BCA-01

VARDHAMAN MAHAVEER OPEN UNIVERSITY, KOTA

Introduction to Computer Science

Course Development Commitee

Chairman
Prof. (Dr.) Naresh Dadhich
Vice-Chancellor
Vardhaman Mahaveer Open University, Kota

Co-ordinator/Convener and Members

Convernor/Coordinator
Prof. (Dr.) D.S. Chauhan
Department of Mathematics
University of Rajasthan, Jaipur

Member Secratary/Coordinator
Sh. Rakesh Sharma
Assistant Professor (Computer Application)
V.M. Open University, Kota

Memeber
1. Prof. (Dr.) D.S. Chauhan
Department of Mathematics
University of Rajasthan, Jaipur
2. Prof. (Dr.) M.C. Govil
Govt. Engineering College, Ajmer
3. Prof. (Dr.) A.K. Nagawat
University of Rajasthan, Jaipur
4. Dr. (Mrs.) Madhavi Sinha
BITS, Jaipur

Editing and Course Writing

Editor
Prof. (Dr.) Swati Chande
Prof. & HOD of Computer Science
IIIM, Jaipur

Writers
1. Sh. Bright Keswani
Asstt. Professor,
Gyan Vihar University,
Jaipur
2. Smt. Poonam Keswani
Software Consultant,
Jaipur
3. Prof. (Dr.) S.S. Sarandeo
Director Computer Deptt.
Rajasthan Vidyapith, Udaipur
4. Sh. Ajay Singh Gaur
Director, T.J.S. College,
Kota
5. Sh. Sanjay Gupta
SAP Module Leader
Samtel India Ltd.
New Delhi
6. Sh. N.K. Joshi
HOD Computer Department
M.I.M.T. Kota
7. Dr. Vijay Singh
Director, Shri Karni College, Jaipur

Academic and Administrative Management

Prof. (Dr.) Naresh Dadhich
Vice-Chancellor
Vardhaman Mahaveer Open University,
Kota

Prof. (Dr.) M.K. Ghadoliya
Director (Academic)
Vardhaman Mahaveer Open University
Kota

Mr. Yogendra Goyal
Incharge
M.P.&D.

Course Material Production

Mr. Yogendra Goyal
Assistant Production Officer
Vardhaman Mahaveer Open University, Kota

Production : Feb. 2011, ISBN No. : 13/978-81-8496-264-2

Printed and published on behalf of Registrar V. M. Open University, Kota.
Printed By : Kanchan Offset Printers, Qty. 500 Book

VARDHAMAN MAHAVEER OPEN UNIVERSITY, KOTA

Introduction to Computer Science

UNIT 1: AN OVERVIEW OF COMPUTERS

Structure of the Unit

1.0 OBJECTIVES

The present global age is the consequence of the computer age. A computer is an electronic device that stores and processes data, according to a list of instructions. It allows a user to manipulate data easily. The speed of performance of a computer is incomparable. The computer and Internet have affected our way of working, communicating, playing and also writing. In fact, computers are used in every aspect of life today. As per today's need, the computer is an essential requirement of each and every one, so this chapter provides the general overview about the computer system.

1.1 INTRODUCTION TO COMPUTER SYSTEM

Since civilizations began, many of the advances made by science and technology have depended upon the ability to process large amounts of data and perform complex mathematical calculations. For thousands of years, mathematicians, scientists and businessmen have searched for computing machines that could perform calculations and analyze data quickly and efficiently. One such device was the abacus. The abacus was an important counting machine in ancient Babylon, China, and throughout Europe where it was used until the late middle ages. It was followed by a series of improvements in mechanical counting machines that led up to the development of accurate mechanical adding machines in the 1930's. These machines used a complicated assortment of gears and levers to perform the calculations but they were far to slow to be of much use to scientists. Also, a machine capable of making simple decisions such as which number is larger was needed. A machine capable of making decisions is called a computer.

Computer is an electronic machine that accepts information, stores it until the information is needed, processes the information according to the instructions provided by the user, and finally returns the results to the user.

It consists of 2 parts-hardware and software. The computer accepts input through input devices like mouse and keyboard. It displays output through output devices like monitor and printer. The size of a computer varies considerably from very small to very big. The speed of computers also has a very large range. Computers have become indispensable in today's world.

Every Computer performs the following sequence of tasks,

- Input
- Storage
- Processing
- Output

When a computer is instructed to do a job, it handles the task in the following sequence:.

1. It accepts the information from the user. This is called 'Input'.
2. It stores the information until it is ready for use. The computer has memory chips, which are designed to hold information until it is needed.
3. It processes the information. The computer has an electronic brain called the 'Central Processing Unit, which is responsible for processing all data and instructions given to the computer.
4. It then returns the processed information to the user. This is called 'Output'.

1.2 ADVANTAGES OF COMPUTERS

The advantages of computers can be identified as follows:

Computers, being machines, are able to repeat any task that is assigned to them, endlessly, with the same precision without getting tired and hence are apt for carrying out *repetitive tasks* 24 X7.

They can process voluminous data involving complex procedures at very *high speed.*

Computers lack the human traits of emotions, feelings, physical and mental exhaustion, and therefore can work with *diligence* for unlimited periods even in difficult conditions.

The same computer can be sued for tasks of totally different nature i.e. computers are *versatile.*

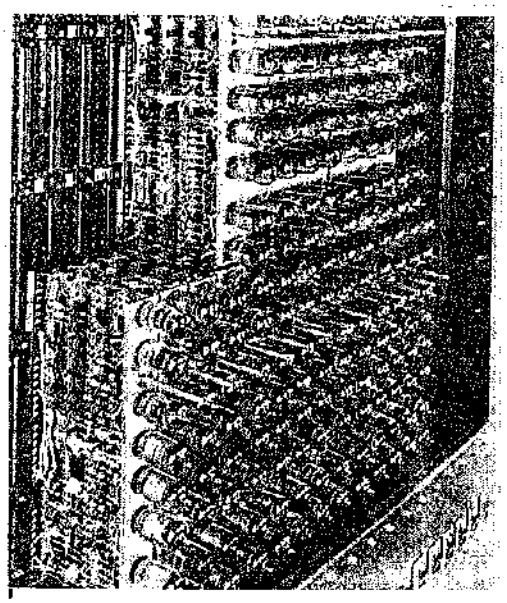
Computers can store huge amount of data and large procedures in its memory at the same time and process it. Their memory can be extended by attaching more memory chips or by storing data in secondary storage.

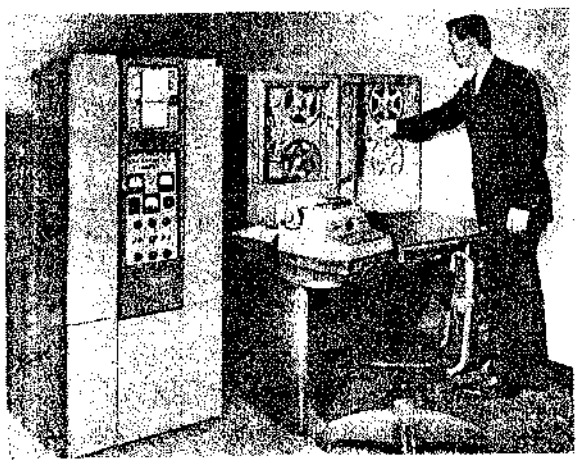
1.3 GENERATIONS OF COMPUTERS

In terms of technological developments over time, computers have been broadly classified into five generations. The lines of distinction between each generation are not exact, and some overlap in technologies exists. Although these demarcations are open to some controversy, as a general description of types of technology in use, the terms first, second, third, fourth and fifth generation are sometimes useful in providing a general perspective of some of the advancements in computing technology. The history of computer development is often referred to in reference to the different generations of computing devices. A generation refers to the state of improvement in the product development process. This term is also used in the different advancements of new computer technology. With each new generation, the circuitry has gotten smaller and more advanced than the previous generation before it. As a result of the miniaturization, speed, power, and computer memory has proportionally increased. New discoveries are constantly being developed that affect the way we live, work and play.

1.3.1 First Generation (1940-1956): Vacuum Tubes

The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, occupying entire rooms. A magnetic drum is a metal cylinder coated with magnetic iron-oxide material on which data and programs can be stored. Magnetic drums were once used as a primary storage device but have now been implemented as auxiliary storage devices like magnetic tape or disk drive. They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions. First generation computers relied on machine language to perform operations, and they could only solve one problem at a time. Machine languages are the only languages understood by computers. While easily understood by computers, machine languages are almost impossible for humans to use because they consist entirely of numbers. Input was based on punch card and paper tapes, and output was displayed on printouts. The UNIVAC and ENIAC computers are





examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

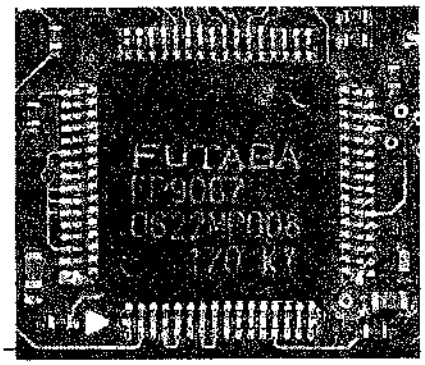
Acronym for Electronic Numerical Integrator And Computer, the world's first operational electronic digital computer, developed by Army Ordnance to compute World War II ballistic firing tables. The ENIAC, weighing 30 tons, using 200 kilowatts of electric power and consisting of 18000 vacuum tubes, 1500 relays, and hundreds of thousands of resistors, capacitors, and inductors, was completed in 1945.

1.3.2 Second Generation (1956-1963): Transistors

Transistors replaced vacuum tubes in the second generation computers. Transistor is a device composed of semiconductor material that amplifies a signal or opens or closes a circuit. Transistors were invented in 1947 at Bell Labs, transistors have become the key ingredient of all digital circuits, including computers. Today's **latest microprocessor** contains tens of millions of microscopic transistors.

Prior to the invention of transistors, digital circuits were composed of vacuum tubes, which had many disadvantages. They were much larger, required more energy, dissipated more heat, and were more prone to failures. The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output. These computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN.

1.3.3 Third Generation (1964-1971): Integrated Circuits



The development of the integrated circuit was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.

A nonmetallic chemical element in the carbon family of elements 'Silicon' - atomic symbol 'Si' - is the second most abundant element in the earth's crust, surpassed only by oxygen. Silicon does not occur uncombined in nature. Sand and almost all rocks contain silicon combined with oxygen, forming silica. When silicon combines with other elements, such as iron, aluminum or potassium, a silicate is formed. Silicon is the basic material used to make computer chips, transistors, silicon diodes and other electronic circuits and switching devices because its atomic structure makes the element an ideal semiconductor. It is commonly or mixed, with other elements, such as boron, phosphorous and arsenic, to alter its conductive properties.

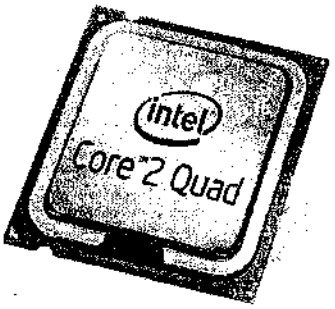
A chip is a small piece of semi conducting material (usually silicon) on which an integrated circuit is embedded. A typical chip is less than ¼-square inches and can contain millions of electronic components (transistors). Computers consist of many chips placed on electronic boards called printed circuit boards. There are different types of chips. For example, CPU chips (also called microprocessors) contain an entire processing unit, whereas memory chips contain blank memory. Semiconductor is a material that is neither a good conductor of electricity (like copper) nor a good insulator (like rubber). The most common semiconductor materials are silicon and germanium. Computer chips, both for CPU and memory, are composed of semiconductor materials. Semiconductors make it possible to miniaturize electronic components, such as transistors. Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the

first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

1.3.4 Fourth Generation (1971-Present): Microprocessors

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the heart of all personal computers and most workstations is a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles. Three basic characteristics differentiate microprocessors:

- **Instruction Set**: The set of instructions that the microprocessor can execute.
- **Bandwidth**: The number of bits processed in a single instruction.
- **Clock Speed**: Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.



The Intel 4004chip, developed in 1971, located all the components of the computer - from the central processing unit and memory to input/ output controls - on a single chip. On large machines, CPUs require one or more printed circuit boards. On personal computers and small workstations, the CPU is housed in a single chip called a microprocessor. Two typical components of a CPU are:

- The arithmetic logic unit (ALU), which performs arithmetic and logical operations.
- The control unit, which extracts instructions from memory and decodes and executes them, calling on the ALU when necessary.

In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors. As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUI's, the mouse and handheld devices.

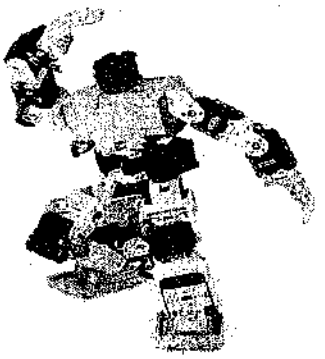
1.3.5 Fifth Generation (Present and Beyond): Artificial Intelligence

Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today. Artificial Intelligence is the branch of computer science concerned with making computers behave like humans. The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence includes:

- **Games Playing**: programming computers to play games such as chess and checkers
- **Expert Systems**: programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)
- **Natural Language**: programming computers to understand natural human languages
- **Neural Networks**: Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains
- **Robotics**: programming computers to see and hear and react to other sensory stimuli.

Currently, no computers exhibit full artificial intelligence (that is, are able to simulate human behavior fully). The greatest advances have occurred in the field of games playing. In the area of robotics, computers are now widely used in assembly plants, but they are capable only of very limited tasks. Robots have great

difficulty identifying objects based on appearance or feel, and they still move and handle objects clumsily.



Natural-language processing offers the greatest potential rewards because it would allow people to interact with computers without needing any specialized knowledge. You could simply walk up to a computer and talk to it. Unfortunately, programming computers to understand natural languages has proved to be more difficult than originally thought. There are also voice recognition systems that can convert spoken sounds into written words, but they do not understand what they are writing; they simply take dictation. Many expert systems help human experts in such fields as medicine and engineering, but they are very expensive to produce and are helpful only in special situations. Today, the hottest area of artificial intelligence is neural networks, which are proving successful in a number of disciplines such as voice recognition and natural-language processing. There are several programming languages that are known as AI languages because they are used almost exclusively for AI applications. The two most common are LISP and Prolog.

1.4 CLASSIFICATION OF COMPUTERS

Computers can be classified into the following categories-

1.4.1 According to Size

1. **Supercomputers:** Supercomputers are widely used in scientific applications such as aerodynamic design simulation, processing of geological data. Supercomputers are the most powerful computers. They are used for problems requiring complex calculations. Because of their size and expense, supercomputers are relatively rare. They are used by universities, government agencies, and large businesses, which require processing of voluminous data.
2. **Mainframe Computers:** Mainframes are usually slower, less powerful and less expensive than supercomputers. They are used by banks and many businesses to update inventory etc. Mainframe computers can support hundreds or thousands of users, handling massive amounts of input, output, and storage and are used in large organizations where many users need access to shared data and programs. Mainframes are also used as e-commerce servers, handling transactions over the Internet.
3. **Minicomputers:** Minicomputers are smaller than mainframe, general purpose computers, and give computing power without adding the prohibitive expenses associated with larger systems. It is generally easier to use. Minicomputers usually have multiple terminals and may be used as network servers and Internet servers.
4. **Workstations:** Workstations are powerful single-user computers. They are used for tasks that require a great deal of number-crunching power, such as product design and computer animation. Workstations are often used as network and Internet servers.
5. **Microcomputers, or Personal Computers:** Microcomputers are the smallest, least expensive of all the computers. Micro computers have smallest memory and less power, are physically smaller and permit fewer peripherals to be attached. Microcomputers are more commonly known as personal computers. The term 'PC' is applied to IBM-PCs or compatible computers. Desktop computers are the most common type of PC. Notebook (laptop) computers are used by people who need the power of a desktop system, but also portability. Handheld PCs (such as PDAs) lack the power of a desktop or notebook PC, but offer features for users who need limited functions and small size.

1.4.2 According to the technology used

1. **Analog Computers**:- These computers recognize data as a continuous measurement of a physical property (voltage, pressure, speed and temperature).

   Example: Automobile speedometer

2. **Digital Computers**:- These are high speed programmable electronic devices that perform mathematical calculations, compare values and store results. They recognize data by counting discrete signal representing either a high or low voltage state of electricity.

3. **Hybrid Computers**:-A computer that processes both analog and digital data.

1.4.3 According to Purpose

1. **General purpose Computers:** A 'General Purpose Computer' is a machine that is capable of carrying out some general data processing under program control. Refers to computers that follow instructions, thus virtually all computers from micro to mainframe are general purpose. Even computers in toys, games and single-function devices follow instructions in their built-in program.

2. **Special purpose Computers:** A computer that is designed to operate on a restricted class of problems. For example, use of special purpose computer equipment to obtain patient diagnostic information.

1.5 APPLICATIONS OF COMPUTERS

There are so many applications of computers, and it is impractical to mention all of them. Computers are now becoming faster, more reliable, effective and whole lot cheaper than they had been ever before. Computer is used every where in the world in every field of life. There are many applications of computer for example,

- **Banking**: Before when there was no computer, every where manual system was followed which was a very complicated and hard work but now with the coming of computer every thing is in a very systematic way. Every bank is now using a computerized system because it is very fast and user friendly. ATM cards are used every where now which let us bank any time we want. PC banking (Personal Computer banking) let us view our bank balance, request transfers between accounts and pay bills electronically etc.

- **Traffic light control**: In traffic light control the computer is being employed to drive the traffic light. There are some programmed codes like 'turn off the red light' or 'turn on the red light' to control the traffic light and to carry out the instructions that follows.

- **Sports:** In sports, computers are used wildly in conjunction with video cameras. These are used to record the motion of all the sports men. 3D programs are used later on to help the trainers see there movements and could improve there styles of playing.

- **Education:** There are many uses of computer in the area of education. In school and colleges every student details need to be stored so a computer program could help in this way. Multimedia, animations, graphics and charts could be used to teach the students and many boring topics can be made interesting using multimedia. Students could access internet for online help and courses for more information.

  Health and Medicine. Computers are helping immensely to monitor the extremely ill in the intensive care unit and provide cross-sectional views of the body. This eliminates the need for hired nurses to watch the patient twenty-four hours a day, which is greatly tiring and error prone. Doctors use

computers to assist them in diagnosing certain diseases. This type of computer is called the 'Expert System', which is basically a collection of accumulated expertise in a specific area of field.

- **Agriculture.** Farmers use small computers to help with billing, crop information, and cost per acre, feed combinations, and market price checks. Cattle ranchers can also use computers for information about livestock breeding and performance.
- **Training.** It is much cheaper and effective to teach pilots how to fly in a computerized cockpit or simulators, than is real airplanes. This is because the learning pilots will feel much more relaxed and confident due to the fact that no life is at risk at that moment. Railway engineers can also be given some kind of training on how to run a train with the help of a computerized system. Training simulations are relatively cheaper and are always available on one-to-one basis making way for personal training.
- **Publishing** - With desktop publishing, we can create page layouts for entire books on your personal computer.
- **Defense** - There is software embedded in almost every weapon. Software is used for controlling flights and targeting in ballistic missiles. It is also used to control access to atomic bombs.
- **Business** - E-business, business through computers, involves management of functions such as marketing, financial analysis, planning, scheduling, customer relationship management, supply chain management, resouce planning etc. using computers. One can predict future trends of business using artificial intelligence software. Software is used in major stock markets. One can do trading online. There are fully automated factories running on software.
- **Entertainment** - Computers serve as a device to watch movies, listen to songs, and also for playing games.
- **Personal Communication** - We can exchange data and information with the movement of a mouse. Sending Email, SMS, Fax has become very convenientas compared to traditional letters and airmails.

Computers are all around us and living without them and avoiding them is virtually impossible. We interact with computers directly or indirectlyin our daily lives - whether we are at the cinemas, the school, railway stations, hospitals or the public library.

1.6 BLOCK DIAGRAM OF COMPUTER

A computer can process data, pictures, sound and graphics. It can solve highly complicated problems quickly and accurately.

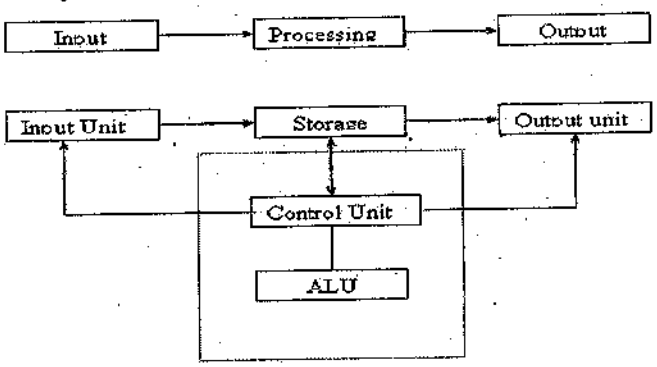


Figure 1: Block Diagram of Computer

Every computer system has the following essential parts–

1. **Input Unit:** Computers need to receive data and instruction in order to solve any problem. Therefore

we need to input the data and instructions into the computers. The input unit consists of one or more input devices. Keyboard is the one of the most commonly used input device. Other commonly used input devices are the mouse, floppy disk drive, magnetic tape, etc. All the input devices perform the following functions.

- Accept the data and instructions from the outside world.
- Convert it to a form that the computer can understand.
- Supply the converted data to the computer system for further processing.

2. **Storage Unit:** The storage unit of the computer holds data and instructions that are entered through the input unit, before they are processed. It preserves the intermediate and final results before these are sent to the output devices. It also saves the data for later use. The various storage devices of a computer system are divided into two categories,

   Primary Storage: Stores and provides very fast access. This memory is generally used to hold the program being currently executed in the computer, the data being received from the input unit, the intermediate and final results of the program. The primary memory is temporary in nature. The data is lost, when the computer is switched off. In order to store the data permanently, the data has to be transferred to the secondary memory.

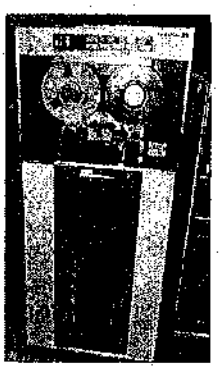
   The cost of the primary storage is more compared to the secondary storage. Therefore most computers have limited primary storage capacity.

   Secondary Storage: Secondary storage is used like an archive. It stores several programs, documents, data bases etc. The programs that you run on the computer are first transferred to the primary memory before it is actually run. Whenever the results are to be saved, they are stored in the secondary memory. The secondary memory is slower and cheaper than the primary memory. Some of the commonly used secondary memory devices are Hard disk, Compact Disk (CD), Pen Drive, etc.,

3. **Output Unit:** The output unit of a computer provides the information and results of a computation to outside world. Printers, Visual Display Unit (VDU) are the commonly used output devices. Other commonly used output devices are speakers, plotters, floppy disk drive, hard disk drive, and magnetic tape drive.

4. **Arithmetic Logical Unit:** All calculations are performed in the Arithmetic Logic Unit (ALU) of the computer. It also does comparison and takes decision. The ALU can perform basic operations such as addition, subtraction, multiplication, division, etc and does logic operations viz, >, <, =, etc. Whenever calculations are required, the control unit transfers the data from storage unit to ALU once the computations are done, the results are transferred to the storage unit by the control unit and then sent to the output unit for displaying results.

5. **Control Unit:** It controls all other units in the computer. The control unit instructs the input unit, where to store the data after receiving it from the user. It controls the flow of data and instructions from the storage unit to ALU. It also controls the flow of results from the ALU to the storage unit. The control unit is generally referred as the central nervous system of the computer that controls and synchronizes its working.

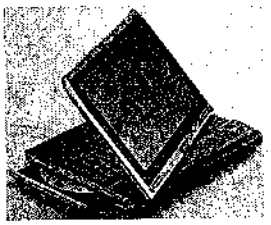


6. **Central Processing Unit:** The control unit and ALU of the computer are together known as the Central Processing Unit (CPU). The CPU is like brain of the systen and performs the following functions:
   - It performs all calculations.

- It takes all decisions about resource allocation and
- It controls all units of the computer.

A PC may have CPU-IC such as Intel 8088, 80286, 80386, 80486, Celeron, Pentium, Pentium Pro, Pentium II, Pentium III, Pentium IV, Dual Core, and AMD etc.

1.7 SOFTWARE AND HARDWARE



A computer system comprises hardware and software. **Hardware** is the physical medium, for example: circuit boards, processors, keyboard etc. **Software** is a general term used to describe a collection of computer programs, procedures and documentation that perform some task on a computer system. The term includes application software such as word processors which perform productive tasks for users, system software such as operating systems, which interface with hardware to provide the necessary services for application software, and middleware which controls and co-ordinates distributed systems. Software are computer programs, for example: operating systems, editors, compilers, etc.

1.8 TYPES OF SOFTWARE

Practical computer systems divide software systems into three major classes:

1. **System software** helps run the computer hardware and computer system. It includes operating systems, device drivers, diagnostic tools, servers, windowing systems, utilities and more. The purpose of system software is to insulate the applications programmer as much as possible from the details of the particular computer complexities being used, especially memory and other hardware features, and such accessory devices as communications, printers, readers, displays, keyboards, etc.
2. **Programming software** usually provides tools to assist a programmer in writing computer programs and software using different programming languages in a more convenient way. The tools include text editors, compilers, interpreters, linkers, debuggers, and so on. An Integrated development environment (IDE) merges those tools into a software bundle, and a programmer may not need to type multiple commands for compiling, interpreting, debugging, tracing, etc., because the IDE usually has an advanced *graphical user interface,* or GUI.
3. **Application software** allows end users to accomplish one or more specific (non-computer related) tasks. Typical applications include industrial automation, business software, educational software, medical software, databases, and computer games. Businesses are probably the biggest users of application software, but almost every field of human activity now uses some form of application software. It is used to automate all sorts of functions.

1.9 DIFFERENCE BETWEEN APPLICATION SOFTWARE AND SYSTEM SOFTWARE

System Software	Application Software
System software will come provided with each computer and is necessary for the computers operation. This software acts as an interpreter between the computer and user. It interprets your instructions into binary code and likewise interprets binary code into language that user can understand. Windows is a more recent version of system software and is known as a graphical interface. This means that it uses graphics or 'icons' to represent various operations. You no longer have to memorize commands; you simply point to an icon and click.	Application software is any software used for specified applications such as: • Word Processing • Spreadsheet • Database • Presentation Graphics • Communication • Tutorials • Entertainment, Games

1.10 SUMMARY

Computer is an electronic device which has made life easy by entering almost every facet of human life. Be it our professional or personal task, using a computer has become a necessity. Word processors are the perfect writing device because you can compose quickly and make changes easily. The Internet provides a fast, free, and unique way to get information or to communicate with others. Computers supply an affordable solution to nonprofessional audio and video composition. These reasons are why computers are so helpful in modern society. With the aid of computers, humankind is entering a new era of enlightenment.

1.11 GLOSSARY

Central Processing Unit (CPU): CPU is responsible for processing data and it controls the function of all the other components.

Control Unit: It controls the electronic flow of information around the computer.

Arithmetic and Logic Unit (ALU): It is responsible for mathematical calculations and logical comparisons.

Motherboard: It is a rigid rectangular card containing the circuitry that connects the processor and all the other components that make up your personal computer.

Read Only Memory (ROM): ROM is a small area of permanent memory that provides startup instructions when the computer is turned on.

Random Access Memory (RAM): This is the area of memory where data and program instructions are stored while the computer is in operation.

Byte: A byte is the amount of space in memory or on a disk needed to store one character.

1.12 FURTHER READINGS

1. V.K.Jain, 'Fundamentals of Information Technology and Computer Programming' (3rd Edition), S.K.Kataria & Sons.
2. Pradeep Sinha, Preeti Sinha, 'Computer Fundamentals' (3rd Edition), BPB Publications.
3. Stephen D. Burd, 'System Architecture' (3rd Edition), Vikas Publishing House.
4. Sushila Madan, 'Introduction to Computer Fundamentals', Taxmanns Allied Services Pvt. Ltd.

1.13 UNIT-END QUESTIONS

1. What is 'Computer'? Explain all components of a computer system.
2. Differentiate between 'Hardware' and 'Software'. Also, give some examples of both.
3. Write a short note on different types of software.
4. Give the classification of Computers.
5. Explain the following-
   (a) Expert Systems
   (b) Use of Computers in banking sector
   (c) Third Generation of Computer
   (d) ALU
   (e) Input and Output Devices
   (f) CU
6. Draw the block diagram of a computer and explain the function of each of the computer's components.
7. What are the advantages of using a computer?

UNIT 2: INPUT & OUTPUT DEVICES

Structure of the Unit

2.0 OBJECTIVES

Computers have become an essential part of our day-today life. Tools and technologies are also changing day by day. The primary objective of this unit is to provide complete information about various tools and devices closely associated with the computer system.

2.1 INTRODUCTION

A computer is of no use unless it is able to communicate with the outside world. Input/Output devices are required for users to communicate with the computer. In simple terms, input devices bring information INTO the computer and output devices bring information OUT of a computer system. These input/output devices are also known as peripherals since they surround the CPU and memory of a computer system.

Some commonly used Input/Output devices are listed in table below.

Table 2.1: Various Input and Output Devices

Input Devices	Output Devices
Keyboard	Monitor
Mouse	LCD
Joystick	Printer
Scanner	Plotter
Light Pen	
Touch Screen	

2.2 INPUT DEVICES

Input devices are used to send information and instructions to the computer. There is some input devices listed below:

1. Keyboard;
2. Mouse;
3. Trackball
4. Joystick and;
5. Scanner etc.

In addition, all storage devices can function as input devices.

2.2.1 Keyboard

A computer keyboard is an array of switches, each of which sends the PC a unique signal when pressed. Two types of switch are commonly used: mechanical and rubber membrane. Mechanical switches are simply spring-loaded 'push to make' types, so when pressed down they complete the circuit and then break it again when released.

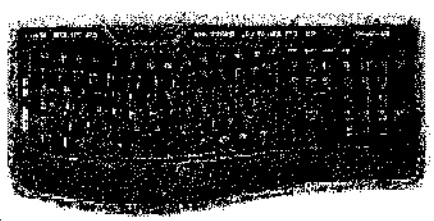


Figure 2.1: Keyboard

Membranes are composed of three sheets: the first has conductive tracks printed on it, the second is a separator with holes in it and the third is a conductive layer. A rubber mat over this gives the springy feel. When a key is pressed, it pushes the two conductive layers together to complete the circuit. The keys are connected up as a matrix, and their row and column signals feed into the keyboard's own microcontroller chip. This is mounted on a circuit board inside the keyboard, and interprets the signals with its built-in firmware program.

A particular key press might signal as row 3, column B, so the controller might decode this as an A and send the appropriate code for A back to the PC. These 'scan codes' are defined as standard in the PC's BIOS, though the row and column definitions are specific only to that particular keyboard. The data and instructions are input by typing on the keyboard. It is easy to use and connected to the computer via a cable.

Keys on the keyboard can also be categorized as under-

1. Alphabet keys from A to Z
2. Numeric Keys from 0 to 9
3. Editing keys are Page-Up, Page-Down, Delete, Insert, Home, End, Tab etc.
4. Control Keys are Enter, Shift, Esc, Caps Lock, Alt, Ctrl etc.
5. Function keys are from F1 to F12 ; and
6. Symbol Keys are !, ~, @, #, $, %, ^, & etc.

General purpose keyboards are 101 keys keyboard. They have 101 keys and can be used with almost all general purpose computers. 105 keys keyboards are known as 'Windows Keyboard' and have keys specially suitable for the Windows operating system.

2.2.2 Mouse

In the early 1980s the first PCs were equipped with the traditional user input device - a keyboard. By the end of the decade however, a mouse device had become an essential for PCs running the GUI-based Windows operating system. The commonest mouse used today is opto-electronic. Its ball is steel for weight and rubber-coated for grip, and as it rotates it drives two rollers, one each for x and y displacement. A third spring-loaded roller holds the ball in place against the other two.

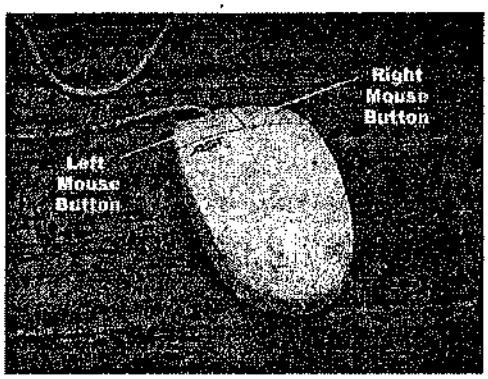


Fig. 2.2: Mouse

These rollers then turn two disks with radial slots cut in them. Each disk rotates between a photo-detector cell, and each cell contains two offset light emitting diodes (LEDs) and light sensors. As the disk turns, the sensors see the light appear to flash, showing movement, while the offset between the two light sensors shows the direction of movement. Also inside the mouse are a switch for each button, and a microcontroller which interpret the signals from the sensors and the switches, using its firmware program to translate them into packets of data which are sent to the PC. Serial mice use voltages of 12V and an asynchronous protocol from Microsoft comprised of three bytes per packet to report x and y movement plus button presses.

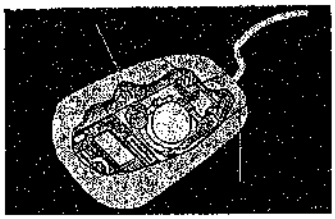


Figure 2.3: Internal structure of Mouse

2.2.3 Joystick

In computers, a joystick is a cursor control device used in computer games and assistive technology . The joystick, which got its name from the control stick used by a pilot to control the ailerons and elevators of an airplane, is a hand-held lever that pivots on one end and transmits its coordinates to a computer. It often has one or more push-buttons, called switches, whose position can also be read by the computer.

Figure 2.4: Joystick

A **joystick** is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. A popular variation of the joystick used on modern video game consoles is the analog stick. The joystick has been the principal flight control in the cockpit of many aircraft, particularly military fast jets, where center stick or side-stick location may be employed. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, wheelchairs and surveillance cameras etc. Miniature finger-operated joysticks have been adopted as input devices for smaller electronic equipment such as mobile phones.

2.2.4 Trackball

A trackball is a specific style of computer mouse that allows the user to keep their hand and arm in one place, while manipulating a ball that moves the on-screen pointer. The computer mouse is a critical element to any home or office PC (personal computer) set up. The mouse provides the user a way to move the pointer on the computer screen to the desired location, as well as the means to select an object. Used in all applications from office software to gaming and web surfing, mouse comfort and ease of use is paramount. A trackball is commonly used instead of a mouse on laptop and notebook computers. The main part of this device is a ball built into the keyboard. The ball has the same function as the ball built into the bottom of a mouse. Turning the ball by hand moves the pointer. A potentiometer measures the amount and direction of rotation of the ball.

