

Open Vocational Education Program

COMPUTER HARDWARE ASSEMBLY AND MAINTENANCE

JOB ROLE

FIELD TECHNICIAN - (COMPUTING AND PERIPHERALS)

NSQF Compliant Level 4



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A Word With You

Dear Learner,

Congratulations for having chosen this course. This course is National Skill Qualification Framework (NSQF) compliant level 4 of the Job Role: Field Technician (Computing and Peripherals).

This course is specially designed keeping in your needs and level in mind. We have ensured that the course contents are presented in a simple, clear and logical manner. We expect you that as a Field Technician or Service Technician you would be able to diagnose the problem in Computer and troubleshoot Computer, attend to customer complaints, install newly purchased products, and configure peripherals such as printers, scanners and network devices.

We are confident that you will enjoy studying this course through Open and Distance learning system. I hope you will find this book informative, interesting and useful.

We wish you all the very best for a bright and successful future.

NIOS Course Team

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SYLLABUS

➤ **Introduction to Computers**

- Functions of Computer
- Characteristics of a Computer
- Computer Generations
- Types of Computers
- Applications of Computers

➤ **Computer Components**

- Block Diagram of a Computer
- Input Devices
- Output Devices
- Computer Memory
- Computer Software

➤ **Data representation in the Computer**

- Data Representation
- Number System
- Character Representation

➤ **Anatomy of a Computer System**

- Components of Computer System
- Memory and Its Types
- Mother board
- Clock Chip and CMOS battery
- Power Supply – SMPS, POWER connectors

➤ **Tools for Assembling Computer**

- Tools
- Precautionary measures

➤ **Assembling a Personal Computer**

- Assembling (step- wise procedure)
- Dis-assembling (step- wise procedure)

➤ **Preparing System for Installation**

- Basic Input Output System
- CMOS memory
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- File system
- Windows 7 Installation (step-wise procedure)
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- Classification of network
- Transmission of Media
- Network Topologies
- Network Models
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- Configuring LINUX System for Networking

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 - Configuring Network Applications
 - Connecting Smart Devices
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 - Mobile Computing
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- **Problem Diagnosis, Troubleshooting and Maintenance**
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 - Control Panel
 - Hardware Troubleshooting
 - Software Troubleshooting
 - Network Troubleshooting
 - Indications and Remedies of Commonly Found Problem
 - System Security
- **New Trends in Computing**
- Virtualization
 - Interacting with Customers
 - Understanding Customer's Requirements
 - Suggesting Solutions
 - Achieving Productivity and Quality
- **Coordinate with Colleagues**
- Interacting with Superiors
 - Coordinating with Colleagues
 - Organizational Context
 - Team work and Multitasking
 - Decision Making



Notes

1

INTRODUCTION TO COMPUTERS

Computer has become indispensable in today's life. It has become difficult to imagine the world without computer. Everywhere computers are used whether it is office, bank, school, college, business, hospitals etc. You must have seen Computers at your home, school or office. Can you guess what type of a device it is?

Computer is an electronic device which accepts input, processes it and produces the desired results. Computer is a machine which performs mathematical operations and logical decisions at an extremely fast speed. Computer not only do calculations but also handles different applications at a time.

In this lesson, you will learn about computers, its parts, and its uses in real life.



OBJECTIVES

After reading this lesson you will be able to:

- define Computer.
- describe generations of Computers.
- list types of Computers.
- explain the uses of Computers.

1.1 WHAT IS A COMPUTER?

You already know computer is an electronic device which accepts input, processes it and produces the desired results. Computer is divided into two main components Hardware and Software. Hardware consists of mechanical and electronic device, which you can see and touch. The four main hardware components of any computer are motherboard, processor, RAM, Hard drive. Software consists of programs, operating system etc., Examples of software: Windows 7, Linux, MS Office, Adobe PageMaker etc. Today's Computers have at least one CPU (Central Processing Unit) that performs most calculations and include main memory, control unit, and an Arithmetic Logic Unit (ALU).



Computer is a general purpose device that is programmed for some task. Do you know what are the two major characteristics of a Computer? Major characteristics of a Computer are (i) it responds to a specific set of instructions in a well-defined manner; (ii) it can execute a pre-recorded list of instructions (a program).



Fig. 1.1 Desktop Computer



Fig. 1.2 Basic operation of a Computer System

1.1.1 How does a Computer work?

- It accepts input from various input devices like keyboard, mouse, scanner, joystick and light pen.
- Microprocessor performs arithmetic and logic operation on it and gives result.
- It communicates results through output devices like monitor and printer etc.
- It stores information in hard disk. There are other storage devices such as computer disk, pendrive, (USB drive) etc.

1.2 WHAT ARE THE CHARACTERISTICS OF A COMPUTER?

Speed: Computers work at very high speed and are much faster than humans. Do you know one second is very large time period for a computer? A Computer can perform millions of calculations in a microsecond.

Storage: Computer can store large amount of data (text, video, picture etc) permanently. You can use this data at any time.

Accuracy: Accuracy means to provide results without any error. Computers can process large amount of data and generate error free results. A modern computer processes large amount of information without any error.

Communication: Today's Computers have capability of communicating with other Computers. You can connect two or more computers.



Automatic: A computer as a machine can not start itself but it can perform some work without human intervention. For example, you have large amount of data and you want to perform some calculation on it. For getting the result, you have to run the appropriate software and all the calculation will be done by Computer.

Diligence: Unlike human being, computer is free from dullness and lack of concentration. It can work for hours without any error until job is finished.

Versatility: Versatility is a most important characteristic of computer. You may use computer to prepare salary slip and at the same time you can use the same computer for paying electricity bill and etc. It means you can perform completely different type of work on a single computer simultaneously.



INTEXT QUESTIONS 1.1

Fill in the blanks:

1. Computer is broadly divided into _____ and _____ categories.
2. Example of system software is _____.
3. Physical components of computer is called _____.
4. Software consists of _____, _____.

1.3 COMPUTER GENERATIONS

The history of computer development is often referred in the different generations of computer devices. A generation refers to state of improvement in the production process. Each generation of computer is characterized by major technological development that fundamentally changes the way computer operates.

- **First Generation:** The period of first generation was 1946-59. The computers of first generation used **vacuum tubes** as the basic components for memory and circuitry for CPU (Central Processing Unit). In this generation mainly batch processing operating system were used. Punched cards, paper tape, and magnetic tape were used as input and output devices. Example : ENIAC (Electronic Numerical Integrator And Computer was the first general purpose electronic digital computer), EDVAC (Electronic Discrete Variable Automatic Computer), UNIVAC (Universal Automatic Computer - world's first commercially available computer), IBM-701 and IBM-650.
- **Second Generation:** The period of second generation was 1959-65. In this generation **transistors** were used. It is cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes. These were also the first computers that stored instruction in their memory. The computers used batch processing and multiprogramming operating system. Example: IBM 1620 , IBM 7094, CDC 1604, CDC 3600, UNIVAC 1108



- **Third Generation:** The period of third generation was 1965-71. The computers of third generation used **Integrated Circuits (IC's)** in place of transistors. A single IC has many transistors, resistors and capacitors along with the associated circuitry. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation. Example: IBM-360 series, Honeywell-6000 series, PDP(Programmed Data Processor), IBM-370/168 and TDC-316
- **Fourth Generation:** The period of fourth generation was 1971-80. The computers of fourth generation used **Very Large Scale Integrated (VLSI) circuits**. VLSI circuits having about 5000 transistors and other circuit elements and their associated circuits on a single chip made it possible to have microcomputers of fourth generation. All the high-level languages like C, C++, DBASE etc., were used in this generation. Example: DEC 10, STAR 1000,PDP 11, CRAY-1(Super Computer) and CRAY-X-MP(Super Computer)
- **Fifth Generation:** The period of fifth generation is 1980 onwards. In the fifth generation, the VLSI technology became **ULSI (Ultra Large Scale Integration)** technology, resulting in the production of microprocessor chips having ten million electronic components. This generation is based on parallel processing hardware and AI (Artificial Intelligence) software used for Robots designing.

1.4 WHAT ARE THE TYPES OF COMPUTERS?

Computer are generally classified by speed, memory size and power consumption, though there is considerable overlap:

- **Microcomputer:** It is based on microprocessor chip as CPU. This is smallest category of Digital Computer. These computers include Personal computer Desktop computers, Notebook computers, Laptop computers, Tablet computers.

Personal computer - It is a small, relatively inexpensive computer designed for an individual user.

Desktop computers - A computer that is used for home application and small office work, is Desktop computer. In this type of computer, monitor is put on the top of computer and it is broad and low. While in tower computer, CPU cases are tall and narrow. In our general life we interact with Desktop Computer.



Fig. 1.3 Desktop computer



Notes

Notebook computers -It is a lightweight computer. A notebook size is also very less in comparison to Desktop Computer and Tower Computer. The display of notebook computer is different from Desktop Computer. Notebook computers price is very high in comparison with Desktop computer. It is easy to move from one place to another place. Notebook computer power is same as Desktop Computer. It is made of same configuration like 1 GB RAM, 1 TB HDD, DVD, etc...

Laptop computer -This type computer is little different from Notebook computers. Its configuration is near about same as Notebook Computer and it can be in the range of high configuration (4 GB RAM, 1 TB HDD, etc.) to low configuration (500 MB RAM, 500 GB HDD, etc.). Most of the times Laptop Computers are also called Notebook Computers.

Tablets - are smaller than laptop PCs, very lightweight, and easy to carry. But they lack the processing power of a laptop as well as a keyboard input. They rely instead on a stylus and touch screen.

- **Minicomputer:** A multi-user computer capable of supporting up to hundreds of users simultaneously. These computers are bigger in size and costlier than Microcomputers. Minicomputers are used in universities and big organisations.
- **Mainframe computer:** A mainframe computer is a very large computer capable of handling and processing very large amounts of data quickly. These are used by large institutions, such as government agencies and large corporations.
- **Supercomputers Or High Performance Computer (HPC):** A supercomputer is typically used for scientific and engineering applications that must handle very large databases. It is an extremely fast computer that can perform hundreds of millions of instructions per second. The speed of the supercomputer are measured by FLOPS (Floating point operations per second).

1.5 APPLICATIONS OF COMPUTERS

You may aware that computers are very productive, efficient and can do anything imaginable. Some of the principle applications of the computer systems are as follows:

Business: Businessmen use computer in the presentation, analysis, calculation and making charts for their business. They also provide online service to their customers using e-commerce, m-commerce. You or your family member must have used online shopping website for purchasing any products. Usage of the computer has reduced the cost of man power and its delivery in an efficient way.

Buildings: In the construction of building, Architects use computer to virtually visualize the complete building. It is performed through different multimedia software. Computer provides accurate structure of buildings with all measurements. It helps in reducing cost of changes and it provides satisfaction to the customer.

Education: Now-a-days, you can see computer has become an inevitable part in spheres of life. Students use computer for preparing or completing assignments and submit it



through online. There are so many online contents study materials which can be viewed by using internet.

Retailing: Most of the retailers product are based on barcode. That's the reason they need computers to read barcode and calculate amount on it. This system helps retailers to sum up so many items within seconds.

Energy: In the energy sectors, companies use computers to calculate items and figure out the place of natural resources. Computers also help in finding the correct geographical location of company's delivery places, vehicles information and communicating with customers.

Transportation: Companies are using computers in the vehicles to provide more services to the consumers. Consumers can easily determine the fuel level, AC system, temperature with the help of this system. Some vehicles do not require driver to reach at destination on predetermined path in some countries.

Agriculture: Farmers can check the requirements of their crops on computers. They use it for billing, checking market value of crop, cost of fields and stock value of agricultural firm. Computers help in prediction of weather conditions and estimation of agricultural production also.

Weather: High Performance Computers (HPC) are also used for executing the weather models (Programs), analyzing weather conditions based on the data collected from various sources like satellite/ GTS/ Internet data and forecasting weather conditions in advance (3 days advance, weekly advance and even monthly advance) like (i) Rainfall prediction, (ii) Temperature prediction, (iii) Wind speed prediction, (iv) Snowfall prediction etc.

Government: Indian government is implementing E-Governance project in each department. This project can be implemented using Computer only and all information will be available online for citizens. Government employee use it for delivering good and transparent services to citizens. Data entry operations, billing, calculation, presentation are also performed through computers in organization.



INTEXT QUESTIONS 1.2

5. Vacuum tubes were used in _____ generation.
6. The first general purpose computer was _____ .
7. Fifth generation computers use _____ .
8. What are the characteristics of a computer?
9. Which computer is a very large computer capable of handling and processing very large amounts of data quickly?
10. Speed of supercomputer is measured in _____ .

**WHAT YOU HAVE LEARNT**

In this lesson you learnt about functions of computer, generations of computers and types of computers. You have also learnt about applications of computers.

Some of the keypoints to remember -

- Computer is an electronic device that can store, process and retrieve data.
- It is broadly divided into hardware and software.
- Important characteristics of computer are storage, accuracy, communication, automatic, diligence, versatility.
- First generation computers used vacuum tubes.
- Second generation of computers used cheaper and more compact transistors.
- Third generation computers used Integrated Circuits (IC's)
- Fourth generation computers used Very Large Scale Integrated circuits(VLSI).
- Fifth generation computers used Ultra Large Scale Integration (ULSI)
- Computers are classified on basis of speed, memory, power consumption as Personal Computers, Microcomputers, Workstation, Minicomputers, Mainframe, Supercomputers.
- Computers are widely used in business, education, transportation, weather, government etc.

**TERMINAL EXERCISE**

1. What is a computer?
2. List down the important functions of a computer.
3. Explain any two characteristics of computer.
3. Explain the generations of computers.
4. How microcomputer is different from minicomputer?
5. What are the types of computers?
5. What are the applications of computer?
6. What is the use of computers in education?

**ANSWERS TO INTEXT QUESTIONS****1.1**

1. Hardware, software
2. Windows or Linux or DOS

**Notes**

Notes

3. Hardware
 4. Programs, operating system
- 1.2**
5. First
 6. ENIAC
 7. Artificial intelligence and expert system computers
 8. Speed, accuracy, diligence, versatility
 9. Mainframe
 10. FLOPS or Floating point operations per second.



Notes

2

COMPUTER COMPONENTS

As you have learnt till now that computer is an electronic device that takes input from the user, does the processing of the data and gives the information. The Computer system consists of both hardware and software which works in coordination to give us the correct data. It works on the principle of GIGO, i.e. Garbage in Garbage out. It means give wrong input to the computer then the output will be not appropriate as it cannot think and act like human beings. Have you ever seen computer components? Computer has lot of components inside and each component does a specified job. In this lesson you will learn about computer components in detail.



OBJECTIVES

After reading this lesson, you will be able to:

- explain components of computer.
- list input devices of computer.
- list output devices of computer.
- explain about types of memory used in computer.
- describe software.

2.1 COMPUTER COMPONENTS

Do you know what is computer hardware and software? Computer hardware is the collection of physical components of a computer system which includes monitor, keyboard, hard disc drive (HDD), RAM, motherboard etc. Software is nothing but a set of instructions (programs) that are stored and run by hardware. Hardware components of a computer system are electronic and mechanical parts. The term computer hardware refers to the physical computer components.



Notes

Computer Components

The major hardware components of a computer system are:

- Processor
- Main memory
- Secondary memory
- Input devices
- Output devices

For desktop computers, the processor, main memory, secondary memory, power supply and supporting hardware are housed in a metal case. Many of the components are connected to main circuit board of the computer, called the motherboard. The power supply supplies power to most of the components. Various input devices and output devices are attached through connectors at the rear of case. Figure 2.1 depicts some of the hardware components of a computer.

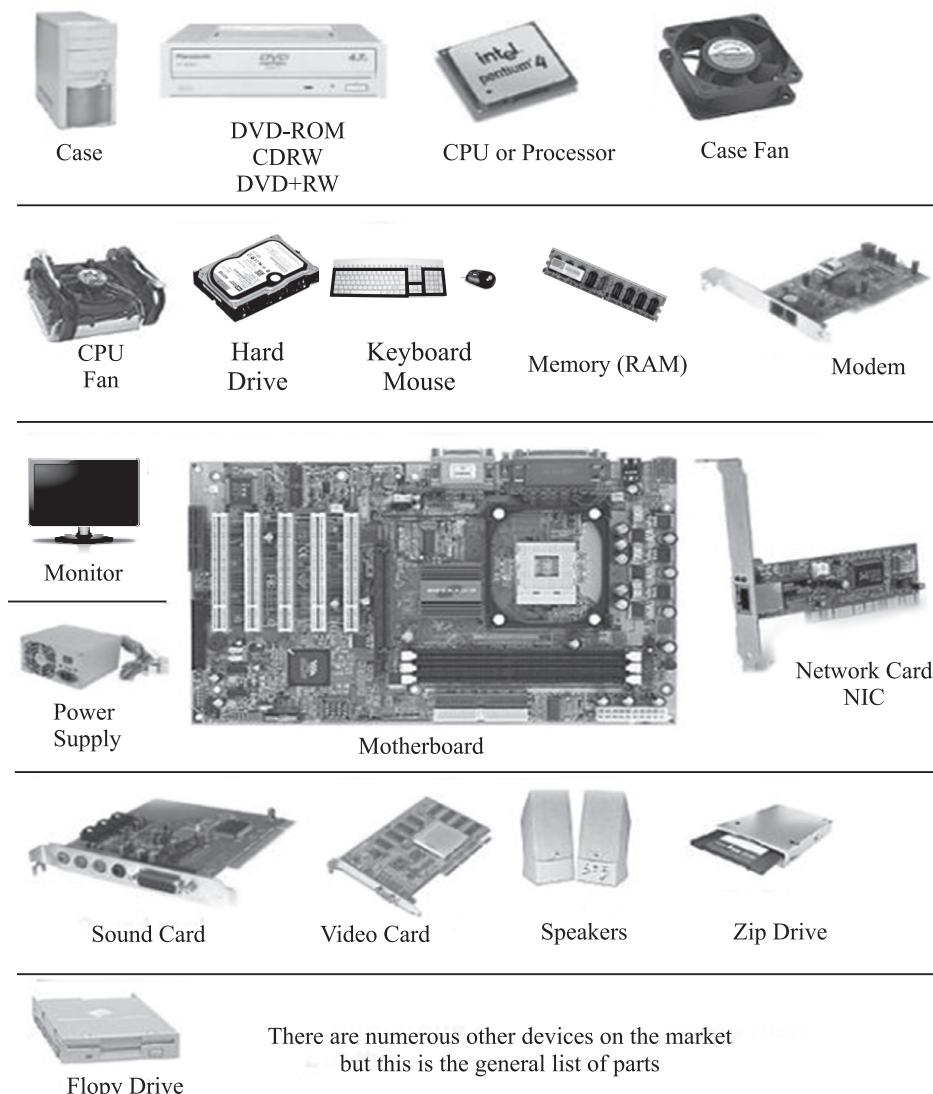


Fig. 2.1 Hardware Components



Notes

Motherboard: A motherboard is a square-shaped board that houses all major components such as the RAM chips, PCI slots, processor, batteries, sound cards, video cards, graphic cards, USB ports and all other internal circuitry. Motherboards are available in different hardware configurations and designs.

Cards: These mainly include video cards, sound cards, graphics cards etc. all of which are installed on the motherboard in their respective slots. These are mainly required for running multimedia applications involving video, audio and graphical images. LAN (Local Area Network) cards and network cards are necessary for computer networking, i.e. connecting your computer to a local network or to the Internet.

Fans: Most computer cabinets make use of at least two fans - a processor fan and a cabinet fan. Their main purpose is to lower the internal temperature and keep the processing components as cool as possible.

