

Information Technology and Management Information System



Block - I

Block Title : Introduction to Computers

UTTARAKHAND OPEN UNIVERSITY

SCHOOL OF MANAGEMENT STUDIES AND COMMERCE

University Road, Teenpani By pass, Behind Transport Nagar, Haldwani- 263 139

Phone No: (05946)-261122, 261123, 286055

Toll Free No.: 1800 180 4025

Fax No.: (05946)-264232, e-mail: info@uou.ac.in, som@uou.ac.in

<http://www.uou.ac.in>

www.blogsomcuou.wordpress.com

Board of Studies

Professor Nageshwar Rao
Vice-Chancellor
Uttarakhand Open University
Haldwani

Professor R.C. Mishra (Convener)
Director
School of Management Studies and Commerce
Uttarakhand Open University
Haldwani

Professor Neeti Agarwal
Department of Management Studies
IGNOU
New Delhi

Dr. L.K. Singh
Department of Management Studies
Kumaun University
Bhimtal

Dr. Abhradeep Maiti
Indian Institute of Management
Kashipur

Dr. K.K. Pandey
O.P. Jindal Global University
Sonipat

Dr. Manjari Agarwal
Department of Management Studies
Uttarakhand Open University
Haldwani

Dr. Gagan Singh
Department of Commerce
Uttarakhand Open University
Haldwani

Er. Sumit Prasad
Department of Management Studies
Uttarakhand Open University
Haldwani

Programme Coordinator

Dr. Manjari Agarwal
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Units Written By		Unit No.
<i>Text material developed by</i>	Manish Anand	
<i>Typeset by</i>	Atharav Writer, Delhi	

Editor(s)

Er. Sumit Prasad
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Er. Subodh Prasad
Assistant Professor
Department of Information Technology
College of Technology
G.B. Pant University of Agriculture & Technology
Pantnagar

ISBN : 978-93-85740-12-1
Copyright : Uttarakhand Open University
Edition : 2016 (Restricted Circulation)
Published by : Uttarakhand Open University, Haldwani, Nainital - 263 139
Printed at : Laxmi Publications (P) Ltd., New Delhi
DUO-8151-51.92-INFO TECH MGMT INFO B-I

CONTENTS

Units	Page No.
1. Introduction to Computers	1
2. Components of Computer System and Indian Computing Environment	19
3. Generation of Computer	38
4. Number System and Computer Arithmetic	61

Course Credit: 6

Course Objective: The objective of the course is to familiarize the students with the basics of computer, its operations, processing and storage and utility of information technology in managerial applications.

Block I: INTRODUCTION TO COMPUTERS

Unit I: Computers—An Introduction

Computers—An Introduction—Computers in Business: Elements of Computer System Setup

Unit II: Components of Computer System and Indian Computing Environment

Components of Computer System and Indian Computing Environment: Role of Computers in Management

Unit III: Generation of Computer

Computer Technology and Programming Language

Unit IV: Number System and Computer Arithmetic

Block II: HARDWARE AND SOFTWARE

Unit V: Types of Computers

(Analog, Digital Hybrid, Micro and Mini Computers, Main Frame Computers and Super Computer)

Unit VI: Input/Output Units

Unit VII: Hardware Troubleshooting

Unit VIII: Operating System Concepts

Unit IX: Software—Languages and Packages

Unit X: Data Files

Types, Master Transactional File, Management of Data Processing System in Business Organisations

Block III: SOFTWARE PACKAGES

Unit XI: MS Office

Introduction to MS Office, MS Word—Text Manipulation, Usage of Spell Checks, Text Formatting, Picture and Tables Insertion

Unit XII: MS-Excel

Unit XIII: MS Power Point and MS Access

Unit XIV: Management of Data Processing System in Business Organisations

Block IV: NETWORKING

Unit XV: Introduction to Networking

Introduction to Networking—LAN, WAN, *etc.*, Uses of Computer Network, Network Structure, Topology-Star, Bus, Ring, *etc.*

Unit XVI: Internet and Intranet

Internet and Intranet—World Wide Web, IP Address, Different Applications of Internet

Unit XVII: Basics of Information Security

Block V: MANAGEMENT INFORMATION SYSTEM

Unit XVIII: Introduction to MIS

Management Information System (MIS) – Definition, Characteristics, Subsystem of MIS (Activity and Function Subsystems), MIS and Top Management

Unit XIX: Structure of MIS

Structure of MIS (Conceptual and Physical Structure), MIS Planning and Control

Unit XX: MIS Master Plan – Content and Description

MIS Master Plan—Content and Description, Nolan Stage Model, Three Stage Model (by Bowman, Davis and Wetherbe)

Unit XXI: Organizational Information Requirements, Analysis and Resource Allocation Stage

Unit XXII: Limitations of MIS

Myths of MIS, Pitfalls of MIS, Limitations MIS

Unit XXIII: Development and Implementation of MIS

Development and Implementation of MIS: System Development Life Cycle, Different Approaches (Waterfall, Prototyping, Evolutionary Approaches, Risk Based Approaches)

Unit XXIV: Decision Support System

Decision Support System (Definition, Relationship with MIS, Evolution of DSS, Characteristics, Classification, Objectives, Components, Functions and Development of DSS)

Unit XXV: Management Information System – Problems and Suggestions

UNIT 1: COMPUTERS – AN INTRODUCTION

Structure

- 1.0 Introduction
- 1.1 Unit Objectives
- 1.2 Introduction to Computer
- 1.3 Definition of Computer
- 1.4 Importance and Characteristics of Computers
- 1.5 Functions/Operations of a Computer
- 1.6 Computers in Business
- 1.7 Elements of Computer System Setup
- 1.8 Strengths and Weaknesses of Computer
- 1.9 Difference between Computer, Human Beings and Calculator
- 1.10 Summary
- 1.11 Glossary
- 1.12 Answers to Check Your Progress
- 1.13 Terminal and Model Questions
- 1.14 References

NOTES

1.0 INTRODUCTION

Nothing has revolutionized modern life the way, rapid progress of computers, has. For better or worse, computers have infiltrated every aspect of our society. Today, computers do much more than simply compute. They make airline or railway reservation and teach on-line; some super store scanners calculate our grocery bills while keeping the store inventory; computerized telephone switching has greatly improved the telephone system and Automatic Teller Machines (ATM) let us conduct banking transactions from virtually anywhere in the world.

As computers become more widespread in the workplace, new ways to harness their potential developed. As smaller computers become more powerful, they could be linked together, or networked, to share memory space, software, and information and communicate with each other.

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to know about:

- A computer and its various parts

- The characteristics of computer
- Computer in Business
- Elements of computers system setup

NOTES

1.2 INTRODUCTION TO COMPUTER

The computer has revolutionized business and personal activities and even the way we talk and think. Nothing symbolizes modern life better than the computers. For better or worse, computers have infiltrated every aspect of our society. Today, computers do much more than simply compute. From the outset, the creation of the computer was based on the concept that a single unit would be used to perform complex calculations with greater speed and accuracy than humans could achieve. Probably, the first computer on the earth was Abacus, invented about 5,000 years ago in Japan and is still in use today. This device allows users to make computations using a system of sliding beads arranged on a rack. Early merchants used Abacus to keep trading transactions. But as the use of paper and pencil spread, particularly in Europe, Abacus lost its importance. In 1642, Blaise Pascal invented a numerical wheel calculator. This brass rectangular box, also called Pascaline, used eight movable dials to add sums up to eight figures long. Pascal's device used a base of ten to accomplish this. In 1694, Gottfried Wilhem von Leibniz, a German mathematician improved Pascaline by creating a machine that could also multiply. Like its predecessor, Leibniz's mechanical multiplier worked by a system of gears and dials. Partly by studying Pascal's original notes and drawings, Leibniz was able to refine his machine. It was not until 1820 that mechanical calculators gained widespread use. Charles Xavier Thomas de Colmar, a Frenchman, invented a machine that could perform four basic arithmetic functions. Colmar's mechanical calculator, the arithometer could add, subtract, multiply and divide. With its more practical approach to computing, the arithometer was widely used until the First World War.

The actual beginning of computers, as we know them today, lay with an English mathematician Charles Babbage. Babbage noticed a natural harmony between machines and mathematics. Machines were able to perform tasks repeatedly without mistake; while mathematics often required the simple repetition of steps. Babbage applied mathematics on machines in 1822 when he proposed a machine to perform differential equations, called 'Difference Engine'. It was large as a locomotive and powered by steam and, the machine could perform calculations and print the results automatically. After working on the Difference Engine for ten years, Babbage began to work on the first general-purpose computer, which he called 'Analytical Engine'. Babbage's Analytical Engine outlined the basic elements of a modern computer and was a breakthrough concept. Consisting of over 50,000 components, the basic design of the Analytical Engine included input devices in the form of perforated cards containing operating instructions and a memory of 1,000 numbers of up to 50 decimal

digits long. It also contained a control unit that allowed processing instructions in any sequence, and output devices to produce printed results.

In 1889, an American inventor, Herman Hollerith developed a tabulating machine to process the US census data. The previous census in 1880 had taken nearly seven years to count but with Hollerith's machine the census results were compiled in just six weeks time. Hollerith brought his machine into the business world, founding Tabulating Machine Company in 1896 [in 1924 it became International Business Machines (IBM)]. Other companies also manufactured punch readers for business use. Both business and government used punch cards for data processing until the 1960s.

In the following years, several engineers made other significant advances. Vannevar Bush developed a calculator for solving differential equations in 1931. The machine could solve complex differential equations. It was cumbersome because hundreds of gears and shafts were required to represent numbers and their various relationships to each other. To eliminate this bulkiness, John V. Atanasoff, a professor at Iowa State College envisioned an all-electronic computer that applied Boolean algebra to computer circuitry. This approach was based on the 19th century work of George Boole who clarified the binary system of algebra, which stated that any mathematical equations could be stated simply as either true or false. By extending this concept to electronic circuits in the form of on or off, Atanasoff and his student Berry had developed the first all-electronic computer by 1940. However, their work was overshadowed by similar developments by other scientists. The first modern computers were built for military purposes during World War II, and the first commercial computers were built during the 1950s. They were built with vacuum tubes, therefore they were heavy, expensive, and unreliable. Nonetheless, aerospace companies were among the first to purchase and use these bulky machines.

A single chip could replace racks of bulky and heavy vacuum tubes. The first application of chips was in the guidance system of the Minuteman ballistic missile. It was followed shortly by the on-board guidance and control computer for the Apollo spacecraft that took men to the Moon. With Minuteman and Apollo as pioneers, chips became faster and cheaper. Today, consumers can buy a pocket computer far more powerful than the ones that took men to the Moon in 1969. Computers are used for a wide range of applications, including personal interactive use (word-processing, games, desktop publishing, web browsing, e-mail), real-time systems (patient care, factories, missiles), embedded systems (cash registers, wrist watches, toasters), and transaction processing (banking, reservations, e-commerce).

The word 'computer' owes its origin to a Latin word 'compute' which means 'to calculate'. Therefore, a computer is considered to be a calculating device that can perform arithmetic and logical operations. It is not just a calculating device; rather it has the capability to process logic operations like comparisons, etc. It acquires the data through an input device, processes it as per the instructions given and gives the information as output. A computer has memory and can store a lot of information. The

NOTES

stored information can be retrieved, used and operated upon as desired. Computations are done at an extremely fast speed with complete reliability and accuracy.

A computer is an electronic device that accepts data and instructions, processes the data according to the set of instructions, and produces the desired information. In fact, computer can be understood as a data processing machine. In other words, a computer is a problem-solving machine that accepts data, stores data, processes data, and presents results.

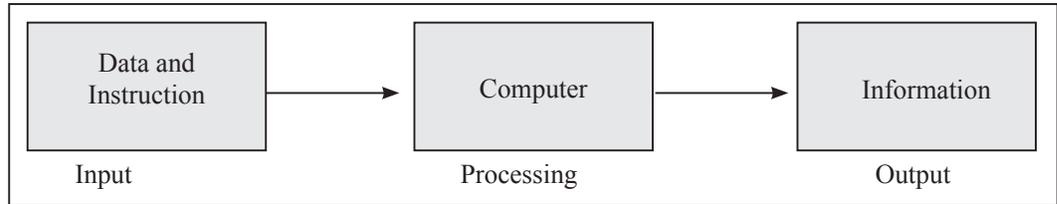


Fig. 1.1: Computer as a Processing System

1.3 DEFINITION OF COMPUTER

In a layman’s language, a computer is a fast calculating device that can perform arithmetic operations. Although the computer was originally invented mainly for doing high speed and accurate calculations, it is not just a calculating device. The computer can perform any kind of work involving arithmetic and logical operations on data. It gets the data through an input device, processes it as per the instructions given and gives the information as an output. We can define computer as follows:

Definition

A computer is a fast electronic device that processes the input data according to the instructions given by the programmer/user and provides the desired information as an output.

The terminology used in the above definition is summarized in Table 1.1.

Table 1.1: Terminology Used in Definition of Computer

<i>Term</i>	<i>Meaning</i>
Data	A set of basic facts and entities which itself has no meaning
Information	Data has some meaning or value
Instruction	A statement given to computer to perform a task
Input	Data and instructions given to computer
Process	Manipulation data
Output	Information obtained after processing of data

1.4 IMPORTANCE AND CHARACTERISTICS OF COMPUTERS

NOTES

After the human brain, a computer is the fastest machine on the earth. Computers can perform millions of calculations at an unbelievable speed. Computers are not only fast, they are very accurate and reliable too. For us, the smallest unit of time is a second but for a computer; a second is not the smallest unit. Rather, it can be divided into millisecond, microsecond, nanosecond and picosecond. A nanosecond is equal to one billionth or thousand-millionth of a second.

Computers play a vital role for processing of data in an organization. Those help in processing the volumes of data efficiently and accurately within a short time. A computer has the following characteristics which make it so important for an organization:

1. **Fast:** A computer is so fast that it can perform the given task (arithmetical or logical) in few seconds as compared to man who can spend many months for doing the same task. A computer can process millions of instructions per second.
2. **Accurate:** While doing calculations, a computer is more accurate than a human. A human can make mistakes in calculations but a computer does not make mistakes, if it is provided accurate instructions.
3. **Diligence:** A computer does not suffer from the human traits of tiredness and boredom. Man will be tired and bored while doing millions of calculations but a computer, being a machine, does this job very efficiently and without any tiredness and boredom.

Check Your Progress

Fill in the blanks:

1. The creation of the was based on the concept that a single unit would be used to perform complex calculations with greater speed and accuracy than humans could achieve.
2. A computer is a machine that accepts data, stores data, processes data, and presents results.
3. A computer is a fast that processes the input data according to the instructions given by the programmer/user and provides the desired information as an output.
4. Computers play a vital role for of data in an organization.

NOTES

4. **High Memory:** A computer has much more memory or storage capacity than human being. It can store millions of data and instructions, which can be retrieved and recalled even after a number of years. This is not possible in case of human brain.
5. **No Intelligence:** A computer is a machine and obviously has no intelligence of its own. Each and every instruction must be given to the computer for doing a task. Man has an intelligence and it is the man who invented computer and gives it all the instructions and logic to work. A computer cannot take decisions on its own and it is the main drawback of it.

1.5 FUNCTIONS/OPERATIONS OF A COMPUTER

A computer can perform a variety of tasks. We use computers for programming, word-processing, spreadsheets, data management, graphics and communications. Much of the processing computers can be separated into two operations—arithmetic operations and logical operations. Processing is built around the computer's ability to perform arithmetic and logical operations. Software is a set of instructions written by humans and given to the computer. These instructions (programmes) tell the computer which operates to apply to the data, to ultimately produce informational output. Software directs the processing sequence and allows a computer to perform specific tasks.

1. **Arithmetic Operations:** Arithmetic operations are computations with numbers (addition, subtraction, division, multiplication, etc.).
2. **Logical Operations:** Logical operations are a comparison of any two numbers to determine if one is greater than, smaller than, or equal to the other. A computer can compare numbers, letters, or special characters. The computer can then take action based on the result of the comparison.

A computer is termed as a data processing machine. It accepts data and then stores or processes it immediately and displays the output for the user. The basic model of a computer shows the working of a computer. All computer systems perform the following five basic operations:

Input Function

The input function is the process of entering data and instructions into the computer system. The computer accepts the data and instructions from the user through various input devices like keyboard, mouse, scanner, etc.

Storage Function

A computer can store data and instructions for future use and processing. A computer has ‘memory’ and can store a large amount of data.

Processing Function

A computer can process the input or stored data as per the instructions by the user. It performs arithmetic and logical operations on data in order to convert them into desired output. Processing is the main function of the computer.

Output Function

With the help of this function, a computer displays the processed results or output. The output is communicated to the user through various output devices like monitor, printer, etc.

Control Function

All the other functions performed by the computer are controlled by this control function. Control function guides the computer to process and give output in the right manner and proper sequence.

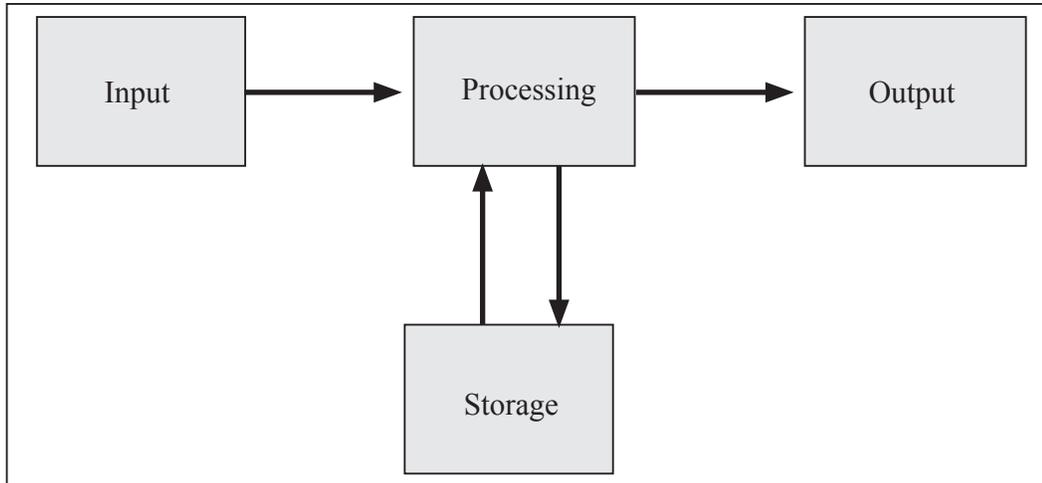


Fig. 1.2: A Simple Model of a Computer

The following diagram shows the interaction of the components of the simple model of a computer. The arrows indicate the flow of control in the form of data and instructions. An input unit provides the input for the processing to CPU (Central Processing Unit) which, after processing, directs the processed data to output unit for display to the user. The storage unit or the memory of computer stores the data.

1.6 COMPUTERS IN BUSINESS

Computers can process vast quantities of business data at enormous speed with unflinching consistency and unimaginable flexibility.

These capabilities of computers open new approaches to problem solving and data processing.

Following six characteristics of computers make them indispensable for use in business:

1. **Speed:** Computers speed up data processing by many orders of magnitude as compared to the manual system.
2. **Data Volume:** Vast amount of data can be stored and processed very quickly.
3. **Repetitiveness:** The more repetitive the task, the more profitable it is to automate it.
4. **Complexity:** Problems with several interacting variables can be solved quickly and accurately.
5. **Accurate Output:** As high accuracy can be obtained as needed; also accuracy is not affected by boredom and fatigue and is not Subjective.
6. **Declining Costs:** There has been a steady decline in the cost of per unit of data processed.

1.7 ELEMENTS OF COMPUTER SYSTEM SETUP

The computers about which we have been discussing come in all shapes and sizes and can be used for various purposes. But all of them have certain characteristics in common. Two of the most important constituents of computers are — hardware and software.

Apart from these two main elements of the computer, *i.e.*, hardware, which represents the physical parts of the computer, and software that represents the programs that instruct the computer what is to be done, computers also include processing. Processing transforms data into information and involves data, people and procedures. Thus all these together are the five elements of the computing process (as a whole). These five elements are:

1. Hardware
2. Software
3. Data

4. People
5. Procedures

But all these elements have to be organized in such a way that each element works smoothly and efficiently, both individually and in coordination with others. During the computing process, computers integrate all these five elements.

Thus we can say that the computing process includes everything necessary to accomplish an activity or to perform a task. All the five elements of computing process are explained below in detail.

Hardware

The term ‘hardware’ refers to the physical parts of the computer or includes anything in the computer that we can touch. It consists of interconnected electronic devices that control everything in the computer.

Hardware can be divided into four major categories. They are:

1. Processor
2. Memory
3. Input and Output Devices
4. Storage Devices

Processor

The complex procedure that transforms data into information (useful and meaningful data) is called processing. This type of transformation mainly includes two components—the processor and the memory.

The Processor acts like the brain of a computer. It organizes and carries out the instructions given to the computer by the user or the message passed on by the software. There are various types of processors available in the market. In PC, we use microprocessor(s) (a number of microprocessors can also be used in one PC). Microprocessors are made of silicon or some other material and are etched with many tiny electronic circuits. The microprocessor is plugged into the circuit board – a hard rectangular board that contains the total circuitry used to connect the processor to the rest of the hardware. This circuit board is called ‘motherboard’. The number of chips and circuit boards (on which the processors are plugged in) is increased when the computer is to be made more powerful. The term Central Processing Unit (CPU), in real terms, is the processor of the computer. This is the “brain” of the computer, without which nothing can be done. It is very small in size and occupies just a few square inches of space.

NOTES

NOTES

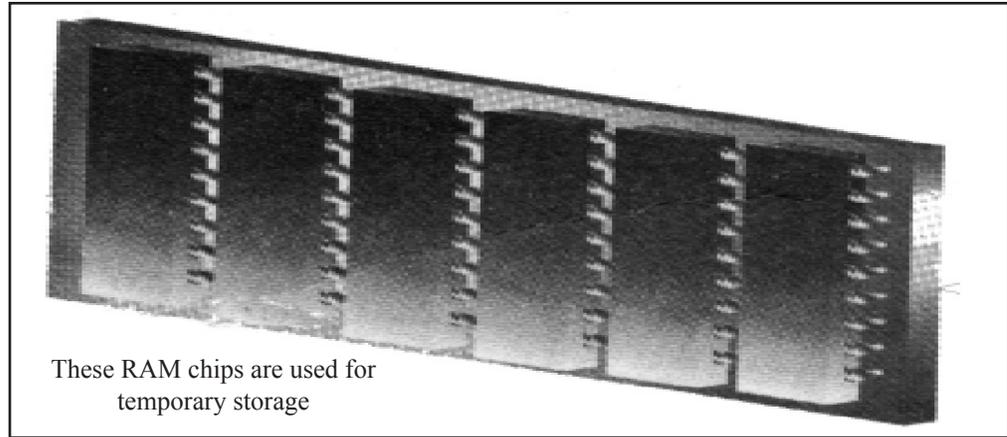


Fig. 1.3

Memory

The software is loaded into the memory of the computer and runs from there only. Not only the software or programs, but also all the data are loaded into the memory for easy access. This memory is called Random Access Memory (RAM). When one talks about memory one often means RAM only.

The main thing to be kept in mind while working on the computer is that RAM is a volatile memory and everything disappears if power goes off or is turned off abruptly in the middle of work. Thus, it is always advisable to frequently save the work on the storage disk while you are working.

The amount of RAM in a computer tremendously affects the speed and power of the computer. The more the RAM, the greater is the power and speed of the computer. The measurement unit of memory is byte. The bigger units of bytes are:

Kilobyte (KB) ~ 1000 bytes [2¹⁰ bytes = 1024 bytes to be precise]

Megabyte (MB) ~ 1000 KB ~ 10,00,000 bytes

Gigabyte (GB) ~ 1000MB ~ 10 'KB ~ 10' bytes

Nowadays PC's have 8 to 16 GB of RAM.

ROM

Read Only Memory holds permanent data or instruction that can only be read, and nothing can be written on it. Information is permanently recorded in it. It is a nonvolatile memory. ROM contains instructions to get the computer started when it is switched on. It also holds instructions for the control of the various peripheral units of the computer, such as graphic display, disk drive, etc. The controls of ROM are built into it at the time of its manufacturing.

Input and Output Devices

The computer accepts the instructions and delivers the results to the user by means of some devices. There are two main types of devices. Input devices are used to enter the instructions whereas output devices are used to see the results of processing. The term 'device' is generically used to refer to any piece of hardware.

Thus, input devices accept the instructions or the data from the user and output devices return the processed data back to the user in the form of visual display or on paper. New types of input devices keep on coming as technology and the users' demands grow. The most commonly used input device is the Keyboard, which accepts numbers, alphabets and commands from the user. Another input device is the Mouse that works with the action of a click or by moving. The diagrams or some drawing is made on the screen by pressing its button and moving it on the surface. Even the commands are executed by clicking it on the commands displayed on the screen. The other commonly used input devices are trackballs, joysticks, scanners, lightpens, microphones, digital cameras, etc. These will be discussed in detail later.

Both Mouse and Trackball are used almost in the same way. Both of them allow one to draw or to execute some action on the screen by a click. The Joystick is generally used to play videogames. A scanner is used as a photocopying machine. It copies the photographs, drawings or the text as it is into the computer memory, thus saving time of drawing or keying in manually.

Lightpen is used to directly draw the figures on the screen of the monitor. Microphones help in inputting our voice directly in the computer or inputting music from CDs or audiocassettes by attaching them to the computer. Digital cameras are used to bring in live images onto the screen, where some changes can also be made thereon. They are generally used in the barber's shops (to see the best hairstyle that suits the customer) or in the optical shops, etc.

The output devices are used to see the results of processed input. The title case output devices mainly used are the screen or VDU (Visual Display Unit) and the Printers. When the soft copy of the output is required it is seen on the screen of the monitor and if hard copy (on paper) is required, then the computer sends it to the printer. Apart from these two output devices, Speakers can also be used as output devices to produce sound, listen to audio CDs or music.

There are some more devices that act as both input and output devices. One such device is the Touch Screen which is a type of monitor that displays virtual buttons which you can touch.

Modem is an example of a communication device that is used to communicate through telephone lines. It performs both the functions. It is used to interconnect the computers. The process of interconnecting the computers is called networking. The network interface cards are used to connect the input of computers so as to share the data and the devices.

Storage Devices

NOTES

Although the computer can be said to be complete with input and output devices, memory and CPU, and can function quite well, but when it comes to the need of storing data or even programs files for future use, some place is required to store them. Storage devices are used to store data permanently or semi-permanently.

Storage holds the data and the software brings into the memory (RAM) a particular program or data required at that point of time. After you have finished with the work, you again put back the programs and data (new one or processed) into the storage.

Storage can be differentiated from memory thus:

1. Storage is cheaper than memory
2. Storage has more space than RAM
3. Storage is not volatile whereas RAM is, i.e., data remains in the storage even if the power is switched off unlike RAM
4. Ram is faster than storage.

The most widely used storage medium is the magnetic disk, which is round in shape and flat. Read and write heads (similar to the heads of cassette players or VCRs) float above and below the disk near the surface. The disk spins around their center.

The device, which holds the disk, is called 'disk drive'. There are some drives which have built-in disks and these disks cannot be detached from them, whereas some drives are meant for removable/replaceable disks. Almost every PC uses non-removable disks, but additional removable diskette drives can also be used. The non-removable drive is the Hard Disk Drive (HDD) and the removable one is the Floppy Disk Drive (FDD). A computer can have any number of HDDs and FDDs as per the user's requirements.

DVD is the digital optical disk storage with 4.7 gigabyte storage capacity on single sided. DVD are the devices that can read DVD disk on computer. DVDs can be single or double sided and can have to layers on each side, a double sided, two layered DVD will hold up to 17 gigabytes of video, audio, or other information.

Pen Drive is a device used to data storage. It is a small portable flash memory card that plugs into a computer.

HDD can store far more data than a diskette can, so the HDD serves as the computer's primary filing cabinet. Diskettes are used to load new programs or data on to the HDD to transport the data or make the backup copies of the data of the HDD.

The floppy diskette or the removable disks are made of plastic, and, to protect them from dust and scratches, are kept enclosed in vinyl cases. Initially, floppies measured 8 inches; they were reduced to 5¼ inches and now we use 3½ inches diskettes. The size of diskettes is decreasing in diameter, but its storage size is increasing. The capacity of the 8" diskette was 360KB, and that of the 5½ inch was 1.2 MB, whereas the 3½ inch diskette stores 1.44MB of data. The name floppy was given because the vinyl cover (on 8" and 5" diskettes) used to be very flimsy or floppy.

Other types of storage devices include CD-ROM drives, tape drives, optical drives etc. CD-ROM is the most popular type of drive after Hard Disk Drives and Floppy Drives. Compact Disks are optical storage devices similar to audio CDs and can store approximately 640MB. In personal computers we generally use CD-ROM (Compact Disk Read Only Memory). The information on CD-ROM cannot be changed.

Since new writable CDs have come into the market, it has become very convenient to store large amount of data, making it easy to transport.

Check Your Progress

State whether the following statements are True or False:

5. Logical operations are computations with numbers such as addition, subtraction, division, multiplication, *etc.*
6. The input function is the process of entering data and instructions into the computer system.
7. All the other functions performed by the computer are controlled by the control function.
8. Arithmetic operations are a comparison of any two numbers to determine if one is greater than, smaller than, or equal to the other.
9. Control function guides the computer to process and give output in the right manner and proper sequence.

1.8 STRENGTHS AND WEAKNESSES OF COMPUTER

Strengths

Following list demonstrates the advantages of computers in today's arena.

- High Speed
 - Computer is a very fast device.
 - It is capable of performing calculation of very large amount of data.
 - The computer has units of speed in microsecond, nanosecond, and even the picosecond.
 - It can perform millions of calculations in a few seconds as compared to man who will spend many months for doing the same task.
- Accuracy
 - In addition to being very fast, computers are very accurate.
 - The calculations are 100% error free.

NOTES

- Computers perform all jobs with 100% accuracy provided that correct input has been given.
- Storage Capability
 - Memory is a very important characteristic of computers.
 - A computer has much more storage capacity than human beings.
 - It can store large amount of data.
 - It can store any type of data such as images, videos, text, audio and many others.
- Diligence
 - Unlike human beings, a computer is free from monotony, tiredness and lack of concentration.
 - It can work continuously without any error and boredom.
 - It can do repeated work with same speed and accuracy.
- Versatility
 - A computer is a very versatile machine.
 - A computer is very flexible in performing the jobs to be done
 - This machine can be used to solve the problems related to various fields.
 - At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.
- Reliability
 - A computer is a reliable machine.
 - Modern electronic components have long lives.
 - Computers are designed to make maintenance easy.
- Automation
 - Computer is an automatic machine.
 - Automation means ability to perform the given task automatically.
 - Once a program is given to computer, i.e., stored in computer memory, the program and instruction can control the program execution without human interaction.
- Reduction in Paper Work
 - The use of computers for data processing in an organization leads to reduction in paper work and results in speeding up a process.
 - As data in electronic files can be retrieved as and when required, the problem of maintenance of large number of paper files gets reduced.

- Reduction in Cost
 - Though the initial investment for installing a computer is high, it substantially reduces the cost of each of its transaction.

NOTES

Weaknesses

Computer is, no doubt, a marvellous tool. Yet it has some limitations. Some of the major limitations of computer are:

1. A computer cannot think on its own. It has to be given instructions to perform any operation. Research is currently underway to impart artificial intelligence to computer. Once this becomes possible, computers will be thinking on its own, then it will be a reasonable replication of human mind.
2. It does not have intuition. It cannot draw a conclusion without going through all intermediate steps.
3. It can do a task only if it can be expressed in a series of finite steps leading to the completion of the task.
4. Similarly, it cannot handle a situation where a finite number of steps generate an impossibly large number of computational operations.
5. It cannot learn from experience. It will commit the same error repeatedly and cannot learn from experience. But changes are taking place in this area as research progresses on artificial intelligence.

1.9 DIFFERENCE BETWEEN COMPUTER, HUMAN BEINGS AND CALCULATOR

Computers and calculators are similar in the sense that both are calculating devices. But what is the difference between a computer and a calculator? Before the advent of computers, calculators were the tools that were made use of by the students to do computation while solving mathematical problems. Not that they are not used these days, in fact, by the time you switch on your computer, you complete the operation on the hand held device known as calculator.

Modern calculators are electronically powered either by dry cell batteries or solar cells. During nineties, there was a calculator in every student's pocket to aid and assist him in carrying out calculations involved in mathematical problems. With modern computers having a built-in calculator to carry on basic mathematical operations, calculators have all but gone from households today.

We know that a calculator can work only with numbers. But so can a computer. Modern calculators are extremely fast in carrying out complex calculations. But so are computers. Then what is the difference between the two?

NOTES

Simply put, calculators can carry only one function at a time. Even when you need to solve a small problem, you need to press a number of buttons to arrive at the solution. On the contrary, a computer is capable of carrying out many operations at the same instant. Computer programs are a series of instructions that are given to computers and it can perform complex calculations with the assistance of those instructions. So if the necessary program is installed on the computer, you do not need to tell the computer what to do next as it can perform all the steps required in getting the answer. It will come with the answer at a lightening fast speed without you having to press any buttons, or mouse clicks in this instance. On the other hand, you need to keep on pushing buttons to solve even easy mathematical problems while using a calculator.

The word ‘computer’ has become very broad in modern times and has come to include smart devices such as smartphones, MP3 players, desktops and laptops. These devices all have a basic calculator that can perform simple mathematical operations, but they are capable of many more operations which are beyond the capacity of a calculator.

<i>Characteristic</i>	<i>Human</i>	<i>Calculator</i>	<i>Computer</i>
Speed	Slow	Fast	Very Fast
Accuracy	Possible to do errors	Good	Very Good
Memory	Less internal memory	No	Large Memory
Operation	All operations. But slow	Arithmetic	Arithmetic and Logical

1.10 SUMMARY

- A computer is an electronic device that can perform a variety of operations according to the instructions given by the programmer/user and provides the desired information as an output. Computers are fast, accurate, diligent, having high memory, but no intelligence.
- Computers are classified as general purpose or special purpose computers according to the purpose of their requirement. According to the technology used, computers are classified as analogs which are used for scientific and engineering application, digitals which are considered as general purpose computers or hybrid computers, which incorporate the technology of both analog and digital computers. According to their size, computer can be classified as super computer, mainframe computer, minicomputer and micro computer.

1.11 GLOSSARY

- **Computer:** This is a machine which executes an algorithm stored in its memory to process data fed to it and produces the required results.

- **Communication Channel:** A medium through which (electric) signals are transmitted and received.
- **Disk Memory:** A back up or peripheral memory in which information is stored as magnetized spots on the surface of disks coated with magnetic material. In hard disks the disks are not flexible. In floppy disks the disk is a circular platter made of flexible magnetic coated plastic sheet.
- **Floppy Disk:** A circular magnetic disk made of flexible plastic sheet coated with magnetic material.
- **IC (Integrated Circuit):** An electronic circuit fabricated on a single chip of silicon.
- **Input Unit:** A part of a computer used to feed programs and data.
- **Memory:** An organized collection of cells used and programs in a computer.
- **Output Unit:** A unit of a computer used to print or display computed results.
- **Processor:** A unit of a computer which interprets instructions, executes them using arithmetic and logic circuits and controls the operation of all the other units of the computer (also known as CPU).
- **RAM (Random Access memory):** A memory used as the main memory of a computer in which the time to retrieve stored information is independent of the address where it is stored.
- **ROM (Read Only Memory):** A memory in which information is permanently written. The information can be read quickly but cannot be changed.

1.12 ANSWERS TO CHECK YOUR PROGRESS

1. Computer
2. problem-solving
3. electronic device
4. processing
5. False
6. True
7. True
8. False
9. True

1.13 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is computer?

NOTES

2. What do you mean by the term 'diligence' respect to computers?
3. What are the characteristics of computer?
4. Name the elements of computer system
5. List some commonly used input devices.

Long Answer Questions

1. Describe the elements of computer system.
2. What is the difference between general purpose and special purpose computers?
3. What is the difference between analog and digital computers?
4. What are the major strengths and weaknesses of a computer?

1.14 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
8. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

UNIT 2: COMPONENTS OF COMPUTER SYSTEM AND INDIAN COMPUTING ENVIRONMENT

NOTES

Structure

- 2.0 Introduction
- 2.1 Unit Objectives
- 2.2 Components of a Digital Computer
 - 2.2.1 The Input Unit
 - 2.2.2 The Output Unit
 - 2.2.3 The Central Processing Unit
 - 2.2.4 Memory
- 2.3 Reduced Instruction Set Computer (RISC)
- 2.4 Indian Computing Environment
- 2.5 Role of Computers in Management
- 2.6 Summary
- 2.7 Glossary
- 2.8 Answers to Check Your Progress
- 2.9 Terminal and Model Questions
- 2.10 References

2.0 INTRODUCTION

Computer components can be broadly divided into two categories – Hardware and Software. Hardware refers to any physical component of a computer. For example, CPU, Monitor, Keyboard, Hard Disk, Floppy Disk, *etc.*, are physical components and thus, are hardware. Software refers to the programs which are required to operate the computer. For example, DOS (Disk Operating System), BASIC, COBOL, dBASE, an Accounting Software, *etc.*, are all software. An analogy of hardware can be the book which you are reading and then software would be the text written on this book. Another analogy could be – ‘brain’ is a hardware but ‘memory stored in brain’ is a software.

Both hardware and software are dependent on each other. CPU, Memory Unit, Hard Disk, *etc.*, are useless until they are provided instructions and data for storage and processing. Similarly, BASIC or COBOL language has no use until it is stored and

processed by hardware components of a computer.

In today's computer industry, a wide variety of hardware components are available for microcomputers. Managers must be aware of the working and uses of different hardware components, so that they can make good decisions about purchase of computer systems.

2.1 UNIT OBJECTIVES

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

- Discuss the components of a computer
- Explain the different input and output devices
- Explain the RISC and CISC architecture
- Discuss Indian computing environment
- Describe the role of computers in management

2.2 COMPONENTS OF A DIGITAL COMPUTER

A digital computer can be broadly classified as a collection of four components. They are:

1. Input unit
2. Output unit
3. Central Processing Unit
4. Memory (Auxiliary)

A block diagram representation of the above is shown in the figure:

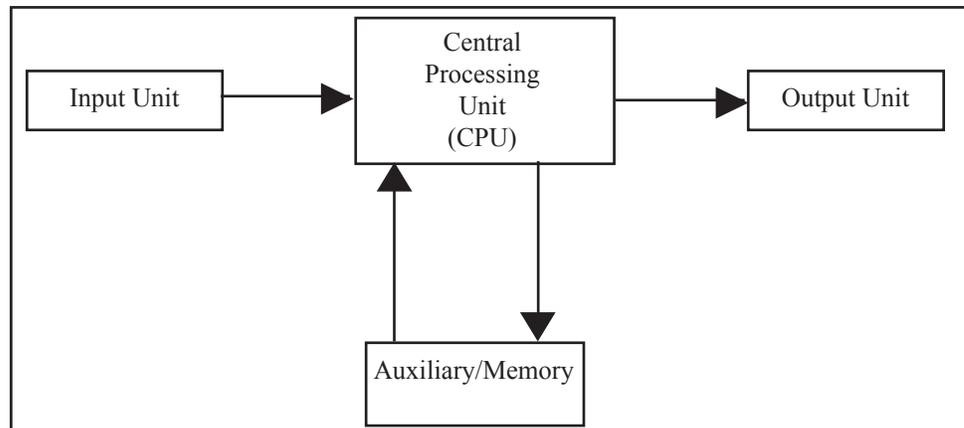


Fig. 2.1: Basic Components of a Digital Computer

2.2.1 The Input Unit

The Input Unit provides an interface between the users and the machine, for inputting data and instruction, etc. One of the most common examples is the keyboard. Data can be input in many more forms – audio, visual, graphical, etc.

Some common input devices are listed below:

1. Keyboard
2. Mouse
3. Voice data entry

NOTES

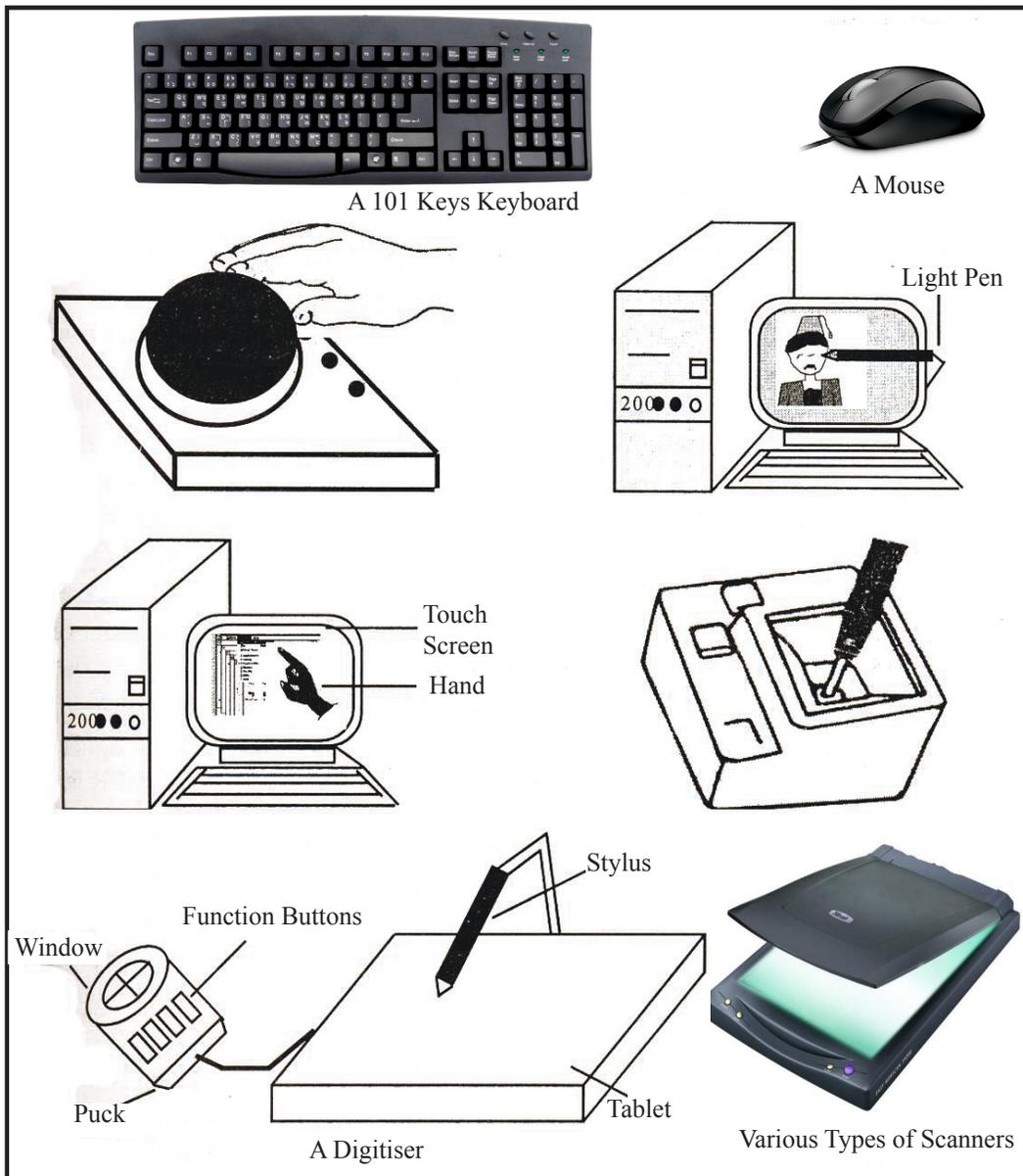


Fig. 2.2: Computer Input Unit

NOTES

4. Joy stick
5. Light pen
6. Scanner
7. Secondary storage devices such as floppy disks, magnetic tapes, etc.

The data in any form is first digitized, i.e., converted into binary form, by the input device before being fed to the Central Processing Unit (CPU).

2.2.2 The Output Unit

Like the Input Unit, the Output Unit also provides an interface between the user and the machine. A common example is the visual display unit (monitor) of a personal computer. The output unit receives the data from the CPU in the form of binary bits. This is then converted into a desired form (graphical, audio, visual, etc.) understandable by the user.

Some common output devices are:

1. Visual Display Unit (Monitor)
2. Printers
3. Speakers
4. Secondary Storage Devices

The input and output unit collectively are referred to as ‘peripherals’.

The input and the output units shall be discussed in more detail in the next chapter.

2.2.3 The Central Processing Unit

The central processing unit is the brain of a computer system. The input and the output devices may vary for different applications, but there is only one CPU for a particular computer. The specifications of a computer are basically characterized by its Central Processing Unit.

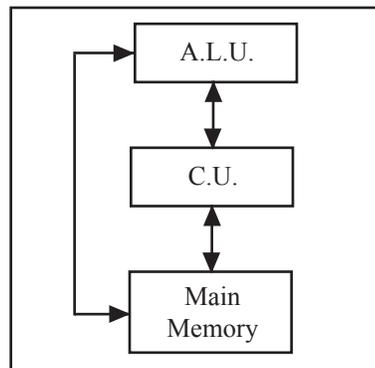


Fig. 2.3: The Central Processing Unit

The Central Processing Unit can be further divided into:

1. The Arithmetic Logic Unit (ALU)
2. The Control Unit
3. Main Memory

The arrows in the above Figures may represent data as well as control information flow.

The CPU processes the data it receives as input (either through input devices or through the memory). As mentioned earlier the CPU receives the data in the form of binary bits, which it can understand.

The CPU performs many tasks, some of which are listed below:

1. The CPU can perform arithmetic calculations such as addition, subtraction, etc.
2. The CPU can perform logical decisions.
3. The CPU with the help of other devices can perform data transmission.
4. The CPU can perform manipulating tasks such as word processing.
5. After performing the required task the CPU may place results in memory or send results to the output device according to the instruction given to it.
6. The CPU with the help of its control unit generates timing signals (also known as enable signals) which provide synchronization between the different devices and the CPU.

As mentioned earlier, the Central Processing Unit consists of:

1. The Arithmetic Logic Unit (ALU)
2. The Control Unit
3. The Main Memory Unit

The Arithmetic Logic Unit (ALU)

As the name may indicate the arithmetic logic unit performs all arithmetic and logic calculations on the data it receives.

Arithmetic Calculations

The arithmetic calculations may be addition, subtraction, multiplication, division, exponentiation, etc.

Logical Calculation

Logical calculations are basically decision making statements, for example, $A > B$ decides whether A is greater than B or not; If A is greater than B the statement is true and logical '1' would be generated, otherwise a logical '0' would be generated.

Some logical decisions decide the further routing of the program. This will be further explained by the figure:

NOTES

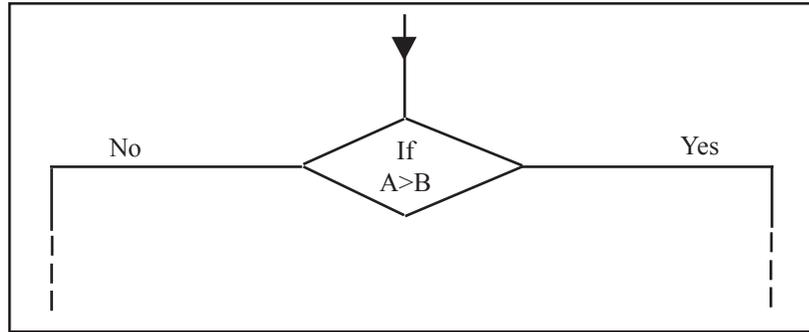


Fig. 2.4: Part of a Flow Chart

In the above Figure the decision box has split the flow chart into two.

The functioning of the arithmetic logic unit would be better understood when we discuss the 'accumulator'.

The Control Unit

The control unit controls the entire operations of the computer and the CPU. It controls all the other devices connecting the CPU, i.e., Input devices, Output devices, Auxiliary Memory etc. Hence, the control unit acts as the nerve centre of the computer.

The control unit upon receiving an instruction decides what is to be done with it. That is, whether it is to be sent to the ALU for further processing or to the output devices or to the memory, etc. In other words the control unit coordinates and controls all hardware operations.

The control unit has an electronic clock that transmits electronic pulses at equal intervals of time. The control unit gives instructions to other devices based upon these pulses. Suppose there are three instructions to be performed. Let the first instruction take three clock pulses to complete; when the fourth clock pulse is received the control unit would start processing the second instruction and so on. Suppose an instruction takes three and a half clock pulses to complete. In such a case the control unit could wait for the fourth clock pulse to complete and take up the next instruction with the fifth clock pulse.

The clock pulse basically provides synchronization between the different parts of the computer. The control unit generates millions of clock pulses per second. The speed at which an instruction is executed depends upon the clock speed which is in MHZ (10^6 HZ).

The Main Memory Unit

The main memory, also known as the primary memory is a part of the central processing unit and is a combination of both RAM (random access memory) and

ROM (read only memory). We shall discuss the RAM and the ROM later but for now we shall define them as follows:

RAM

The random access memory is a read write memory, i.e., information can be read as well as written into this type of memory. It is volatile in nature, i.e., the information it contains is lost as soon as the system is shut down unless 'saved' for further usage by the users. It is basically used to store programs and data during the computer's operation.

ROM

The read only memory, as the name may suggest contains information that can only be read, i.e., you can't write on this type of memory. It is non-volatile or permanent in nature. It is basically used to store permanent programs such as program for the functioning of the monitor.

The main memory is a fast-memory, i.e., it has small access time. It is because of its limited capacity that it is fast. The main memory contains the programs that are currently being worked on. It passes on this information to the control unit as and when required. In case the CPU wants to access some data that is present in a secondary storage device, this data is first transferred to the main memory and then processed.

The main memory is much more costly than the secondary storage devices. Although the ROM IC's of various computers do not vary much in their capacities, the RAM chips are available in wide ranges of storage capacities. In fact, the capacity of the random access memory is an important specification of a computer.

A larger RAM means larger programs (in terms of memory) can be loaded and executed. Suppose you want to run a 68-KB program on a machine with 64-KB. This means that the whole program can not be loaded into the main memory at once resulting in either the non-execution of the program or a very slow execution.

A 64-K memory means that there are approximately 64000 (65,536 to be precise) storage locations which can store 1 bit of data each.

Different memories can be classified on the basis of their concepts:

1. **Access Mode:** It means how easily they are accessible.
2. **Access Time:** The average time required to reach a storage location and obtain its content is called access time.
3. **Transfer Rate:** The transfer rate is the number of characters or words that a device can transfer per second after it has been positioned at the beginning of the record.
4. **Capacity and Cost:** The capacity and cost may depend upon the requirement and the budget.

NOTES

The main memory has a very low access time and a very high transfer rate. It is limited in capacity and costlier than secondary storage devices.

NOTES

The Cache Memory

Another important concept is that of the cache memory, which is also a part of the CPU.

The cache memory lies in the path between the processor and the main memory. The cache memory therefore, has lesser access time than the main memory and is faster than the main memory. A cache memory may have an access time of 100ns, while a main memory may have an access time of 700ns.

The cache memory is very expensive and hence is limited in capacity. Earlier cache memories were available separately but the latest microprocessors contain the cache memory on the chip itself.

The need for the cache memory is due to the mismatch between the speeds of the main memory and the CPU. The CPU clock is very fast, whereas the main memory access time is comparatively slow. Hence, no matter how fast the processor is, the processing speed depends more on the speed of the main memory (the strength of a chain is the strength of its weakest link). It is because of this reason that a cache memory having access time closer to the processor speed is introduced.

The cache memory stores the program (or its part) currently being executed or which may be executed within a short period of time. The cache memory also stores temporary data that the CPU may frequently require for manipulation.

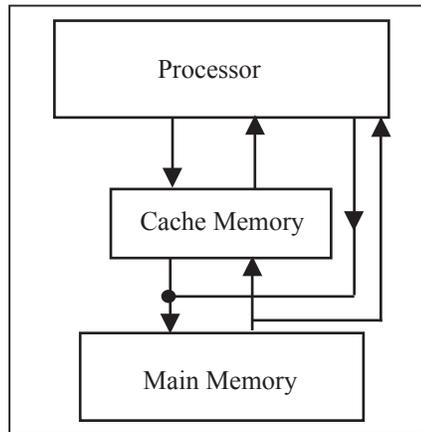


Fig. 2.5: Cache Memory

The cache memory works according to various algorithms, which decide what information it has to store. These algorithms work out the probability to decide which data would be most frequently needed. This probability is worked out on the basis of past observations.

We shall discuss the ‘memory’ later when we discuss the auxiliary memory.
Functioning of the Arithmetic Logic Unit

Register

A register is a combination of memory storage locations called flip-flops. Each flip-flop is capable of storing one bit of information. An n-bit register contains ‘n’ flip-flops and is capable of storing ‘n’ bits of information.

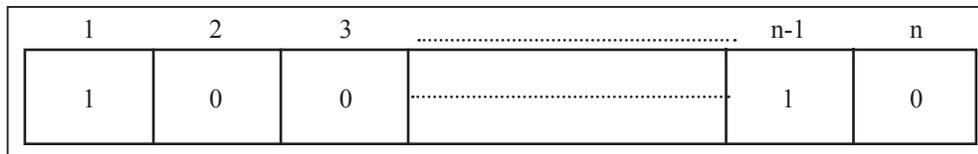


Fig. 2.6: n-bit Register

Accumulator

The accumulator is a register that is present within the arithmetic logic-unit. The accumulator stores data, which is either the result of an operation, or which is to be processed through arithmetic and logical operations.

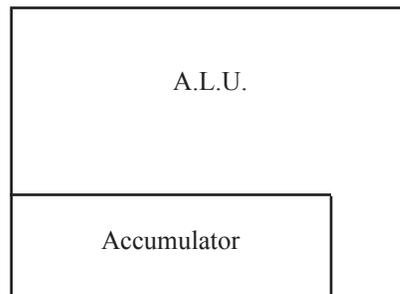


Fig. 2.7: The Detailed A.L.U.

Memory Data Register

The memory data register like the accumulator is used to store data. This register holds all data and instructions temporarily as they pass in or out of the main memory.

Memory Address Register

The memory address register contains the address of the memory location (in main memory) whose data is to be transferred into the memory data register.

In the Figure, the memory address register (MAR) contains the address of the third memory location, the data of which is transferred to the memory data register (MDR).

We shall try to explain the functioning of the ALU with the help of an example. Suppose two numbers are to be subtracted. The following steps are involved:

NOTES

NOTES

1. Let the first instruction cause the number 13 to be placed in the accumulator. When the control unit receives this instruction it decodes it and performs the controlling and coordination function by sending the number to the accumulator. A special purpose register that holds the instruction currently being processed by the control unit is called Current Instruction Register (CIR).
2. The second instruction asks the control unit to send the address of the second number stored in the main memory to the MAR.
3. The control unit then causes the contents of that specific address of the main memory to be copied to the MDR.
4. Once the numerical data is passed on to the MDR, the control unit signals the ALU to perform the SUBTRACT Operation which causes the number in the MDR to be subtracted from the number in the accumulator.

Functioning of the Control Unit

The control unit as said earlier is the nerve centre of the computer. Every instruction before being executed is first interpreted by the control unit. The sequence of operations involved in processing an instruction is known as the instruction cycle. The instruction cycle can be divided into two parts:

1. Fetch cycle
2. Execution cycle

Fetch Cycle

The control unit fetches the instruction from the memory data register and places it in the current instruction register.

Execution Cycle

The control unit then decodes this instruction in the current instruction register and sends the appropriate signal to the concerned device for the execution of the instruction.

The flowchart in the figure 2.4 describes the functioning of the control unit.

Let us now turn our attention back to the memory devices.

2.2.4 Memory

Auxiliary Storage Memory

The auxiliary storage memory, also known as the secondary memory is an external (to the CPU) memory. The auxiliary storage devices store system programs, large data files, assemblers, compilers and other programs. In other words, the auxiliary storage devices are used for bulk storage of data. The storage capacity of these

devices is unlimited as an empty device can replace them once the existing device is completely filled. Even the individual storage devices, such as the magnetic tape have more capacity than the main memory.

The secondary memory is permanent in nature, i.e., the information stored in these devices is not lost unless specifically deleted. Secondary storage devices being permanent in nature can also be used for transportation of data from one computer to another.

Secondary storage devices are cheaper than the main memory. The information stored in the secondary memory is first transferred to the main memory and then processed by the CPU. The final result may then be placed in the secondary memory. It is because of this that the access time of the secondary memory is comparatively high. Hence, the data stored in the secondary storage devices take more time to process than the data already present in the main memory. In fact the access time for data stored in the secondary memory is one thousand times the data stored in the main memory.

Secondary memories may also be considered as input and output devices as they provide the information as input and store the final results in the output.

The secondary storage devices would be discussed in detail in a later chapter.

Memory Hierarchy

The figure 2.5 above is self-explanatory.

Types of Memory

Although various types of memory have been discussed in the previous sections the block diagram given below acts as a good visual aid for memorizing.

As promised earlier we shall now discuss the random access memory (RAM) and read only memory (ROM) in detail.

Random Access Memory (RAM)

The RAM as mentioned earlier is volatile in nature. It retains the stored information as long as the power supply is on. Its contents are lost when the power supply is switched off. The power requirement of the random access memory chips is comparable to that of the microprocessor itself. It is also partially due to this reason, that the RAM is very fast.

RAM is of two types:

1. Dynamic RAM (DRAM)
2. Static RAM (SRAM)

We shall discuss each of these in detail:

Dynamic RAM (DRAM): The dynamic RAM chips contain a transistor that acts as a gate to a capacitor, which is capable of storing electric charge. The charge on

NOTES

the capacitor indicates a '1' bit and no charge indicates a '0' bit. The charge on the capacitor leaks away after a few milliseconds. Therefore, a dynamic RAM has to be refreshed periodically after every two milliseconds. A D-RAM uses its contents in a very short time even though the power supply is ON. A D-RAM consumes less power and has higher packing density. It is cheaper than the static RAM.

Static RAM (S-RAM): Static RAM's are also volatile in nature but they need no regenerator to retain the data. They retain the data as long as they receive the power. The static random access memory consumes more power and is more expensive. The static RAM chips are more complicated and hence require more space. Static RAM's are faster than the dynamic RAM's. Static RAM's have an access time of approximately 85 to 90ns while the dynamic RAM's may take 150 to 200ns to provide information. Static RAM's are recommended for medium sized memories while dynamic RAM's are recommended for large sized memories.

Read Only Memory (ROM)

The read only memory (ROM) contains non-volatile or permanent information. As the name suggests the information contained in this type of memory can only be read; it can not be altered or overwritten. Information is entered into the ROM chip at the time of manufacturing. ROM chips are used for applications which require a permanent information, e.g., a program for the functioning of the visual display unit, a program for controlling the working of a washing machine, *etc.*

With the advent of technology erasable ROM's have become available. We shall discuss these and other ROM's in the following section.

Types of ROM

- **Programmable Read Only Memory (PROM):** A PROM program is used to record information in the PROM chip. Information once programmed into the PROM chip is permanent and can not be changed or erased. The process of entering the information into the PROM chip is known as "burning the PROM." PROM chips are seldom used in modern day computers, but they still find their use in devices where a permanent ROM is required.
- **Masked Read Only Memory (MROM):** In the masked ROM, the information is permanently recorded by the masking and metallization process. It is not easy to perform this process as a large infrastructure is required, and therefore, it is usually the manufacturers who perform this process.
- **Erasable Programmable Read Only Memory (EPROM):** An EPROM is an erasable PROM. An EPROM can be (re) programmed using an EPROM programmer. Exposing it to high intensity ultraviolet light for 30 minutes (approximately) can erase the contents of an EPROM chip. An ultra-violet

source with a wavelength of 2537Å (angstrom) is used for this purpose. The process of changing the contents is not convenient, as the chip has to be removed from the board for exposure to the ultra-violet light source. Another disadvantage is that the user can't erase the contents of a single memory location and the entire memory contents have to be erased. The EPROM chip is cheap, reliable and widely available.

- **Electrically Erasable Programmable Read Only Memory (EEPROM):** EEPROM is an electrically erasable PROM. Using electrical signals can alter the information and that is why the chip need not be removed from the board. One major advantage that this chip has over the EPROM is that even single memory can be altered, i.e., the entire memory need not be erased and reprogrammed unless required. The change in the contents of the EEPROM chip is made in milliseconds, which is much less than the erasing time for EPROM.
- **Non-Volatile RAM:** A non-volatile RAM combines a static RAM and EEPROM. Such a device operates as normal RAM but in case the power fails the entire contents of the RAM are stored in EEPROM. When the power is restored, the data from EEPROM is transferred back to the RAM.

Now that you have an idea of the computer's internal architecture. We shall discuss the RISC & the CISC.

2.3 REDUCED INSTRUCTION SET COMPUTER (RISC)

An important aspect of computer architecture is the design of the instruction set for the processor. The instruction set chosen for a particular computer determines the way that machine language programs are constructed. Early computers had small and simple instruction sets, forced mainly by the need to minimize the hardware used to implement them. As digital hardware became cheaper with the advent of integrated circuits, computer instructions tended to increase both in number and complexity. Many computers have instruction sets that include more than hundred and sometimes even more than 200 instructions. These computers also employ a variety of data types and a large number of addressing modes. The trend for computer hardware complexity was influenced by various factors, such as upgrading existing models to provide more customer applications, adding instructions that facilitate the translation from high-level language into machine language programs and striving to develop machines that move functions from software implementation into hardware implementation. A computer with a large number of instructions is classified as a Complex Instruction Set Computer, abbreviated CISC.

In the early 1980s, a number of computer designers recommended that computers use fewer instructions with simple constructs so they can be executed much faster

within the CPU without having to use memory as often. This type of computer is classified as a Reduced Instruction Set Computer or RISC.

NOTES

CISC Characteristics

The design of an instruction set for a computer must take into consideration not only machine language constraints, but also the requirements imposed on the use of high-level programming languages. The translation from high-level to machine language programs is done by means of a compiler program. One reason for the trend to provide a complex instruction set is the desire to simplify the compilation and improve the overall computer performance. The task of a compiler is to generate a sequence of machine instructions for each high-level language statement. The task is simplified if there are machine instructions that implement the statements directly. The essential goal of a CISC architecture is to attempt to provide a single machine instruction for each statement that is written in a high-level language. Examples of CISC architectures are the Digital Equipment Corporation VAX computer and the IBM 370 computer.

The major characteristics of CISC architecture are:

1. A large number of instructions-typically from 100 to 250 instructions
2. Some instructions that perform specialized tasks and are used infrequently
3. A large variety of addressing modes-typically from 5 to 20 different modes
4. Variable-length instruction formats
5. Instructions that manipulate operands in memory

RISC Characteristics

The concept of RISC architecture involves an attempt to reduce execution time by simplifying the instruction set of the computer. The major characteristics of an RISC processor are:

1. Relatively few instructions
2. Relatively few addressing modes
3. Memory access limited to load and store instructions
4. All operations done within the registers of the CPU
5. Fixed-length, easily decoded instruction format
6. Single-cycle instruction execution
7. Hardwired rather than micro programmed control

A characteristics of RISC processors is their ability to execute one instruction per clock cycle. This is done by overlapping the fetch, decode and execute phases of

two or three instructions by using a procedure referred to as pipelining. A load or store instruction may require two clock cycles because access to memory takes more register operations. Efficient pipelining, as well as a few other characteristics, are sometimes attributed to RISC, although they may exist in non-RISC architectures as well. Other characteristics attributed to RISC architecture are:

1. A relatively large number of registers in the processor unit
2. Use of overlapped register windows to speed-up procedure call and return
3. Efficient instruction pipeline
4. Compiler support for efficient translation of high-level language programs into machine language programs

2.4 INDIAN COMPUTING ENVIRONMENT

Office work includes many administrative and management activities. The preparation, distribution, processing and review of documents are the common activities of an organization. Prior to the advent-of computers, these office activities were either performed manually or with the help of mechanical and electrical machines. During the past few decades, the basic nature of office has changed remarkably. Office automation deals in application of latest technologies in improving the overall proficiency of the office. We may define office automation as follows:

Definition

Office automation is the application of computer and related technologies like communication and networking to integrate the general office tasks so that the efficiency of office work is improved.

Office automation does not mean just to install computers and communication devices in an office, but it is much more than that. We will discuss in later part of this unit, how an office can be automated in a real sense.

2.5 ROLE OF COMPUTERS IN MANAGEMENT

Although all the work of a small or big office can be performed manually, it is very difficult or even impossible today for an organization to compete in the market without office automation. There are many essential requirements of today's office environment, which are listed below:

- To reduce cost of administrative overhead;
- To increase the efficiency of office tasks;

NOTES

- To provide better service to the customers;
- To provide accurate information to the management;
- To provide best and fastest way of communication.

The above requirements cannot be achieved without using latest technologies and therefore, office automation is needed for an organization.

Office Functions Needed to be Automated

Many types of functions are performed in an office. The basic functions, which are needed to be automated in any office are:

1. ***Document Generation:*** In all offices, many documents are needed to be prepared, typed and printed. Typewriters, computers and printers are widely used in automating this routine task of offices.
2. ***Document Processing:*** Documents are also needed to be processed in order to extract useful information required for MIS and other official purposes. Many office automation tools like word processing, desktop publishing etc. are used to perform this task.
3. ***Document Distribution:*** All offices require an electronic distribution system for transferring documents and data within and outside the organization. The main office automation tools for distribution of documents are Photocopiers, Teletax and Fax machines.
4. ***Archival Storage:*** The office documents are also needed to be stored for a long period, so that they can be retrieved when required. This task is achieved by the use of different storage devices like tapes, disks, etc.

Office Automation Systems

For achieving the basic functions of an office, different types of office automation systems are used. These systems can be broadly classified into following four types:

1. ***Document Management Systems:*** These systems include computerized tools for generation, storage, processing and distribution of documents.
2. ***Communication Systems:*** These systems are used for sending messages, documents and data within and outside the organization.
3. ***Teleconferencing Systems:*** An electronic means of communication for conducting seminars and training programmes in an organization is achieved through various teleconferencing systems.
4. ***Support Systems:*** Besides the above major office automation systems, certain support systems for managing the activities of work groups are also used in some offices.

Check Your Progress

Tick (✓) the correct options:

1. The joy stick is a part of which unit:
 - (i) Memory
 - (ii) Control Unit
 - (iii) Input Unit
 - (iv) Output Unit
2. In a database management system which memory would be best suited to store the data:
 - (i) ROM
 - (ii) Non-volatile RAM
 - (iii) EEPROM
 - (iv) Auxiliary Storage Memory
 - (v) RAM
3. Which of the following has the shortest access time?
 - (i) Cache Memory
 - (ii) RAM
 - (iii) ROM Non-volatile RAM
 - (iv) Main Memory
4. Which of the following memories is the costliest?
 - (i) Main Memory
 - (ii) Ram Chip
 - (iii) Cache Memory
 - (iv) Secondary Memory

NOTES

2.6 SUMMARY

- The main components of computer are input/output units, central processing unit and memory unit. Input unit is used to enter data and instructions into a computer. CPU performs all the processing of input data: Memory is used to store the data, instructions and information before, during and after the processing by ALU. Output unit makes available output to the users.
- CPU consists of ALU (Arithmetic Logic Unit) which is responsible for all arithmetic and logical operations. CU (Control Unit) controls the transfer of data and instructions among other units of computer registers, which are used to store data, instructions and memory addresses when ALU performs arithmetic and logical operations. Buses are used to transfer data between registers and clock which measures and allocates a fixed time slot for processing each and every micro operation.
- Memory is the internal storage area, which holds the data and instructions during processing. The three types of main memory or Internal memory are RAM (Random Access Memory), ROM (Read Only Memory) and CMOS (Complementary Metal Oxide Semiconductor Memory).

NOTES

- Computers are used in business for data capturing in on-line as well as off-line mode, for storage and retrieval of information, for output and for transmission. Offices are needed to be automated to reduce cost of administrative overhead and to increase efficiency of office tasks and staff. The hardware components of microcomputer can be classified into motherboard, input devices, output devices, storage devices, cards, ports and cords and power supply. Various input devices are keyboard, mouse back ball, light pen, touch screen, Joy stick, digitizer, Scanner, Optical Mark Reader (OMR), Optical Character Reader (OCR), Bar Code Reader (BCR), Magnetic Ink Character Recognition (MICR) and voice input devices. Various output devices include monitor, printer, plotter and computer output micro file. Storage devices include hard disk, floppy disk, compact disk, Magnetic tape, video disk, Magneto optical drive, DVD ROM/RAM disk, etc.

2.7 GLOSSARY

- **ALU:** Arithmetic Logic Unit of a computer which is used to perform arithmetic and logic operations.
- **Cache Memory:** A small high speed memory which is used to temporarily store a portion of a program or data from the main memory. The processor retrieves instructions or data from the cache memory.
- **CPU:** Central processing unit of a computer. It consists of circuits to perform arithmetic and logic and also has circuits to control and co-ordinate the functioning of the memory and I/O units of a computer.
- **Output Unit:** A unit of a computer used to print or display computed results.
- **Printer:** An output unit to print the results of computation. Line printers print one full line at a time using a character, chain or drum. Character printer print one character at a time serially.
- **Processor:** A unit of a computer which interprets instructions, executes them using arithmetic and logic circuits and controls the operation of all the other units of the computer (also known as CPU).
- **RAM (Random Access Memory):** A memory used as the main memory of a computer in which the time to retrieve stored information is independent of the address where it is stored.
- **ROM (Read only Memory):** A memory in which information is permanently written. The information can be read quickly but not change.

2.8 ANSWERS TO CHECK YOUR PROGRESS

1. c
2. a
3. a
4. a

2.9 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. Why are the input and output devices referred to as 'peripherals'?
2. What are the functions performed by the CPU?
3. Write a short note on the functioning of the control unit.
4. Define 'access time'.
5. How does the cache memory decide what data it has to store?

NOTES

Long Answer Questions

1. Explain the functioning of the memory data register and the memory address register?
2. What does the current instruction register store?
3. Explain how the clock pulse provides synchronization among the different parts of the computer.
4. Distinguish between dynamic and static RAM.
5. What is the difference between RAM and ROM?
6. What is the function of bus in CPU?
7. Define the following:
 - (i) PROM
 - (ii) EPROM
 - (iii) EEPROM
 - (iv) DRAM
 - (v) SRAM
8. Why do we need office automation?
9. Describe various types of office automation system.

2.10 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003

UNIT 3: GENERATION OF COMPUTER

NOTES

Structure

- 3.0 Introduction
- 3.1 Unit Objectives
- 3.2 Generation of Computers
 - 3.2.1 Zeroth Generation Computers
 - 3.2.2 First Generation Computers
 - 3.2.3 Second Generation Computers
 - 3.2.4 Third Generation Computers
 - 3.2.5 Fourth Generation Computers
 - 3.2.6 Fifth Generation Computers
- 3.3 Classification of Programming Languages
 - 3.3.1 Low Level Languages
 - 3.3.2 High Level Languages
 - 3.3.3 Comparison of Assembly and High Level Languages
- 3.4 Summary
- 3.5 Glossary
- 3.6 Answers to Check Your Progress
- 3.7 Terminal and Model Questions
- 3.8 References

3.0 INTRODUCTION

A computer is a machine that works with data and information in the form of numbers. People from the beginning of time, and throughout the years, have invented and continue to develop things that help them count. Cavemen counted with the only counting tools they knew, their fingers and toes. These were considered the first counting tools. A program is a sequence of instructions that tells the hardware of a computer what operations to perform on data. Programs can be built into the hardware itself, or they may exist independently in a form known as software. In some specialized, or dedicated computers the operating instructions are embedded in their circuitry; common examples are the microcomputers found in calculators, wristwatches, automobile engines, and microwave ovens.

A general-purpose computer, on the other hand, contains some built-in programs (in ROM) or instructions (in the processor chip), but it depends on external programs to

perform useful tasks. Once a computer is programmed, it can do only as much or as little as the software controlling it at any given moment enables it to do. Software in widespread use includes a wide range of applications programs-instructions to the computer on how to perform various tasks.

A computer must be given instructions in a language that it understands—that is, a particular pattern of binary digital information. On the earliest computers, programming was a difficult, laborious task, because vacuum-tube ON-OFF switches had to be set by hand. Teams of programmers often took days to program simple tasks such as sorting a list of names. Since that time a number of computer languages have been devised, some with particular kinds of functioning in mind and others aimed more at ease of use—the user-friendly approach.

3.1 UNIT OBJECTIVES

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

- Discuss the various generation of computers
- Define Programming Languages
- Discuss the features of different generation computers
- Describe the generations of Programming Languages

3.2 GENERATION OF COMPUTERS

The computer evolved as a result of man's search for a fast and accurate calculating device. Abacus was the first manual calculating device, which was invented in Asia many centuries ago. In 1617, John Napier, a Scottish mathematician invented a mechanical calculator called 'Napier's bones'. Thereafter, many kinds of computers have been designed and built during the evolution of the modern digital computer. In order to provide a framework for the growth of computer industry, the computer era has been referred to in terms of generations. Computers are classified into following six types based on their historical advancement and electronic components used.

3.2.1 Zeroth Generation Computers

The zeroth generation of computers (1642-1946) was marked by the invention of mainly mechanical computers. Pascaline was the first mechanical device, invented by Blaise Pascal, a French mathematician in 1642. In 1822, Charles Babbage, an English mathematician, designed a machine called Difference Engine to compute tables of numbers for naval navigation. Later on, in the year 1834, Babbage attempted to build a digital computer, called Analytical Engine. The analytical engine had all the parts of a modern computer, i.e.; it had four components—the store (memory unit), the mill (computation unit), the punched card reader (input unit) and the punched/

NOTES

printed output (output unit). As all basic parts of modern computers were thought out by Charles Babbage, he is known as Father of Computers. In later years, Herman Hollerith invented a machine for doing counting for 1880 US census, which was called Tabulating Machine. In 1944, Howard A. Eiken invented first American general purpose electro-mechanical computer, called Mark I and later on its successor, Mark II. The Zeroth generation of computers or the era of mechanical computers ended in 1946 when vacuum tubes were invented.

3.2.2 First Generation Computers

The first generation of computers (1946-1954) was marked by the use of vacuum tubes or valves for their basic electronic component. Although these computers were faster than earlier mechanical devices, they had many disadvantages. First of all, they were very large in size. They consumed too much power and generated too much heat, when used for even short duration of time. They were very unreliable and broke down frequently. They required regular maintenance and their components had also to be assembled manually. The first generation of computers became outdated, when in 1954, the Philco Corporation developed transistors that can be used in place of vacuum tubes.

Examples:

- **ENIAC** (Electronic Numerical Integrator and Calculator) It was the first electronic computer using vacuum tubes. – 1946
- **EDSAC** (Electronic Delay Storage Automatic Calculator) It was the first stored-program computer. – 1949
- **EDVAC** (Electronic Discrete Variable Automatic Computer) It was a successor to EDSAC. – 1951
- **IAS machine** (Princeton's Institute of Advanced Studies) It was a new version of the EDVAC, built by von Neumann. – 1952

The basic design of IAS machine is now known as von Neumann machine, which had five basic parts, viz., the memory, the arithmetic logic unit, the program control unit, the input and the output unit.

Features

1. They used valves or vacuum tubes as their main electronic component.
2. They were large in size, slow in processing and had less storage capacity.
3. They consumed lots of electricity and produced lots of heat.
4. Their computing capabilities were limited.
5. They were not so accurate and reliable.
6. They used machine level language for programming.
7. They were very expensive.

3.2.3 Second Generation Computers

The second generation of computers (1954-64) was marked by the use of transistors in place of vacuum tubes. Transistors had a number of advantages over the vacuum tubes. As transistors were made from pieces of silicon, they were more compact than vacuum tubes. The second generation computers, therefore, were smaller in size and less heat was generated than first generation computers. Although they were slightly faster and more reliable than earlier computers, they also had many disadvantages. They had limited storage capacity, consumed more power and were also relatively slow in performance. Like first generation computers, they also required regular maintenance and their components had also to be assembled manually. Manual assembly of components was very expensive and later many attempts were made to reduce such manual assembly. It was in 1964, when it was discovered that a number of transistors could be sealed up into a tiny package, called Integrated Circuit (IC) or Chip. Second generation computers became outdated after the invention of ICs.

Examples:

- **PDP-1**, developed by DEC was the first minicomputer.
- **NCR 304** (National Cash Register), was first all-transistorized computer.

Features

1. Transistors were used instead of Vacuum Tube.
2. Processing speed is faster than First Generation Computers (Micro Second)
3. Smaller in Size (51 square feet)
4. The input and output devices were faster.

3.2.4 Third Generation Computers

The third generation of computers (1964-1980) was marked by the use of Integrated Circuits (ICs) in place of transistors. ICs were more compact than transistors, as hundreds of transistors could be put on a single small circuit. These computers removed many drawbacks of second generation computers. The third generation computers were even smaller in size which generated less heat and required very less power as compared to earlier two generation of computers. These computers required less human labour at the assembly stage. Although, third generation computers were faster and more reliable, they also had a few disadvantages.

They still had less storage capacity, relatively slow performance and thus could not fulfil the requirements of the users and programmers. The third generation computers became outdated around the year 1978 when it was found that thousands of ICs could be integrated onto a single chip, called LSI (Large Scale Integration).

Examples:

- **IBM 360**, developed by IBM in 1964 was the first product line designed as a family.
- **PDP-8**, developed by DEC in 1965 was the first mass-market minicomputer.
- **PDP-11**, developed by DEC in 1970 was the first highly successful minicomputer.
- **CRAY-1**, developed by Cray in 1974 was the first supercomputer.
- **VAX**, developed by DEC in 1978 was the first super minicomputer.

Features

1. They used Integrated Circuit (IC) chips in place of transistors.
2. Semi conductor memory devices were used.
3. The size was greatly reduced, the speed of processing was high, they were more accurate and reliable.
4. Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) were also developed.
5. The mini computers were introduced in this generation.
6. They used high level language for programming.

3.2.5 Fourth Generation Computers

The fourth generation of computers (1978-till date) was marked by use of Large Scale Integrated (LSI) circuits in place of ICs. As thousands of ICs could be put onto a single circuit, so LSI circuits are still more compact than ICs. In 1978, it was found that millions of components could be packed onto a single circuit known as Very Large Scale Integration (VLSI). VLSI is the latest technology of computer that led to the development of the popular Personal Computers (PCs), also called Microcomputers. All present day computers belong to the fourth generation of computers. These computers are very powerful having a high memory and a fast processing speed. Today's PCs are even more powerful than mainframe computers. Although fourth generation computers offer too many advantages to users, the major drawback of these computers is that they have no intelligence on their own. Scientists are now trying to remove this drawback by making computers which will have artificial intelligence.

Examples:

1. **IBM PC**, developed in 1981 was the first industry standard personal computer, having Intel 8088 memory chip.

2. **IBM PC/AT**, developed in 1982 was the first advanced technology PC, having Intel 80286 memory chip.
3. **386**, developed in 1985, had Intel 80386 memory chip.
4. **CRAY-2**, developed in 1985, was the fourth generation supercomputer.
5. **486**, developed in 1989, had Intel 80486 memory chip.
6. **Pentium**, developed in 1995, has pentium (80586) memory chip.

NOTES

Features:

1. They used Microprocessor (VLSI) as their main switching element.
2. They are also called micro computers or personal computers.
3. Their size varies from desktop to laptop or palmtop.
4. They have very high speed of processing; they are 100% accurate, reliable, diligent and versatile.
5. They have very large storage capacity.

3.2.6 Fifth Generation Computers

The fifth generation computers (Tomorrow's computers) are still under research and development stage. These computers will have artificial intelligence. They will use ULSI (Ultra Large Scale Integration) chips in place of VLSI chips. One ULSI chip contains millions of components on a single IC. The most important feature of fifth generation computers is that they will use an intelligent software. This software will enable the user to tell computer 'What to do' and not 'How to do' by using intelligent programming and knowledge-based problem solving techniques. So, the programmers or users would not be required to give each and every instruction to the computer for solving a problem. These computers will also have user interface in form of speech in natural languages.

Example:

- Yet to develop but ROBOTS have few features of fifth generation computers.

3.3 CLASSIFICATION OF PROGRAMMING LANGUAGES

For the purpose of understanding the programming, languages can be categorized into Low Level and High Level languages as follows:

3.3.1 Low Level Languages

A low level language is a language in which each statement is directly translated into a single machine code. These languages can be further classified under two heads:

1. Machine Languages, 2. Assembly Languages

Machine Languages

NOTES

Unfortunately, the computer's own binary-based language, or machine language, is difficult for humans to use. The programmer must input every command and all data in binary form, and a basic operation such as comparing the contents of a register to the data in a memory-chip location might look like this: 11001010 00010111 11110101 00101011.

Machine-language programming is such a tedious, time consuming task that the time saved in running the program rarely justifies the days or weeks needed to write the program. Therefore, the set of instruction codes, whether in binary or in decimal notation, which can be directly understood by the computer without the help of a translating program, is called *machine code* or *machine language program*.

Let us understand this: a computer understands information composed of only zeros and ones. This means that a computer uses binary digits for its operation. The computer's instructions are therefore coded and stored in the memory in the form of 0s and 1s. A program written in the form of 0s and 1s is called a *machine language program*. There is a specific binary code for each instruction. For example, to add the contents of register A and register B, the binary code is 10000000 for Intel 8085. The binary code (machine code or object code) for a certain operation differs from computer to another. Each microprocessor has its own instruction set and corresponding machine codes. Machine code is the fundamental language of a computer and is normally written as strings of binary 1s and 0s. However, a machine language program need not necessarily be coded as strings of binary digits (1s and 0s). It can also be written using decimal digits. However, the circuitry of the computer would be extremely complex and such computers have not been built.

Two Part Machine Code

The circuitry of a computer is wired in such a way that it immediately recognizes the machine language and converts it into electrical signals needed to run the computer. An instruction prepared in any machine language has a two-part format, as shown below:

<i>LMC assembly language</i>	<i>LMC machine code translations</i>
Get	901
Store 99	399
Get	901
Add 99	199
Put	902

Operation Code

The first part is the command or operation, and it tells the computer what function to perform. Every computer has an operation code or opcode for each of its functions.

Address

The second part of the instruction is the operand, and it tells the computer where to find or store the data or other instructions that are to be manipulated. Thus, each instruction tells the control unit of the CPU what to do and what is the length and location of the data fields that are involved in the operation. Typical operations involve reading, adding, subtracting, writing, and so on.

We know that all computers use binary digits (0s and 1s) for performing internal operations. Hence, a computer's machine language consists of strings of binary numbers. This is the only language which the CPU understands directly. When stored inside the computer, the symbols which make up the machine language program are made up of 1s and 0s. We know that machine language is not a very easy language to learn, because it is difficult to read, understand and remember the long sequences of 0s and 1s. Since human programmers are more at ease with the decimal number system, they preferred to write the computer instructions in decimal numbers. An input device is then used to convert these to binary.

Advantages and Limitations of Machine Language

Programs written in machine language can be executed very fast by the computer. This is mainly because machine instructions are directly understood by the CPU and no translation of the program is required. However, writing a program in machine language has several disadvantages which are discussed below.

The internal design of computers is different from one another and needs different electrical signals to operate; the machine language is also different from one type of computer to another. It is determined by the actual design or construction of the Arithmetic Logic Unit (ALU), the control unit, and the size as well as the word length of the memory unit. Hence, it is important to note that after becoming proficient in the machine code of a particular computer, the programmer will be required to learn a new machine code and would have to write all the existing programs again, in case the computer system is changed.

Although machine language is easily used by the computer, it is very difficult to write a program in this language. It is necessary for the programmer either to memorize dozens of code numbers for the commands in the machine's instruction set or to constantly refer to a reference card. A programmer is also forced to keep track of the storage locations of data and instructions. A machine language programmer must also be an expert who knows about the hardware structure of the computer.

NOTES

NOTES

For writing a program in machine language, the programmer not only has to remember the *opcodes*, but also has to keep a track of the storage locations of data and instructions. It therefore becomes very difficult for him to concentrate fully on the logic of the problem. This frequently causes errors in programming.

It is very difficult to correct or modify machine language programs. Checking machine instructions to locate errors is about as tedious as writing them initially. Similarly, modifying a machine language program at a later date is so difficult that many programmers would prefer to code the new logic afresh instead of incorporating the necessary modifications in the old program. In short, writing a program in machine language is so difficult and time consuming that it is rarely used nowadays.

Assembly Languages

One method programmers devised to shorten and simplify the process is called assembly-language programming. By assigning a short (usually three-letter) mnemonic code to each machine-language command, assembly-language programs could be written and debugged-cleaned of logic and data errors - in a fraction of the time needed by machine-language programmers. Unlike the other programming languages, assembly language is not a single language, but rather a group of languages. Each processor family (and sometimes individual processors within a processor family) has its own assembly language.

In assembly language, each mnemonic command and its symbolic operands equal one machine instruction. An assembler program translates the mnemonic opcodes (operation codes) and symbolic operands into binary language and executes the program. Assembly language, however, can be used only with one type of CPU chip or microprocessor. Programmers who expended much time and effort to learn how to program one computer had to learn a new programming style each time they worked on another machine. What was needed was a shorthand method by which one symbolic statement could represent a sequence of many machine-language instructions, and a way that would allow the same program to run on several types of machines. These needs led to the development of the so-called high-level languages.

In contrast to high-level languages, data structures and program structures in assembly language are created by directly implementing them on the underlying hardware. So, instead of cataloguing the data structures, the program structures can be built (in assembly language you can build any structures you so desire, including new structures nobody else has ever created). Because of the close relationship between assembly languages and the underlying hardware, we will discuss hardware implementation as well as software.

Assemblers

Assembly language is the oldest non-machine language, allowing for a more human readable method of writing programs than writing in binary bit patterns (or even

hexadecimal patterns). We know that a computer does not understand any program written in a language other than its machine language. Hence, the programs written in other languages must be translated into the machine language of the computer before they are executed. Such translation is performed with the help of software. A program which translates an assembly language program into a machine language program is called an assembler. An assembler which runs on a computer for which it produces object codes (machine codes) is called a self assembler (or resident assembler).

Cross Assemblers

A less powerful and cheaper computer may not have enough software and hardware facilities for program development. In such a situation, a faster and more powerful computer can be used for program development. The programs so developed are to be run on smaller computers. For such program development, a cross assembler is required. A cross assembler is an assembler that runs on a computer other than that for which it produces machine codes. These are further classified as: One-pass Assemblers and Two-pass Assemblers.

One-Pass Assemblers

It is an assembler which reads the assembly language programs only once. Such an assembler must be equipped with some means to assign addresses to the labels used in the assembly language program.

Two-Pass Assemblers

It is an assembler which goes through the assembly language program twice. On the first pass, the assembler reads the assembly language program and collects all labels. It assigns addresses to the labels counting their position from the starting address. On the second pass, the assembler produces the machine code for each instruction and assigns addresses to each instruction.

Advantage and Limitations of Assembly Languages

The advantage of assembly language over high-level languages is that the computation time of an assembly language program is less. An assembly language program runs faster to produce the desired result. Following are the major limitations or disadvantages of assembly languages:

Programming is difficult and time-consuming. In addition, assembly languages are machine dependent. The programmer must have detailed knowledge of the structure of the computer he is using. He must have the knowledge of registers and instruction sets of the computer, connections of ports to the peripherals, etc.

The program written in an assembly language for one computer cannot be used in any other computer, i.e., the assembly language program is not portable. Each processor has its own instruction sets and hence its own assembly language.

NOTES

An assembly language program contains more instructions than a high-level language program. Each statement of a program in a high-level language (such as FORTRAN, PASCAL, etc.) corresponds to many instructions in an assembly language program.

In case of an assembly language, instructions are still written at the machine-code level—that is, one assembler instruction is substituted for one machine-code instruction.

Assemblers are available for just about every processor ever made. Native assemblers produce object code on the same hardware that the object code will run on. Cross assemblers produce object code on different hardware that the object code will run on.

Structure of Assembly Language

Format: Free form or column (depends on the assembly language)

Nature: Procedural language with one to one correspondence between language mnemonics and executable machine instructions.

Assembler languages occupy a unique place in the computing world. Since most assembly language statements are symbolic of individual machine-language instructions, the assembler-language programmer has the full power of the computer at his disposal in a way that users of other languages do not. Because of the direct relationship between assembler language and machine language, assembler language is used when high efficiency of programs is needed, and especially in areas of application that are so new and amorphous that existing program-oriented languages are ill-suited for describing the procedures to be followed.

Perhaps the most glaring difference among the three types of languages [high-level, assembly, and machine] is that as we move from high-level languages to lower levels, the code gets harder to read (with understanding). The major advantages of high-level languages are that they are easy to read and are machine-independent. The instructions are written in a combination of English and ordinary mathematical notation, and programs can be run with minor changes on different computers.

The second most visible difference among the different types of languages is that several lines of assembly language are needed to encode one line of a high-level language program.

There are a number of situations in which it is very desirable to use assembler language routines to do part of a job, and use some higher-level language for other parts. It makes sense to use higher-level languages such as FORTRAN, COBOL, or PL/I for parts of procedures for which they are well-suited, and supplement with assembler language routines for those parts of procedures for which the higher-level language is awkward or inefficient.

If one has a choice between assembly language and a high-level language, why choose assembly language? The fact that the amount of programming done in

assembly language is quite small compared to the amount done in high-level languages. It indicates that one generally does not choose assembly language. However, there are situations where it may not be convenient, efficient, or possible to write programs in high-level languages. Programs written to control and communicate with peripheral devices (input and output devices) are usually written in assembly language because they use special instructions that are not available in high-level languages, and they must be very efficient. Some systems programs are written in assembly language for similar reasons. In general, since high-level languages are designed without the features of a particular machine in mind and a compiler must do its job in a standardized way to accommodate all valid programs, there are situations where to take advantage of special features of a machine, to program some details that are inaccessible from a high-level language, or perhaps to increase the efficiency of a program, one may reasonably choose to write in assembly language.

In situations where programming in a high-level language is not appropriate, it is clear that assembly language is to be preferred to machine language. Assembly language has a number of advantages over machine code aside from the obvious increase in readability. One is that the use of symbolic names for data and instruction labels frees the programmer from computing and recomputing the memory locations whenever a change is made in a program. Another is that assembly languages generally have a feature, called macros, that frees the programmer from having to repeat similar sections of code used in several places in a program.

Kinds of Processors

Processors can broadly be divided into the categories of: CISC, RISC, hybrid, and special purpose.

Complex Instruction Set Computers (CISC) have a large instruction set, with hardware support for a wide variety of operations. In scientific, engineering, and mathematical operations with hand coded assembly language (and some business applications with hand coded assembly language), CISC processors usually perform the most work in the shortest time.

Reduced Instruction Set Computers (RISC) have a small, compact instruction set. In most business applications and in programs created by compilers from high level language source, RISC processors usually perform the most work in the shortest time.

Hybrid processors are some combination of CISC and RISC approaches, attempting to balance the advantages of each approach.

Special purpose processors are optimized to perform specific functions. Digital signal processors and various kinds of co-processors are the most common kinds of special purpose processors.

Executable Instructions

There are four general classes of machine instructions. Some instructions may have characteristics of more than one major group. The four general classes of machine instructions are: computation, data transfer, sequencing, and environment control.

Computation: Implements a function from n-tuples of values to m-tuples of values. The function may affect the state. Example: A divide instruction whose arguments are a single-length integer divisor and a double-length integer dividend, whose results are a single-length integer quotient and a single-length integer remainder, and which may produce a divide check interrupt.

Data Transfer: Copies information, either within one storage class or from one storage class to another. Examples: A move instruction that copies the contents of one register to another; a read instruction that copies information from a disc to main storage.

Sequencing: Alters the normal execution sequence, either conditionally or unconditionally. Examples: a halt instruction that causes execution to terminate; a conditional jump instruction that causes the next instruction to be taken from a given address if a given register contains zero.

Environment Control: Alters the environment in which execution is carried out. The alteration may involve a transfer of control. Examples: An interrupt disable instruction that prohibits certain interrupts from occurring; a procedure call instruction that updates addressing registers, thus changing the program's addressing environment.

3.3.2 High Level Languages

To overcome the difficulties associated with assembly languages, high-level or procedure-oriented languages were developed. High-level languages often use English-like words - for example, LIST, PRINT, OPEN, and so on - as commands that might stand for a sequence of tens or hundreds of machine-language instructions. The commands are entered from the keyboard or from a program in memory or in a storage device, and they are intercepted by a program that translates them into machine-language instructions. The instructions written in a high-level language are called statements. The statements resemble more closely English and mathematics as compared to mnemonics in assembly languages. Examples of high-level languages are BASIC, PASCAL, FORTRAN, COBOL, ALGOL, PL/I, PROLOG, LISP, ADA, SNOBOL, etc.

High-level languages permit programmers to describe tasks in a form which is problem oriented rather than computer oriented. A programmer can formulate problems more efficiently in a high-level language. Besides, he need not have a precise knowledge of the architecture of the computer he is using.

Advantages

One of the biggest advantages of a high-level language is that it is machine independent. This is a very valuable advantage because it means that a company changing computers—even to one from a different manufacturer—will not be required to rewrite all the programs that it is currently using. In other words, a program written in a high-level language can be run on many different types of computers with very little or practically no modification.

High-level languages are independent of computer architecture. The same program will run on any other computer which has a compiler for that language. The compiler is machine-dependent and not language-dependent.

A problem oriented language is a computer language designed to handle a particular class of problems. For example, COBOL was designed for business applications. FORTRAN was designed for scientific and mathematical problems. Query languages are designed for phrasing questions (interrogation problems).

Translation

When a program is written in a high-level it has to be converted into the appropriate machine language program before it can be executed. The compiler software is used to compile and create the object codes in machine language. The compiler does not immediately produce machine language program. Suppose a programmer calls from main program, a subprogram from library of subprogram files, then he should submit the source codes for all these together, to the compiler. This will force a compilation of this subprogram whenever it is used by the program. Instead, if we compile the main program and subprogram separately and link them up as necessary for producing the final executable machine program, it will save duplication of compiler effort. The linking of these library programs, the main program is done by an operating system program called 'linker'.

Interpreter

An Interpreter is a translator program for a high-level programming language that translates and program at the same time. The program is still interpreted in its original source language, the way the programmer wrote it. The interpreter translates one program statement into language and then causes the machine language be executed. It then translates the next line, and so on, until the program is finished. Interpreted programs run more slowly than their counterparts, because the compiler translates the entire program all at once before the program is run. However, it is convenient to write a program using an interpreter. Each single line of code can be tested interactively, hence the program-test the results of a programming statement right away. Programs that are interpreted are not one program and must always be run with the interpreter in the computer. For example, if you run a BASIC source language program, the version of the BASIC interpreter must be in the computer.

Compiler vs Linker

Usually a longer program is divided into a number of smaller subprograms called *modules*. It is easier to develop, test and debug smaller programs. A linker is a program that links (combines) smaller programs to form a single program. While developing a program, subroutines are frequently used. The subroutines are stored in a library file. The linker also links subroutines with the main program. Further, the linker links machine codes of the programs. It accepts the user's programs after the editor has edited the program and the compiler has produced the corresponding machine codes.

Interpreter vs Compiler

An interpreter is a program which translates statements of a high-level language program into machine codes. It translates one statement of the program at a time. It reads one statement of a high-level language program, translates it into machine code and executes it. Then it reads the next statement of the program, again translates and executes it. In this way it proceeds further till all the statements of the program are translated and executed. On the other hand, a compiler goes through the entire high-level language program once or twice and then translates the entire program into machine codes. A compiler is 5 to 25 times faster than an interpreter. An interpreter is a small program as compared to a compiler. It occupies less memory space, so it can be used in a smaller system which has limited memory space. The object program produced by the compiler is permanently saved for future reference. On the other hand, the object code of the statement produced by an interpreter is not saved. If an instruction is used the next time, it must be interpreted once again and translated into machine code. For example, during the repetitive processing of the steps in a loop, each instruction in the loop must be reinterpreted as the loop is executed.

Some of the popular high-level languages are briefly explained below:

FORTRAN

The first commercial programmer was probably Grace Hopper (1906-92), an American. After programming an experimental computer at Harvard University, she worked on the UNIVAC I and II computers and developed a commercially usable high-level programming language called FLOWMATIC. To facilitate computer use in scientific applications, IBM then developed a language that would simplify work involving complicated mathematical formulas. Begun in 1954 and completed in 1957, FORTRAN (FORMula TRANslator) was the first comprehensive high-level programming language that was widely used. It is a very useful language for scientific and engineering computations as it contains many functions for performing complex mathematical operations. It is a compact programming language. It is not suitable for processing large business files. It has a number of versions. Earlier, FORTRAN

IV was very popular. In 1977 the American National Standards Institute (ANSI) published a standard for FORTRAN called FORTRAN 77 with the objective that all manufacturers should use the same form of the language.

ALGOL

In 1957, the Association for Computing Machinery set out to develop a universal language that would correct some of FORTRAN's perceived faults. A year later they released ALGOL (ALGOrithmic Language), another scientifically oriented language. It was suitable for scientific and engineering computations. It was used in some universities and computer centres, but not in industries. It was widely used in Europe in the 1960s and 1970s, it has since been superseded by newer languages, while FORTRAN continues to be used because of the huge investment in existing programs.

COBOL

It is an abbreviation for Common Business-Oriented Language. COBOL was developed specially for business data processing. It was introduced by the US industry/government committee in 1960. COBOL is used for large business and commercial applications such as handling of ledgers, accounts, payroll files, etc. It supports simple and limited numeric operations, but it can handle complex non-numeric operations. It is more suitable for manipulating alphanumeric characters than FORTRAN. It can be written in a quasi-English form that may employ commonly used business terms. Its English-like statements can be understood very easily, for example, SUBTRACT WITHDRAWALS FROM OLD BALANCE GMNG NEW BALANCE. Its demerit is that it is not a compact language. It is not easy to learn, and it cannot handle complex mathematical computations as FORTRAN does.

PASCAL

PASCAL, originally designed as a teaching tool, is now one of the most popular microcomputer languages. It is a high-level language named after Blaise Pascal a seventeenth century French mathematician; philosopher and inventor. The mechanical calculator was invented by him. This language was developed by Prof. Nicklaus Wirth at Switzerland's Federal Institute of Technology in the early 1970s. It is a multi-purpose language suitable for both scientific and business applications. Beside numbers, it can also manipulate vectors, matrices strings of characters, sets, records, files and lists. As PASCAL is a compact language, its compiler is quite suitable for a smaller system. Program design debugging is made simpler. It produces a very efficient machine-code program. The program compiled from PASCAL runs several times faster than the same program compiled from FORTRAN BASIC. Like ALGOL, it is block-structured. It is an offspring of ALGOL. It is more versatile than BAS

NOTES

and more modular than FORTRAN. PASCAL is quite similar to C language, but it is not used in professional programming as C language is. It became an ANSI standard language in 1983.

NOTES

Basic

BASIC (Beginner's All-purpose Symbolic Instruction Code) was developed at Dartmouth College in the early 1960s for use by nonprofessional computer users. The language came into almost universal use with the microcomputer explosion of the 1970s and 1980s. Condemned as slow, inefficient, and inelegant by its detractors, BASIC is nevertheless simple to learn and easy to use. Because many early microcomputers were sold with BASIC built into the hardware (in ROM memory) the language rapidly came into widespread use. As a very simple example of a BASIC program, consider the addition of the numbers 1 and 2, and the display of the result. This is written as follows (the numerals 10-40 are line numbers):

```
10 A = 1
20 B = 2
30 C = A + B
40 Print C
```

BASIC is a widely used language for simple computation and analysis. It is now by far the most popular high-level language used in personal computers. To translate BASIC instructions into machine-language codes, interpreters are frequently used in PC systems. However, BASIC language compilers are also available for these systems.

PL/I

It is an abbreviation of Programming Language/I. PL/I was introduced by IBM in 1965. It is a multi-purpose language suitable for both scientific and business applications. It is more powerful than FORTRAN. PL/I is designed to include the features of both FORTRAN (as a scientific language) and COBOL (type file processing techniques as a business data processing language). This has made the language flexible and sophisticated. PL/I became an ANSI standard language in 1976.

C

C, a language Bell Laboratories designed in the 1970s, is widely used in developing systems programs, such as language translators. It is a general-purpose high-level language. This language was designed by a group at Bell Telephone Laboratories, USA in the early 1970s. It has features similar to PASCAL. It permits manipulation of internal processor registers and hence a programmer can write low-level machine instructions. C has the features of assembly language programming. It is a small and concise language. It makes use of a library of functions that are equivalent to subroutines. C programs can use modular and structured concepts. A problem may be

divided into smaller tasks and a function may be used to solve each task. C program may represent a grouping of functions that are linked together to produce the solution of the problem. The advantage of C is that the programs written in it can be shifted from one machine architecture to another without much difficulty. This language is used by system programmers to develop complex programs such as an operating system and application programs. AT and T (Bell Lab's parent company) produce the C compiler and UNIX operating system tools as a single software package. It has many versions which run on PCs and larger machines.

RPG

Report Program Generator (RPG) was developed in 1964, and it was one of the first program generators designed for business reports. RPG II, introduced in 1970, was an advanced version that was widely used as a programming language to develop business applications for small computers. RPG statements are written on pre-printed format and that provides the fixed columns for writing each of the statement. Programs like these were the forerunners of today's fourth-generation languages which allow users to process data without having to know how to be a programmer.

LOGO

LOGO was developed to introduce children to computers. It is an abbreviation for Logic Oriented Graphic Oriented. It was developed by Seymour Papert and Colleagues at MIT in the late 1960s. It is used in serious scientific work in universities. It has also been popularized as a first educational language that children can use to achieve intellectual growth and problem-solving skills. LOGO has graphics capability and children can easily use it to make drawings. They can draw, colour and animate images. It runs on PCs. It is also used to compose music, manipulate text, and manage data, etc.

LISP

LISP and PROLOG are widely used in artificial intelligence. This language was developed by McCarthy in the early 1960s. LISP is suitable for non-numeric operations involving logical operations. It is used extensively in artificial intelligence and pattern recognition. It is also used in designing computer games, proving theorems etc. LISP is capable of searching, handling and sorting long strings or lists of text. So it has often been used to implement computerized translators. It is used primarily on larger computers but LISP compilers are also available for PCs.

PROLOG

PROLOG is primarily used for artificial intelligence. It is a suitable language for developing programs involving complex logical operations. This language was developed in France. The Japanese have chosen it as a standard language for their fifth generation computer projects. It is quite suitable for handling large databases

and for producing rules-based expert systems applications. PROLOG stands for PROgramming in LOGic. It is based on mathematical logic. PROLOG consists of a set of facts and rules that describe objects and relations between objects in a given domain. The statements that are unconditionally true are called facts, while rules provide properties and relations which are true depending on given conditions.

3.3.3 Comparison of Assembly and High Level Languages

Assembly languages are close to a one to one correspondence between symbolic instructions and executable machine codes. Assembly languages also include directives to the assembler, directives to the linker, directives for organizing data space, and macros. Macros can be used to combine several assembly language instructions into a high level language like construct (as well as other purposes). There are cases where a symbolic instruction is translated into more than one machine instruction. But in general, symbolic assembly language instructions correspond to individual executable machine instructions.

High-level languages are abstract. Typically, a single high-level instruction is translated into several (sometimes dozens or in rare cases even hundreds) executable machine language instructions. Some early high-level languages had a close correspondence between high-level instructions and machine language instructions. For example, most of the early COBOL instructions were translated into a very obvious and small set of machine instructions. The trend over time has been for high-level languages to increase in abstraction. Modern object-oriented programming languages are highly abstract (although, interestingly, some key object-oriented programming constructs do translate into a very compact set of machine instructions).

Assembly language is much harder to program than high-level languages. The programmer must pay attention to far more detail and must have an intimate knowledge of the processor in use. But high quality hand-crafted assembly language programs can run much faster and use much less memory and other resources than a similar program written in a high-level language. Speed increases of 2 to 20 times faster are fairly common, and increases of hundreds of times faster are occasionally possible. Assembly language programming also gives direct access to key machine features essential for implementing certain kinds of low-level routines, such as an operating system kernel or micro-kernel, device drivers, and machine control.

High-level programming languages are much easier for less skilled programmers to work in and for semi-technical managers to supervise. And high-level languages allow faster development times than work in assembly language, even with highly skilled programmers. Development time increases of 10 to 100 times faster are fairly common. Programs written in high-level languages (especially object oriented programming languages) are much easier and less expensive to maintain than similar programs written in assembly language (and for a successful software project, the vast majority of the work and expense is in maintenance, not initial development).

Check Your Progress

State whether the following statements are True or False:

1. A linker is a program which links all unsatisfied external references in the program with program libraries.
2. An Interpreter is a translator program for a high-level programming language that translates and programs at the same time.
3. COBOL is a high level language used for scientific applications.
4. Machine language is written in binary code.
5. C, a language Bell Laboratories designed in the 1970s, is widely used in developing systems programs, such as language translators.
6. COBOL is an abbreviation for Common Business-Oriented Language. COBOL was developed specially for business data processing.
7. Application software is written using system software.
8. Operating system is a system software.
9. Report Generators are generally classified as 4GL's since they require the programmer to specify all the instructions and specifications to create a report.
10. 4 GL's are both user oriented as well as machine oriented..

NOTES

3.4 SUMMARY

- There are totally five computer generations known till date. Each generation has been discussed in detail along with their time period and characteristics. The first generation computers were developed during 1943-1958. It used vacuum tubes as the active electronic components and was therefore very large.
- The second generation computers were developed during 1959-1965. The invention of the transistor by three scientists of Bell Telephone Laboratories in 1947 greatly changed the development of computers. The third generation computers were developed during 1966-1973. The development of Integrated Circuit (IC) signalled the beginning of the third generation computers.
- The fourth generation computers were developed during 1974-1990. This generation of computer is presently in use. The development of microprocessor signalled the beginning of the fourth generation of computers. The computers having artificial intelligence (AI) and high processing capacity.

NOTES

- One man communicates with another in a language, which another man can understand. Similarly, man communicates with computer in a language, which machine can understand. This language which consists of a set of commands, understandable by computer directly or after translating is known as Computer Programming Language. In early days of computers, only those languages were used for programming, which could be directly executed on computer.
- Low-level languages are used for development of system software. As they are not used for applications development, managers or application programmers do not need to learn these languages.
- Development of applications using low level languages requires a deep understanding of the hardware. In order to facilitate the programmers to write programs without knowing the internal details of computer components, many languages were developed.

3.5 GLOSSARY

- **Abacus:** An abacus is a manual aid to calculate. It consists of beads or disks that can be moved up and down on a series of sticks or strings within a usually wooden frame.
- **Generation of Computers:** Generation in computer terminology is a change in technology a computer is/was being used.
- **IC:** Integrated circuits. An integrated circuit (IC) is a small electronic device made out of a semiconductor material.
- **AI:** Artificial Intelligence
- **Microprocessor:** A silicon chip that contains a CPU.
- **Compiler:** A system program to translate a high level language program to machine language.
- **Assembler:** A program which translates an assembly language program to its machine language equivalent.
- **Machine Language:** A language which uses numeric codes to represent operations and numeric addresses of operands. Each model of a computer has a unique machine language.
- **Third-generation Computer:** Computer built between 1966 and 1975 which used integrated circuits in CPU, high speed magnetic core main memories, powerful high level languages and saw the advent of time sharing operating system.

- **Assembly Language:** A low-level language for programming a computer in which mnemonics are used to code operations and alphanumeric symbols are used for addresses.
- **Fourth Generation:** Fourth Generation computers:- Computers built between 1975 and now. They use large scale integrated circuits, semiconductor memories and powerful high level languages and operating systems.
- **High Level Languages:** Computer language in which each statement is translated into many machine language statements.