Figure 2.5: Trackball

The traditional computer mouse has been a 'point and click' tool, where the user physically moves the mouse across a mouse pad, desktop, or other surface with either left or right hand until the pointer (or

cursor) is at the correct position on the screen. Once there, the user clicks either the right button or the left button to select the location and place the cursor. This type of navigation requires arm and wrist movement, and the location of the mouse assembly is variable. The trackball mouse performs the same functions as the original style mouse, however instead of moving the entire mouse to position the cursor, a small solid ball is located left of center or directly on the top of the mouse which is used to navigate the cursor across the screen. Using a trackball style mouse allows the PC user to roll the ball with the thumb (or fingers or palm) and move the cursor to the desired location without moving the complete mouse assembly. This reduces the arm and wrist movement previously required to plan the original style mouse and prevents the user from having to reposition the mouse frequently.

In addition to the diminished need for arm movement while manipulating the mouse, the thumb controlled trackball mouse offers greater accuracy in placing the cursor at the anticipated location. Unlike some conventional desktop computer mouse tools, the trackball mouse navigates smoothly and does not "jump" or stick on the mouse pad or desktop surface. Excellent for using when arm movement is constrained, the trackball mouse does not need a mouse pad or smooth surface underneath it to operate efficiently, as the trackball doesn't depend on contact with anything other than the user moving the ball itself.

2.2.5 Scanner

A scanner is a device that captures images from photographic prints, posters, magazine pages, and similar sources for computer editing and display. It is a peripheral that uses light receptors for reading printed material and digitally transferring the information as image objects into a computer system for processing.

Scanners come in hand-held, feed-in, and flatbed types and for scanning black-and-white only, or color. Very high resolution scanners are used for scanning for high-resolution printing, but lower resolution scanners are adequate for capturing images for computer display. Scanners usually come with software, such as Adobe's Photoshop product, that lets you resize and otherwise modify a captured image. Scanners usually attach to your personal computer with a Small Computer System Interface (SCSI). An application such as PhotoShop uses the TWAIN program to read in the image. Some major manufacturers of scanners include: Epson, Hewlett-Packard, Microtek, and Relisys.

Scanners facilitate capturing of the information and storing them in graphic format for displaying back on the graphical screen. Scanner consists of two components, the first one to illuminate the page so that the optical image can be captured and the other to convert the optical image into digital format for storage by computer. The graphic image scanned can now be seen and processed directly by the computer. Substantial research work is going on to establish methods by which the scanned image can be automatically converted into equivalent text for further processing.

2.2.5.1 Bar Code Reader

A bar code is a data coded in the form of light and dark bars. A bar code can be found on the back cover page of most of the books and products. A bar code reader read bar codes and converts them into electric pulses to be processed by a computer. Optical Bar Code Reader (OBCR) scans a set of vertical bars of different widths for specific data and used to read tags and codes in stores, medical records, library books, etc. These are available as hand held devices.

(a) Bar Codes *(b) Bar Code Reader*

Figure 2.6

2.2.5.2 Optical Mark Recognition (OMR)

Optical Mark Recognition (OMR) devices can sense marks on computer readable papers. This kind of device is used by academic and testing institutions to grade aptitude tests where candidate marks the correct alternatives on a special sheet of paper. These answer sheets are then directly read by the optical mark recognition devices and the information sent to a computer for processing. The entrance tests and some of the assignments are being marked by OMR.

	ANSWERS			
	A	B	C	D
Q1	●	○	○	○
Q2	○	●	○	○
Q3	○	●	○	○
Q4	○	○	○	●

Figure 2.7: OMR Sheet

It is used to detect the presence of ordinary pencil or pen marks made on special documents. For accurate reading, characters should be written in specified positions and should be made more precisely. There are two different methods of mark reading – one method relies on the conductivity of graphite to determine the presence of a pencil mark. (also known as 'mark sensing'). The second method is based on the reflectance of light. Here, the presence of a mark is recognized by a drop in light reflectance. Pen marks are also accepted in this method. Using these methods, data can be directly transferred to the computer. The speed of an OCR is near about 200 documents per minute i.e. approximately 4000 characters per minute.

2.2.5.3 Magnetic Ink Character Reader (MICR)

For magnetic ink character recognition, there is a special highly stylized standard character set which is used in documents. This set is known as E13B character set which is accepted by International Standards Organization. Each character of this set is formed in a matrix of 7 x 10 = 70 positions. Some positions are empty and some have ink patterns. When these positions are sensed by sensing device, no electric pulse is generated for blank position and a pulse indicating 1, is generated for, position with ink. In the character set, each character is stored as a unique combination of 0's and 1's, and each character contains total 14 inked elements.

The total number of 0's and 1's for any character is 70. These characters are printed on the documents using the ink which contains 'iron-oxide'. Documents that are to be read are passed through a strong magnetic field, causing the iron oxide in ink encoded characters, to become magnetized. Documents are then passed under a read head when a current flows at strength according to the size of magnetized area. Magnetic Ink Character Recognition (MICR) devices are generally used by the banking industry to read the account numbers on cheques directly and do the necessary processing.

दिनांक
Date.....

PAY.....
..... या धारक को OR BEARER
रूपये RUPEES..... रु. Rs.
..... अदा करे

खा.सं. A./c. No.		डीन D.No.		स.क. INTLS.	

दी बैंक ऑफ राजस्थान लिमिटेड
THE BANK OF RAJASTHAN LTD.
युनिवर्सिटी कैम्पस, बापू नगर, जयपुर–302004
University Campus, Bapu Nagar, Jaipur- 302004
T

|| Cheque Number || || Branch Code ||

Figure 2.8: Cheque

2.2.5.4 Optical Character Recognition (OCR)

Using OCR, each character is scanned photo-electrically and converted into a pattern of electronic signals. These are compared with the stored patterns for all the possible characters until an exact match is found. When the generated signal does not match with any of the already stored characters, the inputted character is rejected. These are the photo-electric device which scans a document and recognize the characters by comparing their shapes with internally stored patterns. Optical character readers recognize the type-writer characters and hand-written characters. These readers can process about 2000-30,000 characters per minute.

0 1 2 3 4 5 6 7 8 9

a b c d e f g h I j

A B C D E F G H I J

Figure 2.9: OCR Character set

2.3 OUTPUT DEVICES

Any device that outputs information from a computer is called, an output device. Since most information from a computer is output in either a visual or auditory format, the most common output devices are the monitor and speakers. These two devices provide instant feedback to the user's input, such as displaying characters as they are typed or playing a song selected from a playlist. While monitors and speakers are the most common output devices, there are many others. Some examples include headphones, printers, projectors, lighting control systems, audio recording devices, and robotic machines. A computer without an output device connected to it is pretty useless, since the output is what we interact with. Anyone who has ever had a monitor or printer stop working knows just how true this is. Of course, it is also important to be able to send information to the computer, which requires an input device.

2.3.1 Monitor

Monitor is a device which is used to produce output on the screen. Desktop screens are usually 14 - 19 inches by diagonal measurement. Pictures on a screen are made up of tiny dots. 1 dot on screen = 1 pixel (from 'picture element'). The more pixels per inch, the clearer and more detailed the picture. One measure of this is the dot pitch, the distance between the dots that make up the picture on the screen. However, different manufacturers measure differently. Most measure from dot center to the center of the nearest same color dot. Some measure from the center of a dot to an imaginary vertical line through the center of the nearest dot of the same color, giving a smaller number for the same dots as the previous method. Some monitors use skinny rectangles instead of dots and so must use a different method altogether.

Old types = CGA, EGA, VGA

Current type = super VGA

Determines what resolutions are available and how many colors can be displayed.

Table 2.2: Various types of Monitor

Type	Stands for	Resolution(s)
CGA	Color Graphics Adapter	320 x 200
EGA	Extended Graphics Adapter	640 x 350
VGA	Video Graphics Adapter	640 x 480
SVGA	Super VGA	800 x 600, 1024 x 768, or 1280 x 1024 etc.

New systems now come with super VGA with a picture size of 800 x 600 pixels (as a minimum) and 16

million colors. The number of colors displayed can vary from 16 to 256 to 64 thousand to 16.7 million. The more colors, the smoother graphics appear, especially photos. The number of colors available actually depends more on the video card used and on how much memory is devoted to the display. It takes 8 bits to describe 1 pixel when using 256 colors. It takes 24 bits per pixel when using 16 million colors. So a LOT of memory is needed to get those millions of colors. Video cards now come with extra memory chips on them to help handle the load.

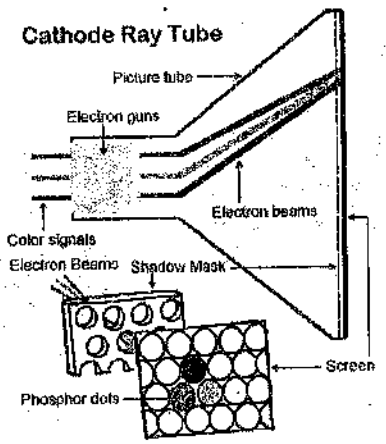


Figure 2.10: Monitor

Different types of Monitors are given as uner,

1. Cathode Ray Tube (CRT): A standard monitor screen is a CRT. The screen is coated on the inside surface with dots of chemicals called 'phosphors'. When a beam of electrons hits a dot, the dot will glow. On a color monitor these phosphor dots are in groups of three: **Red, Green, and Blue.** This **RGB** system can create all the other colors by combining dots. There are 3 signals that control the 3 electron beams in the monitor, one for each RGB color. Each beam only touches the dots that the signal tells it to light. All the glowing dots together make the picture that you see. The human eye blends the dots to 'see' all the different colors. A **shadow mask** blocks the path of the beams in a way that lets each beam only light its assigned color dots.

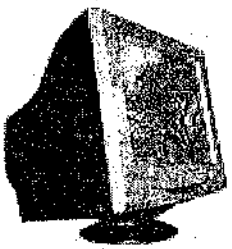


Figure 2.11:CRT

2. Liquid crystal display (LCD) screens use an entirely different technique. The screen is still made of dots but is quite flat. LCD displays are made of two layers of a polarizing material with a liquid crystal solution in between. An electrical signal makes the crystals line up in a way that keeps light from going through entirely or just partly. A black screen has all the crystals lined up so that no light gets through. A color LCD screen uses groups of 3 color cells instead of 3 phosphor dots. The signal for a picture cleverly lets just the right spots show their colors. Your eye does the rest.

Figure 2.12: LCD

3. Plasma display is an emissive flat panel display where light is created by phosphors excited by a plasma discharge between two flat panels of glass. The gas discharge contains no mercury a mixture of noble gases (neon and xenon) is used instead. This gas mixture is inert and entirely harmless. The glass panels seem to be vacuum sealed, because when they are broken the plasma breaks up, seemingly from the addition of air to the space.

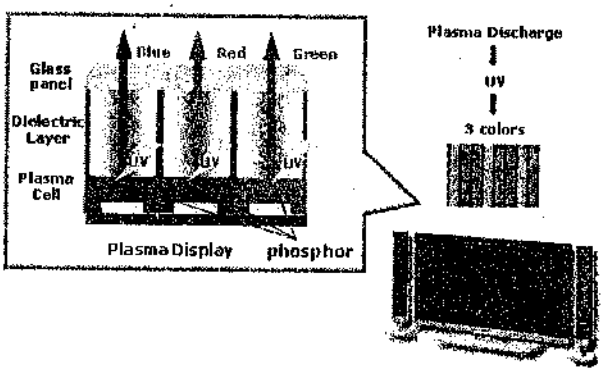


Figure 2.13: Plasma Display

4. Organic Light-Emitting Diode (OLED) is a thin-film light-emitting diode (LED) in which the emissive layer is an organic compound OLED technology is intended primarily as picture elements in practical display devices. These devices promise to be much less costly to fabricate than traditional LCD displays. When the emissive electroluminescent layer is polymeric, varying amounts of OLEDs can be deposited in rows and columns on a screen using simple 'printing' methods to create a graphical color display, for use as computer displays, portable system screens, and in advertising and information board applications. OLED may also be used in lighting devices. OLEDs are available as distributed sources while the inorganic LEDs are point sources of light.

2.3.2 Printers

Printer is a device which helps in printing the soft copy of a file or any program to hard physical file on the paper. Printers usually come in a variety of types. The printer comprises of toner which is the most responsible part in printing the hard copy. There are several major printer technologies available. These technologies can be broken down into two main categories with several types in each:

1. Impact Printers;
2. Non-Impact Printers

1. **Impact Printers** - These printers have a mechanism that touches the paper in order to create an image. There are two main impact technologies:

- A **Dot Matrix Printer** or impact matrix printer refers to a type of computer printer with a print head that runs back and forth on the page and prints by impact, striking an ink-soaked cloth ribbon against the paper, much like a typewriter. Printing involves mechanical pressure, these printers can create multiple copies. Each dot is produced by a tiny metal rod, also called a 'wire' or 'pin'. Manufacturers increased the pin count of the Dot matrix printer print-head from 9 pins to 18, or 24. The increased pin-count permitted superior print-quality. Dot matrix printer technology remains in use in devices such as Cash registers, Account Statement, Bank tellers, ATM and many other point-of-sales terminals. Some are even fitted with USB interfaces to aid connection to modern legacy-free computers. Dot matrix printers are also more tolerant of the hot and dirty operating conditions found in many industrial settings. The simplicity and durability of the design allows users who are not 'computer literate' to easily perform routine tasks such as changing ribbons and correcting paper jams.

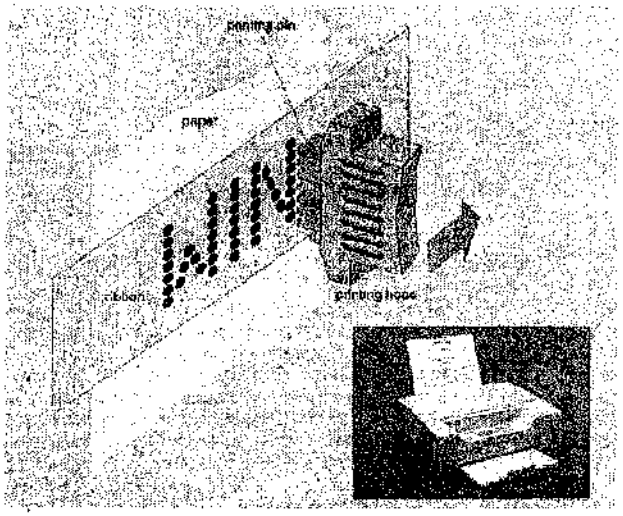


Figure 2.14: Dot Matrix Printer

- **Character Printers** are basically computerized typewriters. They have a ball or series of bars with actual characters (letters and numbers) embossed on the surface. The appropriate character is struck against the ink ribbon, transferring the character's image to the paper. Character printers are fast and sharp for basic text, but very limited for other use.

2. **Non-impact Printers** - These printers do not touch the paper when creating an image. Inkjet printers are part of this group, which includes:

(a) Inkjet Printers - Inkjet printers are one of the most common and effective printing technologies on the market today. There are many variations on this design in use for both commercial and private needs, although models used in the private sector use the same basic design and technologies. Although there are many versions of inkjet printers, they all share some basic methods. One of the basic methods that an inkjet printer utilizes is to force tiny drops of ink out of their nozzles and onto blank paper in such a way as to form a pattern that will end up in an image. Normally, the part of the printer that holds these nozzles, called the print head, will move quickly across the paper, spraying ink. Then the paper will be moved a small distance, and the printer will travel over the paper once again. An image is formed from the small lines of ink.

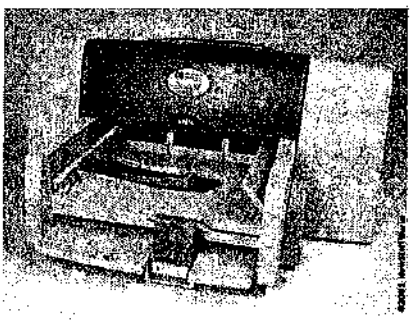


Figure 2.15: Inkjet Printer

(b) Laser Printers - Laser printers are one of the most commonly seen printing devices in every office in today's world. The reason behind this is that laser printers are printing machines that produce high resolution printouts, through the application of xerographic printing process. Laser printers have an amazing speed of generating printouts. A standard quality laser printer can produce about 40 prints in a time span of 60 seconds. Laser printers are available is varying sizes and their printing capacity also differs. A small sized laser printer can print about 5-7 pages per minute, whereas a medium capacity laser printer can generate almost 50 pages in one minute and a high capacity laser printer, which is mostly used when there are printouts to be given in bulk quantities quite often, prints approximately 500-1000 pages per minute.

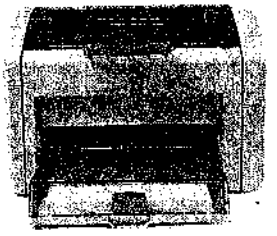


Figure 2.16: Laser Printer

The very first step in laser printing is the transfer of data from a computer to the memory of the image processor of a printer. Now, once the data is transferred to the printer's memory, it is written to the printer's drum with the help of a laser. The drum will keep rotating and the moment it rotates past the laser, it sweeps off the printer's surface neutralizing some spots to about -100v. These spots are the areas where the toner remains stuck to the drum and further gets transferred to the paper. Once the writing process is over, you need to add papers to the printer. Keep the papers into the printer's paper tray. The feed rollers inside the printer pull the paper inside and the registration rollers hold it till its release. As the drum keeps on rotating, the toner settles down in an area which is at a charge of about -100v and remains attached to the drum till the paper comes in. Now, the complete toned image is created on the drum. The moment you apply the paper to the printer, the toner transfer process starts. The transfer corona applies a charge of about +600v to the paper and when the paper passes through the drum, the toner which is at a charge of about -100v gets transferred to the paper. Further, the paper passes through a static charge eliminator that decreases the positive charge in the paper, with the help of its negative charge. The process of fusion takes place in order to secure the printout by melting the minute plastic fragments present on the toner's surface, so as to fix them to the paper fibers.

(c) Dye-sublimation Printers – This type of printers have a long roll of transparent film that resembles sheets of red-, blue-, yellow- and gray-colored cellophane stuck together end to end. Embedded in this film are solid dyes corresponding to the four basic colors used in printing: cyan, magenta, yellow and black (CMYK). The print head uses a heating element that varies in temperature, depending on the amount of a particular color that needs to be applied. The dyes vaporize and permeate the glossy surface of the paper before they return to solid form. The printer does a complete pass over the paper for each of the basic colors, gradually building the image.

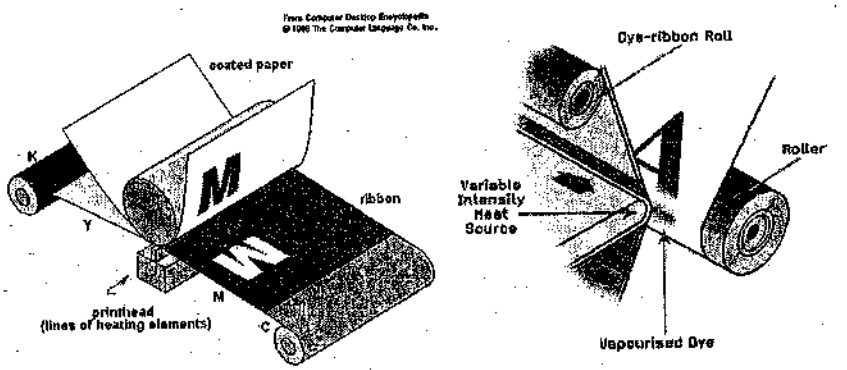


Figure 2.17: Dye-sublimation Printer

(d) Thermal wax Printers – These printers are something of a hybrid of dye-sublimation and solid ink technologies. They use a ribbon with alternating CMYK color bands. The ribbon passes in front of a print head that has a series of tiny heated pins. The pins cause the wax to melt and adhere to the paper, where it hardens in place.

Comparison between Laser Printer and Inkjet Printer

1. The major point of difference between laser and inkjet printers is of course, their technology. The printing technology of the laser printer is really ingenious and begins with an inbuilt laser beam projecting an image of the digital copy of the printed page onto a selenium coated, charged rotating drum. The laser light maps the 'negative' image of the document to be printed, onto the charged drum by the principle of photoconductivity. The selenium coating becomes photoconductive, that is, it loses charge, in those regions, which are not to be printed. Then the drum rolls and picks up dry ink particles, only from those regions which are still charged. Then the drum imprints ink onto paper, by heat and direct contact and your printed paper is ready. Most inkjet printers use a piezoelectric material which has an ink filled cartridge behind the spraying nozzles. When an electric voltage is applied to that piezoelectric material, it vibrates, changing shape or size. This generates a pressure pulse in the ink fluid filled chamber, which makes the nozzle spurt out droplets of ink. That is why it's named the 'inkjet', as it prints with jets of ink produced by voltage pulses.
2. The laser printers are substantially faster in printing pages, than the inkjet printer. The reason of course is the difference in technology that drives the two printers. To a laser printer, it does not matter whether a text or an image is being printed, as its speed of printing stays the same in both cases.
3. The laser printer uses a large single cartridge of toner as its ink, while the inkjet printer needs multiple cartridges of colored ink.
4. Laser printers and especially laser color printers are huge compared to inkjet printers, but they are certainly worth the space. The large size of laser printers is attributed to the space needed by toner cartridges.
5. Laser printers cost more initially, but they do not require a change of cartridge for a long time. The toner cartridges in laser printers can print 2,500 - 10,000 pages, before they require a replacement.
6. The laser jet print quality is a notch better than the inkjet, when it comes to text printing, but even in image printing, they have better resolution and detailing. While inkjet printers are better at printing images and photos, when it comes to providing brightness and rich color.

2.3.3 Plotter

Plotter is an output device used to produce graphical output and is employed for plotting graphs, charts and other design on paper. There are two types of plotters.

(a). Flat bed plotters

(b). Drum plotter

(a) Flat Bed Plotter - In a Flat bed plotter, the paper is fixed on a flat rectangular surface. Here paper does not moves across the paper and plots the corresponding graphical information. The pen holding mechanism is designed to hold more than one pen. Different coloured pens are used. When the command is issued to the plotter, the electronic circuitry activities the pen holding mechanism and a specific pen is selected from the pen holder and plots accordingly.

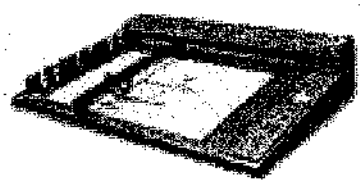


Figure 2.18: Flat-bed Plotter

(b) Drum Plotter - In Drum plotter, the paper on which graphs have to be plotted is placed over a drum

which rotates back and forth and pen-holding mechanism, which moves only in horizontal direction, writes on the paper.

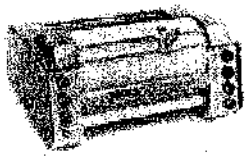


Figure 2.19: Drum Plotter

2.4 SUMMARY

The Chapter has given an introduction to the Input/Output devices. It gives a detailed listing of the various types of input devices and the output devices. The concepts can be very clearly understood by seeing at the figures in the chapter.

2.5 GLOSSARY

Input Device: A hardware unit which sends data or instructions into the memory of the computer for processing.

Output Device: A hardware unit which provides a user with the information resulting from processing by the computer such as a monitor, a speaker, a printer, etc.

Keyboard: A Computer Keyboard is an array of switches, each of which sends the PC a unique signal when pressed.

Joystick: A Joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling.

Trackball: A Trackball is a specific style of computer mouse that allows the user to keep their hand and arm in one place, while manipulating a ball that moves the on-screen pointer.

Scanner: A scanner is a device that captures images from photographic prints, posters, magazine pages, and similar sources for computer editing and display.

Bar Code Reader: A bar code reader read bar codes and converts them into electric pulses to be processed by a computer. Optical Bar Code Reader (OBCR) scans a set of vertical bars of different widths for specific data.

OMR: Optical Mark Recognition (OMR) devices can sense marks on computer readable papers.

Monitor: Monitor is a device which is used to produce output on the screen.

Plasma display: It is an emissive flat panel display where light is created by phosphors excited by a plasma discharge between two flat panels of glass.

Printer: Printer is a device which helps in printing the soft copy of a file or any program to hard physical file on the paper.

Impact Printers: These printers have a mechanism that touches the paper in order to create an image.

Dot Matrix Printer: It refers to a type of computer printer with a print head that runs back and forth on the page and prints by impact, striking an ink-soaked cloth ribbon against the paper, much like a typewriter.

Character Printers: They are basically computerized typewriters. They have a ball or series of bars with actual characters (letters and numbers) embossed on the surface.

Non-impact Printers: These printers do not touch the paper when creating an image.

Plotter: It is an output device used to produce graphical output and is employed for plotting graphs, charts and other design on paper.

Flat bed plotter: In this type of plotter the paper is fixed on a flat rectangular surface. Here paper does not moves across the paper and plots the corresponding graphical information. The pen holding mechanism is designed to hold more than one pen.

Drum plotter: In this type of plotter the paper on which graphs have to be plotted is placed over a drum which rotates back and forth and pen-holding mechanism, which moves only in horizontal direction, writes on the paper.

2.6 FURTHER READINGS

1. V.K.Jain, 'Fundamentals of Information Technology and Computer Programming' (3rd Edition), S.K.Kataria & Sons.
2. Pradeep Sinha, Preeti Sinha, 'Computer Fundamentals' (3rd Edition), BPB Publications.
3. Stephen D. Burd, 'System Architecture' (3rd Edition), Vikas Publishing House.
4. Sushila Madan, 'Introduction to Computer Fundamentals', Taxmanns Allied Services Pvt. Ltd.

2.7 UNIT-END QUESTIONS

1. Differentiate between input and output devices.
2. Explain any two input devices with illustration.
3. Differentiate between Impact and Non-Impact Printers.
4. Make a comparison between Laser Printer and Inkjet Printer.
5. What is the use of Plotter? Explain different types of plotters.
6. Explain the Cathode Ray Tube (CRT).
7. Explain the printing mechanism of Laser printer.
8. Write short notes on each of the following –
    a. Plasma Display
    b. Thermal Wax Printer
    c. Joystick
    d. Trackball
    e. Dot Matrix Printer
    f. Dye Sublimation Printer
    g. Mouse

UNIT 3: COMPUTER MEMORY

Structure of the Unit

3.0 OBJECTIVES

This chapter discusses all about memory – memory and its types, memory hierarchy, its classification, different types of memory etc. The students will get an overview of memory management and storage in computers.

3.1 INTRODUCTION

Memory is a vital part of both machine and animal. Without it we as humans would not have any consciousness and the ability to create. In machines, and especially in computers, memory allows the machine to function in various ways, for example software to be run and data to be saved and processed. Memory is the ability to retain data for a period of time, short or long. This data can be of a complexity including descriptions, sounds, sensations, smells and other sensations like human memory, or it can be predetermined data as in computer memory. One of the differences between human and machine memory is that we can program and access machine memory through the use of software, but we cannot access human memory in the same straightforward manner.

3.2 MEMORY HIERARCHY

Memory hierarchy indicates the levels of memory in a computer system. From fastest to slowest speed, they are:

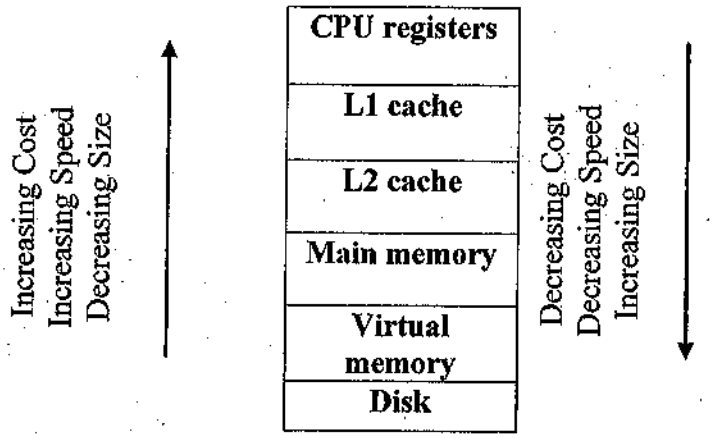


Figure 3.1: Memory Hierarchy

Most modern programs can benefit greatly from a large amount of very fast memory. A physical reality, however, is that as a memory device gets larger, it tends to get slower. For example, cache memories are very fast but are also small and expensive. Main memory is inexpensive and large, but is slow. The memory hierarchy is a mechanism of comparing the cost and performance of the various places we can store data and instructions. Figure 3.1 provides a look at one possible form of the memory hierarchy.

At the top level of the memory hierarchy are the **CPU's registers**. The registers provide the fastest access to data possible on the 80x86 CPU. The central processing unit contains a number of memory locations which are individually addressable and reserved for specific purpose. These memory locations are called registers. Some of theses registers are accessible to the programmer while some others are for the exclusive use of CPU. This latter set of registers is used for storage, interpretation and execution of instructions and the intermediate results. Total number of these registers varies among different computers. Widely used microprocessors have got eighteen 32-bit data registers which are used for storing instructions and operand of various sizes. One of these seven are 32-bit general purpose registers. These registers are accessible to

the programmer and are used for holding addresses or as index registers for indexed memory addressing.

Described below are some important central processing registers. The first one is the program counter. This is 16-bit register. Its only function is to hold the memory address of the next instruction to be fetched, after executing the current instruction it is also called instructions address register, control register or sequence control register. The second one is instruction registers. It is 32-bit register. It is used to store the current instructions which are being executed. These registers are part of the computer.

Working our way down, the **Level One Cache** system is the next highest performance subsystem in the memory hierarchy. L1 cache is a small, fast memory cache that is built in to a CPU and helps speed access to important and frequently-used data. L1 cache is typically smaller and faster than L2 cache. L1 cache is an abbreviation of *Level 1 cache*. On the 80x86 CPUs, the Level One Cache is provided on-chip by Intel and cannot be expanded. The size is usually quite small (typically between 4Kbytes and 32Kbytes), though much larger than the registers available on the CPU chip. The cost per byte of cache memory is much lower than that of the registers because the cache contains far more storage than is available in all the combined registers.

The **Level Two Cache** is present on some CPUs, on other CPUs it is the system designer's task to incorporate this cache (if it is present). L2 cache is a set of memory circuits designed to speed access to important and frequently used data. Early L2 cache designs involved fast static RAM memory chips placed near the CPU. Modern L2 caches involve RAM built directly into the CPU. L2 cache is typically larger but slower than L1 cache. L2 cache is an abbreviation of *Level 2 cache*. For economic reasons, external caches are actually more expensive than caches that are part of the CPU package, but the cost per bit at the transistor level is still equivalent to the in-package caches.

Below the Level Two Cache system in the memory hierarchy falls the **main memory** subsystem. This is the general-purpose, relatively low-cost memory found in most computer systems. Typically, this is DRAM or some similar inexpensive memory technology.

Most modern computer systems implement a **Virtual Memory** scheme that lets them simulate main memory using storage on a disk drive. While disks are significantly slower than main memory, the cost per bit is also significantly lower. Therefore, it is far less expensive (by three orders of magnitude) to keep some data on magnetic storage rather than in main memory. A Virtual Memory subsystem is responsible for transparently copying data between the disk and main memory as needed by a program. Virtual Memory is an imaginary memory area supported by some operating systems in conjunction with the hardware. Virtual memory is an alternate set of memory addresses. Programs use these *virtual addresses* rather than real addresses to store instructions and data. When the program is actually executed, the virtual addresses are converted into real memory addresses. The purpose of virtual memory is to enlarge the *address space*, the set of addresses a program can utilize.

File Storage also uses **disk** media to store program data. However, it is the program's responsibility to store and retrieve file data. In many instances, this is a bit slower than using Virtual Memory, hence the lower position in the memory hierarchy.

3.3 CLASSIFICATION OF MEMORY

Memory is the main component of a computer system. It stores instructions and data in binary form that is used by the central processing unit. Memories are divided into 2 types such as

1) Primary memory
2) Secondary memory

1) Primary memory: The memory unit that communicates directly with processor is called the main memory. Main memory is sometimes called semiconductor memory, since storage cells are made out of semi-conducting material. These memories are available in integrated circuit form called memory ICs or silicon chips of memory. Main memory holds the run time or execution time program instruction and data that are essential to execute or carry out the specified word or task. Main memory is classified into 2 types. They are:

a) Read Only Memory (ROM)

b) Random Access Memory (RAM)

a) Read Only Memory (ROM) –

ROM, as the name itself indicates is a memory that performs the read operation only. It does not permit writing operation. Hence the contents of ROM cannot be altered. The binary information stored in ROM is made permanent during the hard ware productions of the ROM unit and cannot be modified or erased by writing different data words into it. ROM is a non-volatile memory i.e., contents of ROM do not disappear when power is switched off. The binary data stored in ROM during its hardware production is fused such that it is permanent irrespective of presence or absence of the supplied electric energy. Therefore ROM memory chips are used to store permanently the system programs, operating system programs, controls words etc., that are essential for the correct working of computer. Whereas programs to be executed and data to be processed are brought into RAM as and when necessary; computer reads program instructions and data from RAM during execution and stores the computed results back on to RAM. Therefore RAM & ROM being main memories constitute the essential storage unit of a computer without which the user's program cannot be executed, especially in stored program computers. This is a non-volatile memory and the data can only be read from this type of memory. There are two main reasons that read-only memory is used for certain functions within the PC:

- **Permanence:** The values stored in ROM are always there, whether the power is on or not. A ROM can be removed from the PC, stored for an indefinite period of time, and then replaced, and the data it contains will still be there. For this reason, it is called *non-volatile storage*. A hard disk is also non-volatile, for the same reason, but regular RAM is not.
- **Security:** The fact that ROM cannot easily be modified provides a measure of security against accidental or malicious, changes to its contents. e.g. Viruses can not infect true ROMs.

Read-only memory is most commonly used to store system-level programs that should be available to the PC at all times. The most common example is the system BIOS program, which is stored in a ROM called the *system BIOS ROM*. Having this in a permanent ROM means it is available when the power is turned on so that the PC can use it to boot up the system. When we first turn on the PC the system memory is empty, so there has to be *something* for the PC to use when it starts up.

While the whole point of a ROM is supposed to be that the contents cannot be changed, there are times when being able to change the contents of a ROM can be very useful. There are several ROM variants that can be changed under certain circumstances; these can be thought of as "*mostly* read-only memory". The following are the different types of ROMs with a description of their relative modifiability:

There are different variations on the classic ROM chips which were manufacturer produced and could not change. The most common are:

- **PROM** (Programmable Read only Memory): This is a type of ROM that can be programmed using special equipment; it can be written to, but only once. This is useful for organizations that make their own ROMs from software they write, because when they change their code they can

create new PROMs without requiring expensive equipment. This is similar to the way a CD-ROM recorder works by letting us 'burn' programs onto blank disks once and then letting us read from them many times. In fact, programming a PROM is also called *burning*, just like burning a CD-R, and it is comparable in terms of its flexibility. We can say that this type of ROM can be re-programmed by using a special device called a PROM programmer. Generally, a PROM can only be changed/updated once. It uses fusible links that can be burned by using special PROM burning circuit. It can be programmed by the user using a PROM programmer.

- **EPROM** (Erasable Programmable Read only Memory): This type of ROM can have its contents erased by ultraviolet light and then reprogrammed by an RPROM programmer. This procedure can be carried out many times; however, the constant erasing and rewriting eventually renders the chip useless. The information stored in an EPROM can be erased by exposing the memory to ultraviolet light.
- **EEPROM** (Electrically Erasable Programmable Read only Memory): This type of ROM works in a similar way to Flash memory in that its contents can be 'flashed' for erasure and then written to without having to remove the chip from its environment. EEPROMs are used to store a computer system's BIOS, and can be updated without returning the unit to the factory. In many cases, BIOS updates can be carried out by computer users wishing a BIOS update. It is also same as EPROM but the erasing is done by electrical signals.