USB Ports: USB (Universal Serial Bus) ports in simple terms are the ports which you use for connecting your MP3 players, digital cameras, flash drives, etc. to your computer. Today, most computers come with a minimum of 4 USB ports although certain high end machines can have up to 8 or even 10 USB ports.

CD/DVD Drives: If you wish to run any type of CD or DVD on your computer, installing a CD drive or a DVD drive is a must. There are different types of CD/DVD drives available, each offering the user a variety of features and options.

Cables: Internal cables which are used to connect the hard drive, CD/DVD drive, etc. are of two types - a data cable and a power cable. Each one has a different physical structure and a different function.

2.2 BLOCK DIAGRAM OF COMPUTER

Figure 2.2 depicts block diagram of a computer.

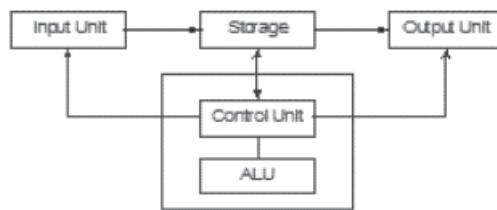


Fig. 2.2 Block Diagram of Computer

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



Input Unit

Computers need to receive data and instructions in order to solve any problem. Therefore it needs data and instructions. The input unit consists of one or more input devices. Keyboard is one of the most commonly used input device. Other commonly used input devices are mouse, joystick, light pen etc. You will be learning about input devices in section 2.3

Storage Unit

The storage unit of the computer holds data and instructions that are entered through the input unit. It preserves the intermediate and final results before these are sent to the output devices. It also saves the data for later use. The various storage devices of a computer system are divided into two categories. Can you guess those two categories? **Primary storage** and **Secondary storage**. Primary storage device stores the data temporarily whereas secondary storage device stores the data permanently.

Output Unit

The output unit of a computer provides the information and results of a computation to outside world. Printers, monitor or Visual Display Unit (VDU) are the commonly used output devices. Other output devices are plotters, speakers etc.

Central Processing Unit(CPU)

You may have heard that CPU is the brain of the Computer. Do you know why? Because you cannot work on Computer without CPU. CPU processes almost all the instructions (like performs calculation, fetches instruction from memory, processes instructions) necessary for your computer to perform.

Control unit and ALU of the computer are together known as Central Processing Unit (CPU).

CPU performs the following functions:

- It does all the calculations.
- It takes all the decisions.
- It controls all the units of the computer.

Arithmetic Logical Unit (ALU)

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

An additional type of ALU, called Floating Point Unit(FPU) or math co-processor is frequently used to perform specialized functions such as division and large decimal number operations. Now-a-days generally the FPU is included as a part of CPU.

**Control Unit (CU)**

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

**INTEXT QUESTIONS 2.1**

1. RAM stands for
2. ALU and CU are part of
3. Major hardware components of computer system are ,

2.3 INPUT DEVICES

Computer will be of no use unless it is able to communicate with outside world. Input/Output devices are required for users to communicate with computer. Input devices bring information into computer. Some common Input devices are:

Keyboard

You must have used computer keyboard. It is one of the commonly used input device. It is text based input device that allows the user to input alphabets, numbers and other characters. It consists of a set of keys mounted on board.

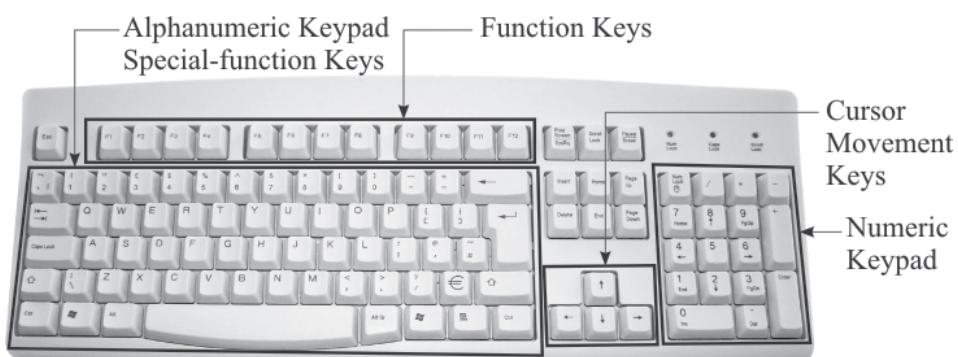


Fig. 2.3 Keyboard

Mouse

Fig. 2.4. depicts a mouse. Mouse is an electro-mechanical device used to point a particular place on the screen and select in order to perform one or more actions. It can be used to select menu commands, start programs etc. It is also called as pointing device.



Notes

Computer Components

The most conventional kind of mouse has two buttons on top: the left one being used most frequently.

Mouse Actions:

- **Left Click:** Used to select item
- **Double Left Click:** Used to open a file or start a program
- **Right Click:** Usually used to display set of commands.
- **Drag and Drop:** It allows you to select and move an item from one location to another.



Fig. 2.4 Mouse

Joystick

A joystick is a vertical stick which moves the graphic cursor in the direction the stick is moved. It typically has button on the top that is used to select option pointed by cursor. Joystick is used as an input device primarily used with video games, training simulator and controlling robots.



Fig. 2.5: Joystick

Some other input devices are:

Scanner: It is used to scan hard copy and sends this as an information to the computer.

Bar Code Reader: Now-a-days you see a bar code on material at every shop which is read by a bar code reader and appropriate information is sent to computer.



Touch Screen: It allows user to make selection by simply touching the screen.

Light Pen : Light pen is an input device that utilizes a light sensitive detector to select objects on a display screen. Light pen is similar to a mouse except that with a light pen you can move the pointer and select objects on the display screen by directly pointing to the objects with pen.

2.4 OUTPUT DEVICES

Monitor is one of the most popular output device. It is also called as Visual Display Unit. The monitor looks like a television screen, except instead of watching television programs on it, the monitor allows for running of computer programs. It is connected to the main computer box.

There are two kinds of monitors:

1. CRT (Cathode Ray Tube)
2. Flat Panel Display Monitor or LCD

Now-a-days CRT monitors are not commonly used. Liquid Crystal Display (LCD) monitors are mostly in use.

Printer

Printers are used to produce paper output (hardcopy). Based on technology used, it can be classified as Impact or Non-impact printers.

Impact Printers use the typewriting printing mechanism where hammer strikes the paper through a ribbon in order to produce output. Dot-matrix and Character printers fall under this category.

Non-Impact printers do not touch the paper while printing. It uses chemical, heat or electric signals to print the symbols on paper. Inkjet, Deskjet , Laser printers falls under this category.



Fig. 2.6 Laser Printer



Plotters : Plotter is a special kind of output device that is like a printer, produce images on paper, but does so in a different way. Plotters are designed to produce large drawings or images, such as construction plans for buildings.

Audio Output: Sound Cards and speaker :

The Audio output is the ability of the computer to output sound. Two components are needed:

- (i) Sound Card-plays content of digitized recordings.
- (ii) Speaker, which is attached to sound card.

2.5 WHAT IS COMPUTER MEMORY?

Computer memory is the part of computer that serves as a repository of information that must be managed and maintained well. It is also known as computer storage.

Computer stores its information in three levels:

- Physical register in the CPU, located at the top level. The information in the registers can be accessed in one CPU clock cycle.
- Primary Memory (executable memory), located at the middle level. For example RAM.
- Secondary Memory, located at a lower level. For example disk and tape.

2.5.1 Primary Memory

It is temporary memory that is used at the time of execution of program. Random Access Memory (RAM) is most common type of memory in computers.

RAM

Figure 2.7 depicts **Random Access Memory**. It is volatile memory. In this memory, information is stored till the power supply is given. Data in a computer's primary storage is stored for very fast retrieval. It is called Random Access Memory because any data in RAM can be accessed just as fast as any other data.

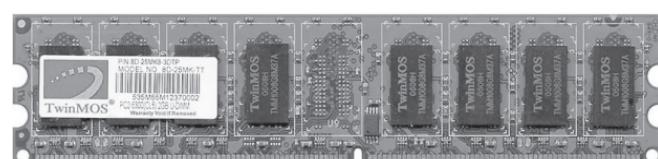


Fig. 2.7 Random Access Memory



2.5.2 Secondary Memory

USB Drives

A USB flash drive, usually portable and rewritable, is a type of flash memory storage device that plugs into a computer's USB port. Flash drives are more expensive than hard drives with the same storage capacity. Fig. 2.8 depicts a USB drive.



Fig. 2.8 USB Drive

Internal Hard Disk Drive

The internal hard disk drive is the main secondary storage device that stores all of your data magnetically, including operating system files and folders, documents, music and video. You can think of the hard disk drive as a stack of disks mounted on top of the one another and placed in a sturdy case. These are spinning at high speeds to provide easy and fast access to stored data anywhere on a disk.

External Hard Disk Drive

External hard disk drives are used when the internal drive does not have any free space and you need to store more data. In addition, it is recommended that you always back up all of your data. An external hard drive can be very useful, as it can safely store large amounts of information. It can be connected by either USB or Firewire connection to a computer and can also be connected with each other in case you need several additional hard drives at the same time.

CD-R

A CD-R, a type of recordable CD, is an optical secondary storage device. It is also known as a WORM -- write once read many -- medium.

DVD(Digital Versatile Disc) - It is an optical disc technology with a minimum of 4.7GB storage capacity on a single side.



2.6 WHAT IS COMPUTER SOFTWARE?

Computer Software is a set of programs used to do different tasks. It is classified mainly into;

- (i) System Software and
- (ii) Application Software.

System software is collection of programs that controls overall operation of a computer system. It can be further divided into Operating System and Utilities.

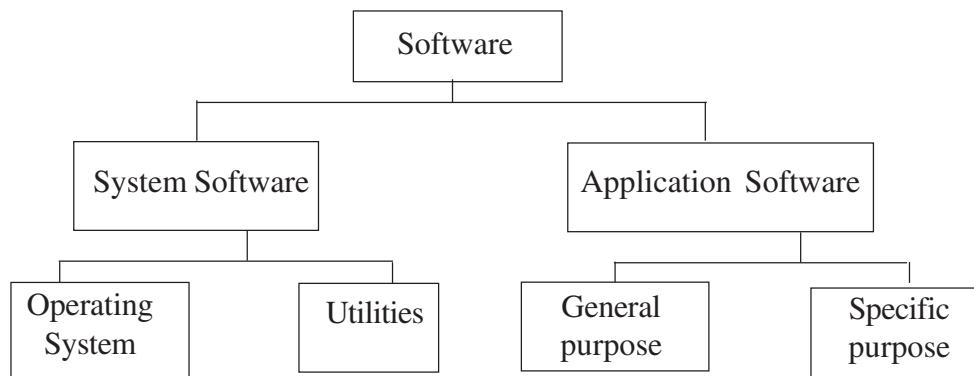


Fig. 2.9 Software classification

Operating System: Operating System (OS) is system software that manages computer hardware as well as software resources and provides common services for computer programs. The operating system is a component of the **system software** in a computer system. Application programs usually require an operating system to function.

Examples - Disk Operating System(DOS), Windows, UNIX, LINUX etc.

Utilities - Utilities are small programs designed for the smooth functioning of the computer systems eg. disk cleanup, disk defragmenter, file searching etc.

Application Software: Application software is a program or group of programs designed for end users to do a specific task.

It can be further divided into -

General Purpose Application software - These softwares are used in schools and at home for general uses like typing a letter, making a small project or presentation eg. - word processor, spreadsheets, databases, desktop publishing packages, graphics packages etc.

Specific Purpose Application software - These softwares are designed to do a specific kind of a task eg. - Railway Reservation system, Payroll Management, Inventory Control System , Library Management System.

**INTEXT QUESTIONS 2.2****Notes*****Fill in the blanks:***

4. Keyboard and mouse are
5. Drag and drop action can be performed through
6. Printer is an device and scanner is an device.
7. Software can be classified as,
8. MS Word is an example of purpose application software.
9. Disk cleanup is an example of software.
10. software is necessary for the computer.

**WHAT YOU HAVE LEARNT**

In this lesson, you have learnt hardware components of Computer like hard drive, motherboard, RAM, CPU etc. You have also learnt about input devices, output devices, memory, primary memory, secondary memory and its uses in our life.

Some of the keypoints to remember

- Computer software is a set of instructions stored and run by hardware.
- Computer hardware is a collection of physical components of a Computer system.
- Random Access Memory (RAM) is volatile memory.
- Control unit and ALU of the computer are together known as CPU.
- Keyboard, mouse, joystick, scanner are the examples of input devices.
- Monitor is also called as VDU (Visual Display Unit).
- Monitor, printer, plotter, sound card and speaker are examples of output devices.
- Computer software mainly classified into System Software and Application software.

**TERMINAL EXERCISE**

1. Explain any four input devices.
2. List any two output devices.
3. What is the difference between primary and secondary memory?



Notes

Computer Components

4. Depict the block diagram of a Computer.
5. Explain in short the different types of System software and Application software.
6. Explain in short the different components of CPU.
7. Differentiate between
 - (a) Internal and External hard drive
 - (b) Primary memory and Secondary memory.



ANSWERS TO INTEXT QUESTIONS

2.1

1. Random Access Memory
2. CPU (Central Processing Unit)
3. Processor, Memory, Input or Output devices

2.2

4. Input Devices
5. Mouse
6. Output, Input
7. System, Application
8. General
9. Utility
10. Operating system



Notes

3

DATA REPRESENTATION IN THE COMPUTER

Computer is not a human being. But how does it understand your instructions? Did you think about it any time? Computer understands only 1's and 0's. Whatever instruction or input you are giving to computer it converts each instruction / input as 1's and 0's. With the help of these two digits computer can represent video, picture and numbers also.

In this lesson, you will learn methods of data representation in a computer. You will also learn different types of number systems in data representation.



OBJECTIVES

After reading this lesson you will be able to:

- explain about data representation.
- list the types of number system used in computer.
- convert from one number system to other.

3.1 DATA REPRESENTATION

Data representation refers to the method used to represent information stored in a computer. Computer stores different types of information like number, text, graphics, video, sound, charts, images etc.

All types of information stored in a computer are stored internally in the form of 0's and 1's. It is very interesting that only with 1 and 0 everything is represented. Computers use numeric codes to represent all the information.



Memory Structure in Computer:

- Memory consists of bits (0 or 1). A single bit can represent two pieces of information (either 0 or 1).
- 1 Nibble is equivalent to 4 bits.
- 1 Byte is equivalent to 8 bits, a single byte can represent $256 = 2^8$ different things.
- Each byte has its own address.

Binary Numbers

Do you know the origin of the word “Bi”? It is a latin word. Do you know the meaning of the latin word “Bi”? Bi means two. Binary numbers are 0's and 1's. Any positive integer (whole number) can be easily represented by a sequence of 0's and 1's. Numbers in this form are said to be in base 2 and these are called binary numbers.

Text

Text can be represented easily by assigning a unique numeric value for each symbol used in the text. For example, the widely used American Standard Code for Information Interchange (ASCII explained in section 3.3) defines 128 different symbols (all the characters found on a standard keyboard, plus a few extra), and assigns each symbol to a unique numeric code between 0 and 127. In ASCII, “A” is 65, “B” is 66, “a” is 97, “b” is 98, and so forth. When you save a file as “plain text”, it is stored using ASCII. ASCII format uses 1 byte per character. 1 byte gives only 256 (128 standard and 128 non-standard) possible characters. The code value for any character can be converted to base 2. Any written message made up of ASCII characters can be converted to a string of 0's and 1's.

Graphics

Graphics that are displayed on a computer screen consist of pixels: the tiny “dots” of color that collectively “paint” a graphic image on a computer screen. The pixels are organized into many rows on the screen. In one common configuration, each row is 640 pixels long, and there are 480 such rows. Another configuration is 800 pixels per row with 600 rows, which is referred to as a “resolution of 800×600”. Each pixel has two properties: its location on the screen and its colour.

A graphic image can be represented by a list of pixels. Imagine all the rows of pixels on the screen laid out end to end in one long row. This gives the pixel list, and a pixel's location in the list corresponds to its position on the screen. A pixel's color is represented by a binary code, and consists of certain number of bits. In a monochrome (black and white) image, only 1 bit is needed per pixel: 0 for black, 1 for white, for example. A 16 color image requires 4 bits per pixel. Modern display hardware allows for 24 bits per pixel, which provides an array of 16.7 million possible colors for each pixel.

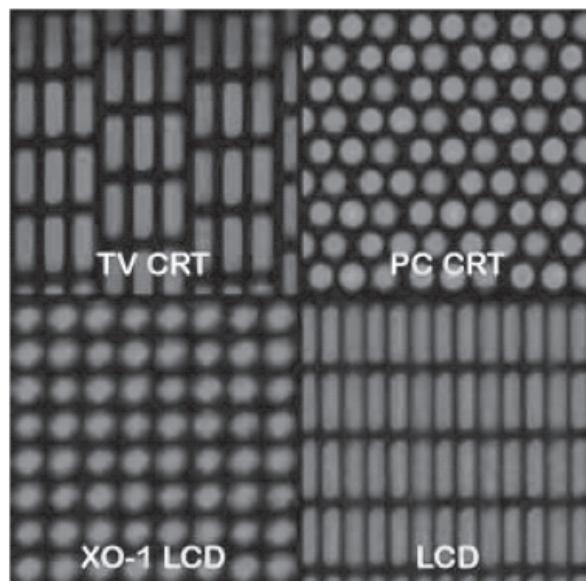


Fig. 3.1: Pixels in Different Display Devices

3.2 NUMBER SYSTEM

Computer stores and processes two basic types of data viz., character and number. The character type data includes alphabets and some special symbols. For example, student name in class, roll number, etc.

Digital computers internally use binary (base 2) number system to represent data and perform arithmetic calculations. The binary number system is very efficient for computers, but not for humans. Representing even relatively small numbers with binary system requires working with long strings of ones and zeroes.

3.2.1 Decimal and Binary Numbers

Have you heard about decimal numbers? In the decimal number system, there are ten possible values that can appear in each digit position, and so there are ten numerals required to represent the quantity in each digit position.

The decimal numerals are from zero to nine (0, 1, 2, 3, 4, 5, 6, 7, 8, 9).

When you write decimal (base 10) numbers, you use a positional notation system. Each digit is multiplied by an appropriate power of 10 depending on its position in the number:

For example:

$$\begin{aligned} 843 &= 800 + 40 + 3 = 8 \times 100 + 4 \times 10 + 3 \times 1 \\ &= 8 \times 10^2 + 4 \times 10^1 + 3 \times 10^0 \end{aligned}$$



For whole numbers, the rightmost digit position is the one's position ($10^0 = 1$). The numeral in that position indicates how many ones are present in the number. The next position to the left is ten's, then hundred's, thousand's, and so on.

Table 3.1 shows decimals and their 4 bit binary equivalents.

Table 3.1: decimal and their 4 bit binary equivalents.

Decimal Pattern	Binary Pattern(in 4 bit)
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010

In a positional notation system, the number base is called the **radix**. Thus, the base ten system that you normally use has a base of 10. When writing numbers in a base other than ten, or where the base is not clear from the context, it is normal to specify the base using a subscript. Thus, in a case where the base is not understood, decimal numbers would be written like this:

$$127_{10} \quad 11_{10} \quad 5673_{10}$$

In binary, counting follows similar procedure, except that only two symbols 0 and 1 are used. Thus, after a digit reaches 1 in binary, an increment resets it to 0 but also causes an increment of the next digit to the left (i.e., 10).

