Basic Concepts of Computer

Computer is an electronic device which is used to store the data, as per given instructions it gives results quickly and accurately.

COMPUTER : Computer is an electronic machine which processes raw data to give meaningful informations.

It accepts information(in the form of digitalized data) and manipulates it for some result based on a program.

- Data : Data is a raw material of information.
- Information : Proper collection of the data is called information.

Characteristics of Computer

1. Speed: - As you know computer can work very fast. It takes only few seconds for calculations that we take hours to complete. You will be surprised to know that computer can perform millions (1,000,000) of instructions and even more per second.

2. Accuracy: - The degree of accuracy of computer is very high and every calculation is performed with the same accuracy. The accuracy level is 7

determined on the basis of design of computer. The errors in computer are due to human and inaccurate data.

3. Diligence: - A computer is free from tiredness, lack of concentration, fatigue, etc. It can work for hours without creating any error. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy. Due to this capability it overpowers human being in routine type of work.

4. Versatility: - It means the capacity to perform completely different type of work. You may use your computer to prepare payroll slips. Next moment you may use it for inventory management or to prepare electric bills.

5. Power of Remembering: - Computer has the power of storing any amount of information or data. Any information can be stored and recalled as long as you require it, for any numbers of years. It depends entirely upon you how much data you want to store in a computer and when to lose or retrieve these data.

6. No IQ: - Computer is a dumb machine and it cannot do any work without instruction from the user. It performs the instructions at tremendous speed and with accuracy. It is you to decide what you want to do and in what sequence. So a computer cannot take its own decision as you can.

7. No Feeling: - It does not have feelings or emotion, taste, knowledge and experience. Thus it does not get tired even after long hours of work. It does not distinguish between users.

8. Storage: - The Computer has an in-built memory where it can store a large amount of data. You can also store data in secondary storage devices such as floppies, which can be kept outside your computer and can be carried to other computers.

History and Evolution of Computers

The word COMPUTER was first used in a book named as ”The Young Mans Gleanings” written by English writer Richard Braithwait. “I haue read the truest computer of Times, and the best Arithmetician that euer breathed, and he reduceth thy dayes into a short number” is the line taken from that book which first used the word COMPUTER.

The answer to the question “Who invented the computer?” is not a simple one. Because it is not a single machine but a collection of different complicated parts,so development of each part can be considered as a separate invention. Many Scientists have contributed to the history of computers. Let us go through various computing devices which were developed prior to the existing computer.

Abacus

Many centuries ago when man started to count the numbers, he thought of a device which can trace the numbers and thus came the existence of ABACUS. It was the first counting device which was developed in China more than 3000 years ago. The name Abacus was obtained from Greek word Abax which means slab. This device basically consists of a rectangular wooden frame and beads.

Napier ’s Bones

It is a device which contains a set of rods made of bones. It was developed by John Napier, a Scottish Mathematician and hence the device was named as Napier’s Bones. The device was mainly developed for performing multiplication and division. Later in 1614 he also introduced logarithms.

Pascaline

Pascaline is a calculating machine developed by Blaise Pascal, a French Mathematician. It was the first device with an ability to perform additions and subtractions on whole numbers. The device is made up of interlocked cog wheels which contains numbers 0 to 9 on its circumference. When one wheel completes its rotation the other wheel moves by one segment. Pascal patented this device in 1647 and produced it on mass scale and earned a handful of money.

Punched Card System

Punched Card System is used for storing and retrieving data. This was invented by Herman Hollerith, an American Statistician in US Census Bureau. The system stores the data coded in the form of punched Tabulator

Herman Hollerith also invented Tabulator which was the first step towards programming. The first tabulator which he invented in 1890 was used to operate only on 1890 census cards. As he was a statistician in census bureau, he developed devices to simplify the tasks related to his department.

Later in 1906, Type 1 tabulator was developed with a plug board control panel which allowed it to do different jobs without being rebuilt. His inventions were the basis for the modern information processing industry.

Digital Era

Coming to the digital era, Binary system made its entry into the computer world. According to this system, 0's and 1's were used. This system was suggested by Claude Shannon, an American Mathematician.

The first electronic computer was built by Dr. John Vincent Atanasoff, a Physics Professor and Clifford Berry. The computer was names as ABC(Atanasoff-Berry Computer). This computer used vacuum tubes for data storage. It was designed mainly for solving systems of simultaneous equations.

In 1946, General Purpose Computer was developed which contained 18000 valves and used to consume 100kilowatts of power and weighted several tonnes.

Transistors

In 1947, Transistors were introduced into the computers. With the introduction of transistors, computations were simpler and faster.

Computer Generations:-

First Gernation Computers 1942 to 1959 (Vacuum Based)

This first generation computers utilized vacuum tubes and magnetic cores. Use of magnetic drum for primary storage. Heat and size problems. Magnetic tape replaced punched cards as secondary storage. Programmed in machine language. The use of the vacuum tube in computers is usually regarded as the beginning of the computer age. Some examples are IBM 650 & 701, UNIVAC, EDVAC and ENIAC.

Characteristics

1. Based on vacuum technology
2. Only machine language is supported
3. Costly and unreliable
4. Bigger size and portability issues
5. Heat generation issues
6. Slow input / output devices

Second Generation of Computers 1959 to 1965 (Transistor Based)

Use of solid state components (transistors and diodes). Smaller in size compare to 1st generation faster processing speeds. Increased memory with faster access times. In primary storage magnetic core were used and magnetic tape for secondary storage. Programmed in high level machine or symbolic language like FORTRAN, COBOL. The computers used multi programming operating system. Examples of Second generation of computers are IBM 1620, IBM 7094, CDC 1604 & 3600 and UNIVAC 1108

Characteristics

1. More reliable than 1st generation computers
2. Used assembly languages

3. Improved accuracy
4. Data calculated in microseconds
5. Costly
6. Air Condition needed
7. Maintenance required
8. Heating issues existed

Third Generation of Computers 1965 to 1970 (Integrated Circuit)

In third generation computers integrated circuit took place of transistors where an IC has many transistors, resistors. Jack Kilby invited the circuit. This development Increased input/output, processing and storage capabilities. The time frame was measured in nanoseconds and then picoseconds, and computer memory became volatile. Time sharing and multiprogramming problem and procedure oriented programming languages. Minicomputers came into widespread use. Examples of third computer generation PDP (personal Data Processor), IBM 360 Series UNIVAC 1106 / 1108, Honeywell 6000 series

Characteristics

1. Integrated circuits were used
2. Reliable and smaller in size
3. Increased commercial production
4. Costly
5. Lesser electricity and maintenance
6. A.C needed
7. High level languages
8. Used for general purpose
9. Mouse and Keywords were used as Input devices

Fourth Generation Computers 1970 – 1980 (VLSI Microprocessor)

The computers of fourth generation based on Very Large Scale Integrated Circuits VLSI. VLSI circuits with 5000 transistors in a single chip which made possible the microcomputers of fourth generation. The very first microprocessor produced by Ted Hoff and introduced by in November 1971 as Intel 4004 to the general public. This generation computer are more powerful, reliable and more affordable than the previous one. It gave birth to the personal computer revolution. The

examples of fourth generation computers are CRAY-1 & CRAY X-MP (Super Computers), Apple, IBM and Macintosh.

Characteristics

1. VLSI technology were used
2. Very Cheap, reliable and portable
3. Virtual memory
4. Distributed operating system
5. Revolution of Personal Computers
6. Compact design
7. Internet concept introduced
8. No Air condition needed
9. Development in computer networks
10. Easily available to general public
11. High level languages used C, C++ and DBASE etc.

Fifth Generation of Computers 1980-Onward (ULSI Microprocessor)

In the fifth computer generation upgraded to Ultra Large Scale Integration (ULSI) circuits. This development became possible of microprocessor chip development having millions of electronics components. 5th Generation Computers capable of reasoning, learning, making inferences, and otherwise behaving in ways usually considered the exclusive province of humans. These machines were equipped with massive primary storage capabilities and extremely fast processing speeds Software was proliferated and got much cheaper. This generation is based on Artificial Intelligence (AI). The examples of fifth generation computers are Laptops, Desktops, Note and Ultra Books.

Characteristics

1. ULSI Circuits
2. Based on parallel processing
3. Based on Artificial Intelligence (IA)
4. Based on Neutral Language Processing
5. User friendly interface
6. More compact design
7. Cheaper Rates and availability to General Public

8. In 5th generation High Level Languages are using like Java, C++ etc.

Classification of Computers:-

Computers differ based on their data processing abilities. They are classified according to purpose, data handling and functionality.

According to purpose, computers are either general purpose or specific purpose. General purpose computers are designed to perform a range of tasks. They have the ability to store numerous programs, but lack in speed and efficiency. Specific purpose computers are designed to handle a specific problem or to perform a specific task. A set of instructions is built into the machine.

According to data handling, computers are analog, digital or hybrid. Analog computers work on the principle of measuring, in which the measurements obtained are translated into data. Modern analog computers usually employ electrical parameters, such as voltages, resistances or currents, to represent the quantities being manipulated. Such computers do not deal directly with the numbers. They measure continuous physical magnitudes. Digital computers are those that operate with information, numerical or otherwise, represented in a digital form. Such computers process data into a digital value (in 0s and 1s). They give the results with more accuracy and at a faster rate. Hybrid computers incorporate the measuring feature of an analog computer and counting feature of a digital computer. For computational purposes, these computers use analog components and for storage, digital memories are used.

According to functionality, computers are classified as :

Analog Computer

An analog computer (spelt analogue in British English) is a form of computer that uses continuous physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved.

Digital Computer

A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system

Hybrid Computer (Analog + Digital)

A combination of computers those are capable of inputting and outputting in both digital and analog signals. A hybrid computer system setup offers a cost effective method of performing complex simulations.

On the basis of Size

Super Computer

Mainframe Computer

A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously. In the hierarchy that starts with a simple microprocessor (in watches, for example) at the bottom and moves to supercomputers at the top, mainframes are just below supercomputers. In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.

Mini Computer

A midsized computer. In size and power, minicomputers lie between workstations and mainframes. In the past decade, the distinction between large minicomputers and small mainframes has blurred, however, as has the distinction between small minicomputers and workstations. But in general, a minicomputer is a multiprocessing system capable of supporting from 4 to about 200 users simultaneously.

Micro Computer or Personal Computer

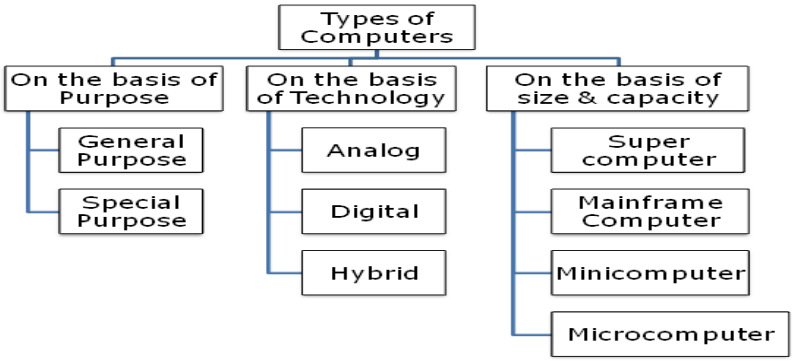
• Desktop Computer: a personal or micro-mini computer sufficient to fit on a desk.

• Laptop Computer: a portable computer complete with an integrated screen and keyboard. It is generally smaller in size than a desktop computer and larger than a notebook computer.

• Palmtop Computer/Digital Diary /Notebook /PDAs: a hand-sized computer. Palmtops have no keyboard but the screen serves both as an input and output device.

Workstations

A terminal or desktop computer in a network. In this context, workstation is just a generic term for a user's machine (client machine) in contrast to a "server" or "mainframe."



Application of Computers:-

Education :

Getting the right kind of information is a major challenge as is getting information to make sense. College students spend an average of 5-6 hours a week on the internet.Research shows that computers can significantly enhance performance in learning. Students exposed to the internet say they think the web has helped them improve the quality of their academic research and of their written work. One revolution in education is the advent of distance learning. This offers a variety of internet and video-based online courses.

Health and Medicine :

Computer technology is radically changing the tools of medicine. All medical information can now be digitized. Software is now able to computer the risk of a disease. Mental health researchers are using computers to screen troubled teenagers in need of psychotherapy. A patient paralyzed by a stroke has received an implant that allows communication between his brain and a computer; as a result, he can move a cursor across a screen by brainpower and convey simple messages.

Science :

Scientists have long been users of it. A new adventure among scientists is the idea of a “collaboratory”, an internet based collaborative laboratory, in which researchers all over the world can work easily together even at a distance. An example is space physics where space physicists are allowed to band together to measure the earth’s ionosphere from instruments on four parts of the world.

Business :

Business clearly see the interest as a way to enhance productivity and competitiveness. Some areas of business that are undergoing rapid changes are sales and marketing, retailing, banking, stock trading, etc. Sales representatives not only need to be better educated and more knowledgeable about their customer's businesses, but also must be comfortable with computer technology. The internet has become a popular marketing tool. The world of cybercash has come to banking – not only smart cards but internet banking, electronic deposit, bill paying, online stock and bond trading, etc.

Recreation and Entertainment:

Our entertainment and pleasure-time have also been affected by computerization. For example:

i) In movies, computer generated graphics give freedom to designers so that special effects and even imaginary characters can play a part in making movies, videos, and commercials.

ii) In sports, computers compile statistics, sell tickets, create training programs and diets for athletes, and suggest game plan strategies based on the competitor's past performance.

iii) In restaurants, almost every one has eaten food where the clerk enters an order by indicating choices on a rather unusual looking cash register; the device directly enters the actual data into a computer, and calculates the cost and then prints a receipt.

Government:

Various departments of the Government use computer for their planning, control and law enforcement activities. To name a few – Traffic, Tourism, Information & Broadcasting, Education, Aviation and many others.

Defence:

There are many uses computers in Defence such as:

1) Controlling UAV or unmanned air-crafts an example is Predator. If you have cable I would recommend watching the shows "Future Weapons" and "Modern Marvels". The show future weapon gives an entire hour to the predator.

2) They are also used on Intercontinental Ballistic Missiles (ICBMs) that uses GPS and Computers to help the missile get to the target.

3) Computers are used to track incoming missiles and help slew weapons systems onto the incoming target to destroy them.

4) Computers are used in helping the military find out where all their assets are (Situational Awareness) and in Communications/Battle Management Systems.

5) Computers are used in the logistic and ordering functions of getting equipments to and around the battlefield.

6) Computers are used in tanks and planes and ships to target enemy forces, help run the platform and more recently to help diagnose any problems with the platforms.

7) Computers help design and test new systems.

Sports:

Analyzing Movements

The best athletes pay close attention to detail. Computers can slow recorded video and allow people to study their specific movements to try to improve their tendencies and repair poor habits.

Writers

Many sportswriters attend several sporting events a week, and they take their computers with them to write during the game or shortly after while their thoughts are fresh in their mind.

Scoreboard

While some scoreboards are manually updated, most professional sports venues have very modern scoreboards that are programmed to update statistics and information immediately after the information is entered into the computer.

Safety

Computers have aided in the design of safety equipment in sports such as football helmets to shoes to mouth guards

Input Devices:-

Following are some of the important input devices which are used in a computer −

- Keyboard
- Mouse
- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader(MICR)
- Optical Character Reader(OCR)
- Bar Code Reader
- Optical Mark Reader(OMR)

Keyboard

Keyboard is the most common and very popular input device which helps to input data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions. Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

Mouse

Mouse is the most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base, which senses the movement of the mouse and sends corresponding signals to the CPU when the mouse buttons are pressed.

Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

Light Pen

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube.

Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved.

Scanner

Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation.

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 in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at.

Microphone

Microphone is an input device to input sound that is then stored in a digital form.

Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks as there are large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.

OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.

Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a handheld scanner or may be embedded in a stationary scanner.

Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

Output Devices:-

Following are some of the important output devices used in a computer.

- Monitors
- Graphic Plotter
- Printer

Monitors

Monitors, commonly called as Visual Display Unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

- Cathode-Ray Tube (CRT)
- Flat-Panel Display

Cathode-Ray Tube (CRT) Monitor

The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity or resolution. It takes more than one illuminated pixel to form a whole character, such as the letter ‘e’ in the word help.

Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, and graphics display.

The flat-panel display is divided into two categories −

- Emissive Displays − Emissive displays are devices that convert electrical energy into light. For example, plasma panel and LED (Light-Emitting Diodes).
- Non-Emissive Displays − Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. For example, LCD (Liquid-Crystal Device).

Printers

Printer is an output device, which is used to print information on paper.

There are two types of printers −

- Impact Printers
- Non-Impact Printers

Impact Printers

Impact printers print the characters by striking them on the ribbon, which is then pressed on the paper.