The advantages of ROM are:

- They are cheaper than RAM
- They are static and do not require refreshing
- They are more reliable than RAM as their circuit is simple.
- They are available in longer sizes than RAM.
- They are easier to interface than RAM.

b) **Random Access Memory** – RAM is also called as read/write memory since it permits both memory read and memory write operation. Therefore programs and data can be stored into the RAM. Similarly the contents of RAM can be erased soon after the completion of current program execution. Results of computation can be written on to it. It is just like a scratch pad where information can be stored and erased.

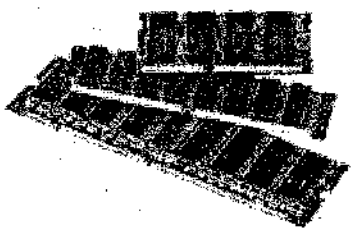


Fig. 3.2

RAM is a volatile memory i.e., the stored data and programs will be erased, immediately when the power supply is switched off. It is a temporary memory and holds the information as long as there is electric power but looses stored data when power supply is cut off. Basically, it is a memory area where information can be written into or read whenever required by the CPU. It is required during calculation. RAM is of two types, Static and Dynamic.

- **SRAM** (Static RAM): It uses flip flops for storage elements. In SRAM once data is written into memory location, the data stays unchanged unless some new data is entered into that location.
- **DRAM** (Dynamic RAM): It uses capacitors as storage element. The dynamic RAM contents may change with time due to leakage of charge. So it is required to refresh the storage elements periodically. It consumes less power as compared to SRAM.

SDRAM (Synchronous Dynamic Random Access Memory): This type of chips first came to the computing forefront in 1997. In just three years, they had become the dominant force in memory chips across the computing spectrum. SDRAM (synchronous DRAM) is a generic name for various kinds of dynamic random access memory (DRAM) that are synchronized with the clock speed that the microprocessor is optimized for. This tends to increase the number of instructions that the processor can perform in a given time. The speed of SDRAM is rated in MHz rather than in nanoseconds (ns). This makes it easier to compare the bus speed and the RAM chip speed. We can convert the RAM clock speed to nanoseconds by dividing the chip speed into 1 billion ns (which is one second).

DDR (Double Data Rate SDRAM): DDR basically doubles the rate of data transfer of standard SDRAM by transferring data on the up and down tick of a clock cycle. DDR memory operating at 333MHz actually operates at 166MHz * 2 (PC2700) or 133MHz*2 (PC2100). DDR is a 2.5 volt technology that uses 184 pins in its DIMMs. It is incompatible with SDRAM physically, but uses a similar parallel bus, making it easier to implement than RDRAM, which is a different technology.

2) Secondary memory: The maximum capacity of primary memory is limited. So to handle more data than allowed by primary memory, secondary memory is used. And it is non-volatile i.e. data is not lost due to current failure. Magnetic tape, Floppy disk and Hard disk are some examples of secondary memory.

3.4 STORAGE TYPES

Computer technology changes rapidly, which makes it difficult for most to keep up with. By the time we buy the 'latest and greatest', the next version is just over the horizon. Likewise, it becomes difficult for institutions to maintain and support all of the technology both financially and physically. Following are the various types of storage used with a computer system,

3.4.1 Semiconductor

Semiconductor memory uses semiconductor-based integrated circuits to store information. A semiconductor memory chip may contain millions of tiny transistors or capacitors. Both *volatile* and *non-volatile* forms of semiconductor memory exist. In modern computers, primary storage almost exclusively consists of dynamic volatile semiconductor memory or dynamic random access memory. Since the turn of the century, a type of non-volatile semiconductor memory known as *flash memory* has steadily gained share as off-line storage for home computers. Non-volatile semiconductor memory is also used for secondary storage in various advanced electronic devices and specialized computers.

3.4.2 Magnetic

Magnetic storage uses different patterns of magnetization on a magnetically coated surface to store information. Magnetic storage is *non-volatile*. The information is accessed using one or more read/write heads which may contain one or more recording transducers. A read/write head only covers a part of the surface so that the head or medium or both must be moved relative to another in order to access data. In modern computers, magnetic storage takes the following forms:

1. Magnetic Disk

a) Floppy disk:

Floppy disks are small, removable, media storage devices. They record data onto a thin, circular

magnetic film encased in a flat, square plastic jacket. Floppy disks are somewhat antiquated, having been replaced by memory sticks and re-writable CD storage devices. Generally, a floppy disk is used to store off-line data.

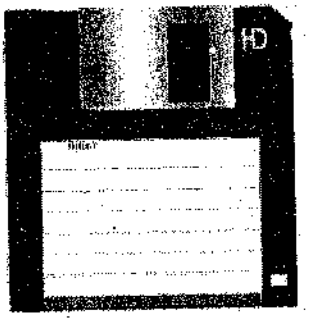


Fig. 3.3

Original floppy disks were 8-inch floppies used in 1971-1975, but the first floppy disks that were widely used commercially were 5.25-inch disks. These floppy disks were quite flexible and required a 5.25-inch floppy drive. The disks could store up to 360 kilobytes (KB) of data, or about one third of a single megabyte. Later, high-density floppy disks held 1.2 megabytes (MB) of data. These floppy disks were widely used until about 1987. A floppy disk is an obsolete storage format that was used on personal computers. Each disk, typically 3.5 inches in height, held 1.44 megabytes of data.

Inside the hard plastic case of the floppy disk is a magnetic material used to store data. It is a similar material to the recording material in a cassette tape. When inserted into a drive, the magnetic tape (which is in the shape of a circle) is spun around rapidly, much like a CD. While spinning, the read/write head of the disk stops at the empty track on the disk. The computer, before sending any information to the disk, quickly checks for things like system stability and whether or not the necessary space is free on the disk.

The write head of the disk sends data to the disk by magnetizing certain parts of the magnetic recording tape. Once the data is on the floppy, an exact copy has been made—one is on the disk, one is on your computer.

(b) Hard disk drive:

A hard disk drive consists of a motor, spindle, platters, read/write heads, actuator, frame, air filter, and electronics. The frame mounts the mechanical parts of the drive and is sealed with a cover. The sealed part of the drive is known as the Hard Disk Assembly or HDA. The drive electronics usually consists of one or more printed circuit boards mounted on the bottom of the HDA.

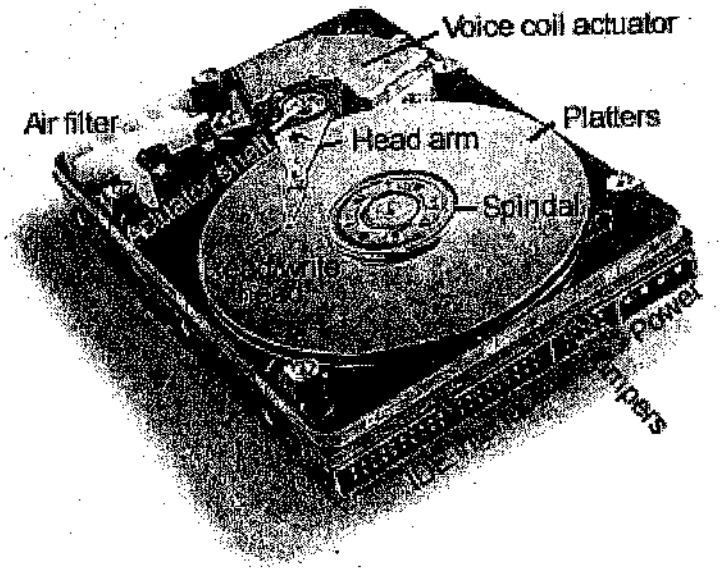


Fig. 3.4

A head and platter can be visualized as being similar to a record and playback head on an old phonograph, except the data structure of a hard disk is arranged into concentric circles instead of in a spiral as it on a phonograph record (and CD-ROM). A hard disk has one or more platters and each platter usually has a head on each of its sides. The platters in modern drives are made from glass or ceramic to avoid the unfavorable thermal characteristics of the aluminum platters found in older drives. A layer of magnetic material is deposited/sputtered on the surface of the platters. Platters are mounted on the spindle which is turned by the drive motor. Most current IDE hard disk drives spin at 5,400, 7,200, or 10,000 RPM and 15,000 RPM drives are emerging.

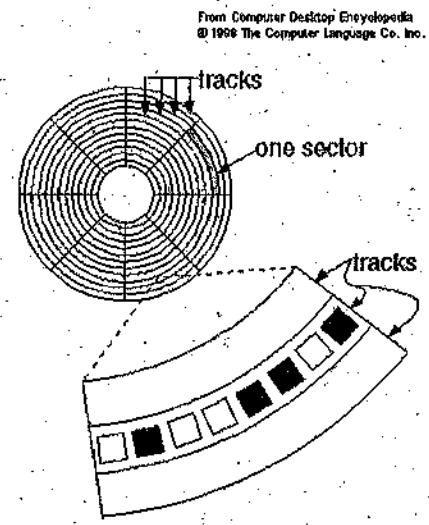


Fig. 3.5

The primary computer storage device, like tape, it is magnetically recorded and can be re-recorded over and over. Disks are rotating platters with a mechanical arm that moves a read/write head between the outer and inner edges of the platter's surface. It can take as long as one second to find a location on a floppy disk to as little as a couple of milliseconds on a fast hard disk.

The disk surface is divided into concentric tracks (circles within circles) and the thinner tracks having more storage. The data bits are recorded as tiny magnetic spots on the tracks. The smaller the spot, the more bits per inch and the greater the storage. Tracks are further divided into sectors, which hold a block of data that is read or written at one time; for example, READ SECTOR 782, WRITE SECTOR 5448. In order to update the disk, one or more sectors are read into the computer, changed and written back to disk. Modern disks have more sectors in the outer tracks than the inner ones because the outer radius of the platter is greater than the inner radius.

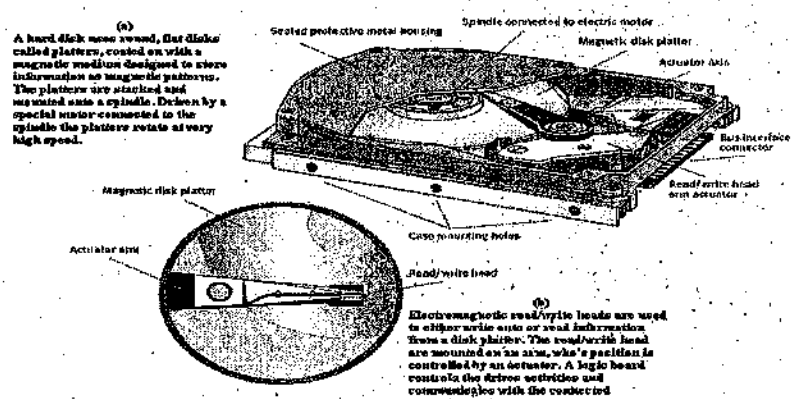


Fig. 3.6

(c) Magnetic tape:

Magnetic Tape is a sequential storage medium used for data collection, backup and archiving. Like videotape, computer tape is made of flexible plastic with one side coated with a ferromagnetic material. Tapes were originally open reels, but were superseded by cartridges and cassettes of many sizes and shapes. Tape has been more economical than disks for archival data, but that is changing as disk capacities have increased enormously. If tapes are stored for the duration, they must be periodically recopied or the tightly coiled magnetic surfaces may contaminate each other.

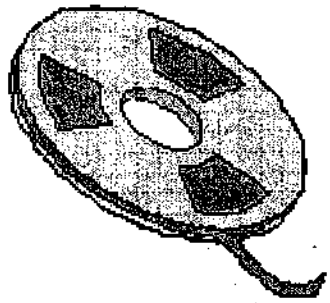


Fig. 3.7

The major drawback of tape is its sequential format. Locating a specific record requires reading every record in front of it or searching for markers that identify predefined partitions. Although most tapes are used for archiving rather than routine updating, some drives allow rewriting in place if the byte count does not change. Otherwise, updating requires copying files from the original tape to a blank tape (scratch tape) and adding the new data in between. Tracks run parallel to the edge of the tape (linear recording) or diagonally (helical scan). A linear variation is serpentine recording, in which the tracks 'snake' back and forth from the end of the tape to the beginning. Old open reel tapes used nine linear tracks (8 bits plus parity), while modern cartridges use 128 or more tracks. Data are recorded in blocks of contiguous bytes, separated by a space called an "inter-record gap" or "inter-block gap." Tape drive speed is measured in inches per second (IPS). Over the years, storage density has increased from 200 to 38,000 bpi.

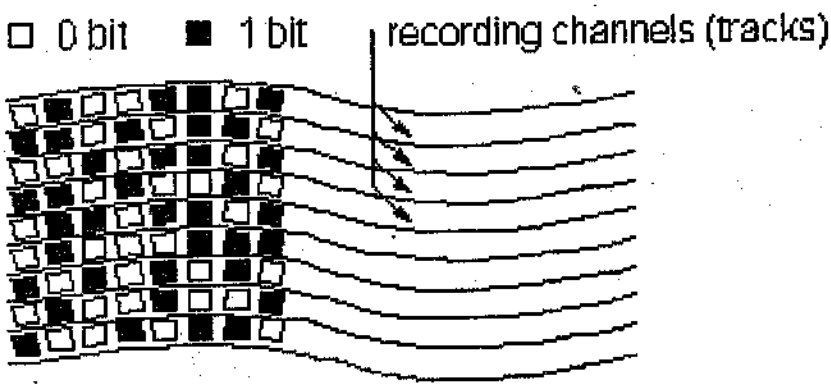


Fig. 3.8

In early computers, magnetic storage was also used for primary storage in a form of magnetic drum, or core memory, core rope memory, thin-film memory, twistor memory or bubble memory. Also unlike today, magnetic tape was often used for secondary storage.

3.4.3 Optical and Magneto Optical

Optical storage, the typical Optical disc, stores information in deformities on the surface of a circular disc

and reads this information by illuminating the surface with a laser diode and observing the reflection. Optical disc storage is *non-volatile*. The deformities may be permanent (read only media), formed once (write once media) or reversible (recordable or read/write media). The following forms are currently in common use:

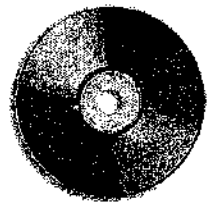


Fig. 3.9

- CD, CD-ROM, DVD, BD-ROM: Read only storage, used for mass distribution of digital information (music, video, computer programs)
- CD-R, DVD-R, DVD+R, BD-R: Write once storage, used for tertiary and off-line storage
- CD-RW, DVD-RW, DVD+RW, DVD-RAM, BD-RE: Slow write, fast read storage, used for tertiary and off-line storage
- Ultra Density Optical or UDO is similar in capacity to BD-R or BD-RE and is slow write, fast read storage used for tertiary and off-line storage.

CDs and DVDs are everywhere these days. Whether they are used to hold music, data or computer software, they have become the standard medium for distributing large quantities of information in a reliable package. Compact discs are so easy and cheap to create, and if we have a computer and CD-R drive, we can create our own CDs, including any information we want.

Magneto-optical disc storage is optical disc storage where the magnetic state on a ferromagnetic surface stores information. The information is read optically and written by combining magnetic and optical methods. Magneto-optical disc storage is *non-volatile*, *sequential access*, slow write, fast read storage used for tertiary and off-line storage.

Erasability always implies that the recording media can undergo an unlimited (or very large) number of write/erase operations without any loss in recording / reading quality. There are two main media designs for rewritable optical systems: MO (magneto-optical) media and phase-change media (known as CD-RW).

The MO systems include basic principles of both magnetic and optical storage systems. MO systems write magnetically, with thermal assist, and read optically. Presently, there are two standard form-factors used for MO systems: 5.5-inch and 3.5-inch, which are protected by hard envelops. The larger form-factor MO disks are capable of holding about as much as the standard CD-ROM. Under pressure from the inexpensive and relatively fast CD-R and CD-RW, MO drives seems to be losing ground. On the other hand, some of the principles of the MO technology (thermally-assisted magnetic recording) may find their way into the most advanced magnetic storage devices of the future.

3.5 SUMMARY

The Chapter has given a broad idea about computer memory. It has also given a detailed listing of the various types of memories and storage devices..

3.6 GLOSSARY

Computer Memory: Memory is the main component of a computer system. It stores instructions and data in binary form that is used by the central processing unit.

Memory Hierarchy: Memory hierarchy is the levels of memory in a computer system.

Primary memory: The memory unit-communicates directly with processor is called the main memory.

ROM (Read Only Memory): It is a memory that performs the read operation only. It will not permit writing operation.

PROM (Programmable Read only Memory): This is a type of ROM that can be programmed using special equipment; it can be written to, but only once.

EPROM (Erasable Programmable Read only Memory): This type of ROM can have its contents erased by ultraviolet light and then reprogrammed by an RPROM programmer.

EEPROM (Electrically Erasable Programmable Read only Memory): This type of ROM works in a similar way to Flash memory in that it can its contents can be 'flashed' for erasure ad then written to without having to remove the chip from its environment.

RAM (Random Access Memory): It is also called as read/write memory since it permits both memory read and memory write operation.

SRAM (Static Random Access Memory): In SRAM once data is written into memory location, the data stays unchanged unless some new data is entered into that location.

DRAM (Dynamic Random Access Memory): The dynamic RAM contents may change with time due to leakage of charge. So it is required to refresh the storage elements periodically.

Secondary memory: Memory which is non-volatile in nature i.e. data is not lost due to current failure.

Semiconductor memory: It uses semiconductor-based integrated circuits to store information. A semiconductor memory chip may contain millions of tiny transistors or capacitors.

3.7 FURTHER READINGS

1. V.K.Jain, 'Fundamentals of Information Technology and Computer Programming' (3rd Edition), S.K.Kataria & Sons.
2. Pradeep Sinha, Preeti Sinha, 'Computer Fundamentals' (3rd Edition), BPB Publications.
3. Stephen D. Burd, 'System Architecture' (3rd Edition), Vikas Publishing House.
4. Sushila Madan, 'Introduction to Computer Fundamentals', Taxmanns Allied Services Pvt. Ltd.

3.8 UNIT END QUESTIONS

1. What do you understand by the term 'Computer Memory'? Explain and illustrate the memory hierarchy.
2. Differentiate between the following-
   a. L1 Cache and L2 Cache
   b. Volatile and Non-Volatile memory

c. RAM and ROM

d. Primary Memory and Secondary Memory

e. Hard Disk and Magnetic tape

3. Explain various types of ROM. Also, give advantages of ROM.
4. Explain various types of RAM and differentiate between SRAM and DRAM.
5. What is Semiconductor Memory? Explain its nature.
6. Explain the process of reading and writing of data in a hard disk.
7. Write a short note on Magneto-Optical disc storage.

UNIT 4: COMPUTER CODES

Structure of the Unit

4.0 OBJECTIVES

Through this unit the students will be able to know about the coding systems followed on different computers for representing data and processes, the difference between them, and their utility.

4.1 IINTRODUCTION TO COMPUTER CODES

A computer accepts data and instructions in machine language. The data must be represented internally by the bits 0 and 1. Binary coding schemes are used to represent data internally in the computer memory. In binary coding, every symbol of text data is represented by a group of bits. The group of bits used to represent a symbol is called a byte. Modern computers use 8 bits to represents a symbol. The most popular text code systems are: BCD and EBCDIC, ASCII, UNICODE.

4.2 NEED FOR CODES

Codes are needed to efficiently represent information in computer system. Memory can be managed very efficiently with help of codes and the degree of understanding improves with code.

4.3 ASCII CODES

ASCII stands for American Standard Code for Information Interchange. It is the standard format used for text files within computers and online.

As computers can only understand numbers, the ASCII code is the numerical representation of alphabetic and special characters, such as 'a' and/or the '©' symbol.

In order to display special characters or symbols within your HTML pages, you must use a special ASCII code. e.g. The ASCII code for 'A' is 65.

4.4 EXTENDED BINARY CODED DECIMAL INTERCHANGE CODE(EBCDIC)

EBCDIC (Extended Binary Coded Decimal Information Code) is an eight-bit character set that was developed by International Business Machines (IBM). It was the character set used on most computers manufactured by IBM prior to 1981.

EBCDIC is not used on the IBM PC and all subsequent "PC clones". These computer systems use ASCII as the primary character and symbol coding system. Computer makers other than IBM used the ASCII system since its inception in the 1960s.

EBCDIC is widely considered to be an obsolete coding system, but is still used in some equipment, mainly in order to allow for continued use of software written many years ago that expects an EBCDIC communication environment.

4.5 BINARY-CODED DECIMAL

BCD represents each of the digits of an unsigned decimal as the 4-bit binary equivalents

Unpacked BCD representation contains only one decimal digit per byte. The digit is stored in the least significant 4 bits; the most significant 4 bits are not relevant to the value of the represented number.

Packed BCD

Packed BCD representation packs two decimal digits into a single byte.

Unpacked BCD

Unpacked BCD representation contains only one decimal digit per byte. The digit is stored in the least significant 4 bits; the most significant 4 bits are not relevant to the value of the represented number.

Decimal	**0**
Binary	**0000 0000**
BCD	
Unpacked	**0000 0000**
Packed	**0000 0000**

.
.
.

Decimal	**10**
Binary	**0000 1010**
BCD	
Unpacked	**0000 0001 0000 0000**
Packed	**0001 0000**

Invalid BCD Numbers

These binary numbers are not allowed in the BCD code: 1010, 1011, 1100, 1101, 1110, 1111

In BCD, a digit is usually represented by four bits which, in general, represent the decimal digits 0 through 9. Other bit combinations are sometimes used for a sign or for other indications (e.g., error or overflow).

Although uncompressed BCD is not as widely used as it once was, decimal fixed-point and floating-point are still important and continue to be used in financial, commercial, and industrial computing.

Recent decimal floating-point representations use base-10 exponents, but not BCD encodings. Current hardware implementations, however, convert the compressed decimal encodings to BCD internally before carrying out computations. Software implementations of decimal arithmetic typically use BCD or some other 10^n base, depending on the operation.

Example: The bit assignment 1001, can be seen by its weights to represent the decimal 9 because:

$$1x8+0x4+0x2+1x1 = 9$$

4.6 8421 CODE

A weighted code in which each decimal digit 0 through 9 is represented by a four-bit codeword. The bit positions in each codeword are assigned weights, from left to right, of 8, 4, 2, and 1. For place = 3, weight is 8 place = 2, weight is 4 place = 1, weight is 2 place = 0, weight is 1.

4.7 2421 CODE

This is a weighted code, its weight are 2, 4, 2 and 1. A decimal number is represented in 4-bit form and total weight of the four bits = 2 + 4 + 2 + 1 = 9. Hence the 2421 code represents decimal number 0 to 9.

Formula is $N = y7 \times w7 + y6 \times w6 + y5 \times w5 + y4 \times w4 + y3 \times w3 + y2 \times w2 + y1 \times w1 + y0 \times w0$,

At place = 3, weight is 2, At place = 2, weight is 4, At place = 1, weight is 2, At place = 0, weight is 1

4.8 UNICODE

It is a 16-bit character set standard, designed and maintained by the non-profit consortium Unicode Inc. Originally Unicode was designed to be universal, unique, and uniform, i.e., the code was to cover all major modern written languages (universal), each character was to have exactly one encoding (unique), and each character was to be represented by a fixed width in bits (uniform).

Parallel to the development of Unicode an ISO/IEC standard was being worked on that put a large emphasis on being compatible with existing character codes such as ASCII or ISO Latin 1. To avoid having two competing 16-bit standards, in 1992 the two teams compromised to define a common character code standard, known both as Unicode and BMP.

Since the merger the character codes are the same but the two standards are not identical. The ISO/IEC standard covers only coding while Unicode includes additional specifications that help implementation.

The same character can be displayed as a variety of glyphs, depending not only on the font and style, but also on the adjacent characters.

A series of character encoding standards intended to support the characters used by a large number of the world's languages; The Unicode standards together with standards for representing character strings as byte strings. International encoding standard that provides a superset of many separate encodings.

A 16-bit code to represent the characters used in most of the world's scripts. UTF-8 is an alternative encoding in which one or more 8-bit bytes represents each Unicode character.

Unicode is a character encoding standard developed by the Unicode Consortium. The aim of the standard is to provide universal way of encoding characters of any language, regardless of the computer system, or platform, being used.

A character set containing characters that are composed of 2 bytes.

4.9 SUMMARY

This chapter introduced the readers to the different standard codes used in computers to represent data.

4.10 GLOSSARY

ASCII stands for American Standard Code for Information Interchange. It is the standard format used for text files within computers and online.

EBCDIC (Extended Binary Coded Decimal Information Code) is an eight-bit character set

BCD represents each of the digits of an unsigned decimal as the 4-bit binary equivalents

8421 code is a weighted code in which each decimal digit 0 through 9 is represented by a four-bit codeword. The bit positions in each codeword are assigned weights, from left to right, of 8, 4, 2, and 1. This is a weighted code, its weight are 2, 4, 2 and 1. A decimal number is represented in 4-bit form and total weight of the four bits = 2 + 4 + 2 + 1 = 9. 2421 code represents decimal number 0 to 9.

4.11 FURTHER READINGS

1. V. Rajaraman, "Fundamentals of Computers", Fourth edition, PHI publications,. 2002.
2. P.K Sinha 'Computer Fundamentals', BPB Publications

4.12 UNIT END QUESTIONS

1. Explain Weighted Code.
2. Explain need of code
3. Convert following to BCD

   A.24 B.567 C 897
4. Perform following BCD Addition

   64 +89

   74 +56
5. Discuss role of Unicode in java.

UNIT 5: INTRODUCTION TO MEMORY, PROCESS AND FILE MANAGEMENT

Structure of the Unit

5.0 OBJECTIVES

The purpose of this unit is to provide information about memory & process management and file system.

5.1 MEMORY MANAGEMENT

Memory management is the act of managing computer memory. In its simpler forms, this involves providing ways to allocate portions of memory to programs at their request, and freeing it for reuse when no longer needed. The management of main memory is critical to the computer system.

Virtual memory systems separate the memory addresses used by a process from actual physical addresses, allowing separation of processes and increasing the effectively available amount of RAM using disk swapping. The quality of the virtual memory manager can have a big impact on overall system performance.

Garbage collection is the automated allocation, and deallocation of computer memory resources for a program. This is generally implemented at the programming language level and is in opposition to manual memory management, the explicit allocation and deallocation of computer memory resources.

Memory management systems on multi-tasking operating systems usually deal with the following issues.

Relocation

In systems with virtual memory, programs in memory must be able to reside in different parts of the memory at different times. This is because when the program is swapped back into memory after being swapped out for a while it can not always be placed in the same location. The virtual memory management unit must also deal with concurrency. Memory management in the operating system should therefore be able to relocate programs in memory and handle memory references and addresses in the code of the program so that they always point to the right location in memory.

Protection

Processes should not be able to reference the memory for another process without permission. This is called memory protection, and prevents malicious or malfunctioning code in one program from interfering with the operation of other running programs.

Sharing

Even though the memory for different processes is normally protected from each other, different processes sometimes need to be able to share information and therefore access the same part of memory. Shared memory is one of the fastest techniques for Inter-process communication.

Logical organization

Programs are often organized in modules. Some of these modules could be shared between different programs, some are read only and some contain data that can be modified. The memory management is responsible for handling this logical organization that is different from the physical linear address space. One way to arrange this organization is segmentation.

5.1.1 Terminology

- Logical address – generated by the CPU; also referred to as virtual address
- Physical address – address seen by the memory unit
- Logical and physical addresses are the same in compile-time and loadtime

address-binding schemes; logical (virtual) and physical addresses differ in execution-time address-binding scheme Relocatable Means that the program image can reside anywhere in physical memory.

Binding Programs need real memory in which to reside. When is the location of that real memory determined?

• This is called mapping logical to physical addresses.

• This binding can be done at compile/link time. Converts symbolic to relocatable. Data used within compiled source is offset within object module.

Compiler: If it's known where the program will reside, then absolute code is generated. Otherwise compiler produces relocatable code.

Load: Binds relocatable to physical. Can find best physical location.

Execution: The code can be moved around during execution. Means flexible virtual Mapping

5.1.2 Basic requirements that drive memory designs

The primary memory access time must be as small as possible. This need influnences both software and hardware design

The primary memory must be as large as possible. Using virtual memory, software and hard ware can make the memory appear to be larger than it actually is

The primary memory must be cost-effective. The cost cannot be more than a small percentage of the total cost of the computer.

5.1.3 Memory Management Algorithms

In an environment that supports dynamic memory allocation, the memory manager must keep a record of the usage of each allocatable block of memory. This record could be kept by using almost any data structure that implements linked lists. An obvious implementation is to define a free list of block descriptors, with each descriptor containing a pointer to the next descriptor, a pointer to the block, and the length of the block. The memory manager keeps a free list pointer and inserts entries into the list in some order conducive to its allocation strategy. A number of strategies are used to allocate space to the processes that are competing for memory.

Best Fit

The allocator places a process in the smallest block of unallocated memory in which it will fit.

Problems:

- It requires an expensive search of the entire free list to find the best hole.
- More importantly, it leads to the creation of lots of little holes that are not big enough to satisfy any requests. This situation is called *fragmentation*, and is a problem for all memory-management strategies, although it is particularly bad for best-fit.

Solution: One way to avoid making little holes is to give the client a bigger block than it asked for. For example, we might round all requests up to the next larger multiple of 64 bytes. That doesn't make the fragmentation go away, it just hides it.

- Unusable space in the form of holes is called *external fragmentation*
- Unusable space in the form of holes is called *external fragmentation*

Worst Fit

The memory manager places process in the largest block of unallocated memory available. The ides is that this placement will create the largest hole after the allocations, thus increasing the possibility that, compared to best fit, another process can use the hole created as a result of external fragmentation.

First Fit

Another strategy is first fit, which simply scans the free list until a large enough hole is found. Despite the name, first-fit is generally better than best-fit because it leads to less fragmentation.

Problem:

- Small holes tend to accumulate near the beginning of the free list, making the memory allocator search farther and farther each time.

Solution:

- Next Fit

Next Fit

The first fit approach tends to fragment the blocks near the beginning of the list without considering blocks further down the list. Next fit is a variant of the first-fit strategy.The problem of small holes accumulating is solved with next fit algorithm, which starts each search where the last one left off, wrapping around to the beginning when the end of the list is reached (a form of one-way elevator)

Compaction

Compaction attacks the problem of fragmentation by moving all the allocated blocks to one end of memory, thus combining all the holes. Aside from the obvious cost of all that copying, there is an important limitation to compaction: Any pointers to a block need to be updated when the block is moved. Unless it is possible to find all such pointers, compaction is not possible. Pointers can stored in the allocated blocks themselves as well as other places in the client of the memory manager. In some situations, pointers can point not only to the start of blocks but also into their bodies. For example, if a block contains executable code, a branch instruction might be a pointer to another location in the same block. Compaction is performed in three phases. First, the new location of each block is calculated to determine the distance the block will be moved. Then each pointer is updated by adding to it the amount that the block it is pointing (in)to will be moved. Finally, the data is actually moved. There are various clever tricks possible to combine these operations.

5.2 PROCESS MANAGEMENT

A process is a sequential program in execution. The components of a process are the following:

- The object program to be executed (called the program text in UNIX)
- The data on which the program will execute (obtained from a file or interactively from the process's user)
- Resources required by the program (for example, files containing requisite information)
- The status of the process's execution

Multiprogramming systems explicitly allow multiple processes to exist at any given time, where only one is using the CPU at any given moment, while the remaining processes are performing I/O or are waiting.

The process manager is of the four major parts of the operating system. It implements the process abstraction. It does this by creating a model for the way the process uses CPU and any system resources. Much of the complexity of the operating system stems from the need for multiple processes to share the hardware at the same time. As a conseuence of this goal, the process manager implements CPU sharing (called *scheduling*), process *synchronization* mechanisms, and a deadlock strategy. In addition, the process manager implements part of the operating system's protection and security.

Process States

During the lifespan of a process, its execution status may be in one of four states: (associated with each state is usually a queue on which the process resides)

- **Executing**: the process is currently running and has control of a CPU
- **Waiting**: the process is currently able to run, but must wait until a CPU becomes available
- **Blocked**: the process is currently waiting on I/O, either for input to arrive or output to be sent
- **Suspended**: the process is currently able to run, but for some reason the OS has not placed the process on the ready queue
- **Ready**: the process is in memory, will execute given CPU time.

Process Control Block (PCB)

If the OS supports multiprogramming, then it needs to keep track of all the processes. For each process, its process control block PCB is used to track the process's execution status, including the following:

- Its current processor register contents
- Its processor state (if it is blocked or ready)
- Its memory state
- A pointer to its stack
- Which resources have been allocated to it
- Which resources it needs

5.3 FILE MANAGEMENT

Files

A file system is a method of storing and organizing computer files and their data. Essentially, it organizes these files into a database for the storage, organization, manipulation, and retrieval by the computer's operating system.

File systems are used on data storage devices such as a hard disks or CD-ROMs to maintain the physical location of the files. Beyond this, they might provide access to data on a file server by acting as clients for a network protocol (e.g., NFS, SMB, or 9P clients), or they may be virtual and exist only as an access method for virtual data (e.g., procfs). It is distinguished from a directory service and registry.

Most file systems make use of an underlying data storage device that offers access to an array of fixed-size physical sectors, generally a power of 2 in size (512 bytes or 1, 2, or 4 KiB are most common). The file system is responsible for organizing these sectors into files and directories, and keeping track of which sectors belong to which file and which are not being used. Most file systems address data in fixed-sized units called "clusters" or "blocks" which contain a certain number of disk sectors (usually 1-64). This is the smallest amount of disk space that can be allocated to hold a file. However, file systems need not make use of a storage device at all. A file system can be used to organize and represent access to any data, whether it is stored or dynamically generated (e.g., procfs).

File systems typically have directories which associate file names with files, usually by connecting the file name to an index in a file allocation table of some sort, such as the FAT in a DOS file system, or an inode in a Unix-like file system. Directory structures may be flat, or allow hierarchies where directories may contain subdirectories. In some file systems, file names are structured, with special syntax for filename extensions and version numbers. In others, file names are simple strings, and per-file metadata is stored elsewhere.

Here we discuss in brief the file systems of popular operating systems:

5.3.1 UNIX File System

Unix family of operating systems create a virtual file system, that makes all the files on all the devices appear to exist in a single hierarchy. In those systems, there is one root directory, and every file existing on the system is located under it somewhere. Unix-like systems can use a RAM disk or network shared resource as its root directory.

The Unix family systems assign a device name to each device and to gain access to files on another device, the operating system must first be informed where in the directory tree those files should appear. This process is called mounting a file system. For example, to access the files on a CD-ROM, one must tell the operating system "Take the file system from this CD-ROM and make it appear under such-and-such directory". The directory given to the operating system is called the mount point – it might, for example, be /media. The /media directory exists on many Unix systems (as specified in the Filesystem Hierarchy Standard) and is intended specifically for use as a mount point for removable media such as CDs, DVDs, USB drives or floppy disks. It may be empty, or it may contain subdirectories for mounting individual devices. Generally, only the administrator (i.e. root user) may authorize the mounting of file systems.