Since binary is a base-2 system, each digit represents an increasing power of 2, with the rightmost digit representing 2^0 , the next representing 2^1 , then 2^2 , and so on. To determine the decimal representation of a binary number simply take the sum of products of binary digits and the powers of 2 which they represent. For example, the binary 100101 is converted to decimal form as follows:



$$\begin{aligned}100101^2 &= [(1) \times 2^5] + [(0) \times 2^4] + [(0) \times 2^3] + [(1) \\&\quad \times 2^2] + [(0) \times 2^1] + [(1) \times 2^0]\end{aligned}$$

$$100101^2 = [1 \times 32] + [0 \times 16] + [0 \times 8] + [1 \times 4] + [0 \times 2] + [1 \times 1]$$

$$100101^2 = 37_{10}$$

3.2.2 Octal Number System

Octal (this word is derived from Latin word Octo meaning 8) or oct is the base 8 number system uses digits (0-7), i.e. : 0, 1, 2, 3, 4, 5, 6, 7.

To determine the decimal representation of a octal number simply take the sum of products of octal digits and the powers of 8 which they represent.

Example : Octal Number - 12570_8 converted to decimal equivalent as follows;

$$\begin{aligned}12570_8 &= [(1 \times 8^4) + (2 \times 8^3) + (5 \times 8^2) + (7 \times 8^1) + (0 \times 8^0)]_{10} \\&= 4096 + 1024 + 320 + 56 + 0 \\&= 5496_{10}\end{aligned}$$

3.2.3 HexaDecimal Number System

Hexadecimal or hex is base 16 number system. It uses 16 distinct symbols

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

The alphabets (A to F) represents the values ten to fifteen.

for example - Hexadecimal Number $19FDE$ converted to decimal equivalent as follows;

$$\begin{aligned}19FDE &= (1 \times 16^4) + (9 \times 16^3) + (F \times 16^2) + (D \times 16^1) + (E \times 16^0) \\&= 65536 + 36864 + 3840 + 208 + 14 \\&= 106462_{10}\end{aligned}$$

All four number systems are equally capable of representing any number.

3.2.4 Conversion from one Number System to Another

Decimal to Binary Conversion

You can use, successive division method for decimal to binary conversion. Successive division requires dividing continuously by the base till the quotient equals to 0.



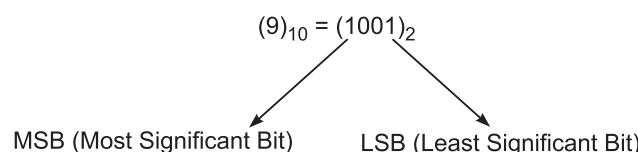
Steps for conversion from Decimal to Binary

1. Divide the decimal number by 2.
2. Take the remainder and record it on the side.
3. Repeat until the decimal number can not be divided .
4. With the bits, record them from bottom to top so that the number will be the number in base 2.

For example conversion of 9 into binary is as follows:

$9/2 = 4$ and remainder = 1	(first remainder is called LSB) (least significant bit)	
$4/2 = 2$ and remainder = 0		
$2/2 = 1$ and remainder = 0		
$1/2 = 0$ and remainder = 1	(last remainder is called MSB) (Most significant bit)	

Now, decimal 9 is equivalent to 1001 in binary number system.



Decimal to Octal Conversion

You can convert decimal to octal. Conversion requires dividing continuously by the base you are converting (in this case it is 8) to until the quotient equals 0.

Steps for conversion from Decimal to octal

1. Divide the decimal number by 8.
2. Take the remainder and record it on the side.
3. Repeat until the decimal number can not be divided.
4. With the bits, record them from bottom to top so that will be the number in base 8.

For example, conversion of 19 into Octal as follows:

$19/8 = 2$	and remainder = 3	(first remainder is called LSB) (least significant bit)	
$2/8 = 0$	and remainder = 2	(last remainder is called MSB) (Most significant bit)	



Now decimal 19 is equivalent to 23 octal number

$$(19)_{10} = (23)_8$$

Decimal to Hexadecimal Conversion

Division method can be used for conversion from decimal to hexadecimal.

Steps for conversion from Decimal to Hexadecimal

1. Divide the decimal number by 16.
2. Take the remainder and record it on the side.
3. Repeat until the decimal number can not be divided.
4. With the bits, record them in order from bottom to top as that will be the number in base 16.
5. In hexadecimal, 10,11,12,13,14,15 are equivalent to A, B, C, D, E, F respectively.

For example, conversion of 229 decimal into hexadecimal

$$229/16 = 14 \text{ and remainder } = 5$$

$$14/16 = 0 \text{ and remainder } = 14 \text{ (i.e., F= 14)}$$

$$\text{So, } (229)_{10} = (\text{E5})_{16}$$



INTEXT QUESTIONS 3.1

Fill in the blanks

1. Computer understands number.
2. Binary number system has base of
3. Octal has range from 0 to
4. Decimal has base of
5. In hexadecimal, remainder 10 is equivalent to

3.3 CHARACTER REPRESENTATION: ASCII, EBCDIC

Even though many people used to think of computers as "number crunchers", people figured out long ago that it is important to handle character data. Character data is not just alphabetic characters, but also numeric characters, punctuation, spaces, etc. Most keys on the central part of the keyboard (except shift, caps lock) are characters.



3.3.1 ASCII (American Standard Code for Information Interchange)

ASCII stands for American Standard Code for Information Interchange. Computer can only understand numbers. ASCII code is the numerical representation of a character such as 'a' or '@' or an action of some sort. ASCII was developed long time ago and now the non printing characters are rarely used for their original purpose. Below is the ASCII character table and this includes description of first 32 non printing characters. Table 3.2 shows ASCII table.

Table 3.2:ACII Table

ASCII	Hex	Symbol	ASCII	Hex	Symbol
0	0	NUL	25	19	EM
1	1	SOH	26	1A	SUB
2	2	STX	27	1B	ESC
3	3	ETX	28	1C	FS
4	4	EOT	29	1D	GS
5	5	ENQ	30	1E	RS
6	6	ACK	31	1F	US
7	7	BEL	32	20	(space)
8	8	BS	33	21	!
9	9	TAB	34	22	"
10	A	LF	35	23	#
11	B	VT	36	24	\$
12	C	FF	37	25	%
13	D	CR	38	26	&
14	E	SO	39	27	'
15	F	SI	40	28	(
16	10	DLE	41	29)
17	11	DC1	42	2A	*
18	12	DC2	43	2B	+
19	13	DC3	44	2C	,
20	14	DC4	45	2D	-
21	15	NAK	46	2E	.
22	16	SYN	47	2F	/
23	17	ETB	48	30	0
24	18	CAN			

Data Representation in the Computer



Notes

ASCII	Hex	Symbol	ASCII	Hex	Symbol
49	31	1	79	4F	O
50	32	2	80	50	P
51	33	3	81	51	Q
52	34	4	82	52	R
53	35	5	83	53	S
54	36	6	84	54	T
55	37	7	85	55	U
56	38	8	86	56	V
57	39	9	87	57	W
58	3A	:	88	58	X
59	3B	;	89	59	Y
60	3C	<	90	5A	Z
61	3D	=	91	5B	[
62	3E	>	92	5C	\
63	3F	?	93	5D]
64	40	@	94	5E	^
65	41	A	95	5F	_
66	42	B	96	60	`
67	43	C	97	61	a
68	44	D	98	62	b
69	45	E	99	63	c
70	46	F	100	64	d
71	47	G	101	65	e
72	48	H	102	66	f
73	49	I	103	67	g
74	4A	J	104	68	h
75	4B	K	105	69	i
76	4C	L	106	6A	j
77	4D	M			
78	4E	N			



ASCII	Hex	Symbol	ASCII	Hex	Symbol
107	6B	k	118	76	u
108	6C	l	119	77	v
109	6D	m	120	78	w
110	6E	n	121	79	x
111	6F	o	122	7A	y
112	70		123	7B	z
113	71	p	124	7C	{
114	72	q	125	7D	
115	73	r	126	7E	{
116	74	s	127	7F	~
117	75	t			

3.3.2 EBCDIC

EBCDIC (Extended Binary Coded Decimal Interchange Code) is a character encoding set used by IBM mainframes. EBCDIC uses the full 8 bits available to it. So, parity checking cannot be used on an 8 bit system. Also, EBCDIC has a wider range of control characters than ASCII.

The character encoding is based on Binary Coded Decimal (BCD). The contiguous characters in the alphanumeric range are formed up in blocks of up to 10, from 0000 binary to 1001 binary. Non alphanumeric characters are almost all outside the BCD range. There are four main blocks in the EBCDIC code page: 0000 0000 to 0011 1111 is reserved for control characters; 0100 0000 to 0111 1111 are for punctuation; 1000 0000 to 1011 1111 for lowercase characters and 1100 0000 to 1111 1111 for uppercase characters and numbers.



INTEXT QUESTIONS 3.2

Fill in the blanks:

6. Nibble = bits.
7. Octal numbers uses digits from to
8. Character representation in computer is done by using code.
9. ASCII stands for
10. EBCDIC stands for

**WHAT YOU HAVE LEARNT****Notes**

In this lesson, you have learnt that computer understands only binary value, 0 or 1. You can convert decimal number into binary number using division method. You can also convert decimal number into octal or hexa decimal number and vice versa. You have also learnt that character and number representation in computer.

Some of the keypoints to remember

- Data representation refers to the method used to represent information stored in a computer.
- Decimal number system uses digits 0 to 9
- Binary number system uses digits 0 and 1
- Octal number system uses digits 0 to 7
- Hexa decimal number system uses digits 0 to 9 and A to F.

**TERMINAL EXERCISE**

1. Convert the following decimal number into binary number.
a) 333 b) 24 c) 643
2. Convert the following decimal number into octal number.
a) 422 b) 78 c) 36
3. Convert the following decimal number into hexadecimal number.
a) 92 b) 54 c) 39

**ANSWERS TO INTEXT QUESTIONS****3.1**

1. Binary (0 or 1)
2. Two
3. 7
4. 10
5. A

3.2

6. 4
7. 0 to 7
8. ASCII
9. American Standard Code for Information Interchange
10. Extended Binary Coded Decimal Interchange Code.



ANATOMY OF A COMPUTER SYSTEM

Structure, parts and connectivity among various internal parts of a computer system, will be discussed in this lesson. As the input, output and storage devices have already been discussed in the previous lessons, the main focus in this lesson will be on the working and functioning of the internal components, modules and sub-assemblies of the system box. The system box has a number of components inside it like CPU, motherboard, RAM, expansion cards etc. All these components, along with the external devices, perform a task together.

Have you ever looked inside a system box before, or seen pictures of the internal components? This lesson will make you aware of some of the basic terminologies and major components and will help you in understanding in brief, about what goes-on inside the computer system box while a task gets performed. If you are familiar with the parts of the computer, you will definitely be comfortable in assembling a system according to the requirement.

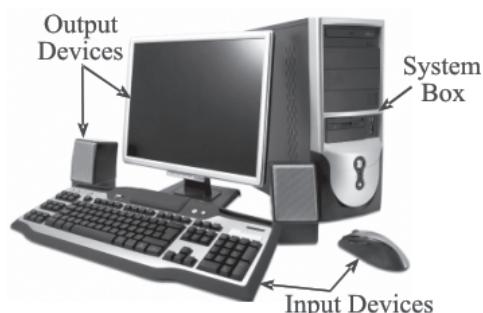


Fig. 4.1 Computer System



OBJECTIVES

After reading this lesson, you will be able to:

- identify the components in the system unit, CPU and motherboard.
- distinguish among the data bus, address bus and the control bus.
- operate the commonly used various plug and play devices.
- locate the slots for various external cards.
- identify various peripheral devices connected internally and externally.



4.1 COMPONENTS OF A COMPUTER SYSTEM

A computer system comprises of a number of components. In this section, you will learn about the components that are responsible for working of the computer system.

4.1.1 Central Processing Unit

Every PC has a Central Processing Unit (CPU). You already know that CPU is the brain of the computer system. Every computer will have a specific type of processor, such as a Pentium chip or an AMD chip. Now let us understand how CPU works. It connects to the motherboard and works alongside the other components, processing many instructions at the same time among the different hardware and memory systems. The processor, as shown in Fig. 4.2, is an electronic device, about one inch square, covered with plastic. Inside this square, there are even smaller squares of silicon, containing millions of tiny electronic parts. A processor may contain 100 million transistors. The chip is usually about the size of a thumbnail. The CPU fits into the motherboard's CPU socket, which is covered by the heat sink, an object that absorbs heat generated in the CPU and dissipates it into the atmosphere. The CPU does the fundamental computing within the system, and directly or indirectly controls all the other components. The speed of the processor is given by its clock speed. A processor's speed is measured in **megahertz (MHz)**, or millions of instructions per second, and **gigahertz (GHz)**, or billions of instructions per second. A faster processor can execute instructions more quickly. However, the actual speed of the computer depends on the speed of many different components.

There are many processor manufacturers for personal computers, but the most well-known ones are Intel and AMD. Advancements in CPU technology have led to systems typically with Dual Core, Triple core or Quad Core processors (on one single chip) instead of the traditional one core per chip. Now all the cores can fit into a single socket as before and a single heat sink and fan can keep everything at the right temperature. CPUs come in different types and speeds. The different versions released by Intel are: 4004, which is a 4-bit processor. 8085, which is a 8-bit processor. 286, a 16-bit processor. 386, 486, 586, 686, K5, K6, K6 MMX, Pentium, Pentium Pro, Pentium MMX, Pentium II, Pentium III and Pentium IV, which are 32-bit processors. Itanium, Pentium D, Celeron, Core Duo, Core 2 Duo, Core 2 Quad, I3, I5 and I7 have 64-bit processor.

A 64-bit processor generally has data and addressing registers that are 64 bits wide that allows storing 2^{64} different values. Hence, a processor with 64-bit memory addresses can directly access 2^{64} bytes of byte addressable memory. However, a CPU might have



Fig. 4.2 Processor



Notes

external data buses or address buses with different sizes from the registers, even larger (the 32-bit Pentium had a 64-bit data bus, for instance).

A generalization would be to suggest that 64-bit architecture would double the amount of data a CPU can process per clock cycle, compared to 32 bit. Users would note a performance increase because a 64-bit CPU can handle more memory and larger files. One of the most attractive features of 64-bit processors is that it can address up to 1 Terabyte (1024GB) of memory.

The processor of the computer system is comprised of **Arithmetic Logic Unit(ALU)** and **Control Unit (CU)**. The processor is responsible for synchronization of instructions and logical and arithmetic operations on the data. In a microcomputer, both ALU and CU are integrated on a single microprocessor chip. The system unit also includes circuit boards, memory chips, ports and other components. A microcomputer's system cabinet may also house disk drives, hard disks, etc., but these are not considered to be part of the CPU.

Functions of Control Unit

Now we will execute some instructions and understand the functions of Control Unit.

Suppose the program or software needs to execute following instructions:

- | | |
|---------------------|--|
| (1) Declare X, Y, Z | • Control bus is used to carry signals that decides what work has to be done like reading, storing, calculation, comparison etc. |
| (2) Read X and Y | • Data bus is used to carry data |
| (3) Z = X + Y | • Address bus is used to carry memory address of the data is carried by the data bus |
| (4) Display Z | |

Interpretation & Execution of a program by the CU using System Bus.

1. The control unit recognizes that the program has been loaded into the primary memory and it begins to execute the first line in the program. This is accomplished with the help of control signals initiated by the control unit via the control bus.

The control unit reads line (1) and directs the primary memory using the control bus to assign memory addresses to variables X, Y and Z (which is communicated via address bus). In simple words, X, Y and Z are three memory variables that are created in RAM for storage purpose.

2. The control unit reads the line (2) and directs the input device, using the control bus, to enter data for X and Y. It also sends the memory addresses of X and Y via the address bus. The values entered travel via the data bus to the control unit. And then again using all the three busses the data gets stored in their respective corresponding addresses in the primary memory.



3. The control unit reads the line (3) using Databus, Control bus, and Address bus and retrieves the values of variable X and Y from primary memory and sends to the ALU for the addition of X and Y. The sum is again moved with the help of bus to primary memory and gets stored in Z variable.
4. The control unit reads the line (4). Data bus Control bus and Address bus retrieves the value of Z variable from primary memory and send it to the output unit to display the sum.

Following are some of the additional components that support the working of the CPU:

Bus

Bus is a transmission path in which signals/data travers within a Computer i.e., address, data, and control bus together constitute the System Bus. In the previous section, you have learnt about the usage of address bus, data bus and control bus. The CPU performs primarily the following four operations:

- **Memory Read:** Reads data or instruction(s) from memory.
- **Memory Write:** Writes data or instruction(s) into the memory
- **I/O read:** Accepts data from input device
- **I/O write:** Sends data to output device

All these operations are performed using a communication process that involve 3 steps:

Step 1: Identify the peripheral or the memory location. It uses the address bus.

Step 2: Transfer data. It uses the data bus.

Step 3: Provide timing or synchronization signal. It uses the control bus.

Address bus: The address bus is a group of wires or lines which is generally identified as A₀, A₁, A₂, and so on. It is unidirectional. Bits flow in only one direction, from the CPU to the peripheral devices. In a computer system, each peripheral or memory location is identified by a binary number, called an address, and the address bus carries an address of a memory location or a peripheral device. The size of the address bus determines the maximum RAM capacity which the processor can address.

Data bus: The data bus is a group of wires used for data flow. These lines are bidirectional i.e., data flow in both directions between CPU and the peripheral devices.

Suppose CPU has 32-bit data bus which implies that it can manipulate 32 bit data. And sometimes we may call it a 32-bit processor. That means 2^{32} different characters can be represented. The data bus influences the microprocessor architecture considerably. It determines the word length and register size of a processor.

Control Bus: The control bus is comprised of various signal lines that carry synchronization signals. These are not group of lines like address or a data bus, but individual lines that provide a pulse to indicate an operation in the CPU. The signals are device specific and are used to activate that device for the specific operation.



4.1.2 Registers

The ALU and Control Unit (CU) communicate with each other and perform operations in memory locations using a register. Registers are used to quickly accept, store, and transfer data and instructions that are being used immediately by the CPU. Do you know the types of Registers?

Types of Registers

1. Memory Address Register (MAR): This register holds the memory addresses of data and instructions. It is used to access data and instructions from memory during the execution phase of an instruction. Suppose CPU wants to store some data in the memory or to read the data from the memory. It places the address of the required memory location in the MAR.

2. Program Counter: The program counter (PC) is a processor register. It is a 16 bit special function register in the 8085 microprocessor. It keeps track of the next memory address of the instruction that is to be executed once the execution of the current instruction is completed. In other words, it holds the address of the memory location of the next instruction when the current instruction is executed by the microprocessor.

3. Accumulator Register: This Register is used for storing the results that are produced by ALU.

4. Memory Data Register(MDR): It is the register of a computer's control unit that contains the data to be stored in the RAM. It is the data that gets stored after being fetched from the computer storage. It acts like a buffer and holds anything that is copied from the memory ready for the processor to use it. MDR holds the information before it goes to the decoder.

The MDR is a two-way register. When data is fetched from memory and placed into the MDR, it is written to in one direction. When there is a write instruction, the data to be written is placed into the MDR from another CPU register, which then puts the data into memory.

5. Index Register: A register which holds a number that can be added to (or, in some cases, subtracted from) the address portion of a computer instruction to form an effective address. Also known as a base register used for modifying operand addresses during the run of a program.

6. Memory Buffer Register(MBR) : This register holds the contents of data or instruction, read from, or written in memory. It means that this register is used to store data/instruction coming from the memory or going to the memory.

Cache Memory

The speed of CPU is extremely high compared to the access time of main memory. Therefore, the performance of CPU decreases due to the slow speed of main memory. To minimise the mismatch in operating speed, a small memory chip is attached between CPU



and main memory whose access time is very close to the processing speed of CPU. It is called Cache memory. Cache memories are accessed much faster than conventional RAM. It is used to store programs or data currently being executed or temporary data frequently used by the CPU. It is also very expensive to have larger size of cache memory.