3.6 ANSWERS TO CHECK YOUR PROGRESS

1. True
2. True
3. False
4. False
5. True
6. True
7. True
8. True
9. True
10. True

3.7 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. Briefly explain ENIAC and EDVAC.
2. List the main features of first generation computers.
3. What are the major differences between second and third generation of computers?
4. What are the limitations of fourth generation of computers?
5. Discuss the features of fifth generation computers.
6. What are Programming Languages? Why are they needed? Discuss.
7. What are Machine Languages? Elaborate.
8. What are Cross Assemblers?

Long Answer Questions

1. Describe in detail various generations of computers.
2. Differentiate between second and third generation of computers
3. What are Assembly Languages? Are they different from Machine Languages? Explain.
4. What are the advantages and limitations of Machine Languages? Discuss.
5. What are the advantage and limitations of Assembly Languages? Discuss.
6. Compare Assembly Language with High Level Language.
7. What is an Interpreter? Compare Interpreter and Compiler.
8. Name some of the popular high-level languages, and explain each of them briefly.
9. What are the Generations of Programming Languages? Elaborate.
10. What are Fourth Generation Languages? Why are they called Non-procedural and Special Purpose Languages? Discuss.

3.8 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
8. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

UNIT 4: NUMBER SYSTEM AND COMPUTER ARITHMETIC

NOTES

Structure

- 4.0 Introduction
- 4.1 Unit Objectives
- 4.2 Data and Information
 - 4.2.1 Data
- 4.3 Representation of Characters in Computers
- 4.4 Bits and Bytes
- 4.5 Text Codes
 - 4.5.1 EBCDIC
 - 4.5.2 ASCII
 - 4.5.3 Unicode
- 4.6 Number System
 - 4.6.1 Representation of Integers or Decimal Numbers
- 4.7 Binary System
 - 4.7.1 Hexadecimal Representation
- 4.8 Binary Arithmetic
- 4.9 Signed Numbers
 - 4.9.1 Sign-magnitude Representation
 - 4.9.2 2's Complement Notation
- 4.10 Binary Multiplication
- 4.11 Binary Division
- 4.12 Summary
- 4.13 Glossary
- 4.14 Answers to Check Your Progress
- 4.15 Terminal and Model Questions
- 4.16 References

4.0 INTRODUCTION

Even people who have been using computers for a few years still marvel at what they can do - how at lightning speed and with amazing accuracy they can sort a mailing list, balance a ledger, typeset a book, or create lifelike models of objects that have never existed.

NOTES

Just how a computer does all this may seem magical, but in fact it is a process based on simple concepts. All the words, numbers and images you put into and get out of the computer are manipulated in relatively simple ways by the computers' processing components.

In this chapter you will learn what data is, how it differs from information, and what form it takes inside the computer.

4.1 UNIT OBJECTIVES

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

- Define Data and Information
- Explain the Representation of Characters in Computers
- Define Number System
- Describe Conversions of Decimal to other Number Systems
- Describe Conversions of Binary System to other Number Systems
- Explain Computer Arithmetic

4.2 DATA AND INFORMATION

4.2.1 Data

We generally talk about data and information. Are they the same terms? And if not, what is the difference between them? Well, data is the raw material and information is what we get after processing the data. To be more precise, data is raw facts and figures and information is a processed data, that is useful and meaningful. Data is the input to processing, and information is the output.

How is data converted into information is explained in Fig. 4.1.

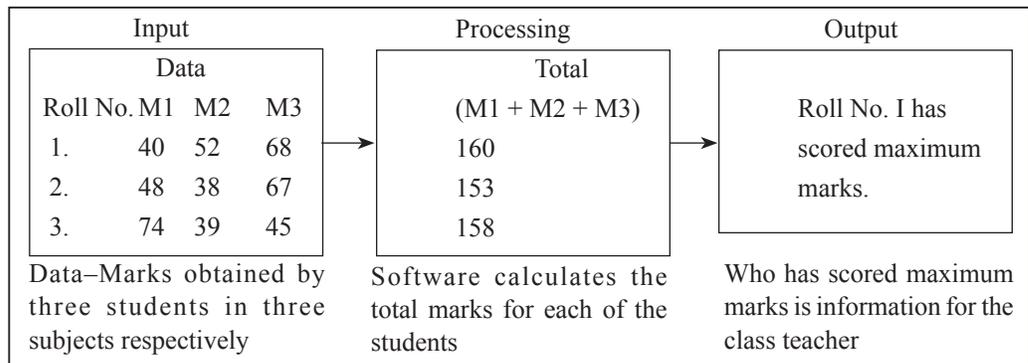


Fig. 4.1

Data is a plural form. The singular form of data is “datum” which is rarely used.

Information distinguishes itself from data, as it is more useful and meaningful. The marks of the subjects, as such are of no use for the teacher but then calculating the total helps him in finding out the ranks of the students. One information can be used as data for taking out another information, i.e., one information becomes input for another type of output, e.g., the total marks calculated as shown above will serve as data to find out the percentage and hence the division of the students, to check how many students have scored distinction, first class, second class or failed. Information can be distinguished from data by some characteristics like whether it is relevant, timely, and accurate, concise and complete. Data should be accurate but may not necessarily possess rest of the characteristics. The characteristics of information are explained as:

- **Relevant:** The information should apply to the situation or the query or problem.
- **Timely:** Information should be presented as and when required. For example, there is no point receiving newspaper after two-three days.
- **Accurate:** Input and output should be accurate, so that no wrong decisions take place. A small mistake can lead to hazardous results.
- **Reliable:** It should be reliable, i.e., there should not be any doubt about the presented information.
- **Concise:** It should not be unnecessarily lengthy, i.e., precision is an important characteristic of information.
- **Complete:** All the important elements should be covered and nothing should be missed.

It seems that computers understand us as we understand them. However, this is not true. They do not understand the language we normally use among ourselves. It is their own language which they understand. That language comprises two distinct physical states produced by electricity, magnetic polarity, or reflected light. All they can understand is whether a switch is on or off. In fact the “brain” of the computer, the CPU, consists primarily of several millions of tiny electronic switches, called transistors.

A computer only appears to understand information because it contains so many transistors and operates at such phenomenal speeds, assembling its individual on/off switches into patterns that are meaningful to us.

The term used to describe the information represented by groups of on/off switches is data. Although the words data and information are often used interchangeably, there is an important distinction between them. Data is raw facts that the computer organizes to produce information.

Data can be explained more explicitly by taking an example. The letters G, O and D do not indicate anything individually but when combined together they do give you a word GOD, which has some meaning. Similarly, a few words can be combined together to form a sentence that might convey some meaningful message to you and thus become information to you. The computer converts the data into information by processing it in some way.

4.3 REPRESENTATION OF CHARACTERS IN COMPUTERS

To discuss how a computer processes data, we should first have an understanding of the form in which data is stored in the computer's memory. There are two basic types of data which are stored and processed by a computer. They are characters and numbers. But to a computer everything is number. Numbers are numbers, letters are numbers, punctuation marks are numbers, sounds and pictures are numbers, even the computer's own instructions are numbers. This might seem very strange.

Characters and numbers are assigned different values by the computer. The output from a computer must be in the form that is understood by the users. Thus the computer translates those values into the form understandable by the normal users, which is again a natural language consisting of numbers and characters. This constitutes external data representation. On the other hand, the values used by a computer to store and process the data is internal representation of data.

Let us see how external data representation is different from the internal data representation. For example, consider the following sentence: GOD IS EVERYWHERE.

It may look like a sentence or a string of characters to you but for the computer it is a string of numbers (just zeros and ones). The computer interprets the sentence in the manner discussed below.

Internal data representation in a computer looks strange because people are in the habit of using base 10 to represent numbers. The system is called base 10 or the decimal system (deci means 10 in Latin). This system uses 10 symbols, viz., 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. When you need to represent a number greater than 9, you use two digits instead of one, as $9+1=10$ and so on. Each symbol in a number is called a digit and, therefore, we can say that the number 10 is a two-digit number.

In the computer all the data has to be converted into electrical switches. A switch has only two states: "on" and "off". And as they take only two numeric symbols they are said to function in base 2. This number system is known as binary system (BI means two).

When a computer needs to represent a quantity greater than 1, it does the same thing you do when you need to represent a quantity greater than 9 in decimal. It uses two or more binary digits.

4.4 BITS AND BYTES

While referring to computerized data, each switch whether it is on or off is called a bit. The term ‘bit’ is nothing but the contracted form of Binary Digit. A bit is the smallest possible unit of data. To represent anything meaningful – in the other words, to convey information – the computer needs groups of bits.

After the bit, the next larger unit is byte. The byte is a group of 8 bits. With one byte, the computer can represent up to 256 different values because it is possible to count from 0 to 255 with these 8 binary digits.

The byte is a very important unit because there are enough different eight-bit combinations to represent all the characters on the keyboard including all the letters (uppercases and lowercases, punctuation marks, numbers and other symbols). The byte is a basic unit for measuring the size of memory; although with today’s memory sizes, it is more common to hear terms like kilobyte (KB) or megabyte (MB) or gigabyte (GB).

1 Kilobyte (KB)	=	1024 bytes ~ 1000 bytes
1 Megabyte (MB)	=	1024 kilobytes ~1000 KB
1 Gigabyte (GB)	=	1024 megabyte ~ 1000MB
1 Terabyte (TB)	=	1024 gigabyte ~ 1000GB and so on.

The number of adjacent bits that can be stored and manipulated as a unit is called computer word. Some of the newer microcomputers have the ability to manipulate a 32-bit word, whereas the older ones could process words up to 16 bits. The length of the word matters, as the longer the word (that registers can hold), the more would be the processing speed.

4.5 TEXT CODES

Characters are similarly represented as series of binary 1’s and 0’s. However, there must be some universally accepted standard coding scheme to do this coding. This way, all the values representing digits, characters, punctuation marks and special symbols can be coded uniquely in terms of binary digits. The three most popular systems developed for this purpose are EBCDIC, ASCII and Unicode.

4.5.1 EBCDIC

Binary Coded Decimal (BCD) system was designed by IBM for one of its early computers. It was one of the first complete systems to represent symbols with bits. BCD codes consisted of 6-bit codes, which allowed a maximum of 64 possible symbols. BCD computers could work only on uppercase letters and a very few other symbols. That was the reason of their not being in use for a long time.

The need for more symbols led IBM to develop EBCDIC system. EBCDIC is pronounced as “EB-SI-DIC” and stands for Extended Binary Coded Decimal

NOTES

NOTES

Interchange Code. EBCDIC is an 8-bit code that defines 256 symbols. EBCDIC is still used in IBM mainframes and mid-range systems. By the time small computers started getting developed the ANSI (American National Standards Institute) had started developing the standards for computers.

ANSI's defined ASCII character set used to represent the symbols, numbers, characters etc. ASCII stands for American Standard Code for Information Interchange. Today, the ASCII character set is the most common.

In this scheme of coding characters 0 to 31 are control characters, 32 to 64 are special characters, 65 to 90 are uppercase alphabets, 97 to 122 are lowercase alphabets and 123 to 127 represent some common symbols. ASCII being a 7-bit code specifies characters only up to 127. There are variations that specify different character sets for codes from 128 to 255. The ISO (International Standards Organization) offers different sets of characters for different language groups.

4.5.3 Unicode

A new standard for data representation, called Unicode Worldwide Character Standard, provides 2 bytes (16 bits) to represent each symbol. That means the range could be anything up to 65, 536 different characters or symbols. That means all the characters and symbols of the world can have the same standard, thus facilitating the interchanging of the data and programs written in any language without requiring any special programs.

4.6 NUMBER SYSTEM

Before we go any further we need to study the various types of number systems and also the transformation rules to inter-convert them (i.e., external representation of data into internal data and vice versa).

4.6.1 Representation of Integers or Decimal Numbers

We now know how characters and strings of characters are represented internally in a computer. Decimal digits are also considered as characters and codes are assigned to them. These codes for digits are primarily used when digits are used merely as symbols with no "value" assigned to them. For example, DL3C 3455 is the registration number of a car, which is a combination of both numbers and characters. Now if we want to store these numbers in the computer and perform calculations too, they are required to be converted into binary system that uses only "0" and "1". The combination of zeros and ones can be used to represent the above given decimal numbers as we discussed earlier.

For example, consider the decimal number 3455. The value of each digit is determined by the digit itself (face value). The position of the digit and the base or radix of the number system determine the actual value represented.

The base of a number system is defined as the number of distinct symbols used to represent numbers in the system. The decimal system uses the ten symbols 1,2,3,4,5,6,7,8,9, and 0. Its base is thus 10.

To a decimal integer, we assign a value but before that we assign weights (place value) to each digit position. The weights are unity for the right most digit and changes to tens, hundreds, thousands, etc., as we proceed towards the left digits of the number.

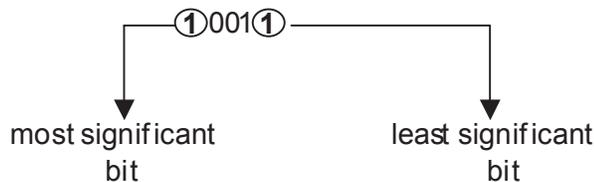
We multiply the digits of the number by its respective weights and then add them all to get the value of that number. Thus, the value of 3455 is calculated as:

$$\begin{array}{rccccr}
 3 \times 1000 & + 4 \times 100 & + 5 \times 10 & + 5 \times 1 & & \\
 3000 & + 400 & + 50 & + 5 & = & 3455 \\
 \text{Thousands} & \text{Hundreds} & \text{Tens} & \text{Units} & & \\
 \text{Position} & \text{Position} & \text{Position} & \text{Position} & &
 \end{array}$$

The notation used above is called ‘positional system’.

4.7 BINARY SYSTEM

As explained in the beginning of the chapter, if a number system has only two symbols then its base is 2. Such a system is called binary system. Numbers in this system are strings of bits. For example, 10011 is a binary number.



The right most bit is called the least significant bit and the left most bit is called the most significant bit. Weights assigned to the bits are the powers of 2 as $2^0 = 1$, $2^1 = 2$, $2^2 = 4$, $2^3 = 8$, $2^4 = 16$, etc.

As the powers of 10 are important in the decimal system, similarly the powers of 2 play an important role when it comes to representation in the binary system. A table is given below which gives powers of 2 and their decimal equivalents. The abbreviation K stands for 1024 and is taken as 1000 (a kilo) approximately. Similarly the notation mega stands for 1024×1024 and so on.

<i>Powers of 2</i>	<i>Decimal equivalent</i>	<i>Abbreviations</i>	<i>Powers of 2</i>	<i>Decimal equivalent</i>	<i>Abbreviations</i>
2^0	1		2^{11}	2048	2K
2^1	2		2^{12}	4096	4K

Contd.../-

NOTES

2^2	4		2^{13}	8192	8K
2^3	8		2^{14}	16384	16K
2^4	16		2^{15}	32768	32K
2^5	32		2^{16}	65536	64K
2^6	64		2^{17}	131072	128K
2^7	128		2^{18}	262144	256K
2^8	256		2^{19}	524288	512K
2^9	512		2^{20}	1048576	1M
2^{10}	1024	1K	2^{21}	2097152	2M

Representation of fractions (L2)

Decimal fractions are interpreted as:

$$\begin{array}{ccccccc}
 0.458 & = & 4 \times 10^{-1} & + & 5 \times 10^{-2} & + & 8 \times 10^{-3} \\
 \uparrow & & \uparrow & & \uparrow & & \uparrow \\
 \text{Decimal} & & \text{One-tenth} & & \text{One-Hundredth} & & \text{One-Thousandth} \\
 \text{Point} & & \text{Position} & & \text{Position} & & \text{Position}
 \end{array}$$

Negative powers of 10 (the base) are used as the weights for the digits in the fractional part of the number.

A binary fraction is represented by a string of 1's and 0's on the right of a binary point. The bits are multiplied by negative powers of 2 to obtain the decimal value of the binary fraction as:

$$\begin{array}{ccccccc}
 0.1101 & = & 1 \times 2^{-1} & + & 1 \times 2^{-2} & + & 0 \times 2^{-3} & + & 1 \times 2^{-4} \\
 \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow \\
 \text{Binary} & = & \frac{1}{2} & + & \frac{1}{4} & + & 0 & + & \frac{1}{16} \\
 \text{Point} & & & & & & & & \\
 & & = 13/16 & & & & & & \\
 & & = 0.8125 \text{ (In Decimal)} & & & & & &
 \end{array}$$

Examples

$$\begin{aligned}
 1. \quad (110101.11)_2 &= 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2} \\
 &= 32 + 16 + 0 + 4 + 0 + 1 + \frac{1}{2} + \frac{1}{4} \\
 &= 53 + \frac{3}{4} \\
 &= 53.75_{10}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad (1011.011)_2 &= 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 + 0 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3} \\
 &= 8 + 0 + 2 + 1 + 0 + 0.25 + 0.125 \\
 &= 11.375_{10}
 \end{aligned}$$

NOTES

4.7.1 Hexadecimal Representation

Counting in the binary system is similar to that in the decimal system. In decimal we start from 0, add 1, obtain 1 and continue adding 1 successively till we get 9. That means in base 10 there are symbols from 0 to 9. Now when we add 1 to 9 we get 10. 1 gets carried to the tens position in the decimal system. Similarly we count 100 after reaching 99 and so on. Counting in binary proceeds exactly in the similar fashion:

0, 1, 10, 11, 100, 101, 110, 111, 1000, 1001, ...

The table given below shows the binary counting sequence. Observe that we require 3 bits to represent decimal numbers 0, and 7 bits to represent 8 and 9. Thus we can say on an average there are 3.2 bits (binary digits) required to represent a decimal digit $[(8 \times 3 + 2 \times 4)/10 = 3.2]$. That means, if we convert a large decimal number to obtain its binary equivalent, it would be approximately 3.2 times the number of digits of the corresponding decimal number.

Thus the binary equivalent of a ten digit decimal number would be 32 bits long. Don't you think that writing such long strings of 0s and 1s are a very cumbersome and error prone task? This problem is solved to a great extent by using the hexadecimal number system, which uses 16 as a base. There are sixteen symbols used by this system viz fifteen symbols. Where is the 16th symbols? Here the symbols A, B, ..., F are used to represent the numbers 10, 11, 12, 13, 14 and 15 respectively. We need only 4 bits to represent a hexadecimal digit. The table below gives the hexadecimal system's symbols, their decimal and binary equivalents.

<i>Binary number</i>	<i>Hexadecimal equivalent</i>	<i>Decimal equivalent</i>	<i>Binary number</i>	<i>Hexadecimal number</i>	<i>Decimal equivalent</i>
0000	0	0	1000	8	8
0001	1	1	1001	9	9
0010	2	2	1010	A	10
0011	3	3	1011	B	11
0100	4	4	1100	C	12
0101	5	5	1101	D	13
0110	6	6	1110	E	14
0111	7	7	1111	F	15

One can verify that $(1101011)_2$ in binary system is equivalent to 107 in the decimal system.

2. Add 100000_2 and 1011_2

Binary	Decimal
100000	32
1011	11
101011	43

The binary equivalent of 43 in the decimal system is 101011.

3. Add 101110 and 111101

Binary	Decimal
101110	46
111101	61
1101011	107

Binary subtraction

Rules for carrying out binary subtractions are:

1. $0 - 0 = 0$
2. $0 - 1 = 1$ with one borrow
3. $1 - 0 = 1$
4. $1 - 1 = 0$

Here are a few examples.

1. Subtracting 101110_2 from 111101_2

Binary	Decimal
111101	61
101110	46
001111	15

Thus 001111 in binary system is equivalent to 15 in the decimal system.

2. Subtracting 1011 from 100000

Binary	Decimal
100000	32
1011	11
010101	21

The binary equivalent of 21 in the decimal system is 10101.

NOTES

NOTES

3. Subtracting 11 from 1001

Binary	Decimal
1001	9
11	3
0110	6

4.9 SIGNED NUMBERS

To represent signed numbers as sequences of bits, the place-value notation used for unsigned numbers must be extended to indicate whether a number is positive or negative. There are two schemes for doing this – sign – magnitude representations and 2’s complement notation.

4.9.1 Sign-Magnitude Representation

In sign-magnitude representations, the sign bit (also known as the high bit) of a binary number indicates whether the number is positive or negative, and the remainder of the number indicates the absolute value (or magnitude) of the number, using the same format as unsigned binary representation. N -bit sign-magnitude numbers can represent quantities from $-(2^{(N-1)} - 1)$ to $+(2^{(N-1)} - 1)$. There are two representations of 0 in sign-magnitude notation: +0 and -0. +0 has a value of 0 in the magnitude field and a positive sign bit. -0 has a value of 0 in the magnitude field and a negative sign bit.

Consider the following example.

The 16-bit unsigned binary representation of 168 is 0000 0000 1010 1000. In a 16-bit sign-magnitude system, -168 would be represented as 1000 0000 1010 1000. Here, the left most bit of the number is the sign bit and the rest of the number gives the magnitude.

Sign-magnitude representations have the advantage that the negative of a number can very easily be taken by simply inverting the sign bit. Determining whether a number is positive or negative is also easy, as it only requires examining the sign bit. Sign-magnitude representation makes it easy to perform multiplication and division on signed numbers, but hard to perform addition and subtraction. For multiplication and division, the hardware can simply perform unsigned operations on the magnitude portion of the inputs and examine the sign bits of the inputs to determine the sign bit of the result.

Consider the following example of multiplying the numbers +6 and -8, using 6-bit sign-magnitude integers.

Binary representation of +6 = 000110

Binary representation of -8 = 101000

To multiply these numbers, their magnitude portions are multiplied as unsigned integers, giving 0110000(48). Then the sign bits of the numbers are examined, multiplied and thereby determined that one of them is negative. Therefore, the result of the multiplication must be negative, giving 1110000(-48).

Addition and subtraction of sign-magnitude numbers require relatively complex hardware, because adding (or subtracting) the binary representation of a positive number and the binary representation of a negative number does not give the correct result. The hardware must take the value of the sign bit into account while computing each bit of the output, and different hardware is required to perform addition and subtraction. This hardware complexity is the reason why very few current systems use sign-magnitude notation for integers.

Consider the following example of addition of +7 and -2 using 8-bit sign-magnitude representation.

8-bit sign-magnitude representations of +7 = 00000111

8-bit sign-magnitude representations of -2 = 10000010

Addition = 10001001

Adding these numbers, sign-magnitude systems interpret it as -17 instead of 5 (which is the correct result).

4.9.2 2's Complement Notation

In 2's complement notation, a negative number is represented by inverting each bit of the unsigned representation of the number and adding 1 to the result, discarding any overflow bits that do not fit in the width of the representation. The name two's complement comes from the fact that the unsigned sum of an n -bit 2's complement number and its negative is 2^n .

Hence, 2's complement can be formed by leaving all least significant 0's and the first 1 unchanged and then replacing 1's by 0's and 0's by 1's in all other higher significant bits. The 2's complement of 1001100 is 0110100.

Example

What is the 8-bit 2's complement representation of -7 and what is the unsigned result of adding the representations of +7 and -7?

Solution

8-bit sign-magnitude representation of +7 = 00000111

Hence,

8-bit negation of each bit of +7 = 11111000 (known as 1's complement)

Adding 1	+	1	
			11111001

NOTES

Thus, the 2's complement representation of +7 is 11111001.

Now adding +7 and -7

$00000111 + 11111001 = 100000000 = 0$ with 1 overflow bit.

Example

Add +5 and -4 with the help of 2's complement.

Solution

4-bit binary notation of +5 = 0101

4-bit binary notation of -4 = 1100

2's complement notation of +5 = 1011

2's complement notation of -4 = 0100

Addition 1111

1111 is 2's complement notation of -1.

Example

Compute -5 -4 in 4 bit 2's-complement notation.

Solution

$-5 -4 = -5 + (-4)$.

2's complement notation of -5 = 0011

2's complement notation of -4 = 0100

Addition 0111

0111 is 2's complement notation of -9.

4.10 BINARY MULTIPLICATION

The rules for this multiplication are:

$0 \times 0 = 0$

$0 \times 1 = 0$

$1 \times 1 = 1$

Here are a few examples:

Multiply 111101 by 1110

Binary	Decimal
111101	61

x 1110	x 14
000000	244
111101x	61x
111101xx	
111101xxx	854
1101010110	

Multiply 110 by 010

Binary

110
x 010
000
110x
000xx
01100

4.11 BINARY DIVISION

The rules for division are same in the binary system as those in the decimal number system.

Example

Divide 100100 by 110

Solution

110 100100	0110
110	
0110	
110	
X	

This is the same as the division of the decimal number 36 by 6. Here, the quotient is 0110 and the remainder is 000.

Example

Divide 110111 by 1011

Solution

1011	110111	101
	1011	
	1011	
	1011	
	X	

NOTES

The quotient is 101 and the remainder is 000.

Check Your Progress

Fill in the blanks:

1. ASCII is practically a bit code.
2. A number system having base r will have distinct symbols.
3. Unicode is used primarily for
4. The binary equivalent of (25.25)₁₀ is
5. A decimal number can be converted into its equivalent integer and fraction parts separately.
6. The most commonly used Unicode Transformation Format currently is

4.12 SUMMARY

Data is the raw material and information is what we get after processing the data. To be more precise, data is raw facts and figures and information are processed data that is useful and meaningful. Data is the input to processing, and information is the output. Basically, there are four types of number system. They are Binary number system, Decimal number system, Octal number system and Hexadecimal number system.

4.13 GLOSSARY

- **Data** : It is the raw material and information is what we get after processing the data.
- **ASCII Codes** : ASCII codes represent text in computers, communications equipment, and other devices that use text.

4.14 ANSWERS TO CHECK YOUR PROGRESS

1. Seven
2. r
3. Internet technologies
4. 11001.001
5. binary
6. UTF-8

NOTES

4.15 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What do you mean by number system?
2. Define computer arithmetic
3. Add the following binary numbers:
 - (i) 101 & 110
 - (ii) 1001.1 & 1100.1
 - (iii) 110.1101 & 100.1010
 - (iv) 1000111 & 0010110
4. Subtract $(10001)_2$ from $(100101)_2$
5. Subtract $(10110)_2$ from $(110011)_2$

Long Answer Questions

1. Briefly state the reason why ASCII can not be less than 7 bit code?
2. What was the main motivation behind the development of Unicode?
3. Add the following binary numbers:
 - (i) 10001 & 11101
 - (ii) 101101 & 11001
 - (iii) 1011001 & 111010
 - (iv) 1110 & 1111
4. Solve the following:
 - (i) $1011011 - 10010$
 - (ii) $1010110 - 101010$

NOTES

- (iii) $1000101 - 101100$
- (iv) $100010110 - 1111010$
- (v) 101001×110
- (vi) 10111×11
- (vii) $101010 \div 110$
- (viii) $10000111 \div 101$

4.16 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
5. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
6. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

Information Technology and Management Information System



Block - II

Block Title : Hardware and Software

UTTARAKHAND OPEN UNIVERSITY

SCHOOL OF MANAGEMENT STUDIES AND COMMERCE

University Road, Teenpani By pass, Behind Transport Nagar, Haldwani- 263 139

Phone No: (05946)-261122, 261123, 286055

Toll Free No.: 1800 180 4025

Fax No.: (05946)-264232, e-mail: info@uou.ac.in, som@uou.ac.in

<http://www.uou.ac.in>

www.blogsomcuou.wordpress.com

Board of Studies

Professor Nageshwar Rao
Vice-Chancellor
Uttarakhand Open University
Haldwani

Professor R.C. Mishra (Convener)
Director
School of Management Studies and Commerce
Uttarakhand Open University
Haldwani

Professor Neeti Agarwal
Department of Management Studies
IGNOU
New Delhi

Dr. L.K. Singh
Department of Management Studies
Kumaun University
Bhimtal

Dr. Abhradeep Maiti
Indian Institute of Management
Kashipur

Dr. K.K. Pandey
O.P. Jindal Global University
Sonipat

Dr. Manjari Agarwal
Department of Management Studies
Uttarakhand Open University
Haldwani

Dr. Gagan Singh
Department of Commerce
Uttarakhand Open University
Haldwani

Er. Sumit Prasad
Department of Management Studies
Uttarakhand Open University
Haldwani

Programme Coordinator

Dr. Manjari Agarwal
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Units Written By		Unit No.
<i>Text material developed by</i>	Manish Anand	
<i>Typeset by</i>	Atharav Writer, Delhi	

Editor(s)

Er. Sumit Prasad
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Er. Subodh Prasad
Assistant Professor
Department of Information Technology
College of Technology
G.B. Pant University of Agriculture & Technology
Pantnagar

ISBN : 978-93-85740-12-1
Copyright : Uttarakhand Open University
Edition : 2016 (Restricted Circulation)
Published by : Uttarakhand Open University, Haldwani, Nainital - 263 139
Printed at : Laxmi Publications (P) Ltd., New Delhi
DUO-8152-69.62-INFO TECH MGMT INFO B-II

CONTENTS

Units	Page No.
5. Types of Computers	79
6. Input/Output Units	96
7. Hardware Troubleshooting	117
8. Operating System Concepts	135
9. Software—Languages and Packages	153
10. Data Files	164

UNIT 5: TYPES OF COMPUTERS

Structure

NOTES

- 5.0 Introduction
- 5.1 Unit Objectives
- 5.2 Types of Computers
 - 5.2.1 Desktop Computers
 - 5.2.2 Analog, Digital and Hybrid Computer
 - 5.2.3 Mainframe Computers
 - 5.2.4 Mainframe RAS Features
 - 5.2.5 Supercomputers
 - 5.2.6 Evolution of Supercomputers
 - 5.2.7 Applications of Supercomputers
 - 5.2.8 Supercomputers of the Future
 - 5.2.9 Mini Computer
 - 5.2.10 Microcomputer
 - 5.2.11 Laptop Computer
 - 5.2.12 Tablet PC
- 5.3 Smartphone
 - 5.3.1 Hand held Computers or Personal Digital Assistant
- 5.4 Processors used in PCs
 - 5.4.1 Intel Pentium Dual Core Processors
- 5.5 System Block
- 5.6 Motherboard
- 5.7 Summary
- 5.8 Glossary
- 5.9 Answers to Check Your Progress
- 5.10 Terminal and Model Questions
- 5.11 References

5.0 INTRODUCTION

The world of business has changed dramatically since the introduction of the first modern multipurpose computer over 50 years ago. The ENIAC (Electronic Numerical Integrator and Computer), designed by Drs. Mauchly and Eckert, two American engineers, was set up at the University of Pennsylvania in 1946. This 30-ton machine occupied a thirty-by-thirty room, contained 18,000 vacuum tubes linked by 500 miles of wiring, and could perform 100,000 operations per second. It consumed

NOTES

so much electricity that it dimmed the lights in the section of Philadelphia where it was housed. Thanks to the development of the integrated chip, the computer has evolved into a far smaller, more powerful, and less expensive machine. Today's microcomputer is 3,000 times lighter than the ENIAC, performs 4000 times faster, and costs several million dollars less. Other innovations have made the computer easy enough for a child to use and versatile enough for applications ranging from astrophysics to arcade-style games. As a consequence of their decreasing size and cost, computers can be found today in virtually every corner of American society, from research facilities and corporate headquarters, to schools and homes.

You need only to look around a business office to see evidence of the computer revolution. In a large office you might find a variety of computers, ranging in size from a mainframe computer housed in a room of its own, to a palm-sized "personal assistant" tucked into an executive's briefcase. A growing number of professions rely on computers, and accounting is one of them.

5.1 UNIT OBJECTIVES

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

- Understand the various types of computers
- List the various types of processors used in PCs
- Discuss the components of System Block
- Describe the function of Motherboard

5.2 TYPES OF COMPUTERS

Computers can be grouped into categories in numerous ways. Table 1 below classifies the main types of computers according to their physical size, processing speed, cost, and number of users. A *microcomputer*, or personal computer (PC), might cost a few thousand dollars. It is a small computer that can fit on a desktop, and is appropriate for a single user. The next larger computer is *minicomputer*. A minicomputer might cost tens of thousands of dollars. It is about the size of a refrigerator and, when combined with various peripherals, might fill a small room. Minicomputers often have several hundred users. Large businesses often have *mainframe computers*. These machines are housed in large rooms or even entire building floors. They cost up to several million dollars, and thousands of users can access the computer simultaneously. In a networked environment, minicomputers and mainframes are both frequently called servers. The largest and most expensive computer, the *supercomputer*, is often used in research settings and other environments that require a computer with extraordinary computing power. Some supercomputers are capable of performing several billion instructions per second.

Table 5.1: Types of Computers

<i>Type</i>	<i>Physical size</i>	<i>Processing speed*</i>	<i>Cost</i>	<i>Number of users</i>
Microcomputer or Personal Computer (PC)	Fits in hand, on lap, or on desktop	Up to 400 MIPS	\$1,000 to \$4,000	One stand-alone or many may access it through a network
Minicomputer	Small cabinet; may fill a small room with accompanying peripherals	Up to 1000 MIPS	\$5,000 to \$200,000	Up to several hundred
Mainframe	Computer requires a partial room; may occupy several rooms with accompanying peripherals	Up to several thousand MIPS	\$250,000 to \$3,000,000	Hundreds to thousands
Supercomputer	Entire room of equipment	Up to 10,000 MIPS	Several million dollars and up	Hundreds to thousands

*Processing speed is commonly measured in millions of instructions per second (MIPS). One instruction is a “basic task,” e.g., adding two 10-digit numbers or storing the result in a specific location. For comparison, the human brain is estimated to be capable of 100 million MIPS.

Computer systems can also be categorized as having either an open architecture or a closed architecture. An open architecture allows third-party vendors to develop and sell hardware and software that is compatible with the system. These vendors produce products that enhance the computer system. The IBM-compatible microcomputers are based on the open architecture design. In a closed architecture system, only one vendor makes all or nearly all of the support systems and does not allow other vendors into the market.

As noted above, computers come in many types. It would be difficult to adequately cover the variations in the components of these different computer types in a brief introduction. Therefore, we will confine the following discussion to personal computers (PCs). However, most of the discussion, especially as relating to basic computer operations, is easily transferable to other computer types.

5.2.1 Desktop Computers

Desktop computers are designed for use at a desk or table. They are typically larger and more powerful than other types of personal computers. Desktop computers are made up of separate components. The main component, called the system unit, is usually a rectangular case that sits on or underneath a desk. Other components, such as monitor, mouse, and keyboard, connect to the system unit.

NOTES

NOTES



Fig. 5.1

5.2.2 Analog, Digital and Hybrid Computer

Analog Computers

Analog computers are used to process analog data. Analog data is of continuous nature and which is not discrete or separate. Such type of data includes temperature, pressure, speed weight, voltage, depth etc. These quantities are continuous and having an infinite variety of values.

It measures continuous changes in some physical quantity e.g. The Speedometer of a car measures speed, the change of temperature is measured by a Thermometer, the weight is measured by Weights machine. These computers are ideal in situations where data can be accepted directly from measuring instrument without having to convert it into numbers or codes.

Analog computers are the first computers being developed and provided the basis for the development of the modern digital computers. Analog computers are widely used for certain specialized engineering and scientific applications, for calculation and measurement of analog quantities. They are frequently used to control process such as those found in oil refinery where flow and temperature measurements are important. They are used for example in paper making and in chemical industry. Analog computers do not require any storage capability because they measure and compare quantities in a single operation. Output from an analog computer is generally in the form of readings on a series of dial (Speedometer of a car) or a graph on strip chart.

Digital Computers

A Digital Computer, as its name implies, works with digits to represent numerals, letters or other special symbols. Digital Computers operate on inputs which are ON-

OFF type and its output is also in the form of ON-OFF signal. Normally, an ON is represented by a 1 and an OFF is represented by a 0. So we can say that digital computers process information which is based on the presence or the absence of an electrical charge or we prefer to say a binary 1 or 0.

A digital computer can be used to process numeric as well as non-numeric data. It can perform arithmetic operations like addition, subtraction, multiplication and division and also logical operations. Most of the computers available today are digital computers. The most common examples of digital computers are accounting machines and calculators.

The results of digital computers are more accurate than the results of analog computers. Analog computers are faster than digital. Analog computers lack memory whereas digital computers store information. We can say that digital computers count and analog computers measure.

Hybrid Computers

A hybrid is a combination of digital and analog computers. It combines the best features of both types of computers, i.e. It has the speed of analog computer and the memory and accuracy of digital computer. Hybrid computers are used mainly in specialized applications where both kinds of data need to be processed. Therefore, they help the user, to process both continuous and discrete data. For example a petrol pump contains a processor that converts fuel flow measurements into quantity and price values. In hospital Intensive Care Unit (ICU), an analog device is used which measures patient's blood pressure and temperature etc, which are then converted and displayed in the form of digits. Hybrid computers for example are used for scientific calculations, in defense and radar systems.

5.2.3 Mainframe Computers

A mainframe computer is a very large computer capable of handling and processing very large amounts of data quickly. They are used by large institutions, such as government agencies and large corporations.

The term 'mainframe computer' is used to distinguish very large computers used by institutions to serve multiple users from personal computers used by individuals. Mainframe computers are capable of handling and processing very large amounts of data very quickly - much more data than a typical individual needs to work with on his or her own computer.

Mainframe computers were developed in the 1950s, have continued to evolve and are still in use today. Mainframe computers are designed to handle very high volumes of input and output and are optimized for computational speed. The speed of mainframes is expressed in million instructions per second (MIPS).

Before the development of powerful personal computers, many agencies relied heavily on mainframes for most of their computing needs. For example, the

photograph below shows one of the computer rooms at NASA back in 1962.

NASA computer room with several mainframe computers (1962) mainframenasasa 1962

NOTES

One of the characteristics of early mainframes is that they did not have the typical interactive interface we are used to with personal computers. Early mainframes accepted all kinds of different inputs, and later versions typically had a dedicated terminal, similar to modern display monitor with a keyboard. Mainframes acquired their name because of their size, typically as large as a 6-foot-tall closet. They also required specialized heating, ventilation and cooling as well as a dedicated power supply. In practice, this meant a separate room had to be dedicated to house the mainframe computer systems.

Mainframe systems can be used by a large number of users. This means that, in a large organization, individual employees can sit at their desk using a personal computer, but they can send requests to the mainframe computer for processing large amounts of data. A typical mainframe system can support hundreds of users at the same time.

As for the actual hardware components inside a mainframe computer, they are similar in type to what personal computers use: motherboard, central processing unit and memory. The individual components are just a lot more powerful and a lot more expensive.

Present-Day Use of Mainframes

With the technological advances in personal computers, the need for mainframe computing has substantially reduced over the years. The computing power of a typical desktop computer today is greater than that of a mainframe system back in the 1980s; however, mainframes systems continue to be widely used for reliable transaction processing. Consider all the transactions that a bank with 1,000 branches across the country needs to process every day. A single desktop computer wouldn't be able to handle this volume of transactions, and it also would not be very secure. So, somewhere in a room with no windows and restricted access sits a mainframe computer crunching all these transactions while creating multiple back-ups along the way for security purposes.

Now, think of different types of industries and their services: airline reservations, electronic commerce, inventory control, shipping, etc. They all need reliable and fast processing of transactions. Not all transaction processing needs to be conducted on mainframes, but it remains one of the market segments in which mainframe computing is very important.

The current mainframe market is dominated by IBM. This company pioneered the early mainframes back in the 1950s and currently holds more than 90% of market share of the mainframe market. What does a modern mainframe look like? The photograph below shows a recent model IBM mainframe.



Fig. 5.2: Modern Mainframe Computer

5.2.4 Mainframe RAS Features

Reliability is the ability of computer hardware or software to consistently perform according to its specifications. Mathematically, reliability measure is the mean time to failure(MTTF). **Availability** is the ratio of the uptime of a system to the total time. **Serviceability** is an expression of the ease with which a system can be maintained or repaired.

The **reliability**, **availability** and **serviceability** features are in the System Z's DNA. System Z is designed to provide an availability of 99.999% (five 9s). The "Z" in System Z's brand-name stands for **zero down-time**. System Z servers have reported an MTTF of 40 years. Organizations run their mission-critical applications on mainframe to provide 24/7 availability.

System Z processors use an **instruction retry** mechanism. Every instruction that executes successfully on the System Z processor is checkpointed, the processor state is saved. If an error is detected, a recovery sequence commences. The processor is fenced off. The processor state is refreshed from the last checkpoint and the instruction is retried. Like having spare tyres on a truck, System Z offers **chip redundancy**. If one processor fails, System Z can **dynamically** switch to a spare without losing a beat! Thousands of error checkers (parity, residue, illegal state, hardware redundancy compares and so on) are embedded on the chip.

5.2.5 Supercomputers

Supercomputers, the world's largest and fastest computers, are primarily used for complex scientific calculations. The parts of a supercomputer are comparable to those of a desktop computer: they both contain hard drives, memory, and processors (circuits that process instructions within a computer program).

NOTES

Although both desktop computers and supercomputers are equipped with similar processors, their speed and memory sizes are significantly different. For instance, a desktop computer built in the year 2000 normally has a hard disk data capacity of 2 to 20 gigabytes and one processor with tens of megabytes of random access memory (RAM)—just enough to perform tasks such as word processing, web browsing, and video gaming. Meanwhile, a supercomputer of the same time period has thousands of processors, hundreds of gigabytes of RAM, and hard drives that allow for hundreds, and sometimes thousands, of gigabytes of storage space.

The supercomputer's large number of processors, enormous disk storage, and substantial memory greatly increase the power and speed of the machine. Although desktop computers can perform millions of floating-point operations per second (megaflops), supercomputers can perform at speeds of billions of operations per second (gigaflops) and trillions of operations per second (teraflops).

5.2.6 Evolution of Supercomputers

Many current desktop computers are actually faster than the first supercomputer, the Cray-1, which was developed by Cray Research in the mid-1970s. The Cray-1 was capable of computing at 167 megaflops by using a form of supercomputing called **vector processing**, which consists of rapid execution of instructions in a pipelined fashion. Contemporary vector processing supercomputers are much faster than the Cray-1, but an ultimately faster method of supercomputing was introduced in the mid-1980s: **parallel processing**. Applications that use parallel processing are able to solve computational problems by simultaneously using multiple processors.

Using the following scenario as a comparative example, it is easy to see why parallel processing is becoming the preferred supercomputing method. If you were preparing ice cream sundaes for yourself and nine friends, you would need ten bowls, ten scoops of ice cream, ten drizzles of chocolate syrup, and ten cherries. Working alone, you would take ten bowls from the cupboard and line them up on the counter. Then, you would place one scoop of ice cream in each bowl, drizzle syrup on each scoop, and place a cherry on top of each dessert. This method of preparing sundaes would be comparable to vector processing. To get the job done more quickly, you could have some friends help you in a parallel processing method. If two people prepared the sundaes, the process would be twice as fast; with five it would be five times as fast; and so on.

Conversely, assume that five people will not fit in your small kitchen. Therefore, it would be easier to use vector processing and prepare all ten sundaes yourself. This same analogy holds true with supercomputing. Some researchers prefer vector computing because their calculations cannot be readily distributed among the many processors on parallel supercomputers. But, if a researcher needs a supercomputer that calculates trillions of operations per second, parallel processors are preferred—even though programming for the parallel supercomputer is usually more complex.

5.2.7 Applications of Supercomputers

Supercomputers are so powerful that they can provide researchers with insight into phenomena that are too small, too big, too fast, or too slow to observe in laboratories. For example, astrophysicists use supercomputers as “time machines” to explore the past and the future of our universe. A supercomputer simulation was created in 2000 that depicted the collision of two galaxies: our own Milky Way and Andromeda. Although this collision is not expected to happen for another three billion years, the simulation allowed scientists to run the experiment and see the results now. This particular simulation was performed on Blue Horizon, a parallel supercomputer at the San Diego Supercomputer Center. Using 256 of Blue Horizon’s 1,152 processors, the simulation demonstrated what will happen to millions of stars when these two galaxies collide. This would have been impossible to do in a laboratory.

Another example of supercomputers at work is molecular dynamics (the way molecules interact with each other). Supercomputer simulations allow scientists to dock two molecules together to study their interaction. Researchers can determine the shape of a molecule’s surface and generate an atom-by-atom picture of the molecular geometry. Molecular characterization at this level is extremely difficult, if not impossible, to perform in a laboratory environment. However, supercomputers allow scientists to simulate such behavior easily.

5.2.8 Supercomputers of the Future

Research centres are constantly delving into new applications like data mining to explore additional uses of supercomputing. Data mining is a class of applications that look for hidden patterns in a group of data, allowing scientists to discover previously unknown relationships among the data. For instance, the Protein Data Bank at the San Diego Supercomputer Center is a collection of scientific data that provides scientists around the world with a greater understanding of biological systems. Over the years, the Protein Data Bank has developed into a web-based international repository for three-dimensional molecular structure data that contains detailed information on the atomic structure of complex molecules. The three-dimensional structures of proteins and other molecules contained in the Protein Data Bank and supercomputer analyses of the data provide researchers with new insights on the causes, effects, and treatment of many diseases.

Other modern supercomputing applications involve the advancement of brain research. Researchers are beginning to use supercomputers to provide them with a better understanding of the relationship between the structure and function of the brain, and how the brain itself works. Specifically, neuroscientists use supercomputers to look at the dynamic and physiological structures of the brain. Scientists are also working toward development of three-dimensional simulation programs that will allow them to conduct research on areas such as memory processing and cognitive recognition.

In addition to new applications, the future of supercomputing includes the assembly of the next generation of computational research infrastructure and the introduction of new supercomputing architectures. Parallel supercomputers have many processors, distributed and shared memory, and many communications parts; we have yet to explore all of the ways in which they can be assembled. Supercomputing applications and capabilities will continue to develop as institutions around the world share their discoveries and researchers become more proficient at parallel processing.

5.2.9 Mini Computer

A minicomputer is a type of computer that possesses most of the features and capabilities of a large computer but is smaller in physical size.

A minicomputer fills the space between mainframe and microcomputer. It is smaller than the former but larger than the latter. Minicomputers are mainly used as small or midrange servers operating business and scientific applications. However, the use of the term 'minicomputer' has diminished and has merged with servers.

A minicomputer may also be called a mid-range computer. A minicomputer is a type of computer that possesses most of the features and capabilities of a large computer but is smaller in physical size. A minicomputer fills the space between mainframe and microcomputer. It is smaller than the former but larger than the latter. Minicomputers are mainly used as small or midrange servers operating business and scientific applications. However, the use of the term 'minicomputer' has diminished and has merged with servers.

A minicomputer may also be called a mid-range computer.

5.2.10 Microcomputer

A microcomputer is a computer with a central processing unit (CPU) as a microprocessor. Designed for individual use, a microcomputer is smaller than a mainframe or a minicomputer.

The term 'microcomputer' is not as commonly used as it was during the 1970s-1980s. We now refer to microcomputers as, simply, computers, or personal computers (PC).

A microcomputer's CPU includes random access memory (RAM), read-only memory (ROM), input/output (I/O) ports, interconnecting wires and a motherboard.

In 1970, Hewlett-Packard (HP) manufactured and released a microcomputer as a calculator with varying levels of programmability, although the Datapoint 2200 by Computer Terminal Corporation (CTC) is credited as the first microcomputer. Intel's x86 processor family can also be traced back to CTC's release.

5.2.11 Laptop Computer

Alternatively referred to as a notebook, a laptop is a portable computer that with the same abilities as a desktop, but is small enough for easy mobility. Portable computers run off AC power or batteries, such as NiMH or Nicad packs, for a few hours.

As can be seen from the picture, the Dell Latitude D610 notebook has everything needed for normal operation; an LCD, keyboard, and touch pad. Although a laptop may have multiple external devices and cables connected to it, no external connections are required for standard usage. Today, most laptop computers are becoming thinner and lighter to help compete with other devices such as tablets. For the PC these computers may be also referred to as Ultrabooks.

5.2.12 Tablet PC

A tablet is a wireless, portable personal computer with a touch screen interface. The tablet form factor is typically smaller than a notebook computer but larger than a smartphone.

The idea of tablet computing is generally credited to Alan Kay of Xerox, who sketched out the idea in 1971. The first widely-sold tablet computer was Apple Computer's Newton, which was not a commercial success. Technological advances in battery life, display resolution, handwriting recognition software, memory, and wireless Internet access have since made tablets a viable computing option.

Today, the most common type of tablet is the slate style, like Apple's iPad, Microsoft's Surface or Amazon's Kindle Fire. External keyboards are available for most slate-style tablets and some keyboards also function as docking stations for the devices.

Other Styles of Tablets Include

Convertible Tablets: Typically have a display that rotates 180 degrees and can be folded to close, screen up, over an integrated hardware keyboard. Convertible models may allow user input through a variety of methods in addition to the hardware keyboard, including natural handwriting with a stylus or digital pen and typing through a screen-based software keyboard.

Hybrid Tablets: Sometimes referred to as convertible or hybrid notebooks. A hybrid is like a regular notebook but has a removable display that functions independently as a slate.

Rugged Tablets: A slate-like model that is designed to withstand rough handling and extreme conditions. Rugged tablets are usually encased in a thick protective shell and have shock-protected hard drives.

5.3 SMARTPHONE

A smartphone is a mobile phone with highly advanced features. A typical smartphone has a high-resolution touch screen display, WiFi connectivity, Web browsing capabilities, and the ability to accept sophisticated applications. The majority of these devices run on any of these popular mobile operating systems: Android, Symbian, iOS, BlackBerry OS and Windows Mobile.

A smartphone is expected to have a more powerful CPU, more storage space, more RAM, greater connectivity options and larger screen than a regular cell phone.

NOTES

High-end smartphones now run on processors with high processing speeds coupled with low power consumptions. That means, they'll allow you to play 3D games, browse the Web, update your Facebook account, call, and text much longer than you used to.

In addition to the features mentioned earlier, smartphones are also equipped with innovative sensors like accelerometers or even gyroscopes. Accelerometers are responsible for displaying screens in portrait and landscape mode, while gyroscopes make it possible for games to support motion-based navigation.

The earliest touch screen smartphones used resistive touchscreen displays, which required the use of slender pointing objects known as styli (or stylus in singular form). Most of the later models however, like the iPhone and most Android phones, employ capacitive displays, which feature multi-touch finger gestures.

5.3.1 Hand held Computers or Personal Digital Assistant

PDA (personal digital assistant) is a term for any small mobile hand-held device that provides computing and information storage and retrieval capabilities for personal or business use, often for keeping schedule calendars and address book information handy.

The term 'handheld' is a synonym. Many people use the name of one of the popular PDA products as a generic term. These include Hewlett-Packard's Palmtop and 3Com's PalmPilot.

Most PDAs have a small keyboard. Some PDAs have an electronically sensitive pad on which handwriting can be received. Apple's Newton, which has been withdrawn from the market, was the first widely-sold PDA that accepted handwriting. Typical uses include schedule and address book storage and retrieval and note-entering. However, many applications have been written for PDAs. Increasingly, PDAs are combined with telephones and paging systems.

Some PDAs offer a variation of the Microsoft Windows operating system called Windows CE. Other products have their own or another operating system.

5.4 PROCESSORS USED IN PCS

Every PC has a Central Processing Unit (CPU). This acts as the brain of your system. It connects to the Motherboard and works alongside the other components processing many instructions at the same time between the different hardware and memory systems.

Advancements in CPU technology now mean systems typically come with Dual Core, Triple core or Quad Core processors (on one single chip) instead of the traditional one core per chip. Now the total number of Cores can slot into a socket as before and a single heat sink and fan can keep everything to the right temperature.

Intel and AMD are the two companies who dominate the PC Processor market. Both have been around for decades and have become the main Chip suppliers for the home and business markets.

Both companies have fierce rivalry and they file and counter file court cases against each other. All we care about is that they have near identical chip products on the market at the same time as they compete for the fastest chip and share of the market. The competing products are very close to each other and really only the techies compare the benchmarks before choosing.

5.4.1 Intel Pentium Dual Core Processors

The Intel Pentium processors with Intel dual-core technology deliver great desktop performance, low power enhancements, and multitasking for everyday computing.

Intel i3 Processors (Ivy Bridge)

Intel Core i3 dual core processors provide 4-way multitasking capability, run at fixed speed ideal for typical tasks and media playback but not for games.

Intel i5 Processors

Intel i5 usually quad core but some dual processors deliver the next level of productivity. Mostly the same as i3 but with Intel Turbo Boost Technology, delivers extra speed when you need it. Like the i3 integrated graphics is included but is only ideal for normal use, not for gaming.

Intel i7 Processors

Intel i7 processors dual or quad core for the most demanding applications with cache and faster clock speeds. Quad-core processors feature 8-way threading, four cores will run faster, and more L3 cache, but will consume more power. High-end use, video and gaming with dedicated video card.

AMD A4: These A4 processors have 2 processor cores and include a Radeon graphics chip aimed for use with lower end systems.

AMD A6: A6 processors dual core, includes turbo function similar to Intels allows for the processor to adapt to the task needed. Integrated graphics, on par with Core i3 range.

AMD A8: 4 processors core is comparable to the i3 and low i5, its graphic part is faster than Intels version, can handle light gaming with ease.

AMD A10: 4 processors these quad cores are comparable with the Intel i5, and some i7s should benefit from better battery life.

ASeries processors use the FM2 socket so they will only fit in a Motherboard with FM2.

2013 AMD Piledrivers are the latest version Piledriver then FX-4, FX-6, FX-8 for either 4-8 cores, they use the AM3+ socket so can only be used in Motherboards with AM3+

NOTES



Fig. 5.3

Each series of processor usually has a couple of generations per series where enhancements and tweaks are made. The main thing to check and consider is that the type of processor is compatible with your motherboard and fits your need and budget.

5.5 SYSTEM BLOCK

A computer system unit is the enclosure that contains the main components of a computer. It is also referred to as a computer case or tower.

A typical desktop computer consists of a computer system unit, a keyboard, a mouse, and a monitor. The computer system unit is the enclosure for all the other main interior components of a computer. It is also called the computer case, computer chassis, or computer tower. Cases are typically made of steel or aluminium, but plastic can also be used. While most computer cases are rather dull, black, metal boxes, some manufacturers try to give the unit some flair with colour and special design elements.

The primary function of the computer system unit is to hold all the other components together and protect the sensitive electronic parts from the outside elements. A typical computer case is also large enough to allow for upgrades, such as adding a second hard drive or a higher-quality video card. It is relatively easy to open up a computer system unit to replace parts and install upgrades. In contrast, it is quite difficult to open up a laptop computer, which is not designed with replacements and upgrades in mind.

Front Side of the System Unit

In most computer system units, the front side contains the elements a user needs frequently, such as the power button, an optical disk drive, an audio outlet for a pair of headphones, and a number of USB connections.

Back Side of the System Unit

The back side contains all other connections - for power, monitor, keyboard, mouse, Internet connection, and any other peripheral devices. There are typically more connections than the minimum necessary to allow for expansion.

Inside the System Unit

Once you open up a computer case, it can initially be difficult to recognize the various components, especially all the different wires. However, if you look closely, you will probably start to recognize a number of components.

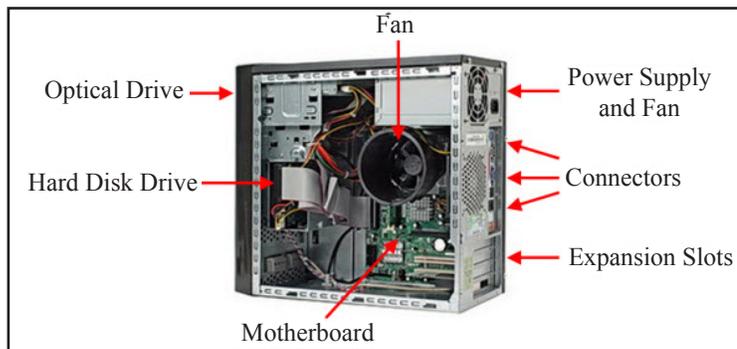


Fig. 5.4: Major Components inside a Computer Case

In this particular example, the **motherboard** is placed vertically, which is quite common. One side of the motherboard is accessible from the back of the computer case - this includes the various **connectors** for input and output devices as well as expansion slots for additional **peripherals**. The motherboard also contains the **central processing unit** (CPU), although it can be difficult to see. A large **fan** is often placed on top of the CPU to avoid overheating. The motherboard also contains the **main memory** of the computer.

5.6 MOTHERBOARD

The motherboard serves to connect all of the parts of a computer together. The CPU, memory, hard drives, optical drives, video card, sound card and other ports and expansion cards—all connect to the motherboard directly or via cables.

The motherboard is the piece of computer hardware that can be thought of as the “back bone” of the PC.

The Motherboard is also known as mainboard, mobo (abbreviation), MB (abbreviation), system board and logic board.

Desktop motherboards, cases and power supplies all come in different sizes called form factors. All three must be compatible to work properly together.

Motherboards vary greatly in respect to the types of components they support. For example, each motherboard supports a single type of CPU and a short list of memory types. Additionally, some video cards, hard drives and other peripherals may not

NOTES

be compatible. The motherboard manufacturer should provide a clear guidance on component compatibilities.

In laptops and tablets, and increasingly even in desktops, the motherboard often incorporates the functions of the video card and sound card. This helps keep these types of computers small in size.

Popular Motherboard Manufacturers

ASUS, AOpen, Intel, ABIT, MSI, Gigabyte, Biostar

Motherboard Description

In a desktop, the motherboard is mounted inside the case, opposite the most easily accessible side. It is securely attached via small screws through pre-drilled holes.

The front of the motherboard contains ports that all of the internal components connect to. A single socket/slot houses the CPU. Multiple slots allow for one or more memory modules to be attached. Other ports reside on the motherboard which allow the hard drive and optical drive (and floppy drive if present) to connect via data cables.

Small wires from the front of the computer case connect to the motherboard to allow the power, reset and LED lights to function. Power from the power supply is delivered to the motherboard by use of a specially designed port.

Also on the front of the motherboard are a number of peripheral card slots. These slots are where most video cards, sound cards and other expansion cards are connected to the motherboard.

Check Your Progress

Fill in the blanks:

1. _____ is a personal or micro-mini computer sufficient to fit on a desk.
2. Laptop Computer is a portable computer complete with an _____ screen and keyboard.
3. _____ have no keyboard but the screen serves both as an input and output device.
4. _____ is the fastest and most powerful type of computer.
5. _____ is a very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously.
6. Mini Computer is a _____ computer.
7. A _____ is the physical arrangement in a computer that contains the computer's basic circuitry and components.

On the left side of the motherboard (the side that faces the back end of the desktop case) are a number of ports. These ports allow most of the computer's external

peripherals to connect such as monitor, keyboard, mouse, speakers, network cable and more.

All modern motherboards also include USB ports here, and increasingly other ports like HDMI and FireWire, that allow compatible devices to connect to your computer when you need them - devices like digital cameras, printers, etc.

The desktop motherboard and case are designed so that when peripheral cards are used, the sides of the cards fit just outside the back end, making their ports available for use.

NOTES

5.7 SUMMARY

- Computers can be broadly classified by their speed and computing power. There are various types of computers such as desktop, laptop, mainframe, super computer, minicomputer, microcomputer, tablet pc, PDA, etc.
- A system unit is the part of a computer that houses the primary devices that perform operations and produce results for complex calculations. It includes the motherboard, CPU, RAM and other components, as well as the case in which these devices are housed.
- The motherboard serves to connect all of the parts of a computer together. The CPU, memory, hard drives, optical drives, video card, sound card and other ports and expansion cards all connect to the motherboard directly or via cables.

5.8 GLOSSARY

- **Desktop Computer:** A personal or micro-mini computer sufficient to fit on a desk.
- **Laptop Computer:** A portable computer complete with an integrated screen and keyboard. It is generally smaller in size than a desktop computer and larger than a notebook computer.
- **Palmtop Computer/Digital Diary/Notebook /PDAs:** A hand-sized computer. Palmtops have no keyboard but the screen serves both as an input and output device.
- **Super Computer:** The fastest and most powerful type of computer.
- **Mainframe Computer:** A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously.
- **Mini Computer:** A midsized computer.
- **Motherboard:** A motherboard is the physical arrangement in a computer that contains the computer's basic circuitry and components.

5.9 ANSWERS TO CHECK YOUR PROGRESS

1. Desktop Computer
2. integrated
3. Palmtops
4. Super Computer
5. Mainframe Computer
6. midsized
7. motherboard

5.10 TERMINAL AND MODEL QUESTIONS

1. Understand the various types of computers.
2. Write a note on supercomputer and its application.
3. What is the difference between a desktop computer and a mainframe computer?
4. List the various types of processors used in PCs.
5. Discuss the components of System Block.
6. Describe the function of Motherboard.
7. Write a note on Classification of Computers.
8. Discuss in detail the importance of smartphone in today's world.

5.11 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
8. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

UNIT 6: INPUT/OUTPUT UNITS

Structure

- 6.0 Introduction
- 6.1 Unit Objectives
- 6.2 Input Units
 - 6.2.1 Keyed Input
 - 6.2.2 Pointing Devices
 - 6.2.3 Mouse and Track Ball
 - 6.2.4 Touchpad
 - 6.2.5 Joysticks
 - 6.2.6 Touch-sensitive Screens
 - 6.2.7 Pen-based Systems
- 6.3 Data Scanning Units
 - 6.3.1 Optical Recognition Systems (ORS)
 - 6.3.2 Bar Code Readers
 - 6.3.3 Optical Mark Readers
 - 6.3.4 Optical Scanners
 - 6.3.5 Voice Recognition Devices
- 6.4 Output Units
 - 6.4.1 Monitors
 - 6.4.2 Audio Output
 - 6.4.3 Printers
 - 6.4.4 Plotters
- 6.5 Summary
- 6.6 Glossary
- 6.7 Answers to Check Your Progress
- 6.8 Terminal and Model Questions
- 6.9 References

NOTES

6.0 INTRODUCTION

A computer system consists of mainly four basic units—input unit, storage unit, central processing unit and output unit. These devices are used to enter information and instructions into a computer for storage or processing and to deliver the processed

data to a user. 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.

6.1 UNIT OBJECTIVES

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

- Describe the Input units
- Describe the Output units

6.2 INPUT UNITS

Data must be entered into a computer before processing may take place. You can enter data into the computer in many ways. A device that allows the user to enter data into a computer is called input device. Most commonly used input devices are keyboards; pointing devices such as mouse and track balls; and scanners. Many other special-purpose input devices are also available. Computers often have more than one input device attached. For example, most personal computers have both a keyboard and a mouse.

6.2.1 Keyed Input

Most input data is entered into the computer by using a keyboard. This input method is similar to typing on a typewriter.

Most typewriters and computer keyboards are QWERTY keyboards. The alphabetic keys are arranged in a manner so that the upper-left row of letters begins with the six letters Q W E R T Y. Designers of other keyboards claim that their boards are easier to learn than the QWERTY keyboard. The Dvorak keyboard is one example. It is not widely accepted, however, because most people have already learned the QWERTY keyboard.

In different parts of the world, we find different keyboards. The coding used on the QWERTY and Dvorak keyboards works with an 8-bit code, which accommodates 256 different characters. Asian languages have many more characters. The Kanji alphabet, for example, has 50,000 characters. Japanese keyboards have to work with a 16-bit code to accommodate all the characters.

Computer keyboards also include keys that are designed to perform specific tasks instead of entering characters only. These special keys include function keys, directional keys and special-purpose keys such as Alt, Ctrl, Enter, Ins, and Esc. These keys enable the user to perform complex tasks easily while using the application.

For example, many applications use a function key to access online help for the user.

Some new keyboards have even 110 keys, with three new keys designed to simplify working with Windows operating systems. Two of these keys, next to the Alt key, bring up the Start menu. The third key, next to the right Ctrl key, brings up a menu of functions that are frequently accessed in whichever application is currently being used.

Prolonged keyboard use can cause wrist problems, sometimes so serious as to require surgery. To help prevent these problems, ergonomic keyboards have been introduced in the market.

One special type of keyboard construction is the MEMBRANE-SWITCH KEYBOARD, in which a protective film covers the keyboard. Membrane-switch keyboards are reliable, durable and resistant to such hazards as liquids or grease. However, membrane keys require more pressure than keys on a standard computer keyboard. You have probably seen membrane-switch keyboards in fast-food restaurants. Membrane-switch keyboards are ideal in situations that require little actual keying.

Many computer systems are designed for SOURCE-DATA AUTOMATION. These systems place keyboards and display units at the most convenient spot for data entry. An example is the use of Point-of-Scale (POS) cash registers in retail stores. POS registers send data directly to a computer file for later processing. This technique has an advantage, because most so-called computer errors are actually keying errors. Capturing data at the source minimizes errors, because the people who key in the data are doing a variety of tasks and are, therefore, less likely to make errors due to boredom or loss of concentration.

A tiny chip, called keyboard controller, detects that a key has been pressed. The keyboard controller places a code into a part of its memory, called keyboard buffer, indicating which key is pressed. This code is called keys scan code. The keyboard controller then signals to the computer's system software that something has happened at the keyboard. It does not specify what has occurred, just that something has. The signal that the keyboard sends to the computer is a special kind of message called an interrupt request. The keyboard controller sends an interrupt request to the system software when it receives a complete keystroke. For example, if you type the letter 'D' the controller immediately issues an interrupt request.

When the system software receives an interrupt request, it evaluates the request to determine the appropriate response. When a key press occurs the system reads the memory location in the keyboard buffer that contains the scan code of the key that was pressed. It then passes the key scan code to the CPU.

6.2.2 Pointing Devices

Wherever possible many people use pointing devices instead of keyboards. An input device is used to move the pointer (cursor) on screen. Pointing devices minimize the

NOTES

amount of typing (consequently, the number of errors). Movements of the pointing device are echoed on the screen by movements of the mouse pointer and by other visual changes. The many pointing devices available include the mouse, the trackball, the light pen, the digitizing tablet, the touch screen and the pen-based systems. Some of them are shown below.



Fig. 6.1

Major Pointing Devices: Clockwise from the upper left are the mouse, the trackball, the pointing stick (red tip) and the touchpad.

6.2.3 Mouse and Track Ball

A mouse is a palm-sized device with a ball built into the bottom. It is usually connected to the computer by a cable (computer wires are frequently called cables) and may have from one to four buttons (usually two). A mouse may be mechanical or optical and comes in many shapes and sizes. When you move the mouse over a smooth surface, the ball rolls, and the pointer on the display screen moves in the same direction. Apple Macintosh, with its graphical user interface, made the mouse popular. Today, most microcomputer systems, regardless of the manufacturer, use a mouse. With the mouse you can draw, select options from a menu, and modify or move text. You can issue commands by pointing with the pointer and clicking a mouse button. In addition to minimizing typing errors a mouse makes operating on a microcomputer easier for the novice. The underside of the mouse houses a device that detects the movement of the mouse relative to the flat surface on which it sits. The 2D motion of the mouse is typically translated into the motion of a cursor on the display.

A mouse is so called, primarily because the cord on early models resembled the rodent's tail, and also because the darting motion of the pointer on the screen appears to be mouse-like.



Fig. 6.2

Operating a mechanical mouse. 1. Pulling the mouse turns the ball. 2. The X and Y rollers grip the ball and transfer the movement. 3. The optical encoding disks include light holes. 4. The infrared LEDs shine through the disks. 5. The sensors then gather the light pulses to convert to X and Y velocities.

How a Mouse Works

The most common type of mouse has a ball inside it that extends just below the housing. When you slide the mouse around on a flat surface, such as the desktop or a mouse pad, the ball rolls.

On two sides of the ball, at 90 degrees angle from each other, are two small rollers that touch the mouse and spin when the ball rolls. A sensor detects how much each roller spins and sends this information to the computer. The computer translates the information and changes the position of the on-screen pointer to correspond to the position indicated by the mouse.

Like the keyboard, the mouse does not send a message directly to the program that the computer is running. Rather, it sends an interrupt request to the CPU. The program that is running checks regularly to see whether a mouse has been used; if it has, the program reads a memory location to see what has happened, and then reacts appropriately.

Like all input devices, the mouse needs some connection to the host computer in order to transmit its input. Typically the mouse uses a thin electrical cord (e.g. an RS-232, ADB or USB cable) for this purpose. It was most likely the combination of the tail-like cord, its size, and shape, which led the inventors of the mouse to name it as such. Cordless (“tail-less”) mice use wireless communication to transmit data via infrared, radio or Bluetooth.

There are several other methods of using a mouse apart from the most basic movement of the device to make a cursor move. A mouse click is the action of pressing and releasing (i.e., ‘clicking’) a button on a mouse in order to trigger an action, usually in the context of a Graphical User Interface (GUI), as in pressing an onscreen ‘button’ by ‘clicking’ on it, or in a computer game to fire a gun in a first-person shooter. The

NOTES

clicking noise is made due to the specific switch technology used nearly universally in computer mice. This switch, called a micro switch or a cherry switch, uses a stiff but flexible metal strip that is bent to actuate the switch. The bending of the metal makes a snapping or clicking noise in the same way as the safety button does on the lids of vacuum-packaged jars to indicate that they have been opened.

Single Clicking

It is the most common method of distinguishing mouse-based input. On a single-button mouse this involves using the mouse's one button. On the multiple-button mouse, it involves any one of the buttons, and is usually characterized by which button is pushed (e.g., left-clicking, right-clicking).

Double Clicking

A double-click occurs when the user presses the button twice in quick succession. This triggers an action separate from that of a single-click. For example, in the Macintosh Finder, the user single-clicks to select a file, and double-clicks in order to open that file. Usability studies have found that the double-click can be confusing and hard to use—for example, users with poor motor skills may not perform the second click fast enough, with the result that the action is interpreted as two single-clicks rather than a double-click. Ironically, the double-click was introduced because the previous solution—separate mouse buttons for separate actions—was also found to be confusing in user studies. Most multiple-button mice allow setting one button to emit a double click on a single press.

Triple-click

A triple-click occurs when the user presses the button three times in quick succession. This also triggers an action separate from that of a single click. It is most commonly seen in word processors to select a whole paragraph and in web browsers to select a whole line of text.

Click-and-Drag

A user “drags” a mouse by depressing and continuing to hold down a mouse button while moving the mouse across the surface.

A TRACK BALL is like an upside-down mouse. Used in the same way as the mouse, the trackball is frequently attached to or built into the keyboard. It is a pointing device consisting of a ball housed in a socket which contains sensors to detect the rotation of the ball on two axes—like an upside-down mouse, but with the ball sticking out more. The user rolls the ball with his thumb, finger, or the palm of his hand to move the cursor. Trackerballs are common on CAD workstations for ease of use, and also on modern portable computers, where there may be no desk space on which to use a mouse. Some trackballs clip onto the side of the keyboard and have integral buttons, which have the same function as mouse buttons. The main advantage of a

track ball is that it requires less desk space than a mouse. Some individuals in the computer industry believe that devices that do not require as much space to use will soon replace the mouse.



Fig. 6.3: Logitech Marble Mouse Trackball

A mouse is not a practical option for people using a laptop computer in a small space. Early alternatives, such as trackballs clipped to the side of the keyboard, have not proved satisfactory either. The Apple PowerBook uses a central trackball. The IBM ThinkPad replaces the trackball with a red plastic button, called trackpoint, located in the middle of the keyboard. You move the button with your thumbs. The newest Apple PowerBooks have a small square of plastic on the front of the keyboard which moves easily to control the pointer.

6.2.4 Touchpad

The TOUCH PAD is a stationary pointing device that many people find less tiring to use than a mouse or a track ball. The movement of a finger across a small touch surface is translated into cursor movement on the computer screen. The touch sensitivity surface may be just 1.5 – 2 inch square, so the finger does not have to move much. Its size makes it most suitable for notebooks and laptops.

6.2.5 Joysticks

A JOYSTICK is a pointing device often used for playing games. It has a gearshift-like lever that is used to move the pointer on the screen. On most joysticks, a button on the top is used to select an option. In industry and manufacturing, joysticks are used to control robots. Flight simulators and other training simulators also use them. Most joysticks are two-dimensional, having two axes of movement, just like a mouse, but three-dimensional joysticks also exist.

Joysticks are often used to control games, and usually have one or more push buttons whose state can also be read by the computer. Most I/O interface cards for PCs have a joystick (game control) port. Modern joysticks generally use a USB interface for connecting to the PC.

An analog one is one that has continuous states, i.e., it returns an angle measure of the movement in any direction in the plane or the space. On the other hand, a digital joystick gives only on/off signals for four different directions, and for mechanically

NOTES

possible combinations (such as up-right, down-left). Additionally, joysticks often have one or more *fire buttons*, which are used to trigger some kind of action. These are digital.

NOTES

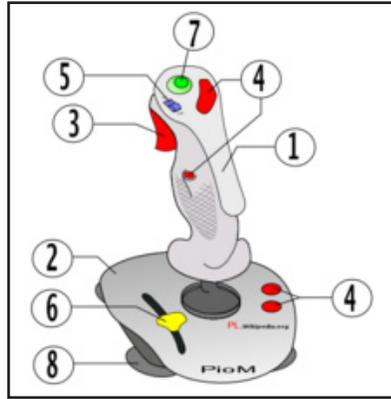


Fig. 6.4

Joystick elements: 1. Stick 2. Holder 3. Fire button 4. Extra buttons 5. Autofire switch 6. Throttle 7. Hat Switch 8. Sucker

6.2.6 Touch-sensitive Screens

Perhaps the easiest way to enter data is with the touch of a finger. TOUCH SCREENS enable the user to select an option by pressing a specific part of the screen. Touch screens are commonly used in grocery stores, fast-food restaurants and information kiosks.

6.2.7 Pen-based Systems

Pen-based Systems are especially useful for people who do not like to type or for those who are frequently on the move. PERSONAL DIGITAL ASSISTANTS (PDA), such as the Apple Newton, are designed for people on the go. The Newton can link entries with data on stored files. For example, if you write, “Call Annie and Wish Happy Birthday”, the Newton adds a line to your “To do” list and links Annie’s phone number from your telephone directory. If your friend Ken moves, you can simply change his address and phone number. The Newton serves equally well as a calendar, a calculator and a notepad.

Pen-based systems are not perfect—they do not always register handwriting correctly. Pen-based computing is just a beginning to gain widespread acceptance. For example, many stores no longer ask you sign a carbon form to charge a purchase; instead you sign on a tablet that automatically records your signature.

Many engineers and architects use a different type of pen called LIGHT PEN. The light pen uses a photoelectric (light sensitive) cell to indicate the screen position to the computer. You operate the pen by touching it to the screen. Light pens are frequently used for Computer-Aided Design (CAD) applications.

Another tool used in CAD and other graphics applications is a digitizing tablet. A DIGITIZING TABLET consists of a grid on which designs and drawings can be entered. Most tablets are pressure-sensitive and the user draws directly on the tablet using a special pen called **STYLUS** or puck. Digitizing tablets are used to design cars, buildings, medical devices and robots.

Check Your Progress

Fill in the blanks:

1. cannot produce multiple copies.
2. The capability of a computer to understand verbal instructions is called
3. produces high-quality graphics.
4. keyboard is most commonly used.
5. can be used to input the picture in the computer.

6.3 DATA SCANNING UNITS

6.3.1 Optical Recognition Systems (ORS)

Optical Recognition Systems provide another means of minimizing keyed input by capturing data at the source. These systems enable the computer to “read” data by scanning printed text for recognizable patterns.

In the 1950s, the banking industry developed one of the earliest scanning systems for the purpose of processing cheques. The Magnetic Ink Character Recognition (MICR) system is still used throughout the banking industry. The bank, branch, account number and cheque number are encoded on the cheque before it is sent to the customer. After the customer has used the cheque and it comes back to the bank, all that needs to be entered manually is the amount. MICR has not been adopted by the other industries because the character set has only fourteen symbols.

6.3.2 Bar Code Readers

Of all the scanning devices, you are probably most familiar with BAR CODE READERS. Many retail and grocery stores use some form of the bar code reader to determine the name of the item being sold and to retrieve its price from a computer system. The code reader may be a hand-held unit or it may be embedded in a countertop. The bar code reader reads the Universal Product Code (UPC), a pattern of bars printed on merchandise. The UPC has gained wide acceptance since its introduction in the 1970’s. Initially, workers resisted the use of the code because the system was used to check their accuracy and speed. Today, bar codes are used

NOTES

to update inventory and ensure correct pricing. Federal Express uses a unique bar code to identify and track each package. Federal Express employees can usually tell a customer within a matter of minutes the location of any package.

Many different types of barcode scanners are available. They can be distinguished in the following manner.

By Light Source

- **LED scanners**, also referred to as **CCD scanners**—even if the CCD is in fact the photo conductor.
- **Laser scanners**, much more expensive than LED scanners, but capable of scanning barcodes at a distance of up to 25cm (~10”).

By Housing

- **Hand-held scanner** with a handle and, typically, a trigger button for switching on the light source.
- **Pen scanners (or wand scanners)**, a pen-shaped scanner that is swiped across a barcode.
- **Stationary scanners**, wall or table-mounted, under or beside which the barcode is passed. These are commonly found at the checkout counters of supermarkets and other retailers.

6.3.3 Optical Mark Readers

You will probably be familiar with Mark Sense Character Recognition systems if you ever take a written examination of the “fill in the bubble” type. Such forms are called Scantron forms. They use a #2 lead pencil; you darken the circular area with the pencil creating input suitable for an OPTICAL MARK READER (OMR). A #2 lead pencil works best because of the number of magnetic particles in that weight lead. The OMR senses the darkened marks, enabling the reader to determine which responses are marked. OMR is very helpful for researchers who need to tabulate responses to large surveys. Almost any type of survey or questionnaire can be designed to be suitable for OMR devices. An OMR unit can be attached to a microcomputer and the data transferred to a file directly.

6.3.4 Optical Scanners

OPTICAL SCANNERS can scan typed documents, pictures, graphics or even handwriting into a computer. Photographs scanned into a microcomputer appear clearly on the screen and can be displayed whenever desired. The copy that the computer stores never yellows with age. Early scanners could recognize only text printed in a special OPTICAL CHARACTER RECOGNITION (OCR) typeface. A scanner converts the image that it sees into numeric digits before storing it in the computer. This conversion process is known as DIGITIZING.

Depending on the volume and type of material to be scanned, you can use a drum scanner, a flatbed scanner, a sheeted scanner or even a small handheld scanner. The small, handheld scanners (priced at about \$150) are used most frequently with microcomputers; however, only 5 per cent of all microcomputer systems are equipped with scanners. In 1995, manufacturers responded to user-reluctance to scanners by releasing a number of new, small paper scanners priced between \$200 and \$500. In 1994, full-page scanners cost between \$500 and \$700. Most of these new devices sit between the keyboard and the monitor, and can interface with a fax machine, send e-mail, and store documents on the disk for archive purposes.

6.3.5 Voice Recognition Devices

Voice input and control systems have the potential of revolutionizing the way we communicate with computers. Steady progress has been made in this area, although some problems still exist. The day may soon come when we will be able to talk to our computers the way the actors do in sci-fi movies like Star Trek.

Computer scientists and linguists have been working on VOICE RECOGNITION SYSTEMS for two decades. The major difficulty has been that different people speak with different accents and intonations. For this reason, most successful voice recognition systems require a period of “training” for the system to get accustomed to an individual’s accent and intonation.

The first few systems could recognize only a few dozen words. A system recently released by IBM, known as Voice Type, is capable of recognizing as many as 32,000 words and is speaker-independent.

Voice recognition has unlimited possibilities and will make computers much easier to use. Speech recognition systems are already being used in many types of settings. In factories, workers use speech recognition systems to control robotic arms when the worker’s own hands are busy. Speech recognition systems enable the physically disabled people to use computers. A microcomputer Voice User Interface (VUI), capable of recognizing input from a variety of individuals, will be considered standard soon.

VIDEO DIGITIZERS can capture input from virtually any type of video device, such as VCR, television and camcorder. Audio digitizers can digitize music or voice from a microphone. It is fairly easy to capture a portion of a television show, add some music that complements the picture and play back the result on a microcomputer to create a multimedia presentation.

6.4 OUTPUT UNITS

Output devices are varied and as innovative as input devices. From traditional printed output to audio output and robots, there is a multitude of forms of computer output.

Most output can be divided into two categories: soft copy and hard copy. Soft copy is ideal when you are writing a document, playing a game, watching a video clip, or

NOTES

reading the latest news. A soft copy is what you see on the monitor. It is temporary; after you have finished with it, there is nothing solid to hold. You can, however, transfer a soft copy to a disk to transport it. A hard copy on the other hand, can be touched and carried. It is usually some form of paper output. It is especially helpful if you need to have a colleague look at your work or you need to give your work to a supervisor or a teacher.

6.4.1 Monitors

When you think about viewing computer output, you probably visualize a monitor. Monitor output is a soft copy; when you have finished viewing it, you cannot move it. Monitor displays are the most common form of soft copy.

Sometimes while watching television, you may notice that the picture looks a little snowy. This condition occurs because the images are not solid but rather created by configurations of dots. These dots, or picture elements, combine to form the image you see. The more picture elements, also known as pixels, the better is the resolution of the image. The better the resolution, the clearer is the picture. Computer monitors are similar to television screens.

The large monitors that you see connected to desktop computers are Cathode-Ray Tube (CRT). Monitors that are used on laptops and notebook computers are known as flat-panel displays. Flat-panel displays weigh less and consume less electricity than CRTs. Common types of flat-panel displays include Liquid Crystal Displays (LCDs), Electro Luminescent (EL) displays and Gas Plasma (GP) displays. Flat-panel display monitors are still more expensive than CRTs, but eventually their prices are expected to decrease. (PixelVision recently released a 16-inch flat-panel display that includes a two million-colour palette and sells for \$10,000.) Can you imagine monitor hanging on the wall like a painting? It may be common in a few years.

Most new monitors are SVGA (Super Video Graphics Adapters), with a pixel configuration of 800 by 600 at low-resolution mode and 1024 by 768 at high-resolution mode. The first number designates the horizontal pixel count, and the second is the vertical pixel count. The higher resolution, with more pixels, provides a clearer, more detailed image. Each pixel displays a single colour at a time. Each colour is represented by a numeric code. For example, bright red could be 12. If the monitor displays only 16 colours, the numeric code can be represented with only four bits. To display 256 colours (each with its own code) requires eight bits.

One monitor may look “sharper” than another, even though they may have the same pixel configuration. This is due to the dot pitch, which is the distance between pixels. A .28 dot pitch gives a crisper image than a .30 dot pitch. The .28 dot pitch is fairly standard. You should consider dot pitch while purchasing a monitor. The dot pitch is built in by the manufacturer and cannot be changed.

With users increasingly viewing video clips, animated objects and complex graphics, monitors have taken on a new importance. Users now must decide how large a

monitor they need. Fourteen-inch to seventeen-inch monitors are commonly used with desktop microcomputer systems. Larger monitors are available, but are expensive.

Display in black and white (monochrome) or colour categorizes monitors. Monochrome monitors are rapidly becoming a thing of the past, as most applications today require colour. In fact, a display of 256 colours is usually necessary for working with informational CD-ROMs and clip-art collections.

In order to connect a monitor to a microcomputer, you must have a graphics adapter board (also known as a video card). Each type of monitor requires a different type of board. The graphics board plugs into an expansion slot inside the computer and the monitor plugs into the board.

In order to run today's graphics-intensive programs properly and quickly, most graphic boards come with some memory capability, known as video memory. It is important to realize that Video RAM (VRAM) must meet higher performance specifications than regular RAM. It is recommended that instead of using RAM on a video card, the user should place VRAM or dynamic RAM (DRAM), which is slightly slower than VRAM, on a video card.

The refresh rate of a monitor is also important and is affected by the video card. Even a steady image is constantly regenerated, or refreshed, from top to bottom. A slow refresh rate of 60 times per second (60Hz) can cause headache; 70Hz is a reasonable minimum. Some monitors, known as interlaced monitors, refresh every other line; non-interlaced monitors are easier on the eyes. The Motion Picture Expert Group (MPEG), has developed standards for video compression that improve the quality of the video on the monitor. MPEG drivers are available as software or as hardware (built-in video card).

6.4.2 Audio Output

Have you ever listened to a concert or watched a television show on a computer? Audio output is the second type of softcopy. New computer systems have such good audio systems that it is possible to listen to music while you work, have the computer tell you when the printer needs paper, play games that include sound, or compose music on the computer. In order to have high quality audio output, good quality sound cards as well as good speakers are needed.

New sound cards even include the capability to have the computer read a text file to you while you continue working on a different application. Voice input and output has proved helpful to individuals with speech and vision impairments. People with speech impairment can key a message into a computer and have the computer repeat it. Of course, computer generated voices are not human; they are synthesized. Speech synthesis, having the computer speak, is a much simpler process than speech recognition.

6.4.3 Printers

The second most common form of computer output is the printed document. Although a computer can operate perfectly well without a printer, it is certainly helpful for the user to have one. Because you can hold printed output, it is considered a form of hard copy.

Printers can be categorized by whether anything mechanical touches the paper; whether they do or do not produce a solid character or how many pages or a line, or a character they produce, at a time.

When a part of the printer presses the paper to form the character, the printer is considered an impact printer. Impact printers can produce carbon copies and are fairly loud, although covers are available to muffle the noise. In contrast, non-impact printers are quiet. However, because nothing presses on the page, a non-impact printer cannot produce carbon copy. This fact is usually not a problem because it is easy to produce multiple originals, but sometimes carbons are required for legal purposes.

Impact Printers

Impact printers can produce a page, a line, or a character at a time. Large computers use line printers. The main drawback of line printers is that they can produce only text and no graphics.

Many small computers use character printers. Although only one character can be produced at a time, many types of character printers can produce graphics as well as text. The most common character printers create images by using a dot pattern. These printers are known as dot matrix printers. If you use a magnifying glass to look at a report created with a DOT MATRIX PRINTER, you can see the small dots forming each character.

LINE MATRIX is a type of line printer that uses an oscillating row of print hammers. The hammers form characters and graphics by impacting a ribbon and transferring dots of ink onto the paper. An impact printer is the one that prints a line at a time. Printronix pioneered this technology in 1974.

BAND (LINE CHARACTER) is a type of line printer that uses a fixed set of characters attached to a continuously revolving metal band. A set of hammers (one for each column) hits the paper, pushing it into the ribbon and against the character image on the band.

Non-impact Printers

Non-impact printers are increasing in popularity largely because of improvement in print quality coupled with decreasing cost. Non-impact printers can produce both text and graphics. Because nothing actually strikes the paper, non-impact printers are fairly quiet. Some of the most popular non-impact printers are laser printers and inkjet printers.

Laser Printers

Laser printers work in the same manner as copy machines. A laser beam creates electrical charges that attract the toner to form an image and transfer it to paper. A printer uses the laser and the electro photographic methods to print a full page at a time. The laser is used to “paint” a charged drum with light, to which the toner is applied and then transferred onto paper. Laser printers come in a variety of sizes; generally the larger and faster the printer, the more expensive it is. Large laser printers are used on mainframes and minicomputers where high quality graphic output is required. Small, “personal” laser printers are suitable for home use. Hewlett Packard recently began production of wireless printers. The HP5P (IBM) and the HP5PM (Mac) enable the user to beam a document from the laptop to an infrared receiver in the front of the printer. The laptop needs to have a built-in infrared transmitter installed, but no cables or wires are required.

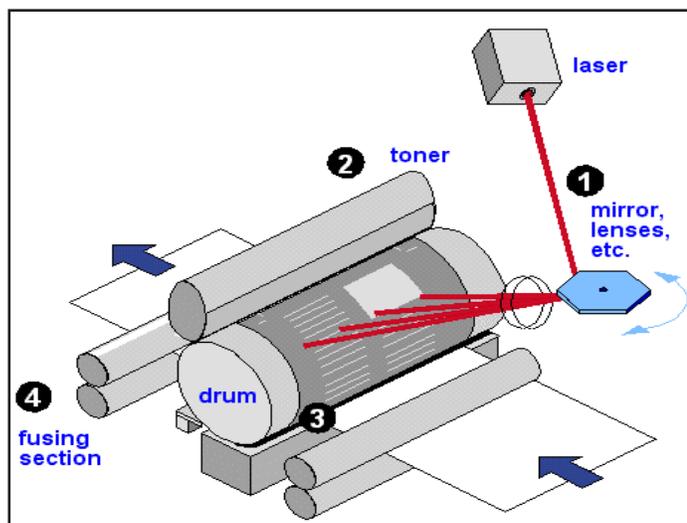


Fig. 6.5

The Laser Mechanism: The laser printer uses electrostatic charges to (1) create an image on the drum, (2) adhere the toner to the image, (3) transfer the toned image to the paper, and (4) fuse the toner to the paper. The laser creates the image by “painting” a negative of the page to be printed on the charged drum. Where light falls, the charge is dissipated, leaving a positive image to be printed.

Inkjet Printers

Inkjet printers are also popular among microcomputer users. Although the resolution is lower on inkjet printers than on laser printers, it is higher than that of dot matrix printers. Inkjet printers are significantly less expensive than laser printers. Electronically charged ink is sprayed through a jet nozzle and passed through an electronic field, which deflects the ink to form a dot matrix character. Colour inkjet printers, which use multiple nozzles, are available at very reasonable prices. Canon

NOTES

recently released a colour inkjet printer that weighs 3 pounds and stands 2 inches high. The perfect choice of printer while travelling!

A well-equipped office at home or at workplace includes an inkjet printer, a fax machine (with its own telephone), a copier and a full sheet scanner. A recent addition to the market is one device that does all four functions. The technology to print a document that has been faxed to you and the technology to copy a document are similar to the technology to print a document from a PC. All three technologies use similar digital patterns and the mechanical aspects are nearly identical.

Other high quality printers include Thermal-wax printers, Dye-sub printers, Fiery printers and IRIS printers.

The thermal-wax printers are primarily used for presentation graphics and handouts. They operate with a ribbon-coated pane of coloured wax that melts and adheres to plain paper as coloured dots passed over a focused heat source. As the paper and the ribbon travel in unison beneath the thermal print head, the wax-based ink from the transfer ribbon melts onto the paper. When cool, the wax is permanent. This type of thermal printer uses a like-size panel of ribbon for each page to be printed, regardless of the contents of the page. Monochrome printers have a black panel for each page to be printed, while colour printers have either three (CMY) or four (CMYK) coloured panels for each page.

The dye-sub printer is a printer that produces continuous-tone images that look like a photographic film. It uses a ribbon containing an equivalent panel of dye for each page to be printed. Colour printers have either three (CMY) or four (CMYK) consecutive panels for each page, thus the same amount of ribbon is used to print a full-page image, as it is to print a tenth of the page. Special dye-receptive paper is used, and the consumables (ribbon and paper) cost more than other printer technologies.

The paper and the ribbon are passed together over the print head, which contains thousands of heating elements that can produce varying amounts of heat. The hotter the element, the greater is the amount of dye released. By varying the temperature, shades of each colour can be overlaid on top of each other. The dyes are transparent and blend into a continuous-tone colour.

Fiery printer servers are special type of computers that transmits documents to a digital colour copier, where they are printed.

IRIS printers are large-format colour printers from the Iris Graphics division of CreoScitex, that are used for digital proofing. Iris printers use a patented continuous inkjet technology to produce consistent, continuous-tone, photo-realistic output on several varieties of paper, canvas, silk, linen and other low-fibre textiles. Iris prints are widely noted for their colour accuracy and ability to match printing and proofing standards. They are also known for their low-cost consumables as compared to other technologies.

6.4.4 Plotters

A plotter, like a printer, produces hard copy output. Plotters, which produce high quality colour graphics, are usually categorized by whether they use pens or electrostatic charges to create images. A continuous curve plotter is used to draw maps from stored data. Computer generated maps can be retrieved and plotted or used to show changes over time. Plotters are generally more expensive than printers, ranging from about \$1,000 to \$75,000 (or even more).

A plotter uses a robotic arm to draw with coloured pens on a sheet of paper. The instructions that a plotter receives from the computer consists of the colour and the beginning and ending coordinates for a line. With this information, the plotter picks up the appropriate pen, positions it at the beginning of the coordinates, drops the pen down to the surface of the paper and draws to the ending coordinates. The plotter draw curves by creating a sequence of very short, straight lines.

Check Your Progress

Fill in the blanks:

6. displays the soft copy.
7. printers use infra-red receiver to receive a document.
8. The banking industry uses
9. Personal computers use and input devices, most commonly.
10. keyboards are resistant to liquids and grease.
11. are the smallest types of computers.

6.5 SUMMARY

- These devices are used to enter information and instructions into a computer for storage or processing and to deliver the processed data to a user. 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. An input device is any device that provides input to a computer. There are many input devices, but the two most common ones are a keyboard and mouse. Every key you press on the keyboard and every movement or click you make with the mouse sends a specific input signal to the computer. The keyboard is very much like a standard typewriter keyboard with a few additional keys. The basic QWERTY layout

NOTES

of characters is maintained to make it easy to use the system. The additional keys are included to perform certain special functions. These are known as function keys that vary in number from keyboard to keyboard. A device that controls the movement of the cursor or pointer on a display screen. A mouse is a small object you can roll along a hard and flat surface. Its name is derived from its shape, which looks a bit like a mouse. As you move the mouse, the pointer on the display screen moves in the same direction.

- A trackball is an input device used to enter motion data into computers or other electronic devices. It serves the same purpose as a mouse, but is designed with a moveable ball on the top, which can be rolled in any direction. A touch pad is a device for pointing (controlling input positioning) on a computer display screen. It is an alternative to the mouse. Originally incorporated in laptop computers, touch pads are also being made for use with desktop computers. A touch pad works by sensing the user's finger movement and downward pressure. Touch Screen allows the user to operate/ make selections by simply touching the display screen. A display screen is sensitive to the touch of a finger or stylus. It is widely used on ATM machines, retail point-of-sale terminals, car navigation systems, medical monitors and industrial control panels. Output device receives information from the CPU and presents it to the user in the desired form. The processed data, stored in the memory of the computer is sent to the output unit, which then converts it into a form that can be understood by the user.

6.6 GLOSSARY

- **Computer:** Computer is an electronic device which is used to store the data, as per given instructions. It gives results quickly and accurately.
- **Input Unit:** This unit is used for entering data and programs into the computer system by the user for processing.
- **Storage Unit:** The storage unit is used for storing data and instructions before and after processing.
- **Output Unit:** The output unit is used for storing the result as output produced by the computer after processing.
- **Keyboard:** The keyboard is very much like a standard typewriter keyboard with a few additional keys. The basic QWERTY layout of characters is maintained to make it easy to use the system. The additional keys are included to perform certain special functions. These are known as function keys that vary in number from keyboard to keyboard.
- **Mouse:** A device that controls the movement of the cursor or pointer on a display screen. A mouse is a small object you can roll along a hard and flat

surface. Its name is derived from its shape, which looks a bit like a mouse. As you move the mouse, the pointer on the display screen moves in the same direction.

- **Trackball:** A trackball is an input device used to enter motion data into computers or other electronic devices. It serves the same purpose as a mouse, but is designed with a moveable ball on the top, which can be rolled in any direction.
- **Touchpad:** A touchpad is a device for pointing (controlling input positioning) on a computer display screen. It is an alternative to the mouse.

6.7 ANSWERS TO CHECK YOUR PROGRESS

1. Non-impact Printers
2. Voice recognition
3. Plotter
4. QWERTY
5. Scanner
6. Monitor
7. Wireless
8. MICR
9. Keyboard, Mouse
10. Membrane Switch
11. Personal Digital Assistants

6.8 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. List four types of output devices.
2. What is an MICR?
3. Write about various types of scanners.
4. What is the difference between impact and non-impact printers?
5. Write a note on trackballs.

Long Answer Questions

1. Describe various types of input devices and differentiate amongst them.
2. Why are Personal Digital Assistants becoming popular?

3. Write a brief note each on all the types of input devices.
4. Write a note on scanning devices.
5. What do you think can come after voice recognition devices?

6.9 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
8. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

UNIT 7: HARDWARE TROUBLESHOOTING

Structure

- 7.0 Introduction
- 7.1 Unit Objectives
- 7.2 Troubleshooting Keyboards
- 7.3 Mouse Troubleshooting
- 7.4 Troubleshooting Printers
- 7.5 Troubleshooting Monitor (VDU)
- 7.6 Networking Troubleshooting
- 7.7 Sound Troubleshooting
- 7.8 Hard Drive Troubleshooting
- 7.9 Summary
- 7.10 Glossary
- 7.11 Answers to Check Your Progress
- 7.12 Terminal and Model Questions
- 7.13 References

NOTES

7.0 INTRODUCTION

In Computer Science, a keyboard is a typewriter keyboard, which uses an arrangement of buttons or keys, to act as mechanical levers or electronic switches. After punch cards and paper tape, interaction via teletype-style keyboards became the main input device for computers.

In spite of the development of other input devices, such as, mouse (computing mouse), touch sensitive screens, pen devices, character recognition, voice recognition, and improvements in computer speed and memory size, the keyboard remains the most commonly used and most versatile device used for direct (human) input into computers.

A keyboard typically has characters imprinted or printed on the keys and each press of a key typically corresponds to a single written symbol. However, to produce some symbols requires pressing and holding several keys at the same time or in sequence. While most keyboard keys produce letters, numbers or signs (characters), other keys or instantaneous key presses can produce actions or computer commands.

In normal usage, the keyboard is used to type text and numbers into a word processor, text editor or other program. In a modern computer, the interpretation of key presses is generally left to the software. A computer keyboard distinguishes each physical key from others and reports all key presses to the controlling software. Keyboards are also

used for computer gaming, either with regular keyboards or by using keyboards with special gaming features, which can expedite frequently used keystroke combinations. A keyboard is also used to give commands to the operating system of a computer, such as Windows' Control-Alt-Delete combination, which brings up a task window or shuts down the machine.

7.1 UNIT OBJECTIVES

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

- Discuss the troubleshooting Exercises for Keyboards
- Explain the troubleshooting of Mouse
- Describe the troubleshooting of Printers
- Discuss the troubleshooting of Monitor (VDU)
- Explain the troubleshooting of Sound system
- Describe the troubleshooting of Networking

7.2 TROUBLESHOOTING KEYBOARDS

There are many types of keyboards, usually differentiated by the switch technology employed in their operation. Since there are so many switches needed (usually about 80-110) and because they have to be highly reliable, this usually defines the keyboard. The choice of switch technology affects key response (the positive feedback that a key has been pressed) and travel (the distance needed to push the key to enter a character reliably). Newer models use hybrids of various technologies to achieve greater cost savings.

Troubleshooting Exercises for Keyboards

Problems with your computer keyboard can often be easily fixed if the suitable troubleshooting actions are taken. If your keyboard isn't working properly, please find the heading which applies to the problems you are experiencing and follow the troubleshooting steps below it.

Keyboard is Entirely Non-Functional

1. Make sure it is plugged into your computer and the wire has not become unfastened from the computer or the keyboard itself (some keyboards have cords which can be unplugged at either end). If it is loose, you may have to turn off the computer and re-boot it before it will start working again.
2. If your mouse and keyboard are both the PS/2 type, verify that you did not by mistake connect them to each other's jacks on the computer. If so, turn the computer off and re-connect them properly.

3. Look to see if the keyboard has an “AT/XT” or “A/X” switch on the side or bottom; unless your computer is over fifteen years old, the switch should be in the “AT” position. If it has a “Lock”, “Pause”, or “Hold” key, you might have pressed it accidentally (pressing it again should unlock the keyboard and/or computer). Some old XT-only keyboards will fit newer computers, but are mismatched with them.
4. If you are attempting to operate a USB keyboard (these are relatively new and have rectangular plugs at the end of their cords), you need to download or otherwise obtain an appropriate USB driver before it will react.

One or More Keys Function Improperly

1. If the keyboard has remained in a cold room for a long period of time, or hasn't been used for weeks, use it for several minutes and be sure to press all the frequently-used keys repeatedly; a text editor like Notepad can be opened before doing this. It might start functioning better after this, at least to some extent.
2. If the keys are producing incorrect letters, check to see if the keyboard has any switches which could be set to an alternative layout (such as Dvorak). Try troubleshooting it by using different keyboards with the computer to determine if the problems are caused by the software or operating system. It could also be a programmable unit (such as the Gateway Any key); you will have to determine how to reset the programmed keys if this is the source of your problems.
3. If more than one of the same letter or number appears when you press a key once, this is called “key bounce.” One way to decrease these problems is to reduce the key repeat rate and/or repeat delay, in your computer's operating system. If you have Windows 95 or later, this can be decreased in the “Keyboard” section of “Control Panel.”

Some of the Basic Precautionary Tips

Keyboard Is Dirty

Keyboards should be cleaned with “spray-n-wipe” cleaner and a cloth or tissue on a monthly basis. Ensure that computer is not powered up while cleaning the keyboard. Compressed air can also be used to clean between the keyboard keys

Another tip: Clean the keys with a cotton swab dipped in alcohol.

“Keyboard Not Found” Message

Your keyboard is not plugged into the computer securely. Unplug it and plug it back in and the problem should go away. If this doesn't work, follow the procedure: “Computer isn't taking inputs from keyboard” (below).

Key Is Stuck

1. If a key does not work or is stuck in the down position, you may try to remove it with a CPU.

2. “Chip puller” tool. These simple “L” shaped tools are great at pulling out keys. Once you’ve pulled out the stuck key, you can try to stretch the spring to “reanimate” its action.

NOTES

Computer Isn’t Taking Inputs from Keyboard

1. Is keyboard connected to computer? Ensure that the keyboard is plugged into the keyboard jack and not into the mouse jack. If the keyboard was unplugged, plug it back in and reboot the computer.
2. If the keyboard still doesn’t work on boot-up, power down the computer and try to borrow a friend’s known-good keyboard for troubleshooting. Plug the new keyboard up and boot up the computer. If the new keyboard works, the old keyboard is bad and needs to be replaced.
3. If the known-good keyboard doesn’t work, check your BIOS to make sure it sees the keyboard. It should say, “Installed.” If the BIOS recognize the keyboard, then you probably have a bad keyboard port.

I Plugged Keyboard into Mouse Port

1. Many mice and keyboards today use a PS/2 connector. If you have plugged your keyboard into the mouse port (or vice versa), follow steps 2 and 3.
2. Shut down the computer and plug the keyboard into the keyboard port. The keyboard port is usually marked with a “keyboard” symbol. Plug the mouse into the mouse port (usually marked with a mouse symbol).
3. Reboot the computer; the keyboard should work now. If the keyboard doesn’t work, check your BIOS to make sure the BIOS recognizes the keyboard. You should see the words, “installed” or “enabled” under the keyboard.
4. If the BIOS recognizes the keyboard but it still doesn’t work, you may have a bad keyboard port.

I Spilled a Drink on My Keyboard!

If you spill any liquid on the keyboard, turn it upside down ASAP. Drain all the water out of the keyboard, shaking it if necessary. If you’ve spilled water on the keyboard, just let it dry. You may use a hair dryer to dry out area under the keys (remember, too much heat and you could damage the electrical components).

If you’ve spilled a soda on the keyboard, completely clean it in warm water. With No soap ! You may use a hair dryer at this point or just let it dry for 2 days. Ensure the keyboard is perfectly DRY before you attempt to use it again. Don’t plug a wet keyboard into electrical equipment. Think safety.

If the keyboard still doesn’t work, replace the keyboard.

Only Types Capitals

USUALLY THIS IS CAUSED BY THE “CAPS LOCK” KEY BEING LEFT ON. PRESS “CAPS LOCK” KEY ONCE to fix this problem.

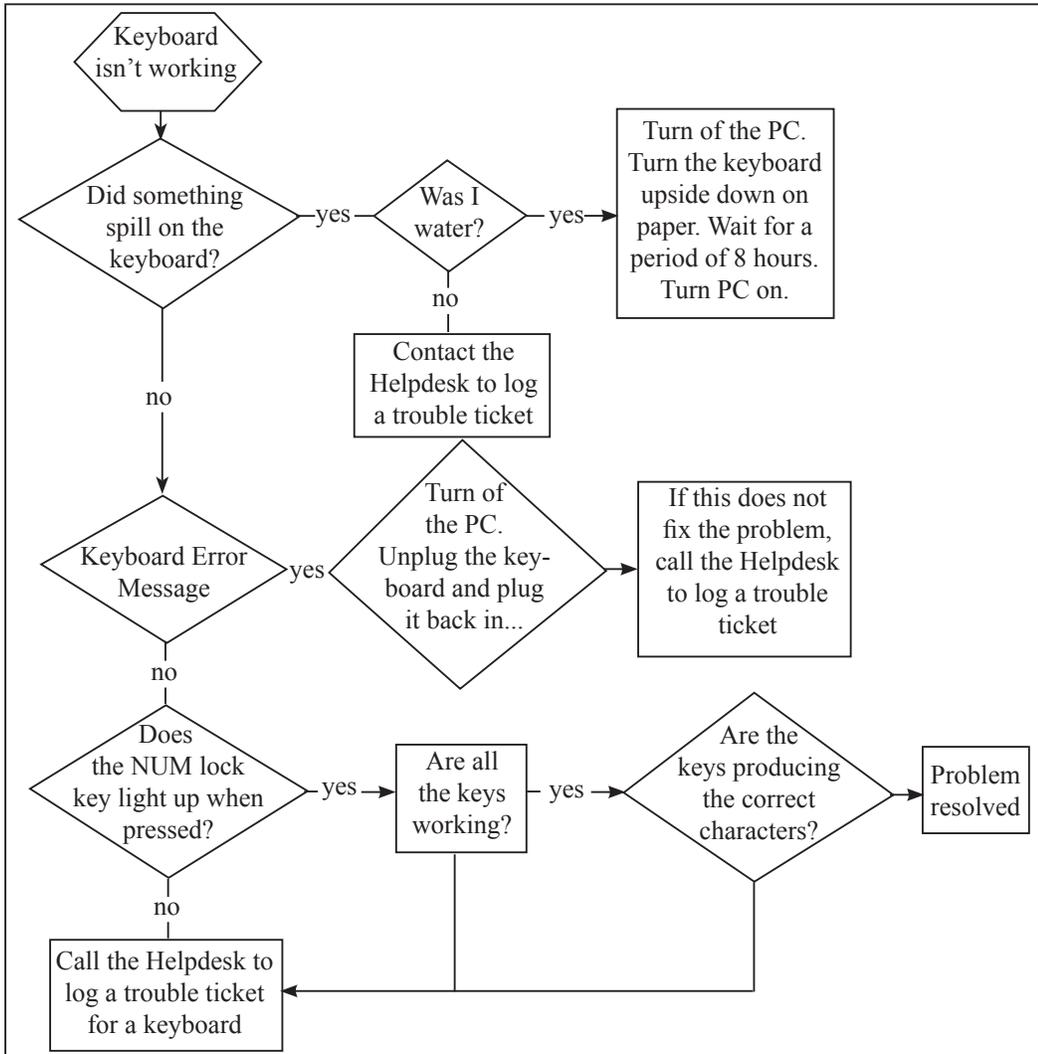
Your “Scroll Lock” function may be engaged. Press the Scroll Lock Key once.

Letters on Keyboard Don't Work

Confirm to see if there are any obstructions to the keys. If other keys work, then your keyboard is going bad and needs to be replaced.

NOTES

Keyboard Troubleshooting Flowchart



7.3 MOUSE TROUBLESHOOTING

The mouse is not working.

Symptom

The mouse is acting erratic.