Characteristics of Impact Printers are the following −

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

These printers are of two types −

- Character printers

- Line printers

Character Printers

Character printers are the printers which print one character at a time.

These are further divided into two types:

- Dot Matrix Printer(DMP)
- Daisy Wheel

Dot Matrix Printer

In the market, one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in the form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character which is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages

- Slow Speed
- Poor Quality

Daisy Wheel

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower) which is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices that require a few letters to be sent here and there with very nice quality.

Advantages

- More reliable than DMP

- Better quality
- Fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

Line Printers

Line printers are the printers which print one line at a time.

These are of two types −

- Drum Printer
- Chain Printer

Drum Printer

This printer is like a drum in shape hence it is called drum printer. The surface of the drum is divided into a number of tracks. Total tracks are equal to the size of the paper, i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on the track. Different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters fonts cannot be changed

Chain Printer

In this printer, a chain of character sets is used, hence it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

Disadvantages

- Noisy

Non-impact Printers

Non-impact printers print the characters without using the ribbon. These printers print a complete page at a time, thus they are also called as Page Printers.

These printers are of two types −

- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

- Faster than impact printers
- They are not noisy
- High quality
- Supports many fonts and different character size

Laser Printers

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

Advantages

- Very high speed
- Very high quality output

- Good graphics quality
- Supports many fonts and different character size

Disadvantages

- Expensive
- Cannot be used to produce multiple copies of a document in a single printing

Inkjet Printers

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done and these have many styles of printing modes available. Color printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

Advantages

- High quality printing
- More reliable

Disadvantages

- Expensive as the cost per page is high
- Slow as compared to laser printer

COM:-

Computer Output Microfilm (COM) is a system that converts stored data directly to microfilm or microfiche. I know around ten people who used to sell Bell & Howell Computer Output Microfilm systems as far back as the 1960s to the 1980s. It almost seems to be a prerequisite for salespeople in the micrographics industry from that era.

COM recorder

Computer Output Microfilm systems are still used today, mostly by organizations who 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.

CPU:-

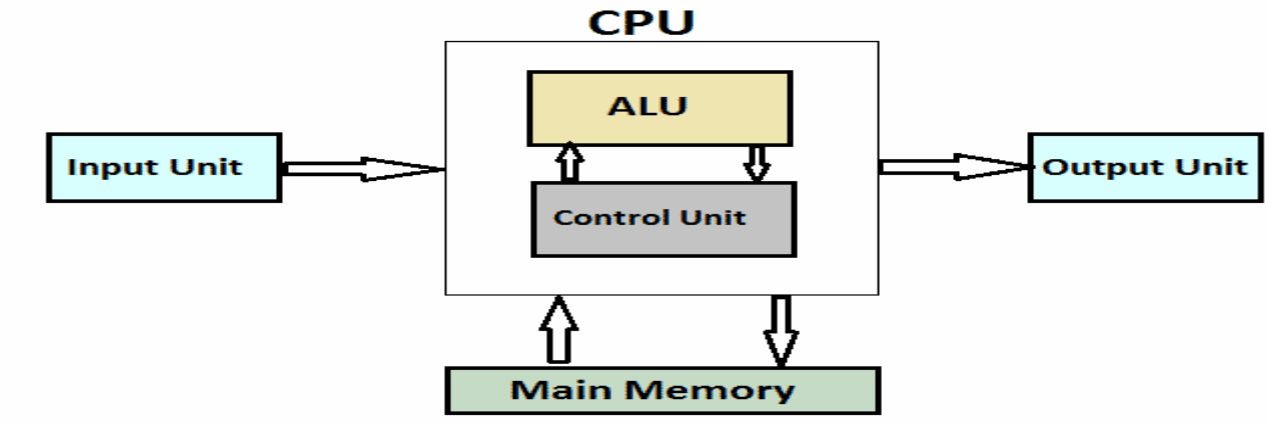
The full form of CPU is Central Processing Unit. Alternatively, it is also known by the name of processor, microprocessor or a computer processor. A CPU is an electronics circuit used in a computer that fetches the input instructions or commands from the memory unit, performs arithmetic and logic operations and stores this processed data back to memory.

A CPU or Central Processing Unit is the heart of a computer and is installed in a socket specified on a motherboard. Since a CPU performs a lot of calculations at a high speed, it gets heat up quickly. To cool down the temperature of a CPU a cooling FAN is installed on it.

Description

- It's a microprocessor chip developed by Intel, AMD or any other company.
- CPU speed depends upon the clock frequency, higher the clock frequency more number of instructions can be executed per second.
- Clock frequency is measured in MHz or GHz.
- CPU word size is the largest number of bits that can be handled by CPU in one clock cycle. It is either 8, 16, 32, 64 or 128 bit.
- This word size value determines number of bit processor i.e. 8-bit processor, 16-bit processor, 32 bit processor etc.
- CPU performance also depends upon the RAM, bus speed and cache size as well.
- Called as heart of the computer.

Block diagram



Control Unit

The Control Unit is an internal part of a CPU that co-ordinates the instructions and data flow between CPU and other components of the computer. It is the CU that directs the operations of a central processing unit by sending timing and control signals.

Arithmetic Logic Unit

The ALU is an internal electronic circuitry of a CPU that performs all the arithmetic and logical operations in a computer. The ALU receives three types of inputs.

- Control signal from CU (Control Unit)
- Data(operands) to be operated
- Status information from operations done previously.

When all the instructions have been operated, the output that consists of data is stored in memory and a status information is stored in internal registers of a CPU.

Working of a CPU

All the CPUs regardless of their origin or type performs a basic instruction cycle that consists of three steps named Fetch, decode and Execute

Fetch

A program consists of a number of instructions. Various programs are stored in memory. During this step, the CPU reads instruction that is to be operated from a particular address in the memory. The program counter of CPU keeps the record of address of the instructions.

Decode

A circuitry called instruction decoder decodes all the instructions fetched from the memory. The instructions are decoded to various signals that control other areas of CPU.

Execute

In the last step, the CPU executes the instruction. For example, it stores a value in the particular register and the instruction pointer then points to other instruction that is stored in next address location.

Clock Speed

The speed of processor is measured by the number of clock cycles a CPU can perform in a second. The more the number of clock cycles, the more number of instructions (calculations) it can carry out. The CPU speed is measured in Hertz. Modern Day processors have speed units of GHz. (1GHz=1 million thousand cycles per second).

CPU Manufacturers

The 3 major giant manufacturers of CPUs used in desktop or laptops are Intel, AMD and VIA(Embedded devices) while Qualcomm, Samsung and Apple are the top three manufacturers of mobile processors.

Memory:-

A memory is just like a human brain. It is used to store data and instructions. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored. The memory is divided into large number of small parts called cells. Each location or cell has a unique address, which varies from zero to memory size minus one. For example, if the computer has 64k words, then this memory unit has 64 * 1024 = 65536 memory locations. The address of these locations varies from 0 to 65535.

Memory is primarily of three types −

- Cache Memory
- Primary Memory/Main Memory
- Secondary Memory

Cache Memory

Cache memory is a very high speed semiconductor memory which can speed up the CPU. It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU. The parts of data and programs are transferred from the disk to cache memory by the operating system, from where the CPU can access them.

Advantages

The advantages of cache memory are as follows −

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores the program that can be executed within a short period of time.
- It stores data for temporary use.

Disadvantages

The disadvantages of cache memory are as follows −

- Cache memory has limited capacity.
- It is very expensive.

Primary Memory (Main Memory)

Primary memory holds only those data and instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed resides in the main memory. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories.
- It is known as the main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is the working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without the primary memory.

Secondary Memory

This type of memory is also known as external memory or non-volatile. It is slower than the main memory. These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, disk, CD-ROM, DVD, etc.

RAM:-

RAM (Random Access Memory) is the internal memory of the CPU for storing data, program, and program result. It is a read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address, that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time. Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence, a backup Uninterruptible Power System (UPS) is often used with computers. RAM is small, both in terms of its physical size and in the amount of data it can hold.

RAM is of two types −

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

Static RAM (SRAM)

The word static indicates that the memory retains its contents as long as power is being supplied. However, data is lost when the power gets down due to volatile nature. SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not be refreshed on a regular basis.

There is extra space in the matrix, hence SRAM uses more chips than DRAM for the same amount of storage space, making the manufacturing costs higher. SRAM is thus used as cache memory and has very fast access.

Characteristic of Static RAM

- Long life
- No need to refresh
- Faster
- Used as cache memory
- Large size
- Expensive
- High power consumption

Dynamic RAM (DRAM)

DRAM, unlike SRAM, must be continually refreshed in order to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second. DRAM is used for most system memory as it is cheap and small. All DRAMs are made up of memory cells, which are composed of one capacitor and one transistor.

Characteristics of Dynamic RAM

- Short data lifetime
- Needs to be refreshed continuously
- Slower as compared to SRAM
- Used as RAM
- Smaller in size
- Less expensive
- Less power consumption

ROM:-

ROM stands for Read Only Memory. The memory from which we can only read but cannot write on it. This type of memory is non-volatile. The information is stored permanently in such memories during manufacture. A ROM stores such instructions that are required to start a computer. This operation is referred to as bootstrap. ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.

Let us now discuss the various types of ROMs and their characteristics.

MROM (Masked ROM)

The very first ROMs were hard-wired devices that contained a pre-programmed set of data or instructions. These kind of ROMs are known as masked ROMs, which are inexpensive.

PROM (Programmable Read Only Memory)

PROM is read-only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM program. Inside the PROM chip, there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

EPROM (Erasable and Programmable Read Only Memory)

EPROM can be erased by exposing it to ultra-violet light for a duration of up to 40 minutes. Usually, an EPROM eraser achieves this function. During programming, an electrical charge is trapped in an insulated gate region. The charge is retained for more than 10 years because the charge has no leakage path. For erasing this charge, ultra-violet light is passed through a quartz crystal window (lid). This exposure to ultra-violet light dissipates the charge. During normal use, the quartz lid is sealed with a sticker.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 ms (millisecond). In EEPROM, any location can be selectively erased and programmed. EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of reprogramming is flexible but slow.

Advantages of ROM

The advantages of ROM are as follows −

- Non-volatile in nature
- Cannot be accidentally changed
- Cheaper than RAMs
- Easy to test
- More reliable than RAMs

- Static and do not require refreshing
- Contents are always known and can be verified

Main secoundry memory are:

1. Magnetic Disk
2. Floppy Disk
3. Hard Disk
4. Optical Disks

Magnetic Disk The Magnetic Disk is Flat, circular platter with metallic coating that is rotated beneath read/write heads. It is a Random access device; read/write head can be moved to any location on the platter

Floppy Disk These are small removable disks that are plastic coated with magnetic recording material. Floppy disks are typically 3.5″ in size (diameter) and can hold 1.44 MB of data. This portable storage device is a rewritable media and can be reused a number of times. Floppy disks are commonly used to move files between different computers. The main disadvantage of floppy disks is that they can be damaged easily and, therefore, are not very reliable. The following figure shows an example of the floppy disk. Figure 3 shows a picture of the floppy disk.

Hard Disk Another form of auxiliary storage is a hard disk. A hard disk consists of one or more rigid metal plates coated with a metal oxide material that allows data to be magnetically recorded on the surface of the platters. The hard disk platters spin at 5 a high rate of speed, typically 5400 to 7200 revolutions per minute (RPM).Storage capacities of hard disks for personal computers range from 10 GB to 120 GB (one billion bytes are called a gigabyte).

Optical Disks Optical Mass Storage Devices Store bit values as variations in light reflection. They have higher area density & longer data life than magnetic storage. They are also Standardized and relatively inexpensive. Their Uses: read-only storage with low performance requirements, applications with high capacity requirements & where portability in a standardized format is needed.

Types of Optical Disk

1. CD-ROM (read only)

2. CD-R: (record) to a CD

3. CD-RW: can write and erase CD to reuse it (re-writable)

4. DVD(Digital Video Disk)

Cache Memory

Input- Output operations are very slow. CPU speeds are quite high compared to the access time of main memory. Thus the processor performance is limited by the slow speed of the main memory. To speed up fetching of instructions to CPU, a buffer or cache (pronounced as cash) is used. Normal RAM is expensive and is not fast enough to match the speed of CPU. To reduce the processing time, certain computers use costlier and higher speed memory devices to form a buffer or cache. This technique uses a small memory with extremely fast access speed close to the processing speed of the CPU. This memory is called cache and it stores data and instructions currently required for processing. Cache memory thus makes main memory appear much faster and larger than it really is. It improves the memory transfer rates and thus raises the effective processor speea.

The CPU searches cache before it searches main memory for data and instructions. Cache is physically located close to the CPU and hence access to cache is faster than to any other memory.

Advantages of Cache Memory :
1. Cache memory is faster than main memory.
2. It stores the program that can be executed within a short period of time.
3. It consumes less access time as compared to main memory.
4. It stores data for temporary use.

Disadvantages of Cache Memory :
1. It is very expensive.
2. Cache memory has limited capacity.

Number System:-

Decimal Number System

The number system that we use in our day-to-day life is the decimal number system. Decimal number system has base 10 as it uses 10 digits from 0 to 9. In decimal number system, the successive positions to the left of the decimal point represent units, tens, hundreds, thousands, and so on.

Each position represents a specific power of the base (10). For example, the decimal number 1234 consists of the digit 4 in the units position, 3 in the tens position, 2 in the hundreds position, and 1 in the thousands position. Its value can be written as

(1 x 1000)+ (2 x 100)+ (3 x 10)+ (4 x l)

$(1 \times 10^3)+ (2 \times 10^2)+ (3 \times 10^1)+ (4 \times l0^0)$

1000 + 200 + 30 + 4

1234

As a computer programmer or an IT professional, you should understand the following number systems which are frequently used in computers.

S.No.	Number System and Description
1	Binary Number System Base 2. Digits used : 0, 1
2	Octal Number System Base 8. Digits used : 0 to 7
3	Hexa Decimal Number System Base 16. Digits used: 0 to 9, Letters used : A- F

Binary Number System

Characteristics of the binary number system are as follows −

- Uses two digits, 0 and 1
- Also called as base 2 number system
- Each position in a binary number represents a 0 power of the base (2). Example 2^0
- Last position in a binary number represents a x power of the base (2). Example 2^x where x represents the last position - 1.

Example

Binary Number: 10101_2

Calculating Decimal Equivalent −

Step	Binary Number	Decimal Number

Step 1	10101_2	$((1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0))_{10}$
Step 2	10101_2	$(16 + 0 + 4 + 0 + 1)_{10}$
Step 3	10101_2	21_{10}

Note − 10101_2 is normally written as 10101.

Octal Number System

Characteristics of the octal number system are as follows −

- Uses eight digits, 0,1,2,3,4,5,6,7
- Also called as base 8 number system
- Each position in an octal number represents a 0 power of the base (8). Example 8^0
- Last position in an octal number represents a x power of the base (8). Example 8^x where x represents the last position - 1

Example

Octal Number: 12570_8

Calculating Decimal Equivalent −

Step	Octal Number	Decimal Number
Step 1	12570_8	$((1 \times 8^4) + (2 \times 8^3) + (5 \times 8^2) + (7 \times 8^1) + (0 \times 8^0))_{10}$
Step 2	12570_8	$(4096 + 1024 + 320 + 56 + 0)_{10}$
Step 3	12570_8	5496_{10}

Note − 12570_8 is normally written as 12570.

Hexadecimal Number System

Characteristics of hexadecimal number system are as follows −

- Uses 10 digits and 6 letters, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F
- Letters represent the numbers starting from 10. A = 10. B = 11, C = 12, D = 13, E = 14, F = 15

- Also called as base 16 number system
- Each position in a hexadecimal number represents a 0 power of the base (16). Example, 16^0
- Last position in a hexadecimal number represents a x power of the base (16). Example 16^x where x represents the last position - 1

Example

Hexadecimal Number: $19FDE_{16}$

Calculating Decimal Equivalent −

Step	Binary Number	Decimal Number
Step 1	$19FDE_{16}$	$((1 \times 16^4) + (9 \times 16^3) + (F \times 16^2) + (D \times 16^1) + (E \times 16^0))_{10}$
Step 2	$19FDE_{16}$	$((1 \times 16^4) + (9 \times 16^3) + (15 \times 16^2) + (13 \times 16^1) + (14 \times 16^0))_{10}$
Step 3	$19FDE_{16}$	$(65536 + 36864 + 3840 + 208 + 14)_{10}$
Step 4	$19FDE_{16}$	106462_{10}

There are many methods or techniques which can be used to convert numbers from one base to another. In this chapter, we'll demonstrate the following −

- Decimal to Other Base System
- Other Base System to Decimal
- Other Base System to Non-Decimal
- Shortcut method - Binary to Octal
- Shortcut method - Octal to Binary
- Shortcut method - Binary to Hexadecimal
- Shortcut method - Hexadecimal to Binary

Decimal to Other Base System

Step 1 − Divide the decimal number to be converted by the value of the new base.

