments with other applications and swap unwanted segments to disk.

6. Supports For Existing DOS Application:

Windows allow most standard DOS application to run under window directly.

7. Support for Object Orientation:

Windows support the concept of object orientation. If every visible portions are treated as the individual object then this concept is called the object oriented concept. Any object has its own features, attributes and functions. For example, one window can be resized, minimizes and close, these are its attributes. It holds some data and information, path for other folders that is its functions.

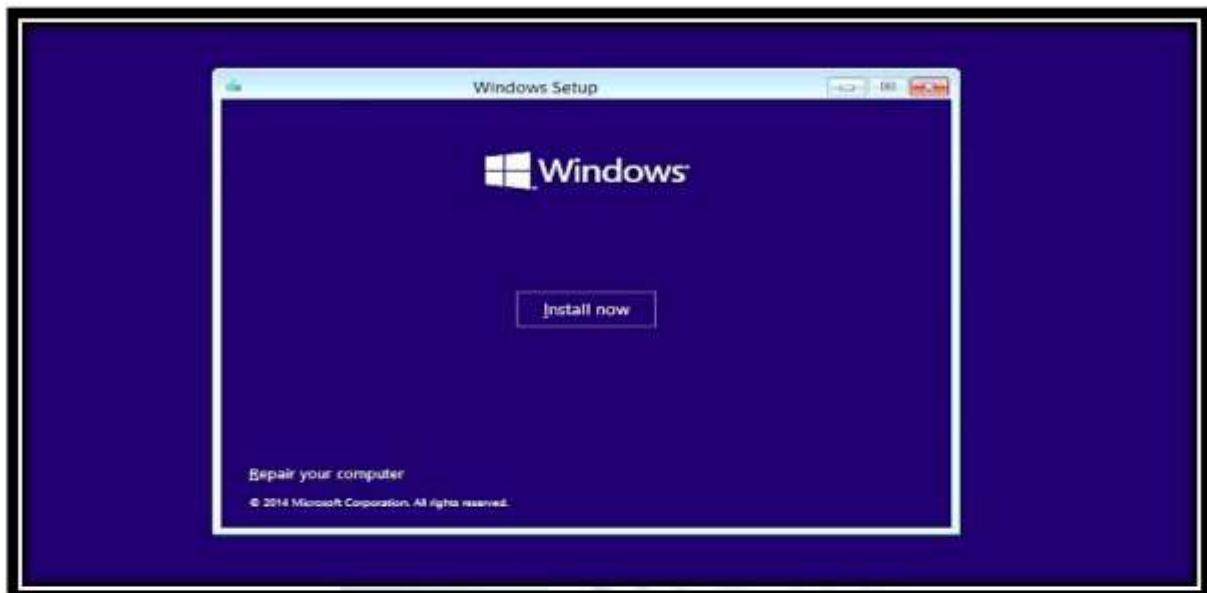
How to Install Windows 10 Using Bootable USB?

1. Plug your USB device into your computer's USB port, and start up the computer. You may be asked to press a key to boot from the USB.
2. Choose your preferred **language, time zone, currency, and keyboard settings**. Once you're happy with customizing these settings, click **Next**. (Note that these settings can be changed in the future after the Windows 10 installation is complete.).

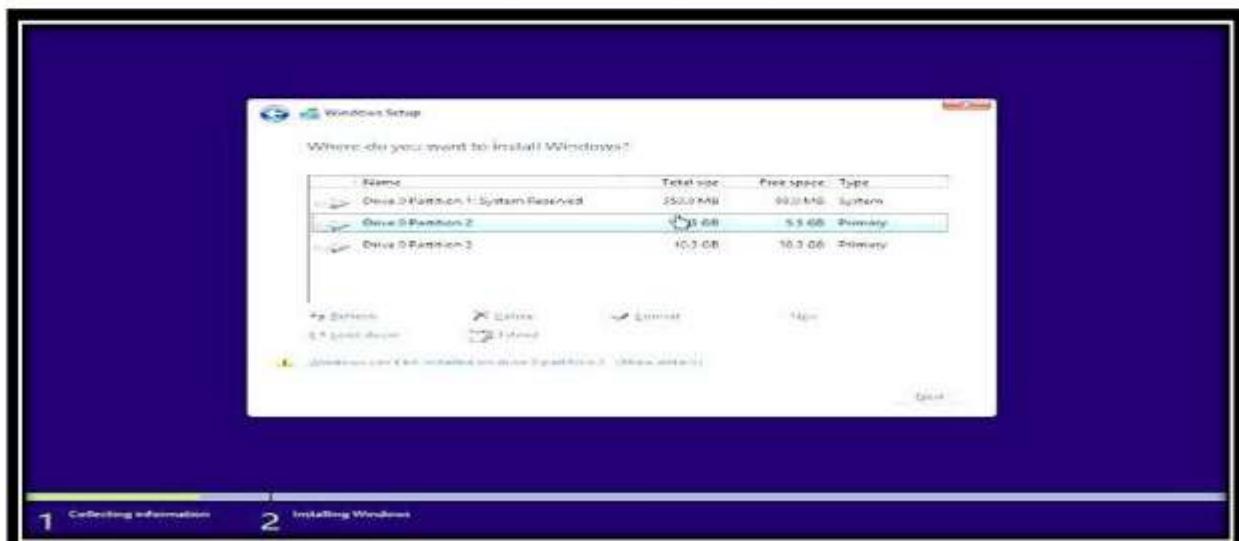


3. Click **Install Now** and select the Windows 10 edition you've purchased. Now click **Next** to start the installation process.

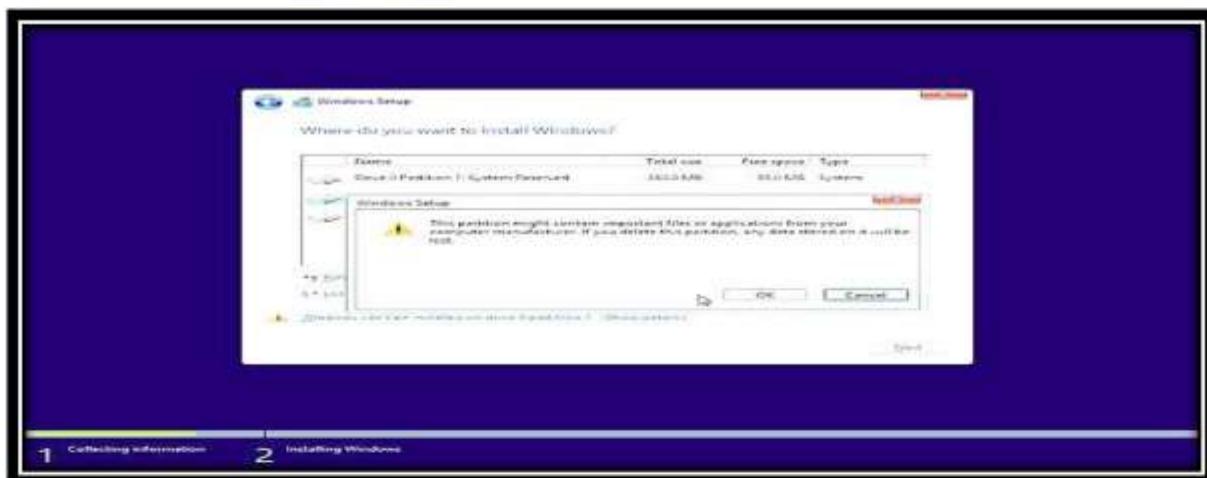
4. Choose your installation type. You can either choose **Upgrade**, which will allow keeping your current files, settings, and apps; or do a fresh clean installation by picking **Custom**. In this example, we'll be choosing custom to do a fresh Windows installation.



5. To install Windows, you need a partition on your hard drive for storing system files; this will become the main C: drive. You can either pick an existing partition or format it, or you can delete everything and create new partitions.
 - ❖ Note: If you haven't yet backed up your hard drive, you may want to stop now, back everything up, and start over. Once you've deleted a partition, you won't be able to recover the data previously stored on it. You can either use one of the existing partitions on your hard drive by formatting it or you can delete the ones there and create new ones from scratch instead:
 - ❖ To use one of the existing partitions, select it, and click **Format**.

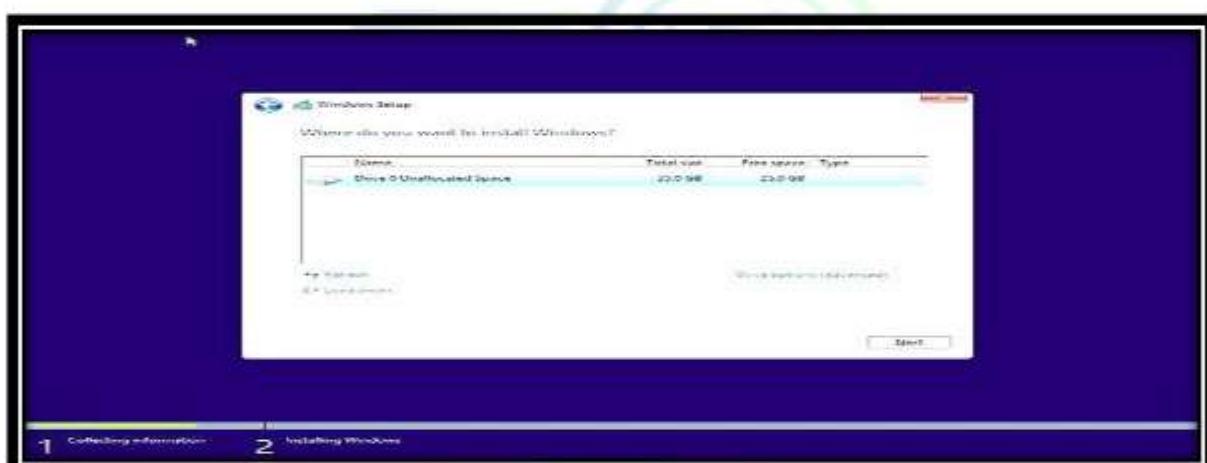


- ❖ To **delete** the existing partitions, select each one and click **Delete**, then **OK**.

