

Applications of Computer in Business



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CHAPTER 01

Introduction to Computer System

- 1.INTRODUCTION**
- 2.USES OF COMPUTER**
- 3.CHARACTERISTICS OF COMPUTER**
- 4.TYPES OF COMPUTER**
- 5.CLASSIFICATION OF DIGITAL COMPUTER**
- 6.TYPES OF PERSONAL COMPUTER**

1.1 Introduction

Computer is an electronic machine that can be programmed to accept data as Input, process this data under given instructions and display results to the user as output and store them for future use.

Computer is called a problem solving machine. It is used to solve user's daily routine problems. User must have to provide instructions to solve his problems. Different set of instructions are used to solve different problems.

Word computer is derived from a Latin word "*Compute*" that means "*to calculate*". Computer is used as a calculating machine. It produces accurate results at very high speed. It also is used to solve various other problems along with calculations. Computer can solve these problems quickly and efficiently.

1.1.1 Information Processing Cycle:

A computer is used to convert data into information under given set of instructions. A computer take a series of steps to convert data into information called information processing cycle.

There are four basic steps in information processing cycle.

- Input
 - Processing
 - Output
 - Storage
- **Input:**
In this step data is inserted into computer. This data can be in any form i.e. Text, numbers, images, audios, videos: Various input devices are used to input data into computer i.e. Key board, mouse, micro phone, scanner etc.
- **Processing:**
In this step computer converts data into useful information. CPU is the main component of the computer that converts data into information.
- **Output:**
In this step results are provided to the user. For this purpose different output devices are used i.e. display screen, Printer, speaker, Projector, etc.
- **Storage:**
Computer stores data, programs and result for future user in this step. For this purpose, secondary storage devices are used i.e. hard disc, USB drive, solid state drives, optical storage media etc.

1.2 Components of Computer

A computer is composed of two major components.

1. Hardware
2. Software

1.2.1 Hardware:

The tangible parts of computer are called hardware. Hardware is the physical aspect of computers, telecommunications, and other devices. It is also called machine. There are five categories of hardware devices.

1.2.1.1 Input Devices:

The data or instruction and commands given to the computer are called Input. A hardware component used to enter data and instruction into the computer is called input devices. Most commonly used input devices are keyboard, mouse, microphone, scanner, digital camera, and PC camera.

Keyboard



Keyboard is used to enter text. It controls alphabets, numeric and other keys for entering different types of data.

Mouse



Mouse is a pointing device. It controls the pointer on the screen. The user gives instructions to computer using mouse. It contains different buttons to perform different tasks like selecting an object or opening a program

Microphone



Microphone is used to enter audible sounds into the computer.

Scanner



It reads printed text and graphics and translates result into digital form.

Digital camera



Digital camera is used to take and store picture in digital form.

1.2.1.2 Output devices

The process of providing information to the user is called output. This information is produced by processing on data. A hardware component used to display information to the user is called output devices. Most commonly used output devices are monitor, printer, and speaker.

Display Screen



Display screens are used to display text, images and videos in soft form.

Printer



Printer is used to print data and images on paper. Such printed output is called hard copy output.

Speaker



Speakers are used to produce audible sounds i.e. speech music etc.

1.2.1.3 System Unit

System unit is a case that contains different electronic components of the computer used to process data. All computer system has a system unit. The electronic components in the system unit are connected to the motherboard. Motherboard is also known as system board or main board. System board is a communication medium for the entire computer system.



Desktop Case



Tower Case



Mother Board

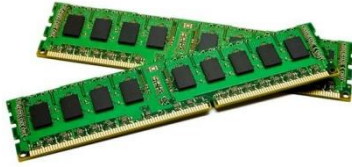
The important components of system unit are as follows:

CPU



CPU stands for **central processing unit**. It is also called processor. It is the brain of the computer. CPU interprets and executes the instructions in the computer.

Memory



The hardware component that stores data and instructions temporarily is called **memory**. It is also called primary memory or main memory. It is used to store input data before processing. It also stores processed data after processing until the data is sent to the output devices.

1.2.1.4 Storage devices

The hardware components used to store data, instructions and information permanently are called storage devices. It is called nonvolatile because its contents remain safe when the computer is turned off. Some examples of storage devices are USB flash drive, hard disks and optical disc etc.



Hard Disc



USB flash Drive



Solid State Drive



Optical Discs

1.2.1.5 Communication Devices

The hardware components used to communicate and exchange data, instructions and information with other computer are called communication devices. Modem is an example of communication device. It enables the computer to communicate with other components through telephone lines or cable.



Network Interface Card



Modem



Bridge

1.3 Uses of Computer

Computer is being used widely in almost every field of life.

1.3.1 Uses in Education

Education is the process of acquiring knowledge. In the traditional model, people learn from other people such as parents, teachers, and employers. Many forms of printed material such as books

and manuals are used as learning tools. Today, educators are using computer to enhance learning process.

Computer can be used in education in the following ways:

1.3.1.1 Computer-Based Training (CBT):

CBT are different programs that are supplied on CD-ROM. These programs include text, graphics, and sounds. Audio and video lectures are recorded on the CDs. CBT is a low-cost solution for educating people. You can train a large number of people easily.

Some benefits of CBT are as follows:

- The students can learn new skills at their own pace. They can easily acquire knowledge in any available time in their own choice.
- Training time can be reduced.
- It is interactive, attractive and easy material. It encourages students to learn the topic.
- Planning and timing problems are reduced or eliminated.
- The skills can be taught at any time and at any place.
- It is very cost-effective way to train a large number of students.

1.3.1.2 Computer-Aided learning (CAL)

Computer aided learning is the process of using information technology to help teaching and enhance the learning process. The use of computer can reduce the time that is spent on preparing material. It can also reduce the administrative load of teaching and research. The use of multimedia projector and slides has improved the quality of teaching. It has also helped the learning process.

1.3.1.3 Online Education

Many websites provide online education. You can download educational material, books and tutorials without going outside. Some universities provide online lectures for the students. Students can ask questions and discuss problems by sending emails to websites.

1.3.1.4 Distance Learning

Distance learning is a new learning methodology. Computer plays the key role in this kind of learning. Many institutes are providing distance learning programs. The student does not need to come institute. The institute provides the reading material and the students attends virtual classroom. In virtual classroom the teacher delivers lecture at his own workplace. The students can attend the lecture at home by connecting to a network. The students can also ask questions to the teacher. The answers are given to the students by email.

1.3.1.5 Online Examination

The trend of online examinations is becoming popular. Different examinations like GRE, GMAT and SAT are conducted online all over the world. The questions are marked by the computer. It minimizes the chance of mistakes. It also enables to announce the result in time.

1.3.2 Uses at Home:

Computer can be used at home in the following ways:

1.3.2.1 Home Budget

Computer can be used to manage the home budget. User can easily calculate his expense and income. You can list all expenses in one column and income in another column. Then you can apply any calculation on these columns to plan your home budget.

1.3.2.2 Computer Games

An important use of computer at home is playing games. Different types of games are available. These games are a source of entertainment and recreation. Many games are available that are specially developed to improve your mental capabilities and thinking power.

1.3.2.3 Working from Home

People can manage the office work at home. The owner of the company can check the work of the employees from home. He can control his office while sitting at home.

1.3.2.4 Entertainment

People can find entertainment on the internet. They can watch movies, listen songs and download different stuff. They can also watch live matches on the internet.

1.3.2.5 Information

People can find any type of information from internet. Educational and informative websites are available to download books, tutorials etc. to improve knowledge.

1.3.2.6 Chatting

People can chat with the friends on internet. They can also talk them. Different messages, files and information can be sent to them.

1.3.3 Uses for Health Care

Computer can be used for health care in the following ways:

1.3.3.1 Hospital Administration

Hospital is an important organization. We can use the computer for administration of a hospital. We can computerize the accounting, payroll and stock system of the hospital. We can keep the record of different medicine, their distribution and use in different wards etc.

1.3.3.2 Recording Medical History

Computer can be used to store medical history of the patients. We can store important facts about patients in computer. We can keep record of his past treatment, suggested medicines and their results. Such system can be very effective and helpful for doctors.

1.3.3.3 Monitoring Systems

Some serious patients must be monitored continuously. Monitoring is needed especially in operations theaters and intensive care units. Many computerized devices are used to monitor the blood pressure, heartbeat and brain of the patients.

1.3.3.4 Life Supports Systems

Life supports systems are available that stores different diseases and their symptoms. Diagnosis of diseases is possible by entering the symptoms of patient. Moreover, different computerized devices are used in laboratories for different tests of blood etc.

1.3.4 Uses in Business

The use of computer technology in business provides many facilities. Businessman are using computer to interact with their customers anywhere in the world. Many business tasks are performed more quickly and efficiently. Computer can also help them to reduce the overall cost of their business. Computer can be used in business as follows:

1.3.4.1 Marketing

A business organization can use computer for marketing their products. Marketing applications provide information about the products to customers. Computer is also used to manage the distribution system, advertising and selling activities. It can also be used in deciding pricing strategies.

1.3.4.2 Stock Exchange

Stock exchange is the most important place of businessmen. Many stock exchanges use computers to conduct bits. The stockbrokers perform all trading activities electronically. They connect with the computer where brokers match the buyers with sellers. It reduces the cost as no paper or special building is required to conduct these activities.

1.3.4.3 Banks

Banks are using powerful computers to perform millions of transactions. Banks are providing the facility of ATM. All ATMs are computerized and connected together through computer network. People can draw money from ATM at any time.

Many banks are now providing **online banking**. The customers can connect to the banks using internet. They can see the accounts status at home. They can also conduct online transactions from homes. It reduces staff and building of banks. Many customers pay their bills from their bank accounts using this facility.

The banks are also providing mobile banking or m-commerce. It is a process of performing banking activities using mobile devices. The user can perform all types of business activities using mobile devices such as Smartphone.

1.3.4.4 Departmental Stores

The use of computer in departmental stores has made the business activities fast and accurate. The cashier can enter sales data in the computer using barcode reader. The barcodes contain the price of the item. The computer uses this input to calculate the bill. The record of the sales is stored in the computer.

1.3.4.5 Office Automation

Office automation is the process of automating office tasks using computers. Many types of tasks are performed in an office. These tasks include the following:

- Decision-making
- Data manipulation
- Documents handling
- Communication and storage

Many computers' technologies area used to perform these activities in an office easily.

1.3.5 Uses in Publishing:

Publishing is the process of making works available to the public. These works include books, magazines, newspapers, music, film, and video. Special software assists graphic designers in developing pages that include text, graphics, and photos; artists in com posing and enhancing songs; filmmakers in creating and editing film; and journalists and mobile users in capturing and modifying video clips.

Many publishers make their works available online Some Web sites allow you to copy the work, such as a book or music, to your desktop computer, mobile computer, smart phone, or other mobile device.

1.3.6 Uses in Manufacturing:

Computer is used in industries in different types of systems. Robots are used to control many complex tasks. A robot is an automatic programmable machine. It moves and performs mechanical tasks. It is used in different applications.

Computer can be used in industry in the following ways:

1.3.6.1 Computer-Aided Manufacturing (CAM):

Computer-aided manufacturing (CAM) refers to the use of computers to assist with manufacturing processes such as fabrication and assembly. Industries use CAM to reduce product development costs, shorten a product's time to market, and stay ahead of the competition.

CAM is used by a variety of industries, including oil drilling, power generation, food production, and automobile manufacturing. Automobile plants, for example, have an entire line of industrial robots that assemble a car

1.3.6.2 Computer-aided Design (CAD):

Many products are designed using CAD (computer aided design). The model of a product is designed on the computer using computer programs. The actual product is produced after completing the design.

1.4 Characteristics of Computer

1.4.1 Speed

Computer processes data at very high speed. It is much faster than human beings. A computer can perform billions of calculations in seconds. Computer speed is measured in Mega Hertz (MHz) or Giga Hertz (GHz). For example, the process of multiplying 750 and 927 can take one or two minutes if it is performed b human beings. However, a computer can perform millions of such calculations within a second.

1.4.2 Reliability

Computer is very reliable. The electronic components in modern computer rarely break or fail.

1.4.3 Accuracy

Accuracy means that the computer provides results without any errors. Computer can process large amounts of data and produce results accurately. The result can be wrong only if the data given to the computer is not correct. Suppose the average marks of a class are required. There can be chance of mistake in the result if it is performed by human beings. However, a computer can produce this result very accurately and quickly.

1.4.4 Storage

Computer can store a large amount of data permanently. People can use this data at any time. The user can store any type of data in the computer. The storage capacity of computer is increasing rapidly. A computer can store thousands of books easily.

1.4.5 Versatility

Computer is versatile machine. It can perform different types of tasks. That is why it is being used in every field of life. Computer is used in hospital, bank, and at home. A user can play games, listen to music, watch movies and use the internet using the computer.

1.4.6 Consistency

Computer works in a consistent way. It does not lose concentration due to heavy work. It does not become tired or bored. Computer performs all jobs with equal attention.

1.4.7 Communication

Most computers have the capability to communicating with other computers. We can connect two or more computers with communication device such as modem. These computers can share data, instructions and information. The connected computers are called network. We can communicate with other people in the world using network like the Internet.

1.4.8 Recalling

A computer can recall the stored data and information as and when required. The data stored in the computer can be used at a later time. The computer can recall the required data in a few seconds.

1.4.9 Control Sequence

A computer works strictly according to the given instructions. It follows the given sequence of execution that is given in program.

1.4.10 Cost Reductions

We can perform a difficult task in less time and less cost. For example, we may have to hire many people to handle an office. The same work can be performed by a single person with the help of computer. It reduces the cost.

1.5 Types of Computers

Different types of computers are as follows:

1.5.1 Analog Computers

Analog computer represents physical quantities in the form of waves or in a continuous form. Voltage, pressure, speed and temperature are some physical properties that can be measured in this way. Its output is usually displayed on a meter or graphs. Analog computer is difficult to operate and use. It has low memory and fewer functions. It provides low accuracy but faster speed than digital computer. It is usually built for special purposes. Analog computer is mainly used in engineering and scientific applications.

Examples

1. Speedometer is used to measure the speed of a car.
2. Analog clock measures time by the distance traveled by hands of clock around a dial.
3. Thermometer is an analog device that measures the length of mercury column.

1.5.2 Digital Computers

Digital computer processes data in numerical form using digital circuits. It performs arithmetic and logic operations with discrete values 0 and 1. Everything is described as ON and OFF where 1 represents ON and 0 represents OFF.

Digital computer can store and process a large amount of data at high speed. The results of digital computers are more accurate than analog computers. Most of the computers available today are digital computers. These computers are available in different sizes, speeds and capacities. Digital computers are commonly used at homes and in offices etc.

Examples

1. Digital watch displays the time that does not vary continuously but changes from one discrete value to the other.
2. Digital scoreboard directly counts discrete values such as the time left to play and the score of each team.

1.5.3 Hybrid Computers

A hybrid computer is a combination of both analog and digital computer. It combines the best characteristics of both types of computers. It can accept data in analog and digital form. Hybrid computers are used in medical labs, hospitals and industrial processes etc.

Examples

Hybrid computer can monitor patient's heart function, temperature and blood pressure etc. This measurement can be converted and displayed in digital form.

1.6 Classification of Digital Computer

Computers can be categorized into seven broad categories. These categories are made on the basis of size, speed, processing power, and price. This classification is not straight forwarded as rapid changes in technology, decreasing distinction in these categories. These categories are discussed below:

1.6.1 Personal Computers

Personal computer is also called microcomputer. It is designed to be used by one person at a time. It consists of a processor, memory and one or more input, output and storage devices. Personal computers are available in different sizes and shapes. It also often contains a communication device. They are widely used by individuals and businesses. The price of personal computer is from several hundred to several thousand dollars.

Most widely used personal computers are Intel-PC and APPLE MAC. PC and its compatible computers use windows operating systems. Apple computers use Mac OS operating system. PC and its compatible computers follow the specifications of the original IBM personal computer. Different companies such as dell, Acer and HP sell PC and its compatible computers. Major types of personal computers are desktop computer and portable computer.



1.6.2 Mini Computers

Mini Computers also called Mid-Range Servers are powerful computers that are used to control access to the hardware, software, and other resources on a network and provide a centralized storage area for programs, data, and information. Servers can support from two to several thousand connected computers at the same time. In many cases, one server accesses data, information, and programs on another server. End users use personal computers or terminals to access data, information, and programs on a server. A terminal is a device with a monitor, keyboard, and memory.



Figure: Server Computer

1.6.3 Mainframes

A mainframe computer is large computer in term of price, power and speed. It is more powerful than minicomputer. It can handle thousands of connected users simultaneously. It consists of multiple processors. It is specially designed to perform multiple tasks of multiple users simultaneously. It is designed for high reliability. It often runs twenty four hours a day. It can be served and upgraded while it is running. It is also known as enterprise server or high-ended server.