Step 2 − Get the remainder from Step 1 as the rightmost digit (least significant digit) of the new base number.

Step 3 − Divide the quotient of the previous divide by the new base.

Step 4 − Record the remainder from Step 3 as the next digit (to the left) of the new base number.

Repeat Steps 3 and 4, getting remainders from right to left, until the quotient becomes zero in Step 3.

The last remainder thus obtained will be the Most Significant Digit (MSD) of the new base number.

Example

Decimal Number: 29_{10}

Calculating Binary Equivalent −

Step	Operation	Result	Remainder
Step 1	29 / 2	14	1
Step 2	14 / 2	7	0
Step 3	7 / 2	3	1
Step 4	3 / 2	1	1
Step 5	1 / 2	0	1

As mentioned in Steps 2 and 4, the remainders have to be arranged in the reverse order so that the first remainder becomes the Least Significant Digit (LSD) and the last remainder becomes the Most Significant Digit (MSD).

Decimal Number : 29_{10} = Binary Number : $11101_{2.}$

Other Base System to Decimal System

Step 1 − Determine the column (positional) value of each digit (this depends on the position of the digit and the base of the number system).

Step 2 − Multiply the obtained column values (in Step 1) by the digits in the corresponding columns.

Step 3 − Sum the products calculated in Step 2. The total is the equivalent value in decimal.

Example

Binary Number: 11101_2

Calculating Decimal Equivalent −

Step	Binary Number	Decimal Number
Step 1	11101_2	$((1 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0))_{10}$
Step 2	11101_2	$(16 + 8 + 4 + 0 + 1)_{10}$
Step 3	11101_2	29_{10}

Binary Number : 11101_2 = Decimal Number : 29_{10}

Other Base System to Non-Decimal System

Step 1 − Convert the original number to a decimal number (base 10).

Step 2 − Convert the decimal number so obtained to the new base number.

Example

Octal Number : 25_8

Calculating Binary Equivalent −

Step 1 - Convert to Decimal

Step	Octal Number	Decimal Number
Step 1	25_8	$((2 \times 8^1) + (5 \times 8^0))_{10}$
Step 2	25_8	$(16 + 5)_{10}$
Step 3	25_8	21_{10}

Octal Number : 25_8 = Decimal Number : 21_{10}

Step 2 - Convert Decimal to Binary

Step	Operation	Result	Remainder
Step 1	21 / 2	10	1
Step 2	10 / 2	5	0
Step 3	5 / 2	2	1
Step 4	2 / 2	1	0
Step 5	1 / 2	0	1

Decimal Number : 21_{10} = Binary Number : 10101_2

Octal Number : 25_8 = Binary Number : 10101_2

Shortcut Method ─ Binary to Octal

Step 1 − Divide the binary digits into groups of three (starting from the right).

Step 2 − Convert each group of three binary digits to one octal digit.

Example

Binary Number : 10101_2

Calculating Octal Equivalent −

Step	Binary Number	Octal Number
Step 1	10101_2	010 101
Step 2	10101_2	2_8 5_8
Step 3	10101_2	25_8

Binary Number : 10101_2 = Octal Number : 25_8

Shortcut Method ─ Octal to Binary

Step 1 − Convert each octal digit to a 3-digit binary number (the octal digits may be treated as decimal for this conversion).

Step 2 − Combine all the resulting binary groups (of 3 digits each) into a single binary number.

Example

Octal Number : 25_8

Calculating Binary Equivalent −

Step	Octal Number	Binary Number
Step 1	25_8	$2_{10}\ 5_{10}$
Step 2	25_8	$010_2\ 101_2$
Step 3	25_8	010101_2

Octal Number : 25_8 = Binary Number : 10101_2

Shortcut Method ─ Binary to Hexadecimal

Step 1 − Divide the binary digits into groups of four (starting from the right).

Step 2 − Convert each group of four binary digits to one hexadecimal symbol.

Example

Binary Number : 10101_2

Calculating hexadecimal Equivalent −

Step	Binary Number	Hexadecimal Number
Step 1	10101_2	0001 0101
Step 2	10101_2	$1_{10}\ 5_{10}$
Step 3	10101_2	15_{16}

Binary Number : 10101_2 = Hexadecimal Number : 15_{16}

Shortcut Method - Hexadecimal to Binary

Step 1 − Convert each hexadecimal digit to a 4-digit binary number (the hexadecimal digits may be treated as decimal for this conversion).

Step 2 − Combine all the resulting binary groups (of 4 digits each) into a single binary number.

Example

Hexadecimal Number : 15_{16}

Calculating Binary Equivalent −

Step	Hexadecimal Number	Binary Number
Step 1	15_{16}	1_{10} 5_{10}
Step 2	15_{16}	0001_2 0101_2
Step 3	15_{16}	00010101_2

Hexadecimal Number : 15_{16} = Binary Number : 10101_2

ALGORITHM

Algorithm

- Set of step-by-step instructions that perform a specific task or operation
- —Natural language NOT programming language

Pseudocode

- Set of instructions that mimic programming language instructions

Flowchart

- Visual program design tool
- —Semantic symbols describe operations to be performed

FLOWCHARTS

Definitions:

A flowchart is a schematic representation of an algorithm or a stepwise process, showing the steps as boxes of various kinds, and their order by connecting these with arrows. Flowcharts are used in designing or documenting a process or program.

A flow chart, or flow diagram, is a graphical representation of a process or system that details the sequencing of steps required to create output.

A flowchart is a picture of the separate steps of a process in sequential order.

TYPES:

High-Level Flowchart

A high-level (also called first-level or top-down) flowchart shows the major steps in a process. It illustrates a "birds-eye view" of a process, such as the example in the figure entitled High-Level Flowchart of Prenatal Care. It can also include the intermediate outputs of each step (the product or service produced), and the sub-steps involved. Such a flowchart offers a basic picture of the process and identifies the changes taking place within the process. It is significantly useful for identifying appropriate team members (those who are involved in the process) and for developing indicators for monitoring the process because of its focus on intermediate outputs.

Most processes can be adequately portrayed in four or five boxes that represent the major steps or activities of the process. In fact, it is a good idea to use only a few boxes, because doing so forces one to consider the most important steps. Other steps are usually sub-steps of the more important ones.

Detailed Flowchart

The detailed flowchart provides a detailed picture of a process by mapping all of the steps and activities that occur in the process. This type of flowchart indicates the steps or activities of a process and includes such things as decision points, waiting periods, tasks that frequently must be redone (rework), and feedback loops. This type of flowchart is useful for examining areas of the process in detail and for looking for problems or areas of inefficiency. For example, the Detailed Flowchart of Patient Registration reveals the delays that result when the record clerk and clinical officer are not available to assist clients.

Deployment or Matrix Flowchart

A deployment flowchart maps out the process in terms of who is doing the steps. It is in the form of a matrix, showing the various participants and the flow of steps among these participants. It is chiefly useful in identifying who is providing inputs or services to whom, as well as areas where different people may be needlessly doing the same task. See the Deployment of Matrix Flowchart.

ADVANTAGES OF USING FLOWCHARTS

The benefits of flowcharts are as follows:

1. Communication: Flowcharts are better way of communicating the logic of a system to all concerned.

2. Effective analysis: With the help of flowchart, problem can be analysed in more effective way.

Proper documentation: Program flowcharts serve as a good program documentation, which is needed for various purposes.

4. Efficient Coding: The flowcharts act as a guide or blueprint during the systems analysis and program development phase.

5. Proper Debugging: The flowchart helps in debugging process.

6. Efficient Program Maintenance: The maintenance of operating program becomes easy with the help of flowchart. It helps the programmer to put efforts more efficiently on that part

Advantages:

- Logic Flowcharts are easy to understand.They provide a graphical representation of actions to be taken.

- Logic Flowcharts are well suited for representing logic where there is intermingling among many actions.

Disadvantages:

- Logic Flowcharts may encourage the use of GoTo statements leadingsoftware design that is unstructured with logic that is difficult to decipher.

- Without an automated tool, it is time-consuming to maintain Logic Flowcharts.

- Logic Flowcharts may be used during detailed logic design to specify a module.

- However, the presence of decision boxes may encourage the use of GoTo statements, resulting in software that is not structured. For this reason, Logic Flowcharts may be better used during Structural Design

LIMITATIONS OF USING FLOWCHARTS

1. Complex logic: Sometimes, the program logic is quite complicated. In that case, flowchart becomes complex and clumsy.

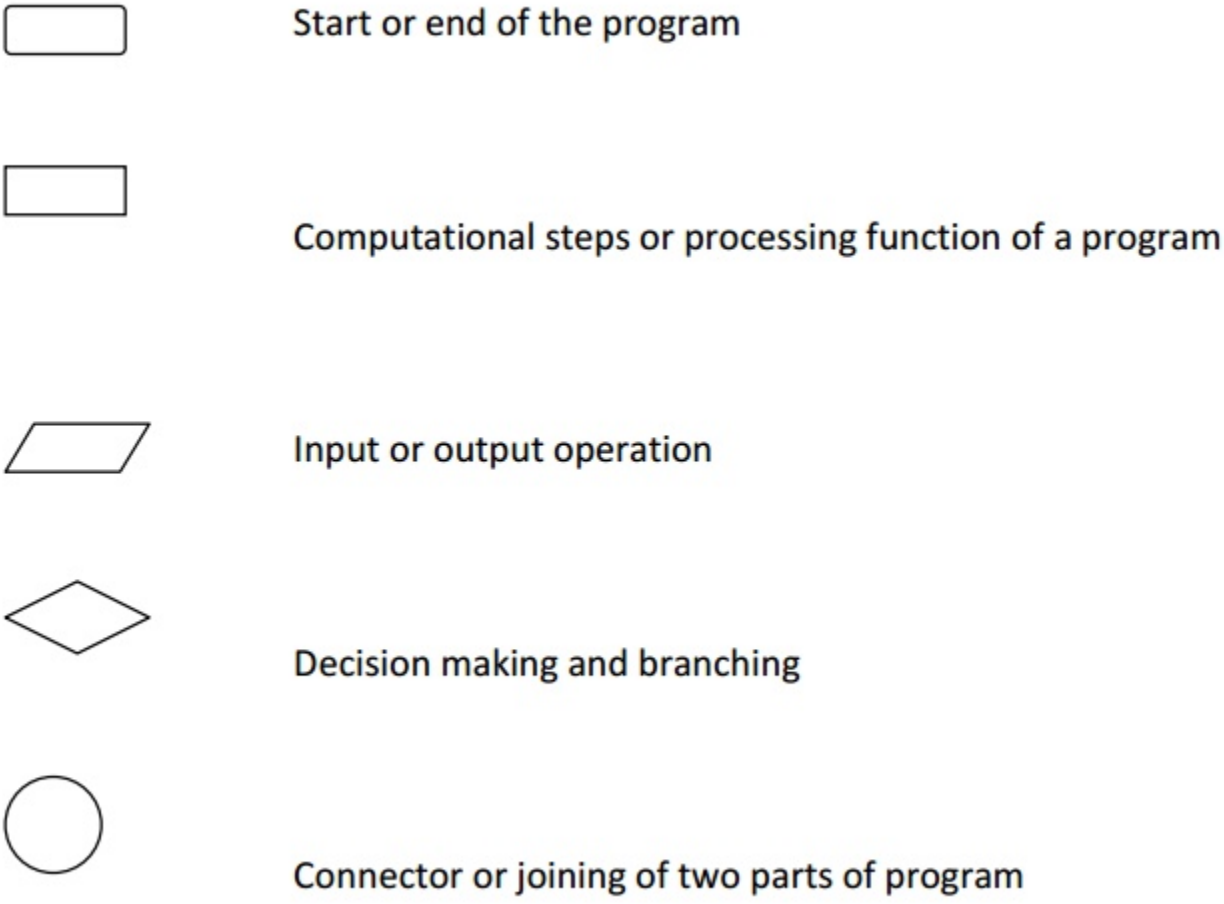
2. Alterations and Modifications: If alterations are required the flowchart may require re-drawing completely.

3. Reproduction: As the flowchart symbols cannot be typed, reproduction of flowchart becomes a problem.

4. The essentials of what is done can easily be lost in the technical details of how it is done.

GUIDELINES FOR DRAWING A FLOWCHART

Flowcharts are usually drawn using some standard symbols; however, some special symbols can also be developed when required. Some standard symbols, which are frequently required for flowcharting many computer programs.



Magnetic Tape

Magnetic Disk

Off-page connector

Flow line

Annotation

Display

GENERATIONS OF PROGRAMMING LANGUAGE

A low-level programming language is a programming language that provides little or no abstraction from computer's microprocessor. A high-level programming language is a programming language that is more abstract, easier to use, and more portable across platforms.

LEVELS OF PROGRAMMING LANGUAGE

FIRST GENERATION OF PROGRAMMING LANGUAGE

The first generation of programming language, or 1GL, is machine language. Machine language is a set of instructions and data that a computer's central processing unit can execute directly. Machine language statements are written in binary code, and each statement corresponds to one machine action.

SECOND GENERATION PROGRAMMING LANGUAGE

The second generation programming language, or 2GL, is assembly language. Assembly language is the human-readable notation for the machine language used to control specific computer operations. An assembly language programmer writes instructions using symbolic instruction codes that are meaningful abbreviations or mnemonics. An assembler is a program that translates assembly language into machine language.

THIRD GENERATION PROGRAMMING LANGUAGE

The third generation of programming language, 3GL, or procedural language uses a series of English-like words, that are closer to human language, to write instructions.

High-level programming languages make complex programming simpler and easier to read, write and maintain. Programs written in a high-level programming language must be translated into machine language by a compiler or interpreter. PASCAL, FORTRAN, BASIC, COBOL, C and C++ are examples of third generation programming languages.

FOURTH GENERATION PROGRAMMING LANGUAGE

The fourth generation programming language or non-procedural language, often abbreviated as 4GL, enables users to access data in a database. A very high-level programming language is often referred to as goal-oriented programming language because it is usually limited to a very specific application and it might use syntax that is never used in other programming languages. SQL, NOMAD and FOCUS are examples of fourth generation programming languages.

FIFTH GENERATION PROGRAMMING LANGUAGE

The fifth generation programming language or visual programming language, is also known as natural language. Provides a visual or graphical interface, called a visual programming environment, for creating source codes. Fifth generation programming allows people to interact with computers without needing any specialised knowledge. People can talk to computers and the voice recognition systems can convert spoken sounds into written words. Prolog and Mercury are the best known fifth-generation languages.

EXT : OPEN PROGRAMMING LANGUAGE

The Open Programming Language (OPL) is an embedded programming language found in portable

devices that run the Symbian Operating System. For example mobile telephones and PDAs. OPL is an interpreted language that is analogous to BASIC.

Feature of a good programming language:-

1. The language must allow the programmer to write simple, clear and concise programs.
2. The language must be simple to use so that a programmer can learn it without any explicit training.
3. The language must be platform independent. That is, the program developed using the programming language can run on any computer system.
4. The Graphical User Interface (GUI) of the language must be attractive, user-friendly, and self-explanatory.
5. The function library used in the language should be well documented so that the necessary information about a function can be obtained while developing application.
6. Several programming constructs supported by the language must match well with the application area it is being used for.
7. The programs developed in the language must make efficient use of memory as well as other computer resources.
8. The language must provide necessary tools for development, testing, debugging, and maintenance of a program. All these tools must be incorporated into a single environment known as Integrated Development Environment (IDE), which enables the programmer to use them easily.
9. The language must be consistent in terms of both syntax and semantics.

These are also Feature of a good programming language:-

1-Naturalness:

A good language should be natural for the application area for which it is designed.That is,it should provide appropriate operators,data structures,control structures and a natural syntax to facilitate programmers to code their problems easily and efficiently.FORTRAN and COBOL are good examples of languages possessing high degree of naturalness in scientific and business application areas,respectively.

2-Abstraction:

Abstraction means ability to define and then use complicated structures or operations in ways that allow many of the details to be ignored.The degree of abstraction allowed by a language directly affects its ease of programming.For Example,object-oriented languages support high degree of abstraction.Hence,writing programs in object-oriented languages is much easier.Object-oriented also support re usability of program segments due to this feature.

3-Efficiency:

Programs written in a good language are translated into machine code efficiently,are executed and require relatively less space in memory.That is,a good programming language is supported with a good language translator (a compiler or an interpreter) that gives due consideration to space and time efficiency.

4-Structured Programming Support:

A good language should have necessary features to allow programmers to write their programs based on the concepts of structured programming.This property greatly affects the ease with which a program may be written.,tested and maintained.More over,it forces a programmer to look at a problem in a logical way so that fewer errors are created while writing a program for the problem.