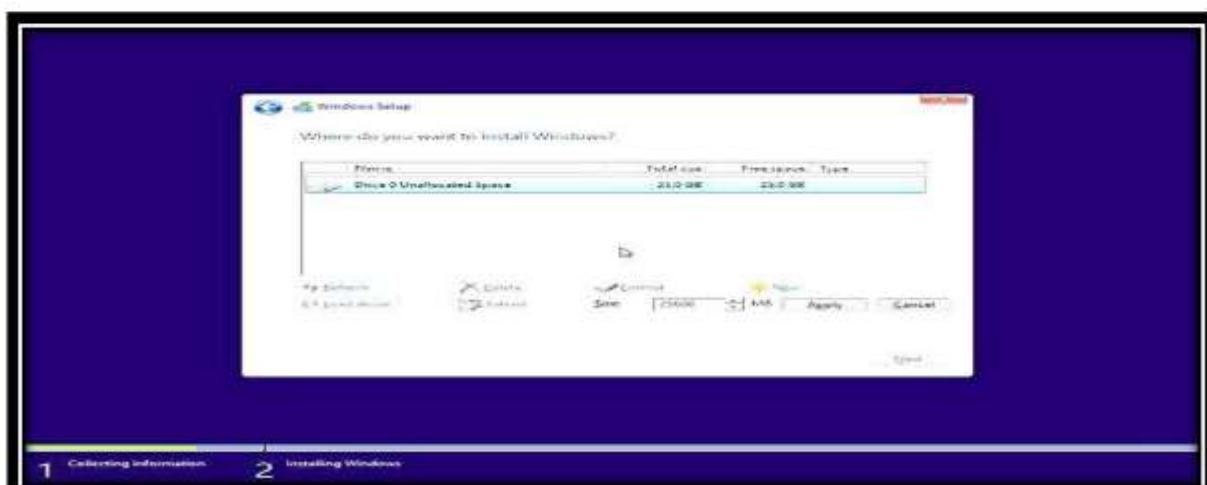


6. If you've deleted all the existing partitions, your hard drive's space will be unallocated, and you'll need to create new partitions. If you just formatted an existing partition, then skip to Step 7 now. **To** create new partitions:

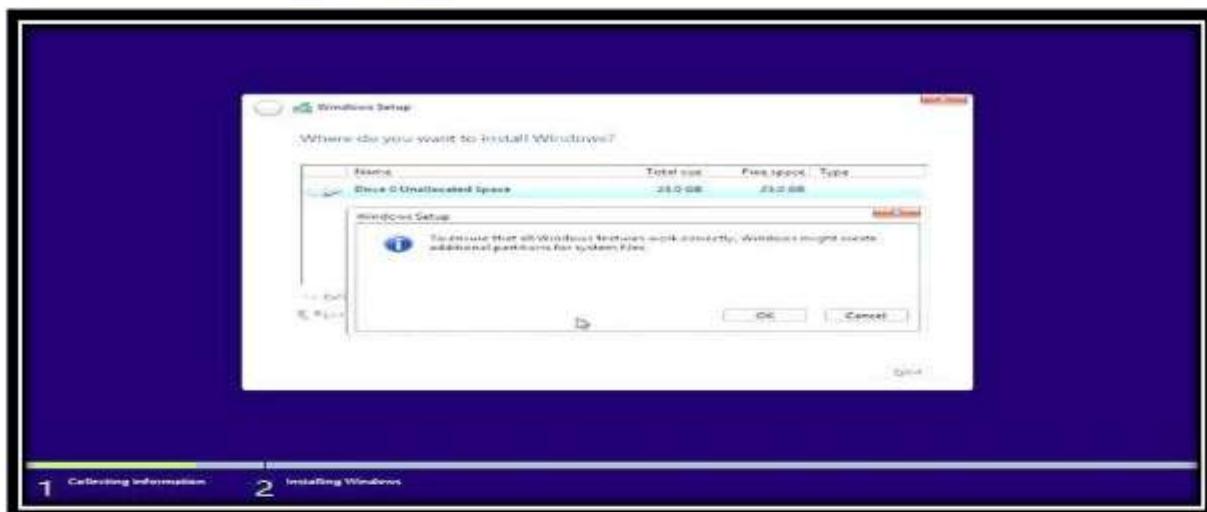
❖ **Click Drive options (advanced).**



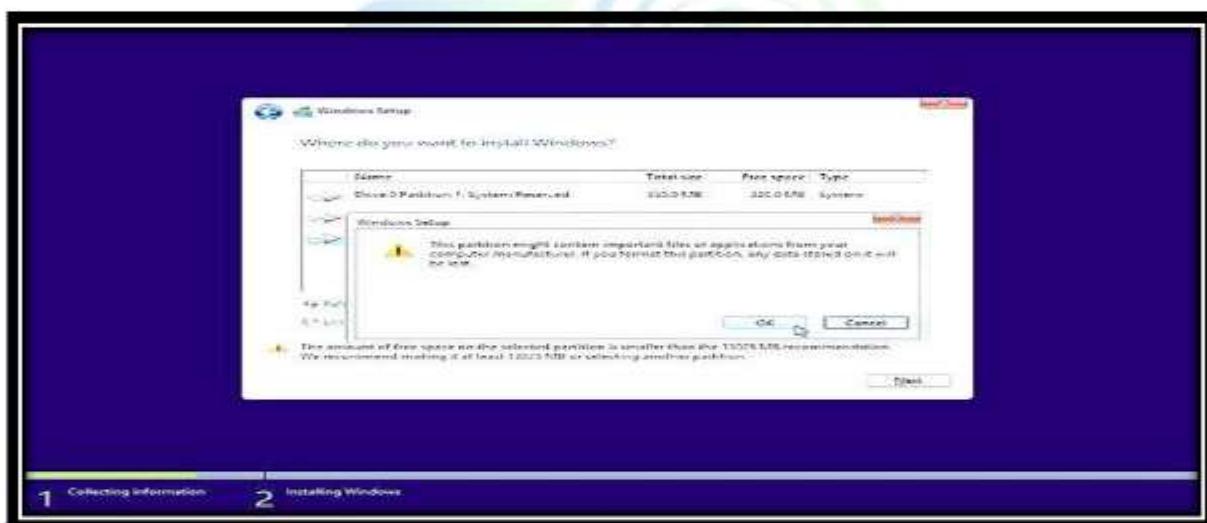
❖ Now click **New** and choose the size for your new partition, then click **Next**.



❖ **Windows** will now create a new partition for storing system files. Click **OK** to accept.



- ❖ Repeat this process if you wish to create more partitions. Once you've finished creating all the partitions you want, format each one except for the partition you want to store your Windows system files on. Select the partitions one by one and click **Format**, then **OK** when prompted.



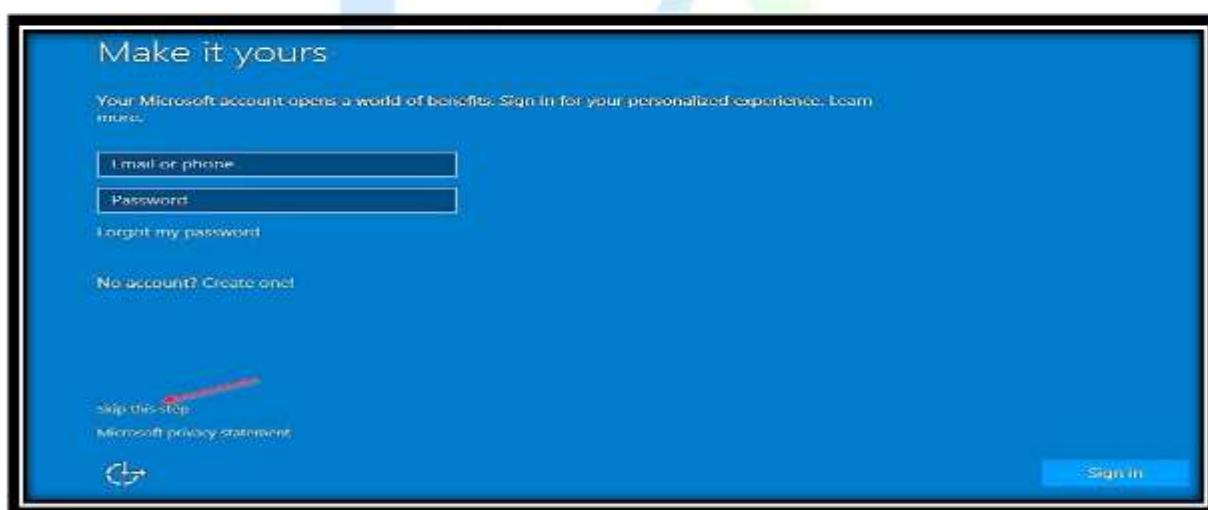
7. Now select the partition where you want to install Windows and click **Next**. The Windows 10 installation will begin. Your computer may reboot a few times during the process. This is normal.



8. After the installation is complete, your computer will automatically restart one last time. When it starts up again for the first time, you'll be able to choose more of your settings, or you use express settings recommended by Microsoft.



9. Finally, sign in to your Microsoft account to use some of the new features with Windows 10 such as password recovery, and to access One Drive. If you don't want to sign in with your Microsoft account, click **Skip this step** and follow the instructions to create a local user account instead.



Software Tools and Application:

Disk Defragmentation:

The process of consolidating fragmented files on a user's hard disk is known as defragmentation. When data is written to disk, it fragments because there isn't enough contiguous space to contain the entire file. Data is broken up by storage algorithms so that it can fit into the available space. Defragmentation is the process of moving data blocks on a hard disk around in order to bring all of the elements of a file together. Defragmentation minimizes file system fragmentation, which improves data retrieval

efficiency and hence the computer's overall performance. At the same time, it cleans the storage and adds more space. Defragmentation is the opposite of fragmentation, which is an inefficient use of computer storage.

ScanDisk:

ScanDisk was initially bought by Microsoft from Symantec (formerly known as Norton). ScanDisk was bundled for use with Microsoft's DOS and Windows systems at the time. Because ScanDisk cannot examine new technology file system (NTFS) disk drives, which have become more widespread in computer systems running post ME versions of Windows, it is no longer included. CHDKSK, ScanDisk's close relative with identical features and the ability to scan NTFS drives, is still in use and has been included with every version of Windows to date (Windows 8).

When you reboot a machine that hasn't been properly shut down, or if the Power On Self-Test identifies initial disk errors, ScanDisk is immediately launched (POST).

System Restore:

System Restore is a Microsoft® Windows® utility for safeguarding and repairing computer software. System Restore creates Restore Points by taking a "snapshot" of some system files and the Windows registry. When a system fails to install or data is corrupted, System Restore can restore it to working order without having to rebuild the operating system. It restores the Windows environment by restoring the data and settings that were previously stored in a restore point.

Disk Partition:

A partition is a logical separation of a hard drive in personal computers. This is usually done so that a user can run a different operating system on the same hard drive, or to give the impression that the hard drive is distinct. It might be advantageous to have the appearance of a separate hard drive for file management or several users on the same machine. When a user formats a hard disk, partitions are generated; these partitions are commonly referred to as the C: drive, A: drive, and so on. Typically, they are used for diskette drives.

Unit VI: Computer Hardware – Computer Fundamentals and Application

Introduction to Computer Hardware:

Computer hardware refers to all of the physical components of a computer, whether it's analog or digital. Hardware refers to the actual components of a computer as opposed to software, which is made up of written, machine-readable instructions or programs that tell physical components what to do and when to do it.

Hardware and software are mutually beneficial. Only when both hardware and software work together properly can a computer device function effectively and create valuable results.

Computer hardware is divided into two types: internal and exterior components. Internal hardware components are those that are required for the computer's proper operation, whereas external hardware components are those that are added to the computer to add or expand functionality.

Internal Computer Hardware Components:

Internal components collectively process or store the instructions delivered by the program or operating system (OS). These include the following:

- 1. Motherboard:** This is a printed circuit board that holds the central processing unit (CPU) and other essential internal hardware and functions as the central hub that all other hardware components run through.
- 2. CPU:** The CPU is the brain of the computer that processes and executes digital instructions from various programs; its clock speed determines the computer's performance and efficiency in processing data.
- 3. RAM:** RAM or dynamic RAM is temporary memory storage that makes information immediately accessible to programs; RAM is volatile memory, so stored data is cleared when the computer powers off.
- 4. Hard Drive:** Hard disk drives are physical storage devices that store both permanent and temporary data in different formats, including programs, OSes, device files, photos, etc.
- 5. Solid-State Drive (SSD):** SSDs are solid-state storage devices based on NAND flash memory technology; SSDs are non-volatile, so they can safely store data even when the computer is powered down.

6. **Optical Drive:** Optical drives typically reside in an on-device drive bay; they enable the computer to read and interact with nonmagnetic external media, such as compact disc read-only memory or digital video discs.
7. **Heat Sink:** This is a passive piece of hardware that draws heat away from components to regulate/reduce their temperature to help ensure they continue to function properly. Typically, a heat sink is installed directly atop the CPU, which produces the most heat among internal components.
8. **Graphics Processing Unit:** This chip-based device processes graphical data and often functions as an extension to the main CPU.
9. **Network interface card (NIC):** A NIC is a circuit board or chip that enables the computer to connect to a network; also known as a *network adapter* or *local area network adapter*, it typically supports connection to an Ethernet network.

Other computing components, such as USB ports, power supplies, transistors and chips, are also types of internal hardware.