Major business organizations use mainframes for business activities. With mainframes, enterprises are able to bill millions of customers, prepare payroll for thousands of employees, and manage thousands of items in inventory. One study reported that mainframes process more than 83 percent of transactions around the world. These computers can act as servers to control data traffic and able to store huge amount of centralized data, information and programs. The user can access a mainframe computer through a terminal or personal computer. The price of mainframe computer is several thousand dollars and can be up to several million dollars. IBM, Sun and Unisys are leading manufacturers of mainframe computers.

1.6.4 Super computers:

Supercomputer is the fastest and most powerful computer. It is biggest in size and more expensive in price than any other computer. It is used to perform complex tasks. It can process more than one quadrillion instructions per second. It has a very large storage capacity and can store several thousand times more data than an average desktop computer. It also consumes so much energy. It can process trillions of instructions in one second.

The modern super computer consists of thousands of microcomputers. The cost of one supercomputer can be up to several billion dollars.

Examples:

- Roadrunner
- Blue Gene
- Deep blue
- ASCI White

Supercomputer are used to run Applications requiring complex, sophisticated mathematical calculations i.e. large-scale simulations and applications in medicine, aerospace, automotive design, online banking, weather forecasting, nuclear energy research, and petroleum exploration.



Figure: IBM Road Runner

1.6.5 Embedded Computers

An embedded computer is designed for special purposes. It works as component in a larger product. These computers are very small and have limited hardware. They perform various functions according to the requirements of the product in which they are embedded.

Embedded computer are used in commonly used product such as:

- **Electronics:** PDAs, mobile, video recorder and DVD player etc.

- **Home devices:** security monitoring systems & programmable microwave ovens etc.
- **Automobile:** car engine controller, airbag controller etc.
- **Process controller and robotics:** machines controllers, blood pressure monitors etc.

1.7 Types of Personal Computer

Personal computer is also called microcomputer. It is designed to be used by one person at a time. It consists of a processor, memory and one or more input, output and storage devices. Personal computers are available in different sizes and shapes. It also often contains a communication device.

Personal Computer can further be classified in following groups.

1.7.1 Desktop Computer:

Standard desktop computers are designed to fit on surface of a table or desk. It has a system unit, a display screen, keyboard and mouse. In some models the system unit is lying on the table, called desktop case and in other, system unit is standing in vertical order called tower case. .



Figure: A Desktop Computer

All in One Computer: System unit and display screen is combined in a single case in this model. Only key board and mouse are separately attached with this system. *HP Touch smart* and *Apple iMac* are examples of all in one computer.



Workstations: A work station is a powerful desktop computer designed to work as a server in the network and provide services to other computers. It can perform complex calculations and equipped with intensive processing power, memory and graphic capabilities.



Home theaters: A home theater combines the features of a high-definition video/audio entertainment system with a desktop computer that is designed to be connected to a television and includes a Blue-ray Disc, digital video recorder, and digital cable television connectivity.



1.7.2 Mobile Computers:

A mobile computer is a personal computer which easily carried from place to place. Similarly, a mobile device is a computing device small enough to hold in your hand. The most popular type of mobile computer is the notebook computer.

1.7.2.1 Note Book Computers:

Notebook computer is also called laptop computer. It is a small, lightweight portable computer. It can be carried from one place to another easily. It uses less power than desktop computer. It operates on a rechargeable battery. Businessmen use laptops to connect with their business activities during travel. Laptops are designed to fit in lap of the user. That's why it is named as laptop. It is almost similar to a desktop computer in working and functionality. But it is more expensive than a typical desktop. On a typical notebook computer, the keyboard is on top of the system unit, and the monitor attaches to the system unit with hinges.



Figure: Notebook Computer

Netbook Computer: *netbook* is a smaller, lighter, thin and often not as powerful as a traditional notebook computer. Most netbooks cost less than traditional notebook computers, usually only a few hundred dollars.

Ultra book: An ultra-thin is another type of notebook computer that is lightweight and usually less than one-inch thick. Some notebook computers have touch screens, allowing user to interact with the device by touching the screen, usually with the tip of a finger.

1.7.2.2 Tablet PCs

Tablet PC a smart computer like a letter-sized slate, the Tablet PC is a special type of notebook computer that allows user to write or draw on the screen using a digital pen. With a digital pen, users write or draw by pressing the pen on the screen, and issue instructions to the Tablet PC by tapping on the screen. For users who prefer typing instead of handwriting, some Tablet PC designs have an attached keyboard; others allow user to connect a separate keyboard to the device. Most Tablet PCs have touch screens. Tablet PCs also support voice input so that users can enter text and issue instructions by speaking into the computer. Tablet PCs are useful especially for taking notes in lectures, at meetings, conferences, and other forums where the standard notebook computer is not practical.

Slate Tablet: Slate tablet consists of a screen and system unit behind it. It doesn't contain a physical key board. Input is made by an on-screen virtual key board.



Figure: Slate Tablet

Convertible Tablet: convertible tablet consists of a screen attached to a key board. Screen can be rotated and fix down over the keyboard. Now it will look like a slate tablet.



Figure: Convertible Tablet

1.7.3 Mobile Devices:

A mobile device is a computing device designed to hold in the hand. Mobile devices typically have small screens and some of them have keyboards. Mobile devices usually have no

disk drives. The programs and data are permanently stored on special memory or on a small storage media such as smart card. Mobile devices can be connected to large network to exchange data. Mobile devices are almost always powered by rechargeable battery system. It has built-in wireless connectivity for internet access. Popular types of mobile devices are smart phones, handheld computer, portable media player and e-book.

1.7.3.1 Handhold Computer:

A handhold computer is a small lightweight computer that fits in a hand. It can communicate with other computers via wireless links. It may contain a small key board or use virtual keyboard. Mostly, mobile employees used handhold computers to connect with their office. It is not very powerful and can perform a limited set of tasks than desktop and laptop.



Figure: Handhold Computer

1.7.3.2 Smart Phones:

A smart phone is a mobile phone having computational capabilities with simple phone features. It can run most of the applications that run on a typical computer. Smart phones have touch screens and equipped with a rich family of sensor i.e. GPS, Gyro-meter etc. It can take input through a virtual keyboard on touch screen or may have a small physical keyboard. A user can make calls and send and receive SMS on a smart phone as well as can browse Internet, send emails, play music, get GPS services and much more.



Figure: Smart Phone



1.7.3.3 Portable Media Player:

A portable media player is a mobile device designed to store, organize and play digital media i.e. music photos and movies. Some portable media player has a touch screen or a touch sensitive pad for input. Media can be scrolled with the help of finger or thumb or stylus using touch screen or small buttons provided on devices. User can use ear-buds to listen sound.

Figure: Portable Media Player

1.7.3.4 E-Book Reader:

E-book reader is designed for reading books, magazines etc. in digital format. It has internal storage space which may contain thousands of E-books.

E-book reader must contain touch screen and built-in wireless connectivity mechanism to connect with internet. User can browse online book stores and can download books using internet. It uses an on screen virtual keyboard to interact with e-book.



Figure: E-Book Reader

1.7.4 Game Consoles:

A game console is a mobile computing device designed for single-player or multiplayer video games. Standard game consoles use a handheld controllers an input device, a display screen as an output device; and hard disks, optical discs, and memory cards for storage. Manageable size of game consoles makes them easy to use at home, in the car, in a hotel, or any location that has an electrical outlet. Three popular models are Microsoft's Xbox 360, Nintendo's Wii (pronounced wee), and Sony's PlayStation 3.



Figure: Game Console

A handheld game console is small enough to fit in one hand, making it more portable than the standard game console. With the handheld game console, the controls, screen, and speakers are built into the device. Because of their reduced size, the screens are small, about three to four inches. Some models use cartridges to store games; others use a memory card or a miniature optical disc. Many handheld game consoles can communicate wirelessly with other similar consoles for multiplayer gaming. Two popular models are Nintendo DS Lite and Sony's PlayStation Portable (PSP). In addition to gaming, many game console models allow users to listen to music, watch movies, keep fit, and connect to the Internet. Game consoles can cost from a couple hundred dollars to more than \$500.



Figure: Handhold Game Console

CHAPTER 02

COMPUTER HARDWARE & SOFTWARE

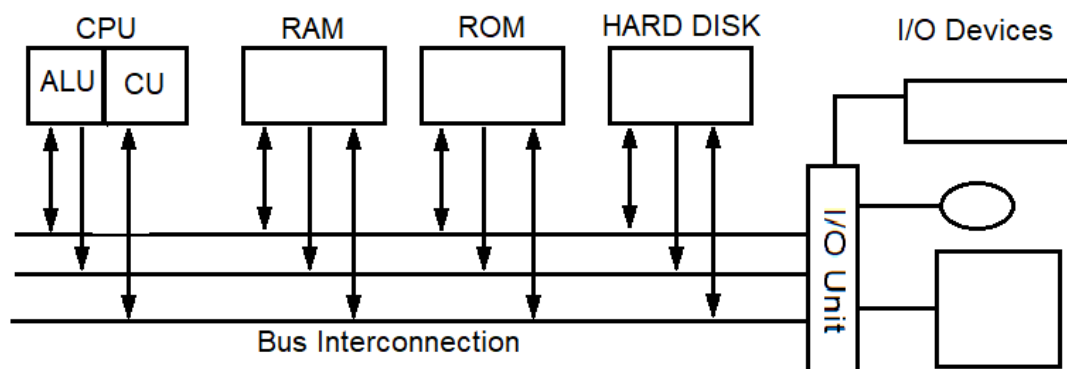
- 1. BASIC ORGANIZATION OF COMPUTER**
- 2. CPU & COMPONENTS**
- 3. PRIMARY MEMORY**
- 4. SECONDARY STORAGE**
- 5. INPUT/OUTPUT DEVICES**
- 6. COMPUTER SOFTWARE**
- 7. INTRODUCTION TO PROGRAMMING**

2.1 Computer Architecture

Computer is an electronic device that converts data into information. It consists of many components like CPU, Main memory, Hard Disk I/O devices. Each of these components performs a specific task during data processing. These components are connected to each other to process data. The way to connect these components is called computer architecture.

The main components of computer architecture are as follow:

1. CPU
 - i. ALU
 - ii. CU
2. Main Memory
3. I/O Unit
4. Bus Interconnection.



2.1.1 System Unit

The **system unit** is a case that contains electronic components of the computer used to process data. System units are available in a variety of shapes and sizes. The case of the system unit, sometimes called the *chassis*, is made of metal or plastic and protects the internal electronic components from damage. All computers and mobile devices have a system unit.

On desktop personal computers, the electronic components and most storage devices are part of the system unit. The main component in the system unit is mother board. It is a board made of silicon. All other electronic components are mounted on mother board. It may include CPU, main memory, ROM, storage devices, optical drive, and expansion slots.

Other devices, such as the keyboard, mouse, microphone, monitor, printer, USB flash drive, scanner, Web cam, and speakers are attached from outside of the system unit using ports and connectors. An all-in-one desktop personal computer is an exception, which houses the monitor and the system unit in the same case.

2.1.2 Mother Board:

Motherboard is also called system board or main board. It is the most important circuit board in the system unit. It is the communication medium for the entire computer system. All components or devices of the computer are connected to the motherboard.

The motherboard contains the processor, memory, expansion slots, ports and connectors etc. it may also include integrated peripherals such as video, sounds and network adapters. It enables the users to attach different devices to it such as keyboard, printer and scanner etc.

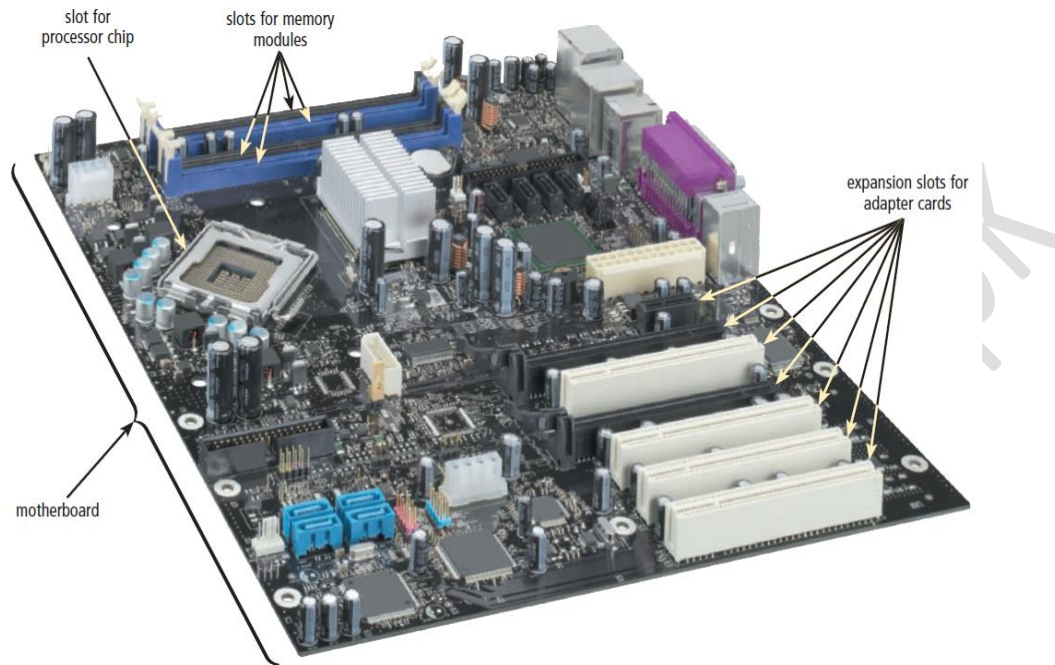


Figure: Mother Board and attached components

2.2 Micro Processor

Processor is also called Central Processing Unit (CPU). CPU interprets and carries out the basic instructions that operate a computer. It is the brain of the computer. It is the most important component of a computer. It is also called processor. A computer cannot work without CPU. All computers must have a central processing unit.

CPU is located on the motherboard. It carries out most of the work a computer. CPU performs all operations on data according to the given instructions. It executes instructions and tells other parts of computer what to do. Most of the work consists of calculations and data transfer.

All functions of processor usually are on a single chip in personal computers. The manufacturers of processor chip are also providing multi-core processors. A single chip that contains two or more separate processors is known as multi-core processor. Multi-core processing reduces access time and increases overall processing. For example, if one core is busy in executing an instruction, another can handle incoming data or instructions. It reduces energy consumption over multiple separate processors.

Multi-core processors include dual-core, quad-core, six-core and eight-core. AMD and Intel offer



Figure: Micro Processor (CPU)

multi-core processors. Two most common multi-core processors are as follows:

1. **Dual-core processor:** A dual-core processor chip contains two separate processors.
2. **Quad-core processor:** A quad-core processor chip contains four separate processors.

2.2.1 Parts of Processor:

CPU consists of two main units known as arithmetic & logical unit and control unit. These components work together to perform processing operations.

2.2.1.1 Control Unit

Control Unit controls and coordinates all activities of computer system. It acts like a supervisor of the computer. It does not execute program instructions by itself. It direct and coordinates all tasks in computer by issuing necessary commands to different components of computer. Control unit also provides clock pulses that are used to regulate and control all operations in the computer system. Important operations performed by control unit are as follows:

1. It fetches instructions from the main memory.
2. It interprets the instructions to find what operation is to be performed.
3. It controls the execution of instructions.

2.2.1.2 ALU (Arithmetic and Logic Unit)

ALU is a part of CPU. Actual execution of instructions takes place in this part. All arithmetic and logical operations are performed in ALU. It consists of two following units:

Arithmetic Unit Arithmetic

Arithmetic unit of ALU performs basic arithmetic functions such as addition, subtraction, multiplication and division.

Logic Unit

Logic unit of ALU performs logical operations like comparing two data items to find which data item is greater then, equal to, or less than the other.

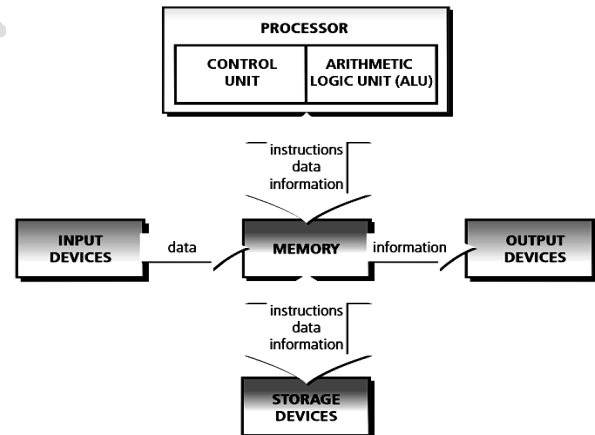


Figure: Connectivity Model of Processor with peripheral devices

2.3 Primary Memory

Memory is an area of a computer that stores data and instructions to be accessed by processor as well as the results of processing. It consists of one or more chips on motherboard or some other circuit boards in the computer. These chips are electronic components that store instructions, waiting to be executed by the processor, data needed by those instructions, and the results of processing the data (information).