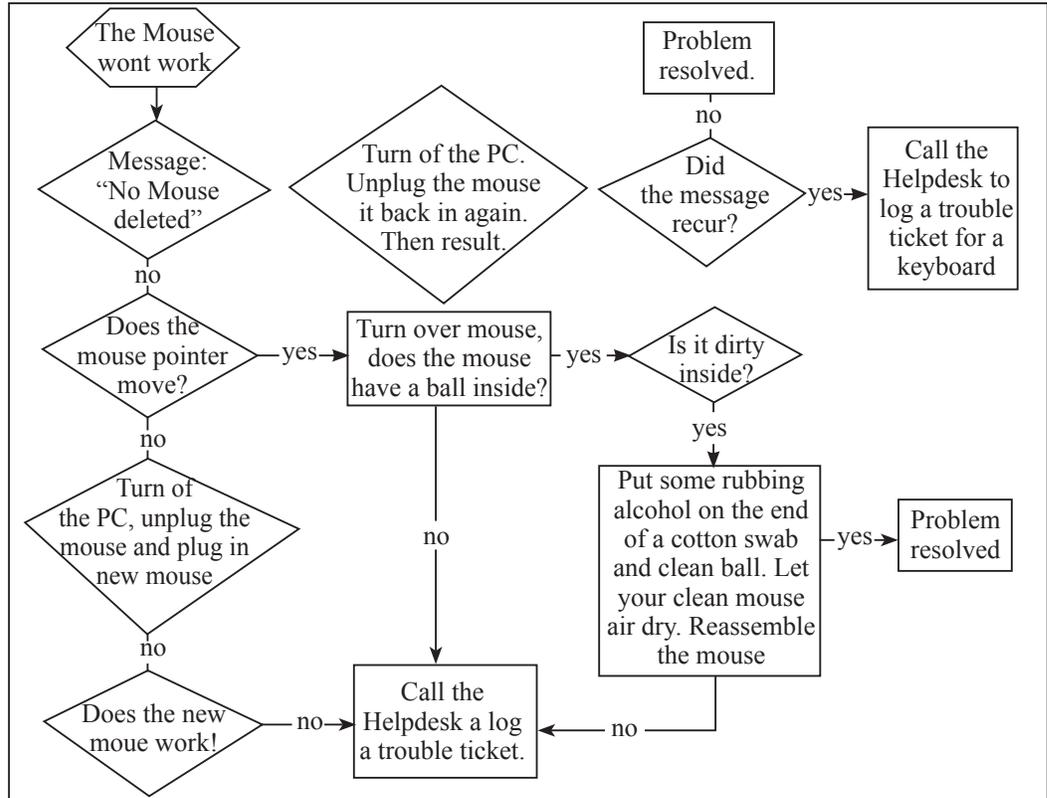
Diagnosis

Reboot the computer and see if that corrects the problem. If not check to see if there is insufficient memory.

NOTES

Symptom

The mouse will only move one way, either vertically or horizontally



Diagnosis

- Clean the mouse.
- Shut down your machine and unplug your mouse from the computer. Open the underside of the mouse and remove the ball. If the ball is a rubber ball, do not clean it with alcohol. Clean it with a soft cloth. There should be no lubricant placed on a mouse ball. Clean the roller in the body of the mouse with a cotton swab that is slightly damp with alcohol. Replace the ball when the rollers are dry and replace the bottom portion.

7.4 TROUBLESHOOTING PRINTERS

In computer science, a printer is a peripheral which produces a text and/or graphics) of documents stored in electronic form, typically on physical print media such as paper or transparencies. Many printers are chiefly used as local peripherals, and are

attached by a printer wire or, in most newer printers, a USB cable to a computer which serves as a document foundation. Some printers, usually known as network printers, have built-in network interfaces, typically wireless and/or Ethernet based, and can serve as a hard copy device for any user on the network. Individual printers are often intended to support both local and network connected users at the same time. In addition, a few modern printers can directly interface to electronic media such as memory cards, or to image capture devices such as digital cameras and scanners; some printers are joint with a scanner and/or fax machine in a single unit, and can function as photocopiers. Printers that include non-printing features are sometimes called multifunction printers (MFP), multifunction devices (MFD), or all-in-one (AIO) printers. Most MFPs include printing, scanning, and copying among their features. Ever since the dawn of the computer age, producing printed output on paper has been one of the computer's principal functions. Furthermore, while other aspects of computer technology have advanced by leaps and bounds over the past few decades, printing techniques have changed only moderately. This essay will briefly review the techniques used in the past, and then will discuss in greater detail the printing methods most often used today for desktop computers and workstations.

Trouble Shooting Printers

Just like all electronics, printers sometimes malfunction. It could be a paper jam, a dud ink cartridge or maybe even a driver issue. The point is, printers are not without their troubles. But, if you are a prepared consumer, you will bone up on the possibilities before a problem even occurs.

The Printer Picks up All the Paper

This is a frustrating one. You are trying to print out something and the printer feeds in the whole paper stack rather than just one-piece at a time. For starters, make sure you fan the paper edge before putting it in the printer feed tray. This helps separate the sheets. Also, be sure to store your paper in a cool, dry place as humidity can contribute to this pesky problem.

Blank Page

Make sure you completely removed that little sticker from the ink cartridge before installing it. If it is removed, run the clean print head function on your printer to make sure all air bubbles are removed. Just whatever you do, do not remove the cartridge once it is been installed!

The Colour and Print Quality is Diminished

This typically happens when one ink well is running low. If fall of your images starts to look a bit purple, blue or orangish, this may be your problem. The usual solution to this problem is to restore the whole printer ink cartridge, unless you can refill the individual ink wells.

NOTES

Printer does not have Power Indicator

First, make sure that the printer is on. When a printer is on it should have some type of light (usually green) that indicates that the printer is receiving power and is on.

If you do not have any indicator light make sure the printer is connected to a working power outlet by verifying each end of the power cable. Next, press the printer power button.

If after following the above steps your printer still cannot get a power status indicator it's likely you're encountering a serious printer issue and we suggest contacting the printer manufacturer for additional steps and/or instructions on repair or replacement.

Cables not Connected Properly

Your printer should have two cables connected to it. The power cable and the data cable. The power cable should have already been verified as being connected if your printer has a power indicator light as mentioned above. Make sure the data cable (parallel cable or USB cable) is also connected from the printer to the computer.

Printer Error (orange or blinking light)

After your printer has completed its initial startup you should have a solid green light. If the light indicator is blinking or orange often this is an indication of a printer error. For example, this could indicate a paper jam, issue with the ink or toner cartridge, or other serious error.

Because there is no standard to what a blinking light or orange light means if you're getting either of these we suggest referring to the printer documentation for troubleshooting steps or methods of determining what the status indicator is reporting.

No Paper or Paper Jam

Without paper your printer will not be able to print. Make sure you have paper in the paper loaded into the printer paper cartridge or tray. Next, verify that no printer paper is jammed or partially fed into the printer. If you have one or more pieces of paper stuck in the printer these will need to be manually removed before the printer will print again.

Inkjet Printer Ink Related Issues

Often when you're encountering an ink related issue your printer status indicator light (mentioned above) should be flashing. If this is not occurring you may want to simply skip to the next section. However, if you've recently inserted a new ink cartridge you may want to try the below suggestions.

Printer Self Tests

Most printers have a way of printing a test page. This page allows you to determine if the printer is physically working or not. This test is usually accomplished by holding

down a series of keys. If you are not sure whether your printer has this feature or how to perform it, refer to your manual or visit your printer manufacturer's web site. In addition to testing the printer using the printer self-test Microsoft Windows users can also perform software self-test to determine if their computer is able to see the printer and it is able to print. Follow the below steps to perform this test.

Microsoft Windows 98, 2000, ME, XP, 2003, and Vista users

1. Click Start, Settings, and open Control Panel.
2. Double-click the Printers or Printers and Fax icon.
3. Right-click on the Printer you wish to test and click Properties. If you do not see your printer listed your printer is not installed.
4. In the Printers Properties window click the Print Test Page button.
5. If the printer is able to print a test page, your printer is installed and setup properly. However, if you are unable to print in other programs, it is possible that the program you are attempting to print from has issues.

Printer Drivers

If your printer does not have any flashing lights and is connected properly it is possible you may be encountering a driver related issue. We suggest visiting our printer driver listing, which links to all major printer manufacturer driver pages and downloading the latest printer drivers for your printer.

Parallel (LPT) Printers

If the printer you are connecting to the computer is an LPT (parallel port) printer we also suggest verifying the below suggestions if your printer is not working.

Parallel Port in CMOS

1. Enter the computers CMOS setup. Additional information about entering the CMOS (BIOS) setup.
2. Once in CMOS verify that your parallel port is enabled or installed.
3. Next, verify the printer or parallel port mode. This option will often have several different modes. If your parallel port is set to ECP mode, we suggest trying a different mode.

Other Parallel Device

If you have a parallel printer with other parallel devices such as a parallel scanner or zip drive, temporarily disconnect these devices to verify they are not causing your issue.

Adding and Troubleshooting Printers from Windows OS:

Step 1: Click on Start >> Settings >> Printers and Faxes

Step 2: Then Click on FILE >> ADD Printer menu to connect the printer to your System. It is only required once you install your printer driver and physically connect printer with the available Interfaces.

Step 3: It will open your ADD Printer wizard with some self explanatory instructions. Read it carefully and implement the same.

Step 4: Once you attach your printer, it will be shown as below with Ready status. Selecting and Right clicking on its properties, it will lead you to whole lot of options TABs.

7.5 TROUBLESHOOTING MONITOR (VDU)

A monitor or display (visual display unit) is an electronic visual display for computers. The monitor comprises the display device, circuitry, and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) thin panel, while older monitors use a cathode ray tube as deep as the screen size.

Troubleshooting Visual Display Unit

Troubleshooting problems with LCD monitors is much like troubleshooting any problem - it pays to be methodical and logical in your thinking!

Basic Troubleshooting

1. Determine the scope of the problem - i.e., what we can eliminate as OK - where we can narrow down the problem to.

For example: Does the monitor work on another PC? – does another monitor work on this PC? – This will demonstrate if the problem lies with the PC - or the monitor.

2. Is the problem intermittent?

What seems to cause the problem to occur? – can the problem be made to move by connecting the suspect item elsewhere?

With intermittent faults, to show where the problem is, you have to be able to move it in order to demonstrate which part is actually faulty. If the fault just goes away - it might well come back. If the fault can be seen to be moved (for example a display fault occurs on two PCs - but the same monitor) - then it is reasonable to think the monitor is faulty.

3. Is it a Combinational Problem?

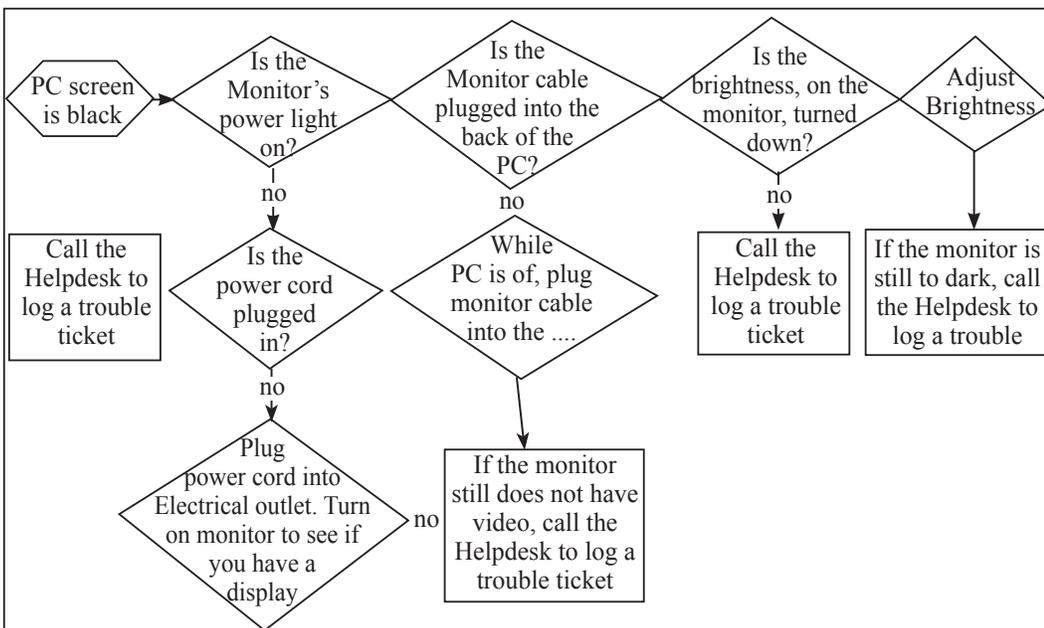
More complex are combinational problems - e.g., monitor 1 works on PC1 - but not PC2, while Monitor 2 works on BOTH PCs. Is monitor 1 faulty? - Probably not. There is most likely a different configuration on the PCs causing the different behaviour. Since PC2 works with the other monitor, it is likely that the problem can be resolved by re-configuring the PC.

In each case above, we are determining the scope of the problem by eliminating what we know is working and OK. With the exception of the combinational problem, most issues can be quickly resolved. Below mentioned table enlists some of the Issues, Causes and suggested solutions:

<i>Issue</i>	<i>Possible Causes</i>	<i>Solution</i>
First line of display not on the top line of the screen	Arrangement problem	Use the V-shift control to adjust the display
Display not covering the whole screen but is compressed in the centre of the screen	Configuration problem	Use the H-shift control to adjust the display
Display not stable	Power supply fluctuations	Change power supply point
	Interference from other devices, such as an electric heater, vacuum cleaner, etc.	Shut off these devices or shift the computer to a different location
Display suddenly vanishes and reappears	Loose contact in VDU socket	Check and replace if necessary
	Bad connections within the system	Call engineer
No display	Bad cable	Change cable
	Brightness maladjustment	Adjust brightness to maximum
	Bad monitor or system problem	Call engineer
Bad or no colour	Monitor maladjustment	Adjust monitor controls
	Color signals are not proper	Call Engineer

Video/Screen Troubleshooting

If the Monitor is Black, diagnosis is given in the flow chart.



7.6 NETWORKING TROUBLESHOOTING

NOTES

Symptom

My PC is not working on the Network.

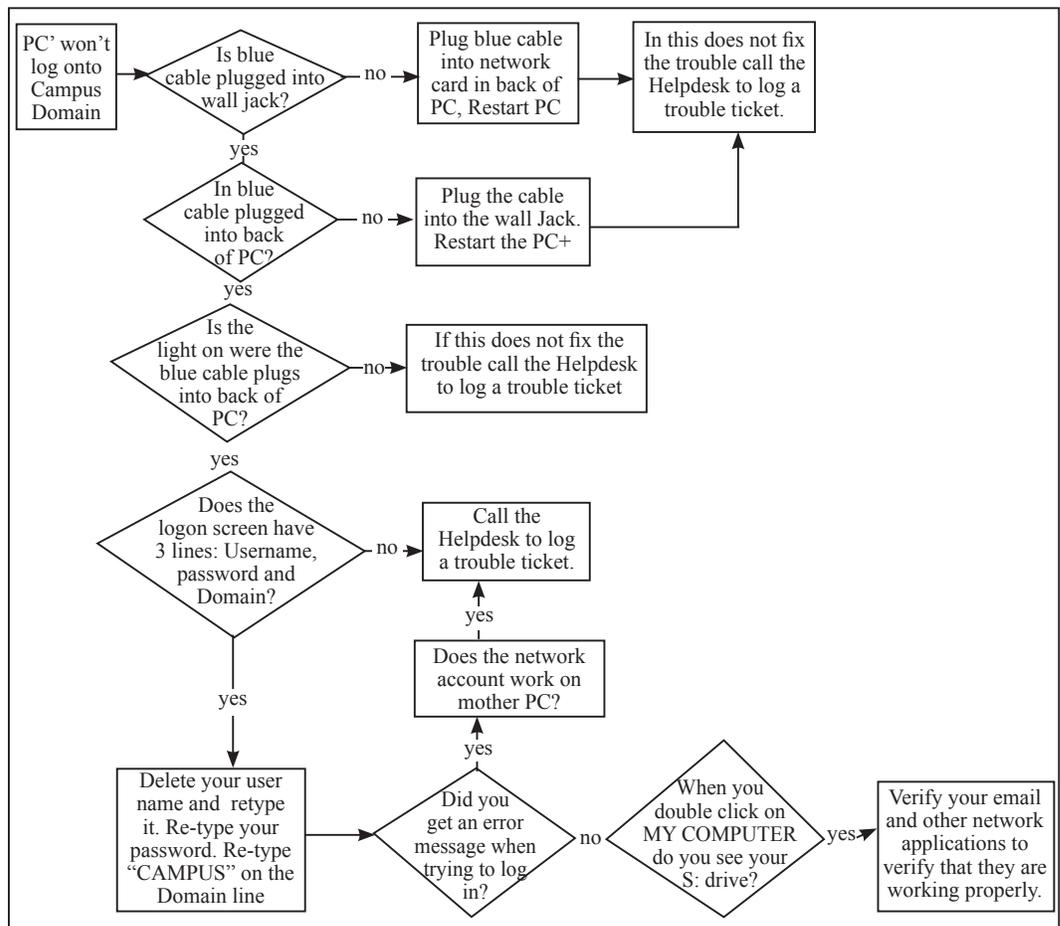
Diagnosis

Programs that **require** network drives to run or operate properly: SIS, HR, FRS, PROD – ALPHA, Network Shares, and some school applications. You would also need a network connection to print to the network laser or colour laser printers within CCRI.

Symptom

Message “No Domain Server Available” or there are no Network drives (like the S drive).

Diagnosis



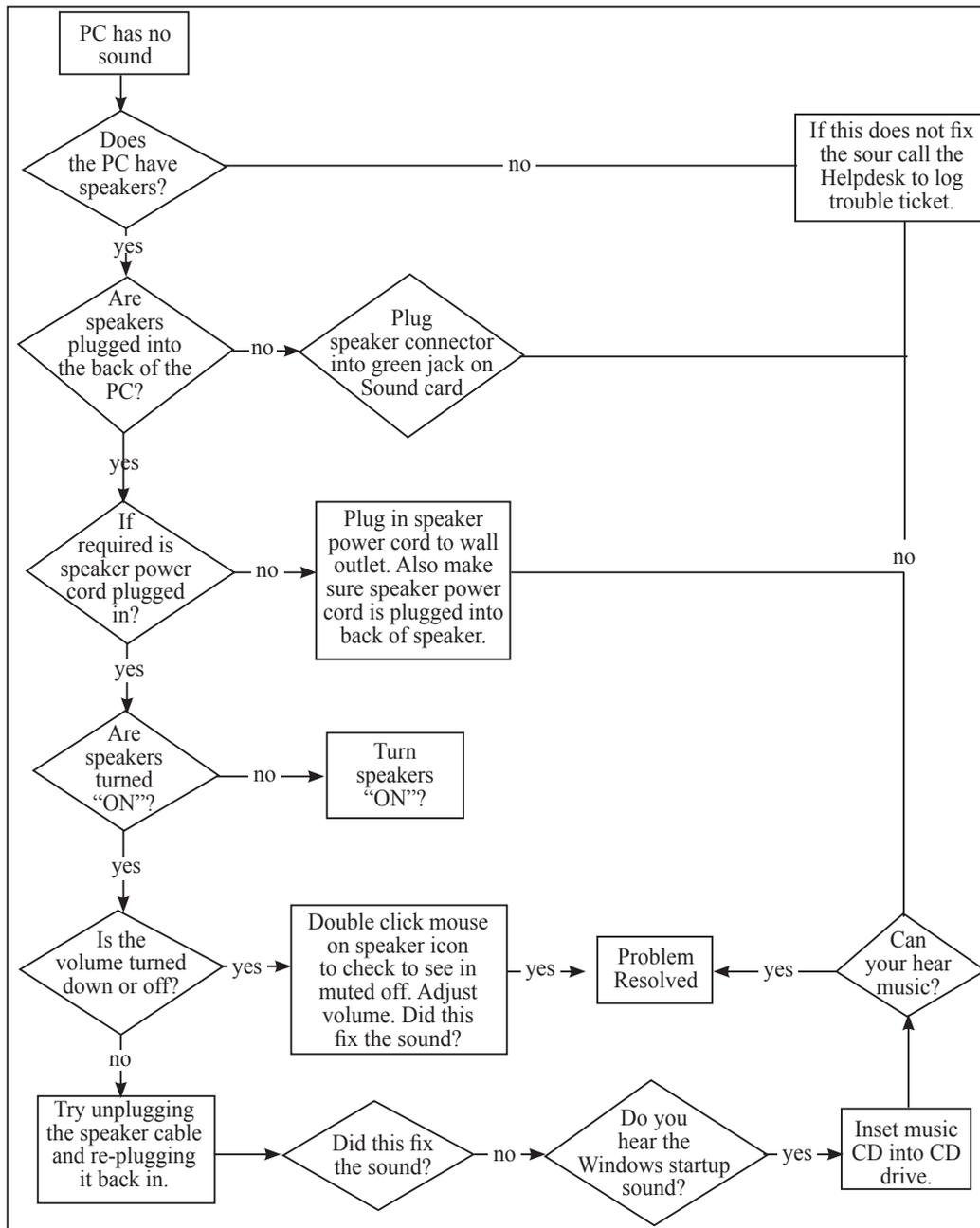
7.7 SOUND TROUBLESHOOTING

Symptom

The computer has no sound.

Diagnosis

NOTES



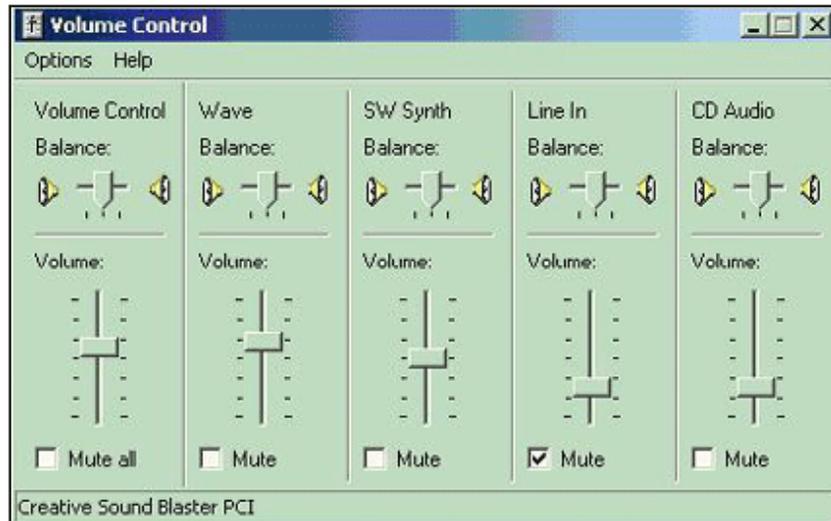
Symptom

No sound is heard from audio (music) CDs.

NOTES

Diagnosis

- Look for the Volume icon in the system tray in the lower right-hand corner of the Windows desktop.
- Place the mouse arrow on this icon.
- Double left-mouse click. The Volume Control dialog box should appear on the computer screen.



- Place the mouse arrow on the “slider” button and slide the arrow up to increase or down to decrease the volume.
- If “Mute all” check box is checked, there will be no sound. To enable the sound again, uncheck the box.
- Ensure the speakers are properly connected to the audio card’s output connector and turned on.

Symptom

There is no volume icon in the lower right corner.

Diagnosis

To place the volume icon in the system tray in the lower right of the desktop:

- Place the mouse arrow on the Start button in the lower left corner.
- Left mouse-click on Settings.
- Left mouse-click on the Control Panel
- Place the mouse arrow on the Multimedia icon



(In Windows XP, look for the Sounds and Audio Devices icon .)

- Double-left mouse click.



- Left mouse-click on the Audio file tab.
- Towards the bottom look for the check box that reads “Show volume control on taskbar.”
- Make sure the box is checked to activate the icon.

NOTES

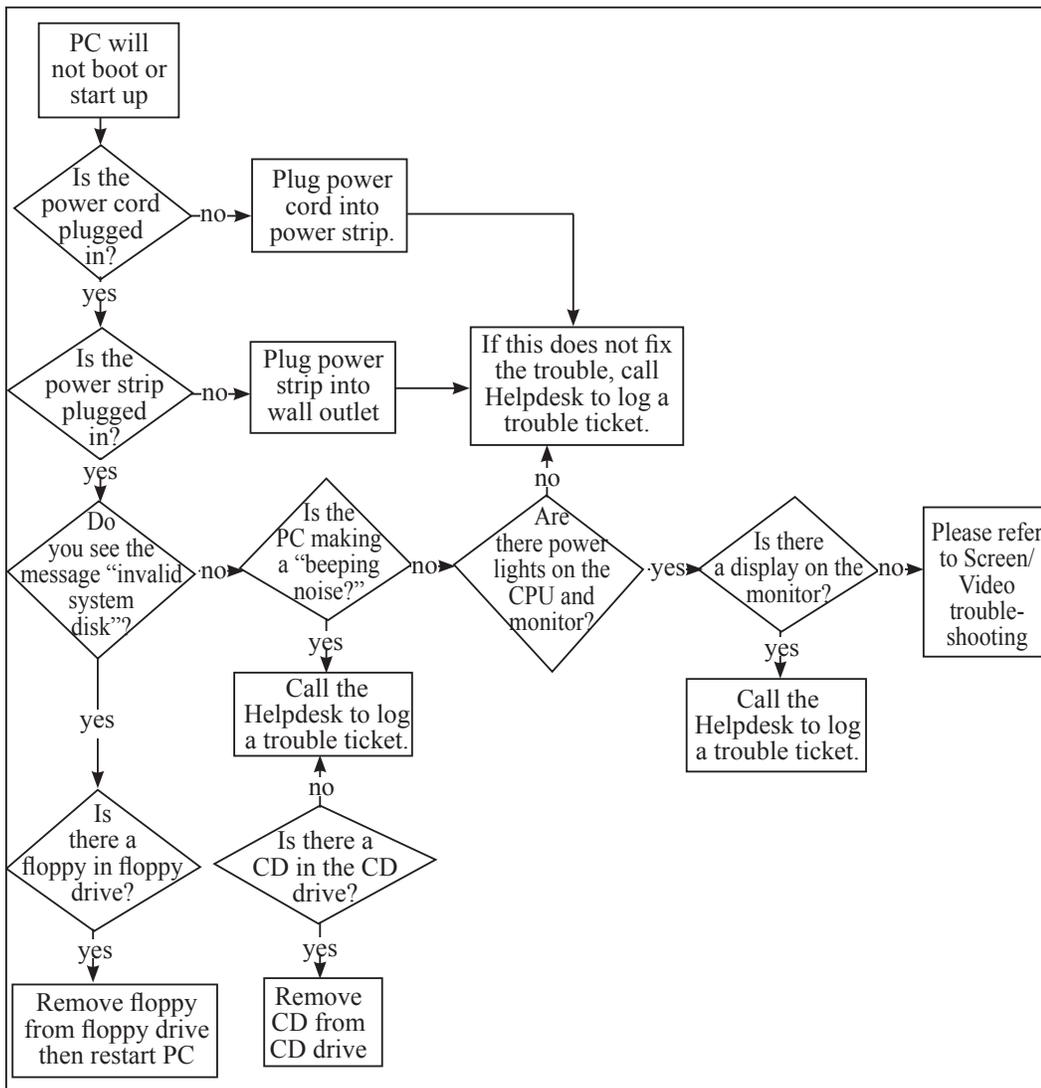
Startup Troubleshooting

If your computer is making noise or attempting to start up, but there is no video or no display on the monitor.

Symptom

No power lights on the monitor/computer.

Diagnosis



NOTES

Check Your Progress

Fill in the blanks:

1. The is used to type text and numbers into a word processor, text editor or other program.
2. If the mouse is acting erratic, then reboot the and see if that corrects the problem.
3. After your printer has completed its initial startup you should have a solid green light. If the light indicator is blinking or orange often this is an indication of a
4. A monitor or is an electronic visual display for computers.
5. In Computer Science, a keyboard is a typewriter keyboard, which uses an arrangement of buttons or keys, to act as mechanical levers or

7.8 HARD DRIVE TROUBLESHOOTING

Symptom

The cursor is stuck on the hourglass.

Diagnosis

Open Task Manager

- Simultaneously press [Ctrl] [Alt] [Delete]. You will see a list of all tasks (programs) currently running. You may notice one program has “Not Responding” instead of “Running” listed next to it. Select this task and click the End Task button.
- Another dialog box will open stating that the program is not responding. Choose End Now to close the program.

Reboot your computer (Warm Boot)

Resetting a computer that is already turned on:

- Press [Ctrl] [Alt] [Delete] once to open the Task Manager.
- Press [Ctrl] [Alt] [Delete] again to restart the computer.

Shut down your computer (Cold Boot)

- Start-up the computer from a powered-down state. If you restart your computer and the problem is not resolved, make an attempt to completely

shut down the computer by pressing the power button. Let it set for 15-30 seconds then restart the computer.

Symptom

You have run out of disk space on your computer. Music files, movies, digital pictures, and other big data files can fill up your hard drive.

Diagnosis

To check for disk space

- Open My Computer. Right click on the C: drive and select Properties from the shortcut menu. A pie chart will appear telling you the used and free space.
- Try running the Disk Cleanup Wizard. This utility can tell you whether you are running out of room and help you clear away some space. Click the Start button and choose Programs | Accessories | System Tools | Disk Cleanup. Choose the disk to clean up (C:) and let the wizard do the work.

NOTES

7.9 SUMMARY

- In Computer Science, a keyboard is a typewriter keyboard, which uses an arrangement of buttons or keys, to act as mechanical levers or electronic switches. As in the case of all mechanical/electronic devices, one should aware of their troubleshooting tips and techniques. We have covered the same for Keyboards. Then we have moved to Printers and there evolution with respect to computer science. We have enlisted various printer interfaces and explained Parallel and USB interfaces in depth. Further, we have elaborated Laser and DeskJet technology and working and in the process to understand Printer technology in detail, puts printer troubleshooting exercises. Finally, we have come to Computer monitor segment and have covered – Cathode Ray Tube, Liquid Crystal Display and Thin film transformers with their workings and suitable working diagrams.

7.10 GLOSSARY

- **Monitor:** A monitor or display (visual display unit) is an electronic visual display for computers
- **Troubleshooting:** It is a form of problem solving, often applied to repair failed products or processes. It is a logical, systematic search for the source of a problem in order to solve it, and make the product or process operational again

7.11 ANSWERS TO CHECK YOUR PROGRESS

1. keyboard
2. computer
3. printer error
4. display (visual display unit)
5. electronic switches

7.12 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What do you mean by troubleshooting?
2. List the steps for troubleshooting keyboard.
3. How to troubleshoot sound in computer system?
4. Explain the troubleshooting of networking.

Long Answer Questions

1. Explain the troubleshooting of Keyboards in detail.
2. With the help of a flow chart discuss the troubleshooting of Keyboards.
3. Discuss the troubleshooting of Printers and Visual display unit?
4. Describe the troubleshooting of Mouse with the diagram.
5. Discuss the troubleshooting steps for a VDU? And up to what extent one layman can troubleshoot the VDU?

7.13 REFERENCES

1. Tripathi Gangwar, *Microprocessor and Its Applications*, Acme Learning
2. Bhuwanesh Jha, *Computer Core Hardware*, Khanna Publications, Nai Sarak, New Delhi
3. Larry L. Wear, James R. Pinkert (Contributor) and William G. Lane (Contributor), *Computers: An Introduction to Hardware and Software Design*, McGraw-Hill Higher Education; February, 1991
4. XP Support – Home Page WinXP © Copyright Kelly Theriot MS-MVP(DTS), 2005

UNIT 8: OPERATING SYSTEM CONCEPTS

Structure

- 8.0 Introduction
- 8.1 Unit Objectives
- 8.2 Defining Operating System
- 8.3 History of Operating Systems
- 8.4 Functions of an Operating System
- 8.5 Structure of Operating System
- 8.6 Network and Distributed Operating Systems
- 8.7 Measuring Performance of a Computer System
- 8.8 Types of Operating Systems
- 8.9 Batch Processing Operating Systems
- 8.10 Summary
- 8.11 Glossary
- 8.12 Terminal and Model Questions
- 8.13 References

NOTES

8.0 INTRODUCTION

An Operating System (OS) to a computer is just like mind to human body. Without thinking and thoughts, a human body will be treated as dead, hence without an operating system, we can state that a computer system is also not operational. An operating system is an integrated set of programs that is used to manage various and overall operations of the computer system. It is designed to support the activities of computer installations. Its prime objective is to improve the performance and efficiency of a computer system and increase facilities. An operating system is responsible for the smoother and efficient operation of the entire computer system. Moreover, it makes the interaction between user and computer easier.

8.1 UNIT OBJECTIVES

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

- Define Operating System
- List the characteristics of Operating System
- Describe functions of Operating System

NOTES

8.2 DEFINING OPERATING SYSTEM

Let us observe some of standard definitions of the operating system:

“An Operating System can be defined as the set of instructions or programs, which make the computer work.”

The above definition gives the basic insight into the functionality of operating system. Let us examine another view about it:

“An Operating System or OS is a software program that enables the computer hardware to communicate and operate with the computer software.”

The above definition emphasizes the role of OS as an Interface between user and computer. Yet, we can have another definition as:

“An Operating System is a software, which controls the computer and its peripherals and makes the computer ready to use by a process called booting.”

As per this definition, OS puts life into the dead hardware.

Thus, an Operating System:

- Is a collection of programs
- Is an intermediary between a user of a computer and the computer hardware
- Makes the hardware usable in an efficient manner
- Makes the computer system convenient to use
- Is the manager of resources

Therefore, an operating system is the most essential software that manages the operation of a computer. The operating system falls under the category of system software. Without an operating system, it is not possible to use the computer. The computer is useless unless it is provided essential software that makes it ready to use. We have seen that an operating system is a software, which makes the computer ready to use by a process called booting. Before discussing more on the operating systems, let us first see what exactly we mean by booting. 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 of operating system from disk to RAM is called booting.

8.3 HISTORY OF OPERATING SYSTEMS

To exactly see what operating systems are and what operating systems do, let us consider how they have developed over the last thirty years. By tracing that evolution you can identify the common elements of operating systems, and see how, and why

they developed as they are now. Operating systems and computer architecture have a great deal of influence on each other. To facilitate the use of the hardware, operating systems were developed. As operating systems were designed and used, it became obvious that changes in the design of the hardware could simplify the operating system. In this short historical review, notice how the introduction of new hardware features is the natural solution to many operating system problems.

Operating systems have been evolving over the years. Let us now take a brief look at this development. Since operating systems have historically been closely tied to the architecture of the computers on which they run, we will look at successive generations of computers to see what their operating systems were like. This mapping of operating systems generations to computer generations is admittedly crude, but it does provide some structure where there would otherwise be none.

Around twenty years ago Jobs and Wozniak, the founders of Apple, came up with the very strange idea of selling information processing machines for use in the home. The business took off, and its founders made a lot of money and received the credit they deserved for being daring visionaries. But around the same time, Bill Gates and Paul Allen came up with an idea even stranger and more fantastical: selling computer *operating systems*. This was much weirder than the idea of Jobs and Wozniak. A computer at least had some sort of physical reality to it. It came in a box, you could open it up and plug it in and watch lights blink. An operating system had no tangible incarnation at all. It arrived on a disk, of course, but the disk was, in effect, nothing more than the box that the OS came in. The product itself was a very long string of ones and zeroes that, when properly installed and coddled, gave you the ability to manipulate *other* very long strings of ones and zeroes. Even then new versions of operating systems are launched almost every month in the market. The market for them is vast enough but people worry about whether it has been monopolized by one company. Even the least technically minded people in our society now have at least a gross idea of what operating systems do; what is more, they have strong opinions about their relative merits.

Every general-purpose computer requires some type of operating system that tells the computer how to operate and how to utilize other software and or hardware that are installed onto the computer. All software programs developed today require some type of an operating system to properly operate. MS-DOS, Unix and Windows are all examples of operating systems.

Because the history of computer operating systems parallels that of computer hardware, it can be generally divided into five distinct time periods, called generations, that are characterized by hardware component technology, software development, and mode of delivery of computer services the user, by hiding the hardware component from the user and thereby helping him to design application programs.

8.4 FUNCTIONS OF AN OPERATING SYSTEM

An operating system provides certain services to programs and to the use of those programs. The specific services provided will, of course, differ from one operating system to another, but there are some common types of function that we can identify. The main functions provided by most operating systems of today are as follows:

Process Management

A *process* is a program in execution. During execution, a process needs certain resources such as CPU time, memory space, files, and I/O devices. At a particular instance of time, a computer system normally consists of a collection of processes. The process management module of an operating system takes care of the creation and deletion of processes, scheduling of various system resources to the different processes requesting them, and providing mechanism for synchronization and communication among processes.

Memory Management

To execute a program, it must be loaded, together with the data it accesses, in the main memory. To improve CPU utilization and to provide better response time to its user, a compute system normally keeps several programs in main memory. The memory management module of an operating system takes care of the allocation and deal location of memory space to the various programs in need of this resource.

File Management

All computer systems are used for storage, retrieval and sharing of information. A computer normally stores such information in units called files. Processes can read information from files and can create new files for storing newly generated information. Information stored in files is made persistent by storing them on a secondary storage media such as a magnetic disk. Files provide a natural and easy means of information sharing. That is, a file can be created by one application and then shared with different applications at a later time. The file management module of an operating system takes care of file-related activities such as organization, storing, retrieval, naming, sharing and protection of files. It allows programs to use a set of operations that allocates and layouts the secondary storage devices.

Device Management

A computer system normally consists of several I/O devices such as terminal, printer, disk, and tape. The device management module of an operating system takes care of controlling all the computer's I/O devices. It keeps track of I/O request from process, issue commands to the I/O devices, and ensures correct data transmission to/from and I/O devices. It also provides an interface between the devices and the rest of the

system that is simple and easy to use. Often, this interface is device independent, i.e., the interface is same for all types of I/O devices.

Security

Computer systems often store large amount of information, some of which is highly sensitive and valuable to their users. Users can trust the system and rely on it only if the various resources and information of a computer system are protected against destruction and unauthorized access. The security module of an operating system ensures this. This module also ensures that when several disjoint processes are being executed simultaneously, one process does not interfere with the others, or with the operating system itself.

Command Interpretation

A user communicates with the operating system, for using the various systems resources, via a set of command provided by the operating system. The operating system also provides a simple language, known as command language (CL) or job control language (JCL), using which a user can put several commands together from the command set to describe the resource requirements of the job. The command interpretation module of an operating system takes care of interpreting user command, supplied individually or in the form of command language, and directing the system resources to handle the request. With this mode of interaction with system, the user is usually not too concerned with the hardware details of the system, or with how the operating system will direct the hardware to handle certain request.

In addition to the above listed major functions, operating system performs few other functions such as keeping an account of which users (or processes) use how much and what kinds of computer resources, maintenance of log of system usage by all users, and maintenance of internal time clock.

8.5 STRUCTURE OF OPERATING SYSTEM

An operating system is basically designed in layered fashion. Or, in other words we can state that most modern operating systems organize their components into a number of layers (levels), each built on top of lower layers. The bottom layer (layer 0) is the hardware, and the highest layer (layer n) is the user interface. The number of in-between layers and their contents varies from one operating system to another. How this is decided is explained below.

The main advantage of the layered approach is modularity. The layers are selected such that each layer uses the functions and services provided by its immediate lower layer. This approach greatly simplifies the design and implementation of the system because each layer is implemented using only those operations provided by its immediate lower level layer.

NOTES

Kernel

The kernel of an operating system is its central controlling part that implements the most primitive of the system's functions. It is the only part of an operating system that a user cannot replace or modify. The precise interpretation of the system's functions that are a part of the kernel vary from one operating system to another. However, typical operating system kernels contain basic functions that are required for process management, memory management, device management, and low-level security features like access control. In some systems, the kernel is larger and provides for more than these functions, whereas in others, it is smaller.

Monolithic Kernel and Micro Kernel

The two commonly used models for kernel design in operating systems are monolithic kernel and micro kernel. In the monolithic kernel model, most operating system services such as process management, memory management, device management, the kernel provides file management, and security. As a result, the kernel has a large, monolithic structure.

On the other hand, in the micro kernel model, the main goal is to keep the kernel as small as possible. Therefore, in this model, the kernel is a very small nucleus of software that provides only the minimal facilities necessary for implementing additional operating system services. The only services provided by the kernel in this model are low-level device management, a limited amount of low-level process management, and some memory management. All other operating system services, such as file management, additional process and memory management activities, and security are implemented as user-level server process. Each server process has its own address space and can be programmed separately.

Resident and Non-Resident Operating System Modules

With all the functionalities of an operating system implemented, it becomes a large software. Obviously, all the functionalities of an operating system are not needed all the time. As the main memory capacity of a system is limited, it is customary to always keep in the system's memory only a very small part of the operating system and to keep its remaining part in the on-line storage device such as hard disk. Those modules of an operating system that are always kept in the system's main memory are called resident modules and those that are kept on hard disk are called non-resident modules. The non-resident modules are loaded into the memory on demand, that is, as and when they are needed for execution. The system kernel should not be confused with the resident modules of the operating system. The two are not necessarily the same. In fact, for most operating systems they are different. The following two criteria normally determine whether a particular operating system module should be resident: Its frequent use, and whether the system can operate at all without it.

For example, file directories can be maintained on disk and loaded into the memory when required. Status information for inactive processes can similarly be swapped out on disk. In fact, the resident part of an operating system is a subset of its kernel.

Command Interpretation

The command interpretation module (known as command interpreter) of an operating system serves as an interface for the user to communicate with the computer via its operating system. It provides a set of commands using which the user can give instructions to the computer for getting some job done by it. The commands supported by the command interpretation module are known as system calls. When a user gives instructions to the computer by using these system calls, the command interpreter takes care of interpreting these commands and directing the system resources to handle the requests. Thus the command interpreter hides the hardware details of the system from the user. In this manner, it greatly contributes to the ‘ease of use’ objective of an operating system. The two broad categories of user interfaces supported by various operating systems are command-line interface and graphical user interface. They are briefly described below.

Command-Line Interface

This is the textual user interface in which the user gives instruction to the computer by typing command. That is, to enter a command, the user uses the keyboard to type words and symbols. For example, in Unix, the user has to type “delreport.txt” to delete the file named report.txt. If the user types a command incorrectly, the command interpreter will respond with a message indicating that it did not understand the command. When this happens the user has to just retype the command correctly. There is no problem in typing simple commands as illustrated in the example above. However, users often need to give detailed instructions to the computer about their jobs when they submit them for execution. For example, while submitting a job for execution, a user may need to supply the following information:

- His/her identification for security and accounting purpose.
- The software and hardware resource requirements of the job.
- The I/O device requirements of the job.
- The directories in which the data files to be used by the job are stored.
- The action, which the system should take in exceptional conditions, such as when the input data is missing or incorrect, or when an I/O device malfunctions.

To facilitate this, the system, which supports command-line interface, also supports some type of command language (CL) or job-control language (JCL). Users can write codes in the JCL to give instructions to the systems. These coded statements tell the operating system such things as the name of the job, the user’s name and

NOTES

account number, the I/O devices to use during processing, the compiler to use if language translation is needed, where to find the data files, and so on. The command interpreter is designed to interpret the codes written in JCL and invoke appropriate system actions.

Graphical User Interface (GUI)

User interface plays an important role in ease of use. The more intuitive the user interface of a system is, the easier it is to use. An intuitive user interface allows a user to use the system effectively even if he/she has never seen it before. That is, how the user interface works is very obvious to any user. Such a user interface is called user friendly. Graphical User Interface (GUI) is a user-friendly interface that is much easier to learn and use than a command-line interface. Unlike command-line interface in which commands are textual, GUI commands are graphical (pictorial). A GUI provides to the user a screen full of graphic icons (small images on the screen) or menus and allows the user to make a rapid selection from the displayed icons or menus to give instructions to the computer. A point-and-draw device is normally used to point rapidly and select a particular graphic icon or menu item from the multiple options displayed on the screen. For example, we saw that in a system that uses command-line interface, to delete a file named report.txt we need to type a command like “delreport.txt.” However, in a system that uses GUI, simply using a mouse to drag the icon that represents the file until it is superimposed on an icon shaped like a trashcan performs the same operation. Then releasing the mouse button that was used for dragging the file, causes the file to disappear into the bulging trashcan.

Shell

The command interpreter of an operating system that serves as its user interface is often referred to as the shell because it forms the outer layer of an operating system covering the other modules of the operating system. The shell can be a command-line interface or GUI. It is also possible to have many different shells for the same operating system. For example, an operating system can have a command-line shell as well as a GUI shell allowing the users to switch from one shell to another. Beginners often find it convenient to work with GUI shell, whereas advanced users find it more convenient to work with command-line shell. Some operating systems also support multiple command-line shells. It is like supporting multiple JCLs and allowing the user to use a language that he/she is most comfortable with. For example, many Unix operating systems support three command-line shells known as C shell, Bourne shell and Korn shell. Real-time Operating Systems: for many applications, successful processing means that the application produces correct results when its processing is completed. However, in real life, we often come across situation in which it is not only sufficient to obtain correct results, but the results must be produced within some specified time frame (deadline) to be useful.

Some of the examples of such application are:

- An aircraft must process accelerometer data within a certain period (say every 20 milliseconds) that depends on the specifications of the aircraft. Failure to do so could cause the aircraft to stray from its right course or may even cause it to crash.
- Failure to respond in time to an error condition in a nuclear reactor thermal power plant could result in a meltdown.
- Failure to respond in time to an error condition in the assembly line of an automated factory could result in several product units that will have to be ultimately discarded.
- A request for booking a ticket in a computerized railway reservation system must be processed within the passenger's perception of a reasonable time (say 3 minutes).

Systems that are designed for processing such application are called real-time systems. That is, a real-time system is a system that must satisfy the requirement of producing the desired results before a certain deadline. If it delivers the correct result, but after the deadline, the system is regarded as having failed. Thus, timely production of the result of processing is as important as its correctness in real-time systems. Operating systems that are designed to handle the processing requirements of real-time systems are called real-time operating systems. The goals of CPU scheduling in traditional timesharing computer system are optimal throughout, optimal resource utilization, and fairness. In contrast, the main goal of CPU scheduling in real-time systems is to allow as many time-critical processes as possible to be processed in time to meet their deadlines.

8.6 NETWORK AND DISTRIBUTED OPERATING SYSTEMS

Over the past few decades, advancements in microelectronic technology have resulted in the availability of fast, inexpensive computers, and advancements in communication technology have resulted in the availability of cost-effective and highly efficient computer networks. The net result of the advancements in these two technologies is that the price-performance ratio has now changed to favour the use of interconnected multiple computers in place of the single, high-speed computer. Computer systems consisting of interconnected multiple computers are called distributed computing systems. That is, a distributed computing system is a collection of computer systems interconnected by a communication network in which each computer has its own local memory and other peripheral devices, and the communication between any two computers of the system takes place by passing message over the communication network. The operating system, commonly used

for distributed computing systems can be broadly classified into two types – network operating systems and distributed operating systems.

The three most important features commonly used to differentiate between these two types of operating systems are system image, autonomy, and fault tolerance capability.

These features are explained below:

System Image

The most important feature used to differentiate between the two types of operating system is the image of the distributed computing system from the point of view of its users. In case of a network operating system, the users view the distributed computing system as a collection of distinct machines connected by a communication subsystem. That is, the users are aware of the fact that multiple computers are being used. On the other hand, a distributed operating system hides the multiple computers are being used. On the other hand, a distributed operating system hides the existence of multiple computers and provides a single-system image to its users. That is, it makes a collection of networked machines appear to its user as a virtual uniprocessor by providing similar type of user interface as provided by centralized operating systems.

Autonomy

In a network operating system, each computer of the distributed computing system has its own local operating system (the operating system of different computers may be the same or different), and there is essentially no coordination at all among the computers except for the rule that when two processes of different computers communicate with each other, they must use a mutually agreed on communication protocol. Each computer functions independently of other computers in the sense that each one makes independent decisions about the creation and termination of their own processes and management of local resources. Notice that due to the possibility of difference in local operating system, the system calls for different computers of the same distributed computing system may be different in this case. On the other hand, with a distributed operating system, there is a single system-wide operating system and each computer of the distributed computing system runs a part of this global operating system. The distributed operating system tightly interweaves all the computers of the distributed computing system in the sense that they work in close cooperation with each other for the efficient and effective utilization of the various resources of the system. That is, processes and several resources are managed globally (some resources are managed locally). Moreover, there is a single set of globally valid system calls available on all computers of the distributed computing system.

Fault Tolerance Capability

A network operating system provides little or no fault tolerance capability in the sense that if 10% of the machines of the entire distributed computing system are down at any moment, at least 10% of the users are unable to continue with their work. On

the other hand, with a distributed computing system. Therefore, the fault tolerance capability of a distributed operating system is usually very high as compared to that of a network operating system.

NOTES

8.7 MEASURING PERFORMANCE OF A COMPUTER SYSTEM

The efficiency of an operating system and the overall performance of a computer system is usually measured in terms of the following:

Throughput

Throughput is the amount of work that the system is able to do per unit time. It is measured as the number of process that are completed by the system per unit time. For example, if n processes are completed in an interval of t seconds, the throughput is taken as n/t processes per second during that interval. Throughput is normally measured in processes/hour. Note that the value of throughput does not depend only on the capability of a system, but also on the nature of jobs being processed by the system. For long processes, throughput may be one process/hour; and for short processed, throughput may be 100 processes/hour.

Turnaround Time

From the point of view of an individual user, an..... important criterion is how long it takes the system to complete a job submitted by him/her. Turnaround time is the interval from the time of submission of a job to the system for processing to the time of completion of the job. Although higher throughput is desirable from the point of view of overall system performance, individual users are more interested in better turnaround time for their jobs.

Response Time

Turnaround time is usually not a suitable measure for an interactive system, because in an interactive system a process can produce some output fairly early during its execution and can continue executing, while previous results are being output to the user. Thus another measure used in case of interactive systems is response time, which is the interval from the time of submission of a job to the system for processing to the time the first response for the job is produced by the system. In any computer system, it is desirable to maximize throughput and to minimize turnaround time and response.

8.8 TYPES OF OPERATING SYSTEMS

As computers have progressed and developed so have the types of operating systems. Many types of operating systems are available for computers, which can be divided into the following major categories:

Single-user Operating Systems

These operating systems are used for mainly computers having only one terminal (stand-alone PCs). MS-DOS (Microsoft-Disk Operating System) and PC DOS (Personal Computer Disk Operating System) are the two important single user operating systems. Both systems are almost identical and are simply called DOS. OS/2 and Windows NT are other popular single-user multi-tasking operating systems for microcomputers.

Microsoft DOS: MS-DOS, developed by 'Microsoft Inc.' in 1981, is the most widely used operating system of IBM compatible microcomputers. The latest version identification number of a release of software) of MS DOS is 7.

PC DOS: PC DOS is essentially the same operating system as MS-DOS, but developed and supplied by IBM for its personal computers.

Multi-user Operating Systems

These operating systems are used for those computers (micro to mainframe), which have many terminals (multi-user systems). The popular operating systems used for multi-user systems are Windows 2000, Windows XP Professional, UNIX, NETWARE, MVS, OS/400, VMS and Linux. Multiuser operating systems are used on networks of computers and allow many different users to access the same data and application programs on the same network. It also allows users to communicate with each other. There are many different types of Network Operating System, each one suited to a different multi-user. This allows multiple users to utilize the computer and run programs at the same time. Operating systems that would fall into this category are:

Unix: AT&T at Bell Laboratories initially developed UNIX in 1969. Unix is a highly successful operating system for multi-user systems. Actually, it is more popular among scientific and engineering users rather than business users. In 1980, Microsoft developed its own version of UNIX for 286s and higher PCs, which is called XENIX. UNIX System V Release 4 is the latest version of UNIX.

NetWare: NetWare is a group of network operating system developed by Novell, Inc., that provides multi-user capabilities.

MVS (Multiple Virtual Storage): MVS is one of the most complex multi-user operating systems ever developed for IBM mainframes. In MVS, each job (timesharing user or batch program) is assigned its own virtual storage space.

OS/400: OS/400 is the IBM's operating system for its AS/400 computer.

VMS (Virtual Memory Storage): VMS operating system is used on DEC's VAX series of minicomputers.

Linux: Linux is a 32-bit UNIX-like operating system that has been developed recently for microcomputers. It is the world's first free operating system developed and maintained by thousands of people worldwide.

Further, modern computer operating systems may also be classified into three other groups, which are distinguished by the nature of interaction that takes place between the computer user and his or her program during its processing. The three groups are called batch, time-sharing and real time operating systems.

8.9 BATCH PROCESSING OPERATING SYSTEMS

Earlier, some computer systems were capable of doing only one thing at a time. They had a list of instructions to carry out – and these would be carried out, one after the other. These systems where things are done in a series is called serial system. At times, when there was a lot of work to be done, these works were pooled and the collections of these instructions would be given to the computer to work on overnight. Since the computer was working on batches of instructions, this type of operating system was called Batch. Processing Operating System. Batch-processing operating systems are good at churning through large numbers of repetitive jobs on large computers. Jobs like: printing of invitations for AGM, consolidation of marks and presenting result, working out the pay of each employee in a large firm; or processing all the questionnaire forms in a large survey.

In a batch processing operating system environment, users submit jobs to a central place where these jobs are collected into a batch, and subsequently placed on an input queue at the computer where they will run. In this case, the user has no interaction with the job during its processing, and the computer's response time is the turnaround time—the time from submission of the job until execution is complete, and the results are ready for return to the person who submitted the job.

Time Sharing Operating Systems

In this environment, a computer provides computing services to several or many users concurrently on-line. Here, the various users are sharing the central processor, the memory, and other resources of the computer system in a manner facilitated, controlled, and monitored by the operating system. The user, in this environment, has nearly full interaction with the program during its execution, and the computer's response time may be expected to be no more than a few seconds.

Multitasking Operating Systems

Multitasking operating systems are now very common. They enable the computer to run more than one piece of software at the same time. It is quite common to sit at your computer and have a word-processor open and running, as well as an Internet browser, and an audio CD player all at the same time. The operating system allows you to switch between the applications and even transfer data between them (for example, it helps you to copy a picture from an Internet site shown on your browser application and paste it into your DTP application).

NOTES

Operating systems that allow multiple software processes to be run at the same time are called multitasking operating systems. Operating systems that would fall into this category are:

- Windows 2000
- Windows XP Professional
- Linux

Multitasking operating systems allow a user to do more than one thing at the same time.

Real Time Operating Systems

Real Time Operating Systems are designed to service those applications where response time is of the essence in order to prevent error, misrepresentation or even disaster. Examples of real time operating systems are those, which handle airlines reservations, machine tool control, and monitoring of a nuclear power station. The systems, in this case, are designed to be interrupted by an external signal that requires the immediate attention of the computer system.

In fact, many computer operating systems are hybrids, providing for more than one of these types of computing service simultaneously. It is especially common to have a background batch system running in conjunction with one of the other two on the same computer.

Multiprogramming Operating System

A multiprogramming operating system is a system that allows more than one active user program (or part of user program) to be stored in main memory simultaneously. Thus, it is evident that a time-sharing system is a multiprogramming system, but note that a multiprogramming system is not necessarily a time-sharing system. A batch or real time operating system could, and indeed usually does, have more than one active user program simultaneously in main storage. Another important, and all too similar, term is 'multiprocessing'.

Multiprocessing Operating Systems

A multiprocessing system is a computer hardware configuration that includes more than one independent processing unit. The term 'multiprocessing' is generally used to refer to large computer hardware complexes found in major scientific or commercial applications.

This is an operating system that allows multiple processors to be utilized. Operating systems that would fall into this category are:

- Windows 2000
- Windows XP Professional
- Linux

A networked computing system is a collection of physically interconnected computers. The operating system of each of the interconnected computers must contain, in addition to its own stand-alone functionality, provisions for handing communication and transfer of program and data among the other computers with which it is connected. 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 uniprocessor 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; all that should be handled automatically and efficiently by the operating system.

Network operating systems are not fundamentally different from single processor operating systems. They obviously need a network interface controller and some low-level software to drive it, as well as programs to achieve remote login and remote files access, but these additions do not change the essential structure of the operating systems.

True distributed operating systems require more than just adding a little code to a uni-processor operating system, because distributed and centralized 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 optimize the amount of parallelism achieved.

Multithreading Operating Systems

Operating systems that allow different parts of a software program to run concurrently. Operating systems that would fall into this category are:

- Windows 2000
- Windows XP Professional
- Linux
- Unix

CUI vs GUI

Now we know that an operating system is that important system software which helps in running the computer system. It is an integrated set of specialized programs. The hardware cannot work without the operating system. In fact, an operating system

NOTES

provides an interface between the hardware and the user. It acts as a translator that conveys information between you and your computer system. An operating system performs all the functions of storage management and I/O (Input/Output) device management. The user is saved the effort and time of knowing hardware just because of the presence of an operating system.

Now let us look at more technical aspects of operating systems, i.e., Command User Interface and Graphical User Interface.

Command-Line User Interface (CUI)

By CUI, one means Command-Line User Interface. It actually means that the operating system provides command-line interface to the user. Command-Line is a prompt where the user types in the command instead of using the mouse to perform a command. A command-line operating system only uses a keyboard to navigate and does not utilize a mouse. Because command-line operating systems require commands to be used, these type of operating systems are much more difficult to learn for new users and can take time. However, a command line operating system can be a very valuable resource and should not be ignored. For example, users who have Microsoft Windows may find trivial tasks such as renaming 100+ files in a folder a very difficult task, however this is something that can be done in a matter of seconds through a command line. The examples of CUI are MS-DOS and Unix. We will discuss these two operating systems in detail in the following chapters.

Graphical User Interface (GUI)

Both DOS and Unix are command-line operating systems. The greatest disadvantage of CUI is that one has to remember a list of tedious commands to perform any operation and mouse cannot be used. Another is the GUI. GUI stands for Graphical User Interface. It is based on graphics (icons, pictures and menus) instead of text; and uses a mouse as well as a keyboard as an input device. Today's major operating systems provide a graphical user interface. Applications typically use the elements of the GUI that come with the operating system and add their own graphical user interface elements and ideas. A GUI sometimes uses one or more images for objects familiar in real life, such as the desktop, the view through a window, or the physical layout in a building.

Elements of a GUI include things such as: windows, pull-down menus, buttons, scroll bars, iconic images, wizards, the mouse, and no doubt many things that have not been invented yet. With the increasing use of multimedia as part of the GUI, sound, voice, motion video, and virtual reality interfaces seem likely to become part of the GUI for many applications. A system's graphical user interface along with its input devices is sometimes referred to as its "look-and-feel." The GUI familiar to most of us today in either the Mac or the Windows operating systems and their applications originated at the Xerox Palo Alto Research Laboratory in the late 1970s. Apple used it in their first Macintosh computers. Later, Microsoft used many of the same ideas in their first version of the Windows operating system for IBM-compatible PCs.

Check Your Progress

State whether the following statements are True or False:

1. Response time is the time taken in an interactive program from the issuance of a command to the commence of a response to that command.
2. Turnaround time is the time required for a particular process to complete, from submission time to completion. (Wall clock time.)
3. The memory manager in an OS coordinates the memories by tracking which one is available, which is to be allocated or deal located and how to swap between main memory and secondary memories.
4. Operating System is a set of computer program that manages the hardware and software resources of a computer.
5. In a multiprogramming environment, OS decides which process gets the processor when and how much time. This function is called process scheduling.

NOTES

8.10 SUMMARY

- Operating system (OS) is a program or set of programs, which acts as an interface between a user of the computer & the computer hardware. The main purpose of an OS is to provide an environment in which we can execute programs. The main goals of the OS are (i) To make the computer system convenient to use, (ii) To make the use of computer hardware in efficient way. Operating System is a system software, which may be viewed as collection of software consisting of procedures for operating the computer and providing an environment for execution of programs. It is an interface between user and computer. So an OS makes everything in the computer to work together smoothly and efficiently.

8.11 GLOSSARY

- **Memory Management:** The memory manager in an OS coordinates the memories by tracking which one is available, which is to be allocated or deal located and how to swap between main memory and secondary memories.
- **Operating System:** (An operating system (OS) is a set of computer program that manages the hardware and software resources of a computer.
- **Processor Management:** In a multiprogramming environment, OS decides which process gets the processor when and how much time. This function is called process scheduling.
- **CPU Utilization:** Ideally the CPU would be busy 100% of the time, so as to waste 0 CPU cycles. On a real system CPU usage should range from 40% (lightly loaded) to 90% (heavily loaded.)

NOTES

- **Throughput:** Number of processes completed per unit time. May range from 10 / second to 1 / hour depending on the specific processes.
- **Turnaround Time:** Time required for a particular process to complete, from submission time to completion. (Wall clock time.)
- **Waiting Time:** How much time processes spend in the ready queue waiting their turn to get into the CPU.
- **Load average:** The average number of processes sitting in the ready queue waiting their turn to get into the CPU.
- **Response Time:** The time taken in an interactive program from the issuance of a command to the *commence* of a response to that command.

8.12 ANSWERS TO CHECK YOUR PROGRESS

1. True
2. True
3. True
4. True
5. False

8.13 TERMINAL AND MODEL QUESTIONS

1. What is an operating system?
2. What are the needs and functions of an operating system?
3. What are the different types of operating systems?
4. Explain the differences between CUI and GUI.
5. Discuss a case where CUI can be preferred to GUI.
6. Discuss the elements of a GUI.

8.14 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouerson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
8. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

UNIT 9: SOFTWARE – LANGUAGES AND PACKAGES

NOTES

Structure

- 9.0 Introduction
- 9.1 Unit Objectives
- 9.2 Computer Software Concept
 - 9.2.1 System Software
 - 9.2.2 Application Software
- 9.3 Software Packages
- 9.4 Word Processor
- 9.5 Database Management Packages
- 9.6 Summary
- 9.7 Glossary
- 9.8 Answers to Check Your Progress
- 9.9 Terminal and Model Questions
- 9.10 References

9.0 INTRODUCTION

In this unit, we are discussing all the important software concepts and providing you the latest knowledge of all the software available in the market. Many types of software are available for various applications. The software development field is so advanced that day by day existing types software are becoming outdated and new types are coming in the market. So we must get aware of the latest developments in the software industry.

Here, we will discuss software packages which are required for general and special purpose.

9.1 UNIT OBJECTIVES

After going through this unit, you will be able to know about:

- Software packages
- Word processor
- Database management package

9.2 COMPUTER SOFTWARE CONCEPT

NOTES

Computer software consists of sets of instructions that mould the raw arithmetic and logical capabilities of the hardware units to perform.

In order to communicate with each other, we use natural languages like Hindi, English, Bengali, Tamil, Marathi, Gujarati, etc. In the same way programming languages of one type or another are used in order to communicate instructions and commands to a computer for solving problems. Learning a programming language requires learning the symbols, words and rules of the language.

Program and Programming: A computer can neither think nor make any judgement on its own. Also it is impossible for any computer to independently analyze a given data and follow its own method of solution. It needs a program to tell it what to do. A program is a set of instructions that are arranged in a sequence that guides the computer to solve a problem.

The process of writing a program is called Programming. Programming is a critical step in data processing. If the system is not correctly programmed, it delivers information results that cannot be used. There are two ways in which we can acquire a program. One is to purchase an existing program, which is normally referred to as packaged software and the other is to prepare a new program from scratch in which case it is called customized software.

A computer software can be broadly classified into two categories-System Software and Application Software.

Today, there are many languages available for developing programs software. These languages are designed keeping in mind some specific areas of applications. Thus, some of the languages may be good for writing system programs/software while some other for application software. Since a computer can be used for writing various types of application/system software, there are different programming languages to perform some specific function for the organization. For example, a payroll system to compute the salaries of the employees of an organization is termed as application software.

1. **System Programming Languages:** System programs are designed to make the computer easier to use:

An example of system software is an operating system, which consists of many other programs for controlling input/output devices, memory, processor, etc. To write an operating system, the programmer needs instruction to control the computer's circuitry (hardware part). For example, instructions that move data from one location of storage to a register of the processor. C and C++ languages are widely used to develop system software.

2. **Application Programming Language:** Application programs are designed for specific applications, such as payroll processing, inventory control, etc. To write

programs for payroll processing or other applications, the programmer does not need to control the basic circuitry of a computer. Instead, the programmer needs instructions that make it easy to input data, produce output, do calculations and store and retrieve data.

NOTES

Programming languages that are suitable for such application programs support these instructions but not necessarily the types of instructions needed for development of system programs.

There are two main categories of application programs: business programs and scientific application programs. Most programming languages are designed to be good for one category of applications but not necessarily for the other, although there are some general purpose languages that support both types. Business applications are characterized by processing of large inputs and large outputs, high volume data storage and retrieval but call for simple calculations. Languages, which are suitable for business program, development, must support high volume input, output and storage but do not need to support complex calculations. On the other hand, programming languages that are designed for writing scientific programs contain very powerful instructions for calculations but rather poor instructions for input, output etc. Amongst traditionally used programming languages, COBOL (Commercial Business Oriented Programming Language) is more suitable for business applications whereas FORTRAN (Formula Translation - Language) is more suitable for scientific applications. Before we discuss more about languages let us briefly look at the categories of software, viz., system and application software.

9.2.1 System Software

Language Translator

A language translator is a system software which translates a computer program written by a user into a machine understandable form.

Operating System

An operating system (OS) is the most important system software and is a must to operate a computer system. An operating system manages a computer's resources very effectively, takes care of scheduling multiple jobs for execution and manages the flow of data and instructions between the input/output units and the main memory. Advances in the field of computer hardware have also helped in the development of more efficient operating systems.

Utilities

Utility programs are those which are very often requested by many application programs. A few examples are: SORT/MERGE utilities, which are used for sorting large volumes of data and merging them into a single sorted list, formatting, etc.

9.2.2 Application Software

Application software is written to enable the computer to solve a specific data processing task. A number of powerful application software packages, which does not require significant programming knowledge, have been developed.

These are easy to learn and use as compared to the programming languages. Although these packages can perform many general and special functions, there are applications where these packages are not found adequate. In such cases, application program is written to meet the exact requirements. A user application program may be written using one of these packages or a programming language. The most important categories of software packages available are:

- Database Management Software
- Spreadsheet Software
- Word Processing Desktop Publishing (DTP) and presentation Software Graphics Software
- Data Communication Software
- Statistical and Operational Research Software.

9.3 SOFTWARE PACKAGES

A software package is an assemblage of files and information.

Database Management Software

Databases are very useful in creation maintaining query, the databases and generation of reports. Many of today's Database Management System are Relational Database Management System's. Many RDBMS packages provide smart assistants for creation of simple databases for invoices, orders and contact lists. Many database management systems are available in the market these days. You can select any one based on your needs, for example, if you have only few databases then package like dBase, FoxPro, etc., may be good. If you require some additional features and moderate work load then Lotus Approach, Microsoft Access are all-right. However, if you are having high end database requirements which require multi-user environment and data security, access right, very good user interface, etc., then you must go for professional RDBMS package like Ingress, Oracle, and Integra, etc.

Accounting Package

The accounting packages are one of the most important packages for an office. Some of the features, which you may be looking on an accounting, may be:

- tax planner facility
- facility for producing charts and graphs
- finding accounts payable

- simple inventory control facility
- payroll functions
- on-line connection to stock quotes
- creation of invoices easily

NOTES

Communication Package

The communication software includes software for fax. The fax-software market is growing up. Important fax software is Delrina's WinFax PRO 4.0. Some of the features such as Remote Retrieval and Fax Mailbox should be looked into fax software. These features ensure that irrespective of your location you will receive the fax message.

Another important feature is fax Broadcast. This allows you to send out huge numbers of faxes without tying up your fax machine all day.

If you have to transfer files from your notebook computer to a desktop computer constantly, then you need a software program that coordinates and updates documents. One such software is Laplink for Windows. This software offers very convenient to use features. For example, by simply dragging and dropping a file enables file transfer. This software can work if a serial cable or a Novell network or a modem connects you.

Desktop Publishing Packages

Desktop Publishing Packages are very popular in the Indian context. Newer publishing packages also provide certain in-built formats such as brochures, newsletters, flyers, etc., which can be used directly. Already created text can be very easily put in these packages, so are the graphics placements. Many DTP packages for English and languages other than English are available. Microsoft Publisher, PageMaker, Corel Ventura are few popular names. Desktop publishing packages, in general, are better equipped in Apple-Macintosh computers.

Information Providers

One of the very interesting information providers which will become popular in India also is Automap road atlas by Microsoft. This package may provide city-to-city driving instructions and maps. You may also get the best route, calculate the time it will take. Many information providers are the Internet access programs. Today, the Internet access packages come as a part of operating system, however, many other packages can be used for accessing information on the World Wide Web. One very simple to use popular tool of browsing Internet is Netscape Navigator.

Organisers, Contact Managers, PIMs

Some of the tasks of an office manager can be:

NOTES

- to be able to track contacts
- to balance schedules
- to manage projects
- to prioritize tasks

These things can be easily done using organizers programs, which have a phone book model for maintaining lists of contacts. They also have a calendar for entering appointments and to-dos. Some of these packages are Okna's DeskTop Set for Windows, Lotus organizer, Microsoft Outlook, etc.

If you are interested in knowing more, than only names and addresses about your contacts such as details like the industry they are working with, the products they are manufacturing, their business with you last year, when did you last spoke to them, etc., then you must look to contact management software. One such software is "Symantec Act! for Windows".

If you want to go even further then you can look for a personal information manager (PIM). PIM is a tool that stores virtually any information such as reference materials, project details, etc. The PIM document contains outlines, folders and links. Most of the data in the PIMs is presented as an outline, for example, the clients may represent the top level, the date of an appointment with him at the next level, and the details of the meeting indented further below. This item can be linked to any other, allowing data to be entered only once and linked up to all other appropriate places.

Suites

Suites are a set of packages sold as a group package mainly for the business user. The suite package includes programs for Word-processing, Electronic Spreadsheet, Databases, and Presentation Graphics software and may be a mail software.

For example, Microsoft Office Professional for Windows includes programs as Microsoft Word, Microsoft, Excel and Microsoft Access, and a license for Microsoft Mail, etc. The word-processing, spreadsheet, and presentation-graphics software interfaces in a suite are well-integrated allowing easy data transfer among these applications. Today there is a growing family of Office-compatible products, which will be included in suites.

In the fast developing software era the list discussed above cannot be complete. Please refer to latest PC journals for most recent software trends.

9.4 WORD PROCESSOR

Word processing includes typing in text and manipulating it so as to give a very systematic and organized look to your document, which enables easy reading. The application software or program which helps us in processing the text is called 'Word Processing Software', or simply 'Word Processor'. So, you can say that a word processor is nothing but a computer program that helps you to:

- type your text
- correct spelling mistakes and grammatical errors
- align text within margins
- offer a variety of font styles and font sizes
- see a preview of the text that you have typed in.

NOTES

Popular Word Processing Packages

The commonly used word processing packages are:

- MS-WORD
- Word Star
- Word Perfect
- Professional Write

Uses of Word Processing

Normally, a word processor can accomplish the following tasks:

- Brochures
- Newsletters
- Reports
- Advertisement
- Resumes and Cover letters
- Books
- Directories
- World Wide Web Pages

There is absolutely no end to what a word processor can do. By now you must have realized that the word processing applications have become much more sophisticated than before.

9.5 DATABASE MANAGEMENT PACKAGES

Business processes are always associated with a huge amount of data. To store, manipulate and processes such data, some software packages are needed, which are collectively known as Database Management Packages/Software/Systems (DBMS). DBMS is defined as a software that organizes and maintains the data in a database for providing the information.

Microsoft Access is a Windows based Relational Database Management System (RDBMS). It has received huge acceptance by users because of its versatility and easy to use interface. MS-Access is best suited for maintaining any type of information.

NOTES

It can keep huge records of data ranging from keeping an address book to inventory details. Access finds its immense usage in registering telephone numbers, expense details, store or warehouse information. Whatever data is entered, it can be viewed from different angles using forms. Data can also be sieved and extracted based on certain conditions using queries. Reports help in analyzing the data and help you to come at certain meaningful inferences. The very frequently used operations can be automated by creating and saving macros.

What is a Database

A database is a collection of related information. An example of a typical database is a private telephone directory. It contains related information about each person like his name, address and telephone number. Other examples of a database include list of customers and suppliers, maintenance of stock in warehouses, collection of tapes in libraries, maintenance of members in a country club, etc.

Components of a Database

All the information stored in an Access database is kept in tables as illustrated in Table 9.1.

Table: A table is a collection of some specific kind of data. It is the basic element of the database. Data put in a table is organized in rows and columns.

Record: Each row is called ‘record’ and it contains the complete information about one particular item, e.g., in a telephone directory all the essential details about a single person like his name, address and city form one record.

Column: Each column is called ‘field’. It holds information about a certain type for all records. A field could be a name, address, telephone number, etc.

Table 9.1: An Example of a Typical Table

<i>S. No.</i>	<i>Name</i>	<i>Address</i>		<i>City</i>
1.	Manoj Banal	160, A-2, Sector-3, Rohini	Delhi	5418765
2.	Shaveta Verma	GP-42, Vasant Enclave	Delhi	7117653
3.	Dinesh Kumar	K-4, Adhyapak Nagar	Delhi	5165433
4.	Monika Bansal	F-179, Moti Nagar	Delhi	5418776
5.	Vicky Mehta	WZ-143/4C New Mahavir Nagar	Delhi	5153148

In the example shown in Table 9.1, the table contains five records and five fields. Thus, each record contains a complete and wholesome information about one item. Each column contains the same type of information for all the records like S.No.,

Name, Address, etc. The field 'Name' contains the information related to 'Name' for all records. So, you can have any number of records as well as fields in your table. You can add more records to your table. In the similar manner, you can also expand the field list. Your database can have any number of tables. The 'Relational' concept allows to build relations between different tables.

NOTES

Check Your Progress

Fill in the blanks:

1. An operating system (OS) is the most important and is a must to operate a computer system.
2. A is a system software which translates a computer program written by a user into a machine understandable form.
3. consists of sets of instructions that mould the raw arithmetic and logical capabilities of the hardware units to perform.
4. System software consists of all the programs, languages and documentation supplied by the manufacturer of the
5. programs are developed by the user in order to perform some specific function for the organization.
6. may be considered as application software or system software which is very often used in the development of a program.

9.6 SUMMARY

- An operating system is an integrated set of specialized programs that is used to control and manage the resources and overall operation of a computer system.
- MS-windows is a GUI based operating system. In windows operating system, multiple applications can be simultaneously run in different windows. In MS-windows, the screen upon which icons, windows, etc., are displayed is known as desktop.
- A database refers to the collection of interrelated data and database management systems (DBMS) is a computer program that manages a database effectively and efficiently.

9.7 GLOSSARY

- **Operating System:** An operating system is an integrated set of specialized programs that is used to control and manage the resources and overall operation of a computer system.
- **System Software:** This consists of all the programs, languages and documentations supplied by the manufacturer of the computer.
- **Application Software:** These programs are developed by the user in order to perform some specific function for the organization.
- **Utility Software:** Utility software may be considered as application software or system software which is very often used in the development of a program.

9.8 ANSWERS TO CHECK YOUR PROGRESS

1. System software
2. Language translator
3. Computer software
4. Computer
5. Application software
6. Utility software

9.9 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is an operating system?
2. What is system software?
3. Define application software.
4. What do you understand by utility software?
5. What do you mean by Software Packages?

Long Answer Questions

1. What do you mean by operating system?
2. Define software packages. Explain different software packages in detail.
3. Discuss Word processor in detail.

4. Describe the Database management package.
5. Describe computer software concept.

9.10 REFERENCES

1. Sanjeev Gupta and Shameena Gupta, *Computer Aided Management (Using MS-Office 2003 Tools)*, Excel Books
2. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien
3. Joseph W. Habraken, *Microsoft Office 2003 All-In-One*, Que Publishing
4. Jennifer Ackerman Kettell, Guy Hart-Davis and Curt Simmons, *Microsoft Office 2003: The Complete Reference*, McGraw-Hill Professional
5. Laurie Ann Ulrich, *How to Do Everything with Microsoft Office 2003*, McGraw-Hill Professional

UNIT 10: DATA FILE

NOTES

Structure

- 10.0 Introduction
- 10.1 Unit Objectives
- 10.2 Various Types of files
 - 10.2.1 Data Structure
 - 10.2.2 Data Hierarchy
 - 10.2.3 Format of a Record
- 10.3 File Organization and Design
- 10.4 Master File
- 10.5 Transaction File
- 10.6 Designing Reports
- 10.7 Relevance of Database Management Systems
- 10.8 Integration of Application
- 10.9 Introduction to a Micro Database Manager
- 10.10 Summary
- 10.11 Glossary
- 10.12 Answers to Check Your Progress
- 10.13 Terminal and Model Questions
- 10.14 References

10.0 INTRODUCTION

Files and database have become an essential component of everyday life in modern society. In the course of a day, most of us encounter several activities that involve some interaction with a database, like in banks to deposit and withdraw funds; if we make a hotel or airline reservation; if we access computerized library catalog; or if we order a magazine subscription from a publisher, chances are that our activities will involve someone accessing a database.

To understand the basics of database, we must start with files and its various types and organization which together form the database.

10.1 UNIT OBJECTIVES

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

- Various types of files

- Various file organizations
- Master and transaction file
- File design
- Designing and generating reports
- Relevance of database management system

NOTES

10.2 VARIOUS TYPES OF FILES

Depending upon the type of content, a file can be categorized as:

1. Data file
2. Program file
3. Object code file
4. Executable file
5. Text file (unformatted file)
6. Formatted file

Data Files

1. A data file is used to store the data records. These data files are well defined data structures that contain related data organized in convenient groupings (records) of data items.
2. Each data file has two additional types of records: Header record, and trailer record.
3. Header records contain file identification information and keep apart different groups of records in a file.
4. Trailer records contain codes to mark the end of a set of data records. These also record file usage information.

Categories of Data Files

Depending upon the nature of data, data files can be categorized as:

1. Master file
2. Transaction file
3. Work file
4. Audit file
5. Backup file

File Organization

Data in files can be organized in different ways. These data records can be organized in anyone of the following ways:

1. Serial
2. Sequential
3. Indexed Sequential
4. Directly Accessible/Random

Program Files

Program files are used to store programs in different languages provided by different software vendors. These files have different extensions depending on the language used to write a program.

E.g.: 1. A program file written in 'C' language has extension. C.

2. A program file written in C++ language has extension. CPP.

Object Code Files

These files store compiled programs written in a language. They contain the machine code.

E.g.: After compilation, C compiler creates a file having extension.OBJ

Executable Files

These files store ready to execute programs. They may have extension.EXE.COM or .BAT. These programs can be directly executed from the command prompt.

Unformatted Text Files

- These files are simple files containing simple text.
- Text files can be created using any text editor or line editor.

E.g.: Text files can be created using MS-DOS Edit editor or Notepad editor provided by MS-Windows.

Formatted Text Files

These files contain formatted text. These also contain some commands and symbols to format the text. These files can be created using any word processor.

E.g.:MS-WORD creates a formatted text file having extension. DOC.

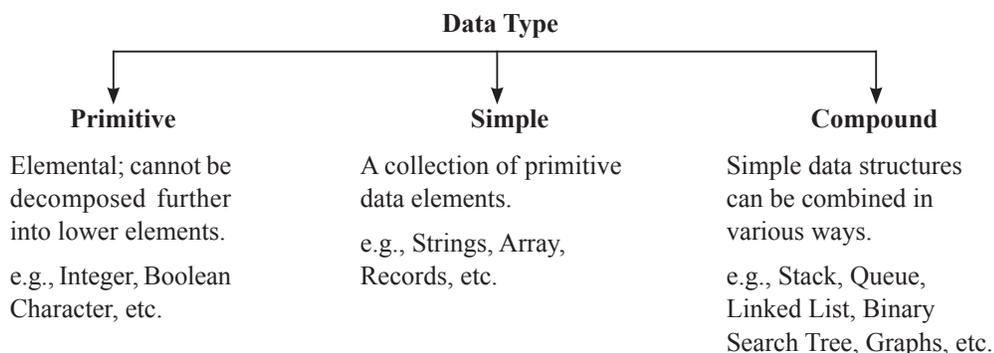
10.2.1 Data Structure

Data may be organized in various ways; the logical or mathematical model of a particular situation using data is called a 'data structure'.

A data structure is a class of data that can be characterized by its organization and the operations that are defined on it.

Data structures are also called abstract data types.

NOTES



Data Type

<i>Primitive</i>	<i>Simple</i>	<i>Compound</i>
Elemental; cannot be decomposed further into lower elements.	A collection of primitive data elements.	Simple data structures can be combined in various ways.
e.g., Integer, Boolean Character, etc.	e.g., Strings, Array, Records, etc.	e.g., Stack, Queue, Linked List, Binary Search Tree, Graphs, etc.

10.2.2 Data Hierarchy

Listed below are the components of the data hierarchy in the ascending order of complexity:



This is called ‘data hierarchy’ because databases are composed of files, files are composed of records, and so on.

Bit

The term ‘bit’ is short for binary digit. It can assume either of the two states, representing numeric value 0 or 1.

NOTES

Byte

In a computer system, basic unit of information is called 'byte'. A byte of information is generally stored by using 8 bits in a specified combination.

Field or Item

A field or item of data is one or more bytes that contain data about attributes of an entity.

Record

A record is a collection of fields relating to a specific entity.

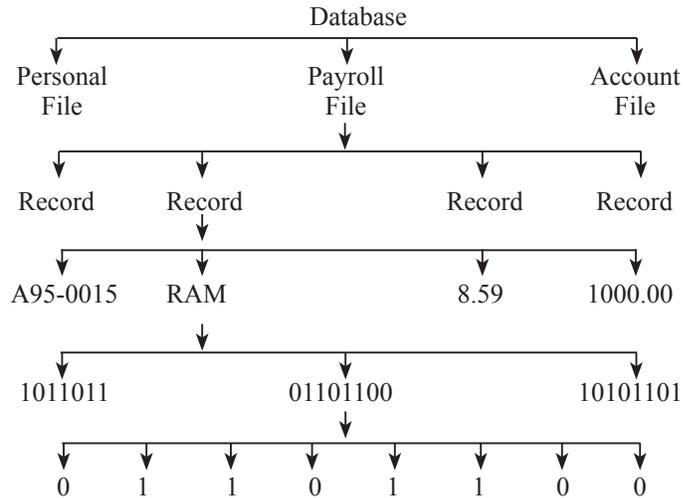
File

A file is a collection of related records.

The concept of a computer file is very similar to the manual file in a filing cabinet.

Database

A database consists of all the files of an organization, structured and integrated to facilitate updation of files and retrieval of information from them.



10.2.3 Format of a Record

1. Fixed length record format
2. Variable length record format

Fixed Length

- Fixed length record format contains the records of the same length (fixed format). So the information does not expand with time or use.

- For this type of format, record is designed by specifying a fixed number of storage positions.

e.g.: Product record

Variable Length

- Variable length record format may contain the records of different lengths. So the information may vary with time and use.
- It is a record in which the data is allowed to occupy only the spaces which it needs.

e.g.: Wage history record

Record Layout

- Arrangement of data fields in a record.
- Normally contains two types of data fields:
 - Key field
 - Non-key field

Key field is a field which contains a unique identifier for the entity about which data is being stored in the record.

Non-key fields store values of various attributes of the entity identified by the key field value.

Data Codes

Data about entities can be recorded in two formats.

1. Clear form
2. Coded form

Using clear or natural format, attributes of the entity are described or narrated using normal language.

Many attributes can be described more concisely and uniquely using different types of codes.

e.g.: Suppose an item is made of steel and one of the attributes of the item being recorded is material.

In the clear format value of attributes material will be recorded as “Steel”.

In the coded format, suppose steel is assigned material code “1”. Then the value of attribute material in the data record will be recorded as “1”.

Coding can be done in different ways as described below.

NOTES

NOTES

Alphabetic Codes

Alphabetic codes contain alphabetic characters. These codes are easily rememberable and their meanings often seem obvious.

e.g.: Code “M” is used for male.

Code “F” is used for female.

Numeric Code

Numeric code contains digits and are widely used primarily for their convenience of showing the classification of hierarchy or related data items.

e.g.: Pincode used in postal service.

Alphanumeric Code

Alphanumeric code contains both numeric and alphabetic characters. Alphanumeric codes allow a large number of codes using fewer positions.

e.g.: Vehicle licence number.

10.3 FILE ORGANIZATION AND DESIGN

File organization refers to the relationship to the key to the record to the physical location of that record in the computer file.

The two main objectives of computer based file organization are:

- ease of file creation and maintenance, and
- providing an efficient means of storing and retrieving information.

The four file organization methods that are commonly used in business data processing applications are:

1. Serial
2. Sequential
3. Direct or Random
4. Indexed Sequential

The selection of a particular file organization depends upon factors like, the type of application, the method of processing for updating files, size of file, etc.

Serial File Organization

In serial file organization records are stored without any consideration of their order or sequence.

Records have to be accessed in the serial fashion only.

Examples are: memory dumps, archival files, records of events, transaction files.

Each record is written after the last record in the current file. The order of records in the serial file is according to the time when the data was generated.

Sequential File Organization

In a sequential file, records are arranged in the ascending or descending order or chronological order of a key field.

To access these records, the computer must read the file in a sequence from the beginning.

The retrieval search ends only when the desired key matches with the key field or the currently read record.

On an average, about half the file has to be searched to retrieve the desired record from a sequential file.

Sequentially organized files are normally created and maintained on storage media such as magnetic tape, cartridge tape, magnetic disks, etc.

Advantages

1. Easy to organize, maintain, and understand.
2. There is no overhead in address generation locating a particular record requiring only the specification of the key field.
3. Relatively inexpensive I/O media and devices can be used.
4. It is the most economical and efficient file organization where the *activity ratio* (the ratio of the total number of records in transaction file and the total number of records in master file) is very high. That is why this file organization is most suitable for transaction files.

Disadvantages

1. It proves to be very inefficient and uneconomical for applications in which the activity ratio is very low.
2. Since an entire sequential file may need be read to retrieve and update few records, accumulation of transactions into batches is required.
3. Transactions must be stored and placed in sequence prior to processing.
4. Timeliness of data in the file deteriorates while batches are being accumulated.
5. Data redundancy is typically high since the same data maybe stored in several files, sequenced on different keys.
6. Random enquiries are virtually impossible to handle.

Applications

- Payroll system
- Billing and customer statement preparation
- Bank cheque processing
- Financial accounting

Direct or Random File Organization

A direct file (also referred to as a relative or random organization) consists of records organized in such a way that it is possible for the computer to directly locate the desired record without having to search through any other records first.

A record is stored by its key field.

For mapping the key fields to the locations, an arithmetic procedure called hashing algorithm is frequently used.

This address generating function is selected in such a manner that the generated addresses should be distributed uniformly over the entire range of the file area and a unique address must be generated for each record key.

A Direct Access Storage Device (DASD) such as drum, disk, etc., are essential for storing a direct file.

Advantages

1. The access to and retrieval of a record is quick and direct (within a fraction of a second).
2. Transactions need not be sorted and placed in sequence prior to processing.
3. Accumulation of transactions into batches is not required before processing them. They may be processed as and when generated.
4. It can also provide up-to-the minute information in response to enquiries from simultaneously usable on-line stations.
5. If required, it is also possible to process direct file records sequentially in a record key sequence.
6. A direct file organization is most suitable for interactive on-line applications.

Disadvantages

1. These files must be stored on a direct access storage device. Hence, relatively expensive hardware and software resources are required.
2. File updation (addition and deletion of records) is more difficult as compared to sequential files.
3. Address generation overhead is involved for accessing each record due to hashing function.

4. May be less efficient in the use of storage space than sequentially organized file.
5. Special security measures are necessary for on-line direct files that are accessible from several stations.
6. System design around it, is complex and costly.

NOTES

Applications

A direct file organization is most suitable for interactive on-line applications such as:

1. Airline/Railway reservation systems.
2. Teller facility in banking applications.

Indexed Sequential File Organization

Basic principle “having index (directory)”.

E.g.: A directory (index) in a large multistoried building that helps one to locate a particular person’s room within a building instead of searching door by door.

The contents (which serve as an index) help us to locate (page of the desired topic) so that one can turn directly to that page to begin reading instead of searching each page.

Indexed sequential files use exactly the same principle.

In an indexed sequential file, records are stored sequentially on a direct access device (i.e., magnetic disk) and data is accessible either randomly or sequentially.

The sequential access of data occurs as one record at a time until the desired item of data is found.

The records of the file can be stored in random sequence but the index table is in a sorted sequence on the key value.

This technique is known as Indexed Sequential Access Method (ISAM).

Advantages

1. Permits the efficient and economical use of sequential processing techniques when the activity ratio is high.
2. Permits direct access processing of records in a relatively efficient way when the activity ratio is low.

Disadvantages

1. These files must be stored on a direct access storage device. Hence, relatively expensive hardware and software resources are required.
2. Less efficient in the use of storage space than some other alternatives.

Applications

This file organization is a compromise approach that combines some of the advantages of both sequential and direct approaches, and therefore used in almost all the applications, like Material A/C, Banking Industry, etc.

10.4 MASTER FILE

Master files are files of a fairly permanent nature, e.g., inventory, payroll, etc. They include some information which is of a permanent nature and also data which is continuously updated by recent transactions.

E.g.: The master file could contain records having the following fields:

Emp No. Emp Name Emp Address Date of Joining

These attributes about an employee change less frequently.

Updation of Master File

The normal means of updating a master file is by:

1. Addition of data/records
2. Deletion of data/records
3. Amending of data/values

Types of Master Files

1. Static master files (or reference files)
 - (i) Permanent or semi-permanent nature.
 - (ii) Example of some business entities are products, suppliers, customers, employees, etc.
 - (iii) These are subject to occasional revision.
2. Dynamic master files (or table files)
 - (i) Transitory nature
 - (ii) Examples of some business entities are customer orders, works orders, price lists, etc.

10.5 TRANSACTION FILE

Transaction files are files in which the data relating to business events is recorded, prior to a further stage of processing and are created from source documents used for recording events or transactions.

E.g.: Customer's orders for product
 Purchase orders, job cards, invoice, despatch notes, etc.

A transaction file is a temporary file containing all relevant data about all transactions of one type.

- E.g.: Daily sale transaction file
 Daily stores issue file

A transaction file normally has two purposes:

1. To accumulate data about relevant events as they occur.
2. To update master files to reflect the results of most recent transactions.

NOTES

Check Your Progress

Fill in the blanks:

1. A is used to store the data records.
2. Data in files can be organized,, or
3. is the most economical and efficient file organization.
4. A is essential for storing a direct file.
5. System design around random file organization is and
6. are files of a fairly permanent nature.
7. Commercial outputs need output called

10.6 DESIGNING REPORTS

Systems analysts specify reports when they need a record of data or a report of information, or circulate a large volume of information to several persons simultaneously.

Only those reports whose printing is absolutely necessary should be printed. One well designed report may sometimes replace several poorly designed ones. Providing unnecessary details assists no one, so analysts should be alert to avoid producing extraneous data.

Printed Reports

Printed reports vary in size, although analysts often use these standard sizes:

- 9 1/2 by 11 inches
- 11 by 14.7/8 inches
- 8 by 14.7/8 inches

These sizes are for continuous forms (sometimes called pin-fed or fan-fold forms)—connected sheets of papers that feed into the printer one after the other.

NOTES

All the features of printed output are available in microfilm and microfiche, the two film output methods. Film output reduces output cost by approximately one-third. After developing in the microfiche machine, film can be stored and retrieved when needed. For reference data used only sporadically, such as private saving account balance that changes infrequently and can have interest pasted every three months, microfilm could be a useful output option.

A page of output takes so little space when stored on microfilm. One square inch of a film can store as much information as several pages of paper report. A 3.5 inch card stores the equivalent of hundreds of pages.

The time taken to locate the film reel or card containing the information wanted the user must maintain an index and to load the film into a microfilm or microfiche reader for viewing is a real disadvantage.

Special Forms

Reports could be printed on a simple paper. But usually, when an organization sends a report to its customer, the logo and the name of the organization are also printed on it. Sometimes, the report is printed on a paper which is “pre-printed”. Recall your high school marksheets. The name of the board, the year and the logo of the board as well as the name of examination passed were printed on the paper. The marks, name, school name, date of birth, etc., were printed afterwards. Another example is your electricity bill. The titles of various labels are preprinted. The values against them are printed by the information system.

Layout of a Printed Report

An output layout is the arrangement of items on the output medium. When analysts design an output layout, they build a mock up of the actual report or document as it will appear after the system is in operation. The layout should show the location and position of the following:

- All variable information
 - Item details
 - Summaries and totals
 - Control breaks
 - Separators
- All preprinted details
 - Headings
 - Document names and titles
 - Corporate name and address
 - Instructions
 - Notes and comments

As we discussed earlier, the layout is a blueprint that will guide the construction of programs later in the development process. Each variable in the layout must be accounted for in programs instructions.

Guidelines for Designing Printed Report

- Reports and documents have to be designed to be read from left to right and from top to bottom.
- The most important items should be easiest to find.

Warehouse Stock Information Report

Parameter:

Warehouse = Distribution Center

Product	UOM	On Hand Qty.	Quantity Allocated	Qty. Available	Consumed Past 7 Days	Consumed Past 30 Days	Days Cover
Azalea Bush	Each	2	2	0	8.0	8.0	7.5
Gardenia	Each	1,017	1	1,016	36.0	36.0	847.5
Hibiscus	Each	108	5	101	2.0	2.0	1,620.0
Hosta Fujibotan	Each	100	1	97	0.0	0.0	99,999.0
Lotus	Each	102	11	90	8.0	8.0	382.5
Plum Tree	Each	0	0	0	0.0	0.0	99,999.0
Rose Bush	Each	5	0	5	0.0	0.0	99,999.0

Fig. 10.1: Sample of Report Layout

- All pages should have a title and page number and show the date on which the output was produced.
- All columns must be labelled.
- Abbreviations must be avoided.

Some organizations specify standards that guide design practices in addition to the above guidelines. A sample report format is shown in Figure 10.1.

Report Generation

Commercial outputs need formatted output. These formatted outputs are known as reports. A formatted report may have the following:

1. Report heading
2. Page heading
3. Page numbering
4. Footers
5. Some remarks
6. Date, month, and year of printing

NOTES

NOTES

Commercial outputs may also extend over multiple pages. In that case, one will have to keep a provision in ones program so that certain details get printed on every page. E.g.: One may have to print page headings on every page.

Report maybe of:

1. Single page
2. Multiple page

Languages provide different picture templates for these purposes.

Multiple Page Report

Multiple page reports in general may consist of following parts:

1. Report heading
2. Report sub heading
3. Page heading
4. Page footer
5. Report detail

Report Heading

It represents the title of the report and appears, only on the first page of the report.

Report Sub Heading

It is printed as and when required on each page.

Page Heading

It is printed on the top of each page.

Page Footer

It is printed at the bottom of each page. It is generally the total number of records on the page, sum of the numeric data, etc.

Report Detail

This constitutes the main body of report. The output details or the information of the main consequence is listed in this group.

Reports with Control Break

The most important objective of a program is reporting. We need summarized information for decision making. For presenting the summarized information one can use the concept of control break.

In control break report, one needs group information based on some common criterion.

Example:

Indian Office Automation Products New Delhi			
Date:		Page No.:	
Region Wise Sales Report			
Salesman Name	Region of Sales	Product	Sales
Rishabh Surya	Mumbai Mumbai	Fax	60,000
		Telex	50,000
Sales of Mumbai Region:			1,10,000
Atul Raghav	Delhi Delhi	PC	45,000
		Telex	50,000
Sales of Delhi Region:			95,000

NOTES

Fig. 10.2

In this report control break is on the region.

Analysis of report shows the following points:

1. Records of a particular region are grouped together and printed at one place.
2. When the control break occurs, certain procedures are followed. Such as total sales of that region.
3. It may be necessary that performance of each region is printed on each page, i.e., when the control break occurs the report is printed on a fresh page.
4. At the end of the report, it may be necessary to calculate and print the grand totals.

Label Generation

Creating labels means to generate address slip in computer. Creating mailing labels is a two-step process:

1. Designing Label Form
2. Production of Labels

Designing Label Form

In this step, we design labels. We select the label layout and then place the fields, text and pictures and other objects on it. After designing label, don't forget to save it.

Production of Labels

When you have designed the label form you want, you can print the labels at any time. At this time, label is ready to use.

10.7 RELEVANCE OF DATABASE MANAGEMENT SYSTEMS

NOTES

Database Management System (DBMS) is very important for an organization. One of the main advantages of using a database system is that the organization can exert, via the DBA, centralized management and control over the data. The database administrator is the focus of the centralized control. Following are the important features of DBMS:

1. **Reduction of Redundancies:** DBA avoids unnecessary duplication of data and effectively reduces the total amount of data storage required. It also eliminates the extra processing necessary to trace the required data in a large mass of data. Another advantage of avoiding duplication is the elimination of the inconsistencies that tend to be present in redundant data files. Any redundancies that exist in the DBMS are controlled and the system ensures that these multiple copies are consistent.
2. **Shared Data:** A database allows the share of data under its control by any number of application programs or users.
3. **Integrity:** Data integrity means that the data contained in the database is both accurate and consistent. Therefore, data values being entered for storage could be checked to ensure that they fall within a specified range and are of the correct format. Centralized control can also ensure that adequate checks are incorporated in the DBMS to provide data integrity.
4. **Security:** Data is of vital importance to an organization and maybe confidential. Such confidential data must be accessed by the authorized persons only. The DBA who has the ultimate responsibility for the data in the DBMS can ensure that proper access procedures are followed, including proper authentication schemes for access to the DBMS and additional checks before permitting access to sensitive data. Different levels of security could be implemented for various types of data and operations.
5. **Conflict Resolution:** Since the database is under the control of the DBA, therefore, he should resolve the conflicting requirements of various users and applications. In short, DBA chooses the best file structure and access method to get optimal performance for the response critical applications, while permitting less critical applications to continue to use the database, albeit with a relatively slow response.
6. **Data Independence:** Data independence is usually considered from two points of view—physical data independence and logical data independence. Physical data independence allows changes in the physical storage devices or organization of the files to be made without requiring changes in the conceptual view or any of the external views and hence in application programs using the database.

Logical data independence implies that application programs need not be changed if fields are added to an existing records nor do they have to be changed if fields not used by application programs are deleted.

Limitations of DBMS

Despite so many advantages of using a database management system, there are situations where a DBMS may not be feasible to use. This is expected as no system is absolutely perfect. Some of the limitations of DBMS and the possible situations where it may not be suitable to be used are listed below:

1. ***Initial Investment:*** Database systems are generally designed and optimized to cater to the data management needs of large enterprises which call for a large initial investment. If the cost is not justified for a particular situation, it is advisable to look for a cheaper alternative.
2. ***General Purpose:*** DBMS is very general in nature by design because it has to adopt to wide variety of data management situations. Though, it can be configured for a particular application, if the solution is required for a very specific purpose it is better to have a non-DBMS system.
3. ***Overhead:*** Normally a lot of overhead is involved in providing security, concurrency control, recovery, and integrity functions in a DBMS. Many of these features may not be required in a particular situation. In such circumstances DBMS is not a viable proposition. In situations where the database and applications are simple, well defined, and not expected to change much over a large period of time, DBMS is an overkill. Most of the features will not be used or be rarely used. Therefore, DBMS is not a suitable solution.
4. ***Inadequate Responsiveness:*** Real-time systems, where processing time is critical, may not be suitable for DBMS. The time overheads may be unacceptable in such cases.
5. ***Vulnerability to Intrusion:*** Due to the existence remote accessibility and use of public domain transmission lines DBMSs are vulnerable to intentional and/or unintentional intrusion which may compromise with the data security requirements. Despite tight security provisions DBMSs do not offer much to this end. Before the adoption of the DBMS technology the data manager must assess the security, privacy and confidentiality needs.
6. ***Data Quality and Integrity:*** Since DBMS allows multi-user environment there is a fair chance for a malicious user to tamper with the data. Moreover, it is very easy even for authorized users to make modification to the database that violates integrity constraints.

The analysts contemplating switching to DBMS technology for data management therefore are cautioned that DBMS is not a panacea for all the situations.

NOTES

10.8 INTEGRATION OF APPLICATION

NOTES

In a typical business organization several applications work in tandem to realize its business objectives. However, when implemented and managed separately the applications neither achieve a cost effective solution nor they are easily manageable. The application availability and sharing can be greatly enhanced by integrating the existing applications in one single unit. The management control and the security concerns make application integration mandatory. Therefore, these individual applications need to be integrated into not department-wide but enterprise-wide application. Many solutions have come to foray like ERP (Enterprise Resource Planning).

According to a recent survey, a typical global company has 30 to 50 enterprise applications and spends 25 to 40 per cent of its Information Technology (IT) budget on application integration. And integration requirements are intensifying with the current wave of acquisitions and mergers. Custom point-to-point solutions and other e-band-aids can solve pieces of the problem in the short term, but they are typically expensive to produce and difficult to maintain. Application integration aims at creating a cost-effective integration architecture and infrastructure to promote interoperability among applications. And interoperability is the key to agility for the accelerating change that rules today's global marketplace.

Cross-functional business processes through integration enable the open flow of information between systems, across organizations, between enterprises and among trading partners. Several technologies are available to integrate web-based applications, front-and-back-office systems, ERP systems, and package software applications. Some of the most popular application integration solutions are PeopleSoft, Oracle, SAP, and other leading ERP systems, as well as all leading database management systems (DBMSs). A typical application integration looks similar to the one depicted in the figure given below:

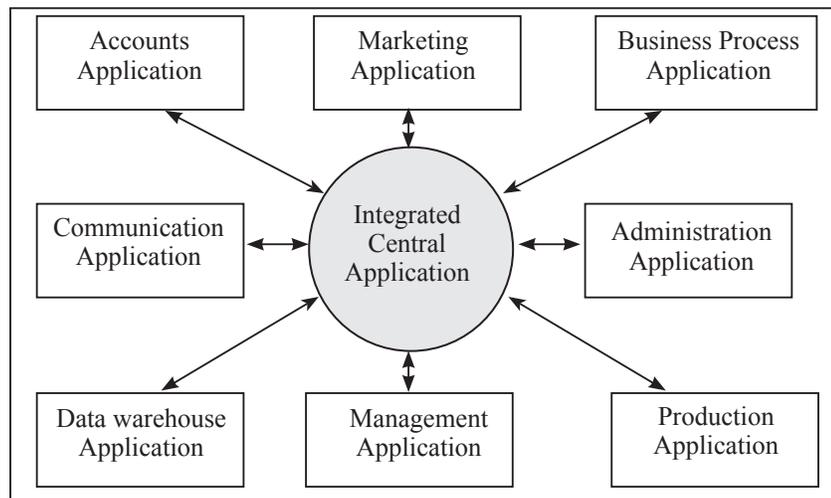


Fig. 10.3

There are several issues related to integration of applications, such as:

1. **Cost:** Cost is by and large the most important issue in application integration. The cost of integration must justify the overall improvement achieved.
2. **Compatibility:** Generally, the applications are developed and implemented in isolation with little or no consideration with other applications. This fact gives rise to compatibility problems among the component applications.
3. **Legacy Applications:** Some applications may exist in the organization which is probably very old (say implemented in very old technology) and yet cannot be thrown off. Such systems are called legacy systems. Integration of these systems sometimes is very challenging.
4. **Migration:** The database and/ or process maybe required to be implemented in new technology from existing old ones. Many a time the source code does exist only in an executable form of the process maybe available. In such cases, reverse engineering exercise maybe needed.
5. **Operational Control:** Once an application is integrated with another one, there is in general a shift in the control from one entity to another. There may also be a sharing of control on the application. Therefore, a redesigning of the control and authority is often required.
6. **Security:** Application integration exposes the system to more security threats than when they are stand-alone. The vulnerability of the system to security threats must be considered very seriously.
7. **User training:** Along with the integration there maybe significant change in the way, users have been interacting with the system hitherto. Therefore, user training in the new environment must also be considered carefully.

10.9 INTRODUCTION TO A MICRO DATABASE MANAGER

The database manager is a program module which provides the interface between the low-level data stored in the database and the application programs and queries submitted to the system. Databases typically require lots of storage space (in gigabytes). This must be stored on disks. Data is moved between disk and main memory as and when needed. The goal of the database system is to simplify and facilitate access to data. The performance in terms of response time, is also very important.

The database manager module is responsible for all these tasks in the following way:

1. **Interface with the file manager:** Database manager interacts with the file manager of the operating system by storing raw data on disk using the file system usually provided by a conventional operating system. The database manager would translate a DML (Data Manipulation Language) statement into sequence of low-level file system commands for storing, retrieving and updating data in the database.

NOTES

2. **Integrity Enforcement:** It enforces integrity by checking that updates in the database do not violate consistency constraints. For example, in a bank database, it is the task of the database manager to see that no bank account balance is below ` 1000 as otherwise it would violate consistency constraint.

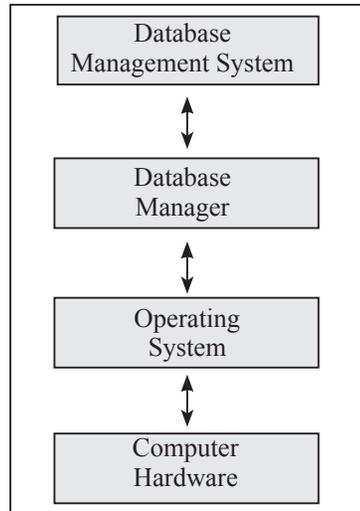


Fig. 10.4

3. **Security Enforcement:** By defining security checks and constraints, the database manager ensures that the database is safe. The database manager is endowed with the power of letting the users use the database and also deny it. It is the sole responsible person to provide access rights to a user like - read only, read-write, etc.
4. **Backup and recovery:** Database is such a valuable asset that the database manager must ensure that it is not damaged or lost. Therefore, it regularly takes backup of the database. In case of any failure it initiates suitable recovery procedure to resurrect the database. It must also do it in the least amount of time.

Check Your Progress

State whether the following statements are True or False:

8. A transaction file is a temporary file containing all relevant data about all transactions of one type.
9. In a serial file, records are stored without any consideration of their order or sequence.
10. A direct file organization is most suitable for airline/railway reservation systems.
11. Reports and documents have to be designed to be read from left to right and from top to bottom.
12. A database does not provide data sharing and data security.

10.10 SUMMARY

- A file is a collection of related records. A file is made up of records, which are made up of fields, which in turn are made up of characters. Fields within logical records are normally called “data items”. A record is recognized or identified by the record KEY.
- Data files can be broadly classified as master files, transaction files, and references files. The physical nature of the storage device will have a direct bearing on the way files are organized on it and also on the method of access. There are three main types of file design: sequential, indexed sequential and direct access. System analysts specify reports when they need a record of data or a report of information. Printed reports vary in sizes. Its all the features are available in microfilm and microfiche.
- The layout is a blueprint that will guide the construction of programmes later in the development process. A formatted report may have Report heading, Page heading, Page numbering, Footers, some remarks, date, month and year of printing.
- In control break report, one needs group information based on some common criteria. DBMS reduces data-redundancy, allows to share data, assures data integrity and security, resolves the conflicts among various users and supports data independence. The database manager module is responsible for managing interface with the file manager, integrity enforcement, security enforcement, backup and recovery of data.

NOTES

10.11 GLOSSARY

- **File:** A collection of related records.
- **Data File:** Well defined data structures that contain related data organized in convenient groupings of records.
- **Program Files:** Files used to store programs.
- **Executable Files:** Files which store ready to execute programs.
- **Direct File:** A file which consists of records that can be directly located without having to search through any other records.
- **Index Sequential Access Method (ISAM):** The technique where the records of the file can be stored in random sequence but the index table is in sorted sequence on the key value.
- **Master Files:** Files which include some information of permanent nature and are updated by recent transactions.

- **Transaction Files:** Files in which the data relating to business events recorded, prior to further stage of processing and are created from source documents used for recording events or transactions.
- **Database Manager:** A program module which provides the interface between the low level data stored in the database and the application programs and queries submitted to the system.