External Hardware Components:

External hardware components, also called *peripheral components*, are those items that are often externally connected to the computer to control either input or output functions. These hardware devices are designed to either provide instructions to the software (input) or render results from its execution (output). Common input hardware components include the following:

1. **Mouse:** A mouse is a hand-held pointing device that moves a cursor around a computer screen and enables interaction with objects on the screen. It may be wired or wireless.
2. **Keyboard:** A keyboard is an input device featuring a standard QWERTY keyset that enables users to input text, numbers or special characters.
3. **Microphone:** A microphone is a device that translates sound waves into electrical signals and supports computer-based audio communications.
4. **Camera:** A camera captures visual images and streams them to the computer or through a computer to a network device.
5. **Touchpad:** A touchpad is an input device, external or built into a laptop, used to control the pointer on a display screen. It is typically an alternative to an external mouse.
6. **USB Flash Drive:** A USB flash drive is an external, removable storage device that uses flash memory and interfaces with a computer through a USB port.
7. **Memory Card:** A memory card is a type of portable external storage media, such as a CompactFlash card, used to store media or data files.

Other input hardware components include joysticks, styluses and scanners.

Examples of output hardware components include the following:

- 1. Monitor:** A monitor is an output device similar to a TV screen that displays information, documents or images generated by the computing device.
- 2. Printer:** Printers render electronic data from a computer into printed material.
- 3. Speaker:** A speaker is an external audio output device that connects to a computer to generate a sound output.
- 4. Headphones, Earphones, Earbuds:** Similar to speakers, these devices provide audio output that's audible only to a single listener.

Power Supply:

A Power Supply Unit (PSU) converts mains Alternating Current (AC) to low voltage Direct Current (DC) power for the internal components of the computer. Modern personal computers universally use a switched mode power supply. Some power supplies have a manual selector for input voltage, while others automatically adapt to the supply voltage.

Supplies power throughout the computer. Power supplies converts potentially adapt lethal 110-115 or 220-230 volt Alternating Current (AC) into a steady low voltage Direct Current (DC) usable by the computer. A power supply is rated by the number of watts it generates.

Types of Power Supply:

There are two types of Power Supply. They are explained below:

1. AT (Advanced Technology):

AT uses the P8 and P9 as the main connectors where it connects to the AT socket of the motherboard. When installing P8/P9 black wires which represent ground face each other and chips face out.

2. ATX (Advanced Technology Extended):

ATX has a special power soft switch that can enable the PC to go into suspend or sleep mode.

Power Rating:

As all of the rails come from one transformer and primary-side switching components, there is an overall maximum power limit. Power requirement for a modern desktop personal computer may range from 300 watt to more than 1000 watts for a file server or a computer with multiprocessors.

The power rating of a PC power is rated by the manufacturer. Simple, general purpose computers rarely require more than 300-350 watts maximum. It is possible to overload voltage form a power supply well below the total rating of the power supply. For example, most PSU's (Power Supply Unit) create their 3.3V output by regulating down their 5V rail. As such, 3.3V and 5V typically have a combined limit as well.

A 3.3V rail may have a 10 a rating by itself (33 W), and the 5V rail may have a 20 a rating (100 W) by itself, but the two together may only be able to output 110 W. In this case, loading the 3.3 V rail to maximum (33 W), would leave the 5 V rail only be able to output 77 W. Since suppliers are self-certified, a manufacturer's claimed output may be double or more what is actually provided.

Although a too large power supply will have an extra margin of safety as far as not over loading an electricity than a more appropriately sized unit. Computer power supplies generally may shut down or malfunction if they are loaded too lightly, less than about 15% of rated total load. Some power supplies have non-load protection.

The most important factor for suitability for certain graphics cards is the PSU's total 12V output. If the total 12V output stated on the PSU is higher than the suggested minimum of the card, then that PSU can fully supply the card. However a system will have other loads on the 12 Volt supply.

Power supplies are usually sized so that the typical calculated system consumption is about 60% of the rated capacity, and the maximum system demand does not exceed the rated capacity of the supply. The power supply ratings often given by the manufacturer of single component, typically graphics cards should be treated with skepticism. These manufacturers want to minimize support issues due to under rating of the power supply specifications and advise customers to use a more powerful power supply to avoid these issues.

Concept of Switched-Mode Power Supply (SMPS):

A SMPS "Switched-Mode Power Supply" is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. It converts the main power supply 230volts to 12volts, 5volts, 3 volts and distribute to all components of computer.

Like other power supplies, an SMPS transfer power from a source like mains power, to a load, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. Ideally, a switched-mode power supply dissipates no power.



Fig: Switched Mode Power Supply

Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supply may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weights are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed and simple designs may have a poor power factor.

Types of SMPS:

Switched-Mode Power Supply is categorized into three parts which are explained below:

1. AT SMPS:

AT stands for Advanced Technology. These are all old SMPSs. They had 12 pin power connector; this is called as AT power connector. They were used in Pentium-I, Pentium-MMX, Pentium-II and Pentium-III CPUs.

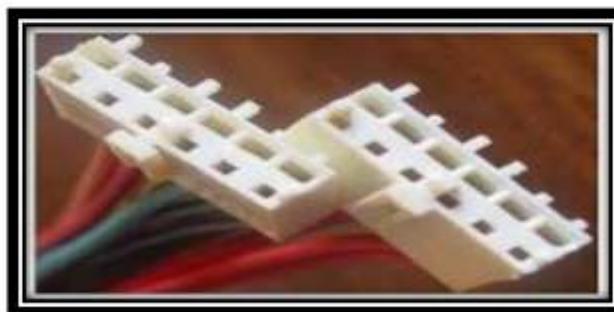


Fig: AT SMPS

2. ATX SMPS:

ATX stands for Advanced Technology eXtended. They had 20 pin Power connector; this is called as ATX power connector. They were used in Pentium-III, Pentium-IV and AMD CPUs.



Fig: ATX SMPS

3. BTX SMPS:

BTX stands for Balanced Technology eXtended. They have 24 pin Power connector; this is also called as ATX power connector. It has 15pin SATA power connectors. They are used in Dual core, core2duo, Quad core, i3, i5, i7 and latest AMD CPUs.

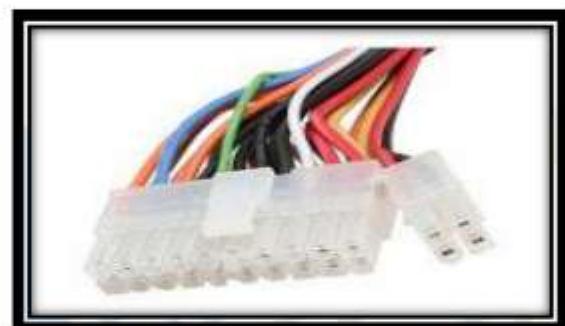


Fig: BTX SMPS

Concept of Uninterruptable Power Supply (UPS):

UPS stands for "Uninterruptible Power Supply". It is a device that allows a computer to keep running for at least a short time period, when the primary power source is lost. Typically, a UPS keeps a computer running for several minutes after a power outage, enabling us to save data that is in RAM and shut down the computer gracefully. Many UPSs now offer a software component that enables us to automate backup and shut down procedures in case there's a power failure while we are away from the computer.

Types of Uninterruptable Power Supply (UPS):

1. Online UPS:

This UPS can maintain the system to work for specific operation even if the regular power supply is cut-off. The UPS is automatically turned on when powered off. Example of online UPS is home based UPS.

2. Offline UPS:

The UPS has to turn on manually whenever the regular power supply can't be maintained. The system has to shut-down to turn on the UPS. Example of offline UPS is inverter-battery, generator.

Motherboard:

A motherboard is one of the most essential parts of the computer system. It holds the crucial electronic components of the system such as processor, memory and expansion slots and connects directly or indirectly to every parts of the PC. The motherboard (also known as main board, system board, planar board or logic board, or colloquially) is the main circuit board inside the PC.

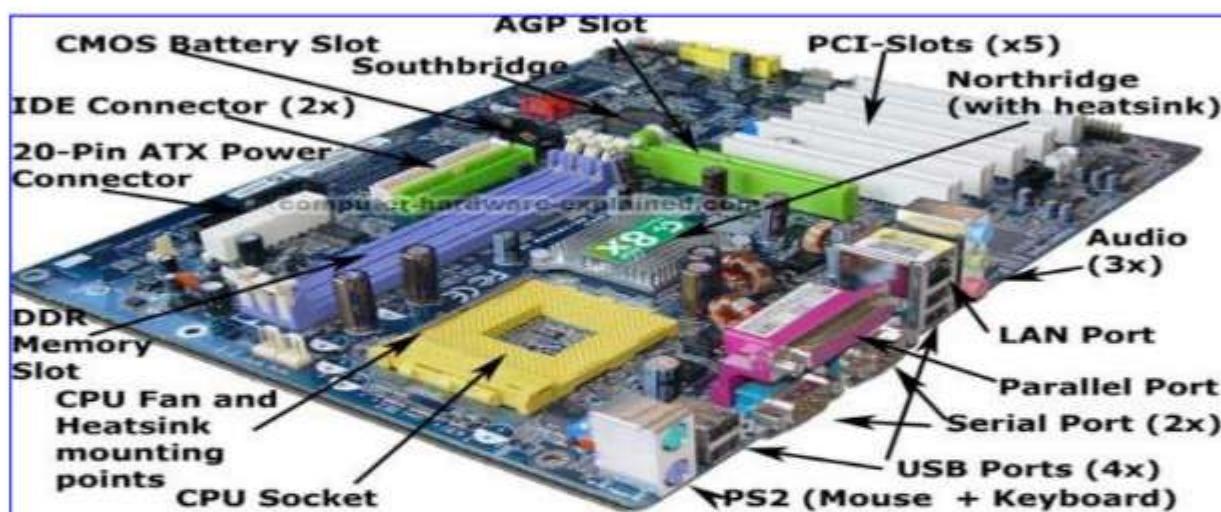


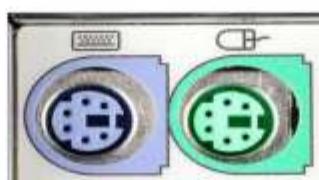
Fig: Pentium IV Motherboard

It is made of a chipset, some interconnections or buses. Motherboard specially refers to a Printed Circuit Board "PCB" with expansion capability-the board is the mother of all components attached to it, which often include sound cards, video cards, network cards, hard drives or other forms of persistent storage, TV tuner cards, cards providing extra USB or firewire slots and a variety of other custom components.

Components of Motherboard:

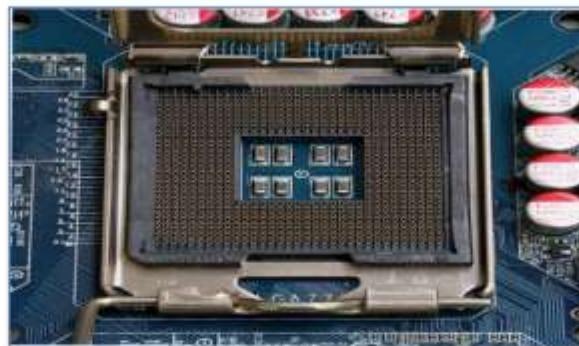
1. PS/2 Socket:

It is used to connect the PS/2 mouse and keyboard.



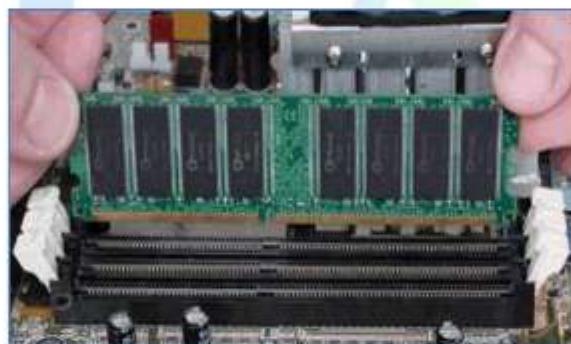
2. CPU Socket:

The actual CPU (Microprocessor) is directly placed onto this socket. CPU Fan & Heat sink Mounting Points: A CPU Fan and Heat sink mounting points are kept over the CPU Since high speed CPUs generates a lot of heat, there are heat sinks and mounting points for fans right next to the CPU socket to cool the CPU.