Memory stores three basic categories of items:

1. The operating system and other system software that control or maintain the computer and its devices.
2. Application programs that carry out a specific task such as word processing.
3. The data being processed by the application programs and resulting information.

All the Instruction to be executed and corresponding data must be loaded in Memory before execution. This role of memory to store both data and programs is known as the **stored program concept**.

2.3.1 Structure of Main Memory:

The main memory of a computer consists of thousands or millions of cells of storage locations. Each cell can store a bit. One bit can represent 0 or 1. Bit stands for binary digit. The memory cells are logically organized into groups of 8 bits known as byte.

Each byte in the memory has a unique number assigned to it. The number is known **byte address** or **memory address**. The schema of arranging the cells into a byte and bytes into memory chip is shown in the following figure. The number shows the byte number assigned to a byte. It is also known as the address of the byte.

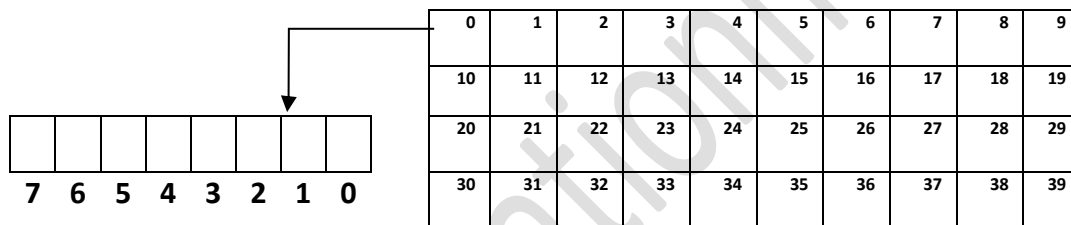


Figure: Internal Structure of Memory (Bytes, Byte Address and bits).

2.3.2 Memory Sizes

Size of memory and storage devices is measured in terms of the number of bytes available for storage. A byte is a group of 8 bits. A **kilobyte (KB or K)** is equal to exactly 1,024 bytes. To simplify memory and storage definitions, computer users often round a kilobyte down to 1,000 bytes. For example, if a memory chip can store 100 KB, it can hold approximately 100,000 bytes (characters). A **megabyte (MB)** is equal to approximately 1 million bytes. A **gigabyte (GB)** equals approximately 1 billion bytes. A **terabyte (TB)** is equal to approximately 1 trillion bytes.

Term	Abbreviation	Number of Bytes	2's Power
Kilobyte	Kb	1024	2^{10} byte
Megabyte	Mb	1048576	2^{20} byte
Gigabyte	Gb	1,073,741,824	2^{30} byte
Terabyte	Tb	1,099,511,627,776	2^{40} byte

2.3.3 Types of Main Memory:

There are two types of memory in computer that are as follows:

1. **Volatile Memory** Volatile memory loses its contents when the computer is turned off. RAM is the most common type of volatile memory.
2. **Non-volatile Memory** Non Volatile Memory does not lose its contents when the computer is turned off. ROM, flash memory and CMOS are

examples of non-volatile memory.

2.3.3.1 Random Access Memory (RAM)

RAM stands for Random Access Memory. It is also called direct access memory. Random access means that each individual byte in entire memory can be accessed directly. RAM is used to store data and instructions temporarily. A program must be loaded into RAM before execution.

RAM is a volatile memory. It means that its contents are lost when the power is turned off. RAM is a read/write memory. CPU can read data from RAM and write data to RAM. It is used to store data and instruction while it is being executed. RAM is also called main memory or primary storage.

RAM plays very important role in the processing speed of a computer. A bigger RAM size provides larger amount of space for processing. So the processing speed is increased. The amount of data that can be stored in RAM is measured in bytes. Most desktop computers typically have 4 GB of RAM or more.

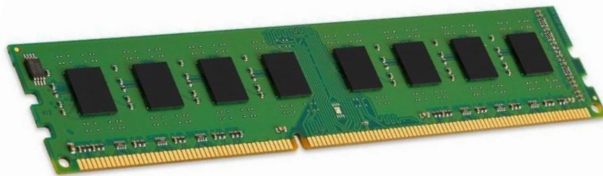


Figure: RAM Module

Different types of RAM are as follows:

1. DRAM

DRAM stands for Dynamic Random Access Memory. It is used in most of the computers. It is the least expensive kind of RAM. It requires an electric current to maintain its electrical state. The electrical charge of DRAM decreases with time that may result in loss of data. DRAM is recharged or refreshed again and again to maintain its data. The processor cannot access the data of DRAM when it is being refreshed. That is why it is slow.

2. SRAM

SRAM stands for static Random Access Memory. It can store data without any need of frequent recharging. CPU does not need to wait to access data from SRAM during processing. That is why; it is faster than DRAM. It utilizes less power than DRAM. SRAM is more expensive.

3. MRAM

MRAM stands for Magneto Resistive Random Access Memory. It stores data using magnetic charges instead of electrical charges. RAM uses far less power than other RAM technologies so it is ideal for portable devices. It also has greater storage capacity. It has faster access times than RAM. It retains its contents when the power is removed from computer.

2.3.3.2 Read-Only Memory (ROM)

ROM stands for read only memory. The instruction in ROM prepares the computer for use. These instructions can only be read but cannot be changed or deleted. It is not possible to write new information or instructions into the ROM.

ROM stores data and instructions permanently. When the power is switched off, the instructions stored in ROM are not lost. Therefore, ROM is called non-volatile memory.

The information in ROM is stored by the manufacturer. When the computer is switched on, the instructions in the ROM are automatically loaded into the memory of the computer. ROM contains a small set of instructions called ROM BIOS. BIOS stands for Basic Input/output System. These instructions tell the computer how to access hard disk, find operating system and load the operating system in RAM.

Different types of ROM are as follows:

1. PROM

PROM stands for programmable Read Only Memory. This form of ROM is initially blank. The user or manufacturer can write data and programs on it using special devices. The user can write data and instructions on it only once. If there is any error in writing the instructions, the error cannot be removed from PROM. The chip becomes unusable.

2. EPROM

EPROM stands for Erasable Programmable Read Only Memory. This form of ROM is initially blank. The user or manufacturer can write data and programs on it using special devices. The data and programs written on it can be erased with special devices using ultraviolet rays. The user then can write new program on it.

3. EEPROM

EEPROM stands for Electronically Erasable Programmable Read Only Memory. In this memory, user can erase and write instructions with the help of electrical pulses. If there is any error in writing the instructions; the user can erase the contents electronically. The contents of EEPROM can be modified easily.



Figure: ROM Chips

2.4 Secondary Storage

Storage is the place where data, instructions, and information are stored permanently for future use. It is also called secondary storage. Every computer stores system software and application software. Users store a variety of data and information on mainframes computers, servers, desktop computers, notebook computers smart phones, portable media players, and other mobile devices. For this purpose, store medium is an essential part of the computer. Different storage media are used. I.e. magnetic disc, optical discs, solid state drives, flash memory etc.

Data stored on a storage medium remain intact even when power is removed from the computer. Thus, a storage medium is nonvolatile. Most memory (i.e., RAM), by contrast, holds data and instructions temporarily and thus is volatile.

2.5 Secondary Storage Devices

A hardware device that is used to store and read data and information from storage media is called storage device. There are two main operation of a storage device.

1. **Read:** the process of copying data or information from the storage medium to memory is called reading data.
2. **Write:** the process of copying data from memory to storage medium is called writing data.

2.5.1 Characteristics of Storage Devices:

1. Capacity:

Capacity is the number of bytes (characters) a storage medium can hold.. For example, a USB flash drive can store up to 4 GB of data (approximately four billion bytes) and a typical hard disk has 320 GB (approximately 320 billion bytes) of storage capacity.

2. Speed:

The speed of storage devices is defined by access time. Access time measures (1) the amount of time it takes a storage device to locate an item on a storage medium or (2) the time required to deliver an item from memory to the processor. The access time of storage devices is slow, compared with the access time of memory.

3. Transfer Rate:

Transfer rate is the speed with which data, instructions, and information transfer to and from a device. Transfer rates for storage are stated in KBps (kilobytes per second), MBps (megabytes per second), and GBps (gigabytes per second).

2.5.2 Storage Units:

Basic data storage units are as follow:

Storage Unit	Approximately	Exact Figures
Kilobyte (KB)	1 thousand	2^{10} or 1,024
Megabyte (MB)	1 million	2^{20} or 1,048,576
Gigabyte (GB)	1 billion	2^{30} or 1,073,741,824
Terabyte (TB)	1 trillion	2^{40} or 1,099,511,627,776
Petabyte (PB)	1 quadrillion	2^{50} or 1,125,899,906,842,624
Exabyte (EB)	1 quintillion	2^{60} or 1,152,921,504,606,846,976
Zettabyte (ZB)	1 sextillion	2^{70} or 1,180,591,620,717,411,303,424
Yottabyte (YB)	1 septillion	2^{80} or 1,208,925,819,614,629,174,706,176

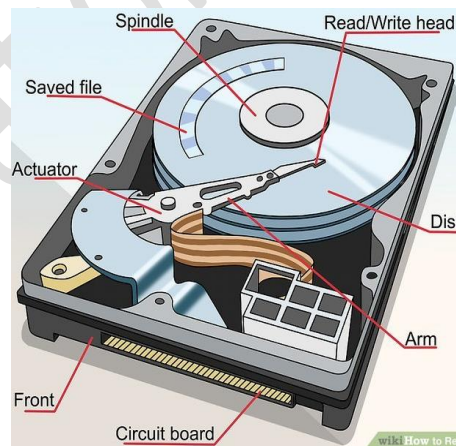
2.5.3 Hard Disks:

A hard disk, also called a hard disk drive or hard drive, is a storage device that contains one or more inflexible, circular platters that use magnetic particles to store data, instructions, and information.

Hard disk is the primary storage device in a computer to store programs and data permanently. Most personal computers have at least one hard disk drive. Some large scale computers contain hundreds of hard disks. The capacity of hard disk can be up to 8 TB or more.

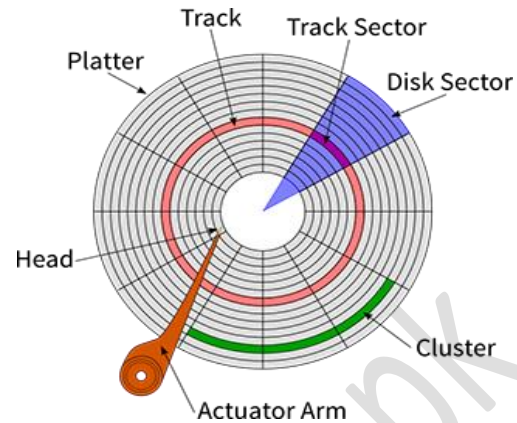
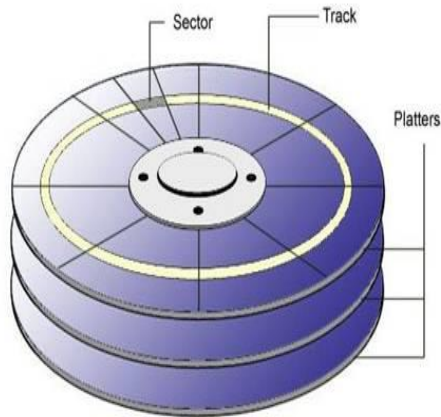
The traditional hard disk is a type of magnetic disk. It is also called fixed disk because it is fixed in the system unit. It consists of several circular disks called platters that are coated with magnetic material. The platters are fixed on the top of one another enclosed in a sealed case. Each platter has two read/write heads, one for each side. The hard disk also has arms that move the read/write heads to the proper location on the platters to read and write data. The platters in the hard disk typically spin at the high rate between 5400 and 15000 revolutions per minute (RPM).

The user can read and write data from hard disk many times. The disk must be formatted before any data can be written on the hard disk. Formatting is a process that creates process and sectors on the disk. Tracks are in the form of circles on the surface of the hard disk. Each track on a device is divided into sectors. Each sector is typically stores up to 512 bytes of data. Two or more sectors can be combined to form a cluster. A cluster is the smallest unit of disk space that stores data. All tracks in the same position on all surfaces of all disks in a hard drive form a cylinder.



2.5.3.1 Characteristics of a Hard Disk

Characteristics of a hard disk include its capacity, platters, read/write heads, cylinders, sectors and tracks, revolutions per minute, transfer rate, and access time.



1. Capacity:

The capacity of a hard disk is determined from whether it uses longitudinal or perpendicular recording, the number of platters it contains, and the composition of the magnetic coating on the platters.

2. Formatting:

The disk must be formatted before reading or writing data on it. Formatting is the process of dividing the disk into tracks and sectors, so that the operating system can store and locate data and information on the disk. A track is a narrow recording band that forms a full circle on the surface of the disk. The disk's storage locations consist of pie-shaped sections, which break the tracks into small arcs called sectors. On a hard disk, a sector typically stores up to 512 bytes of data. Sometimes, a sector has a flaw and cannot store data. When you format a disk, the operating system marks these bad sectors as unusable. For reading and writing purposes, sectors are grouped into clusters. A cluster is the smallest unit of disk space that stores data and information. Each cluster, also called an allocation unit, consists of two to eight sectors (the number varies depending on the operating system). Even if a file consists of only a few bytes, it uses an entire cluster. Each cluster holds data from only one file. One file, however, can span many clusters.

3. Transfer Rate:

Depending on the type of hard disk, transfer rates range from 15 MBps to 320 MBps. Access time for today's hard disks ranges from about 4 to 15 ms. Hard disks improve their access time by caching, specifically using disk cache.

2.5.3.2 Hard Disk Performance

The following factors affect the performance of hard disk:

Seek Time is also called positioning performance. It is the time required by read/write head to reach the correct location on the disk. It is often used with rotational speed to compare performance of hard drives. It is measured in milliseconds (ms).

Spindle Speed is also called transfer performance. It is the speed at which the drive transfers data. It is measured in revolutions per minute (RPM).

Latency is the time required by the spinning platter to bring the desired data to read/write head. It is measured in milliseconds (ms).

2.5.4 Flash Memory

Flash memory is a type of nonvolatile memory that can be erased electronically and rewritten. Flash memory chips are a type of solid state media, which means they consist entirely of electronic components, such as integrated circuits, and contain no moving parts. The lack of moving parts

makes flash memory storage more durable and shock resistant than other types of media such as magnetic hard disks or optical discs.

2.5.4.1 Types of flash memory storage:

- **Solid state drives**
- **Memory cards**
- **USB flash drives**

2.5.4.1.1 Solid State Drives:

A **solid state drive (SSD)** is a storage device that typically uses flash memory to store data, instructions, and information.

With available form factors of 3.5 inches, 2.5 inches, and 1.8 inches, SSDs are used in all types of computers including servers, desktop computers, and mobile computers and devices such as portable media players and digital video cameras. Storage capacities of current SSDs range from 16 GB to 256 GB and more.

SSDs have several advantages over magnetic hard disks.

- Access times of SSDs are about 0.1 ms, which is more than 80 times faster than a hard disk.
- Transfer rates of SSDs are faster than comparable hard disks. For example,
- SSD transfer rates range from 80 to 100 MBps, while transfer rates of a typical 2.5-inch hard disk is about 60 MBps.
- SSDs generate less heat and consume less power than hard disks.
- Manufacturers claim that SSDs will last more than 50 years, which is much greater than the 3 to 5 year hard disk stated lifespan.

The disadvantages of SSDs are they currently have a higher failure rate than hard disks, and their cost is much higher per gigabyte. As the price of SSDs drops, experts estimate that increasingly more users will purchase computers and devices that use this media.

2.5.4.1.2 Memory Cards:

A memory card is a removable flash memory to store data. Most of these cards are very small and can retain data without power. The existing data can be erased and new data can be written easily. Memory cards are available in many shapes and sizes. They are commonly used with smart phones, portable media players, digital camera and other portable devices.

A memory card can be inserted into a slot on computer or mobile device. However, a card reader can be attached to the computer if it does not have a slot. The card reader is usually connected to the USB port of the computer. The card readers are designed to read multiple types of memory cards.