5.3.2 File systems under Microsoft Windows

File Allocation Table (FAT)

The FAT based filing system, supported by all versions of Microsoft Windows, was an evolution of that used in Microsoft's earlier operating system e.g. MS-DOS. FAT traces its roots back to the short-lived M-DOS project and Standalone disk BASIC before it. Over the years various features have been added to it, inspired by similar features found on file systems used by operating systems such as Unix.

Older versions of the FAT file system (FAT12 and FAT16) had file name length limits, a limit on the number of entries in the root directory of the file system and had restrictions on the maximum size of FAT-formatted disks or partitions. Specifically, FAT12 and FAT16 had a limit of 8 characters for the file name, and 3 characters for the extension (such as .exe). This is commonly referred to as the 8.3 filename limit. VFAT, which was an extension to FAT12 and FAT16 introduced in Windows NT 3.5 and subsequently included in Windows 95, allowed long file names.

FAT32 also addressed many of the limits in FAT12 and FAT16, but remains limited compared to NTFS.

exFAT (also known as FAT64) is the newest iteration of FAT, with certain advantages over NTFS with regards to file system overhead. exFAT is only compatible with newer Windows systems, such as Windows 2003, Windows Vista, Windows 2008, Windows 7 and more recently, support has been added for WinXP.

5.3.3 NTFS

NTFS was introduced with the Windows NT operating system. Hard links, multiple file streams, attribute indexing, quota tracking, sparse files, encryption, compression, reparse points (directories working as mount-points for other file systems, symlinks, junctions, remote storage links) are also supported by the system

5.3.4 Disk Allocation Methods

An important function of the file system is to manage space on the secondary storage, which includes eeping track of both disk blocks allocated to files and the free blocks available for allocation. The main problems in allocating space to files are:

1. effective utilization of disk space
2. fast accessing of files

Management of disk blocks is a familiar problem that we have encountered and discussed in relation to main-memory management. But, secondary storage introduces two additional problems:

1. slows disk access time and
2. larger number of blocks to deal with

In spite of that, many considerations are similar to both environments, particularly, contiguous and non contiguous allocation of files. Three widely used allocation techniques are contiguous, linked and indexed. The last two belongs to non contiguous allocation of files. Each method has its advantages and disadvantages.

While discussing those allocation strategies we will consider that a file is a sequence of blocks. All I/O operations on disk occur in term of blocks. The conversion from logical records to physical blocks is done by the software.

Contiguous Allocation

In contiguous allocation, files are assigned to contiguous areas of secondary storage. A user specifies in advance the size of the area needed to hold a file to be created. If the desired amount of contiguous space is not available, the file cannot be created.

One advantage of contiguous allocation is that all successive records of a file are normally physically adjacent to each other. This increases the accessing speed of records. It means that if records are scattered through the disk its accessing will be slower. Accessing a file which has been contiguously allocated is fairly easy. For sequential access the file system remembers the disk address of the last block and when necessary reads the next block. For direct access to block B of a file that start at location L, we can immediately access block L+B. Thus contiguous allocation supports both sequential and direct accessing.

The file directories in contiguous allocation systems are relatively straight forward to implement. For each file it is necessary merely to retain the starting address of the file and the file's size. If the size of the file is N blocks long, and starts at location L then it occupies blocks L, L+ 1 ..... L+N- 1. The directory entry for each file indicates the address of the starting block and the size of the length for this file.

The difficulty with contiguous allocation is how to find a space for a new file, if the implementation of a free space list is done through a bit map method then for the creation of a n- bytes long file, we need to find n 0 bits in a row. To understand the problem of contiguous storage allocation, let us consider disk space as a collection of free and used segments. Each segment is a contiguous set of disk blocks. To satisfy a request of a file of n free contiguous blocks, set of unused blocks are searched to determine which hole (an unallocated segment is called a hole) is best suited for allocation. This problem can be seen as a particular application of the dynamic storage allocation problem discussed in the previous unit, which is how to satisfy a request of size N from a list of free holes. Two most common strategies are:

i. First - fit
ii. Best - fit

First - fit - In this case as soon as the first hole (that is big enough) is encountered, searching is stopped and memory is allocated for creating a file. Searching can start either at the beginning of the set of holes or where the previous first - fit search ended.

Best - fit - In this case the entire list is searched for and the smallest hole, that is big enough, is allocated for creating a file.

Neither first-fit nor best-fit is clearly best in terms of storage utilization, but first-fit is generally faster.

These algorithms suffer from external fragmentations. As files are allocated and deleted the free disk space is broken into little pieces. External fragmentations refer to the scattered groups of free blocks that are too small for allocation but which as a collection may represent a large percentage of disk size.

As in the similar situations found when managing dynamically partitioned memory, this problem can be dealt with by occasional compaction of the disk. Depending upon the total amount of disk storage and the average file size, external fragmentation may be either a minor or a major problem.

The major problem with contiguous allocation is how to determine the space needed for a file. While this is not a problem when copying files, accurate estimation of file size is generally difficult and unreliable. For example, what may be reasonable basis for estimating the size of a new file having created by editor? One

way to handle this problem is to make some initial guessing and to allocate a suitable free area for the file in question.

If the file turns out to be larger than guessed, its extension can be placed in some other disk area. This is often called file overflow. Accessing of overflowed contiguous area is cumbersome, and it loses most of the appeal of contiguous allocation.

Non Contiguous Allocation

Because files do tend either to grow or shrink overtime and because users rarely know in advance how large their files will be contiguous. Storage allocation systems are being replaced by more dynamic non contiguous storage allocation systems. In this section we will discuss two schemes:

i. Linked allocation
ii. Indexed allocation
Linked Allocation

Linked allocation is essentially a disk-based version of the linked list. With linked list allocation each file is linked list of disk blocks. These disk blocks may be scattered through the disk. A few bytes of each disk block contains the address of the next block. The directory contains a pointer to the first (and last) blocks of the file.

The advantage of linked allocation is:

(i) its simplicity (ii) no disk compaction required. Because of noncontiguous nature of allocation, the linking does not produce any external disk fragmentation. Any disk block on the free space can be used to satisfy a request, since all blocks are linked together. There is also no need of declaration of the size of a file in linked allocation while it is created. A file can continue to grow as there are free blocks. Consequently, it is never necessary to have disk compaction.

The disadvantages of linked allocation are:.

i. Slow direct accessing of any disk block - To find out the Nth block of a file, we must start at the beginning of that file and follow the Dointer until we get to the Nth block.

ii. Space requirement for pointers - If a pointer requires two words out of a 512 words block, then around 39 percent of the disk is being pond only for pointers, not for information. Each file therefore requires more space.

iii. Reliability - Since disk blocks are linked by pointers, a single damaged pointer can make thousands of disk blocks inaccessible. Some operating systems address this problem by storing pointers in a dedicated file and making redundant copies of it. The idea is to copy the list of pointers into the main memory and thus facilitate faster access of disk blocks. Redundancy of pointers files is employed for safer recovery.

Indexed allocation

One disadvantage with linked allocation method is that it does not support direct accessing since blocks are scattered all over the disk. This problem is solved by indexed allocation by placing all of the pointers together into a index block.

In this scheme each file is provided with its own index block, which is an array of disk block pointers (addresses). The Kth entry in the index block points to the Kth disk block of the file. The directory contains the address of the index block. To read the Kth disk block the pointer in the Kth index block entry is used to find the desired block and then read.

Although quite different in their implementations index blocks basically serve the same purpose as page map table do in paged memory systems.

ndexed allocation is more complex. If the index block is already in memory, then the access can be made directly. However, keeping the index block in memory requires considerable space. If the memory space is not available then we may have to read first the index block and then the desired data block. For a two level index, two index block reads might be needed. For a very large file accessing a block near the end of

a file would require reading in all of the index blocks to follow the pointer chain before the data block could finally be read. Thus the performance of indexed allocation depends upon the index structure, the size of file and the position of block desired.

Some systems combine contiguous allocation with indexed allocation by using contiguous allocation for small files (upto 3 to 4 blocks) and automatically switch to an indexed allocation if the file grows large. Since most files are small, and contiguous allocation is efficient for small files, average performance can be quite good.

5.4 SUMMARY

This chapter has provided information on the prime functions of an operating system, memory management, process management and file system organization and use.

5.5 GLOSSARY

Memory Management: Memory management is the act of managing computer memory.

Process Management: This invloves sheduling, allocating resources for and executing processes in a system.

File System: It is the system of organization of files in storage devices.

5.6 FURTHER READINGS

1. P.K Sinha '*Computer Fundamentals*', BPB Publications.

2. Fundamentals of Information Technology Alexis Leon, Mathews Leon, Vikas Publishing.

5.7 UNIT END QUESTIONS

1. What are the different types of Memory available for a computer system?
2. How is memory managed?
3. What is a process?
4. What do understand by Management of a Process?
5. What is a file?
6. What is file system?
7. How are Unix, Windows and Network file systems different?

UNIT 6: OPERATING SYSTEMS

Structure of the Unit

6.0 OBJECTIVES

After going through this unit, you would be able to:

- Understand the purpose of an operating system
- Describe the general goals of an operating system
- Describe various functions performed by the OS
- List, discuss and compare various types of OS, and
- Describe various structures of operating system.

6.1 INTRODUCTION TO OPERATING SYSTEMS

Computer is a hardware and it is useless unless it is provided with the necessary software. System software controls the working of hardware and aids in effective execution of a general user's applications. An operating system is the most essential system software that manages the operation of a computer. Without an operating system, it is not possible to use the computer. We can not even make the computer ready to use, unless you provide it an operating system by a process called booting. Before discussing the need of an operating system, lets first define the term 'booting' as follows:

When we switch on the computer, the instructions stored in ROM are automatically executed. These instructions help the computer to load the operating system from external storage device (disk) to internal storage (RAM). This process of loading operating system from disk to RAM is called booting. The term 'booting' comes from the word 'bootstrap'. As bootstrap helps you to get our boots on, similarly booting helps the computer to get ready. The process of booting is illustrated in figure.

6.2 FUNCTIONS OF OPERATING SYSTEMS

An operating system must perform at least the following functions in order to enable the computer to process user programs satisfactorily.

Process Management is concerned with allocating CPU to various competing jobs/processes to ensure maximum

Input/Output or Device Management refers to coordination and control of various I/O devices and is an output from the system. important function of the operating system. This involves receiving the request for I/O interrupts and communicating back to the requesting process.

Memory Management OS allocates memory to itself and its resident system programs, sets aside areas for application program and user partition, arranges the I/O buffers and reserves storage for specialised purposes.

File Management or Information Management computers use a lot of data/ programs which are stored on secondary storage devices. File management function of an OS involves keeping track of all different files and maintaining the integrity of data stored in the files including file directory structure.

Job Control: When the user wants to run an application program, he must communicate with the OS, telling it what to do. He does this by using the OS's job control language or JCL. JCL consists of a number of OS commands, called system commands, that control the functioning of the operating system.

House Keeping includes all the support services necessary to ensure smooth operation of the computer system, viz., security, protection, and resource accounting, back-up and restoration, etc.

OS as a Resource Manager for four major resources.

Resource Examples	Software to	Task Accomplish
1. Memory	Core(Main) paging	Memory Management
2. Processors	CPU, I/O channels	Traffic scheduler controller
3. Devices	Tapes, drums	Spooling
4. Information (system user)	Segment	File System, Library

The efficiency of an operating system and the overall performance of a computer installation are judged by a combination of two main factors. They are:

1. **Throughput :** It is the total volume of work performed by the system over a given period of time.
2. **Turnaround Time :** It as also known as response time and is defined as the interval between the time a user submits his job to the system for processing and the time he receives results. Response time is especially important where many different users share the use of the system and the overall progress of their work depends upon their receiving prompt results from the system.

6.3 CLASSIFICATION OF OPERATING SYSTEMS

The variations and differences in the nature of different operating systems may give the impression that all operating systems are absolutely different from each other. But this is not true. All operating systems contain the same components whose functionalities are almost the same. For instance, all the operating systems perform the functions of storage management, process management, protection of users from one-another, etc. The procedures and methods that are used to perform these functions might be different but the fundamental concepts behind these techniques are just the same. Now let us quickly look at the different types of operating systems.

6.3.1 Multi-User Operating System

A multi-user operating system allows for multiple users to use the same computer at the same time and/or different times.

Some examples of multi-user operating systems are:

Linux, Unix, Windows 2000

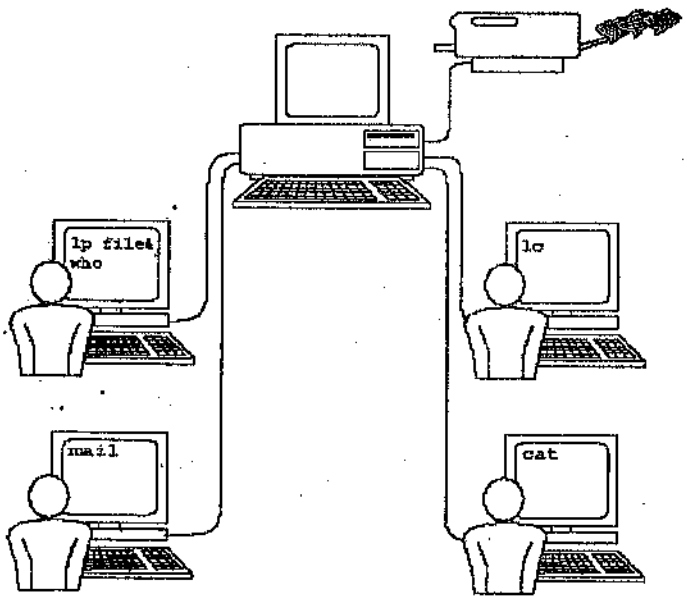


Fig. 6.1 Multiuser Operating System

6.3.2 Multitasking Operating System

An operating system that is capable of allowing multiple software processes to run at the same time. Some examples of multitasking operating systems are:

Unix, windows 2000

Advantages and Limitations of Multitasking Operating System :

There are some advantages of Multitasking Operating Systems which are given below :

1. They improve the performance of computer system by allowing parallel processing of segments of programs. Better performance is directly reflected by increased throughput and lowered turnaround time of such systems.

2. In addition to the CPUs, they also facilitate more efficient utilization of all the other devices of the computer system.

3. It provides a built in backup. If one of the CPUs breaks down the other CPUs automatically takes over the complete workload until repairs are made. Thus a complete breakdown of such system is very-very rare.

It has some disadvantage also

1. A very sophisticated operating system is required to schedule, balance and coordinate the input, output and processing activities of multiple CPUs. The design of such as OS is a time taking job and requires highly skilled computer professionals.
2. A large main memory is required for accommodating the sophisticated operating system along with several users programs.
3. Such systems are very expensive. In addition to the high charges paid initially, the regular operation and regular operation and maintenance of these system is also a costly affair.

6.3.3 Multiprogramming Operating System

The objective of a multiprogramming operating system is to increase the system utilisation efficiency. The batch processing system tries to reduce the CPU idle time through operator interaction. However, it cannot reduce the idle time due to IO operations. So, when some IO is being performed by the currently executing job of a batch, the CPU sits idle without any work to do. Thus, the multiprogramming operating system tries to eliminate such idle times by providing multiple computational tasks for the CPU to perform. This is achieved by keeping multiple jobs in the main store. So, when the job that is being currently executed on the CPU needs some IO, the CPU passes its requirement over to the IO processor. Till the time the IO operation is being carried out, the CPU is free to carry out some other job. The presence of independent jobs guarantees that the CPU and IO activities are totally independent of each other. However, if it was not so, then it could lead to some erroneous situations leading to some time-dependent errors.

A multiprogramming supervisor has a very difficult job of managing all the activities that take place simultaneously in the system. He has to monitor many different activities and react to a large number of different situations in thecourse of working. The

multiprogramming supervisor has to look through the following control functions:

1. Processor Management – The supervisor has to decide as to which program should be made to run at the central processor at any given point of time.

2. Storage management – The supervisor is vested with the important decision of finding out how different storage areas are to be allocated to different jobs present in the system.

3.IO management – The supervisor again has to decide as to how and when to start the I/O operations at various IO devices in the system. Let us discuss these supervisory functions in detail.

Difference Between Multiprogramming and Multiprocessing :

Multiprogramming is the interleaved execution of two or more processes by a single CPU computer system. On the other hand multiprocessing is the simultaneous execution of two or more processes by a computer system having more than one CPU. To be more specific we may point out here that multiprogramming involves executing a portion of one program then a segment of another, etc, in brief consecutive time periods. Multiprocess design, however makes it possible for the system to simultaneously work on several program segments of one or more program.

6.3.4 Batch Operating Systems

The main function of a batch processing system is to automatically keep executing one job to the next job in the batch. The main idea behind a batch processing system is to reduce the interference of the operator during the processing or execution of jobs by the computer. The batch monitor carries out all functions of a batch processing system. The batch monitor permanently resides in the low end of the main store. The current jobs out of the whole batch are executed in the remaining storage area. In other words, a batch monitor is responsible for controlling all the environment of the system operation. The batch monitor accepts batch initiation commands from the operator, processes a job, perform the job of job termination and batch termination. In a batch processing system, we generally make use of the term 'turn around time'. It is defined as the time from which a user job is given to the time when its output is given back to the user.

This time includes the batch formation time, time taken to execute a batch, time taken to print results and the time required to physically sort the printed outputs that belong to different jobs. As the printing and sorting of the results is done for all the jobs of batch together, the turn around time for a job becomes the function of the execution time requirement of all jobs in the batch.

We can reduce the turn around time for different jobs by recording the jobs or faster input output media like magnetic tape or disk surfaces. It takes very less time to read a record from these media. For instance, it takes round about five milliseconds for a magnetic 'tape' and about one millisecond for a fast fixed-head disk in comparison to a card reader or printer that takes around 50-100 milliseconds.

Thus, if you use a disk or tape, it reduces the amount of time the central processor has to wait for an input output operation to finish before resuming processing. This would reduce the time taken to process a job which indirectly would bring down the turn-around times for all the jobs in the batch. Another term that is commonly used in a batch processing system is job scheduling. Job scheduling is the process of sequencing jobs so that they can be executed on the processor. It recognises different jobs on the basis of first-come-first served (FCFS) basis. It is because of the sequential nature of the batch.

The batch monitor always starts the next job in the batch. However, in exceptional cases, you could also arrange the different jobs in the batch depending upon the priority of each batch. Sequencing of jobs according to some criteria require scheduling the jobs at the time of creating or executing a batch. On the basis of relative importance of jobs, certain 'priorities' could be set for each batch of jobs. Several batches could be formed on the same criteria of priorities. So, the batch having the highest priority could be made to run earlier than other batches. This would give a better turn around service to the selected jobs.Now, we discuss the concept of storage management. At any point of time, the main store of the computer is shared by the batch monitor program and the current user job of a batch. The big question that comes in our mind is-how much storage has to be kept for the monitor program and how much has to be provided for the user jobs of a batch.

However, if too much main storage is provided to the monitor, then the user programs will not get enough storage. Therefore, an overlay structure has to be devised so that the unwanted sections of monitor code don't occupy storage simultaneously. Next we will discuss the concept of sharing and protection. The efficiency of utilisation of a computer system is recognised by its ability of sharing the system's hardware and software resources amongst its users.

Whenever, the idea of sharing the system resources comes in our mind certain doubts also arise about the fairness and security of the system. Every user wants that all his reasonable requests should be taken care

of and no intentional and unintentional acts of other users should fiddle with his data. A batch processing system guarantees the fulfillment of these user requirements. All the user jobs are performed one after the other. There is no simultaneous execution of more than one job at a time. So, all the system resources like storage IO devices, central processing unit, etc. are shared sequentially or serially. This is how sharing of resources is enforced on a batch processing system.

Though all the jobs are processed simultaneously, this too can lead to loss of security or protection. Let us suppose that there are two users A and B. User A creates a file of his own. User B deletes the file created by User A. There are so many other similar instances that can occur in our day to day life. So, the files and other data of all the users should be protected against unauthorised usage. In order to avoid such loss of protection, each user is bound.

6.3.5 Time Sharing Operating Systems

The time sharing systems were developed with a main aim to provide fast response to the requests made by the user. The computing environment which best illustrates the advantages of time-sharing systems over multiprogramming or batch processing systems is one in which a number of interactive terminals are simultaneously used for program development and computational purposes. The response given by the system is shown visually on the screen. The user expects a very fast response from the system if the request made by him requires very less processing by the CPU.

For instance, on giving a program statement by the user, the compiler should display the error message quickly. If this interaction takes little time, then the compilation of the user program will proceed rapidly. Both the interactive as well as non-interactive programs can participate in time-sharing. The time sharing systems provide a good rate of program activity for all programs in the system. In order to provide good program activities, certain basic changes are required in the structure of the operation system. These changes mainly involve the processor management and storage management components of the operating system.

Advantages and Disadvantages of Time Sharing System:

There are some advantages of Time Sharing System which are given below.

1.It provides advantage of quick response. The turnaround time or the response time is negligible in case of a timesharing system. Thus, timesharing allows managers to react more rapidly.

2.Offers computing facility to small users. Small users can gain direct access to much more sophisticated hardware and software than they could otherwise justify or afford.

3.Reduces the output of paper. If a manager can retrieve at any time the specific information he needs from an online file, he does not need a bulky report that contains much of the file information.

Some disadvantages are also given below.

1. Question of security. Since hundreds of users use a timesharing system simultaneously,

Provision must be made to protect the security and integrity of user programs and data.

2. Problem of reliability. A time sharing system should be highly reliable as it caters to the needs of several users.

3. Problem of data communication. In a timesharing system, the users interact with the main computer system through remote terminals that require data communication facilities. The cost of data communication has been declining but not so rapidly as the cost of data processing.

4. Question of overhead involved. The reader can probably appreciate that the timesharing system with its control functions such as switching from user to user and swapping programs in and out takes up an appreciable amount of CPU time. This is termed overhead and must be minimized in the overall hardware software design.

6.3.6 Real Time Operating Systems

Since the earliest days of computing, the range and complexity of applications into which computers were drawn has risen to a greater extent. A specific class among these is the real time systems. A real time system is said to be one which responds back fast so that it is able to make an impact on the environment in which it is working. A real time system is actually very fragile because any system interacts with its working environment. The real time system is mostly applied in those systems where the response or the feedback is immediately required. For instance, process control systems in factories or missile tracking system for defence. Another important area of real time system application is in the airline seat reservation system in whose case the availability of a seat is checked, reserved and booked while the operator is interacting with the customer.

Thus, the interaction between the computer and the application environment has to be very quick in case of a real time system.

Therefore, the operating system has to be designed in such a manner so that it is able to meet the need of quick response. However, the response requirements of an application are found out by the nature and type of the application. Since the response time requirements of a real time system are critical, a general time-sharing system may not be able to satisfy them. When a real time application is to be supported by a computer system along with general time-sharing series, then the real time application is given the higher processing priority. This helps in giving out a quick response for the application.

The real time application and the time-sharing support are the activities that are carried out in the foreground and they enjoy a high processing priority. Among these two also, the real time application enjoys a higher processing priority than the timesharing system. The batch processing activities run in the background. Thus, when no higher priority programs are active, then this provides work for the processor.

6.3.7 Distributed Operating Systems

A distributed computing system consists of a number of computers that are connected and managed so that they automatically share the job processing load among the constituent computers, or separate the job load as appropriate particularly configured processors. Such a system requires an operating system which, in addition to the typical stand-alone functionality, provides coordination of the operations and information flow among the component computers. The networked and distributed computing environments and their respective operating systems are designed with more complex functional capabilities. In a network operating system, the users are aware of the existence of multiple computers, and can log in to remote machines and copy files from one machine to another. Each machine runs its own local operating system and has its own user (or users). A distributed operating system, in contrast, is one that appears to its users as a traditional uni-processor system, even though it is actually composed of multiple processors. In a true distributed system, users should not be aware of where their programs are being run or where their files are located; that should all be handled automatically and efficiently by the operating system. True distributed operating systems require more than just adding a little code to a uni-processor operating system, because distributed and centralised systems differ in critical ways. Distributed systems, for example, often allow program to run on several processors at the same time, thus requiring more complex processor scheduling algorithms in order to optimise the amount of parallelism achieved.

6.3.8 Embedded Operating Systems

An embedded operating **system** is an operating system for embedded computer systems. These operating systems are designed to be very compact and efficient, forsaking many functions that non-embedded computer operating systems provide, and which may not be used by the specialized applications they run. They are frequently also real-time operating systems.

Examples of embedded operating systems could include the software used in Automated Teller Machines, CCTV systems, a TV set top box, a GPS, missiles, etc.

6.4 SUMMARY

This Unit presented the principal operations of an operating system. In this unit we had briefly described about the use and the types of operating systems. An operating system is a program that acts as an interface between a user of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which a user may execute programs. The primary goal of an operating system is to make the computer convenient to use. And the secondary goal is to use the hardware in an efficient manner. Operating systems may be classified by both how many tasks they can perform "simultaneously" and by how many users can be using the system "simultaneously". That is: single-user or multi-user and single-task or multi-tasking. A multi-user system must clearly be multi-tasking.

6.5 GLOSSARY

Operating System: An operating system is an interface between the user and the computer.

Throughput : It is the total volume of work performed by the system over a given period of time.

Turnaround Time : Also called response time, is defined as the interval between the time a user submits his job to the system for processing and the time he receives results.

Multi-use Operating System: A multi-user operating system allows for multiple users to use the same computer at the same time and/or different times.

Multitasking Operating System: An operating system that is capable of allowing multiple software processes to run at the same time.

Multiprogramming: Multiprogramming is the interleaved execution of two or more processes by a single CPU computer system.

Batch Operating System: The main function of a batch processing system is to automatically keep executing one job to the next job in the batch.

Time Sharing Operating Systems: The time sharing systems were developed with the aim to provide fast response to the requests made by the user, using the theory of alloting time slices to users.

Real time Operating Systems: A real time system is said to be one which responds back fast so that it is able to make an impact on the environment in which it is working.

Distributed Computing System: It consists of a number of computers that are connected and managed so that they automatically share the job processing load among the constituent computers, or separate the job load as appropriate particularly configured processors.

Embedded Operating System is an operating system for embedded computer systems.

6.6 FURTHER READINGS

1. Madnick and Donovan, Operating systems – Concepts and design, McGrawHill Intl. Education.
2. Milan Milenkovic, Operating Systems, Concepts and Design, TMGH, 2000.
3. D.M. Dhamdhere, Operating Systems, A concept-based approach, TMGH, 2002.
4. Abraham Silberschatz and James L, Operating System Concepts, Addition Wesley Publishing Company.
5. Harvay M. Deitel, Introduction to Operating Systems, Addition Wesley Publishing Company.
6. Andrew S. Tanenbaum, Operating System Design and Implementation, PHI.

6.7 UNIT END QUESTIONS

1. What do you mean by an operating system? Give examples.
2. What is difference between multiprogramming and multiprocessing system?
3. What are the main functions of an operating system?
4. Write short note on the following:
   (a) Real Time System
   (b) Embedded System

UNIT 7: DISK OPERATING SYSTEM

Structure of the Unit

7.0 OBJECTIVES

After going through this unit, you should be able to:

- Define the basic concept of DOS.
- Discuss various internal command
- Discuss various external command
- Printing in DOS

7.1 INTRODUCTION TO MS-DOS

MS-DOS (Microsoft Disk Operating System) is a single-user, single-tasking computer operating system that uses a command line interface. In spite of its very small size and relative simplicity, it is one of the most successful operating systems that has been developed to date.

The role of DOS is to interpret commands that the user enters via the keyboard. These commands allow the following tasks to be executed:

- file and folder management
- disk upgrades
- hardware configuration
- memory optimisation
- program execution

These commands are typed after the prompt, in the case of MS-DOS.

7.2 OVERVIEW OF DOS COMMANDS

In MS-DOS there are two types of commands. An Internal command, which is a command embedded into the command.com file, and an external command, which is not embedded into command.com and therefore requires a separate file to be used.

For example, if your computer does not have fdisk.exe and you try using the fdisk command, you would receive an error "Bad command or file name." Fdisk is an external command that will only work if fdisk.exe, or in some cases, fdisk.com, is present.

7.2.1 Internal DOS commands

Internal commands are the commands stored in the system memory and loaded from the file command.com. Since they reside in the computer's memory as long as it is on, they are also called Resident commands. Below are examples of internal MS-DOS commands.

1. CD (Change Directory)

It is a command used to switch directories in MS-DOS. For example, if you needed to run Windows 3.11 from DOS, you would type:

cd windows - Changing the directory to Windows;

win - To run the win.com file within the windows directory.

Syntax

CHDIR [drive:][path]

CHDIR[..]

CD [drive:][path]

CD[..]

Examples

cd

Goes to the highest level, the root of the drive.

cd..

Goes back one directory. For example, if you are within the C:\Windows\COMMAND> directory, this would take you to C:\Windows>

Windows 95, 98, and later versions have a feature in the CD command that allows you to go back more than one directory when using the dots. For example, typing: **cd...** with three dots after the cd would take you back two directories.

cd windows

If present, would take you into the Windows.directory. Windows can be substituted with any other name.

cd\windows

If present, would first move back to the root of the drive and then go into the Windows directory.

cd\windows\system32

If present, would move into the system32 directory located in the Windows directory. If at any time you need to see what directories are available in the directory you're currently in use the dir command.

cd

Typing cd alone will print the working directory. For example, if you're in c:\windows> and you type the cd it will print c:\windows. For those users who are familiar with Unix / Linux this could be thought of as doing the pwd (print working directory) command.

2. MD (Make Directory)

This command allows us to create your own directories in MS-DOS.

Syntax

Creates a directory.

MKDIR [drive:]path

MD [drive:]path

Examples

md test

The above example creates the "test" directory in the directory you are currently in.

md c:\test

Create the "test" directory in the c:\ directory.

3. RD (Remove Directory)

rd / rmdir

Removes empty directories in MS-DOS. To delete directories with files or directories within them the user must use the deltree command, or if you are running Microsoft Windows 2000 or Windows XP use the /S option.

Syntax

Removes (deletes) a directory.

RMDIR [drive:]path

RD [drive:]path

Windows 2000 and Windows XP Syntax.

RMDIR [/S] [/Q] [drive:]path

RD [/S] [/Q] [drive:]path

/S Removes all directories and files in the specified directory in addition to the directory itself. Used to remove a directory tree.

/Q Quiet mode, do not ask if ok to remove a directory tree with /S.

Examples

rmdir c:\test

Remove the test directory, if empty. If you want to delete directories that are full, use the deltree command or if you're using Windows 2000 or later use the below example.

rmdir c:\test /s

Windows 2000, Windows XP and later versions of Windows can use this option with a prompt to permanently delete the test directory and all subdirectories and files. Adding the /q switch would suppress the prompt.

4. Dir

The dir command allows us to see the available files in the current and/or parent directories.

Syntax

Microsoft Windows 95, 98, and ME syntax

Displays a list of files and subdirectories in a directory.

DIR [drive:][path][filename]

Specifies drive, directory, and/or files to list. (Could be enhanced file specification or multiple filespecs.)

[drive:][path][filename]
Specifies drive, directory, and/or files to list. (Could be enhanced file specification or multiple filespecs.)

/P Pauses after each screenful of information.

/W Uses wide list format.

/A attributes:D Directories R Read-only filesH Hidden files A Files ready for archiving

S System files - Prefix meaning not

/O List by files in sorted order, sortorder:N By
name (alphabetic) S By size (smallest first)E By extension (alphabetic) D By date & time (earliest first)G Group directories first - Prefix to reverse orderA By Last Access Date (earliest first)

/S Displays files in specified directory and all subdirectories.

/B Uses bare format (no heading information or summary).

/L Uses lowercase.

/V Verbose mode.

Examples

dir

Lists all files and directories in the directory that you are currently in.

dir *.exe

The above command lists any executable file or any file that ends with .exe. See our wildcard definition for other wildcard (e.g. *) examples.

dir /ad

List only the directories in the current directory. If you need to move into one of the directories listed use the cd command.

dir /s

Lists the files in the directory that you are in and all sub directories after that directory, if you are at root "C:\>" and type this command this will list to you every file and directory on the C: drive of the computer.

dir /p

If the directory has a lot of files and you cannot read all the files as they scroll by, you can use this command and it will display all files one page at a time.

dir /w

If you don't need the info on the date / time and other information on the files, you can use this command to list just the files and directories going horizontally, taking as little as space needed.

dir /s /w /p

This would list all the files and directories in the current directory and the sub directories after that, in wide format and one page at a time.

dir /on

List the files in alphabetical order by the names of the files.

5. path

Path command is used to specify the location where MS-DOS looks when using a command. For example, when using the command "format", if the path is not specified to where the command is you will receive bad command or file name.

Syntax

Displays or sets a search path for executable files.

PATH [[drive:]path[;...]]

PATH ;

Type PATH ; to clear all search-path settings and direct Windows to search

only in the current directory.

Type PATH without parameters to display the current path.

Examples

path=c:\windows\command

This is where a lot of DOS commands are stored in Window 95; if you are not able to do a dos command, type this command in, allowing all commands you type in, such as "deltree", to be loaded from this directory. However, if you have another file in another directory such as C:\DOS it will no longer look there.

6. move

move allows us to move files or directories from one folder to another, or from one drive to another

Syntax

Moves files and renames files and directories.

To move one or more files:

MOVE [/Y|/-Y] [drive:][path]filename1[,...] destination

To rename a directory:

MOVE [/Y|/-Y] [drive:][path]dirname1 dirname2

[drive:][path]filename1
Specifies the location and name of the file or files you want to move.

destination — Specifies the new location of the file. Destination can consist of a drive letter and colon, a directory name, or a combination. If you are moving only one file, you can also include a filename if you want to rename the file when you move it.

[drive:][path]dirname1
Specifies the directory you want to rename.

dirname2 — Specifies the new name of the directory.

/Y — Suppresses prompting to confirm you want to overwrite an existing destination file.

/-Y — Causes prompting to confirm you want to overwrite an existing destination file.

The switch /Y may be present in the COPYCMD environment variable. This may be overridden with /-Y on the command line. Default is to prompt on overwrites unless MOVE command is being executed from within a batch script.

Examples

move c:\windows\temp*.* c:\temp

Move the files of c:\windows\temp to the temp directory in root, this is of course assuming you have the windows\temp directory.

7. date

The date command can be used to look at the current date of the computer as well as change the date to an alternate date.

Syntax

Displays or sets the date.

DATE [date]

Type DATE without parameters to display the current date setting and a prompt for a new one. Press ENTER to keep the same date.

Examples

date

Display the current date and prompt for a new one. If no date is entered, the current date will be kept.

8. time

Allows the user to view and edit the computer's time.

Syntax

Displays or sets the system time.

TIME [time]

Type TIME with no parameters to display the current time setting and a prompt for a new one. Press ENTER to keep the same time.

Examples

time 12:00

Set the time to 12:00

9. ren and rename

Used to rename files and directories from the original name to a new name.

In earlier releases of MS-DOS instead of using ren or rename you need to use the move command to rename your MS-DOS directories or files.

Syntax

Renames a file/directory or files/directories.

RENAME [drive:][path][directoryname1 | filename1] [directoryname2 | filename2]

REN [drive:][path][directoryname1 | filename1] [directoryname2 | filename2]

Note that you cannot specify a new drive or path for your destination.