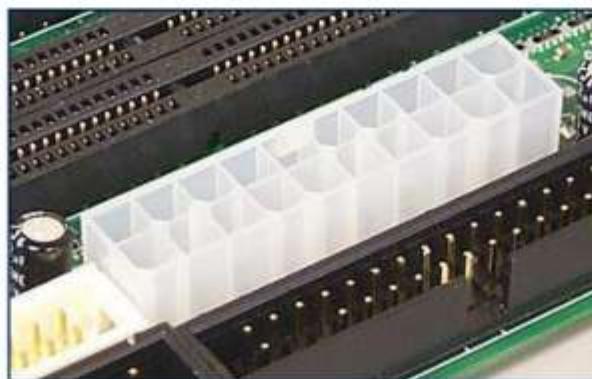
3. DDR Memory Slot:

DDR Memory Slots are used for the system's main memory, typically in the form of DRAM (Dynamic read only memory).



4. Power Connector:

Power connector is used to distribute power to the CPU and other components.



5. North Bridge:

North Bridge is a chip forms which provide 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.



6. South Bridge:

South Bridge is a second chip which controls the input and output functions. It is not connected directly to the CPU but to the Northbridge. This input/output controller is referred to as the Southbridge. The Southbridge handles several connectors, which provide the physical interface to input/output devices and the motherboard. The Northbridge and Southbridge combined are referred to as the chipset.



7. ROM:

ROM refers to read only memory which holds the system BIOS.



8. CMOS Battery Slot:

CMOS (Complementary Metal Oxide Semiconductor) battery slot is used to hold the CMOS battery. It helps to give backup to the board.



9. IDE Connector:

IDE stands for Integrated Drive Electronics and is used to connect the PATA Cable for traditional Hard disk and CD-ROM.



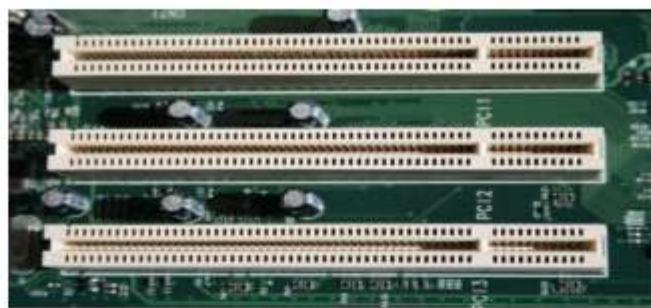
10. SATA Connector:

It is used to connect the SATA cable for Modern Hard disk and CD-ROM.



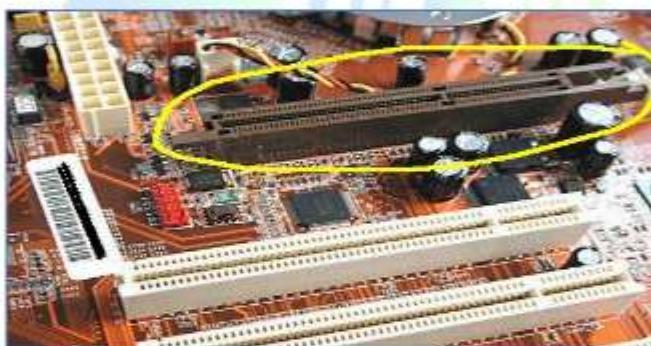
11. PCI Slot:

PCI stands for Peripheral Component Interconnect. It allows the connection of devices into the computer such as modems, sound cards, network cards, video cards etc.



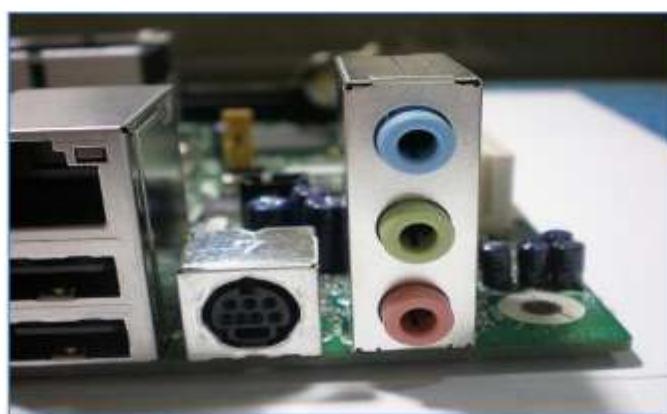
12. AGP Slot:

AGP (Accelerated Graphics Port) is an advanced port designed for Video cards and 3D accelerators.



13. Audio Port:

Audio port is for the external audio devices.



14. LAN Port:

LAN port is for the LAN connection to the computer through RJ45 connector.



15. Parallel Port:

It is used to connect the printer.



16. Serial Port:

It is used to connect the devices with serial connector like traditional mouse, modem, network and even printer and joystick.



History of Motherboards:

❖ In 1981:

IBM "planar" Breadboard was the first motherboard used in PC, chips were wired together and in housed RAM and CPU with supplier parts and keyword/cassette tapes.

❖ In 1984:

IBM came up with the AT (Advanced Technology) design that the component based PC which we know today was born. The AT form factor proved very popular and become a standardized motherboard to fit all desktops and tower cases.

❖ In 1986:

Birth of gigabyte formed by Yeh pei-cheng in Taiwan.

❖ In 1987:

Elite group former world's largest motherboard manufacturer creator of ESC boards.

❖ In 1986:

A small Taiwanese company formed by former ACER employees took their name from Pegasus; they would later become the world's biggest motherboard manufacturer.

❖ In 1993:

Intel develops PAGA for settings- Plastic pin grid array was developed by Intel in 1993. It assisted in integrated circuit packaging.

❖ In 1995:

Intel release new motherboard ATX form factor. The ATX was first major motherboard development since the AT in 1984. Featuring many improvements including new dimensions and layout improving space and interchange ability of parts, it solved many issues faced by system builders from the original AT.

❖ In 1997:

Intel begins manufacturing motherboards. Intel starts its own motherboard division with great reputation stability.

❖ In 1998:

Micro ATX boards produced. The first backward compatible board that although nearly half the size of a standard ATX board was fully compatible, usually they contain more integrated peripherals and are made for smaller PCs, but less expansion stats.

❖ In 2001:

Mini ITX produced by VIA. The small ITX sized motherboard was launched in 2001 and was built for small cases. Yes still manages to pack out all the features of a regular ATX but again with less just the one and performance as an ATX and micro ATX.

❖ In 2005:

Intel introduces balanced Technology Extended. Intel's concept to redesign the ATX case was short lived. Mainly because compatible components were limited as well as it not being able to accept energy efficient components.

❖ In 2007:

ASUSTek becomes world's largest maker of computer motherboards. Intel's concept to redesign the ATX case was short lived. Mainly because compatible components were limited. As well as it not being able to accept energy efficient components.

❖ In 2009:

The mobile ITX- as of 2012, VIAS mobile -ITX is the world's smallest compliant motherboard form factor. Just 60mm by 60mm.

Types of Motherboards:

1. XT (Extended Technology):

- ❖ XT stands for Extended Technology
- ❖ Old Technology
- ❖ They have slot type processors and slots. Example: Pentium-I, Pentium-MMX, Pentium-II and Pentium-II Processors.

2. AT (Advanced Technology):

- ❖ AT stands for Advanced Technology.
- ❖ Advanced Technology Motherboards have PGA (Pin Grid Array) Socket, SD Ram slots, 20pin power connector PCI slots and ISA slots. we find the above components on AT motherboards.
- ❖ Example: Pentium-III Processors

3. Baby AT (Advanced Technology):

- ❖ Baby AT Motherboards have the combination of XT and AT.
- ❖ They have both slot types of processor sockets and PGA processor sockets, SD Ram slots and DDR Ram slots.

- ❖ Example: Pentium-III and Pentium-IV

4. ATX (Advanced Technology Extended):

- ❖ ATX stands for Advanced Technology eXtended.
- ❖ Latest motherboards all are called as ATX motherboards.
- ❖ In these motherboards we can find; DDR Ram slots, PCI slots, AGP slots, Primary and secondary IDE interfaces, SATA connectors, 20pin and 24 pin ATX power connector and Ports.
- ❖ Example: Pentium-IV, Dual Core, Core 2 Duo, Quad Core, i3, i5 and i7 Processors.

System Chipset:

In a computer system, a chipset is a set of electronic components in an integrated circuit that manages the data flow between the processor, memory and peripherals. It is usually found on the motherboard. Chipsets are usually designed to work with a specific family of microprocessors. Because it controls communications between the processor and external devices, the chipset plays a crucial role in determining system performance.

The system chipset and controllers are the logic circuits that are the intelligence of the motherboard. They are the "traffic cops" of the computer, controlling data transfers between the processor, cache, system buses, peripherals-basically everything inside the computer. Since data flow is such a *critical* issue in the operation and performance of so many parts of the computer, the chipset is one of the few components that have a truly major impact on your PC's quality feature, speed and internet.

Today when referring to the motherboard chipset such as ALT, AMD, INTEL, nudea, via or sis chipset, these chipsets may include instructions that help to control the CPU, PCI, ISA, USB are broken into the multi-layered architecture referred as North bridge and South Bridge as well as Super Input/output chip. An example of a recent Intel chipset is the 1820 or the Intel 820 chipset.

System Bus:

A bus is basically a collection of wires, chips and slots inside the computer through which data is transmitted from one part of computer to another and to and fro from peripheral devices.

Functions of Bus:

- ❖ It travels information from one place to another.
- ❖ It carries data, address and instruction.
- ❖ One component of computer interacts with other via bus.

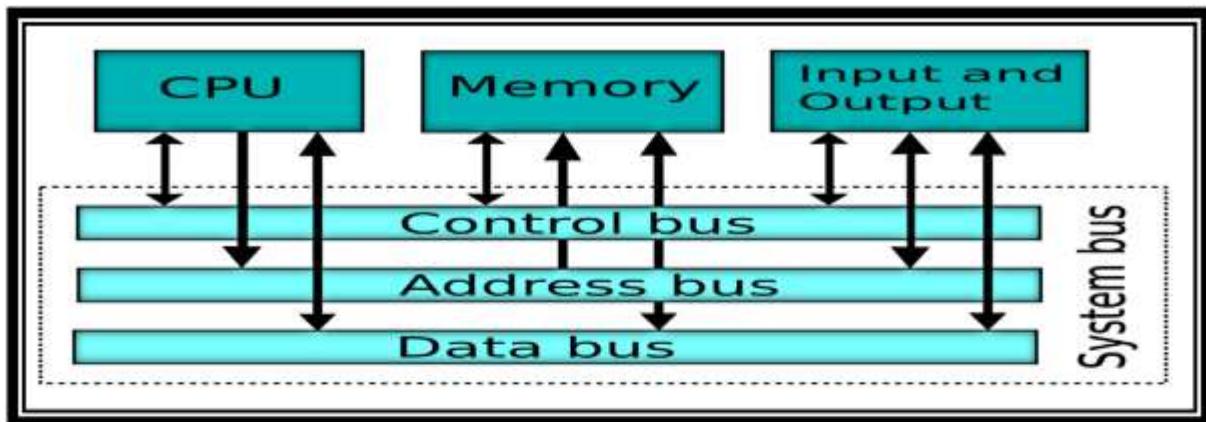


Fig: Bus structure in a computer system

Types of System Buses:

1. Data Bus:

The electric road through which the actual data are transferred from one unit of computer to another is called data bus. It is a collection of wires through which data are transferred In and Out of the CPU. Actually the data bus is a group of parallel wires. The number of wires in the bus affects the speed at which data can transfer from one component of computer to another.