There are many types of flash memory cards with different storage capacity. Different portable devices use different types of memory card. The common types of memory cards are compact Flash (SG), Secure Digital High Capacity (SDHC), Security Digital Extended Capacity (SDXC), microSD, microSHDC and Memory Stick etc.

2.5.4.1.3 USB Flash Drives

USB flash drive is a flash memory storage device that is connected to a USB port n computer or mobile device. It is also called thumb drive, Key drives, or jump drives.

USB flash drive is very easy to use because it is light in weight and small in size. It can easily be placed in pocket or attached to a keychain. It is commonly used to transfer documents, photos,

music and videos from one computer to other. It is available in different shapes, sizes and capacities. The storage capacity of USB drive can be 256 GB or more.

A special type of USB flash drive includes and installed software that is accessed through an interface like windows. It is called U3 smart drive. Some USB flash drives have fingerprint reader to authenticate the users.

2.5.5 Optical Discs:

An optical disc is a type of storage media that consists of a flat, round, portable disc made of plastic that is written and read by LASER beams. (The spelling, disk, is used for magnetic and flash memory media, and disc is used for optical media.) Optical discs used in personal computers are 4.75 inches in diameter and less than one- twentieth of an inch thick.

Nearly every personal computer today has some type of optical disc drive installed in a drive bay. On some, you push a button to slide out a tray, insert the disc, and then push the same button to close the tray; others are slot loaded, which means you insert the disc in a narrow opening on the drive. When you insert the disc, the operating system automatically may start the program, music, or video on the disc.

Optical discs store items by using microscopic pits (indentations) and lands (flat areas) that are in the middle layer of the disc.

A high-powered laser light creates the pits. A lower-powered laser light reads items from the disc by reflecting light through the bottom of the disc. The reflected light is converted into a series of bits the computer can process. A land causes light to reflect, which is read as binary digit 1. Pits absorb the light; this absence of light is read as binary digit 0.

Optical discs commonly store items in a single track that spirals from the center of the disc to the edge of the disc. As with a hard disk, this single track is divided into evenly sized sectors on which items are stored.

2.5.5.1 Types of Optical Discs

There are two types of optical discs

1. CDs
2. DVDs

2.5.5.2 Compact Disc

A **CD** or *compact disc* is a type of optical disc, used to store and transfer data from one computer to another computer. It can store 750 mb data.

Advantages:

1. CDs can be used to store audios videos or graphics.
2. It is widely used to distribute software.
3. It is least expensive kind of storage media.
4. CDs are reliable and easy to handle.

1. CD ROM:

CD ROM stands for **Compact Disc Read only Memory**. A typical CD-ROM holds from 650 MB to 1 GB of data, instructions, and information. To read a CD-ROM, insert the disc in a **CD-ROM drive** or a CD-ROM player.

The speed of a CD-ROM drive determines how fast it installs programs and accesses the disc. Original CD-ROM drives were single-speed drives with transfer rates of 150 KBps. Manufacturers measure all optical disc drives relative to this original CD-ROM drive. They set an X to denote the

original transfer rate of 150 KBps. For example, a 48X CD-ROM drive has a data transfer rate of 7,200 (48 × 150) KBps, or 7.2 MBps. Current CD-ROM drives have transfer rates, or speeds, ranging from 48X to 75X or faster. The higher the number, the faster the CD-ROM drives. Faster CD-ROM drives are more expensive than slower drives.

2. CD-R:

A **CD-R** (*compact disc- recordable*) is a multisession optical disc on which users can write, but not erase, their own items such as text, graphics, and audio. *Multisession* means you can write on part of the disc at one time and another part at a later time. Each part of a CD-R, however, can be written on only one time, and the disc's contents cannot be erased.

3. CD-RW:

A **CD-RW** (*compact disc-rewritable*) is an erasable multisession disc that can be used to write on multiple times. CD-RW overcomes the major disadvantage of CD-R because it allows users to write and rewrite data, instructions, and information on the CD-RW disc multiple times — instead of just once.

Many personal computers today include either a CD-R or CD-RW drive, or a combination drive that includes CD-R or CD-RW capabilities, as a standard feature so that users can burn their own discs. The process of writing on an optical disc is called *burning*. Some operating systems, such as Windows, include the capability of burning discs.

2.5.5.3 Digital Video Disc

Digital Video Disc is denoted as DVD. A DVD stores data, instructions, and information in a slightly different manner and thus achieves a higher storage capacity. DVD quality is also very good than CDs because images are stored at higher resolution. A DVD is capable of storing 4.7 GB to 17 GB data, depending on the storage techniques used. The first storage technique involves making the disc denser by packing the pits closer together. The second involves using two layers of pits. For this technique to work, the lower layer of pits is semitransparent so that the laser can read through it to the upper layer. This technique doubles the capacity of the disc. Finally, some DVDs are double-sided.

1. DVD ROM:

A **DVD-ROM** (*digital versatile disc-read-only memory* or *digital video disc-read-only memory*) is a high-capacity optical disc on which users can read but not write or erase. Manufacturers write the contents of DVD-ROMs and distribute them to customers. DVD-ROMs store movies, music, music videos, huge databases, and complex software.

To read a DVD-ROM, you need a **DVDROM drive** or DVD player. Most DVD-ROM drives also can read audio CDs, CD-ROMs, CD-Rs, and CD-RWs.

2. DVD R:

DVD R stands for *digital versatile disc-Recordable*. This type of DVD is initially blank. The user can write and save his data on it once. This data can further be read many times but cannot be changed or erased.

3. DVD RW:

DVD RW stands for *digital versatile disc-Re-Writeable*. User can erase and re-write data on it as many times as required.

2.6 Computer Software

A set of instructions, organized to complete a certain task, is called software. It tells the computer what to do and how to do. Software is also called program.

Software consists of GUI (Graphical User Interface) and back end logic. User access the software via GUI (Graphical User Interface) or simply UI (User Interface). A computer works according to the instructions written in software with exact sequence.

There are two broad categories of software.

- System software
- Application software

2.6.1 System Software:

System software consists of set of programs that control or maintain the operations of the computer and its devices. It controls the usage and allocation of hardware components. System software provides foundation for all application software to perform their operation smoothly and efficiently. System software acts as the interface between the user, the application software, and the computer's hardware. Two types of system software are the operating system and utility programs.

2.6.1.1 Operating System:

An operating system is a set of programs that coordinates all the activities among computer hardware devices. It provides a means for users to communicate with the computer and other software. Most common used OS are Microsoft's Windows, and Mac OS, Apple's operating system. When a user starts a computer, portions of the operating system are copied into memory from the computer's hard disk. These parts of the operating system remain in memory while the computer is on and help the user to perform basic operations on hardware i.e.

- Communicating with the computer user: receiving commands and carrying them out or rejecting them with an error message.
- Managing allocation of memory, of processor time, and of other resources for various tasks.
- Collecting input from the keyboard, mouse, and other input devices, and providing this data to the currently running program.
- Conveying program output to the screen, printer, or other output device.
- Accessing data from secondary storage.
- Writing data to secondary storage.

2.6.1.2 Utility Program:

A utility program is used to perform maintenance tasks usually related to managing a computer, its devices, or its programs. For example, a utility program can be used to transfer digital photos to an optical disc. Similarly there is another utility, Disk Defragmentation which is used to defragment the disk. The data is stored on the disks in chunks, so if we are using several files and are making changes to these files then the different portions of file are saved on different locations on the disk. These chunks are linked and the operating system knows how to read the contents of

file from the disk combining all the chunks. Similarly when we delete a file then the place where that file was stored on the disk is emptied and is available now to store other files. As the time goes on, we have a lot of empty and used pieces on the disk. In such situation we say that the disk is fragmented now. If we remove this fragmentation the chunks of data on the disk will be stored close to each other and thus reading of data will be faster. For the purpose of removing fragmentation on the disk the Defragmentation utility is used. Most operating systems include several utility programs for managing disk drives, printers, and other devices and media.

2.6.2 Application Software

Application Software is the software that is designed to do a particular task for user. It helps the user to finish his daily routine tasks. Users use the application programs according to their needs. Users perform all operation on the computer with the help of particular Application software. i.e. A widely used type of application software related to communications is a Web browser, which allows users with an Internet connection to access and view Web pages or access programs. Many other types of application software exist that enable users to perform a variety of tasks. These include personal information management, note taking, project management, accounting, document management, computer aided design, desktop publishing, paint/image editing, photo editing, audio and video editing, multimedia authoring, Web page authoring, personal finance, legal, tax preparation, home design/landscaping, travel and mapping, education, reference, and entertainment (e.g., games or simulations, etc.).

Some more examples of application software are:

- Word Processor (MS Word)
- Spread Sheet (MS Excel, Lotus123)
- Internet Browsers(Chrome , Mozilla Firefox, Internet Explorer)
- Computer Games etc.

2.7 Programming Languages

A set of words, symbols and rules used to write computer programs is called programming language. It is also called computer language. Computer language is used to write instructions for computer. These set of instructions are called computer programs or software. Therefore, computer language is a mean of communication between computer and user. There are many languages are available to write computer programs. Programmer chooses computer language according to the nature of program.

2.7.1 Types of Computer Language:

There are two types of computer languages.

1. Low Level Languages
2. High Level Languages

2.7.1.1 Low Level Languages:

The languages which are closed to computer hardware and far from human understanding are called low level languages. A computer can easily understand and execute the instructions written in low level languages. Low level languages are further divided into two types.

- i. Machine Language

ii. Assembly Language

i. Machine Language:

A language in which instructions are written in binary form (0, 1) is called machine language. It is the native language of a computer. A computer can directly understand and execute programs written in machine language. No translation is required for machine language. It is also called first generation language (1GL). Machine language is very difficult to understand for humans. So it is very hard to write a program in machine language.

ii. Assembly Language:

A language, in which symbols are used to write computer instructions instead of binary numbers, is called assembly language. These symbols are called mnemonics (pronounced as ne-mo-nics). For example, add is used for addition, sub is used for subtraction. It is also called symbolic language. Assembly language is one step higher than machine language. It is second generation language (2GL). A computer can't understand instructions of assembly language directly. So a language translator is used to translate assembly language instructions into machine code. Assembly language is also very difficult to understand for humans so it is very hard to write a program in assembly language.

2.7.1.2 High Level Languages:

The languages that are close to human understanding and far from computer hardware are called high level languages. Instructions of high level languages are written in English-like words such as print, scan, if, else, etc. These languages are easy to understand and learn. So it is very easy to write programs in these languages. A computer can't understand these languages directly. So, each high level language has a language translator. Examples of high level languages are FORTRAN, COBOL, C, C++, JAVA, Visual Basic etc.

2.8 Language Processor

A language translator is a program that is used to translate a program of high level language or assembly language into machine language. It is also called a language processor. A program written in high level language is called source code. A computer cannot understand source code directly. It must be translated into machine code. Machine code is also called object code. A language processor or language translator is used to convert source code into object code.

A computer can understand instructions written in machine code only. But, a programmer uses high level languages to write computer programs. A computer can't understand this code directly. Every high level language has a language translator. This language translator translates the high level code into machine language code.

2.8.1 Types of Language Translators

There are three types of language translators.

1. Compiler
2. Interpreter
3. Assembler

2.8.1.1 Compiler

A compiler is a language translator which is used to translate a program of high level language into machine language as a whole. It takes the complete program and scans it for syntax errors. If there is no error, it translates the program into machine language. If there is any error in the program, it will show an error message. A programmer should correct the error, then it will translate the program.

Output of compiler is an executable file (.exe file). This file can be executed many times. It is faster type of translator.

2.8.1.2 Interpreter

Interpreter is language translator which is used to translate a program of high level language into machine language statement by statement. It takes one instruction and scans it for syntax errors. If there is no error it translates the instruction into machine language and execute it. If there is any error in the program, it will show an error message. Programmer should correct the error then it will translate the instruction. After executing the instruction, it takes next instruction and repeats the steps for next instruction. It directly executes the instruction and don't return any executable file. It is slower than compiler.

2.8.1.3 Assembler

Assembler is a language translator which is used to translate instructions of Assembly language into machine code.

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CHAPTER 03

Input Devices

1. INPUT DEVICES
2. KEYBOARD
3. POINTING DEVICES
4. GAME CONTROLLERS
5. SCANNING DEVICES
6. READING DEVICES

3.1 Input:

Process of entering data and instructions into computer is called input. Computer needs data to process and instructions as well. These instructions guide the computer, how to perform data manipulation to produce useful information. Data can be in any form such text, numbers, audio, video and graphics etc.

3.2 Input Devices:

A hardware component is used to enter data and an instruction into computer is called input devices. The data and instructions are entered into the computer in different ways using different input devices. A user selects an input device according to data type and application requirements. The commonly used input devices are keyboard, pointing devices, touch screens, digital cameras, scanners and other reading devices.

3.2.1 Keyboard:

A keyboard is an input device that contains keys. Users press to enter data and instructions into a computer. Keyboard is a commonly used input device to input text data.

A standard keyboard contains over 100 keys. Desktop computer keyboards typically have from 101 to 105 keys.

The arrangements of a key on a keyboard is called keyboard layout. The most popular keyboard layout is QWERTY. The letters Q,W,E,R,T and Y appear on the top row of the main area of a keyboard. DVORAK is another widely used key board layout.



Figure: A standard Keyboard

3.2.1.1 Components of Keyboard:

There are four main components of a standard key board:

1. Functions Keys
2. Alphanumeric key pad
3. Home pad
4. Numeric Pad

5. Special Keys

1. Functions Keys:

The function keys are used to perform special functions. There are 12 function keys from f1 to f12. These keys are located in a row on top of the key board. Function of function keys vary from software to software. Some of them are used for same purpose as f1 is used to open help in every software.

2. Alphanumeric key Pad:

Alphanumeric key pad contains key for both alphabetic (A-Z) and numbers(0-9).this pad is used to enter text data. Both upper case and lower case letter can be typed using shift and caps lock keys. Main key pad also contain some special keys for different purposes. Their details are as follow:

Tab key **Tab key** is used to move the cursor to the next tab stop. It is also used in dialog boxes to move from one option or field to another.

Caps lock key **Caps lock** is a toggle key. The characters appear in uppercase if it is pressed. The characters appear in a lowercase if it is not pressed. Numbers and symbols are not affected. The status light under **caps lock** turns on when it is pressed.

Shift Key SHIFT key is used to type capital letter or symbols. It is commonly used in word processor in combination with cursor movement keys to select text.

Ctrl Key CTRL key produces different results depending on the type of software. It is used in combination with other keys as shortcut to some commands. For example, CTRL+O is used to open a file.

Alt Key ALT key is used in combination with other keys to perform special functions. In windows-based programs, it can be used to navigate menus and dialog boxes. For example, Alt+F4 is used to close a file or program.

Window Key Window key opens start menu when pressed.

Enter key **Enter key** is used to enter commands or input data in the computer. It also used to start new line in word processing.

Backspace key **Backspace key** is used to delete a signal character from the left of the cursor.

3. Home Pad:

Home pad contains keys to control the position of cursor in the document. These keys are also called cursor control keys. The **Cursor control keys** consist of arrow key, **Home**, **End**, **Page Up** and **Page Down** keys. These keys are used to move the cursor within the text or around the screen. Different cursor control keys are as follows:

Home Home key is normally used in word processing or text editor to move cursor to the top of the screen.

End End key is normally used in word processing to move the cursor to the right of screen or to the end of the screen or document.

Page Up Page Up key is normally used in word processing or other applications to move the cursor one page up on the screen.

Page Down Page Down key is normally used in word processing or other application to move the cursor one page down on the screen.

Arrows Arrow keys have four direction arrows to move cursor up, down, left and right.

4. Numeric Pad:

Numeric Pad is located on the right hand side of most keyboards. It contains numeric keys from 0 to 9 in calculator arrangement. It also contains arithmetic operations keys +, -, *, / that are used in different arithmetic operations. A special key **Num lock** is there in numeric pad to turn numeric pad on and off. It is a toggle key. Status of numeric pad is determined by status lights above the numeric pad.

5. Special Keys:

Special keys are used for special purposes as follow.

Esc **ESC** key is used to terminate command or cursor task.

Insert **Insert** is a toggle key used to switch between Insert Mode and overwrite mode.

Delete Delete key is used to delete a single letter or number to the right of the cursor on the screen. It is also use to delete the selected object.

Print Screen This key is used to take a screen shot of the current screen. This screen shot then can be saved in image format.

Scroll lock It locks and unlocks the cursor on the screen in some programs. The cursor moves normally when it is turned off. It does not work in all programs.

Pause/Break It stops the screen when information is moving too fast to read.

3.2.1.2 Types of Keyboard:

Different types of keyboards are as follows:

1. QWERTY Keyboard

A standard keyboard is normally called QWERTY keyboard. This is because the first six keys on top row of letters on these keyboards are Q, W, E, R, T, Y.