Examples

rename c:\chope hope

Rename the directory chope to hope.

rename *.txt *.bak

Rename all text files to files with .bak extension.

rename * 1_*

Rename all files to begin with 1_. The asterisk (*) in this example is an example of a wild character; because nothing was placed before or after the first asterisk, this means all files in the current directory will be renamed with a 1_ in front of the file. For example, if there was a file named hope.txt it would be renamed to 1_pe.txt.

10. cls

Cls is a command that allows a user to clear the complete contents of the screen and leave only a prompt.

Syntax

CLS

Examples

cls

Running the cls command at the command prompt would clear your screen of all previous text and only return the prompt.

11. copy

Allows the user to copy one or more files to an alternate location.

Syntax

Copies one or more files to another location.

COPY [/A | /B] source [/A | /B] [+ source [/A | /B] [+ ...]] [destination] [/A | /B]] [/V] [/Y | /-Y]

source Specifies the file or files to be copied.

/A Indicates an ASCII text file.

/B Indicates a binary file.

destination Specifies the directory and/or filename for the new file(s).

/V Verifies that new files are written correctly.

/Y Suppresses prompting to confirm you want to overwrite an existing destination file.

/-Y Causes prompting to confirm you want to overwrite an existing destination file.

The switch /Y may be preset in the COPYCMD environment variable. This may be overridden with /-Y on the command line.

To append files, specify a single file for destination, but multiple files for source (using wildcards or file1+file2+file3 format).

Examples

copy *.* a:

Copy all files in the current directory to the floppy disk drive.

copy autoexec.bat c:\windows

Copy the autoexec.bat, usually found at root, and copy it into the windows directory; the autoexec.bat can be substituted for any file(s).

copy win.ini c:\windows /y

Copy the win.ini file in the current directory to the windows directory. Because this file already exists in the windows directory it normally would prompt if you wish to overwrite the file. However, with the /y switch you will not receive any prompt.

copy myfile1.txt+myfile2.txt

Copy the contents in myfile2.txt and combines it with the contents in myfile1.txt.

copy con test.txt

Finally, a user can create a file using the copy con command as shown above, which creates the test.txt file. Once the above command has been typed in, a user could type in whatever he or she wishes. When you have completed creating the file, you can save and exit the file by pressing **CTRL+Z**, which would create ^Z, and then press enter. An easier way to view and edit files in MS-DOS would be to use the edit command.

7.2.2 External DOS commands

Internal commands are contained within COMMAND.COM and are loaded during the boot sequence. Because of this, a certain amount of the limited DOS memory is committed to holding internal commands. Hence, some commands do not need to be loaded into memory every time we boot, because they are used infrequently, or because they are large and take up a lot of space. These commands are stored as separate files in the DOS directory and are called External commands. They are stored as .EXE or .COM files and loaded into memory as and when required.

1. fdisk

Fdisk is one of the more commonly used MS-DOS commands, even today with Windows 95 and Windows 98. Fdisk allows the user to delete and/or create partitions on the hard disk drive.

Syntax

Configures a hard disk for use with MS-DOS.

FDISK [/STATUS] /X

/STATUS Displays partition information.

Examples

Fdisk - This would get you into the fdisk option screen that you can see in the fdisk simulation. Also keep in mind when deleting a partitions ANYTHING that is on that partition of the hard drive will be ERASED, also once the partition is delete it will not be redetected until you format that partition, so if you delete your primary partition, which is the c: drive, you will not be able to put anything on that drive or even read from that drive until it is formatted.

2. Print

Print was first introduced in MS-DOS 2.0 as PRINT.COM and later was changed to PRINT.EXE in MS-DOS 5.0 and above. This command allowed users to print a text file to a line printer, in the back-ground.

Syntax

Print /d:device /b:size /u:ticks1 /m:ticks2 /s:ticks3 /q:size /t drive:\path\ filename /c /p

Options:

/d:device	Name of printer devicePrinter
	Ports: LPT1, LPT2 orLPT3Serial Ports: Com1, Com2, Com3 or Com4
/b:size	Sets size (in bytes) of internal buffer.
	Default=512 with range of 512 to 16384.
/u:ticks1	Maximum number of clock ticks

PRINT is to wait for a printer to become available. Default=1 with a range of 1 to 255.

/m:ticks2	Maximum number of clock ticks PRINT can take to print a character or printer. Default=2 with a range of 1 to 255.
/s:ticks3	Maximum number of clock ticks allocated for background printing. Default=8 with range of 1 to 255.
/q:qsize	Maximum number of files allowed in print queue. Default=10 with range of 1 to 255.
/t	Removes files from the print queue.
drive:\path\filename	Location and filename of file to be printed.
/c	Removes files from the print queue.
/p	Adds files to the print queue.

Examples

print c:\file.txt /c /d:lpt1

Prints the file file.txt to the parallel port lpt1.

The print command is only able to print ASCII text.

The /d, /b, /u, /m, /s and /q switches can only be used once. If a different value needs to be used the computer must be restarted.

7.3 SUMMARY

In this unit you learnt about various Internal and External commands. It provides Character User Interface (CUI) environment. MS-DOS is a text based desktop operating systemdeveloped by Microsoft that runs on Intel 8086.

7.4 GLOSSARY

Internal Commands: These are the commands stored in the system memory and loaded from the file command.com.

External Commands: External commands are commands that do not reside in the COMMAND.COM file. These include all other COM files, as well as EXE and BAT files.

7.5 FURTHER READINGS

1. Harvay M. Deitel, Introduction to Operating Systems, Addition Wesley Publishing Company.

2. Alexis Leon, Mathews Leon, Fundamentals of Information Technology, Vikas Publishers.

7.6 UNIT END QUESTIONS

1. What are the differences and similarities between Copy and Copy con?

2.How can we find the path of a directory or file.?

3. Define the various syntax to sjow the list of directory and files.

4. How can we change the current date and time of the system?

5. How can we delete a directory or file in DOS?

UNIT 8: WINDOWS

8

Structure of the Unit

8.0 OBJECTIVES

After going through this unit, you should be able to:

- Understand the concept of GUI
- Describe the process of installation of various software
- File and Folder management
- Features of window operating system
- Describe the various utilities of Window's operating system

8.1 INTRODUCTION TO WINDOWS OPERATING SYSTEM

In 1983 Microsoft announced the development of Windows, a graphical user interface (GUI) for its own operating system (MS-DOS), which had shipped for IBM PC and compatible computers since 1981. The product line has changed from a GUI product to a modern operating system over two families of design, each with their own codebase and default file system.

The 3.x and 4.x family includes DOS, Windows 95, Windows 98 and Windows Me. The DOS-based Windows for Workgroups 3.11 achieved the breakthrough from 16- to 32-bit networking and 32-bit disk access. The notable change with Windows 95 was from Program Manager to Explorer, not from 16- to 32-bits. The 32-bit performance was originally offered for 286, but for all practical purposes it was only supported on versions 386 and higher.

Windows NT family started with NT 3.1 in 1993. Modern Windows operating system versions are based on the newer Windows NT kernel that was originally intended for OS/2. Windows runs on x86, x86-64 and Itanium processors. Earlier versions also ran on the Alpha, MIPS, Fairchild Clipper and PowerPC architectures. Some work was done to port it to the SPARC architecture. The NT kernel borrows many techniques from VMS. With NT4.0 in 1996 the shell changed from Program.

8.2 WINDOWS XP INSTALLATION

Installing Windows XP can take up to two hours. To make the process more manageable, it has been broken up into several sections. When you are ready, install Windows XP:

Part 1: Begin the installationPart 2: Continue the installationPart 3: Complete the installation

Part 1: Begin the installation

1. Insert the Windows XP CD into your computer and restart your computer.

2. If prompted to start from the CD, press SPACEBAR. If you miss the prompt (it only appears for a few seconds), restart your computef to try again.

3. Windows XP Setup begins. During this portion of setup, your mouse will not work, so you must use the keyboard. On the Welcome to Setup page, press ENTER.

4. On the Windows XP Licensing Agreement page, read the licensing agreement. Press the PAGE DOWN key to scroll to the bottom of the agreement. Then press F8.

5. This page enables you to select the hard disk drive on which Windows XP will be installed. Once you complete this step, all data on your hard disk drive will be removed and cannot be recovered. It is extremely important that you have a recent backup copy of your files before continuing. When you have a backup copy, press D, and then press L when prompted. This deletes your existing data.

6. Press ENTER to select Unpartitioned space, which appears by default.

7. Press ENTER again to select Format the partition using the NTFS file system, which appears by default.

8. Windows XP erases your hard disk drive using a process called formatting and then copies the setup files. You can leave your computer and return in 20 to 30 minutes.

Part 2: Continue the installation

9. Windows XP restarts and then continues with the installation process. From this point forward, you can use your mouse. Eventually, the Regional and Language Options page appears. Click Next to accept the default settings. If you are multilingual or prefer a language other than English, you can change language settings after setup is complete.

10. On the Personalize Your Software page, type your name and your organization name. Some programs use this information to automatically fill in your name when required. Then, click Next.

11. On the Your Product Key page, type your product key as it appears on your Windows XP CD case. The product key is unique for every Windows XP installation. Then, click Next.

12. On the Computer Name and Administrator Password page, in the Computer name box, type a name that uniquely identifies your computer in your house, such as FAMILYROOM or TOMS. You cannot use spaces or punctuation. If you connect your computer to a network, you will use this computer name to find shared files and printers. Type a strong password that you can remember in the Administrator password box, and then retype it in the Confirm password box. Write the password down and store it in a secure place. Click Next.

13. On the Date and Time Settings page, set your computer's clock. Then, click the Time Zone down arrow, and select your time zone. Click Next.

14. Windows XP will spend about a minute configuring your computer. On the Networking Settings page, click Next.

15. On the Workgroup or Computer Domain page, click Next.

Part 3: Complete the installation

16. Windows XP will spend 20 or 30 minutes configuring your computer and will automatically restart when finished. When the Display Settings dialog appears, click OK.

17. When the Monitor Settings dialog box appears, click OK.

18. The final stage of setup begins. On the Welcome to Microsoft Windows page, click Next.

19. On the Help protect your PC page, click Help protect my PC by turning on Automatic Updates now. Then, click Next.

20. Windows XP will then check if you are connected to the Internet:

- If you are connected to the Internet, select the choice that describes your network connection on the Will this computer connect to the Internet directly, or through a network? page. If you're not sure, accept the default selection, and click Next.
- If you use dial-up Internet access, or if Windows XP cannot connect to the Internet, you can connect to the Internet after setup is complete. On the How will this computer connect to the Internet? page, click Skip.

21. Windows XP Setup displays the Ready to activate Windows? page. If you are connected to the Internet, click Yes, and then click Next. If you are not yet connected to the Internet, click No, click Next, and then skip to step 24. After setup is complete, Windows XP will automatically remind you to activate

and register your copy of Windows XP.

22. On the Ready to register with Microsoft? page, click Yes, and then click Next.

23. On the Collecting Registration Information page, complete the form. Then, click Next.

24. On the Who will use this computer? page, type the name of each person who will use the computer. You can use first names only, nicknames, or full names. Then click Next. To add users after setup is complete or to specify a password to keep your account private, read Create and customize user accounts.

25. On the Thank you! page, click Finish.

Congratulations! Windows XP setup is complete. You can log on by clicking your name on the logon screen. If you've installed Windows XP on a new computer or new hard disk drive, you can now use the File and Settings Transfer Wizard to copy your important data to your computer or hard disk drive.

After logon, take a few minutes to validate your copy of Windows. Validation gives you access to hundreds of free downloads from the Microsoft Download Center. To learn about the new features Windows XP provides, click the Start button, click All Programs, click Accessories, and then click Tour Windows XP

8.2.1 Installing and running program

How to install a software program can depend on the operating system being used and the program being installed. Because of all the different possibilities, we have created the below steps as guidelines for installing programs in each of the major operating systems.

1. Make sure your computer meets the requirements of the program, game, or utility you are attempting to install.

2. The manuals for the program or the read me file located in the same directory as the install commonly contain exact instructions on how to install a program.

3. After installing or during the installation, a program may need to install other programs,files, or utilities before it is able to run. If this is the case, the program will commonly prompt you to install the program or you may need to run a separate install before the program can be fully used.

4. When installing a program, utility, or game, it is always a good idea first to close or disable any other programs that are running.

5. After installing a new program if it prompts you to reboot the computer, do it.

8.3 SETTINGS CONTROL PANEL AND ALL FEATURES

The Control Panel is a powerful tool to customize our computer. It is the place to go to install new hardware, add and remove programs, change the look of your screen, controlling user accounts, changing accessibility options and much more. The control panel is the part of the Microsoft Windows, which allows users to view and manipulate basic system settings and controls.

The Control Panel is a special folder that does not physically exist, but contains shortcuts to various applets for manage system. In recent versions of windows, the control panel has two views, classic view and category view to switch between these through an option the appears on the left side of the window.

Many of the individual Control Panel applets can be accessed in other ways. For instance Display Properties can be accessed by right-clicking on an empty area of the desktop and choosing properties.

1. Accessibility option :

Accessibility option allows us to change accessibility of our computer for all people including disable or

handicapped. It is largely a combination of hardware and software, which is used to enable use of a computer by a person with a disability or impairment.

There are numerous types of impairments that impact computer use. These include :

· Visual impairments such as low vision, complete or partial blindness.

· Hearing impairment including deafness or hard of hearing.

· Motor or dexterity impairment such as paralysis or repetitive injury.

We can change keyboard, mouse, sound and display setting for accessibility.

2. Add New Hardware :

Every time when we add hardware with our computer system then windows automatically detect it. And "Plug and Play" or PnP appears on the system and require specific driver for the hardware. In the case when hardware does not installed properly and not recognized by system we add hardware by these steps.

Click start, then on settings and then click on Control Panel.

· In Control Panel click on Add Hardware and then click Next.

· Windows will scan your computer looking for things that it believes are newly added to the computer.

· Windows will ask you if the hardware is already installed. Check the answer that's right for you and click Next.

· You will be presented with a list of things and you will need to pick your device out of the list and click Next.

· If the device is working windows will say so. If not you will be prompted to add or update device drivers.

· Many hardware devices will come with a disk that will contain device drivers and software.

8.4 File and folder management

Every Windows folder provides easy access to common file and folder management tasks. When you open any folder on your computer, a list of hyperlinked tasks is displayed next to the folder contents. You can select a file or folder, and then click a task to rename, copy, move, or delete it. You can also send a file in e-mail or publish it to the Web.

In addition to the basic file and folder tasks provided in all Windows folders, there are several folders that provide links to specialized tasks.

My Pictures and My Music folders provide task links that can help you manage your picture and music files.

In the My Computer folder, you can view and select the drives on your computer, the devices with removable storage, and the files stored on your computer. You can use the task links in this folder to view information about your computer, change system settings using Control Panel, and perform other system management tasks.

Use the Recycle Bin tasks to empty the Recycle Bin or restore deleted files and folders to their original locations. The Recycle Bin is displayed on your desktop

8.5 FEATURES OF WINDOWS OPERATING SYSTEM

8.5.1 Graphical user interface

An interface is a shared boundary or connection between two dissimilar objects, devices or systems through which information is passed. The connection can be either physical or logical.

A user interface is a linkage between a human and a computer. It consists of a display device and one or more input devices (e.g. a keyboard and a mouse). The two main types of user interfaces are the command line interface (CLI), the display for which contains text only, and the graphical user interface (GUI), which also includes images (e.g., windows, icons and menus). Most GUIs use a desktop metaphor, i.e., resemble a desktop with folders (i.e., directories), files, images, etc. that can be moved around, resized and otherwise manipulated.

8.5.2 Moving and sharing information

Copying or moving information from one location to another within a program is easy using the cut-and-paste commands that almost all Windows programs support. Cutting-and-pasting uses the Clipboard to store information temporarily. Moving or copying information between programs is also easy using the Clipboard. You can use the ClipBook Viewer to look at what's on the Clipboard. Some programs also let you use your mouse to drag information from one location to another. You can use the

Clipboard to move or copy text, a range of spreadsheet cells, a picture, a sound, or almost any other piece of information you can create with a Windows application. The Clipboard can hold only one chunk of information at a time, so you either have to paste it somewhere else right away, or not cut or copy anything else until you've pasted the information where you want it. If you cut or copy another chunk of information, it replaces the information already on the Clipboard. To use the Clipboard to move or copy information within or between files, or to share information between programs, you cut or copy the information from one window and paste it in another. You can also use the ClipBook Viewer to see what's on the Clipboard.

8.5.3 Working with sound, graphics and video

Multimedia has become a popular technology in the ever-changing world of computers. More and more

research work on this new technology of sound, animation and text is making it better and better with every passing day. It is one of the most realistic ways of working even for people having no knowledge of computers.

- The text can be used for adding emphasis.
- Graphics provides a visual impact. It is generally said that a picture is worth a thousand words. Thus graphics can be used for enhancing a presentation.
- Voice tries to enhance a presentation to the extent that a presentation moves on to the form of persuasion. Many people want to listen about a particular topic rather than reading about it.
- The video part of multimedia can be used as a powerful communicator providing clear cut instruction.
- The animation can be used effectively for attracting attention. Animation also makes a presentation light, thus can be used for presentation of several complex subjects. It is also a tool which helps in focusing attention. For example a chart if drawn through animation may be focused on to quickly.

8.5.4 Backing up files

The Backup utility helps us to protect data from accidental loss if our system hardware or storage media

failure. For example we can use Backup to create a duplicate copy of the data on your hard disk and then archive the data on another storage device. The backup storage medium can be a logical drive such as our hard drive or a separate storage device such as a removable disk. If the original data on our hard disk is accidentally erased or overwritten, or becomes inaccessible because of a hard disk failure, we can easily restore the data from the archived copy.

Backup creates a copy of our data to create an accurate copy of the contents of our hard drive, including open files that are being used by the system. Users can continue to access the system while the backup utility is running without risking loss of data.

By using this utility we can take backup of files and folders on a computer that is running windows XP home edition.

To install the Backup utility from the Windows XP CD, we have to perform the following activities.

1. Insert your Windows XP CD into the CD drive or DVD drive of the computer.
2. Click Exit.
3. Locate the CDDrive:\ValueAdd\Msft\Ntbackup folder on the CD.
4. Double-click Ntbackup.msi to install the Backup utility.
5. When the Backup or Restore Wizard prompts you, click Finish.
6. Remove the Windows XP CD.

8.5.5 Configuring keyboard and mouse

The keyboard and mouse are the primary way of interacting with the computer. Smooth and responsive functioning is a must. Here are some tips to help ensure trouble-free mousing.

8.6 COMPONENTS OF WINDOWS

8.6.1 Taskbar

In computing, a taskbar is a bar displayed on a full edge of a GUI desktop that is used to launch and monitor running applications. Microsoft incorporated a taskbar in Windows 95 and it has been a defining aspect of Microsoft Windows's graphical user interface ever since. Some desktop environments, such as KDE and GNOME, include a more configurable taskbar. Other operating systems may use different methods for task management or application launching such as a panel or a dock.

The taskbar was originally developed as a feature of Windows 95. There are some elements of it :

The **Start menu,** which is accessed by a button on the taskbar, contains commands that can access programs, documents, and settings.

The **Quick Launch bar**, introduced with Internet Explorer 4, contains shortcuts to applications. Windows provides default entries, such as Launch Internet Explorer Browser, and the user or third-party software may add any further shortcuts that they choose. A single click on the application's icon in this area launches the application. This section may not always be present: for example it is turned off by default in Windows XP and Windows 7.

The Windows shell places a **taskbar button** on the taskbar whenever an application creates an unowned window: that is, a window that doesn't have a parent and that is created according to normal Windows user interface guidelines. Typically all Single Document Interface applications have a single taskbar button for each open window, although modal windows may also appear there.

o Windows XP introduced *taskbar grouping*, which can group the taskbar buttons of several windows from the same application into a single button. This button pops up a menu listing all the grouped windows when clicked. This keeps the taskbar from being overcrowded when many windows are open at once.

o Windows Vista introduced window previews which show thumbnail views of the application in real-time. This capability is provided by the Desktop Window Manager.

o Windows 7 introduced jump lists which are menus that provide shortcuts to recently opened documents, or various options which apply to that specific program, that appear when the user right-clicks on an icon in the taskbar or drags the icon upwards with the mouse left click.

- Windows 7 introduced the ability to pin applications to the taskbar so that buttons for launching them appear when they are not running. Previously, the Quick launch was used to pin applications to the taskbar; however, running programs appeared as a separate button.
- Windows 7 removed several classic taskbar features.

8.6.2 Toolbars

In a graphical user interface on a computer monitor a **toolbar** is a GUI widget on which onscreen buttons, icons, menus or other input or output elements are placed. Toolbars are seen in office suites, graphics editors and web browsers.

Earlier forms of toolbars were defined by the programmer and had set functions, and thus there was no difference between a toolbar with buttons and just a row of buttons. Most modern programs and operating systems however, allow the end user to modify and customize toolbars to fit their personal needs. Some prominent examples of customizable toolbars are panels of the GNOME and KDE desktop environments, functions of which range from expandable menus and buttons for applications, window lists, notification areas, clocks and resource monitors to volume controls and weather report widgets.

Detachable toolbars of Inkscape. Shown inside is Inkscape with undocked toolbars.

Some applications, e.g. graphics editors, allow their toolbars to be detached and moved between windows and other toolbars.

The first toolbar appeared on the Xerox Alto computer in 1973.

8.6.3 Windows Explorer

Windows Explorer is a file manager application that is included with releases of the Microsoft Windows operating system from Windows 95 onwards. It provides a graphical user interface for accessing the file systems. It is also the component of the operating system that presents the user interface on the monitor and enables the user to control the computer.

8.6.4 Recycle Bin

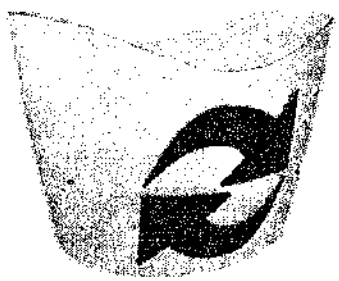


Fig: 8.1: Icon for Recycle Bin

In the Microsoft Windows operating systems, the Recycle Bin is a holding area for files and folders that are held before final deletion from a storage device.

Microsoft introduced the Recycle Bin in the Windows 95 operating system. The Recycle Bin keeps some files that have been deleted, whether accidentally or intentionally. Whether a deleted file is put into the Recycle Bin depends on how it is deleted; typically only files deleted via the Explorer graphical interface (but not necessarily other Windows graphical interfaces such as file selection dialogs) will be put into the Recycle Bin; files deleted via the Command Prompt, or via operating system APIs are not. Users can review the contents of the Recycle Bin before deleting the items permanently. In previous Windows operating systems and in MS-DOS, undeletion was the only way to recover accidentally deleted files. The

Recycle Bin holds data that not only lists deleted files, but also the date, time and the path of those files. The Recycle Bin is opened like an ordinary Windows Explorer folder and the files are viewed similarly. Deleted files may be removed from the Recycle Bin by restoring them with a command, or by deleting them permanently.The Recycle Bin's icon indicates whether there are items in the Recycle Bin. If there are no files or folders in the Recycle Bin, then the icon resembles an empty wastepaper basket. Otherwise if there are files and/or folders the icon resembles a full wastepaper basket.Prior to Windows Vista, the default configuration of the Recycle Bin was to hold 10% of the total capacity of the host hard disk drive. For example, on a hard drive with a capacity of 20 gigabytes, the Recycle Bin will hold up to 2 gigabytes. If the Recycle Bin fills up to maximum capacity, the oldest files will be deleted in order to accommodate the newly deleted files. If a file is too large for the Recycle Bin, the user will be prompted to permanently delete the file instead.

8.6.5 Briefcase

In Microsoft Windows. the Briefcase is a special folder that supports simple two-way file synchronization.TheWindows Briefcase was introduced in Windows 95.File synchronization (or 'syncing') in computing is the process of making sure that files in two or more locations are updated through certain rules

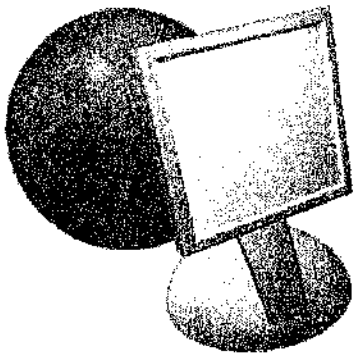


Fig: 8.2: Icon for Recycle Bin

Network Neighborhood is the Microsoft Windows name for a method to browse the Local Area Network. Network Neighborhood has now become My Network Places in Windows XP.

8.7 SUMMARY

Microsoft first introduced an operating environment named Windows in November 1985 as an add-on to MS-DOS in response to the growing interest in graphical user interfaces (GUIs). Microsoft Windows is a series of operating systems and graphical user interfaces produced by Microsoft. In this unit your have learned about various feature of Window Operating System. As of October 2009, Windows had approximately 91% of the market share of the client operating systems for usage on the Internet.

8.8 GLOSSARY

User Interface: User interface is a linkage between a human and a computer. It consists of a display device and one or more input devices. The two main types of user interfaces are the command line interface (CLI), the display for which contains text only, and the graphical user interface (GUI), which also includes images (e.g., windows, icons and menus).

8.9 FURTHER READINGS

1. David Pogue, Windows XP for Starters: The Missing Manual,Orielly Publications.

2. David A. Karp, Tim O'Reilly, Troy Mott, Windows XP in a Nutshell, Second Edition,Orielly Public

8.10 UNIT END QUESTIONS

1. Differentiate between GUI and CUI ?
2. Describe the various component of Window?
3. What are the differences and similarities between icon and Folders?
4. Write down the steps to change the Desktop and Screensaver.?
5. How we can add a new hardware? Define the steps.

UNIT 09 : DATA COMMUNICATION

9

Structure of the Unit

9.0 OBJECTIVES

After going through this unit, you will be in a position to

1. Understand What is Data Transmission
2. Differences between Mode of Communication
3. What is Pulse Code & Delta Modulation
4. About Encoding of Digital & Analog Data &Signals

9.1 INTRODUCTION

Data Communications is the transfer of data or information between a source and a receiver. The source transmits the data and the receiver receives it. The actual generation of the information is not part of Data Communications nor is the resulting action of the information at the receiver. Data Communication is interested in the transfer of data, the method of transfer and the preservation of the data during the transfer process.

The purpose of Data Communications is to provide the rules and regulations that allow computers with different disk operating systems, languages, cabling and locations to share resources. The rules and regulations are called protocols and standards in Data Communications.

9.2 DIGITAL SIGNALS

Digital signals are non-continuous, they change in individual steps. They consist of pulses or digits with discrete levels or values. The value of each pulse is constant, but there is an abrupt change from one digit to the next. Digital signals have two amplitude levels called nodes. The value of which are specified as one of two possibilities such as 1 or 0, HIGH or LOW, TRUE or FALSE and so on. In reality, the values are anywhere within specific ranges and we define values within a given range.

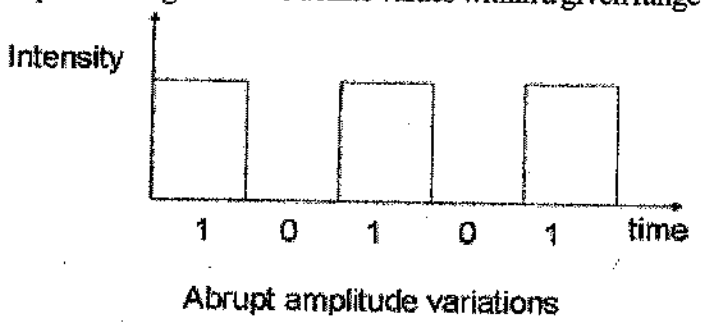


Fig 9.1 Digital Signals

9.3 ANALOG SIGNALS

An Analog signal is any continuous signal for which the time varying feature (variable) of the signal is a representation of some other time varying quantity, i.e., analogous to another time varying signal. It differs from a digital signal in terms of small fluctuations in the signal which are meaningful. Analog is usually thought of in an electrical context; however, mechanical, pneumatic, hydraulic, and other systems may also convey analog signals.

Analog signals have a great advantage over digital signals in that they have a much higher density which can present more refined information. Essentially, there is the potential for the signal resolution to be infinite. In addition, the process to create an analog signal is achieved much more simply. By merely adjusting the time quantities, information can be presented.

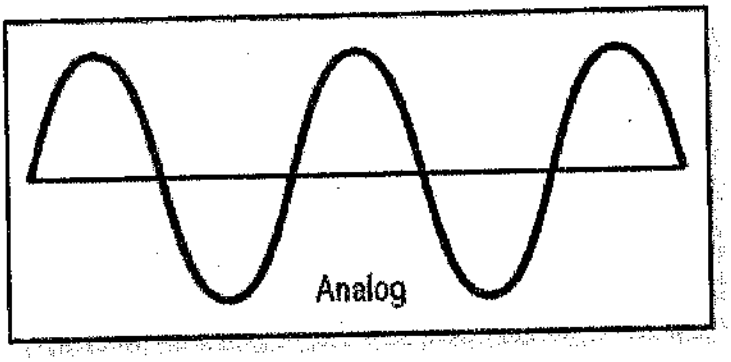


Fig. 9.2 : Analog Signals

9.4 MODE OF COMMUNICATION

Data can be transfer in three ways: Simlex, half-duplex and full duplex communication. The communication device may be telephone, computer and terminals.

9.4.1 Simplex Communication :

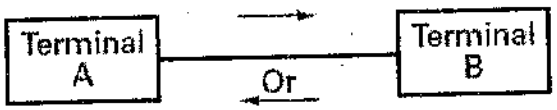
In simplex communication only one way data can be transferred between the two communicating devices. One device can only transmit data to another device and second one can only receive data. Examples are television and radio broadcasting.

Transmission in Only One Direction

Fig. 9.3 : Simplex Communicatiuon

9.4.2 Half Duplex Communication :

In half-duplex communication, both communication device can transmit and receive data, but not simultaneously. This way of communication is also referred as 'two way alternate'. Example : talk radio phones used in police employ the half-duplex standard; only one person can talk at a time.

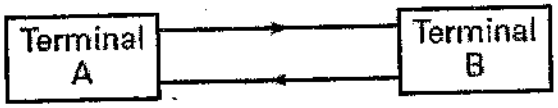


Transmission in either direction,
but not simultaneously

Fig. 9.4 : Half Duplex Communication

9.4.3 Full Duplex Communication :

In full duplex communication, both communication devices can simultaneously send and receive data from each other. This mode of communication is also known as two way simultaneously' like two-way lane with two-way bridge.



Transmission in both directions simultaneously

Fig. 9.5 : Full Duplex Communication

9.5 DATA ENCODING TECHNIQUE

Both digital and analog data could be encoded into either digital or analog signal. The process of encoding and modulation.

There are four possible encoding between data and carrier signal. These are digital data to digital signal, analog data to digital signal ,digital data to analog signal, and analog data to analog signal.

9.5.1 Encoding of Digital Data into Digital Signal

A digital signal is a sequence of discrete discontinuous voltage pulses. Encoding each data bit into signal element that transmit binary data. Binary 0 for lower voltage and binary 1 for higher voltage level. Different encoding technique to encode digital data into digital signal are define below and depicated in Fig 9.6

Definition of digital signal encoding formats.

Non-Return to Zero –Level(NRZ-L)

Bit 0 = high level

Bit 1= low level

Non return to Zero Inverted (NRZ-I)

Bit 0= no transition at beginning of interval i.e. one bit

Bit 1= transition at beginning interval

Bipolar-AMI

Bit 0 =no line signal

Bit 1= positive or negative level, alternating for successive zeros

Manchester

Bit 0= transition from high to low in middle of interval

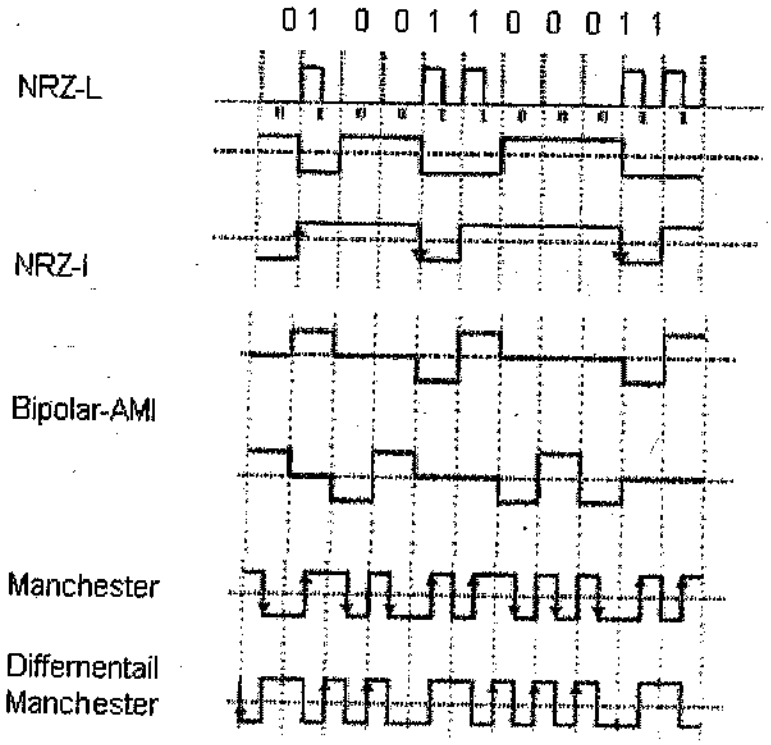
Bit 1= transition from low to high in middle of interval

Differential Manchester

Always a transition in middle or interval

Bit 0= transition at beginning of interval

Bit 1= no transition at beginning of interval



9.6 Digital Signal Encoding Format

9.5.2 Encoding of Digital Data into Analog Signals

This is the case of transmitting digital data using analog signals. Example is public telephone network. which was designed to receive, switch , and transmit analog signals in the voice frequency range of about 300 to 3400Hz. It Uses modem, Which convert digital data to analog signals and analog data to digital signals.

There are three basic encoding or modulation tecgniques for transforming digital data into analog signals are smplitude shift keying (ASK), frequency shift keying (FSK),phase shift keying (PSK).

In all these cases,the resulting signals occupies a bandwidth centered on the carrier frequency. These modulation techniquesare illustrate in Fig. 9.7

In ASK two different amplitudes of the carrier frequency represent the two binary values. One of the amplitudes is zero represent binary 0,and binary digit 1 is represent by present of constant amplitude. The ASK technique is used to transmit digital data over optical fiber.

In FSK, the binary values are represented by two different frequencies near the carrier frequency. FSk use for ful duplex operation over a voice grade line. FSK is less susceptible to error than ASK,It is also used for high frequency (3 to 30 MHz) radio transmission.