Each wire can transfer one bit of data at a time. A data bus with 8 wires can transfer 8 bits (one byte) of data at a time. These lines are bi-directional (data flow in both directions between processor and memory or peripheral devices). The data bus connects the CPU, memory unit and other hardware devices on the motherboard.

2. Address Bus:

We know that the components of computer are connected to one another through the system bus. So it is important to assign a unique ID to each component. This ID is called the address of that component. Therefore the computer bus, which is used to identify different components of a computer as well as specify the address of different memory locations, is called address bus.

For example when a computer component wants to communicate with other component, it specifies the address of the destination component. Similarly, when CPU wants to write some data at memory location 932, it places the address of main memory and the address of location i.e. 932 on the address bus.

When the main memory sees its address on the address bus, it reads the data from the data bus and writes it to the specified location within the main memory.

3. Control Bus:

The electric path, through which the control unit sends out control signals (commands) to control the sequence of operations that takes place while a program is being executed, is called control bus. For example, the control unit directs the transfer of data from the main memory to the ALU for arithmetic or logical operations. Similarly, data flow between secondary memory and main memory is controlled by the control unit through this bus.

System BIOS:

BIOS is an acronym for Basic Input / Output System. On virtually every computer available, the BIOS makes sure all the other chips, hard drives, ports and CPU function together.

The BIOS software has a number of different roles, but its most important role is to load the operating system. When you turn on your computer and the microprocessor tries to execute its first instruction, it has to get that instruction from somewhere. It cannot get it from the operating system because the operating system is located on a hard disk, and the microprocessor cannot get to it without some instructions that tell it how. The BIOS provides those instructions.

Common Tasks That the BIOS Perform:

- ❖ A power-on self-test (POST) for all of the different hardware components in the system to make sure everything is working properly
- ❖ Activating other BIOS chips on different cards installed in the computer - For example, SCSI and graphics cards often have their own BIOS chips.
- ❖ Providing a set of low-level routines that the operating system uses to interface to different hardware devices - It is these routines that give the BIOS its name. They manage things like the keyboard, the screen, and the serial and parallel ports, especially when the computer is booting.
- ❖ Managing a collection of settings for the hard disks, clock, etc.

The BIOS is special software that interfaces the major hardware components of your computer with the operating system. It is usually stored on a Flash memory chip on the motherboard, but sometimes the chip is another type of ROM.

When We Turn On Our Computer, The BIOS Does Several Things. This Is Its Usual Sequence:

- ❖ Check the CMOS Setup for custom settings
- ❖ Load the interrupt handlers and device drivers
- ❖ Initialize registers and power management
- ❖ Perform the power-on self-test (POST)
- ❖ Display system settings

- ❖ Determine which devices are bootable
- ❖ Initiate the bootstrap sequence

The first thing the BIOS does is check the information stored in a tiny (64 bytes) amount of RAM located on a complementary metal oxide semiconductor (CMOS) chip. The CMOS Setup provides detailed information particular to your system and can be altered as your system changes. The BIOS uses this information to modify or supplement its default programming as needed.

Interrupt handlers are small pieces of software that act as translators between the hardware components and the operating system. For example, when you press a key on your keyboard, the signal is sent to the keyboard interrupt handler, which tells the CPU what it is and passes it on to the operating system. The device drivers are other pieces of software that identify the base hardware components such as keyboard, mouse, hard drive and floppy drive. Since the BIOS is constantly intercepting signals to and from the hardware, it is usually copied, or shadowed, into RAM to run faster.

Processor:

Invention of microprocessor is considered as one of the greatest breakthrough in the history of computer since it brought the revolution in computer architecture.

A microprocessor is a single chip in which millions of components like transistors are integrated together in different layers and it performs all the operations of the computers processors; since it is so small, it is called a microprocessor. It is a complete CPU built on a single chip by using VLSI or ULSI technology.

And it is the control center for a computer. It guides directs and governs all operations and components inside the computers. It is considered as a brain of the computer. It is linked with various peripherals equipments including input/output devices, secondary storage and memory unit. It performs mathematical computation, logical comparison, executes instructions and transfer information between all parts of computer.

Intel Corporation of USA developed the first microprocessor named "Intel 4004" in 1971 A.D. It contained about 1600 transistors. It was a 4 bits microprocessor and process only 4 bits of data at a time. Since then, the technology has increased by leaps and bounds. The microprocessors available today are more powerful than many of the large computers of the past. They have become cheaper and more reliable. The modern processors are available in 32, 64 or higher bits word length.

The microprocessor is responsible for the following functions:

- ❖ To control and coordinates all the operations and other components of the computer system.
- ❖ To carry out processing.
- ❖ To give commands to all the other components of the computer system.
- ❖ To control the sequence of operations in the computer system.
- ❖ To interpret the data, instruction and information in the computer system.

Microprocessor Has Three Components:

1. Control Unit (CU):

The control unit of the microprocessor coordinates and controls the various operations and initiates the appropriate sequence of micro-operation for each task. It controls and guides the interpretation, flow and manipulations of all data. It is responsible for executing the instruction of the program and fetching the data required for the next instruction from memory. It also controls and coordinates the functions of all other units of the computer and ensures smooth operation. It is mainly responsible for the followings:

- ❖ Data exchanges of CPU with the memory or input/output components.
- ❖ Internal operations in the CPU such as moving data between registers.
- ❖ Making ALU perform a particular operation on the given data.
- ❖ Regulating other internal operations.
- ❖ Generate control mechanism to hardware and software.

2. Arithmetic and Logic Unit (ALU):

It is responsible for doing all type of arithmetic operation like addition, subtraction, multiplication, and division on integer and real operands. It also can perform the logical operation or comparison like equal to, greater than, less than, etc. between two operands. It receives its operands from the register section of the CPU and stores its results back in the register section.

3. Register:

Registers are electronic memory chips made from transistors and flip-flops which serve as temporary storage location in the CPU. The instructions execution is performed in the CPU by taking data from registers. Registers quickly accept, hold and transfer the data and instruction which are being executed currently. The size and number of these registers determine the overall speed of the computer. Registers size and types vary from one CPU to others.

A PC normally uses the following types of registers:

a. Memory Address Register (MAR):

It specifies the address of memory location from which data or instruction is to be accessed for read operations or to which the data is to be stored for write operation.

b. Memory Buffer Register (MBR):

It is register which buffers the content data to be written in the memory or it receives the data from the memory.

c. Program Counter (PC):

It keeps the track of the instruction that is to be executed next.

d. Instruction Register (IR):

Here the instructions are loaded prior to execution.

e. Accumulator Register (AR):

This register is used to store data temporarily for computation by ALU. AC contains one of the data that is going to execute on ALU and after processing the result of the computation by ALU is also stored back to AC. Hence, it works as a mediator between ALU and other registers.

Types of Processors:

1. Complex Instruction Set Computing (CISC):

CISC stands for Complex Instruction Set Computer. If the control unit contains a number of micro-electronic circuitry to generate a set of control signals and each micro-circuitry is activated by a micro-code this design approach is called CISC design. The features of CISC processors are:

- a. CISC chips have a large amount of different and complex instructions.
- b. CISC machines generally make use of complex addressing modes.
- c. Different machine programs can be executed on CISC machine.
- d. CISC machines uses micro-program control unit.
- e. CISC processors are having limited number of registers.

Examples of CISC processors are: Intel 386, Intel 486, Pentium, Pentium Pro, Pentium II, Pentium III, Motorola's 68000, Motorola's 68020, Motorola's 68040, etc.

2. Reduced Instruction Set Computer (RISC):

RISC stands for Reduced Instruction Set Computer. To execute each instruction, if there is separate electronic circuitry in the control unit, which produces all the necessary signals, this approach of the design of the control section of the processor is called RISC design. It is also called hard-wired approach. Features of RISC processors are:

- a. RISC processors use a small and limited number of instructions.
- b. RISC machines mostly uses hard-wired control unit.
- c. RISC processors consume less power and are having high performance.
- d. Each instruction is very simple and consistent.
- e. RISC uses simple addressing modes.

f. RISC instruction is of uniform fixed length.

Examples of RISC processors are: IBM RS6000, IBM MC88100, DEC's Alpha 21064, DEC's Alpha 21164, DEC's Alpha 21264, etc.

3. Explicitly Parallel Instruction Computing (EPIC):

EPIC stands for Explicitly Parallel Instruction Computing. It is a 64-bits microprocessor instruction set, jointly defined and designed by Hewlett Packard and Intel that provides up to 128 general and floating point unit registers and uses speculative loading, predication and explicit parallelism to accomplish its computing tasks.

By comparison current 32-bits CISC and RISC microprocessor architectures depend on 32-bits registers, branch prediction, memory latency and implicit parallelism which are considered a less efficient design. Processors based on EPIC architecture are simpler and more powerful than traditional CISC or RISC processors. These processors are mainly targeted to next-generation, 64 bits, high-end users and workstation market (not for personal computer market).

Intel's first 64-bits CPU micro-architecture is based on EPIC. Intel's first implementation long expected and well-known as Merced "its code name" was christened with the Itanium brand name in October, 1999. It is expected that Itanium-based systems will be compatible with version of existing and future operating systems including HP-UX, 64-bits Windows, Intel Architecture Linux, Project Monterey and Novell Modesto.

4. Multi-Core Processors:

A multi-core processor is an integrated circuit (IC) to which two or more processors have been attached for enhanced performance, reduced power consumption and more efficient simultaneous processing of multiple tasks.

Multi-core processor enables building of computers with better overall system performance by handling more work in parallel. Multi-core chips consume less power and generate less heat than single-core chips. Hence, multi-core technology is also referred to as energy-efficient or power-aware processor technology.

Chip makers like Intel, AMD, IBM and Sun have introduced multi-core processor for servers, desktops and laptops. The current multi-core processors are dual-core per chip, quad-core per chip, 8-core per chip, and 16-core per chip. Industry experts predict that multi-core processors will be useful immediately in server class machines but won't be very useful on the desktops systems until software vendors develop considerably more multi-threaded software. Until this occurs, single-core chips will continue to be used. Also, since single-core chips are inexpensive to manufacture, they will continue to be popular for low-priced PCs for a while.

Examples of Multi-core processors: Dual-core processors (AMD Phenom II X2 and Intel Core Duo), Quad-core processor (AMD Phenom II X4, Intel's i5 and i7), Six-core processor

(AMD Phenom II X6, Intel Core i7 Extreme Edition 980X), Eight-core processor (Intel Xeon E7-2820 and AMD FX-8350), Ten-core processor (Intel Xeon E7-2850), etc.

Storage Devices:

To read and write data, computers use a variety of storage devices and media. A computer would not work properly without permanent or temporary storage. Without a location to store digital data, most computers would be entirely worthless. After all, storage houses everything from the operating system to programs and individual data.

Magnetic tape and floppy disks were used in the early days of computer memory. Hard disks, solid state drives, cloud storage services, and other similar devices are now increasingly often utilized.

Storage device types may be divided into two groups in general:

- ❖ Temporary
- ❖ Permanent

For computers, there are about a dozen different forms of persistent storage. Temporary memory, on the other hand, is frequently confined to Random Access Memory (RAM) and cache memory. Each sort of memory or storage has its own set of pros and downsides. It's critical to know what possibilities are available on the market today and to choose which solutions are appropriate for a certain computer.

Types of Temporary Storage Devices:

1. RAM (Random Access Memory):

RAM, unlike the storage technologies previously discussed, stores volatile data. Data in RAM is continually cycled in and out, and it vanishes when the power is turned off. The CPU of a computer uses RAM, which serves as a conduit between the CPU and non-volatile storage devices.