5-Compactness:

In a good language,programmers should be able to express the intended operations concisely without losing readability.Programmers generally do not like a verbose language because they need to write too much.Many programmers dislike COBOL,because it is verbose in nature (Lacks Compactness)

6-Locality:

A good language should be such that while writing a program,a programmer need not jump around the visually as the text of a program is prepared.This allows the programmer to concentrate almost solely on the part of the program around the statement currently being worked with.COBOL and to some extent C and Pascal lack locality because data definitions are separated from processing statements,perhaps by many pages of code,or have to appear before any processing statement in the function/procedure.

7-Extensibility:

A good language should also allow extensions through a simply,natural and elegant mechanism.Almost all languages provide subprogram definition mechanisms for the purpose,but some languages are weak in this aspect.

8-Suitability to its Environment:

Depending upon the type of application for which a programming language has been designed,the language must also be made suitable to its environment.For Example, a language designed for a real-time

applications must be interactive in nature.On the other hand,languages used for data-processing jobs like payroll,stores accounting etc may be designed to operative in batch mode.

Software Definition:-

Software is a general term for the various kinds of programs used to operate computers and related devices. (The term hardware describes the physical aspects of computers and related devices.)

Software can be thought of as the variable part of a computer and hardware the invariable part. Software is often divided into application software (programs that do work users are directly interested in) and system software (which includes operating systems and any program that supports application software).

Software, in its most general sense, is a set of instructions or programs instructing a computer to do specific tasks. Software is a generic term used to describe computer programs. Scripts, applications, programs and a set of instructions are the terms often used to describe software.

Software is often divided into three categories:

1. System software serves as a base for application software. System software includes device drivers, operating systems (OSs), compilers, disk formatters, text editors and utilities helping the computer to operate more efficiently. It is also responsible for managing hardware components and providing basic non-task specific functions. The system software is usually written in C programming language.

2. Programming software is a set of tools to aid the developers to write programs. The various tools available are compilers, linkers, debuggers, interpreters and text editors.

3. Application software is intended to perform certain tasks. Examples of application software include office suites, gaming applications, database systems and educational software. Application software can be a single program or a collection of small programs.

Relationship between software and hardware:-

A computer is mainly divided into two parts, the hardware and the software. All of the computer's components fall under either of these categories. The hardware is the physical aspect of the computer, things that we can touch, while, software is the non-physical aspect. The easiest way to distinguish among the two is that anything we see when the computer is off is the hardware, while anything we see on the monitor is the software.

Hardware is the actual components that your computer is made of, such as the monitor, keyboard, CPU, etc. Without hardware, the computer would not exist and the software would have nothing to run on. The software, on the other hand, is any program that you load onto a computer, such as the operating system, the server, the web browser, media player, etc. It is the code and instructions that tells the computer hardware how to operate. This code can be viewed and executed using the hardware. The hardware serves as the delivery system for software solutions. It gives something for the software to operate on.

Types of Hardware:

- Input devices – keyboard, image scanner, microphone, pointing device, graphics tablet, joystick, light pen, mouse, touchpad, touchscreen, trackball, webcam
- Output devices – monitor, printer, speakers
- Removable data storage - optical disc drive (CD-RW, DVD+RW), floppy disk, memory card, USB flash drive
- Computer case - central processing unit (CPU), hard disk, motherboard, network interface controller, power supply, random-access memory (RAM), sound card, video card
- Data ports - Ethernet firewire, parallel port, serial port, universal serial bus (USB)

Types of Software:

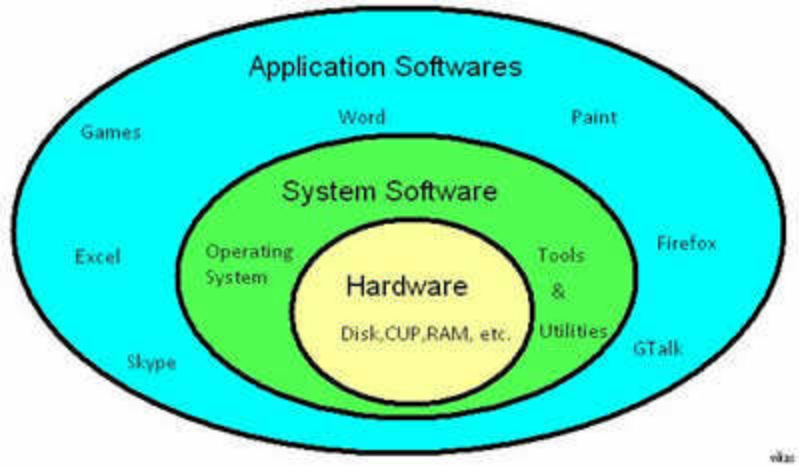
- System software - device drivers, operating systems, servers, utilities, window systems
- Programming software - compilers, debuggers, interpreters, linkers, text editors
- Application software - accounting software, office suites, databases, media players, web browser

Key Difference: Software refers to a set of programs which is capable of performing some specific tasks on a computer system. They can be broadly classified into two categories - System software and Application software.

Software refers to computer programs which perform specific functions as instructed. It can be a single program or may refer to a number of programs collectively. These instructions are defined in proper step by step manner. It is important to mention that hardware becomes incapable for extending its capabilities without support of the software. These software programs assist computer systems and network to start and work.

Software are broadly classified into two categories –

System Software – This software is usually engaged in background processes. This software sync the work of hardware and other types of programs. It acts as a middle layer between hardware and user applications. System software includes programs like –



Operating system – It is a well-known example of system software. This software interacts with the hardware and provides the capability for running various types of programs. Desktop uses operating sytems like Windows, Linux and MacOS, whereas Android and Windows are commonly used operating systems for mobiles. There are different types of operating systems like real time, distribute, embedded, etc., It is necessary to consider the hardware specifications before deciding the operating system.

Language translators – It includes assemblers, compilers and interpreters. These programs have been designed for programming languages like C, Cobol, Pascal, etc. Machine language is translated into machine code with the help of an assembler. Compiler translates the code written in a high level language to a lower one. An interpreter is capable of executing programs directly. It executes the program in a line by line manner.

Common Utility Programs – These programs are designed specifically for managing the computer device and its resources. It includes programs like communication tools and disk formatter. They are more focused on the operations of computer infrastructure. For example – Virus scanner is a kind of common utility programs which provides protection to the system from unwanted guests like Trojans and viruses.

Application Software – System Software are more concerned about the background programs of the computer system. However, an application software performs some specific task on a system. There are numerous types of application software. They deal mainly with solving out some specific computing types of problems. They work for fulfillment of specific needs only. These types of software are also known as apps in short. Some of the common application software are –

Introduction to Operating Systems

A computer system has many resources (hardware and software), which may be require to complete a task. The commonly required resources are input/output devices, memory, file storage space, CPU etc. The operating system acts as a manager of the above resources and allocates them to specific programs

and users, whenever necessary to perform a particular task. Therefore operating system is the resource manager i.e. it can manage the resource of a computer system internally. The resources are processor, memory, files, and I/O devices. In simple terms, an operating system is the interface between the user and the machine.

Operating System Management Tasks

1. Processor management which involves putting the tasks into order and pairing them into manageable size before they go to the CPU.
2. Memory management which coordinates data to and from RAM (random-access memory) and determines the necessity for virtual memory.
3. Device management which provides interface between connected devices.
4. Storage management which directs permanent data storage.
5. Application which allows standard communication between software and your computer.
6. User interface which allows you to communicate with your computer.

Functions of Operating System

1. It boots the computer
2. It performs basic computer tasks e.g. managing the various peripheral devices e.g. mouse, keyboard
3. It provides a user interface, e.g. command line, graphical user interface (GUI)
4. It handles system resources such as computer's memory and sharing of the central processing unit(CPU) time by various applications or peripheral devices.
5. It provides file management which refers to the way that the operating system manipulates, stores, retrieves and saves data.
6. Error Handling is done by the operating system. It takes preventive measures whenever required to avoid errors.

Types of Operating Systems

Following are some of the most widely used types of Operating system.

1. Simple Batch System
2. Multiprogramming Batch System
3. Multiprocessor System

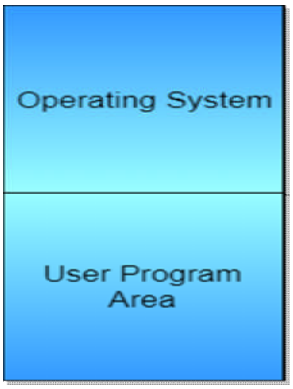
4. Desktop System
5. Distributed Operating System
6. Clustered System
7. Realtime Operating System
8. Handheld System

SIMPLE BATCH SYSTEMS

- In this type of system, there is no direct interaction between user and the computer.
- The user has to submit a job (written on cards or tape) to a computer operator.
- Then computer operator places a batch of several jobs on an input device.
- Jobs are batched together by type of languages and requirement.
- Then a special program, the monitor, manages the execution of each program in the batch.
- The monitor is always in the main memory and available for execution.

Following are some disadvantages of this type of system :

1. No interaction between user and computer.
2. No mechanism to prioritise the processes.



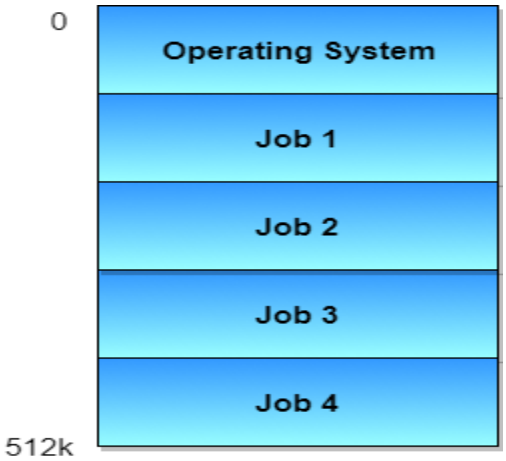
MULTIPROGRAMMING BATCH SYSTEMS

- In this the operating system picks up and begins to execute one of the jobs from memory.
- Once this job needs an I/O operation operating system switches to another job (CPU and OS always busy).
- Jobs in the memory are always less than the number of jobs on disk(Job Pool).

- If several jobs are ready to run at the same time, then the system chooses which one to run through the process of CPU Scheduling.
- In Non-multiprogrammed system, there are moments when CPU sits idle and does not do any work.
- In Multiprogramming system, CPU will never be idle and keeps on processing.

Time-Sharing Systems are very similar to Multiprogramming batch systems. In fact time sharing systems are an extension of multiprogramming systems.

In time sharing systems the prime focus is on minimizing the response time, while in multiprogramming the prime focus is to maximize the CPU usage.



MULTIPROCESSOR SYSTEMS

A multiprocessor system consists of several processors that share a common physical memory. Multiprocessor system provides higher computing power and speed. In multiprocessor system all processors operate under single operating system. Multiplicity of the processors and how they do act together are transparent to the others.

Following are some advantages of this type of system.

1. Enhanced performance
2. Execution of several tasks by different processors concurrently, increases the system's throughput without speeding up the execution of a single task.
3. If possible, system divides task into many subtasks and then these subtasks can be executed in parallel in different processors. Thereby speeding up the execution of single tasks.

DESKTOP SYSTEMS

Earlier, CPUs and PCs lacked the features needed to protect an operating system from user programs. PC operating systems therefore were neither multiuser nor multitasking. However, the goals of these operating systems have changed with time; instead of maximizing CPU and peripheral utilization, the systems opt for maximizing user convenience and responsiveness. These systems are called Desktop Systems and include PCs running Microsoft Windows and the Apple Macintosh. Operating systems for these computers have benefited in several ways from the development of operating systems for mainframes.

Microcomputers were immediately able to adopt some of the technology developed for larger operating systems. On the other hand, the hardware costs for microcomputers are sufficiently low that individuals have sole use of the computer, and CPU utilization is no longer a prime concern. Thus, some of the design decisions made in operating systems for mainframes may not be appropriate for smaller systems.

DISTRIBUTED OPERATING SYSTEMS

The motivation behind developing distributed operating systems is the availability of powerful and inexpensive microprocessors and advances in communication technology.

These advancements in technology have made it possible to design and develop distributed systems comprising of many computers that are inter connected by communication networks. The main benefit of distributed systems is its low price/performance ratio.

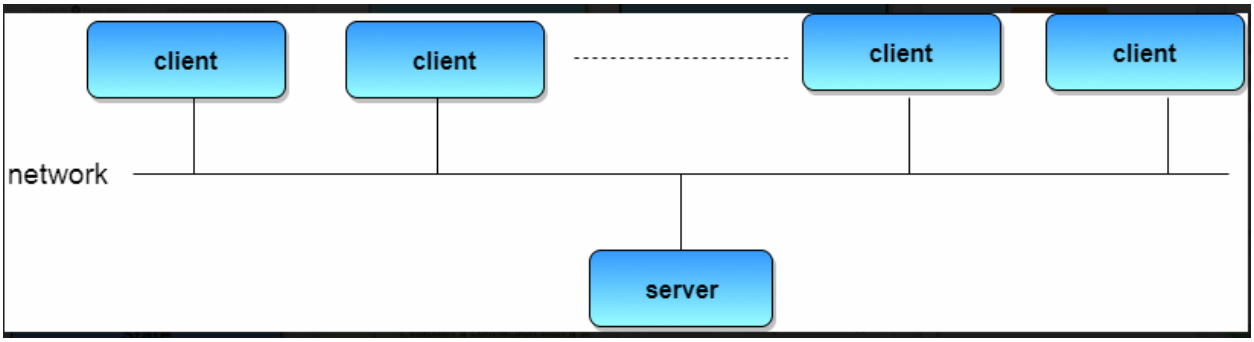
Following are some advantages of this type of system.

1. As there are multiple systems involved, user at one site can utilize the resources of systems at other sites for resource-intensive tasks.
2. Fast processing.
3. Less load on the Host Machine.

The two types of Distributed Operating Systems are: Client-Server Systems and Peer-to-Peer Systems.

Client-Server Systems

Centralized systems today act as server systems to satisfy requests generated by client systems. The general structure of a client-server system is depicted in the figure below:



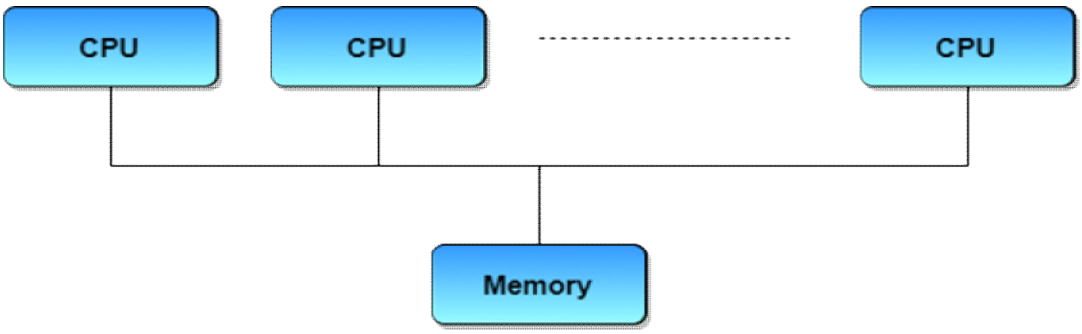
Server Systems can be broadly categorized as compute servers and file servers.

- Compute-server systems provide an interface to which clients can send requests to perform an action, in response to which they execute the action and send back results to the client.
- File-server systems provide a file-system interface where clients can create, update, read, and delete files.

Peer-to-Peer Systems

The growth of computer networks - especially the Internet and World Wide Web (WWW) – has had a profound influence on the recent development of operating systems. When PCs were introduced in the 1970s, they were designed for personal use and were generally considered standalone computers. With the beginning of widespread public use of the Internet in the 1980s for electronic mail and ftp many PCs became connected to computer networks.

In contrast to the tightly coupled systems, the computer networks used in these applications consist of a collection of processors that do not share memory or a clock. Instead, each processor has its own local memory. The processors communicate with one another through various communication lines, such as high-speed buses or telephone lines. These systems are usually referred to as loosely coupled systems (or distributed systems). The general structure of a client-server system is depicted in the figure below:



CLUSTERED SYSTEMS

- Like parallel systems, clustered systems gather together multiple CPUs to accomplish computational work.
- Clustered systems differ from parallel systems, however, in that they are composed of two or more individual systems coupled together.
- The definition of the term clustered is not concrete; the general accepted definition is that clustered computers share storage and are closely linked via LAN networking.
- Clustering is usually performed to provide high availability.

- A layer of cluster software runs on the cluster nodes. Each node can monitor one or more of the others. If the monitored machine fails, the monitoring machine can take ownership of its storage, and restart the application(s) that were running on the failed machine. The failed machine can remain down, but the users and clients of the application would only see a brief interruption of service.
- Asymmetric Clustering - In this, one machine is in hot standby mode while the other is running the applications. The hot standby host (machine) does nothing but monitor the active server. If that server fails, the hot standby host becomes the active server.
- Symmetric Clustering - In this, two or more hosts are running applications, and they are monitoring each other. This mode is obviously more efficient, as it uses all of the available hardware.
- Parallel Clustering - Parallel clusters allow multiple hosts to access the same data on the shared storage. Because most operating systems lack support for this simultaneous data access by multiple hosts, parallel clusters are usually accomplished by special versions of software and special releases of applications.