10.12 ANSWERS TO CHECK YOUR PROGRESS

1. Data file
2. serially sequentially, index sequentially, randomly
3. sequential file organization
4. direct access storage device
5. complex, costly
6. Master files
7. formatted, reports.
8. True
9. False
10. True
11. True
12. False

10.13 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What are the various types of files depending on the type of content?
2. What are data files? What are its various categories?
3. What is a program file?
4. Which files are said to be executable files?
5. What is the difference between unformatted and formatted text files?
6. What do you mean by file organization?
7. What are the various methods of file organization?
8. What is a formatted text file?

Long Answer Questions

1. What is the difference between a data file and an executable file?
2. What is the difference between a program file and an object code file?

3. Describe various types of file organizations.
4. Compare sequential with index sequential file organization.
5. What are the advantages and disadvantages of random file organization?
6. What is a master file? Describe its various types.
7. What is the purpose of having a transaction file?
8. Describe various file design methods.
9. List some applications of sequential file.
10. Why do we require printed report?
11. Describe the layout of a printed report.
12. What should a formatted report contain?
13. Describe the reports with control break.
14. What do you mean by data redundancy and integrity?
15. How does DBMS support security of data?
16. What are the issues related to integration of an application?
17. What are the responsibilities of a database manager module?

10.14 REFERENCES

1. Sanjeev Gupta and Shameena Gupta, *Computer Aided Management (Using MS-Office 2003 Tools)*, Excel Books
2. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien
3. Gio Wiederhold, *File Organization for Database Design*, McGraw-Hill
4. Alan L. Tharp, *File Organization and Processing*, J. Hiley & Sons
5. Yahiko Kambayashi, Sakti P. Ghosh and Jr Witold Lipski, *Data Base File Organization: Theory and Applications*, Academic Press

Information Technology and Management Information System



Block - III Block Title : Software Packages

UTTARAKHAND OPEN UNIVERSITY
SCHOOL OF MANAGEMENT STUDIES AND COMMERCE
University Road, Teenpani By pass, Behind Transport Nagar, Haldwani- 263 139
Phone No: (05946)-261122, 261123, 286055
Toll Free No.: 1800 180 4025
Fax No.: (05946)-264232, e-mail: info@uou.ac.in, som@uou.ac.in
<http://www.uou.ac.in>
www.blogsomcuou.wordpress.com

Board of Studies

Professor Nageshwar Rao
Vice-Chancellor
Uttarakhand Open University
Haldwani

Professor R.C. Mishra (Convener)
Director
School of Management Studies and Commerce
Uttarakhand Open University
Haldwani

Professor Neeti Agarwal
Department of Management Studies
IGNOU
New Delhi

Dr. L.K. Singh
Department of Management Studies
Kumaun University
Bhimtal

Dr. Abhradeep Maiti
Indian Institute of Management
Kashipur

Dr. K.K. Pandey
O.P. Jindal Global University
Sonipat

Dr. Manjari Agarwal
Department of Management Studies
Uttarakhand Open University
Haldwani

Dr. Gagan Singh
Department of Commerce
Uttarakhand Open University
Haldwani

Er. Sumit Prasad
Department of Management Studies
Uttarakhand Open University
Haldwani

Programme Coordinator

Dr. Manjari Agarwal
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Units Written By		Unit No.
<i>Text material developed by</i>	Manish Anand	
<i>Typeset by</i>	Atharav Writer, Delhi	

Editor(s)

Er. Sumit Prasad
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Er. Subodh Prasad
Assistant Professor
Department of Information Technology
College of Technology
G.B. Pant University of Agriculture & Technology
Pantnagar

ISBN : 978-93-85740-12-1
Copyright : Uttarakhand Open University
Edition : 2016 (Restricted Circulation)
Published by : Uttarakhand Open University, Haldwani, Nainital - 263 139
Printed at : Laxmi Publications (P) Ltd., New Delhi
DUO-8153-68.44-INFO TECH MGMT INFO B-III

CONTENTS

Units	Page No.
11. MS Office	188
12. MS Excel	224
13. MS Power Point and MS Access	247
14. Management of Data Processing System in Business Organisations	278

UNIT 11: MS OFFICE

NOTES

Structure

- 11.0 Introduction
- 11.1 Unit Objectives
- 11.2 Introduction to MS Office
- 11.3 Starting MS Word 2010
- 11.4 Creating, Opening, Saving and Closing a Document
- 11.5 Adding Text in a Document
- 11.6 Editing the Text
 - 11.6.1 Cutting, Copying and Pasting Text
 - 11.6.2 Clipboard
 - 11.6.3 Paste Preview
- 11.7 Summary
- 11.8 Glossary
- 11.9 Answers to Check Your Progress
- 11.10 Terminal and Model Questions
- 11.11 References

11.0 INTRODUCTION

There are many software packages to do the job of word processing. Some of them work in DOS environment such as WordStar, Word Perfect, and Professional Write etc. Today, working in Windows has become very popular and MS Word is the most popular word processing software these days, which runs under Windows operating system. This Unit provides an overview of MS Office and MS Word and in the subsequent Units the elements of MS Office are dealt in detail.

11.1 UNIT OBJECTIVES

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

- Discuss the history of MS Word
- Explore the new features of Word 2010s
- Describe how to create, open and save a Word document
- Describe ways of adding and editing text in MS Word 2010

- Use Find and Replace tool in MS Word 2010
- Learn how to adjust character, line and paragraph spacing and alignment
- Discuss the method of inserting bullets and numbers in a Word document
- Describe how to apply text formatting in a Word document
- Discuss steps of applying paragraph formatting
- List the steps of adding and removing Word Art in Word 2010
- Learn how to create and edit hyperlinks in Word 2010
- Understand how to insert special characters and equations in Word 2010

NOTES

11.2 INTRODUCTION TO MS OFFICE

MS Office is the most efficient suite of applications for document creation, communication and business information analysis. For many functions, the business platform has evolved from paper to the Web. Microsoft Office extends desktop productivity to the web, streamlining the way you work and making it easier to share access and analyze information so you get better results. Office offers a multitude of new features. Of particular importance for this release are the features that affect the entire suite. These Office-wide, or shared features hold the key to the new realm of functionality enabled by Office. Office offers a new Web-productivity work style that integrates core productivity tools with the Web to streamline the process of sharing information and working with others. It makes it easier to use an organization's intranet to access vital business information and provides innovative analysis tools that help users make better, timelier business decisions. Office delivers new levels of resiliency and intelligence, enabling users and organizations to get up and run quickly, stay working and achieve great results with fewer resources.

Functions of MS Office

1. ***A Common User Interface:*** While learning one application of the suite you get to learn the operational basics of the other applications while maintaining some uniqueness in the applications. Consistency in MS Office applications is in the form of:
 - (i) Tool Bars
 - (ii) Menus
 - (iii) Dialog Boxes
 - (iv) Customizable features and operational features which are similar too.
2. ***Quick Access:*** The MS-Office provides the Microsoft Office Short-cut Bar which is used for the following:
 - (i) Create a new file based on templates and wizards.

NOTES

- (ii) Open the existing files, the related applications will be launched automatically.
 - (iii) Add tasks, make appointments, record tasks and add contacts and journal entries.
 - (iv) Create a new Outlook Message.
 - (v) Switch between and launch Microsoft Office Applications.
3. ***Date Sharing Across Applications:*** Microsoft Office provides several means of sharing data between applications:
- (i) ***Copying:*** Copies the data from the source application to the target applications using the clipboard.
 - (ii) ***Linking:*** Links the data from the source document to the target document and saves with the source document.
 - (iii) ***Embedding:*** Embeds the data from the source document to the target document and saves with the source document.
- Moreover, Microsoft Office extends the data sharing beyond application integration by providing workgroup integration with the Microsoft Outlook. Users can mail documents, spreadsheets, presentations and data files from within the source applications.
4. ***A Common Language:*** Providing the common language has been a more challenging goal from Microsoft Office. It provides a common macro-programming language for all the applications.

Components of MS Office

The components of MS Office are MS Word, MS Excel, MS PowerPoint and MS Access.

MS Word

MS Word is a powerful word processor that allows you to create Memos, Fax coversheets, Web pages, Reports, Mailing labels, Brochures, Tables and many other professional and business applications. MS Word provides easy graphics handling, calculation of the data tables, ability to create a mailing list, list sorting and efficient file management.

MS Excel

MS Excel is a spreadsheet package. When you start Excel, a blank workbook appears in the document window. The workbook is the main document using excel for storing and manipulating the data. A workbook has individual worksheets each consisting of data. Each worksheet is made up of 256 columns and 65,536 rows.

MS PowerPoint

MS PowerPoint is a powerful presentation software which is used to create professional quality presentations. These can be reproduced on the Transparency, Paper, 35mm slide, Photo print, on screen presentations.

Microsoft Access

MS Access is the relational database application in the Microsoft Office Professional. With Access, you can organize data into manageable related units, Enter, modify and locate data, Extract subsets of data based on the specific criteria, Create custom forms and reports, Automate common database tasks, and Graph data relationships.

11.3 STARTING MS WORD 2010

Assuming you have Microsoft Office 2010 installed in your PC, to start word application, follow the following steps at your PC:

Step (1): Click Start button.

Step (2): Click All Programs option from the menu.

Step (3): Search for Microsoft Office from the sub menu and click it.

Step (4): Search for Microsoft Word 2010 from the submenu and click it.

This will launch Microsoft Word 2010 application.

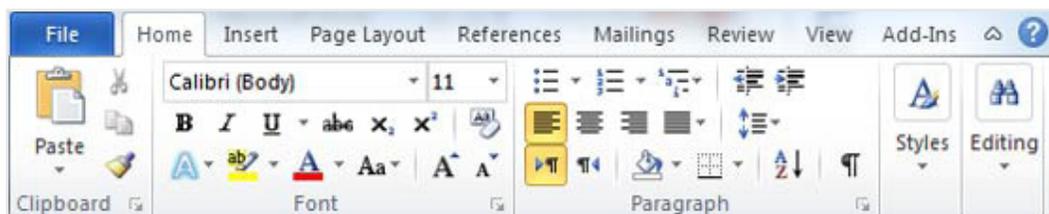
Exploring MS Word 2010 User Interface

Following is the basic window which you get when you start word application. Let us understand various important parts of this window.

File Tab: The File tab replaces the Office button from Word 2007. You can click it to check Backstage view, which is the place to come when you need to open or save files, create new documents, print a document, and do other file-related operations.

Quick Access Toolbar: This you will find just above the File tab and its purpose is to provide a convenient resting place for the Word most frequently used commands. You can customize this toolbar based on your comfort.

Ribbon: Understanding the Ribbon is a great way to help understand the changes between Microsoft 2003 and Microsoft 2010. The ribbon holds all of the information in previous versions of Microsoft Office in a more visual streamline manner through a series of tabs that include an immense variety of program features.



Ribbon contains commands organized in three components:

- **Tabs:** They appear across the top of the Ribbon and contain groups of related commands. Home, Insert, Page Layout are examples of ribbon tabs.
- **Groups:** They organize related commands; each group name appears below the group on the Ribbon. For example, group of commands related to fonts or group of commands related to alignment, etc.
- **Commands:** Commands appear within each group as mentioned above.
- **Minimize, Maximize and Close Button:** Minimize, maximize and close buttons are provided on the upper right corner of the MS Word 2010 window. It is used to minimize, maximize or close the MS Word 2010 window respectively.
- **Contextual Tabs:** Display for a specific purpose. They are used “in context”. For example, a Picture Tools Tab displays when you select a picture. These tabs display on the Ribbon only when particular types of objects are selected or when specific tasks are being performed.
- **Title Bar:** This lies in the middle and at the top of the window. Title bar shows the program and document titles.
- **Rulers:** Word has two rulers – a horizontal ruler and a vertical ruler. The horizontal ruler appears just beneath the Ribbon and is used to set margins and tab stops. The vertical ruler appears on the left edge of the Word window and is used to gauge the vertical position of elements on the page.
- **Help:** The Help Icon can be used to get word related help anytime you like. This provides nice tutorial on various subjects related to word.
- **Zoom Control:** Zoom control lets you zoom in for a closer look at your text. The zoom control consists of a slider that you can slide left or right to zoom in or out, .and + buttons you can click to increase or decrease the zoom factor.
- **View Buttons:** The group of five buttons located to the left of the Zoom control, near the bottom of the screen, lets you switch among Word’s various document views.
- **Print Layout view:** This displays pages exactly as they will appear when printed.
- **Full Screen Reading View:** This gives a full screen look of the document.
- **Web Layout view:** This shows how a document appears when viewed by a Web browser, such as Internet Explorer.
- **Outline view:** This lets you work with outlines established using Word’s standard heading styles.
- **Draft view:** This formats text as it appears on the printed page with a few exceptions. For example, headers and footers aren’t shown. Most people prefer this mode.

- **Document Area:** The area where you type. The flashing vertical bar is called the insertion point and it represents the location where text will appear when you type.
- **Status Bar:** This displays document information as well as the insertion point location. From left to right, this bar contains the total number of pages and words in the document, language, etc. You can configure the status bar by right-clicking anywhere on it and by selecting or deselecting options from the provided list.
- **Dialog Box Launcher:** This appears as very small arrow in the lower-right corner of many groups on the Ribbon. Clicking this button opens a dialog box or task pane that provides more options about the group.

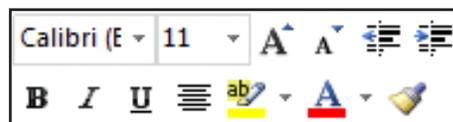
Key Tips

Word 2010 provides shortcuts for the ribbon, called KeyTips, so you can quickly perform tasks without using your mouse.

To make KeyTips appear on the ribbon, press the ALT key. Next, to switch to a tab on the ribbon using your keyboard, press the key of the letter displayed under that tab. In the example shown above, you would press N to open the Insert tab, P to open the Page Layout tab, S to open the References tab, and so on. Once you've switched to a ribbon tab in this way, all available KeyTips for that tab appear on the screen. You can then finish the sequence by pressing the final key for the command you want to use. To go back one level while in a sequence, press the ESC key. Doing so multiple times in a row cancels KeyTips mode.

Mini Toolbar

In Microsoft Word, Excel, PowerPoint and Outlook, the mini toolbar is a smaller version of the full toolbar found near the top of the application window. The mini toolbar appears when you highlight text and either move your mouse cursor over the highlighted text or right-click on the highlighted text.



The mini toolbar features some of the most commonly used text editing functions, which include Font type, Font size, Increase font size, Decrease font size, Increase indent of text, Decrease indent of text, Bold, Italics, Underline, Center text (alignment), Highlight text, Font Color, and Format Painter.

Live Preview

One of the nice features introduced with Office 2007 and 2010 is that of Live Preview. Now with Live Preview you can see the effects of your changes before they happen.

NOTES

- First you will need a document with some text in it.
- Make sure the ‘Home’ tab is open
- Hover your mouse over any one of the styles in the Home tab.
- You should now see what your document would look like if you apply that style, if you move the cursor to another style the preview will change accordingly.

This feature also works with selected text and things like Font types and sizes, simply select any text you want to change and then open the font menu, and hover your mouse to see the effect of any change.

Working with Ribbons

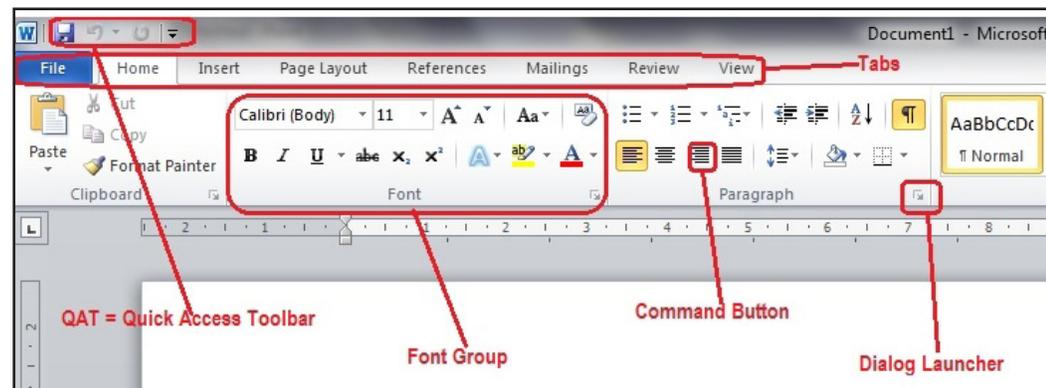
Microsoft Office 2010 displays commands in a series of icons stored on different tabs. This combination of icons and tabs is known as the Ribbon interface, which appears in Word, PowerPoint, Excel, Outlook, and Access. The following tables show you the commands grouped under each ribbon tab for each of the four programs.

Word 2010 Ribbon Tabs		
<i>Ribbon tab name</i>	<i>Command groups</i>	<i>Dialog box shortcut</i>
Home	Clipboard, Font, Paragraph, Styles, and Editing	Ctrl+D (Font) or Alt+Ctrl+Shift+S (Styles)
Insert	Pages, Tables, Illustrations, Links, Header and Footer, Text and Symbols	*
Page Layout	Themes, Page Setup, Page Background, Paragraph and Arrange	*
References	Table of Contents, Footnotes, Citation and Bibliography, Captions, Index and Table of Contents	*
Mailings	Create, Start Mail Merge, Write and Insert Fields, Preview Results and Finish	*
Review	Proofing, Language, Comments, Tracking, Changes, Compare and Project	*
View	Document Views, Show, Zoom, Window and Macros	*

Exploring the Ribbon

The key feature of the Ribbon is that it groups together related commands to make them easier to locate. In this article, we use the Word 2010 Ribbon as an example to show how the Ribbon works and how to change the commands on a Ribbon. However, the same principles that we apply here, also apply to the complete Office 2010 suite.

There are five main components to a Ribbon; QAT (Quick Access Toolbar), tabs, command buttons, groups of command buttons, and dialog launchers.



NOTES

Customizing the Ribbon

The ribbon is designed to help you quickly find the commands that you need to complete a task. Commands are organized in logical groups that are collected together under tabs. Each tab relates to a type of activity, such as writing or laying out a page. To reduce screen clutter, some tabs, known as contextual tabs, are shown only when they are needed. When the ribbon is minimized, you see only the tabs.

To minimize the ribbon, click Minimize the Ribbon. The Minimize the Ribbon button is in the upper-right corner of the program window.

11.4 CREATING, OPENING, SAVING AND CLOSING A DOCUMENT

Creating a New Document

A new, blank document always opens when you start Microsoft Word. Here are the steps to open a new document:

Step (1): Click the File tab and select New option.

Step (2): When you select **New** option from the first column, it will display a list of templates in the second column. Just double click on **Blank document**, which is very first option in the template list. You can use a short cut to open a blank document anytime. Try using **Ctrl + N** keys and you will see a new blank document similar to above window is opened.

Opening Existing Document

There may be a situation when you open an existing document and edit it partially or completely. If you want to open an existing document, follow the following simple options:

NOTES

Step (1): Click the **File tab** and select **Open** option.

Step (2): This will display following file **Open dialog box**, which lets you navigate through different file folders and also lets you select a file which you want to open.

Step (3): Finally locate and select a file which you want to open and click small triangle available on **Open** button to open the file. You will have different options to open the file, but simply use **Open** option.

This will open your selected file. You can use **Open Read-Only** option if you are willing just to read the file and you have no intention to modify, i.e., edit the file. Other options can be used for advanced usage.

Saving a Word Document

Once you are done with typing in your new word document, it is time to save your document to avoid losing work you have done on a Word document. Following are the steps to save an edited word document:

Step (1): Click the **File tab** and select **Save As** option.

Step (2): Select a folder where you would like to save the document, Enter file name which you want to give to your document and Select a Save as type, by default it is **.docx** format.

Step (3): Finally, click on **Save** button and your document will be saved with the entered name in the selected folder.

Saving New Changes

There may be a situation when you open an existing document and edit it partially or completely, or even you would like to save the changes in between editing of the document. If you want to save this document with the same name then you can use either of the following simple options:

- Just press **Ctrl + S** keys to save the changes.
- Optionally you can click on the floppy icon available at the top left corner and just above the **File tab**. This option will also save the changes.
- You can also use third method to save the changes, which is **Save** option available just above the **Save As** option as shown in the above screen capture.

If your document is new and it was never saved so far, then with either of the three options, word would display you a dialogue box to let you select a folder, and enter document name as explained in case of saving the new document.

Closing an Document

When you finish working with a document, you would like to close it. Closing a document removes it from your computer screen and if you had other documents

open, Word displays the last document you used, otherwise you see a blank Word window. Here are simple steps to close an opened document:

Step (1): Click the **File tab** and select **Close** option.

Step (2): When you select **Close** option and if document is not saved before closing, it will display following Warning box asking whether the document should be saved or not.

Step (3): Now its up to you if you want to save the changes, then click **Save**, otherwise click **Don't Save** button. To go back to the document click **Cancel** button.

NOTES

11.5 ADDING TEXT IN A DOCUMENT

Let us see how easy is to enter text in a word document. Hope you are aware that when you start a word, it displays a new document by default. Document area is the area where you type your text. The flashing vertical bar is called the insertion point and it represents the location where text will appear when you type. So just keep your mouse cursor at the text insertion point and start typing whatever text you would like to type. I typed only two words “Hello Word” as shown below. The text appears to the left of the insertion point as you type. There are following two important points which would help you while typing:

- You do not need to press Enter to start a new line, as the insertion point reaches the end of the line, Word automatically starts a new one. You would need to press enter if you want to have a new paragraph.
- When you want to add more than one space between words, use the Tab key instead of the spacebar. This way you can properly align text when you use proportional fonts.

Adding Text by Inserting Text Boxes

You may want to **insert a text box** into your document to draw attention to specific text or have the ability to **easily move text** within a document. Text boxes are basically treated the same as **shapes**, so you can add the same types of effects to them and can even change their shape.

Text boxes are useful for helping to organize your document. They are basically treated the same as **shapes**, so when you **insert a text box** you can **format** it by changing its **fill color**, **outline color**, and **shape style**, as well as create **WordArt** and add **3D effects**.

To insert a text box:

1. Select the **Insert** tab on the Ribbon.
2. Click the **Text Box** command in the **Text** group. A drop-down menu will appear.

NOTES

3. Select **Draw Text Box**.
4. Click and drag on the document to create the text box.
5. You can now start typing to create text inside the text box.

From the drop-down menu, you can also select one of the built-in text boxes that have predefined colors, fonts, positions, and sizes. If you choose this option, the text box will appear automatically, so you will not need to click and drag to draw it.

To move a text box:

1. Click the text box.
2. Hover the mouse over one of the edges of the text box. The mouse pointer becomes a **cross with arrows** on each end .
3. **Click and drag** the text box to the desired location on the page.

To resize a text box:

1. Click the text box.
2. Click and drag one of the **sizing handles** on the corners or sides of the text box until it is the desired size.

If you drag the sizing handles on any of the four corners, you will be able to change the height and width at the same time. The sizing handles on the top or bottom of the text box will only allow you to resize vertically, while the handles on the left and right sides will resize the text box horizontally.

To change the text box shape:

1. Select the text box. A new **Format** tab appears with **Drawing Tools**.
2. Go to the **Format** tab.
3. Click the **Edit Shape** command.
4. Click **Change Shape** to display a drop-down list.
5. Select the desired shape from the list.

To choose a shape style: Choosing a **shape style** allows you to apply a preset fill and outline color, and in some cases other effects such as **beveling** and **shadow**. You don't have to pick a style for your text box, but it can help you save time or experiment with different appearances.

1. Select the text box. The **Format** tab appears.
2. Select the **Format** tab.
3. Click the **More** drop-down arrow in the Shape Styles group to display more style options.

4. Hover your mouse over the styles to see a live preview.
5. Select the desired style.

To change shape fill:

1. Select the text box. The **Format** tab appears.
2. Click the **Format** tab.
3. Click the **Shape Fill** command to display a drop-down menu.
4. From the drop-down menu, you can select a **color** from the list, choose **No Fill**, or select **More Fill Colors** to use a color that's not on the list.

To change the shape outline:

1. Select the text box. The **Format** tab appears.
2. Click the **Shape Outline** command to display a drop-down list.
3. Select a **color** from the list, choose **No Outline**, or select **More Outline Colors** to use a color that's not on the list.
4. From the drop-down menu, you can change the outline **color**, **weight** (thickness), and whether it is a **dashed** line.

To change shadow effects:

1. Select the text box. The **Format** tab appears.
2. Select the **Format** tab.
3. Click the **Shape Effects** command.
4. Click **Shadow**.
5. Move your mouse over the menu options to see a live preview in your document.
6. Click the desired option to select the shadow effect.

To choose a different shadow color for your shape, select **Shadow Options** from the drop-down menu, then click the **Color** button.

Selecting the Text

Text can be selected a word at a time, a sentence at a time, a line at a time, or a paragraph at a time. You can also select consecutive and non-consecutive blocks of text. The table below describes the method for selecting single and multiple blocks of text. You must select text in order to format, cut, copy, or paste it.

11.6 EDITING THE TEXT

Editing the text is as simple in Word 2010 as in previous versions of Word. One can easily cut, copy or paste text in Word 2010.

NOTES

11.6.1 Cutting, Copying and Pasting Text

In addition to typing directly into a document, you can insert text by copying or cutting and then pasting. You can also drag and drop text from one document or location to another. For example, you can copy the text of one Campus phone directory, paste it into a new document for another campus and simply edit the numbers, saving lots of time! You must select text or objects in order to cut, copy, or format them.

11.6.2 Clipboard

The Clipboard is a temporary storage area. When copied, text is duplicated to the Clipboard. When cut, it is moved to the Clipboard. When pasted, text is placed at the insertion point whether in the same document or a different one. Clipboard items may be pasted as needed.

Clipboard Task Pane

The Clipboard Task Pane allows you save up to 24 items. If you copy multiple items, the most recent item will display at the top of the list. All items remain in the Clipboard until they are cleared.

Use the Clipboard Task Pane

1. Select the text you wish to copy.
2. Home Tab > Clipboard group > Arrow button.
3. Home Tab > Clipboard group > Copy.
 - Continue selecting and copying until you have collected all items.
4. Place the insertion point where you want to paste in the document.
5. Click an icon in the Clipboard task pane to paste that item.

11.6.3 Paste Preview

Paste Preview is new to Word 2010 and it is easy! When you paste, Paste Preview makes available a live preview of paste options prior to choosing one. This increases efficiency by eliminating the need to paste and undo if you want a different paste option. After pasting, click the Paste Options button, to display the paste options. Scroll each option to see the live preview.

1. Select the appropriate item.
2. Home Tab > Clipboard group > Copy.
3. Place the insertion point where you want to paste in the document.
4. Home Tab > Clipboard group > Paste.
5. Click and preview each option prior to Pasting:

Finding and Replacing Text

Find

The find command searches quickly for a particular word, phrase, or formatting within your document. Use Find to easily and efficiently search for references to specific items. For example, if you needed to find the location in a document where a survey was addressed, search for the word survey to find each location of the word.

When you click the find command, a Navigation pane opens to the left of the work area. At the top of the pane, in the text field, type the word or phrase you want to find. All matches found will display in the Navigation pane. In the document, each match will be highlighted. Click a specific match in the Navigation pane to move directly to that location in the document. Scroll each match to see its page number in a screen tip.

1. Home Tab > Editing group > Find.

The Navigation pane displays on the left.

2. Click the text field where it says Search Document.
3. Type the word or phrase you wish to find.
4. Click the magnifying glass search icon .
5. Click any result in the Navigation pane to go to that location.

Replace

The replace command gives you an additional option while finding items. You can find a particular word, phrase, or formatting and immediately replace it with another word, phrase, or formatting. You would want to use this feature when a particular word or phrase is outdated or would better be expressed differently. For example, if a document was created using the acronym MCC instead of Maricopa Community Colleges, use the Find and Replace to search for each instance of MCC and replace it with MCCCCD.

Find and Replace

1. Home Tab > Editing group > Replace. The Find and Replace dialog box displays.
2. In the “Find what:” field, type the word or phrase to find.
3. In the “Replace with:” field, type the word or phrase with which to replace the word or phrase found.
4. Click the Find Next button to find the next instance.
5. Click the Replace button to replace the word or phrase.

NOTES

NOTES

Aligning Text

There are four types of paragraph alignment available in Microsoft Word—left-aligned, centered, right-aligned, and justified.

Left Aligned Text: A paragraph's text will be said left aligned if it is aligned with left margin. Here is a simple procedure to make a paragraph text left aligned.

Step (1): Click anywhere on the paragraph you want to align and click **Align Text Left** button available on **Home tab** or simply press **Ctrl + L** keys.

Center Aligned Text: A paragraph's text will be said center aligned if it is in the center of the left and right margins. Here is a simple procedure to make a paragraph text center aligned.

Step (1): Click anywhere on the paragraph you want to align and click Center button available on Home tab or simply press Ctrl + E keys.

Right Aligned Text: A paragraph's text will be said right aligned if it is aligned with right margin. Here is a simple procedure to make a paragraph text right aligned.

Step (1): Click anywhere on the paragraph you want to align and click Align Text Right button available on Home tab or simply press Ctrl + R keys.

Justify Aligned Text: A paragraph's text will be said justify aligned if it is aligned with both left and right margins. Here is a simple procedure to make a paragraph text justify aligned.

Step (1): Click anywhere on the paragraph you want to align and click Justify button available on Home tab or simply press Ctrl + J keys.

When you click **Justify** button, it displays four options, justify, justify low, justify high and justify medium. You need to select only justify option. Difference between these options is that low justify creates little space between two words, medium creates a bit more space and high creates maximum space between two words to justify the text.

Adjusting Character, Line and Paragraph Spacing

A line spacing is the distance between two lines in a Microsoft Word document. You can increase or decrease this distance as per your requirement by following few simple steps. This chapter will explain how to set distance between two lines as well as how to set distance between two paragraphs.

Spacing between Lines: Following are the simple steps to adjust spacing between two lines of the document.

Step (1): Select the paragraph or paragraphs for which you want to define spacing. You can use any of the text selection methods to select the paragraph(s).

Step (2): Click the **Line and Paragraph Spacing Button** triangle to display a list of options to adjust space between the lines. You can select any of the options available by simply clicking over it.

Spacing between Paragraphs: You can also set distance between two paragraphs. Following are the simple steps to set this distance.

Step (1): Select the paragraph or paragraphs for which you want to define spacing and click the **Paragraph Dialog Box** Launcher available on **Home tab**.

Step (2): Click **Before** spinner to increase or decrease the space before the selected paragraph. Similarly, click **After** spinner to increase or decrease the space after the selected paragraph. Finally, click **OK** button to apply the changes.

Setting Character, Line and Paragraph Spacing

You can use **Line Spacing** option available at the dialog box to set line spacing as we have seen in the previous example. You can try it yourself.

Inserting the Current Date and Time in a Document

Word 2010 offers a list of date/time formats, among them you can select any format to show in the document. Furthermore, it offers multiple languages to show the date/time, you can pick out any language in which date/time to be shown. For inserting date or time in the document, place the insert cursor where you want to insert date or time and under Insert tab, click Date & Time in Text group. Now select the Date/time format along with language and click OK. You can also set selected date/time format as default. Just click Set as Default button to make any specified format default date/time format.

Typing date-and-time Word keyboard Shortcuts

Word offers handy keyboard shortcuts to insert the date and time:

Alt+Shift+D: Insert the current date into your text. This command inserts a content control into your document — text that can be updated.

Alt+Shift+T: Insert the current time into your text. This command inserts a time field, which can be updated, just like any other field.

Using the Word PrintDate Field

The PrintDate field reflects the current date (and time, if you like) that a document is printed. Here's how it's done:

1. Click the Insert tab.
2. In the Text group, choose Quick Parts→Field.
The Field dialog box appears.
3. Select Date and Time from the Categories drop-down list.
4. Select PrintDate from the Field Names list.

5. In the Field Properties section of the Field dialog box, choose a date-and-time format.
6. Click OK.

NOTES

You can put the PrintDate field into the header of important documents, which lets people know the date the thing was printed. PrintDate works well for that purpose; the other fields in the Date and Time category are updated only when you manually refresh them.

Inserting Bulleted and Numbered Lists

Microsoft word provides bullets and numbers to put a list of items in a nice order. This chapter will teach you simple steps to create either of the bulleted or numbered lists in simple steps.

Create a List from Existing Text: This is very simple to convert a list of lines into a bulleted or numbered list. Following are the simple steps to create either bulleted list or numbered list.

Step (1): Select a list of text to which you want to assign bullets or numbers. You can use any of the text selection methods to select the text.

Step (2): Click the **Bullet Button** triangle to display a list of bullets you want to assign to the list. You can select any of the bullet styles available by simply clicking over it.

Step (3): If you are willing to create a list with numbers then click the Numbering Button triangle instead of bullet button to display a list of numbers you want to assign to the list. You can select any of the numbering styles available by simply clicking over it.

Create a List as You Type: You can create a bulleted list as you type. Word will automatically format it according to your text. Following are the simple steps to create bulleted list as you type.

Step (1): Type *, and then either press the **SPACEBAR** or press **TAB** key, and then type the rest of what you want in the first item of the bulleted list.

Step (2): When you are done with typing, press **Enter** to add the item in the list automatically and go to add next item in the list.

Step (3): Repeat Step 2 for each list item.

You can create a numbered list as you type. Word will automatically format it according to your text. Following are the simple steps to create numbered list as you type.

Step (1): Type 1, and then either press the **SPACEBAR** or press **TAB** key, and then type the rest of what you want in the first item of the numbered list.

Step (2): When you are done with typing, press **Enter** to add the item in the list automatically and go to add next item in the list.

Step (3): Repeat Step 2 for each list item.

You can create sub-lists which are called multi-lists. This is simple to create sub-lists, just press **Tab** key to put items in sub-list. You can try it yourself.

Using Bookmarks

Benefits of using bookmarks in Microsoft Word 2010:

1. Bookmarks identify important text and provide the reader with a quick way to navigate through long documents.
2. Bookmarks are an easy way to “refer” a reader to another location in a document. For example, the text “Figure 1 shows...” could be cross-referenced to the actual Figure 1 a page later in the document.

Identifying and Creating Bookmarks in your Document

1. Click in the location of your document where you want like to add a bookmark. For example, “Figure 1.”
2. From the *Insert* tab, select *Bookmark*.
3. Name your bookmark, or reference point. For example, the bookmark for “Figure 1” might be “figure1.”
4. Click the *Add* button when you are finished creating your bookmark.
5. After you have gone through steps 1-4 and clicked *Add* you are brought back to your document. If you are in normal view, there may not necessarily be any bookmark identifiers in your document.
6. Repeat for any reference points you would like to link to in your document.

Linking to Bookmarks within your Document

1. Highlight and select with your cursor the text that will be linked to a bookmark. For example, “See Figure 1 on page 6” would be selected because it would be linking to “Figure 1.”
2. From the *Insert* tab, select *Hyperlink*.
3. From the *Insert Hyperlink* window, select *Place in this Document*.
4. Select a bookmark to link your text to from the list.
5. The highlighted text you selected should be displayed in the *Insert Hyperlink* window.
6. When you are finished, click the *OK* button.
7. Your text should now be hyperlinked to your bookmark. To test the link, press and hold the *Ctrl* key on your keyboard and click the text. It should take you to your bookmark. In the example this page has been using, the text would bring you to «Figure 1» when clicked.
8. Repeat for each bookmark you created in the first section.

NOTES

Applying Text Formatting

Formatted text can emphasize important information and help organize your document. In Word, you have several options for adjusting the **font** of your text, including **size**, **color**, and inserting special **symbols**. You can also adjust the **alignment** of the text to change how it is displayed on the page.

To change the font size:

1. Select the text you want to modify.
2. Click the drop-down arrow next to the Font Size box on the Home tab. A drop-down menu appears.
3. Select the desired font size from the menu. Alternatively, you can type the value you want and then press Enter on your keyboard.

You can also use the Grow Font and Shrink Font commands to change the size.

To change the font:

1. Select the text you want to modify.
2. Click the drop-down arrow next to the Font box on the Home tab. The Font drop-down menu appears.
3. Move the mouse pointer over the various fonts. A live preview of the font will appear in the document.
4. Select the font you want to use. The font will change in the document.

To change the font color:

1. Select the text you want to modify.
2. Click the Font Color drop-down arrow on the Home tab. The Font Color menu appears.
3. Move the mouse pointer over the various font colors. A live preview of the color will appear in the document.

Select the font color you want to use. The font color will change in the document.

Your color choices aren't limited to the drop-down menu that appears. Select **More Colors** at the bottom of the list to access the Colors dialog box. Choose the color you want, then click OK.

To highlight text:

1. From the **Home** tab, click the **Text Highlight Color** drop-down arrow. The **Highlight Color** menu appears.
2. Select the desired highlight color.
3. Select the text you want to modify. It will then be highlighted.
4. To switch back to the normal cursor, click the **Text Highlight Color** command.

If you already have a well formatted text and you want to apply similar formatting to another text then Microsoft Word provides a feature to copy and apply a format from one text to another text. This is a very useful and time saving operation.

Copy and Apply of text formatting works for various text attributes, for example, text fonts, text colors, margins, headings, etc.

Copy and Apply Text Formatting

Following are the simple steps to copy and apply text formatting from one portion of your document to another portion of your document in a word document.

Step (1): Select the text containing the formatting that you want to copy. I have selected a text which has bold and underlined font as shown below.

Step (2): Click the **Home tab** and click the **Format Painter** button to copy the format of the selected text. As soon as you click the format painter button, the mouse pointer changes to a paint brush when you move the mouse over your document.

Step (3): Now you are ready to apply the copied text format to any of the selected texts. So select a text using mouse where you want to apply the copied text format. While selecting a text, you have to make sure that your mouse pointer is still in paint brush shape. After selecting the text, just release right click button of the mouse and you will see that newly selected text is changed to the format used for the original selection. You can click anywhere outside the selection to continue working on your document for further editing.

Copy and Apply Text formatting multiple times:

Step (1): If you are intended to apply formatting at multiple places, then you would have to double click **Format Painter** button while copying text format. Later on you just keep selecting text where you want to apply the text formatting.

Step (2): When you are done with applying formatting at all the places, again click once at **Format Painter** to come out of format applying operation.

Clear Formatting Options

All of the setting can be reset to the plain text, or the default formatting. To reset text to default settings:

Step (1): Select the text that you want to reset.

Step (2): Click **Clear Formatting** button in the **Home tab** Font group, or simply use **Ctrl + SPACEBAR**.

Applying Paragraph Formatting

Paragraph is a unit of text or other content that starts at the beginning of a document, immediately after a hard return (a carriage return), a page break, or a section break, or at the beginning of a table cell, header, footer, or list of footnotes and ends with a

NOTES

hard return (carriage return) or at the end of a table cell. Word documents generally contain paragraphs with different formatting. Even a very simple document with a centered heading and a justified body contains paragraphs with two different types of formatting.

Word's graphical user interface (GUI) provides ways to apply numerous formatting options to your paragraphs. However, these options are not available in a single location, and some of these locations differ in different versions of Word.

The Paragraph Groups in Word 2010 and Word 2007

In Word 2010 and Word 2007 many options are available directly in the **Paragraph** group on the **Home** tab of the Ribbon, in the **Paragraph** group on the **Page Layout** tab, and on the contextual toolbar and menu that appear when you right-click within text.

Alignment

Alignment or *justification* refers to the way in which the lines of a paragraph are aligned. There are four types of alignment, and the type of alignment of the paragraph where your cursor is located is indicated by the highlighted button in the **Paragraph** group on the **Home** tab.

- With *left alignment* () (the default), the left-hand ends of all the lines in the paragraph are aligned along the left-hand margin of the text area.
- With *center alignment* () , the mid-points (centers) of all the lines in the paragraph are aligned along the same imaginary vertical line at the center of the text area between the margins.
- With *right alignment* () , the right-hand ends of all the lines in the paragraph are aligned along the right-hand margin of the text area.
- With *justified alignment* or *full justification* () , all the lines in the paragraph, except the last line, are extended so that the left-hand end of each line is aligned along the left-hand margin of the text area, the right-hand end of each line is aligned along the right-hand margin of the text area, and the lines are all of the same length. This is achieved by inserting additional space between words.

You can change the type of alignment of the paragraph where your cursor is located or of a group of selected paragraphs by clicking the applicable button in the **Paragraph** group on the **Home** tab. There are also shortcut keys for setting the type of alignment.

Keyboard Shortcuts

The keyboard shortcuts (or shortcut keys or shortcut key combinations) that you can use to quickly apply paragraph formatting are listed in the following table.

Keyboard shortcuts for use in paragraph formatting

<i>Key</i>	<i>Action</i>
Ctrl+E	Applies center alignment.
Ctrl+J	Applies justified alignment.
Ctrl+Shift+J	Spreads the current paragraph across the entire width between the margins.
Ctrl+M	Increases the indentation of the current paragraph or selected paragraphs to the next tab stop.
Ctrl+Shift+M	Decreases the indentation to the preceding tab stop.
Ctrl+Q	Resets the paragraph formatting to the default paragraph formatting of the applied style.
Ctrl+R	Applies right alignment.
Ctrl+Shift+S	In Word 2010 and Word 2007, opens the Apply Styles task pane for applying, creating, or modifying styles and formatting (use Alt+Ctrl+Shift+S to modify a style without applying it to the selection). In Word 2003, selects the Styles drop-down list on the Formatting toolbar, if the Formatting toolbar is displayed, or opens the Style dialog box.
Alt+Ctrl+Shift+S	Opens the Styles pane (Word 2010 and Word 2007).
Ctrl+1	Applies single line spacing to the current paragraph or selected paragraphs.
Ctrl+2	Applies double spacing to the current paragraph or selected paragraphs.
Ctrl+5	Applies 1.5 line spacing to the current paragraph or selected paragraphs.
Ctrl+0	Adds or removes additional space before the current paragraph or selected paragraphs.
Shift+F1	In Word 2010 and Word 2007, shows or hides the formatting properties in the task pane. In Word 2003, shows the Show Formatting task pane.
F4	Redoes the last action performed.

Note: When you apply justified alignment to a paragraph, the last line does not extend across the full width of the text area. You can make all the lines in a paragraph extended across the full width of the text area by placing your cursor within the paragraph and pressing **Ctrl+Shift+J**, but it should be mentioned that in this case Word also adds space between letters within words to extend the lines.

Indents

The *indent before text* refers to the width of the additional empty space that is inserted between the margin and the text on the left-hand side of a paragraph of left-to-right text, and the *indent after text* refers to the width of the additional empty space that is inserted between the text and the margin on the right-hand side of a paragraph of left-to-right text. You can quickly increase the indent before text to the next tab stop by clicking the **Increase Indent** button () in the **Paragraph** group on the **Home** tab, and you can quickly decrease the indent before text to the preceding tab stop by clicking the **Decrease Indent** button () in the **Paragraph** group on the **Home** tab. You can set the indent before text (the left indent for left-to-right text) to values that do not correspond to tab stops, and you can also set the indent after text (the right indent for left-to-right text) in the **Paragraph** group on the **Page Layout** tab.

Paragraph Spacing

The spacing between your paragraphs is determined by the spacing before it and the spacing after it that are set for each paragraph. You can modify the spacing before a paragraph and the spacing after it by changing the values in the applicable boxes in the Paragraph group on the Page Layout tab.

Note: When the first of two consecutive paragraphs has non-zero spacing after it and the second paragraph has non-zero spacing before it, only the larger of the two spaces will be inserted between the paragraphs.

Borders

If you want to add borders around the paragraph where your cursor is located, click the Borders button () to add the current default borders (the original default or the last border style that you selected). If you want to select a border style that differs from the current default border style, click the small arrow on the Borders button, and select one of the border styles displayed or click Borders and Shading to define your own custom borders. If you want to add borders around multiple paragraphs, select the applicable paragraphs before you click the Borders button or the small arrow on it.

Shading (Colored Background)

If you want to add shading with the current default background color to the entire text area of the paragraph where your cursor is located, click the **Shading** button () in the **Paragraph** group on the **Home** tab. If you want to select a background color other than the current default color, click the small arrow on the **Shading** button and then click one of the colors displayed or define your own custom color. If you want to apply the same shading to multiple paragraphs, select the applicable paragraphs before you click the **Shading** button or the small arrow on it.

If you choose a very dark background color, Word will automatically change the text color to white to maintain good contrast and keep your text visible.

Adding and removing WordArt

You can also format text in your WordArt or on your slide by using the options in the **Font** group on the **Home** tab or for, the options in the **Basic Text** group on the **Message** tab.

Add or Change a Fill for Text of WordArt

1. Select the text in the WordArt that you want to add a fill to.

To add WordArt to a Microsoft Excel 2010 worksheet, you need to insert a text box first. To insert a text box, on the **Insert** tab, in the **Text** group, click **Text Box**, and then drag to draw a text box. Type your text into the text box and then follow the steps provided.

2. Under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click the arrow next to **Text Fill**, and then do one of the following:
 - (i) If you do not see the **Drawing Tools** or **Format** tabs, make sure that you selected the text in the WordArt. You might have to double-click the text to open the **Format** tab.
 - (ii) To add or change a fill color, click the color that you want. To choose no color, click **No Fill**. If you click **No Fill**, your text will not be visible unless you previously added an outline to the text.
 - (iii) To change to a color that is not in the theme colors, click **More Fill Colors**, and then either click the color that you want on the **Standard** tab, or mix your own color on the **Custom** tab. Custom colors and colors on the **Standard** tab are not updated if you later change the document theme.
 - (iv) To add or change a fill picture, click **Picture**, locate the folder that contains the picture that you want to use, click the picture file, and then click **Insert**. If you select non-continuous pieces of text and apply a picture fill, each individual selection is filled with the whole picture. The picture does not span the text selections.
 - (v) To add or change a fill gradient, point to **Gradient**, and then click the gradient variation that you want. To customize the gradient, click **More Gradients**, and then choose the options that you want.
 - (vi) To add or change a fill texture, point to **Texture**, and then click the texture that you want. To customize the texture, click **More Textures**, and then choose the options that you want.

Note: Picture and texture fills for WordArt are not available in Word 2010.

NOTES

Add or Change an Outline for Text or WordArt

1. Select the text in the WordArt that you want to add an outline to.
To add the same outline to text in multiple places, select the first piece of text, and then press and hold CTRL while you select the other pieces of text.
2. Under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click the arrow next to **Text Outline**, and then do one of the following:
 - (i) If you do not see the **Drawing Tools** or **Format** tabs, make sure that you selected the text in the WordArt. You might have to right-click the WordArt to open the **Format** tab.
 - (ii) To add or change an outline color, click the color that you want. To choose no color, click **No Outline**. To change to a color that is not in the theme colors, click **More Outline Colors**, and then either click the color that you want on the **Standard** tab, or mix your own color on the **Custom** tab. Custom colors and colors on the **Standard** tab are not updated if you later change the document theme.
 - (iii) To add or change the thickness of the outline, point to **Weight**, and then click the thickness that you want. To customize the thickness, click **More Lines**, and then choose the options that you want.
 - (iv) To add or change the outline to dots or dashes, point to **Dashes**, and then click the style that you want. To customize the style, click **More Lines**, and then choose the options that you want.

Add or Change an Effect for Text or WordArt

1. Select the text in the WordArt that you want to add an effect to.
To add the same effect to text in multiple places, select the first piece of text, and then press and hold CTRL while you select the other pieces of text.
2. Under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click **Text Effects**, and then do one of the following:

If you do not see the **Drawing Tools** or **Format** tabs, make sure that you selected the text in the WordArt. You might have to right-click the WordArt to open the **Format** tab.

 - (i) To add or change a shadow, point to **Shadow**, and then click the shadow that you want. To customize the shadow, click **Shadows Options**, and then choose the options that you want.
 - (ii) To add or change a reflection, point to **Reflection**, and then click the reflection variation that you want.

- (iii) To add or change a glow, point to **Glow**, and then click the glow variation that you want. To customize the glow colors, click **More Glow Colors**, and then click the color that you want. To change to a color that is not in the theme colors, click **More Colors**, and then either click the color that you want on the **Standard** tab, or mix your own color on the **Custom** tab. Custom colors and colors on the **Standard** tab are not updated if you later change the document theme.
- (iv) To give your text the appearance of depth by adding or changing an edge, point to **Bevel**, and then click the bevel that you want. To customize the bevel, click **3-D Options**, and then choose the options that you want.
- (v) To add or change a 3-D rotation, point to **3-D Rotation**, and then click the 3-D rotation that you want. To customize the 3-D rotation, click **3-D Rotation Options**, and then choose the options that you want.
- (vi) To add or change the warp or path of the text, point to **Transform**, and then click the warp or path that you want.

Note: To create a custom effect by adding multiple individual effects, repeat step 2.

Delete a fill from text or WordArt

1. Select the text in the WordArt that you want to delete a fill from.

To delete the same fill from multiple pieces of text, click the first piece of text, and then press and hold CTRL while you click the other pieces of text.

2. Under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click the arrow next to **Text Fill**, and then do one of the following:

If you do not see the **Drawing Tools** or **Format** tabs, make sure that you selected the text in the WordArt. You might have to right-click the WordArt to open the **Format** tab.

- (i) To delete a fill color, picture, or texture, select another fill type. If you click **No Fill**, your text will not be visible unless you previously added an outline to the text.
- (ii) To delete a fill gradient, point to **Gradient**, and then click **No Gradient**.

Delete an Outline from Text or WordArt

1. Select the text in the WordArt that you want to delete an outline from. To delete the same outline from multiple pieces of text, click the first piece of text, and then press and hold CTRL while you click the other pieces of text.

NOTES

2. Under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click the arrow next to **Text Outline**, and then click **No Outline**.

If you do not see the **Drawing Tools** or **Format** tabs, make sure that you selected the text in the WordArt. You might have to right-click the WordArt to open the **Format** tab.

Delete an Effect from Text or WordArt

1. Select the text in the WordArt that you want to delete the effect from.

To delete the same effect from multiple pieces of text, click the first piece of text, and then press and hold CTRL while you click the other pieces of text.

Under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click the arrow next to **Text Effects**, and then do one of the following:

If you do not see the **Drawing Tools** or **Format** tabs, make sure that you selected the text in the WordArt. You might have to right-click the WordArt to open the **Format** tab.

- (i) To delete a shadow from the text, point to **Shadow**, and then click **No Shadow**.
- (ii) To delete a reflection from the text, point to **Reflection**, and then click **No Reflection**.
- (iii) To delete a glow from the text, point to **Glow**, and then click **No Glow**.
- (iv) To delete an edge from the text, point to **Bevel**, and then click **No Bevel**.
- (v) To delete 3-D rotation from the text, point to **3-D Rotation**, and then click **No Rotation**.
- (vi) To delete a path or warp from the text, point to **Transform**, and then click **No Transform**.
- (vii) If you added multiple individual effects, repeat step 2 to delete all of the effects.
- (viii) To delete all the effects at once, under **Drawing Tools**, on the **Format** tab, in the **WordArt Styles** group, click the **More** button , and then click **Clear WordArt**.

Delete the Entire WordArt

Select the WordArt that you want to remove, and then press DELETE.

Make sure that you select the entire WordArt object, and not just the text inside the WordArt object. When the whole WordArt object is selected, it is surrounded by a solid border line. When the text inside the WordArt object is selected, the border is a dashed line.

Creating and Editing Hyperlink

Everyone knows about hyperlinks on a web page, but in a Word document? Yes. In fact hyperlinks can be created in all Microsoft Office applications; PowerPoint, Excel and Word.

What is a hyperlink? A hyperlink is a selectable object that includes the path information to another object. The object can be a target on the same document, a file on the same computer, or a uniform resource locator giving the location of a web page halfway around the world. The process of creating a hyperlink is exactly the same in all cases. Some point on the document or webpage is turned into an active spot which includes the path information and by clicking on it will take you to a specific destination.

Benefits of Creating Hyperlinked Text with Microsoft Word

1. Creating hyperlinked text easily allows document reviewers to visit a web resource without having to close out of the document.
2. As URLs often appear long, complicated, and messy when simply pasted into a document, hyperlinked text makes the document more visually appealing to the viewer.
3. Creating linked text allows the viewer to know what URL they will be visiting and/or any instructions for visiting the URL.

In the image above, both links take the user to the same website. However, the link on top appears messy. WPI users will recognize that the link will take them to a trusted WPI webpage. However, users outside of the WPI community might not associate the link as being a trusted source. Many web URLs also appear long and can take up many lines. The second link in the above image identifies where the viewer will be taken and looks cleaner.

Creating a Basic Hyperlink

1. In your web browser, go to the URL you intend to use in your document.
2. Select the URL for the webpage and right-click. Then select *Copy*.
3. In your Word document, select the text you want to transform into a hyperlink to the webpage you located in Step 1.

For example, if you wanted the text “ATC Teaching with Technology Collaboratory” to link to <https://www.wpi.edu/+Collaboratory>, you would select and highlight the phrase.

4. From the *Insert* tab, select *Hyperlink*.

NOTES

5. The *Insert Hyperlink* window appears.
6. Verify that the text you highlighted in Step 3 is in the textbox next to *Text to Display*:
7. Paste the URL from Step 1 into the textbox next to *Address*. You can do this by putting your cursor in the textbox, right-clicking and then selecting *Paste*.
8. Select *OK*. Your text now appears as a hyperlink. To check the link and verify that it works, hold down the *Ctrl* key on your keyboard and click the link. Your default Internet browser should open up the URL.

Inserting and Editing Equation

Microsoft Word 2010 includes built-in support for writing and editing equations.

Write an Equation

To write an equation, you can use Unicode character codes and Math AutoCorrect entries to replace text with symbols.

When you type an equation, Word automatically converts the equation into a professionally formatted equation.

1. On the **Insert** tab, in the **Symbols** group, click the arrow next to **Equation**.
2. Click the equation that you want, or click **Insert New Equation** to type an equation.

Insert a frequently used or preformatted equation

- (i) On the **Insert** tab, in the **Symbols** group, click the arrow next to **Equation**, and then click the equation that you want.
- (ii) Add an equation to the list of frequently used equations
- (iii) In the document, select the equation that you want to add.
- (iv) Under **Equation Tools**, on the **Design** tab, in the **Tools** group, click **Equation**, and then click **Save Selection to Equation Gallery**.
- (v) In the **Create New Building Block** dialog box, type a name for the equation.
- (vi) In the **Gallery** list, click **Equations**.
- (vii) Select any other options that you want.

Insert a Commonly used Math Structure

1. On the **Insert** tab, in the **Symbols** group, click the arrow next to **Equation**, and then click the equation that you want.
2. Under **Equation Tools**, on the **Design** tab, in the **Structures** group, click the structure type that you want, such as a fraction or a radical, and then click the structure that you want.

3. If the structure contains placeholders, click in the placeholders and type the numbers or symbols that you want. Equation placeholders are small, dotted boxes in an equation $\frac{\square}{2}$.

Change an Equation that was written in Office Word 2007

1. Click the equation that you want to edit.
2. Make the changes that you want.

Change an Equation that was written in a Previous Version of Word

To change an equation that was written in a version of Word prior to Word 2007, you must use the Equation 3.0 add-in or the Math Type add-in that was used to write the equation.

When you open a document that contains an equation that was written in a previous version of Word, you cannot use the built-in support for writing and changing equations.

Change an equation that was written by using Equation 3.0

1. Double-click the equation that you want to edit.
2. Make the changes that you want.

To get help in Equation Editor, click **Equation Editor Help Topics** on the **Help** menu.

Change an equation that was written by using Math Type

To change an equation written with Math Type, you need to have Math Type installed.

1. Double-click the equation that you want to edit.
2. In Math Type, edit the equation.
3. On the **File** menu, click **Close and Return to name of the document that contains the equation**.

Convert your document to the Word 2010 and Word 2007 format

If you convert your document and save it as a .docx file, you will not be able to use previous versions of Word to change any equations in the document.

1. Click the **File** tab.
2. Click **Info**, and then click **Convert**.
3. Click the **File** tab.
4. Click **Save As**.

In the **Save as type** list, click **Word Document** to save your document as a .docx file.

Inserting Special Characters in a Document

Word refers to a specific set of characters as *special characters*. The special characters are listed on the Special Characters tab of the Symbol dialog box. To

NOTES

NOTES

open the Symbol dialog box in Word 2010 or Word 2007, in the Symbols group on the Insert tab of the Ribbon, click Symbol, and then click More Symbols. In Word 2003, on the Insert menu, click Symbol. After the Symbol dialog box opens, click the Special Characters tab.

You can double-click any of the special characters listed to insert it into your document. Some of them can also be inserted by pressing the applicable shortcut key, and others are inserted by the AutoCorrect feature when the applicable character sequence is typed. You can also click the Shortcut Key and AutoCorrect buttons to add, delete, or modify the shortcut keys and AutoCorrect character sequences that can be used to insert any of the special characters.

Word's special characters include both special symbols and nonprinting characters that do something other than display a symbol or white space. The latter group of special characters includes the following special characters.

- **Nonbreaking Space:** A nonbreaking space, which is also called a *hard space* keeps the text before it and after it together on the same line while inserting a space in between. Nonbreaking spaces are often used to keep the parts of names and dates together. Nonbreaking spaces are also used to keep numbers together with the names of units that follow them, as in 0.5 liter. A nonbreaking space can be inserted by pressing **Ctrl+Shift+Space**. When nonprinting characters are shown, a nonbreaking space is displayed as a ring (°).
- **Nonbreaking Hyphen:** A nonbreaking hyphen, which is also called a *hard hyphen*, ensures that two words that are separated only by a hyphen remain together on the same line. A nonbreaking hyphen can be inserted by pressing **Ctrl+_**. When nonprinting characters are shown, a nonbreaking hyphen is displayed as a long hyphen.
- **Optional Hyphen:** An optional hyphen is a hyphen that is displayed or printed only when the part of the word after it needs to be moved to the next line. An optional hyphen can be inserted by pressing **Ctrl+-**. When nonprinting characters are shown, an optional hyphen is displayed as a hooked hyphen (¬).
- **Em Space:** An em space is a space that is equal in length to the length of the em dash of the same font.
- **En Space:** An en space is a space that is equal in length to the length of the en dash of the same font.
- **1/4 Em Space:** A 1/4 em space is a space that is equal in length to 1/4 of the length of the em dash of the same font.
- **No-width Optional Break:** A no-width optional break, which is also called a *zero width non-joiner (ZWNJ)*, is a nonprinting character that can be used to control where a word or phrase breaks if it falls at the end of a line. For example, you can use a no-width optional break to tell Word where to break

a URL that is too long to fit on a single line without causing the hyperlink to stop working. In alphabets that have connecting and non-connecting forms of some characters, a zero width non-joiner eliminates the space between two characters and causes them to be displayed or printed in their non-connecting forms if different connecting and non-connecting forms are available. A zero width non-joiner is typically used to show the separated form of characters that normally combine together.

- **No-width non-break:** A no-width non-break, which is also called a *zero width joiner (ZWJ)*, is a nonprinting character that prevents a word, number, or phrase from breaking if it falls at the end of a line. Instead, Word moves the entire piece of text to the beginning of the next line. Many users have tried to use a no-width non-break to prevent Word from breaking a line after an en dash or an em dash and to thereby create a nonbreaking en dash or a nonbreaking em dash. Unfortunately, this does not work. However, the minus sign (hexadecimal Unicode 2212), which is nearly identical to an en dash, and the horizontal bar (hexadecimal Unicode 2015), which is nearly identical to an em dash, are nonbreaking characters and can serve as a nonbreaking en dash and a nonbreaking em dash. In alphabets that have connecting and non-connecting forms of some characters, a zero-width joiner eliminates the space between two characters and causes them to be displayed and printed in their connecting forms if such forms are available. A zero width joiner is typically used to combine two characters that normally do not form a ligature or a part of a connected sequence of characters.

When a special character is not available in the current font, Word inserts the applicable character from another font that supports the character.

Searching for Special Characters

Word also provides codes to help you find special characters in a document. To see the list of available codes while you are entering a search or replacement string, press **Ctrl+F** or **Ctrl+H** to open the **Search and Replace** dialog box. Then click **More** and click **Special**. The following table lists some of the special characters and the corresponding codes that you can use in the **Find what** or **Replace with** text box.

Codes for finding special characters

<i>Special character</i>	<i>Code</i>
Em dash (—)	^+
En dash (–)	^=
Nonbreaking hyphen	^~
Optional hyphen	^-
Nonbreaking space	^s

Contd.../-

NOTES

Section mark (§)	^%
Paragraph mark (¶)	^v
Right to left mark	^r
Left to right mark	^h
No-width optional break (zero width non-joiner)	^o
No-width non-break (zero width joiner)	^y

The above table lists the special characters and the corresponding codes.

Check Your Progress

State whether the following statements are True or False:

1. Title Bar displays the document name followed by a program name.
2. Formatting Toolbar contains buttons used for formatting.
3. Status Bar displays position of the insertion point and working mode buttons.
4. Insertion Point is the location where the next character appears.
5. A hyperlink is a selectable object that includes the path information to another object.
6. Alignment or justification refers to the way in which the lines of a paragraph are aligned.

11.7 SUMMARY

- **Microsoft Word 2010** is a word-processing program, designed to help you create professional-quality documents. With the finest document formatting tools, **Word** helps you organize and write your documents more efficiently. **Word** also includes powerful editing and revising tools so that you can collaborate with others easily. We have learnt how to create our own documents, open existing documents and finally save them before closing. The standard toolbar and the formatting toolbar offer a variety of buttons which offer a quick service to the user.
- Text can also be justified between the margins. Proper line spacing can be given in between the printed lines. Text entries separated by commas can be put in the bulleted or numbered form. This makes the major heads clearly readable and long remembered. The 'Find and Replace' feature of

WORD helps us in finding a particular word and can be replaced with some other desired word. This makes searching of the words easier and global replacements happen without fail in no time. WORD can also give numbers to your page which make referencing easier. You can format text in Microsoft Word 2010 by changing fonts, font size, and font style (bold, italics, underline, etc.). Text formatting lets you add a professional look to your documents.

- Word documents generally contain paragraphs with different formatting. Even a very simple document with a centered heading and a justified body contains paragraphs with two different types of formatting. Word's graphical user interface (GUI) provides ways to apply numerous formatting options to your paragraphs.

11.8 GLOSSARY

- **Title Bar:** It displays the document name followed by a program name.
- **Menu Bar:** It contains a list of options to manage and customize documents.
- **Standard Toolbar:** It contains shortcut buttons for the most popular commands.
- **Formatting Toolbar:** It contains buttons used for formatting.
- **Ruler:** Ruler is used to set margins, indents, and tabs.
- **Status Bar:** It displays position of the insertion point and working mode buttons.
- **Scroll Bars:** These are used to view parts of the document.
- **View Buttons:** It changes the layout view of the document to Normal View, Web Layout View, Reading Layout View, Print Layout View, or Outline View.
- **Insertion Point:** It is the location where the next character appears.
- **Hyperlink:** A hyperlink is a selectable object that includes the path information to another object.
- **Alignment or justification** refers to the way in which the lines of a paragraph are aligned.
- **Indent before text:** It refers to the width of the additional empty space that is inserted between the margin and the text on the left-hand side of a paragraph of left-to-right text.
- **Indent after text:** It refers to the width of the additional empty space that is inserted between the text and the margin on the right-hand side of a paragraph of left-to-right text.

11.9 ANSWERS TO CHECK YOUR PROGRESS

1. True
2. True
3. True
4. True
5. True
6. True

11.10 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is a Word Processor?
2. Differentiate between title bar and menu bar.
3. Describe the new features of Word 2010.
4. What is the use of ribbon in MS Word 2010? Explain in detail.
5. What are the two methods of opening a document? Discuss in detail.
6. Why the file has to be saved before closing it?
7. Write short notes on the following:
 - (i) Dialog Box launcher
 - (ii) Live Preview
 - (iii) Screen tips
8. What does alignment of text mean?
9. How can the text be made bold and italicized?
10. How can you change the case of the text?
11. Discuss the steps by which bullets and numbers can be put to existing text entries.
12. How can you insert a table in your document? Explain any two ways.

Long Answer Questions

1. Describe various steps of apply text formatting in a Word document.
2. List the steps to copy and apply text formatting from one portion of your document to another portion of your document in a word document.
3. Discuss steps of applying paragraph formatting.

4. List the steps of adding and removing Word Art in Word 2010.
5. Learn how to create and edit hyperlinks in Word 2010.
6. How will you insert special characters and equations in Word 2010? Explain using example.

NOTES

11.11 REFERENCES

1. J. K. Shahjahan, *MS Office 2000*, Excel Books
2. Sanjeev Gupta and Shameena Gupta, *Computer Aided Management (Using MS-Office 2003 Tools)*, Excel Books
3. Joseph W. Habraken, *Microsoft Office 2003 All-In-One*, Que Publishing
4. Jennifer Ackerman Kettell, Guy Hart-Davis and Curt Simmons, *Microsoft Office 2003: The Complete Reference*, McGraw-Hill Professional
5. Laurie Ann Ulrich, *How to Do Everything with Microsoft Office 2003*, McGraw-Hill Professional

UNIT 12: MS EXCEL

NOTES

Structure

- 12.0 Introduction
- 12.1 Unit Objectives
- 12.2 MS Excel
- 12.3 Backstage View
- 12.4 Moving Around the Worksheet
- 12.5 Saving Your Work
- 12.6 Data Entry
- 12.7 Row and Column Basics
- 12.8 Cell Introduction
- 12.9 Copy and Paste
- 12.10 Find and Replace Dialogue
- 12.11 Spell Check Basis
- 12.12 Using Symbols and Special Characters
- 12.13 Adding Comment to Cell
- 12.14 Undo Changes and Redo Changes
- 12.15 Functions
- 12.16 Cell References in Formulas
- 12.17 Graphs and Charts
- 12.18 Borders and Gridlines
- 12.19 Printing your Work
- 12.20 Summary
- 12.21 Glossary
- 12.22 Answers to Check Your Progress
- 12.23 Workspace Terminal and Model Questions
- 12.24 References

12.0 INTRODUCTION

MS-EXCEL is a very powerful and easy-to-use spreadsheet package; perhaps the most commonly used these days. It is a member-application included in MS Office suite. It works very well with numbers and their complex calculations.

Excel helps prepare your data in an organized, orderly and meaningful fashion. Excel finds its major application in creating reports, using formulas and performing

calculations. It is best suited for scientific and statistical analysis. Excel can also be used to prepare Profit and Loss accounts, Balance sheet, and other Tax statements. It works well for both simple and complicated numbers. It can be used for preparing analytical reports including statistical analysis, forecasting and regression analysis. Good looking and attractive charts can be created which depict data in clear and meaningful fashion. Excel can also be used to create relationships between different types of data.

Excel can do all the work of a full-fledged word-processor but it lacks the advanced features of desktop publishing. It also supports high level features of object linking and embedding, which means in simple terms, that data from Word (so also from any other program of Office 2003 suite), can be safely and easily put and linked with data in Excel and vice versa.

12.1 UNIT OBJECTIVES

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

- Explain MS-Excel as a spreadsheet package
- Discuss MS Excel working

12.2 MS EXCEL

Spreadsheets were originally developed for book keeping; however, they are also useful for scientific calculations, data manipulation and for producing graphs. Microsoft Excel includes some statistical functions, but for serious research work a specialized package should be used. Excel can also sort and select data; however, for large amounts of data or more complex tasks, a database program should be used instead.

Starting Excel

To start up the program:

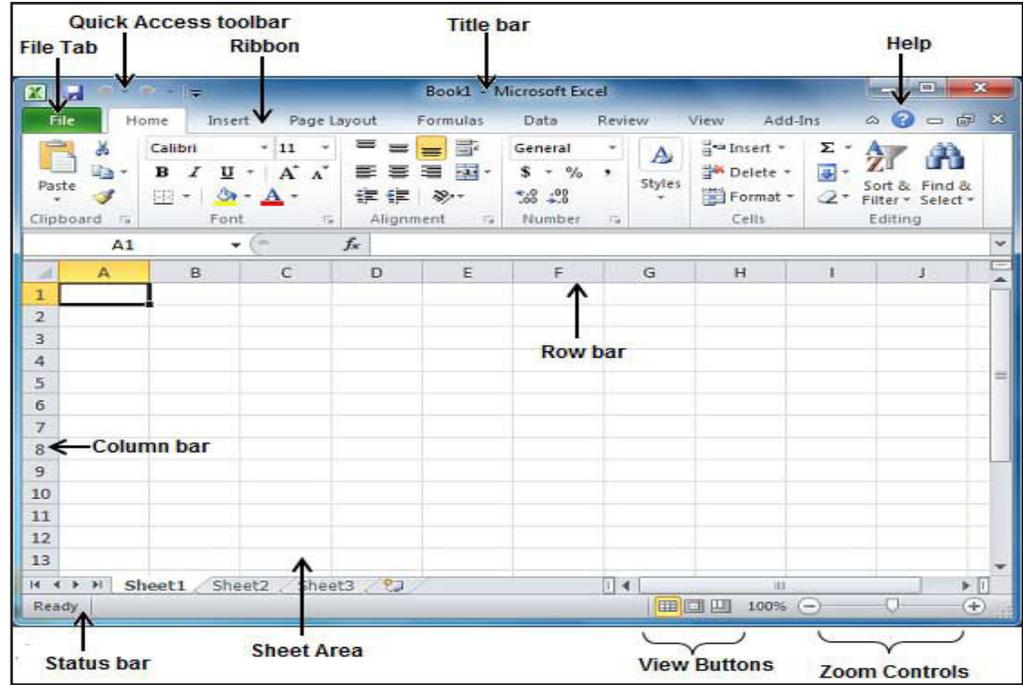
1. Open the Windows Start menu
2. Choose All Programs then Microsoft Office followed by Microsoft Office Excel 2010

You can create a *shortcut* to this software by dragging Microsoft Excel from this menu onto the *Desktop* using the *right* mouse button - select Create Shortcut(s) Here from the popup menu.

The Excel Screen

You will see an empty worksheet, as below, ready to enter your data:

NOTES



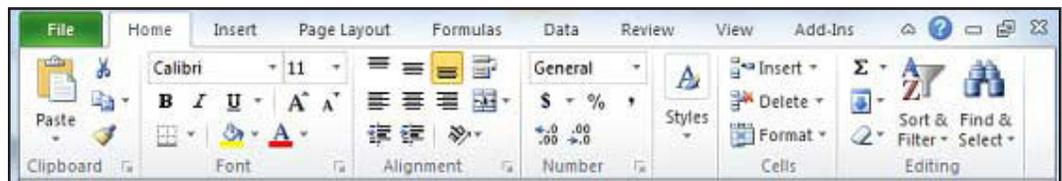
File Tab

The File tab replaces the Office button from Excel 2007. You can click it to check Backstage view, which is the place to come when you need to open or save files, create new sheets, print a sheet, and do other file-related operations.

Quick Access Toolbar

This you will find just above the File tab and its purpose is to provide a convenient resting place for the Excel most frequently used commands. You can customize this toolbar based on your comfort.

Ribbon



Ribbon contains commands organized in three components:

- **Tabs:** They appear across the top of the Ribbon and contain groups of related commands. Home, Insert and Page Layout are the examples of ribbon tabs.
- **Groups:** They organize related commands; each group name appears below the group on the Ribbon. For example, group of commands related to fonts or group of commands related to alignment, etc.
- **Commands:** Commands appear within each group as mentioned above.

Title Bar

This lies in the middle and at the top of the window. Title bar shows the program and sheet titles.

Help

The Help Icon can be used to get excel related help anytime you like. This provides nice tutorial on various subjects related to excel.

Zoom Control

Zoom control lets you zoom in for a closer look at your text. The zoom control consists of a slider that you can slide left or right to zoom in or out, . and + buttons you can click to increase or decrease the zoom factor.

View Buttons

The group of three buttons located to the left of the Zoom control, near the bottom of the screen, lets you switch among excel's various sheet views.

- ***Normal Layout view:*** This displays page in normal view.
- ***Page Layout view:*** This displays pages exactly as they will appear when printed. This gives a full screen look of the document.
- ***Page Break view:*** This shows a preview of where pages will break when printed.

Sheet Area

The area where you enter data. The flashing vertical bar is called the insertion point and it represents the location where text will appear when you type.

Row Bar

Rows are numbered from 1 onwards and keep on increasing as you keep entering data. Maximum limit is 1,048,576 rows.

Column Bar

Columns are numbered from A onwards and keep on increasing as you keep entering data. After Z, it will start series of AA, AB and so on. Maximum limit is 16,384 columns.

Status Bar:

This displays sheet information as well as the insertion point location. From left to right, this bar can contain the total number of pages and words in the document, language, etc.

You can configure the status bar by right-clicking anywhere on it and by selecting or deselecting options from the provided list.

Dialog Box Launcher

This appears as very small arrow in the lower-right corner of many groups on the Ribbon. Clicking this button opens a dialog box or task pane that provides more options about the group.

NOTES

12.3 BACKSTAGE VIEW

The Backstage view has been introduced in Excel 2010 and acts as the central place for managing your sheets. The backstage view helps in creating new sheet, saving and opening sheets, printing and sharing sheets, and so on.

Getting to the Backstage View is easy: Just click the File tab, located in the upper-left corner of the Excel Ribbon. If you already do not have any opened sheet then you will see a window listing down all the recently opened sheets as follows:

If you already have an opened sheet then it will display a window showing detail about the opened sheet as shown below. Backstage view shows three columns when you select most of the available options in the first column.

First column of the backstage view will have following options:

<i>Option</i>	<i>Description</i>
Save	If an existing sheet is opened, it should be saved as is, otherwise it will display a dialogue box asking for sheet name.
Save As	A dialogue box will be displayed asking for sheet name and sheet type, by default it will save in sheet 2010 format with extension .xlsx
Open	This option will be used to open an existing excel sheet.
Close	This option will be used to close an opened sheet.
Info	This option will display information about the opened sheet.
Recent	This option will list down all the recently opened sheets
New	This option will be used to open a new sheet.
Print	This option will be used to print an opened sheet.
Save & Send	This option will save an opened sheet and will display options to send the sheet using email, etc.
Help	You can use this options to get required help about excel 2010.
Options	Use this option to set various option related to excel 2010.
Exit	Use this option to close the sheet and exit.

Sheet Information

When you click Info option available in the first column, it displays the following information in the second column of the backstage view:

- **Compatibility Mode:** If the sheet is not a native excel 2007/2010 sheet, a Convert button appears here, enabling you to easily update its format. Otherwise, this category does not appear.
- **Permissions:** You can use this option to protect your excel sheet. You can set a password so that nobody can open your sheet, or you can lock the sheet so that nobody can edit your sheet.
- **Prepare for Sharing:** This section highlights important information you should know about your sheet before you send it to others, such as a record of the edits you made as you developed the sheet.
- **Versions:** If the sheet has been saved several times, you may be able to access previous versions of it from this section.

Sheet Properties

When you click Info option available in the first column, it displays various properties in the third column of the backstage view. These properties include sheet size, title, tags, categories, etc.

You can also edit various properties. Just try to click on the property value and if property is editable, it will display a text box where you can add your text like title, tags, comments, Author.

Exit Backstage View

It is simple to exit from Backstage View. Either click on File tab or press Esc button on the keyboard to go back in excel working mode

12.4 MOVING AROUND THE WORKSHEET

Various keys or key combinations can be used to move the *active cell* around the worksheet. These include <Enter>, <Tab>, <Home> and the <arrow> keys (make sure <Scroll Lock> is not turned *on*). You can also move directly to a cell using the mouse:

1. Using the mouse, point to any cell other than A1.
2. Click on the left mouse button to make this the active cell - note that the name of the cell in the *Name Box* on the command line has changed accordingly.
3. Move the active cell around the screen - try pressing the <arrow> keys, <Tab> (and <Shift Tab>) and <Enter> (and <Shift Enter>), noting the names of the cells in the *Name Box*.
4. End by making A1 the active cell.

To move to the left edge of a block of data, hold down <Ctrl> and press an <arrow> key in the direction you wish to move. <Ctrl> and <Home> move the active cell to cell A1.

NOTES

12.5 SAVING YOUR WORK

It is important to save your work frequently - you never know when the computer might fail!

1. Click on the [Save] button or use Save As... from the File menu
Up until now your work has been known as Book1; you are now asked to give it a proper name.
2. Type test into the *File name:* box
Note that the default drive is set to My Documents. Avoid working directly from/to floppy disks; copy your files to *My Documents*.
3. Press <Enter> or click on [Save] to carry out the save.

Note that once the file has been saved, the new name (*test.xls*) appears at the top of the screen.

Press <Ctrl s> every so often to save your file as you are working on it, thereby ensuring you do not lose any changes you have made. <Ctrl s> is a shortcut key for the Save command.

12.6 DATA ENTRY

In MS Excel there are 1048576*16384 cells. MS Excel cell can have Text, Numeric value or formulas. MS Excel cell can have maximum of 32000 characters.

Inserting Data

For inserting data in MS Excel just activate the cell type text or number and press enter or Navigation key.

Inserting Formula

For inserting formula in MS Excel go to formula bar, enter the formula and then press enter or navigation key. See the screen-shot below to understand it.

Modifying Cell Content

For modifying the cell content just activate the cell, enter a new value and then press enter or navigation key to see changes. See the screen-shot below to understand it.

Let us see how we can **Move Data** with **MS Excel**.

Step(1) Select the data you want to Move. **Right Click** on it. Select the **cut option**.

Step(2) Select the **first cell** where you want to move the data. Right click on it and paste the data. You can see the data is moved now.

12.7 ROW AND COLUMN BASICS

MS Excel is in a tabular format consisting of rows and columns.

- Row runs horizontally while Column runs vertically.
- Each row is identified by row number which runs vertically at the left of the sheet.
- Each column is identified by column header which runs horizontally at the top of sheet.

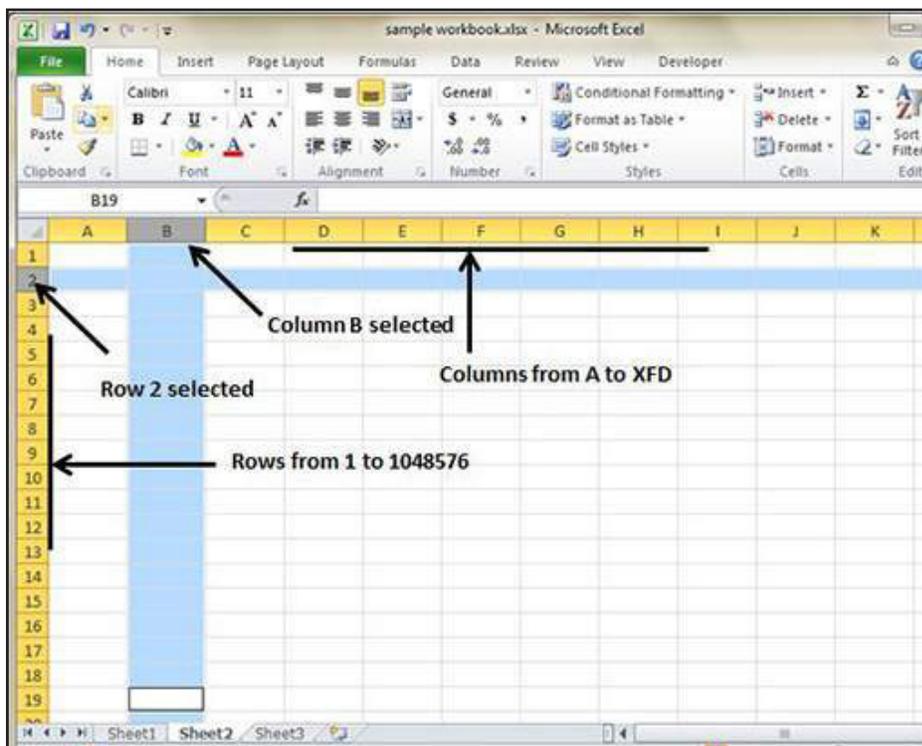
NOTES

For **MS Excel 2010** Row numbers range from **1** to **104857** in total **1048576** rows and Columns range from **A** to **XFD** in total **16384** columns.

Navigation with Rows and Columns

Let us see how to move to last row or last column.

- You can go to last row by clicking Control + Down Navigation arrow.
- You can go to last column by clicking Control + Right Navigation arrow.



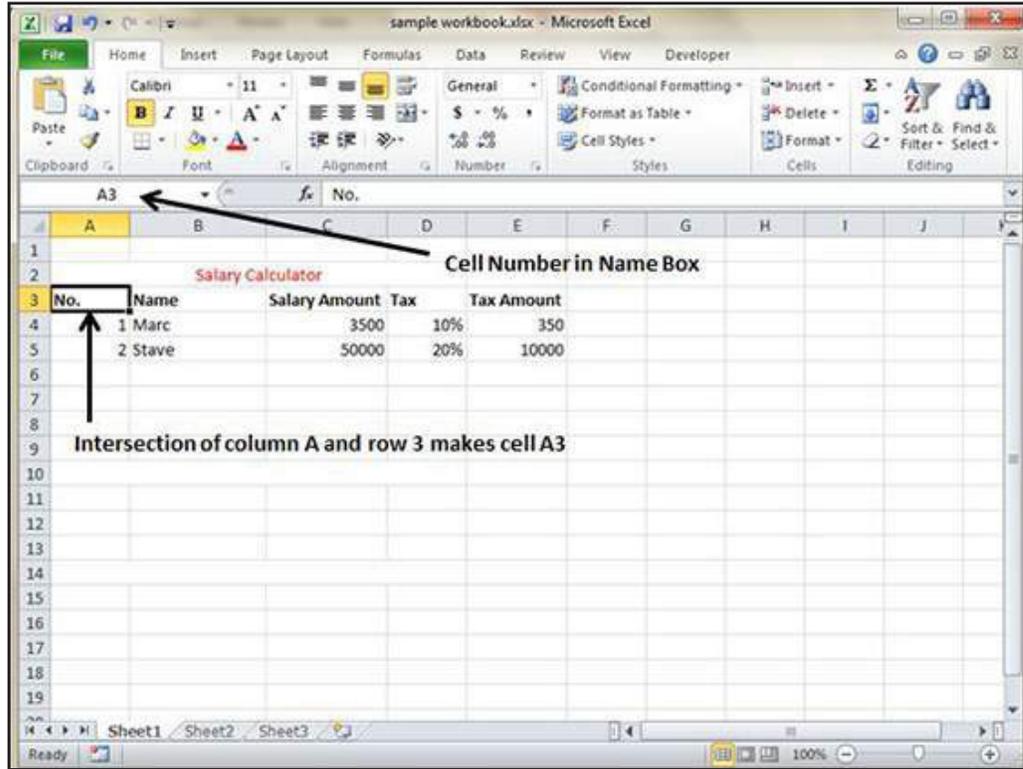
12.8 CELL INTRODUCTION

The intersection of rows and columns is called cell.

Cell is identified with Combination of column header and row number.

For example: A1, A2

NOTES



Setting Font

You can assign any of the fonts that is installed for your printer to cells in a worksheet. You can set the font of the selected text from Home » **Font group** » **select the font**. Setting font from format cell dialogue

- Right click on cell » Format cells » Font Tab
- Press Control + 1 or Shift + Control + F

Text-Formatting

Various options available in Home tab of the ribbon as below:

- **Bold:** It makes text highlighted by choosing Home » Font Group » Click B or Press Control + B
- **Italic:** It makes text italic by choosing Home » Font Group » Click I or Press Control + B
- **Underline:** It makes text to be underlined by choosing Home » Font Group » Click U or Press Control + B
- **Double Underline:** It makes text highlighted by choosing Home » Font Group » Click arrow near U » Select Double Underline
- **Strike-through:** It makes strikes the text in the centre vertically.

- **Super Script:** It makes content to appear as super.
- **Sub Script:** It makes content to appear as sub.

Change Alignment

You can change Horizontal and Vertical alignment of the cell. By default, Excel aligns numbers to the right and text to the left. Click on the available option in the Alignment group in Home tab to change alignment. Right click on cell and choose format cell. In format cells dialogue choose Alignment Tab. Select the available options from the Vertical alignment and Horizontal alignment options. 1. Horizontal Alignment : You can set horizontal alignment to Left, Centre, Right, etc.

- **Left:** Aligns the cell contents to the left side of the cell.
- **Center:** Centers the cell contents in the cell.
- **Right :** Aligns the cell contents to the right side of the cell.
- **Fill :** Repeats the contents of the cell until the cell's width is filled.
- **Justify:** Justifies the text to the left and right of the cell. This option is applicable only if the cell is formatted as wrapped text and uses more than one line.

Vertical Alignment

You can set Vertical alignment to top, middle, bottom, etc.

- **Top:** Aligns the cell contents to the top of the cell.
- **Center:** Centers the cell contents vertically in the cell.
- **Bottom:** Aligns the cell contents to the bottom of the cell.
- **Justify:** Justifies the text vertically in the cell; this option is applicable only if the cell is formatted as wrapped text and uses more than one line.

Merge Cells

MS Excel enables you to merge two or more cells. When you merge cells, you don't combine the contents of cells. Rather, you combine a group of cells into a single cell that occupies the same space. Choose Merge & Center control on the Ribbon is simpler. To merge cells, select the cells that you want to merge and then click the Merge & Center button. Choose Alignment tab of the Format Cells dialogue box to merge cells. The **Home » Alignment group » Merge & Center control** contains a drop-down list with these additional options:

- **Merge Across:** When a multi-row range is selected, this command creates multiple merged cells—one for each row.
- **Merge Cells:** Merges the selected cells without applying the Center attribute.
- **Unmerge Cells:** Unmerges the selected cells.

NOTES

Wrap Text and Shrink to Fit

If you have text too wide to fit the column width but don't want that text to spill over into adjacent cells, you can use either the Wrap Text option or the Shrink to Fit option to accommodate that text.

12.9 COPY AND PASTE

MS Excel provides copy paste option in different ways. The simplest method of copy paste is as below.

- To do copy paste just select the cells you want to copy. Choose copy option after right click or press **Control + C**.
- Select the cell where you need to paste this copied content. Right click and select paste option or press **Control + V**.

In this case MS Excel will copy everything—values, formula, Formats, Comments and validation. MS Excel will overwrite the content with paste. If you want to undo this press Control + Z

Copy Paste using Office Clipboard

When you copy data in MS Excel it puts the copied content in Windows and Office Clipboard. You can view clipboard content by Home -> Clipboard. View the clipboard content. Select cell where you need to paste. Click on paste to paste the content.

Copy Paste in Special Way

You may not want to copy everything in some cases for example you want to copy only Values or you want to copy only formatting of cells. Select the paste special option as below.

Below are the various options available in paste special.

- **All:** Pastes the cell's contents, formats, and data validation from the Windows Clipboard.
- **Formulas:** Pastes formulas, but not formatting.
- **Values:** Pastes only values not the formulas.
- **Formats:** Pastes only the formatting of the source range.
- **Comments:** Pastes the comments with the respective cells.
- **Validation:** Pastes validation applied in the cells.
- **All using source theme:** Pastes formulas, and all formatting.
- **All except borders:** Pastes everything except borders that appear in the source range.
- **Column Width:** Pastes formulas, and also duplicates the column width of the copied cells.

- **Formulas & Number Formats:** Pastes formulas and number formatting only.
- **Values & Number Formats:** Pastes the results of formulas, plus the number.
- **Merge Conditional Formatting:** This icon is displayed only when the copied cells contain conditional formatting. When clicked, it merges the copied conditional formatting with any conditional formatting in the destination range.
- **Transpose:** Changes the orientation of the copied range. Rows become columns, and columns become rows. Any formulas in the copied range are adjusted so that they work properly when transposed.

12.10 FIND AND REPLACE DIALOGUE

MS Excel provides Find & Replace option for finding text within the sheet. Let us see how to access Find & Replace Dialogue. To access the Find & Replace, Choose Home -> Find & Select -> Find or press Control + F Key. You can see the Find and Replace dialogue.

You can replace the found text with the new text with Replace tab. Now Let us see various options available under the Find dialogue.

- **Within:** Specifying the search should be in Sheet or workbook.
- **Search By:** Specifying the internal search method by rows or by columns.
- **Look In:** If you want to find text in formula as well then select this option.
- **Match Case:** If you want to match the case like lower case or upper case of words then check this options.
- **Match Entire Cell Content:** If you want to exact match of the word with cell then check this option.

12.11 SPELL CHECK BASIS

MS Excel Provides feature of Word Processing program Spelling check. We can get rid of the spelling mistakes with the help of spelling check feature.

Let us see how to access spell check.

- To access the spell check, Choose Review ⇌ Spelling or press F7.
- To check the spelling in just a particular range, select the range before you activate the spell checker.
- If the spell checker finds any words it does not recognize as correct, it displays the Spelling dialogue with suggested options.

Let us see various options available in spell check dialogue.

- **Ignore Once:** Ignores the word and continues the spell check.
- **Ignore All:** Ignores the word and all subsequent occurrences of it.
- **Add to Dictionary:** Adds the word to the dictionary.
- **Change:** Changes the word to the selected word in the Suggestions list.
- **Change All:** Changes the word to the selected word in the Suggestions list and changes all subsequent occurrences of it without asking.
- **AutoCorrect:** Adds the misspelled word and its correct spelling (which you select from the list) to the AutoCorrect list.

12.12 USING SYMBOLS AND SPECIAL CHARACTERS

If you want to insert some symbols or special characters that are not found on the keyboard in that case you need to use Symbols option.

- Go to Insert » Symbols » Symbol to view available symbols. You can see many symbols available there like Pi, alpha, beta, etc.
- Select the symbol you want to add and click insert to use the symbol.

Go to Insert » Symbols » Special Characters to view available special characters. You can see many special characters available there like Copyright, Registered, etc. Select the special character you want to add and click insert to use the special character.

12.13 ADDING COMMENT TO CELL

Adding comment to cell helps in understanding the purpose of cell, what input it should have, etc. It helps in proper documentation.

To add comment to cell select the cell and perform any of the actions below:

- Choose Review » Comments » New Comment.
- Right-click the cell and choose Insert Comment from available options.
- Press Shift+F2.

Initially comment consists of Computer's user name. You have to modify it with text for the cell comment.

Modifying Comment

- You can modify the comment you entered before as below.
- Select the cell on which comment appears.
- Right-click the cell and choose Edit Comment from available options.
- Modify the comment.

Formatting Comment

You can do several formatting of comments. For formatting comment Right click on cell » Edit comment » Select comment » Right click on it » Format comment. With formatting of comment you can change color, font, size, etc. of the comment.

12.14 UNDO CHANGES AND REDO CHANGES

Undo Changes

You can reverse almost every action in Excel by using the Undo command. We can undo changes in 2 ways.

- From the Quick access tool-bar » Click Undo
- Press Control + Z

You can reverse the effects of the past 100 actions that you performed by executing Undo more than once. If you click the arrow on the right side of the Undo button, you see a list of the actions that you can reverse. Click an item in that list to undo that action and all the subsequent actions you performed.

Redo Changes

You can again reverse the action done with undo in Excel by using the Redo command. We can redo changes in 2 ways.

- From the Quick access tool-bar » Click Redo
- Press Control + Y

12.15 FUNCTIONS

Insert Function:  **AutoSum:** 

Excel has hundreds of built-in functions which, as in mathematics, are denoted by using brackets after the function name. These can be seen via the [Insert Function] button on the *Formula Bar*.

1. Move to an empty cell and click on the [Insert Function] button
2. From *Or select a category:* choose All
3. Scroll down the *Select a function:* list to get an idea of what's provided

Note that information about any function selected is given at the foot of the *Insert Function Window*, while additional help is available via the Help on this function link. Do not try inserting any of the functions into your empty cell, just note what is available.

4. Press <Esc> or click on [Cancel] to close the window

Calculating Totals - the SUM Function

Imagine you want to work out four-year totals, so that your model looks like this:

NOTES

	A	B	C	D	E	F
1.	Profit and Loss					
2.		2005	2006	2007	2008	Totals
3.	Income	25,000	30,000	33,000	34,650	122,650
4.	Costs	15,000	18,000	19,800	20,790	73,590
5.	Pre-Tax Profit	10,000	12,000	13,200	13,860	49,060
6.	Tax	3,000	3,600	3,960	4,158	14,718
7.	After-Tax Profit	7,000	8,4000	9,240	9,702	34,342
8.						

1. Type the heading Totals into cell F2 and press <Enter>

Next you need to add up the figures across each row. One way of calculating this for row 3 would be to use the formula =B3+C3+D3+E3. This works - but imagine you had twenty items to add up, or a thousand! Instead, you can use a *function* to work out the value. To specify a *function* you type its name then, in brackets, the cell or range of cells to which it is to be applied. To signify a cell range, a colon is used to separate the starting cell from the end cell.

2. In cell F3 type =SUM(B3:E3) - press <Enter> to carry out the calculation

If ##### appears, you will need to widen the column to display the answer. The SUM() function (and other commonly-used ones) is also available from the [AutoSum] button. Using this, you can calculate the missing total figures in one go:

3. Select F4 to F7
4. Click on the [AutoSum] button - the remaining totals are filled in
Sometimes Excel guesses the range of cells to be summed incorrectly. The default is to total down a column rather than across a row. See what happens by recalculating the total in F7.
5. Move to F7 and press <Delete> to clear the cell
6. Click on the [AutoSum] button - note the range is incorrect
7. Drag through the correct cells (B7 to E7) to amend the range then press <Enter> to complete the calculation.

The IF Function

Another, slightly different function is IF, which lets you test whether something is true or not and take different action as appropriate. This next example shows you how it works.

What would happen if, in 2008, there was an exceptional Costs bill of ` 35,000 (for new equipment or premises, for example). Income is only ` 34,650 so the business would make a small loss.

1. Type a new Costs figure of 35000 into cell E4 and press <Enter>

Note that the Pre-Tax Profit is correctly shown as negative. However, the Tax figure is also negative - as if the tax collector was giving the business money for making a loss. This does not usually happen! To make the model behave correctly, you need to alter the formula in the 2008 Tax cell E6:

2. Move to E6
3. Type =IF(E5>0,E5*taxrate,0) and press <Enter>

This means that if the contents of E5 (*the Pre-Tax Profit*) are more than (>) zero, the tax paid is equal to 30% of Pre-Tax Profit, otherwise, the tax is zero. This produces a zero tax figure when the Pre-Tax Profit is in fact a loss. This example should teach you that spreadsheet models, even if they behave correctly in most circumstances, may break down under special conditions.

4. Copy the new formula from E6 into D6 to B6 by dragging the cell handle backwards
5. Reset the original formula in E4 - move to E3 then drag the *cell handle* down to E4.

NOTES

12.16 CELL REFERENCES IN FORMULAS

Most formulas you create include references to cells or ranges. These references enable your formulas to work dynamically with the data contained in those cells or ranges. For example, if your formula refers to cell C2 and you change the value contained in C2, the formula result reflects new value automatically. If you didn't use references in your formulas, you would need to edit the formulas themselves in order to change the values used in the formulas. When you use a cell (or range) reference in a formula, you can use three types of references: relative, absolute, and mixed references.

Relative Cell References

The row and column references can change when you copy the formula to another cell because the references are actually offsets from the current row and column. By default, Excel creates relative cell references in formulas.

Absolute Cell References

The row and column references do not change when you copy the formula because the reference is to an actual cell address. An absolute reference uses two dollar signs in its address: one for the column letter and one for the row number (for example, \$A\$5).

Mixed Cell References

Both the row or column reference is relative, and the other is absolute. Only one of the address parts is absolute (for example, \$A5 or A\$5)

NOTES

12.17 GRAPHS AND CHARTS

Chart Wizard:



While plotting a graph, it is easy to first select the data to be plotted. It is important to include the column and row headings (if there are any) as these are used for the category (x) and value (y) names.

To select non-adjacent areas, you first drag through one area and then use control select (hold down <Ctrl> as you drag through further areas).

1. Select the required data area - cells A2 to E7 (i.e., missing out the Totals and main heading)
2. Click on the Chart Wizard button

The Chart Wizard takes you through four steps before it draws the graph. These allow you to change the default settings if you want. The stages are:

(i) Step 1 - Chart Type

There are 14 different standard types (plus a further 20 built-in custom types) to choose from. The default is for a column chart, of which there are 7 sub-types. To preview a particular chart, a Press and Hold to View Sample button is provided.

3. Click on [Next>] to select the default *Column* graph

(i) Step 2 - Chart Source Data

4. If you did not previously select the data, type A2:E7 as the *Data range*:

The sample chart shows Income, Costs, etc., along the x-axis, with the various years shown by different coloured bars. To graph by *Year*:

5. Change *Series in*: from Columns to Rows - press <Enter> or click on [Next>]

(i) Step 3 - Chart Options

This allows you to change many different options on your chart. Use the *Titles tab* to add titles to your graph:

6. Click in the *Chart title*: box, then type Financial Statistics 2005/08 - press <Tab>

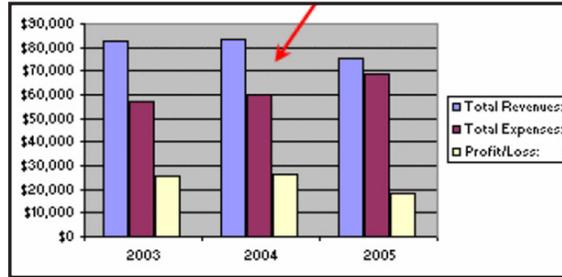
7. In the *Category (X)* axis: box type Year - press <Enter> or click on [Next>]

(i) Step 4 - Chart Location

The final step of the wizard asks whether the chart is to be placed on a separate chart sheet or as an object on the current worksheet. Often it is better to separate out charts from the rest of your work but, here, accept the default:

8. Press <Enter> or click on [Finish]

Your graph should now appear in the centre of the screen, as below:



NOTES

Moving and Rescaling Charts

Do not worry if a chart partly covers the data, that is still all there; indeed, the two are intricately linked. If you were to alter any of the original data, the graph would immediately be updated. Further, you can copy additional values directly from the worksheet and paste the data straight onto the graph. To move and rescale the chart rectangle:

1. Point inside the chart rectangle, hold down the left mouse button and drag the chart to the required position - here, move the top left corner into cell G1
2. Next, point the mouse to one of the corners or side *handles*, hold down the mouse button and drag the rectangle to its required size - here, drag the bottom right handle to cell L23

To move the chart onto its own chart sheet:

3. Open the Chart menu and choose Location...
4. Set *Place chart* to As new sheet: - press <Enter> for [OK]

The chart is much bigger and clearer on a separate sheet, and is no longer dominated by the *Legend*.

Altering the Chart Type

Chart Type:



There are over a hundred different styles of graph which Excel can produce. To change the type, use the *list arrow* attached to the [Chart Type] button on the *Chart Toolbar*. This appears automatically when a chart is *active* (on a chart sheet or when clicked on a worksheet). If the toolbar is not displayed, it can be switched on via the View menu - choose Toolbars and then Chart. Using the mouse, select some of the different chart types shown, to see what is available.

3-D Rotation

Excel allows you to rotate a 3-D graph to whatever angle and pitch you require, which can be very useful when some data values are hidden behind others. The procedure is as follows:

1. Change the chart to a 3D-Area Column (the middle graph in the third row)
Sadly, the *Profit* figures are hidden by the *Income* and *Costs*. To rectify this:

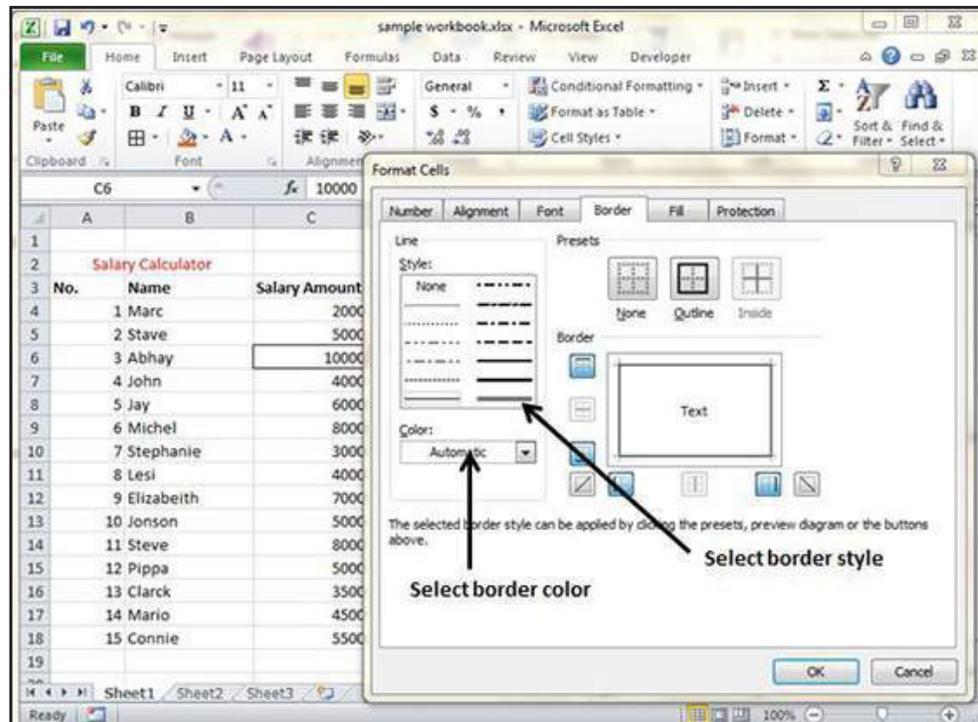
NOTES

- Using the list arrow attached to the [Chart Objects] button (the first on the toolbar) choose Corners - black corner handles should appear on the chart and the mouse pointer becomes a cross when held over one of these handles.
The mouse can now be used to rotate the graph.
- Point to one of the *Corners* and hold down the mouse button. As you move the mouse around, the graph will rotate.
- Point to a different corner, if necessary, to change the angle of tilt.
Another way to display the profit figures would be to reverse the axis values:
- [Undo] the rotation then *double click* on the axis with the labels *Income* etc.
- Move to the Scale tab and turn on Series in reverse order - press <Enter> for [OK].

12.18 BORDERS AND GRIDLINES

Apply Borders

MS Excel enables you to apply borders to the cells. For applying border select the range of cells Right Click » Format cells » Border Tab » Select the Border Style. Then you can apply border by Home Tab » Font group » Apply Borders.



Apply Shading

You can add shading to the cell from the Home tab » Font Group » Select the Color.

12.19 PRINTING YOUR WORK

If you want to print a copy of a worksheet with no layout adjustment, use the Quick Print option. There are two ways in which we can use this option.

- Choose File » Print(which displays the Print pane), and then click the Print button.
- Press Ctrl+P and then click the Print button (or press Enter).

Adjusting Common Page Setup Settings

You can adjust print settings available in Page setup dialogue in different ways as below. Page setup options include Page orientation, Page Size, Page Margins, etc.

- The Print screen in Backstage View is displayed when you choose File » Print
- The Page Layout tab of the Ribbon

Choosing Your Printer

To switch to a different printer, choose File » Print and use the drop-down control in the Printer section to select a different installed printer.

Specifying What you Want to Print

Sometimes you may want to print only a part of the worksheet rather than the entire active area. Choose File » Print and use the controls in the Settings section to specify what to print.

- **Active Sheets:** Prints the active sheet or sheets that you selected
- **Entire Workbook:** Prints the entire workbook, including chart sheets
- **Selection:** Prints only the range that you selected before choosing File » Print

Check Your Progress

Fill in the blanks:

1. includes some statistical functions, but for serious research work a specialized package should be used.
2. MS-EXCEL is a very powerful and easy-to-use package.
3. A is a box at the intersection of a row and a column in a worksheet where data is stored.
4. are combination of all the vertical cells joined together in a single vertical line.
5. Rows are combination of all the horizontal cells joined together in a single

Contd.../-

NOTES

NOTES

6. is a group of worksheets, which can be stored as a unit. A workbook is stored on the disk in the form of a file with extension .xls.
7. Each of a single workbook has its own identity and is separate from other worksheets.
8. Using it is possible to sent mails to more than one person.
9. In Excel automatically creates sum.
10. Calculations can be performed through
11. A cell with dark border around it is called
12. The Mail merge option is in menu.
13. In Excel, the intersection of row and column is known as
14. In Excel replace option is in menu.
15. In MS Excel, Macro is in menu.

12.20 SUMMARY

- MS-EXCEL is a very powerful and easy-to-use spreadsheet package; perhaps the most commonly used these days. It is a member-application included in MS Office suite. It works very well with numbers and their complex calculations.
- Spreadsheets were originally developed for book keeping; however, they are also useful for scientific calculations, data manipulation and for producing graphs. Microsoft Excel includes some statistical functions, but for serious research work a specialized package should be used. Excel can also sort and select data; however, for large amounts of data or more complex tasks, a database program should be used instead.

12.21 GLOSSARY

- **Cell:** A Cell is a box at the intersection of a row and a column in a worksheet where data is stored.
- **Column:** Columns are combination of all the vertical cells joined together in a single vertical line.
- **Row:** Rows are combination of all the horizontal cells joined together in a single horizontal line.
- **Workbook:** It is a group of worksheets, which can be stored as a unit. A workbook is stored on the disk in the form of a file with extension .xls.
- **Worksheet:** It is the working area of MS-Excel. Each worksheet of a single

workbook has its own identity and is separate from other worksheets.

- **Workspace:** It is the working area of MS-Excel where workbooks, worksheets and other related objects may be opened and manipulated.

NOTES

12.22 ANSWERS TO CHECK YOUR PROGRESS

1. Microsoft Excel
2. Spreadsheet
3. Cell
4. Columns
5. horizontal line
6. Workbook
7. worksheet
8. MailMerge
9. Autosum
10. Excel
11. Active
12. Tools
13. cell
14. Edit
15. Tools

12.23 WORKSPACE TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. How many rows and columns are there in MS-Excel Worksheet?
2. What do you mean by range of cells?
3. What do you mean by cell referencing and what are different types of referencing?
4. Why is formatting necessary?
5. Define embedded chart.
6. Define chart sheet.

Long Answer Questions

1. Explain various types of charts available in MS-Excel.
2. Which types of files can be imported and exported from MS-Excel?
3. What are the different types of data that can be entered in MS-Excel?
4. What is the difference between copying and moving a range?

NOTES

5. What are the different components of chart? Explain.
6. What do you use MS Excel for? Elaborate.
7. What are the major features of MS Excel? Discuss.
8. Explain the major functions used in MS Excel.
9. With the help of an example create a worksheet and then show how you will take printouts of the worksheet.

12.24 REFERENCES

1. J. K. Shahjahan, *MS Office 2000*, Excel Books
2. Sanjeev Gupta and Shameena Gupta, *Computer Aided Management (Using MS-Office 2003 Tools)*, Excel Books
3. Joseph W. Habraken, *Microsoft Office 2003 All-In-One*, Que Publishing
4. Jennifer Ackerman Kettell, Guy Hart-Davis and Curt Simmons, *Microsoft Office 2003: The Complete Reference*, McGraw-Hill Professional
5. Laurie Ann Ulrich, *How to Do Everything with Microsoft Office 2003*, McGraw-Hill Professional

UNIT 13: MS POWERPOINT AND MS ACCESS

Structure

- 13.0 Introduction
- 13.1 Unit Objectives
- 13.2 MS PowerPoint
- 13.3 Creating a New Presentation
- 13.4 Saving a Presentation
- 13.5 Changing the Bullet Point Character
- 13.6 Changing the Layout to Include a Picture
- 13.7 Adding Drawings and Pictures
- 13.8 Applying a Slide Design
- 13.9 PowerPoint Views
- 13.10 Moving through the Slides
- 13.11 Deleting Slides
- 13.12 Changing the Order of Slides
- 13.13 Creating Notes Pages
- 13.14 Running the Presentation
- 13.15 Animating your Presentation
- 13.16 MS Access
- 13.17 Find and Apply a Template
- 13.18 Create a Database from Scratch
- 13.19 Open an Existing Access Database
- 13.20 Get Started Using Your New Database
 - 13.20.1 Add a Table
 - 13.20.2 Paste Data from Another Source into an Access Table
 - 13.20.3 Import or Link to Data from Another Source
- 13.21 Import Data from a Spreadsheet or Other Program
- 13.22 Use an Earlier-version Database in Several Versions of Access
- 13.23 Summary
- 13.24 Glossary
- 13.25 Answers to Check Your Progress
- 13.26 Terminal and Model Questions
- 13.27 References

NOTES

13.0 INTRODUCTION

Presentation is a powerful managerial tool of communication through which you can compile and deliver your ideas, concepts, plans or products to the audience in a structured, effective and impressive manner. Teachers, professors, politicians and sales representatives make presentations to sell their concepts. A presentation is generally organized in units of information delivery that can take any of the following forms:

- Slides
- Transparencies
- Printed handouts
- Slide show

Slides and transparencies used to be projected in front of the audience using overhead projector or otherwise. The operation of this equipment was mainly manual, semi-automated at the best. This approach had obvious limitations. Computers have now replaced the traditional method of presentation entirely.