2. Enhanced keyboard

An enhanced keyboard contains twelve function keys. It contains two control keys, two ALT keys, arrow keys and additional keys between the typing areas and numeric keypad.

3. Wireless keyboard

A keyboard that requires no wire is called **wireless keyboard** or **coreless keyboard**. It transmits data using wireless technology like radio waves or infrared light waves.

Wireless keyboard are available in variety of features and styles. Many wireless keyboards must be within the line of sight of the receiver with a maximum range of around 10 feet. A wireless keyboard using radio signals provides a range of 100 feet.

4. Portable keyboard

A keyboard that can be easily removed or attached from handheld computer is called portable keyboard.

5. Ergonomic keyboard

A keyboard that is specially designed to reduce the change of wrist injuries during typing is called ergonomic keyboard.

The goal of this keyboard is to provide comfort, efficiency and safety. The user who spends a lot of time on typing may experience repetitive strain injuries of wrist and hands.

6. Gaming keyboard

A **gaming keyboard** is a type of keyboard that is specially designed for playing games on the computer. It includes programmable keys to customize the keyboard for the game being used. The keys on gaming keyboards light up to visible in all lighting conditions.

7. Virtual keyboard

A **virtual keyboard** is special type of keyboard. The user types on the optical-detectable surface or within a wireless area rather than pressing physical keys. This system provides the capability of full keyboard to the users of small handheld devices such as smart phone.

A virtual keyboard is also called **projection keyboard**. **VKEY** is the trade mark name of the virtual keyboard developed by **virtual devices Inc.**

3.2.2 Pointing Devices:

A **pointing device** is an input device that is used to control position of a pointer on the screen. In a graphical user interface, a **pointer** is a small symbol on the screen whose location and shape change as a user moves a pointing device. A pointing device can be used to move the insertion point; select text, graphics, and other objects; and click buttons, icons, links, and menu commands.

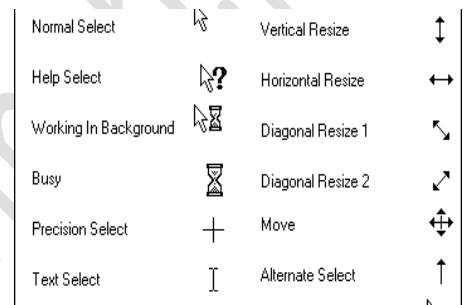


Figure: different shapes of pointer

Various pointing devices are in use according to user requirements.

1. Mouse
2. Track ball
3. Touch pad
4. Pointing Stick

3.2.2.1 Mouse:

Mouse is a popular pointing device that fits in user's hand easily. It is used to control the pointer on the screen and input instructions, clicking on them. Mouse is moved on a flat surface to control the movement of the cursor or pointer. A mouse usually has two or three buttons. These buttons are used to perform different tasks such as clicking a button or menu command selecting an object or pointing a program etc. It may also include a scroll wheel to scroll long documents. It is connected with computer through USB ports or wireless connection. There are many types of mouse i.e. mechanical mouse, optical mouse air mouse.

Mechanical mouse has a rotating ball under it. When rolled on a flat surface, it senses the movement of ball and move pointer accordingly. Optical mouse use a laser beam for same purpose. A newer type of mouse, called an air mouse, is a motion-sensing mouse that, in addition to the typical buttons, allows user to control objects, media players, and slide shows by moving the mouse in predetermined directions.



Figure: Mouse



Figure: Mechanical Mouse



3.2.2.2 Track Ball:

A trackball is a stationary pointing device with a ball on its top or side. This ball is rolled using fingers, thumb or palm to move the cursor on the screen. This device has a buttons similar to those on mouse. It has a large rotating ball on the top. The body of the track ball is not moved. The ball is rolled with fingers. The position of the cursor on the screen is controlled by rotating the ball. a trackball is a good alternative to a mouse because the device is stationary and takes less space to move than mouse. Track ball is often included in laptop computers. It can also be used as separate input device desktop computers.



Figure: Track Ball

3.2.2.3 Touch Pad:

A touch pad is a good alternative to a mouse because the device is stationary. User has to slide his finger on touch pad to move and control the pointer on the screen. It has two buttons near to work like mouse. User also can tap the surface of touch pad to perform mouse operations, like click or double click. Touch pads are commonly used with notebook computers and tablet PCs. The user can also use an external wireless touchpad with desktop computer.



Figure: Touch pad

3.2.2.4 Pointing Stick:

Pointing stick is a pressure-sensitive device. It looks like a pencil eraser and exists between keys (G, H and B) on the keyboard. The pointer on the screen moves when the user pushes the pointing stick. There are also two mouse like buttons



below Keyboard to perform all operations. It requires no additional space or cleaning like a mouse.

Pointing stick is used in notebook computers.

3.2.3 Touch Screen:

A touch screen is a touch-sensitive display device. The user input data and command by touching different areas of the screen with the finger or stylus to input data and issue commands. Many touch screens today are multi-touched and can recognize input from more than one finger at a time. For example, the user can use two fingers to enlarge or rotate an image on the screen. Modern Operating Systems provide increased support for touch screen.

Touch screen are commonly used in tablets, mobile devices, retail store self-checkouts, ATMs and information kiosks.

Figure: Pointing Stick

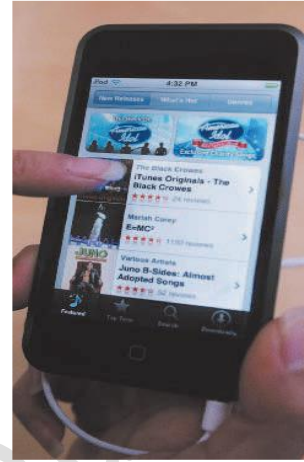


Figure: Touch Screen

3.2.4 Game Controllers:

Game controllers are specialized input devices that direct movements and actions of on-screen objects in a game. Game controllers are used to play video games or computer games. Game controllers include gamepads, joysticks and wheels, light guns, dance pads, and a variety of motion-sensing controllers.

3.2.4.1 Game Pads:

Gamepad controls the movement and action of players or objects in games. User can use game pads by holding in both hands. It is a multifunction input device that includes programmable buttons, thumb stick and a directional pad. The user can program the buttons to correspond to certain actions such as changing a weapon, opening a door etc. The directional pad and thumb sticks control the movement. Gamepads communicate with a game console or a personal computer via wired or wireless technology.



Figure: Game Pad

3.2.4.2 Joysticks:

A joystick is a vertical lever mounted on a base.. The stick can be moved in any direction to direct the movement of game object around the computer screen. A joystick contains multiple buttons on it to perform various game functions i.e. Firing, changing weapon or hitting a punch. It can perform a similar function to a mouse or trackball.



3.2.4.3 Gaming Wheels:

A gaming wheel is a car steering wheel like input device that consists of steering wheel and a separate set of foot pedals to mimic real-world driving. Most gaming wheels incorporate programmable buttons as well. These buttons are used to apply different function during game.



3.2.5 Digital Camera:

A digital camera is a mobile device used to take pictures and store the images digitally, instead of on traditional film. Digital camera uses internal flash memory or external memory card to store capture images. Today, many mobile devices such as smart phones, PDAs, and portable media players have a built-in digital camera. In digital camera making a picture is relatively inexpensive than a traditional film camera. Picture in digital memory of camera can be transferred to a computer without any intermediate conversion. Digital cameras are available in different shapes sizes and qualities. Images made by a digital camera can be edited after transferred in computer using different Photoshop applications. Some digital cameras offer picture enhancement applications to improve picture quality.

3.2.5.1 Types of Digital Cameras

There are two important types digital cameras are as follows:

Point-and-shoot camera: A point-and shoot camera is an affordable and lightweight digital camera. It has lenses built into it and a screen that displays an approximation of the image to be the photographed. Point-and-shoot cameras are available in a wide variety of size and capabilities. It provides acceptable quality photographic image for the home or small business user. Most point-and-shoot cameras includes zoom and autofocus capability and use built-in flash.



DSLR Camera: DSLR (Digital single lens reflex) camera is the most versatile and expensive type of digital camera. It allows the user to change the lens to get the required zoom. Its lens may cost hundreds or thousands of dollars. It has a screen to display the image to be photographed. The user can manually adjust focus and exposure. DSLRs can also record high definition videos. DSLR cameras are much heavier and larger than point-and shoot cameras.



3.2.6 Voice Input

Voice input is the process of entering audible sounds i.e. speech, music etc. in the computer using microphone. The microphone may be a stand-alone peripheral that sits on top of a desk, or built in the computer or device, or in a headset. Some external microphones have a cable that attaches to a port on the sound card on the computer. Others communicate using wireless technology such as Bluetooth. Uses of voice input include instant messaging that supports voice conversations, chat rooms that support voice chats, VoIP, and voice recognition. Recall that VoIP (Voice over IP) enables users to speak to other users over the Internet. **Voice recognition**, also called *speech recognition*, is the computer's capability of distinguishing spoken words. Other popular voice recognition programs for personal computers include IBM ViaVoice and Dragon Naturally Speaking.



Figure: Microphone

3.2.7 Video Input:

Video input is the process of entering full-motion images and storing them on a computer's storage medium such as a hard disk or optical disc. Most of video devices record video in analog format. Computer is a digital device. To input video from an analog device into a personal computer, the analog signal must be converted to a digital signal. A video capture card is used to convert analog video into digital format. Analog devices are attached with a video capture card. Video capture card read analog data form video device and convert it into digital format before entering into computer.

Most new computers are not equipped with a video capture card because not all users have the need for this type of adapter card. It is mostly provided as expansion card.

A **digital video (DV) camera** records video as digital format instead of analog. Many DV cameras can capture still frames, as well as motion. To transfer recorded images to a hard disk or optical disc, users connect DV cameras directly to a USB port or a FireWire port on the system unit. Thus, the computer does not need a video capture card. Simply connect the video device to the computer and begin transferring images. After saving the video on a storage medium, such as a hard disk or optical disc, user can play it or edit it using video editing software on a computer.



Figure: Digital Video Camera

3.2.8 Scanners and Reading Devices:

Scanner is an optical device that reads data or information directly from source. It could be written documents, a price tag, a graphic image or a photograph. A scanning device reads the data or information and then converts it computer readable form and store into computer for further processing. There are two types of scanning devices:

1. Optical Scanner
2. Optical Readers

3.2.8.1 Optical Scanner:

An optical scanner, usually called a scanner, is a light-sensing input device that reads printed text and graphics and then translates the results into a form the computer can process.

The quality of scanned images depends on the resolution. Resolution describes the sharpness of an image. It is measured in the dpi. The typical scanner scans at a resolution of 300 dpi or 600 dpi. Professional scanners usually scan at 1200 dpi or more. Higher resolution results in a better image but also increase large file size.

There are four types of optical scanner:

1. Flatbed Scanner
2. Sheet fed Scanner
3. Handhold Scanner

1. Flatbed scanner:

Flatbed scanner is a photocopier machine like machine. It has a glass top. Document to be scanned must be placed on that glass top and scanner copy the image to computer memory. It is generally used at home and office to scan photos, book pages and other documents etc. it is most commonly used image scanner



Figure: Flatbed Scanner

2. Sheet fed scanner:

A sheet fed scanner works similarly to a flatbed scanner but documents are inserted on the top of the scanner like a fax machine. It pulled the paper from scanning mechanism and copies the image to computer memory. It also enables automatic sheet feeding. However, this feature also prevents the device from scanning bound-book pages or other documents thicker or larger than a sheet of paper.



Figure: Sheet fed Scanner

3. Handhold Scanner:

A handheld or pen scanner is a portable scanner. It typically can scan only 2 to 5 inches at a time. Handheld scanners are useful scanners to input small amount of data. The scanner must be moved over the image to be scanned by hand. Some handheld scanners include trays to keep the scanner moving in a straight line. It is designed to scan short articles and single line like web addresses, names or photo numbers.



Figure: Handhold Scanner

3.2.8.2 Optical Readers:

Optical readers are device that uses a light source to read characters, marks and codes. It then converts them into digital data that can be processed by a computer. There are different types of optical readers are available. The common types of optical readers are as follows:

1. Optical Character Recognizer
2. Optical Mark Recognizer
3. Bar Code Reader
4. RFID Readers
5. MICR Readers
6. Magnetic Stripe Card Readers

1. Optical Character Recognizer

Optical character recognition is a technology that reads type-written, computer printed or hand written characters from ordinary documents. It translates the image into the form that can be organized by the computer. Most OCR devices include a small optical scanner for reading characters and sophisticated software to analyze what is read. A common OCR device is handheld wand reader. It is used to retail store to read price tags by reflecting light on printed characters.

OCR devices read printed characters using an OCR font. Most commonly used OCR font is called OCR-A. An OCR device determines the shapes of characters by detecting patterns of light and dark. OCR software compares these shapes with predefined shapes stored in memory and converts the shapes into characters.



Figure: OCR Scanner

Explain
that
Stuff!
01234567890

Figure: OCR Font

2. Optical Mark Recognizer

OMR stands for optical mark recognition. It is also called mark sensing device. These devices use light beam to read data. That data is converted into digital format and sent to the computer for further processing.

An OMR device detects marks such as circles and rectangles on specially printed forms. It is often used in multiple choice test such GAT, SAT and GRE. The students answer the questions by filling the circles.



Figure: OMR Scanner

3. Bar Code Reader

A bar code reader, also called a bar code scanner, is an optical reader that uses laser beams to read bar codes. A bar code is an identification code that consists either of a set of vertical lines and spaces of different widths. Another variation of bar code is a two-dimensional pattern of dots, squares, and other images called QR(Quick Response)code. The bar code represents data that identifies the manufacturer and the item. A newer type of bar code, called a 2-D bar code, can store much more data than the traditional linear bar code.



Figure: Barcode Reader

Manufacturers print a bar code either on a product's package or on a label that is affixed to a product. A variety of products such as groceries, books, clothing, vehicles, mail, and packages have bar codes. Some airports now are accepting electronic boarding passes by using a bar code reader to scan a bar code that is displayed on the screen of a smart phone or PDA. Every manufacturer uses its own type of bar code. The United States Postal Service (USPS) uses a POSTNET bar code. Retail and grocery stores use the UPC (Universal Product Code) bar code.

4. MICR Readers

MICR (magnetic-ink character recognition) devices read text printed with magnetized ink. An MICR reader converts MICR characters into a form the computer can process. The banking industry uses MICR for check verification processing. Each check has pre-coded MICR characters at the lower-left edge. The MICR characters represent the bank routing number, the customer account number, and the check number.

When a bank receives a check for payment, it uses an MICR inscriber to print the amount of the check in MICR characters in the lower-right corner. The check then is sorted or routed to the customer's bank, along with thousands of others. Each check is inserted in an MICR reader, which sends the check information including the amount of the check — to a computer for processing. When you balance your checkbook, verify that the amount printed in the lower-right corner is the same as the amount written on the check; otherwise, your statement will not balance.

5. Magnetic Stripe Card Readers

Magnetic stripe card Reader is also called magstripe reader. It reads the magnetic stripe on the back of the credit cards and banks cards etc. the stripe is divided into three horizontal tracks. It contains information to identify the user and card issuing company.

The information on the stripe include user name, account number, card expiration date and country code. This information can be used to make payments, authenticate users and grant access to a secure area etc. the magstripe reader reads the information stored on the stripe when the user swipes the card. The magstripe reader rejects the card if the card is damaged, dirty or erased. The contents of the magnetic stripe can be erased due to magnetic field.



Figure: MICR Reader



Figure: MICR Text

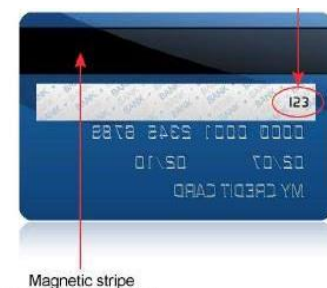


Figure: Magnetic Stripe Card

3.2.9 Biometric Input:

Biometric is a technology to authenticate the identity of a person by verifying personal characteristics. Biometric devices analyze some biometric identifier and then grant access to a program, system or room. A biometric identifier is a physiological or behavioral characteristic of

a person. It is related to the physical or chemical activities in the body. The fingerprints, hand geometry, facial features, voice and eye patterns are some examples of biometric identifiers.

A biometric device converts a personal characteristic in a digital code. This digital code is compared with the digital code stored in the computer. The access is not grants to the user both digital codes do not match.

3.2.9.1 Finger Print Reader:

A fingerprint reader is most widely used biometric device. It scans the curves and indentations of a fingerprint. The fingerprint reader is very inexpensive and cost less than 100 dollars. It can be easily used by home and small business users to authenticate users. The external fingerprint readers are also available that can be plugged into USB port. Some latest keyboards and notebook computers also have fingerprint reader for logging on the computer using fingerprints without entering user name and password.