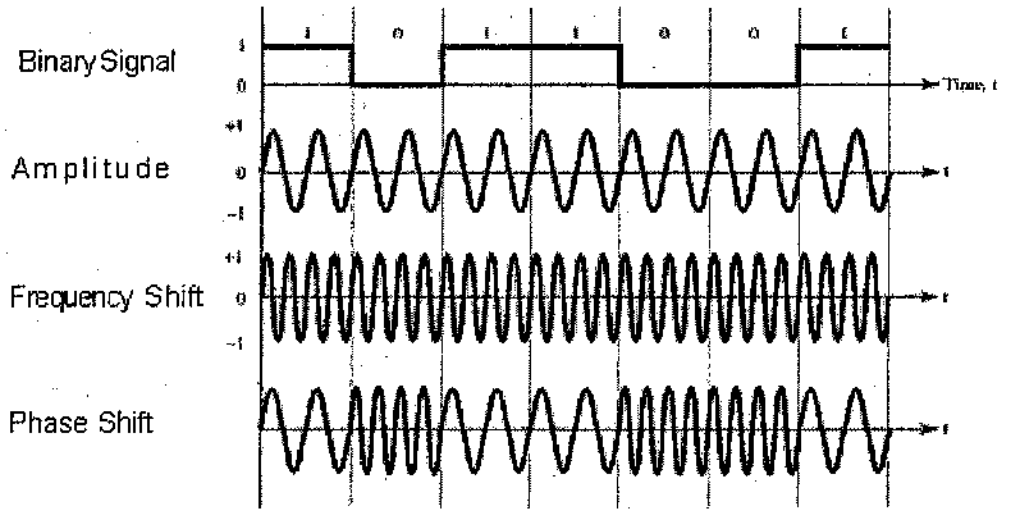


Fig : 9.7 Modulation on analog signals for digital

In PSK, the phase of the carrier signal is shifted to represent data. A binary 0 is represent by sending a signal burst of the same phase as the previous signals burst sent.A binary 1 is represented by sending a signal burst of opposite phase to the precding one.This is known as differential PSK(DPSK). DPSK has a energy of 3-dB over non coherent binary system(PSK). DPSK does not require the carrier phase synchronization essential for PSK and others. But it required more hardware and error in DSPK tend to occur in- group of two.

Most efficient use of bandwidth can be achieved can be achieved if each signaling element represents more than one bit. In Quardrature phase shift keying (OPSK) uses phase shift of multiples of 90 degree. The combination of modulation techniques to transmits multiple bits per baud. Fig.9.8 illustrate (a)

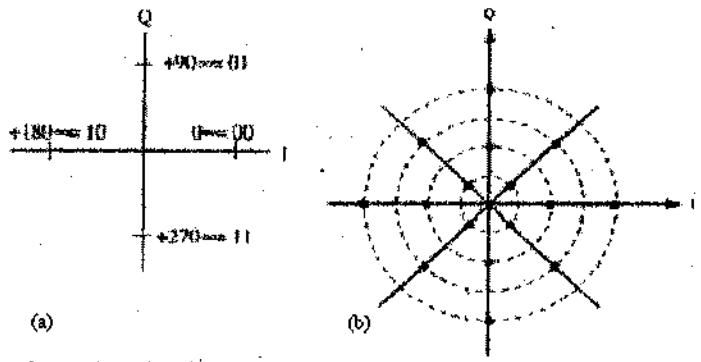


Fig : 9.8 [a] 3 bits /baud modulation ,(b) 4 bits/baud modulation

that dots at 0,90,180 and 270 degrees, with two amplitude levels per phase shift. The distance from the origin indicates amplitude. It has eight valid combinations and can be used to transmit 3 bits per baud Fig. 9.8(b) use different modulation scheme,in which 16 different combinations of amplitude and phase are used. Where phases are 30 degress apart and phases at 45,135,225 and 315 degrees have two amplitude level and others phases have one amplitude level (4X2+8X1=16). It can be used to transmit 4 bits per baud .The scheme when used to transmit 9600bps over a 2400- baud line is called Quadrature Amplitude Modulatin (QAM). Different combination of amplitude and phase modulation can be uses to achieve higher data transfer rate.

9.5.3 Encoding of Analog Data into Digital Signals

This case is transforming analog data into digital Signals.Basically this is a process of converting analog data into digital data, is known as digitization. The digital data can be transmitted using NRZ-1.(digital signals) or using modulating technique to convert in analog aignals.The device used for converting analog data into digital form for transmission, and subsequently recovering the original analog data from the digital is known as a codec(codec- decoder)depicts the process of digitizing analog data.

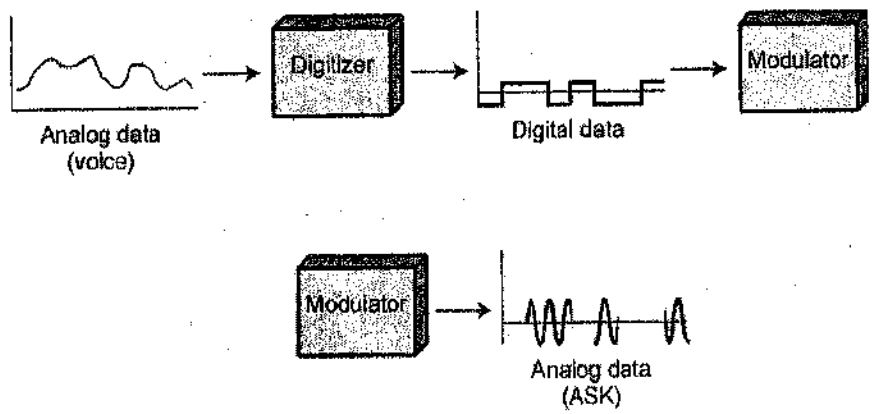


Fig : 9.9 Digitizing analog data

Two principal techniques used in codec. Pulse code modulation(PCM),Differential PCM and delta modulation (DM),

9.5.3.1 Pulse Code Modulation

PCM is as a digital transmission system with an analog -to -digital converter (ADC) at the input and a digital -to -analog (DAC)at the output end.

PCM is based on the Nyquist sampling theorem, states that if an arbitrary signal has been run through a low pass filter (LPF)of bandwidthd H, the filtered signal can be completely reconstructed by making only 2H samples per second .At lower sampling rate,information would be lost, and at a higher one.no extra information would be gained. for example 8000 samples pper second is sufficient for a 4KHz telephone line.

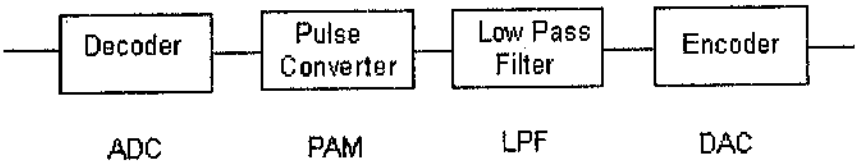


Fig : 9.10 PCM Gendration System

The original signal is assumed to be band limited with a bandwidth of H sample is taken at sampling rate 2H.Each sample occurs in every 1/2H second. These samples are represented as narrow pulses whose amplitude is proportional to the value of the original sigmal. This process is known as pulse amplitude

modulation (PCM). Pulse code modulation scheme is illustrated.

To produce PCM data, the PAM samples are quantizing. That is the amplitude of each PAM pulse is approximated by an n bit integer in this example n =3,thus 8 levels are available for the PAM paluse.

PAM forms the heart of the modern telephones system, which have one sample time is 125 use for 8000 sample/second. Another telephone carrier is T1(1.544 Mbps). It consists of 24-voice channel multiplexed together. Each channel occupy8 bit in a frame,24x8=192+1(1bit for framing), Total of 193 bits per sample in the channel. This gives a gross data rate 193x8000=1.544 Mbps per channel.

Perfect signal reconstruction is impossible in PCM.Because the ADC operation at the transmitter introduces permanent errors that appear at the receiver as quantization noise(error) in the reconstructed sample.It is much more immune to noise and interference.

Using nonlinear encoding and uniform quantizing technique can refine the quantizing error.Differential PCM (DPCM) used nonlinear encoding to refined the quantizing error. Many of the live information signal speech and TV exhibit significent correlation between sucessive samples. Original signal reconstructs through an integrator. instead of using a linear PCM.A better approximation to signal is provided through a predictor and the difference between the successive signals. DPCM is useful if the difference between the successive signals is not widely. otherwise encoding logic may require several sampling periods to reconstruct the original signals. Differential PCM differs from PCM in respect that here only the relative amplitude of various samples are indicated.not the abdolute magnitude. That is each word in this system indicates difference in amplitude between this sample and the previous sample.The logic behind this approach is that there are very little variations from sample to sample and thetransmission of difference would require only a fewer bits and hence a smaller bandwidth. Encoding and decoding process in DPCM tend to become very complicated.

An improvement to differential PCM is to extrapolate the precious few values to predict the next value and then to encode the difference between the actual signal and predicted one. The transmitter and receiver must use the same prediction algorithm.Such schemes are called predictive encoding. They are useful because they reduce the size of the numbers to be encoded,hence the number of bits to be sent.

9.5.3.2 Delta Modulation (DM)

In delta modulation an analog input is approximated by a staircase function, that moves up or down by one quantizing level at each sampling interval(Ts).An Example is shown where staircase function is overlaid on the original analog waveform.At each sampling time, the function moves up or down a constant amount &The output of delta modulation process generated binary 1 if the staircase function is to go up during the next interval: a binary 0is generated otherwise.

The transitions (up or down) occurs at each sampling Interval is chosen so that the staircase function tracks the original analog waveform as closely as possible. The output of DM process is therefore a binary sequence that can be used at the receiver end to reconstruct the staircase function.It passes through a low-pass filter to produce an analog approximation of the analog input signal.

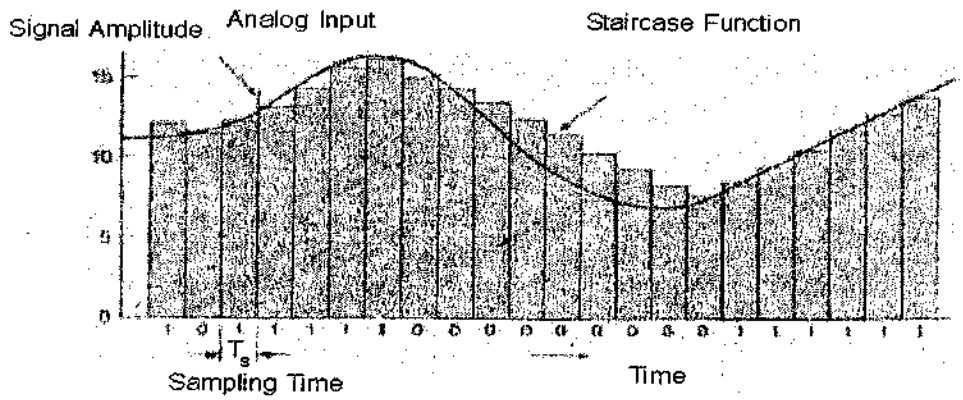


Fig ; 9.11 Delta Modulation

The delta modulation reflects the fact that each input sample has been encoded as a single pulse of height The singaling rate of DM is only one bit per sample. So that sometime DM may called "one-bit-PCM".

This system can't handle rapidly veruing samples.DM performance quality depends on the granular noise, slop- overload noise, and regeneration errors. In DM. the quantizing error depends upon the size of the step assigned to each binary digit8 and the sampling rate.The principal advantage of DM over PCM is the simplicity of its imple-mentation. But PCM has better signal to Noise ratio characteristics at the same data rate.

9.5.4. Encoding Analog Data into Analog Signals

we have already used modulation technique ASK,FSK,and PSK to convert digital data to analog signal.Now we use modulation technique to convert analog data into analog signal.There are three-modulation technique, amplitude modulation, frequency modulation and phase modulation.Illustrated amplitude,phase,and frequency modulationby a sine wave(analog).

In AM, resulting signal has a components at the original frequency plus a pair of components, and each spaced fm Hz (modulated frequency)from the carrier.The carrier frequency remainsame.

The shape of the frequency of the frequency modulation and phase modulation signals is very similar. It requires same modulation function. As with AM, both FM and PM result in a signal whose bandwidth is centered at a carrier frequency FM and PM require greater bandwidth as compare to AM

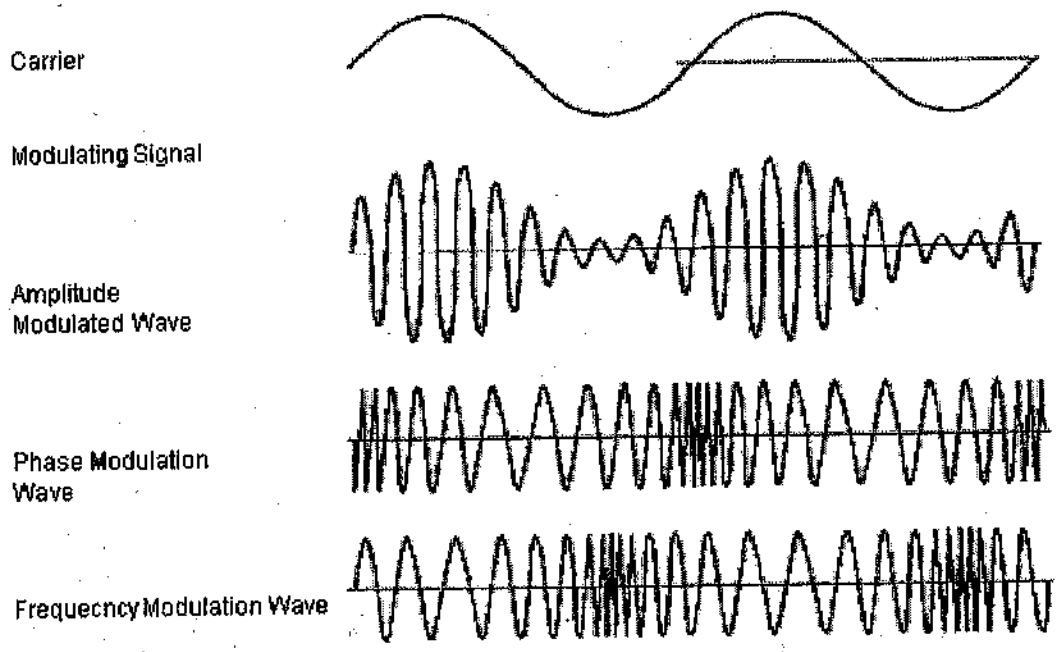


Fig : 9.12 Amplitude,Phase and Frequency Modulation

9.6 SUMMARY

In this lesson you learnt about the Data Transmision, the transfer of data between a source and a receiver.In Simplex mode of transmission data can be transfered only one way, one device can only trasmit data to another and second can only receive. In case of Half duplex communication data can be transmitted and received both but not simultenously like Wireless set where on one person can talk at a time.Full duplex communication is where data can be both received and transmited simultaneously.

Both of Digital data and analog data could be encoded in to either digital signals or analog signals. Digital signals are non continous ,they change in individual steps. They consist of pulses or digits with discrete levles of values. The value of each pulse is constant. Binary 0 for lower and binary 1 for higher voltage level. In case of transforming analog data into digital signals,basically this is a process of converting analog data in digital data is know as digitization.

9.7 GLOSSSARY

Digital Signals : Digbital signals are non-continuous signals

Analog Signals : Analog signals are continuous signals

Modes of Communication : There are three modes in which data can be transferred in a network,

(i) Simplex, (ii) Half Duplex (iii) Full Duplex

9.8 FURTHER READINGS

Andrew S-Taneabaum, Computer Networks, 4th edition, Prentice Hall India

B.A. Foronzan, Data Communication and Networking, McGraw Hill Publication.

9.9 UNIT END QUESTIONS

Q.1 What are Digital and Analog Signals ?

Q.2 Diffrenciate between Simplex, Half Duplex and Full Duplex Mode ?

Q.3 What is Pulse Code Modulation ?

Q.4 Define the tenn Digitization ?

Q.5 Write True or False for the following statements.

[5.1] In half duplex trasmission data can travel in both directions simultenously.

[5.2] PCM stand for Pulse Code Modulation

[5.3] Delta Modulation may called " One-bit-PCM".

[5.4] Digitization is the process of converting analog data into digital data.

10

UNIT 10 : INTRODUCTION TO INTERNET

Structure of the Unit

10.0 OBJECTIVES

After going through this lesson, you will be in a position to understand

1. What is Intenet.
2. LAN, MAN & WAN
3. Different types of Connections
4. What is ISP
5. What is Electornic mail (Email)
6. What is Search Engine
7. What is Web Browser

10.1 INTRODUCTION

In 1969, the US Department of Defense started a project to allow researchers and military personnel to communicate with each other in an emergency. The project was called ARPAnet and it is the foundation of the Internet.

Throughout the 1970's, what would later become the Internet was developed. While mostly military personnel and scientists used it in its early days, the advent of the World Wide Web in the early 1990's changed all that.

Today, the Internet is not owned or operated by any one entity. This worldwide computer network allows people to communicate and exchange information in new ways.

According to www.commerce.net, in April of 1999, there were 92.2 million Internet users over the age of 16 in the United States and Canada. By 2005, it is predicted 75% of the total US population will be online.

The Internet is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks of local to global scope that are linked by a broad array of electronic and optical networking technologies. The Internet carries a vast array of information resources and services, most notably the inter-linked hypertext documents of the World Wide Web (WWW) and the infrastructure to support electronic mail.

10.2 LOCAL AREA NETWORK

A LAN is two or more connected computers sharing certain resources in a relatively small geographic location (the same building, for example). LAN can be one of two types: wired or wireless. A wired LAN requires Ethernet cable to physically connect all computers on the network to a main device called a switch. A wireless LAN uses radio waves to communicate, eliminating the need for wires.

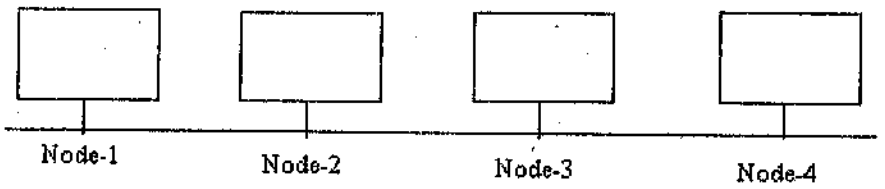


Fig : 10.1 Local Area Netwok

10.3 METROPOLIAN AREA NETWORK (MAN)

MAN is a large computer network that usually spans a city or a large campus. A MAN usually interconnects a number of local area networks (LANs) using a high-capacity backbone technology, such as fiber-optical links, and provides up-link services to wide area networks and the Internet. The cable television is the largest Matropolian Area Network (MAN) in existence. A MAN is optimized for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities. MANs can also depend on communications channels of moderate-to-high data rates. A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations. MANs might also be owned and operated as public utilities. They will often provide means for internetworking of local networks.

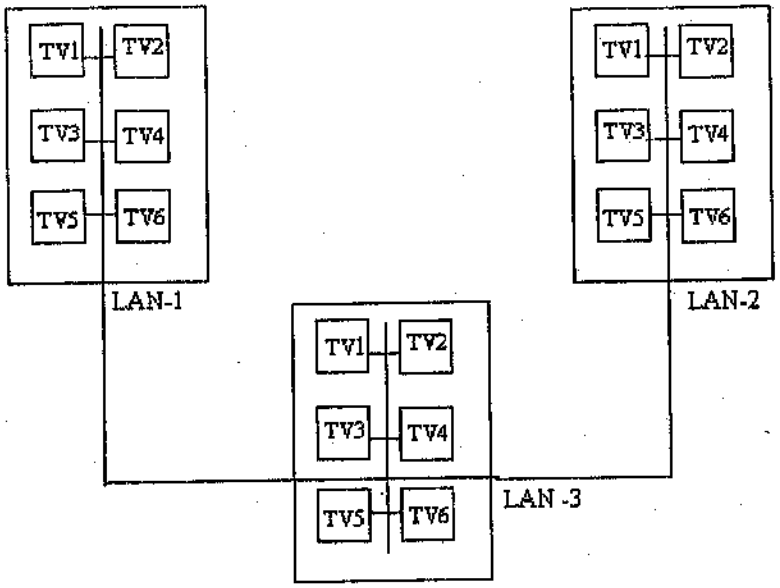


Fig : 10.2 Metropolian Area Netwok

10.4 WIDE AREA NETWORK (WAN)

A WAN typically consists of 2 or more LANs. The computers are farther apart and are linked by telephone lines, dedicated telephone lines, or radio waves. The Internet is the largest Wide Area Network (WAN) in existence.

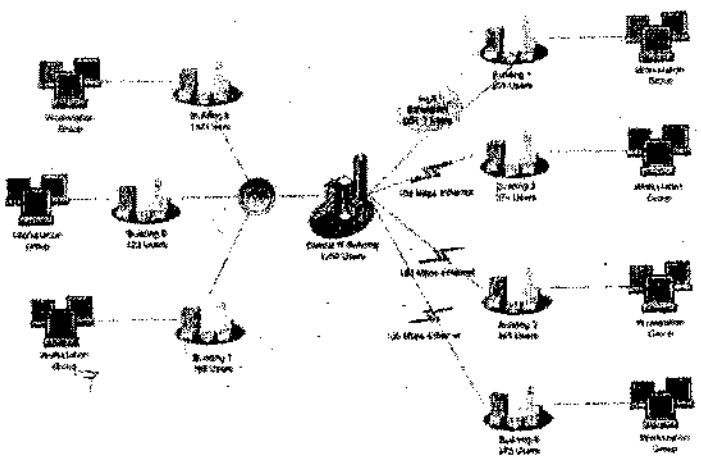


Fig : 10.3 Wide Area Network

10.5 INTERNET

The Internet is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks of local to global scope that are linked by a broad array of electronic and optical networking technologies. The Internet carries a vast array of information resources and services, most notably the inter-linked hypertext documents of the World Wide Web (WWW) and the infrastructure to support electronic mail.

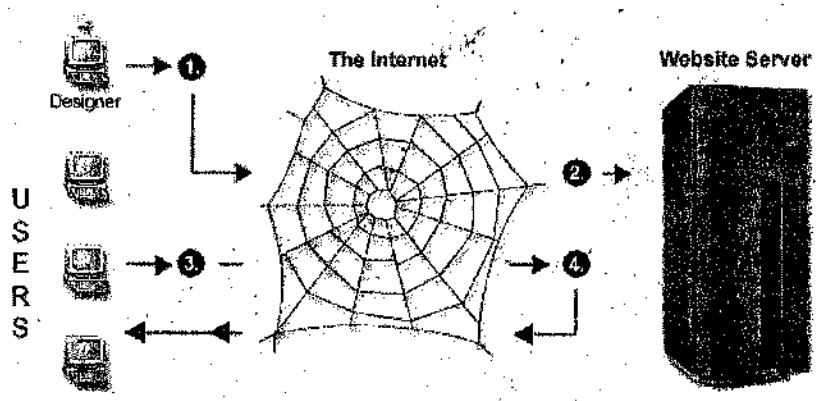


Fig : 10.4 Internet work process

10.6 DIAL-UP CONNECTION

Dial Up (analog up to 56k) was the first widely used type of Internet connection. It uses a modem that is hooked up to the computer and dials in using a phone line. While it is the cheapest method to connect to the Internet, dialup is a very slow connection and the quality is also not very good. The Internet speeds range from 2400 bps to 56 Kbps. The connection is often lost and the data is limited. To start out with, dialup Internet was acceptable and was okay for reading text-only documents and emails. However, with images, it is best to use another method of connecting to the Internet. The Internet allows us to stay in touch with friends and relatives we don't see so often. We can send messages to each other, and even talk to one another using cameras just like we were sitting in the same room. The Internet allows us to do research for school or read the latest news online. Other people use it to play games with other people online or share files with one another such as music and pictures. It keeps us connected to everything that is going on through the World Wide Web. There are several different methods we can use to connect to the Internet. These can depend on our budget or whether we value speed in our connection. This can also depend on the frequency of use of the Internet.

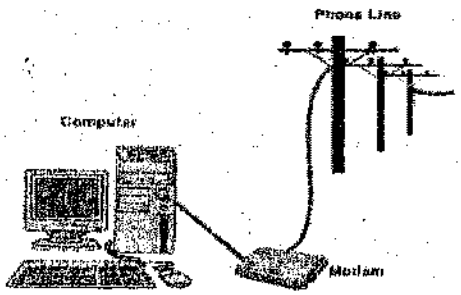


Fig : 10.5 Dial Up Internet Connection

10.7 ISDN

ISDN stands for Integrated Services Digital Network. It still requires dialing up to a server to connect to the Internet. It is meant for sending voice, video and information through analog and digital phone lines.

Integrated services refers to ISDN's ability to deliver at minimum two simultaneous connections, in any combination of data, voice, video, and fax, over a single line. Multiple devices can be attached to the line, and used as needed. That means an ISDN line can take care of most people's complete communications needs at a much higher transmission rate, without forcing the purchase of multiple analog phone line.

Base Rate Interface : The entry level interface to ISDN is the Basic(s) Rate Interface (BRI), a 128 kbit/s service delivered over a pair of standard telephone copper wires. The 144 kbit/s rate is broken down into two 64 kbit/s bearer channels ('B' channels) and one 16 kbit/s signaling channel ('D' channel or delta channel).

BRI is sometimes referred to as 2B+D

Primarty Rate Infterface : The other ISDN service available is the Primary Rate Interface (PRI), which is carried over an E1 (2048 kbit/s) in most parts of the world. An E1 is 30 'B' channels of 64 kbit/s, one 'D' channel of 64 kbit/s and a timing and alarm channel of 64 kbit/s. In North America PRI service is delivered on one or more T1s (sometimes referred to as 23B+D) of 1544 kbit/s (24 channels). A T1 has 23 'B' channels and 1 'D' channel for signalling (Japan uses a circuit called a J1, which is similar to a T1).PRI-ISDN is popular throughout the world, especially for connection of PSTN circuits to PBXs.

10.8 ADSL

Asymmetric Digital Subscriber Line is a new fast growing technology which provides a fast and permanent connection to the internet. ADSL is asymmetric which means that the speed of download is different to the speed of upload. For example, a 512Kbps/128Kbps connection means you are receiving data up to 512Kbps and outputting data up to 128Kbps. ADSL works by splitting your current phone line into two separate channels. One of these channels is used for voice and the other for data. usage.The speed of ADSL is largely greater than a regular dial-up connection. It allows more data to be sent over the existing copper telephone lines.

Benefits : [1] ADSL is not charged by the minute like dial-up modem connections. A fixed charge is added to your phone bill every month. [2] You don't need to miss important telephone calls while you are connected to the internet. With ADSL you are able to receive calls while being on the internet at the same time.

10.9 LEASED LINE CONNECTION

A leased line is a service contract between a provider and a customer, whereby the provider agrees to deliver a symmetric telecommunications line connecting two locations in exchange for a monthly rent (hence the term lease). It is sometimes known as a 'Private Circuit'. An internet leased line is a premium internet connectivity product, delivered over fibre normally, which is dedicated and provides uncontended, symmetrical speeds.

For example, a T-1 channel is a type of leased line that provides a maximum transmission speed of 1.544 Mbps. You can divide the connection into different lines for data and voice communication or use the channel for one high speed data circuit. Dividing the connection is called multiplexing.

10.10 SATELLITE

Internet over Satellite (IoS) allows a user to access the Internet via a satellite that orbits the earth. A satellite is placed at a static point above the earth's surface, in a fixed position. Because of the enormous distances signals must travel from the earth up to the satellite and back again, IoS is slightly slower than high-speed terrestrial connections over copper or fiber optic cables.

A satellite Internet connection is an arrangement in which the upstream (outgoing) and the downstream (incoming) data are sent from, and arrive at, a computer through a satellite. Each subscriber's hardware includes a satellite dish antenna and a transceiver (transmitter/receiver) that operates in the microwave portion of the radio spectrum. In a two-way satellite Internet connection, the upstream data is usually sent at a slower speed than the downstream data arrives. Thus, the connection is asymmetric. A dish antenna, measuring about two feet high by three feet wide by three feet deep, transmits and receives signals. Uplink speeds are nominally 50 to 150 Kbps for a subscriber using a single computer. The downlink occurs at speeds ranging from about 150 Kbps to more than 1200 Kbps, depending on factors such as Internet traffic, the capacity of the server, and the sizes of downloaded files.

10.11 ISP

An ISP (Internet Service Provider) is a company that provides individuals and other companies access to the Internet and other related services such as Web site building and virtual hosting. An ISP has the equipment and the telecommunication line access required to have a point-of-presence on the Internet for the geographic area served. The larger ISPs have their own high-speed leased lines so that they are less dependent on the telecommunication providers and can provide better service to their customers. Among the largest national and regional ISPs are AT&T WorldNet, IBM Global Network, MCI, Netcom, UUNet, and PSINet.

10.12 WEB TV

Web TV that enable you to surf the Web on your TV. Most Web TV products today consist of a small box that connects to your telephone line and television. It makes a connection to the Internet via your telephone service and then converts the downloaded Web pages to a format that can be displayed on your TV. These products also come with a remote control device so that you can navigate through the Web. Recently, the name WebTV has been trademarked by Microsoft.

10.13 WORLD WIDE WEB [WWW]

The World Wide Web, abbreviated as WWW and commonly known as the Web, is a system of interlinked hypertext documents accessed via the Internet. With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them by using hyperlinks.

10.14 E-MAIL

Electronic Mail is a method of sending a message from a user at a computer to a recipient on another computer.An e-mail message consists of a header and the body of the message The first part, the header, contains the information about where the message has to be sent, and the path that has followed to reach its destination, as well as other information like date, return path, etc. The body is the actual message that is being sent.

An e-mail address has the form user@subdomain.subdomain.domain, e.g. rahul@xyz.res.in

10.15 WEB BROWSER

A web browser is a software application for retrieving, presenting, and traversing information resources on the World Wide Web. An information resource is identified by a Uniform Resource Identifier (URI) and may be a web page, image, video, or other piece of content. Hyperlinks present in resources enable users to easily navigate their browsers to related resources.

Although browsers are primarily intended to access the World Wide Web, they can also be used to access information provided by Web servers in private networks or files in file systems. Some browsers can be also used to save information resources to file systems. Ex : Internet Explorer, Opera, Firefox etc.

10.16 SEARCH ENGINE

A web search engine is designed to search for information on the World Wide Web. The search results are generally presented in a list of results and are often called hits. The information may consist of web pages, images, information and other types of files. Some search engines also mine data available in databases or open directories. Unlike Web directories, which are maintained by human editors, search engines operate algorithmically or are a mixture of algorithmic and human input. Example : Google.co.in, Yahoo.com.

10.17 SUMMARY

In this lesson you learnt about the Internet.Computers can communicate with one another through Local Area Network in small business for example an office through Metropolian Area Network in a Campus or City. Through WAN where limiti is exceeded and all over the world communicate through this.E-mail stands for electronic mail. This is one of the most widely used features of Internet. Mails are regularly used without the help of postage stamp we can transfer mails anywhere in the world. E-mail data is transmitted through Internet and therefore within minutes the message reaches the destination may it be anywhere in the world.Therefore the mailing system through e-mail is excessively fast and is being used widely for mail transfer.

In this unit you also learn that web browser is a software application for retrieving, presenting, and traversing information resources on the World Wide Web.An ISP (Internet service provider) is a company that provides individuals and other companies access to the Internet. Web TV enables you to surf the Web on your TV. Most WebTV products today consist of a small box that connects to your telephone line and television. A leased line is a service contract between a provider and a customer, whereby the provider agrees to deliver a symmetric telecommunications line connecting two locations in exchange for a monthly rent (hence the term lease). It is sometimes known as a 'Private Circuit'. ISDN stands for integrated services digital network.

10.18 GLOSSARY

1. **LAN/MAN/WAN :** On the basis of the spread of the networks in terms of distance, they have been classified into local (upto about a km), metropolitan (a city) and wide (across cities) area networks.
2. **Internet :** It is a network of networks.

3. **ISDN :** Integrated Services Digital Network
4. **ISP :** Internet Service Provider

10.19 FURTHER READINGS

Andrew S-Taneabaum, Computer Networks, 4th edition, Prentice Hall India.
B.A. Foronzan, Data Communication and Networking, McGraw Hill Publication.

10.20 UNIT-END QUESTIONS

Q1. What is Intenet ?

Q2. What is Difference between LAN WAN & MAN ?

Q3. Describe the term ISP

Q4. Wrie Short Notes On :

[A] Email [B] WWW [C] Search Engine

Q5 Define the term ISDN

Q6. Write True or False for the following statments

[1] ISP Stand for Internet Service Protocol

[2] The Internet is the largest Wide Area Network (WAN) in existence.

[3] india@indiatimes.com is a valid Email Address

[4] Internet Explorer is a Web Brower

[5] MAN stand for Metropolian Area Netwok

[6] LAN Stand for Local Access Netwo

UNIT 11 : SECURITY

Structure of the Unit

11.0 OBJECTIVES

After studying this unit, you should be able to understand:

- Importance of maintaining security for computer system
- Different types of security threats
- Viruses & Anti-viruses
- Firewalls

11.1 INTRODUCTION

Computer security is a branch of computer technology known as information security as applied to computers and networks. The objective of computer security includes protection of information and property from theft, corruption, or natural disaster, while allowing the information and property to remain accessible and productive to its intended users. The term computer system security means the collective processes and mechanisms by which sensitive and valuable information and services are protected from publication, tampering or collapse by unauthorized activities or untrustworthy individuals and unplanned events respectively. The strategies and methodologies of computer security often differ from most other computer technologies because of its somewhat elusive objective of preventing unwanted computer behavior instead of enabling wanted computer behavior.

11.2 NEED OF SECUTIRY

Why Security?

Computer security is required because most organizations can be damaged by hostile software or intruders. There may be several forms of damage which are obviously interrelated. These include:

- « Damage or destruction of computer systems.
- « Damage or destruction of internal data.
- « Loss of sensitive information to hostile parties.
- « Use of sensitive information to steal items of monitary value.
- « Use of sensitive information against the organization's customers which may result in legal action by customers against the organization and loss of customers.
- « Damage to the reputation of an organization.
- « Monitary damage due to loss of sensitive information, destruction of data, hostile use of sensitie data, or damage to the organization's reputation.

The methods used to accomplish these unscrupulous objectives are many and varied depending on the circumstances.

Computer systems are vulnerable to many threats that can inflict various types of damage resulting in significant losses. This damage can range from errors harming database integrity to fires destroying entire computer centers. Losses can stem, for example, from the actions of supposedly trusted employees defrauding a system, from outside hackers, or from careless data entry clerks. Precision in estimating computer security-related losses is not possible because many losses are never discovered, and others are "swept under the carpet" to avoid unfavorable publicity. The effects of various threats varies considerably: some affect the confidentiality or integrity of data while others affect the availability of a system.

Computer security is important because without it, your computer would be vulnerable to viruses, worms, and other malicious code.

A computer security suite protects you against the most common internet security threats – viruses, spyware and intruders. Anyone who uses the internet should be using an antispyware product, antivirus software, and a firewall of some type. These three products provide the security that is necessary to keep your identity safe and your computer "clean".

11.3 ATTACKS

Computer security threats are relentlessly inventive. Masters of disguise and manipulation, these threats constantly evolve to find new ways to annoy, steal and harm. Arm yourself with information and resources to safeguard against complex and growing computer security threats and stay safe online.

1. Errors and Omissions

Errors and omissions are an important threat to data and system integrity. These errors are caused not only by data entry clerks processing hundreds of transactions per day, but also by all types of users who create and edit data. Many programs, especially those designed by users for personal computers, lack quality control measures. However, even the most sophisticated programs cannot detect all types of input errors or omissions. A sound awareness and training program can help an organization reduce the number and severity of errors and omissions.