If a computer relied solely on non-volatile storage, it would be much too sluggish to be useful. Any data stored in RAM is immediately available to the CPU, functioning as the CPU's working memory. RAM has a direct impact on a computer's performance. Most PCs require 8 GB of RAM to run quickly and smoothly.

For demanding usage instances, 16 GB or more is sometimes necessary. RAM is pricey as compared to other forms of storage, yet it serves a critical role. A high-quality RAM module improves PC performance and speeds up program loading times.

2. ROM (Read Only Memory):

This sort of memory can only read data from the computer and cannot write data to it, as the name implies. Another key feature is that when the power is turned off, the data in the ROM is not lost (i.e. it is non-volatile data).

ROM is often used to store important and essential data that aids in the first power-up and hardware test and configuration of a computer system. After the computer has been turned on, it begins to use various forms of storage such as the hard drive, RAM, and so on. The BIOS (Basic Input Output System) of a computer is an example of ROM, as it initializes the hardware and aids in the startup of the entire computer system.

3. Cache Memory:

Cache memory is built into the processor chip of CPUs. Cache memory is quicker than RAM, although it has significantly less store space. In a nutshell, such memory stores program instructions and other data that a CPU needs right away. This configuration enables a computer to operate more quickly and efficiently. In nanoseconds, the cache memory processes the minute compute instructions.

Types of Permanent Storage Devices:

1. Hard Disk Drive:

A non-volatile storage media is a hard disk drive (HDD). Unless overwritten or destroyed, non-volatile data stays on a device. An electromagnet produces positive or negative charges on the disk surface in hard drives. As the revolving disk and actuator arm work together, the charges produce binary code that can be read.

Data is read along tracks and wedges, which are concentric circles and sectors, respectively. Hard drives are still widely used nowadays, but their popularity is waning. HDDs have a number of advantages, including large storage capacity and cheap overall costs, which is why they are commonly used for backup and archiving.

Alternative storage options are sometimes more expensive for identical storage capabilities. A two-terabyte hard disk may now be had for \$50.00 or less. Hard drives, on the other hand, have mechanical elements that wear out over time and are vulnerable to data loss due to impact damage. Although many hard drives have high read/write rates, new forms of speedier storage are also accessible. Mechanical HDDs feature a revolving head, which is why you'll find RPM (Revolutions per Minute) numbers like 7.5 K or 10 K on HDDs.

2. Magnetic Tape Device:

In 1951, the Eckert-Mauchly UNIVAC I system employed magnetic storage device cassettes for the first time. Surprisingly, magnetic tape is still in use today and continues to develop. Data is written onto magnetic tape in a variety of ways that are beyond the scope of this explanation.

However, data may be written on magnetic tape throughout its length or breadth. Magnetic tape is now widely utilized in academic settings as well as in a variety of other applications, such as backup storage systems. Magnetic tape reading requires specialized

equipment. Magnetic tape may appear to regular customers to be an out-of-date technology. Magnetic tape is still being developed for commercial usage by researchers.

Tape has a larger storage capacity than hard drives and is more dependable than hard disks. They also have a comparable total cost when compared to equivalent hard drives. In fact, according to some observers, the usage of magnetic tape will continue to develop and expand. In the future, tape may be used to replace hard disks in business settings.

3. Floppy Disks:

Floppy disks were used as storage media in general from 1971 to 1999. Mainstream computers no longer feature the disk drives needed to read floppy disks. In some circumstances, finding a functional floppy disk drive outside of an industrial setting might be difficult. Floppy disks, on the other hand, used a magnetic disk that could be read and written using read/write heads. To access data on floppy drives, various motors and the floppy disk drive are necessary.

Floppy disks had the advantage of being both inexpensive and quick in the past. They were often used to start up a computer and supplemented a computer's primary storage device well (e.g. older computers using MSDOS operating system could boot-up using a floppy disk).

The majority of floppy disks have a storage capacity of less than two megabytes. Unfortunately, floppy disks had a storage capacity of just 240 megabytes. Despite the fact that floppy disks are still employed in industrial settings, consumers frequently see them as antiquated when compared to hard drives. Floppy disks came in a variety of sizes over the years.

4. SSD (Solid State Drive):

NAND flash memory is used in solid state drives to provide lightning-fast read/write rates. Because transistors are linked in series on a circuit board, SSDs have no moving components. As a result, data may be accessible quickly and without a lot of noise or heat. The storage drive is accessed by the operating system of a computer, and SSDs are available in both internal and external formats. Faster read/write rates result in faster loading times, a more responsive operating system, and other advantages.

SSDs are often more expensive than HDDs with identical storage capabilities. However, they cannot be matched in terms of read/write speeds or durability. Solid state drives lose memory quality after millions of write operations, yet unlike hard drives, they are not subject to damage. They're also less noisy than hard drives and have smaller form factors. Because of the non-mechanical operation, portable gadgets have a longer battery life, which is always a good thing.

5. USB Flash Drive:

USB Flash Drives, like SSDs, use NAND flash memory. These storage devices are meant to be portable and pocketable. They connect to a computer through USB and have high

read/write rates. Flash drives are best employed as ultraportable storage devices, to put it simply.

Flash drives are a great way to swiftly transfer files from one device to another. They're also frequently utilized as data backup devices for enormous volumes of data. The advantages of USB flash drives are self-evident. The data is safe since these gadgets are incredibly portable and have no moving components. There are also a range of storage sizes on the market, while capacities more than 256 GB are unusual.

It doesn't help that flash drives are more expensive than HDDs, which have significantly larger capacity for less money. Memory sticks are useful for a number of things, and it's never a bad idea to have a few on hand.

6. SD Card:

SD Cards use flash memory and are intended for use in portable devices like cameras and cellphones. SD Card readers are found in most computers and many smartphones. Full-size SD, miniSD, and microSD cards with varied capacity are available from manufacturers. Desktop PCs and laptops frequently accept full-size SD cards. MiniSD and microSD cards are often supported by cameras, smartphones, and tablets.

SD cards are classified according to their read/write speeds, which range from 12.5 megabytes per second to 3,938 megabytes per second. SD Cards, like USB flash drives, are small and portable. When compared to flash drives and other memory, smaller capacities are accessible at a lower cost.

They're great for storing files on portable devices or transferring files across devices. Otherwise, higher-capacity cards are far more expensive, and they aren't suited for running computer applications or operating systems.

7. CD:

Optical storage devices are known as Compact Disks (CDs). Disk drives read binary data from small pits and bumps on the disks. CDs rotate at a steady pace when in an optical disk drive. To read the binary data, a laser glides across the disk's surface. This data is read by an optical lens and sent to the computer or laptop in use. CDs can be read-only or read/write depending on the disk type. Audio and other small amounts of data are commonly found on CDs. Because the storage capacity is only 700 MB, they aren't ideal for storing high-definition video.

Fortunately, CDs are inexpensive and take up little space. They're prone to scratches, which render the disk unreadable, causing difficulties with dependability. Optical disk drives are no longer included in all PCs and laptops. There are now better disk-based storage choices available.

8. DVD:

DVDs, of course, appear to be CDs since they are the same size. However, all DVDs include a spiral track that holds more data than a CD. Because of the larger density, the DVD drive

need a sharper laser to read data. DVDs are similar to CDs in terms of functionality, however they have a larger storage capacity. Dual layering is a method of increasing the storage capacity of DVDs.

DVDs are capable of storing large quantities of data, including standard definition video. In today's world, the typical DVD has 4.7 GB of read/write data. BluRay Disks have mostly replaced DVDs, therefore they're now regarded outdated.

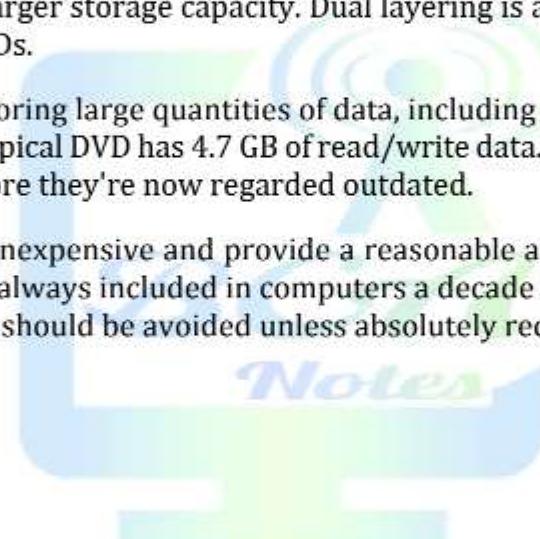
Regardless, DVDs are inexpensive and provide a reasonable amount of storage space. A DVD drive was almost always included in computers a decade ago. In 2020, that may not be the case, thus DVDs should be avoided unless absolutely required.

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Unit VII: System Care Guide – Computer Fundamentals and Application

Maintenance:

Past and current maintenance practice in both private and government sectors would imply that maintenance is the action associated with equipment repair after it is broken. The dictionary defines maintenance as "The work of keeping something in proper condition upkeep"; this would imply that the maintenance should be actions taken to prevent a device or component degradation experience with the operation of device to keep it in proper working order.

Types of Maintenance:

1. Breakdown Maintenance:

It means that people wait until equipment fails and repair it. Such thing could be used when the equipment failure doesn't significantly affect the operation/production or generate any significance loss other than any repair cost.

2. Preventive Maintenance (1951):

It is a daily maintenance (cleaning, inspection, oiling and re-tightening) design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration periodic inspection or equipment condition diagnosis to measure deterioration. It is further divided into periodic and predictive maintenance just like human. It is extended by preventive medicine; the equipment service life can be prolonged by doing preventive maintenance.

a. Periodic Maintenance (Time Based Management):

The Time Based Management (TBM) consists of periodically inspecting servicing and cleaning equipment and replacing the parts to prevent sudden failure and process problems.

Time Based Management (TBM) is maintenance performed on equipment based on a calendar schedule. This means that time is the maintenance triggers for these types of maintenance. TMB is planned maintenance. Example: The maintenance that is done on air-condition every year before summer.

b. Predictive Maintenance:

This is a method in which the service life of important part is predicted based on the inspection or diagnosis in order to use the limit of their service life compared to periodic maintenance, the predictive maintenance is condition based maintenance. It manages trend values by measuring and analyzing the data about deterioration and employs a surveillance system designed to monitor conditions through an on-line system.

3. Corrective Maintenance:

It improves equipment and its component so that preventive maintenance can be carried out reliably equipment with design weakness must be redesigned to improve reliability or improving maintenance.

4. Maintenance Prevention:

It indicates the design of new equipment weakness of current studied (on site information leading to failure prevention, easier maintenance and prevents of detect safety and ease of manufacturing) and are incorporated before commissioning a new equipment. Surveillance system (Example: CCTV Camera)

System Care:

One of the most important aspect of maintenance is caring for our system hardware. This includes maintaining the various components that make up to our PC, along with looking at overall factors that affects a system as a whole. This chapter takes a detailed look at what we can do to keep our system components and media operating at peak frequency. Some of the system care factors are:

System Care Factors:

1. General System Care Factors:

There are many aspects to system care and maintenance that affect the system as a whole, or every component in the life system as opposed to being specific to a particular environment. These factors are included in this section.

2. Environment Care Factors:

In the last few decades we all have become much more turned into our external environment and how it affects us as well, it affects PC as well we are much more important than PCs of course, but as it happens, many of the things that makes humans sick or uncomfortable, have a similar impact on computers. These sections take a look of these issues.

3. Cooling and Ventilation Care Factors:

Keeping our system cool is an essential factor for caring our system. A cool system runs more reliably and last longer than one that runs hot. Overheating of the internal components can leads to the data loss or even damage our equipment. In recent years, as processors in particular PCs have gotten faster and hotter, the subject of cooling has become more important than ever. This section takes a look at various issues related to areas in the reference volume where particular cooling mechanism for different components are discussed in more detailed.