Main memory access by the CPU may take as long as 180 ns. However, it may take 45 ns to access external cache memory or, even less for internal (Level 1) or on-board (Level 2) cache. While the CPU is processing information retrieved from cache, the cache controller is refreshing cache with data and instructions from main memory or a storage device. Fig. 4.3 depicts cache memory chips.

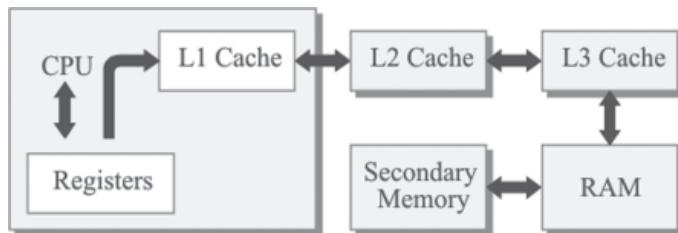


Fig. 4.3 Cache memory chips

There are two categories of cache memory: Internal and External.

In older CPUs, and even in some current CPUs, internal cache memory is located in the CPU, and external is located on the motherboard between the RAM and the CPU. It is often called 'cache RAM'. Internal Cache memory is often called "level 1" or L1 cache. External cache is often called "level 2" or L2 cache. L2 Cache may be on-board (in the CPU chip) or in Static RAM (SRAM) chips on the motherboard. External cache acts as a quick access buffer between the RAM and L1 cache in the CPU.

L2 Cache RAM is a small block of high-speed memory, usually SRAM (Static RAM), located between the CPU and main memory. It is used to store data or instructions that are used often. There are several types of SRAM having a speed of 4-8 ns.



INTEXT QUESTIONS 4.1



4. Which register is used for storing the results that are produced by ALU?

 - (i) Program Counter (ii) Memory
 - (iii) Accumulated Register (iv) Memory Data register

4.1.3 Memory

Memory is a storage area in Computer which holds data and instructions. The measuring unit of memory is byte where

1 Byte = 8 bits

1024 Byte = 1 Kilo Byte (KB)

1024 KB = 1 Mega Byte (MB)

1024 MB = 1 Giga Byte (GB)

1024 GB = 1 Tera Byte (**TB**) and so on.

Have you heard the types of memory? There are two types of computer memories: Primary and Secondary. Primary memory is accessible directly by the processor. ROM and RAM are the parts of a primary memory. ROM stores some basic programs, pre-programmed by the manufacturer, while RAM is the area where data gets stored temporarily.

The storage capacity of the main memory is also very limited. Often it is necessary to store hundreds of millions of bytes of data for the CPU to process. Therefore, additional memory is required in all the computer systems. This memory is called **auxiliary memory** or secondary storage or **secondary memory**. In this type of memory the cost per bit of storage is low. However, the operating speed is slower than that of the primary memory. Huge volume of data are stored here on permanent basis and transferred to the primary storage as and when required. Most widely used secondary storage devices are magnetic tapes, magnetic disks, flash drives, CD-ROM etc.,

ROM

The ROM is Read Only Memory that can only be read by the CPU but it cannot be changed or modified as the name suggests. The Basic Input/Output System (BIOS) is stored in the ROM that checks and initializes various peripherals attached to the PC when the switch is turned ON. "BIOS" is a pre-programmed software that controls the computer's start up processes and other basic components such as keyboard, monitor/display, disk drives, etc. The programs that are preloaded in the ROM are also known as *firmware*. A conventional ROM looks like as shown in Fig. 4.4. The memories, which do not lose their content on failure of power supply, are known as non-volatile memories. ROM is a non-volatile memory. This area is only readable by the user and cannot be used for storing data.



Fig . 4.4 ROM



ROM can be categorized into two types:

1. The permanent type - includes Masked ROM and PROM
2. Semi-permanent includes EPROM and EEPROM.

1. PERMANENT ROM

- a) **Masked ROM:** In this ROM, a bit pattern is permanently recorded by the masking and metallization process. It is an expensive and specialized process.
- b) **PROM:** It is **Programmable Read Only Memory**. This memory has ni-chrome or polysilicon wires arranged in a matrix. These wires can be functionally viewed as diodes or fuses. This memory can be programmed by the user with special software that selectively burns the fuses according to the bit pattern to be stored. You know that it is not possible to modify or erase programs stored in ROM, but it is possible for you to store your program once in PROM chip. Once the programs are written, these cannot be changed and remain intact even if power is switched off. Therefore, programs or instructions written in PROM cannot be erased or changed.

2. SEMI PERMANENT ROM

- a) **EPROM:** This stands for **Erasable Programmable Read Only Memory**, which overcomes the problem of PROM and Masked ROM. EPROM chip can be programmed time and again by erasing the information stored earlier in it. It uses the technology of charging gates, using high voltage. Information stored in EPROM can be erased by exposing it to ultraviolet light.
- b) **EEPROM:** This stands for **Electrically Erasable Programmable Read Only Memory**. This concept is same as that of EPROM. The only difference is that the memory can be altered using electrical signals. The whole of the memory need not be erased.

RAM

RAM stands for **Random Access Memory**. It randomly selects and uses any location of the memory directly to store and retrieve data. It takes same time to retrieve any address of the memory as it takes for the first address. It is also called read/write memory. The storage of data and instructions inside the primary storage is temporary, i.e. data or instruction stored in RAM disappears from RAM as soon as the power to the computer is switched off. So now we can say that RAM is a volatile memory. You can store and retrieve data much faster with primary memory compared to secondary memory. Secondary memory such as floppy disk, magnetic disk, etc., are external and located outside the motherboard whereas RAM is located on the motherboard.

RAM is also referred to as **Dynamic Random Access Memory (DRAM)**. It consists of chips of memory, either in short chips (Dual In-line Pin (DIP) chips) or in memory modules. Memory modules are either "Single Inline Memory Modules" SIMMs or "Dual In-Line Memory Modules" DIMMs. A single 30-pin SIMM can hold up to 4MB and a 72-pin SIMM can hold up to 32 MB of memory. Nowadays, DRAM comes in either DDR, DDR2 or DDR3 form.



The term "**DDR**" stands for **Double Data Rate**. **DDRSDRAM** was capable of two data transfers per clock cycle, giving it twice the theoretical peak bandwidth of previous SDRAM (Synchronous Dynamic Random Access Memory or Synchronous DRAM is a type of memory that synchronizes itself with the computer's system clock). DDR2 RAM provides 4 data transfers per cycle, while DDR3 increases the number to 8. Assuming a base clock speed of 100Mhz, DDR RAM will provide 1600 MB/s of Bandwidth, DDR2 provides 3200 MB/s, and DDR3 provides 6400 MB/s. Examples of DDR2 and DDR3 RAM are shown below in the Fig. 4.5.

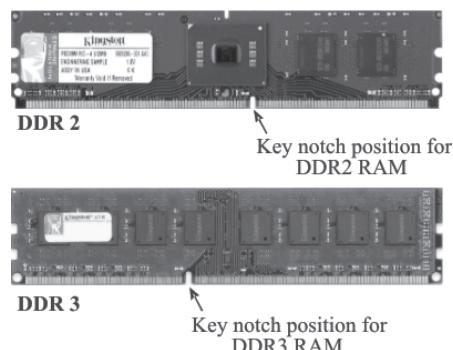


Fig. 4.5 DDR2 RAM and DDR3 RAM

These are also known as Magnetic Disk. It is an external storage unit that is located inside the system box. It looks like as given in Fig. 4.6. You might have seen the gramophone record, which is circular like a disk. Magnetic disks used in computer are made on the same principle. It rotates with very high speed inside the disk drive. Data are stored on both the surface of the disk. Each disk consists of a number of invisible concentric circles called tracks. Information is recorded on tracks of a disk surface in the form of tiny magnetic spots. The presence of a magnetic spot represents one bit (1) and its absence represents zero bit (0). The information stored in a disk can be read many times without affecting the stored data.



Fig. 4.6 Hard disk

4.1.4 Motherboard

Motherboard also known as main board, it provides the connectivity and holds the various internal components in the system box. Computer major components that work to process data, are located on the motherboard as shown in fig. 4.7.

It is made up of fibreglass, typically brown or green in colour, with a meshwork of copper lines. Power, data, and control signals, also called traces, travel to all components through these electronic circuits. A group of these wires assigned to a set of functions is called a bus. The components of a motherboard are: Chipset, Microprocessor or CPU, Clock, chip, Memory, Bus, ports etc.



Notes

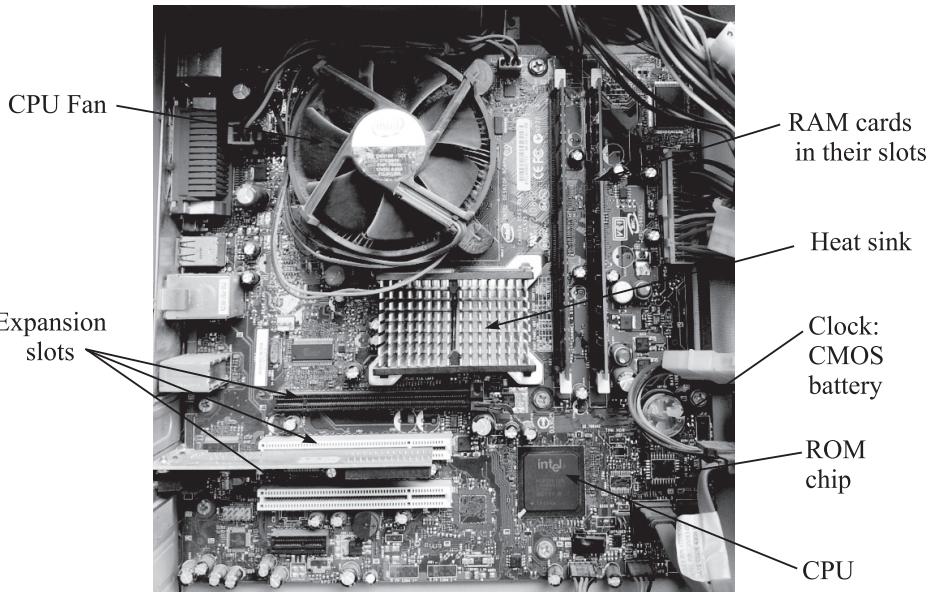


Fig. 4.7 Computer's major components located on the motherboard

Form Factors

In order to bring about uniformity in the design of motherboard so that further designing and assembly of a computer system may be eased, designs of motherboards of computer systems have been standardized. These standardizations are called Form Factor. A motherboard form factor defines the type and location of components, the power supply capacity and the processor type, that will fit onto the motherboard. There are several motherboard form factors, each with different layouts, components, and specifications. Any specific motherboard will be suitable only for certain processors and types of memories, based on type of processor and memory sockets installed on the motherboard.

The form factor is also a deciding factor for the use of video, sound cards, hard drive controllers (PATA and SATA) and support for various port types (parallel, serial, USB, etc). Therefore, if you want to assemble a computer, it must be ensured that the motherboard, the power supply, processor, memory and the box are compatible with each other. Form factors like ATX and BTX are commonly used in the motherboard industries.

- **ATX:** It is a short form of Advanced Technologies Extended form factor. With the need for a more integrated form factor which defined standard locations for the keyboard, mouse, I/O, and video connectors, in the mid 1990's, the ATX form factor was introduced. The ATX form factor brought about specific changes to the motherboard, along with the case and power supply. Some of the design specification improvements of the ATX form factor included a single 20-pin connector for the power supply, a power supply to blow air into the case instead of out for better air flow, less overlap between the motherboard and drive bays, and integrated I/O Port connectors soldered directly onto the motherboard. The ATX form factor was overall a better design for upgrading a system.



- **BTX: Balanced Technology Extended** form factor, unlike its predecessors is not an evolution of a previous form factor but a total break away from the popular and dominating ATX form factor. BTX was developed to take advantage of technologies such as Serial ATA, USB 2.0, and PCI Express. Changes to the layout with the BTX form factor include better component placement for back panel I/O controllers and it is smaller than micro ATX systems. The BTX form factor enables the industry to develop smaller size systems with an increased number of system slots. Today the industry accepts the ATX form factor as the standard.

Memory Slots

The motherboard has slots or sockets for system memory as shown in fig 4.8. Depending on the motherboard form factor, special sockets accept the memory card. These memory cards come in various types of DRAM or SDRAM memory sticks, also called modules. These sticks are **Single Inline Memory Module (SIMM)**, **Dual Inline Memory Module** and **RAMBUS Inline Memory Module (RIMM)**. SIMM is the oldest technology, while DIMM and RIMM are the current standards. Both of these physical memory slot types move data 64 bits or 128 bits at a time. For example, a motherboard having 6 memory slots, 4 DIMM slots for DDR2 and 2 DIMM slots for DDR3. The slots look similar, but DIMM for DDR2 have 184 pins while DIMM for DDR3 have 240 pins.



Fig. 4.8 Memory Slot

Processor Slots

Every motherboard contains at least one CPU socket, and its location depends on the form factor. A common CPU socket type is a **zero insertion force (ZIF)** socket, which is square in shape, has a placement lever that holds the CPU securely when closed, and makes it easy to put CPU in the socket when open. Various types of CPU sockets like PGA (Pin Grid Array), SPGA (Staggered Pin Grid Array) and LGA (Land Grid Array) are used on the motherboard for the CPU placement. These socket types uses different technologies for connection between the processor and the motherboard. Fig. 4.9 shows a typical slot for a processor.

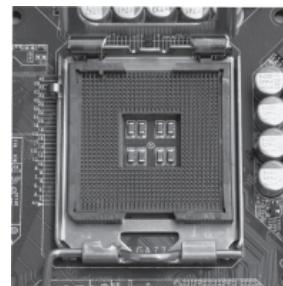


Fig. 4.9 Processor Slot



INTEXT QUESTIONS 4.2

5. $1024 \text{ KB} = 1 \text{ _____.}$
- | | |
|----------|---------|
| (i) MB | (ii) GB |
| (iii) TB | (iv) ZB |



Notes

4.1.5 Clock Chip and CMOS battery

The components in a computer are designed to operate in perfect synchronization with one another. This requires a time keeper. The clock chip provides the timing signals in the form of electronic pulses that are used by the internal components to set up a working pace. The chip generates a regular beat like the ticking of a clock and the operations are timed to this beat. The faster the beats, higher is the speed of the processor. The speed of a clock is measured in terms of frequency of pulses generated. Its unit is MHz (Mega Hertz). For example, a PC of third generation has a clock speed of 2.4 GHz. It is one way of measuring speed of a computer.

CMOS is an acronym for **Complementary Metal Oxide Semiconductor** and is shown in fig. 4.10. It is the term usually used to describe the small amount of memory on a computer motherboard that stores the BIOS settings. The CMOS is usually powered by a CR2032 cell battery. Most CMOS batteries will last the lifetime of a motherboard (up to 10 years in most cases) but will sometimes need to be replaced. Incorrect or slow system date and time and loss of BIOS settings are major signs of a dead or dying CMOS battery.

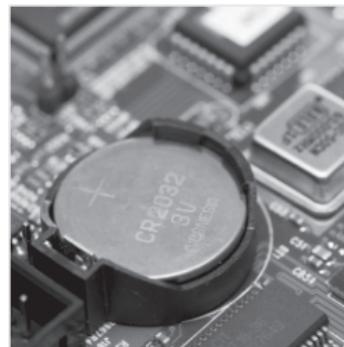


Fig. 4.10 CMOS Battery

The function of the CMOS battery is to maintain important information for the BIOS to begin the start-up sequence in computers. Remember, BIOS is pre-programmed software loaded in ROM. It stores the date and time and the system configuration details.

4.1.6 Drives

There are different types of drives:-

Hard Disk Drive (HDD): Have you seen Hard Disk Drive? A hard disk drive usually looks like a small size book but actually is a much heavier device as shown in Fig. 4.11.



Notes

The hard disk drive is the main, and usually largest, data storage device in a computer. Can you guess what are the files stored in HDD? The operating system, software files and most other files are stored in the hard disk drive.

The hard drive is sometimes referred to as the "C drive" due to the fact that Microsoft Windows designates the "C" drive letter to the primary partition on the primary hard drive in a computer by default. The sides of the hard drive have pre drilled, threaded holes for easy mounting in the system box. The hard drive is mounted so that the end with the connections faces inwards of the computer.

The rear end of the hard drive contains a port for a cable that connects it to the motherboard. It also has a connection for power supply.

CD/DVD Drive: This is also known as optical drive. Optical drives retrieve and/or store data on optical discs like CDs, DVDs, and BDs (Blu-ray discs) which hold much more information than any portable media like a floppy disk. Most optical drives can play and/or record onto a large number of different disc formats. An example of this drive is given in Fig 4.12.

Popular optical drive formats include CD-ROM, CD-R, CD-RW, DVD, DVD-RAM, DVD-R, DVD+R, DVD-RW, DVD+RW, DVD-R DL, DVD+R DL, BD-R, and BD-RE. The front of the optical drive has a small open/close button that ejects and retracts the drive bay door.

The sides of the optical drive have pre-drilled, threaded holes for easy mounting in the 5.25 inch drive bay in the system box. The optical drive is mounted so that the end with the connections faces inwards of the computer and the end with the drive bay faces outwards. The rear end of the optical drive contains a port for a cable that connects it to the motherboard. It also has a connection for power supply.

Tape Drive: A tape drive is a data storage device that reads and writes data onto a magnetic tape. Magnetic tape data storage is typically used for offline, archival data storage. It looks like fig. 4.13. Tape media generally is much cheaper and is of long archival stability. A



Fig. 4.11 Hard Disk Drive



Fig. 4.12 CD/DVD Drive



Fig. 4.13 Tape Drive



tape drive provides sequential access storage, unlike a disk drive, which provides random access storage. A disk drive can move to any position on the disk in a few milliseconds, but a tape drive must physically wind tape between reels to read any one particular piece of data. As a result, tape drives have very slow average seek times.

4.1.7 Chipset

The chipset is made up of one or more electronic components that connect(s) and control(s) the motherboard components, such as processor, expansion bus, and internal memory. All components communicate with the processor through the chipset, which is also called the hub of data transfer. Chipsets are a series of chips soldered onto the motherboard and are not upgradable without a replacement. Every processor has different chipset. The speed of the motherboard is determined by the speed of the chipset.