Clustered technology is rapidly changing. Clustered system use and features should expand greatly as Storage Area Networks(SANs). SANs allow easy attachment of multiple hosts to multiple storage units. Current clusters are usually limited to two or four hosts due to the complexity of connecting the hosts to shared storage.

REAL-TIME OPERATING SYSTEM

It is defined as an operating system known to give maximum time for each of the critical operations that it performs, like OS calls and interrupt handling.

The Real-Time Operating system which guarantees the maximum time for critical operations and complete them on time are referred to as Hard Real-Time Operating Systems.

While the real-time operating systems that can only guarantee a maximum of the time, i.e. the critical task will get priority over other tasks, but no assurity of completeing it in a defined time. These systems are referred to as Soft Real-Time Operating Systems.

HANDHELD SYSTEMS

Handheld systems include Personal Digital Assistants(PDAs), such as Palm-Pilots or Cellular Telephones with connectivity to a network such as the Internet. They are usually of limited size due to which most handheld devices have a small amount of memory, include slow processors, and feature small display screens.

- Many handheld devices have between 512 KB and 8 MB of memory. As a result, the operating system and applications must manage memory efficiently. This includes returning all allocated memory back to the memory manager once the memory is no longer being used.
- Currently, many handheld devices do not use virtual memory techniques, thus forcing program developers to work within the confines of limited physical memory.
- Processors for most handheld devices often run at a fraction of the speed of a processor in a PC. Faster processors require more power. To include a faster processor in a handheld device would require a larger battery that would have to be replaced more frequently.
- The last issue confronting program designers for handheld devices is the small display screens typically available. One approach for displaying the content in web pages is web clipping, where only a small subset of a web page is delivered and displayed on the handheld device.

Some handheld devices may use wireless technology such as BlueTooth, allowing remote access to e-mail and web browsing. Cellular telephones with connectivity to the Internet fall into this category. Their use continues to expand as network connections become more available and other options such as cameras and MP3 players, expand their utility.

Introduction To Computer Networks

Modern world scenario is ever changing. Data Communication and network have changed the way business and other daily affair works. Now, they highly rely on computer networks and internetwork.

A set of devices often mentioned as nodes connected by media link is called a Network.

A node can be a device which is capable of sending or receiving data generated by other nodes on the network like a computer, printer etc. These links connecting the devices are called Communication channels.

Computer network is a telecommunication channel using which we can share data with other coomputers or devices, connected to the same network. It is also called Data Network. The best example of computer network is Internet.

Computer network does not mean a system with one Control Unit connected to multiple other systems as its slave. That is Distributed system, not Computer Network.

A network must be able to meet certain criterias, these are mentioned below:

1. Performance
2. Reliability
3. Scalability

Performance

It can be measured in the following ways :

- Transit time : It is the time taken to travel a message from one device to another.
- Response time : It is defined as the time elapsed between enquiry and response.

Other ways to measure performance are :

1. Efficiency of software
2. Number of users
3. Capability of connected hardware

Reliability

It decides the frequency at which network failure take place. More the failures are, less is the network's reliability.

Security

It refers to the protection of data from any unauthorised user or access. While travelling through network, data passes many layers of network, and data can be traced if attempted. Hence security is also a very important characteristic for Networks.

Properties of a Good Network

1. Interpersonal Communication : We can communicate with each other efficiently and easily. Example: emails, chat rooms, video conferencing etc, all of these are possible because of computer networks.
2. Resources can be shared : We can share physical resources by making them available on a network such as printers, scanners etc.
3. Sharing files, data : Authorised users are allowed to share the files on the network.

Basic Communication Model

A Communication model is used to exchange data between two parties. For example: communication between a computer, server and telephone (through modem).

Source

Data to be transmitted is generated by this device, example: telephones, personal computers etc.

Transmitter

The data generated by the source system is not directly transmitted in the form its generated. The transmitter transforms and encodes the data in such a form to produce electromagnetic waves or signals.

Transmission System

A transmission system can be a single transmission line or a complex network connecting source and destination.

Receiver

Receiver accepts the signal from the transmission system and converts it into a form which is easily managed by the destination device.

Destination

Destination receives the incoming data from the receiver.

Data Communication

The exchange of data between two devices through a transmission medium is called Data Communication. The data is exchanged in the form of 0's and 1's. The transmission medium used is wire cable. For data communication to occur, the communication device must be a part of a communication system. Data Communication has two types - Local and Remote which are discussed below:

Local

Local communication takes place when the communicating devices are in the same geographical area, same building, or face-to-face etc.

Remote

Remote communication takes place over a distance i.e. the devices are farther. The effectiveness of a data communication can be measured through the following features :

1. Delivery: Delivery should be done to the correct destination.
2. Timeliness: Delivery should be on time.
3. Accuracy: Data delivered should be accurate.

Components of Data Communication

1. Message: It is the information to be delivered.
2. Sender: Sender is the person who is sending the message.
3. Receiver: Receiver is the person to whom the message is being sent to.
4. Medium: It is the medium through which the message is sent. For example: A Modem.
5. Protocol: These are some set of rules which govern data communication.

Uses of Computer Networks

Had it not been of high importance, nobody would have bothered connecting computers over a network. Let's start exploring the uses of Computer Networks with some traditional usecases at companies and for individuals and then move on to recent developments in the area of mobile users and home networking.

Business Applications

Resource Sharing: The goal is to make all programs, equipments, and especially data, available to anyone on the network without regard to the physical location of the resource and the user.

Server-Client model: One can imagine a company's information system as consisting of one or more databases and some number of employees who need to access them remotely. In this model, the data is stored on powerful computers called servers. Often these are centrally housed and maintained by a system administrator. In contrast, the employees have simple machines, called clients, on their desks, with which they access remote data.

Communication Medium: A computer network can provide a powerful communication medium among employees. Virtually every company that has two or more computers now has e-mail (electronic mail), which employees generally use for a great deal of daily communication

E-Commerce: A goal that is starting to become more important is doing business with consumers over the Internet. Airlines, bookstores and music vendors have discovered that many customers like the convenience of shopping from home. This sector is expected to grow quickly in the future. The most popular forms are listed in the below figure:

Home Applications

Some of the most important uses of the Internet for home users are as follows:

- Access to remote information
- Person-to-person communication
- Interactive entertainment
- Electronic commerce

Mobile Users

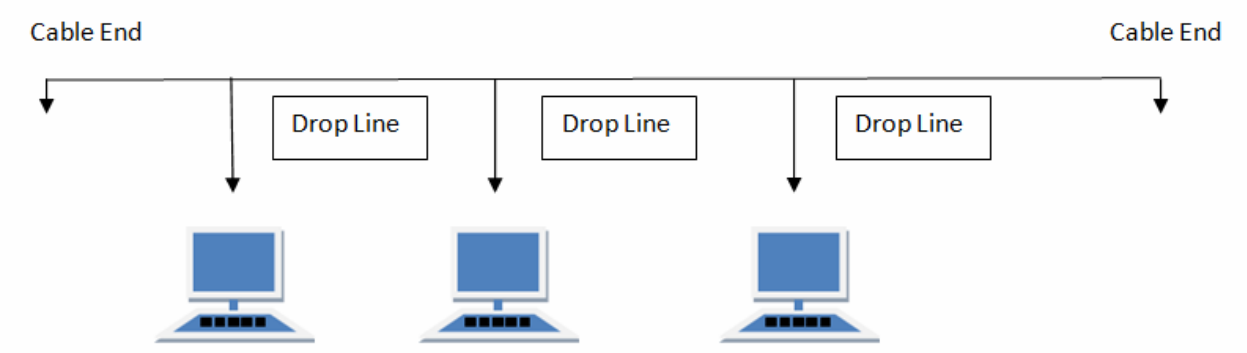
Mobile computers, such as notebook computers and Mobile phones, are one of the fastest-growing segments of the computer industry. Although wireless networking and mobile computing are often related, they are not identical, as the below figure shows.

Types of Network Topology

Network Topology is the schematic description of a network arrangement, connecting various nodes(sender and receiver) through lines of connection.

BUS Topology

Bus topology is a network type in which every computer and network device is connected to single cable. When it has exactly two endpoints, then it is called Linear Bus topology.



Features of Bus Topology

1. It transmits data only in one direction.
2. Every device is connected to a single cable

Advantages of Bus Topology

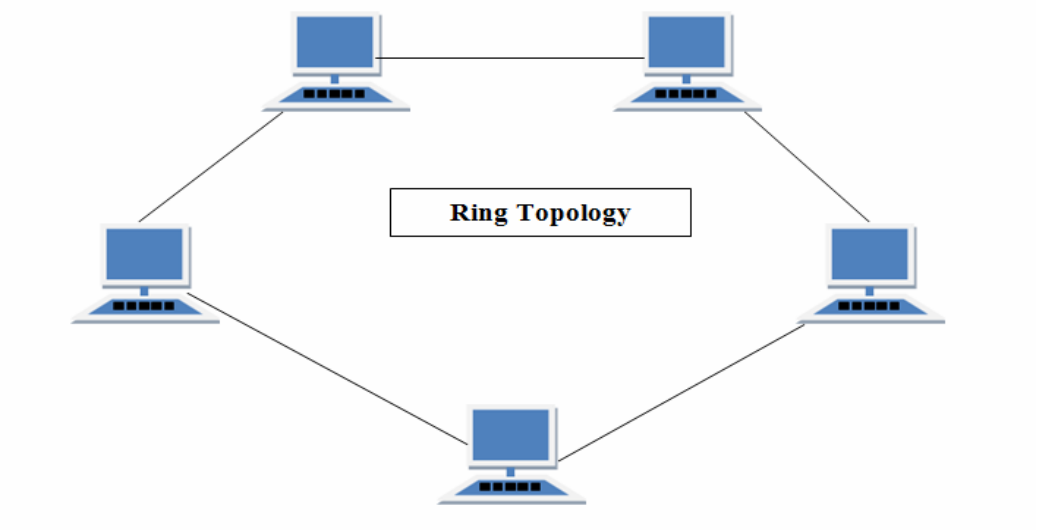
1. It is cost effective.
2. Cable required is least compared to other network topology.
3. Used in small networks.
4. It is easy to understand.
5. Easy to expand joining two cables together.

Disadvantages of Bus Topology

1. Cables fails then whole network fails.
2. If network traffic is heavy or nodes are more the performance of the network decreases.
3. Cable has a limited length.
4. It is slower than the ring topology.

RING Topology

It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first. Exactly two neighbours for each device.



Features of Ring Topology

1. A number of repeaters are used for Ring topology with large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.
2. The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.
3. In Dual Ring Topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.
4. Data is transferred in a sequential manner that is bit by bit. Data transmitted, has to pass through each node of the network, till the destination node.

Advantages of Ring Topology

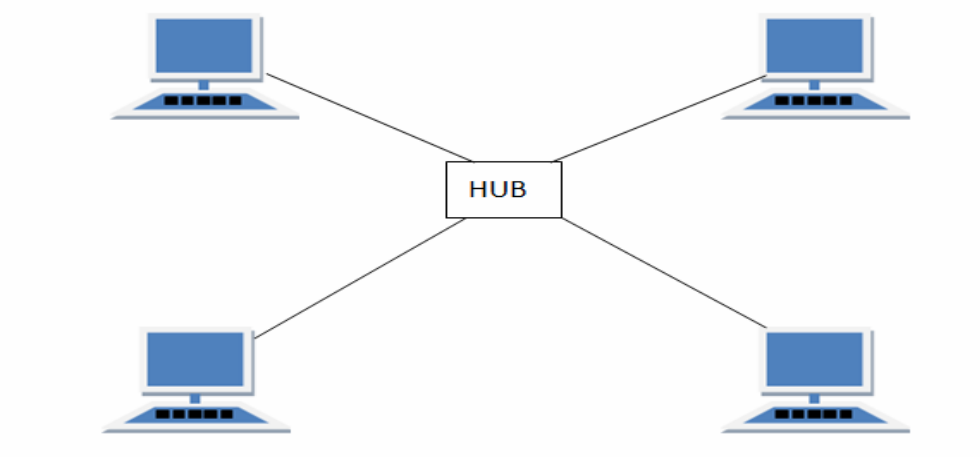
1. Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
2. Cheap to install and expand

Disadvantages of Ring Topology

1. Troubleshooting is difficult in ring topology.
2. Adding or deleting the computers disturbs the network activity.
3. Failure of one computer disturbs the whole network.

STAR Topology

In this type of topology all the computers are connected to a single hub through a cable. This hub is the central node and all others nodes are connected to the central node.



Features of Star Topology

1. Every node has its own dedicated connection to the hub.
2. Hub acts as a repeater for data flow.
3. Can be used with twisted pair, Optical Fibre or coaxial cable.

Advantages of Star Topology

1. Fast performance with few nodes and low network traffic.
2. Hub can be upgraded easily.
3. Easy to troubleshoot.
4. Easy to setup and modify.
5. Only that node is affected which has failed, rest of the nodes can work smoothly.

Disadvantages of Star Topology

1. Cost of installation is high.
2. Expensive to use.
3. If the hub fails then the whole network is stopped because all the nodes depend on the hub.
4. Performance is based on the hub that is it depends on its capacity

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MESH Topology

It is a point-to-point connection to other nodes or devices. All the network nodes are connected to each other. Mesh has n(n-1)/2 physical channels to link n devices.

There are two techniques to transmit data over the Mesh topology, they are :

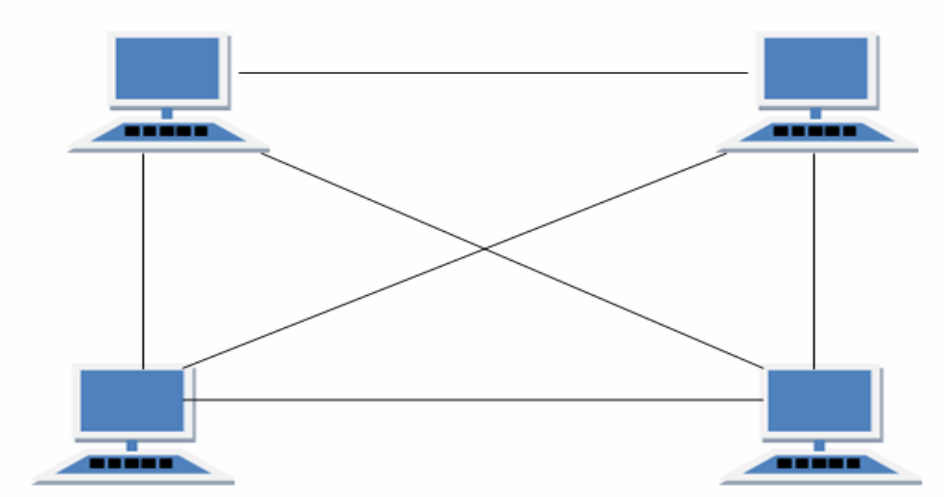
1. Routing
2. Flooding

Routing

In routing, the nodes have a routing logic, as per the network requirements. Like routing logic to direct the data to reach the destination using the shortest distance. Or, routing logic which has information about the broken links, and it avoids those node etc. We can even have routing logic, to re-configure the failed nodes.

Flooding

In flooding, the same data is transmitted to all the network nodes, hence no routing logic is required. The network is robust, and the its very unlikely to lose the data. But it leads to unwanted load over the network.



Types of Mesh Topology

1. Partial Mesh Topology : In this topology some of the systems are connected in the same fashion as mesh topology but some devices are only connected to two or three devices.
2. Full Mesh Topology : Each and every nodes or devices are connected to each other.