4. Power Care Factors:

Many issues with PCs are ultimately related to power problems. Providing a good, reliable power source to our PC is one essential aspect of system care. In fact, the quality of the power used to run our PC is so important.

5. Power Problem Protection:

Power problem include line noise, surges, brownouts and block outs when power problems strike, they can cause permanent damage either our equipment or our data. The only effective way to deal with power problem is to prevent them from happening in the first place. Here, are some steps we can take to greatly reduce the chances of power problems in our PC.

- ❖ Use power protection device
- ❖ Check protection device regularly
- ❖ Don't cut, corner with power
- ❖ Use dedicated circuits if possible
- ❖ Turn off power during a blackout
- ❖ Turn off and disconnect the power card during an electronic storm

6. Data Loss and Virus Prevention Factors:

The hardware in our system will work better and more reliably and last longer, if it is maintained regularly according to the directions. But ultimately we can get away with poor preventive maintenance practices in most cases, at worst our hardware will fail and we will have to replace it. Expensive, but not the end of the world usually however, there is the one thing that if lost cannot be readily replaced our data.

Data can never properly be replaced; it can only be protected against loss. This is why it is so critical that we take positive proactive steps to reduce our changes of catastrophic data loss.

Steps To Prevent Our Data From Virus:

- ❖ Never open junk, unsolicited email attachments even if they appear to come from friends colleagues.

- ❖ Always save the attachments to disk. Don't open it immediately, scan the file using installed antivirus.
- ❖ Ensure that we are running latest antivirus.
- ❖ Security patch: a program code that fixes and closes vulnerabilities in Microsoft software on PCs servers.
- ❖ Firewall: helps to prevent intrusion from an outside source. Firewalls also block some viruses from spreading from one computer to another.
- ❖ Keep a copy of an important work (back up your files)
- ❖ Don't execute the program or files which we found on the internet without checking them.

7. Data Problem Prevention Factors:

The best way to avoid data loss is using our computer wisely. There are many specific activities we can undertake that will help to protect our data and prevent it from being lost are backup, etc.

Backup:

Backup is the process or activity of copying files so that they will be preserved in case of equipment failure or other damages. The retrieval of files we backup is called restoring them. Backup can be categorized into following types:

1. Full Back up:

It is the starting point for all other backups and contains all the data in the files and folders that are to be backup because full backup stores all files and folders. Frequent full backup results in faster and simple restore operation.

Advantages:

- ❖ Restore is faster.

Disadvantages:

- ❖ Backing up is the slowest process.
- ❖ The storage space requirements are the highest.

2. Increment Backups:

Increment backups mean backing up everything that has changed since last full backup. The backup software creates copies of all the files that has been changed since previous backup.

Advantages:

- ❖ Backing up is the fast process.

- ❖ It requires lowest storage space.

Disadvantages:

- ❖ Restore is the slower process.

3. Partial Backup:

To process to copy all the selected files and folders to another backup media that can be stored when required.

Advantages:

- ❖ Backup is faster than full backup.
- ❖ It requires low storage space than full backup.

Disadvantages:

- ❖ The restore process is slower than full backup.

4. Differential Backup:

In this backup process the software takes at each files and folders that has been changed since last full backup. In this process the parts of files and folders that has been changed since last full backups are copied.

Advantages:

- ❖ Restore is faster than increment backup.
- ❖ Backing up is faster than full backup.

Disadvantages:

- ❖ Restore is slower than full backup.
- ❖ Backing up is slower than increment backup.
- ❖ Storage space requirement are higher than increment backup.

Disaster Recovery:

It is the process, policies and procedure related to prepare for recovery or continuation of infrastructure critical to organization after a natural or human induced disaster.

Strategies for Data Protection:

- ❖ Backups made to backup media (DVD, HDD, Magnetic Tape/Disk, etc.)
- ❖ Backup's mode to on-site and off-site.
- ❖ High availability of system parts that re-enables organization.

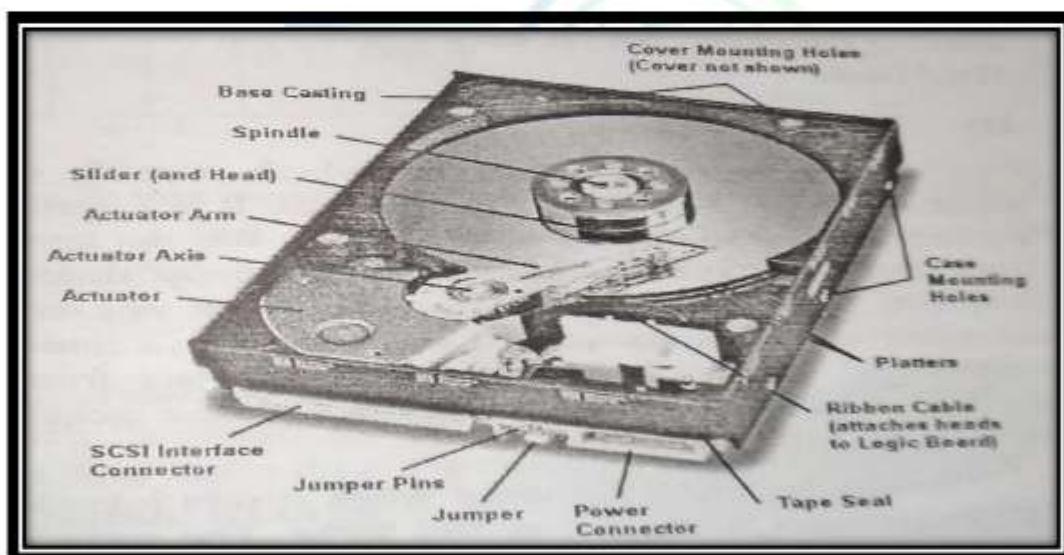
Pre-cautionary Measure:

- ❖ Surge protectors
- ❖ Use of power-backups like UPS
- ❖ Fire preventions
- ❖ Antivirus software

Devices and Media:

Hard Disk:

Hard disk is a secondary storage device of computer. It is an air-tight sealed unit consisting of number of magnetic disks (platters) mounted on a spindle. It was introduced by IM in 1956 A.D. At first it was called "Winchester Disk". Unlike floppy disk, the platters cannot be bent so they are hard disk. It has read/write facility; we can read from as well as write to it. We can access the information from hard disk randomly. It is mainly used to store large volume of data and programs permanently as it also non-volatile in nature.



Data is stored on both sides of each of disk. It's RPM "Revolution Per Minute" and storage capacity is very high. Hard disks make it more convenient and faster when large volume of data needs to be stored and accessed.

The disk is divided into a number of concentric circles called tracks and these tracks are divided into invisible segments called sector. The read/write heads of HDD "Hard Disk Drive" are used to read from and write data to hard disk.

A disk drive contains the mechanical, electrical, and electronic components for holding one or more disks and for reading or writing of information on it. That is, it contains the central shaft on which the disks are mounted, the access arms, the read/write head and motors to rotate the disks and to move the access arms. The disk drive which is used for hard disk is called Hard Disk Drive. It rotates at high speed and measured in Revolution per Minute "RPM". In market 5400 and 7200 RPM Hard Disk are available.

Generally Hard disk is available in two forms: PATA Hard disk and SATA Hard disk:

PATA is an acronym for Parallel Advanced Technology Attachment and it is an interface standard for the connection of storage devices such as hard disk, floppy drive and CD-ROM drives in computers. The Hard disk that supports Parallel ATA is called PATA Hard disk. Due to the Parallel ATA interface, data access rate of PATA hard disk slower than SATA Hard disk. For many years Parallel ATA provided the most common and the least expensive interface for the application. By the beginning of 2007, it had largely been replaced by Serial Advanced Technology Attachment "SATA" in new systems. Generally, there are 48 pins or cables in PATA Hard Disk.

SATA is an acronym for Serial Advanced Technology Attachment. It is an interface standard for connecting computer systems to mass storage devices such as a Hard drive. SATA was introduced in 2002 to replace the slower Parallel ATA interface standard. The Hard disk that supports Serial ATA is called a SATA hard disk and it is a device in computer used for storing files such as software programs, documents and media. SATA cables have fewer wires and therefore are narrower and less bulky than PATA cables. They take up less space, helping increase airflow inside the computer case. SATA hard disks can be attached to a running computer. SATA uses a seven-pin connector because there are 7 pins of slot in SATA Hard Disk.

Floppy Disk:

It is a round and flat disk which is made of Mylar (a plastic material) coated with magnetic material. It is a read/write memory as we can read from as well as write to it. We can access the information from floppy randomly. We can use floppy disk to store data and program, back up files, transfer data from one computer to another computer etc. It is also called diskette. It is a removable disk so it is very useful to transfer small amount of data from one computer to another. A floppy disk is kept within a plastic jacket in order to protect from possible damage.

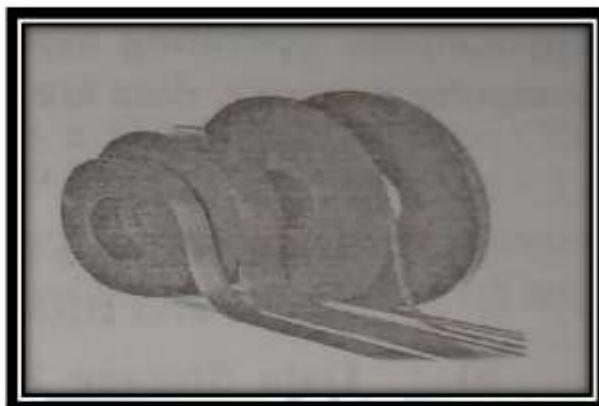
It was 8 inch in diameter when it was invented at first but later it available in 5.25 inch or 3.5 inch in diameter. It rotates at 360 RPM. The surface of each disk is divided into a number of concentric circular areas called track. Then each track is divided into different parts called sectors. Each sector can store 512 bytes of data. The 3.5" floppy disk has 80 tracks and 18 sectors in each track. The total capacity of 3.5" double sided floppy disk is about 1.44 MB of data.



The floppy disk needs a special device to manage and manipulate data in it and this device is called Floppy Disk Drive "FDD". The FDD has read/write head to read from and write data to floppy disk. Generally the floppy drive is named as A: or B: drive in PCs.

Magnetic Tape:

It is a secondary storage device of computer which is made of Mylar "a type of plastic material" coated with magnetic material only one side of the tape. It is similar to the tape used in a tape recorder except that it is of higher quality and is more durable. It is a low cost storage device and it has large storage capacity. It is mainly used to back up the large amount of data and information. It is also used to transfer data from one computer to another.



The tape consist strips "small slices" of tapes. The strips per inches determine the capacity of Magnetic tape. Each and every strip of the Magnetic tape consist 8 magnetic elements arranging in one direction. If we place data, every cell can hold one character in one box i.e. one byte or 8 bits per box.

Flash Memory:

Flash memory is a non-volatile, in-circuit-erasable and programmable solid state memory which is made of semiconductor chips. It was introduced at first in the mid 1980's by Fujio Masuoko at Toshiba Corp, Japan. It can be reprogrammed at high speed and hence the name flash.



It is derived from "Electrically Erasable Programmable Read Only Memory". In flash memory, the entire memory can be erased in a few seconds by using electric erasing technology. Flash memory is used in many input/ output and storage device. It is also used to store data and programming algorithm in cell phones, digital cameras and MP3 music player etc.

Flash memory serves as a hard drive for consumer devices. Music, phone list, applications, operating system and other data are generally stored on flash chips. Unlike the computer memory, data are not erased when the device is turned off.