Figure: Fingerprint Reader

3.2.9.2 Facial Recognition System:

A facial reorganization system captures the live face image of a person. It compares this image with another image stored in the computer to authenticate the person. This system is used in buildings to authenticate a person before allowing him enters. It is also used in airports to protect the public. Some notebook computers use this system to protect computer system. The system can also identify the user with or without glasses, makeup or jewelry.



Figure: Facial Recognition

3.2.9.3 Hand Geometry Recognizer:

The hand geometry system is used in biometric devices to measure the shape and size of hand. Hand geometry is entered into computer after converting in digital signal to identify the person. It is mostly used for making attendance. The cost of this system is more than 1000 dollars and only larger companies usually use it.



Figure: Hand geometry reader

3.2.9.4 Voice Verification System:

A voice verification system compares the voice of a person with the stored voice. Some large companies use this system use this system as time and attendance devices. It is also used for accessing sensitive files and networks. The financial organizations use this system in a secure telephone banking transactions.

3.2.9.5 Signature Verification System:

A signature verification system identifies the shape of a handwritten signature. It also measures the pressure and motion used to write the signature. This system uses special pens and



tablets. Banks use signature verification system to identify and authenticate customers.

Figure: Signature verification System

3.2.9.6 Iris Recognition System:

An iris recognition system uses iris recognition to read the patterns in the iris of an eye. These patterns are unique in the eyes. These systems are very expensive and are used by the government security organizations, military and large financial organizations. Some organizations use retinal scanners that work similarly. However, this scanner scans the patterns of blood vessels in the back of the retina.



Figure: IRIS Verification to unlock cell phone

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CHAPTER 04

Output Devices

1. OUTPUT DEVICES
2. DISPLAY DEVICES
3. PRINTER
4. PROJECTOR
5. SPEAKER

4.1 Output

Output is data that has been processed into a useful form (INFORMATION). Output vary depending on hardware and user needs. There are following types of output: Text, number, audio, video, and images.

4.2 Output Devices:

An output device is any type of hardware component that conveys information to one or more people. Output devices take information from the computer and convert it in a form that is understandable by the users. Commonly used output devices include display devices; printers; speakers, headphones, and ear-buds; data projectors; interactive whiteboards; and force-feedback game controllers and tactile output.

4.2.1 Display Devices:

A display device or display is an output device that displays text, graphics and video. The output displayed by a display device is called soft copy. Display devices consist of a screen and the components that produce the information on the screen. The display for a desktop typically is a monitor that is a separate physically devices. The screen is a part of monitor that also includes the housing for its electronic components. Mobile computers and devices typically integrate the display in their same physical case. Some displays have touch screens. Display devices are available in a wide variety of sizes.

4.2.1.1 Features of Display Devices:

Display devices can be distinguished on the basis of the following features:

1. Size And Aspect Ratio

Display screens are measured diagonally from corner t corner. Display screens are available in various sizes. Desktop computers range from 17 to 30 inches but the large one are available for special purpose. Laptop screens are usually between 14 and 17 inches. Net books typically have 10-inch displays. Tablet screens are between 7 and 10 inches. Most display screens are wide screen which means they use a 16:9 or 16:10 aspect ratio similar to widescreen television. The aspect ratio is the ratio of the width to the height.

2. Color

The display devices can be monochrome or color. The color display screens display output in multiple colors. The color display screens also called RGB monitor. The number of colors a monitor can display is called color depth or bit depth. The RGB display screens can create 256 colors and thousands of variations of these colors. RGB stands for red, green and blue.

The monochrome display screens display output in single color. The monochrome display screens show images in a single color usually white, green, blue, red or amber. However, monochrome monitor can display difficult shades of one color. The number of shades of one color that the monitor can display is refreshed to as gray-scale.

3. Resolution

Resolution is an important characteristic of any display device. The number of pixels displayed on screen is called screen resolution. Pixels are the dots or picture elements that from image on screen.

Resolution determines the amount of information that can be displayed at one time. It is expressed as the number of horizontal pixels by the number of vertical pixels. For example, a monitor or screen with a 1600*900 resolution displays up to 1600 pixels per horizontal row and 900 pixels per vertical row. It dispels a total of 1,440,000 pixels to create a screen image. A higher screen resolution displays more information than a lower screen resolution but everything appears smaller. A higher resolution provides sharper and clearer image.

4. Refresh rate

The refresh rate is the speed with which a monitor redraws the image on screen. It is also known as vertical scan rate or vertical frequency. It is measured in hertz. It indicates the number of times the screen is refreshed in one second. Refresh is necessary because the phosphors hold their glow for a fraction of second. The image on the screen appears more solid if refresh rate is high. The screen will flicker less. The refresh rate should be at least 72Hz. Common monitor have refresh rates between 75 and 85 Hz.

5. Dot pitch

The distance between each pixel on display is called dot pitch or pixel pitch. It is measured in millimeters. The display devices typically have a dot pitch between .26 and .23. a lower pitch means less blank space between pixels and results in sharper images.

6. Video adapters

The video adapter is a circuit board that determines the graphics capabilities of the computer such as:

- Screen resolution available
- The number of bits used to store color information about each pixel called bit depth.
- The total number of colors that can be used to display images.
- Number of monitors that can be connected to the computer via that video card
- Types of connectors that can be used to connect a monitor to the computer.

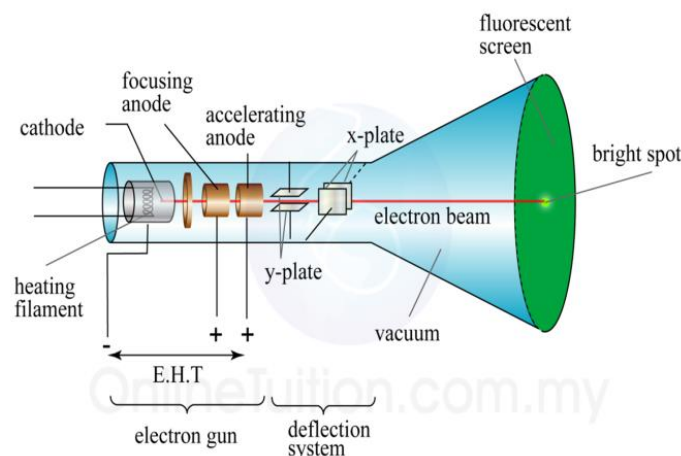
Most video cards also have memory chips known as video RAM or VRAM. It is used to support graphics display. A sufficient amount of video RAM is required to support higher resolutions, higher bit depth and a greater number of colors. Most video cards today contain a video RAM from 256 MB to 2 GB.

4.2.1.2 Types of Display Devices

Different types of display devices are as follows:

1. Cathode Ray Tube

This monitor uses cathode ray tube (CRT). CRT creates an image on the screen using the beam of electrons. CRT consists of one or more guns that fire a beam of electrons inside the screen. The screen is coated with very tiny phosphor dots from inside. The beam of electrons repeatedly falls on the surface of screen. Every beam-fall takes only a fraction of second. CRT in color monitors consists of three guns. These guns generate red, green, and blue (RGB) colors. The other colors are generated with a combination of these three colors.



2. Flat Panel Display Technologies

Different technologies used in flat panel displays are as follows:



I. Liquid crystal display (LCD):

A Liquid crystal display (LCD) uses charged liquid crystals between two sheets of material such as glass or plastic to light up appropriate pixels to form the image on screen backlight. It uses CCFL (cold cathode fluorescent lamp) as the light source also known as the backlight. LCTs provide a sharper picture than CRTs and emit less radiation. It also requires less power and takes up less space than CRT. Mobile computers and mobile devices have built-in LCD screens

II. Light Emitting Diode (LED)

A display that uses LED for the backlight is called an LED display. It is also known as LED-LCD display. It consumes less power and is thinner, lighter and brighter than LCD display that uses CCFT technologies. However, it can be more expensive than LCD. The display screens of laptops and mobile devices often use LCD backlight technology.

III. Organic light emitting diode (OLED)

Organic light emitting diode (OLED) is a type of flat-panel display that uses emissive organic material to brighter or sharper images. OLED displays use layers of organic material that emits a visible light when electric current is applied. OLED displays do not use backlighting as they emit a visible light. This characteristic makes OLED more energy efficient than LCD and ELD.

The portable devices using OLED provide longer battery life. OLEDs are thinner and wider viewing angle than LCDs. They are also brighter and sharper than LCDs. OLED displays are incorporated into many digital cameras, mobile phones, and portable digital media.

A newer use of OLED technology is in the head-mounted display (HMD), which is a display in a helmet, goggles, or glasses. HMDs are used by pilots, military and law enforcement personnel, engineers, Scientists, travelers, and video game players.

IV. Gas plasma display

Gas plasma display uses gas plasma technology. This technology uses a layer of gas between two glass plates. The gas releases ultraviolet lights when voltage is applied. The pixels on the screen glow due to this ultraviolet light and form an image. Plasma display is available in the size of up to 150 inches wide. It provides richer colors than LCD monitors but is more expensive. That is why, it is not commonly used. It provides higher display quality.

4.2.2 Printers:

A printer is an output device that prints characters, symbols and graphics on paper. The printed output is called hard copy. Print resolution is commonly measured in dot per inch (dpi).

Printed information, called hard copy, exists physically and is a more permanent form of output than that presented on a display device (soft copy).

A hard copy, also called a printout, is either in portrait or landscape orientation. A printout in portrait orientation is taller than it is wide, with information printed across the shorter width of the paper. A printout in landscape orientation is wider than it is tall, with information printed across the widest part of the paper.

4.2.2.1 Types of Printers:

Printers are classified into two main categories.

1. Impact printers
2. Non-impact printers

4.2.2.1.1 Impact Printers:

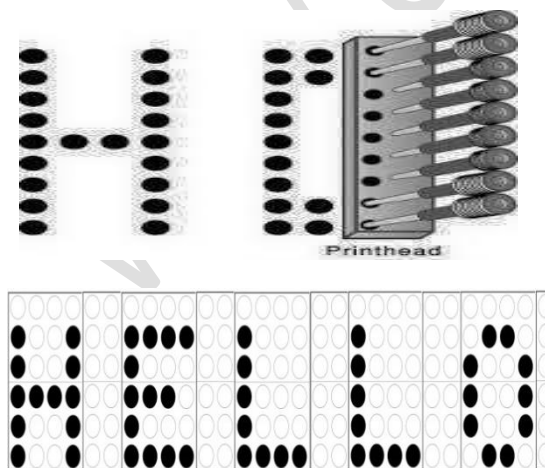
An impact printer works like a typewriter. It prints characters or images by striking a print hammer or set of pins against an inked ribbon. The ink is pressed from the inked ribbon on the paper to produce the output. Impact printers are the oldest print technologies which are still produced. The impact printers are used where low-cost printing is required. The most common forms of impact printers are:

- Daisy wheel printer
- Dot matrix printer
- Line printer

1. Dot matrix printer

A dot matrix printer is an impact printer. It produces printed images when tiny pins on a print head strike an inked ribbon. When the ribbon presses against the paper, it creates dots that form characters and graphics. The print head on a dot matrix printer can contain nine to twenty four pins. A higher number of pins print more dots that produce higher quality.

The speed of dot matrix printer is measured by number of characters it can print in one second. The speed of most dot matrix printers ranges from 350 to 1100 characters per seconds (cps). Dot matrix printers do not provides high quality output. They produce a lot of noise while printing. The printing cost of these printers is very cheap.



2. Line printer

Line printer is a fast impact printer. It prints an entire line at a time. Its speed is measured in lines per minute (LPM). Many line printers can print 3000 lines per minute.

Two types of line printers are as follows:

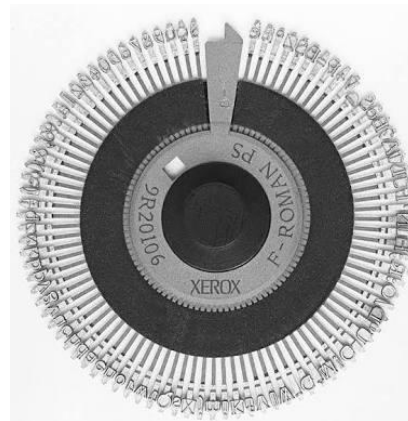
Band printer band printer prints characters by striking hammers on a rotating horizontal band. A band contains the shapes of numbers, letters and other characters.

Chain printer chain printer is similar to band printer. It contains complete set of characters on several sections of chain. The chain rotates at a high speed. Print hammers are located at each horizontal print position. The paper and ribbon are located between the hammers and the chain. The Chain rotates and the hammers strike when the proper characters are in front of the print positions.



3. Daisy Wheel Printer

Daisy wheel printer is similar to a type writer. It uses a print wheel. The print wheel is called daisy wheel. Each petal of daisy wheel contains a character. A motor rotates wheel, a hammer strike a Petal against the ribbon. When the desired character reaches the position of the paper this prints the character on the paper. Daisy wheel printer is slower than dot matrix printer but batter in quality.



4.2.2.1.2 Non-impact Printers

A non-impact printer prints characters and graphics on paper without striking paper. The characters are printed on paper with different means such as LASER. Some printers use spray ink while others use heat and pressure to create images. These printers are faster and more costly than impact printers. They produce no noise during printing. The print quality of non-impact printers is better than impact printers. Different kinds of non-impact printers are:

1. Laser Printer:

LASER stands for Light Amplification by Stimulated Emission of Radiation. The laser printer is a non-impact printer. Its working is similar to photocopying machine. It uses laser beams to burn special powder on the page to create a permanent image. The powder is contained in the toner. Laser printer prints complete page at a time. It is also known as page printer. The printing speed of laser printers for home and small office user is 12 to 45 pages per minutes (ppm). The printing speed of laser printers for large business users is 150 ppm or more. The speed depends on the contents being printed. The plane text is printed faster than graphics.

Laser printer prints text and graphics in high quality resolution. A typical laser printer provides a resolution of 1200 DPI or more. It also prints higher speed than inkjet and dot matrix printers. It does not make much noise. Laser printer is mostly used in the business field. The black and white printing cost of laser printer is less than inkjet printers. Laser printers are available in black and white as color models.



2. Inkjet Printer:

An inkjet printer is a type of non-impact printer. It prints characters and graphics by spraying tiny drops of liquid ink on paper. These printers can produce quality text and graphics in both black and white and colors including photos. A typical inkjet printer provides a resolution of 600 DPI or more.

The price of inkjet printers is less than laser printers. However, they are slower than laser printers. Most inkjet printers can print from 10 to 35 pages per minutes. However, they print graphics and colors at slower rate. They are also comparatively inexpensive. Most inkjet printers usually have two print cartridges. One cartridge contains black ink and other contains colors.



3. Thermal printer

A Thermal printer produces output by melting wax-based ink onto paper or by burning dots specially coated paper. The basic thermal printer is not very expensive. Its print quality is not high and its



fades over the time. It is typically used to print ATMs receipts, electronic tickets at airports, purchase receipts at retail stores etc. Some special types of thermal printers can produce very high quality of output. These printers are more expensive and are used in professional applications such as photography studios and medical labs etc.

4. Photo printer

Photo printer is a color printer designed to print high-quality photographs. It is also called snapshot printer. Some photo printers print photo one or more sizes only. For example, some photo printers print photo 3*5 inches. Some printers can up to letter size, legal size photos etc. some printers use inkjet technology to print photographs.

Many photo printers have a built-in card slot. The printer can print digital photos directly from a media card. It means that there is no need to transfer the image from media card to the computer to print them. Some photo printers also have built-in LCD color screens. The user can view pictures before printing them.

5. Portable printer

Portable printer is a small, light-weight and battery-powered printer. It can be used by mobile users to print Images from notebook computer, tablet or smart phones while travelling. Its size is bit wider than page on which it prints. Portable printer fits in briefcase easily. Many printers connect to parallel port or USB port. Some portable printers have built-in wireless port to communicate with the computer wirelessly.



6. Label and postage printer

Label printer is a small printer. It prints on an adhesive type material that can be placed on different items like envelopes, packages, CDs ,types etc. many label printers also print bar codes. Postage printer is a special type of label printer. It has a built-in digital scale. It prints postage stamps. It allows the users to buy and print digital postage from their personal computers. The digital postage is also called internal postage.



4.2.3 Plotter

A plotter is an output device that is used to produce high-quality graphics in a variety of colors. Plotters are used to print maps, architectural drawings, graphs and charts. A plotter worked by drawing lines on paper using pens held in a mechanical arm.