13.1 UNIT OBJECTIVES

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

- Explain MS-Excel as a spreadsheet package
- Discuss MS Excel working

13.2 MS POWERPOINT

Microsoft PowerPoint is widely used for making professional quality presentations in a variety of formats, including on-screen computer slide shows, black-and-white or colour overheads, and 35mm slides. You can also use it for notes and class presentations. In addition, PowerPoint can be used as a drawing package for preparing pictures, forms, posters and leaflets.

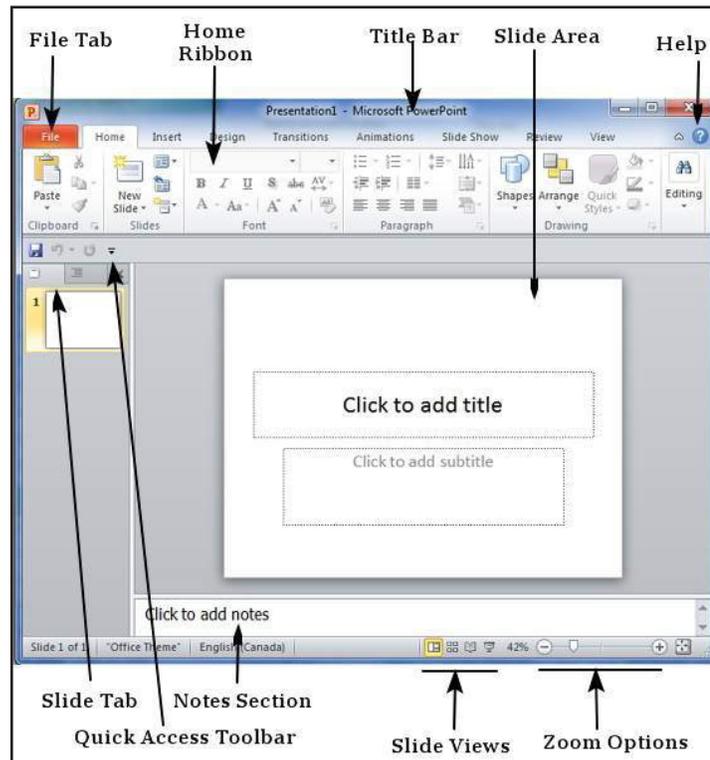
Starting PowerPoint

To load PowerPoint:

1. Open the Start menu, select All Programs then Microsoft Office and finally Microsoft Office PowerPoint.

Drag the PowerPoint icon from this menu onto the **Desktop** to give yourself a direct link next time you want to run the software.

Below is the screen, ready to enter information onto your first (title) slide:



NOTES

Fig. 13.1:

- **File Tab:** This tab opens the **Backstage** view which basically allows you to manage the file and settings in PowerPoint. You can save presentations, open existing ones and create new presentations based on blank or predefined templates. There are other file related operations that can be executed from this view too.
- **Ribbon :** The ribbon contains three components:
 - **Tabs:** They appear across the top of the Ribbon and contain groups of related commands. Home, Insert, Page Layout are example of ribbon tabs.
 - **Groups:** They organize related commands; each group name appears below the group on the Ribbon. For example group of commands related to fonts or group of commands related to alignment, etc.
 - **Commands:** Commands appear within each group as mentioned above.
- **Title Bar:** This is the top section of the window. It shows the name of the file followed by the name of the program which in this case is Microsoft PowerPoint.
- **Slide Area:** This is the area where the actual slide is created and edited. You

NOTES

can add, edit and delete text, images, shapes and multimedia in this section.

- **Help:** The Help Icon can be used to get PowerPoint related help anytime you need. Clicking on the “?” opens the PowerPoint Help window where you have a list of common topics to browse from. You can also search for specific topics from the search bar at the top.
- **Zoom Options:** Zoom control lets you zoom in for a closer look at your text. The zoom control consists of a slider that you can slide left or right to zoom in or out, - and + buttons you can click to increase or decrease the zoom factor. The maximum zoom supported by PowerPoint is 400% and the 100% is indicated by the mark in the middle.
- **Slide Views:** The group of four buttons located to the left of the Zoom control, near the bottom of the screen, lets you switch between PowerPoint views.
 - **Normal Layout view:** This displays page in normal view with the slide on the right and a list of thumbnails to the left. This view allows you to edit individual slides and also rearrange them.
 - **Slide Sorter view:** This displays all the slides as a matrix. This view only allows you to rearrange the slides but not edit contents of each slide.
 - **Reading View:** This view is like a slide show with access to the Windows task bar in case you need to switch windows. However, like the slide show you cannot edit anything in this view and clicking will progress the presentation to the next slide.
- **Notes Section:** This section allows you to add notes for the presentation. These notes will not be displayed on the screen during the presentation; these are just quick reference for the presenter.
- **Quick Access Toolbar:** The Quick Access Toolbar is located just under the ribbon. This toolbar offers a convenient place to group the most commonly used commands in PowerPoint. You can customize this toolbar to suit your needs.
- **Slide Tab:** This section is available only in the Normal view. It displays all the slides in sequence. You can add, delete and reorder slides from this section.

13.3 CREATING A NEW PRESENTATION

PowerPoint offers a host to tools that will aid you in creating a presentation. These tools are organized logically into various ribbons in PowerPoint. The table below describes the various commands you can access from different menus

<i>Menu category</i>	<i>Ribbon commands</i>
Home	Clipboard functions, manipulating slides, fonts paragraph settings, drawing objects and editing functions.
Insert	Insert tables, pictures, images, shapes, charts, special texts, multimedia and symbols.
Design	Slide setup, slide orientation, presentation themes and background.
Transitions	Commands related to slide transitions.
Animations	Commands related to animation within the individual slides.
Slide Show	Commands related to slide show set up and previews.
Review	Proofing content, language selection, comments and comparing presentations.
View	Commands related to presentation views, Master slides, color settings and window arrangements.

Besides these depending on the objects selected in the slide, there are other menu tabs that get enabled.

Add New Slides

Here are the steps that allow you to insert a new slide in the deck:

Step (1): Right click in the **Navigation Pane** under any existing slide and click on the **New Slide** option.

Step (2): The new slide is inserted. You can now change the layout of this slide to suit your design requirements.

Step (3): To change the slide layout, right click on the newly inserted slide and go to **Layout** option where you can choose from the existing layout styles available to you.

Add Text to the Slide

PowerPoint allows users to add text to the slide in a well-defined manner to ensure that the content is well distributed and easy to read. The procedure to add the text in a PowerPoint slide is always the same - just click in the text box and start typing. The text will follow the default formatting set for the text box, although this formatting can be changed later as required. What changes are the different kinds of content boxes that support text in a PowerPoint slide. Given below are some of the most common content blocks you will see in PowerPoint.

Title Box

This is typically found on slides with title layout and in all the slides that have a title

box in them. This box is indicated by “**Click to add title**”.

Subtitle Box

This is found only in slides with Title layout. This is indicated by “**Click to add subtitle**”.

Content Box

This is found in most of the slides that have a placeholder for adding content. This is indicated by “**Click to add text**”. As you can see, this box allows you to add text as well as non-text content. To add text to such a box, click anywhere on the box, except on one of the content icons in the center and start typing.

Text Only Box

This is not a default content box available in PowerPoint, but you can create it using Slide Master, if required. This is also indicated by “**Click to add text**”. The only difference between Text Only Box and the Content box is that former only supports text in the content area.

13.4 SAVING A PRESENTATION

It is a good idea to save your presentation at regular intervals while you are working on it, rather than wait until you have finished the last slide. For example, you can save after completing each slide, or every 15 minutes.

Save to *My Documents*, which is the default location for saving your files:

1. From the **File** menu, select **Save** (or use <Ctrl s> from the keyboard)
2. Ensure that you *Save in: My Documents*
3. The *File name*: has already been set for you (PowerPoint uses the main title you entered on the first slide—IT Services. You can change this here if you want. Note that PowerPoint automatically adds a .ppt extension)
4. Press <Enter> or click on [Save]

13.5 CHANGING THE BULLET POINT CHARACTER

You may want to change the bullet point character that is used:

1. Click on the line you want to change—e.g., *Different Ways of Learning*.
2. Open the **Format menu** and select **Bullets and Numbering**.

Various alternative bullet point characters are available, such as tick marks and squares. You can also get further choices through the [**Customize...**] or [**Picture...**] buttons. Take care while choosing non-standard characters as they may result in poor accessibility – it is best to stick to those offered here, unless

you know what you are doing. Note also that the size of the bullet point can be changed relative to the text, as can its colour.

3. Choose the bullet character required—e.g. the *tick marks*
4. Press <Enter> or click on [OK]

The round bullet point on the one line has now changed to a tick mark. If you wanted to change *all* the bullet points on a slide, you would first need to select the whole list. Note that once a bullet point character is set up for a list, it is carried forward to the next list entry (so you can have done this before typing in the text). To standardize the list:

5. Drag through all the bulleted lines
6. Repeat steps 2 to 4, as above

To change *all* the bullet points on *every* slide in a presentation to a certain bullet point character, you need to change it on the *Master Slide*.

You can also use the Format Painter to copy the format of one list entry to the whole list.

13.6 CHANGING THE LAYOUT TO INCLUDE A PICTURE

What if you decide that you would like to add a picture to illustrate this slide? The easiest way to do this, keeping what you have done already, is to choose a slide layout which includes a picture placeholder. The *Task Pane* should still be open with **Slide Layout** showing (if not, open the **Format** menu and choose **Slide Layout...**).

1. Scroll down the layouts to the last section headed *Other Layouts*
2. In the second row, click on either [**Title, Text and Clip Art**] (on the left) or [**Title, Clip Art and Text**] (on the right)

13.7 ADDING DRAWINGS AND PICTURES

Microsoft Office provides its own set of clip art, which can be inserted into a slide very easily.

1. Where it says *Double click to add clipart* (on the picture placeholder), do as it says
2. The *Select Picture* window appears, with many different pictures to choose from:
3. Type training into the Search text: box then press <Enter> or click on [Go]
4. Click on the picture you like best, then press <Enter> or click on [OK]

Your chosen clip art will be inserted and the Picture toolbar will appear.

The buttons on the toolbar allow you to change things like the picture's contrast, brightness and colour. The cropping tool lets you cut off unwanted areas by trimming down the edges of the picture. You can experiment with these options

NOTES

if you like. Clicking on the slide away from the clip art closes the Picture toolbar. When you click on the clip art again, the toolbar will reappear.

If you lose a toolbar, open the View menu, choose Toolbars, then select the name of the toolbar you want displayed.

You can also reposition, change the size and rotate the picture:

5. To reposition the image, press the <arrow keys> or point inside the picture placeholder then hold down the mouse button and drag it to the required position.
6. To change the size, point to one of the white circles (border *handles*) around the picture with the mouse, hold down the mouse button and drag the handle.
7. The green circle can be used to rotate the picture - move the pointer over it then hold down the mouse button and move the mouse left or right.

13.8 APPLYING A SLIDE DESIGN

A slide design template can make your presentation look more professional. The default design uses black text on a white background. This is somewhat boring and simple, but good for accessibility. One of the best aspects about PowerPoint is that you can create slide masters and then save them as templates to be reused later. There are different aspects of a design which can be created and saved to ensure you can reuse the hard work you spent on creating the first copy. Given below are the steps to save design templates.

Step (1): Create a new design template from the **Slide Master** view. Depending on your needs, this template could have different colors, images, logos or symbols included in the master slide and the layout templates.

Step (2): Go to **Edit Theme** group under the **Slide Master** ribbon.

Step (3): Navigate to **Edit Themes > Themes > Save Current Theme**

Step (4): In the **Save Current Theme** dialog, enter the Theme name and click Save.

Step (5): This template is now saved and available on your PowerPoint design template view to be applied to any presentation.

13.9 POWER POINT VIEWS

It is possible to view your presentation in a number of different ways. To switch between views:

- **Either:** *Open the View* menu and choose one of the first 4 options

- **Or:** Click on the button you require at the bottom left of the PowerPoint window (above the **Draw** menu button on the Drawing toolbar)

The table below gives a better idea of what the 3 different view buttons give you:

View	On Screen	Use To
 Normal View	Shows the slides in miniature, the slide in full, and speaker's notes underneath	Edit contents of slides; try out animation effects
 Slide Sorter	Shows a miniature of each slide in the current order	Add, delete and move slides; rehearse timings
 Slide Show	Plays the presentation on screen from the current slide	Practice presentation

NOTES

Fig. 13.2:

From the View menu, there are also the following options:

- **Slide Show** runs the presentation, similar to the button, *but from the first slide*.
- **Notes Page** gives a view with more space for speaker's notes under the slide. Here, you can type up exactly what you plan to say for each slide. The notes can then be printed out so you have them to consult while giving an actual presentation.
- **Zoom...** changes the magnification—*Fit* displays the whole slide in the available space.

If you are preparing a presentation and have trouble seeing the text, use the **Zoom...** Feature here (or the *[Zoom]* button) to increase the slide magnification.

13.10 MOVING THROUGH THE SLIDES

There are several ways to move between slides, while preparing a presentation in *Normal* view:

- Click on the required slide miniature in the left-hand section of the screen.
- Use the scroll bar button on the right of the main display—drag the indicator up or down (the current slide details are displayed as you do so).
- Use the double arrow buttons (*[Previous Slide]* and *[Next Slide]*) at the foot of the scroll bar.
- Press the *<Page Up>* or *<Page Down>* keys.
- Use the *<up arrow>* or *<down arrow>* keys.

13.11 DELETING SLIDES

It is easy to delete slides in *Slide Sorter* view (though you can also do so in *Normal* view), especially if you have a lot of slides to deal with.

1. Click on the **[Slide Sorter View]** button or choose **Slide Sorter** from the **View** menu.
2. Click on the slide to be deleted, then press the **<Delete>** key.
3. To reinstate the slide, click on the **[Undo]** button or choose **Undo Delete Slide** from the **Edit** menu.

13.12 CHANGING THE ORDER OF SLIDES

As with deleting slides, the easiest way to move slides around is within *Slide Sorter* view.

1. Make sure you are in *Slide Sorter* view.
2. Click on the slide you wish to move, then hold down the mouse button and drag the slide to the new position—a vertical line indicates this.
3. Release the mouse button when the slide is correctly positioned.

Note that in *Normal* view you can change the order by moving (*drag & drop*) the slide miniatures up and down the left panel. In both views, you can also cut/copy and paste slides via the *Clipboard*.

13.13 CREATING NOTES PAGES

In *Notes Page* view, you can create notes that you can print out and use as a guide during your presentation. Each printed page contains an image of the corresponding slide and its notes.

1. Select one of your slides then, from the **View** menu, choose **Notes Page**.
2. Click in the *notes placeholder* below the copy of the slide (where it says *Click to add text*).
3. To enlarge the page so that you can read what you are typing, click on the *list arrow* attached to the **[Zoom]** button and select 100%.
4. Type in some notes for the speaker, for example: Remember to say...
5. Close the notes by clicking on the **[Normal View]** button (or use **Normal** in the **View** menu).
6. Press **<Ctrl s>** to save any changes to your file.

13.14 RUNNING THE PRESENTATION

Once you have made the slides for a presentation, you can run it as a slide show. Remember that if you use the **[Slide Show]** button then the show will begin from

the currently selected slide; if you use the command from the View menu (or press <F5>) then the show starts from the first slide.

You can run a presentation from the current slide using the key combination <Shift F5>.

NOTES

1. Click on slide 1 to ensure the show starts from the very beginning.
2. Click on the [Slide Show] button (or use <F5> or Slide Show from the View menu).
3. To move forward one slide, click the left mouse button (or press <Enter>, <n>, <right arrow>, <down arrow> or the <spacebar> on the keyboard).
4. To move back one slide, press the <left arrow> key (or <p> or <up arrow>).

You can also click the *right* mouse button to display a popup menu. This presents you with a number of useful tools, including:

- (i) Next and Previous to move back/on one slide, respectively
- (ii) Last Viewed—useful if you have jumped to another slide (out of sequence)
- (iii) Go to Slide—to jump to another slide in the presentation
- (iv) Screen—gives you control over the display
 - (a) Choose Black Screen or White Screen to temporarily suspend the presentation
 - (b) Choose Speaker Notes to display your notes to your audience
 - (c) Switch Programs displays the Windows *Task Bar*
- (v) Pointer Options—annotation pens for scribbling over your presentation
 - (a) Choose Ballpoint Pen to change the arrow pointer to a pen which can be used to draw on the slide - choose Felt Tip Pen for a wider pen or Highlighter to highlight text
 - (b) Choose Ink Color to change the colour of the pen
 - (c) Use Eraser or Erase All Ink on Slide to remove any pen marks you may have drawn
 - (d) Use Arrow Options and Automatic to set your pen back to a pointer or Hidden to hide the pointer
- (vi) Help gives information about other key combinations you can use during the show
- (vii) End Show—use this if you need to finish early.

When you reach the end of the show, PowerPoint gives you a black *End of slide show* screen. If you have added ink annotations to your slides, you are asked if you want to keep them; you are then returned to the previous view. To leave the slide

show at any other time, press the <Esc> key.

NOTES

13.15 ANIMATING YOUR PRESENTATION

Presentations are greatly improved by adding animation. PowerPoint gives you a wide selection of built-in animations, both while moving between one slide and the next and within each slide (as you introduce points in a list, for example).

Slide Transitions

Instead of simply moving abruptly from one slide to another during a presentation, slide transitions allow slides to dissolve into each other, using a variety of different special effects. These can make your on-screen presentation look even better and more professional, but do not get too carried away!

1. Check you are in *Normal* view and that the first slide is selected.
2. Open the Slide Show menu and choose Slide Transition.
3. Under *Apply to selected slides:*, choose Blinds Horizontal.

As you select a transition, PowerPoint quickly shows you what it will look like on the miniature version of the slide. Try out some of the other transitions, if you like. Note that a *small star* symbol appears on the left of each miniature—this indicates that a transition has been setup on this slide. Next, explore the other useful options in the *Slide Transition* window:

4. Under *Modify transition*, change the *Speed:* of the transition effect (e.g., choose Medium or Slow to see the effect clearly) and set up a *Sound*.
5. If you do not want to click on the mouse every time to move on, under *Advance slide*, set the next slide to appear *Automatically* after a set number of seconds.
6. Move to the next slide and repeat steps 3 to 5, choosing different effects.
7. Finally save your presentation (press <Ctrl s>) then run it (<F5>) to see the effects—press <Esc> when you've seen enough.

The [Apply to All Slides] button applies the same transition throughout your presentation. Using a standard transition is good for accessibility; only choose something different for effect.

Animation Schemes

PowerPoint offers animation supports which can be used effectively to add some motion in a monotonous presentation and make it more interesting. Animation can be applied to any object on the slide and the motions can be automated, timed or triggered.

Given below are the steps to add and preview animations in the slide.

Step (1): Go to the **Animation** ribbon and click on **Animation Pane** to display the animation sidebar.

Step (2): Select one of the objects in the slide and click on **Add Animation** menu option.

Step (3): Choose from one of the Animation options.

- **Entrance** will cause the object to appear in the screen
- **Emphasis** will cause the object to emphasis without appearing or leaving the screen
- **Exit** will cause the object to disappear from the screen

Step (4): Once you add the animation for an object, it would show up in the **Animation pane**.

Step (5): By default, all the animations are initiated by a click, but you can change this. To change the trigger right click on the animation object on the pane and choose an alternate trigger.

- **Start On Click** will cause the animation to start when you click the mouse
- **Start With Previous** will cause the animation to begin with the previous animation; if this is the first object it will begin as soon as you reach the slide during the slide show
- **Start After Previous** will cause the animation to begin after the previous animation ends

Step (6): From the timing section, you can also manipulate the animation timings

Step (7): To preview the animation settings just click **Play** on the animation pane

Closing the Presentation

To quit from Power Point:

1. Choose Exit from the File menu
2. Press <Enter> for [Yes] to save the changes in the current file.

13.16 MS ACCESS

Microsoft Access is a database software package. A database is an organized collection of records. Telephone and address books are examples of paper databases. With Access, you can create a computerized database. Access 2010 is a database application design and deployment tool that you can use to keep track of important information. You can keep your data on your computer, or you can publish to the Web — so others can use your database with a web browser. Many people start using Access when the program that they are using to keep track of something gradually becomes less fit for the task. For example, suppose you are an event planner, and you want to keep track of all the details that you need to manage to make your events successful. If you use a word processor or spreadsheet program to do this, you can easily run into trouble with duplicate and inconsistent data. You can use calendaring software, but tracking financial information in a calendar is not a good fit.

NOTES

Relational Databases in Access

Sometimes you need a relational database to track such information — a storehouse of data that has been separated into smaller collections of data (called tables) to eliminate redundancy, and then related together based on common bits of information (called fields). For example, an event planning relational database might contain a table with customer information, a table with vendor information, and a table with event information. The table with event information might have a field to relate it to the customer table, and a field to relate it to the vendor table. That way, for example, if a vendor's phone number changed, the information could be changed once in the vendor table, instead of in every event that involved the vendor.

Access is a tool that you can use to quickly and easily develop relational database applications that help you manage information. You can create a database to help you keep track of just about any kind of information, such as inventory, professional contacts, or business processes. In fact, Access comes with templates that you can use right away to track a variety of information, making things easy even for a beginner.

Start MS Access

When you start Access 2010, you see the Microsoft Office Backstage view, where you can get information about the current database, create a new database, open an existing database, and view featured content from Office.com.



Fig. 13.3:

Backstage view also contains many other commands that you can use to adjust, maintain, or share your databases. Commands in Backstage view generally apply to entire databases, not to objects inside of a database.

13.17 FIND AND APPLY A TEMPLATE

Access provides you with a wide variety of templates that you can use to speed up your database creation process. A template is a ready-to-use database that contains all of the tables, queries, forms, and reports needed for performing a specific task. For example, there are templates that can be used to track issues, manage contacts, or keep a record of expenses. Some templates contain a few sample records to help demonstrate their use. Template databases can be used as is, or you can customize them to better fit your needs. To find and apply a template to your database, do the following:

NOTES

1. On the **File** tab, click **New**.
2. Under **Available Templates**, do one of the following:
 - (i) To reuse a template that you've recently used, click **Recent Templates**, and then select the template that you want.
 - (ii) To use a template that you already have installed, click **My Templates**, and then select the template that you want.
 - (iii) To find a template on Office.com, under **Office.com Templates**, click a template category, select the template that you want, and then click **Download** to download the template from Office .com to your computer.

You can also search for templates on Office.com from within Access. In the **Search Office.com for templates** box, type one or more search terms, and then click the arrow button to search.

3. Optionally, click the folder icon next to the **File Name** box to browse to a location where you want to create the database. If you don't indicate a specific location, Access creates the database in the default location that is displayed below the **File Name** box.
4. Click **Create**. Access creates the database and opens it for use.

13.18 CREATE A DATABASE FROM SCRATCH

If none of the templates fits your needs, or if you have data in another program that you want to use in Access, you may decide that it is better to create a database from scratch. In Access 2010, you have a choice: a standard desktop database, or a web database. To create a new database, do the following:

Start Access

1. On the **New** tab in backstage view, click **Blank Database** or **Blank Web Database**.

NOTES

2. The choice that you make here will determine what features are available in the database.

Desktop databases cannot be published to the Web, and web databases do not support some desktop features, such as totals queries.

3. On the right, type a name for your database in the **File Name** box.

To change the location in which you create the file, click **Browse**  next to the **File Name** box, browse to and select the new location, and then click **OK**.

4. Click **Create**.

Access creates the database, and then opens an empty table (named Table1) in Datasheet view.

5. Access puts the cursor in the first empty cell in the **Click to Add** column of the new table. To add data, begin typing — or you can paste data from another source.

- (i) Entering data in the Datasheet view is designed to be very similar to entering data in an Excel worksheet. The main restriction is that data must be entered in contiguous rows and columns, starting at the upper-left corner of the datasheet. You should not try to format your data by including blank rows or columns as you might do in an Excel worksheet, because doing so will waste space in your table. The table merely contains your data. All visual presentation of that data will be done in the forms and reports that you design later.

- (ii) The table structure is created while you enter data. Any time that you add a new column to the datasheet, a new field is defined in the table. Access sets the data type of the field based on the type of data that you enter. For example, if you have a column in which you have entered only date values, Access will set the data type of that field to Date/Time. If you later attempt to enter a non-date value (such as a name or a phone number) in that field, Access displays a message informing you that the value does not match the data type of the column. When possible, you should plan your table so that each column contains the same type of data, whether it is text, dates, numbers, or some other type. This makes it much easier to build queries, forms, and reports that select just the data that you want. If you do not want to enter data yet, click **Close** . Access will delete Table 1 if you close it without saving.

13.19 OPEN AN EXISTING ACCESS DATABASE

To quickly open one of the last several databases that you had open, on the **File** tab, click **Recent**, and then click the file name.

1. On the **File** tab, click **Open**.
2. Click a shortcut in the **Open** dialog box — or, in the **Look in** box, click the drive or folder that contains the database that you want.
3. In the folder list, double-click folders until you open the folder that contains the database.
4. When you find the database, do one of the following:
 - (i) To open the database in default open mode, double-click it.
 - (ii) To open the database for shared access in a multiuser environment, so that both you and other users can both read and write to the database at the same time, click **Open**.
 - (iii) To open the database for read-only access, so that you can view it but cannot edit it, click the arrow next to the **Open** button, and then click **Open Read-Only**.
 - (iv) To open the database for exclusive access, so that no one else can open it while you have it open, click the arrow next to the **Open** button, and then click **Open Exclusive**.
 - (v) To open the database for read-only access, click the arrow next to the **Open** button, and then click **Open Exclusive Read-Only**. Other users can still open the database, but they only have read-only access.

If you can't find the database that you want to open

1. In the **Open** dialog box, click the **My Computer** shortcut—or, in the **Look in** box, click **My Computer**.
2. In the list of drives, right-click the drive that you think might contain the database, and then click **Search**.
3. Enter your search criteria, and then press ENTER to search for the database.
4. If the database is found, open it by double-clicking it in the **Search Results** dialog box.

Because the search was initiated from the **Open** dialog box, you must click **Cancel** in that dialog box before the database will open.

You can directly open a data file in an external file format (such as dBASE, Paradox, Microsoft Exchange, or Excel). You can also directly open any ODBC data source, such as Microsoft SQL Server or Microsoft FoxPro. Access automatically creates a new Access database in the same folder as the data file, and adds links to each table in the external database.

13.20 GET STARTED USING YOUR NEW DATABASE

NOTES

Depending on the template that you used, you might need to do one or more of the following to get started with the new database:

1. If Access displays a **Login** dialog box with an empty list of users, use the following procedure to get started:
 - (i) Click **New User**.
 - (ii) Fill in the **User Details** form.
 - (iii) Click **Save & Close**.
 - (iv) Select the user name you just entered, and then click **Login**.
2. If Access displays an empty datasheet, you can begin typing data directly into that datasheet, or click other buttons and tabs to explore the database.
3. If Access displays a **Getting Started** page, you can click links on that page to learn more about the database, or click other buttons and tabs to explore the database.
4. If Access displays a **Security Warning** message in the message bar, and you trust the source of the template, click **Enable Content**. If the database requires a login, you will need to log in again.

13.20.1 Add a Table

You can add a new table to an existing database by using the tools in the **Tables** group on the **Create** tab.

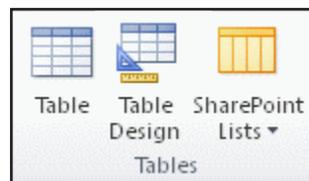


Fig. 13.4:

In a web database, only the **Table** command is available in the **Tables** group. Regardless of which view you start in, you can always switch to the other view by using the view buttons on the status bar of the Access window.

Create a blank table in Datasheet view: In Datasheet view, you can enter data immediately, and let Access build the table structure behind the scenes. Field names are assigned numerically (Field1, Field2, and so on), and Access sets the field data type, based on the type of data that you enter.

1. On the **Create** tab, in the **Tables** group, click **Table** .
2. Access creates the table, and then places the cursor in the first empty cell in the **Click to Add** column.

3. To add data, begin typing in the first empty cell — or you can paste data from another source, as described later in this article.
 - (i) To rename a column (field), double-click the column heading, and then type the new name.
 - (ii) To move a column, select it by clicking its column heading, and then drag it to where you want it. You can also select several contiguous columns and drag them all to a new location together.

NOTES

To add more fields to your table, you can either begin typing in the **Click to Add** column in Datasheet view, or you can add new fields by using the commands in the **Add & Delete** group on the **Fields** tab.

Create a table starting in Design view: In Design view, you first create the new table's structure. Then you either switch to Datasheet view to enter data, or you enter your data by using some other method, such as with a form. Design view is not available for tables in a web database.

1. On the **Create** tab, in the **Tables** group, click **Table Design**. 
2. For each field in your table, type a name in the **Field Name** column, and then select a data type from the **Data Type** list.
3. You can enter additional information for each field in the **Description** column. The description that you enter is displayed in the status bar when the insertion point is in that field, and is used as the status bar text for any controls that you create by dragging the field from the **Field List** pane to a form or report, and for any controls that are created for that field by the Form Wizard or Report Wizard.
4. After you have added all of your fields, save the table:
 - (i) On the **File** tab, click **Save**.
5. You can begin entering data into the table at any time by switching to Datasheet view, clicking in the first empty cell, and typing. You can also paste data from another source, as described in the next section.

Create a table based on a SharePoint list: With a SharePoint list, your data can be used by people who do not have Access. Moreover, list data is stored on a server, which generally offers better protection against data loss than files stored on a desktop computer. You can either start with a new list, or you can link to an existing list. You must have sufficient permissions on the SharePoint site where you want to create the list; this can vary by site, so contact your SharePoint administrator for details about your options. This feature is not available in a Web database.

1. On the **Create** tab, in the **Tables** group, click **SharePoint Lists**.
2. You can use one of the list templates to create a standard SharePoint list, such as **Contacts** or **Events**. You can also choose to create a custom list, or to link to or import an existing list. Click the option that you want.

3. If you choose any of the list templates or to create a custom list, the **Create New List** dialog box opens to guide you through the process. If you choose to use an existing list, the **Get External Data** dialog box opens to help you.

NOTES

13.20.2 Paste Data from Another Source into an Access Table

If your data is currently stored in another program, such as Excel, you can copy and paste your data into an Access table. In general, this works best if your data is already separated into columns, as they are in an Excel worksheet. If your data is in a word processing program, you should first separate the columns of data by using tabs, or convert the data into a table in the word processing program, and then copy the data. If your data needs any editing or manipulation (for example, separating full names into first and last names), you might want to do this before you copy the data, particularly if you are not familiar with Access.

When you paste data into an empty table, Access sets the data type of each field according to what kind of data it finds there. For example, if a pasted field contains nothing but date values, Access applies the Date/Time data type to that field. If the pasted field contains only the words “yes” and “no”, Access applies the Yes/No data type to the field.

Access names the fields depending on what it finds in the first row of pasted data. If the first row of pasted data is similar in type to the rows that follow, Access determines that the first row is a part of the data and assigns the fields generic names (Field1, Field2, and so on). If the first row of pasted data is not similar to the rows that follow, Access uses the first row as field names, and excludes the first row in the actual data.

If Access assigns generic field names, you should rename the fields as soon as possible to avoid confusion. Use the following procedure:

1. On the **File** tab, click **Save** to save the table.
2. In Datasheet view, double-click each column heading, and then type a name for the column.
3. Save the table again.

13.20.3 Import or Link to Data from Another Source

You might have data that you’ve been collecting in another program that you would like to use in Access. Perhaps you work with people who store their data in other programs, and you want to work with their data in Access. Or, maybe you have multiple disparate sources of data, and need a “landing pad” where you can bring them all together for deeper analysis.

Access makes it easy to import or link data from other programs. You can bring in data from an Excel worksheet, from a table in another Access database, from a SharePoint list, or from any of a variety of other sources. The process differs slightly depending on the data source, but these instructions will get you started:

1. On the **External Data** tab, in the **Import & Link** group, click the command for the type of file that you are importing from.

For example, if you are importing data from an Excel worksheet, click **Excel**. If you don't see the correct program type, click **More**.

If you can't find the correct format type in the **Import & Link** group, you may need to start the program in which you originally created the data, and then use that program to save the data in a file format that Access supports (such as a delimited text file), and then import or link to the data.

2. In the **Get External Data** dialog box, either click **Browse** to browse to the source data file, or type the full path of the source data file in the **File name** box.
3. Click the option that you want under **Specify how and where you want to store the data in the current database**. You can create a new table by using the imported data, or create a linked table that maintains a link to the data source.
4. Click **OK**.

Depending on your choice, the **Link Objects** dialog box or the **Import Objects** dialog box opens.

5. Use the dialog box to finish the process. The exact procedure you follow depends on the import or link option that you choose.
6. On the last page of the wizard, click **Finish**.
7. If you choose to import, Access asks whether you want to save the details of the import operation that you just completed.

If you think that you will be performing this same import operation again, click **Save import steps**, and then enter the details.

8. You can then easily reproduce the import operation by clicking **Saved Imports** in the **Import** group on the **External Data** tab, clicking the import specification, and then clicking **Run**.

If you don't want to save the details of the operation, click **Close**.

Access imports the data into a new table, and then displays the table under **Tables** in the Navigation Pane.

To learn more about how to import data into Access, follow the links in the **See Also** section of this article.

Next Steps

The rest of the design process varies based on your goals, but you probably want to consider creating queries, forms, reports, and macros. This article does not provide information about creating additional database objects.

NOTES

13.21 IMPORT DATA FROM A SPREADSHEET OR OTHER PROGRAM

NOTES

If you are familiar with other database or spreadsheet programs, you probably know the basics of how these applications work and what databases are used for. Access differs from many other database applications by allowing you to create relational databases, and it further differs from most spreadsheet programs by offering tools for developing sophisticated queries, forms, and reports. Access also provides many options for working with other database programs, such as SQL Server.

Import an Excel Worksheet into Access

Many people begin to explore Access after first building a list in Excel. Excel is a great place to start a list, but as the list grows, it becomes harder to organize and keep updated. Moving the list to Access is usually the next logical step.

A database table is similar in structure to a worksheet, in the sense that data is stored in rows and columns. As a result, it is usually easy to import a worksheet into a database table. The main difference between storing your data in a worksheet and storing it in a database is in how the data is organized. Simply importing your entire worksheet as a new table in a database will not solve the problems associated with organizing and updating your data, particularly if your worksheet contains redundant data. To solve those problems, you must split the spreadsheet data into separate tables, each one containing related data. Access features the Table Analyzer Wizard, which can help you to complete this process. After importing your data into a table, the wizard helps you to split the table into separate tables, each of which contains data that is not duplicated in any of the other tables. The wizard also creates the necessary relationships between the tables.

Import an Excel Worksheet as a Table in a New Database

1. On the **File** tab, click **New**, and then click **Blank Database**.
2. Type a name for the new database in the **File Name** box, and then click **Create**.

The new database opens, and Access creates a new empty table, Table 1.

3. Close Table 1.

When asked if you want to save changes to the design of Table 1, click **No**.

4. On the **External Data** tab, in the **Import & Link** group, click **Excel**. 
5. In the **Get External Data** dialog box, click **Browse**.
6. Use the **File Open** dialog box to locate your file.
7. Select the file, and then click **Open**.
8. In the **Get External Data** dialog box, ensure that the **Import the source data into a new table in the current database** option is selected.

9. Click **OK**.
10. Follow the instructions, clicking **Next** or **Back** to navigate through the pages. On the last page of the wizard, click **Finish**.

Access asks whether you want to save the details of the import operation that you just completed. If you think that you will be performing this same import operation again, click **Yes**, and then enter the details. You can then easily reproduce the operation in the future by clicking **Saved Imports** in the **Import** group on the **External Data** tab. If you don't want to save the details of the operation, click **Close**. Access imports the data into a new table, and then displays it under **All Tables** in the Navigation Pane.

Use the Table Analyzer Wizard to Organize your Data

After your data is imported into an Access table, you can use the Table Analyzer Wizard to quickly identify redundant data. The wizard then provides a simple way to organize the data into separate tables, so that it can be stored in the most efficient way. Access preserves the original table as a backup, and then creates new tables that you can use as the basis for your database application.

1. Open the Access database that contains the table that you want to analyze.
2. On the **Database Tools** tab, in the **Analyze** group, click **Analyze Table**.

The Table Analyzer Wizard starts.

The first two pages of the wizard contain a short tutorial — complete with buttons that you can click to see examples. If you don't see the introductory pages, but instead see a check box labeled **Show introductory pages?**, select the check box, and then click **Back** twice to see the introduction. If you don't want to see the introductory pages again after reading the introduction, you can clear the **Show introductory pages?** check box.

3. On the **Which table contains fields with values that are repeated in many records?** page, select the table that you want to analyze, and then click **Next**.
4. You can let the wizard decide which fields go in which tables, or you can make that decision yourself. If you follow the wizard's suggestions, you can still make changes to the table layout on the next page of the wizard.

If you let the wizard decide which fields to put in which tables, its choices may not always be appropriate for your data, especially if there is not much data to work with. You should check the wizard's results carefully. On the other hand, the wizard may suggest a more efficient organization than the one that you are thinking of, so it is a good idea to at least try the wizard's decisions once. If you don't like the suggestions, you can still rearrange the fields manually, and you can always click **Back** and arrange all of the fields yourself.

5. Click **Next**. On this page, you specify which tables contain which fields. If you chose to let the wizard decide, you should see multiple tables connected by

NOTES

relationship lines. Otherwise, Access creates only one table containing all of the fields. In either case, you can make changes on this page.

- (i) You can drag fields from a table to a blank area of the page to create a new table that contains those fields. Access prompts you for a table name.
 - (ii) You can drag fields from one table to another table if you think that they will be stored more efficiently there.
 - (iii) Most tables will be given an **ID** or a **Generated Unique ID** field. To learn more about the ID fields, click **Tips** in the upper-right corner of the wizard.
 - (iv) To undo a change, click the **Undo** button.
 - (v) To rename a table, double-click its title bar, type the new name, and then click **OK**.
6. After you have the fields arranged the way that you want them, click **Next**.
 7. If the wizard finds records that have very similar values, it will identify those values as possible typographical errors and present a screen where you can confirm what to do about them. Scroll through the list to find any that have values in the **Correction** column, and then click the appropriate item in the drop-down list. Select **(Leave as-is)** to keep the wizard from making any changes to the value. When you are finished, click **Next**.
 8. The wizard asks whether you want to create a query that resembles your original table. If you have already built forms and reports that are based on the original table, creating such a query is a good idea. If you choose **Yes, create the query**, the wizard renames the original table by appending “_OLD” to the table name, and then names the new query by using the name of the original table. The forms and reports that were based on the table now use the query for their data, and they continue to work as before.
 9. Click **Finish**. The wizard creates the new tables as specified, and then opens them. Close them when you are finished inspecting the results.

Work with Data from other Programs

Access 2010 provides features for working with data that is stored in other programs. **Create a new Access database that links to data in another file format.** You can use Access to open a file in another file format such as text, dBASE, or a spreadsheet. Access automatically creates an Access database and links the file for you.

1. Start Access.
2. On the **File** tab, click **Open**.
3. In the **Open** dialog box, click the type of the file that you want to open in the list. If you're not sure of the file type, click **All Files (*.*)**.

4. If needed, browse to the folder containing the file that you want to open. When you find the file, double-click it to open it.
5. Follow the instructions in the wizard. On the last page of the wizard, click **Finish**.

Import or link data to an existing Access database: You can either import data from other sources and programs into Access tables so that the data is contained within the Access file, or you can link to the data from Access so that the data remains in the original file (outside of the Access file).

NOTES

1. On the **External Data** tab, in the **Import & Link** group, click the format in which the data is stored.

You can import or link to data from the following sources:

- (i) **Excel:** You can bring in data from a worksheet or a named range in an Excel workbook. Each worksheet or named range must be imported or linked separately.
- (ii) **Access:** This is very handy for separating your process from your data, creating a split database. That is, you can use one database to contain all your forms, reports, and macros, and keep your data in another database. You can then develop improvements without interrupting anyone's work. You can also combine data from many different Access databases in one, making it easier to summarize data across departments or between business partners.
- (iii) **ODBC database:** Many programs support this format, including many database server products. This helps you create 'landing pad' databases, where you combine data from different systems.
- (iv) **Text file:** You can connect to a simple text file, and can even use Access to change the contents of that file. This can help make Access data easy to consume by a wide range of programs.
- (v) **XML file:** This format also offers compatibility with a variety of other programs, including some web servers.
- (vi) **SharePoint list:** This makes your data usable with a web browser, the standard way to use a SharePoint list.
- (vii) **Data Services:** You can connect to web data services inside your enterprise.
- (viii) HTML Document
- (ix) **Outlook folder:** You can connect to Outlook folders, so you more easily integrate your contact information with the rest of your data.
- (x) **dBase file:** dBase is a popular alternative database system that is supported by Access.

The **Get External Data** dialog box appears.

2. Follow the instructions in the dialog box.

Access will import or link the data to your database. For most formats, you must specify the location of the data, and then choose how you want the data to be stored in your database.

13.22 USE AN EARLIER-VERSION DATABASE IN SEVERAL VERSIONS OF ACCESS

If your Access database or Access project was created in Access 2000 or later, you can use the database or project in the version of Access in which it was created or in any later version—even if the file is security enabled. For example, Access 2000 files can be used in Access 2000, Access 2002, Access 2003, Access 2007, and Access 2010. You may have a situation where you want to keep your data in an earlier version of Access, but you have users with a later version of Access that want to link to that data but still take advantage of some of the features of the later version. The solution is to create a new “front-end” database in the later version (containing forms, reports, queries, macros, but no tables), and link it to the tables in the earlier version file. Use one of the following procedures, depending on whether your database is contained in one file, or is already split into a front-end/back-end application.

Use an Access Database File in Several Versions of Access

If all the tables, forms, and other objects of your earlier-version Access database are contained in one file, and you want to use the database in several versions of Access, you can create a new front-end database in a later version and link it to the original file. Users that have the earlier version of Access are still able to use the original database. Users that have the later version can use the new front-end database to link to the same data. You can create several front-end versions if you need to accommodate multiple versions of Access.

Step 1: Make a copy of the existing database, and save it in a new format

Use the following procedure to convert the database to any of the three most recent formats: Access 2000, Access 2002-2003, or Access 2007. This command preserves the original database in its original format, and creates a copy in the format that you specify.

1. Close the Access file. If the file is a multiuser Access database located on a server or in a shared folder, ensure that no one else can open it.
2. Start Access 2010.
3. On the **File** tab, click **Open**.
4. Browse to the location of the file that you want to convert, and then double-click it to open it. If the **Database Enhancement** dialog box appears, asking whether you want to enhance the database, click **No**.
5. If a form opens when you start the database, close the form.

6. On the **File** tab, click **Save Database As**.
7. In the **Save As** dialog box, type a name for the new database.
8. Click **Save**.

Step 2: Split the copy database, and use the original file as the back-end database

Split the converted database by using the following procedure:

1. On the **Database Tools** tab, in the **Move Data** group, click **Access Database**. 
2. In the **Database Splitter** dialog box, click **Split Database**. You can make a backup if you want, but you could also just re-create the copy by using the original database.
3. Type a name for the back-end database, and then click **Split**.

Step 3: Connect the new front-end to the original database

1. Delete the back-end database that the Database Splitter tool created — being careful not to delete your original database.
2. Link the new front-end database to the tables in the original database: On the **External Data** tab, in the **Import & Link** group, click **Linked Table Manager**. 
3. Click **Select All**, and then select the **Always prompt for new location** check box.
4. Click **OK**, browse to the earlier-version database, and then double-click it.

If all goes well, Access displays a message stating that all selected linked tables were successfully refreshed. You can now enhance the new front-end database to support new features for users who have newer versions of Access. Users who have earlier versions can continue to use the earlier version database.

Use a Front-end/back-end Application in Several Versions of Access

If your Access database is already a front-end/back-end application, you can convert the front end to the new file format. No changes are necessary for the back-end database.

The following procedure shows you how to use the **Save Database As** command to convert the front-end database to any one of the three most recent formats: Access 2000, Access 2002-2003, or Access 2007. This command preserves the original database in its original format and creates a copy in the format that you specify.

1. Close the front-end database. If the file is a multiuser Access database located on a server or in a shared folder, make sure that no one else can open it.
2. Start Access 2010.
3. On the **File** tab, click **Open**.
4. Browse to the location of the front-end database, and then double-click it to open it. If the **Database Enhancement** dialog box appears, asking whether you want to enhance the database, click **No**.

NOTES

NOTES

5. If a form appears when you open the database, close the form.
6. On the **File** tab, click **Save Database As**.
7. In the **Save As** dialog box, type a name for the new database.
8. Click **Save**.

Check Your Progress

Fill in the blanks:

1. offers a host to tools that will aid you in creating a presentation. These tools are organized logically into various ribbons in PowerPoint.
2. A template can make your presentation look more professional.
3. In view, you can create notes that you can print out and use as a guide during your presentation.
4. are greatly improved by adding animation.
5. Slide allow slides to dissolve into each other, using a variety of different special effects.
6. Animation can be applied to any object on the slide and the motions can be, or
7. Microsoft Access is a
8. Access 2010 is a design and deployment tool that you can use to keep track of important information.
9. The extension of a Power Point is
10. Ctrl+S is the shortcut key for
11. is an example for Data base Management system.
12. define the left and right side margin of a paragraph.
13. is a data type in MS Access.
14. is a program that helps to create slide presentations quickly.
15. Clip art is a collection of files.
16. Picture option is in menu.

13.23 SUMMARY

- Microsoft PowerPoint is widely used for making professional quality presentations in a variety of formats, including on-screen computer slide

shows, black-and-white or colour overheads, and 35mm slides. You can also use it for notes and class presentations. In addition, PowerPoint can be used as a drawing package for preparing pictures, forms, posters and leaflets. Presentation is a powerful managerial tool of communication through which you can compile and deliver your ideas, concepts, plans or products to the audience in a structured, effective and impressive manner.

- Slides and transparencies are used to be projected in front of the audience using overhead projector or otherwise. The operation of this equipment was mainly manual, semi-automated at the best. This approach had obvious limitations. Computers have now replaced the traditional method of presentation entirely.
- Microsoft Access is a database software package. A database is an organized collection of records. With Access, you can create a computerized database. Access 2010 is a database application design and deployment tool that you can use to keep track of important information.

13.24 GLOSSARY

- **Title Bar:** This is the top section of the window. It shows the name of the file followed by the name of the program which in this case is Microsoft PowerPoint.
- **Slide Area:** This is the area where the actual slide is created and edited. You can add, edit and delete text, images, shapes and multimedia in this section.
- **Normal Layout View:** This displays page in normal view with the slide on the right and a list of thumbnails to the left. This view allows you to edit individual slides and also rearrange them.
- **Slide Sorter View:** This displays all the slides as a matrix. This view only allows you to rearrange the slides but not edit contents of each slide.
- **Notes Section:** This section allows you to add notes for the presentation. These notes will not be displayed on the screen during the presentation; these are just quick reference for the presenter.
- **Quick Access Toolbar:** The Quick Access Toolbar is located just under the ribbon. This toolbar offers a convenient place to group the most commonly used commands in PowerPoint. You can customize this toolbar to suit your needs.
- **Slide Tab:** This section is available only in the Normal view. It displays all the slides in sequence. You can add, delete and reorder slides from this section.
- **Microsoft Access:** It is a database software package.

NOTES

13.25 ANSWERS TO CHECK YOUR PROGRESS

1. PowerPoint
2. slide design
3. Notes Page
4. Presentations
5. Transitions
6. Automated, timed, trigger
7. database software package
8. database application
9. ppt
10. save
11. MS Access
12. justify
13. Currency
14. Power Point
15. graphic
16. Insert

13.26 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is MS PowerPoint?.
2. What are the major features of MS PowerPoint?
3. What is Access?
4. What do you mean by Relational databases in Access?

Long Answer Questions

1. What do you use MS PowerPoint for? Elaborate.
2. Discuss the major features of MS PowerPoint.
3. Explain the major functions used in MS PowerPoint.
4. Create a PowerPoint Presentation with animated slides.
5. How will you open MS Access 2010?

6. Explain how to find and apply a template in MS Access.
7. How will you create a database from scratch in MS Access?
8. How will you open an existing Access database in MS Access?
9. How will you add a table in MS Access?
10. How will you paste data from another source into an Access table?
11. How will you import or link to data from another source in MS Access?

NOTES

13.27 REFERENCES

1. J. K. Shahjahan, *MS Office 2000*, Excel Books
2. Sanjeev Gupta and Shameena Gupta, *Computer Aided Management (Using MS-Office 2003 Tools)*, Excel Books
3. Joseph W. Habraken, *Microsoft Office 2003, All-In-One*, Que Publishing
4. Jennifer Ackerman Kettell, Guy Hart-Davis and Curt Simmons, *Microsoft Office 2003: The Complete Reference*, McGraw-Hill Professional
5. Laurie Ann Ulrich, *How to Do Everything with Microsoft Office 2003*, McGraw-Hill Professional

UNIT 14: MANAGEMENT OF DATA PROCESSING SYSTEMS IN BUSINESS ORGANIZATION

Structure

- 14.0 Introduction
- 14.1 Unit Objectives
- 14.2 Modes of Data Processing
- 14.3 Basic Functions of Data Processing
- 14.4 Application Portfolio Development
- 14.5 Management of Data Processing Systems in Business Organizations
- 14.6 Data Processing Cycle
- 14.7 Data Processing Flowcharting Symbols
- 14.8 Characteristics of EDP Systems
- 14.9 Limitations of EDP Systems
- 14.10 Summary
- 14.11 Glossary
- 14.12 Answers to Check Your Progress
- 14.13 Terminal and Model Questions
- 14.14 References

14.0 INTRODUCTION

The computer processes the data to give information. Processing of data is done by the CPU in various ways. In this unit we will discuss various types of data processing techniques, their functions, data hierarchy, data processing cycle and structure.

14.1 UNIT OBJECTIVES

After going through this unit, you will be able to know about:

- Various modes of data processing
- Basic functions carried out in data processing
- Data hierarchy and data structure
- Application portfolio of business organization

14.2 MODES OF DATA PROCESSING

Organizations generally follow the following types of data processing systems with the aim of optimizing efficiency. The systems are:

NOTES

Batch Processing

Also referred to as serial or off-line or sequential processing.

This type of processing requires the data to be initially grouped (as a batch) before it is processed serially, and the results obtained periodically.

The batch might be a group of sales orders or purchase orders, etc., collected off-line.

The batch is processed at a definite period of time in a stipulated frequency, and each transaction in batch is processed in a serial order.

The method of batch processing reduces the idle time of a computer system because transition from one job to another does not require operator intervention.

It is the most appropriate method of processing for many types of applications, such as payroll or preparation of customer statements, where it is not necessary to update information (records) on daily basis.

Batch processing suffers from several disadvantages which are as follows:

- Reduces timeliness in some cases.
- It makes each job wait in line at each step and often increases its turnaround time.
- It is difficult to provide the desired priority scheduling.

On-line Processing

On-line processing is that type of processing where the result of data processing transaction is available immediately.

It permits transaction data to be fed under CPU control directly into secondary on-line storage devices from the point of origin without sorting it first.

It also permits users to enter into a conversation with the computer to send and receive messages, within a fraction of a second after the enquiry message is transmitted.

This conversation permits the user to process transactions one after another with greater assurance that the actions taken by the computer are correct. This type of processing also provides a satisfaction to the users that they are able to command the machine. However, this type of processing can not be used in all circumstances as otherwise the processing time will increase. Examples of online applications include: Banking, stock exchanges, stock control, work progress control in plants, inventory status, etc.

Real Time Processing

Real time system is defined as a data processing system in which the time interval required to process and respond to inputs is so small that the response itself is useful for controlling the physical activity of a process. Real time processing provides immediate (not periodic, as in batch processing) transaction input capability from all input originating stations.

The essential requirements of a real time processing system include:

- direct connection (on-line) between input/output devices and the central processor, and
- fairly fast response time, allowing two-way communication.

The characteristic of real time data processing that truly distinguishes it from the more common batch and on-line processing systems is the immediacy of its response on receipt of a message.

Thus, all on-line systems are not necessarily real time data processing systems. The application areas of real time systems are:

- Enquiries about customer's account status can be answered in seconds.
- Credit appraisal can be carried out immediately.
- Sales analysis master file can be updated on-line. This file provides a ready information to the sales manager regarding sales trends, etc.

Real time system also finds extensive application in airlines booking, banking system, air and ground traffic control, automatic radar connected defence and space programs.

Distributed Data Processing

Distributed processing, broadly speaking, involves a computer system linked by a communication network where processing is performed by separate computers.

Often, each computer in the system is chosen to handle a specific workload with the network supporting the system as a whole. When distributed processing is used, it requires that databases to be located at different sites for efficient functioning.

The database is broken up into logical cooperating parts and situated at a different location. User can access data from any location, easily accessing the local as well as the remote databases.

Distributed Database Systems (DDBS) forms the backbone of distributed computing.

This form is most convenient for organizations with many branch offices located over great distances. Each branch stores data elements relating to its daily operations at its own site. A major part of processing can be taken care of at the local level.

A typical application is in banks where all the branches have intelligent terminals linked to a big computer at the head office. Data from the branches is sent to the master where it is processed.

14.3 BASIC FUNCTIONS OF DATA PROCESSING

Data Processing is the restructuring, manipulation or recording of data by people or machine, to increase their usefulness and value for some particular purpose.

Following are the basic functions carried out in any data processing:

Origination

The first function involved in the processing of data is the origination of the data to be processed.

Specifically, the nature, type and origin of the source documents must be determined, such as sales orders, purchase orders, etc.

Data Capture

Data must be recorded or captured in some form or the other before they can be processed. What data are important and should be collected for input and processing depends upon the organization and the system.

Data may be captured in paper forms using source documents and in paperless forms through:

- Keyboards
- Automated teller machines
- Other direct input devices that accept input data in machine readable form

Sorting

Normally, it is easier to work with data if they are arranged in a logical sequence, e.g., first to last time sequence.

Biggest to smallest.

Oldest to newest, etc.

Arranging classified data in such a sequence is called “sorting”.

Merging

This function allows multiple files to be put together in a sequence, provided the files are already in a sorted order.

E.g.: A file of a new customer could be merged into an existing customer master file that is stored on a magnetic disk in customer number sequence.

Calculating

The arithmetic manipulation of data to create meaningful results is known as calculating, and is a common data processing task.

This process is usually the most significant part of the manipulation operation because the results are generally provided as part of the output.

NOTES

Summarizing

Reducing masses of data to a more concise and usable form is called summarizing. Generally, the data is summarized into the form desired for output.

E.g.: Pie charts

Bar charts

Other graphs

These are the few of the many of computer generated graphics that are used to view data at a glance.

Managing Output Results

Once data have been captured and manipulated, one or more of the following operations may be needed:

Output

After the various operations on the data are completed, the delivery or communication of the information or results must be carried out by:

1. Reporting, which is the format presentation and distribution of processed data.
2. Issuance of documents, such as cheques, invoices, and reports.
3. Retrieval, which is the fetching of a specific item or items of stored information at the request of a user.
4. Analysis, which encompasses all of the ways in which the receivers utilize output, i.e., use the information provided by the system.
5. Communicating and reproducing (transmission).

Transferring data from one location or operation to another, for use or further processing, is data transmission, a process that continues until information in a usable form reaches the final user. Sometimes, of course, it is necessary to copy or duplicate output documents.

Storage

Finally, the results of the processing of data must be retained for future use of reference. This function is called storage.

14.4 APPLICATION PORTFOLIO DEVELOPMENT

An application portfolio of a business organization is a compilation of information about the organization's investments in its IT-based application infrastructure. The information is organized to show how these investments support the organization's mission and programs and to demonstrate the relationships among current and planned

investments. The portfolio enhances the ability of key decision-makers to assess the probable impact of investments on the organization's programs and infrastructure, as well as on the overall IT infrastructure. These decision-makers include organization executives, managers, etc.

Portfolio-based application management is intended to guide the stewardship of vital assets of the organization. It is central to plans of the organization to improve the overall performance. The portfolio approach recognizes the maturing capabilities of the organization. It also recognizes the continuous advance of technology and the need for the organization to see new initiatives in the context of their total operations, including their IT application investments. The portfolio provides a process for coordinating new projects in the context of a business plan and with consideration of the larger IT application portfolio.

The approach has its origin to 1996 Washington State Strategic Plan and includes the foundational policies, procedures, and processes necessary to make informed decisions about IT alternatives and achieve a very high rate of project success.

The application portfolio:

- Discloses links among organization strategies and business plans and investments in applications;
- Facilitates analysis of the risks associated with investments made in applications and helps ensure that appropriate risk mitigation strategies are adopted;
- Provides a baseline for organization-level performance reporting; and
- Helps ensure that the organization IT infrastructure as a whole is effectively integrated.

Characteristic of Portfolio-based IT Management

Portfolio-based IT application management refines the oversight process used to shepherd a number of complex projects through the development process. Those experiences, coupled with extensive consultations with key stakeholders, made clear the need redress shortcomings of the existing process.

The portfolio concept is grounded in the management principle that any significant investment requires careful monitoring to maximize its value and insulate it from threats to its integrity. This principle is well understood with respect to traditional investment categories, real property, commercial paper, and equity investments—all of which are commonly managed in portfolios. These portfolios allow decision-makers to view the range of investments as a whole but also consider discrete investments in context.

The need for an application portfolio is less well understood with respect to investments but no less important. Organization investments on applications involve significant taxpayer funds; are often mission-critical; and are increasingly interrelated in a digital, networked environment. Investments in applications can be leveraged

with great effect if the portfolio is sufficiently flexible to adapt to changing business and service needs. Their value, on the other hand, can be undermined by rigid design, unsubstantiated claims about capabilities or performance, and neglect.

NOTES

Portfolio-based application management is a coordinated approach to the stewardship of the full range of technology investments. It ensures that new initiatives are seen both in the context of the organization wide infrastructure and the respective department-specific application portfolios.

It establishes a framework within which:

- Comprehensive information about the context of an organization's overall operations is readily available for decision-making.
- The development and deployment of application is driven by the clearly defined business needs of an organization in serving citizens and fulfilling its legislative mandate.
- Department heads bring executive focus to application investments and will have new management tools for meeting statutory responsibilities for the stewardship of these investments in their respective departments.
- A formal, objective process exists to evaluate whether a project should be initiated and by which to determine the most appropriate form of oversight based on a comprehensive risk analysis.
- Large projects are broken into smaller, more easily managed projects with each phase adding value on its own without committing funding authorities to subsequent phases.

Portfolio-based IT management organizes information about all IT resources into the perspective of an investment portfolio. The portfolio is responsive to the needs of a variety of decision-makers, including agency executives, agency technical managers, agency program managers and the like. Information is structured to facilitate recognition of trends, analysis of problems and opportunities, and the evaluation of alternatives within the context of an organization's overall investment.

Included in the application portfolio is information about an organization's:

- Mission, strategies, programs, and business processes
- Installed hardware, software, and networks and physical facilities
- Technical management and staff capabilities
- Applications that support organization programs and business processes
- Partnerships or interfaces with other organizations
- Current and planned projects
- Cost and benefits of current and planned investments
- Problems and opportunities involving the applications.

14.5 MANAGEMENT OF DATA PROCESSING SYSTEMS IN BUSINESS ORGANIZATIONS

NOTES

In a typical business organization the data processing system maybe fairly complex. Managing the system is the key factor that determines the success of the organization as a whole. The structure of the management depends on the size and complexity of the system. There may be systems simple enough to be managed by a single manager, while in some cases an entire department maybe involved. In a typical scenario the organization of the data processing system consists of:

1. EDP (Electronic Data Processing) Manager
2. System Programmers
3. Application Programmers
4. Auditors
5. Maintenance Engineers
6. Database Administrators, etc.

In general, following are the responsibilities of the data processing manager:

1. Identifying the need of acquisition of new technology including hardware and software.
2. Evaluating the same.
3. Procuring the approved technology.
4. Providing the EDP services to all the users in the organization according to their needs.
5. Adding new features of processing and removing obsolete ones.
6. Incorporating new business rules and providing required interfaces to the users.
7. Accounting for the usage of the resources.
8. Ensuring the availability of the system by scrutinising and by taking corrective measures in case of any breakdown.

14.6 DATA PROCESSING CYCLE

Electronic Data Processing involves use of electronic processing devices including computers to carry out data processing tasks. Data processing itself is a cyclic process of a sequence of simpler tasks. Though exact nature of these sub-tasks differs from process to process a general simplistic data processing can be represented as in the following figure. This is referred to as Data Processing Cycle.

NOTES

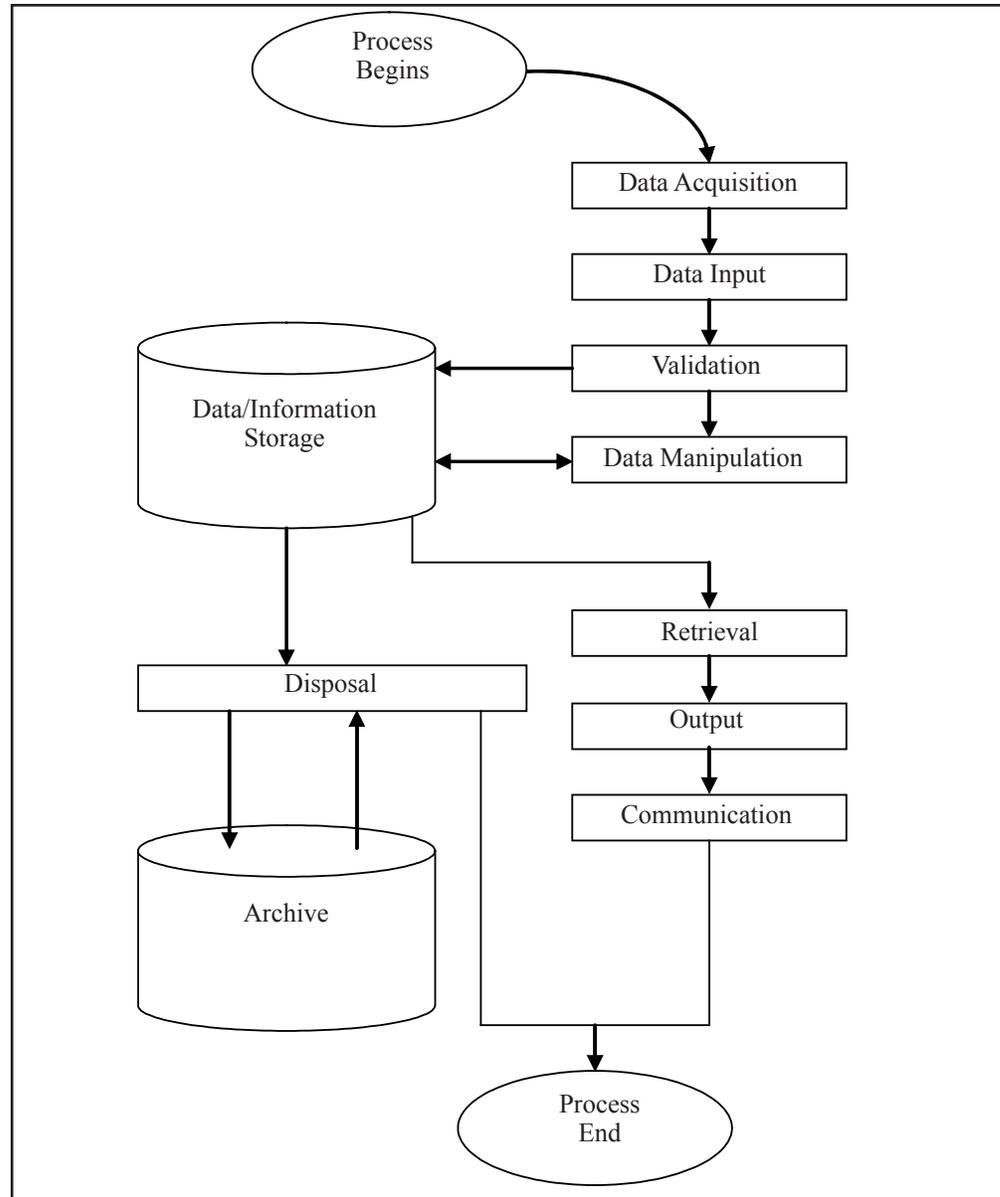


Fig. 14.1

Data Acquisition: Data processing (Electronic or otherwise) begins with the act of data acquisition. The manner which data is acquired depends on the nature of data source. The data source could be as simple as a printed paper or a computer magnetic disk and as complex as a thermal photograph or recorded voice.

Data Input: The data thus received is not always ready in the form suitable to store and/or process further. Therefore, the acquired data is put into a recognizable format, such as a document, spreadsheet, database or slideshow electronically or manually.

Validation: Whenever data is acquired there is a possibility of errors entering into the data. An incorrect data can never generate correct result. Therefore, data should be checked to see that it is correct. Moreover, it is also important to ensure that the

data entry operator has a proper permission for effecting the data entry. Validation may already have been done by the computer if you are using one: for example, if certain rules have been created for one cell in a spreadsheet or database. Some typical validation checks employed for data validation are listed below.

- **Password** can be used to ensure that the operator is authorized to access computer resources, i.e., programs and files.
- **Numeric check** is used to ensure that numerical entries are entered into and accepted by the system. For example, 0-9, +, - should only be accepted as entry for a phone number and not A, X or Y.
- **Alphabetic check** ensures that letters are entered into and accepted by the system where only letters are required to be entered, e.g., letters A-Z in employee name.
- **Sign checks** ensures that positive or negative signs are entered into and accepted by the system where only such signs are required to be entered, e.g., hours worked.
- **Arithmetic check** ensures the validity of the result of a mathematical computation, e.g., total employees for period equals number of employee numbers in system.
- **Limit checks** ensures that only data within predetermined limits will be entered into and accepted by the system, e.g., rate per hour cannot be lower than the minimum set by law or higher than the maximum set by management.
- **Self checking digit** ensures that only specific code numbers prepared by using a specific arithmetic operation will be entered into and accepted by the system, e.g., employee numbers generated by the modules method with prime number weighting.
- **Size check** ensures that only data using fixed or defined field lengths will be entered into and accepted by the systems, e.g., number of dependents requires exactly two digits.
- **Data check** ensures that no blanks will be entered into and accepted by the system when data should be present, e.g., an “M” or “F” is entered in response to whether Male or Female.
- **Control Total checks** ensures that no unauthorized changes are made to specified data or data fields and all data have been entered.
- **Data Manipulation:** This step is the actual transformation of the data into some form of desired output or into a form closer to the desired output. It is the part which will probably take the most of time of total processing time.
- **Data Storage:** The input data may be useful at a later time. Therefore, the input data is stored on persistent storage devices usually on secondary storage devices. Similarly, the processed data and derived information may also be saved for later use.

NOTES

NOTES

- **Retrieval:** Data and information can be fetched from the storage as and when required. This step is referred to as retrieval. Retrieval may be necessary in either further processing of stored data and information or in communicating to the user for probably decision making.
- **Output:** This sub-process prepares reports in the user format by retrieving data and/or information from the storage. In this sense it is opposite of input process. This process prepares reports (hard copy or soft copy) in a readable, useful format, on paper or on a website or even on the console.
- **Communication:** Reports thus prepared in the last phase need to be communicated to the person or process requiring the same. For communication a suitable communication channel like Computer Network can be employed.
- **Disposal:** Repeated accumulation of data and/or information into the storage will eventually deplete the available storage space unless either the storage is continuously expanded or the resident data/information is regularly examined and removed from the storage if no more required. In this sense this phase acts in a manner opposite to acquisition.

While carrying out data disposal two options exist. If the data is not going to be used or required any time in the future, it can be thrown out of the system completely thus freeing the occupied storage. If the data is needed but not very frequently, it can be archived on cheap offline storages such as RAID or microfiches.

Check Your Progress

Fill in the blanks:

1. In processing the result of data processing translation is available immediately.
2. forms the backbone of distributed computing.
3. Data must be or before they can be processed.
4. Basic unit of information in a computer system is called
5. A data structure can be characterized by its and that are defined unit.
6. The approach recognizes the maturing capabilities of the organization.

14.7 DATA PROCESSING FLOWCHARTING SYMBOLS

Electronic Data Processing can be described very conveniently using standard data processing flowcharting symbols enumerated below. The symbols offer the best description of data processing cycles.

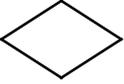
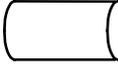
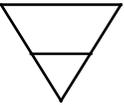
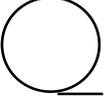
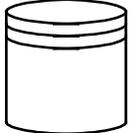
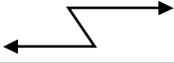
Object	Symbol	Description
	Document	Data collection form. It could be either paper-based or online form
	Automatic Operation	An electronic activity that transforms input to output of some type
	Manual Operation	An activity performed by human operator
	Decision	Specifies which step should be taken under a given IF-THEN-ELSE situation
	Input/Output	Any data interchange between the processing system and the outside world
	Primary storage	Storage directly accessed by the electronic process
	Secondary storage	Backup storage indirectly accessible to electronic processor
	Magnetic tape	A secondary storage for sequential data storage
	Magnetic disk	A secondary storage for random storage of data
	Communication link	Link accessing remote locations
	Flowline	Direction of flow of processing
	Visual Display Unit	Softcopy output device
	On-page connector	Connects flowcharts on the same page
	Off-page connector	Connects flowcharts spanning different pages
	Manual input	Data entry manually

Fig. 14.2

A practical example of data processing cycle is presented below. This data processing

represents a typical data entry operation for application forms' collection.

NOTES

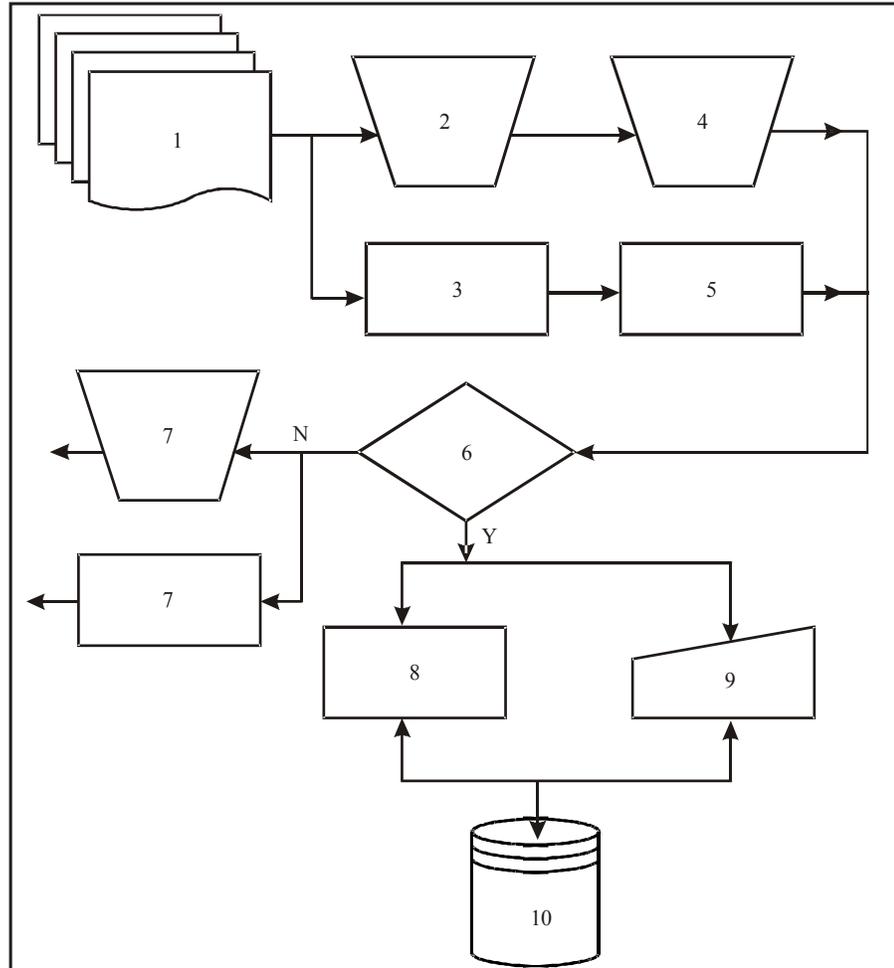


Fig. 14.3

1. Application forms – both hard copies and e-mails.
2. Manual collection of hard copy of applications.
3. Automatic collection through web-site forms.
4. Manual validation to ensure that the applicants have filled in all the required fields correctly.
5. Automatic validation for the input.
6. The condition “VALID?”
7. If the printed application form is invalid dispose it off manually/electronically.
8. Automatic data entry into storage.
9. Manual data entry.
10. The storage.

14.8 CHARACTERISTICS OF EDP SYSTEMS

- **Processes are Standardized:** Standardized processing ensures that

computers process like transactions in a like manner. Therefore, the similar processes are put through the same controls ensuring that clerical error is committed. Even then if an error does occur it can be systematically identified and eliminated.

- **Functions are Segregated:** Similar functions performed by a number of individuals can be segregated into a single function. This removes the incompatible duties from the individual workers.
- **Stronger Control on Errors and Irregularities:** Decreased human involvement in operations reduces the potential for committing errors and intentional fraud.
- **Automatic Processing:** EDP initiates a required process automatically without the active involvement of human operator. Therefore, processing is fast and accurate.

NOTES

14.9 LIMITATIONS OF EDP SYSTEMS

Despite the multitude of advantages offered by EDP it should be remembered that it is not without pitfalls. Some of the limitations of EDP are listed below:

- **Downtime:** EDP relies on electronic devices which are inherently prone to failures due to many reasons. Some of the reasons of failure may not be even apparent. They can be unearthed only after a detailed session of troubleshooting. Until the system resurrects the processes will remain suspended. This downtime may prove costly at times in terms of business loss.
- **Cybercrime:** Sophisticated users may exploit the weaknesses of an EDP system to commit data theft, unfair manipulations and other related crimes.
- **Error at Source:** Remote data entry points (i.e., POS – Point Of Sale) may not be strictly controlled giving rise to inconsistency in the data system thus escalating multiple errors throughout the system.
- **Transaction Trail Loss:** Due to volatile nature transaction trails may be lost or partially obscured as many control procedures in EDP systems do not leave documentary evidence of performance.

Check Your Progress

State whether the following statements are True or False:

7. The method of batch processing reduces the idle time of a computer system.
8. The first function involved in the processing of data is the capturing of data.
9. The data is summarized into the form desired for output.
10. A database is a collection of related records.
11. EDP is essentially a manual system..

14.10 SUMMARY

- Various types of data processing systems followed by the organization to optimize their efficiency are batch processing, online processing, real time processing and distributed data processing.
- The basic functions carried out in any data processing include the origination of the data to be processed, capturing of data before processing, sorting the data, merging the multiple files, performing calculations and summarizing it. Then the results of processing of data are stored for future reference.
- The smallest unit of data is *bit*. 8 bits form one *byte*. One or more bytes that contain data about attributes of an entity is a *field*. A collection of fields relating to a specific entity forms a *record*, collection of related records forms a file and the collection of all files of an organization form a database.
- An application portfolio of a business organization is a compilation of information about the organization's investments in its IT-based application infrastructure. The portfolio approach recognizes the maturing capabilities of the organizations. The portfolio concept is grounded in the management principle that any significant investment requires careful monitoring to maximize its value and insulate it from threats to its integrity. The portfolio is responsive to the need of a variety of decision-makers, including agency executives, agency technical managers, agency program managers and the like.

14.11 GLOSSARY

- **Batch Processing:** Processing that requires the data to be initially grouped (as a batch) before it is processed serially, and the results obtained periodically.
- **Online Processing:** Processing where the result of data processing transaction is available immediately.
- **Real Time Processing:** Data processing system in which the time interval required to process and respond to input is so small that the response itself is useful for controlling the physical activity of a process.
- **Distributed Data Processing:** Data processing which involves a computer system linked by a communication network where processing is performed by separate computers.
- **Sorting:** Arranging the data in a local sequence.
- **Bit:** Representing numeric value 0 to 1.
- **Byte:** Basic unit of information, generally stored by using 8 bits.

- **Field:** One or more bytes that contain data about attributes of an entity.
- **Record:** A collection of fields relating to a specific entity.
- **File:** A collection of related records.
- **Database:** Collection of all files of an organization.
- **Data Structure:** A class of data that can be characterized by its organization and the operations that are defined on it.
- **Application Portfolio:** A compilation of information about the organization's investment in its IT- based application infrastructure.

NOTES

14.12 ANSWERS TO CHECK YOUR PROGRESS

1. Online
2. Distributed Database systems
3. recorded, captured
4. byte
5. organization, operations
6. portfolio
7. True
8. False
9. True
10. False
11. False

14.13 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is the aim of any processing system?
2. Define batch processing system.
3. What are the disadvantages of batch processing system?
4. Define on-line processing.
5. What are the essential requirements of a real time processing system?
6. Describe distributed data processing.
7. What are the basic functions of data processing?
8. What is the difference between data capturing and data merging?
9. What are various ways to summarize data?

NOTES

10. Describe data hierarchy.
11. What is a data structure?
12. What do you mean by application portfolio?
13. What are the characteristics of portfolio-based IT management?
14. What information is included in the application portfolio of an organization?
15. Who belong to the organization of the data processing system?
16. List the responsibilities of the data processing manger.

Short Answer Questions

1. Describe various modes of data processing system.
2. What is the difference between on-line processing and Real-time processing?
3. What do you mean by the terms merging and summarizing of data?
4. How does the information communicated?
5. Why is storage of information required?
6. Describe the hierarchy of data.
7. Draw a process cycle diagram for publication.
8. Justify the usability of EDP in a shopping chain.
9. What are the limitations of an EDP system? Suggest some improvements.

14.14 REFERENCES

1. Ramesh Bangia, *Business Systems*, Laxmi Publications
2. Robert J Thierauf, *Data Processing for Business and Management*, John Wiley & Sons
3. Elias M. Awad, *Business Data Processing*, Prentice-Hall
4. Gershon J. Wheeler, Donlan F. Jones, *Business Data Processing: An Introduction*, Addison-Wesley Publishing. Co.
5. Barbara J. Burian and Stuart S. Fink, *Business Data Processing*, Prentice-Hall

Information Technology and Management Information System



Block - IV Block Title : Networking

UTTARAKHAND OPEN UNIVERSITY

SCHOOL OF MANAGEMENT STUDIES AND COMMERCE

University Road, Teenpani By pass, Behind Transport Nagar, Haldwani- 263 139

Phone No: (05946)-261122, 261123, 286055

Toll Free No.: 1800 180 4025

Fax No.: (05946)-264232, e-mail: info@uou.ac.in, som@uou.ac.in

<http://www.uou.ac.in>

www.blogsomcuou.wordpress.com

Board of Studies

Professor Nageshwar Rao
Vice-Chancellor
Uttarakhand Open University
Haldwani

Professor R.C. Mishra (Convener)
Director
School of Management Studies and Commerce
Uttarakhand Open University
Haldwani

Professor Neeti Agarwal
Department of Management Studies
IGNOU
New Delhi

Dr. L.K. Singh
Department of Management Studies
Kumaun University
Bhimtal

Dr. Abhradeep Maiti
Indian Institute of Management
Kashipur

Dr. K.K. Pandey
O.P. Jindal Global University
Sonipat

Dr. Manjari Agarwal
Department of Management Studies
Uttarakhand Open University
Haldwani

Dr. Gagan Singh
Department of Commerce
Uttarakhand Open University
Haldwani

Er. Sumit Prasad
Department of Management Studies
Uttarakhand Open University
Haldwani

Programme Coordinator

Dr. Manjari Agarwal
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Units Written By	Unit No.
<i>Text material developed by</i>	Laxmi Publications (P) Ltd., New Delhi
<i>Typeset by</i>	Atharav Writer, Delhi

Editor(s)

Er. Sumit Prasad
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Er. Subodh Prasad
Assistant Professor
Department of Information Technology
College of Technology
G.B. Pant University of Agriculture & Technology
Pantnagar

ISBN : 978-93-85740-12-1
Copyright : Uttarakhand Open University
Edition : 2016 (Restricted Circulation)
Published by : Uttarakhand Open University, Haldwani, Nainital - 263 139
Printed at : Laxmi Publications (P) Ltd., New Delhi
DUO-8154-50.74-INFO TECH MGMT INFO B-IV

CONTENTS

Units	Page No.
15. Introduction to Networking	295
16. Internet and Intranet	322
17. Basics of Information Security	345

UNIT 15: INTRODUCTION TO NETWORKING

Structure

- 15.0 Introduction
- 15.1 Unit Objectives
- 15.2 Local Area Networks (LAN)
- 15.3 Metropolitan Area Networks (MAN)
- 15.4 Wide Area Networks (WAN)
- 15.5 Routing
 - 15.5.1 Gateways or Routers
 - 15.5.2 Repeater
 - 15.5.3 Bridges
 - 15.5.4 Routing Techniques
- 15.6 Network Topology
 - 15.6.1 Star Topology
 - 15.6.2 Ring Topology
 - 15.6.3 Bus Topology
 - 15.6.4 Mesh Topology
 - 15.6.5 Tree Topology
- 15.7 Transmission Technology
- 15.8 Protocols
- 15.9 Summary
- 15.10 Glossary
- 15.11 Answers to Check Your Progress
- 15.12 Terminal and Model Questions
- 15.13 References

NOTES

15.0 INTRODUCTION

A network can be defined as the interconnection of two or more systems. The minimum number of systems required to make a network is two. Computer systems connected in a network can exchange information between themselves and share the use of hardware devices connected such as the printer, etc.

A system with one main controlling unit known as the master and many slave terminals is not a network.

Computer networks are of three types:

1. Local area networks (LAN)
2. Metropolitan area networks (MAN)
3. Wide area networks (WAN)

We shall discuss each of these in detail.

15.1 UNIT OBJECTIVES

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

- Define Computer Networks
- Discuss different types of Computer Networks
- Describe the LAN, MAN, and WAN
- Discuss various types of Network topology.

15.2 LOCAL AREA NETWORKS (LAN)

Networks that connect computers lying within a small distance (such as a room, or within a building) from each other are called local area networks (or LANs).

Local area networks normally use coaxial cables to connect the computers together. Two or more computers connected together can share, besides data, their peripherals such as printers, modems, etc. This cuts down a lot on the hardware equipment cost.

Besides coaxial cables, a plug-in card is also required for each computer. The coaxial cables connect the plug-in cards of the computers to form a network. A special software is also required for the network to operate.

All local area networks transfer data in digital form at a high speed and have a low implementation cost.

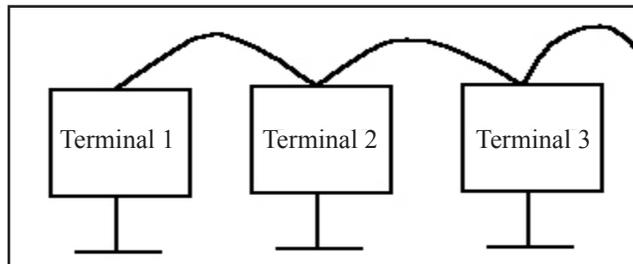


Fig. 15.1: Local Area Network

Some applications performed by a LAN are as follows:

1. File transfer and access

2. Accessing the internet
3. Providing Management Information System.

15.3 METROPOLITAN AREA NETWORKS (MAN)

A metropolitan area network uses the distributed queue dual bus. The metropolitan area network is larger than a LAN and it may cover areas as large as a city. The distributed queue dual bus system consists of two buses connected to all the computers.

The Figure below depicts the two buses connecting three nodes.

The dual bus helps the transmission of data in both directions simultaneously. Data going up uses Bus A and data going down uses Bus B.

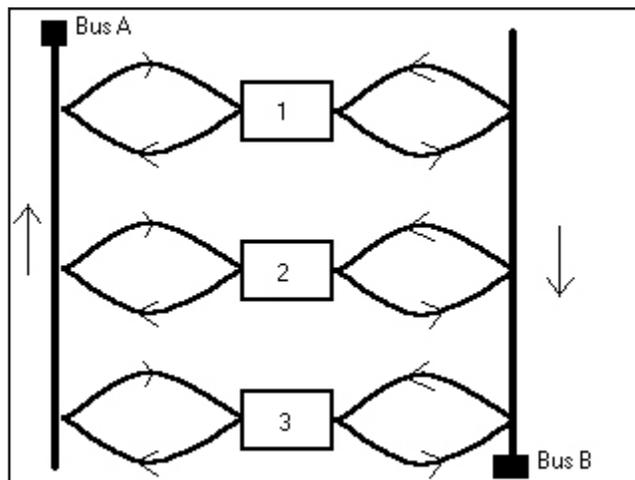


Fig. 15.2: Metropolitan Area Network

Suppose information has to be passed from terminal 3 to 1, it will use Bus A and if a reply has to be sent back (from 1 to 3) it will use Bus B.

15.4 WIDE AREA NETWORKS (WAN)

A wide area network connects computers which are very remotely placed. It may connect across the countries or continents or the entire globe. Wide Area Networks are also referred to as Long Haul Networks (LHNs).

Wide area networks can either be point to point type or broadcast type. In a point to point type network, the source and the destination machines are connected to each other via several intermediate routers. A point to point type network may be

NOTES

separated into two parts– the hosts and the subnet. The machines between which communication is to be established are called hosts. The hosts are connected to each other by what is known as the subnet. The subnet consists of the transmission lines (coaxial cables, fibre optic cables, etc.) and the intermediate switching elements also called ‘routers’. The main function of a router is to receive the transmitted data and then select an appropriate channel to forward it to the destination host or to another router. When a data packet arrives at a router it is stored in the router until the output transmission line is free and is then transmitted or forwarded to destination host.

The broadcast type wide area networks (WAN) use a satellite or ground radio system. All or some routers have antennas through which they can receive the incoming signal from the satellite. When a ground radio system is being used the routers can communicate with each other. It may also be possible that in a network, while some routers receive their outputs through their antennas, others are point to point type.

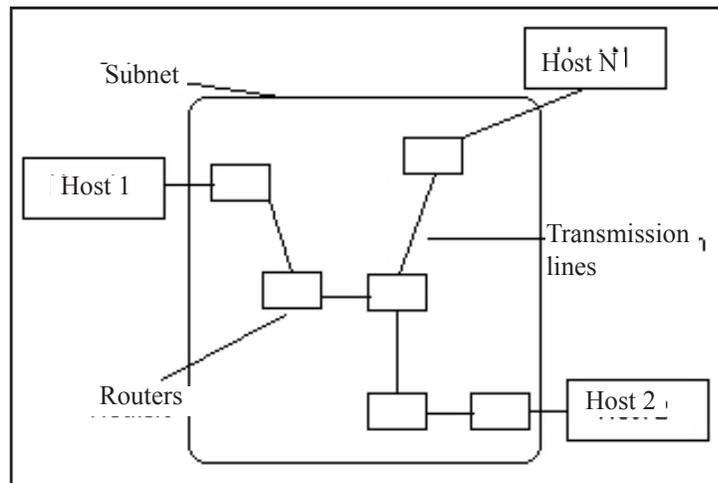


Fig. 15.3: The Complete Network

15.5 ROUTING

When data is to be transmitted between two remote machines using intermediate machines, certain routing techniques (such as a routing algorithm in the intermediate machine) have to be applied. The intermediate machines may be termed as one of the following:

1. Gateways or routers
2. Repeaters
3. Bridges

We shall discuss each of these in detail as follows:

15.5.1 Gateways or Routers

Gateway is one of several types of communication servers. The function of a gateway is to allow two or more dissimilar networks to communicate as a single logical entity. The two machines that have to transfer data between themselves may have different operating systems (OS) or their transport protocols may be different. It is then the job of the gateway to connect such machines. Gateways, in general, are also called routers. It may be possible that exist several routers between the source and the destination machine. When a packet of data is transmitted from one router to another it is stored in the intermediate router until the communication channel is free and then it is forwarded.

15.5.2 Repeater

A repeater receives the incoming signal, repeats it or amplifies it and retransmits the transformed signal. After certain distances the signal experiences a loss of power hence a repeater is required to boost the power of the signal. By using repeaters the network can be extended but only finite extension is possible due to physical constraints such as noise. As the signal travels a certain distance some form of disturbance (referred to as noise) is added to it. When the repeater amplifies the signal the noise also gets amplified, hence over a large distance it may be possible that the signal becomes unrecognizable.

15.5.3 Bridges

A bridge is a device that is used to connect two networks so that they are able to perform as one. A bridge can also be used to connect two networks that use the same technology, such as the Ethernet network and the Token Ring network. One of the main functions of the bridge is to partition one large network into two networks which subsequently increases the performance of the network.

We shall try to explain the functioning of a bridge with the help of the following example.

Nodes 1, 2 and 3 are connected to LAN 1 and nodes 4,5,6 and 7 are connected to LAN 2

Suppose node 1 on LAN 1 wishes to communicate with node 6 on LAN 2. The data packet transmitted from node 1 on LAN 1 contains the address of node 6 on LAN 2. When the data packet is received by the bridge node it is checked for its address. If node 6 was connected to LAN 1 the bridge would not have broadcast the message to the other side, i.e., LAN 2, and would have left the message alone. But, in this case, the bridge transmits the message to LAN 2 from where node 6 collects it.

Thus, as it is evident from the example, the bridge has partitioned the network into two and it is acting like a traffic policeman controlling the flow of traffic across an intersection.

NOTES

15.5.4 Routing Techniques

Computer networks may use one of the following routing techniques:

1. Circuit Switching
2. Packet Switching
3. Message Switching

We shall discuss each of these methods in detail.

Circuit Switching

Circuit switching is analogous to a simple telephone call. A physical circuit is established between the two machines. Once the connection is established, the data transfer takes place and then the connection is released. Now, another location can be dialled and a new circuit can be established. The transfer of data using this type of switching technique is very fast but it is error prone. It is the responsibility of the user to check for errors and the integrity of the data.

Packet Switching

A Packet switching network divides the data to be transmitted into packets which are of a fixed size and carry error checking information with them. Each packet of data contains the address of its final destination when it is transmitted. As the packet moves through intermediate machines, it is inspected for its address and is accordingly routed to another intermediate machine. Messages being transmitted through this type of network are less error prone than those transferred through circuit switching networks. In case a particular packet is found corrupt on arrival, the destination machine can request the source machine for its retransmission.

Message Switching

In a Message switching network, the message as a whole is transmitted, i.e., it is not divided into packets. Each message contains the address of its final destination and it is upto the intermediate machines as to what path they want the message to go through. The message switching network is a store and forward network. Once the message arrives at an intermediate machine it is stored in the machine until the output line is free, and then transmitted. In case of heavy traffic on the transmission line, the messages are queued up and accordingly dispatched when their turn comes.

15.6 NETWORK TOPOLOGY

There are several different ways to organize the computers to form a network. These organizations of the computers in a network are referred to as network topology.

The different network topologies possible are:

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

We shall discuss each of these in detail.

15.6.1 Star Topology

The star topology consists of a central computer to which all other computer terminals are connected. Two computers in this type of network cannot have direct communication. They can only communicate via the central computer. In case the central computer breaks down, the network becomes redundant.

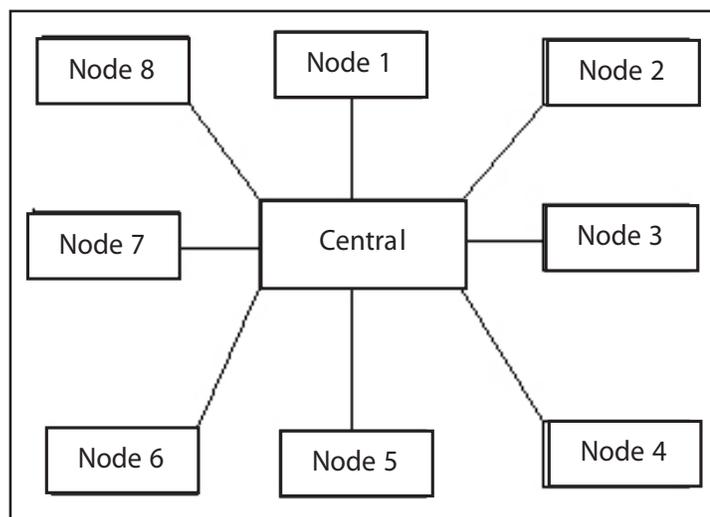


Fig. 15.4: Block Diagram Depicting a Network in Star Topology

One very important advantage of this type of network topology is that in case any one node is faulty or is having problems, it can be isolated from the network without affecting any other terminal.

The star topology is the most commonly used network topology in data communication today. The performance of the system is good for moderate load. However, when traffic is high, the system may have some problems.

A disadvantage of star topology is that two terminals can't interact directly, i.e., they have to go via the central computer. This leads to no privacy in the network.

Another disadvantage is the network's dependence on the main (central) computer. If the central computer breaks down the entire network stops functioning.

The star network requires that each and every terminal be connected using a different cable. This leads to a somewhat increased cost for the cable as well as the installation of the cables.

NOTES

15.6.2 Ring Topology

In the ring topology, the different computers are connected to each other forming a closed loop (in the form of a ring). The data is passed from one computer to the other in a series until it reaches its desired destination.

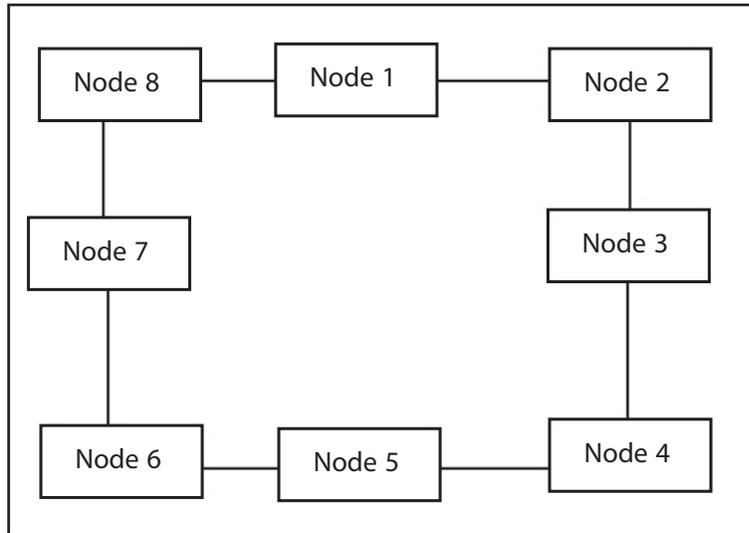


Fig. 15.5: Block Diagram Depicting a Network in Ring Topology

There is no concept of a central computer in this case. The data is divided into packets when transmitted and each packet contains the address of the node that it is destined for. Unlike the star topology, this type of network requires lesser amount of cable and there are not much of installation problems either.

The biggest disadvantage of this type of topology is that the failure of one node may lead to the failure of the entire network. Since data from the source node passes through a series of nodes before reaching the destined node, the failure of even one node may lead to the network failure. However, the use of a bidirectional ring (data transfer in both directions is possible) can temporarily solve this problem by choosing a path that does not contain the faulty node. Unlike the star topology, it is relatively difficult to diagnose the faulty node in the ring network.

If the star topology provides less privacy, the ring topology provides zero privacy. However, the ring topology provides a better performance under heavy traffic as well.

It is also easy to add or remove terminals in a ring network which is not as easy in the case of a star network as only a certain specified terminal can be inserted into the central computer.

15.6.3 Bus Topology

The bus topology is also referred to as the multipoint topology. All nodes are connected to a bus that runs through the network.

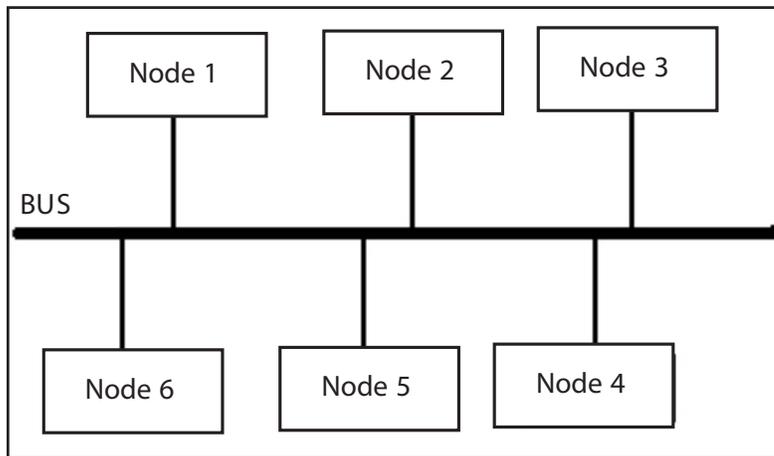


Fig. 15.6: Block Diagram Depicting a Network in Bus Topology

Each node is given a unique address. Information containing the address of the destined node is available at all the nodes but only the node with the specific address responds. The bus can transmit data in both directions.

If one node of the network goes faulty, the network can still remain working. However, the fault diagnosis of such a system is very difficult as each and every node has to be tested to find the faulty one. Once the fault is found, the computer node having the fault is usually not disconnected from the network, but repaired on the spot.

The bus network topology is easy to extend as only new nodes have to be added along the bus. However, for a larger network, signal amplifiers known as repeaters may be used to strengthen the signal. The cable length and the installation do not pose much of a problem as the cable length required is short as compared to other topologies.

15.6.4 Mesh Topology

The mesh topology requires that every terminal be connected to every other terminal in the network.

Hence, all the computers must have adequate number of interfaces for the connections to be made. Because of this requirement the installation is somewhat difficult. The length of cable required is also quite high as compared with other topologies.

Data transfer using mesh topology is faster than the earlier discussed topologies. Mesh networks are also quite fault resistant. If a particular path fails, data can be routed via alternate paths.

NOTES

NOTES

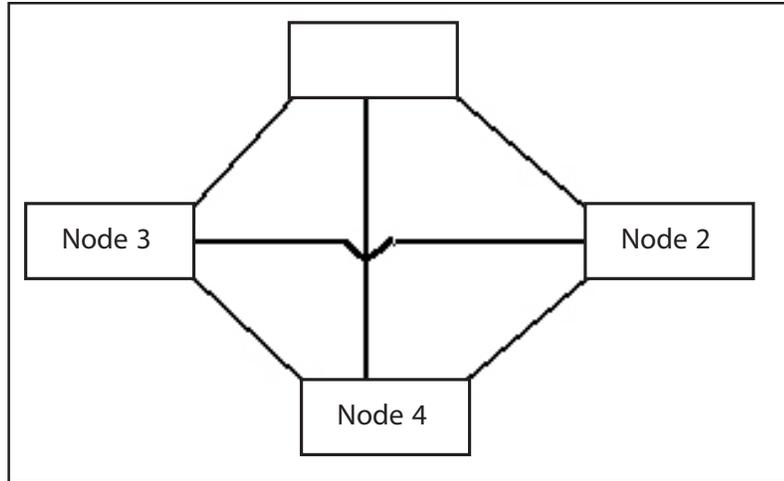


Fig. 15.7: Block Diagram Depicting a Network in Mesh Topology

To save on the cost of interconnections and to reduce the complexity of the system, we can make use of the hybrid mesh network. In this type of network, some of the main or more frequently used networks are connected to each other like a mesh network. The computer terminals are attached to these main terminals.

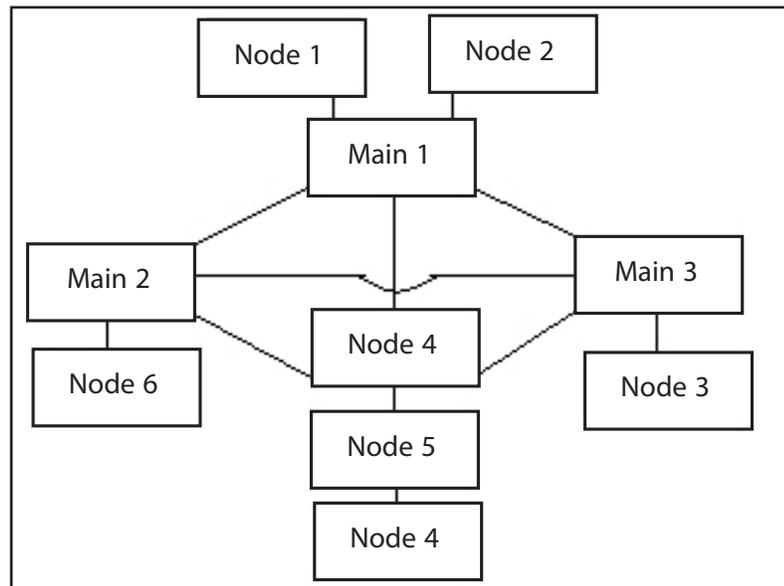


Fig. 15.8: : Block Diagram Depicting a Network in Hybrid Mesh Topology

15.6.5 Tree Topology

The tree topology requires the computers to be linked in a hierarchical way. Data transmission in this topology is relatively slow. The packets carrying the addresses of the destination nodes should have the complete address, i.e., all the nodes above it in hierarchy also have to be mentioned.

The tree network like the star network is dependent on the main computer. Hence, the failure of the main computer shall lead to the failure of the entire network.

The tree network is very flexible as any number of nodes can be added or removed easily.

NOTES

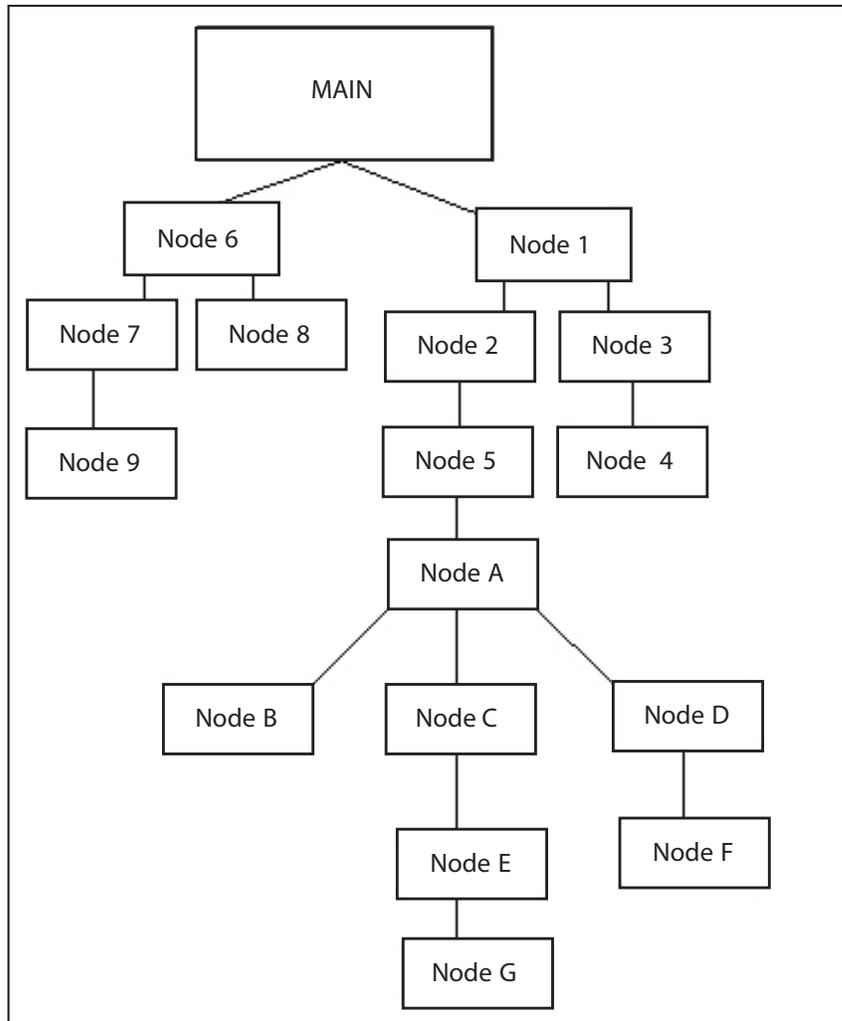


Fig. 15.9: Block Diagram Depicting a Network in Tree Topology

15.7 TRANSMISSION TECHNOLOGY

There are two types of transmission technologies possible – broadcast networks and point to point networks.

Broadcast Networks

In this type of network, a single communication channel is shared by all the machines in the network. A packet of data to be transmitted contains the address of the destination machine. A broadcast network is very similar to a railway announcement

system. When a particular train departure is announced, everyone present at the station hears it, but only those who have to board the train respond to it. The Bus and the Ring Topology are examples of Broadcast Networks.

NOTES

Point to Point Networks

As the name suggests, the machines are connected point to point. Data is routed from the source machine to the target machine via intermediate machines or directly.

Internet works and the Internet

A collection of different networks connected together or a collection of hosts connected together by a subnet is called internetwork. The hosts may be further connected to other terminals through a LAN or a WAN. An internetwork can be as large as you can imagine.

The internet is a very large internetwork that is available world-wide. The internet is the largest network in the world. It provides the world-wide web service implemented by the HTTP protocol.

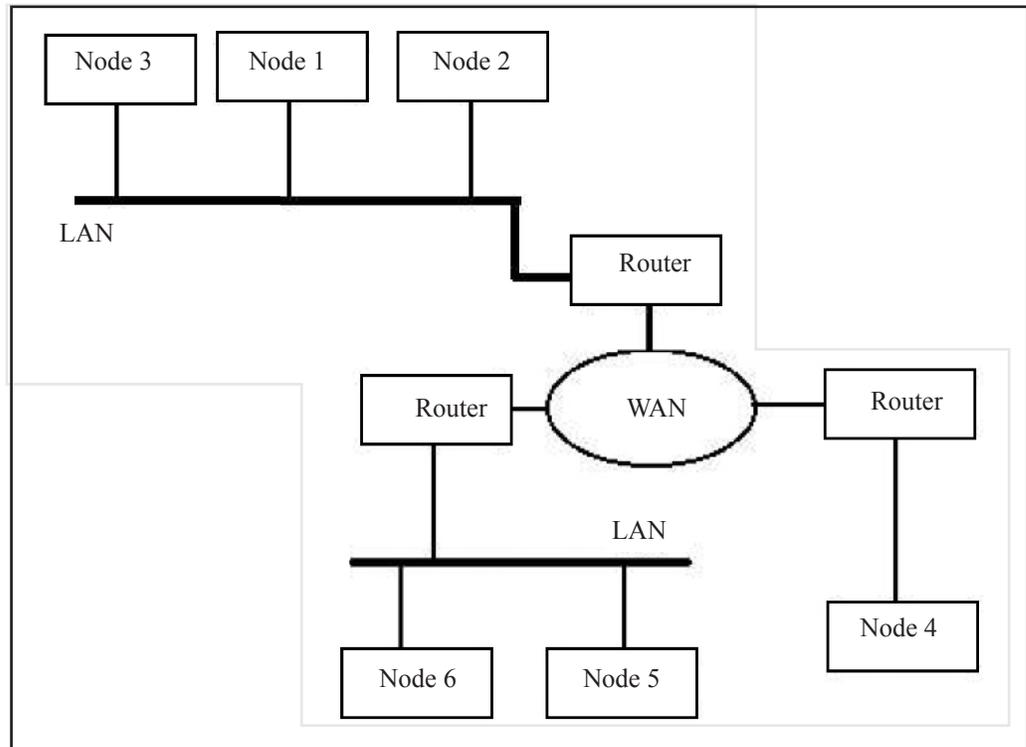


Fig. 15.10: Internetwork

Accessing the Internet

Before you access the Internet, you must have an account with an internet service provider (ISP). You call the ISP on its phone number through your modem (connected

to the telephone line). Once a connection is established, you are required to provide some kind of identification indicating the authenticity of your account. This is known as login procedure.