Features of Mesh Topology

1. Fully connected.
2. Robust.
3. Not flexible.

Advantages of Mesh Topology

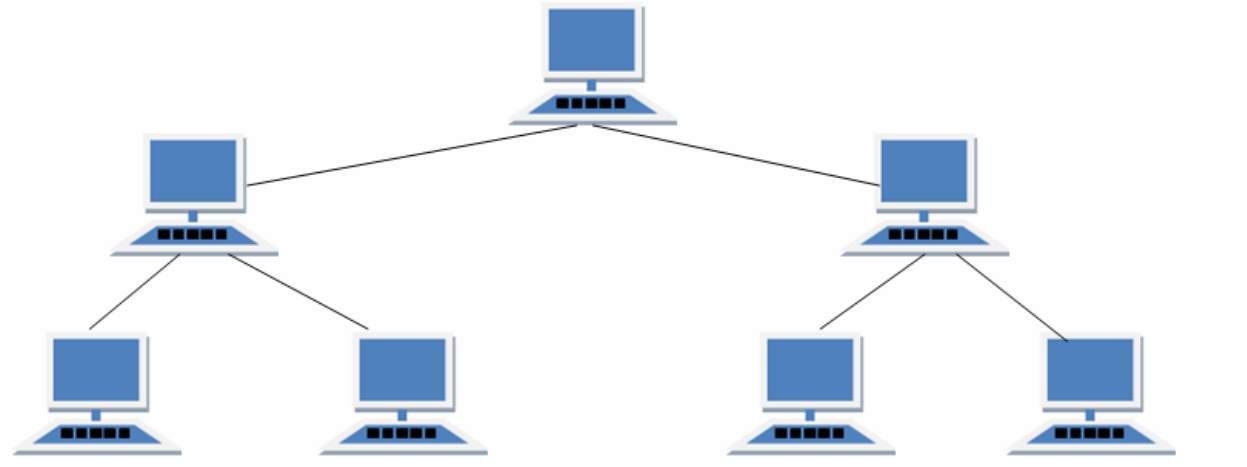
1. Each connection can carry its own data load.
2. It is robust.
3. Fault is diagnosed easily.
4. Provides security and privacy.

Disadvantages of Mesh Topology

1. Installation and configuration is difficult.
2. Cabling cost is more.
3. Bulk wiring is required.

TREE Topology

It has a root node and all other nodes are connected to it forming a hierarchy. It is also called hierarchical topology. It should at least have three levels to the hierarchy.



Features of Tree Topology

1. Ideal if workstations are located in groups.
2. Used in Wide Area Network.

Advantages of Tree Topology

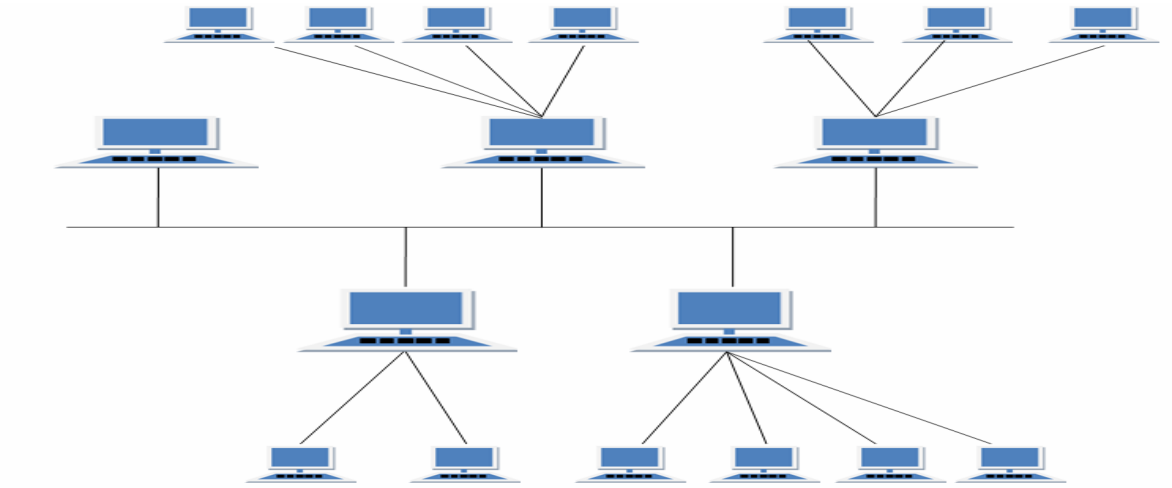
1. Extension of bus and star topologies.
2. Expansion of nodes is possible and easy.
3. Easily managed and maintained.
4. Error detection is easily done.

Disadvantages of Tree Topology

1. Heavily cabled.
2. Costly.
3. If more nodes are added maintenance is difficult.
4. Central hub fails, network fails.

HYBRID Topology

It is two different types of topologies which is a mixture of two or more topologies. For example if in an office in one department ring topology is used and in another star topology is used, connecting these topologies will result in Hybrid Topology (ring topology and star topology).



Features of Hybrid Topology

1. It is a combination of two or topologies
2. Inherits the advantages and disadvantages of the topologies included

Advantages of Hybrid Topology

1. Reliable as Error detecting and trouble shooting is easy.
2. Effective.
3. Scalable as size can be increased easily.
4. Flexible.

Disadvantages of Hybrid Topology

1. Complex in design.
2. Costly.

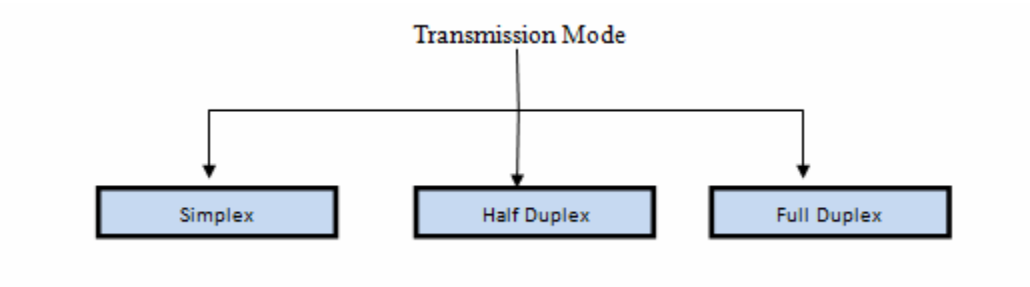
Transmission Modes in Computer Networks

Transmission mode means transferring of data between two devices. It is also called communication mode. These modes direct the direction of flow of information. There are three types of transmission mode. They are :

Simplex Mode

Half duplex Mode

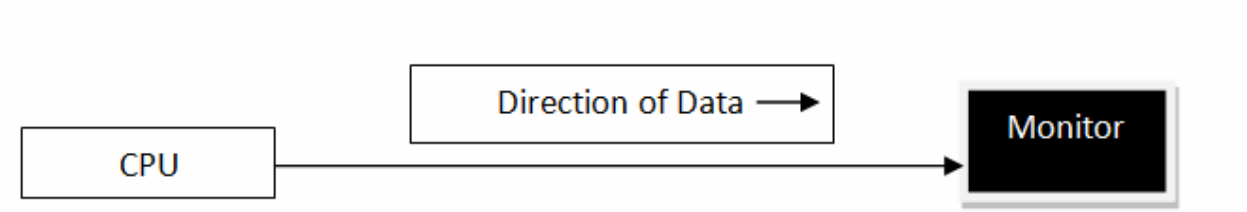
Full duplex Mode



SIMPLEX Mode

In this type of transmission mode data can be sent only through one direction i.e. communication is unidirectional. We cannot send a message back to the sender. Unidirectional communication is done in Simplex Systems.

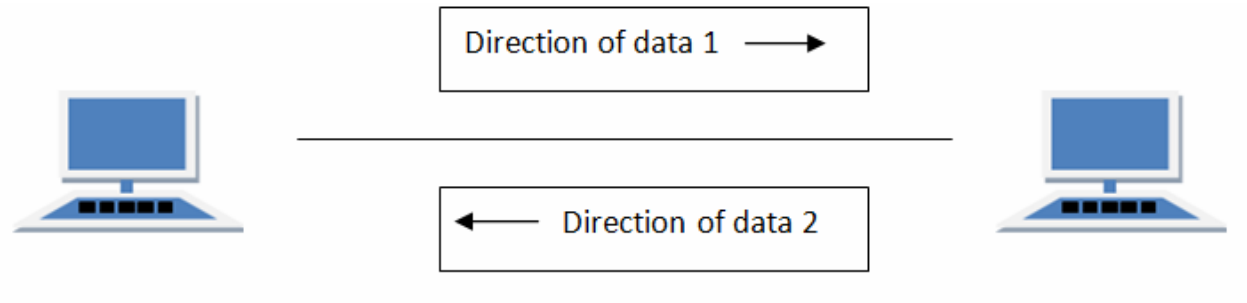
Examples of simplex Mode is loudspeaker, television broadcasting, television and remote, keyboard and monitor etc.



HALF DUPLEX Mode

Half-duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half-duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted. Hence half-duplex transmission implies a bidirectional line (one that can carry data in both directions) but data can be sent in only one direction at a time.

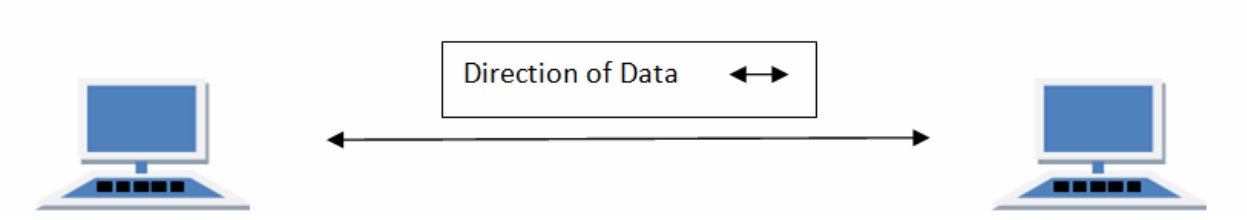
Example of half duplex is a walkie- talkie in which message is sent one at a time and messages are sent in both the directions.



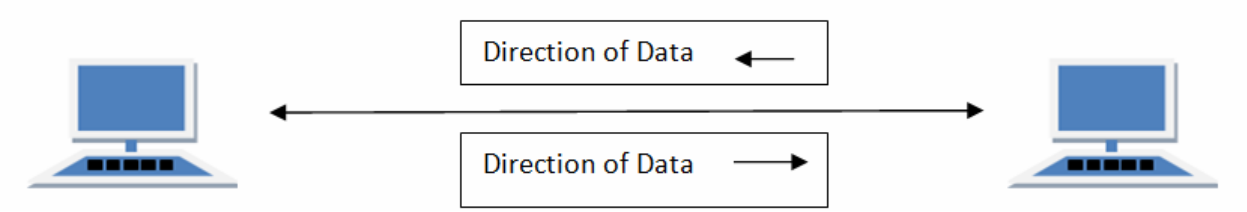
FULL DUPLEX Mode

In full duplex system we can send data in both directions as it is bidirectional. Data can be sent in both directions simultaneously. We can send as well as we receive the data.

Example of Full Duplex is a Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time.



In full duplex system there can be two lines one for sending the data and the other for receiving data.

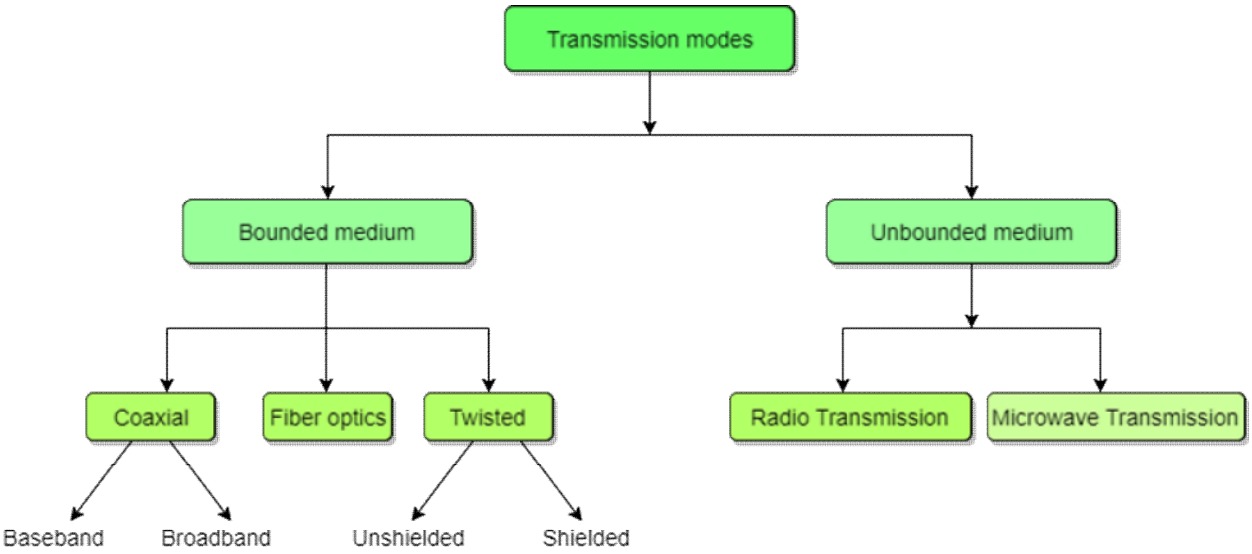


Transmission Mediums in Computer Networks

Data is represented by computers and other telecommunication devices using signals. Signals are transmitted in the form of electromagnetic energy from one device to another. Electromagnetic signals travel through vacuum, air or other transmission mediums to move from one point to another(from sender to receiver).

Electromagnetic energy (includes electrical and magnetic fields) consists of power, voice, visible light, radio waves, ultraviolet light, gamma rays etc.

Transmission medium is the means through which we send our data from one place to another. The first layer (physical layer) of Communication Networks OSI Seven layer model is dedicated to the transmission media, we will study the OSI Model later.



Factors to be considered while selecting a Transmission Medium

1. Transmission Rate
2. Cost and Ease of Installation
3. Resistance to Environmental Conditions
4. Distances

Bounded/Guided Transmission Media

It is the transmission media in which signals are confined to a specific path using wire or cable. The types of Bounded/ Guided are discussed below.

Twisted Pair Cable

This cable is the most commonly used and is cheaper than others. It is lightweight, cheap, can be installed easily, and they support many different types of network. Some important points :

- Its frequency range is 0 to 3.5 kHz.
- Typical attenuation is 0.2 dB/Km @ 1kHz.
- Typical delay is 50 μs/km.
- Repeater spacing is 2km.

Twisted Pair is of two types :

- Unshielded Twisted Pair (UTP)
- Shielded Twisted Pair (STP)

Unshielded Twisted Pair Cable

It is the most common type of telecommunication when compared with Shielded Twisted Pair Cable which consists of two conductors usually copper, each with its own colour plastic insulator. Identification is the reason behind coloured plastic insulation.

UTP cables consist of 2 or 4 pairs of twisted cable. Cable with 2 pair use RJ-11 connector and 4 pair cable use RJ-45 connector.

Advantages :

- Installation is easy
- Flexible
- Cheap
- It has high speed capacity,
- 100 meter limit
- Higher grades of UTP are used in LAN technologies like Ethernet.

It consists of two insulating copper wires (1mm thick). The wires are twisted together in a helical form to reduce electrical interference from similar pair.

Disadvantages :

- Bandwidth is low when compared with Coaxial Cable
- Provides less protection from interference.

Shielded Twisted Pair Cable

This cable has a metal foil or braided-mesh covering which encases each pair of insulated conductors. Electromagnetic noise penetration is prevented by metal casing. Shielding also eliminates crosstalk (explained in KEY TERMS Chapter).

It has same attenuation as unshielded twisted pair. It is faster the unshielded and coaxial cable. It is more expensive than coaxial and unshielded twisted pair.

Advantages :

- Easy to install
- Performance is adequate
- Can be used for Analog or Digital transmission
- Increases the signalling rate
- Higher capacity than unshielded twisted pair
- Eliminates crosstalk

Disadvantages :

- Difficult to manufacture
- Heavy

Coaxial Cable

Coaxial is called by this name because it contains two conductors that are parallel to each other. Copper is used in this as centre conductor which can be a solid wire or a standard one. It is surrounded by PVC installation, a sheath which is encased in an outer conductor of metal foil, barid or both.

Outer metallic wrapping is used as a shield against noise and as the second conductor which completes the circuit. The outer conductor is also encased in an insulating sheath. The outermost part is the plastic cover which protects the whole cable.

Here the most common coaxial standards.

- 50-Ohm RG-7 or RG-11 : used with thick Ethernet.
- 50-Ohm RG-58 : used with thin Ethernet
- 75-Ohm RG-59 : used with cable television
- 93-Ohm RG-62 : used with ARCNET.

Advantages :

- Bandwidth is high
- Used in long distance telephone lines.
- Transmits digital signals at a very high rate of 10Mbps.
- Much higher noise immunity
- Data transmission without distortion.
- The can span to longer distance at higher speeds as they have better shielding when compared to twisted pair cable

Disadvantages :

- Single cable failure can fail the entire network.
- Difficult to install and expensive when compared with twisted pair.
- If the shield is imperfect, it can lead to grounded loop

Fiber Optic Cable

These are similar to coaxial cable. It uses electric signals to transmit data. At the centre is the glass core through which light propagates.

In multimode fibres, the core is 50microns, and In single mode fibres, the thickness is 8 to 10 microns.

The core in fiber optic cable is surrounded by glass cladding with lower index of refraction as compared to core to keep all the light in core. This is covered with a thin plastic jacket to protect the cladding. The fibers are grouped together in bundles protected by an outer shield.