Users, data entry clerks, system operators, and programmers frequently make errors that contribute directly or indirectly to security problems. In some cases, the error is the threat, such as a data entry error or a programming error that crashes a system. In other cases, the errors create vulnerabilities. Errors can occur during all phases of the systems life cycle.

2. Fraud and Theft

Computer systems can be exploited for both fraud and theft both by "automating" traditional methods of fraud and by using new methods. For example, individuals may use a computer to skim small amounts of money from a large number of financial accounts, assuming that small discrepancies may not be investigated. Financial systems are not the only ones at risk. Systems that control access to any resource are targets (e.g., time and attendance systems, inventory systems, school grading systems, and long-distance telephone systems). Computer fraud and theft can be committed by insiders or outsiders. Insiders (i.e., authorized users of a system) are responsible for the majority of fraud.

Since insiders have both access to and familiarity with the victim computer system (including what resources it controls and its flaws), authorized system users are in a better position to commit crimes. Insiders can be both general users (such as clerks) or technical staff members. An organization's former employees, with their knowledge of an organization's operations, may also pose a threat, particularly if their access is not terminated promptly.

3. Employee Sabotage

Employees are most familiar with their employer's computers and applications, including knowing what actions might cause the most damage, mischief, or sabotage. The downsizing of organizations in both the public and private sectors has created a group of individuals with organizational knowledge, who may retain potential system access (e.g., if system accounts are not deleted in a timely manner). The number of incidents of employee sabotage is believed to be much smaller than the instances of theft, but the cost of such incidents can be quite high.

4. Malicious Hackers

The term malicious hackers, sometimes called crackers, refers to those who break into computers without authorization. They can include both outsiders and insiders. Much of the rise of hacker activity is often attributed to increases in connectivity in both government and industry. One 1992 study of a particular

Internet site (i.e., one computer system) found that hackers attempted to break in at least once every other day. The hacker threat should be considered in terms of past and potential future damage. Although current losses due to hacker attacks are significantly smaller than losses due to insider theft and sabotage, the hacker problem is widespread and serious.

5. Malicious Code

Malicious code refers to viruses, worms, Trojan horses, logic bombs, and other "uninvited" software. Sometimes mistakenly associated only with personal computers, malicious code can attack other platforms. Actual costs attributed to the presence of malicious code have resulted primarily from system outages and staff time involved in repairing the systems. Nonetheless, these costs can be significant.

Malicious Software: A Few Key Terms

Virus: A code segment that replicates by attaching copies of itself to existing executables. The new copy of the virus is executed when a user executes the new host program. The virus may include an additional "payload" that triggers when specific conditions are met. For example, some viruses display a text string on a particular date. There are many types of viruses, including variants, overwriting, resident, stealth, and polymorphic.

Trojan Horse: A program that performs a desired task, but that also includes unexpected (and undesirable) functions. Consider as an example an editing program for a multiuser system. This program could be modified to randomly delete one of the users' files each time they perform a useful function (editing), but the deletions are unexpected and definitely undesired!

Worm: A self-replicating program that is self-contained and does not require a host program. The program creates a copy of itself and causes it to execute; no user intervention is required. Worms commonly use network services to propagate to other host systems.

6. Threats to Personal Privacy

The accumulation of vast amounts of electronic information about individuals by governments, credit bureaus, and private companies, combined with the ability of computers to monitor, process, and aggregate large amounts of information about individuals have created a threat to individual privacy. The possibility that all of this information and technology may be able to be linked together has arisen as a specter of the modern information age.

11.4 SECURITY PRINCIPLES

Once you have determined the value of your data, you need to develop a set of policies to help protect it. These policies are called security policies and may apply to users, the IT department, and the organization in general. When writing your policies, consider:

1. What data may a user take home?
2. If a user works from home or remote offices and uses the internet to transmit data, how secure must the data be when in transmission across the internet?
3. What policies, network structure, and levels of defenses are required to secure your data depending on its importance, value and the cost of defending it?

The first items that should be defined are the policies related to the use and and handling of your data. This will help you determine defensive measures and procedures. I have categorized policies into three different areas listed below:

« User Policies - Define what users can do when using your network or data and also define security settings that affect users such as password policies.

« IT Policies - Define the policies of the IT department used to govern the network for maximum security and stability.

« General Policies - High level policies defining who is responsible for the policies along with business continuity planning and policies.

User Policies

Define what users can and must do to use your network and organization's computer equipment. It defines what limitations are put on users to keep the network secure such as whether they can install programs on their workstations, types of programs they can use, and how they can access data. Some policies include:

« Password Policies - This policy is to help keep user accounts secure. It defines how often users must change their passwords, how long they must be, complexity rules (types of characters used such as lower case letters, upper case letters, numbers, and special characters), and other items.

« Proprietary Information Use - Acceptable use of any proprietary information owned by the company. Defines where it can be stored and where it may be taken, how and where it can be transmitted.

« Internet Usage - Use of internet mail, Use of programs with passwords or unencrypted data sent over the internet.

« System Use - Program installation, No Instant Messaging, No file sharing such as Kazaa, Morpheus. Restrictions on use of your account or password (not to be given away).

« VPN and remote user system use (remote access) - Must be checked for viruses/trojans/backdoors. Must have firewall, must have AV.

« Acceptable use of hardware such as modems - No use of modems to internet without a personal firewall.

IT Policies

These policies include general policies for the IT department which are intended to keep the network secure and stable.

« Virus incident and security incident - Intrusion detection, containment, and removal. 1. prepare (policies, checklists/procedures) 2 identify (get evidence) 3 contain (pull off network, modify passwords) 4 eradicate (fix, determine cause, improve defenses, test for vulnerablilties) 5 recover (validate the system, monitor for re-infection) 6 lessons learned (make recommendations to prevent a similar incident)

« Backup policy - Define what to back up, who backs it up, where it is stored, how long it is stored, how to test backups, what program is used to do backups.

« Client update policies - Update clients how often and using what means or tools.

« Server configuration, patch update, and modification policies (security) - Remove unneeded services (harden server). What servers should have IDS. How is it determined to do an update? What is done when someone works on the server?

« Firewall policies - What ports to block or allow, how to interface to it or manage it, who has access to the control console.

« Wireless, VPN, router and switch security, dmz policy, email retention, auto forwarded email policy, ability for IT to audit and do risk assessment, acceptable encryption algorithms

General Policies

« High level program policy - Defines who owns other policies, who is responsible for them, scope and purpose of policies, any policy exceptions, related documents or policies.

« Business continuity plan - Includes the following plans:

- o Crisis Management - What to do during the (any) crisis which may threaten the organization.
- o Disaster Recovery - Subfunctions:

- § Server recovery
- § Data recovery
- § End-user recovery
- § Phone system recovery
- § Emergency response plan
- § Workplace recovery

Policy Levels

Policies can exist on many levels of the organization from a group or team level, to department level, plant level, or global organizational level. some policies may only be effective on a local level while others may be enterprise wide throughout the organization.

11.5 VIRUSES

Perhaps the most well known computer security threat, a computer virus is a program written to alter the way a computer operates, without the permission or knowledge of the user. A virus replicates and executes itself, usually doing damage to your computer in the process.

How is a computer virus a threat to computer security?

Think of a biological virus – the kind that makes you sick. It's persistently nasty, keeps you from functioning normally and often requires something powerful to get rid of it. A computer virus is very similar. Designed to relentlessly replicate, computer viruses infect your programs and files, alter the way your computer operates or stop it from working altogether. It's estimated that the Conficker virus infected more than 10 million computers in 2009. Tens of thousands of computer viruses now operate over the Internet, and new computer viruses are discovered every day.

How does a computer virus find me?

Even if you're careful you can pick up computer viruses through normal Web activities like:

- « Sharing music, files or photos with other users
- « Visiting an infected Web site
- « Opening spam email or an email attachment
- « Downloading free games, toolbars, media players and other system utilities
- « Installing mainstream software applications without fully reading license agreements

What does a computer virus do?

Some computer viruses are programmed to harm your computer by damaging programs, deleting files, or reformatting the hard drive. Others simply replicate themselves or flood a network with traffic, making it impossible to perform any internet activity. Even less harmful computer viruses can significantly disrupt your system's performance, sapping computer memory and causing frequent computer crashes.

What are the symptoms of a computer virus?

Your computer may be infected if you recognize any of these malware symptoms:

- « Slow computer performance
- « Erratic computer behavior
- « Unexplained data loss

« Frequent computer crashes

Types of Viruses

Viruses

A software virus is a parasitic program written intentionally to alter the way your computer operates without your permission or knowledge.

A virus attaches copies of itself to other files such as program files or documents and is inactive until you run an infected program or open an infected document. When activated, a virus may damage or delete files, cause erratic system behaviour, display messages or even erase your hard disk.

A virus may spread through email and instant messenger attachments, through infected files on floppy disks or CD-ROMs, or by exploiting a security flaw in Microsoft Windows.

Macro Viruses

Macros are simple programs that can be written to automate repetitive tasks in a document or make calculations in a spreadsheet. Macros can be written in documents created by Microsoft Word, in spreadsheets created by Microsoft Excel and in many other kinds of documents.

Macro viruses are malicious macro programs that are designed to replicate themselves from file to file and can cause damage to the files on your computer. They spread whenever you open an infected file.

Trojan Horses

Trojan horses are programs that appear to serve some useful purpose or provide entertainment, which encourages you to run them. But these programs also serve a covert purpose, which may be to damage files, to place a virus on your computer or to allow a hacker to gain access to your machine. More commonly these days, you can be enticed into running a Trojan by clicking a link on a viral web site or in an email.

Trojans that allow a hacker to gain access to your machine, called Remote Access Trojans (RATs), are particularly prevalent at the moment. Over 50% of all spam (unsolicited email) is sent from home or work computers that have been compromised by RATs.

A Trojan horse is not a virus because it does not replicate and spread like a virus.

Worms

Worms are programs that replicate and spread, often opening a back door to allow hackers to gain access to the computers that they infect.

Worms can spread over the Internet by expoiting security flaws in the software of computers that are connected to the Internet. Worms can also spread by copying themselves from disk to disk or by email.

Zombies

A Zombie is a dormant program that lies inactive on a computer. It can be activated remotely to aid a collective attack on another computer. Zombies don't normally damage the computer on which they reside but can damage other computers.

Zombies often arrive as email attachments and when the attachment is opened they install themselves secretly and then wait to be activated.

Phishing

A Phishing attack is when you are are sent an email that asks you to click on a link and re-enter your bank or credit card details. These emails can pretend to be from banks, Internet service providers, on-line stores and so on, and both the email and the web site it links to appear genuine. When you enter your bank or credit card details they are then used fraudulently.

Internet Based Attacks

While your computer is connected to the Internet it can be subject to attack through your network communications. Some of the most common attacks include:

« Bonk – An attack on the Microsoft TCP/IP stack that can crash the attacked computer.

« RDS_Shell – A method of exploiting the Remote Data Services component of the Microsoft Data Access Components that lets a remote attacker run commands with system privileges.

« WinNuke – An exploit that can use NetBIOS to crash older Windows computers.

11.6 FIREWALLS

What is a Firewall ?

A firewall is a secure Internet gateway that is used to interconnect a private network to the Internet (see Figure 11.1). There are a number of components that make up a firewall:

i) the Internet access security policy of the organisation. This states, at a high level, what degree of security the organisation expects when connecting to the Internet. The security policy is independent of technology and techniques, and should have a lifetime independent of the equipment used. An example of

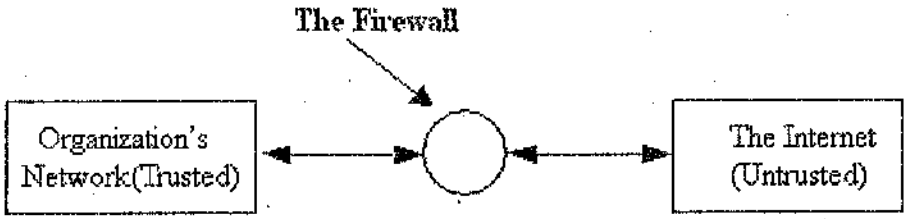


Figure 11.1

statements from such a security policy might be: external users will not be allowed to access the corporate network without a strong level of authentication; any corporate information not in the public domain must be transferred across the Internet in a confidential manner, and corporate users will only be allowed to send electronic mail to the Internet - all other services will be banned.

ii) the mapping of the security policy onto technical designs and procedures that are to be followed when connecting to the Internet. This information will be updated as new technology is announced, and as system configurations change etc. For example, regarding authentication, the technical design might specify the use of one-time passwords. Technical designs are usually based on one of two security policies, either:

permit any service unless it is expressly denied, or deny any service unless it is expressly permitted. The latter is clearly the more secure of the two.

iii) the firewall system, which is the hardware and software which implements the firewall. Typical firewall systems comprise a IP packet filtering router, and a host computer (sometimes called a bastion host or application gateway) running application filtering and authentication software. Each of these firewall components are essential. A firewall system without an Internet access security policy cannot be correctly configured. A policy without enforced procedures is worthless as it is ignored.

Advantages of Firewalls

Firewalls have a number of advantages.

They can stop incoming requests to inherently insecure services, e.g. you can disallow rlogin, or RPC services such as NFS.

They can control access to other services e.g. bar callers from certain IP addresses, filter the service

operations (both incoming and outgoing), e.g. stop FTP writes hide information e.g. by only allowing access to certain directories or systems

They are more cost effective than securing each host on the corporate network since there is often only one or a few firewall systems to concentrate on.

They are more secure than securing each host due to: the complexity of the software on the host - this makes it easier for security loopholes to appear. In contrast, firewalls usually have simplified operating systems and don't run complex application software, the number of hosts that need to be secured (the security of the whole is only as strong as the weakest link).

Disadvantages of Firewalls

Firewalls are not the be all and end all of network security. They do have some disadvantages, such as:

They are a central point for attack, and if an intruder breaks through the firewall they may have unlimited access to the corporate network.

They may restrict legitimate users from accessing valuable services, for example, corporate users may not be let out onto the Web, or when working away from home a corporate user may not have full access to the organization's network.

They do not protect against back door attacks, and may encourage users to enter and leave via the backdoor, particularly if the service restrictions are severe enough. Examples of backdoor entrance points to the corporate network are: modems, and importing/exporting floppy discs. The security policy needs to cover these aspects as well.

They can be a bottleneck to throughput, since all connections must go via the firewall system. Firewall systems on their own cannot protect the network against smuggling i.e. the importation or exportation of banned material through the firewall e.g. games programs as attachments to Email messages. Smuggling could still be a significant source of virus infection if users download software from external bulletin boards etc. The recent Melissa and Love Bug viruses were smuggled inside Email messages unbeknown to the recipients. This is an area that the security policy needs to address. There are software packages that can help in this e.g. Mimesweeper runs in the firewall and will check Email attachments before letting them pass. It will remove potentially dangerous attachments or stop the Email altogether.

The biggest disadvantage of a firewall is that it gives no protection against the inside attacker. Since most corporate computer crime is perpetrated by internal users, a firewall offers little protection against this threat. E.g. an employee may not be able to Email sensitive data from the site, but they may be able to copy it onto a floppy disc and post it.

Consequently organizations need to balance the amount of time and money they spend on firewalls with that spent on other aspects of information

11.7 ETHICAL HACKING

Ethical Hacking is the use of programming skills to determine vulnerabilities in computer systems. It is also known as penetration testing, intrusion testing, or red teaming.

While the non-ethical hacker exploits these vulnerabilities for mischief, personal gain or other reasons, the ethical hacker evaluates them, points them out, and may suggest changes to systems that make them less likely to be penetrated by black hats. Ethical Hackers can work in a variety of ways. Many companies utilize ethical hacking services from consultants or full-time employees to keep their systems and information as secure as possible. Gaining unauthorized access is however a crime, no matter what the intent.

The work of ethical hacking is still considered hacking because it uses knowledge of computer systems in an attempt to in some way penetrate them or crash them. This work is ethical because it is performed to

increase the safety of the computer systems. It's reasoned that if a white hat can somehow break the security protocols of a system, so can a black hat. Thus, the goal of ethical hacking is to determine how to break in or create mischief with the present programs running, but only at the request of the company that owns the system and specifically to prevent others from attacking it. People enter the field of ethical hacking in a variety of ways. Many people are very computer savvy and many, but not all, have an educational background in computer science. In some instances, the white hat has gained his or her experience by first being a black hat.

Designing impenetrable systems or identifying the current weaknesses of a system are vital parts of keeping the Internet safe and information private, and even with the present teams of ethical hackers that perform this work, there is still more work to do.

11.8 ANTI-VIRUS SOFTWARES

Antivirus software is used to prevent, detect, and remove malware, including computer viruses, worms, and trojan horses. Such programs may also prevent and remove adware, spyware, and other forms of malware.

A variety of strategies are typically employed. Signature-based detection involves searching for known malicious patterns in executable code. However, it is possible for a user to be infected with new malware for which no signature exists yet. To counter such so-called zero-day threats, heuristics can be used. One type of heuristic approach, generic signatures, can identify new viruses or variants of existing viruses by looking for known malicious code (or slight variations of such code) in files. Some antivirus software can also predict what a file will do if opened/run by emulating it in a sandbox and analyzing what it does to see if it performs any malicious actions. If it does, this could mean the file is malicious.

Anti-virus software gives protection against viruses and worms. In order to be effective, anti-virus software should be regularly updated - otherwise it will fail to give protection against new viruses. No surfer (i.e. PC or workstation) should be without anti-virus protection. Serious thought should also be given to installing Firewall software (which protects against hackers and provides additional protection against some viruses).

11.9 SUMMARY

This chapter highlights the need for security in computer based systems. It discusses security principles, types of attacks, viruses, anti-virus software and Firewalls. A brief description of Ethical Hacking has also been provided.

11.10 GLOSSARY

Virus: computer virus is a computer program that can copy itself and infect a computer.

Antivirus: Antivirus or anti-virus software is used to prevent, detect, and remove computer viruses.

Ethical hacking: also known as penetration testing or white-hat hacking involves the same tools, tricks, and techniques that hackers use, but ethical hacking is legal. Ethical hacking is performed with the target's permission.

Firewall: A firewall is a part of a computer system or network that is designed to block unauthorized access while permitting authorized communications. It is a device or set of devices that is configured to authorize or disallow network transmissions based upon a set of rules and other criteria.

11.11 FURTHER READINGS

1. V. Rajaraman, "Fundamentals of Computers", Fourth edition, PHI publications,. 2002.

2. P.K Sinha 'Computer Fundamentals', BPB Publications

3. Fundamentals of Information Technology Alexis Leon, Mathews Leon, Vikas Publishing

11.12 UNIT END QUESTIONS

1. What are the attacks that may occur on a computer system?
2. What is a virus?
3. How can a virus harm a computer program?
4. What is the use of an antivirus?
5. What are Firewalls?
6. What is hacking?
7. What is the difference between ethical hacking and hacking?

UNIT 12 CRYPTOGRAPHY

Structure of the Unit

12.0 OBJECTIVES

After studying this unit, the students would be able to understand the concept of Cryptography, its use and techniques. They would also get acquainted with Digital Signatures and smart techniques such as smart cards, smart tags etc.

12.1 INTRODUCTION TO CRYPTOGRAPHY

Cryptography is the science of using Mathematics to encrypt and decrypt data. Cryptography enables one to store sensitive information or transmit it across insecure networks such as the Internet so that it cannot by anyone except the intended recipient.

Cryptography can be strong or weak. Cryptographic strength is measured in the time, and resources it would require to recover the plaintext. The result of strong cryptography is ciphertext that is very difficult to decipher without possession of the appropriate decoding tool.

Weak cryptography means weak security! Weak cryptography has well documented vulnerabilities that enable attackers to guess encryption keys via brute force and use such keys to decrypt and steal information.

In conventional cryptography, also called secret-key or symmetric-key encryption, one key is used both for encryption and decryption.

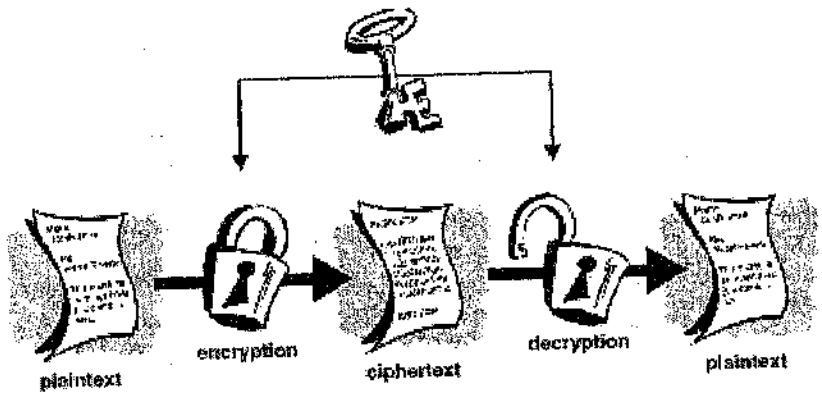


Fig. 12.1: Conventional Cryptography

Conventional encryption is very fast. It is especially useful for encrypting data that is not going anywhere. However, conventional encryption alone as a means for transmitting secure data can be quite expensive simply due to the difficulty of secure key distribution.

For a sender and recipient to communicate securely using conventional encryption, they must agree upon a key and keep it secret between themselves. If they are in different physical locations, they must trust a courier, the Bat Phone, or some other secure communication medium to prevent the disclosure of the secret key during transmission. Anyone who overhears or intercepts the key in transit can later read, modify, and forge all information encrypted or authenticated with that key.

Public key cryptography

The problems of key distribution are solved by public key cryptography, the concept of which was introduced by Whitfield Diffie and Martin Hellman in 1975. Public key cryptography is an asymmetric scheme that uses a pair of keys for encryption: a public key, which encrypts data, and a corresponding private, or secret key for decryption. We publish our public key to the world while keeping our private key secret. Anyone with a copy of our public key can then encrypt information that only we can read. Even people we have never met.

It is computationally infeasible to deduce the private key from the public key. Anyone who has a public key can encrypt information but cannot decrypt it. Only the person who has the corresponding private key can decrypt the information.

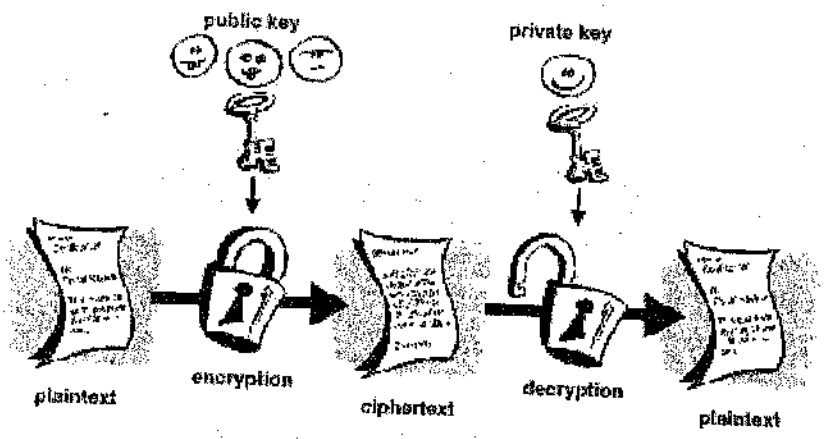


Fig. 12.2: Public key encryption

The primary benefit of public key cryptography is that it allows people who have no preexisting security arrangement to exchange messages securely. The need for sender and receiver to share secret keys via some secure channel is eliminated; all communications involve only public keys, and no private key is ever transmitted or shared.

12.2 DIGITAL SIGNATURE

A major benefit of public key cryptography is that it provides a method for employing digital signatures.

A digital signature is an electronic signature that can be used to validate the identity of the sender of a message or the signer of a document, and probably to ensure that the original content of the message or document that has been sent is unchanged. Digital signatures are easily transportable, cannot be imitated by someone else, and can be automatically time-stamped. The ability to ensure that the original signed message arrived means that the sender cannot easily repudiate it later.

A digital signature can be used with any kind of message, whether it is encrypted or not, simply so that the receiver can be sure of the sender's identity and that the message arrived intact. A digital certificate contains the digital signature of the certificate-issuing authority so that anyone can verify that the certificate is real.

Digital signatures enable the recipient of information to verify the authenticity of the information's origin, and also verify that the information is intact. Thus, public key digital signatures provide authentication and data integrity. A digital signature also provides non-denial, which means that it prevents the sender from claiming that (s)he did not actually send the information.

A digital signature serves the same purpose as a handwritten signature. However, a handwritten signature is easy to counterfeit. A digital signature is superior to a handwritten signature in that it is nearly impossible to counterfeit, plus it attests to the contents of the information as well as to the identity of the signer.

Some people tend to use signatures more than they use encryption. For example, you may not care if anyone knows that you just deposited $1000 in your account, but you do want to be darn sure it was the bank teller you were dealing with.

The basic manner in which digital signatures are created is illustrated in Figure 1-6. Instead of encrypting information using someone else's public key, you encrypt it with your private key. If the information can be decrypted with your public key, then it must have originated with you.

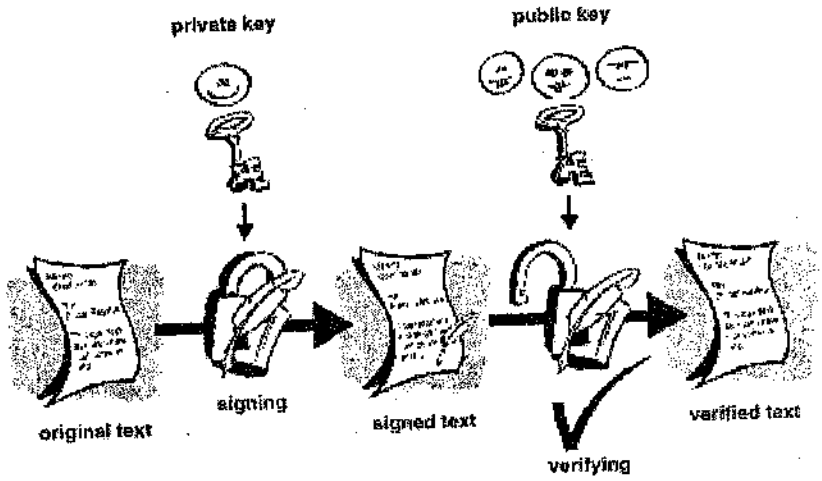


Fig. 12.3: Simple digital signatures

12.3 SMART TECHNOLOGY

Smart Card or Chip card technology is fast becoming commonplace in our culture and daily lives.

Smart Card

A smart card, typically a type of chip card, is a plastic card that contains an embedded computer chip–either a memory or microprocessor type–that stores and transacts data. This data is usually associated with either value, information, or both and is stored and processed within the card's chip. The card data is transacted via a reader that is part of a computing system. Systems that are enhanced with smart cards are in use today throughout several key applications, including healthcare, banking, entertainment, and transportation. All applications can benefit from the added features and security that smart cards provide.

Smart cards improve the convenience and security of any transaction. They provide tamper-proof storage of user and account identity. Smart card systems have proven to be more reliable than other machine-readable cards, like magnetic stripe and barcode, with many studies showing card read life and reader life improvements demonstrating much lower cost of system maintenance. Smart cards also provide vital components of system security for the exchange of data throughout virtually any type of network. They protect against a full range of security threats, from careless storage of user passwords to sophisticated system hacks. The costs to manage password resets for an organization or enterprise are very high, thus making smart cards a cost-effective solution in these environments.

Smart cards can be classified as contact smart cards and contactless smart cards.

Contact Smart Card: A smart card that operates by physical contact between the reader and the smart card's different contacts

Contactless Smart Card: A smart card with no visible module that communicates by means of a radio frequency signal. There is no need of physical contact between the card and a reader

Smart Tags

Another application based on this concept is the SmartTag. An implementation of which can be found in India. The following is the description of the same from, http://www.dgexpressway.com/smarttags.htm

The Smart Tag allows a motorist to travel non-stop through the toll plaza. It is an electronic device the size of a computer mouse which is installed in the windscreen behind the rear view mirror of your vehicle. It is charged with the denomination of our choice and has the capability of interacting with sensors placed at the toll gates. Which means that all we have to do is to slow down to 20 Km/hr i.e. we don't have to stop, near

the toll gates, the sensor at the gates interact with our Smart Tag, the transaction is recorded and the toll deducted, we hear a confirmation beep inside our car and we are off. All of this takes less than a second and is extremely convenient to commuters and the best way to do away with waiting periods at the toll gates. Smart tag works like a debit card, it has no expiry and we can use it till we keep re-charging the amount in our account. Designated lanes for Smart Tag holders have been created to ensure a seamless drive through.

12.4 SUMMARY

This unit provided an introduction to cryptography and also introduced the readers to digital signatures. A brief on smart cards and smart tags has also been provided.

12.5 GLOSSARY

Cryptography: Cryptography is the science of using Mathematics to encrypt and decrypt data.

Digital Signature: A digital signature is an electronic signature that can be used to validate the identity of the sender of a message or the signer of a document.

Smart Card: A smart card, is a plastic card that contains an embedded computer chip–either a memory or microprocessor type–that stores and transacts data.

12.6 FURTHER READINGS

1. Tanenbaum, A.S., Computer Networks, 4th edition, Prentice Hall, 2003
2. www.pgpi.org/doc/pgpintro/
3. http://www.smartcardbasics.com/smart-card-overview.html
4. http://www.dgexpressway.com/smarttags.htm

12.7 UNIT END QUESTIONS

1. What is Cryptography?
2. What are the types of cryptography?
3. What is the significance of Digital Signatures?
4. What are Smart Cards?
5. Discuss applications of Smart Cards.
6. How have the Smart tags proved beneficial in controlling traffic issues?

UNIT 13: MANAGEMENT INFORMATION SYSTEM

Structure of the Unit

13.0 OBJECTIVES

This unit describes the meaning, characteristics, role, functions and structure of MIS.

13.1 INRODUCTION AND DEFINITION

MIS Definition: -

The MIS has more than one definition, some of which are give below.

1. The MIS is defined as a system which provides information support for decision making in the organization.

2. The MIS is defined as an integrated system of man and machine for providing the information to support the operations, the management and the decision making function in the organization.

3. The MIS is defined as a system based on the database of the organization evolved for the purpose of providing information to the people in the organization.

4. The MIS is defined as a Computer based Information System.

Though there are a number of definitions, all of them converge on one single Point, i.e., the MIS is a system to support the decision making function in the organization.

A management information system (MIS) is a system or process that provides information needed to manage organizations effectively. Management information systems are regarded to be a subset of the overall internal controls procedures in a business, which cover the application of people, documents, technologies, and procedures used by management accountants to solve business problems such as costing a product, service or a business-wide strategy. Management information systems are distinct from regular information systems in that they are used to analyze other information systems applied in operational activities in the organization. Academically, the term is commonly used to refer to the group of information management methods tied to the automation or support of human decision making, e.g. Decision Support Systems, Expert systems, and Executive information systems.

13.2 CHARACTERISTICS OF MIS

MIS provide Information to the manager in the organization to take decision or it also known as information system or computer based information system.

MIS provide Varity of report and document to the management.

MIS retrieve information about internal operation from database.

MIS also obtain data about the business environment from external environment.

MIS play as an important role in the management of any enterprise such as small, medium, large organization.

MIS as a system can be broken down into subsystems.

MIS aid middle level managers in taking regular & repetitive decisions that are tactical in nature.

Information system has been classified as Decision Support Systems (for top level, strategic decisions), Management Information Systems (for middle level, strategic decisions) & Transaction Process Systems (for operational levl, transaction processing).

The MIS lies at the middle level of the information system pyramidal structure and interacts with the Decision Support System (DSS) and the Transaction Processing System (TPS).

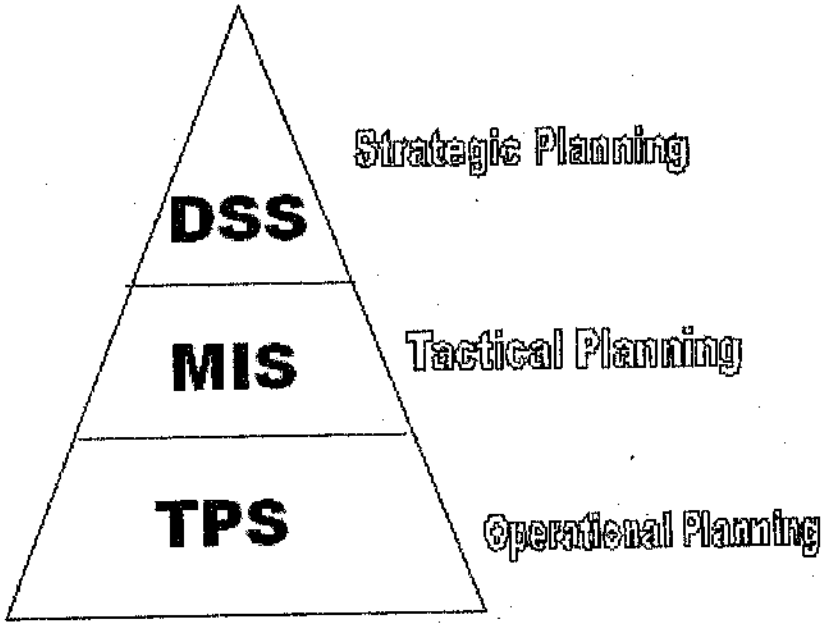


Fig. 13.1: Information Systems

13.3 FUNCTION OF MIS

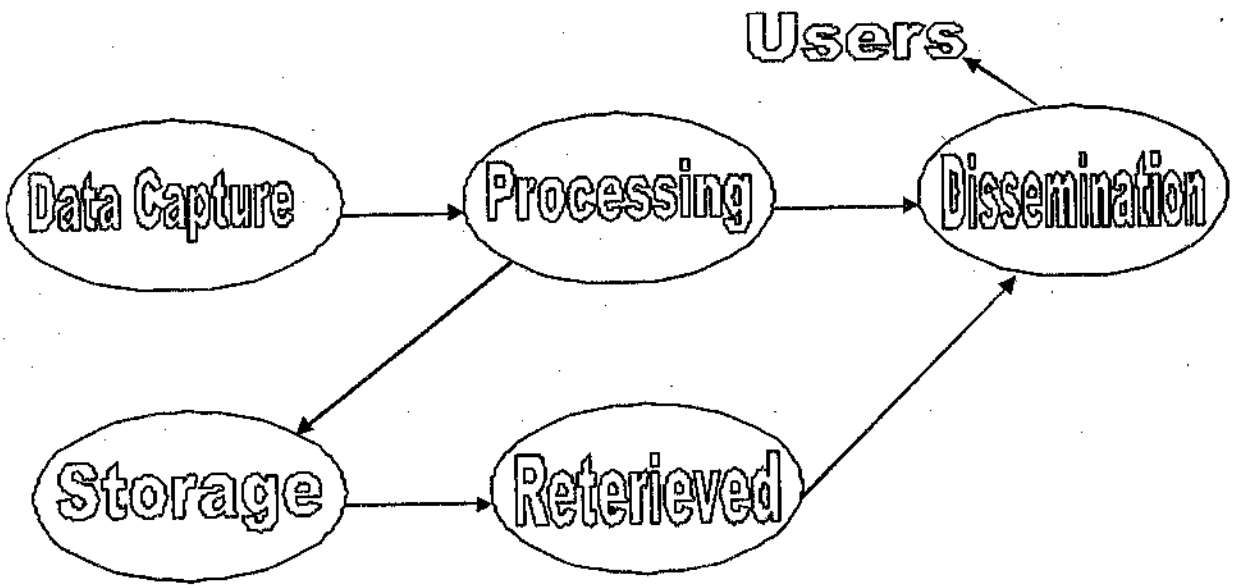


Fig. 13.2: MIS Functions

MIS is a system which can do collection, transmission, storage, processing, maintenance and use of information, composed of human, computer and other peripheral equipments. As an emerging science, the main task of it is to strengthen the information management of enterprises by taking advantage of modern computer and network communication technology to the largest extent, and set up the correct data based on the research of human resource, financial resource, equipments, technology, etc. owned by enterprises, and provide timely various of processed and systemized information data to the manager so as to make correct decisions and improve continuously the management level and economic benefits of enterprises.