After the login procedure and the successful authentication of your account, you are connected to the Internet. At this point of time, you require a communication software (web/network browser) that uses the hyper text transfer protocol (HTTP). One of the key roles that a communication software performs is to decide the proper speed between the communicating terminals.

NOTES

15.8 PROTOCOLS

A protocol is a set of rules according to which the communicating computers communicate. If I wish to communicate with you, I can do so with the help of a commonly understood language, let's say English. However, if I can speak only French and you can understand only English then communication between us is going to be very difficult unless a third person volunteers to step in and act as a translator. Similarly, for computers to communicate, a common set of rules or protocols must be defined. The most common protocol used in networking is the TCP/IP (Transmission control protocol/Internet protocol). The Internet is predominantly based on TCP/IP.

Layers

The networks are organized as a series of layers. Each layer has a specific function depending upon the protocol being followed.

Each layer provides certain services to the higher layers. How the offered services are being implemented is not known to the higher layer.

Shown below in the figure is a 3-layer network. The layer 'n' on one machine is called a 'peer' of layer 'n' on the other machine. In other words, the corresponding layers on the two communicating machines are called peers. It may seem from the figure that data transmission takes place between corresponding layers between the two machines, but it is not so. The actual data transmission takes place through the physical medium.

The layers on the transmitting machines add some control information to the data that is to be transmitted and pass it down to the lower layer. The lower layer again adds some more control information (e.g., it attaches a header to identify the sequence of the data packet) and passes it down to the next lower layer. At the receiving end, these headers are stripped off by the corresponding layers and the data packet is passed on until it reaches the final layer. Each layer receives and decodes the information sent by its peer.

Interface

The term 'interface' here refers to the services the lower layer offers to the upper layer. Between the two layers is the interface. While designing a network, the functions that are to be performed by a particular layer should be very clear. Hence, well defined interfaces are a necessity for a successful network design. The upper layer passes what is known as an interface data unit (IDU) to the lower layer. The IDU may be divided into two parts - the interface control information (ICI) and the service data unit (SDU).

The service data unit contains the data being transmitted along with some control information that has been passed on from the still upper layers. The interface control unit contains control information (e.g., headers that are required by the peer entity on the receiving end).

Open Systems Inter Connection Reference Model

The basic reference model is the OSI model, declared in 1983 as an international standard. This model deals with connecting open systems (open for communication). The OSI model consists of seven functional layers on either machine.

At the top is the application layer, where end users interact with system or where application software is executed. At the bottom is the physical layer where logical information is converted into signals and transported through the physical transmission medium.

The function of each layer is defined keeping in mind the definition of the internationally standardized protocol. The number of layers in a particular model is variable. Only when a different level of abstraction is required should a new layer be created.

The active elements in each layer are called entities. It is the entities in each layer that interact with entities of other layers through well defined Service Access Points (SAP's) using specific interface protocols. A layer to the outside system behaves like a black box.

The number of layers should be large enough so that some sort of a similarity between the functions being performed in a particular layer is maintained.

As said earlier, the OSI model can be divided into seven layers each performing a distinct function. These layers are discussed in detail as follows:

The Physical Layer

The primary task of the physical layer is the transmission of raw bits over the communication channel. The physical layer has no knowledge of the structure of data that it is required to transmit. The physical layer does the following functions.

1. The physical layer involves the physical transmission of the data stream through the media. Connecting to routers, deciding the data rate and deciding which

signal is to be transmitted first in case of multipoint signals, is the job of the physical layer.

2. The physical layer controls the mechanical characteristics of the transmission media.
3. Activation and deactivation of the physical connection.

NOTES

The physical layer provides the following services to the data link layers:

1. The physical layer provides the data link layer with physical connections, data units and end points.
2. Since the physical layer transmits and receives data in the form of bits an indication of the sequence of these bits is necessary. This is provided by the physical layer to the data link layer.
3. When errors are detected in received frames, the physical layer requests for the retransmission of the frame. Hence, the physical layer also performs error detection.

The Data Link Layer

The functions performed by the data link layer include:

1. The data link layer defines the protocol to detect and correct errors that may occur during data transfer.
2. The data link layer receives the data from the physical layer in the form of bits. It is in this layer where the frame boundaries are created and the raw data is sequenced into frames.
3. The data link layer establishes and releases the link and maintains a supervision of the physical connection.
4. In case of a fast sender and a slow receiver the data link layer informs the sender of the buffer space available at the receiver's end in order to control the transmission rate.
5. The data link layer also supervises the traffic regulation for transmission in both directions.

The data link layer provides the following services to the network layer:

1. Sequence control.
2. Indicating transmission errors.
3. Indicating the quality of service.

The Network Layer

The network layer performs the following functions:

1. The network layer handles the routing functions by selecting primary or alternate routes for transmitting data.

NOTES

2. The network layer provides the addresses of intermediate nodes or systems through which data is transmitted.
3. The network layer performs the multiplexing tasks in case more than one type of signal is to be transmitted.

Hence, in other words, the network layer controls the operation of the subnet.

4. In case of two heterogeneous systems having different protocols, the network layer provides a common addressing system.
5. The network layer forms data blocks and segments at the source and reassembles them at the destination.

The network layer provides the following services to the transport layer:

1. Provision of network address.
2. Provision of network connections.
3. Identification of network end points.
4. Indicating the quality of service.
5. Sequence control.

The Transport Layer

The transport layer performs the following functions:

1. The transport layer has the job of receiving data from the network layer and delivering it within the destination machines. Multiple programs may be using the network from a single computer. The transport layer manages (sends and receives) the data of multiple programs within the network.
2. The transport layer and the layers above it are end to end layers. The lower layers carry on the bit to bit transmission of data routing each data packet through different paths. It is from the transport layer and upwards that the data starts getting sequenced and a meaningful conversation occurs.
3. The transport layer performs the error detection (end-to-end) of the data transmitted and sends a request for retransmission when necessary.
4. Again, in case of a fast sender and a slow receiver, the transport layer performs the data flow control.

The services provided to the session layer include:

1. Data transmission.
2. Establishing and releasing transport connections.

The Sessions Layer

The functions performed by the sessions layer are:

1. The sessions layer allows users on different machines to establish sessions between them. The sessions layer handles the details of the user names, passwords and other user authorizations. Each login is considered a session.

2. The data transfer rates, the method of error control, the mode of transmission (simplex, half duplex, full duplex), etc., are decided by the sessions layer.
3. The sessions layer inserts checkpoints (in the form of headers) in the data packets it transmits, so that just in case the connection gets disconnected the process can be continued rather than having to restart it.
4. The sessions layer, like the transport layer, provides the data flow control.

The services provided to the presentation layer are:

1. Establishing and disconnecting the session.
2. Indication of errors.
3. Performing synchronization (inserting checkpoints).

The Presentation Layer

The presentation layer performs the following functions:

1. The two interacting systems may be using different character code. For example, one system may be using the ASCII character code and the other might be using the EBCDIC character code. In order to ensure a meaningful exchange of data, the presentation protocol defines the rules on how the data will be presented and exchanged in a common neutral language.
2. The presentation layer, unlike the lower layers, is concerned with the syntax of the information transmitted. This layer performs the proper coordination of syntax and presentation profiles.
3. The presentation layer may also perform data encryption, data decryption and data compression, etc., if required.

The presentation layer provides the following services to the application layer:

1. Syntax translation.
2. Data formatting (encryption, compression, etc.)
3. Selection of syntax and presentation profile.

The Application Layer

The application layer performs the following functions:

1. The application layer provides the end user an interface with the system. This layer also controls the operating system functions.
2. The application layer performs an identification of the communication partners and establishes availability. The application layer also checks for authorization and validity.
3. The application layer checks for errors and requests for their correction.

4. The application layer, like the presentation layer, is concerned with the syntax of the data and hence, it performs a proper coordination of the syntax and presentation profiles.

NOTES

The application layer provides the users with many services. Some of these are listed below:

1. File transfers
2. Database queries, insertions and deletions, remote job entry, etc.
3. Electronic mail

We shall discuss two of the above three most commonly used services in detail.

File Transfer

To perform a file transfer between two systems, the fundamental requirement is a common protocol. In this section we shall discuss about file transfer protocol (FTP). The file transfer protocol (FTP) is an application of the TCP/IP. The file transfer protocol gives the user an access to a remote machine file system. The user once given access can browse, upload or download files. The user needs an FTP client application and the remote host should have an FTP server component. The FTP client application enables the user to send commands to the FTP host. The FTP server component processes these commands and performs the necessary action. The FTP is also an Internet tool, since the Internet uses the TCP/IP. Thus, the file transfer protocol can also be used to copy files from an Internet site or for uploading a file to a remote net server.

Electronic Mail

Electronic mail is a fast and efficient method to exchange messages and other data. To interact through the electronic mail one needs to have an e-mail account. Once the account is created the user is assigned an electronic mail box. The user can send messages to other users through his mail account and can receive incoming messages in his mailbox. The messages are instantly delivered and it is not necessary for the recipient to be present while the mail is delivered to his mailbox; he/she can scan the mail later.

The electronic mail system allows a very easy merging of a particular message. Just typing the e-mail user names of all the recipients would deliver the message to each of them. Moreover, the user can put a restriction to the delivery of messages. It is also at the user's discretion as to which sender's message he wants to receive in his mail box.

Choosing the Right Kind of E-mail Service

E-mail accounts for more than 50% usage of Internet. By using the right kind of e-mail services one can save a lot of time and money. Here is a list of all the main types of

e-mail services available on the net, along with their advantages and disadvantages (nothing is perfect!). Also listed are some of the free e-mail service providers for each type of service available on the Internet. Users with an internet account should go for POP mail. The choice depends on the user and what service suits him personally.

Types of E-mail Services

There are 3 main types of e-mail services, each having some advantages and disadvantages.

POP Mail

POP mail services store your incoming messages on a server and you download the messages using an e-mail software package (Eudora, Netscape messenger, Outlook express, etc.). Once they are downloaded, the messages are stored on your PC. POP mail services are similar to the e-mail service offered by most ISP's.

Advantages

1. You can work offline, compose or read messages, and just connect to send mail or download new messages.
2. The mail program used by your browser (Outlook express for Internet explorer, Netscape messenger for Netscape) can be configured to receive and send all your e-mail automatically. This is very useful when you are browsing the net and find a link to an e-mail address where you want to send any mail. With the mail program properly configured, you can send the mail immediately without going to your web based e-mail service providers' site.
3. Since all messages are stored on your computer after you download them, you can refer to them at any time without connecting to the Internet and easily cut and paste the information into other applications.
4. Once downloaded, the messages can be automatically deleted from the server. Thus, only new messages would be available each time you connect to receive your mail.
5. You can also use powerful and intelligent e-mail software, which may include spelling check options, clever filtering options and all kinds of other features.

Disadvantages

1. The biggest disadvantage of POP mail is that you can not access your e-mail while "on the road", i.e., on another computer since you need the e-mail software configured for it.
2. If you sign up with a free POP mail service, you can generally expect to receive unwanted advertisements or spam mails in your mailbox.
3. The signing up and setting up procedure is not as easy as a web based e-mail but once configured you will find it easy to download and send mail.

Web-based E-mail

With web-based e-mail, your e-mail is stored by the free e-mail service provider you signed up with; thus you have to log into the site you signed up in order to gain access to your e-mail. Most of the large free e-mail providers offer web-based e-mail since it is relatively easy to implement. Different web-based free e-mail services come with different functionality, such as online spell-checkers, personal address books, distribution lists, etc.

Advantages

1. You can easily log in and collect your e-mail from any web browser.
2. There's no need to configure any program in order to access e-mail.
3. It is easier to register and no setup is required.

Disadvantages

1. It is time consuming, i.e., you got to go to the e-mail providers' site, log in, wait for all your messages to show up; then read each message individually and stay connected on the net while you do so. All this requires a lot of your time and consequently money on the connection.
2. Many web-based services take advantage of advanced functions such as Java in order to provide an attractive interface. You will therefore, need to have latest web browsers in order to keep your range of options open (generally you need Netscape 3.x or better or IE 3.x or better).
3. Most web-based services cannot match the functionality of a good e-mail package. Some common problems are server down, high traffic, etc. (making access slow and reading and sending mail difficult & time consuming).
4. Advertising banners rotate as you read your e-mail. This can increase your access time.

Mail Forwarding Services

Mail forwarding services, as the name implies, do not offer you a NEW e-mail account. Rather, they pass e-mail to your existing account (POP or web-based), but offer a different mailing address. Therefore, you need an e-mail account before you sign up for mail forwarding services.

Advantages

1. E-mail forwarding services let you continue use your existing e-mail account given to you by your ISP. If you change the ISP at any time, just change the e-mail address your e-mail is forwarded to, and it will automatically be redirected to your new address.

2. Forwarding services let you choose a memorable or fun name, often much more distinctive than your current address.

Disadvantages

1. With an e-mail forwarding service, you are putting another layer between the sender and your email account. This means that you are twice as exposed to network problems; if either the forwarding service or your e-mail account is down, the e-mail will not get through.
2. Generally, mail forwarding services make money by gluing a small advertisement at the top or bottom of each e-mail message they forward (or sometimes both).
List of free e-mail service providers.

POP Mail

1. Amex Mail (www.amexmail.com)
This service is provided by USA.NET
2. Crosswinds (<http://home.crosswinds.net>)
Free POP mail address and free web space (unlimited for personal sites, 25MB for business sites). You cannot use your free e-mail address to run a mailing list. Not very reliable and server remains down at times.
3. Newmail (www.newmail.net)
Newmail offers web-based and POP mail services, plus 5MB of space for storing messages and address books, filters, etc. Does not offer SMTP.
4. PeachWorld Network(www.peachworld.com)
You can send/receive messages up to 1.5MB here.
5. POPAccount(www.popaccount.com)
Free web-based and POP mail service with no advertisements attached to POP mail messages.
6. SoftHome(www.softhome.net)
I am personally using this service for the last 6 months and have had no problems whatsoever. Also till date their has been no spam mail in my inbox.
7. ForFree(www.forfree.at)
Very fast-loading site; provides free POP3/SMTP e-mail, as well as free site hosting (5MB) and free mailing list services.
8. Freemail(www.freemail.everperfect.com)
Does not display advertising in messages.
9. Friendly E-mail (www.mypad.com)
Also offers free web-based e-mail and a choice of over 3 dozen different domain names.

NOTES

NOTES

10. HotPop(www.hotpop.com)

Free POP mail. MIME format supported. There are no ads in the messages; instead HotPop will send you separate advertisement from selected advertisers. You can also forward e-mail to an existing account. HotPop comes with a choice of domain names. HotPop filters spam before it hits your mailbox.

Web-based E-mail

Most of you maybe using this service and may know lot of free e-mail providers but here is my own list:

1. MrPost (www.mrpost.com)

Special service enables you to add web-based e-mail to your own site FREE of charge. Also offers web-based instant messaging and chat.

2. MyOwnE-mail (www.myownemail.com)

Over 200 domain names to choose from. Free web-based mail, plus mail forwarding services at \$11.95 per year.

3. MuslimE-mail (www.muslimemail.com)

This free e-mail service also offers free web hosting for muslims and many other services. Other domain names are available at a premium.

4. GhanaMail (www.ghanamail.com/emurl)

A no-questions-asked web-based e-mail service. All you need to do to sign up and choose a user name and password.

5. gurlmail (www.gurlmail.com)

Another Who-Where-powered free e-mail service. Gives 4MB storage for e-mail messages.

6. HotMail (www.hotmail.com)

The largest web-based free e-mail service, now a part of the Microsoft family. Most of you must be having a HotMail account. If you decide to go for POP mail after reading this article and do not want to change from Hotmail then there is a good news for you. Hotmail can support POP-mail-like functionality through a free third-party utility called CwebMail (available at www.cwebmail.com).

7. Eudora Web-Mail(www.eudoramail.com)

Free e-mail service

8. Fastermail.com(www.fastermail.com)

Free e-mail service.

9. 123india.com(www.123india.com)
India's very own e-mail service.

Mail Forwarding Services

Automatically redirects your e-mail-address.

1. Easy To(<http://easy.to/remember>)

An intriguing free service that provides free e-mail forwarding in the form `username@easy.to`. Seven domain names to choose from.

2. FlashMail(www.flashmail.com)

FlashMail offers free web-based e-mail, POP mail, mail forwarding and retrieval of e-mail from an existing account, all via a very clean and simple interface.

3. Grabmail(www.grabmail.com)

Free e-mail service offers 5MB of disk space, folders, an address book, vacation Auto responders, access to your existing POP mail accounts and more. Grabmail also offers mail forwarding facilities.

4. IName(www.iname.com)

Also offers free web-based e-mail services; IName powers the free e-mail offerings of dozens of large sites.

5. NetForward(www.netforward.com)

A choice of over 20 domain names. Free mail forwarding service that offers to remove the "tag-line" in messages for a one-time fee of \$9.50.

6. Netherlands.com(netherlands.com)

Free e-mail forwarding address at "Netherlands.com" or one of over 1,000 sub-domains.

7. USA.NET(www.usa.net)

The company behind NetAddress, USA.NET also offers its own free e-mail under the `usa.net` domain.

8. Bigfoot(www.bigfoot.com)

Bigfoot allows e-mail to be forwarded to up to 5 separate e-mail accounts automatically. It also offers various mail filtering options.

9. Bitmail(www.bitmail.com)

Private users can choose any e-mail address they like; businesses can choose an e-mail address based on their telephone number. Only the first year's service is free.

NOTES

NOTES

Check Your Progress

Choose the correct option:

1. The distributed queue dual bus system is used in:
 - a. LAN
 - b. WAN
 - c. MAN
 - d. PAN
2. Which of the following have the highest transmission rate?
 - a. LAN
 - b. WAN
 - c. MAN
 - d. PAN
3. Which of the following topologies consists of a central(main) computer?
 - a. Ring topology
 - b. Mesh topology
 - c. Star topology
 - d. None of the above
4. Which of the following topologies is most easily extensible?
 - a. Ring topology
 - b. Bus topology
 - c. Star topology
 - d. Tree topology
5. In case a particular node fails which of the following network topologies is still most efficient to work on?
 - a. Ring topology
 - b. Mesh topology
 - c. Star topology
 - d. Bus topology
6. Which of the following topologies is the fastest?
 - a. Ring topology
 - b. Mesh topology
 - c. Star topology
 - d. Bus topology
 - e. Tree topology
7. Which layer, of the following layers in the OSI model is not an end to end layer?
 - a. Physical layer
 - b. Transport layer
 - c. Network layer
 - d. Data link layer
8. Which layer, of the following layers in the OSI model has the function of providing the authorization to the correct user:
 - a. Sessions layer
 - b. Transport layer
 - c. Network layer
 - d. Presentation layer
9. Which layer, of the following layers in the OSI model is most concerned with the syntax of the data?
 - a. Presentation layer
 - b. Sessions layer
 - c. Network layer
 - d. Data link layer.

15.9 SUMMARY

NOTES

- A network can be defined as the interconnection of two or more systems. The minimum number of systems required to make a network is two. Computer systems connected in a network can exchange information between themselves and share the use of hardware devices connected such as the printer, etc. A system with one main controlling unit known as the master and many slave terminals is not a network. Networks that connect computers lying within a small distance (such as a room, or within a building) from each other are called local area networks (or LANs).
- Local area networks normally use coaxial cables to connect the computers together. Two or more computers connected together can share, besides data, their peripherals such as printers, modems, etc. This cuts down a lot on the hardware equipment cost.
- Besides coaxial cables, a plug-in card is also required for each computer. The coaxial cables connect the plug-in cards of the computers to form a network. A special software is also required for the network to operate.
- Networks that connect computers lying within a small distance (such as a room, or within a building) from each other are called local area networks (or LANs). A metropolitan area network uses the distributed queue dual bus. A wide area network connects computers which are very remotely placed. It may connect across the countries or continents or the entire globe.
- Gateway is one of several types of communication servers. A repeater receives the incoming signal, repeats it or amplifies it and retransmits the transformed signal. A bridge is a device that is used to connect two networks so that they are able to perform as one. A Packet switching network divides the data to be transmitted into packets which are of a fixed size and carry error checking information with them. Circuit switching is analogous to a simple telephone call. A physical circuit is established between the two machines. In a Message switching network, the message as a whole is transmitted, i.e., it is not divided into packets.
- The star topology consists of a central computer to which all other computer terminals are connected. Two computers in this type of network cannot have direct communication.
- In the ring topology, the different computers are connected to each other forming a closed loop (in the form of a ring). The data is passed from one computer to the other in a series until it reaches its desired destination. The bus topology is also referred to as the multipoint topology. All nodes are connected to a bus that runs through the network.

NOTES

15.10 GLOSSARY

- **Local Area Networks:** Networks that connect computers lying within a small distance (such as a room, or within a building) from each other are called local area networks (or LANs).
- **Metropolitan Area Network:** A metropolitan area network uses the distributed queue dual bus.
- **Wide Area Network:** A wide area network connects computers which are very remotely placed. It may connect across the countries or continents or the entire globe.
- **Packet Switching:** A Packet switching network divides the data to be transmitted into packets which are of a fixed size and carry error checking information with them.
- **Circuit Switching:** Circuit switching is analogous to a simple telephone call. A physical circuit is established between the two machines.
- **Message Switching:** In a Message switching network, the message as a whole is transmitted, i.e., it is not divided into packets.
- **Star Topology:** The star topology consists of a central computer to which all other computer terminals are connected. Two computers in this type of network cannot have direct communication.
- **Ring Topology:** In the ring topology, the different computers are connected to each other forming a closed loop (in the form of a ring). The data is passed from one computer to the other in a series until it reaches its desired destination.
- **Bus Topology:** The bus topology is also referred to as the multipoint topology. All nodes are connected to a bus that runs through the network.

15.11 ANSWERS TO CHECK YOUR PROGRESS

1. c
2. b
3. c
4. b
5. d
6. b
7. a
8. a
9. a

15.12 TERMINAL AND MODEL QUESTIONS

NOTES

Short Answer Questions

1. What do you mean by Computer Networks?
2. What are the different types of Computer Networks?
3. Why are the WAN's also referred to as long haul networks (LHN's)?
4. List down the disadvantages of using Star topology.

Long Answer Questions

1. Define broadcast and point to point type networks. Write example of each.
2. What do you understand by the term 'protocol'?
3. Differentiate between LAN and WAN by listing down the merits and demerits of each over the other.
4. Differentiate between Pop mail and Web mail.
5. Which type of e-mail service would you prefer? State reasons.
6. Given below are some abbreviations, write their full form.
 - (i) TCP/IP
 - (ii) FTP
 - (iii) HTTP
 - (iv) HTML
 - (v) ICI
 - (vi) IDU
 - (vii) ASCII
 - (viii) OSI
 - (ix) SDU
 - (x) LHN
 - (xi) MAN

15.13 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003
8. Manoj Kumar and M. Shamir Bhudookan, *Information Technology for 'O' Level*, Editions De L'Ocean Indien

UNIT 16: INTERNET AND INTRANET

NOTES

Structure

- 16.0 Introduction
- 16.1 Unit Objectives
- 16.2 World Wide Web
- 16.3 Advantages
- 16.4 Terminologies Related to Internet
- 16.5 Web Browsers
- 16.6 Search Engines
- 16.7 Domain Name System (DNS)
- 16.8 Electronic Mail (E-mail)
- 16.9 I.P. Address
- 16.10 Intranet
- 16.11 File Transfer Protocol (FTP)
- 16.12 Simple Mail Transfer Protocol (SMTP)
- 16.13 Telnet – Remote Login
- 16.14 Hyper Text Transfer Protocol
- 16.15 Different Applications of Intranet
- 16.16 Summary
- 16.17 Glossary
- 16.18 Answers to Check Your Progress
- 16.19 Terminal and Model Questions
- 16.20 References

16.0 INTRODUCTION

The World Wide Web and the Internet have impacted the world including business, social and political life in the last few years. It is expected that this trend will certainly continue well into the future too. You must be very much familiar with the term World Wide Web, which is also known as web or WWW or W3 and has established itself as the most popular part of the Internet by far. The upper three layers, viz., session, presentation and application layers are considered as user or application layers of the OSI models. They are implemented in software. In most of the protocols, the functions of these layers are converged into a single layer called 'application layer'. TCP is one of the examples of such types of protocols. The application layer, the highest layer of OSI model interacts with software applications which enable source

and destination machines to communicate properly. It provides different services which are described herein.

16.1 UNIT OBJECTIVES

NOTES

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

- Understand the advantages of WWW in the present scenario
- Understand different terminologies associated with WWW
- Learn how a web is designed using HTML and FrontPage
- Comprehend concept of Web Browser
- Learn about Search engines
- Understand how DNS is able to provide the quick translation of text of the IP addresses into corresponding binary numbers
- Learn about email and its various features
- Venture into multimedia concepts and its components, development tools, etc.
- Know about File Transfer Protocol (FTP) to facilitate file transfers across the Internet
- Understand concepts of Telnet as a means of remote login
- Learn about SMTP and its mechanism to send and receive mails
- Understand Hyper Text Transfer Protocol and its role in accessing the websites

16.2 WORLD WIDE WEB

It is an incredible mine of information! Once you start searching anything ranging from documents to pictures to software, it almost appears limitless. It provides you documents, sound files, view images, animation, and video, speak and hear voice, and view programs that run practically on any software in the world. Therefore, it facilitates the rich and diverse communication by enabling you to access and interact with text, graphics, animation, photos, audio and video. It has now become very simple for you to understand how the web works and what it is. Its implementation is based on client server system and employs your personal computer as client, web browser software, a connection to an Internet service provider, servers, routers and switches to direct the flow of information. You may be aware of all terms used in the formation of a web except web browser.

A browser is a software, which your computer uses to view WWW documents and access the Internet. The browser program residing in your computer facilitates you

NOTES

with the advantages of text formatting, hypertext links, images, sounds, motion, and other features. Internet Explorer and Netscape are some of the widely used browsers. Browsers have sub programs called plug-ins to handle the documents you find on the Web. It may also other plug-ins stored elsewhere in your computer.

Web is very simple to use. Whenever you wish to visit any website, say your institute's website, you simply enter the address or URL of the website in your web browser to forward your request to the web server of the institute to provide you the intended web page. The institute's web server then sends your request on the Internet to find the intended website. Once it is obtained, the web server returns the same to your computer where the browser loaded with different plug-ins interprets the data, displaying it on your computer screen. The intended web page, which is now available on your desktop, may have click able links. On clicking on the same, you may visit other pages. In this manner, the information scattered across the globe can be linked together.

It now becomes essential to explain as to how the different web pages with different text format and standards could be linked to a particular web page. The binding forces that hold the Web together are the hypertext and the hyperlink. The hyperlink allows electronic files on the Web to be linked so you can jump easily between them using hypertext protocol. As you have learnt that web browsers that enable you to access the Web also distinguish between web pages and other types of data on the Internet because web pages are written in a computer language called Hypertext Markup Language or HTML.

World Wide Web (WWW): The *World Wide Web* is an information space that provides resources, which are identified by global identifiers called Uniform Resource Identifiers (URI). There is software, which in conjunction with servers, proxies, spiders, browsers and multimedia applications enables a user to identify and explore resources on web space. In networking language, www is a client-server information system that utilizes the Internet to access computers containing millions of hypertext documents.

16.3 ADVANTAGES

Many companies have understood the advantages of having a presence on the World Wide Web and have successfully addressed their corporate objectives by integrating their website as part of their business strategy. We are aware that a website can generate awareness of the products and services of the company and provide a global storefront for the company 24 hours a day with automating many business procedures. It is relatively inexpensive and versatile for establishing and maintaining a website. Its interactive feature makes it superior to other advertising media. Below are some advantages offered by the WWW:

- **Presence on the Web:** It enables businesses to be in touch with several million people who have access to the World Wide Web with more and more added

every day. No business can afford to ignore this many potential customers.

- **Networking:** It helps in developing lines of communication to enhance contact with potential clients and organizations. It helps in speedy and reliable communication and advertisement.
- **Provide Business Information:** It facilitates the websites to publish business services, hours, location, phone and e-mail for the public to view like any printed form of advertising. Unlike the conventional advertisement, the website provides instant communication with information about the business that may change regularly.
- **Service to Customers:** A website provides access to business information and services to their customers online that may not be available any other way. The customers can be from anywhere in the world and shop in online stores like never before and from the comfort of their homes. They can easily and quickly search the database to locate the exact item that they were looking for and purchase it online.
- **Conduct Business:** A website may provide means of doing business.
- **Provide Files to Download:** Details and information of products and services in the form of pamphlets, brochures, advertisements, and even a demonstration video can be downloaded from the company's website.
- **Remote Office Access:** It facilitates offices and employees to be in touch with one another from remote places to accomplish their tasks effectively.

16.4 TERMINOLOGY RELATED TO INTERNET

- **World Wide Web (the Web, WWW, W3):** It is defined as a client-server information system using the Internet to access computers containing millions of hypertext documents. **Web page:** It is a single hypertext document written in Hypertext Markup Language (HTML) and described in HTML basics. This normally contains the basic information and links to navigate in the websites to which it belongs.
- **Website:** It is written in HTML and is a collection of linked Web pages on a Web server. Web server is the machine where a website is located or hosted. It may be organization owned or Internet Service Provider (ISP) owned.
- **Home Page:** It provides a point of entry to a Website with help. It also contains all relevant links of that particular website.
- **Web Client:** It refers to the computer and software used to access a website and web pages.
- **Web Server:** It is the computer or server which provides a space for hosting a website. The web client access web servers to retrieve information from

NOTES

a website.

- **Web Browser:** It is the client software used to explore and display web pages from a website.
- **Search Engines:** They are software that enables searching of the content available on Internet.
- **Hypertext:** It defines the documents containing embedded links (hyperlinks) to other documents or other parts of the same document.
- **HTML:** Hypertext Markup Language defines the rules for formatting a web page so that a web browser displays the page properly. The documents available on Web are developed, using the programming language called HTML, which may be considered as the foundation of the Web. It is the HTML and the other programming that make possible hyperlinks. The click ability feature of hyperlinks makes the web unique. The working of hypertext links depends upon the URL. Each hyperlink contains URL and you send a request by clicking on the link so that the requested document can be retrieved on your machine from other computer. It may be anywhere in the world. TCP/IP and HTML could make this possible. We may now define the HyperText Mark-up Language (HTML) as a standard format for documents on the WWW, which could be viewed by using WWW browsers.
- **URL:** It denotes Uniform Resource Locator. It is the address of a document on the World Wide Web. Web browsers enable a person to enter a known address of a web server or a specific document within that server. Addresses begin with http://, ftp://, gopher://, WAIS://, file:// etc.
- **Protocols:** They are sets of communication rules that enable client machines and servers to communicate accurately with each other.
- **Hyper Text Transport Protocol (HTTP) :** Hypertext Transfer Protocols are the rules that enable the transmission of web documents from one computer to another via the Internet. WWW is a client/server-computing environment. A client computer by clicking on a link requests a document from Web server. In order to serve the request of client, Web server uses a protocol called HTTP or Hyper Text Transport Protocol.

16.5 WEB BROWSERS

A web browser is the software program used to access the World Wide Web, i.e., the graphical portion of the Internet. The first browser, called NCSA Mosaic, was developed at the National Centre for Supercomputing Applications lab at Illinois in the early 1990s. The easy-to-use point-and-click interface fuelled the growth of the Web. The web browser software program facilitates a user to display and interact

with text, images, videos, music and other information typically located on a web page at a website on the www or a LAN. Text and images on a web page normally designed to provide hyperlinks to other web pages at the same or different website. Thus web browser enables point to point click to reach directly to the targeted web pages.

Some of the popular web browsers are Internet Explorer, Mozilla Firefox, Safari, AOL Explorer, etc. Web browsers belong to HTTP user agent category. Browsers also provide in accessing information provided by web servers in private networks or content in file systems.

Web browsers talk with web servers using HTTP (hypertext transfer protocol) to retrieve web pages. HTTP enables web browsers to provide information to web servers to retrieve web pages from them. Different web pages have a URL address starting with http:// for HTTP access. There may be different other URL types and their corresponding protocols and most of the browsers support them. FTP (file transfer protocol) is one of the examples of such types. Other examples are rtsp: for RTSP (real-time streaming protocol) and https: for HTTPS (an SSL encrypted version of HTTP).

The file format for a Web page is normally HTML (hyper-text markup language) and is identified in the HTTP protocol with a MIME content type. Most of the browsers support different formats such as the JPEG, PNG and GIF image formats including HTML. The combination of HTTP content type and URL protocol specification enables designers to embed images, animations, video, sound and streaming media into a web page or to make them accessible through the web page.

16.6 SEARCH ENGINES

A search engine is an information retrieval system to access and retrieve information stored on WWW or a computer system attached to the Internet. Search engines enable to minimize the time required to find information and the amount of information on a computer system. The computer system may be a standalone system or attached to the Internet. The search engines are popular among people as web search engines to explore information on the World Wide Web.

Search engines are interface to a group of contents that allows users to specify criteria about the content by providing some keywords so that the engine can find the several matching contents to the corresponding keywords out of million of webpages. The keywords provided are referred to as a search query. Several styles of search query syntax are used. Search query differs for different types of search engines, whereas some search engines enable users to enter two or three words separated by space while other search engines may require users to provide entire documents, pictures, sounds, and various forms of languages. Some search engines attempt to enhance the

search queries to provide a quality set of items through a process known as query expansion.

NOTES

Index-based Search Engine

In such engines, the list of items to meet the criteria specified by the query is typically sorted or indexed. Indexing contents by relevance from highest to lowest minimizes the time needed to explore the desired information. Some search engine uses probabilistic approach to rank contents based on measures of similarity, popularity or authority. Boolean search engines typically provide contents which match exactly without regard to order, although the term ‘boolean search engine’ may simply refer to the use of boolean-style syntax. Thus, in order to provide a set of matching contents that are sorted based on some criteria quickly, a search engine will typically collect metadata about the group of contents under consideration through a process called indexing. The advantage of index is that it needs a smaller amount of computer storage.

Types and Characteristics

Some of the popular search engines with their types and characteristics are given below:

Alta Vista: It is a crawler type which results ranked based on how many times search words appear in the text. It searches full text.

Excite: It is also a crawler type and uses meta tags.

Google: It is also a crawler type that performs based on the number of times other sites are linked to the ranked site.

Yahoo – It is crawler type and performs similar to Google.

16.7 DOMAIN NAME SYSTEM (DNS)

Now we have two types of IP address in the form of decimal numbers and text for the same host. You know that lists of all IP addresses are maintained centrally by ICANN in the form of distributed database directory. There are several distributed servers, which maintain this list of IP addresses. The reasons behind the distributed servers are very logical and simple. It helps in disaster management and in diverting the load of the traffics in the form of requests from clients to other DNS servers located at different sites. DNS server maintains database in both forms that is textual and decimal notations. For example, DNS server maintains the address of google site as www.google.com and 2116.23.9.53.99. In this manner, DNS is used to provide host-to-IP address mapping of remote hosts to the local hosts and vice versa. It is now amply clear that the DNS maintains a distributed database to map between hostnames and IP addresses. Whenever a client requests a service from a site, the site runs DNS protocol to access the distributed database which is nothing but Domain Name Systems. Therefore, the DNS provides the protocol, which allows clients and servers to communicate with each other. DNS enables a system to use a resolver,

which resolves the host name to IP address understandable by server.

You may be now thinking of how DNS is able to provide the quick translation of text of the IP addresses within fractions of seconds from a directory of billions of such addresses. This could be made possible by using Domain concepts, which uses hierarchical arrangements of text addresses translation.

You can see from Fig. 16.1 that at the top level is the root server, which has null label. Below this is another level domain or domain as com, edu, int and so on which are grouped together. Below this different sub domains or groups have been created. Table 16.1 below corresponds to some commonly appearing domain names with their respective sites. The DNS can accommodate almost all kinds of organizations by allowing each group to choose between geographical or organizational naming hierarchies.

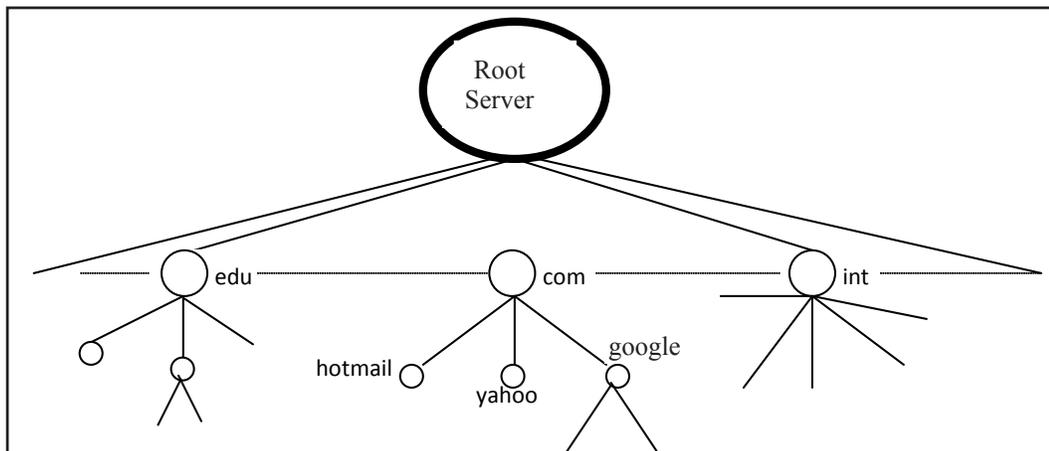


Fig. 16.1: DNS Hierarchy

Table 16.1: Internet Domains

<i>Domain</i>	<i>Indicative site</i>
Com	Commercial institute
Edu	Educational institute
Org	Nonprofit organization
Net	Network service provider
Gov	Government department
Mil	Military
Biz	Business
Country code	For example, in for India, us for the USA, au for Australia, jp for Japan and so on

NOTES

We know that the servers maintaining addresses are distributed and have locations throughout the world. Then this question arises as to how text addresses are organized in hierarchical arrangement. You may refer to Fig. 16.1 above and Table 16.1. The hierarchy is represented into zones and each zones is a hierarchy of one or more nodes without any overlapping. Each zone is represented by a server and undoubtedly with one backup server. Root server as shown in Fig. 16.1 is only one, which is just indicative; there may be several root servers at several locations in the world. Each root is aware of the location of each DNS server of specific domains.

The process is now very simple to understand. When you need to connect with a particular site, you first send your request to your local host. If your local host can provide the translation, your request is completed. If not, your local host then sends your request one level above in the hierarchy. If the server at one level above is able to handle the same, you get your intended website at your desktop through your local server. If not, then the server at one level above from your local server either sends your request again to another server or informs your local server that your request is failed and gives the address of another server to process your request. This process continues till a server is found who knows the address, otherwise, the request is filtered up to the root server. Depending upon the domain address, root server forwards the request to the one of the domain servers represented at the next level of hierarchy. This process continues and the information of text address is returned to Root server and then back to your local server.

16.8 ELECTRONIC MAIL (E-MAIL)

Electronic mail is one of the most popular network services. The use of Electronic mail, or e-mail may probably be cited as the foremost reason for the popularity of Internet. The proliferation of cyber café can be credited to e-mail or World Wide Web. E-mail provides an efficient and fast means of communication with relatives, friends or colleagues throughout the world. You cannot only communicate with one person at a time or thousands but also you can receive and send files and other information in a short time. In an e-mail communication, the intended receiver or receivers of the message are not required to be present at their desktop at the time of receiving of the message by their computer. It works like a postal mail. In a postal mail postman puts the sender's message in your mailbox and when you come back from your work, you access your mailbox to retrieve the message. Therefore, we may consider it in a way a substitute of postal mail. However, it has many-many more superior features than postal mail. E-mail has two parts:

User Agent: It is the user interface to the mail system. The user agent system enables to provide ways to view, edit, and reply to messages, etc. It also accesses messages stored in a system mailbox. The user agent enables the user to use a text editor to create a file that the user agent hands over to the message transfer agent.

Message Transfer Agent (MTA): It is a software package that transports messages created by a user to destination mailboxes possibly on remote machines. The MTA has to perform more complex jobs than other applications:

1. MTA handles temporary failures when a destination machine is temporarily unavailable; it stores the message on the local machine for later delivery. Thus, the User Agent typically just stores messages into a storage area.
2. MTA distinguishes between local and remote recipients.
3. MTA needs to deliver copies of a message to several machines.
4. MTA has to allow mixing text, voice, and video in a message and appending documents and files to a message.

As discussed above, the email addresses consist of the following components:

Mailbox names: A mailbox is associated with one login id within a mail server to store the emails of the user. Therefore, a specific name is provided to the mailbox associated with each IDs.

Symbolic names: It refers to the name of a service rather than a specific user. For example, a postmaster is universally recognized as an address for post mail problems. In email system, the symbolic names are aliases for specific mailboxes.

Group names (mail exploders): It refers to an alias for a set of recipients. MTA consults an internal database to specify the mail addresses.

16.9 I.P. ADDRESS

IP address is short for Internet Protocol (IP) address. An IP address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. Contrast with IP, which specifies the format of packets, also called datagrams, and the addressing scheme.

The Format of an IP Address

The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address.

Within an isolated network, you can assign IP addresses at random as long as each one is unique. However, connecting a private network to the Internet requires using registered IP addresses (called Internet addresses) to avoid duplicates.

Static Versus Dynamic IP Addresses

An IP address can be static or dynamic. A static IP address will never change and it is a permanent Internet address. A dynamic IP address is a temporary address that is assigned each time a computer or device accesses the Internet.

NOTES

The four numbers in an IP address are used in different ways to identify a particular network and a host on that network. Four regional Internet registries -- ARIN, RIPE NCC, LACNIC and APNIC-- assign Internet addresses from the following three classes:

Class A - supports 16 million hosts on each of 126 networks

Class B - supports 65,000 hosts on each of 16,000 networks

Class C - supports 254 hosts on each of 2 million networks

The number of unassigned Internet addresses is running out, so a new classless scheme called CIDR is gradually replacing the system based on classes A, B, and C and is tied to adoption of IPv6. In IPv6 the IP address size is increased from 32 bits to 128 bits.

What is My IP Address?

To view your IP address you can use the ipconfig (IPCONFIG) command line tool. Ipconfig displays all current TCP/IP network configuration values and refreshes Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) settings.

To launch the command prompt from a Windows-based computer click: Start > All Programs > Accessories > Command Prompt. Type ipconfig and press the Enter key.

You can also use Google search to find your IP address. Type “what is my IP address” as a search query and Google will show the IP address of the computer from which the query was received as the top search result.

16.10 INTRANET

An intranet is a private computer network built inside Organization Company or a university. Intranet uses internet protocols with some times wired and sometimes wireless medium network connectivity to securely share part of an organization’s information or operations with its employees and students respectively. Intranet can also be described as the organizations own private inter accessible website that holds all the information on running matters of the organization. The same concepts and technologies of the Internet such as clients and servers running on the Internet protocol suite like Hyper Text Transfer Protocol (HTTP) and File Transfer Protocol (FTP) are used to build an intranet.

The use of intranet is increasing in the corporate sector day by day for the sharing of information and applications, collaboration between various companies to solve a common problem, teleconferencing, sharing the sophisticated corporate directories, sales and customer relationship management tools like MS project manager etc., to advance productivity.

16.11 FILE TRANSFER PROTOCOL (FTP)

NOTES

The File Transfer protocol is among the oldest protocols still used in the Internet. FTP is widely available on almost all browsers indicating that all computing platforms, including DOS, OS/2, UNIX, and up to the mainframe level have this service available. You can very well understand from its name that it facilitates the majority of file transfers across the Internet. In other word, FTP is a file server access protocol that enables a user to transfer files between two hosts across the network or Internet using TCP. You may see the versatility of this application layer protocol, it accomplishes its job even intended hosts at separate locations could potentially be running different operating systems, using different file storage systems, and using different character sets. Accessing FTP sites over the Internet requires that the user must have the knowledge of the location and the name of the desired files.

Unlike Telnet, FTP does not require any familiarity with the remote operating system. The user is still required, however, to be familiar with the FTP command set built into the protocol itself so that he or she can productively manage the session.

Modern FTP servers known as `ftpd` support two different TCP connections, viz., control and data connections. First control connection is invoked for the entire duration of transfer of file or FTP session. It facilitates the exchange of commands issued by the client, and replies originating from server. Data connection is established as and when it is required. Its main function is to facilitate transfer of files and directory listings to and from the client at the client's request.

Whenever you wish to do FTP, you need to invoke a few commands. These commands basically are related to transfer a file from remote computer to your computer or from your computer to the remote computer. There are anonymous as well as authorized privileges with regard to transfer of a file from a server. In case of anonymous FTP servers, you can do FTP without authorization. You need to login with a username, which is anonymous, and a password that is your e-mail address. Apart from this, there are authorized servers for which you need to register before you are permitted to do FTP. After registration, you will get a password.

Trivial File Transfer Protocol (TFTP)

TFTP, like FTP, is also an Internet service intended for the transfer of files from one computer to another over a network. It does not provide password protection or user directory capability. Unlike FTP, however, TFTP does not rely on TCP for transport services. Instead, TFTP uses UDP to shuttle the requested file to the TFTP client. Furthermore, diskless devices that keep software in ROM to use it to boot themselves can use it. It is simpler than the File Transfer Protocol (FTP) but less capable. FTFTP facilitates to quickly send files across the network with fewer security features than FTP.

16.12 SIMPLE MAIL TRANSFER PROTOCOL (SMTP)

NOTES

Electronic mail (E-mail) is considered the most widely used TCP/IP application. The Internet mail protocols enable a client machine to exchange mail and message between TCP/IP hosts. Three standard protocols are applied to provide such mail application. The SMTP is one of them. The three standards are given below:

- **SMTP:** It is a standard for exchange of mail between two computers (STD 10/RFC 821), which specifies the protocol used to send mail between TCP/IP hosts.
- **Mail:** It is a standard (STD 11) defining the format of the mail messages, syntax of mail header fields, a set of header fields and their interpretation and about a set of document types other than plain text ASCII to be used in the mail body.
- **DNS-MX:** It is a standard for the routing of mail using the Domain Name System (RFC 974).

SMTP, an application layer protocol, is used to send e-mail messages across the Internet. It utilizes TCP as the transport protocol to send email to a destination mail exchanger, referred to as mail server. A client machine sends email to a mail exchanger or an email is sent from mail exchanger to another mail exchanger. E-mail transmitted using SMTP is normally transmitted from one mail exchanger to another directly. E-mail was never designed to be instantaneous but it appears so often.

Mail Exchangers are nothing but the software application programs to support the SMTP protocol. Mail Exchangers such as sendmail or Microsoft Exchange wait for IP datagrams that arrive on the network interface with a TCP port number of 25. When a message is arrived, the mail exchanger checks to find out if it is for one of its users and accordingly move the mail to the user's mailbox. The data sent using SMTP is 7-bit ASCII data, with the high-order bit cleared to zero is found adequate in most instances for the transmission of English text messages, but is inadequate for non-English text or non-textual data. To overcome these limitations, Multipurpose Internet Mail Extensions (MIME) defines a mechanism for encoding text and binary data as 7-bit ASCII within the mail envelope and SMTP Service Extensions specifies a mechanism to extend the capabilities of SMTP beyond the limitations.

How SMTP Works

SMTP is end-to-end delivery in which an SMTP client machine contacts the destination host's SMTP server directly to deliver the mail. Unlike the store-and-forward principle that delivers the mail content to the destination host through a number of intermediary nodes in the same network, SMTP continues the mail content being transmitted until it has been successfully copied to the host's SMTP. In case of store and forward mechanism, the successful transmission from the sender only indicates that the mail content has reached the first intermediate hop. There are

instances when mail is exchanged between the TCP/IP SMTP mailing system and the locally used mailing systems. Such applications are referred to as mail gateways or mail bridges. However, SMTP guarantees only delivery to the mail-gateway host, not to the real destination host, which is located beyond the TCP/IP network. In case of a mail gateway, the SMTP end-to-end transmission is host-to-gateway, gateway-to-host or gateway-to-gateway. SMTP does not specify the format of mail beyond the gateway.

- Each message of SMTP contains the following fields.
- A header or envelope that is terminated by a null line.

Contents: Everything after the null or blank line is the message body with sequence of lines containing ASCII characters.

Simple Mail Transfer Protocol defines a client/server protocol. The client SMTP machine initiates the session by sending SMTP message and the mail server responds by receiving SMTP message to the session request.

Mail Exchange

The SMTP design is based on the model of communication illustrated in Fig. 16.2. After the client machine mail request, the sender-SMTP sets a two-way connection with a receiver-SMTP. The receiver-SMTP may be the destination machine or an intermediate machine (mail gateway). The sender-SMTP will initiate commands which are replied to by the receiver-SMTP.

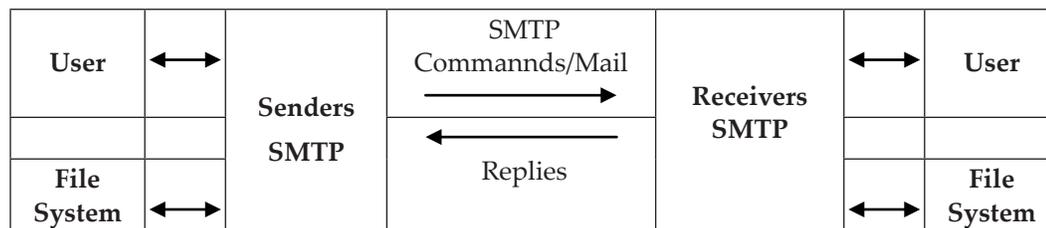


Fig. 16.2: SMTP Communication

1. The client machine SMTP sets a TCP connection with the destination machine SMTP and then waits for the server to send a service ready message or a service not available message.
2. HELO (HELO is an abbreviation for hello) is sent and the receiver machine will identify itself by sending back its domain name. The client machine SMTP uses this to verify if it reached the right destination SMTP. If the client machine SMTP supports SMTP Service Extensions, it substitutes an EHLO command in place of the HELO command. A destination machine SMTP which does not support service extensions responds with a 500 Syntax error, command unrecognized message. The client machine SMTP then retries with HELO, or if it cannot transmit the message without one or more service extensions, it

NOTES

should send a QUIT message. If a receiver-SMTP supports service extensions, it responds with a multi-line 250 OK message which includes a list of service extensions which it supports.

3. The client machine now initiates the start of a mail transaction by sending a MAIL command to the destination machine. This command has the reverse-path that is used to report errors. It should be noted that a path is more than just the user mailbox@host domain name pair. Besides, it has a list of routing hosts.
4. The next step of the actual mail exchange provides the server SMTP with the destinations for the message, the message may go to more than one recipient. This is accomplished by sending one or more RCPT TO:<forward-path> commands. Each of them will receive a reply 250 OK when the destination is known to the server or a 550 No such user here when it is not known to the server.
5. When all RCPT commands are sent, the sender forwards a DATA command to notify the destination machine that the message contents are following. The server replies with 354 Start mail input, end with <CRLF>.<CRLF>. It should be noted that the ending sequence that the client machine uses to terminate the message data.
6. The client machine now sends the data line by line ending with the 5-character sequence <CRLF>.<CRLF> line upon which the destination machine acknowledges with a 250 OK or an appropriate error message when anything went wrong.
7. Now, there are several possible actions:
 - (i) The destination machine has no more messages to transmit, it will end the connection with a QUIT command. This command is answered with a 221 Service closing transmission channel reply.
 - (ii) The destination machine has no more messages to transmit, but it is ready to receive messages (if any) from the other side. It will issue the TURN command. The two SMTPs now switch their role of sender/receiver and the client machine that was previously the destination machine now transmits messages by starting with step 3 above.
 - (iii) The client machine wants to transmit another message and simply follows step 3 to transmit a new MAIL command.

16.13 TELNET – REMOTE LOGIN

A remote login facility enables a user to create a login session to a remote machine and then execute commands. Telnet is an Internet standard remote login protocol to connect a local terminal with a remote login session. It copies keystrokes to the remote machine and copies output from the remote machine to the source machine.

Telnet is a program that allows a user with remote login capabilities to use the computing resources and services available on the host. It emulates the remote terminal on your desktop and therefore referred to as terminal emulation protocol of TCP/IP. Telnet can also be used to connect other ports serving user defined as well as well-known services. It works as client server model where it establishes a virtual connection using the TCP transport protocol. The telnet program requires two arguments, i.e., the name of a computer on which the server runs and the protocol port number of the server. After establishing connection, the Telnet server and client enter a phase of option negotiation to determine the options that each side will like to support for the connection. They are always free to change their options even after establishing the connection. This provides it a versatile terminal emulation due to many options. It can transfer binary data, support byte macros, emulate graphics terminals, and convey information to support centralized terminal management.

Telnet service is unique in the same that it is not platform-specific like other TCP/IP services. A DOS user running Telnet, for example, can connect to a UNIX host or a mainframe computer. The down side of using Telnet, however, is that, unless the user is familiar with the operating system running on the remote platform, he or she cannot use the desired resources easily. Telnet aims to provide three services:

- Telnet defines a Network Virtual Terminal (NVT) standard to describe a standard terminal. Client programs then interact with the NVT. The server translates NVT operations into specific commands to the actual hardware/operating system.
- Telnet enables the remote machines connecting together to negotiate options with one another. Option negotiation makes agree both the remote machines on a common level of service.
- Telnet treats connections of the remote machines symmetrical and enabling them to use programs. Telnet also defines data and command sequences to deal with heterogeneity. The client machine translates keystrokes into NVT format and sends them to the server machine at remote location. The server machine translates NVT operations into the appropriate local representation.
- Some of the Telnet commands are given below:
 - Interrupt process (IP) – It terminates the running program.
 - Abort output (AO) – It refers to discard any buffered output.
 - Are you there (AYT) – This command allows client to send an out-of-band query whether to verify the remote end is still there.
 - Erase character (EC) – It refers to erase the previous character.
 - Erase line (EL) – It deletes the entire current line.
 - Synchronize – It clears data path to remote party.
 - Break – It is equivalent of the BREAK or ATTENTION key.

16.14 HYPER TEXT TRANSFER PROTOCOL

NOTES

In order to access any website, the web browsers are used which are assisted by the URL that uses the http scheme. It is the URL or the port number that assists the browser to link with a Website. The server indicates a computer connected to the Internet while the port number indicates a type of socket to which the browser plugs in to link with the web server. The web server not only provides the requisite web pages but also describes a computer program that runs on a computer to provide web pages. When a browser receives a URL will attempt to connect with the server computer having the required web pages by connecting to the specified port number. The URL can be provided to the browser either by typing it at its specified location or by clicking on the link available on some already displayed web page or document.

It is the role of the browser to connect with the server where the requisite requests from client or user is stored or available. When the web server receives the request from the browser, it replies back to the browser, which is client in this case. The information basically contains the HTTP protocol version, name of the server, the media type of the document and date, etc. The media type of the document is a quite important information because the browser is required to know what kind of document this is before it can process it. HTML is the most common media type transferred over the Web. Other media types are GIF image and JPEG image. Several times a response like “HTTP 404 Not Found” is displayed, which means that the request document is not available at the link. There are different responses defined in HTTP. Briefly, in order to access a web page, HTTP involves browser that issues a request followed by a few headers. In response, the server replies back with a few headers and a document.

The web server basically maps the URLs to files on its hard disks. The web server interprets the path in any URL to map it with a filename on its hard disk. In order to make it work to map with the requisite file, the web server is configured to contain a “document root” directory relative to which all URLs are resolved as filenames. Let us take an example, suppose the URL is `http://myspace.tutorial.in`, and the document root is `D:\WWWFiles\`. When a user types the URL `http://myspace.tutorial.in/ lesson1/networking.htm` into browser, the browser requests the server for the document `/lesson1/networking.htm`. The web server begins searching in the directory `D:\WWWFiles\lesson1` for a file called `networking.htm`. If the requisite file is available it responds with a header followed by the document. If it is not available, it responds a 404 Not Found followed by a helpful error message telling the user to search elsewhere.

16.15 DIFFERENT APPLICATIONS OF INTERNET

In order to access any website, the web browsers are used which assist Internet is interconnection of large number of heterogeneous computer networks all over the

world that can share information back and forth. These interconnected networks exchange information by using same standards and protocols.

Applications of Internet

The internet is treated as one of the biggest inventions. It has a large number of uses.

1. **Communication:** It is used for sending and receiving message from one and other through internet by using electronic mail. Some of the websites providing this service are yahoo.com Hotmail.com rediffmail.com etc.
2. **Job searches:** Getting information regarding availability of job in different sectors and areas. You can publish your resume is online for prospective job. Some of the websites providing this service are naukri.com, monster.com, summerjob.com, recuritmentindia.com, etc.
3. **Finding books and study material:** Books and other study material stored around the world can be easily located through internet. Latest encyclopaedias are available online.
4. **Health and medicine:** Internet provides information and knowledge about field of health medicine people can have information about various disease and can receive help .patient can be taken to virtual check room where they can meet doctors.
5. **Travel:** One can use internet to gather information about various tourist places. It can be used for booking Holiday tours , hotels, train and flights. Some of the web sites providing this service areindiatravelog.com, rajtravel.com, makemytrip.com.
6. **Entertainment:** One can download jokes, songs movies, latest sports, update through internet. Some of the web sites providing this service are cricinfo.com, movies.com espn.com
7. **Shopping:** Internet is also used for online shopping. By just giving accounts details you can perform the transaction. You can even pay your bills and perform bank related transaction.
8. **Stock market updates:** You can sell or buy shares while sitting on computer through internet. Several websites like ndtvprofit.com, moneypore.com, provide information regarding investment.
9. **Research:** A large number of people are using internet for research purposes. you can download any kind information by using internet.
10. **Business use of internet:** Different ways by which intenet can be used for business are:
 - (i) Information about the product can be provided online to the customer .
 - (ii) It provides market information to the business.

NOTES

NOTES

- (iii) It helps business to recruit talented people.
- (iv) It helps in locating suppliers of the product.
- (v) Fast information regarding customers view about companies product.
- (vi) Eliminates middle men and arranges a direct contact with customer.

Check Your Progress

Fill in the blanks:

1. World Wide Web is defined as a _____ information system using the Internet to access computers containing millions of hypertext documents.
2. _____ defines the documents containing embedded links (hyperlinks) to other documents or other parts of the same document.
3. Hypertext Transfer Protocols are the rules that enable the transmission of _____ from one computer to another via the Internet.
4. Web Browser is the client software used to explore and display _____ from a website.
5. _____ refers to the electronic version of the postal mail that uses user agent and message transfer agent to transport the message at the destination mail boxes.
6. File Transfer Protocol is a file _____ that enables a user to transfer files between two hosts across the network or Internet using TCP.
7. _____ are software that enables searching of the content available on Internet.
8. _____ denotes Uniform Resource Locator. It is the address of a document on the World Wide Web.
9. _____ refers to the computer and software used to access a website and web pages.
10. _____ is a single hypertext document written in Hypertext Markup Language (HTML) and described in HTML basics. This normally contains the basic information and links to navigate in the websites to which it belongs.
11. _____ is written in HTML and is a collection of linked Web pages on a Web server. Web server is the machine where a website is located or hosted. It may be organization owned or Internet Service Provider (ISP) owned.

16.16 SUMMARY

NOTES

- The World Wide Web that has become a de facto standard for any professional belonging to any discipline finds its extensive use and utility in providing information stored in a computer system attached to the Internet or www. Different web designing techniques are used to make the information in a presentable form to the users. Some of the web designing techniques such as HTML has become a standard for web pages. In addition to the above, In HTML webpage design, the limited use of colors often makes the appearance of the colors more powerful. It is also possible to add an image or a plain color as background with the help of its specifications in the <body> tag. Form also gives navigability to a website. Forms are objects that enable to enter information in the form of text boxes, drop-down menus or radio buttons. Front Page provided by Microsoft, however, provides an excellent tool for designing WebPages with very minimal knowledge of HTML has been replaced by more advanced tools. FrontPage enables to work in a
- The uppermost layer of OSI models provides a number of services to the users using the TCP/IP protocol. Domain Name System (DNS) provides the quick translation of text of the IP addresses within fractions of seconds from a directory of billions of such addresses. This could be made possible by using Domain concepts, which uses hierarchical arrangements of text addresses translation. The servers maintaining addresses are distributed and have locations throughout the world. Electronic mail is one of the most popular network services and uses user agent and message transfer agent to transport messages created by a user to destination mailboxes possibly on remote machines. Multimedia applications have enthused life in webpages making them interactive. The convergence of different media such as text, pictures, video and sound into a single media has contributed enormously for the growth of Internet and www. Applications of multimedia packages are found in all walks of life. With the advancement and innovation in presentation tools of multimedia, the multimedia applications have been giving impressions of virtual reality to its end users.
- Protocols working with TCP/IP like File Transfer Protocol (FTP) and Trivial File Transfer Protocol (TFTP) are file server access protocol that enable a user to transfer files between two hosts across the network or Internet using TCP. Simple Mail Transfer Protocol (SMTP) that is used to transfer mails from one computer system to another computer system attached to the same network or different networks uses end-to-end delivery in which an SMTP client machine contacts the destination host's SMTP server directly to deliver the mail. Telnet is an Internet standard remote login protocol to

connect a local terminal with a remote login session. It copies keystrokes to the remote machine and copies output from the remote machine to the source machine.

NOTES

16.17 GLOSSARY

- **Frames:** It is for displaying more than one HTML document in the same browser window or to divide the screen into separate windows.
- **Home Page:** It provides a point of entry to a Website with help. It also contains all relevant links of that particular website.
- **HTML:** Hypertext Markup Language defines the rules for formatting a web page so that a web browser displays the page properly.
- **World Wide Web (WWW):** It is defined as a client-server information system using the Internet to access computers containing millions of hypertext documents.
- **Hypertext:** It defines the documents containing embedded links (hyperlinks) to other documents or other parts of the same document.
- **Hyper Text Transport Protocol (HTTP):** Hypertext Transfer Protocols are the rules that enable the transmission of web documents from one computer to another via the Internet.
- **Search Engines:** They are software that enables searching of the content available on Internet.
- **URL:** It denotes Uniform Resource Locator. It is the address of a document on the World Wide Web.
- **Web Browser:** It is the client software used to explore and display web pages from a website.
- **Web Client:** It refers to the computer and software used to access a website and web pages.
- **Web Page:** It is a single hypertext document written in Hypertext Markup Language (HTML) and described in HTML basics. This normally contains the basic information and links to navigate in the websites to which it belongs.
- **Website:** It is written in HTML and is a collection of linked Web pages on a Web server. Web server is the machine where a website is located or hosted. It may be organization owned or Internet Service Provider (ISP) owned.
- **Electronic Mail:** It refers to the electronic version of the postal mail that uses user agent and message transfer agent to transport the message at the destination mail boxes.

- **File Transfer Protocol (FTP):** It is a file server access protocol that enables a user to transfer files between two hosts across the network or Internet using TCP.
- **Hyper Text Transfer Protocol:** It refers to access any website.
- **MPEG compression:** There are a number of MPEG hardware compression and playback cards available for a range of systems. Hardware compression is much faster, and allows greater resolution than in software and is of better quality.
- **Multimedia:** It is defined as a communications network comprising of computer platforms and software that supports the interaction with atleast one of the types of the above-mentioned mediums.
- **Simple Mail Transfer Protocol (SMTP):** It enables a client machine to exchange mail and message between TCP/IP hosts.
- **Sound:** It is used to set the rhythm or a mood in a package. Sound files in various sound file formats like the MP3 are embedded easily into a multimedia package.
- **Telnet:** A remote login facility enables a user to create a login session to a remote machine and then execute commands.
- **Video:** It is nothing but the motion pictures that requires millions of bits. Multimedia packages contain digital video that is usually produced from analog video.

NOTES

16.18 ANSWERS TO CHECK YOUR PROGRESS

1. client-server
2. Hypertext
3. web documents
4. web pages
5. Electronic Mail
6. server access protocol
7. Search Engines
8. URL
9. Web Client
10. Web Page
11. Website

16.19 TERMINAL AND MODEL QUESTIONS

NOTES

Short Answer Questions

1. What is the correct HTML tag to make a text bold?
2. How an image can be inserted in HTML?
3. How a HTML document can be created from normal word document?
4. How MIDI file and wave file are differentiated?
5. Define the role of frames in html?
6. Provide a link of another site and define links to send an email to different people. Take relevant example.

Long Answer Questions

1. There are several search engines. Explain the different types of search engines with their characteristics.
2. Differentiate between HTTP and FTP. Write some advantages of both protocols.
3. What is relevance of Front Page in designing web pages when most of the web pages are designed in HTML?
4. How is the HTML document used for making a hyperlink? Explain with example.
5. How does SMTP work in transferring mails from one computer system to another computer system attached to different networks?
6. What is animation? Explain with examples.
7. How is www different from Internet? Explain.

16.20 REFERENCES

1. *Computer Networks and Internet* by Rajneesh Agrawal and Bhata Bhushan Tiwari, published by Vikas Publication
2. *Remote Access for Cisco Networks*, by Burton, Bill, published by McGraw-Hill Osborne Media
3. *Data Communications and Networking* by Behrouz A. Forouzan and Sophia Chung Fegan published by McGraw-Hill Companies
4. *Computer Networks* by Andrew S. Tanenbaum, published by Prentice Hall
5. Web Tutorials on HTML and Front Page

UNIT 17: BASICS OF INFORMATION SECURITY

Structure

- 17.0 Introduction
- 17.1 Unit Objectives
- 17.2 Network Security
- 17.3 Levels of Security
- 17.4 Data Security
- 17.5 Security Threats
- 17.6 Firewalls
- 17.7 Data Encryption
- 17.8 Authentication
- 17.9 Summary
- 17.10 Glossary
- 17.11 Answers to Check Your Progress
- 17.12 Terminal and Model Questions
- 17.13 References

NOTES

17.0 INTRODUCTION

Over the past several years, the world has become interconnected in ways not previously imaginable. Small and large companies have presence on WWW and their offices spread across the globes have inter-office collaboration on a daily basis. Hence, all of these interconnections rely in large part on our ability to protect the networks that create those connections. Network security is a broad topic with multi-layered approach. It can be addressed at the data link layer, network layer and application layer. The issues concerned are: packet intrusion and encryption, IP packets and routing tables with their update version, and host-level bugs occurred at data link layer, network layer and application respectively.

The TCP/IP protocols are being used globally irrespective of the nature of the organizations whether it belongs to general category of organizations or security specific sensitive organizations. The news or information about hacking of some website or portal by some undesired people is very common nowadays. This shows that TCP/IP protocols are susceptible to intercept. This generated a need to ensure all round security for the network in an organization. The task of network administrator had to widen to include the overall security of the network. He has to ensure that all parts of this network are adequately protected and adequate measures of security have been implemented within a TCP/IP network. He should be aware of an effective

NOTES

security policy. He should also be able to pinpoint the main areas of risk that the network may face. Basically, these main areas of risk vary from network to network depending upon the organization functioning. There are therefore various security related aspects, which have direct implications for network administrator along with the means to monitor the implemented measures of security effectively and to tackle the problem of breach of security if it happens.

17.1 UNIT OBJECTIVES

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

- Understanding various aspects of network security for TCP/IP network
- List general security related issues and requirements for their protection
- The possible issues for data security and how the same can be protected
- Spell out various security measures such as invalid access, eavesdropping, firewall, and encryption
- Conceptual firewall architecture under various protection schemes
- Learn about data encryption and related technologies
- Understand the procedure and need of authentication

17.2 NETWORK SECURITY

The main objective of the network is to share information among its users situated locally or remotely. Therefore it is possible that undesired user can hack the network and can prove to be harmful for the health of the network or user. There are few basic points, which must be followed by network administrator to provide the network an adequate security other than network specific security as in case of e-commerce, etc. These are given below:

- Networks are designed to share information. Therefore, the network must be clearly configured to identify the shareable information and non-shareable information.
- The network should also clear with whom the shareable information could be shared.
- With the increase of system security, the price for its management will also increase accordingly; therefore a compromising level between security and prices should be established as per the requirement of the network security system policy. This will largely depend upon the level of security needed to apply in the network, overall security requirements and the effective implementation of chosen level of security.

- Division of the responsibilities concerning the network security must be clearly defined between users and system administrator.
- The requirements for security must be detailed within a network security policy of the organization that indicates the valuable data and their associated cost to the business.
- After defining the detailed network security policy and identifying the clear cut responsibilities in the organization, the system administrator should be made then responsible for ensuring that the security policy is effectively applied to the company environment, including the existing networking infrastructure.

17.3 LEVELS OF SECURITY

The evolution of security levels can be looked into different form, contributed by the US Department of Defense. The first step in this direction was the describing of the Trusted Computer System Evaluation Criteria in December 1985 that is popular by the name of Orange Book. In continuation with this Orange Book security level another security level known as Trusted Network Interpretation of the Trusted Computer System Evaluation Criteria or Red Book was described in July 1987. The security levels contain the security-related problems in the component or modular form. Each level contains the specific security problem, which is broken down into different divisions. Each of the divisions or classifications provides a representation of a security level defined in terms of the following general categories:

- User identification and authentication
- The capability to monitor and audit system activity
- Provision of discretionary access
- Control of the reuse of resources
- Identifying specific areas of possible attack
- Provision of suitable countermeasures
- The level of system trusts, including systems architecture, design, implementation, transport, and trust of other hosts.

17.4 DATA SECURITY

Data security concerns with the protection of data contained in a file or many files in a computer either as a standalone or on a network from unauthorized interception by providing some sort of security.

In case of postal system, a postcard as a carrier of information is open to all. It does not have any sort of security measures. An envelope is used to hide information from

NOTES

other people. It means that envelope here acts as a means for security. Therefore, postcard and envelope have different purpose with respect to security issue. These two particular cases initiated similar actions to solve the security-related issues in case of data communication. Emails are open to all as post cards. Following the envelope example in postal system will enable users to secure at least some of their data.

The access protection provided by logon passwords are not a full proof system and these may easily be bypassed. The bypassed methods include booting from a diskette or connecting the stolen hard drive as a secondary one to another computer. In this manner, any vital data might easily be accessed. Consequently, encryption of the information seems to be the only effective way to protect data from going or intercepting by the unauthorized persons. The encryption must be developed with the philosophy to ensure reliable data security and almost impossible to decrypt data without the right password or right user. The main drawback of the password-based encryption includes the loss of password or registration of wrong password due to wrong spelling or some other human mistakes. In this case, it becomes absolutely impossible to restore the data. There are other rules to avoid such situations.

17.5 SECURITY THREATS

The invalid access to the host can be prevented to a certain extent in case of conventional host to terminal as the number of terminals connected is limited. The situation is entirely different in case of Internet where Internet allows access from any terminal connecting on a network. Therefore, this requires proper security measures. Below is the list of some of the threats happening frequently in the network:

Viruses and Worms

The term 'virus' refers specifically to malware inserting malicious code into existing documents or programs. It spreads itself by various means. Still viruses are considered the most common type of network security threat. Almost 90 per cent of viruses spread through attachments on emails. However, a cautious user action may prevent the spread of virus because virus requires a user action to insert itself into a computer. It is therefore suggested that never open an email attachment, which is not expected, even though the sender appears to be known. However, this preventive measure will do little to stop worms from infecting the network because worms do not need a host file and they propagate themselves. When they infect a computer, they often make quick copies of it and infect an entire network within a few hours. To avoid attacks from viruses and worms, a latest version of anti virus software should be used.

Trojan Horses

This malware attack disguises itself as something innocent like a computer game or a search results page. Once installed on a computer, the Trojan horse may download

and install a keylogger onto the infected computer to record every keystroke by a computer's user, thus stealing vital details of the users. They usually hide themselves in a downloadable free software on a website. The users should detest themselves from downloading freeware. It is often observed that organizations block free download software to prevent themselves from the attack of Trojan horses. Sometimes, a computer infected with Trojan horse are required to be reformatted, therefore, it is suggested that preventive steps need to be enforced effectively than curing the infected computer system.

Spam

Spam constitutes 70 to 84 per cent of daily emails sent throughout the world that demands an ever increasing need for IT resources to filter out this irritating and potentially malicious menace. Spam email comprises unsolicited emails promoting products and coordinated spam attacks to consume so much bandwidth on a network so as to cause it to crash. Spam may use techniques "news service" spam, which uses legitimate news headlines to trick recipients into opening spam emails. Good email filters are used to filter the spams. And much of what slips through can be avoided by staying away not to trick with the emails. There should be check for signing of any online service or freebie. The naming system for creating email accounts should not be easily guessable because spammers are increasingly going through common name lists in order to harvest emails to spam.

Phishing

Emails with titles such as, "URGENT: Update Account Status" are all attempts by a spammer to "phish" the account details. The Phishing refers to spam emails to trick recipients into clicking on a link to an insecure website and provide details considering the website as genuine one. Typically, phishing attempts are carried out to steal account information for e-commerce sites such as banks, eBay or regular financial institutions' websites. A phishing email tricks the user to click a link, which will take the user to a page where the user is asked to re-enter all his or her account details including credit card number(s) and/or passwords. These websites are not actual site, even though they look like it. To protect the network, users should be cautious and detest themselves to open and provide vital details requested by any financial institutions. They should confirm the integrity before supplying such details. Financial institution should also educate their employees about the most common ways in which hackers try to phish the account information.

Packet Sniffers

Packet sniffers are the technique used to capture data streams over a network to obtain sensitive data like usernames, passwords, credit card numbers, etc. Thus, packet sniffers are more malicious forms of threats to the network security. Packet

NOTES

sniffers monitor and record details that are coming from and going to a computer over a compromised network. To get access to a network, packet sniffers use honeypots. They are simply unsecured wifi access points that hackers create to trap users who are using them. Making users aware of the threat of packet sniffers is the best prevention policy. A user should be aware not to access the Internet through an unsecured connection. Falling to packet sniffers technique will lead to compromise with sensitive network data. In addition, the user should use a variety of different sign on names and passwords to access various levels of network security. This helps at the instance when login information is compromised, the damage can at least be limited in scope.

Maliciously-Coded Websites

Maliciously coded websites create charitable websites enabling a user to make donations and thus stealing the vital personal information. Maliciously coded websites are also used to enter networks for installing keylogger. Information regarding some charitable institution should be obtained from security certified sites.

Password Attacks

A 'Password Attack' includes a number of techniques used by the hackers to steal passwords. Some of them are listed below:

Brute-force: It is a method in which a hacker tries to guess a password by repeatedly entering in new combinations of words and phrases compiled from a dictionary to steal the password. Developing difficult to guess usernames and passwords can prevent it.

Packet sniffers: It has been discussed above.

IP-spoofing: Like honeypots, IP spoofing involves the interception of data packets by a computer successfully pretending to be a trusted server/ resource.

Zombie Computers and Botnets

'Zombie' computer is a computer under seize of a spammer who has infected the computer attached to a network with malware so that it acts as a tool of a spammer by silently sending out thousands of emails from the owner's email address. Thus, an innocent user's computer sends thousands of spam messages without the knowledge of the user. The spammers organize zombie computers into small groups called 'botnets'. These 'botnets' then transmit spam including phishing attempts, viruses and worms. The botnets normally send spamming and phishing attacks.

Denial-of-Service Attack (DoS)

Denial-of-Service attack (DoS) is an attack method to deny the access to webpages of a website or network to the legitimate users.

17.6 FIREWALLS

Invalid Access/Possibility of Eavesdropping

A LAN shown in Fig. 17.1 is connected to the Internet to enable access to the outside world. The terminals getting connected to Internet have the access to a variety of servers to obtain a variety of information. It also provides the opportunity to the undesirable person to execute commands on the servers and other computers. Thus allowing users or terminals to access the server or other computers through website to obtain desired information may create number of problems. These problems can be classified as:

Hackers may access the others' computer and servers without valid authentication for stealing the information not meant for general purpose. The confidential information may reach in wrong hands. Hacking will establish the fact that there is a security lapse in the particular system or network and the system or network is unstable and prone to tamper.

Hacking may also lead to interception of the information from the network, which is lacking for security measures. The information may be tempered or altered from actual contents.

NOTES

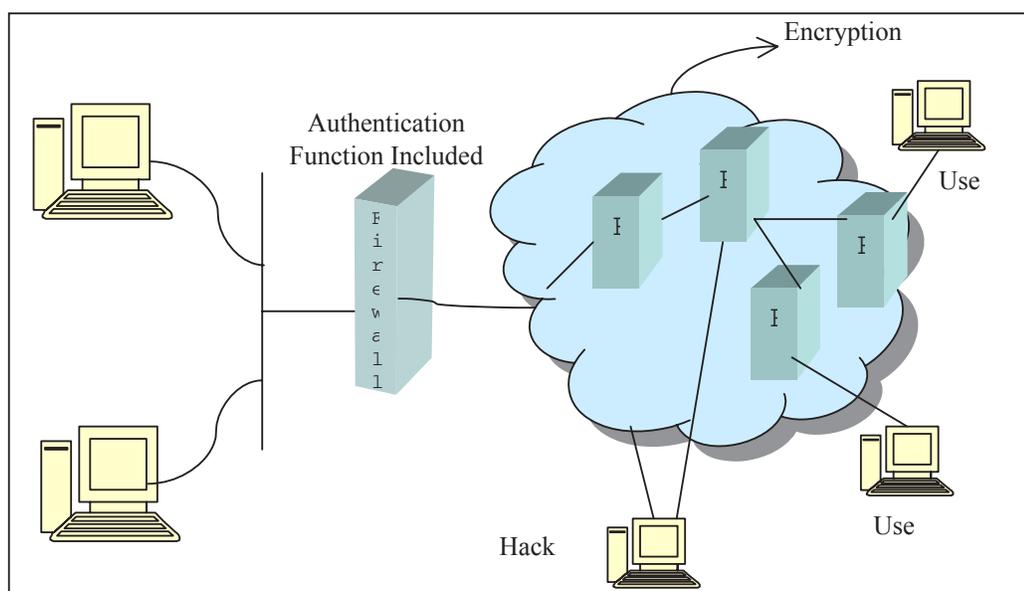


Fig. 17.1: Unauthorized Access to LAN and Eavesdropping

Firewalls (Access Control)

Internet provides a two-way flow of traffic that may not be suitable for many organizations where some information may concern exclusively within the organization. These organizations may like to use intranet. Intranet is also a TCP/IP

NOTES

network based on the Internet to work only within the organization. To make a line between the information meant only for the benefit of the organization or its Intranet and the information open to all or meant for Internet, some security measures are employed to control the two-way flow of traffic. Such measure is known as firewall.

A firewall is a combination of software and hardware components to control the traffic that flows between a secure network and an insecure network using rules defined by the system administrator. Usually, the secure network may be LAN and insecure network is the Internet. The firewall is put at the gateway of a network or at a connection between the two networks. Thus, all traffic from one network to the other is forced to pass through the firewall. The firewall blocks or permits traffic based on the security policy as defined in rules' table. In this way the secure trusted network finds itself inside the firewall while the insecure network is kept outside the firewall. The firewall is configured in such a manner so that it enables some traffic to access the Internet from inside so that people on secure network can access Internet for data and send e-mail outside the firewall and vice versa. However, the firewall can be thought of as a pair of mechanisms to block traffic or to allow traffic. In brief, the firewall provides a gateway to traffic with only one entrance and exit to the network. Based on the role of firewalls, those can be classified as the one which blocks the undesirable traffic while another allows traffic.

Network Architecture for Firewall

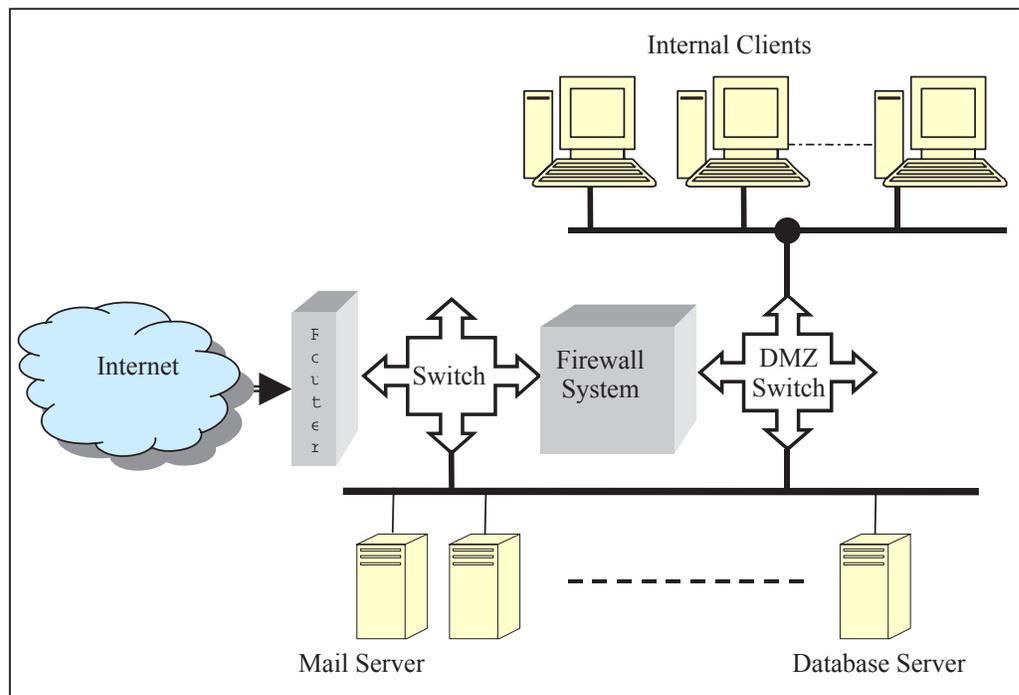


Fig. 17.2: Router Connected to Firewalls

The firewall is considered as the first program to receive and handle incoming network traffic and the last program to handle outgoing traffic. Hence it is placed in a network so that it controls all incoming and outgoing traffic. This forces to configure the internal network to implement security policy of firewall to protect specific services running on the systems. Following are some examples of network structure to protect it from external threads using a firewall:

- A router connection to the Internet is plugged into firewall system as shown in Fig. 17.2.
- Router may follow some filtering rules provided by the owner of the router. The owner may ISP.
- A proxy server is used to monitor the traffic on the network, which also allows the users to a limited number of services by blocking some unwanted services. This is integrated with the firewall as depicted in Fig. 17.3.

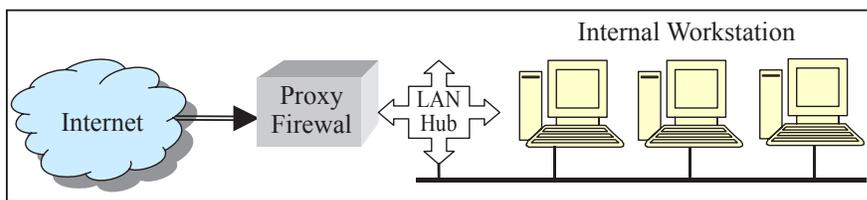


Fig. 17.3: Proxy Server Connected with Firewall

Firewall Architectures

The OSI layers play major role in designing the different types of firewall architectures. Figure 17.4 describes the architecture.

Firewall types	OSI Model	TCP/IP Model			
Application Roxy	Application	FTP	Telnet	SMTP	Others
	Presentation				
Circuit Gateway	Session	TCP		UDP	
	Transport	IP			
Packet Filter	Network	Ethernet	FDDI	X.25	Others
	Data Link				
	Physical				

Fig. 17.4: OSI and TCP/IP Layered Model with Firewall Architectures

Traffic passing through a firewall consists of packets carrying the data, acknowledgment, request or command from the originating system, the source and destination IP addresses, the source and destination ports, details of the protocol to handle the packets, error checking information, the type and status of the data being sent, etc.

Conceptually, firewalls are classified into following 3 types based on the level of protection provided by any firewall in securing a private network when connected to the public Internet:

NOTES

- Packet Filter
- Circuit Filter
- Application Level Filter
- Static Packet Filter

The data to be transmitted is broken up into numbered packets at the senders end and reassembled at the receiving end. The packet filtering mechanism examines only the protocol and the address detail of each TCP/IP packet and ignores its data contents and context. The firewall does not bother to know applications on the host or local network. Filtering thus examines incoming or outgoing packets and allows or disallows their transmission or acceptance on the basis of a set of configurable rules, called policies. These policies may be dependent on allowing or disallowing packets on the basis of the source IP address, allowing or disallowing packets on the basis of their destination port and allowing or disallowing packets according to protocol. A static packet filter operates at the network layer or OSI layer 3. Figure 17.5 shows this relationship.

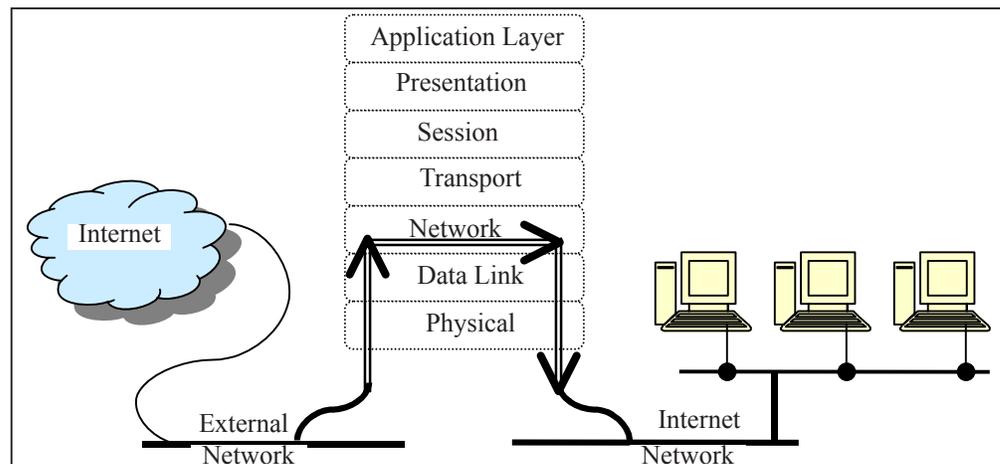


Fig. 17.5: Static Packet Filter

A packet filter does not bother to know the difference between real and forged information. It offers the IP Spoofing, not knowing packet payload, etc., security threats to the network. Advantages of this firewall are that it offers low impact on network performance and has low cost. Its disadvantages are that it operates only at network layer, therefore it only examines IP and TCP headers. It remains unaware of packet payload, therefore offers low level of security. Static packet filter firewall lacks state awareness that may require numerous ports be left open to facilitate services that use dynamically allocated ports. It is susceptible to IP spoofing and difficult to create rules (order of precedence).

Dynamic Packet Filter

A dynamic packet filter firewall is capable of monitoring the state of active connections and decides which network packets should be allowed through the firewall. Dynamic packet filter records session information such as IP address and port numbers and combines the application level gateways with packet filters to make it secure and fast. Its advantage over static packet filter is to know about the state of the packet and is quite useful in case of UDP. Like static packet filter, it also operates through the network layer of OSI layer 3 to Session layer as shown in Fig. 17.6.

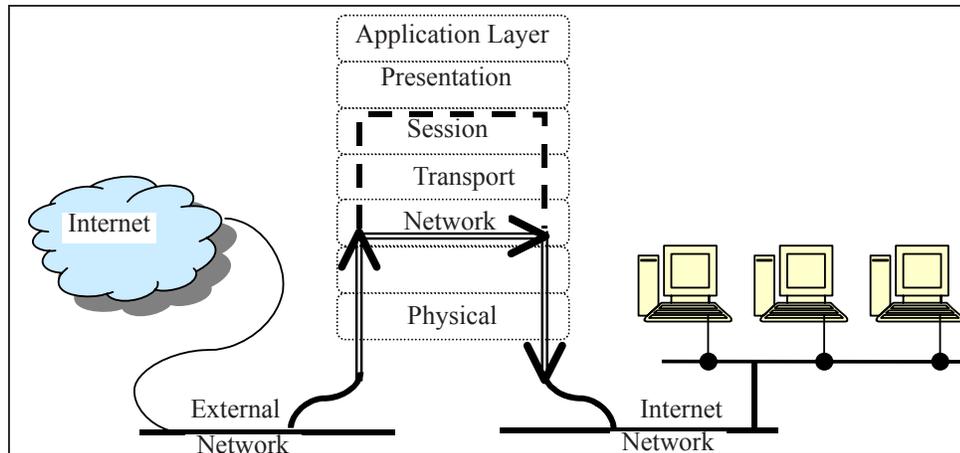


Fig. 17.6: Dynamic Packet Filter

The dynamic packet filter firewall examines the packet's IP and protocol headers to determine either to accept or deny a packet. It keeps track of the new and established connections. Details of the established connections are entered into a table in RAM. The details of the incoming packets are compared to the packets in this table. If the packet is an existing connection, it is permitted to pass without any further examination. Thus, the dynamic packet filter provides a measurable performance increase over a static packet filter. The advantages offered are low cost, measurable performance due to state awareness, scalability and extensibility. The disadvantages are that it operates only at network layer, therefore it only examines IP and TCP headers. It also does not examine the packet payload, therefore offers low level of security. Like static packet filter, the dynamic packet filter is also susceptible to IP spoofing.

Circuit Level Gateway

The circuit level gateway operates at OSI layer 5, i.e., the session layer as illustrated in Fig. 17.7. It is considered an extension of a packet filter because it performs basic packet filter operations supplemented with the details of the verification of proper handshaking of TCP and the session information used for creating the connection. Thus the circuit level gateway requires more data to act upon than a static or dynamic packet filter.

NOTES

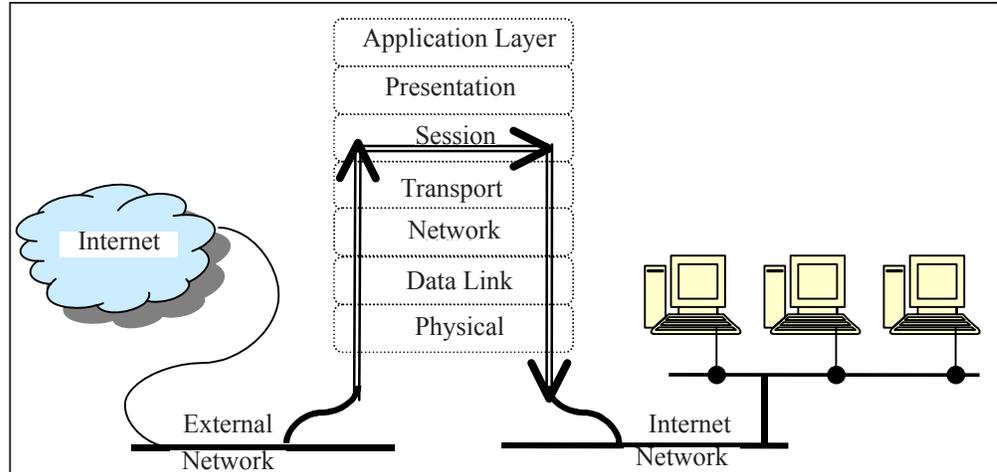


Fig. 17.7: Circuit Level Gateway

The circuit level gateway validates connection based on source IP address and /or port, destination IP address and/or port, application, password, handshaking and sequence numbers before allowing data to be exchanged. Like packet filter, the circuit level gateway examines the IP header and TCP header and compares them with details available in table that contains the rules to determine for allowing or discarding the packets to pass. It is considered an improvement over packet filter in the level of security it provides. Moreover, it provides little impact on network performance as it operates at session layer of the OSI model. It does not examine the payloads the packets it relays between two networks and therefore provides an opportunity to pass undesirable packets through itself to a server behind the firewall.

The advantages offered are low to moderate impact on network performance, blocking of direct connection to server behind firewall, higher level of security than a static or dynamic packet filter and facilitating services for a wide range of protocols. It also offers a number of disadvantages of the packet filters by providing any data to simply pass through the connection and low to moderate level of security.

Application Level Gateway

Application level gateway, as its name indicates, is a firewall that filters information at the application level and blocks all IP traffic between the private network and the Internet. Figure 17.8 shows an application level gateway. It works according to the proxy principle indicating that that internal client machines create connections to the firewall to communicate with a proxy server. It is up to the firewall to decide as to whether the internal client machine should be allowed to communicate or not. If the internal client machine is allowed, the firewall establishes a connection to the external server and operates on behalf of the client. In such a case, the proxy firewall works with different proxy servers and each proxy server provides a particular application protocol like http-proxy or ftp-proxy to handle differently. It is also used to retrieve and store information from the Internet in a cache memory to optimize

the response and download times by determining URLs for applications. Similar to the circuit level gateway, an application level gateway intercepts incoming and outgoing packets to act upon as a proxy for applications so that packets could be exchanged across the gateway. Its role as a proxy server provides a high level of security, as it tends to prevent direct connection between a secured server or client machine and an unsecured host. The proxies that an application level gateway runs are application specific and examine the entire packet so that undesirable packets can be disallowed at the application layer of the OSI model.

Proxy Firewall

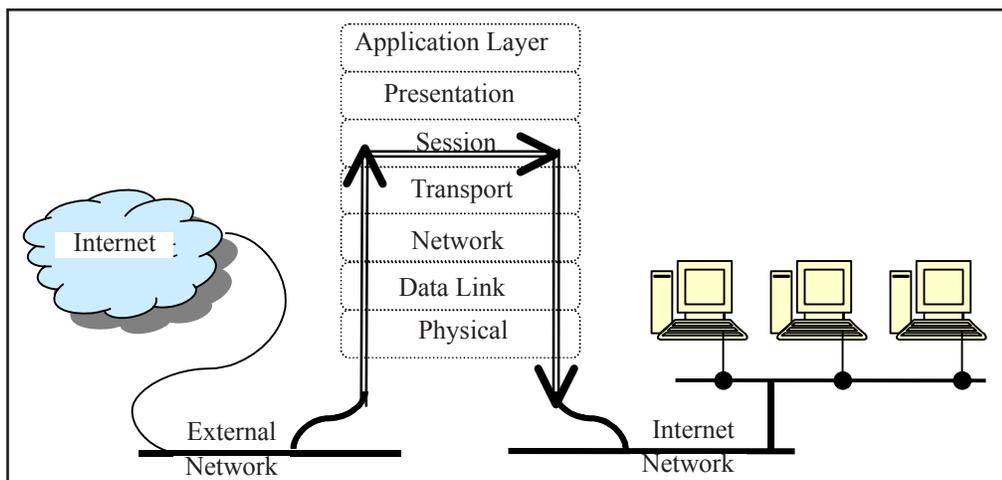


Fig. 17.8: Application Level Gateway Firewall

The application level gateway performs on the packets that are generated by applications by either copying or forwarding or filtering them. An HTTP proxy copies, forwards and filters HTTP traffic and blocks all other services or applications. Briefly, an application specific proxy examines each packet that passes through the gateway, verifying the payloads of the packet. Some of the advantages of application level proxy are better handling of traffic, its awareness of services, breaking of direct connection to server behind firewall eliminating the risk of an entire class of covert channel attacks, highest level of security, etc. Its weaknesses are to provide a poor implementation that tends to allow limited connections and complex setup that needs more and detailed attentions to the applications that use the gateway.

17.7 DATA ENCRYPTION

Encryption is a technique to hide data from unauthorized persons by encoding data so that it may not be viewed and modified. The process of data encryption involves converting the data into encrypted data called ciphertext using a mathematical formula called algorithm. These algorithms generate a key and then encapsulate the message

NOTES

with this key. Two types of encryptions, such as asymmetric and symmetric are in vogue. The presentation layer deals with the translation, encryption/decryption, authentication and compression, which are explained as below:

Translation – It converts the complex data structures used by an application strings, integers, structures, etc., into a byte stream that may be transmitted across the network. The message is represented in such a way that communicating machines agree to the format of the data being exchanged. For example, ASCII or EBCDIC character set. The translation may be direct or indirect. In direct translation method, ASCII code is translated as the EBCDIC at the destination machine. In the indirect method, the ASCII code is first translated to a standard format at the source machine itself before transmission. The destination machine converts it into EBCDIC code. Direct method is not desirable with obvious reason as the destination machine needs to deal with several computers in the network and therefore are required to have a table of conversion for different data formats. The indirect method that includes Abstract Syntax Notation 1 (ASN.1) is recommended by OSI. This method takes care of formatting, diverse nature of data such as text, programs, etc., and the diversity in data storage format.

Abstract Syntax Notation

Abstract Syntax Notation (ASN.1) is an OSI standard dealing with the issue of representing, encoding, transmitting, and decoding data structures. It has two parts as given below:

1. An abstract syntax describing the data structures in an unambiguous manner. The syntax enables users to use integers, character strings, and structures instead of bits and bytes.
2. A transfer syntax describing the bit stream encoding of ASN.1 data objects. Data and additional fields are sent to describe the type of data. At the destination machine, the reverse operation is applied to convert from ASN.1 format to the internal representation of the destination machine.

There are alternative approaches to the data representation but they have disadvantages. In one approach, the source machine converts data into the format expected by the destination machine so that the destination machine does not need to perform any decoding. The disadvantage to this approach is that every source machine needs to know how to encode data for every possible destination machine. In another approach, ASN.1 converts everything into a common form similarly to the network standard representation of TCP/IP. However, the disadvantage of this method is that communication between two identical machines results in needless conversions.

ASN.1's abstract syntax is much like in form to that of any high level programming language. ASN.1 comprises primitive types and complex types building on primitive types.

Encryption/Decryption: It deals with security and privacy issues. Encryption is used to scramble the data so that only authorized persons can unscramble the data of a

conversation. Decryption reverses the encryption process to translate the message back into its original form. To encrypt the data, the sender in the source machine uses an encryption algorithm and a key to transform the plaintext (original message) into a ciphertext (encrypted message). At the destination machine, the reverse process takes place. The receiver has a key and decryption algorithm to translate back the ciphertext into the original plaintext.

Encryption and decryption methods are of two types. They are conventional and public key methods. In the conventional method, the encryption and the decryption keys are the same and secret. The disadvantage of the conventional method is that the decryption algorithm is always the inverse of the encryption algorithm and therefore whoever knows the encryption algorithm will be able to deduce the decryption algorithm and thus the secrecy and privacy of message is threatened.

In the public key encryption approach, every user has the same key and algorithm for encryption of the message. However, the decryption algorithm and the key are kept secret. Thus, the message could be encrypted by anyone; however, an authorized person could decrypt it. The decryption algorithm is designed in such a way that it could not be deduced from the inverse of the encryption algorithm. Also, different encryption and decryption keys make it difficult to decrypt the message by an unauthorized person.

1. **Authentication:** It verifies the antecedents of the remote party being the real party rather than an impostor. It means that the message is received from an authentic person, not from an impostor. Digital signature is one of the several authentication approaches that use public key encryption method.
2. **Data Compression:** It compresses data to reduce the amount of transmitted data thus saving in bandwidth and money. There are three general methods to data compression. Each method considers that the data stream may be transformed into a more compact representation. This compact data stream is reconstructed back into the original data at the destination machine.
3. **Finite Set of Symbols:** It is considered that a library with many branch offices in which the previous days transactions are transmitted to every other branch after closing. Transactions are comprised of checked out and returned books. The information could be exchanged in the following manners:

The name of the book, its author, the copy number, etc., together with the type of transaction are sent.

The library needs to maintain an officewise table assigning a unique ID number to every book in every branch. Transactions then refer to the book's ID number instead of its title. As the book IDs are small and contain few bytes, so less data will be transmitted.

It may be noted from the above descriptions that the above technique is used throughout programming and pointers and array subscripts are frequently exchanged to avoid the cost of transferring large amounts of data between subroutines. It is also assumed that all objects occur with equal frequency and that the set of objects, books

Cryptography

Data on the network is not secret and therefore requires to be kept secure from undesirable persons sitting behind the machines attached to the network. The malicious intentions may include bringing down of servers attached to the network, using people's private information like credit card numbers for fraudulent activities and sabotaging of major organizations by accessing their websites. It is therefore aimed to secure data and prevent from eavesdroppers from listening to and stealing data. The user data on a computer is also protected by providing password restricted access to the data and resources so that only authorized people get to use these. Security aspects also involve identifying miscreants and thwarting their attempts to cause damage to the network among other resources. The network security deals with various issues which are given below:

1. ***Authentication:*** It involves verifying of the antecedents of the person who has requested for services from a remote machine or access to the remote machine either through physically or by sending an e-mail before allowing him or her to do so. Authentication involves a process to authenticate person's identity to a remote machine.
2. ***Integrity:*** It involves the veracity of the message which is received by a remote machine. In other words, it is indeed the same message without any alteration which was sent by the source machine. In this case, cyclic redundancy code method will not be enough as intruders in the system or communication channel may deliberately alter the message. Security should ensure that nobody along the entire route should be able to alter the message.
3. ***Confidentiality:*** It ensures that no person should be able to read the message on the way. This necessitates implementation of the encryption techniques down the line.
4. ***Non-repudiation:*** It is an important aspect of security to declare the ownership of the message. Once a message is sent down the communication channel, there should be no way that it is denied that it was not sent.
5. ***Authorization:*** It enables to use the services for which permission is granted to a particular client.
6. ***Authentication*** refers to keep a secret of two persons secure from the third person. However, the non-repudiation requires to prove that even the sender could not have generated the message. To implement security issues as given above, a technique called cryptography is applied. Encryption is of two types:

Asymmetric Encryption

Two mathematically related keys, viz., public key and private key are generated to encrypt and decrypt the message. Asymmetric encryption is considered more secure

NOTES

than symmetric encryption. Asymmetric key encryption that involves a key pair as public and private keys involves six major steps:

1. **Plaintext:** Plaintext is the text message to which an algorithm is applied.
2. **Encryption Algorithm:** It provides mathematical operations to conduct substitutions and transformations to the plaintext.
3. **Public and Private Keys:** They constitute a pair of keys which are used for encryption and decryption of the message.
4. **Ciphertext:** Application of algorithm on plaintext produces the encrypted or scrambled message.
5. **Decryption Algorithm:** This algorithm is applied to generate the ciphertext and the matching key to produce the plaintext.

The encryption process converts the text message to a hash code by using a mathematical formula. This hash code is then encrypted with the help of the sender's private key. The private key is generated with the help of the algorithm. The encrypted hash code and the message are encrypted again using the sender's private key. Subsequent to this, the sender encrypts the secret key with the recipient's public key, so only the recipient can decrypt it with his or her private key.

In the decryption process, the recipient uses his or her private key along with the secret key to decipher the encrypted hash code and the encrypted message. The recipient then uses the sender's public key to decrypt the hash code and to verify the sender's identity. The recipient generates a hash code from the message. If this generated hash code equals the hash code forwarded by sender, this verifies that the message has not been changed on the way.

Symmetric Encryption

Symmetric encryption, also referred to as conventional or single-key encryption is based on a secret key, which is shared by both communicating parties. The sending party encrypts the plain text to cipher text message using the secret key. The receiving party on receipt of the cipher text message uses the same secret key to decrypt it to plain text. Examples of symmetric encryption are the RSA algorithm. Symmetric encryption method has the following five major parts:

1. **Plaintext:** It is the text message to be transmitted on which an algorithm is applied.
2. **Encryption Algorithm:** It enables mathematical operations to conduct substitutions and transformations to the plaintext.
3. **Secret Key:** They constitute a part of algorithm for encryption and decryption of the message.
4. **Ciphertext:** This is the encrypted message generated by applying the algorithm to the plaintext message using the secret key.

5. **Decryption Algorithm:** This is the encryption algorithm that decrypts the cipher text into plain text by using the ciphertext and the secret key.

In the application of the symmetric encryption, the sender and the receiver are required to exchange secret keys in a secure manner with the aid of a strong encryption algorithm.

NOTES

Digital Signature

Computer-based information systems have been finding an increasingly important role in business transaction encompassing all the areas of human life, such as education, economics, social, political, health, telecommunication, trade, etc. The continued growth and acceptance of business transaction largely depends upon the security of data transmissions. Hence, the need for establishing a framework for the authentication of these computer-based information systems arises. Conventionally, a signature on a document indicates that the statements mentioned in the document bind the person who has signed the document and the document will not be changed once the parties to the transaction have signed it. Likewise, digital signature may be considered as the replica of the above-mentioned procedure as electronic code for the document validity.

Cryptography is widely used to create digital signatures. Digital signature technology aims to promote use of digital signatures on computer-based documents such as electronic mail messages, their attachments and to facilitate electronic commerce. It also calls for a legal environment. Therefore, it becomes necessary to build an institutional infrastructure to make digital signatures work effectively and enable us to conduct legally binding paperless communication. Advantages offered by digital signatures are numerous. They are harder to forge than a penned signature, the parties can verify to whom they are dealing with and they can verify that a message was not altered in transit. Companies like VeriSign, RSA, Baltimore Adobe Systems and Entrust, etc., are actively involved in the development of digital signature technologies and its widespread use.

The digital signature technology is supported by an infrastructure containing certification authorities (CA), online databases called repositories and public-key encryption technology so that electronic documents could be signed in a legally binding fashion. Consequently, a well-functioning Public Key Infrastructure (PKI) has been established to facilitate the communicating parties.

Some Useful Definitions

Some of the terms and definitions, which are involved with digital signature technology, are briefly explained in the following lines:

1. **Access control:** It restricts access to resources and allows only privileged entities to access. Basically, types of access control include mandatory access control and discretionary access control among many others.

NOTES

2. **Algorithms:** It explicitly describes the method to solve a particular problem. The efficiency of algorithms can be measured as the number of elementary steps it takes to compute the problem.
3. **Authentication:** It is a process used to ascertain the identity of a person or the integrity of specific information. For a message, authentication involves ascertaining its source and that it has not been modified or replaced in transit.
4. **Asymmetric cryptosystem:** It is the core of digital signature technology. It is also referred to as public key cryptosystem. It generates a secure key pair that consists of a pair of key as private key and public key.
5. **Certification authority:** It is a person who issues a certificate, which indicates a certification authority as subscriber. The certificate also contains a public key corresponding to a private key used to digitally sign another certificate.
6. **Hash function:** It is used in both creating and verifying a digital signature. A hash function is the result of an input of any size that becomes mathematically transformed into a string of a fixed size such that the message yields the same hash result every time the algorithm is executed using the same message as input. Any change to the message invariably produces a different hash result when the same hash function is used. Hash function is sometimes called a one way function or message digest algorithm. Hash result is the output produced by a hash function upon processing a message.

Digital Signature Technology

The foundation of digital signatures, however, could be traced back in cryptography but a digital signature does not necessarily involve encryption or confidentiality of the signed message. More specifically, a digital signature is an appendage to its message. The transformations involved in creating the digital signature do not affect the message or make it confidential although some implementations may provide for optional message confidentiality.

Digital signature is an actual transformation of an electronic message using public-key cryptography. Through this process, the digital signature is appended to the document being signed. The principles underlying the use of cryptography in electronic communications are based upon the fact that computer works only on binary numbers on which mathematical functions could be performed.