4.2.3.1 Types of plotters

Different types of plotters are as follows:

- Flatbed plotter
- Drum plotter

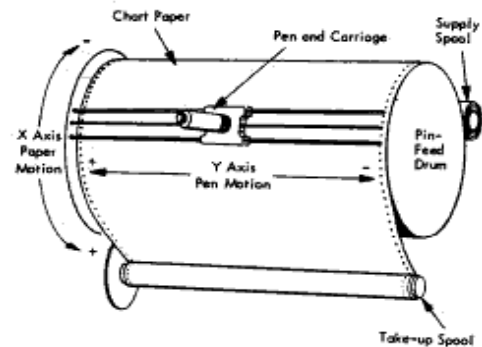
4.2.3.1.1 Flatbed plotter

Flatbed plotter is used to plot or draw images. It contains pens for drawing images. The paper is placed on table-like surface. Software instructs the pens to move down on the paper. The pens then moves on the paper for creating images. Most flatbed plotters have one or more pens of different colors and widths.



4.2.3.1.2 Drum Plotter

Drum plotter uses a rotating drum or cylinder. The drawing pens are mounted on the drum. The pens move to the left and right as the drum rotates. The movement creates the desired image. The advantage of drum plotter is that the length of the plot is almost unlimited. The roll paper can be used to draw very lengthy images. The width of the image depends on the width of the drum.



4.2.4 Audio Output Devices:

An audio output device is a hardware component that produces audible sounds like music, speech, or beeps.

Commonly used audio output devices are:

- **Speakers**
- **Headphones**
- **Ear buds**

4.2.4.1 Speakers:

Speaker is a commonly used audio output device. Most personal computers and mobile devices have a small internal speaker that usually emits only low-quality sound. Surround sound speakers or speaker systems are used to generate higher-quality sounds for playing games, interacting with multimedia presentations, listening to music, and viewing movies. Some speaker system consists of only one pair of speakers. Other includes additional speakers and the subwoofer to create better sound for multimedia content. The speakers for more desktop computers are built directly into the system unit or in monitor. Portable computers and mobile devices typically have speakers integrated into the device. There are also wireless speakers available to play audio.



4.2.4.2 Headphones:

Headphones are used instead of speakers so that other people are not disturbed at places such as public library. The headphones are placed outside of the ear. Headset is a headphone with a built-in microphone. It is often used when making telephone calls or participating in web conferences using computer. Wireless headsets are commonly used with mobile phones.

A headset is a device that functions as both headphones and a microphone. Computer and smart phone users wear a headset to free their hands for typing and other activities while talking or listening to audio output.

CHAPTER 05

Data Communication and Networks

1. DATA COMMUNICATION SYSTEM AND COMPONENTS
2. TRANSMISSION MEDIA
3. NETWORKS AND ITS TYPES
4. NETWORK TOPOLOGIES
5. DATA COMMUNICATION DEVICES

5.1 Data Communication

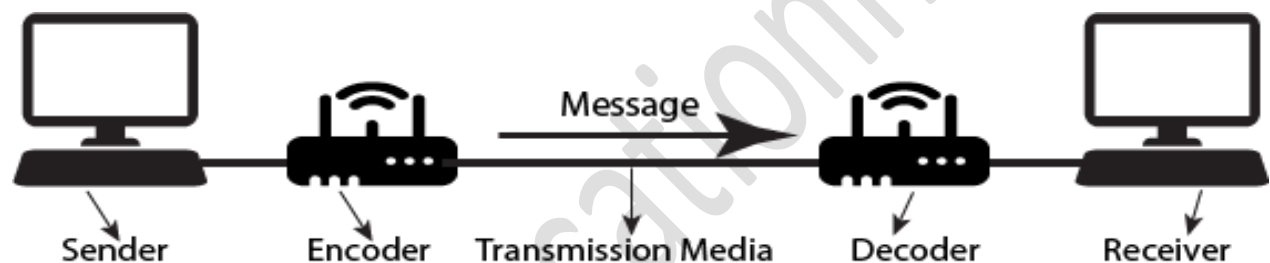
Data communication is a process of transferring data electronically from one place to another. Data can be transferred by using some transmission media. Transmission media may be wired or wireless. Data may consist of text, graphics and sound etc. An electromagnetic or light wave used to transmit data from one place to another is called a signal. Transmission of data from one place to another place in the form of signals is called transmission.

5.2 Data Communication System

For data transmission we need a proper combination of different devices and other components which can transfer data from one place to another smoothly and efficiently. That set of devices and other components is called data communication system. There are five basic components of data communication system.

Basic Components of Data Communication System:

1. Message
2. Sender
3. Receiver
4. Transmission Media
5. Encoder/Decoder



5.2.1 Message:

The message is the data or information to be transferred. It can consist of text, numeric values, images, audio, videos etc.

5.2.2 Sender:

The sender is the device that sends data over the network. It can be a computer, cell phone, digital camera, fax machine or scanner etc. Usually, a computer is used as sender in a communication system.

5.2.3 Receiver:

The receiver is the device that receives data from network. It can be a computer, cell phone, television, fax machine or printer etc. Usually, a computer is used as receiver in a communication system.

5.2.4 Transmission Media:

The path or channel through which data is transferred from sender to receiver is called transmission media. It is also known as communication media or transmission channel or communication channel. It can either be wired or wireless. i.e. twisted pair cable, fiber optic cable, microwaves etc.

5.2.5 Encoder/Decoder:

The computer works with digital data. And mostly, transmission medium can carry analog signals. Therefore for data transmission, digital data must be converted into analog signals

at sender side it is called **encoding**. And analog signal must be converted into digital data at receiving side it is called **decoding**.

The device that converts digital signal into analog signals is called **encoder**. This analog signal can pass through transmission media. The device that converts analog signals into digital form is called **decoder**. The communication without encoder and decoder is impossible.

Properties of Good Communication System

The important properties of a good data communication system are as follows:

1. Delivery

The communication system must deliver data to the correct destination. A good communication system makes sure that data is received by the intended device or the user.

2. Accuracy

Accuracy is an important property of a good communication system. The communication system must deliver data accurately. There should be no alteration or loss in data during transmission. The altered or incorrect data is of no use.

3. Timeliness

The communication system should deliver data within time. Data may become useless if it is not delivered in time.

5.3 Signal

An electromagnetic or light wave that represents data is called signal. Signals are used to transfer data in the network using wired or wireless transmission medium.

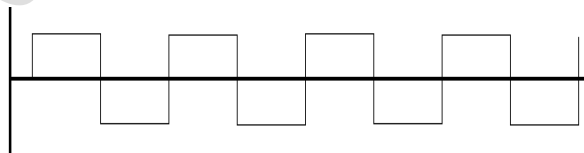
5.3.1 Types of Signals:

There are two types of signals.

1. Digital Signal
2. Analog Signal

5.3.1.1 Digital Signal

Digital signal represents data in series of electrical pulses in form of ON and OFF. These signals are in discrete (discontinuous) form. Digital signals provide fast, efficient, and error free communication. Data inside the computer is represented in digital form. Computer can understand only digital data.



5.3.1.2 Analog Signal

Analog signals are continuous electrical signals in the form of wave. This wave is also called carrier wave. Telephone lines can carry analog signals only. Light, sound, pressure are examples of analog signals.

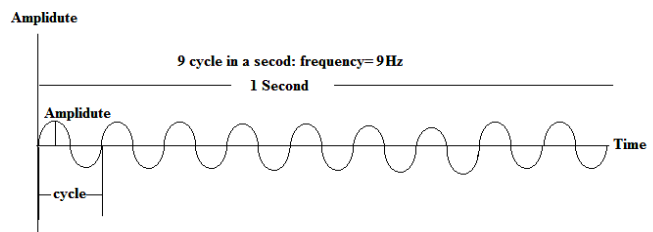
There are two characteristics of analog signals.

i. Frequency

The number of times a wave repeats itself in a second is called frequency of wave. Unit of frequency is hertz.

ii. Amplitude

The height of signal at a specific time is called its amplitude. It represents the strength of signal. It is measured in volts.



5.4 Transmission Media

The path or channel through which data is transferred from sender to receiver is called transmission media or communication media. It is also called transmission channel or communication channel. It can either be wired or wireless.

5.4.1 Types of Transmission Media:

There are two types of transmission media:

1. **Guided Media**
2. **Unguided Media**

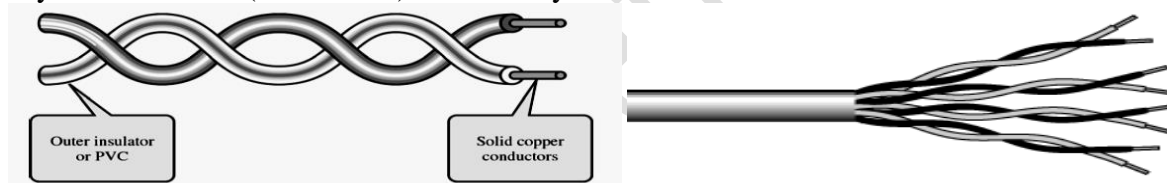
5.4.1.1 Guided Media

A type of transmission media, in which devices are connected with each other using physical wires, is called guided media. It is also known as bounded media. There are three types of wire used as guided media:

- i. Twisted pairs cable
- ii. Coaxial cable
- iii. Fiber optic cable

1. Twisted pairs cable

Twisted pair is a couple of copper wires which are twisted together. These wires are covered with insulation material. These wires are twisted with each other. It usually has 3-12 twists per inch. These twists protect the wire from interference of external electromagnetic signals. A twisted pair cable consists of 4 pairs. Twisted pairs cable is most commonly used cable. It can carry data over very short distance (100 meters). It is mostly used in LANs.



Type of Twisted Pair Cable

There are two type of Twisted Pair Cable:

Shielded Twisted Pair

It contains a layer of foil shielding. The shielding reduces electromagnetic interference (EMI). EMI originates from devices such as motors, power lines and some lighting devices such as fluorescent lights. STP is expensive than UTP.

Unshielded Twisted Pair

UTP doesn't contain any layer of foil shielding. That's why it is less resistant to electromagnetic interference (EMI).

Advantages:

- It is a least expensive cable.
- It is very easy to install.

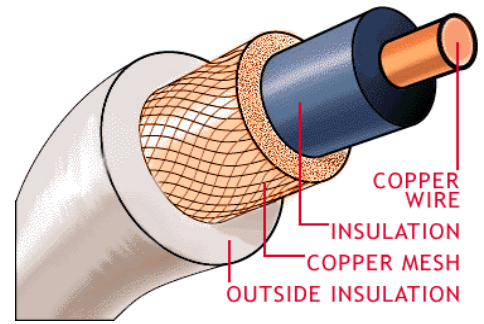
Disadvantages:

- It provides very low transmission speed.
- It can transfer data over very short distance.

2. Coaxial Cable

Coaxial cable consists of a single copper wire called conduit. It is covered by an insulation material. This insulated copper wire

is then surrounded by copper mesh. This mesh is again covered by a plastic jacket. This jacket and copper mesh are responsible to protect the main conduit from external electromagnetic interference. The main conduit is logical divided in 4-22 sub channels called tubes. These tubes carry separate data. Coaxial cable is mostly used by telephone companies, cable TV to provide long distance communication. It is costly than twisted pair cable but provide faster communication speed.



Advantages:

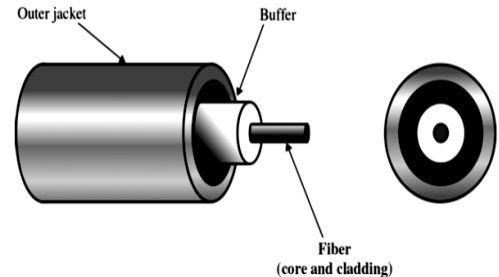
- It provides faster data transmission speed than twisted pair cable.
- It is very easy to install.

Disadvantages:

- It is more expensive cable.

3. Fiber optic cable

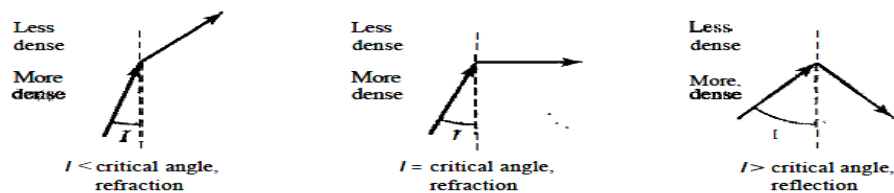
Fiber optic cable consists of thin strands made of glass or plastic called fiber optics. This fiber optics carries data in form of light pulses. It is thin than a human hair. Optical fiber is consist two layers of transparent glass or plastic, inner layer is called



core, outer layer is called *cladding*. Data travels in the core and cladding reflects the light wave back into core. Cladding is further covered with plastic jacket for protection.

A fiber optic cable consists of hundreds of fiber optics. Data is converted into light waves to transmit on a fiber optic cable at sender side. Receiver receives this light wave and converts it into digital for further processing.

Fiber optics uses the light's property of refraction to transmit data. Refraction is a property of material to pass data through or reflect it back into same medium.



Advantages

- It provides fastest data transmission speed.
- It is more secure and reliable than other types of cables.
- External electromagnetic interference can't affect data over fiber optics.

Disadvantages

- It is very expensive cable.
- It difficult to install and maintain.

5.4.1.2 Unguided Media

A type of transmission media, in which devices are connected with each other using microwaves or radio signals, is called unguided media. These signals travel through air and transfer data from one location to another location. It is also called unbounded media.

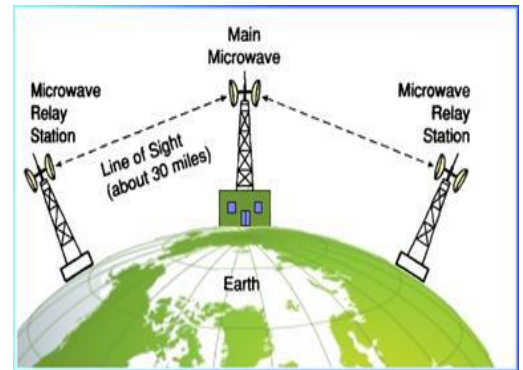
Examples of unguided media are:

- i. Microwaves
- ii. Satellite communication

iii. Radio communication

1. Microwaves:

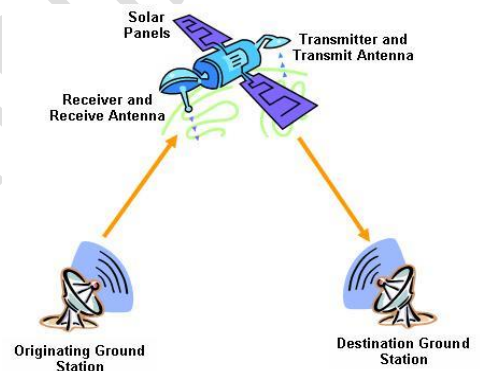
In microwave transmission, microwaves are used to transfer data from one site to another through air. Microwaves are high frequency radio waves, Microwaves uses *line of sight* transmission method. In line of sight transmission, signal travels in a straight line and can't bend. Transmitter and receiver must be in a straight line to communicate with each other. There must be no obstacle between transmitter and receiver. Therefore microwaves stations are installed on high towers. Distance between two stations should be 20-30 miles.



Microwave stations are called relay station, each station receives signal from previous station and transmit it to the next station. It also amplifies the signal before transmission. In this way data can be transferred over long distances.

2. Satellite communication:

In satellite transmission, satellites are used to transfer data from one site to another distant site. Satellite is a transmission object that are placed 22300 miles above the earth. Satellites act as relay station and receive message from earth base station and transmit it to some other earth based station. Satellite also amplifies the signal. Earth stations receive data from computer convert it into radio signals and transmit to satellite. Satellite receives this signal amplifies it and transmit to destination earth station. Satellites are used when other types of communication is not possible like with ships, aircrafts, hikers, TV transmissions etc. a satellite can transfer data from pole to pole of earth.



Radio communication:

Mobile Communication is used in mobile computers to communicate data from on computer to other computer. It is also called a wireless local area network (WLAN). In radio communication, radio signals like, infrared, Bluetooth or wifi signal are used to carry data through air.



5.5 Computer Networks

A collection of two or more computers that are connected together to share information and resources is called computer network. The resources may include printers, hard disks, scanners or programs etc. The computers in the network are connected together through communication media. The communication media can be a physical cable or a wireless connection. The computers in the network can be in the same room, building or at different places.

Some **examples** of computer network are as follows:

1. Computer networks can be used in an office. Different people in the office can access common information. If all user computers are connected through a network, they can share their files and exchange mail. They can also send faxes and print documents from any computer in the network.

2. Internet is also an example of a computer network in which millions of computers are connected through phone lines. People using this network can share information, files and talk with one another.