4.1.8 Ports

All the input and output devices like keyboard, printer and the mouse are connected to the system through ports. These ports are the interfaces for external devices on the motherboard. The CPU communicates with the outside devices, using these ports. Different ports of a computer are shown in fig. 4.14. Modern computers don't require many of these ports these days as most external connections go through the generic USB ports. However, some of these ports may be found to be existing on the motherboard. Usage and functioning of each of these ports are explained below:

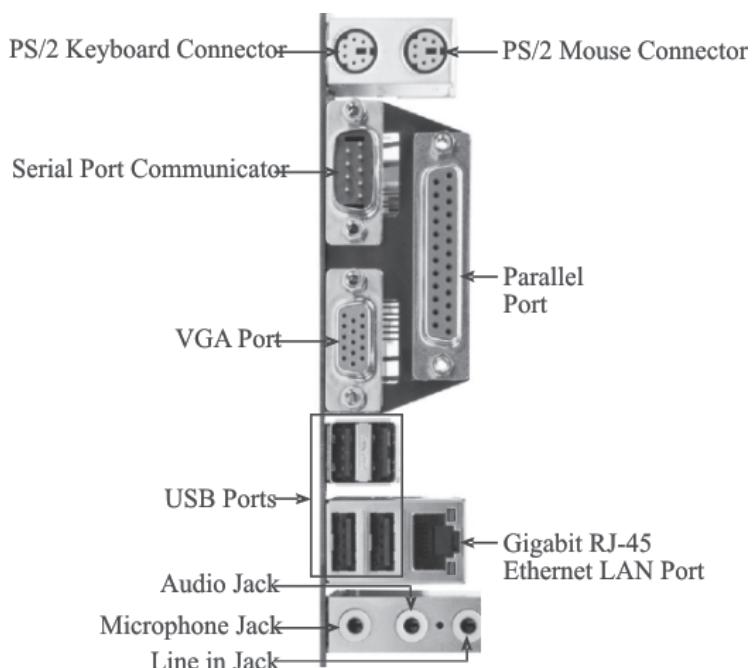


Fig. 4.14 Different Ports of a Computer



- (a) **USB port:** Universal Serial Bus (USB) is a popular port for high speed wired communication between electronic systems peripherals and devices with or without a computer. It eliminates the mix of different ports for different devices like printers, keyboards, mouse, and other peripherals. That means USB-bus allows many peripherals to be connected using a single standardized interface socket. USB also allows **hot swapping** means that the devices can be plugged and unplugged without rebooting the computer or turning off the device. That means, when plugged in, everything configures automatically.
- (b) **PS/2 Port:** ATX boards have 2 PS/2 ports, one for the mouse and the other for the keyboard. These are of same size and shape but with a different colour. This is because the mouse and keyboard connectors are not interchangeable. Plugging the keyboard in to the mouse connector and vice versa will make both of them useless. The usual way for these to be plugged in is to plug the mouse into the green port and the keyboard into the purple port.
- (c) **Serial Port:** The serial port is a type of connection that is used for peripherals such as mouse, gaming controllers, modems, and older printers. It is sometimes called a *COM port* or an *RS-232* port which is its technical name. There are two types of serial ports -- DB9 and DB25. DB9 is a 9-pin connection, and DB25 is a 25-pin connection. A serial port can only transmit one bit of data at a time, whereas a parallel port can transmit many bits at once. The serial port is typically the slowest port you will find on a PC. Today's computers have replaced serial ports with much faster and more compatible USB ports.
- (d) **Parallel Port:** The parallel port is mainly used for scanners and printers, and is associated with LPT1. It uses a 25-pin connector (DB-25) and is rather large compared to most new interfaces. Parallel ports send data in parallel i.e. more than one bit at a time. If the channel is 8 bits wide then a parallel port would send 8 bits at a time. These ports are much faster than serial ports. Parallel ports also are fast becoming extinct as the USB ports are taking over their place.
- (e) **Audio Port:** The Sound card that is built into the expansion board has three connectors. These are Speaker out, Line in and Mic in.
- (i) Speaker out is used for the connection of external speakers.
 - (ii) Line in is for external sources of audio that you want to hear through your computer.
 - (iii) Mic in port which is used for the Microphone.
- (f) **VGA Port:** It has the accommodation for the pins that are available with the monitor cable. If you have a VGA graphics card then this port will be on the back of your graphics card.



Notes

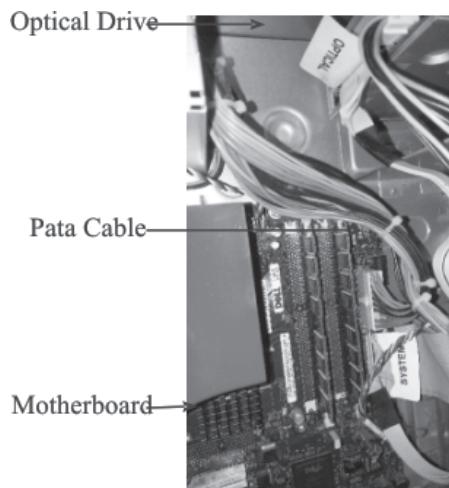
**INTEXT QUESTIONS 4.3**

9. CMOS is a type of small _____.
- (i) clock
 - (ii) memory
 - (iii) processor
 - (iv) socket
10. HDD stands for _____.
- (i) Hard disk data
 - (ii) Hard disk doctor
 - (iii) Hard disk drive
 - (iv) None of these

4.1.9 Cables

You must have seen various cables are used for connecting components in the system box. Each cable has specific configuration and interfaces. Major cables used in the system box, are as follows:

Parallel Advanced Technology Attachment (PATA) cables: Termed as PATA is an interface for connecting storage devices like hard drives and optical drives to the motherboard. Fig. 4.15 & 4.16 will help you to understand the PATA cables connectivity in the system box. These are long and flat cables with 40-pin connectors or 80-pin connectors on either side. One end plugs into a port on the motherboard, usually labelled IDE, and the other into the back of a storage device like a hard drive.

**Fig. 4.15** PATA Cables**Fig. 4.16** PATA Cables

Serial Advanced Technology Attachment cables: Termed as SATA is an interface used to connect hard drives and optical drives to a computer's motherboard. Fig. 4.17 and 4.18 shows the appearance and use of SATA cable. SATA transfer rates start at 150Mbps, which is significantly faster than even the fastest PATA drives. Do you know besides faster transfer rates, the SATA interfaces have several other advantages over the PATA



Notes

interface? For instance, SATA drives have their own independent bus, so there is no competition for bandwidth as there is with PATA drives. It also uses smaller, thinner cables, which allows for better airflow inside the computer. SATA cables can be as long as one meter, while PATA cables have a maximum length of 40cm. This gives manufacturers more liberty when designing the internal layout of their computers. Serial ATA uses only 7 conductors, while Parallel ATA uses 40. This means there is less likelihood of electromagnetic interference with SATA devices.



Fig. 4.17 SATA Cables

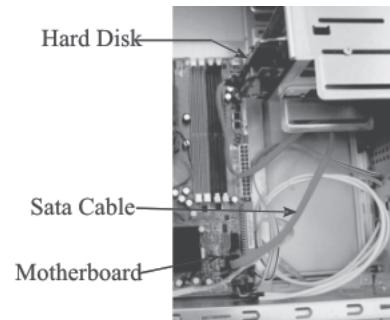


Fig. 4.18 SATA Cables

4.1.10 SMPS

SMPS stands for **S**witch **M**ode **P**ower **S**upply. SMPS is one of the most important components in the system box. As every electronic component is driven by power, SMPS device receives the main power supply and then converts it into the required voltages that the system requires. Successful operation of such device depends on the functioning of the power supply.

It is a device that takes input from the normal power supply of 240V AC current and converts into 5 V DC and 12 V DC current or as required by the computer. In simple words it steps down the voltage as a computer requires a lesser voltage power. It is also known as a power supply unit (PSU) located inside the system box. It supplies power to the motherboard and also to the other installed devices.

4.1.11 CPU Fan

Fig. 4.19 shows the connector and the motherboard header for the fan assembly. A computer fan is any fan inside, or attached to, a system box used for active cooling of the internal components by drawing cool air into the case from the outside. It expels warm air from inside, or moves air across a heat sink to cool a particular component. The fan moves the heat away from the heat sink.

The heat sink/fan assembly usually has a 3-pin power connector.



Fig. 4.19 CPU Fan



Notes

4.1.12 Heat Sink

Fig. 4.20 shows the heat sink. It is a two-part cooling device. The heat sink draws heat away from the CPU. It is designed in a special way to lower the temperature of an electronic device by dissipating heat into the surrounding air. All modern CPUs require a heat sink. Some also require a fan. A heat sink without a fan is called a **passive heat sink**; a heat sink with a fan is called an **active heat sink**. Heat sinks are generally made of aluminium alloy and often have fins to enhance their surface area.

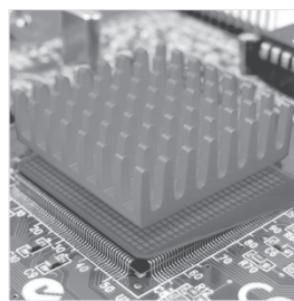


Fig. 4.20 Heat Sink

4.1.13 Connectors

Motherboard Power Connectors: Just like other components, motherboard requires power to operate. The ATX main power connector will have 20 or 24 pins. The power supply may also have a 4-pin or 6-pin ATX power connector that connects to the motherboard. A 20-pin connector will work in a motherboard with a 24-pin socket.

SATA Power Connectors: SATA power connectors use a 15-pin connector. Serial advanced technology attachment (SATA) power connectors are used to connect to hard disk drives, optical drives, or any devices that have a SATA power socket.

Molex Power Connectors: Hard disk drives and optical drives that do not have SATA power sockets use a Molex power connector.

Berg Power Connectors: The 4-pin Berg power connector supplies power to a floppy drive Cards.

4.1.14 Cards

Display Adaptor Card: Images that are formed on the monitor use a technology that is provided by a display adaptor card. The key elements of a display adaptor card are the video controller and the memory. The memory is used to store the information of the image before it gets displayed on the screen. The controller does the change that takes place on the image before it gets displayed on the screen.

Two types of display adaptors are available in the market. One type is for display in text mode and the other is for graphics mode. In text mode, individual characters get printed on the screen while in graphics mode the images get formed using dots called pixels. Resolution indicates the number of pixels on the screen. It is an important element that differentiates among various display adaptor cards. Higher the resolution (more the number of pixels), better the quality of pictures displayed on the screen. The different types of display adaptor cards are:

- **EGA:** Enhanced Graphics Adapter, is a card that supports 16 colours at a time. It provides a resolution of either 640 x 200 pixels or 640 x 350 pixels.
- **VGA:** Video Graphics Array system provides resolution of 720 x 400 pixels. In text mode and graphics mode, the resolution is either 640 x 480 with 16 colours or 320 x 200 with 256 colours.



Notes

- **SVGA:** Super Video Graphics Array, is a higher version of VGA. It provides resolution of:
 - (a) 640 x 480 pixels with 256 to 65536 colours
 - (b) 1024 x 768 pixels with 256 colours
 - (c) 800 x 600 pixels with 256 to 65536 colours
 - (d) 1280 x 1024 pixels with 16 colours

Video Card/Graphics Card: The video card handles video and graphics that are displayed on the monitor. Users who plan to watch DVD's, or edit home videos or play games need a graphics card. Sometimes the graphic processors are built into the motherboard.

A video adapter card, is the interface between a computer and a display monitor. Video adapter cards use Peripheral Component Interconnect(PCI), Advance Graphics Port (AGP), and Peripheral Component Interconnect Express(PCIe) expansion slots on the motherboard for connectivity

Network Interface Card (NIC): A Network Interface Card (NIC) enables a computer to connect to a network. As shown in fig. 4.21, it uses Peripheral Component Interface (PCI) and PCIe expansion slots on the motherboard for connection. NIC allows computers to communicate over a computer network by using cables or wirelessly.



Fig. 4.21 NIC

4.2 MORE ON FLASH MEMORIES

Flash memory is an electronic storage medium that can be erased and reprogrammed electrically. Flash memory is a non-volatile storage medium. You may have learnt about non-volatile memory which retains data even after its power supply being switched off. For example, when a Flash storage device is removed from a digital camera, all data (and pictures) which was stored or saved will remain on the Flash storage device.

The ability to retain data is key to flash memory applications such as digital films for digital cameras, mobile phones, tablets and other transportable devices. Flash memory technology is a mix of EPROM and EEPROM technologies. The term "FLASH" was chosen because a large chunk of memory could be erased at one time. The name, therefore, distinguishes flash devices from EEPROMs, where each byte is erased individually. NOR and NAND are the two forms of flash memory.

NOR Flash memory: The world's leading manufacturers of flash devices (Intel, AMD) use NOR cell configurations. NOR is mostly found in cellular phones (to store the phone's



operating system) and Personal Digital Assistant (PDAs). It is also used in computers to store the BIOS program.

NAND Flash memory: To reduce cell area, the NAND configuration was developed. NAND Flash memory reads and writes in high-speed, sequential mode, handling data in small, block sizes ("pages"). NAND Flash can retrieve or write data as single pages, but cannot retrieve individual bytes like NOR Flash. NAND Flash memory is commonly found in solid-state hard drives, audio and video Flash media devices, television set-top boxes, digital cameras, cell phones (for data storage) and other devices where data is generally written or read sequentially. For example, most digital cameras use NAND-Flash based digital film, as pictures are usually taken and stored sequentially. NAND Flash memory is less expensive than NOR Flash memory.



INTEXT QUESTIONS 4.4

Choose the correct answer:



WHAT YOU HAVE LEARNT

In this lesson, you have learnt about the internal components of a computer, their functions and their use in data processing. Some key points to remember are summarized below:

- The CPU is the processor that includes ALU and CU.
 - The system bus includes data, address and the control bus.
 - Address bus is unidirectional while data and control bus are bidirectional.
 - Data bus carries data and instructions, address bus carries memory addresses while control bus carries the control signals.
 - Register is a small unit of temporary memory located inside the CPU.
 - Cache memory is a small memory chip that lies between the RAM and the CPU. It is used to accelerate data transfer between them.

Notes

- ROM is a non volatile memory where the BIOS programs are pre loaded by the manufacturer and are used in booting of the system.
- Motherboard is a printed circuit board that provides connectivity and slots for various internal and external components directly or indirectly.
- USB ports are interfaces of connection for external devices. These ports allow any device to be connected without any driver to be installed separately. These implements plug and play technology.
- Connectors are electronic devices that connect a cable to a peripheral.
- Network Interface Card also known as NIC is used to connect a computer to a network



TERMINAL EXERCISE

1. What are the major components of a computer system?
2. Name any 6 internal components of a system box.
3. What is a CPU? How does it work?
4. Describe the various types of cables used inside the system box.
5. Differentiate between the following:
 - (a) RAM and ROM
 - (b) DDR2 RAM and DDR3 RAM.
6. What is SMPS?
7. State the function of a network card.
8. What is flash memory? Differentiate between NOR and NAND flash memories.



ANSWERS TO INTEXT QUESTIONS

4.1

1. (i) ALU
2. (iii) CPU
3. (i) System
4. (iii) Accumulated register



Notes

4.2

- 5. (i) MB
- 6. (ii) Non-volatile memory
- 7. (ii) False
- 8. (ii) Zero Insertion Force

4.3

- 9. (ii) Memory
- 10. (iii) Hard Disk Drive

4.4

- 11. (ii) Cable
- 12. (ii) Network Interface Card
- 13. (i) non-volatile



Notes

5

TOOLS FOR ASSEMBLING COMPUTER

A computer system contains many different components. When you assemble a computer, you have to fit / connect these components with each other. For this job, you need to use a number of tools. Therefore it is necessary for you to be familiar with these tools to use them appropriately.

In the previous lesson, you have learnt about anatomy of a Computer System and various components of a Computer System. You also learnt about their function in a Computer System. In this lesson, you will learn about the tools needed to assemble a computer using these components.



OBJECTIVES

After reading this lesson you will be able to:

- identify various tools used in assembling a computer.
- enlist the uses of each tool.

5.1 TOOLS

From practical point of view, you will not need many tools to assemble a computer. In fact, these days a PC can be assembled using only one screwdriver. But the things are easier if you have some additional tools also. Having these tools will make the job fun and will save you a lot of time. Fig. 5.1 shows some of the tools.



Screwdriver set



Needle-nose pliers

Tools for Assembling Computer



Wire Cutter



Notes



Cleaning brush
and Handsfree)



Torch (preferably LED)



Couglers

Fig. 5.1 Tools

5.1.1 Screwdriver Set

For small tasks related to computer system hardware, only one screwdriver is sufficient. But if you are serious about hardware assembly, you should have a set of screwdrivers. Screwdriver sets are easily available in the market. Most of the screws used in computers are number two, a few are little bit smaller. Also some screws are hard to reach. Therefore you need screwdrivers with long shafts. Usually screwdriver sets provide you one shaft and multiple changeable bits of different sizes. You must procure such a screwdriver set. The bits are usually magnetic. Magnetic bits help you to pick screws from the locations of hard reach. These also help you to fix the screws with ease.

5.1.2 Needle-nose Pliers

Nose pliers are useful when you have to pick and hold some cables. Sometimes screws reach such locations from where it is difficult to pick them by hand. In such situations nose pliers are helpful.



5.1.3 Wire Cutter

Now-a-days, all the components and cables are available in such a form that there is no need to cut any cables. However, there may be some situations where you will have to cut some cables, there you will require a wire cutter.

5.1.4 Couplers

If you need to make a cable joint inside a Computer in some situation, do it using couplers. This ensures safety from short circuits.

5.1.5 Anti-static Wrist Strap

Static electricity is the biggest danger to the expensive parts you are about to assemble. Even a tiny shock, very small for you to feel, can be harmful to some computer parts. To save the components from static electricity, it is important to use your anti-static wrist strap. After you have the power supply installed (NOT switched on) in the case, clip the end of the wrist strap to the outside of the power supply. This will ensure that there is no inequality of charge that will allow a spark to jump from you to the case.

5.1.6 Cleaning Brush

Sometimes you may need to remove dust from the computer parts. A small painting brush can be used to do that job. You can keep a convenient painting brush with you and use it when required.

5.1.7 Torch (Preferably LED and Handsfree)

It is always preferred to work at a place where there is sufficient light. But in real life situations, you may sometimes have to work at dimly lit areas. In such cases a torch will prove to be very helpful. The torch should be hands free with some hook or stand so that you can easily place it at any convenient location. You cannot work properly if you have to hold the torch with your hands or chin or neck. It is preferred to use an LED torch as it has much longer life than the conventional torch and consumes far less energy.

5.2 PRECAUTIONS

A computer runs on electricity and expensive electronic components are used in it. Therefore, it is very important to be careful and take precautions while assembling (or disassembling) a computer. Here, we enlist a few such precautions:

1. Switch off and unplug the computer before starting any work on it.
2. Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.
3. Always use screwdrivers that have insulated handles designed for electrical work.



4. Prepare a place to keep any screws that you may remove. A container or piece of paper with labels for each part (casing, motherboard, CD drive, etc) is ideal to avoid confusion between the similar-looking screws.
5. If a component does not come out easily, do not forcefully remove it. Instead, check that you are removing it correctly and that no wires or other parts are in the way.
6. Always use suitable screwdriver to suit the screw.
7. Do not apply any extra force to fit any screw. If a screw is not fitting with normal turn of the screwdriver, it means the screw is either misfit for that place or it has not been properly positioned.
8. Do not use pliers on the handle of a screwdriver for extra turning power.
9. Do not use defective screwdrivers (i.e., ones with rounded or damaged edges or tips; split or broken handle; or bent shaft).
10. Do not hold the screws or any such item in one hand while using the screwdriver with the other. If the screwdriver slips out of the slot, it may injure your hand.

**INTEXT QUESTIONS 5.1**

1. Cleaning Brush is required to:
(A) Paint the outer box (B) Spread lubricant
(C) Not required at all (D) Clean the dust
2. Couplers are used for:
(A) Joining cables (B) Cutting wires
(C) Picking screws (D) Removing Dust
3. Precautions that need to be taken while assembling a computer include:
(A) Not to apply an extra force (B) Clean handling
(C) Insulated screwdrivers (D) All of the above.

**WHAT YOU HAVE LEARNT**

In this lesson, you have learnt about:

- Different tools are used for assembling a computer.
- Screwdriver set which is the most important tool in the toolkit used for computer assembly.
- Precautions that must be taken while assembling or disassembling a computer.



TERMINAL EXERCISE

1. Why should you have screwdriver set and not just a single screwdriver for assembling a computer?
2. What is the importance of anti-static wrist strap?
3. Mohit is learning computer system assembly. He does not have any pliers in his toolkit. What kind of difficulties may he have to face during practicals?
4. List any four precautionary measures to be taken while working with screwdrivers.
5. Why should you not apply extra force to fit the screws?