Digital signatures employ asymmetric public key cryptography (PKC), which involves a pair of mathematically related signing keys, one for creating a digital signature or transforming data into a seemingly unintelligible form, and another key for verifying a digital signature or returning the message to its original form. Computer equipment and software utilizing two such keys are often collectively termed an asymmetric cryptosystem. Two keys are:

- **Private key:** The key to a key pair, which is used to create a digital signature. It can be used to sign a message that only the corresponding public key can verify. Signer knows it only.
- **Public key:** It is the key to a key pair that is used to verify a digital signature. Key pair consists of private and public key.

A digital signature may be considered more secure than a handwritten signature. Furthermore, secure digital signatures cannot be repudiated. It means that the signer of a document cannot later disown it by claiming the signature was forged. Figures 17.9 and 17.10 explain the above-mentioned concepts.

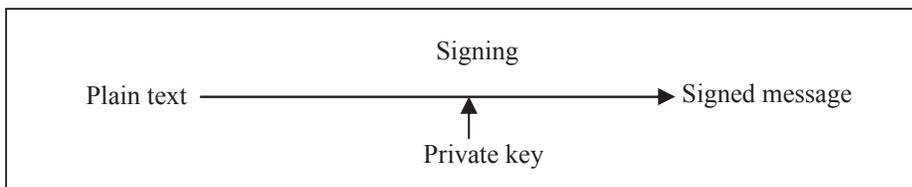


Fig. 17.9: Signing a Message using Private Key

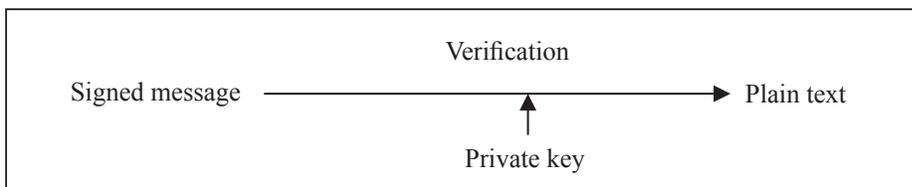


Fig. 17.10: Verification of a Signed Message

The message digest, which represents the message and can be used to detect changes in the message, is then encrypted with the sender's private key, which results in a digital signature. The message digest and the message itself are then routed to the appropriate recipient. The recipient uses the sender's public key to decrypt the digital signature and see the message digest. Next, the recipient applies to the message the same hash function the sender used, and the hash function is then compared with the decrypted message digest. The signature is verified if both are the same.

17.8 AUTHENTICATION

A user is required to be first authenticated before accessing the network or Intranet of an organization. The authentication procedures are built into the firewall implemented to the network or Intranet for the security measures. However, the network security authentications aim to secure the network. A number of different ways are available to secure remote access to a system. Some of them encrypt all the data being transferred across the network while others protect only the authentication. If the data is sensitive or directly related to business, it is advised to encrypt all the data and not just the authentication. Some of the procedures for validating user's login or access are given below:

NOTES

1. **Using UNIX password for authentication:** The password without encryption is not secure and is susceptible to be intercepted, therefore unencrypted password is not suitable for authentication of login. The reasons being that the server may have a substantial number of active users.
2. **Using IP address for authentication:** Packet-filtering types of firewalls use IP address for authentication of data. They implement a set of already defined procedures over the received packet before routing to the desired destination. Each packet received is checked to determine the access validity to the requested network or only for some available services on the network. The drawback of this type of authentication procedure is that the IP may fall into wrong hands. Consequently, undesirable user or hacker may impersonate and hack the network by getting access through the authenticated IP address hacked as explained above. The strong point of this technique is that packet filtering technique enables the network to determine the type, protocol, source and destination addresses for unauthorized access.

Check Your Progress

Fill in the blanks:

1. _____ concerns with the protection of data contained in a file or many files in a computer either as a standalone or on a network from unauthorized interception by providing some sort of security.
2. _____ is a process used to ascertain the identity of a person or the integrity of specific information.
3. Decryption Algorithm is the _____ that decrypts the cipher text into plain text using the ciphertext and the secret key.
4. Encryption Algorithm enables _____ to conduct substitutions and transformations to the plaintext.
5. A firewall is a combination of _____ and _____ components to control the traffic that flows between a secure network and an insecure network using rules defined by the system administrator.
6. _____, also referred to as conventional or single-key encryption is based on a secret key, which is shared by both communicating parties.

Using one time password for authentication: The above two procedures have some loose ends, which need to be properly tightened. In case of password authentication, the password remains unencrypted and is therefore susceptible to be hacked. Access to a network by some undesirable person may be prevented when the password is validated only once to login to remote network. There are different passwords

that are transferred over the network for each and every login. The authentication system should ensure the highest security of all types so that even if a hacker gets the password, he or she should not login to the network with that password.

NOTES

17.9 SUMMARY

- The Internet, which was initially conceived for academic point of view, has spanned into every aspect of life. This has even entered so deeply and intimately in day to day affairs of individual that people have started desiring to be on network from anywhere at any time. The tremendous growth of the Internet also vitiated the problem of security and undesirable elements have entered into the fray. Network security in all its varieties is a huge and growing problem for network security managers and business owners. As we all become more interconnected and access more and more personal information through networks, they become more and more vulnerable to attack. The basic advantage of any network is in its capability of sharing the permitted resources among users who have authorization to access the network either locally or remotely. Hence, this becomes necessary to keep away the unauthorized person to get access into the network. This will largely depend upon the level of security needed by the network. Remote access security is largely dependent upon authentication by UNIX password, IP address and one-time password. Among these, one time password may be considered as a full proof security measure for remote access.

17.10 GLOSSARY

- **Access Control:** It restricts access to resources and allow only privileged entities to access. Basically, types of access control include mandatory access control and discretionary access control among many others.
- **Application Level Gateway:** Application level gateway, as its name indicates, is a firewall that filters information at the application level and blocks all IP traffic between the private network and the Internet.
- **Asymmetric Cryptosystem:** It is the core of digital signature technology. It is also referred to as public key cryptosystem. It generates a secure key pair that consists of a pair of key as private key and public key.
- **Asymmetric Encryption:** Two mathematically related keys, viz., public key and private key are generated to encrypt and decrypt the message.
- **Authentication:** It is a process used to ascertain the identity of a person or the integrity of specific information. For a message, authentication involves ascertaining its source and that it has not been modified or replaced in transit.

NOTES

- **Botnets:** The spammers organize zombie computers into small groups called 'botnets'. These 'botnets' then transmit spam including phishing attempts, viruses and worms. The botnets normally send spamming and phishing attacks.
- **Brute-force:** It is a method in which a hacker tries to guess a password by repeatedly entering in new combinations of words and phrases compiled from a dictionary to steal the password. Developing difficult to guess usernames and passwords can prevent it.
- **Certification authority:** It is a person who issues a certificate, which indicates a certification authority as subscriber. The certificate also contains a public key corresponding to a private key used to digitally sign another certificate.
- **Ciphertext:** This is the encrypted message generated by applying the algorithm to the plaintext message using the secret key.
- **Circuit Level Gateway:** It is considered an extension of a packet filter because it performs basic packet filter operations supplemented with the details of the verification of proper handshaking of TCP and the session information used for creating the connection.
- **Data Security** concerns with the protection of data contained in a file or many files in a computer either as a standalone or on a network from unauthorized interception by providing some sort of security.
- **Decryption Algorithm:** This is the encryption algorithm that decrypts the cipher text into plain text using the ciphertext and the secret key.
- **Denial-of-Service Attack (DoS):** Denial-of-Service attack (DoS) is an attack method to deny the access to webpages of a website or network to the legitimate users.
- **Dynamic Packet Filter:** A dynamic packet filter firewall is capable of monitoring the state of active connections and decides which network packets should be allowed through the firewall.
- **Encryption Algorithm:** It enables mathematical operations to conduct substitutions and transformations to the plaintext.
- **Firewalls:** A firewall is a combination of software and hardware components to control the traffic that flows between a secure network and an insecure network using rules defined by the system administrator.
- **Hash function:** It is used in both creating and verifying a digital signature. A hash function is the result of an input of any size that becomes mathematically transformed into a string of a fixed size such that the message

yields the same hash result every time the algorithm is executed using the same message as input.

- **IP-spoofing:** Like honeypots, IP spoofing involves the interception of data packets by a computer successfully pretending to be a trusted server/resource.
- **Maliciously-Coded Websites:** Maliciously coded websites create charitable websites enabling a user to make donations and thus stealing the vital personal information.
- **Packet Sniffers:** Packet sniffers are the technique used to capture data streams over a network to obtain sensitive data like usernames, passwords, credit card numbers, etc.
- **Password Attacks:** A 'Password Attack' includes a number of techniques used by hackers to steal passwords.
- **Phishing:** Emails with titles such as, "URGENT: Update Account Status" are all attempts by a spammer to "phish" the account details.
- **Plaintext:** It is the text message to be transmitted on which an algorithm is applied.
- **Private Key:** The key to a key pair, which is used to create a digital signature. It can be used to sign a message that only the corresponding public key can verify. Signer knows it only.
- **Public Key:** It is the key to a key pair that is used to verify a digital signature. Key pair consists of private and public key.
- **Secret Key:** They constitute a part of algorithm for encryption and decryption of the message.
- **Spam:** Spam constitutes 70 to 84 per cent of daily emails sent throughout the world that demands an ever-increasing need for IT resources to filter out this irritating and potentially malicious menace.
- **Static Packet Filter:** The packet filtering mechanism examines only the protocol and the address detail of each TCP/IP packet and ignores its data contents and context.
- **Symmetric Encryption:** Symmetric encryption, also referred to as conventional or single-key encryption is based on a secret key, which is shared by both communicating parties.
- **Trojan Horses:** This malware attack disguises itself as something innocent like a computer game or a search results page.
- **Viruses:** The term 'virus' refers specifically to malware inserting malicious code into existing documents or programs.

- **Zombie Computers:** ‘Zombie’ computer is a computer under seize of a spammer who has infected the computer attached to a network with malware, so that it acts as a tool of a spammer by silently sending out thousands of emails from the owner’s email address.

17.11 ANSWERS TO CHECK YOUR PROGRESS

1. Data Security
2. Authentication
3. encryption algorithm
4. mathematical operations
5. software and hardware
6. Symmetric encryption

17.12 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What are different criteria to keep information private when it is sent over a public network?
2. How does the encryption affect performance of network?
3. There are certain information bases on the Internet that need to be prevented by any undesirable person to get. How can an undesirable person be kept from accessing this?
4. What is a Cipher?

Long Answer Questions

1. How do we keep our own and other people’s computers safe from hackers? Explain with the help of a hypothetical situation.
2. How do we keep viruses from attacking all our computers if we get connected to the Internet?
3. What does the term ‘packet filtering firewall’ mean? Where would such a device be used and for what purpose?
4. What is a Cipher? Why are ciphers used for large messages?

5. Describe briefly two kinds of security attacks, which can be directed against an Internet-connected computer system.
6. What is the difference between secret key and public key encryption?

NOTES

17.13 REFERENCES

1. Burton, Bill , *Remote Access for Cisco Networks*, published by McGraw-Hill Osborne Media
2. Behrouz A. Forouzan, and Sophia Chung Fegan, *Data Communications and Networking*
3. Andrew S. Tanenbaum, *Computer Networks*, Prentice Hall
4. *Web Tutorials on HTML and Front Page*
5. Gary Halleen and Greg Kellogg, *Security Monitoring with Cisco Security MARS*, Cisco Press, Jul. 6, 2007
6. *Security Threat Mitigation and Response: Understanding CS-MARS*, Dale Tesch/Greg Abelar, Cisco Press, Sept. 26, 2006

Information Technology and Management Information System



Block - V

Block Title : Management Information System

UTTARAKHAND OPEN UNIVERSITY

SCHOOL OF MANAGEMENT STUDIES AND COMMERCE

University Road, Teenpani By pass, Behind Transport Nagar, Haldwani- 263 139

Phone No: (05946)-261122, 261123, 286055

Toll Free No.: 1800 180 4025

Fax No.: (05946)-264232, e-mail: info@uou.ac.in, som@uou.ac.in

<http://www.uou.ac.in>

www.blogsomcuou.wordpress.com

Board of Studies

Professor Nageshwar Rao
Vice-Chancellor
Uttarakhand Open University
Haldwani

Professor R.C. Mishra (Convener)
Director
School of Management Studies and Commerce
Uttarakhand Open University
Haldwani

Professor Neeti Agarwal
Department of Management Studies
IGNOU
New Delhi

Dr. L.K. Singh
Department of Management Studies
Kumaun University
Bhimtal

Dr. Abhradeep Maiti
Indian Institute of Management
Kashipur

Dr. K.K. Pandey
O.P. Jindal Global University
Sonipat

Dr. Manjari Agarwal
Department of Management Studies
Uttarakhand Open University
Haldwani

Dr. Gagan Singh
Department of Commerce
Uttarakhand Open University
Haldwani

Er. Sumit Prasad
Department of Management Studies
Uttarakhand Open University
Haldwani

Programme Coordinator

Dr. Manjari Agarwal
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Units Written By		Unit No.
<i>Text material developed by</i>	Manish Anand	
<i>Typeset by</i>	Atharav Writer, Delhi	

Editor(s)

Er. Sumit Prasad
Assistant Professor
Department of Management Studies
Uttarakhand Open University
Haldwani

Er. Subodh Prasad
Assistant Professor
Department of Information Technology
College of Technology
G.B. Pant University of Agriculture & Technology
Pantnagar

ISBN : 978-93-85740-12-1
Copyright : Uttarakhand Open University
Edition : 2016 (Restricted Circulation)
Published by : Uttarakhand Open University, Haldwani, Nainital - 263 139
Printed at : Laxmi Publications (P) Ltd., New Delhi
DUO-8155-74.34-INFO TECH MGMT INFO B-V

CONTENTS

Units	Page No.
18. Introduction to MIS	372
19. Structure of MIS	393
20. MIS Master Plan—Content and Description	410
21. Organizational Information Requirements, Analysis and Resource Allocation Stage	424
22. Management Information System—Problems, Limitations and Suggestions	432
23. Development and Implementation of MIS	437
24. Decision Support System	462
25. Management Information system—Problem and Suggestion	476

UNIT 18: INTRODUCTION TO MIS

NOTES

Structure

- 18.0 Introduction
- 18.1 Unit Objectives
- 18.2 Meaning of Management Information System
- 18.3 Nature of Management Information System
- 18.4 Characteristics of MIS
- 18.5 Sub-system of an MIS
 - 18.5.1 Organizational Functional Sub-systems
 - 18.5.2 Activities Sub-systems
- 18.6 Requirements of Management Information System
- 18.7 Significance of Management Information System
- 18.8 Utilization of Models
- 18.9 Role of Management Information System
- 18.10 Summary
- 18.11 Glossary
- 18.12 Answers to Check Your Progress
- 18.13 Terminal and Model Questions
- 18.14 References

18.0 INTRODUCTION

Management Information System is an old management tool, which has been long used by people for better management and scientific decision making.

Management Information System is mainly dependent upon information, which is a vital ingredient of any Management Information System. Information is the most critical resource of Management Information System. We all know that information is a vital factor for our existence. Just as our body needs air, water and clothes, we are as much dependent upon information. To make life more interesting and to achieve the feeling of being a part of the social system, we want to know our surroundings and for that we need information. Information is an important input for achieving our goals, such as learning to help each other and to become integral part of society.

Actually, information system is not a new concept; it is as old as the hills. From

the Biblical times, humans have been making the use of information generated through information systems in all times. There have been systems that generated and communicated information. Kings and rulers had their own ways of designing information systems to retrieve information. The main objective of these information systems was to ascertain the well being of their people in the kingdom and to effectively and efficiently manage the kingdom. The church had its own information system. In India, Tainali Rama, Akbar and many others had impressive management information systems in operation. Similarly, the merchants of Venice had their own fully functional appropriate management information system in place.

The characteristics of information generated through the information system have been changing as per needs. As the trade and commerce changed its nature, the information system had to be modified accordingly.

Later examples include East India Co. which had its own information system. The allied forces during the Second World War also had elaborate information system.

So throughout the centuries, information system has been an important element of all human activities. This importance has only grown many folds over the time.

There are so many factors responsible for enhancing the importance of Management Information System, such as:

1. Dynamic and competitive nature of market place.
2. Globalization of resources/economy.
3. Increasing complexities of business organization (i.e., sole organization to large corporate system approach).
4. The information revolution (credit card, overnight package delivery).

Traditionally, the Management Information System operated manually in which human beings were major source for providing information and all the working was carried out through pen and paper. This approach posed certain drawbacks:

1. It did not provide timely and accurate information.
2. It could not store volume of information for future use.
3. Paper work involved was immense.
4. Costly in terms of cost as well as time consuming.
5. Sometimes secrecy was not compromised.

These limitations, however, existed mainly due to lack of potency in the tools employed rather than the lack of will. Computers were duely introduced to the management information systems once they became available for the MIS designers.

18.1 UNIT OBJECTIVES

After going through this unit, you will be able to know:

- The concept and definition of Management Information System;
- The requirements and problems of Management Information System;
- The advantages and disadvantages of Management Information System;
- The significance and role of Management Information System.

18.2 MEANING OF MANAGEMENT INFORMATION SYSTEM

Management Information System is a combination of three English letters.

M Which stands for Management.

I Which stands for Information.

S Which stands for System.

With the help of these three letters we can make a number of combinations, viz.,

MI Management Information means information regarding management. (qualification of management, number of managers, policies, etc.)

MS Management System means the basic structure of the management, like the hierarchical order of management.

IS Information System, which provides information.

SM System Management means how to manage a system whether it is a business organization, computer system, etc.

SI System Information means the information regarding the system like what are the different parts of a system, how they relate to each other, etc.

IM Information Management means how to manage a particular information.

MIS: Management Information System.

Before going into the details of what Management Information System is, we ought to know the meaning of three different terms which form Management Information System.

Management

We can define management in many ways, like:

“Manage Man Tactfully” or Management is an art of getting things done by others.

But for the purpose of Management Information System, management comprises the process and activity that a manager does in the operation of their organization, i.e., to plan, organize, direct and control operations.

Information

Information simply means processed data or in the layman's language, data which can be converted into meaningful and useful form for a specific user.

System

1. System can be defined as a set of elements joined together for a common objective.
2. A group of interrelated or interacting elements forming a unified whole, e.g., business organization as system.
3. A group of interrelated components working together towards a common goal by accepting input and producing output in an organized transformation process.

Management Information System: There are a number of definitions of Management Information System given by different authors. Some of them are:

1. According to Jerome or J. Kanter "Management Information System is a system that aids management in making, carrying out and controlling decisions". Here Management Information System is a system that aids management in performing its job.
2. According to G. B. Davis, Management Information System is "an integrated man/machine system for providing information to support the operations, management and decision making functions in an organization." Here the system utilizes hardware and software, manual procedures, management decision model and database.
3. After the introduction of computer, some people define Management Information System as computer based information system.
4. As a system based on the database of the organization evolved for the purpose of providing information to the people in the organization.

In simple terms Management Information System is an information system that provides information to support managerial decision making.

A more comprehensive definition is that Management Information System consists of people, equipment and procedures to gather, sort, analyze, evaluate and distribute, timely and accurate information to the decision maker.

NOTES

NOTES

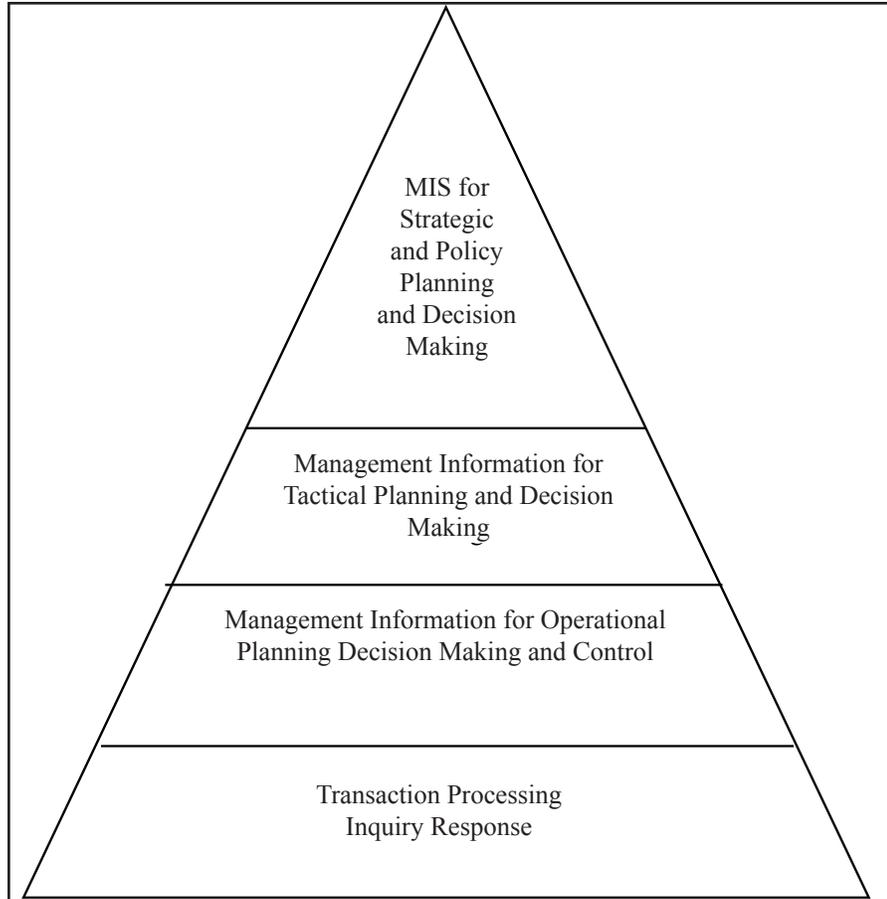


Fig. 18.1: MIS

18.3 NATURE OF MANAGEMENT INFORMATION SYSTEM

The concept of Management Information System is gaining popularity from last decade or two, although it is an old management tool. Management Information System is a necessity of all organizations. Its nature is changed due to change into business scheme.

1. **Report-orientation:** In the early years, the function of Management Information System was to process data from the organization and present it in the form of reports at regular intervals. But after sometime the difference between data and information merged. Information being the finished product was prepared after processing the raw data. So because of this fact the concept of Management Information System is further modified, as information rather than voluminous data has become the requirement of the user. Although data can be analyzed by different persons separately giving various shades and shapes to the information. So the system concept is now individual-oriented.

2. **Action-oriented:** This concept was further modified due to the need that information should be such that it leads to some action, decision or investigation or research.
3. **Exception-oriented:** After having action-oriented nature of Management Information System it was realized that there must be some specific or selective approach to the action or the analysis of data. So the concept of exception was introduced indicating that Management Information System is related to the exceptional situations of business rather than routine matters.
4. **Database Orientation:** As we know our environment is dynamic in nature so the change in every system is a must. So is the case with Management Information System as the business environment becomes competitive. The concept was then evolved that the system should be capable of handling a need-based exception reporting. This need may be of individual group or organizational. To fulfil, this need, a common database is prepared which can be used by each and every individual accordingly. So the concept of Management Information System based on DATABASES is emerged and proven to be effective.
5. **End User Orientation:** After successfully implementing these changes, the concept of end user computing using multiple databases emerged. This concept brought a basic change in the nature of Management Information System, that is decentralization of system and independency of user over computer professionals or experts. Now the user uses the database to collect the information and uses that information accordingly. The concept of Management Information System has been moulded to a system which handles the databases, provides computing facilities to the end user, and gives a variety of decision making tools to the user of the system.
6. **Academic Discipline Orientation:** Management Information System is based on the information gathered for analyzing the data. While analyzing the data it relies on many academic disciplines like theories, principles, concepts from management, organization behaviour, computer science, psychology and human behaviour. The principles of these academic fields are used in designing a Management Information System, in preparing its different modules, etc.

The Management Information System entails specific objective if it is prepared with systematic planning and designing.

A systematic approach is made after analyzing the basic needs, goals and objectives of an organization. To use different social sciences like theories of communication etc., Management Information System has to depend on the system theory which provides solution to every problem by adopting a systematic path.

The concept therefore is a mixture of theories of management, information and concept of system and the end product of this mixing is Management Information System.

Basically, Management Information System is a combination of several subsystems based on the databases in the organization. These subsystems are for storing, organizing, processing and so on.

NOTES

Management Information System is a product of multi-disciplinary approach to the business management. The major disciplines that contribute to the study of Management Information System are mainly Computer Science, Operation Research, Management Science, Sociology, Political Science and Psychology. In general we can divide the field of Management Information System into two broad approaches, i.e., technical and behavioural. Management Information System is a hybrid product of these two approaches that makes it a socio-technical system. We can better understand it with the help of the following diagram:

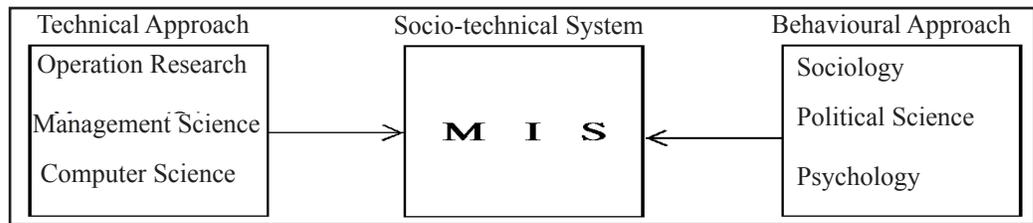


Fig. 18.2: Socio-technical Approach for MIS

Technical Approach

Technical approach Management Information System emphasizes mathematically based or systematic models to study Management Information System as well as the hardware aspect of it. The major role player of technical approach is computer science which provides ways of computation as well as how to store large volume of data and its retrieval. Management science gives the concept of decision support and the models for management practices. Operations Research comprises how to optimize the resources of the management.

Behavioural Approach

But, due to high expectation of human beings, now Management Information System field is concerned with behavioural problems also.

The behavioural problems can not be handled by the mathematical model used in technical approach. The major role player of this approach is sociology that focuses on the impact of Management Information System on groups, organizations and society as a whole. Psychology is concerned with how each stake holder in an organization responses to the information system and cognitive models of human reasonings. Political science is concerned with what is the political scene/scenario in the country, what is the manifesto of ruling party, etc.

So Management Information System combines the theoretical work of computer science, management science and O.R. with a practical orientation towards building

systems and applications. It also pays attention to behavioural issues. So Management Information System is to be kept in close supervision because it needs to be modified according to the changes in the business organization.

The Management Information System concept is of dynamic nature and the modified model of Management Information System meets all the needs of organization as it passes through various stages. And a good Management Information System is that which serves modified information requirement of every stage so that scientific and better decision making is possible.

After understanding the nature of Management Information System, we now deal with the characteristics, prerequisites, myths, advantages and disadvantages of Management Information System.

18.4 CHARACTERISTICS OF MIS

The basic characteristics of an effective Management Information System are as follows:

1. **Management-oriented:** As we all know that the basic objective of Management Information System is to provide information support to the management in the organization for decision making. So an effective Management Information System should start its journey from appraisal of management needs to mission and goal of the business organization. It may be individual or collective goals of an organization. The Management Information System is such that it serves all levels of management in an organization, i.e., top, middle and lower level.
2. **Management Directed:** When Management Information System 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.

Manager should guide the Management Information System 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 whole exercise in making an effective Management Information System.

3. **Integrated:** By integration we mean a comprehensive or complete view of all the subsystems in the organization of a company. Development of information should be integrated so that all the functional and operational 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.
4. **Common Data Flows:** The integration of different subsystems will lead to a common data flow which will further help in avoiding duplicacy and redundancy

NOTES

in data collection, storage and processing. For example, customer orders are basis for many activities in an organization, viz., billing, sales for cashing, etc. So, by common data flows, we mean to use common input, processing and output procedures. Data is collected by a system analyst from its original source only one time. Then he utilizes that 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 simplifies the operations and produce an efficient information system.

5. **Heavy Planning-element:** The preparation of Management Information System 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 in mind two things: first, he has to keep future objectives as well as firm's information well in advance and also secondly, he has to keep in mind that his Management Information System will not be obsolete before it gets into action.
6. **Subsystem Concept:** When we want to see a problem into sub-parts, we are able to give better solution to the whole problem. Although Management Information System is viewed as a single entity but for its effective use it should be broken down into small parts or subsystems so that more insight and attention is paid to each subsystem. Priorities will be set and phase of implementation will be made easy. While making or breaking down the whole Management Information System into subsystems, it must be kept in mind that the subsystem should be easily manageable.
7. **Common Data Base:** This is the basic feature of Management Information System to achieve the objective of using Management Information System in business organizations. It avoids duplication of files and storage which leads to reduction of cost. 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 database allows it to be accessed by each subsystem and thus, eliminates the necessity of duplication in data storage, updating, deletion and protection.
8. **Computerized:** We can use the Management Information System without computer. But the use of computers increases the effectiveness and efficiency of the system. We can handle the queries more quickly and efficiently with the computerized Management Information System. The other benefits are accuracy, storage capacity and timely information.
9. **User friendly/Flexibility:** The Management Information System should be flexible, i.e., there should be room for further modification because Management

Information System takes much time in preparation and our environment is dynamic in nature. Management Information System should be such that it should be used independently by the end user so that they do not depend on the experts.

NOTES

10. **Information as a Resource:** Information is the major ingredient of any Management Information System. So it should be treated as a resource and managed properly.

18.5 SUBSYSTEM OF AN MIS

The process of MIS development is quite complex and one is likely to lose insight frequently. Thus, the system, though viewed as a single entity, must be broken down into digestible sub-systems which are more meaningful at the planning stage.

Central Database

A central database is the mortar that holds the functional systems together. Each system requires access to the master file of data covering inventory, personnel, vendors, customers, etc. If the data is stored efficiently and with common usage in mind, one master file can provide the data needed by any of the functional systems. It seems logical to gather data once, to properly validate it and to place it on a central storage medium that can be accessed by any other sub-system.

MIS has been introduced as a broad concept referring to a federation of sub-systems. Two approaches to define the sub-systems of an MIS are according to the organizational functions which they support and according to managerial activities for which they are used.

18.5.1 Organizational Functional Sub-systems

Because organizational functions are somewhat separable in terms of activities and are defined managerially as separate responsibilities, MIS may be viewed as a federation of information systems – one for each major organizational function. There may be common support systems used by more than one subsystem, but each functional system is unique on its procedures, programs, models, etc. Typical major sub-systems for a business organization engaged in manufacturing are:

<i>Major functional subsystem</i>	<i>Some typical uses</i>
Marketing	Sales forecasting, sales planning, customer and sales analysis
Manufacturing	Production planning and scheduling
Logistics	Planning and control of purchasing, inventories, distribution

NOTES

Personnel	Planning personnel requirements, analyzing performance, salary administration
Finance and accounting	Financial analysis, cost analysis, capital requirements planning, income measurement
Information processing	Information system planning, cost-effectiveness analysis
Top management	Strategic planning, resource allocation

The database is the primary means of integration of various subsystems. A data item that is stored or updated by one sub-system is then available to the other sub-systems. For instance, the sales and inventory information used by the marketing sub-system is supplied through the logistics sub-system; the same data is used by the manufacturing sub-system for production planning and scheduling.

18.5.2 Activities Sub-systems

Another approach to understanding the structure of an information system is in terms of the sub-systems which perform various activities. Some of the activities sub-systems will be useful for more than one organizational function sub-systems.

<i>Activity subsystem</i>	<i>Some typical uses</i>
Transaction processing	Processing of orders, shipments, and receipts
Operational control	Scheduling of activities and performance reports
Management control	Formulation of budgets and resource allocation
Strategic planning	Formulation of objectives and strategic plans.

Note that these activities sub-systems correspond to the levels of the pyramid structure that defines MIS.

18.6 REQUIREMENTS OF MANAGEMENT INFORMATION SYSTEM

To get the synergistic impact of Management Information System in business organization a Management Information System must bear the following prerequisites:

1. **Database:** As we know it is a super file which has all records or data related to a particular organization at one place. It will lead to reduction of redundant duplication. However, this master file is sub-divided into the major information sub-sets needed to run a business. These sub-sets are (a) Customer calls file (b) Supplier file, (c) Employee file, (d) Inventory file and (e) General ledger accounting file.

Database should be user-oriented and should be capable of being used as a common data source for different users and avoid duplication of efforts in storage and retrieval of necessary data and information.

Database should be authorized to be viewed by an authorized person. So it should be controlled by a separate authority that is a DBA (Database Administrator).

The maintenance of database requires computer hardware, software and computer professionals who are experienced and qualified too. In addition to this, it requires good data collection system having system experts who know the various techniques of data collection as well as knowledge of the working of company.

2. **Qualified System and Management Staff:** In a Management Information System we have two types of experts: one computer and system expert who prepares the system and other the management staff who directs the system experts about their needs and requirements from a Management Information System.

Both of them should have expertise in their respective fields. But they must possess certain knowledge of other fields also. For example, system experts must have some knowledge of management concepts so that they can better understand what the management wants from them.

Same is the case with management experts. They must have some basic knowledge of computer, so they can help the computer experts in designing as well as independently use the system.

This prerequisite is a very ideal situation but it has to face the problem of procurement of suitable experts. The problem is overcome by recruiting fresh candidates because they can work with the experienced people that are already working on the project. Or we could hire a qualified person and retain them also.

3. **Top Management Support:** To use or implement the Management Information System effectively, it must have the top management support. Top management support is also required for some behavioural aspects of the subordinates because they are ready to perform those activities which are supported by the top management. The other reason why top management support is essential is because the resources involved in Management Information System are very large and it is the policy matter which is decided by the top management only.

To gain the support from top management, the persons who are in favour of installing Management Information System in the organization must place the cost and benefit analysis of having a Management Information System and other supportive facts before the top management. This action of subordinates will lead to change in the attitude of top management towards Management Information System and they will give their full support.

NOTES

4. **Active Participation of Operating Management:** As the support of top management is a prerequisite, the active participation of operating management is also a basic requirement of successful implementation of Management Information System. There is some behavioural problem among the operative staff, that after implementing Management Information System their service would no more be required and they would need the help of some outsider while performing their work. These problems can also be handled by educating the operative management about the benefits of Management Information System.
5. **Control and Maintenance of Management Information System:** Control of the Management Information System means to control the operation of the system as it was designed to operate. Sometimes users develop their own procedure or shortcuts to use the system that may reduce its effectiveness. To check such practices, the management at each level should devise check mechanism for information systems control.

Maintenance means alterations and modifications according to the need and requirement of the user. So there must be some scope of improvement in the system.
6. **Evaluation of Management Information System:** The Management Information System should be evaluated at regular time intervals to meet the future needs. The evaluation process must have the following steps:
 - (i) Evaluate whether flexibility exists in the system to cope with any expected or unseen information requirement in future.
 - (ii) Take the feedback from users as well as designers about the capabilities and shortcomings in the system.
 - (iii) Guiding the appropriate authority about the criterion to be taken to maintain the effectiveness of Management Information System.

18.7 SIGNIFICANCE OF MANAGEMENT INFORMATION SYSTEM

Management is the function of planning, organizing, staffing, directing and controlling. To perform these major functions, a manager has to lay down the policy, communicate, motivate and take decisions in different business situations. The management has to take long term as well as short term decisions in order to achieve the overall goal of an organization. This decision making is better and sound, if the organization is small or every thing is under the control of management. This is a rosy picture which is theoretically possible but in real life situation where things are complex and uncertain as well as dynamic in nature, the management has to depend more on scientific decision making rather than based on his own judgment only.

For scientific decision making, it is necessary that they should be based on the data concerning the past performance viewed in present situation and projected for emerging future trends. This type of decisions are arrived after collecting, processing and analyzing data and after that providing information rather than being based on the intuition or judgment of the management. To achieve this goal, every effort needs to be made to devise means for obtaining data, storing it in such a manner that all relevant data can be accessed with ease and processed to meet the desired objective of assisting in decision making. Management Information System is the tool which helps the management by providing the relevant information in the right form to the right person and at the right time.

Right person means the various users of information in an organization like clerk, an assistant, an officer, an executive or a manager.

To meet the objective of providing information, the Management Information System has to work in an integrated manner. It is a complete solution in a sense that it is composed of an integrated database, a system for using the database to develop required timely information and a plan to utilize that information in future management plan and action. Management Information System not only deals with the planning, coordinating, evaluating and controlling of general processing, but also using and disposing the corporate and operation information.

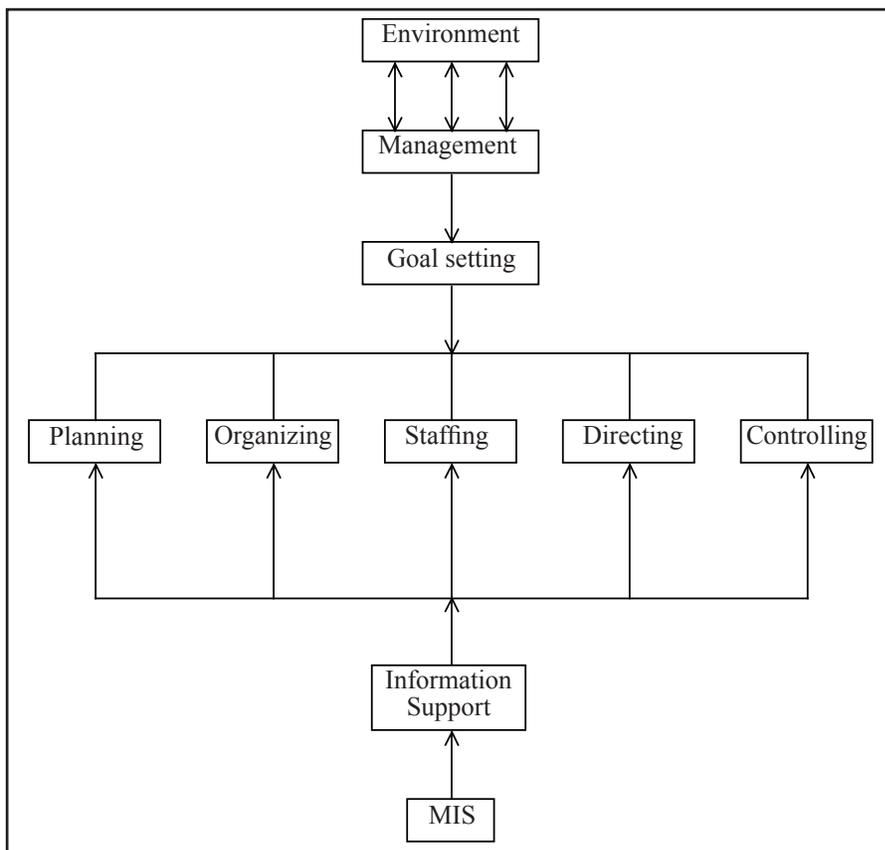


Fig. 18.3: Purpose of Management Information System in Management

NOTES

Management Information System is a complex system made by different subsystems in which data is processed to produce information which is used by each level of management either operational, middle or top level of management. To understand the need and purpose of Management Information System in an organization, we can take the help of Fig. 18.3.

The management after analyzing its environment sets the goals and objectives to be accomplished and for this information is required. To perform each task of planning, organizing, staffing, directing and controlling all other information needs are provided or supplemented by the Management Information System. So the objective of Management Information System is to set the objective to be achieved. Information needed to evaluate performance must be traced out and must be applied effectively. An effective mechanism must be developed, installed and maintained and the overall system's adequacy as a basis of information for management decision must be reviewed and appraised continually.

Management Information System is the product of continuous and careful efforts done by experts to meet the informational needs of management. It helps in performing day to day functions, enhances strategic decision making for planning and control. So the main purpose of Management Information System is to support the management in decision making, broadly in the management processes.

18.8 UTILIZATION OF MODELS

It is usually insufficient for human recipients to receive only raw data or even summarized data. Data usually needs to be processed and presented in such a way that the result is directed towards the decision to be made. To do this, processing of data items is based on a decision model. For example, an investment decision relative to new capital expenditures might be processed in terms of capital expenditure decision model.

Decision models can be used to support different stages in the decision making process. "Intelligence" models can be used to search for problems and/or opportunities. Models can be used to identify and analyze possible solutions. Choice models such as optimization models may be used to find the most desirable solution.

In a comprehensive information system, the decision maker has available a set of general models that can be applied to many analysis and decision situations plus a set of very specific models for unique decisions. Similar models are available for planning and control. The set of models is the model base for MIS.

Data Models

The underlying data model plays an important role in database design. The physical or logical structure of a database is spelt out by the data model. A data model is

a collection of conceptual tools used for describing data, data relationships, data semantics and data constraints. Evolution of different data models is still in progress, as the primary objective is to evolve a high level data model. The model should enable the designer to incorporate a major portion of semantics of the database in the schema. Numerous data models have been proposed which can be broadly classified into following categories:

1. Object based data models
 2. Record based data models
 3. Physical data models
1. **Object Based Data Models:** These models are used in describing data and data relationships in accordance with concept. In general, the object based data models are gaining wide acceptance for their flexible structuring capabilities. Various data integrity constraints can be specified explicitly by using the object-based models.

The Entity relationship model which is an object based model is widely used in practice as an appropriate database design tool.

2. **Record Based Data Models:** These models are used to specify the overall logic structure of the database. With some models a higher level description of the implementation of the structure of the database can also be specified explicitly. The data integrity constraints cannot be specified explicitly with these models. The three widely accepted record based data models are Relational model, Network model and Hierarchical model.
3. **Physical Data Models:** These models are used to have higher level description of the storage structure of the database and their access mechanism. With the physical model it is possible to implement the database at the system level. A very few physical data models have been proposed so far. Two of these well known models are the unifying model and the frame memory model.

Models are generally most effective when the manager can use interactive dialog to build a plan or to iterate through several decision choices under different conditions.

18.9 ROLE OF MANAGEMENT INFORMATION SYSTEM

Management Information System is the networking of information that supports management decision making.

The role of Management Information System in business is to identify the information needs of different level of management and prepare a system to satisfy those needs

NOTES

successfully. Actually information is a vital resource in managing business effectively and efficiently. So, it is the main function of Management Information System to gather, sort, analyze and use the information for better decision making. The role of Management Information System can be shown with the help of Fig. 18.4 as under:

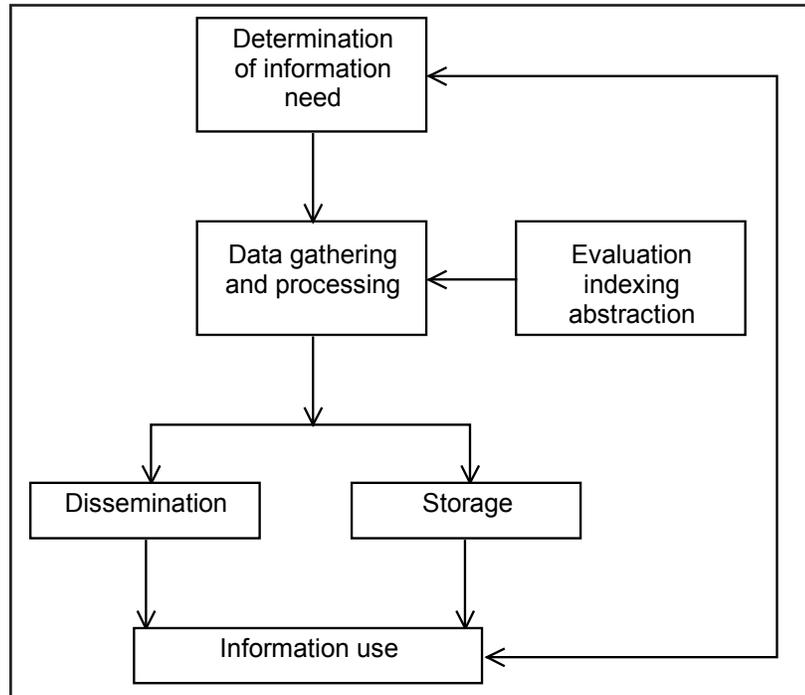


Fig. 18.4: Role of MIS

The role of Management Information System begins with the identification of required information needs by different persons in an organization, and ends with the collection of information and its processing. It has to evaluate the information relevance according to the needs and give it to the right person in the right form at the right time for making better decisions or managing the enterprise efficiently. The excess of information or irrelevant information of this moment can be stored for some future need. After using the information, the user may be identified.

For example in today's complex and competitive market scene, information on the policies of the competitor regarding product, promotion, pricing and placing its product is very much required by the management.

In the layman's language, Management Information System plays the same role that heart plays in the human body. The heart supplies blood to various parts of the body for its regular working. It also purifies the blood and helps human beings in the period of crises. Same is the case with Management Information System. Management Information System collects the data, processes it to supply relevant, accurate and timely information to all subsystem of business organization like finance, marketing, production, personnel and R&D.

Check Your Progress

Fill in the blanks:

1. Significance of Management Information System in the _____ is such that it provides right information to right person at right time.
2. _____ is a strategic edge in the hands of the manager over the competitive environment.
3. Physical Data Models are used to have _____ of the storage structure of the database and their access mechanism.
4. A _____ is a series of functions or activities within an organization that work together for the aim of the organization.
5. The role of Management Information System begins with the _____ of required information needs by different persons in an organization, and ends with the collection of information and its processing.
6. In general, the _____ are gaining wide acceptance for their flexible structuring capabilities.

NOTES

Management Information System satisfies the information needs of all levels of management, i.e., top, middle and operation level as well as the information needs of individual, group and organization.

To satisfy the diverse needs, Management Information System develops different subsystems like query, analysis, modelling and decision support system.

However, the role of Management Information System is changing in the present scenario as the new relationship between organization and information system has emerged that can be well understood by Fig. 18.5.

In modern times, interdependence is growing between the business strategies, rules and procedures on one side and software, hardware, database and telecommunication of information on the other side. A change in any of these components often requires change in other components. This relationship is critical when management plans for the future.

This is a new concept regarding the role of information system because in early times, the Management Information System dealt with technical operational issues. Managers were bound to delegate authority to the concerned lower level technical workers. But because today's systems directly affect how managers decide and how top management plans, the responsibility cannot be delegated to the technical decision maker these days, Management Information System plays a strategic role in the life of the firm.

NOTES

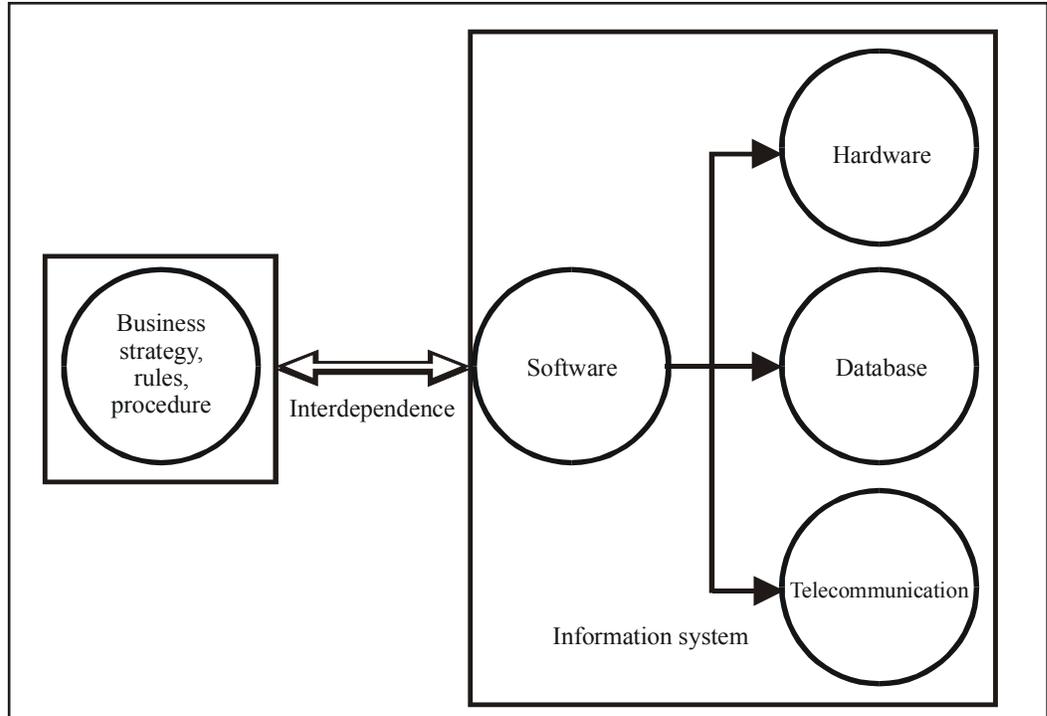


Fig. 18.5: Role of MIS Strategy

18.10 SUMMARY

- Management Information System is not a new term to us. It is an old concept. Actually every civilization has its own way to acquire, sort, use and manage information.
- Management Information System concept is of dynamic nature and the modified model of Management Information System meets all the needs of organization.
- Management Information System can be defined as consisting of people, equipment and procedures to gather, sort, analyze, evaluate and distribute timely and accurate information to the decision makers.
- An effective Management Information System has these characteristics – management oriented, management directed, Integrated, common data flows, heavy planning element, subsystem concept, common database, user-friendly – information as a resource and last but not the least should be computerized.
- There are certain misconceptions regarding Management Information System like the study of Management Information System is about the use of computers, more data in report means more information for managers, accuracy in reporting is of vital importance, etc.

- To get the synergistic impact of Management Information System on business organization, a Management Information System must have a database, qualified system and management staff, Top management support, active participation of operating management, control and maintenance of Management Information System. But there are certain problems with Management Information System like non-availability of experts, how to select sub-systems, non-cooperation from staff, high turnover of staff, difficulty in quantifying the benefits.
- By implementing the Management Information System, one gets many advantages like it provides timely, accurate, scientific and reliable information for better and effective decision making. It avoids duplication of efforts and also co-ordinates the whole organization.
- Of course Management Information System has certain drawbacks since the quality of the operation of Management Information System depends upon the quality of input processes. It takes into account only quantitative factors, not the qualitative ones.
- Significance of Management Information System in the Business Organization is such that it provides right information to right person at right time.
- Management Information System is a strategic edge in the hands of the manager over the competitive environment.

18.11 GLOSSARY

- **Management Information System Concept:** It is of dynamic nature and the modified model of Management Information System meets all the needs of organization.
- **Physical Data Models:** These models are used to have higher-level description of the storage structure of the database and their access mechanism.
- **System:** A series of functions or activities within an organization that work together for the aim of the organization.

18.12 ANSWERS TO CHECK YOUR PROGRESS

1. Business Organization
2. Management Information System
3. higher-level description
4. system
5. identification
6. object based data models

18.13 TERMINAL AND MODEL QUESTIONS

NOTES

Short Answer Questions

1. Define MIS and write about its importance.
2. What is the need for a database?
3. Explain the utilization models of MIS.

Long Answer Questions

1. Define the term Management Information System. Also describe its various features.
2. What are the advantages and disadvantages of Management Information System?
3. Do you think that there are certain prerequisites to implement a successful Management Information System in an organization? Justify your answer.
4. Is Management Information System a product of various academic disciplines?
5. What are the major misconceptions regarding Management Information System?
6. Why is Management Information System looked upon as a strategic need of management today?
7. What do you understand by the term MIS? How does it assist managers in their day-to-day functioning?
8. Discuss various functions of MIS System.

18.14 REFERENCES

1. Peter C. Jurs, *Computer Software Applications in Chemistry*, Wiley-IEEE
2. William S. Davis, *Computer Fundamentals*, Addison-Wesley Longman, 1992
3. Margaret Stephens, Rebecca Treays, Jane Chisholm, Philippa Wingate, Colin Mier and Sean Wilkinson, *Computer for Beginners*, EDC Publishing, 1995
4. Marlin D. Ouverson, *Computer Anatomy for Beginners*, Reston Pub. Co, 1982
5. Dan Gookin and Andy Rathbone, *PCs for Dummies*, IDG Books Worldwide, 1992
6. V. Rajaraman and Dharma Rajaraman, *Computer Primer*, Prentice Hall of India, 2006
7. V. Rajaraman, *Fundamentals of Computers*, Prentice Hall of India, 2003

UNIT 19: STRUCTURE OF MIS

Structure

NOTES

- 19.0 Introduction
- 19.1 Unit Objectives
- 19.2 Hierarchy of Management Activity
 - 19.2.1 Information Systems for Operational Control
 - 19.2.2 Information System for Management Control
 - 19.2.3 Strategic Planning
- 19.3 MIS Structure Based on Organizational Function
 - 19.3.1 Sales and Marketing Sub-systems
 - 19.3.2 Production Sub-system
 - 19.3.3 Logistics Sub-system
 - 19.3.4 Personnel Sub-system
 - 19.3.5 Finance and Accounting Sub-system
 - 19.3.6 Information Processing Sub-system
 - 19.3.7 Top Management Sub-system
- 19.4 Synthesis of MIS Structure
 - 19.4.1 Conceptual Structure
 - 19.4.2 Physical Structure
 - 19.4.3 Some Issues of MIS Structure
- 19.5 Summary
- 19.6 Glossary
- 19.7 Answers to Check Your Progress
- 19.8 Terminal and Model Questions
- 19.9 References

19.0 INTRODUCTION

Management information system supports management activity. This means that the structure of an information system can be classified in terms of a hierarchy of management planning and control activities.

19.1 UNIT OBJECTIVES

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

- Know MIS structure and its activities

- Understand the MIS based organization function
- Know the synthesis of MIS structure

NOTES

19.2 HIERARCHY OF MANAGEMENT ACTIVITY

The following categories of management planning and control were defined by Anthony:

<i>Level</i>	<i>Comments</i>
Strategic planning	Definition of goals, policies, and general guidelines charting course for organization. Determination of organizational objectives.
Management control and tactical planning	Acquisition of resources. Acquisition tactics, plant location, new products. Establishment and monitoring of budgets.
Operational planning and control	Effective and efficient use of existing facilities and resources to carry out activities within budget constraints.

The three levels of management activity can be differentiated on the basis of the planning horizon for each level. Strategic planning deals with long range considerations. The decisions to be made are concerned with the choice of business direction, market strategy, product mix, etc. Management control and tactical planning has a medium term planning horizon. It includes acquisition and organization of resources, structuring of work, and acquisition and training of personnel. It is reflected in the capital expenditure budget, the three-year staffing plan, etc. Operational planning and control is related to short term decisions for current operations. Pricing, production levels, inventory levels, etc., are a result of operational planning and control activities.

A particular manager may have responsibility for a mix of management activities, but proportions shift with management level. For instance, a shop floor supervisor will spend most of his or her time on operational planning and control. An executive vice president will devote, by comparison, more time to strategic planning.

The activities and information processing for the three levels are interrelated. For example, inventory control at the operational level depends on accurate processing of transactions; at the level of management control, decision made about safety stock and reorder frequency are dependent on correct summarization of results of operations; at the strategic level, results in operations and management control are related to strategic objectives, competitor behaviour, and so forth to arrive at inventory strategy. There is a marked contrast between characteristics required of information for strategic planning and for operational control, with management

control and tactical planning being somewhat in the middle. Given these differences, information system support for strategic planning should be quite different from information system support for operational control.

Decisions vary as to the degree of structure within each level of management activity, although the majority of decisions at the operational control level are relatively structured and the majority of decisions at the strategic planning level are relatively unstructured. Examples of structured and unstructured decisions at each management level are given below. Table 19.1 also shows that information systems to support structured versus unstructured decisions are characteristically different. Structured decision systems provide decision rules and exception reports but are relatively inflexible as to content and format. Decision support systems (DSS), on the other hand, are characterized by flexible access to the database. Such components are required to “support” the manager in the decision making process, rather than attempting to provide solutions or make decisions for the user.

Table 19.1: Types of Decision by Management Activity

		<i>Operational control</i>	<i>Management control</i>	<i>Strategic planning</i>
Structured decision systems	Structured	Inventory reorder decisions, production scheduling, selection of vendor, hiring of new supervisor	Pricing of bids, selection of credit line institutions, allocation of advertising, internal organization of a department	Acquisition of a company, addition of new product line, entry into new market, new organization of company
Decision support systems	Unstructured			

The following three sections summarize the characteristics of information systems support for the three levels of the hierarchy of management planning and control.

19.2.1 Information Systems for Operational Control

Operational control is the process of ensuring that operational activities are carried out effectively and efficiently. Operational control makes use of pre-established procedures and decision rules. A large percentage of the decisions are programmable. The procedures to follow are generally quite stable. The operating decisions and resulting action usually cover short time periods (a day to a week). Individual transactions are often important, so that the operational system must be able to respond to both individual transactions and summaries of transactions.

Processing support for operational control consists of:

1. Transaction processing

2. Report processing
3. Inquiry processing

NOTES

These three types of processing contain various decision making routines which implement pre-specified decision rules or provide output describing the decision that will be taken unless the user responsible overrides it. Some examples will illustrate the type of decision procedures that can be designed into operational control system.

- An inventory withdrawal transaction produces a transaction document. The transaction processing program can also examine the balance on hand, etc., and decide (using pre-established criteria) if a replenishment order should be placed. If so, the order quantity is calculated by use of an order quantity algorithm, and an action document is produced which specifies the need for an order plus the order quantity. The human recipient (e.g., inventory analyst) may accept the order as it is or may choose to override the programmed decision by cancelling it or adjusting the order quantity.
- An inquiry to a personnel file describes the requirements for a position. The computer search of the employee file uses pre-programmed rules to select and rank candidates.
- A telephone order clerk taking an order enters the data online using a visual display terminal. In the case of a stock out, programmed decision rules are applied to identify substitute items which the order taker can suggest to the customer.
- A programmed decisions rule in a report processing procedure may cause issuance of special reports to provide information in a problem area. An example might be a report showing orders still outstanding after 30 days, produced as a result of an unusually high (the limit pre-specified) 30-day balance.

The database for operational control and operational decision making contains primarily internal data generated from transactions. The data items are generally quite current. Care must be taken to interpret data being recorded from operations, since the sequence of processing is often significant; for example, additions to inventory are processed before withdrawals in order to avoid the appearance of being out of stock when new stock has been received.

19.2.2 Information System for Management Control

Management control information is required by managers of departments, profit centres, etc., to measure performance, decide on control actions, formulate new decision rules to be applied by operational personnel, and allocate resources. Summary information is needed; it must be processed so that trends may be observed, reasons for performance variances may be understood, and solutions may be suggested. The control process requires the following types of information:

1. Planned performance (Standard, Expected, Budgeted, etc.)

2. Variances from planned performance
3. Reasons for variances
4. Analysis of possible decisions or courses of action.

NOTES

The database for management control consists of two major elements; one the database provided by operations and the other the plans, standards, budgets, etc., which define management expectations about performance. There may also be some external data such as industry comparisons and cost indices.

The processing requirements to support management control activities are the following:

1. Planning and budget models to assist managers in finding problems in direction and preparing and revising plans and budgets. This includes projections of effects of current actions.
2. Variance reporting programs to process scheduled reports showing performance and variances from planned performance or other standards such as competitor 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 for management evaluation.
5. Inquiry models to assist in responding to inquiries.

The outputs from the management control information system are plans and budgets, scheduled reports, special reports, analysis of problem situations, decisions for review, and inquiry responses.

19.2.3 Strategic Planning

The purpose of strategic planning is to develop strategies by which an organization will be able to achieve its objectives. The time horizon for strategic planning tends to be fairly long, so that fundamental shifts in the organization may be made. For example:

1. A department store chain may decide to diversify into the mail order business.
2. A department store chain with stores in the central city may decide to change to a discount type of operation in the suburbs.
3. A company manufacturing industrial products may decide to diversify into consumer lines.

Strategic planning activities do not have to occur on a periodic, regular cycle as do management control activities. They can be somewhat irregular, although some strategic planning may be scheduled into the yearly planning and budgeting cycle. Data requirements for strategic planning are generally for processed, summarized

NOTES

data from a variety of sources. There is need for considerable external data. Some examples of types of data that are useful in strategic planning illustrate the nature of the data requirements:

1. Outlook for the economy in the company's current prospective areas of activity
2. Current and prospective political environment
3. Current capabilities and performance of the organization by market, country, etc. (based on current policies)
4. Prospects for the industry in each economy
5. Capabilities of competitors and their market shares
6. Opportunities for new ventures based on current or expected developments
7. Alternative strategies
8. Projections of resource requirements for the alternative strategies.

This database contains some "hard" facts, but much is based on judgment. Much of the data cannot be collected on a regular basis, and much of it cannot be specified completely in advance. For this reason, some have argued that it is impossible (or certainly impractical) to have a management information system for strategic planning activities. They point out the difficulty of efficiently coding, storing, and retrieving the multitude of rumours, facts, hunches, etc., that enter into an assessment of prospects for an industry, a market, or an economy.

An alternative to this view is that information system support cannot be as complete for strategic planning as it is for management control and operational control, but the system is one source of information that can provide substantial aid to the process of strategic planning. For example:

1. The evaluation of current capabilities is based on internal data generated by operational processing requirements, but it may need to be summarized in a special way for planning use.
2. The initial projections of future capabilities can be developed by analysis of past data. This first approximation is adjusted by management of the basis of judgment and experience.
3. Fundamental market data on the industry and competitors can probably be kept in the organization's database.
4. Databanks of public information regarding the industry and competitors may be purchased in machine readable form for use with planning and decision models.

19.3 MIS STRUCTURE BASED ON ORGANIZATIONAL FUNCTION

The structure of management information system can also be described in terms of organizational functions. Though there is no standard classification of functions, a

typical set of functions in a manufacturing organization includes production, sales and marketing, finance and accounting, materials, personnel and information systems. Each of these functions, as already discussed, has unique information needs and each requires information system support designed specifically for it. Moreover, a management information system is essentially an integration of information systems that are designed to support the functional sub-systems of the organization. Each functional sub-system requires applications to perform all information processing related to the function, although this may involve calling upon a database, a model base, and some computer programs which are common to all functional sub-systems. Within each functional sub-system, there will be applications for transaction processing, operational control, managerial control, and strategic planning.

19.3.1 Sales and Marketing Sub-systems

The sales and marketing function generally includes all activities related to the promotion and sales of products or services. The transactions are sales orders, promotion orders, etc. The operational control activities include the hiring and training of the sales force, the day-to-day scheduling of sales and promotion efforts, and periodic analyses of sales volumes by region, product, customer, etc. Managerial control concerns comparisons of overall volumes by region, product, customer, etc. Managerial control concerns comparisons of overall performance against a marketing plan. Information for managerial control may include data on customers, competitors, competitor products, and sales force requirements. Strategic planning for the marketing function involves consideration of new markets and new marketing strategies. The information requirements for strategic planning include customer analysis, competitor analysis, consumer survey information, income projection, demographic projections, and technology projections.

19.3.2 Production Sub-system

The responsibilities of the production or manufacturing function include product engineering, planning of production facilities, scheduling and operation of production facilities, employment and training of production personnel, and quality control and inspection. Typical transactions to be processed are production orders (based on an explosion of the sales orders and inventory requirements into component parts), assembly orders, finished parts, tickets, scrap tickets, and time keeping tickets. Operational control requires detailed reports comparing actual performance to the production schedule and highlighting areas where bottlenecks occur. Management control requires summary reports which compare overall planned or standard performance to actual performance for such classifications as cost per unit and labour used. Strategic planning for manufacturing includes alternative manufacturing approaches and alternative approaches to automation.

19.3.3 Logistics Sub-system

The logistics function encompasses such activities as purchasing, receiving, inventory control, and distribution. The transactions to be processed include purchase requisitions, purchase orders, manufacturing orders, receiving reports, tickets for inventory, shipping orders, and bills of lading. The operational control function uses information contained in reports such as past-due purchases, past due shipments to customers, out of stock items, overstocked items, inventory turnover reports, vendor performance summaries, and shipper performance analyses. Managerial control information for logistics consists of overall comparisons between planned and actual inventory levels, costs for purchased items, stock-outs, inventory turnover, etc. Strategic planning involves the analysis of new distribution strategies, new policies with regard to vendors, and “make versus buy” strategies. Information on new technology, distribution alternatives, etc., is required.

19.3.4 Personnel Sub-system

The personnel sub-system includes hiring, training, record keeping, payment, and termination of personnel. The transactions result in documents describing employment requisitions, job descriptions, training specifications, personnel data (background, skills, experience), pay rate changes, hours worked, paychecks, benefits, and termination notices. Operational control for personnel requires decision procedures for action such as hiring, termination, changing pay rates, and issuing benefits. Management control of the personnel function is supported by reports and analyses showing the variances resulting from differences between planned and actual performance for such classifications as number of employees hired, cost of recruiting, composition of skills inventory, cost of training (by employee, by program), salary paid, distribution of wage rates, and conformance with government equal opportunity requirements. Strategic planning for personnel is involved with evaluating alternative strategies for recruiting, salary, training, benefits, and building location to ensure that the organization obtains and retains personnel necessary to achieve its objectives. The strategic information required includes analyses of shifting patterns of employment, education, and wage rates by area of the country (or world).

19.3.5 Finance and Accounting Sub-system

Finance and accounting are somewhat separate functions but are sufficiently related to be described together. Finance is responsible for ensuring adequate organizational functioning at as low a cost as possible (in a manner consistent with other objectives). This function covers granting of credit to customers, collection processes, cash management, and financing arrangements (loans, sales of stock, leasing). Accounting covers the classification of financial transactions and summarization into the standard financial reports (income statement and balance sheet), the preparation of budgets, and classification and analysis of cost data. Budget and cost data are input for managerial control reports, which means that accounting provides input for

managerial control applications in all functions. Among the transactions associated with finance and accounting are credit applications, sales, billings, collection documents (statements), payment vouchers, cheques, journal vouchers, ledgers, and stock transfers. Operational control over the function itself requires daily error and exception reports, records of processing delays, reports of unprocessed transactions, etc. The managerial control level for accounting and finance utilizes information on budgeted versus actual cost of financial resources; cost of processing accounting and error rates. The strategic planning level for accounting and finance involves a long run strategy to ensure adequate financing, a long range tax accounting policy to minimize the impact of taxes, and planning of systems for cost accounting and budgeting.

19.3.6 Information Processing Sub-system

The information processing function is responsible for ensuring that the other functions are provided the necessary information processing services and resources. Typical transactions for information processing are requests for processing, requests for corrections or changes in data and programs, reports of hardware and program performance, and project proposals. Operational control of information processing operation requires information on the daily schedule of jobs, error rates, and equipment failures; for new project development it requires daily or weekly schedules of programmer progress and test time. Managerial control over information processing requires data on planned versus actual utilization, equipment costs, overall programmer performance, and progress compared to schedule of projects to develop and implement new applications. Strategic planning for information systems involves the organization of the function (such as centralized or decentralized), the overall information system plan, selection of strategic uses of information, and the general structure of the hardware and software environment. For example, a major strategic decision might be implement microcomputer workstations for all analysts, planners, and managers.

Office automation may be defined as a separate system or included within information processing. Office automation includes a wide range of support facilities for knowledge work and clerical activities. Examples are word processing, electronic mail, electronic filing, and data and voice communications.

19.3.7 Top Management Sub-system

The top management function (chief executive officer plus staff) operates separately from the functional areas, but also includes the functional vice presidents acting in a top management capacity, such as in management committees. The transaction processed by top management is primarily inquiries for information and support of decisions. The transaction documents, therefore, tend to be letters and memoranda. Responding to the inquiries and making decisions requires either access to the database and decision models of the organization or transmittal of the requests to

NOTES

other parts of the organization. The information for operational control in the top management function includes meeting schedules, correspondence control files, and contact files. Managerial control by top management uses information which summarizes the management control being exercised by other functions to evaluate whether the functions are performing as planned. This requires access to the plans and actual performance of all the functions. Strategic planning activities relate to matters such as direction of the company (which business it should be in) and plans for ensuring necessary resources. The strategy determined by top management sets the framework for strategic planning within function and also coordinates planning to remove major inconsistencies. Strategic planning at the top management level requires a wide variety of summarized external and internal data. Information system support for strategic planning may include ad hoc retrieval of data, ad hoc analyses, and decision support systems.

Check Your Progress

Fill in the blanks:

1. Planning and _____ models to assist managers in finding problems in direction and preparing and revising plans and budgets.
2. The structure of _____ can also be described in terms of organizational functions.
3. The _____ function uses information contained in reports such as past-due purchases, past due shipments to customers, out of stock items, overstocked items, inventory turnover reports, vendor performance summaries, and shipper performance analyses.
4. _____ information for logistics consists of overall comparisons between planned and actual inventory levels, costs for purchased items, stock-outs, inventory turnover, etc.
5. The _____ includes hiring, training, record keeping, payment, and termination of personnel.

19.4 SYNTHESIS OF MIS STRUCTURE

The MIS structure has been described in terms of support for decision making, management activity, and organizational function. These three approaches will now be synthesized into a management information system structure. This is essentially a conceptual framework which allows one to describe an existing or planned information system. There is also a physical structure which defines the way an MIS is implemented.

19.4.1 Conceptual Structure

The conceptual structure of a management information system is defined as a federation of functional sub-systems, each of which is divided into four major information processing components, transaction processing, operational control information system support, managerial control information system support, and strategic planning information system support. Each of the functional sub-systems of the information system has some unique data files which are used only by that sub-system. There are also files which need to be accessed by more than one application and need to be available for general retrieval. These files are organized into a general database managed by a database management system.

A further amplification of the structure is the introduction of common software. In addition to application programs written especially for each sub-system, there are common applications which serve multiple functions. Each sub-system has linkages to these common applications. There are also many analytical and decision models that can be used by many applications. These form the model base for the information system.

The sub-system has unique programs and unique files for its basic activities. It shares the use of common applications software, a model base, a database, and the database management system. The database management system controls all files in the common database, and may also be used for storage and retrieval of the files unique to a function. The combination of all sub-systems forms the management information system for the organization.

Within the three management activity classifications of a functional sub-system of the information system, applications can be classified as to the type of management information support provided. These can be monitoring information, action information, and decision support.

The amount of information processing resources required varies by level of management activity. Transaction processing is substantially more significant in terms of processing time, data volume, etc., than strategic planning. This concept of the large transaction processing base and fairly small strategic planning component can be visualized as a pyramid. The lower part of the pyramid describes structured, well-defined procedures and decision, while the top part of the pyramid represents more ad hoc, unstructured processes and decisions. The bottom levels of the pyramid are of more use to clerical personnel and lower level managers, while the higher levels apply primarily to top management.

19.4.2 Physical Structure

The physical structure of an MIS would be identical to the conceptual structure if all applications consisted of completely separate programs used by only one function, but this is frequently not the case. Substantial economies can be achieved from:

Integrated processing

Use of Common Modules

NOTES

Integrated processing is achieved by designing several related applications as a single system in order to simplify the interconnections and reduce the duplication of input. A good example is an order entry system. The recording of an order initiates a sequence of processing, each step using new data but also much of the data from prior processing. The major steps in a typical sequence are:

<i>Step</i>	<i>New data entered</i>	<i>Documents produced</i>
Order entry	Sales representative identification, customer identification, Items ordered, Quantity of each item	Order acknowledgement Credit exception notice Order register Picking document Items out of stock Items to be ordered
Shipping invoicing	Actual quantity shipped Freight cost	Shipping document Invoice register Sales journal Back-order register
Collection	Amounts received Returns and allowances	Customer statements Returns and allowances register Accounts receivable aging
Analysis		Sales by representative, district, customer, or other category

Note that a large number of documents and reports are prepared from the initial entry of the order plus later entry of actual quantity shipped, freight, amounts received on account, and returns and allowances. The assumption is made that the customer name, address, and credit status, plus price of each item, are contained in customer files and billing files. The documents and reports from order entry are not associated and finance functions.

Modularity is the design of an information system as a number of small sets of processing instructions called modules. Some modules are used only once in a single application; others are used in a large number of applications. The use of modules even in cases where each has a single purpose is desirable because it improves control over system development and modification. The modules can be written and tested separately, allowing more efficient maintenance by identification of the boundaries of the module being changed. The use of modules is thus an application of system principles.

The physical structure of an information system is affected by the use of common modules for many processing operations. For example, a common input data validation routine may be used for all applications. If an application consists of major modules for input, input validation and error control, processing, and output, the use of a common module of input validation and error control means that no application is complete without using this module.

19.4.3 Some Issues of MIS Structure

There are several issues regarding the structure of management information systems about which there is an ongoing debate. Among these are the extents of formal versus informal information systems, manager resistance to formal information systems, the extent of integration of files and processing, the extent of user – machine interaction, and generalized versus individualized systems.

Formal Versus Informal System: The management information system as described in this chapter encompasses only part of the total information processing that takes place in an organization. The complete information processing system of an organization consists of both public systems and private systems. “Public” is used in the sense of being known to relevant persons in the organization and available to all who have authority to access the information. Private systems are kept by individuals. These may supplement or duplicate the public systems, and they may be unsanctioned and discouraged or sanctioned and encouraged. There is a formal information system which is manifested by documents and other records, usually indicating compliance with pre-specified rules and procedures. The informal information system may process information that is vital to organizational functioning but without formal records of that process.

The management information system defined earlier, with its pre-specified procedures and programs for applications, is a part of the formal public system. It is organizationally public and access is dependent only upon having appropriate organizational authority to enter or retrieve data or to receive reports or inquiry responses. There is also an informal public system that serves all persons in the organization who connect with it. The informal system has few predetermined rules. Examples of the public informal information system are electronic mail, telephone calls, conversations at gathering points such as the water cooler, notes on the bulletin boards, articles and other publications distributed in the office (perhaps annotated), and presentations by external information sources such as sales representatives.

In addition to these formal and informal public systems, many private information systems tend to exist in organizations. Some of these are quite formal, at least for the individual owner and any support staff who help maintain it. For example, an industrial sales manager might maintain a separate file of performance data on sales representatives which she uses to augment the information received from the formal sales information system. The manager’s secretary might collect and maintain the data (for instance, from the sales representatives’ daily customer call reports), but the information is available only for the sales manager’s use, possibly without the sales representatives’ knowledge. This is a formal private system. It is based not upon the function or the job title but upon the person who occupies the position. Many individuals also have their own private informal information systems. Primarily through personal contact they maintain a flow of information which may be critical to decision making but is available to them as individuals rather than as occupiers of a formal position.

NOTES

The public information system of an organization tends to be larger than the private system, but the latter includes a significant portion of organizational information flows. The effect of a comprehensive information system of the type described is to increase the scope of the formal, public system. This increase reduces the need for private, formal systems and probably reduces the need for both public and private informal systems. It belongs to the position rather than the person, so that when a new person comes into a position he or she will have in place the necessary information support to function in that position.

Increasing the scope of the public formal system also has associated costs. There are the costs of eliciting requirements, designing the system, programming, testing, and writing procedures for operating and using the system. Because of the high cost of developing systems, the tendency has been to only automate systems that can be justified as public systems so that the costs are shared over many users. However, the trends to end user computing means users have access to terminals or personal computers and powerful application development languages which facilitate them to develop their own systems. Many applications developed by users on personal computers are highly individualized, and are thus formal, private system.

There is an ongoing debate as to how much organizational information processing can effectively be made part of the formal system and how much should remain in the informal systems. It can be argued that many important decisions are based on information received through informal channels that cannot be formalized, especially at top management levels. A well-known study by Mintzberg shows that as much as 80 per cent of chief executive's time is spent in verbal communication. A study of information systems managers by Ives and Olson showed a similar pattern. This is especially noteworthy because these managers cannot be said to be unfamiliar with the capabilities of the formal, public information system.

Advocates of increasing the scope of the formal public system claim that if it can reduce the time spent by managers in informal communication, their productivity will increase and thus benefit the organization. Skeptics of this view claim that the only information systems that will affect managerial productivity are enhancements to informal systems such as electronic mail and to formal private systems such as user developed decision supports systems.

Extent of Integration: Some advocates of "total systems" have argued for complete integration of all formal information processing, the experience to date suggests that such a tightly integrated system is impractical. There are too many factors to consider all at once, and maintenance is difficult. For this reason, information systems tend to have a modular design with integration only where required (as in the order entry system example). Inconsistencies among sub-systems are reduced by the use of standards and the common database.

Data integration is accomplished by the use of a common database. A common database does not necessarily eliminate the need for separate files. Some files are significant only to one application and therefore may be designed for and maintained by that application.

Data requirements for different levels of management activity also suggest the need for more than one database rather than complete integration. For example, the data collected from external sources and stored for strategic planning is so different from internal data for operational control that some different databases may be desirable.

Extent of User-Machine Interaction

The information system structure does not specify online user machine interaction; it indicates only support for various operational and management activities. Online processing of transactions is often desirable because the transaction is completed immediately. Inquiries are generally more effective if immediate response is available. The use of analysis, planning, and decision models is frequently enhanced if the analyst, planner, or decision maker can interact directly with the computer program, asking “What if” questions during problem analysis. With the decreasing costs of both computer and communications technology, the trend is to online interactive processing for both transaction processing and decision support systems.

The computer system that supports online transaction processing may not be able to support interactive models. However, having an information system does not imply that a single computer system must be used. An organization may use its in-house computer for transaction processing but provide alternatives for interactive models such as providing a small in-house interactive system, renting time on an outside computer through timesharing, or providing personal computers. These approaches encourage managers and staff specialists to develop their own support models, rather than depending on the staff of the information processing functions to provide them.

Check Your Progress

State whether the following statements are True or False:

6. Management Information System (MIS) is a subset of the overall internal control of a business covering the application of people, documents, technologies, and procedures.
7. Management accountants use MIS for solving business problems such as costing a product, service or a business-wide strategy.
8. Management Information Systems are distinct from regular information systems in the sense that they are used to analyze other information systems applied in operational activities in the organization.
9. MIS does not refer to the group of information management methods tied to the automation or support of human decision-making.
10. ‘MIS’ is a planned system of collecting, processing, storing and disseminating data in the form of information needed to carry out the functions of management.

19.5 SUMMARY

- Programmed or structured decisions have traditionally been made through habit, by operating procedures or with other accepted tools. More modern techniques for making such decisions involve Operations Research (OR), mathematical analysis, modelling and simulation, etc. Decisions of this kind can be delegated to lower levels in an organization or can be automated.

19.6 GLOSSARY

- **Operational Control:** The process of ensuring that operational activities are carried out effectively and efficiently.
- **Conceptual Structure of MIS:** A federation of functional sub-systems.
- **Logistics Function:** Activities such as purchasing, receiving, inventory control, and distribution.

19.7 ANSWERS TO CHECK YOUR PROGRESS

1. Budget
2. management information system
3. operational control
4. Managerial control
5. personnel sub-system
6. True
7. True
8. True
9. False
10. True

19.8 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. Define MIS.
2. What do you mean by Conceptual Structure?
3. What is Physical Structure?
4. What are the components of MIS?

Long Answer Questions

1. Describe various components of MIS.
2. Distinguish between structured and non-structured decisions.
3. Explain the process of decision making in MIS.
4. What are the syntheses of MIS structure?
5. Discuss MIS structure based on Management activity and organizational function.

NOTES

19.9 REFERENCES

1. Amrit Tiwana, *The Essential Guide to Knowledge Management*, Pearson education, 2001
2. Ratnaja Gogula, *Knowledge Management – A New Dawn*, ICFAI, 2002
3. Gordon B. Davis and Margrethe H. Olson, *Management Information Systems: Conceptual foundations, Structure and Development*, 2nd Edition, Tata McGraw Hill International Book Company, 2000
4. E. Wainright Martin, Carol V. Brown, Danial W. DeHayes, Jeffrey A. Hoffer and Williams C. Perkins, *Management Information Technology*, 3rd Edition, Prentice Hall International Edition, 1999
5. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 5th Edition, Tata McGraw Hill, 1999

UNIT 20: MIS MASTER PLAN – CONTENT AND DESCRIPTION

NOTES

Structure

- 20.0 Introduction
- 20.1 Unit Objectives
- 20.2 MIS Master Plan- Contents and Description
- 20.3 Nolan Stage Model
- 20.4 Three-Stage Model of Planning Process
- 20.5 Summary
- 20.6 Glossary
- 20.7 Answers to Check Your Progress
- 20.8 Terminal and Model Questions
- 20.9 References

20.0 INTRODUCTION

We all know the law of nature, that everything either man, animal or an event has a definite starting or beginning and it also has a definite ending or termination. Likewise, the computer based information system or Management Information System has its starting or beginning and after passing through so many activities it has a completion stage. As life is a continuous process, management information system development also follows the same principle, means development of management information system is also a continuous process, because after utilizing some of the information, the need for next information arrives.

Using the system approach to develop information system involves a multistep process called the information system development cycle, also known as system development life cycle or phases/stages of Management Information System. The steps taken to develop Management Information System are designing of Management Information System, so that they all are analogues to each other. Reader need not get confused when he or she comes across any of these terms regarding development of Management Information System or information system.

Before going into details of development process of Management Information System, one should go for planning as well as see the motivation or opportunities behind development of Management Information System and certain principles to be followed while designing the Management Information System. In the subsequent sections of this chapter we will discuss each of these aspects in detail.

20.1 UNIT OBJECTIVES

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

- Discuss the MIS master plan
- Explain the Nolan stage model
- Describe the three stage planning process model

NOTES

20.2 MIS MASTER PLAN- CONTENTS AND DESCRIPTION

The master plan typically has two components – (a) a long-range plan for three to five years (or more) and (b) a short-range plan for one year.

The plan provides a basis for resource allocation and control. The long-range portion provides general guidelines for direction and short-range portion provides a basis for specific accountability as to operational and financial performance. The master development plan establishes a framework for all detailed information system planning.

In general, it contains four major sections:

1. Information system goals, objectives and architecture;
2. Inventory of current capabilities;
3. Forecast of development affecting the plan;
4. The specific plan.

Information System Goals, Objectives and Architecture

This section of the plan might contain the descriptions of the following:

1. Organizational goals, objectives and strategies
2. External environment
3. Internal organizational constraints such as management philosophy
4. Assumptions about the business risks and potential consequences
5. Overall goals, objectives, and strategy for information system
6. Architecture of the information system.

Current Capabilities

It includes such items as the following:

1. ***Inventory of:***
 - (i) Hardware

NOTES

- (ii) Generalized Software
 - (iii) Application systems
 - (iv) Personnel
2. ***Analysis of:***
 - (i) Expense
 - (ii) Hardware utilization
 - (iii) Software utilization
 - (iv) Personnel utilization
 3. Status of projects in process
 4. Assessment of strengths and weaknesses

Forecast of Developments Affecting the Plan

Planning is affected by current and anticipated technology. The impact of such developments as PCs, LAN, DBMS and Office automation should be reflected in the long-range plan.

Software availability should also be forecast and the impact on future systems anticipated.

Methodology changes may also be forecast. Environmental developments such as government regulations, tax laws, and competitor actions can also be included insofar as they affect information systems.

The Specific Plan

The Specific Plan is prepared for the next year. The plan should include:

1. Hardware acquisition schedule
2. Purchased software schedule:
 - (i) System software
 - (ii) Applications software
3. Application development schedule
4. Software maintenance and conversion schedule.
5. Personnel resources required and schedule of hiring and training.
6. Financial resources required by object of expenditure (hardware, software, personnel, etc.) and by purpose (operations, maintenance, new development, etc.).

20.3 NOLAN STAGE MODEL

Information system planning is focused on determining the information needs and also ensuring that information system planning aligns with the overall business planning.

For information system planning R.Nolan has given a model known as Nolan stage model. It initially had four stages of growth and later on it was reviewed, and as a result there is an addition of two intermediate growth stages. The Nolan model basically describes in which stage organization's information system exists. This will provide a base for planning to proceed to next stage of the growth. We can see the contribution of this model for MIS planning after going through each stage of Nolan's model.

The Nolan stage model explains the evolution of information system within an organization by considering the various stages of growth. This model was developed in the mid of seventies. Expenditure on information technology increases as the information system passes through various stages. Various stages of Nolan's stage model is shown in Fig. 20.1.

NOTES

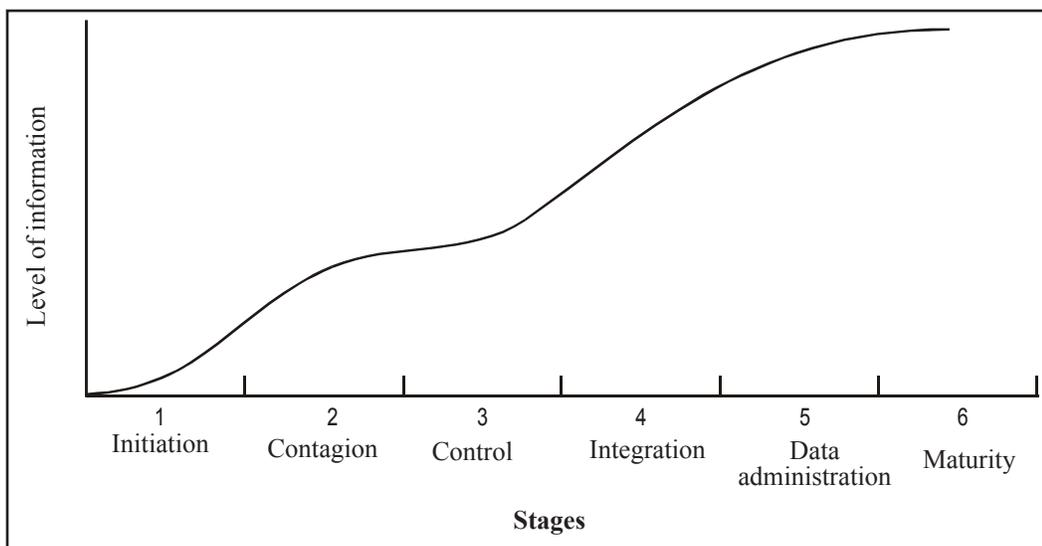


Fig. 20.1: The Six Stages of Nolan's Model

Stage 1: Initiation

This is the first stage of Nolan's model. This stage depicts that computer system is used for transaction-processing which is basically the bottomline of the organization hierarchy. At transaction processing level typically, high volume of data processing is done in terms of accounting the business transactions, billing and payroll, etc. So very little planning of information system is required. The users are mostly unaware of the technology. So new applications are the development with the help

of traditional languages like Cobol, Fortran, etc. System analysis and design has very few methodologies.

NOTES

Stage 2: Contagion

This is the second stage of Nolan's growth model, also known as expansion stage. It is related to unplanned and uncontrolled growth. Actually at this moment the users have developed their interest to know the possibilities of it but still, they do not know much about its pros and cons. The growth of large number of IT applications with minimum check on whether they are required or not, are the key features of this stage. Technical problems with the development of programs appears. There was very little control of the development of information system as well as expenditure associated with IT.

Stage 3: Control

This is the third stage of Nolan's stage model. Because of the unplanned growth, of a large number of IT applications as well as projects, a need arose to manage the information system and also the reorganization of data processing department. The data processing manager becomes more accountable or responsible to justify the expenditure on information system development. The growth of projects is controlled by imposing changes on user department for information system development project and the use of computer services. Users are witnesses of progress in the development of information systems. Pent-up repressed demand and frustration occur in user departments. Organizations are unable to apply cost-effectiveness criteria.

Stage 4: Integration

This is the fourth stage of Nolan's model, known as integration stage. At this stage data processing has a new direction. Information systems are more information oriented, i.e., they lay importance on information product. Because of this concept and to facilitate it, there is an introduction of interactive terminals in the user department, the development of database and the introduction of data communication technology has taken place. The controlled user departments are now in a position to satisfy the repressed demand for information support. So there is a tremendous growing demand for IT applications. As a consequence of this, there is a hike in expenditure also. A new problem has emerged, i.e., redundancy of data.

Sage 5: Data Administration

This is the fifth stage of Nolan's stage model. This stage did not exist in the initial model. This stage has come into existence to overcome and also to control the problem of data redundancy. At this moment it is realized that data is an important resource of the organization. So it should be duly planned and managed. This stage is characterized by the development of an integrated database serving whole organization's information need. It also develops an IT application to successfully

access these databases. Users become more accountable for the integrity and appropriate use of the data and information resources.

Stage 6: Maturity

This is the sixth stage. This was added to the enhanced model. This stage indicates towards a mature organization, which took information system as an integral part of the organization functioning. It indicates that the application portfolio is complete and a representative of an organization’s activity. Actually, application portfolio matches with the overall objectives of the organization. Planning of the information system was coordinated and comprehensive because top management realized that information was an important resource. Manager of information system is on the same footing as other managers of the organization. Thus, planning of development of information system in the organization is built into the organization’s overall development.

There is a summarized view of Nolan’s stages and growth process at each stage in Table 20.1.

NOTES

Table 20.1: Stage of Nolan’s Model along with Growth Processes

	<i>Stage 1</i>	<i>Stage 2</i>	<i>Stage 3</i>	<i>Stage 4</i>	<i>Stage 5</i>	<i>Stage 6</i>
Growth process	Initiation	Contagion	Control	Integration	Data administration	Maturity
Application portfolio	Cost reduction application	large number of applications	restructuring of existing application	data base technology	integration of applications	total integration effective information flow.
Data-processing	specialized for technology administration	user’s need base	middle base program management	user IS management	data	data resource accounts team
Data-processing planning and control	less	more/less	formalized	tailored system	share data system	data resource strategic planning
User of awareness and IS Accountability	unaware	Superficially enthusiastic	arbitrarily held accountable	accountability learning	effective accountable	acceptance joint user

Use of Nolan’s Model in Information System Planning

Nolan’s stage model gave an evolutionary explanation for information system development within an organization. In fact Nolan’s model is a contingency model that identifies a pattern of growth that an organization needs to go through before

NOTES

achieving maturity. Every stage witnessed a learning process. It was not possible to skip any of the stages in the growth process. While progressing to next stage, the organization must go through each stage proceeding it. For example, if one wants to move to stage 4, one has to go through stage number 1, 2 and 3.

The model has been used for planning purpose. The model can be applied to identify the current stage of the growth. Also planning changes to move in a controlled manner to the next stage. This has implications for what has to be achieved in order to progress to the next stage. Planning is required in the areas of application portfolio, technology used, the planning and control structure and the level of the user awareness and involvement. Manager should go for planning because it will speed up the progress process, i.e., move to the next stage and also accompanying organizational learning.

We know the model was developed way back, i.e., during 1970s and after that there was a tremendous change in the field of information technology. So this model incorporated the changed technology concepts in 1980s and 1990s information system.

Nolan's model was mainly criticized on the following grounds.

1. It ignores the fact that advances in information technology made user self sufficient or now they are not dependent on computer centres.
2. It ignores the fact that there has been tremendous development in the area of communication and local area networks which is used to PCs and other technologies together.
3. It ignores the fact that new software development tools support the user.

Despite this criticism, the model finds its validity in many applications of information system planning till today. Every organization realizes that their information system has to undergo these stages. But how long it stays in each stage depends upon the learning process of the organization. This model is used for IS planning where there is a shift of emphasis between the user and the computer centre in the process of growth and where there is more from concentration on processor technology to data management. At last we may say that this model helps a manager to be proactive.

20.4 THREE-STAGE MODEL OF PLANNING PROCESS

A number of techniques have been proposed for information system planning. A problem is to evaluate the place of a technique in the flow of activities for developing a long-range information plan and long-range information architecture. The three-stage model of information system planning developed by Bowman, Davis and Wetherbe (1983) clarifies the basic planning activities, the order of activities and alternative techniques and methodologies that apply.

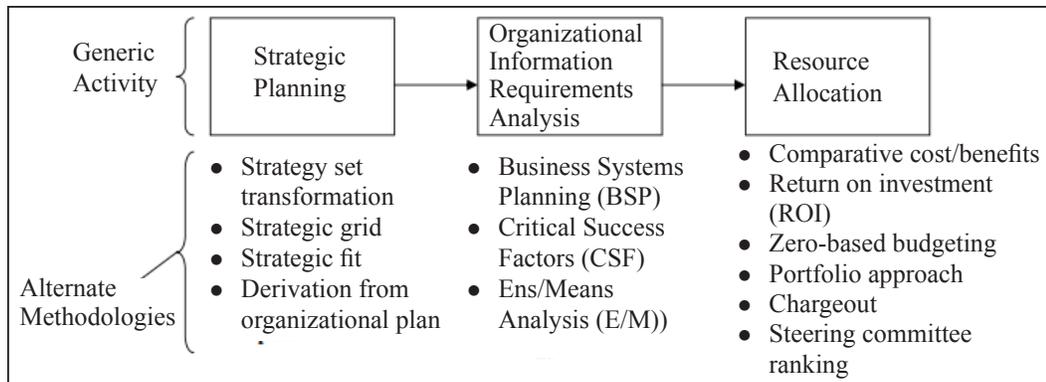


Fig. 20.2: Three-Stage Model of Information System Planning Process

Strategic Planning Stage

The objectives of the strategic planning stage of information system planning are to create objectives, goals and strategies that align with the organizations' objectives, goals and strategies. Four techniques useful in this strategic alignment are:

1. Derivation of organization plan,
2. Use of strategic grid,
3. Fit with organization culture,
4. Strategic set transformation.

Strategic Fit with Organization Culture

Each organization has its own culture and subunits within the organization. The sub units possess their own culture which may be called subculture. It may be well articulated or relatively obscure. Strategic planning needs to be in line with organization culture. It should not be alienated from the cultural trend existing in the organization.

Derivation of Information System Strategy from Organizational Plan

If the organization has a plan that reflects organization goals, objectives, and strategies, information system goals, objectives, and strategy can be derived from it. Each objective, goal, and strategy in the plan is analyzed for required information system support. These can then be organized into information system goals, objectives, and strategies.

The McFarlan–McKenney Strategic Grid

The grid defines four types of information system planning situations depending on the strategic impact of the existing information systems applications portfolio and the strategic impact of the portfolio of applications planned for development. The cells define the position of the information systems activity relative to the organization.

NOTES

Strategic: Information system activities are critical to the current competitive strategy and to future strategic directions of the enterprise. Information systems applications are part of new strategic directions.

Factory: Information system applications are vital to the successful functioning of well-defined, well-accepted activities. However, information systems are not part of future strategic directions.

Support: Information system applications are useful in supporting the activities.

Organization: Information systems are not part of future strategic directions.

Turnaround: This is a transition state from support to strategic. The organization has had support-type applications but is now planning for applications vital to strategic success of the organization.

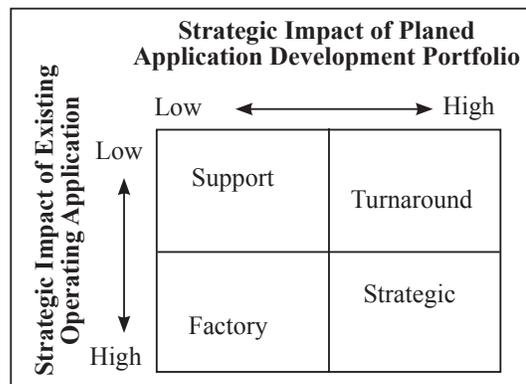


Fig. 20.3:

Goals, objectives, and strategies for information systems should fit with the culture in order to avoid high resistance and high risk of failure. Clues of culture can be obtained from the following sources:

- Stories
- Meetings
- Top management behaviour
- Physical layout
- Ritual
- Documents

Strategic Set Transformation

Strategy set transformation is used to produce goals and strategy for the information system by the following steps:

1. Explain the organization’s strategy set
 - (i) Outline the organization’s claimant structure. The client, claimant, or stakeholders in the organization are identified. Examples are owners,

customers, suppliers, and employees.

- (ii) Identify goals for the claimants.
 - (iii) Identify organizational goals and strategies for each claimant group.
2. Validate the organizational goals and strategies by asking management to critique the statements. The organizational objectives, strategies, and strategic organizational attributes form the organizational strategy set.
 3. Transform the organizational strategy set into the information system strategy set.
 - (i) Identify one or more information system objectives for each organizational strategy and for each relevant organizational objective and attribute.
 - (ii) Identify information system constraints from organization strategy set and from information system objectives.
 - (iii) Identify information system design strategies based on organizational attributes, information system objectives and information system constraints.

NOTES

Changing Trend of Organizational Cultural and MIS Plan

In fact the concept of culture and clarification of its nature is not an idle academic pursuit. It has practical relevance. Along with developing the concept of culture, it requires to know what needs to be changed for culture to change. In fact in the perspective of organizational activities, culture is a peculiar phenomenon. It is commonly agreed that in an organization culture exists and it is a useful concept. But fewer agree on exactly what it is. According to Kroeber and Kluckhohn (1952), "Culture consists of explicit and implicit, of and for acquired and transmitted by symbols, consisting the distinctive achievements of human groups, including their embodiments in artefacts; the essential core of culture consists of traditional (historically derived and selected) and especially their attached values; culture systems may, on the one hand, be considered as product of action, on the other as conditioning element of future action." This idea of culture includes from many different approaches.

In general, definition of culture is to deal primarily either with the way we act or the way we think. At one extreme, culture may be defined as, "the way we do things around here." Deal T. E. and Kennedy A. A. (1982) At the other end it may be defined as, "the way we think about things around here or the fabrics of meaning with which human beings interpret their experience and guide their actions", Geertz C. (1973). Between these extremes, some authors have defined culture in terms of both thought and behaviour. An example would be, "the commonly shared beliefs, values and characteristic patterns of behaviour that exist within an organization." Margulis N. Raia A. P. (1978) Practical managers tend to view culture primarily in terms of behaviour. Managers are primarily interested in making practical change in people's work, goals, method, and behaviours. By contrast academicians tend to view

NOTES

culture primarily in cognitive terms. Academicians are generally more concerned with “why culture changes?” than with “why change culture?” Deal and Kennedy (1982) and Peters and Waterman (1982) have made statements about the nature of organization culture mainly based on statements of CEOs and senior executives of large multinational organizations; these interesting executive stories are probably truly the myths of culture. Many of these cultural statements are more the products of corporate PR machine. Schein E. H. (1985) has defined culture as an unconscious and largely invisible entity which by definition is almost to measure, study or change. Aspects of culture are unconscious and in a sense invisible. Advanced research shows that one needs to define culture as unconscious and invisible – cultures are commonly held and relatively stable beliefs, attitudes and values that exist within the organization. This may be considered to be the working definition of culture. Culture thus may be thought as “the way people think about things around here”. Our working definition identifies an entity that clearly impacts upon organization effectiveness. That is defined in this way; culture is tied to behaviour and consequently is of practical relevance. Culture is capable of change and it can be empirically studied. Further emphasis upon beliefs, attitudes and values as the major elements of culture enables us to draw upon previous empirical research on the nature of belief, attitude and value formation and change in developing our understanding of culture and the ways in which it can be changed.

Mechanism of Change in Organization Culture and MIS Plan

Changes in organization culture take place in many cases during implementation of strategic changes. It is likely to be the self-sealing, embedded product of past strategy and, unless carefully managed, will act to negate any future strategy which requires a major change in the way people think or do things around. Organization culture undergoes change when common beliefs, attitudes and values that exist when organization is subjected to change. In case studies conducted in organizations subjected to cultural change it has been observed that cause of cultural change appears because of six reasons, viz., by changing people in the organization; by changing position of people in organization; by changing beliefs, attitudes, values directly; by changing behaviour; by changing the systems and structure; and changing the corporate image. Hence goals, objectives and strategy of information systems should fit with the culture in order to avoid high resistance and high risk of failure. If the culture is not clear to information systems planners, clues can be obtained from sources such as (i) Stories, (ii) Meetings, (iii) Top management behaviour, (iv) Physical layout, (v) Ritual, (vi) Documents. These clues can be organized into rules of the game and classified into organizational tasks and relationships. The fit between culture and proposed information system plan can be assessed. Explicit decisions can be made to ignore the culture (not favourable), drop the strategy, seek a better fitting strategy or plan (most difficult) actions to change. Conclusion: The complexity of the information resources environment suggests that planning of MIS is vital to

success of an organization. The development of an information plan for information resources is a vital of a good management. There are varieties of approaches to organize planning. The approach chosen should include appropriate participation and review by the organization to ensure that the plan meets organizational needs and that it has organizational support. The cultures of different organizations differ with respect to the value attached to data and information; these also differ with respect to data discipline. Even differences in accuracy can be observed within the organization. Accounting has a higher level of accuracy than sales, which reflects not only data processing system but also training, and culture of the function. Accountants have a culture which emphasizes accuracy (reinforced by training and “tales of finding the function of a rupee error”); sales people have a culture that focuses on the sales, without concern for even several hundred rupees – planning needs to take care of this.

Check Your Progress

Fill in the blanks:

1. The plan provides a basis for and control.
2. is focused on determining the information needs and also ensures that information system planning aligns with the overall business planning.
3. The provides general guidelines for direction and short-range portion provides a basis for specific accountability as to operational and financial performance.
4. The explains the evolution of information system within an organization by considering the various stages of growth.
5. The developed by Bowman, Davis and Wetherbe (1983) clarifies the basic planning activities, the order of activities and alternative techniques and methodologies that apply.
6. Each organization has its own culture and subunits within the organization possess their own culture which may be called
7. Strategic planning needs to be in line with
8. Strategic planning should not be alienated from the cultural trend existing in the

20.5 SUMMARY

- The master plan typically has two components - (a) a long-range plan for three to five years (or more) and (b) a short-range plan for one year.
- The plan provides a basis for resource allocation and control. The long-range portion provides general guidelines for direction and the short-range

NOTES

portion provides a basis for specific accountability as to operational and financial performance.

- The master development plan establishes a framework for all detailed information system planning.
- Information system planning is focused on determining the information needs and also ensures that information system planning aligns with the overall business planning.
- For information system planning R.Nolan has given a model known as Nolan stage model which initially had four stages of growth and later on it was reviewed. As a result there is an addition of two intermediate growth stages. The Nolan model basically describes in which stage organizations information system exists. This will provide a base for planning to proceed to next stage of the growth. We can see the contribution of this model for MIS planning after going through each stage of Nolan's model.
- A number of techniques have been proposed for information system planning. A problem is to evaluate the place of a technique in the flow of activities for developing a long-range information plan and long-range information architecture. The three-stage model of information system planning developed by Bowman, Davis and Wetherbe (1983) clarifies the basic planning activities, the order of activities and alternative techniques and methodologies that apply.

20.6 GLOSSARY

- **Master Development Plan:** The master development plan establishes a framework for all detailed information system planning.
- **Information System Planning:** Information system planning is focused on determining the information needs and also ensures that information system planning aligns with the overall business planning.
- **Nolan Stage Model:** The Nolan stage model explains the evolution of information system within an organization by considering the various stages of growth.
- **Subculture:** Each organization has its own culture and subunits within the organization possess their own culture which may be called subculture.
- **Strategic Planning:** Strategic planning needs to be in line with organization culture.

20.7 ANSWERS TO CHECK YOUR PROGRESS

1. resource allocation
2. Information system planning

3. long-range portion
4. Nolan stage model
5. three-stage model of information system planning
6. subculture
7. organization culture
8. organization

NOTES

20.8 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What do you mean by MIS Plan?
2. Define Nolan stage plan.
3. What is the three-stage planning process model?
4. What do you mean by strategic fit?
5. Define subculture.

Long Answer Questions

1. Discuss the MIS master plan
2. Explain the Nolan stage model
3. Describe the Nolan six-stage planning model
4. Describe the three-stage planning process model

20.9 REFERENCES

1. Amrit Tiwana, *The Essential Guide to Knowledge Management*, Pearson education, 2001
2. Ratnaja Gogula, *Knowledge Management – A New Dawn*, ICFAI, 2002
3. Gordon B. Davis and Margrethe H. Olson, *Management Information Systems: Conceptual foundations, Structure and Development*, 2nd Edition, Tata McGraw Hill International Book Company, 2000
4. E. Wainright Martin, Carol V. Brown, Danial W. DeHayes, Jeffrey A. Hoffer Williams C. Perkins, *Management Information Technology*, 3rd Edition, Prentice Hall International Edition, 1999
5. Harold Koontz and Heinz Wehrich, *Essentials of Management*, 5th Edition, Tata McGraw Hill, 1999

UNIT 21: ORGANIZATIONAL INFORMATION REQUIREMENT ANALYSIS AND RESOURCE ALLOCATION STAGE

Structure

- 21.0 Introduction
- 21.1 Unit Objectives
- 21.2 Organizational Information Systems Analysis (Requirement Analysis)
- 21.3 Information System Requirements
- 21.4 Resource Allocation
- 21.5 Summary
- 21.6 Glossary
- 21.7 Answers to Check Your Progress
- 21.8 Terminal and Model Questions
- 21.9 References

21.0 INTRODUCTION

In MIS, the information is recognized as a major resource like capital and time. If this resource has to be managed well, it calls upon the management to plan for it and control it, so that the information becomes a vital resource for the system. A wide variety of techniques is applied for IS planning. However, organizations select these techniques based on the persuasive power of IS developers rather than on a sound logic. The main reason of selecting wrong techniques is attributed to the non-identification of the stage the information system of the organization is in. This model describes the four generic planning activities, viz., strategic planning, requirement analysis, resource allocation and project planning.

21.1 UNIT OBJECTIVES

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

- Discuss the Organizational information
- Explain the Requirements Analysis
- Describe the Resource Allocation

21.2 ORGANIZATIONAL INFORMATION SYSTEMS ANALYSIS (REQUIREMENTS ANALYSIS)

NOTES

After the feasibility study, the analyst takes the formal acceptance of the proposed system from the requested department. The next step is to study the current system in detail, so that the system requirements can be determined. Systems analysis, also called as ‘Problem Analysis’ or ‘Requirement Analysis’ is the obtaining of the actual specifications of the system by clearly understanding the needs of the users. After analysis, a document is prepared by the analyst, which is called “Software Requirement Specification (SRS)” document. We will discuss various parts and characteristics of an SRS in subsequent part.

Many methods and languages have been developed for requirements analysis. Structured Analysis and Design Technique (SADT) – simply called as ‘Structured Analysis’ is the most commonly used method for analysis. We will discuss this method in detail in subsequent part. Problem Statement Language (PSL) and Requirements Statement Language (RSL) are some of the languages developed for specifying the requirements. PSL is fundamentally the same as the structured analysis, but it is purely textual whereas structured analysis uses both text and graphics. RSL has been specially designed for specifying the requirements of realtime control systems.

Structured Analysis

Structured analysis is a development method for analysis of existing system. It is a set of techniques that allow the analyst to design the proposed system. The main purpose of structured analysis is to completely understand the current system.

Tools of Structured Analysis

Data flow diagrams, data dictionary and process descriptions are the main tools for structured analysis.

1. **Data Flow Diagrams (DFDs):** Data flow diagrams are widely used graphic tools for describing the movement of data within or outside the system. As a DFD consists of a series of bubbles joined by lines, it is also known as a ‘bubble chart’. The basic DFD format is shown in Figure 21.1
2. **Data Dictionary:** Data dictionary is an organized list of terms and their definitions for all the data elements and data structures that are pertinent to the system. It stores names along with their descriptions of all data used in a system.
3. **Process Descriptions:** Process descriptions are another major tool of structured analysis, that describes the sequence of different processes in the system. Structured English (pseudocode), decision tree and decision table are commonly used process descriptions.