Fiber optic cable has bandwidth more than 2 gbps (Gigabytes per Second)

Advantages :

- Provides high quality transmission of signals at very high speed.

- These are not affected by electromagnetic interference, so noise and distortion is very less.
- Used for both analog and digital signals.

Disadvantages :

- It is expensive
- Difficult to install.
- Maintenance is expensive and difficult.
- Do not allow complete routing of light signals.

UnBounded/UnGuided Transmission Media

Unguided or wireless media sends the data through air (or water), which is available to anyone who has a device capable of receiving them. Types of unguided/ unbounded media are discussed below :

- Radio Transmission
- MicroWave Transmission

Radio Transmission

Its frequency is between 10 kHz to 1GHz. It is simple to install and has high attenuation. These waves are used for multicast communications.

Types of Propogation

Radio Transmission utilizes different types of propogation :

- Troposphere : The lowest portion of earth's atmosphere extending outward approximately 30 miles from the earth's surface. Clouds, jet planes, wind is found here.
- Ionosphere : The layer of the atmosphere above troposphere, but below space. Contains electrically charged particles.

Microwave Transmission

It travels at high frequency than the radio waves. It requires the sender to be inside of the receiver. It operates in a system with a low gigahertz range. It is mostly used for unicast communication.

There are 2 types of Microwave Transmission :

1. Terrestrial Microwave

2. Satellite Microwave

Advantages of Microwave Transmission

- Used for long distance telephone communication
- Carries 1000's of voice channels at the same time

Disadvantages of Microwave Transmission

- It is Very costly

Terrestrial Microwave

For increasing the distance served by terrestrial microwave, repeaters can be installed with each antenna .The signal received by an antenna can be converted into transmittable form and relayed to next antenna as shown in below figure. It is an example of telephone systems all over the world

Features of Satellite Microwave :

- Bandwidth capacity depends on the frequency used.
- Satellite microwave deployment for orbiting satellite is difficult.

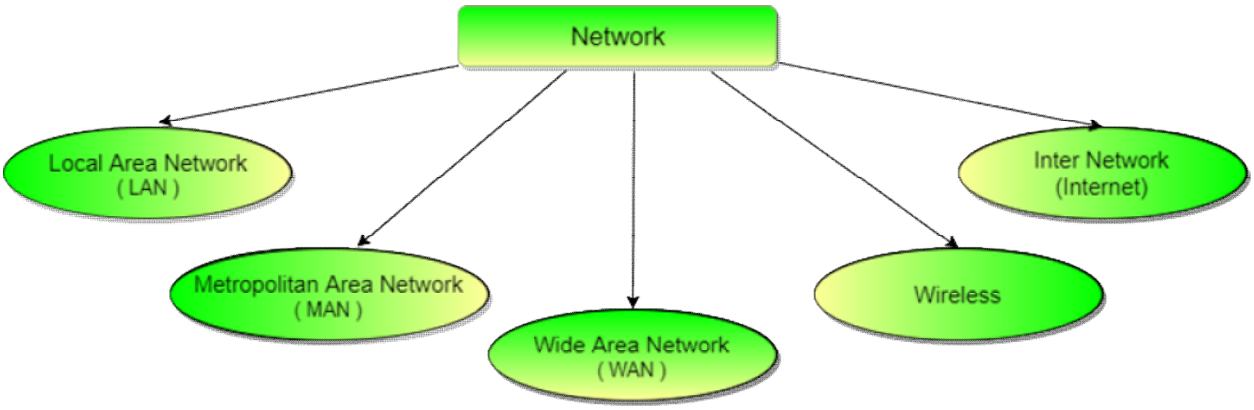
Advantages of Satellite Microwave :

- Transmitting station can receive back its own transmission and check whether the satellite has transmitted information correctly.
- A single microwave relay station which is visible from any point.

Disadvantages of Satellite Microwave :

- Satellite manufacturing cost is very high
- Cost of launching satellite is very expensive
- Transmission highly depends on whether conditions, it can go down in bad weather

Types of Communication Networks:-



Local Area Network (LAN)

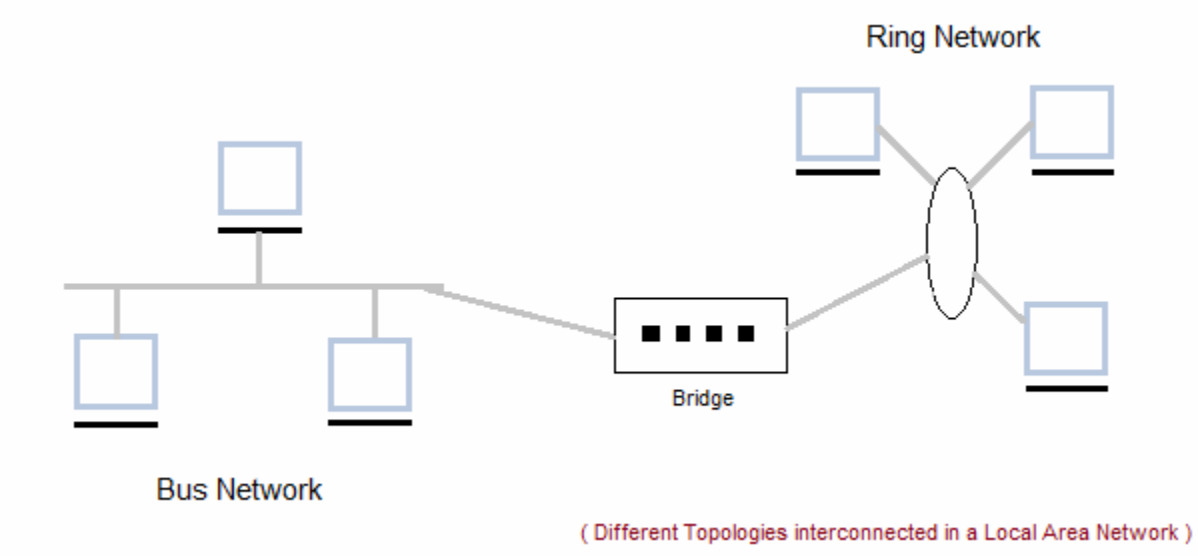
It is also called LAN and designed for small physical areas such as an office, group of buildings or a factory. LANs are used widely as it is easy to design and to troubleshoot. Personal computers and workstations are connected to each other through LANs. We can use different types of topologies through LAN, these are Star, Ring, Bus, Tree etc.

LAN can be a simple network like connecting two computers, to share files and network among each other while it can also be as complex as interconnecting an entire building.

LAN networks are also widely used to share resources like printers, shared hard-drive etc.

Applications of LAN

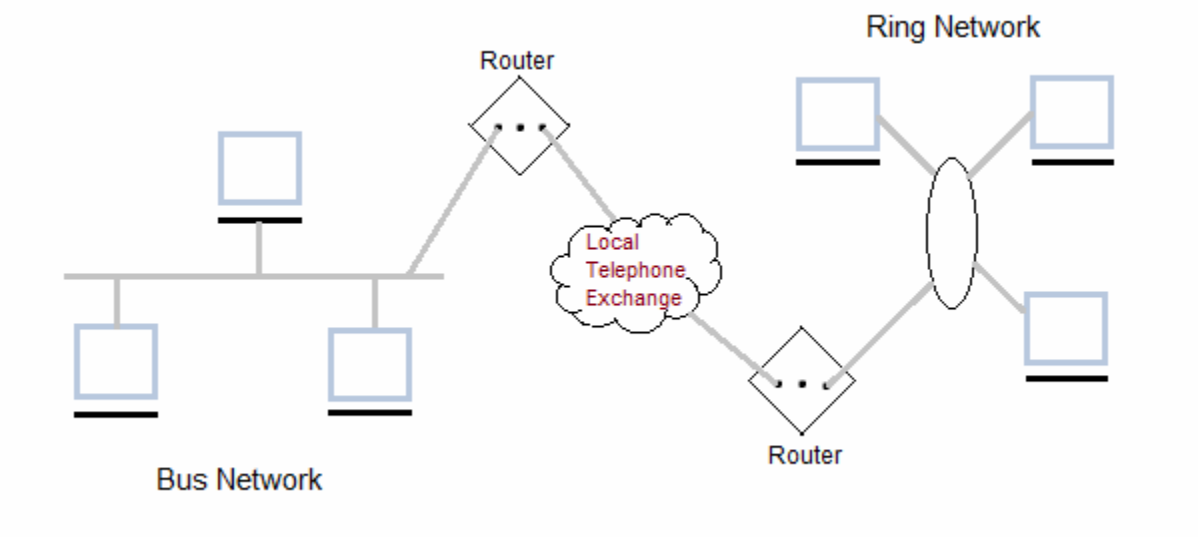
- One of the computer in a network can become a server serving all the remaining computers called clients. Software can be stored on the server and it can be used by the remaining clients.
- Connecting Locally all the workstations in a building to let them communicate with each other locally without any internet access.
- Sharing common resources like printers etc are some common applications of LAN.



(Different Topologies interconnected in a Local Area Network)

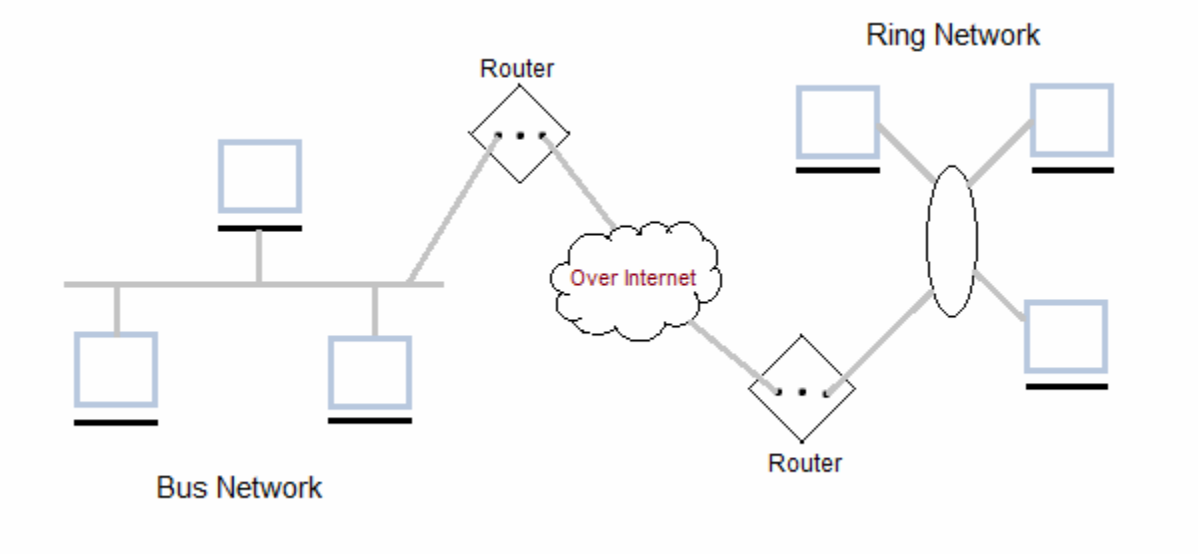
Metropolitan Area Network (MAN)

It is basically a bigger version of LAN. It is also called MAN and uses the similar technology as LAN. It is designed to extend over the entire city. It can be means to connecting a number of LANs into a larger network or it can be a single cable. It is mainly hold and operated by single private company or a public company.



Wide Area Network (WAN)

It is also called WAN. WAN can be private or it can be public leased network. It is used for the network that covers large distance such as cover states of a country. It is not easy to design and maintain. Communication medium used by WAN are PSTN or Satellite links. WAN operates on low data rates.



Wireless Network

Digital wireless communication is not a new idea. Earlier, Morse code was used to implement wireless networks. Modern digital wireless systems have better performance, but the basic idea is the same.

Wireless Networks can be divided into three main categories:

1. System interconnection
2. Wireless LANs
3. Wireless WANs

System Interconnection

System interconnection is all about interconnecting the components of a computer using short-range radio. Some companies got together to design a short-range wireless network called Bluetooth to connect various components such as monitor, keyboard, mouse and printer, to the main unit, without wires. Bluetooth also allows digital cameras, headsets, scanners and other devices to connect to a computer by merely being brought within range.

In simplest form, system interconnection networks use the master-slave concept. The system unit is normally the master, talking to the mouse, keyboard, etc. as slaves.

Wireless LANs

These are the systems in which every computer has a radio modem and antenna with which it can communicate with other systems. Wireless LANs are becoming increasingly common in small offices and homes, where installing Ethernet is considered too much trouble. There is a standard for wireless LANs called IEEE 802.11, which most systems implement and which is becoming very widespread.

Wireless WANs

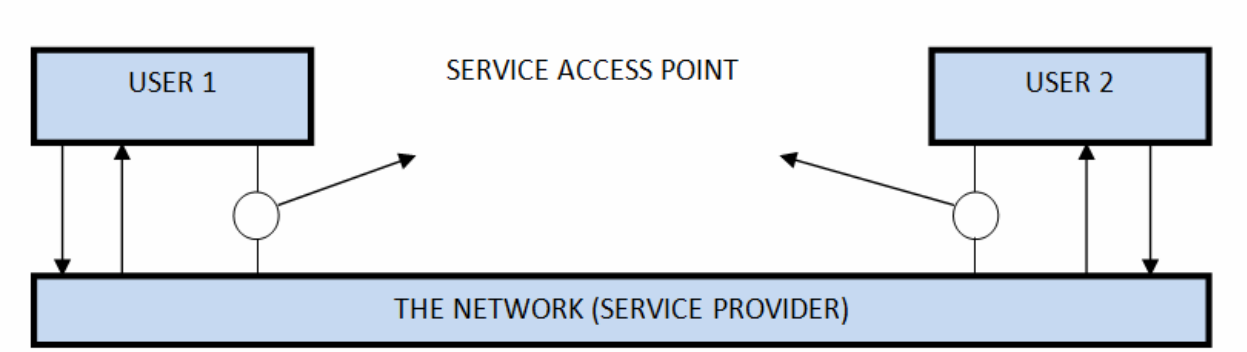
The radio network used for cellular telephones is an example of a low-bandwidth wireless WAN. This system has already gone through three generations.

- The first generation was analog and for voice only.
- The second generation was digital and for voice only.
- The third generation is digital and is for both voice and data.

Relationship of Services to Protocol

Services

These are the operations that a layer can provide to the layer above it. It defines the operation and states a layer is ready to perform but it does not specify anything about the implementation of these operations.



Protocols

These are set of rules that govern the format and meaning of frames, messages or packets that are exchanged between the server and client.

Multiplexing:-

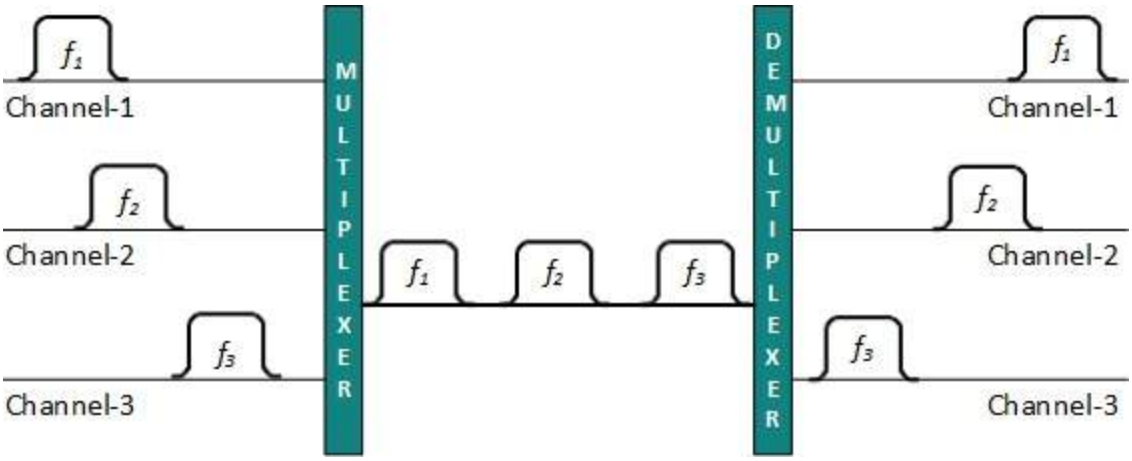
Multiplexing is a technique by which different analog and digital streams of transmission can be simultaneously processed over a shared link. Multiplexing divides the high capacity medium into low capacity logical medium which is then shared by different streams.

Communication is possible over the air (radio frequency), using a physical media (cable), and light (optical fiber). All mediums are capable of multiplexing.

When multiple senders try to send over a single medium, a device called Multiplexer divides the physical channel and allocates one to each. On the other end of communication, a De-multiplexer receives data from a single medium, identifies each, and sends to different receivers.