ANSWERS TO INTEXT QUESTIONS

5.1

1. D
2. A
3. D



Notes

6

ASSEMBLING A PERSONAL COMPUTER

In the previous lesson, you have learnt various tools used in computer assembly and precautions to be taken while assembling and dis-assembling a computer. Now you are ready for assembling a computer. Assembling and dis-assembling a computer are not very difficult jobs. With some practice and careful handling of devices and knowledge in computer hardware components one can easily do this.

In this lesson you will learn step-by-step procedure for assembling a personal computer and dis-assembling a personal computer.



OBJECTIVES

After reading this lesson you will be able to:

- open the case.
- install and uninstall power supply.
- attach the required components to the motherboard.
- install and uninstall internal drives.
- attach internal cables.

6.1 ASSEMBLING PROCEDURE

Step 1: Procure the Parts

For assembling, personal computer following parts are required:

1. Motherboard
2. Computer Case (body) and Power Supply (Switched Mode Power Supply)



Notes

3. Hard Disk Drive (HDD)
4. RAM (Check the latest model in the market)
5. Processor Fan
6. SATA Cables / ID
7. CPU / Processor
8. Power Cables
9. Case Fan
10. Optical-Drive (DVD / CD-RW Drive)

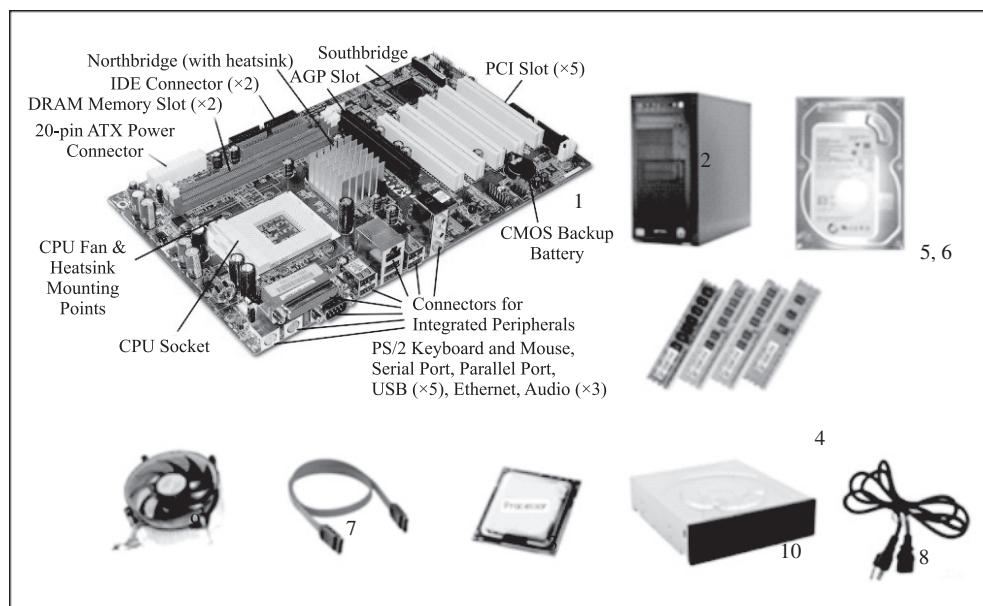


Fig. 6.1 Parts for assembling a computer

In the lesson 4, you have learnt about the components of computer system in detail. Those components are depicted in Fig 6.1.

1. **Cabinet (with SMPS):** Cabinet is also called as system box or system unit. It is a rectangular box which contains most of the components of a computer system. Now-a-days cabinet has built-in SMPS (Switch Mode Power Supply). SMPS takes the 240V AC (Alternating Current) input and supplies the required voltages to the components of computer system.
2. **Processor:** A processor is the brain of a computer. The speed of a computer depends mainly on the processor speed. The processor speed is measured in megahertz (mHz) or gigahertz (GHz).



Notes

3. **Heat sinks and Cooling fans:** When a computer starts, lot of heat is generated. To reduce the heat inside the computer, heat sinks are mounted on the processors.
4. **Motherboard:** As you know already that motherboard is the main circuit board in which all the components (like CPU, memory, mass storage interfaces, connectors for input and output devices etc.,) of a computer system are attached. The specifications of a motherboard depends on many factors like the chipset it has, maximum RAM it can support, bus speed, processor to be used etc.
5. **RAM:** Random Access Memory (RAM) is also referred as main memory or primary memory. RAM is used to store the data temporarily when the computer is on.
6. **Hard Disk Drive (HDD):** HDD is a data storage device. HDD stores all the software and data which we want to use in the computer. Hard disks capacities varying from a few GB to a few TB. This is also called secondary memory.
7. **SATA Cables:** Serial Advanced Technology Attachment (SATA) or Serial ATA cables that connects HDD and optical drive to the motherboard.

These are the components to be fixed inside the system box. Other than above some external devices like keyboard, mouse and monitor are also required.

Step 2: Collecting / organising the Tools and Accessories

Get the tools as specified in lesson 5

- i. Screwdriver set
- ii. Needle-nose Pliers
- iii. Wire cutter
- iv. Couplers
- v. Anti-static wrist strap
- vi. Cleaning brush
- vii. Torch (preferably LED and Hands free)

Step 3: Open the Case

To open the computer-system case, first remove the screws on the side panel. Then slide the side panel carefully to remove it.



Notes

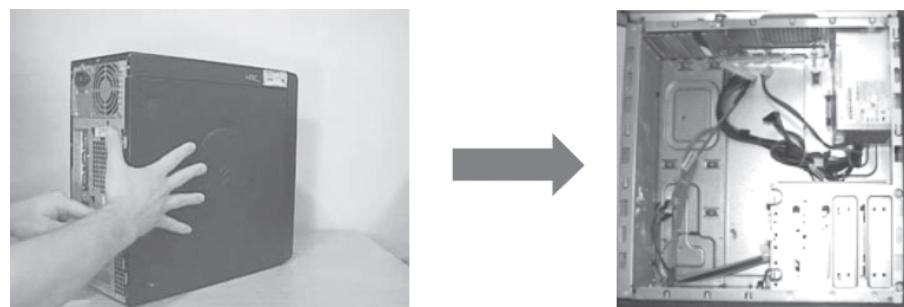


Fig. 6.2 Open the case

Warning: Open the case carefully, it might have sharp edges.

Step 4: Prepare the Case for Assembly

Before assembly, two things have to be performed:

- Remove any kind of packaging materials that could possibly have been delivered inside the case.
- Remove the cover on the suitable drive bay in the front of panel to mount our DVD drive.

Step 5: Ground Yourself

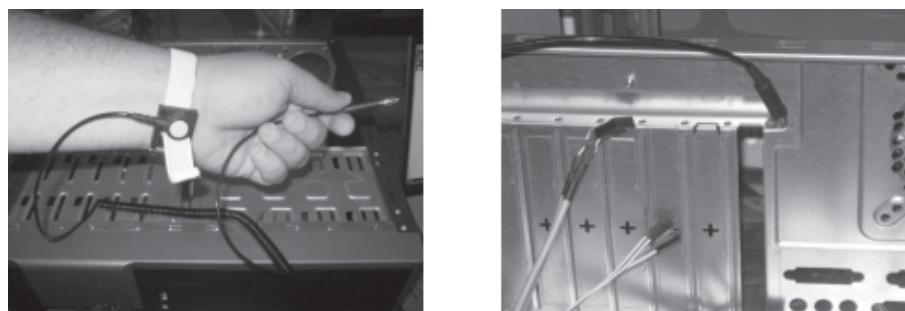
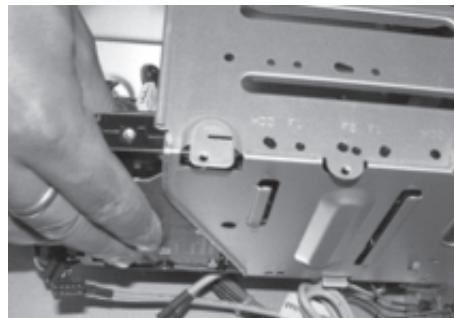


Fig. 6.3 Protecting hardware from static charge

Place the ground level strap on your wrist and attach the other end to the computer system case.

Caution:

If you don't wear ground level strap, static electrical energy could damage computer system parts.

**Step 6: HDD Installation****Notes****Fig. 6.4** HDD installation

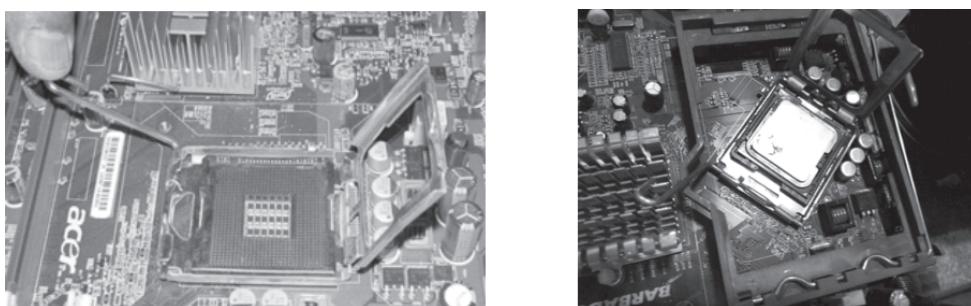
Put the HDD in one of the suitable case / slot/ bay (refer fig 6.4) available and tighten the screws.

Step 7: Optical Drive Installation**Fig. 6.5** Optical drive installation

Place the optical disk drive in the suitable bay (refer fig 6.5) and tighten the screw.

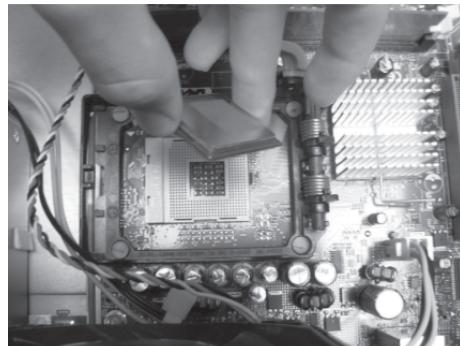
Step 8: Central Processing Unit (CPU) Installation

There is a clip on one side of the processor socket on the motherboard. Open that clip and the corresponding flap.

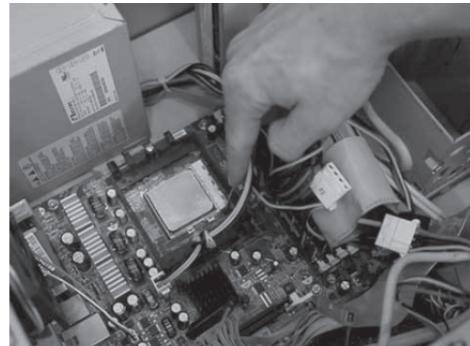
**Fig. 6.6** Processor installation on motherboard

**Notes**

Mount the processor on the processor socket as shown below. By observation you will find some cut on one side of the processor socket and a corresponding cut on the processor. Processor can be mounted on the matching sides only. Mount the processor and push a little.



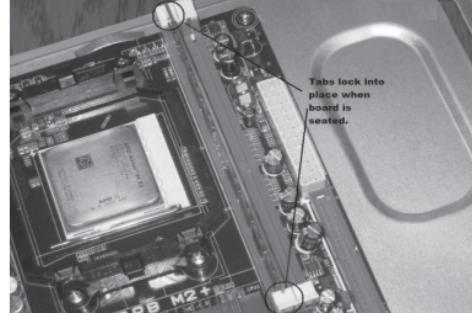
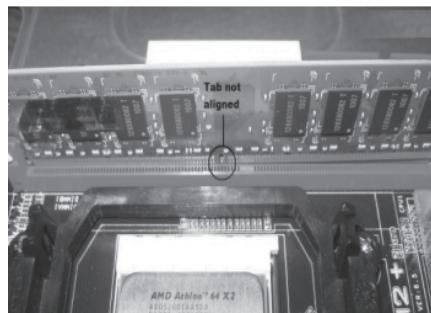
(a)



(b)

Fig. 6.7 (a-b) Placing the processor

After placing it correctly, push the clip down (as shown in figure 6.7 (b)) so that the processor gets placed properly.

Step 9: RAM Installation**Fig. 6.8 RAM installation**

Put RAM sticks in the memory slots on the mother board. Before this you may have to open the side locks of the memory slots if they are not already open. One stick can be placed in one memory slot. Here you will find corresponding cuts on the memory stick and the memory slot so that memory sticks can be inserted only in the correct manner. Then close the side locks.

Step 10: CPU Fan Installation and Motherboard Installation

Place the fan with heat sink just above the processor and tighten the screws. Ensure that it is placed correctly; otherwise the processor may get damaged.

Now you can place the motherboard in the cabinet and tighten the screws.



Notes

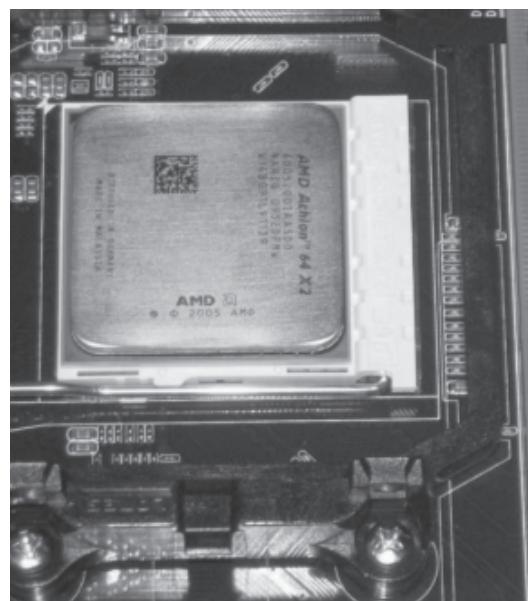


Fig. 6.9 CPU fan installation

Step 11: Case Fan Installation:

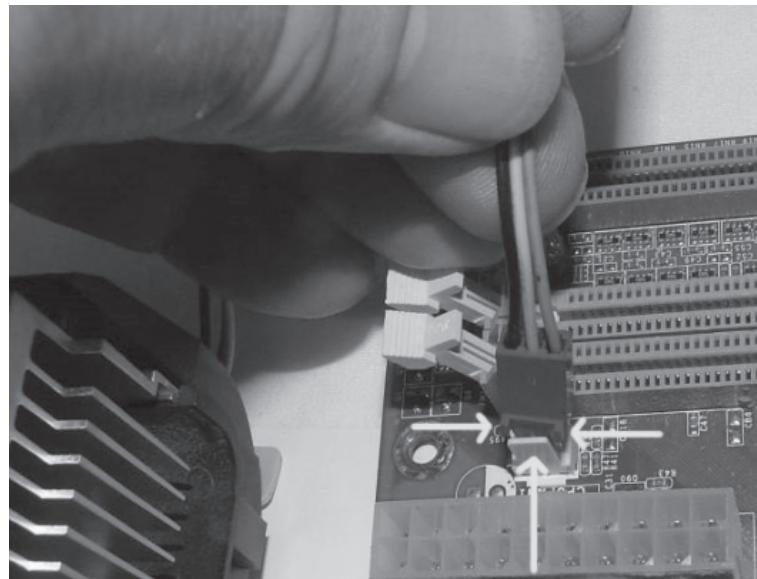
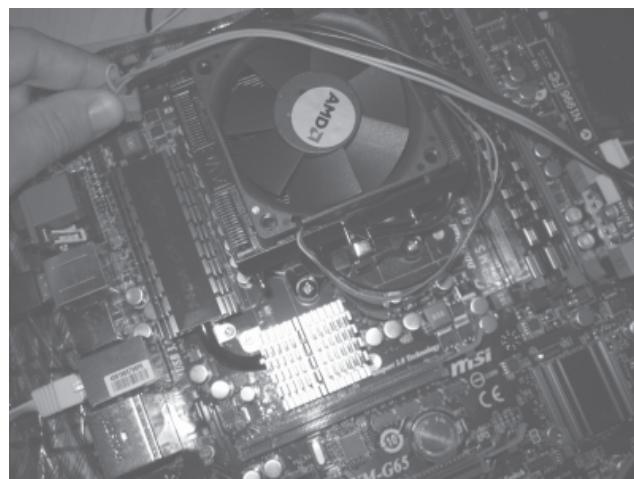


Fig. 6.10 Case fan installation

It is very simple to do. Just put it after all the components have been placed but before connecting cables and tight the screws.



Notes

Step 12: Install Power supply**Fig. 6.11** Install power supply**Step 13: Connect the cables****Fig. 6.12** Connect cables

If all the components are set to their place, then connect the power cables and data cables suitably. The details of cables may vary from motherboard to motherboard. Therefore, you have to refer to the documentation (which you must have received with the motherboard) to find the correct connections.

Now your hardware is assembled. You should once again ensure that all the screws are tightly fixed and cables are properly connected. Now connect the keyboard, mouse and monitor to your computer case and connect one end of the power cord to the computer and other end of cord with s pin plug to the power supply socket.

**Notes**

Similarly give power supply to the monitor. After that switch on the computer and use the bootable CD / DVD or pendrive to install the operating system and configure your computer for use.

**INTEXT QUESTIONS 6.1**

1. RAM is used to store the information _____ in the Computer.
2. SATA stands for _____.

6.2 DIS-ASSEMBLING (STEP-WISE PROCEDURE)

This section explains a step-wise procedure of how to dismantle a desktop computer.

Step 1: Unplug the following

- USB
- Power cables
- Keyboard
- Mouse
- Network cable
- Monitor
- Printer
- Any other connected device

Step 2: Cooling fans

Remove the case fan first and then the processor fan. (The Cabinet has two fans Fan1 for processor & Fan 2 for Case.)

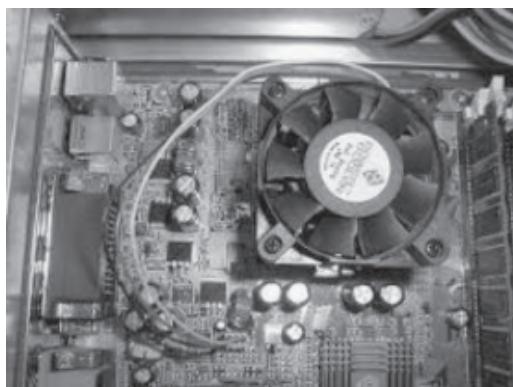


Fig. 6.13 Cooling fans



Step 3: Power supply

System supplies the power to the slots like portable drive, internal drive and CD/DVD drive[s]. Now, you remove the power supply from these slots.

Step 4: Processor

To remove the processor, open the clip and the flap (recall how did you install the processor) and carefully pull the processor out of its slot in the motherboard.

Step 5: Optical Drive

Unscrew the optical drive and pull it out from the front side of the cabinet.

Step 6: Hard disk drive (HDD)

Disconnect the hard disk drive from the mother board by pulling out the SATA / ID cable from the HDD. Unscrew the drive and remove it from the cabinet.

Step 7: Random Access Memory (RAM)

To remove the RAM chip, push down the tabs which are holding the chip in memory slots. If this process is done successfully, the chip will automatically come out from the memory slot.

Step 8: Motherboard

Before removing the motherboard, make sure that all the power cables have been detached from it and no external device is connected to it. Then you can unscrew the motherboard and carefully remove it from the cabinet.



WHAT YOU HAVE LEARNT

In this lesson you have learnt about installing hard disk drive, optical drive, mother board, Central Processing Unit and RAM. Also you have learnt about installing case fan, system fan and connecting cables for assembling your computer. In this lesson you have also learnt about how to dis-assemble your computer.

Some of the keypoints to remember

- Motherboard is the main circuit board in which all components like CPU, memory input and output devices etc., of a computer system are attached.
- Hard Disk Drive stores all the software and data which we want to use in computer.
- Serial Advanced Technology Attachment (SATA) cable connects HDD and opical drive to the motherboard.