At present, MIS of enterprises has been the main resort to reform technology and improve the management level. The office and management of an enterprise will be towards an effective, rapid and paperless direction. MIS is generally used for system decision-making. For instance, enterprise employee can make use of MIS to find out problems that need to be solved urgently and feedback in time to the upper managers in

order to make them understand the current progress and its shortages. The main functions of MIS are as follows:

1. **Data processing:** - It includes the collection, transmission, storage, processing and output of data. It simplifies the statistics and reduces to the lowest cost by supplying a unified format.
2. **Function of prediction:** - It predicts the future situation by applying modern mathematics, statistics or simulation.
3. **Function of plan:** -It arranges reasonably the plans of each functional department in accordance with the restrictions afforded by enterprises and provides the appropriate planning reports according to different management.
4. **function of control :** -It monitors and inspects the operation of plans and comprises with the differences between operation and plan in accordance with the data afforded by every functional department, and be assistant to managers to control timely each method by analyzing the reasons why the differences comes into being.
5. **function of assistance :** - It derivates instantly the best answers of related problems by applying to various of mathematics' mode and analyzing a plentiful data stored in computers in the hope of using rationally human resource, financial resource, material resource and information resource for relative abundant economic benefits.
6. The Basic characteristics of an effective Management Information System are as follows
7. **Management-oriented:** The basic objective of MIS is to provide information support to the management in the organization for decision making. So an effective MIS should start its journey from appraisal of management needs, mission and goal of the business organization. It may be individual or collective goals of an organization. The MIS is such that it serves all the levels of management in an organization i.e. top, middle and lower level.
8. **Management directed:** When MIS is management-oriented, it should be directed by the Management because it is the management who tells their needs and requirements more effectively than anybody else.
9. Manager should guide the MIS professionals not only at the stage of planning but also on development, review and implementation stages so that effective system should be the end product of the whole exercise in making an effective MIS.
10. **Integrated:** It means a comprehensive or complete view of all the sub systems in the Organization of a company. Development of information must be integrated so that all the operational and functional information sub systems should be worked together as a single entity. This integration is necessary because it leads to retrieval of more meaningful and useful information.
11. **Common data flows:** The integration of different sub systems will lead to a common data flow which will further help in avoiding duplicity and redundancy in data collection, storage and processing. For example, the customer orders are the basis for many activities in an organization viz. billing, sales for cashing, etc. Data is collected by a system analyst from its original source only one time. Then he utilizes the data with minimum number of processing procedures and uses the information for production output documents and reports in small numbers and eliminates the undesirable data. This will lead to elimination of duplication that simplify the operations and produce an efficient information system.
12. **Heavy planning-element:** The preparation of MIS is not a one or two day exercise. It usually takes 3 to 5 years and sometimes a much longer period. So the system expert has to keep 2 things in mind – one is that he has to keep future objectives as well as the firm's information well in advance and also he has to keep in mind that his MIS will not be obsolete before it gets into action.

13. **Sub System concept:** When a problem is seen in 2 sub parts, then the better solution to the problem is possible. Although MIS is viewed as a single entity but for its effective use, it should be broken down in small parts or subsystems so that more attention and insight is paid to each sub system. Priorities will be set and phase of implementation will be made easy. While making or breaking down the whole MIS into subsystems, it should be kept in mind that the subsystems should be easily manageable.

14. **Common database:** This is the basic feature of MIS to achieve the objective of using MIS in business organizations. It avoids duplication of files and storage which leads to reduction in costs. Common database means a "Super file or Master file" which consolidates and integrates data records formerly stored in many separate data files. The organization of the database allows it to be accessed by each subsystem and thus, eliminates the necessity of duplication in data storage, updating, deletion and protection.

15. **Computerized:** MIS can be used without a computer. But the use of computers increases the effectiveness and the efficiency of the system. The queries can be handled more quickly and efficiently with the computerized MIS. The other benefits are accuracy, storage capacity and timely information.

16. **User friendly/Flexibility :** An MIS should be flexible i.e. there should be room for further modification because the MIS takes much time in preparation and our environment is dynamic in nature.MIS should be such that it should be used independently by the end user so that they do not depend on the experts.

17. **Information as a resource:** Information is the major ingredient of any MIS. So, an MIS should be treated as a resource and managed properly.

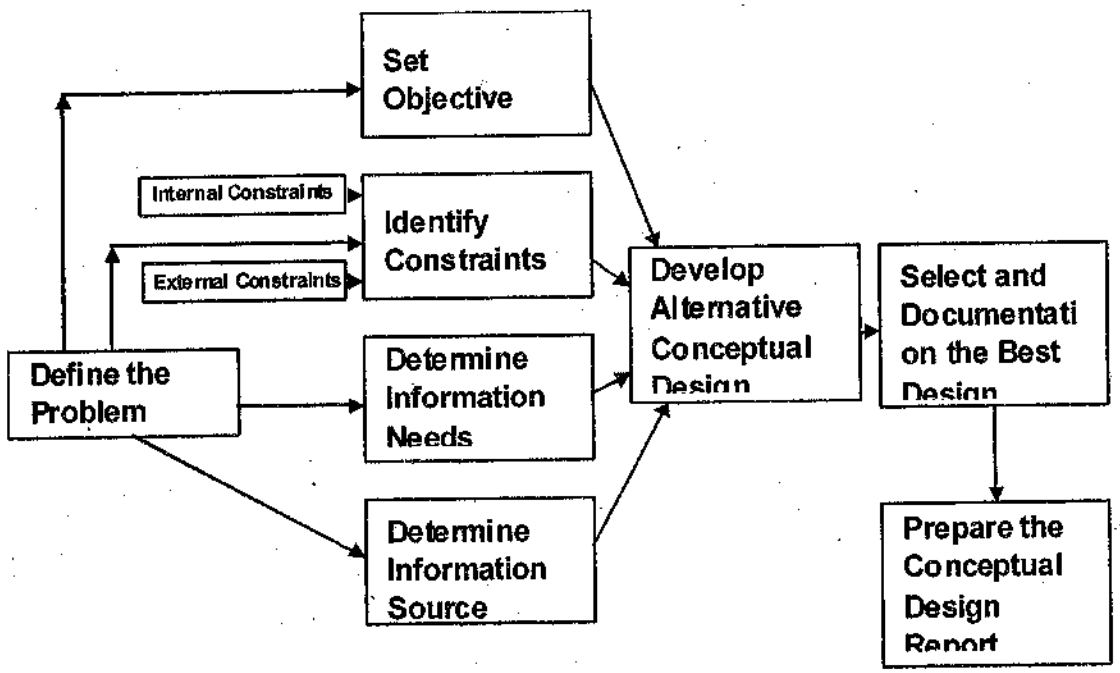


Fig. 13.3: Conceptual Design of MIS

13.4 STRUCTURE OF MIS:-

MIS for decision making:

Decision making can be classified into two types:

1. Structured, programmable decisions: -

When a decision can be programmed, an organization can prepare a decision rule or a decision procedure. This can be expressed as a set of steps to follow, a flowchart, a decision table, or a formula. The decision procedure will also specify the information to be acquired before the decision rules are applied. Since structured programmable decisions can be pre specified, many of these decisions can be handled by lower level personal with little specialized knowledge. This procedure can also be completely automated although human review may be required. The process of structured decision making includes entering the required input data, validation procedure to check the input, processing of the input using decision logic and output of the programmed decision in a form that is useful for action.

2. Unstructured, non programmable decisions;-

The unstructured decision has no pre-established decision procedure either because the decision is too in frequent to justify the cost involves in preparing the decision procedure, or because the decision process in not understood well enough, or is too changeable to establish a decision procedure. The support requirements for an unstructured decision making include access to data and a variety of analysis & decision procedures. The data requirements are not completely know in advance hence data retrieval must allow ad hoc retrieval requests.

MIS Structure based on Management activity: -

MIS supports management activities. This means that the structure of an information system can be classified in terms of hierarchy of management planning and control activities.

Hierarchy of Management activities –

1. **Strategic Planning** – Definition of goals, policies, objectives and general guidelines for an organization.

2. **Management control and tactical planning** – Acquisition of resources, tactics, plant Location, new products. Establishment and monitoring of budgets.

3. **Operational planning and control** – Effective and efficient use of existing facilities and Resources to carry out activities within budget constraints.

The following 3 sections summarize the characteristics of information system support for the 3 levels of hierarchy of Management planning and control.

1. **Operational Control** – This is a process of ensuring that the operational activities are carried out effectively and efficiently. A large % of decisions are programmable and the procedure used is quite stable. It makes use of pre-established procedures and decision rules. Individual transactions are often important; hence the system must be able to respond to both individual transactions and summaries of transactions. The data required for this process is generally current and the sequence of processing is often significant.

Processing support for operational control consists of: -

-Transaction processing – Inventory withdrawal transaction can examine balance on Hand, calculate order quantity, produce action document.

- Enquiry processing – An enquiry for personal files describing the requirement for a Position.
- Report processing – A report showing orders still outstanding after 30 days.

2. Management Control – This system is required by managers of departments, profit Centers to measure performance, decision on control actions, formulate new decision rules and allocate resources. Summary information is needed and it must be processed so that trends may be observed, reasons for performance variations and solutions may be suggested.

The control process requires the following types of information:

1. Planned performance – To assist managers in finding problems and reviewing plans and budgets. It projects the effect of current action.

2. Variance from planned performance – This report shows performance and variations from planned performance.

3. Problem analysis models to analyze data to provide input for decision making.

4. Decision models to analyze a problem situation and provide possible solutions.

5. Inquiry model to provide assistance to enquiries.

3. Strategic Planning – The purpose of strategic planning is to develop strategies by which an organization will be able to achieve its objectives. These activities do not occur on a Periodic basis. Data required for strategic planning are generally for processed.

13.5 ROLE OF THE MANAGEMENT INFORMATION SYSTEM: -

The role of the MIS in an organization can be compared to the role of heart in the body. The information is the blood and MIS is the heart. In the body the heart plays the role of supplying pure blood to all the elements of the body including the brain.

The heart works faster and supplies more blood when needed. It regulates and controls the incoming impure blood, processes it and sends it to the destination in the quantity needed. It fulfills the needs of blood supply to human body in normal course and also in crisis.

The MIS plays exactly the same role in the organization. The system ensures that an appropriate data is collected from the various sources, processed, and sent further to all the needy destinations. The system is expected to fulfill the information needs of an individual, a group of individuals, the management functionaries: the managers and the top management.

The MIS satisfies the diverse needs through a variety of systems such as Query Systems, Analysis Systems, Modeling Systems and Decision Support Systems the MIS helps in Strategic Planning, Management Control, Operational Control and Transaction Processing.

The MIS helps the clerical personnel in the transaction processing and answers their queries on the data pertaining to the transaction, the status of a particular record and references on a variety of documents.

The MIS helps the junior management personnel by providing the operational data for planning, scheduling and control, and helps them further in decision making at the operations level to correct an out of control situation.

The MIS helps the middle management in short them planning, target setting and controlling the business functions. It is supported by the use of the management tools of planning and control.

The MIS helps the top management in goal setting, strategic planning and evolving the business plans and their implementation.

The MIS plays the role of information generation, communication, problem identification and helps in the process of decision making. The MIS, therefore, plays a vita role in the management, administration and operations of an organization.

13.6 APPLICATIONS OF MIS: -

Financial Management: -

Financial MIS Provides financial information to all financial managers within an organization. It integrates financial & operational information from multiple sources. Financial MIS eases analysis by providing fast financial data. It enables financial analysis from different aspects; time, product, customer. With Financial MIS, one can analyze historical and current data. Also one can monitor use of funds. Few examples or functions of Financial MIS are Costing, P&L reporting, Auditing, Funds management, etc.

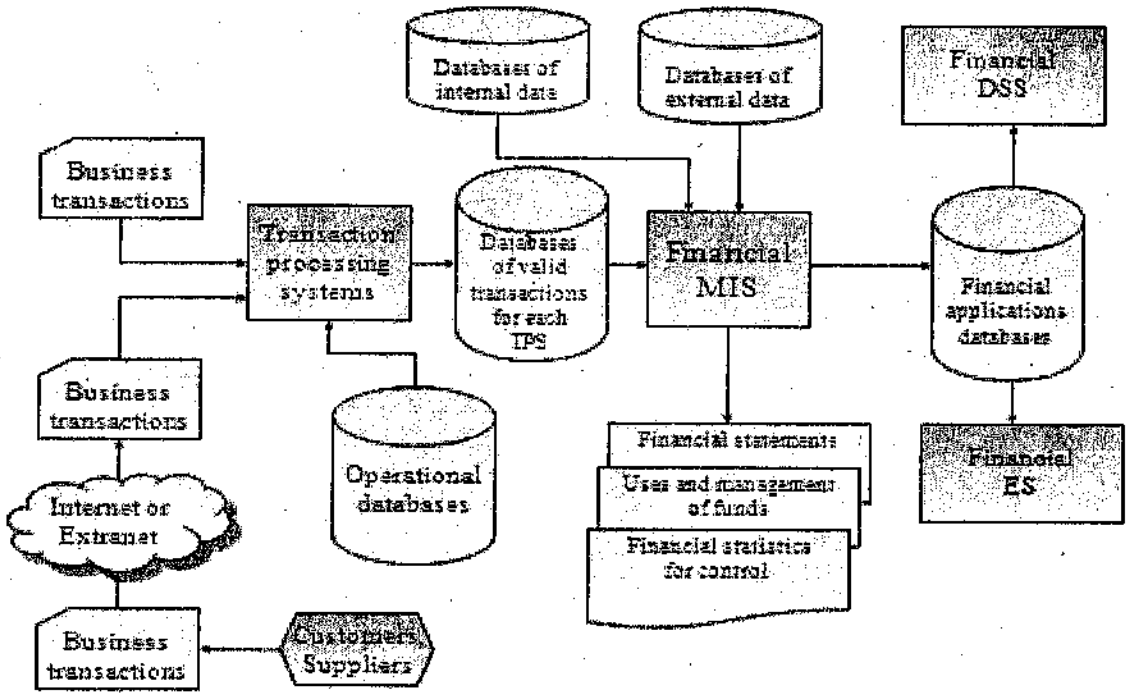


Fig. 13.4: Financial MIS

Inputs to the Financial Information System: -

- Strategic plan or corporate policies
  - o Contains major financial objectives and often projects financial needs.

Transaction processing system (TPS)

- o Important financial information collected from almost every TPS – payroll, inventory control, order processing, accounts payable, accounts receivable, general ledger.
- o External sources
- o Annual reports and financial statements of competitors and general news items.

Financial MIS Subsystems and Outputs: -

Financial subsystems

- o Profit/loss and cost systems
- o Auditing
- o Internal auditing
- o External auditing
- o Uses and management of funds

Financial management function has a primary objective of meeting the financial needs of the business, from time to time, by way of providing working capital and long-term loans to run the business with the goal of containing the cost of capital at the minimum.

The second objective of financial management is to meet the statutory compliance by way of declaring the audited financial results, submit all reports and return to the government and tax authorities and fulfill the obligations to the shareholders.

In meeting these objectives financial management uses a variety of tools and techniques as under:

1. Break Even Analysis
2. Cost Analysis .

3. Cash Flow Projections
4. Ratio Analysis
5. Capital Budgeting and ROI Analysis
6. Financial Modeling
7. Management Accounting
8. Expense Analysis, Auditing and control

Material Management: -

The objective of material management is to provide material for production, maintenance and services at economical prices, in an appropriate quantity and quality with least stock outs and with no extra cost of carrying the inventory.

Production Management: -

The objective of production management function is, to provide manufacturing services to the organization.

Production management involves the manufacture of products of a certain specified quality and within certain costs in a stipulated time fulfilling the promises given to the customer.

The production management function is supported by other functions, viz., production planning and control, industrial engineering, maintenance and quality control.

Production management has a very strong interface with material management function.

The functional goals of the production management are fuller utilization of the manufacturing capacity, minimal rejections, maximum uptime of plant and equipment and meeting the delivery promises.

Personnel Management: -

Personal Management function has the primary objective of providing suitable manpower in number and with certain ability, skills, and knowledge, as the business organization demands from time to time .Its goal is to control personnel cost through continuous increase in manpower productivity by resorting to the following techniques.

1. Human Resource Development through training and upgrading the skills.
2. Motivation through leadership and job enrichment.
3. Promotion and rewards through performance appraisal.
4. Grievance handling.
5. Structuring the organization.

13.7 SUMMARY

- A management information system (MIS) is a system or process that provides information needed to manage organizations effectively. Management information systems are regarded to be a subset of the overall internal controls procedures in a business, which cover the application of people, documents, technologies, and procedures used by management accountants to solve business problems such as costing a product, service or a business-wide strategy.
- MIS provide Information to the manager in the organization to take decision or it also known as information system or computer based information system.
- The role of the MIS in an organization can be compared to the role of heart in the body. The information is the blood and MIS is the heart. In the body the heart plays the role of supplying pure blood to all the elements of the body including the brain.
- The MIS helps the top management in goal setting, strategic planning and evolving the business plans and their implementation.
- Financial MIS Provides financial information to all financial managers within an organization. It integrates financial & operational information from multiple sources. Financial MIS eases analysis

by providing fast financial data. It enables financial analysis from different aspects; time, product, customer.

- The objective of material management is to provide material for production, maintenance and services at economical prices, in an appropriate quantity and quality with least stock outs and with no extra cost of carrying the inventory.
- The objective of production management function is, to provide manufacturing services to the organization.
- Personal Management function has the primary objective of providing suitable manpower in number and with certain ability, skills, and knowledge, as the business organization demands from time to time .Its goal is to control personnel cost through continuous increase in manpower productivity by resorting to the following techniques.
- Decision support system (DSS) is a computer-based information system that supports business or organizational decision-making activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

13.8 GLOSSARY

IS - is an integrated set of components for collecting, storing, processing & communicating information.

MIS - Converts data into information and aids middle managers in tactical decisions

DSS - An IS that supports strategic business decision making activities

TPS - An IS to collect, store, modify and retrieve the transactions of an organisation.

13.9 FURTHER READINGS

1. W.S. Jawadekar, Management Information System: Text and Cases, TMH publishers

2. Laudon & Laudon, Management Information System, Pearson Education

13.10 UNIT-END QUESTIONS

1) What is MIS, and how it helps in the organization? Explain the MIS through the integration model.
2) What is system?
3) What are the characteristics of system?
4) What is the role of MIS?
5) Explain the applications of MIS.
6) How many type of function used by MIS?
7) Define the conceptual design of MIS.
8) What is structure of MIS?
9) Explain the management activity in the MIS.
10) How many type of information requires for the controlling the process.
11) Explain the financial MIS.
12) What is DSS?

UNIT 14: E-COMMERCE

Structure of the Unit

14.0 OBJECTIVES

At the end of this unit students will be familiar with the concept, use, application and technology of e-commerce.

14.1 INTRODUCTION TO E-COMMERCE:

E-commerce (electronic commerce), is online commerce verses real-world commerce. It means buying and selling of goods and services across the internet, especially the World Wide Web. E-commerce includes retail shopping, banking, stocks and bonds trading, auctions, real estate transactions, airline booking, movie, etc.

E-Business is the creation of new, and the redesigning of existing value chains and business processes through the application of information technology. E-Business is more than e-commerce. It is a subset of e-business, it is the purchasing, selling, and exchanging of goods and services over computer networks (such as the Internet) through which transactions or terms of sale are performed electronically.

A further definition of e-commerce is provided at a European Union web site (Esprit, 1977):

"Electronic commerce is a general concept covering any form of business transaction or information exchange executed using information and communication technology, between companies, between companies and their customers, or between companies and public administrations."

Electronic commerce includes electronic trading of goods, services and electronic material.

E-Commerce or electronic commerce involves carrying out business over the Internet with the assistance of computers, which are linked to each other forming a network. To be specific ecommerce would be buying and selling of goods and services and transfer of funds through digital communications.

14.2 ADVANTAGES OF E-COMMERCE

The major advantages of e-commerce are:

1. **Global Market**: The most important advantage of e-commerce is that it enables a business concern or individual to reach the global market. It caters to the demands of both the national and the international market, as your business activities are no longer restricted by geographical boundaries. We can access the global market for selling and purchasing products and services. Even time restrictions are nonexistent while conducting businesses.
2. **Lower Cost**: The direct cost-of-sale for an order taken from a web site is lower than through traditional means (retail, paper based), Electronic commerce gives the customers the opportunity to look for cheaper and quality products. using e-commerce, consumers can easily search on a specific product and sometimes even find out the original manufacturer to purchase a product at a much cheaper price than that charged by the wholesaler. Shopping online is more convenient and time saving than conventional shopping
3. **Faster:** As there is no human interaction during the on-line electronic purchase order process. Also, electronic selling virtually eliminates processing errors, as well as being faster and more convenient for the visitor.
4. **Less Time**: The strategic benefit of making a business 'e-commerce enabled', is that it helps reduce the delivery time ,it reducing both the time and personnel required to complete business processes, and reducing strain on other resources.
5. **Better customer services**: It reduces the time period involved with business process re-engineering, customization of products to meet the demand of particular customers, increasing productivity and customer care services.

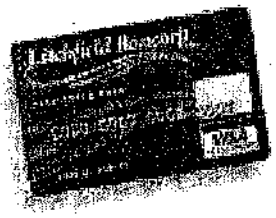
6. **Easy to business**: Electronic commerce reduces the burden of infrastructure to conduct businesses and thereby raises the amount of funds available for profitable investment. It collects and manages information related to customer behavior, which in turn helps develop and adopt an efficient marketing and promotional strategy.

14.3 ELECTRONIC PAYMENT SYSTEM

Electronic Payment is a financial exchange that takes place online between buyers and sellers. An **e-commerce payment system** facilitates the acceptance of electronic payment for online transactions. It is essential for all online businesses to be able to accept and process electronic payments in a fast and secure way .The content of electronic exchange is usually some form of digital financial instrument (such as encrypted credit card numbers, electronic cheque or digital cash) that is backed by a bank or an intermediary, or by a legal tender. Electronic payments systems can also increase cash flow, reduce administrative costs and labor and provide yet another way for the customers to pay. There are mainly two types of money transfers token based and token less money transfer .In token based money , options are ATM, Debit card , Credit card, Smart card etc. and token less money transactions are e cheque ,e cash etc.

14.3.1 ATM Card:

An **ATM card** is an example of token based money transfer, it is a card issued by a bank Or credit



union. It can be used at an Auto teller machine for deposits, withdrawals, account information, and other types of transactions, often through interbank networks.

A Smartcard is similar to a credit card; however it contains an embedded 8-bit microprocessor and uses electronic cash which transfers from the consumers' card to the sellers' device. A popular smartcard initiative is the VISA Smartcard. Using the VISA Smartcard you can transfer electronic cash to your card from your bank account, and you can then use your card at various retailers and on the internet.

14.3.2 Credit Card:

A credit card is an example of token based money. Credit cards have become one of the most common forms of payment for e-commerce transactions .It is plastic card, with a magnetic strip or

an embedded microchip, connected to a credit account and used to buy goods or services it may be used repeatedly to borrow money or buy products and services on credit. It is issued by banks, savings and loans, retail stores and other businesses. It has credit limit used to purchase goods and services and to obtain cash advances on credit. The cardholder is then billed by the issuer for repayment of the credit extended.

It allows you to make partial or monthly payments for purchases, but charges interest on the amount owed. You can also pay your balance in full to avoid interest payments. Banks and other card issuers set interest rates and fees.

14.3.3 Debit Card:

ATM (Automated Teller Machine) debit card is a multifaceted, powerpacked globally accepted plastic debit card which enables one to access ones account from anywhere. It is directly linked to a cardholder's bank account. Whenever a card holder withdraws money from an ATM or uses the debit card for making payments, his/her account balance is automatically reduced. The ATM debit card has the name of the debit card holder embossed on the debit card.

Both debit cards and credit cards offered by the same financial institutions but Debit cards and credit cards differ in some significant ways In the case of a credit card, the issuer offers credit and overdraft facilities. This facility is not available with a debit card, which will only debit payments from existing and available funds within the cardholders account. A credit cardholder therefore has a monthly bill to pay in every month that the card is used. If they don't pay that bill, high interest charges are applied

14.3.4 E-Cash:

Electronic cash is the debit POS-system. It is a strictly PIN-based debit system where transactions are debited to the cardholder's current account immediately after presentment of the transaction by the merchant to its bank. The corresponding card is typically issued to the cardholder in combination with an account opening. The electronic cash-system is designed to contribute to the successive replacement of cash in the retail sector. One of its attractive assets is the payment guarantee given by the issuing bank.

14.3.5 E-Cheque:

Electronic cheque is a form of Electronic tokens. They are designed for many individuals and entities that might prefer to pay on credit or through some mechanism other than cash. Once registered, a buyer can then contact sellers of goods and services. To complete a transaction, the buyer sends a check to the seller for a certain amount of money. These checks may be sent using Email or other Transport methods. When deposited, the cheque authorizes the transfer of account balances from the account against which the cheque was drawn to the account to which the cheque was deposited.

The electronic cheques are modeled on paper checks, except that they are initiated electronically. They use digital signatures for signing and endorsing and require the use of digital certificates to authenticate the payer, the payer's bank and bank account. They are delivered either by direct transmission using telephone lines or by public networks such as the Internet. Cheques use conventional encryption than Public and private keys as in e-Cash, Electronic cheques are much faster. The risk is taken care of by the accounting server, which will guarantee that the cheque would be honored.

14.4 SECURE ELECTRONIC TRANSACTION

Secure Electronic Transaction (SET) is a set of security protocols and formats that enable users to employ the existing credit card payment infrastructure on an open network in a secure fashion. It is an open protocol which has the potential to emerge as a dominant force in the securing of electronic transactions it is standard protocol for securing credit card transactions over insecure networks, specifically, the Internet. SET was not itself a payment system. SET allowed parties to cryptographically identify themselves to each other and exchange information securely. SET used a blinding algorithm that, in effect, would have let merchants substitute a certificate for a user's credit-card number. If SET were used, the merchant itself would never have had to know the credit-card numbers being sent from the buyer, which would have provided verified good payment but protected customers and credit companies from fraud. SET is an open standard for protecting the privacy, and ensuring the authenticity, of electronic transactions. It is jointly developed by Visa and MasterCard, in conjunction with leading computer vendor's .It relies on the science of cryptography – the art of encoding and decoding messages.

The SET protocol relies on two different encryption mechanisms, as well as an authentication mechanism. SET uses symmetric encryption, in the form of the aging Data Encryption Standard (DES), as well as asymmetric, or public-key, encryption to transmit session keys for DES transactions (IBM, 1998). Rather than offer the security and protection afforded by public-key cryptography, SET simply uses session keys (56 bits) which are transmitted asymmetrically – the remainder of the transaction uses symmetric encryption in the form of DES. This has disturbing connotations for a "secure" electronic transaction protocol – because public key cryptography is only used only to encrypt DES keys and for authentication, and not for the main body of the transaction. The computational cost of asymmetric encryption is cited as reason for using weak 56 bit DES (IBM, 1998), however other reasons such as export/import restrictions, and the perceived need by law enforcement and government agencies to access the plain-text of encrypted SET messages may also play a role.

14.5 JOINT ELECTRONIC TRANSACTION

To facilitate electronic transactions among Supply-chain partners joint transactions are prevalent. Inter-firm communication and interactions for joint electronic transactions and potential collaboration between supply chain partners is made easy through this concept.

14.6 SECURITY THREAT TO E COMMERCE:

Threat is a risk and vulnerability over the transaction. It is especially important for e commerce transaction if we are performing e commerce transactions it may happen that our system or data may be hacked in the network. It is important that we understand the risks facing in e-commerce system, and the potential impact of any security incident. There is security issues associated with E-Commerce.

E-Commerce is the transaction of goods and services and the payment for those goods and services over the Internet. Therefore, the physical place where all of these transactions occur is at the Server level. The server can be viewed as the central repository for your "E-Commerce Place of Business", which consists of the actual website which displays your products and services, the customer database, and the payment mechanism]. If there are any attacks to this server, in one blow, there is the potential you could lose everything. Thus, being proactive about security takes on a much greater magnitude now.

Threats to E-Commerce servers fall into two general categories: (a) Threats from an actual attacker(s) and (b) Technological failure

The intent is to garner personal information from people for the sheer purposes of exploitation (such obtaining Credit Card and Bank Account information; Phishing schemes, obtaining usernames and passwords, etc.). With the latter, anything related to the Internet can cause problems. This can be anything from a network not configured properly to data packets being lost, especially in a wireless access environment. Even poorly written programming code upon which your E-Commerce site was developed can be very susceptible to threats. The biggest threats to E-Commerce customers are that of Phishing. Specifically, Phishing can be defined as "the act of sending an e-mail to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft.

The direct threats to E-Commerce servers can be classified as either (1) Malicious Code Threats; or (2) Transmission Threats. With the malicious or rogue programming code is introduced into the server in order to gain access to the system resources. Very often, the intent of Malicious Code Attacks is to cause large scale damage to the E-Commerce server. With the latter, the threats and risks can be classified as either as active or passive. With passive threats, the main goal is to listen (or eavesdrop) to transmissions to the server. With active threats, the intent is to alter the flow of data transmission or to create a rogue transmission aimed directly at the E-Commerce server.

Malicious Code Attacks

The most common threat under this category is the worms and viruses. A virus needs a host of some sort in order to cause damage to the system. The exact definition is "... a virus attaches itself to executable code and is executed when the software program begins to run or an infected file is opened."

Worms are infecting system. A worm does not need a host to replicate. Rather, the worm replicates itself through the Internet, and can literally infect millions of computers on a global basis

Transmission Threats

Another type of threat is Service Attack; the main intention is to deny our customers the services provided on the E-Commerce server. There is no actual intent to cause damage to files or to the system, but the goal is to literally shut the server down. This happens when a massive amount of invalid data is sent to the server. Because the server can handle and process so much information at any given time, it is unable to keep with the information and data overflow. As a result, the server becomes "confused", and subsequently shuts down.

Data Packet Sniffing

This refers to the use of Data Packet Sniffers. While it is an invaluable tool to the Network Administrator for troubleshooting and diagnosis, an attacker can also use a sniffer to intercept the data packet flow and analyze the individual data packets. Usernames, passwords, and other confidential customer data can then be hijacked from the E-Commerce server. This is a very serious problem, especially in wireless networks, as the data packets literally leave the confines of the network cabling and travel in the air. Ultimately, Data Packet Sniffing can lead to hijacking sessions. This is when the attacker eventually takes control over the network connection, kicks off legitimate users (such as your customers) from the E-Commerce server, and ultimately gains control of it.

IP Spoofing

Another type of threat is to change the source address of a data packet to give it the appearance that it originated from another computer. With IP Spoofing, it is difficult to identify the real attacker, since all E-Commerce server logs will show connections from a legitimate source.

Port Scanning

This is from the network ports of the E-Commerce server. When conducting such a scan, an attacker can figure out what kind of services are running on the E-Commerce server, and from that point figure out the vulnerabilities of the system in order to cause the greatest damage possible.

Trapdoors/Backdoors

When developing the code for an E-Commerce site, developers often leave "trapdoors" or "backdoors" to monitor the code as it is developed. Instead of a implementing a secure protocol in which to access the code, backdoors provide a quick way into the code. While it is convenient, trapdoors can lead to major security threats if they are not completely removed prior to the launch of the E-Commerce site. an attacker is always looking first for vulnerabilities in the E-Commerce server. Trapdoors provide a very easy vulnerability for the attacker to get into, and cause system wide damage to the E-Commerce server.

14.7 SUMMARY

"Electronic commerce is a general concept covering any form of business transaction or information exchange executed using information and communication technology, between companies, between companies and their customers, or between companies and public administrations."

Electronic commerce includes electronic trading of goods, services and electronic material.

Advantage of E-commerce

* Global market
* Lower cost

* Faster
* Less Time
* Better customer services
* Easy to business

An **e-commerce payment system** facilitates the acceptance of electronic payment for online transactions.

* An **ATM card** is an example of token based money transfer, it is a card issued by a bank or credit union. It can be used at an Auto teller machine for deposits, withdrawals, account information, and other types of transactions, often through interbank networks.
* A credit card is an example of token based money. Credit cards have become one of the most common forms of payment for e-commerce transactions.
* ATM (Automated Teller Machine) debit card is a multifaceted, power packed globally accepted plastic debit card which enables one to access ones account from anywhere. It is directly linked to a cardholder's bank account.
* Electronic cash is the debit POS-system. It is a strictly PIN-based debit system where transactions are debited to the cardholder's current account immediately after presentment of the transaction by the merchant to its bank.
* Electronic cheque is a form of Electronic tokens. They are designed for many individuals and entities that might prefer to pay on credit or through some mechanism other than cash.

- Secure Electronic Transaction (SET) is a set of security protocols and formats that enable users to employ the existing credit card payment infrastructure on an open network in a secure fashion.
- SET used a blinding algorithm that, in effect, would have let merchants substitute a certificate for a user's credit-card number.
- SET uses symmetric encryption, in the form of the aging Data Encryption Standard (DES), as well as asymmetric, or public-key, encryption to transmit session keys for DES transactions (IBM, 1998).

14.8 GLOSSARY

E-commerce- E-commerce (electronic commerce), is online commerce verses real-world commerce.

Electronic Payemnt System - Electronic Payment is a financial exchange that takes place online between buyers and sellers

Secure Electronic Transaction - Secure Electronic Transaction (SET) is a set of security protocols and formats that enable users to employ the existing credit card payment infrastructure on an open network in a secure fashion.

14.9 FURTHER READINGS

1. Doing Business on the Internet E-COMMERCE (Electronic Commerce for Business): S. Jaiswal, Galgotia Publications.
2. E-Commerce An Indian Perspective: P.T.Joseph, S.J., PHI.
3. E-Commerce Business.Technology. Society, Kenneth C. Laudon, Carol Guericó Traver, Pearson Education.
4. E-Commerce: Schneider, Thomson Publication

14.10 UNIT-END QUESTIONS

1.) What is E-commerce?

2.) What are the advantages of E-commerce?

3.) What is the difference between the ATM card and Credit Card?

4.) Explain the SET working.

5.) What is IP Spoofing?

6.) What is Security threat to e-commerce?

7.) How EPS work in E-commerce?

8.) "A Smartcard is similar to a credit card "prove it?

9.) How the server becomes "confused", and subsequently shuts down?

10.) In which EPS technique encryption than Public and private keys are used?

11.) How to affect the virus and worms to the system.

12.) What is the full form of ATM?