5.6 Uses/Advantages of Computer Networks

1. Communication

People can communicate easily and efficiently with one another using computer networks. They can talk, chat and send emails etc.

2. Data and Information Sharing

Computer networks can be used to share data and information stored on a central server. All the users of the organization can access shared data easily. Using Internet, this data can be shared among user all over the world.

3. E-Mail

E-Mail stands for electronic mail. It is the exchange of text messages and computer files transmitted via a communications network such as a local area network or the Internet. An Email software is required to send and receive emails.

4. Hardware Resources Sharing

Computer networks can be used to share hardware resources like printer, scanner, hard disk etc. among different users in an organization. It provides a low cost solution for office management.

5. Software Sharing

The individual licensed copy of software can be costly. The software can be shared over a network among many users to save a lot of money. In this case, the user does not need to purchase separate copy of the software for each computer.

6. Internet Access Sharing

A computer network also allows the sharing of an Internet connection. A high-speed connection can be shared among many users over the network.

7. Data Centralization and Management

A network can be used to manage the company's critical data effectively. Data can be stored on shared servers instead of storing it on different computers. All users can use the data easily. The administrator can apply security on important data. It becomes easier to take backup of data regularly.

8. Instant Messaging

Instant Messaging (IM) is a real-time Internet communications service. It notifies tire user when one or more people are online and then allows exchanging messages or files with them. It can be used in desktop computers, notebook computers and wireless Web-enabled handheld computer.

5.7 Types of Computer Networks

Computer networks are categorized according to the way they are used and the distance they cover. Different types of computer networks are:

1. LAN - Local Area Network
2. WAN - Wide Area Network
3. MAN - Metropolitan Area Network

5.7.1 LAN - Local Area Network

LAN stands for Local Area Network. Local Area Network covers very small geographic area. A Local Area Network can connect computers and other devices in a building, office or group of consecutive buildings. It can cover area up to 1 KM. It is designed to share data, software and hardware resources among various computers easily.

Data transfer speed of a LAN is very fast. Its speed is measured in Kbps, Mbps or Gbps. A LAN can share 10Mb to 1000Mb per second. It is much faster than other types of networks. i.e. Wide Area Network. A network of a Computer Lab of a college is an example of Local Area Network. It may connect less no. of nodes.

Uses of LAN

1. It is used to share hardware resources (printer, hard disc etc.) among members of LAN.
2. It is also used to share software resources (data, software).
3. Member of LAN can communicate with each other.

Advantages of LAN

1. The resources like printers, CD-ROM drives, hard disks and software can be shared using LAN. This is cheaper than buying devices for each workstation in the network.
2. The users in LAN can easily communicate with each other. They can also transfer data easily and rapidly between different computers in the network.
3. The individual licensed copy of software can be costly. A lot of money can be saved by using the same software over network instead of purchasing separate copy of the software for each workstation. The network versions of software applications such as MS Office are available. These applications are loaded on the server and shared by different users in the LAN.
4. LAN allows an easier and more efficient way to manage different computers from server. IT administrator can remotely troubleshoot the problems on computers across the network instead of doing it individually.
5. The users can save their data centrally on the server in LAN. They can access the saved data from any workstation on the network. They do not need to use the same workstation all the time.
6. LAN allows multiple users to share a single Internet connection. An organization can purchase one high-speed connection and share it on different workstations in LAN.
7. LAN can manage important data in a better way. Data can be centralized on shared servers instead of storing it on different computers. Everyone can find the data easily. Security can be implemented easily.

Limitations of LAN

1. LAN can be threat to user's privacy. The network administrator can access personal files of users. He can also monitor network and Internet activities of the user.
2. LAN generally saves money over time. However, it may require high initial costs of installation. The cables, network cards and software are expensive. The installation may also require the services of a technician.
3. The proper maintenance of LAN requires time and expertise. A network administrator may be required to manage network properly.

4. LAN can put critical data at risk if it is not secured properly. The unauthorized users may access important data and can damage it.

5.7.2 WAN - Wide Area Network

WAN stands for Wide Area Network. A Wide Area Network covers a large geographic area. It connects computers and other devices in different cities and countries. The computers in WAN are often connected through telephones lines. Leased lines, fiber optics and satellites can also be used to connect devices in a WAN. WAN provide a data transfer speed from 56Kbps to 50Mbps. It is expensive than LAN. It is not fast as LAN. The internet is the largest WAN in the world.

The mainframe and microcomputers are used as a server or host computers in WAN. User can access different data file or services hosted on these servers using their personal computers. A personal computer connected to a host or server computer is called a terminal.

A terminal attached to host computer can upload and download data. The transfer of data from personal computer to host compute is known as uploading. The transfer of data from host computer to personal computer is known as downloading.

Examples:

- The network connecting the ATMs of a bank located in different cities.
- The network connecting NADRA offices in different cities of Pakistan.
- Internet is the largest WAN in the world.
- PTCL Network.
- Mobile Company Networks.

Advantages of WAN

Some important advantages of WAN are as follows:

1. **Communication Facility:** A big company may exist at multiple locations in a country. The employees can communicate using WAN. It saves long distance phone calls. Video conferencing is another use of WAN where users can communicate through their computer system.
2. **Remote Data Entry:** Remote data entry is possible in WAN. The user can sit at any location and enter, update and process data on any computer attached to WAN. For example, the user can access the data on a computer located at Karachi while sitting in Faisalabad.
3. **Centralized Data:** The centralized data storage is an important advantage of WAN. It means that data can be stored in single location even if the organization is spread over many cities. WAN can manage critical data in a better way by storing it at a centralized server. The centralized data can be shared among different users anywhere in the world.

Disadvantages of WAN

Some important disadvantages of WAN are as follows:

1. **Hardware, Software & Setup Costs:** Setting up a WAN requires an investment in hardware, software, planning, designing and implementing. The cost of devices used in WAN is very expensive.
2. **Hardware & Software Management Costs:** Managing a WAN is complicated. It requires intensive training. A network manager usually needs to be employed.

3. **Data Security Problems:** A poorly-secured WAN puts critical data at risk. It may expose data to hackers, unauthorized access and even sabotage. Virus can spread quickly across the WAN if it enters the central backing store.
4. **Failure of Server:** If a server fails, all computers connected with the server are affected.

5.7.3 MAN - Metropolitan Area Network

MAN Stands for Metropolitan Area Network. A MAN is a network that covers area of a city. It usually connects two or more LANs in a city. It covers larger area than LAN and smaller area than WAN. It uses coaxial cable or fiber optics to provide reliable and efficient communication services. For Example, A company has several branch offices in a city. They can design a MAN by connect all their branch offices' LANs. Cable TV is another example of MAN.

Advantages of MAN

Some advantages of MAN are as follows:

- MAN covers a large area than LAN.
- It provides higher speed than LAN.

Disadvantages of MAN

Some disadvantages of MAN are as follows:

- It is more expensive than LAN.
- It is difficult to maintain as compare to LAN.

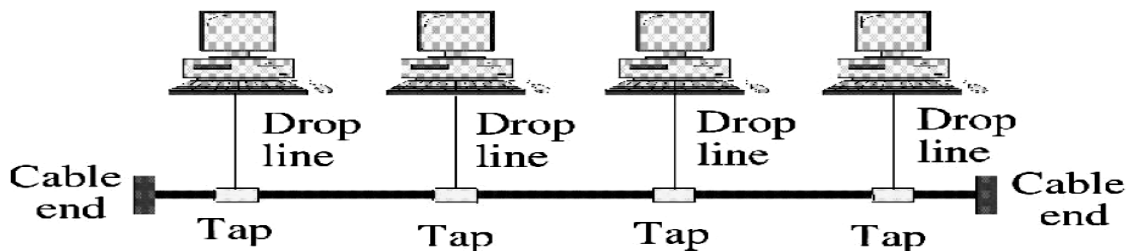
5.8 Computer Networks Topologies

Nodes of a network can be configured or arranged in different ways. This arrangement or layout of connected devices in a network is called Network topology. It is geometrical shape of network. There are many network topologies.

1. Bus topology
2. Star topology
3. Ring topology
4. Tree topology
5. Mesh topology

5.8.1 Bus Topology

In bus topology, all the nodes share same communication medium. This communication medium is called bus. A high bandwidth wire such as coaxial cable is used as bus to provide efficient transmission between devices. This wire is also called backbone. On both ends of wire, terminators are used to terminate the signal. Bus topology is commonly used topology. It supports very less number of computers. As all computer are sharing common bus, so they take turns to transmit data.



Working of Bus Topology

Sending computer prepare a data packet. This packet contains data and address of sender and receiver. It transmits this packet on bus. All computers receive this packet. They compare the receiver address with their address. If the receiver address matches with their address, they open the data packet and use data, otherwise delete the packet.

Advantages

1. It is simple and easy to install.
2. It uses less cabling than other topologies.
3. It is less expensive.
4. If one node fails, there is no effect on other network.

Disadvantages

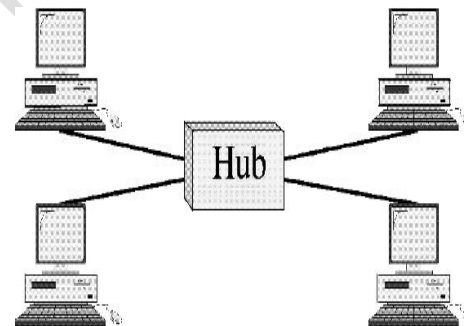
1. It is easy to reconfigure.
2. It supports a small number of computers.
3. If the main bus fails, the whole network fails.
4. It provides a low transmission speed because of share bus.

5.8.2 Star Topology

In a star topology, each device has a direct link to a central controller, called a hub or switch. The computers are not directly linked to one another. The hub acts as an exchange: If one device wants to send data to another, it sends the data to the hub, which then sends the data to the other connected device.

Working of Star Topology

In Star topology all the communication takes place between computers and hub. Sending computer prepare data packet containing data and address of receiver and sender and sends this packet to the hub. Hub checks the receiver's address and forward the data packet to intended receiver. In this way all communication takes place.



Advantages

1. It is easy to install and modify the network.
2. Adding or removing a new computer in the network doesn't affect the network.
3. If one node fails, there is no effect on other network.
4. It is more flexible than other topologies.

Disadvantages

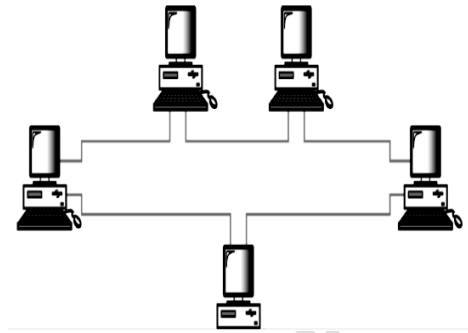
1. It used large length of cable.
2. If central hub fails, the whole network will fail.
3. It is more expensive.

5.8.3 Ring Topology

In a ring topology, each device has a dedicated connection with only the two devices. Each device is connected to the next device, and the last device is connected to the first device to form a ring. A signal is passed in the ring in one direction, from device to device, until it reaches its destination. Each device receives a signal from its previous device, regenerates the signal and passes it to the next device. Ring topology was common when IBM introduced its local-area network Token Ring.

Working of Ring Topology

In ring topology, every computer is connected to the next computer. And data travels only in one direction. Only one computer can transmit data so they take turns and sending computer prepare data packet containing data and receiver address and send it to the next computer. Each computer receives this packet compare receivers address with their address and if it matches it opens that packet and uses data. If its address doesn't match then it regenerates the packet and forwards it to the next computer in the ring. The packet passes along the ring until it reaches its destination.



Advantages

1. It is Easy to Install and Reconfigure
2. It uses very less cabling.
3. It is less expensive topology.
4. Every computer has equal status in the network.

Disadvantages

1. If one node fails, it affects whole network.
2. Adding and removing a computer in network will stop the whole network.
3. It is difficult to troubleshoot.
4. It provides slow transmission speed.

5.8.4 Mesh Topology

In Mesh topology every computer is physically connected with all other computer in the network. There is a dedicated link between every pair of computers. A message can travel on several paths in the network from sender to receiver. In this way, performance and reliability of network increases. It is the most expensive topology as very large cable is used to connect the devices. It is mostly used in Wide Area Networks.

Working of Mesh Topology

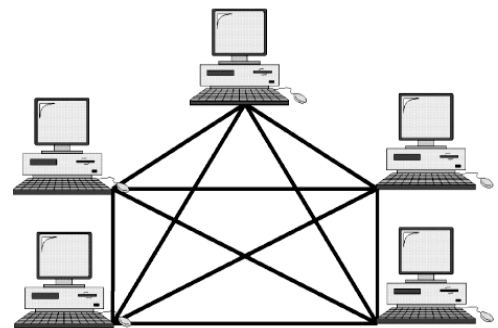
All devices have dedicated links between them so sending device can send data using this link. If this link is not working then sender sends the data packet using some indirect link in the network. There are several indirect links in the network so sender will find a free link and use it to transfer his data.

Advantages

1. It provides improved data transmission using dedicated link.
2. It is easy to troubleshoot
3. It maintains data security using dedicated links.

Disadvantages

1. It is difficult to install and configure.
2. It is very expensive due to huge length of cables.



5.8.5 Tree Topology

In Tree Topology multiple star network are connected using a backbone. In this way, tree topology contains characteristics of both star and bus topology. All the nodes in a star are connected with a hub and all the hubs are further connected with a backbone. Therefore, a node in one star network can communicate with nodes in other star networks using backbone.

Advantages

1. A contains the advantages of both star and bus topologies.

2. It is used to expand an existing star network.
3. If one segment is down, there is no effect on other segments in the network.

Disadvantages

1. Due to different type of hardware, it is different to configure and maintain.
2. If backbone fails, complete network will breakdown.
3. A lot of maintenance is required in a Tree network.

5.9 Network Communication Devices

The hardware used to transmit data, instructions and information between a sending and receiving device is called communication device; A communication device at sending end sends data to a communication channel. A communication device at receiving end receives data from communication channel. Sometimes, communication device may also convert the data from digital to analog and analog to digital signals. Some important communication devices are as follows:

5.9.1 Modem

Modem is a communication device that sends and receives data from one computer to another on the Internet through telephone lines. The sending and receiving computers both must have dialup modems.

Computer stores information in the form of digital signals. However, the information transmitted over the telephone lines is in the form of analog signals. The dialup modem receives data from computer in digital form and converts it into analog form. This process is called modulation. It sends analog signals to other computer using telephone lines. The dialup modem on receiving computer receives data in analog form. It converts the analog data back into digital form. This process is called demodulation.

A dialup connection must be re-established each time the modem is used. It provides a transfer rate of up to 56 Kbps and is much slower than broadband connections. Dialup modem is not used today.

5.9.2 Network Interface Card

Network card is a communication device used to connect a computer to a network. It is also called network interface card (NIC). It is a circuit board installed on the motherboard.

Nowadays, most computer systems have a network card built into the motherboard. Each computer on the network must have a network card. There are different network cards available. A network card for desktop computer is an adapter card. It has a port to connect the cable. A network card for mobile computer is in the form of USB adapter, ExpressCard module etc. A wireless network card is used to transmit data wirelessly. It usually has an antenna that can be positioned properly for the best signals. An amplifier can be used for increasing the signal strength. Some network cards support wired as well as wireless networks.

5.9.3 Hub

A hub also called concentrator or multi-station access unit (MAU). It provides a central point for cables in a network. Hubs also transmit signals and have multiple ports to which devices are connected.

Hub connects the computers to a network. It broadcasts all messages to every computer on the network but only the intended recipient computer takes the message. The computers that are not the recipients of the message ignore the message. A hub can handle only one-way information traffic at a time.

5.9.4 Switch

Network switch is more intelligent device than hub. The switch improves the efficiency of the data transfer in the network. It receives a message from any device connected to the network and then transmits the message only to that device for which the message was meant. It can also handle multiple communications channels at the same time.

5.9.5 Router

A router is a communication device connects multiple networks using similar or different protocols. It manages the best route between any two communication networks. Routers are used when several networks are connected together. A router can be used on a network of any size. It can connect networks of different countries. They transfer data in less time. The router is an intelligent device. It uses algorithms to find out the best path to transfer data to a network.

5.9.6 Gateway

Gateway is a device that connects two or more networks with different types of protocols. It is an intelligent device. It can convert data according to the protocol. A gateway can be used to connect a personal computer network to mainframe computer network.

5.9.7 Bridge

A network bridge can be used in computer networks to interconnect two LANs and to separate network segments. A segment is a section of a network. When a bridge receives a signal, it determines the segment where the signal should be sent. It reads the addresses of sending and receiving computers. The bridge does not pass the signal to the other segment if sending and receiving computers are both in the same segment. It reduces network traffic and increases network performance.