Frequency Division Multiplexing

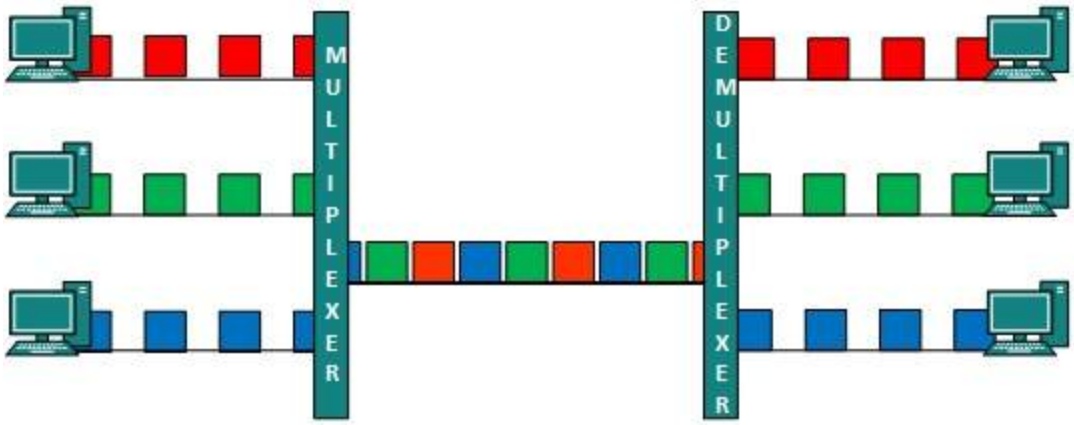
When the carrier is frequency, FDM is used. FDM is an analog technology. FDM divides the spectrum or carrier bandwidth in logical channels and allocates one user to each channel. Each user can use the channel frequency independently and has exclusive access of it. All channels are divided in such a way that they do not overlap with each other. Channels are separated by guard bands. Guard band is a frequency which is not used by either channel.



Time Division Multiplexing

TDM is applied primarily on digital signals but can be applied on analog signals as well. In TDM the shared channel is divided among its user by means of time slot. Each user can transmit data within the provided time slot only. Digital signals are divided in frames, equivalent to time slot i.e. frame of an optimal size which can be transmitted in given time slot.

TDM works in synchronized mode. Both ends, i.e. Multiplexer and De-multiplexer are timely synchronized and both switch to next channel simultaneously.



Wavelength Division Multiplexing

Light has different wavelength (colors). In fiber optic mode, multiple optical carrier signals are multiplexed into an optical fiber by using different wavelengths. This is an analog multiplexing technique and is done conceptually in the same manner as FDM but uses light as signals.

Code Division Multiplexing

Multiple data signals can be transmitted over a single frequency by using Code Division Multiplexing. FDM divides the frequency in smaller channels but CDM allows its users to full bandwidth and transmit signals all the time using a unique code. CDM uses orthogonal codes to spread signals.

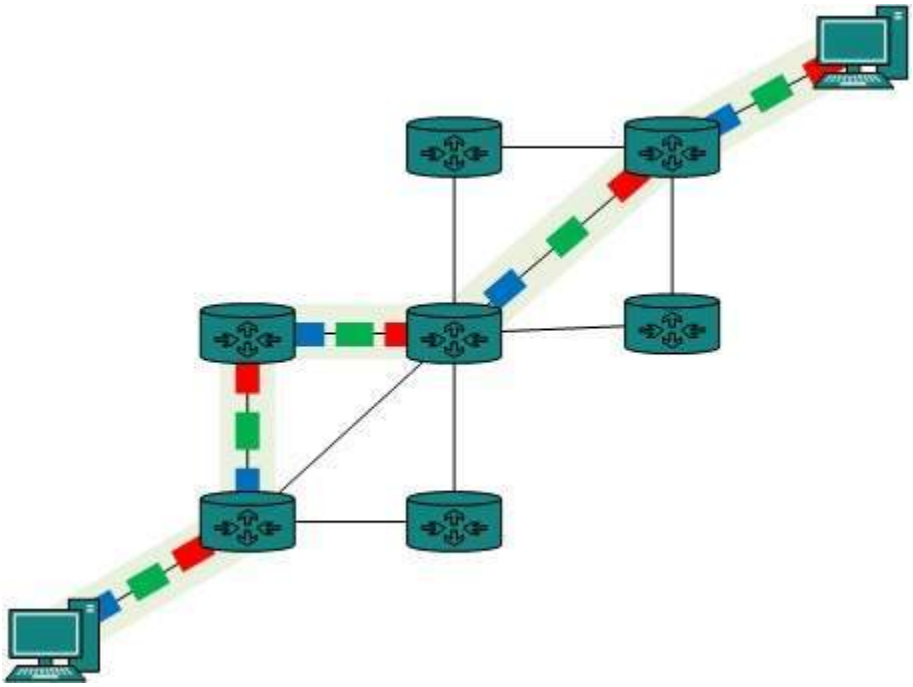
Each station is assigned with a unique code, called chip. Signals travel with these codes independently, inside the whole bandwidth.The receiver knows in advance the chip code signal it has to receive.

Circuit Switching

When two nodes communicate with each other over a dedicated communication path, it is called circuit switching.There 'is a need of pre-specified route from which data will travels and no other data is permitted.In circuit switching, to transfer the data, circuit must be established so that the data transfer can take place.

Circuits can be permanent or temporary. Applications which use circuit switching may have to go through three phases:

- Establish a circuit
- Transfer the data
- Disconnect the circuit

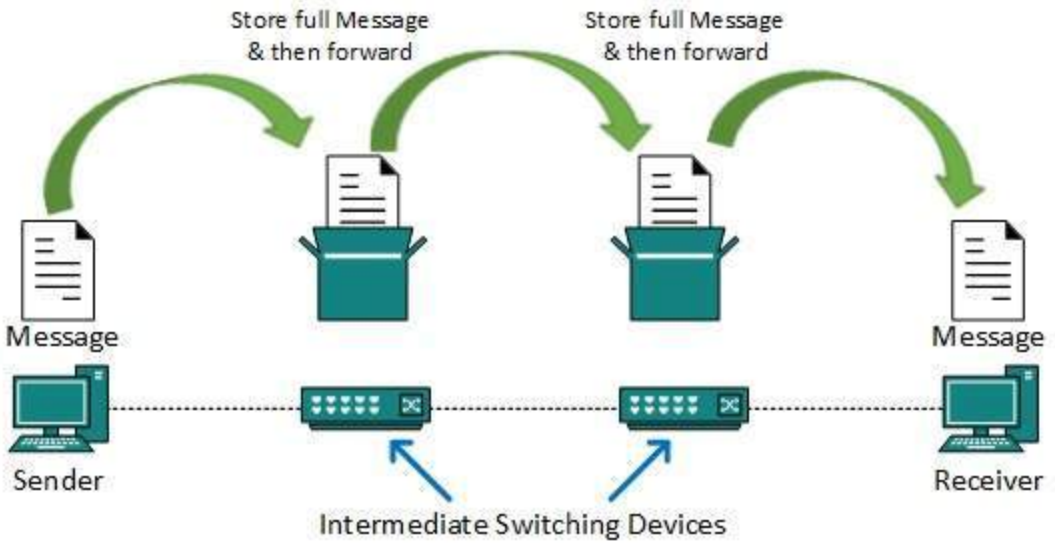


Circuit switching was designed for voice applications. Telephone is the best suitable example of circuit switching. Before a user can make a call, a virtual path between caller and callee is established over the network.

Message Switching

This technique was somewhere in middle of circuit switching and packet switching. In message switching, the whole message is treated as a data unit and is switching / transferred in its entirety.

A switch working on message switching, first receives the whole message and buffers it until there are resources available to transfer it to the next hop. If the next hop is not having enough resource to accommodate large size message, the message is stored and switch waits.



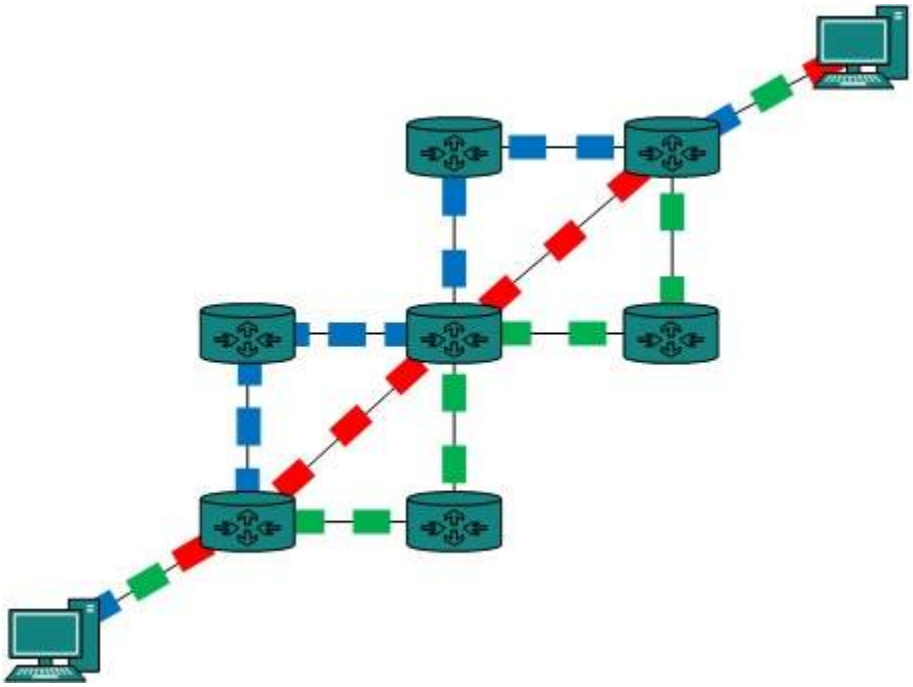
This technique was considered substitute to circuit switching. As in circuit switching the whole path is blocked for two entities only. Message switching is replaced by packet switching. Message switching has the following drawbacks:

- Every switch in transit path needs enough storage to accommodate entire message.
- Because of store-and-forward technique and waits included until resources are available, message switching is very slow.
- Message switching was not a solution for streaming media and real-time applications.

Packet Switching

Shortcomings of message switching gave birth to an idea of packet switching. The entire message is broken down into smaller chunks called packets. The switching information is added in the header of each packet and transmitted independently.

It is easier for intermediate networking devices to store small size packets and they do not take much resources either on carrier path or in the internal memory of switches.



Packet switching enhances line efficiency as packets from multiple applications can be multiplexed over the carrier. The internet uses packet switching technique. Packet switching enables the user to differentiate data streams based on priorities. Packets are stored and forwarded according to their priority to provide quality of service.

Evolution of Interne:-

The Internet has revolutionized the computer and communications world like nothing before. The invention of the telegraph, telephone, radio, and computer set the stage for this unprecedented integration of capabilities. The Internet is at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location. The Internet represents one of the most successful examples of the benefits of sustained investment and commitment to research and development of information infrastructure. Beginning with the early research in packet switching, the government, industry and academia have been partners in evolving and deploying this exciting new technology. Today, terms like “bleiner@computer.org” and “http://www.acm.org” trip lightly off the tongue of the random person on the street. 1

This is intended to be a brief, necessarily cursory and incomplete history. Much material currently exists about the Internet, covering history, technology, and usage. A trip to almost any bookstore will find shelves of material written about the Internet. 2

In this paper,3 several of us involved in the development and evolution of the Internet share our views of its origins and history. This history revolves around four distinct aspects. There is the technological

evolution that began with early research on packet switching and the ARPANET (and related technologies), and where current research continues to expand the horizons of the infrastructure along several dimensions, such as scale, performance, and higher-level functionality. There is the operations and management aspect of a global and complex operational infrastructure. There is the social aspect, which resulted in a broad community of Internauts working together to create and evolve the technology. And there is the commercialization aspect, resulting in an extremely effective transition of research results into a broadly deployed and available information infrastructure.

Domains

While every computer has its own unique address, every user using the Internet has a unique address called a domain. A domain recognizes one or more IP addresses. An example of a domain is weather.com and is part of the URL such as http://www.weather.com. The standard top-level domains are:

- com - Commercial business
- edu - Educational institutions
- gov - Government agencies
- mil - Military
- net - Networks organization
- org - Organizations (nonprofit)

There are additional top-level domains that are now recognized on the Internet. They include:

- aero - Air-transport industry
- biz - Businesses
- coop - Cooperatives
- info - Unrestricted use
- museum - museums
- pro - Accountants, lawyers, physicians, and other professionals
- tv - Television

Some countries use a sub-domain or geographical domain as part of their address. Fox example, an academic institution such as Oxford University in the United Kingdom can use ac.uk. An example of a URL with this domain is http://www.ox.ac.uk/.

Browser

Browser is a piece of software such as Mozilla Firefox and Internet Explorer that allows a computer to access and display documents, view pictures, hear sound, and view video clips from the World Wide Web.

E-mail

E-mail is mail that's electronically transmitted by your computer. As opposed to snail mail, e-mail sends your messages instantaneously, anywhere in the world. It has the capability to send messages at any time and to anyone.

File Transfer Protocol (FTP)

File Transfer Protocol is the standard method for downloading and uploading files over the Internet. With FTP, you can login to a server and transfer files (meaning you can "send" or "receive" files).

Homepage

Homepage or Home page is the first page that is viewed when the browser starts. It is also the page of a Web site that provides the introduction or content with links.

Hypertext Transfer Protocol (HTTP)

HTTP is the abbreviation for Hypertext Transfer Protocol. It is the set of rules by which Web pages are transferred across the Internet.

Internet Protocol (IP) Address

The Internet is composed of local, regional, national, and worldwide computer networks. Each computer on the Internet can be identified by a set of unique numbers that is called an Internet Protocol (IP) address. The IP address is composed of four different numbers separated by periods such as 205.134.120.60.

Link or Hypertext Link

Link or Hypertext Link is an underlined word(s), phrase(s), or graphics on a Web page that transports the reader to additional or related information on the Internet.

TelNet

A terminal emulation protocol (or Internet program) used to connect a computer to a remote host or server. Telnet is one of the oldest Internet activities and is primarily used to access online databases or to read articles stored on university servers.

Uniform Resource Locator (URL)

The Uniform Resource Locator (URL) is an addressing scheme that is used on the Internet to locate resources and/or services on the World Wide Web. Basically the URL is the address of a computer file that has been put on a computer server to access the Internet.

Web Page

A Web page is a single hypertext file or a page that is part of a Web site.

Website

A Website is a collection of World Wide Web pages or files.

Uses of Internet

The key to success of Internet is the information. The better the quality, the more usage of Internet operations.

Large volume of Information: Internet can be used to collect information from around the world. This information could relate to education, medicine, literature, software, computers, business, entertainment, friendship, tourism, and leisure. People can search for information by visiting the home page of various search engines such as Google, Yahoo, Bing, etc.

News and Journals: All the newspapers, magazines and journals of the world are available on the Internet. With the introduction of broadband and advanced mobile telecommunication technologies such as 3G (third generation) and 4G (fourth generation), the speed of internet service has increased tremendously. A person can get the latest news about the world in a matter of few seconds.

Electronic Mode of Communication: Internet has given the most exciting mode of communication to all. We can send an E-mail (the short form of Electronic Mailing System) to all the corners of the world.

Chatting: There are many chatting software that can be used to send and receive real-time messages over the internet. We can chat with our friend and relatives using any one of the chatting software.

Social Networking: People can connect with old friends on social networking sites. They can even chat with them when they are online. Social networking sites also allow us to share pictures with others. We can share pictures with our loved ones, while we are on a vacation. People are even concluding business deals over these social networking sites such as Facebook.

Online Banking (Net-Banking): The use of internet can also be seen in the field of banking transactions. Many banks such as HSBC, SBI, Axis Bank, Hdfc Bank, etc. offers online banking facilities to its customers. They can transfer funds from one account to another using the net-banking facility.

E-commerce: Internet is also used for carrying out business operations and that set of operations is known as Electronic Commerce (E-commerce). Flipkart is the largest e-commerce company in India. The rival, Amazon, is giving stiff competition to Flipkart.

Mobile commerce: Mobile commerce (also M-Commerce) refers to the commercial transaction that takes place over the mobile internet. Using the mobile internet technology, many companies have introduced mobile version of websites and mobile apps, to promote and sell their products. Customers can simply browse several through the products and buy online through mobile internet.

Mobile wallet: Many companies offer the service of mobile wallet to its customers. Users must have a smart-phone and internet connection to use this service. Users can pay an amount into their mobile wallet, which they can use to make online payment such as bill payments, recharges, etc.

Entertainment: Apart from a major source of knowledge and information, the utility of Internet in the field of entertainment cannot be undermined. We can visit various video sites and watch movies and serials at our convenient time.

Technology of the Future: Internet is the technology of future. In the times to come, offices would be managed at distant places through Internet.