NOTES

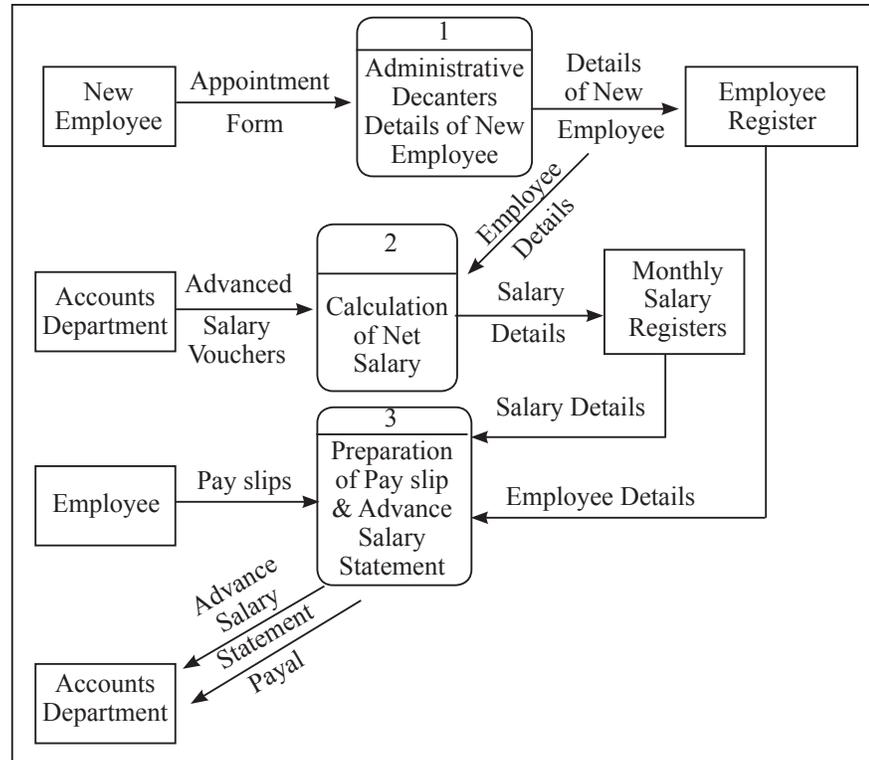


Fig. 21.1

21.3 INFORMATION SYSTEM REQUIREMENTS

The following diagram illustrates a brief sketch of the process of information requirement analysis:

The following three methodologies can be adopted to determine the requirements in developing a management information system for any organization:

- **Business Systems Planning (BSP):** This methodology is developed by IBM. It identifies the IS priorities of the organization and focuses on the way data is maintained in the system. It uses data architecture supporting multiple applications. It defines data classes using different matrices to establish relationships among the organization, its processes and data requirements.
- **Critical Success Factor (CSF):** This methodology is developed by John Rockart of MIT. It identifies the key business goals and strategies of each manager as well as that of the business. Next, it looks for the critical success factors underlying these goals. Measure of CSF effectiveness becomes an input for defining the information system requirements.
- **End/Means (E/M) Analysis:** This methodology is developed by Wetherbe and Davis at the University of Minnesota. It determines the effectiveness criteria for outputs and efficiency criteria for the processes generating

the outputs. At first it identifies the outputs or services provided by the business processes. Then it describes the factors that make these outputs effective for the user. Finally it selects the information needed to evaluate the effectiveness of outputs

NOTES

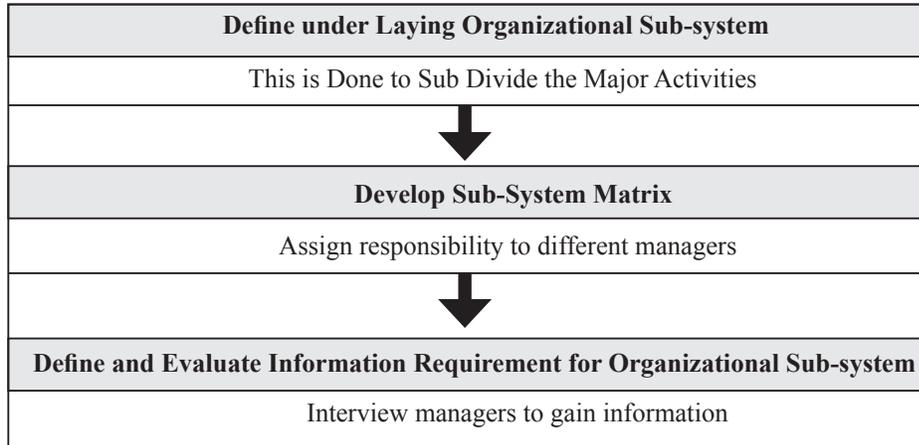


Fig. 21.2

Technology for Information Systems

The technology requirement for an information system can be categorized as:

- Devices
- ***Data Center Systems:*** It is the environment that provides processing, storage, networking, management and the distribution of data within an enterprise.
- ***Enterprise Software:*** These are software systems like ERP, SCM, Human Resource Management, etc., that fulfil the needs and objectives of the organizations.
- ***IT Services:*** It refers to the implementation and management of quality IT services by IT service providers through people, process and information technology. It often includes various process improvement frameworks and methodologies like six sigma, TQM, and so on.
- Telecom Services

System Test Planning and Execution

The system should be fully tested for errors before being fully operational.

The test plan should include for each test:

- Purpose
- Definition
- Test inputs
- Detailed specification of test procedure
- Details of expected outputs

NOTES

Each sub-system and all their components should be tested using various test procedures and data to ensure that each component is working as it is intended.

The testing must include the users of the system to identify errors as well as get the feedback.

System Operation

Before the system is in operation, the following issues should be taken care of:

- Data security, backup and recovery;
- Systems control;
- Testing of the system to ensure that it works bug-free in all expected business situations;
- The hardware and software used should be able to deliver the expected processing;
- The system capacity and expected response time should be maintained;
- The system should be well documented including:
 - A user guide for inexperienced users
 - A user reference or operations manual for advanced users
 - A system reference manual describing system structures and architecture.

Once the system is fully operational, it should be maintained throughout its working life to resolve any glitches or difficulties faced in operation and minor modifications might be made to overcome such situations.

Factors for Success and Failure

MIS development projects are high-risk, high-return projects. Following could be stated as critical factors for success and failure in MIS development:

- It should cater to a specific, well-perceived business.
- The top management should be completely convinced, able and willing to such a system. Ideally there should be a patron or a sponsor for the system in the top management.
- All users including managers and other employees should be made an integral part of the development, implementation, and use of the system.
- There should be an operational prototype of the system released as soon as possible, to create interest among the users.
- There should be good support staff with necessary technical, business, and interpersonal skills.
- The system should be simple, easy to understand without adding much complexity. It is a best practice, not to add up an entity unless there are both a use and user for it.

- It should be easy to use and navigate with high response time.
- The implementation process should follow a definite goal and time.
- All the users including the top management should be given proper training, so that they have a good knowledge of the content and function of the system, and can use it fully for various managerial activities such as reporting, budgeting, controlling, planning, monitoring, etc.
- It must produce useful outputs to be used by all managers.
- The system should be well integrated into the management processes of planning, decision-making, and monitoring.

21.4 RESOURCE ALLOCATION

Resource allocation consists of developing the hardware, software, data communications, facilities, personnel, and financial plans needed to execute the master development plan. This stage provides the framework for technology and labour procurement, and identifies the financial resources needed to provide appropriate service levels to users. Funding requests from the ISD fall into two categories;

- Request for spending far exceed the available fund
- Those necessary to stay in business
- Those for improving the information architecture.

Check Your Progress

Fill in the blanks:

1. Systems analysis, also called as 'Problem Analysis' or is the obtaining of the actual specifications of the system by clearly understanding the needs of the users.
2. After analysis, a document is prepared by the analyst, which is called
3. is a development method for analysis of existing system. It is a set of techniques that allow the analyst to design the proposed system.
4. Process descriptions are another major tool of that describes the sequence of different processes in the system.
5. methodology is developed by IBM.
6. Critical Success Factor (CSF) methodology is developed by
7. methodology is developed by Wether be and Davis at the University of Minnesota.
8. consists of developing the hardware, software, data communications, facilities, personnel, and financial plans needed to execute the master development plan.

21.5 SUMMARY

- In MIS, the information is recognized as a major resource like capital and time. If this resource has to be managed well, it calls upon the management to plan for it and control it, so that the information becomes a vital resource for the system. A wide variety of techniques is for IS. However, organizations select these techniques based on the persuasive power of IS developers rather than on a sound logic. The main reason of selecting wrong techniques is attributed to the non-identification of the stage the information system of the organization is in. This model describes the four generic planning activities, viz., strategic planning, requirement analysis, resource allocation and project planning.
- Systems analysis, also called ‘Problem Analysis’ or ‘Requirement Analysis’ is the obtaining of the actual specifications of the system by clearly understanding the needs of the users. After analysis, a document is prepared by the analyst, which is called Software Requirement Specification (SRS) document.
- Resource allocation consists of developing the hardware, software, data communications, facilities, personnel, and financial plans needed to execute the master development plan. This stage provides the framework for technology and labour procurement, and identifies the financial resources needed to provide appropriate service levels to users

21.6 GLOSSARY

- **Business Systems Planning (BSP)** :It identifies the IS priorities of the organization and focuses on the way data is maintained in the system.
- **Critical Success Factor (CSF)**: It identifies the key business goals and strategies of each manager as well as that of the business.
- **End/Means (E/M) Analysis**: It determines the effectiveness criteria for outputs and efficiency criteria for the processes generating the outputs.
- **Resource Allocation**: It consists of developing the hardware, software, data communications, facilities, personnel, and financial plans needed to execute the master development plan.
- **Structured Analysis** : It is a development method for analysis of existing system. It is a set of techniques that allow the analyst to design the proposed system.

21.7 ANSWERS TO CHECK YOUR PROGRESS

1. Requirements Analysis
2. Software Requirement Specification (SRS) document
3. Structured analysis
4. structured analysis
5. Business Systems Planning (BSP)
6. John Rockart of MIT
7. End/Means (E/M) analysis
8. Resource allocation

NOTES

21.8 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What do you mean by Organizational Information Requirement?
2. What is Business Systems Planning (BSP)?
3. Define the term Critical Success Factor (CSF).
4. What do you understand by End/Means (E/M) Analysis?
5. Define Resource Allocation.
6. What is Structured Analysis?

Long Answer Questions

1. Discuss the Organizational Information Requirement.
2. Explain the methodologies of Requirements Analysis.
3. Describe Resource Allocation.

21.9 REFERENCES

1. Amrit Tiwana, *The Essential Guide to Knowledge Management*, Pearson Education, 2001
2. Ratnaja Gogula, *Knowledge Management – A New Dawn*, ICFAI, 2002
3. Gordon B. Davis Margrethe H. Olson, *Management Information Systems: Conceptual foundations, Structure and Development*, 2nd Edition, Tata McGraw Hill International Book Company, 2000
4. E. Wainright Martin, Carol V. Brown, Danial W. DeHayes, Jeffrey A. Hoffer and Williams C. Perkins, *Management Information Technology*, 3rd Edition, Prentice Hall International Edition, 1999
5. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 5th Edition, Tata McGraw Hill, 1999

UNIT 22: LIMITATIONS OF MIS

NOTES

Structure

- 22.0 Introduction
- 22.1 Unit Objectives
- 22.2 Myths Regarding Management Information System
- 22.3 Limitation of Management Information System
- 22.4 Summary
- 22.5 Glossary
- 22.6 Answers to Check Your Progress
- 22.7 Terminal and Model Questions
- 22.8 References

22.0 INTRODUCTION

All of you know that an Information System is a system that gathers data and disseminates information with the sole purpose of providing information to its users. The main objective of an information system is to provide information to its users. Information systems vary according to the type of users who use the system. A Management Information System is an information system that evaluates, analyzes, and processes an organization's data to produce meaningful and useful information based on which the management can take right decisions to ensure future growth of the organization.

22.1 UNIT OBJECTIVES

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

- Explain the myths of MIS
- Describe the limitation of MIS

22.2 MYTHS REGARDING MANAGEMENT INFORMATION SYSTEM

There are certain myths or misleading thinking about Management Information System in the minds of people and these myths should be clarified with some logic. Some of them are as follows.

1. ***The Study of Management Information System is about the Use of Computers:*** This statement is incorrect; we may or may not prepare or develop Management Information System without the use of computer. Basically computer is a media to gather, sort and analyze the data. Mainly Management Information System depends on many other factors like size of the organization, information needs, the time taken to answer a query, etc.
2. ***More Data in Reports means More Information for Managers:*** This statement is also not true because the quantity of data does not matter as quality matters. Moreover it also depends on the requirements of the manager. Also, too much quantity will lead to confusion.
3. ***Accuracy in Reporting is of Vital Importance:*** This statement is true at operational level, designing of any system, control of aircraft, etc. But high accuracy will lead to higher cost. So it is relevant but not desirable in many cases as higher or top management takes their decision on the basis of rules, policies, etc. They want a vague idea about the cost. For example, they are interested in total cost of starting a new business rather than the unit cost. So for top management, a fairly, correct presentation of relevant data is more important than accuracy.

22.3 LIMITATION OF MANAGEMENT INFORMATION SYSTEM

By implementing the Management Information System, one gets many advantages. Some of them are:

1. It provides timely, accurate, scientific, reliable and permanent information.
2. It avoids duplication of efforts.
3. Coordinates the whole organization.
4. It provides the information in form and formats as required by the information seeker.
5. It helps in making better and scientific decisions by the management.
6. Speed of processing and fast retrieval of data is possible.
7. The scope for the use of information system has expanded (provides information to remote areas users).

Limitations of Management Information System

1. The quality of the operation of Management Information System depends on the quality of input process.

NOTES

2. Management Information System is not a substitute for effective management.
3. Management Information System may not have requisite flexibility to quickly update itself with the changing needs of time, especially in a fast changing and complex environment.
4. Management Information System cannot provide tailor-made information packages suitable for the purpose of every type of decision made by the executives.
5. Management Information System takes into account only quantitative factors. It cannot consider the qualitative factors like moral and attitude of managers, which have a major impact on decision making by the managers.
6. Management Information System is less useful in non-programmed decisions which are not of routine nature. The reason being the information for these decisions is not provided by the existing system.
7. Management Information System is not successful where secrecy is maintained in disseminating information to their workers. In other words where sharing of information is not the culture of organization, the working of organization is affected in absence of required information.
8. The effectiveness of Management Information System is also affected or reduced in case of a change in the top management, organizational structure and operational team.

Check Your Progress

Fill in the blanks:

1. is basically a service and to quantify the benefits of a service is very difficult. It is difficult to quantify the benefits and also compare them with the cost of achieving these benefits.
2. Management Information System cannot provide tailor-made information packages suitable for the purpose of every type of decision made by
3. MIS helps in making better and scientific decisions by the
4. provides the information in form and formats as required by the information seeker.
5. The of Management Information System is also affected or reduced in case of a change in the top management, organizational structure and operational team.

22.4 SUMMARY

NOTES

- A Management Information System is an information system that evaluates, analyzes, and processes an organization's data to produce meaningful and useful information based on which the management can take right decisions to ensure future growth of the organization.
- Basically computer is a media to gather, sort and analyze the data. Mainly Management Information System depends on many other factors like size of the organization, information needs, and the time taken to answer a query. Non-availability of experts is the main challenge before the planner of Management Information System that it is difficult to find experts who can determine the basic objective of the organization expected to result from a Management Information System and then implement them to produce an effective Management Information System.
- Non-cooperation from staff is the most critical problem in implementing a Management Information System effectively in the organization. The fears of retrenchment and exposure before subordinates are some of the main reasons of this non-cooperation. High turnover among the experts is a major challenge.
- Management Information System is basically a service and to quantify the benefits of a service is very difficult. It is difficult to quantify the benefits and also compare them with the cost of achieving these benefits. Management Information System cannot provide tailor-made information packages suitable for the purpose of every type of decision made by the executives. It helps in making better and scientific decisions by the management. It provides the information in form and formats as required by the information seeker. The effectiveness of Management Information System is also affected or reduced in case of a change in the top management, organizational structure and operational team.

22.5 GLOSSARY

- **Information System:** An Information System is a system that gathers data and disseminates information with the sole purpose of providing information to its users.
- **Management Information System:** A Management Information System is an information system that evaluates, analyzes, and processes an organization's data to produce meaningful and useful information based on which the management can take right decisions to ensure future growth of the organization.

22.6 ANSWERS TO CHECK YOUR PROGRESS

1. Management Information System
2. Executives
3. Management
4. MIS
5. Effectiveness

22.7 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What are the main points of myths of Management Information System?
2. What is the main objective of Information System?

Long Answer Questions

1. Explain the myths regarding Management Information System.
2. Discuss the benefits of Management Information System.
3. Discuss the limitations of Management Information System.

22.8 REFERENCES

1. Amrit Tiwana, *The Essential Guide to Knowledge Management*, Pearson Education, 2001
2. Ratnaja Gogula, *Knowledge Management – A New Dawn*, ICFAI, 2002
3. Gordon B. Davis and Margrethe H. Olson, *Management Information Systems: Conceptual foundations, Structure and Development*, 2nd Edition, Tata McGraw Hill International Book Company, 2000
4. E. Wainright Martin, Carol V. Brown, Danial W. DeHayes, Jeffrey A. Hoffer and Williams C. Perkins, *Management Information Technology*, 3rd Edition, Prentice Hall International Edition, 1999
5. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 5th Edition, Tata McGraw Hill, 1999

UNIT 23: DEVELOPMENT AND IMPLEMENTATION OF MIS

NOTES

Structure

- 23.0 Introduction
- 23.1 Computer Software Systems
- 23.3 MIS Development Process
 - 23.1.1 Waterfall Model
 - 23.1.2 Prototype Model
 - 23.1.3 RAD Model
- 23.4 Implementations of Management Information System
- 23.5 Methods of Implementing Management Information System
- 23.6 Implementation Steps of Management Information System
- 23.7 Evaluation of Management Information System
- 23.8 Structure for Evaluation of Management Information System
- 23.9 Maintenance
- 23.10 Problems Related to the Maintenance of Management Information System
- 23.11 Measures to Overcome these Problems
- 23.12 Summary
- 23.13 Glossary
- 23.14 Answers to Check Your Progress
- 23.15 Terminal and Model Questions
- 23.16 References

23.0 INTRODUCTION

Computer software has become a driving force. It is the engine that drives business decision making. It is a key factor that differentiates modern products and services. Software is virtually inescapable in a modern world.

The software development process has been the focus of considerable attention over the last decade. It is a frame work for the tasks that are required to blind high-quality software.

23.1 UNIT OBJECTIVES

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

- Discuss the MIS development process
- Describe various phases of development

- Explain implementation of Management information system
- Discuss Risk based Approaches MIS development

NOTES

23.2 COMPUTER SOFTWARE SYSTEMS

A commercial organization performs various activities. The important ones among them include financial accounting, inventory control, and payroll. Most of these activities are carried out manually. As the dimensions of these activities increase, the organization may prefer to mechanize the activities to operate smoothly. Computer manufacturers have come to the rescue of business organizations. They have developed packages/programs, for carrying out the activities like payroll preparation, inventory control, invoicing system, and financial accounting. This unit discusses these four important computerized applications in detail.

When we consider the payroll problem, it is obligatory on the part of every employer to pay the wages to employees within a prescribed time limit. When the number of employees is large, it is preferred to have a computerized system of preparing the pay bills rather than manual ones. A computer software package on payroll thus becomes an integral part of a large business organization.

Similarly, financial accounting is another field where computerization can play an important role. The financial accounting package is one which helps the organization in preparing various financial reports, ledgers, and journals of monetary transactions.

In a large production-oriented organization, it is essential to have a control over the investment in inventory of raw materials. A computerized inventory control system can reduce considerable amount of time in processing the data which is necessary to control inventory.

23.3 MIS DEVELOPMENT PROCESS

Software development for business applications is not an easy task. In developing a large software (e.g., MIS), many people are involved and many months or even years are spent. However, a small application (e.g., Payroll) can be developed in few weeks or months by a single or few programmers. For such small systems, software development activities maybe done implicitly without proper documentation. But, for large systems, these activities must be done explicitly with proper planning and documentation. Whether a system is small or large, software development revolves around a life cycle that begins with the recognition of users' needs and understanding their problem. A plan is made for solving the problem and then a sequence of activities are performed step by step. The basic activities or phases that are performed for developing software are:

1. **Feasibility Study:** Feasibility study is the first phase in development of a new system (candidate system). This phase starts when the user faces a problem in the current system (manual or already computerized) and submits a formal

request to the EDP department or an outside software development company either for a new system or for modifying the current system. After receiving the request, the overall in charge of software development team, Systems Analyst, begins the preliminary investigations to determine whether the system requested is feasible to develop or not.

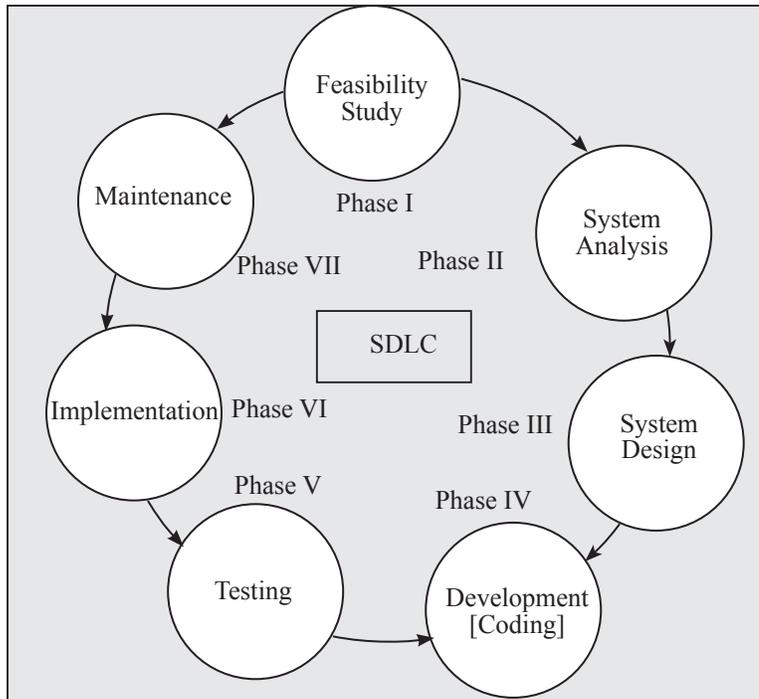


Fig. 23.1: Seven Phases of Software Development Life Cycle

2. **Systems Analysis:** When the systems analyst decides that the requested system is feasible and the management agrees to continue the development process, the next phase of SDLC is determination of systems requirements. This phase includes studying of existing system in details and collecting data in order to find out the requirements of the users.
3. **Systems Design:** After collecting and studying user's requirements, the system is designed. This phase involves identification of inputs data, output reports and the procedures to process the data.
4. **Development of Software:** When the design (properly documented) is accepted by the requested department, the programmers start designing of data structures and writing of program. The programmers test their individual programs and integrate them into a single system.
5. **Systems Testing:** Testing is the most vital phase of SDLC. In this phase, the system as a whole is tested with different techniques to ensure that the software is bug free.
6. **Implementation:** The tested system is installed at the user's place and implemented. This is generally considered the last phase of SDLC. However,

NOTES

the systems development work continues until the users of requested department accepts the candidate system.

- 7. **Maintenance:** After implementation, the systems need be maintained in order to adapt the changing business needs. Maintenance is sometimes not considered as a phase of SDLC, but it is an essential part of a software project that never ends.

The different phases of Software Development Life Cycle (SDLC) are illustrated in Fig. 23.2.

It may be possible that the candidate system fails due to any major mistake occurred in any of the development phase. In that case, any or all of the phases are needed be reviewed again, so that the system is completely accepted by the requested department. This is the reason, why ‘life cycle’ term is used in software development phases. We will discuss about each phase in detail in subsequent sections.

Examples of SDLC

The phases of System Development Life Cycle are often sequenced in many different ways so as to achieve different objectives. These variations give rise to different Development Models. Each model aims at achieving its specific goals by arranging the SDLC phases in appropriate ways. Some of the popular SDLC are described below.

23.1.1 Waterfall Model

This model of system development is the simplest in the sense that it follows all the development phases in discrete steps one followed by the other. A phase does not begin unless the previous phase has concluded as shown on the next page. The development phases do not overlap and are mutually exclusive.

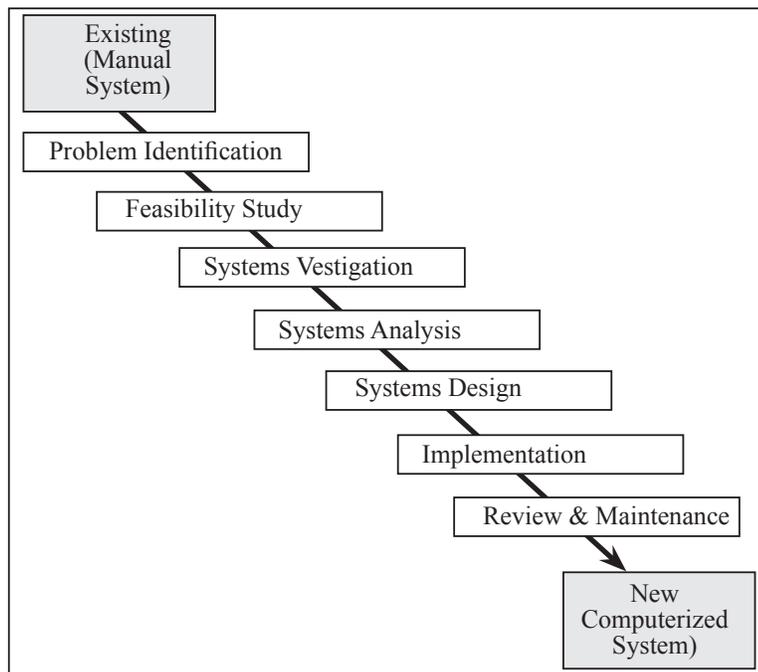


Fig. 23.2

The name – waterfall – signifies that once a phase is over it is not the development does not enter it again much the same as water does not flow upwards in a waterfall.

Advantages of Waterfall Model

- It is most suitable for small systems in which the needs of the users' are more or less understood.
- It is resource efficient as once a phase is over the same resources can be employed in the next phase.
- It is easy to assess the progress of development as the development takes place through neatly separated phases.

Disadvantages of Waterfall Model

- Changes in the requirement are inevitable during the development process. This model does not cater to changes readily. It is difficult to accommodate changes because once a phase is over it cannot be redone to incorporate any change.
- Development is time-taking as phases cannot be initiated in parallel.
- It is unsuitable for systems in which the users' needs are not properly understood.

23.1.2 Prototype Model

The SDLC approach to system development is most suited in cases where the users' requirements can be ascertained in the beginning of the project. However, in cases where the users are not sure what they want (note that users are very often not computer experts) another approach to development – prototyping – is more suitable.

In prototyping approach, a rough copy, which has the feel and look of the new system, is developed with only limited functionality. The users are allowed to interact with this prototype and the desired modifications are recorded. These new features are added and again users are allowed to interact with the modified system. The procedure is repeated until the required system is evolved. Prototype approach is illustrated in the Figure 23.3.

Generally there are two types of prototypes:

- Throw away Prototype
- Permanent or Evolutionary Prototype

Throwaway Prototyping: Throwaway or Rapid Prototyping refers to the creation of a model that will eventually be discarded rather than becoming part of the finally delivered system. After preliminary requirements gathering is accomplished, a simple working model of the system is constructed to visually show the users what their

NOTES

NOTES

requirements may look like when they are implemented into a finished system. The most obvious reason for using Throwing Prototyping is that it can be done quickly. Throw away prototype is presented to the users just to investigate a particular need. Once the need is determined the prototype is discarded. It is not modified but the modification is done to the original prototype which will ultimately turn into the final system.

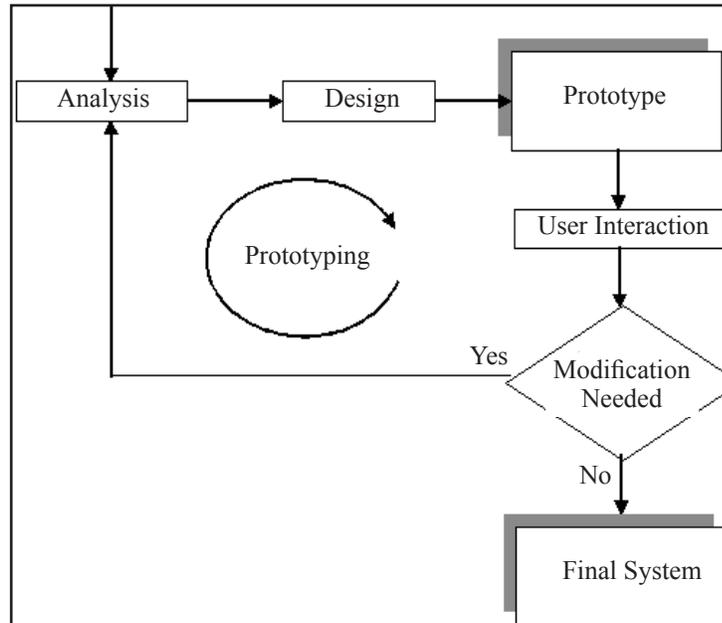


Fig. 23.3

On the other hand, Permanent or Evolutionary prototype is refined gradually through the users' interaction and finally takes the shape of the final system.

Types of Prototyping: System prototyping are of various kinds. However, all the methods are in some way based on two major types of prototyping:

- **Evolutionary Prototyping:** Evolutionary Prototyping (also known as Breadboard Prototyping) is quite different from Throwing Prototyping. The main goal when using Evolutionary Prototyping is to build a very good prototype in a structured manner so that we can refine it or make further changes to it. The reason for this is that the Evolutionary prototype, when built, forms the heart of the new system, and the improvements and further requirements will be built on to it. It is not discarded or removed like the Throwing Prototype. When developing a system using Evolutionary Prototyping, the system is continually refined and rebuilt.
- **Incremental Prototyping:** The final product is built as separate prototypes. At the end the separate prototypes are merged in an overall design.

Advantages of Prototyping

- It is very effective in identifying the users' need.
- Users' response is very close to what they actually need.
- It is more convenient for the users' to work and tell with working model of the system.
- The development is easy and precise.
- The users' get the look and feel of the upcoming system and therefore training them becomes easier.
- The prototype is very likely to end up into the system that users' want.
- Prototyping and SDLC may be used in a combined approach wherever applicable.

Disadvantages of Prototyping

- Increased project duration because of increased user interaction.
- The approach needs special Software such as fourth generation languages.
- Cost and duration of the development is not easy to estimate in advance.

23.1.3 RAD Model

Rapid Application Development or RAD is a software system development process that involves use of Computer Aided Software Engineering tools (CASE). It was developed by James Martin in the 1980s as a variant to prototype model.

CASE tools are employed to generate a system prototype to reflect the users' primary needs. The prototype thus produced is iteratively modified to incorporate the new and additional needs of the user. In the process Visual Basic and Delphi can be used as RAD tool. RAD model aims at reducing development time, though sometimes at the expense of generating efficient executable code.

Advantages of RAD Model

- Speed of development is increased greatly through methods including rapid prototyping, virtualization of system related routines, the use of CASE tools, and other techniques.
- Decreased end-user functionality arising from narrower design focus, hence reduced complexity.
- Larger emphasis on simplicity and usability of GUI design.

Disadvantages of RAD Model

- Scalability is reduced as the capabilities are ascertained in the beginning of the development.
- Since a RAD developed system starts as a prototype and evolves into a finished application the final product suffers from reduced features.

- Features also reduce due to deferring the inclusion of the features in later versions in order to finish a release in a short amount of time.

NOTES

Check Your Progress

Fill in the blanks:

1. is the first phase in the development of a new system.
2. The system analyst decides that the requested system is and the management agrees to continue the process.
3. phase involves identification of inputs data, output reports and the procedures to process the data.
4. is sometimes not considered as a phase of SDLC.

23.4 IMPLEMENTATIONS OF MANAGEMENT INFORMATION SYSTEM

Implementation is an important managerial activity related to adoption, management and routinization of an innovation. Implementation is an activity which starts when the system is developed and ready to install in the organization. So implementation is a process of inducting a newly developed Management Information System into the organization for the use by the end user, owners, etc. In the absence of proper implementation even the most sophisticated system will be a failure. Before implementation the designer or the developer has to make an environment to get support from all levels of management or in other words to avoid resistance. The user needs training to learn. So in addition to developing the technical skills, the training should also motivate the users. For implementation process, the system analyst plays the role of a change agent. Basically, the system analyst is the catalyst for the entire change process and he is responsible for ensuring that changes are acceptable to all the persons in the organization. The favourable implementation outcome can be subjected to various factors such as the role of users in the implementation, the extent of management support for the implementation effort, the complexity and level of risk involvement in the implementation activity and the quality of management of the implementation process.

23.5 METHODS OF IMPLEMENTING MANAGEMENT INFORMATION SYSTEM

Once the design of Management Information System is complete, it should be implemented. Implementing a new system requires a conversion from the previous system. Approach to conversion is shown in Fig. 23.4.

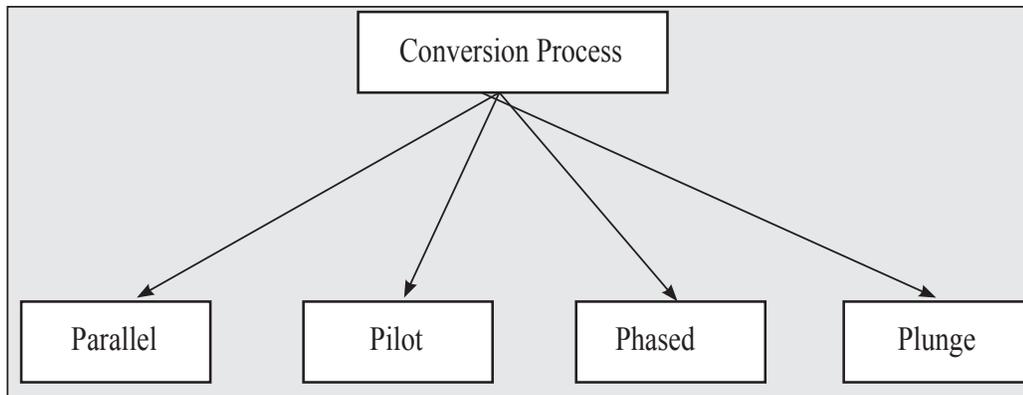


Fig. 23.4: Approaches to Conversion Process

Parallel

When new and old systems run in parallel for a trial period and a comparison of both is done. If the proposed system gives a satisfactory solution to information need, it is accepted and old one becomes obsolete.

Pilot

In this the new system is introduced at one location or site only for trial. If its performance is according to the need it is introduced in whole of the company or organization.

Phased

Introduce the system in phases, i.e., the new system is introduced at one site at a time. This method is useful when upgrading of an old system is being done.

Plunge

It is also known as immediate cut over or change-over. Introduce the new system as and when it is ready to work and remove the old one directly.

Except for the timing and for obvious variations, the implementation steps for all four methods may be covered together.

It should be pointed out that occasionally, design and implementation are carried on simultaneously. Such a process provides operational testing of the design on a continuous basis, but it limits consideration of major design alternatives. It is a trial-and-error process. Completion of conceptual and analytical design in advance of equipment installation offers many advantages besides cost.

So above are the four basic methods of implementing Management Information System in an organization after the completion of the design.

23.6 IMPLEMENTATION STEPS OF MANAGEMENT INFORMATION SYSTEM

NOTES

The implementation of the Management Information System is the culmination of the design process. It is necessary to document the system as installation takes place, so that there will be an up-to-date reference to designs during the designs phase. The final documentation should be complete, formal and accurate version of the Management Information System. The major implementation activities are shown in a flowchart in Fig. 23.5.

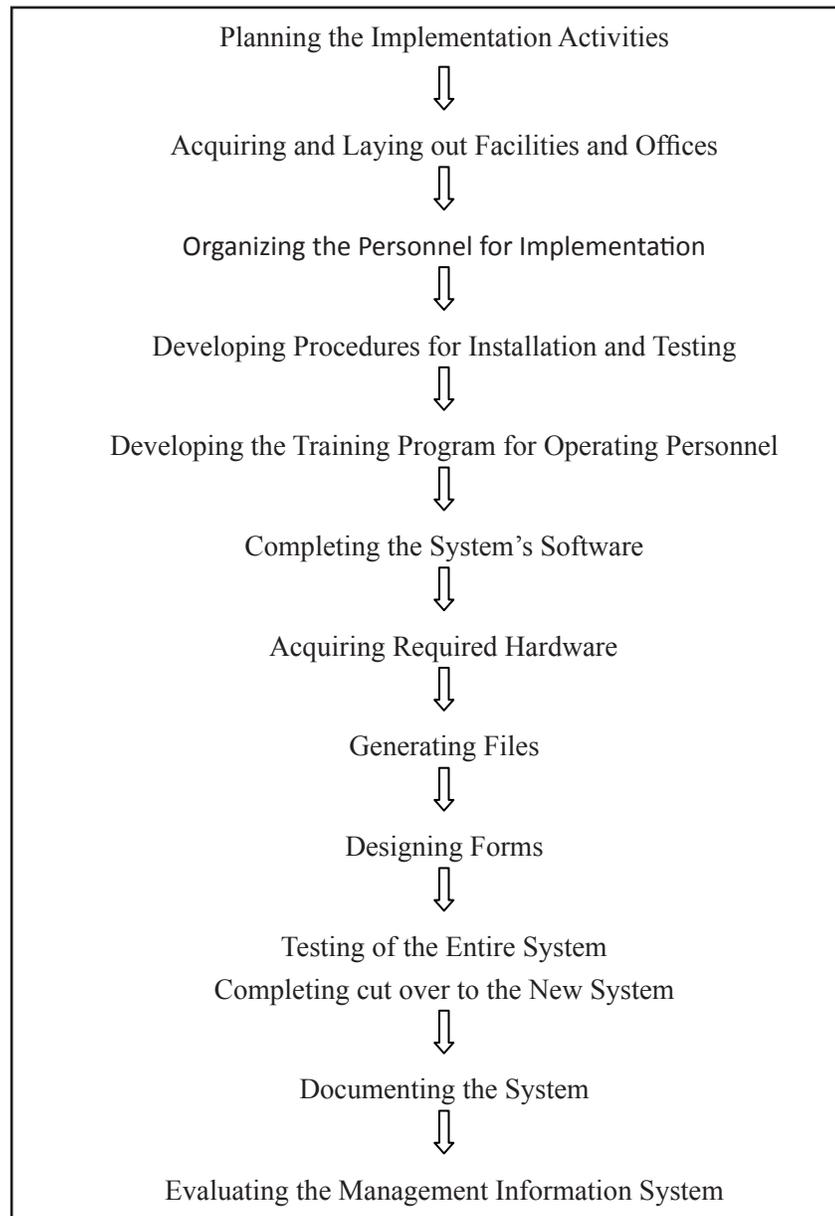


Fig. 23.5: Implementation Process

1. **Planning the Implementation Activities:** The three main phases in implementation take place in series; these are the initial installation; the test of the system as a whole; and the evaluation, maintenance, and control of the system. On the other hand, many implementation activities should be undertaken in parallel to reduce implementation time. The planning and the action to implement the plan should be bound closely together. Planning is the first step of management, not the last one. Further, the Management Information System design and the urgent need for the system at the time the design is complete will weigh heavily on the plan for implementation. And, finally, the planning process is a function of line management, at least as far as key decisions or alternative plans are concerned. The systems analyst may prepare plans to assist managers, but managers must have the last say. At the same time, managers require the services of the systems analyst to make detailed plans. The managers prefer to make decisions based upon the most recent information: the Management Information System specifications, the proposed plans of the systems analyst, and the current operating situation.

2. **Acquiring and Laying out Facilities and Offices:** The Management Information System project managers must prepare the rough layouts of the Management Information System and estimates of particular floor areas he or she feels will be needed. The manager should then prepare cost estimates and submit a proposal for management's approval.

Facilities and space planning should begin as soon as approval of gross space allocations is obtained. The urgency for such planning is twofold. First, there may be a long lead time if new partitions, electrical work, air conditioning, or even new buildings are required. Secondly, the detailed work flow depends upon the physical arrangements of the buildings. The training of operations personnel will be more successful if it is based on exact physical relationships among the people and the equipment.

Space planning must take into account the space occupied by people, by equipment and the movement of people and equipment in the work process. Related to these are the number and kinds of exits; location of utilities, outlets, and controls; environmental requirements for the equipment; safety factors; and working conditions for the personnel. A large investment in good working conditions will repay its cost many times.

3. **Organizing the Personnel for Implementation:** Once the implementation tasks are defined in the planning phase, management usually assigns a project manager to guide the implementation. A manager of management information systems may assume this responsibility by virtue of a permanent assignment. In smaller companies, someone from the finance/accounting department, or even the computer centre manager, may be placed in charge. A project manager, who

NOTES

is responsible for the entire Management Information System development and implementation, usually works best.

The role of a line manager must be made clear. Because the purpose of the Management Information System is to increase the amount and quality of their contributions, the system is really their system. Top management must take explicit steps to make the middle managers aware of this and of the necessity for their involvement in implementation. Essentially, the system specialists are there to assist management with the implementation; they are assigned to the project as needed for this purpose.

Besides assigning responsibilities to the line managers, systems specialists, and computer programmers, top management should make sure that line functional personnel have active parts in the implementation. These are the people who will operate the system, and they also must feel that it is their system.

Proper organization by assignment of specific leadership and task responsibility diffused widely throughout the whole organization can prevent the moans and wails so often heard after a new Management Information System is installed and fails. Mature people respond to work assignments that call for their full talents. They must have a hand in shaping and constructing the system.

4. ***Developing Procedures for Installation and Testing:*** The project leader has the network plan available for proceeding with the implementation. The leader must now call upon key people in the project to prepare more detailed procedures for system installation.

Procedures for evaluating and selecting hardware must be spelled out. Procedures for buying or constructing software should be established. Procedures for phasing in parts of the Management Information System or for operating the Management Information System in parallel must be developed. Obviously there are many procedures that must be delineated in advance if the entire implementation is to be saved from chaos.

It is necessary to develop the testing procedures on the basis of the design and test specifications. The procedures should prescribe:

- (i) Which segments of the system will be tested
- (ii) When such tests are to be performed
- (iii) Test problems to be run
- (iv) Who will perform the tests
- (v) How will the tests be run
- (vi) Who will evaluate the test results and approve the system segment or recommend modification?

5. ***Developing the Training Programme for Operating Personnel:*** A program should be developed to impress upon management and support personnel the nature and goals of the Management Information System and to train operating personnel in their new duties. In the case of management, many of those who participate in the development of the system, two short seminars are usually adequate.

Particular attention should be paid to the training of first-line supervisors. They must have a thorough understanding of what the new Management Information System is like and what it is supposed to do. Because, in essence, they oversee the operation of the system, they must learn how it will operate. They are faced with many changes in their work and they must obtain acceptance of changes from their subordinates.

Certain professional support personnel—such as computer centre personnel, marketing researchers, production planners, and accounting personnel who provide input to the Management Information System or are concerned with processing data and information—should also attend one or several orientation meetings. Because these people will be working with only a small part of the Management Information System, the seminars should be designed to provide them with an understanding of the complete system. This will furnish direction for their own jobs and give them a perspective that may reduce the likelihood of blunders.

Finally, longer and more formal training programs should be established for people who perform the daily operational tasks of the Management Information System. These are the clerks, the computer operators, the input and output machine operators, file maintenance personnel, and possibly printing production and graphic arts personnel.

6. ***Completing the System's Software:*** After developing the training programme for operating personnel, the next step in implementation of Management Information System is completing the system software by the organization. Today many software packages are commercially available. Therefore, for small companies all software might be purchased. In large companies with specialized forecasting, planning, operating, and control models, most software must be developed internally or under contract. In either case, the software development must take into account the nature of the hardware.

Purchase of software packages has a pitfall. Often, so much modification of the software is required to fit the company that it would have been cheaper to have developed the entire software internally.

If the software development route is pursued, an additional set of activities emerges. Systems designers and programmers provide the flow diagrams and the block diagrams during the detailed design stage. Some modification

NOTES

may be required, however, as the implementation stage progresses. In the implementation stage, the coder converts block diagrams into sequences of statements or instructions for the processing (computer) equipment.

7. **Acquiring Required Hardware:** The acquisition of computer system equipment is a complex subject more suitable for a specialized personnel. Basically, the design of the computer system and the architecture available from the vendors are closely tied together. Once a choice of CPU and peripheral equipment is made, a major decision is whether to buy or lease. Capital expenditure analysis is only one of many factors involved in this decision. Others are prestige, usage, anticipated replacement schedule, and vendor's options.

An alternative used by smaller companies is simply to lease computer time from a service bureau.

8. **Generating files:** In the implementation stage, the actual data must be obtained and recorded for the initial testing and operation of the system. This requires a checklist of data, format of data, storage form and format, and remarks to indicate when the data have been stored. The implementation also requires the development of a procedure for updating each piece of the data and for updating entire sections of the file as required. This collection of data used in routine operations is often called the master file.

When data are obtained from the environment—as are economic, competitive, and financial data, or vendor sources—a procedure for obtaining the data may be developed along with the initial acquisition. Responsibility for file maintenance for each file item should also be assigned.

In the detailed design phase, each item of data for the files is specified and the retrieval methods (indexes) are developed. In the implementation stage, forms must be designed so that the data may be analyzed by the programmers and coders for storage in the computer. Thus, the file name, maximum number of characters required to record each data element, frequency of access, volume of operations on the element, retention characteristics, and updating frequency are examples of relevant information required to translate a specification into a file element.

The development of files or databases belongs in the conceptual realm of information system designers and storage and retrieval experts. The translation of specifications for files into computer programs is a function of computer specialists.

9. **Designing Forms:** A vast amount of detailed data, both external and internal to the company, must be collected for input to the Management Information System. If control over marketing is to be exercised or sales forecasting is carried out, then somewhere, everyday, a salesperson must sit in a room and fill out a form summarizing the day's activities. Obviously, the form ensures

that the right information is supplied in a manner that simplifies processing for computer storage.

Forms are required not just for input and output but also for transmitting data at intermediate stages. In a personnel system, input to the computer may consist of all known applicants for all known jobs within a company. The computer may provide sorted output to match jobs and applicants. The personnel recruiting specialist may then have to add a statement of his or her activities—on a form, which is attached to the computer output. The entire package is then forwarded to the manager of personnel.

10. **Testing of the entire System:** As each part of the total system is installed, tests, should be performed in accordance with the tests specifications and procedures. Tests during the installation stage consist of component tests, subsystem tests, and total system acceptance tests. Components may consist of:

- (i) Equipments old or new
- (ii) New forms
- (iii) New software programme
- (iv) New data collection methods
- (v) New work procedures
- (vi) New reporting formats

11. **Completing Cut over to the New system:** Cut over is the point at which the new component replaces the old component or the new system replaces the old system. This usually involves a good deal of last-minute physical transfer of files, rearrangement of office furniture, and movement of work stations and people. Old forms, old files, and old equipment suddenly retire.

The systems designer may observe the cut over and smoothing out of system operations in a short time.

The debugging process associated with the cut over to the new system may extend for several months. Programmes may require improvement, forms may need to be changed for more efficient operation, or employees may desire transfer to different jobs within the system. In particular, the operational testing of the system over a period of several months exposes it to a volume and variability of data and conditions that could not be practically achieved in pre-acceptance testing. Production records such as productive time and non-productive time give indications of future maintenance requirements and idle-time costs.

12. **Documenting the System:** The next step in the implementation is documentation of the system in an organization. The documentation of Management Information System includes preparation of written description of the scope,

NOTES

purpose, information flow components, and operating procedures of the system. It also includes the flowchart and layout charts, desk equipment, forms, output reports and formats, data processing procedures, etc. It also consists of the method for controlling and revising the system.

Documentation is necessary for replacing the sub-systems and evaluating and upgrading the system.

13. ***Evaluating the Management Information System:*** After the documentation of the system, the next step is evaluating the Management Information System. The evaluation should be done for each step of the system. Evaluation should not be delayed beyond the reasonable time of debugging. It should be made by the customers as well as by the designers.

So above are the various steps, which help us in implementation of Management Information System of an organization/company.

23.7 EVALUATION OF MANAGEMENT INFORMATION SYSTEM

After the Management Information System has been operating smoothly for a short period of time, an evaluation of each step in the design and of the final system performance should be made. There is always the pressure to go on to new jobs, but the feedback principle should apply to the work of the Management Information System as well as to the product. Thousands of rupees are invested in the Management Information System, and it is a good business to measure the value of the results.

Evaluation should not be delayed beyond the time when the systems analysts have completed most of the debugging. The longer the delay, the more difficult it will be for the designer to remember the important details.

The evaluation should be made by the customers as well as by the designers though it is less important than the previous evaluations. The financial specialists should evaluate the project in terms of planned cost versus actual cost of design, implementation, and operation. They should also attempt to identify cost savings and increased profits directly attributable to the Management Information System.

A clear-cut method for measuring the costs and benefits of a new Management Information System has not yet been found. We present here a structure that, when adapted to a specific company, will permit partial evaluations.

23.8 STRUCTURE FOR EVALUATION OF MANAGEMENT INFORMATION SYSTEM

The measurement of costs or benefits of Management Information System is the measurement of a change or difference between the old and the new. The measurement

of change must be related to the basic goals of the Management Information System, the principal activities that further these goals, or many minor activities that further these goals. In other, words, we may measure the many changes accomplished throughout the system. The former is obviously the most desirable.

What we have is a hierarchy of levels at which we consider measuring costs and benefits. For a particular Management Information System, the designer may select the levels at which measurement is to take place based upon specific objectives of the total system is attempted at the system level. At the system level, judgment of broad concepts might be taken into account as follows:

1. **System Integrity:** How well are the subsystems integrated into the total system without redundancy? How flexible is the system? How easily may the system be expanded?
2. **Operating Integrity:** How skilled are the people operating the system when backup is there to prevent system breakdown in the event of loss of key personnel or equipment failure?
3. **Internal Integrity:** How well does the system do what it is supposed to do? How valid are system outputs? How secure is the system against human error, manipulation, sabotage, or theft?
4. **Procedural Integrity:** How good is the documentation of the system and procedures? Are procedures such that employees are motivated to follow them? How well are procedures followed in practice? What controls ensure that procedures are followed?

23.9 MAINTENANCE

In the maintenance of Management Information System of organization, control and maintenance of the system are the responsibilities of the managers. Control of the system means the operation of the system as it was designed to operate. Sometimes operators will develop their own private procedures or will short-circuit procedures designed to provide checks. Often people make unauthorized changes to improve the system, changes that are not approved or documented. Managers themselves may not be factoring into decisions information supplied by the system, such as sales forecast or inventory information, and may be relying on intuition. It is upto management at each level in the organization to provide periodic spot-check of the system for control purpose.

Maintenance is closely related to control. Maintenance is the ongoing activity that keeps the Management Information System at the highest levels of effectiveness and efficiency within cost constraints. In other words, maintenance of the Management Information System is directed towards reducing errors due to design, environment

changes, and improving the system's scope and services. These activities are sometimes classified as (1) emergency maintenance, (2) routine maintenance, (3) requests for special (one-time) reports, and (4) systems improvements.

NOTES

Maintenance may be applied to the following activities of Management Information System of an organization.

1. Change in policy statements
2. Change in reports
3. Change in forms
4. Change in procedures
5. System controls and security needs
6. Change in hardware
7. Software addition or modification
8. Change in economic conditions
9. New technology
10. Industry and competitive conditions
11. Change in government policies, regulations, and legislation

Maintenance may be applied to the following activities or entities:

1. **Change in Policy Statements:** Change in policy statements often takes place in the organizations with the passage of time. The manager should change the policy relating of Management Information System according to the different situations, so that there should be proper environment for the maintenance. The change must be made according to the required standard of the organization as there should not be obstacles achieving the goals of the organization.
2. **Change in Reports:** When a manager of an organization replaces an outgoing manager, he should change the reports of the outgoing manager according to his convenience. But before changing the reports, it must be kept in mind that, it should not affect adversely on the maintenance of Management Information System. The change in reports of the outgoing manager must be done with the proper consent of the related staff. There must be regular change in reports of maintenance of Management Information System.
3. **Change in Forms:** For the proper maintenance of Management Information System, there must be change in forms of reports of maintenance of Management Information System. The change in forms is done with the change in environment of the organization, so that the new forms should not be contrary to the existing reports.

4. **Change in Procedures:** The procedures of the maintenance of Management Information System must be changed with the change in form, software and hardware in an organization. The new procedure must be related to the new forms and easily adoptable in new software and hardware. The pros and cons of new procedures must be taken into account before implementing it. The procedures must not be contrary to the goals of the organization.
5. **System Controls and Security Needs:** The system controls and maintenance of the system are the responsibilities of the line manager of an organization. Sometimes, there are unauthorized changes in the existing system for its improvement, which is not accepted in the organizations. Maintenance is closely related to control. It helps in improving the system's scope and services, and reducing the error due to the environment changes. Each system is to be tested in accordance with the test specifications and procedure prevailing in the particular organization. Each new form may be tested relatively independent of the system to which they belong.
6. **Change in Hardware:** There should be proper change in the acquisition of computer system equipment with the passage of time. The design of the computer system and the architecture available from vendors are closely tied together. Once a choice of a new CPU and peripheral equipment has been made, then make a decision whether to buy or lease. The capital expenditure analysis must also be taken into consideration. Other factors like usage, anticipated replacement schedule and vendor's options should also be taken into account.
7. **Software Addition or Modification:** There is a continuous need for change in software packages. There should be proper planning, forecasting, operating, and control models, so that software must be developed internally or under contract. The addition or modification of software must be taken into account depending on the nature of the hardware.

It would have been cheaper to have developed the entire software internally in the organization.

8. **Change in Economic Conditions:** Changes in general economic conditions play a major role in defining financial information systems. If the system is properly designed, it should meet the needs of all users, not just the accounting and finance departments. General economic conditions dictate corporate policy in several areas, and the ability to internalize these changes is an important part of a good systems design. As these changes are only partly predictable, the system should be evaluated periodically to ensure both proper inclusion and measurement of new conditions. Changes in the unemployment rate, both nationally and locally, could affect the direct labour cost and could also affect the time frame for completion of planned projects. Changes in inflation and

NOTES

interest rates have even more far-reaching impacts. A rise in interest rates may hinder customers attempting to obtain short-term credit to purchase a company's product. The same rise in interest rates may stop a company from expanding plant capacity, stockpiling inventories, or replacing and updating fixed assets. This list is not all inclusive, but it should be noted that periodic systems evaluations will help to ensure that these and similar items are included.

9. **New Technology:** The development of computer technology, applications programs, and management techniques have progressed at such a rate as to make farcical the articles of only a few years ago suggesting that total information systems would always be myths. Data communications system interactive systems with video displays, tremendous storage capacities, and higher-speed computers are staggering to old-line managers. This new technology is being introduced and used by different institutions.
10. **Industry and Competitive Conditions:** Change in industrial conditions should be treated in the same manner as changes in economic conditions; however, the timing of reactions of these changes may be more important. The expansion or collapse of a market for a company's products is of such importance that failure to react on a timely basis may mean failure of the business as a whole. Competitive strategies, price policy, hiring, and capital budgeting are but a few of the areas affected by changes in business conditions. New technology, either in production of products or in the creation of alternative products, may affect even the basic concepts that form the corporate objectives.

New standards for measurement such as package sizes or the metric system may have great financial impact. Industry innovations in reporting or gathering data, such as point-of-purchase data collection in retailing and video responses to stock price information in brokerage houses, are other examples. These and the changes cited earlier require anything from routine to major changes in the Management Information System.

11. **Change in Government Policies, Regulations, and Legislation:** Large companies require specialists or lawyers to keep management apprised of the numerous change in reporting requirement, compliance requirements, and pressures for change. For example, banks must be aware of new regulations, maximum interest rates, interest rates established through Federal Reserve activities, minimum down payments required on loans and mortgages, acceptance rules. Manufacturing companies must be aware of change in pension rules, financial disclosure, and so on. Healthcare facilities must be aware of legislation and rulings with regard to state and federal government payments for the elderly, indigent, and so on. In other words there is a continuous flow of rules from government that requires constant updating of the Management Information System in a company.

23.10 PROBLEMS RELATED TO THE MAINTENANCE OF MANAGEMENT INFORMATION SYSTEM

NOTES

Maintenance is the ongoing activity that keeps the Management Information System at the highest levels of effectiveness and efficiency within cost constraints. The problems which can arise in the area of maintenance of Management Information System are as follows:

1. **No Plan for Maintenance:** The first and foremost problem in maintenance of the Management Information System is lack of proper planning. Inadequate planning slows down the work of maintenance. Without proper planning there are a lot of unnecessary events, which increase the total loss of maintenance and ultimately reduces the profit of the organization.
2. **No Process Allocation for Maintenance:** Another major problem relating to maintenance is that there are no resources allocated particularly to the maintenance of Management Information System. So for the regular upkeeping of the Management Information System, one has to depend upon other departments regarding the resources. Without the proper resources allocation, there is always a lack of fund, which ultimately deteriorates the maintenance.
3. **Lack of Management Interest, Understanding and Commitment:** The another area of negligence is lack of management interest, understanding and commitment to the Management Information System department. Due to non-interest of management, they are not interested in the development of Management Information System. They are also not bothered about the various commitments made by them to the Management Information System department. They are least interested about the functioning of Management Information System.
4. **Lack of User Understanding and Cooperation:** The lack of user understanding and cooperation towards the functioning of Management Information System is another problem in the maintenance of Management Information System. Most of the users are not in a position to understand the importance of maintenance of Management Information System, so they pay least attention towards the proper and smooth running of the Management Information System and its timely maintenance.
5. **Lack of Qualified Personnel:** The another problem comes into picture is lack of qualify personnel for the maintenance of Management Information System. The main reason is that, nobody takes the maintenance as a serious problem. Everyone takes it as an ordinary problem. In the case of any breakdown, non-functioning or interruption in the working of Management Information System, the organization has to depend on its unqualified or semiskilled staff or, on

the professionals available in the market, which is a very time consuming and costly method of maintenance.

6. **Inadequate Documentation:** Inadequate documentation is also a very big problem in the maintenance of Management Information System. Due to lack of proper documentation, the maintenance is not done properly and not upto the mark. It effects are on the performance of Management Information System department, which may cause decrease in the overall efficiency of the organization.

23.11 MEASURES TO OVERCOME THESE PROBLEMS

These are some of the problems which are generally faced by maintenance department of Management Information System in an organization. The following measures should be taken to overcome these problems:

1. **Proper Planning for Maintenance:** Maintenance cannot be performed in a haphazard manner, information basis or on a first-come, first-served basis. Four steps are necessary for a good maintenance program:
 - (i) Log all requests for change. Only written requests should be accepted and included in the log.
 - (ii) Assign priorities to all requests. These will be determined by urgency of the project for the Management Information System, long-range benefits, time and resources required, and, in some cases, management dictum.
 - (iii) Prepare annual and short-range (usually monthly) plans.
 - (iv) Document maintenance as it occurs when a project is completed, revise the Management Information System design manual.
2. **Responsibility for Maintenance:** Specific responsibility for maintenance should be assigned to a supervisor and team of Management Information System analysts, programmers, and forms specialists. Fragmentation of responsibility to Management Information System analysts, the computer experts, and the forms coordinator, without at least a unifying committee, can lead to compounding of Management Information System maintenance as primarily computer program maintenance, it is not. The most important maintenance activities may precede, or not even include, program maintenance.
3. **Initiation of Maintenance Projects:** Maintenance activity may be initiated by error reports, a user's change request, a member of the maintenance team, or company management. Usually, specially designed forms for error reports and for change requests must be completed. A barrier to solicit information on errors or for changes is the detail required on the form. It may be more useful to have

a very simple form that calls for only the requests of correction or change and a brief statement of the need. Once a maintenance analyst receives such a form, a more detailed documentation may be filled out after an interview.

4. **Adequate Documentation:** The another measure which should be taken for the proper maintenance is adequate documentation, so that there should be proper and smooth functioning of the Management Information System. Adequate documentation also helps the organization in increasing its efficiency.
5. **Qualified Personnel:** There should be proper qualified personnel for the proper maintenance of Management Information System. With the availability of qualified personnel, the organization need not look here and there for its maintenance of Management Information System and working of the organization is also very smooth and proper. The qualified personnel can immediately remove any problem faced by the Management Information System department.

These are some of the measures that should be taken to overcome the problems faced in the maintenance of Management Information System.

Check Your Progress

State whether the following statements are True or False:

5. Few people can easily develop large software in very short duration of time.
6. Feasibility study begins when the user faces a problem in the current system.
7. The programmers can design data structures before the actual acceptance of the design by the requested department.
8. Implementation is generally considered as the last phase of SDLC.

23.12 SUMMARY

- For development of a large software for any business application, many people are involved and many months or even years are spent. Whether a system is small or large, software development revolves around a life cycle that with the recognition of user's needs and understanding their problem. The various phases involved include feasibility study, system analysis, system design, and development of software, system testing, implementation and maintenance. If the candidate system fails due to any major mistake occurred in any of the development phase, any or all of the phases are needed to be reviewed again, so that the system is completely accepted by the requested department. Implementation is a next stage to design stage which relates to introduce a new system in place of old system. Actually

NOTES

implementing a new system requires conversion from old to new system. For conversion process we have four different approaches such as:

- Pilot
 - Parallel
 - Plunge
 - Phased
- After the introduction and running of the Management Information System in the organization for some time, say for one month or six months, an evaluation of each step in the design and of the final system, performance should be done. Evaluation should not be delayed beyond the time when the system analyst has completed most of the debugging. The evaluation should be made by the customers, managers, end users and employees of the organization.
 - The measurement of cost and benefit of a Management Information System is the measurement of a change or difference between the existing and the new system. The structure for evaluation of Management Information System comprises system integrity, operating integrity, internal integrity and procedural integrity. Maintenance is closely related to control. Maintenance is the ongoing activity that keeps the Management Information System at the highest level of efficiency and effectiveness.

23.13 GLOSSARY

- **System Analysis:** Study of existing system in detail and collecting data in order to find out the requirements of the users.
- **System Design:** Identification of input, output and procedures to process the data.
- **System Testing:** Testing of the whole system with different techniques to ensure that the software is bug free.

23.14 ANSWERS TO CHECK YOUR PROGRESS

1. Feasibility study
2. Feasible, development
3. System design
4. Maintenance
5. False
6. True
7. False
8. True

23.15 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is a computer software system?
2. Define system implementation.
3. What are the seven phases of SDLC? Draw diagram.
4. What is system testing? Why is it required?
5. What will happen if a system fails?

Long Answer Questions

1. Explain system development life cycle of MIS.
2. Discuss various implementation strategies for implementing newly - developed Management Information System.
3. Describe the various phases of software development process.
4. Explain the different approaches of MIS Development.
5. Discuss the various activities of implementation process. Explain them with an example.
6. Define the meaning of evaluation of Management Information System.
7. What type of structure do you use for the evaluation of Management Information System?
8. Is system maintenance necessary? Explain various activities where it may be applied.
9. What are the major problems related to maintenance of Management Information System and how a system analyst overcomes these problems?

23.16 REFERENCES

1. N.D.Birrell and M.A.Ould, *A Practical Handbook for Software Development*, Cambridge University Press
2. Pankaj Jalote, *An Integrated Approach to Software Engineering*, Springer
3. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, McGraw-Hill Professional
4. Peter J. L. Wallis, *The Software Development Process*, Pergamon Infotech
5. Scott E. Donaldson and Stanley G. Siegel, *Successful Software Development*, Prentice Hall

NOTES

UNIT 24: DECISION SUPPORT SYSTEM

NOTES

Structure

- 24.0 Introduction
- 24.1 Unit Objectives
- 24.2 Definition of Decision Support System
- 24.3 Relation of DSS with MIS
 - 24.3.1 Information Support for Decision Making Process
 - 24.3.2 The Functional Support Role
 - 24.3.3 The Decision Support Role
 - 24.3.4 The Communication Decision Support System Role
- 24.4 Evolution of DSS
- 24.5 Characteristics of DSS
- 24.6 Classification of DSS
- 24.7 Objectives
- 24.8 Components
- 24.9 DSS Analysis Techniques
- 24.10 Summary
- 24.11 Glossary
- 24.12 Answers to Check Your Progress
- 24.13 Terminal and Model Questions
- 24.14 References

24.0 INTRODUCTION

Decision support systems (DSS) are interactive software-based systems intended to help managers in decision-making by accessing large volumes of information generated from various related information systems involved in organizational business processes such as office automation system, transaction processing system, etc.

DSS uses the summary information, exceptions, patterns, and trends using the analytical models. A decision support system helps in decision-making but does not necessarily give a decision itself. The decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

24.1 UNIT OBJECTIVES

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

- Define Decision support system
- Discuss the relation of DSS with MIS
- Explain the evolution of DSS
- Describe the characteristics of DSS
- Discuss the classification of DSS
- Explain the objectives of decision support system
- Describe the components of decision support system
- Explain the DSS analysis techniques

NOTES

24.2 DEFINITION OF DECISION SUPPORT SYSTEM

Decision support systems provide solutions to the unstructured problems using simulation techniques and system models. Decision Support Systems (DSS) are a class of computerized information system that support decision-making activities. DSS are interactive computer-based systems and subsystems intended to help decision makers use communications technologies, data, documents, knowledge and/or models to complete decision process tasks.

According to Sprague and Watson (1996) conceptual models or frameworks are crucial to understand a new and/or complex system. They define DSS broadly as an interactive computer based system that helps decision-makers use data and models to solve ill-structured, unstructured or semi-structured problems.

DSS provides varying analysis without much programming effort and is usually directed towards non-technical users/managers. Managers' main uses for a DSS include searching, retrieving and analyzing decision relevant data to allow them to summarize main points which assist them in making more informed and educated decisions. Users often search for correlations between data without rewriting the underlying MIS or software application and most DSS allow graphic capabilities, which not only allow trend analysis and reporting for top executives, but also assist managers in mapping out conjoint analysis and alternative scenarios to answer "what if" queries. Consequently, DSS supports both tactical and strategic decisions and are employed to leverage manager's expertise in a certain field.

24.3 RELATION OF DSS WITH MIS

A properly designed DSS is an interactive software based system intended to help decision makers compile useful information from raw data, documents, personal

knowledge, and/or business models to identify and solve problems and make decisions. The DSS basically helps in the information system in the intelligence phase where the objective is to identify the problem and then go to the design phase for solution. The choice of selection criteria varies from problem to problem.

24.3.1 Information Support for Decision Making Process

Simon's model of decision making proposes three stages in the decision making process. MIS plays its role in all the three stages. Given below is a brief description of these three stages of the decision making process and the role of MIS.

Intelligence Stage: In this stage, an information system may provide information about internal as well as external environments. Internal information is generated from the functional areas, whereas external information is collected from various sources, such as databases, newspapers, government reports, personal contacts, etc. Availability of a large amount of information makes it necessary to scan the environment and data sources to get the relevant information. Thus, information systems can be used to scan the business environment of an organization.

In order to get the required information in the intelligence phase of decision making, MIS must be designed so as to answer pre-specified as well as ad hoc queries (unique, unscheduled, situation specific) made by the decision maker. In other words, information system design may have various models (like historical planning and extra organizational) and a query language capability (decision support system capability).

Design Stage: At this stage, various alternatives are developed and evaluated. In the case of structured decisions, information systems can support by quantifying and automating a decision making process. On the other hand, for semi-structured to unstructured decisions, information systems can support such decision making by providing

1. the ability to make ad hoc queries for information in the organizational databases,
2. the ability to reach a decision in an interactive process (decision support system capability).

Thus, information systems should be designed to incorporate various models of business operations and advanced statistical, optimization techniques, etc., so that these could be used to manipulate information already collected in the intelligence stage to develop and evaluate various alternatives.

Choice Stage: It is the choice stage in which a course of action is selected and feedback is collected on the implemented decision. Information systems can provide summarized and organized information to the decision makers at this stage. Several models may be used to select the most appropriate alternative and thus help decision makers select the best course of action. Information systems can also help the decision maker monitor the successful implementation of a decision by providing feedback.

During the process of decision making chooses to return to any information system. An information system, to support the choice stage of the decision-maker, should have optimization models and suggestion models.

In business, information systems support business processes and operations, decision-making, and competitive strategies.

NOTES

24.3.2 The Functional Support Role

It can also be called Data Base Management System wherein maximum utilization in an efficient manner based on the organizational needs is obtained by analyzing, processing and referencing of Data Base. Not only for the business, but for all kinds of organizations such as Disaster Management Organization for using it as Disaster Management Information System.

Business processes and operations support functions are the most basic. They involve collecting, recording, storing, and basic processing of data. Information systems support business processes and operations by recording and storing accounting records including sales data, purchase data, investment data, and payroll data. Processing such records into financial statements such as income statements, balance sheets, ledgers, and management reports, etc., recording and storing inventory data, work in process data, equipment repair and maintenance data, supply chain data, and other production/operations records processing these operations records into production schedules, production controllers, inventory systems, and production monitoring systems recording and storing such human resource records as personnel data, salary data, and employment histories, recording and storing market data, customer profiles, customer purchase histories, marketing research data, advertising data, and other marketing records processing these marketing records into advertising elasticity reports, marketing plans, and sales activity reports recording and storing business intelligence data, competitor analysis data, industry data, corporate objectives, and other strategic management records processing these strategic management records into industry trends reports, market share reports, mission statements, and portfolio models. The bottom line is that the information systems use all of the above to implement, control, and monitor plans, strategies, tactics, new products, new business models or new business ventures.

24.3.3 The Decision Support Role

The business decision-making support function goes one step further. It becomes an integral part – even a vital part – of decision-making. It allows users to ask very powerful “What if...?” questions: What if we increase the price by 5%? What if we increase price by 10%? What if we decrease price by 5%? What if we increase price by 10% now, then decrease it by 5% in three months? It also allows users to deal with contingencies: If inflation increases by 5% (instead of 2% as we are assuming), then what do we do? What do we do if we are faced with a strike or a new competitive threat? An organization succeeds or fails based on the quality of its decisions. The

enhanced ability to explore “what if” questions is central to analyzing the likely results of possible decisions and choosing those most likely to shape the future as desired. “Business decision-making support function” is a phrase likely to quicken the pulse of no one but an accountant, but, in fact, it is all about turning wonderful dreams into solid realities.

24.3.4 The Communication Decision Support System Role

Information systems can support a company’s competitive positioning. Here are three levels of analysis:

1. The supports for help in piloting the chain of internal value. They are the most recent and the most pragmatic systems within the reach of the manager. They are the solutions to reductions of costs and management of performance. They are typically named “Business Workflow Analysis” (BWA) or of “Business Management Systems p2p”. Tool networks, they ensure control over piloting the set functions of a company. The real-time mastery in the costs of dysfunctions causes distances from accounts, evaluation and accounting that are presented in the evaluation and qualitative reports.
2. All successful companies have one (or two) business functions that they do better than the competition. These are called core competencies. If a company’s core competency gives it a long term advantage in the marketplace, it is referred to as a sustainable competitive advantage. For a core competency to become a sustainable competitive advantage it must be difficult to mimic, unique, sustainable, superior to the competition, and applicable to multiple situations. Other examples of company characteristics that could constitute a sustainable competitive advantage include: superior product quality, extensive distribution contracts, accumulated brand equity and positive company reputation, low cost production techniques, patents and copyrights, government protected monopoly, and superior employees and management team. The list of potential sustainable competitive advantage characteristics is very long. However, some experts hold that in today’s changing and competitive world, no advantage can be sustained in the long run. They argue that the only truly sustainable competitive advantage is to build an organization that is so alert and so agile that it will always be able to find an advantage, no matter what changes occur.
3. Information systems often support and occasionally constitute these competitive advantages. The rapid change has made access to timely and current information critical in a competitive environment. Information systems, like business environmental scanning systems, support almost all sustainable competitive advantages. Occasionally, the information system itself is the competitive advantage. One example is Wal-Mart. They used an extranet to integrate their whole supply chain. This use of information systems gave Sam Walton a

competitive advantage for two decades. Another example is Dell Computer. They used the internet to market custom assembled PC's. Michael Dell is still benefiting from this low-cost promotion and distribution technique. Other examples are eBay, Amazon.com, Federal Express, and Business Workflow Analysis.

NOTES

24.4 EVOLUTION OF DSS

Decision Support Systems have evolved over the past three decades from simple model-oriented systems to advanced multi-function entities. During the 1960's, most Decision Support Systems were fairly based on powerful (and expensive) mainframe computers which provided managers with structured, periodic reports. MIS theory developments during the 1970's saw Decision Support Systems evolve into more elaborate computer-based systems that supported production, promotion, pricing, marketing and some logistical functions. By the early 1980's Decision Support Systems enjoyed more interests from academics and the framework for Decision Support Systems was greatly expanded by the end of the decade. It was only during the 1990's that a paradigm shift occurred in Decision Support Systems and more complex systems, which incorporated, advanced database technology and client/server capabilities, were emerging from many areas in business processes. As many organizations started to upgrade their network infrastructure, object oriented technology and data warehousing started to make its mark on Decision Support Systems. The rapid expansion of the Internet provided additional opportunities for the scope of Decision Support Systems and consequently many new innovative systems such as OLAP and other web-drive systems were developed.

24.5 CHARACTERISTICS OF DSS

The characteristics of DSS are that these are more flexible and adaptable to rapidly changing decision making requirements than other popular management information and reporting systems. The criterion of DSS is to provide managers with a set of capabilities or alternatives which they can sieve out to generate information to enable decisional processes. The characteristics of DSS are:

1. **Identifiable:** DSS may be independent systems that collect or replicate data from other information systems OR subsystems of a larger, more integrated information system.
2. **Repeated Use:** DSS is intended for repeated use. A specific DSS may be used routinely or used as needed for ad hoc decision support tasks.
3. **Ancillary:** DSS can support decision makers at any level in an organization. They are NOT intended to replace decision makers.

NOTES

4. **Interaction:** DSS is computer-based system designed for interactive use by decision makers or staff users who control the sequence of interaction and the operations performed.
5. **Facilitation:** DSS facilitates and supports specific decision-making activities and/or decision processes.
6. **Comprehensive Data Access:** It allows users to access data from different sources concurrently, leaving organizations the freedom to choose the data warehouse that best suits their unique requirements and preferences.
7. **Supports Individual and Group Decision Making:** It provides a single platform that allows all users to access the same information and access the same version of truth, while providing autonomy to individual users and development groups to design reporting content locally.
8. **Decision Impact:** DSS is intended to improve the accuracy, timeliness, quality and overall effectiveness of a specific decision or a set of related decisions.
9. **Task-oriented:** DSS provides specific capabilities that support one or more tasks related to decision-making, including intelligence and data analysis; identification and design of alternatives; choice among alternatives; and decision implementation.
10. **Easy to Develop and Deploy:** DSS delivers an interactive, scalable platform for rapidly developing and deploying projects. Multiple projects can be created within a single shared metadata. Within each project, development teams create a wide variety of re-usable metadata objects.
11. **Integrated Software:** DSS's integrated platform enables administrators and IT professionals to develop data models, perform sophisticated analysis, generate analytical reports, and deliver these reports to end users via different channels (Web, email, file, print and mobile devices).
12. **Flexibility:** DSS features are flexible and can be altered according to need providing a helping hand in the work process.

24.6 CLASSIFICATION OF DSS

DSS has been classified in different ways as the concept matured with time. As and when the full potential and possibilities for the field emerged, different classification systems also emerged. Some of the well known classification models are given below:

According to Donovan and Madnick (1977) DSS can be classified as,

- Institutional-when the DSS supports ongoing and recurring decisions
- Ad hoc-when the DSS supports a one off-kind of decision.

Hackathorn and Keen (1981) classified DSS as,

- Personal DSS
- Group DSS
- Organizational DSS

Alter (1980) opined that decision support systems could be classified into seven types based on their generic nature of operations. He described the seven types as:

- **File Drawer Systems:** This type of DSS primarily provides access to data stores/data related items.
- **Data Analysis Systems:** This type of DSS supports the manipulation of data through the use of specific or generic computerized settings or tools.
- **Analysis Information Systems:** This type of DSS provides access to sets of decision oriented databases and simple small models.
- **Accounting and Financial Models:** This type of DSS can perform ‘what if analysis’ and calculate the outcomes of different decision paths.
- **Representational Models:** This type of DSS can also perform ‘what if analysis’ and calculate the outcomes of different decision paths, based on simulated models.
- **Optimization Models:** This kind of DSS provides solutions through the use of optimization models which have mathematical solutions.
- **Suggestion Models:** This kind of DSS works when the decision to be taken is based on well-structured tasks.

Modern classifications of DSS are:

Model Driven DSS is a DSS that uses a model (quantitative) based on heuristics, optimization, simulation, etc., for deriving solutions to problems. It has access to the models and has flexibility of changing the parameters of the model. Real data or transactional data from databases of TPS is then passed through the model to arrive at the solution. The system is capable of producing different scenarios.

Data Driven DSS is a DSS that gives access to time-series internal data. Data warehouses that have tools that provide facility to manipulate such data are examples of advance systems. Executive Information Systems are examples of data-driven DSS.

Communications-driven DSS is a DSS that uses network and communications technologies to support decision-relevant collaboration and communication. In such systems, communication technologies are the most important component.

Document-driven DSS is a DSS that uses computer storage and processing to provide document retrieval and analysis.

Knowledge-driven DSS is a DSS that collects and stores ‘expertise’ so that it can be used for decision-making when required.

NOTES

Distinction: DSS and Programmed Systems

These are in contrast with programmed decision systems which supplant human decision making rather than supporting human decision making process. The example of programmed decision systems that assist routine structured decisions are re-ordering inventory, triggering reminder notices, selecting audit samples, approving loans, etc. The outputs of DSS are not predefined and therefore cannot be pre-formatted because needs for types of information required for an unstructured problems cannot be exactly determined and are always subject to change. The property of well designed DSS is that it is flexible to generate immediate responses to a variety of disjointed queries with the assistance of inbuilt formulas, functions, sorts, graphs, formal models and other statistical tools.

24.7 OBJECTIVES

There are three decision to be achieved by the decision support system, namely:

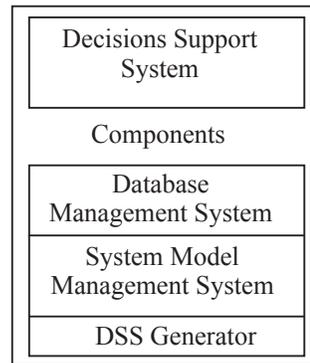
1. Increase the effectiveness of the manager's decision-making process.
2. Supports the manager in the decision-making process but does not replace it.
3. Improve the directors' effectiveness of decision making.

Comparison between Computer Systems and Decision Support Systems: Computer systems are Management Information Systems that are programmed using the computer, to help departments in their daily work and solve recurring problems with the extraction of the required reports and statistics on a regular basis. While decision support systems offer different alternatives to solve new and non-repeated problems (semi-programmed) clarifying the advantages and disadvantages and the financial cost of each alternative, this is done by building separate data warehouses.

24.8 COMPONENTS

The basic components of DSS are not predefined and therefore cannot be pre-formatted because needs for types of information required for an unstructured problem cannot be exactly determined and are always subject to change. The property of well designed DSS is that it is flexible. To generate an effective computerized DSS, the DSS generator, the model management system, the database management system and the dialogue management system are used. The DSS generator is the software used to develop DSS and coordinate its processing tasks. The model management system enables the creation, maintenance and application of quantitative and statistical prototypes or models to manipulate the DSS data as per the needs of the decision maker. The database management system enables the decision maker to create,

maintain and query DSS database by the processes of retrieval, data reconfiguration (sorting, exchanging columns and joining data, graphical presentations), selection and projection tasks. The dialogue management provides user interfaces such as window based pull down menus and screen formats that support flexible and interactive outputs (Refer Figure 24.1).



24.9 DSS ANALYSIS TECHNIQUES

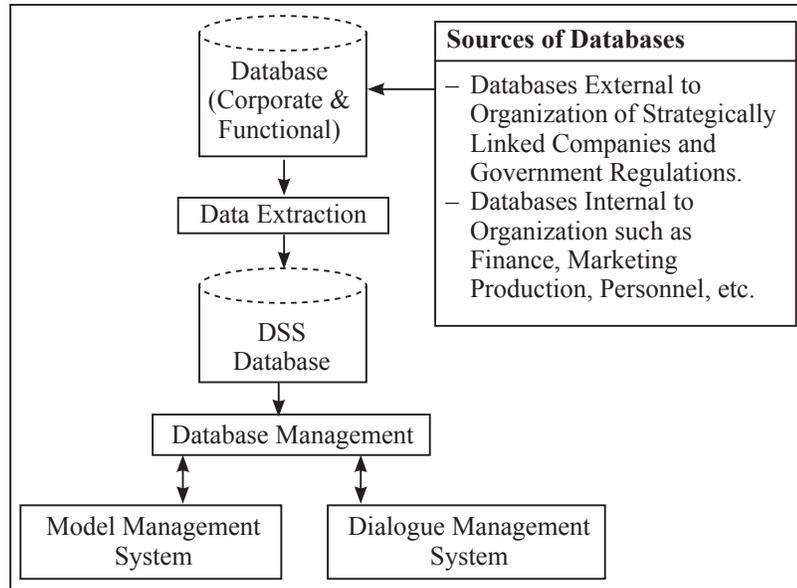
The fundamental DSS analysis techniques are implemented through the use of statistical tools, optimizing tools, what if analysis and artificial intelligence routines.

Statistical Tools

Enable

- Data handling tasks such as sorting and distributing data on the criterion used by a decision maker;
- Automated regression analysis used to discern trends for relevant predictions;
- Automated correlation analysis used to determine strength of association among number of variables;
- Analysis of variance (ANOVA) used to show whether the groupings of observations are statistically significant;
- Non-parametric statistics used for samples of data where underline probability distribution is not determinable ;
- Cluster analysis used for classification of observations into groups such that similarities within groups are minimized;
- Factor analysis used to reduce a large number of variables into smaller number of factors retaining the crux of information;
- Forecasting prediction for future derived from the statistical inferences from most of the analysis techniques defined above.

NOTES



Important optimizing tools have already been discussed under the purview of operational research systems. These recommend certain choices to the decision maker and generate an assortment of predictive information and optimizing techniques.

What if Analysis or Sensitivity Analysis

What if analysis or sensitivity analysis is a non-probabilistic simulation technique that enables the decision maker to reformulate a problem repeatedly until feasible, concrete and viable information is arrived at.

Decision maker can utilize a popular DSS generator Execucom IFPS (Integrated Financial Modeling System)/Plus to set more than one set of estimates to forecast optimum success rate in launch of new product or diversification of business group into new ventures of business by use of what if analysis.

The basis of calculation is based on prudent questions such as:

- What if debt to equity ratio is maintained at 20 per cent too high for the new business?
- What if sales projections are set 5 per cent too low?
- Spreadsheets are also suited for what if analysis. Decision maker can continue to vary the underlying assumptions and use this interactive session to arrive at certain concrete strategic decisions.

Role of Artificial Intelligence and Expert Systems in DSS

The role of AI routines or expert systems in decision support is significant as these systems pinpoint why the business lapse or deviation in anticipated results occurred after inspecting the actual results in comparison to forecasts through knowledge based attributes. For instance the intelligent DSS can suggest that the net profits for a particular period decreased owing to an abnormal increase in price of raw materials

or mismanagement of cash handling or inappropriate tax planning. DSS generator IFPS/plus is endowed with such Artificial intelligence routine features.

Group Decision Support Systems and Executive Information System

Of late, GDSS (Group Decision Support Systems) and EIS (Executive Information System) are gaining rapid popularity. GDSS involve group members geographically dispersed to interact with decision support system as well as communicate with one another under Local Area Network or Wide Area Network of computer system, videoconferencing and e-mail and work simultaneously to concretely arrive at the best decisions. EIS is designed to support top level managers to review decisions and use heuristic approach to arrive at the best decision and disseminate the set of top level decisions for strategic planning and implementation with appropriate comments through e-mail. Commander EIS (from Comshare Inc.), Executive Edge (from Execucom System Co.) and Express EIS (from Information resources Inc.) are some of the specialized EIS software packages popular worldwide.

NOTES

Check Your Progress

Fill in the blanks:

1. In, an information system may provide information about internal as well as external environments.
2. As, various alternatives are developed and evaluated.
3. It is the choice stage in which a course of action is selected and feedback is collected on the
4. The characteristics of DSS are that these are more and to rapidly changing decision making requirements than other popular management information and reporting systems.
5. tasks such as sorting and distributing data on the criterion are used by a decision maker.
6. statistics is used for samples of data where underline probability distribution is not determinable.
7. used to reduce a large number of variables into smaller number of factors retaining the crux of information.
8. Programmed decision systems assist routine decisions.

24.10 SUMMARY

- Decision support systems (DSS) are interactive software-based systems intended to help managers in decision-making by accessing large volumes

NOTES

of information generated from various related information systems involved in organizational business processes such as office automation system, transaction processing system, etc.

- DSS uses the summary information, exceptions, patterns, and trends using the analytical models. A decision support system helps in decision-making but does not necessarily give a decision itself. The decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.
- Decision support system provides solutions to the unstructured problems using simulation techniques and system models. Decision Support System (DSS) is a class of computerized information system that support decision-making activities. DSS is an interactive computer-based system and subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to complete decision process tasks.
- A properly designed DSS is an interactive software based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions. The DSS basically helps in the information system in the intelligence phase where the objective is to identify the problem and then go to the design phase for solution. The choice of selection criteria varies from problem to problem.

24.11 GLOSSARY

- **Decision Support System:** Provides solutions to the unstructured problems using simulation techniques and system models.
- **Unstructured Decisions:** Decisions which are not well-defined and have no pre-specified procedure.
- **Intelligence Stage:** An information system may provide information about internal as well as external environments.

24.12 ANSWERS TO CHECK YOUR PROGRESS

1. Intelligence stage
2. Design stage
3. implemented decision
4. flexible; adaptable
5. Data handling

6. Non parametric
7. Factor analysis
8. structured

NOTES

24.13 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. Define Decision support system.
2. What are the Characteristics of DSS?
3. List the Objectives of decision support system
4. What are the Components of decision support system?
5. What do you mean by DSS Analysis Techniques?

Long Answer Questions

1. Describe the characteristics of a Decision Support System.
2. Discuss the relation of DSS with MIS
3. Explain the evolution of DSS.
4. What are the components of a Decision Support System?
5. Discuss the various classifications of DSS.
6. Distinguish with examples: Decision Support System and Programmed System.
7. Discuss important DSS analysis techniques.
8. Discuss role of AI and Expert Systems in DSS.

24.14 REFERENCES

1. Amrit Tiwana, *The Essential Guide to Knowledge Management*, Pearson Education, 2001
2. Ratnaja Gogula, *Knowledge Management – A New Dawn*, ICFAI, 2002
3. Gordon B. Davis, Margrethe H. Olson, *Management Information Systems: Conceptual Foundations, Structure and Development*, 2nd Edition, Tata McGraw Hill International Book Company, 2000
4. E. Wainright Martin, Carol V. Brown, Danial W. DeHayes, Jeffrey A. Hoffer, Williams C. Perkins, *Management Information Technology*, 3rd Edition, Prentice Hall International Edition, 1999
5. Harold Koontz, Heinz Weihrich, *Essentials of Management*, 5th Edition, Tata McGraw Hill, 1998

UNIT 25: MANAGEMENT INFORMATION SYSTEM – PROBLEMS AND SUGGESTIONS

Structure

- 25.0 Introduction
- 25.1 Unit Objectives
- 25.2 Problem in Developing MIS
- 25.3 Problems and Solutions in Implementing Management Information System
- 25.4 Inference
- 25.5 Role of MIS
- 25.6 Components of a Good MIS Solution
- 25.7 Functionality and Expandability
- 25.8 Flexibility
- 25.9 Usability
- 25.10 Reports
- 25.11 Standards and Compliance
- 25.12 Administration and Support
- 25.13 Technical Specifications and Correctness
- 25.14 Cost
- 25.15 Summary
- 25.16 Glossary
- 25.18 Answers to Check Your Progress
- 25.19 Terminal and Model Questions
- 25.20 References

25.0 INTRODUCTION

Management Information System (MIS) can be defined as collecting and processing of raw data into useful information and its dissemination to the user in the required format. It consists of information, which impacts managements to feel the pulse of the organization and take decisions accordingly. In fact a full MIS consists of all the systems that the institution uses too generate the information that guide management's decisions and actions.

Microfinance Institutions (MFI'S), over the past few years, have been paying increasing attention to information systems. They are increasingly realizing that information lies at the very heart of microfinance. The practitioners as well as donors have become aware of the vital need for formal and informal financial institutions to manage large amounts of data. As a result, there is a massive drive to improve the effective understanding and use of these data. Needless to say that it is not possible to collect and collate large volumes of data without adopting new technology. As a result the MFIs are watching the developments in information technology very closely.

25.1 UNIT OBJECTIVES

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

- Explain the problem in developing MIS
- Discuss the component of the good MIS solution
- Describe the problems and solutions in implementing management information system

25.2 PROBLEM IN DEVELOPING MIS

Despite the availability of technology, today there is a problem in developing a good and problem free MIS software for the MFIs. The diverse nature of microfinance creates an intriguing complexity for software application development. Some of the complexities in developing a single or a small number of software to meet the needs of the MFIs are discussed below.

1. **Many Institutional Models:** The organizational forms is a function of the specific of social, political, economics, regulatory and legal environments throughout the world. There are a variety of organizational forms that are assumed by the MFIs for carrying on their work. The MFIs can be in the form of credit union, cooperatives, Non governmental Organizations (NGO) and even banks. All have their own varied type of requirement for MIS and its automation.
2. **Different Lending Methodologies:** MFIs have vast different lending methodologies across the globe and even within the same country. Some MFIs follow individual lending some follow village banking methodology and yet others might be following solidarity group lending . In India, for example, some MFIs follow the e Grameen Model as per the example of the Grameen Bank, Bangladesh while other follow Self Help Group Model as propagated by the institutions like National Bank for Agriculture and Rural development (NABARD).

3. **Methodology on Interest Payment:** The practices for calculating interest and the periodicity for its payment vary according to the product and organization. These variations can occur even within the same organization depending on the product and the area of operation.
4. **Other varied requirements:** There are variations in terms of the currencies languages and reporting requirements of the MFIs.

25.3 PROBLEMS AND SOLUTIONS IN IMPLEMENTING MANAGEMENT INFORMATION SYSTEM

In the previous section, certain prerequisites of an effective Management Information System are mentioned. But there are certain problems, challenges and constraints for which we are suggesting possible solutions. Some of them are as follows:

1. **Non-availability of experts:** This is the main challenge before the planner of Management Information System that it is difficult to find experts who can determine the basic objective of the organization expected to result from a Management Information System and then implement them to produce an effective Management Information System. But this problem can be solved by providing necessary training to the existing staff or by proper selection of new entrants in the organization.
2. **Selection of sub-systems:** Experts face the problem of how to select the sub-system of Management Information System to be installed and operated upon. For this, the experts must see what is the need and importance of a function for which Management Information System has to be installed in the organization for the first time.
3. **Non-standardized system:** Because of the different objectives of business organization, the approach adopted by experts for designing and implementing Management Information System is a non-standardized one. To deal with this problem nothing can be done at the initial stage but as time passes the standardization may be arrived for the organization in the same industry.
4. **Non-cooperation from staff:** This is the most critical problem in implementing a Management Information System effectively in the organization. The fears of retrenchment, exposure before subordinates are some of the main reasons of this non-cooperation. However, this can be handled by proper education, giving lectures, communicating with them about the benefits of the system and also by involving some of the middle level managers in the process of development and implementation.
5. **High turnover of experts:** High turnover among the experts is a major challenge. There are many attractive reasons like high pay packets, promotion, future

prospects, behaviour of top linking managers, etc. Organizations retain them by providing better working conditions and paying at par with other similar concerns.

6. **Difficulty in quantifying the benefits:** Management Information System is basically a service and to quantify the benefits of a service is very difficult. It is difficult to quantify the benefits and also compare them with the cost of achieving these benefits. So the people who want to introduce Management Information System concept has to face the questions by different managers about its utility in the organization. Although we cannot quantify the benefits but one thing we should keep in mind is that Management Information System is a tool which is essential to fight out competition and the state of uncertainty that surrounds the business organization these days.

NOTES

25.4 INFERENCE

All these wide variations complicate the development of software that can be picked off the shelf and implemented in most of the MFIs. It creates great burden on software companies creating quality application that is affordable and meets all the requirements of the MFIs. In fact this is the major problem faced by those responsible for providing automation in the industry.

The need of technology cannot be overstated but the complexity and diversity forces one to take a hand look at the following:

1. What is the role of MIS in improving the sustainability of MFIs?
2. What are the basic components of sound microfinance packages for MFIs?
3. Why are there so few solutions available?

25.5 ROLE OF MIS

25.5.1 Sustainability

Let us look at what does the MIS do for the sustainability of MFIs?

The answer is Nothing., MIS will not do much for the sustainability of microfinance if institutions ignore good business practices. The following are some of the widely stipulated best business practices :

1. Focus on profitability
2. Quality loans
3. Provision for loan loss reserve

4. Community accepted and appropriate accounting procedures
5. Gathering and reporting of accurate and timely information.

NOTES

These good business practices should be in place before any MFI even thinks about MIS software. Without quality business practices, MIS will do little if anything to sustain these institutions. In fact, MIS can complicate the situation by creating a financial drain and propagating but allows you to do bad business more efficiently. If, however, the MFIs follow good business practices, MIS will go a long way in sustaining these institutions. Some examples of what MIS can do for good MFIs are:

1. Increased productivity and efficiency
2. Lower transaction cost per loan
3. Greater outreach in rural and urban areas
4. Faster delivery of more products and services
5. More accurate and timely reporting
6. Better decision making

25.5.2 Uses of MIS

1. Since it can be programmed to follow business rules uniformly, MIS reinforces discipline in accounting and portfolio tracking.
2. Computers can link all data pertaining to a customer or customer group hence MIS can provide a consolidated view of each customer or group.
3. MIS allow for single entry of data that can then be used by many people. Data once entered can be accessed, manipulated and used by all users. Thus MIS reduces duplication of effort and increases speed of work.
4. MIS integrates information and process.
5. MIS supports workflow and procedures for users.
6. MIS can be ported to remote areas via laptop or palm technology.
7. MIS application can be customized or enhanced to support new products and institutional growth.

25.6 COMPONENTS OF A GOOD MIS SOLUTION

The catch is that most MIS solutions provide only some of the functionality and capabilities needed for sustainability and outreach.

This can be better understood by knowing the components of a good MIS solution.

They can be organized under the following categories:

1. Functionally and Expandability
2. Flexibility
3. Usability
4. Reporting
5. Standards and Compliance
6. Technical Specification and Correctness
7. Cost

NOTES

25.7 FUNCTIONALITY AND EXPANDABILITY

The MIS solution for the MFIs should have some sort of functional completeness and integration. The areas that must be covered by the solution should be:

1. **Accounting packages:** The solution should have an accounting component wherein the data can be captured regarding the financial transactions of the MFI.
2. **Portfolio tracking:** The solution should have a module for entering the details of the various products of the MFI and its linking individual borrower-wise in order to enable the organization to track its loan portfolio and product mix.
3. **Deposit Monitoring:** The solution should have the data about the depositors of the MFIs wherein tracking could be done individually unit wise depending on the practice being followed by the MFI. In case it is accepting deposits from the individuals then it should be capable of handling data individual borrower-wise or in case it is accepting deposits from the groups then it should be capable of handling data groupwise.
4. **Customer Information Systems:** The software should be capable of capturing non- financial data about the customer also. e.g. The software should be able to capture the details like name, address, family history and other demographic information which is needed to maintain proper records and identifying the customer.

The software should be capable of handling large volumes of data so that it is to handle the growing needs of the organization. In fact the software should be capable of growing with the organization. This is critical as MFIs can grow very fast.

NOTES

25.8 FLEXIBILITY

MIS can be built around Accounts or around Customer. In modern financial software's it is much more preferable to have a Customer centric design as the MFIs need to be as much customer focussed as possible in order to sustain themselves. In such a design the information regarding a customer or group is easily accessible.

Secondly, the software should be parameter driven i.e. it should allow the user to put in business rules for the MIS. It should also be able to accept new products and customers.

Thirdly, the solutions should be able to handle multiple institution types. It should not be limited to one type of institutional model as diversity is the hallmark of MFIs. The solution should be capable of being implemented in a variety of organizational forms. Further, it should also be able to deal with variety of organizational structure like single unit or multi branch structures.

Fourthly, since the MFIs have a variety of lending methodologies hence the software should not restrict itself to one or two types of methodologies, as that will limit its acceptability with the clients.

Fifthly, the software should be able to handle various interest rates of loans and deposit products. It should be able to make accurate calculations of interest and repayments based on these interest rates. It should be able to handle various payment types and frequencies based on the customer. This is important because MFIs can have a variety of repayment facilities for different customers. The software should be able to handle various types of customer accounts. As discussed earlier, the MFIs operate in diverse environments hence the software should be able to handle multiple languages and currencies.

25.9 USABILITY

The success of the software depends, more than anything else, on its deployment and adaptability at the user's end. Since most of the MFIs do not have a specialized MIS department or computer professionals, the MIS software should be user friendly. To begin with the software one should have a familiar and friendly user interface. The software should be window based as that is the most popular operating system in today's world.

The display on the screen should be logical. there should be consistency in terms of language format and functions. The data entry should be easy and straightforward for the user to understand.

The software vendor should provide some amount of training while implementing the software. User documentation and on-line help should be provided in order to enable the MFIs to maintain continuity at its level in case of employee turnover or

when some new problem creeps up. The software should as far as possible facilitate straightforward workflow and not create unnecessary complications. In case software requires any MFIs change too much in terms of its workflow then it will probably not be used.

25.10 REPORTS

The reports required by any MFIs can be classified into 4 categories, viz.

1. **General Reports:** By general reports we mean reports like the performance on the budgetary front like comparative report on actual expenses vis-à-vis the budgeted expense or say report on consolidated performance of the MFI.
2. **Management Reports:** These are the types of reports that are generally for the usage of management for decision making and monitoring the performance of the MFIs, e.g., report providing the statistical summary about the MFI, statement of cash flows, delinquencies, etc.
3. **Financial Reports:** These are the standard reports about the financial transactions by the MFIs, e.g., trial balance, daily transactions, audit reports, etc.
4. **Customer Reports:** These are customer specific reports, e.g., account statement, balance inquiries, etc..

The software should have the capabilities for generation and linking of these reports automatically. Most software's do contain a host of predefined reports.

Depending on the nature of work and the organizational structure, different MFIs have different modes and timings for generation of reports. Hence, the system should be capable of generating the reports online or in batch mode on real time or set schedule basis. The software should have the flexibility of generating ad hoc, i.e., user defined reports in addition to the predefined reports. To facilitate meaningful inquiry into the database the software should also provide for some tool based report generation capability.

25.11 STANDARDS AND COMPLIANCE

The software should have been built on the foundation of sound accounting practices as accepted by the environment in which the MFI is operating. Some of the desirable features of the accounting soundness of the software could be:

1. It should comply with the Generally Accepted Accounting Principles (GAAP) or International Accounting Standards (IAS) and the local requirements.
2. It should provide for the real time or batch mode updating of the ledgers as per the convenience of the MFI.

NOTES

3. It should also provide partial posting of the entries in order to allow for distribution of the work of data entry.
4. It should have the capability for categorizing the loan given by the MFIs. For e.g. it should be able to categorize a certain loan into current or delinquent so as to curb operation on the delinquent accounts.
5. The software should be capable of maintaining the accounts either on cash or accrual basis as per the practice followed by the MFI.
6. It should be capable of calculating the interest automatically as per the practice followed by the MFI. Interest may be calculated on the basis of current payment, late payment deposit or loan accounts etc.

In addition to the sound accounting practices, the software should also be able to meet the regulatory norms applicable on the MFI. These regulatory norms can be from the side of donor or local authorities. The software should have the facility for modifying old norms and adding new ones as and when required e.g. the software should be capable of accepting changes in the tax rates as applicable. The software should be especially complaint to the regulations of Central Bank of the country and should be able to generate the required reports for submission to the Central Bank.

The software should preferably be also integrated with external entities, e.g. in future we may see the development of a national payment system. This is especially useful, as several times the person in the MFI will ensure that the MFIs does not violate any such requirement inadvertently.

25.12 ADMINISTRATION AND SUPPORT

There are many administrative and support issues that make or mark the success of software in any organization. Some of them are discussed here under.

1. **Security:** Since the database is the heart and soul of the MIS, the software should be capable of restricting access to it by login id, etc. It should have in built safeguards to restrict access to the database, restrict its modification and manipulation by unauthorized users, it should also be adequately protected against virus attack.
2. **Backup and Recovery:** The system should have the feature for the user to take a regular backup. The system should have the feature of enabling full or incremental backup so that the user is adequately protected against system failure or sabotage. In case of a failure, the system should be able to restore transactions, balances and statements, etc. from the data backed up by the user. In short it should be easy for the user to restart the system accurately from the stored data.
3. **Fault tolerance:** The system should be tolerant to the glitches like unreliable power supply that occur during the course of operation. It should continue to

function and notify the user during problem periods. In case of total failure the system should be able to restart accurately when the problem has been resolved.

4. **Period processing:** The software should be capable of handling the data in terms of fixed period of operation, for e.g. one financial year or quarter, etc it should be able to relate the data to the multiple periods as reporting may be required to be done for various periods, it should accurately and automatically post the calculations at the end of the period with minimum human intervention.
5. **Support Infrastructure and Maintenance:** The support infrastructure and maintenance service should be available. They need to be accessible to the user and should be provided timely in order to keep the system running at peak efficiency at all times.
6. **Versions and Upgrades:** No software can be such that it needs no upgrades in future. Hence the MIS software should be upgraded and new functionalities should be added to it as the organization and its needs grow. It is preferable that the new functions should be added as per pre- determined schedule as it helps in managing the cost of the upgrades.

25.13 TECHNICAL SPECIFICATIONS AND CORRECTNESS

1. **Technical and Architecture:** The software should be built on the platform of a sturdy relational database as they provide the facility of making customized queries to database by the user. A host of database under this category are available in the market today, e.g. Oracle Paradox, etc. The programming language should be current robust and modern e.g. C, C++, Java etc. so that the software is stable despite unreliable infrastructure.
2. **Performance:** The software should be capable of supporting multiple simultaneous users without compromising the performance in terms of speed. System should also not slow down as the database grows in size. The user should get fast response time from the interface and the reports should be generated quickly so that the user does not have to wait for inordinately long time to get the job done.

25.14 COST

The price and cost of software can be argued from the point of view of value to the institution. The price of the software should be commensurate to the level of complexity or functionality. The price should be such that the MFI gets a high return on investment. The cost of the software may be worked out in terms of the cost per

NOTES

user or cost per customer such that its ownership represents value to the institution. For e.g. if it costs an MFI \$ 14 per loan account and it has 50000 customer then an expenditure of \$ 1 per customer i.e. total \$ 50000 spent on IT will not be a very big expenditure for it.

Why So Few Solutions?

Despite the popularity of MFIs and the acknowledged need of good MIS solutions there are very few of them available in the market. The primary reason for this poor availability is money. There is little financial incentive for software companies to develop microfinance solutions for two primary reasons. One is the diversity and complexity across institution and countries in term or organizational form, lending methodologies, legal and regular environments, currency and language. Second is a lack of ability or willingness to pay for robust solutions by the MFIs.

Due to poor financial position of the majority of the MFIs, they are not able to pay for robust solutions. This makes it unattractive for the software companies to enter in this market. It is economics more than anything else.

What Should We Do?

Thus, what can be done to improve the situation? In a nutshell, the following could be the possible course of action.

1. ***Good Business Practices:*** The MFIs should first focus on building good microfinance practices as only they can sustain the MFI. This is the most important prerequisite for the future of the MFIs and the success of MIS in them.
2. ***Strategies with Information Technology:*** The organizing should elevate its view on Information Technology to a strategic level.

Information Technology should be woven in the organizational operation and decision-making process in such a manner so that it becomes a core competency of the organization.

3. ***Value based approach:*** The MFIs should take a value- based approach to MIS solution not a cost or price approach. They should see the expenditure in Information Technology as an investment and not expense.
4. ***95% rule:*** Instead of trying to get or build a software which caters to the 100% needs of the MFI they should take a software which will satisfy 95% of the needs for the simple reason that organizations spend most of the money in getting that additional 5% functionally.
5. ***Buy high quality software:*** The MFIs should resist from buying poor quality software as they may ultimately lead to heavy losses in terms of data and time. Hence, it is advisable that MFIs should buy only high quality and stable software solutions.

6. **Customization:** The MFIs should try to manage as far as possible with the features provided in the software. They should customize only when absolutely necessary, as it is costly every time one tries to modify the programme code.
7. **Avoid Internal Development:** Unlike the popular perception it is not a good idea to try and develop the solution internally. This is so because, one, the MFI will not have as qualified developers as a software company and, two they may use their valuable human resources more profitable else where.

NOTES

Check Your Progress

Fill in the blanks:

1. The solution should have an accounting component wherein the data can be captured regarding theof the MFI.
2. The MIS software should be..... and new functionalities should be added to it as the organization and its needs grow.
3. software should be able to capture the details like name, address, family history and other demographic information which is needed to maintain proper records and identifying the customer.

25.15 SUMMARY

- A Management Information System is an information system that evaluates, analyzes data and also ease the operation of organization.
- Accounting packages solution should have an accounting component wherein the data can be captured regarding the financial transactions of the MFI.
- The solution should have a module for entering the details of the various products of the MFI and its linking individual borrowerwise in order to enable the organization to track its loan portfolio and product mix.
- The solution should have the data about the depositors of the MFIs wherein tracking could be done individual unit wise depending of the practice being followed by the MFI. In case it is accepting deposits from the individuals then it should be capable of handling data individual borrower – wise or in case it is accepting deposits from the groups then it should be capable of handling data groupwise.
- Customer Information Systems software should be capable of capturing non- financial data about the customer also. e.g. The software should be

NOTES

able to capture the details like name, address, family history and other demographic information which is needed to maintain proper records and identifying the customer.

- The software should be capable of handling large volumes of data so that it is to handle the growing needs of the organization. In fact the software should be capable of growing with the organization. This is critical as MFIs can grow very fast.
- The software should be capable of handling the data in terms of fixed period of operation, for e.g. one financial year or quarter, etc it should be able to relate the data to the multiple periods as reporting may be required to be done for various periods, it should accurately and automatically post the calculations at the end of the period with minimum human intervention.

25.16 GLOSSARY

- **Strategies:** A strategy is a general direction in which an objective is to be sought.
- **Management Information System:** A Management information system, or MIS, broadly refers to a computer-based system that provides managers with the tools to organize, evaluate and efficiently manage departments within an organization.

25.17 ANSWERS TO CHECK YOUR PROGRESS

1. financial transactions
2. upgraded
3. Customer Information Systems

25.18 TERMINAL AND MODEL QUESTIONS

Short Answer Questions

1. What is the role of MIS?
2. What are the Components of a Good MIS Solution?
3. Discuss the Functionality and Expandability.
4. Define flexibility and usability in terms of MIS.

Long Answer Questions

1. Explain the problem in developing MIS.
2. Discuss the component of the good MIS solution.
3. Describe the problems and solutions in implementing management information system.

NOTES

25.19 REFERENCES

1. Amrit Tiwana, *The Essential Guide to Knowledge Management*, Pearson Education, 2001
2. Ratnaja Gogula, *Knowledge Management – A New Dawn*, ICFAI, 2002
3. Gordon B. Davis and Margrethe H. Olson, *Management Information Systems: Conceptual foundations, Structure and Development*, 2nd Edition, Tata McGraw Hill International Book Company, 2000
4. John Cann., Microfinance Institutions issues in Sustainability: Chapter on Management Information System: Issues and Challenges
5. Ramesh Arunachalam, Design and Implementation of MIS in MFIs
6. E. Wainright Martin, Carol V. Brown, Danial W. DeHayes, Jeffrey A. Hoffer and Williams C. Perkins, *Management Information Technology*, 3rd Edition, Prentice Hall International Edition, 1999
7. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 5th Edition, Tata McGraw Hill, 1999