TERMINAL EXERCISE



Notes

1. Write short note on assembling a Computer?
2. What are the components or parts you have to unplug before dis-assembling your Computer?
3. What are parts you required for assembling a Computer?



ANSWERS TO INTEXT QUESTIONS

6.1

1. Temporarily
2. Serial ATA or Serial Advanced Technology Attachment cable.



PREPARING SYSTEM FOR INSTALLATION

In the previous lesson, you have learnt about how to assemble a Computer System. Once we have assembled, the computer has to be made ready for use by installing various softwares. But one must be aware of the hardware and software requirements before preparing for installation. When you first startup your computer, setup the Basic Input/Output System (BIOS). Whenever you build the system or make any changes in its components, you need to run the BIOS setup. It additionally manages flow of information between the computer's software package and its connected peripheral devices.

Once the system is switched on, a set of operations is performed, which is known as booting. After booting you will proceed in the identification of Hard Disk Drive (HDD) and the device driver. In this lesson you will learn in detail about various aspects of installation in a computer system.



OBJECTIVES

After reading this lesson you will be able to:

- list the functions of BIOS.
- explain the types of booting.
- differentiate different types of Hard Disk Drives (HDD).
- list out the purposes of device drivers.

7.1 BIOS (BASIC INPUT/OUTPUT SYSTEM)

BIOS is a type of firmware. When BIOS boots up (starts up) it loads the operating system from hard disk or diskette drive into computer system's Random Access Memory. With BIOS, your computer system understands exact details about the attached input and output devices. Any modification in a computer requires changes in BIOS program.



Notes

7.1.1 The BIOS Program

Manufactures of processors and BIOS programs always follow a defined regulation. BIOS program will be allocated a fixed place in memory where the processor can look for. This place contains the initial code of BIOS program which starts executing and then begins. The boot sequence that will call different programs and load operating system in memory. The BIOS instructions are usually placed in a special pre allocated memory space.

7.1.2 Flash BIOS

The BIOS program in your system is programmed into a Read Only Memory (ROM). ROM which unlike RAM is not re-writeable, that is why they are referred to as "read-only". This creates an issue if you want to go for any changes in the BIOS. In the earlier days any changes required in the BIOS lead to a brand new BIOS chip which could only be provided by the manufacturers. With advancements in technology BIOS has started coming as a flash drive, which is easy to upgrade.

Systems having flash BIOS facility use a special variety of BIOS memory referred to as associate EEPROM, which means "**Electrically Erasable Programmable Read-Only Memory**". It can be easily deleted and changed employing a special program. This method is named as flashing the BIOS, which provides easy access at reduced cost.

Motherboards are now-a-days available to provide some "safety feature" to stop accidental (or malicious) changes (refer BIOS attack) to the flash BIOS. It is a jumper that has to be modified before acting as a flash BIOS upgrade. This additional security feature provides the facility feature of not to open the case, (which may be described in the manual provided along with motherboard).

The biggest disadvantage of upgrading BIOS with flash process is that BIOS is more exposed and sometimes if power supply interrupts then it may lead to corrupted BIOS chip. System can be corrupted if you boot with the incorrect flash BIOS chip consisting of wrong data/instructions.

7.1.3 BIOS Attack

An unauthorised alteration of the BIOS in a PC, is called as BIOS attack i.e. BIOS attack infects the BIOS with malicious code. BIOS routines are run when the computer is booted. BIOS with malicious code, while booting takes complete control of the computer.

7.1.4 Boot Block

The system can go to unbootable state if the flash process is not finished properly. This is because it may corrupt the BIOS code. Boot block helps to overcome from a state where the BIOS code is wrong or corrupted. Hence when next time the boot block loads up, it runs the correct code.



Notes

7.2 BIOS CMOS MEMORY

The BIOS settings must be saved in non-volatile memory so that it is accessible later when the system is reopened. A special variety of memory is employed to store this data, referred to as CMOS memory. It has small battery which is used to trickle a little charge to ensure that there is no loss of information.

CMOS is expanded as "**Complementary Metal Oxide Semiconductor**", a technology that helps to create semiconductors like processors, chipset chips, DRAM, etc. CMOS has the benefit of requiring less power as compared to any another technology. This is the reason why it is selected, so that the quantity of power needed from the battery would be negligible.

CMOS checksum is used as an error-detecting code. CMOS checksum error shows that boot up settings which were set earlier have been changed. On every occasion the system is booted, the system recalculates and compares it to the stored result. If they are totally different, then the system is aware that the CMOS has been corrupted warns you with a some message, like "CMOS confirmation Error".

As technology has evolved, various alternative kinds of batteries are used to supply power to the CMOS. BIOS setup is stored in CMOS in-built memory. Plug and Play BIOS carry a non-volatile memory to carry extended system configuration information which holds the resource configurations of system devices once Plug and Play is employed. CR2032 lithium coin cells are used to supply power to memory and real-time clock.

The durability of these cells varies from 2 to 10 years, determined by the motherboard type, time during which machine is switched off and the surrounding temperature. BIOS settings will be reset as default, if the cell is replaced, but if cell is replaced when power supply is on, changes in settings will not happen.



Fig. 7.1: CMOS battery

7.2.1 CMOS Memory Block

A battery provides backup so that the settings do not seem to be lost once the machine is switched off or unplugged. But sometimes certain things cause the CMOS memory to be erased or loose its settings. This might happen if the battery fails owing to some type of malfunction, or simply as a result of some motherboard error.

It is therefore advisable to keep a copy of the CMOS memory data. In normal conditions the battery can last for a long period of time keeping their BIOS setting intact. Backup is required only if there is any modification.

CMOS backup is not same as the regular backup. Alternative ways that are used for CMOS backup are:

Preparing System for Installation

- **Manual Backup:** It is done manually, by recording all current settings of the BIOS. Though it is a lengthy process but it is reliable.
- **CMOS Backup Utilities:** In this the various utilities automatically take the backup of the data at regular interval of time, which can be further stored to a storage device. If something happens accidentally, some of these utilities restore the complete CMOS settings.



Notes

7.3 BOOTING

When a computer is switched on, a set of instructions (operations) are performed by a computer. This complete process is known as **booting**. This process is repeated every time a machine is switched on after being turned off. This power-on self testing takes few seconds to complete. This process involves initializing peripheral devices and loading the operating system.

System starts with a little set of instructions in ROM and then subsequently the operating system is loaded on to the RAM. As the system is switched off, software as well as data are stored on nonvolatile storage devices.

Many systems use computer networks for booting. In this case, operating system is kept on the server, and a portion of it is shifted to the user's system with the help of Trivial File Transfer Protocol. After the transfer, the operating system takes over the control of the booting process of the user's machine.

Types of Booting

1. **Warm Booting:** A warm booting is started from the operating system. To perform warm boot in Windows operating system, you have to select, restart from the Start menu. In warm booting, there is no need of pressing a button on the computer itself.
2. **Cold Booting:** To perform a cold booting or hard booting you have to start up the computer which is turned off. A cold booting is done by pressing the power button to switch on the system.

In both types of booting the system clears the RAM and starts the boot sequence from scratch. Warm booting might not clear all caches, which stores temporary informations. If you are troubleshooting your computer, you have to perform cold booting.



INTEXT QUESTIONS 7.1

1. BIOS is:
 - A. Application Software
 - B. Hardware
 - C. Firmware



Notes

2. BIOS Program is located at
- Special reserved memory area
 - User memory area
 - No restriction

State True or False (T/F)

- A warm booting is done by pressing the power button of your computer.
- The boot operation starts by running an initial set of instructions.
- Operating system is in the Random Access Memory when system is turned on.

7.4 HARD DISK DRIVE (HDD)

7.4.1 Determining the Speed or RPM of a Hard Drive

To confirm the speed or Revolutions Per Minute (RPM) of a Hard drive you need to first determine the manufacturer and model of the drive. Once you have confirmed this, you will search for the drive on the manufacturer's web content to see the revolutions per minute of the drive. You may also look the sticker on the HDD to examine its revolutions per minute.

Disk Utilities

Many disk utilities that are designed to setup the hard drive can find and setup a hard drive; For instance, the fdisk utility will show extra data regarding the scale of the disk drive and and also partition of data.

You can have the list of all precise data concerning your Hard Disk, like specifying the manufacturer, model, type, and size of the drive.

7.4.2 Jumpers

Jumpers allow the system to close or open an electrical circuit. It is made of small pins set that can be covered by jumper block. A Jumper is also known as appropriately sized conductive sleeve.

A jumper is called **closed jumper** when it is covering at least two pins and an **open jumper** when it is covering only one pin or no pin.

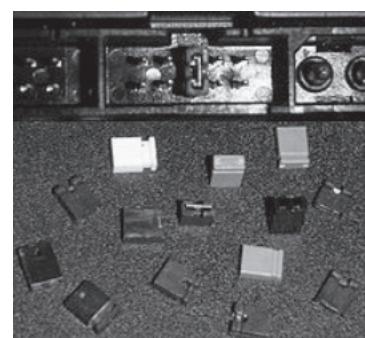


Fig. 7.2: Jumper

7.4.3 Cable Select

Another method of setting up the hard disk is Cable Select system. As obvious, which connector on the cable is connected to a device; decides whether it is designated as master or slave. Master/slave is a model of communication where one device has one-way control

Preparing System for Installation

over one or more devices. The advantage of this system is that when hard disk is changed from slave to master or vice versa, settings need not to be changed.

With the design of this new system, connecting hard drives becomes easier as master/slave jumper settings are not required to be configured again and again. Cable Select also known as CS, is completely different from traditional IDE cables.

With the advancement in the technology, enhancement in the concept of CS has also happened. You are able to set each drive to CS connect.

To deploy cable select, each of the hard disks must be set to the "cable select" (CS) setting, typically employing a jumper, with the usage of a special cable which typically has three connectors, with the center one supposed for the motherboard. The remaining two connectors are used alternatively to connect to the drives which can act as master or slave. The drives can be inter-changed by altering the connector on the cable they use.



Notes

7.5 DEVICE DRIVERS

Device driver is a set of instructions that determines and helps in using a peripheral device which is connected with the system. Once a program calls a particular procedure within the driver, it sends instructions to the device. Drivers are specific to hardware and dependent on operating system.

Application

Modern hardware and operating system drivers work in numerous environments. Drivers may interface with many devices such as: printers, video adapters, Network and sound cards, image scanners or digital cameras etc.



INTEXT QUESTIONS 7.2

State True or False

6. A jumper is closed when it is covering only one pin or no pin.
7. We use small tools like tweezers or very small plier to change the settings of jumper.
8. Device driver is a set of instructions, that helps in using peripheral devices which is connected with the system.



WHAT YOU HAVE LEARNT

In this lesson you have learnt about BIOS, flash BIOS, functioning of BIOS, attacks on BIOS, CMOS and its backup, bootstrap loading and its types, HDD, jumpers, Master/Slave HDD, device drivers and their purpose and applications of device drivers.

Notes

Some of the Keypoints to remember

- Basic Input Output System (BIOS) is a type of firmware.
- An unauthorised alteration of the BIOS in a PC is called as BIOS attack.
- CMOS Checksum is used as an error-detecting code.
- When a computer is switched on, a set of instructions are performed by a computer is known as booting.



TERMINAL EXERCISE

1. What is a BIOS Attack?
2. Describe Flash BIOS? What is its use?
3. What is the purpose of Jumpers?
4. What are the applications of device drivers?



ANSWERS TO INTEXT QUESTIONS

7.1

1. C
2. A
3. False
4. True
5. False

7.2

6. False
7. True
8. True



Notes

8

OPEARING SYSTEM INSTALLATION

Operating System acts as an interface between the Computer System and the user. It is the platform on which all other applications are installed. Hence Operating System installation ensures that the hardware meet the least requirements for running the system efficiently. You are also aware that data in Computers is stored in the form of files. To manage, organize these files on various storage media, we have file systems. File system is a method of managing various files in the computer. This lesson will make you understand the system requirements, file system and installation steps for Windows and Linux (Ubuntu) Operating Systems.



OBJECTIVES

After reading this lesson you will able to:

- list file system used in Windows operating system.
- install Windows 7 operating system.
- list the types of file system used in Linux.
- install Linux (Ubuntu) Operating System.

8.1 WINDOWS OPERATING SYSTEM

8.1.1 File System

As mentioned before, a file system is a technique for managing files on various storage media, such as hard disks, CDs etc. In the Microsoft Windows operating system, users are provided with the various options of file systems while formatting such media. In Windows the following two most common file systems are used:

- FAT
- NTFS



File Allocation Table

The **File Allocation Table** (FAT) 32 and FAT were used in earlier versions of Windows Operating systems. It was developed by Microsoft to manage data on storage media. FAT contains names of files, date and time stamps, names of directories and attributes of files.

The FAT system is compatible with all major operating systems. It was the default file system for all Windows operating system prior to Windows 2000. But FAT suffers from few problems such as over-fragmentation, file corruption and limits to file names and size.

New Technology File System

Microsoft required an operating system which gives additional steadiness and wellbeing measures. The Windows objective was to design operating system that ought to be as secure as Unix, supported expanded filenames, had network capability and did not waste storage space. In 1993, Microsoft released Windows nongovernmental association 3.1 with NTFS (**New Technology File System**) version 1.0. NTFS provides a well-formed File system that is largely used by Windows 2000 and XP and was developed by MS Corporation for its Windows NT line of operating systems, beginning with Windows NT 3.1 and Windows 2000, including Windows XP, Windows Server 2003, and all their successors to date.

NTFS is refined as compared to FAT file system in a number of respects:

- file compression - NTFS can compress files.
- encryption - provides strong and secure files or folders.
- journaling - NTFS is a journaling file system (uses NTFS log to record changes).
- hard links - allows different file names to directly refer to the same file contents.

8.1.2 WINDOWS 7

Windows 7 uses the NTFS (New Technology File System) which is the most regularly utilized system these days. This is a file of an extraordinary configuration that is found on the MFT (Master File Table) zone of an allotment. The master file table (MFT) is a database in which information about every file and directory on an NT File System (NTFS) volume is stored. There is at least one record for every file and directory on the NTFS logical volume. Each record contains attributes that tell the operating system (OS) how to deal with the file or directory associated with the record. This zone is just accessible to OS administration applications and concentrated devices that can address the hard drive straightforwardly. For e.g., windows kernel, device drivers etc. The MFT is a table that rundown all files with their traits and security parameters. The MFT likewise stores locations of divisions (hard drive clusters) where file substances (fragments) are physically present.



Windows

This is the imperative folder that is placed on the computer's hard disk partition. It keeps all executables, drivers and libraries of the system. That is the reason it is emphatically prescribed not to erase files from folder. This folder may have an alternate name.

Users

This folder contains client (users) profiles. Naturally it is found in the root folder of the system partition. It contains various standard folders. These folders contain different client subfolders including desktop, documents, pictures, favorites. Other subfolder is utilized to store data of different applications, programs, appdata, application data, cookies, local settings and others. You should not change their substance unless you are truly certain what you are doing.

Boot

This folder contains working system boot files. It is covered up, and it is not prescribed to change its content.

Program data

Applications store their information, setup files and other data in this folder. One should not erase anything from this folder.

Recuperation

This folder contains data needed to log into the System Recovery Console. It is concealed and you can not change its content.

Recycle.bin

This folder is Windows Recycle Bin which contains the erased files. The folder is covered up, however you can securely erase its content and in addition the folder itself. The files in this folder can be restored.

Windows 7 Installation

To start the installation of WINDOWS 7 on any supported PC, you must start with the modifying your BIOS settings to make your PC boot from a CD/DVD or USB drive before it boots from the primary hard disk.

1. Insert a genuine Windows 7 CD in your DVD-ROM drive. Now Windows 7 installation screen appears as shown in Fig. 8.1.

The Microsoft windows installation window appears

Notes



Fig. 8.1 Starting Windows

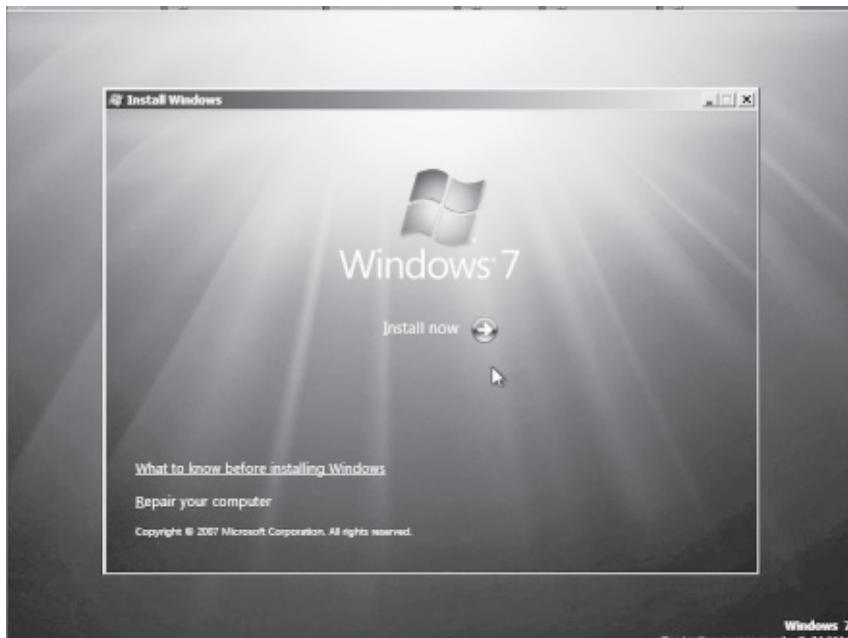
2. On Windows 7 installation page you choose desired language (shown in Fig. 8.2)



Fig. 8.2 Enter your language and other preferences



- Now select **Install now** as shown in Fig. 8.3



Notes

Fig. 8.3 Install Windows 7

- Accept the terms and conditions (read instructions before accepting)