Types of Flash Memory:

1. Code Storage Flash:

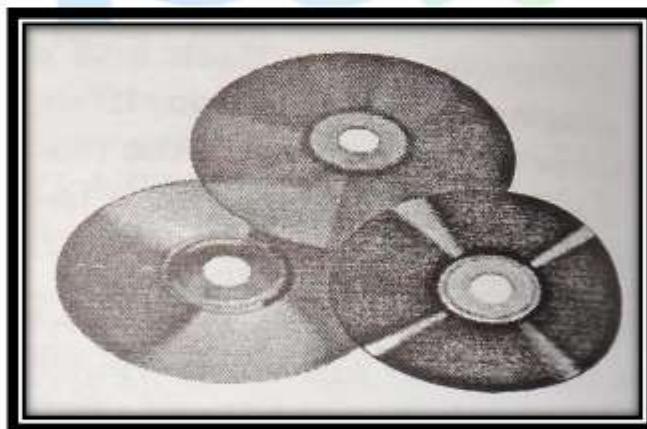
It stores programming algorithms and is largely found in cell phone and BIOS chip. It is built by using NOR Gate for internal memories.

2. Data Storage Flash:

It stores data and generally comes in digital camera, MP3 players, pen drive, etc. It is built by using NAND Gate because of high density.

Optical Disk:

Optical memory is a non-volatile secondary storage medium. It is a flat round disk. It is made of plastic polycarbonate material coated with aluminum alloy and a very fine laser beam is projected on the reflecting surface to read data from the disk. The intensity of the reflected light of the laser changes as it encounters a pit and land. The land reflects higher intensity light than pit. The higher and less intensity light is translated as 1 and 0 respectively to the digital circuit of the computer.



Optical memory is very useful for the distribution of large amount of data to a large number of users. It can be easily transferred from one place to another place as it is small in size and is not attached to computer like hard disk.

Types of Optical Disk:

1. CD:

CD Stands For "Compact Disk" And It Has The Following Types:

❖ **CD-ROM:**

CD-ROM stands for "Compact Disk Read Only Memory". Because of the optical storage medium, laser beam is used to access data from the disk. It can store about 700 MB of data or 80 minutes of video or audio. CD-ROM technology is very useful for distributing large amount of data like computer software, movies, audio or video songs at low cost to large number of users. CD-ROM cannot be written again once they are written. The users cannot write new data or modify the existing data to the CD-ROMs.

❖ **CD-R:**

CD-R stands for "Compact Disk Recordable" and initially it is a blank disk. Unlike CD-ROM, it can be written only once with the laser beam by using a special device called CD-Writer or Burner. It is also, called WORM "Write Once Read Many" optical memory device. After it is written, it cannot be erased or modified. Hence, it is very useful for storage of large volume of data and file permanently.

❖ **CD-RW:**

CD-RW stands for "Compact Disk ReWritable". As the name suggests, it can be erased and written many times like magnetic disk. It also needs a special device called CD-Writer to write into it. The main advantage of CD-RW is that it can be erased and re-written.

2. DVD:

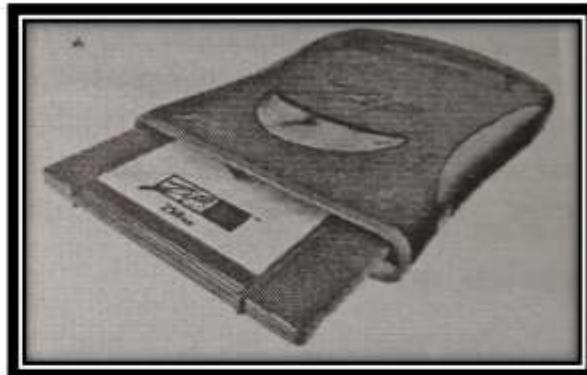
DVD stands for "Digital Versatile Disk" or "Digital Video Disk". It is also a type of optical memory device which has a very large storage capacity. It is also considered as the improved form of CD-ROM. DVD also uses the same technology as a CD-ROM for reading and writing data.

DVD delivers movies with impressive picture and sound quality and it can be randomly accessed like audio CDs by a DVD drive or DVD player. Because of its huge storage capacity and vivid picture quality, movies, PC games, educational software, encyclopedia etc. are being stored and distributed to a large number of people. It is also available in the form of DVD-ROM, DVD-R, and DVD-RW.



External Storage Device:

The storage devices which are not permanently attached to the computer system are called external storage devices. External storage devices are especially used to back up the important data and programs and to transfer them from one computer to another computer.



The examples of external storage devices are Removable Hard Disk, Pen drive, Zip drive, Jazz drive etc. The external Hard disk is also a type of External Storage Device. These devices generally have cord to attach with computer system, through which data and information is transmitted to and from computer.

RAID (Redundant Array of Independent Disks):

RAID (Redundant Array of Independent Disks; originally redundant array of inexpensive disks) is a way of storing the same data in different places (thus redundantly) on multiple hard disks. By placing data on multiple disks, input/output operations can overlap in a balanced way, improving performance.



Since multiple disks increases the main time between failures "MTBF", storing data redundantly also increases fault tolerance. A RAID appears to the operating system to be a single logical hard disk. RAID employs the technique disk striping, which involves partitioning each drive's storage space into units ranging from a sector (512 bytes) up to several megabytes. The strips of all the disks are interleaved and addressed in order.

In a single user system where records, such as medical or other scientific images, are stored the strips are typically set up to be small (perhaps 512 bytes) so that a single record spans all disks and can be accessed quickly by reading all disks at the same time.

In a multi-user system, better performance requires establishing a stripe wide enough to hold the typical or maximum size record. This allows overlapped disk input/output across drives.

Types of RAID:

❖ RAID-0:

This technique has striping but no redundancy of data. It offers the best performance but no fault-tolerance.

❖ RAID-1:

This type is also known as disk mirroring and consists of at least two drives that duplicate the storage of data. There is no striping. Read performance is improved since either disk can be read at the same time. Write performance is the same as for single disk storage. RAID-1 provides the best performance and the best fault-tolerance in a multi-user system.

❖ RAID-2:

This type uses striping across disks with some disks storing error checking and correcting (ECC) information. It has no advantages over RAID-3.

❖ RAID-3:

This type uses striping and dedicates one drive to storing parity information. The embedded error checking (ECC) information is used to detect errors. Data recovery is accomplished by calculating the exclusive-OR (X-OR) of the information recorded on the drives. Since an input/output operation addresses all drives at the same time, RAID-3 correct overlap input/output. For this reason, RAID-3 is best for single-user system with long record application.

❖ RAID-4:

This type of RAID uses large stripe, which means we can read records from any single drive. This allows us to take advantages of overlapped input/output for read operations.

Since all write operations have to update the parity drive, no input/output overlapping is possible, RAID-4 offers no advantages over RAID-5.

❖ **RAID-5:**

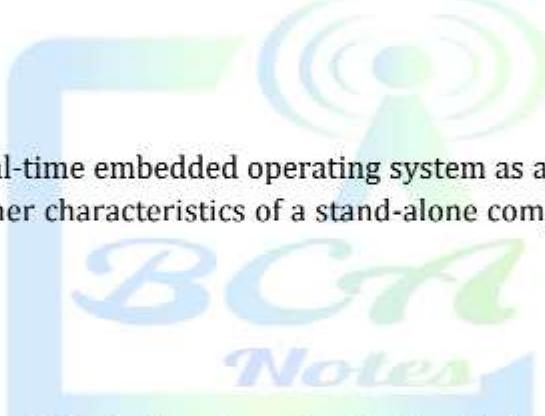
This type includes a rotating parity array, thus addressing the write limitation in RAID-4. Thus, all read and write operations can be overlapped. RAID-5 stores parity information but not redundant data (but parity information can be used to reconstruct data). RAID-5 requires at least three and usually five disks for the array. It's best for multi-user systems in which performance is not critical or which do few write operations.

❖ **RAID-6:**

This type is similar to RAID-5 but includes a second parity scheme that is distributed across different drives and thus offers extremely high fault and drive failure tolerance.

❖ **RAID-7:**

This type includes a real-time embedded operating system as a controller, caching via a high-speed bus, and other characteristics of a stand-alone computer. One vendor offers this system.



❖ **RAID-10:**

Combining RAID-0 and RAID-1 is offered to as RAID-10, which offers higher performance than RAID-1 but at much higher cost. There are two subtypes: In RAID-0+1, data is organized as stripes across multiple disks, and then the striped disk sets are mirrored. In RAID-0+1, the data is mirrored and the mirrors are striped.

❖ **RAID-50 (or RAID-5+0):**

This type consists of a series of RAID-5 groups and striped in RAID-0 fashion to improve RAID-5 performance without reducing data protection.

❖ **RAID-53 (or RAID-5+3):**

This type uses striping (in RAID-0 Style) for RAID-3's virtual disk blocks. This offers higher performance than RAID-3, but at much higher cost.

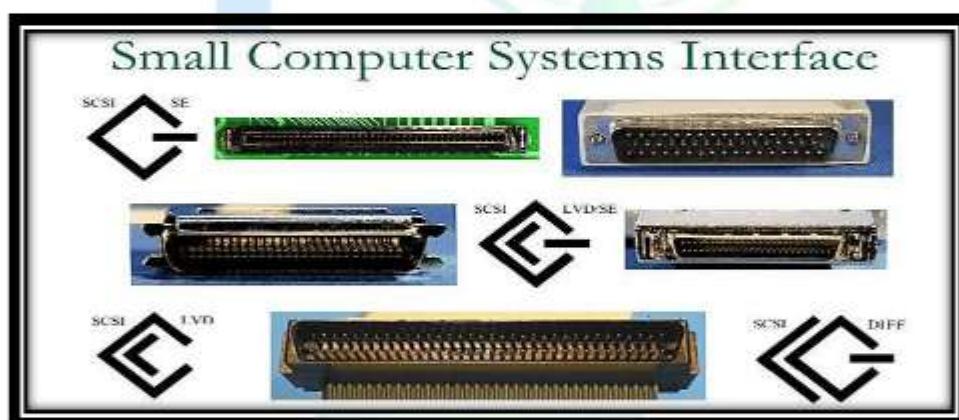
❖ **RAID-S (also known as Parity RAID):**

This is an alternate, proprietary method for striped parity RAID from EMC symmetric that is no longer in use on current equipment. It appears to be similar to RAID-5 with some performance enhancements as well as the enhancements that come from having a high-speed disk cache on the disk array.

SCSI (Small Computer System Interface):

Small Computer System Interface is a set of standards for physically connecting and transferring data between computers and peripherals devices. The SCSI standards define commands, protocols, and electrical and optical interfaces.

SCSI is most commonly used for hard disks and tape drives, but it can connect a wide range of other devices, including scanners and CD drives. The SCSI standard defines command sets for specific peripheral device types: the presence of "unknown" as one of these types means that in theory it can be used as an interface to almost any device, but the standard is highly pragmatic and addressed toward commercial requirements.



SCSI is an intelligent, peripheral, buffered, peer to peer interface. It hides the complexity of physical format. Every device attaches to the SCSI bus in a similar manner. Up to 8 or 16 devices can be attached to a single bus. There can be any number of hosts and peripheral devices but there should be at least one host.

SCSI uses handshake signals between devices, SCSI-1, SCSI-2 have the option of parity error checking. Starting with SCSI-U160 (part of SCSI-3) all commands and data are error checked by a CRC32 checksum. The SCSI protocol defines communication from host to host, host to a peripheral device, and peripheral devices to a peripheral device.

However, most peripheral devices are exclusively SCSI targets, incapable of acting as SCSI initiators unable to initiate SCSI transactions themselves. Therefore peripherals-to-peripheral communications are uncommon, but possible in most SCSI applications. The Symbioses Logic 53C810 chip is an example of a PCI host interface that can act as a SCSI target.