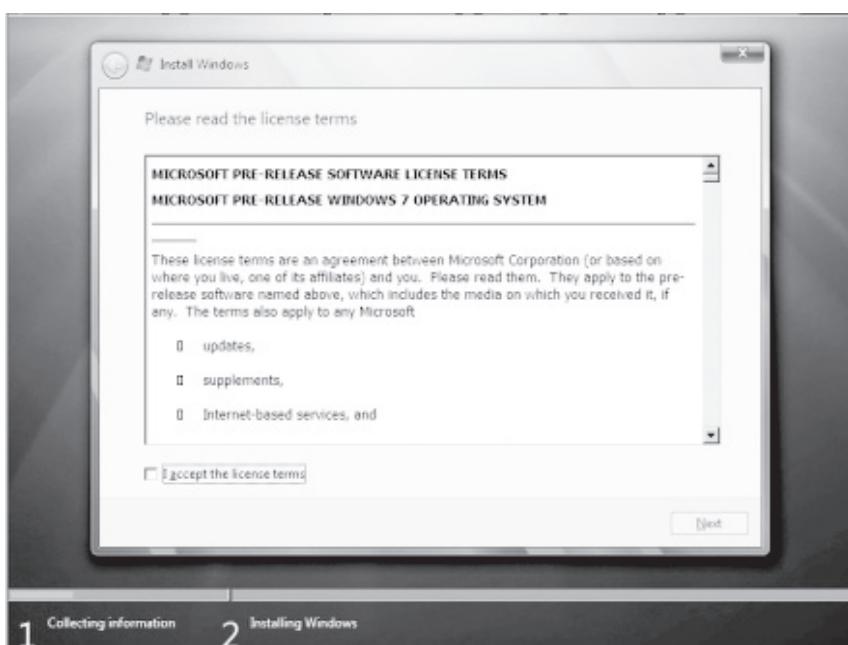


Fig. 8.4 Accept License terms

Notes

5. Then the option for upgrading or reinstallation of the windows appears (shown in Fig. 8.5)

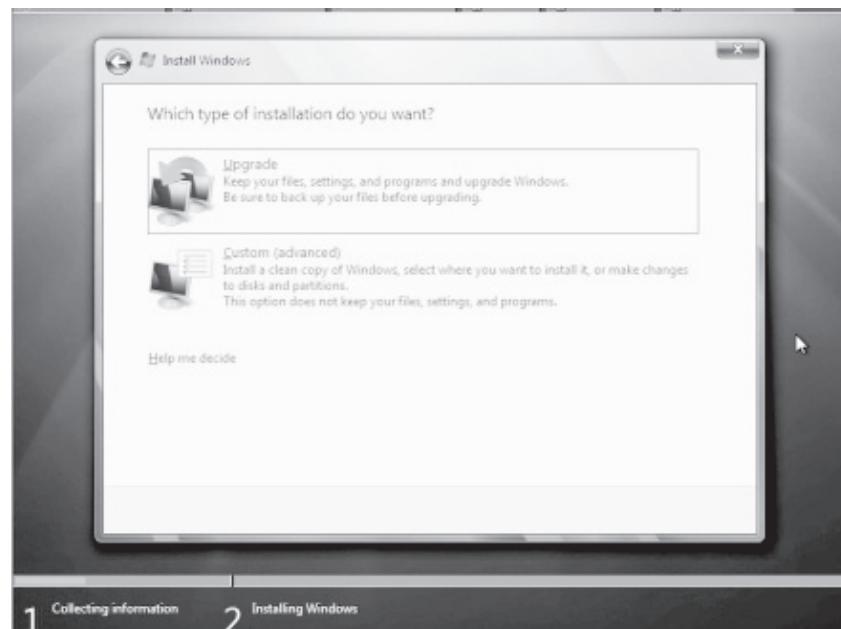


Fig. 8.5 Choose type of Installation

6. If you are upgrading, then the compatibility report is checked and displayed as shown in Fig. 8.6

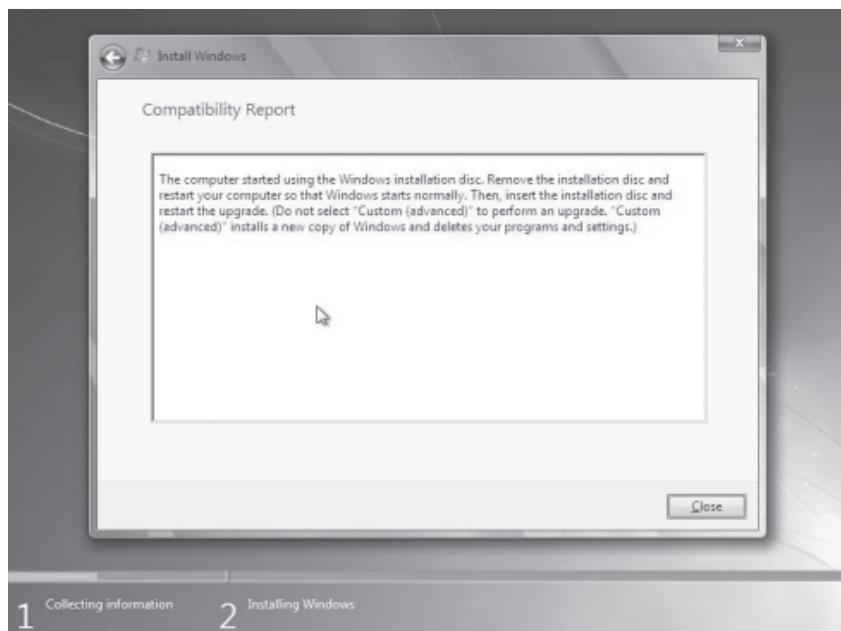


Fig. 8.6 Compatibility Report

Opearting System Installation

7. Choose the drive in which Windows has to be installed and drive partition can be selected from advanced options (shown in Fig. 8.7).

Notes

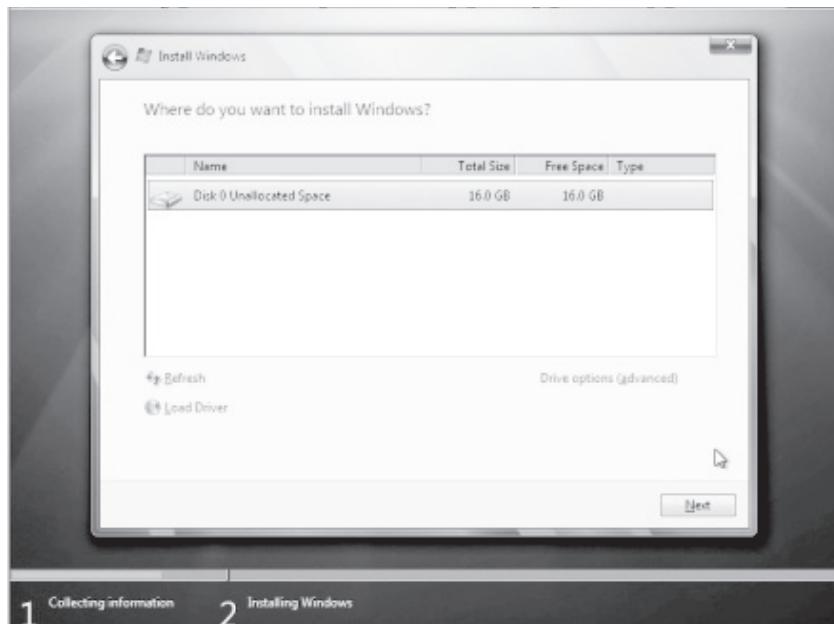


Fig. 8.7 Choose the drive

8. Windows 7 installation starts

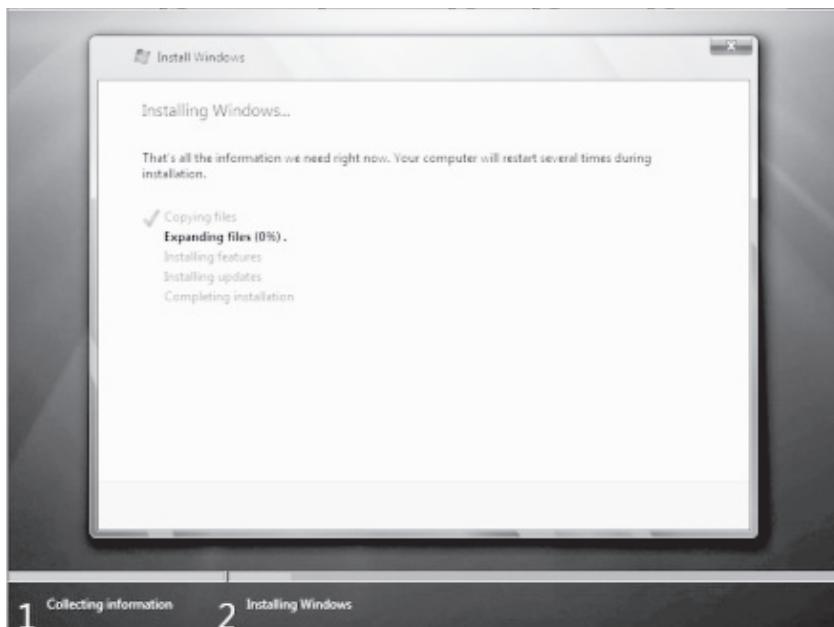


Fig. 8.8 Installing Windows

Notes

9. Now System reboots



Fig. 8.9 System reboots

10. Then the system registry settings are updated as shown in Fig. 8.10



Fig. 8.10 Setup is updating

Opearating System Installation

11. The boot process continues and the system will start its services as shown in Fig. 8.11

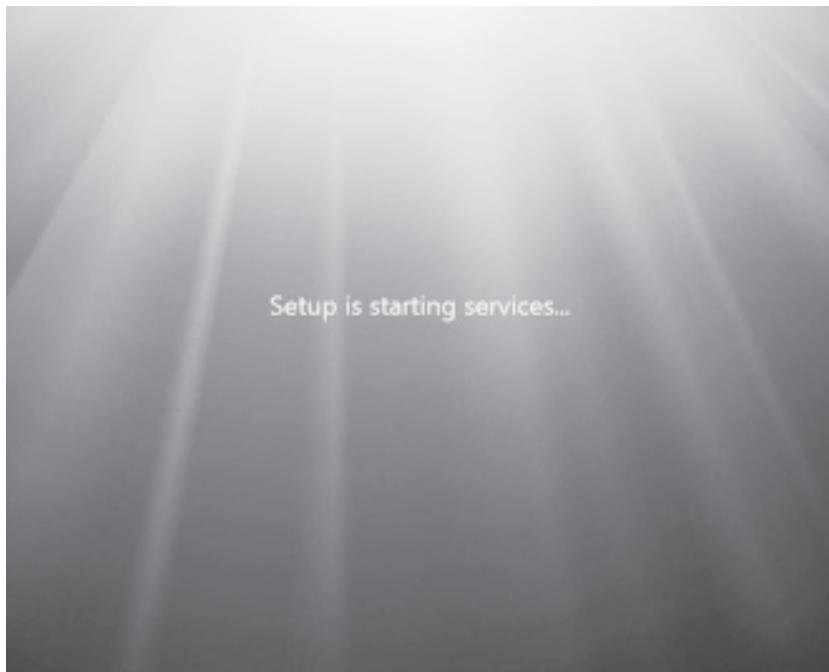
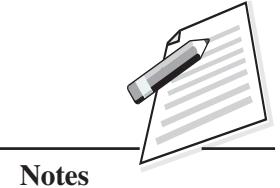


Fig. 8.11 Setup is starting services

12. Then you are redirected to the boot page and video performance is checked by the boot process (as shown in Fig. 8.12).

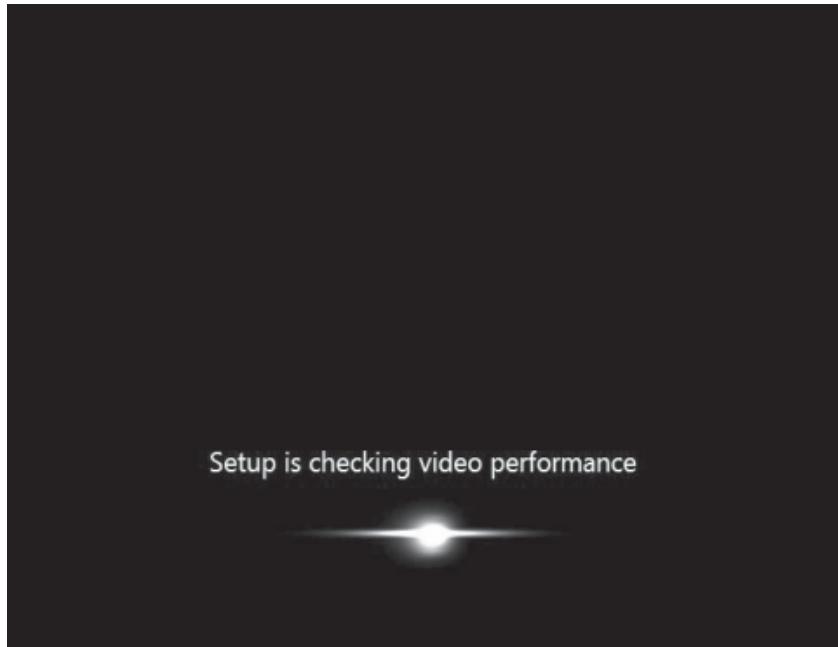


Fig. 8.12 Setup is checking video performance

Notes

13. Enter username and computer name in the screen (refer Fig. 8.13) that appears.

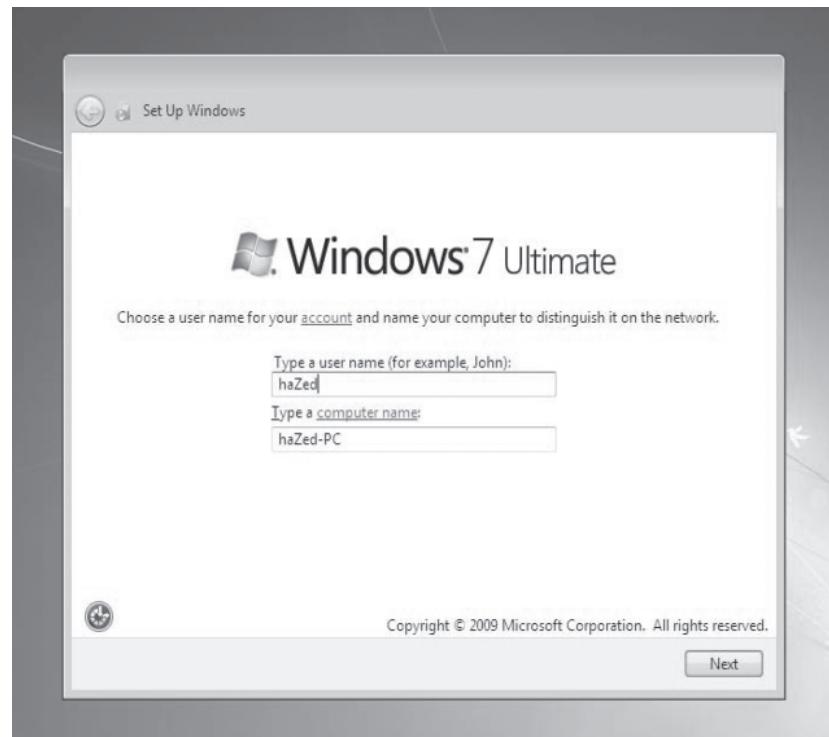


Fig. 8.13 Enter username and Computer name

14. Enter your password (shown in Fig. 8.14)

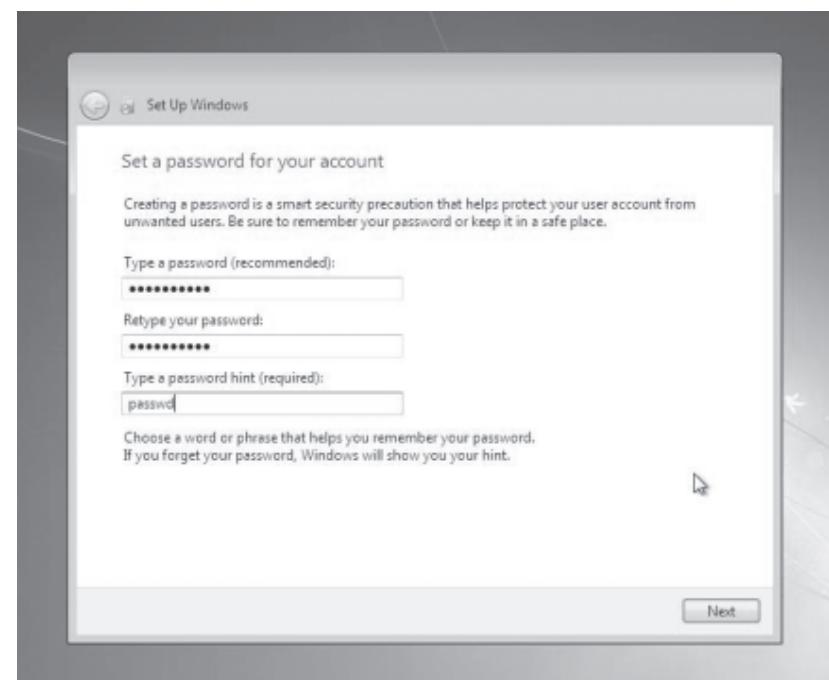


Fig. 8.14 Set a password for your account

Opearting System Installation

15. The screen appears showing that Enter the product key and Click Next (as shown in Fig. 8.15)



Notes

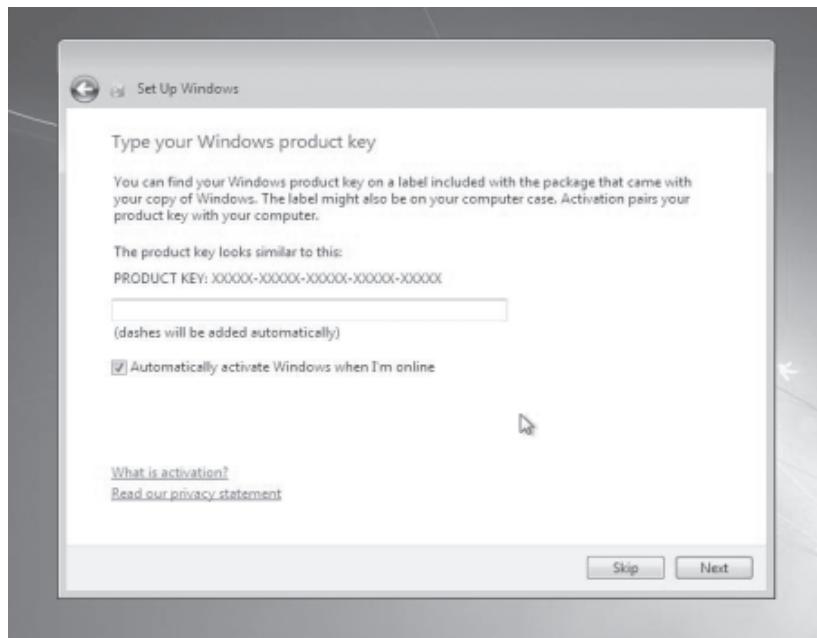


Fig. 8.15 Enter Product key

16. Time zone can be changed according to the place (as shown in Fig. 8.16)

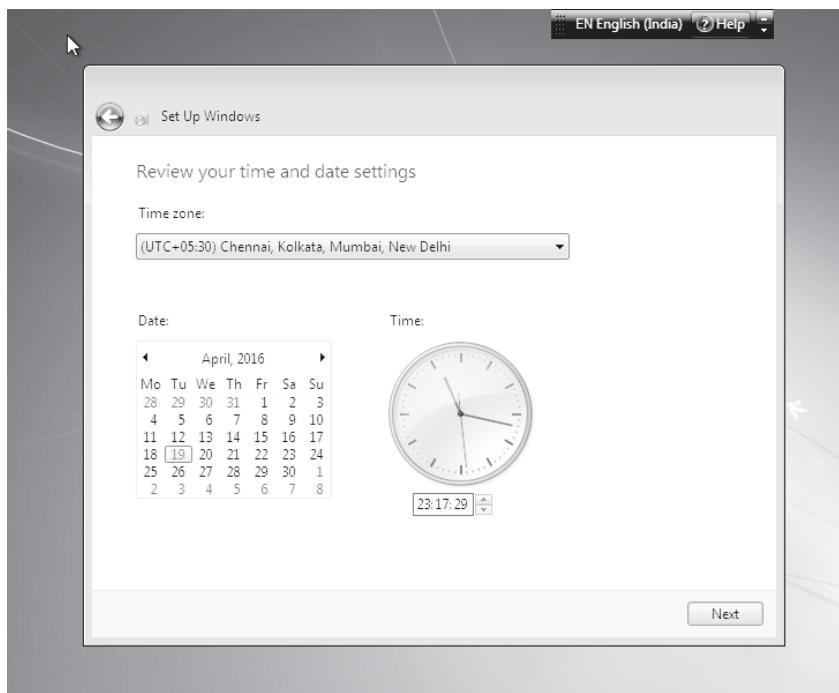


Fig. 8.16 Review your time and date

Notes

17. You can select the type of network whether home or office (as shown in Fig. 8.17).



Fig. 8.17 Select the type of Network

18. Choose home network and complete the remaining configuration if you need (as shown in Fig. 8.18).

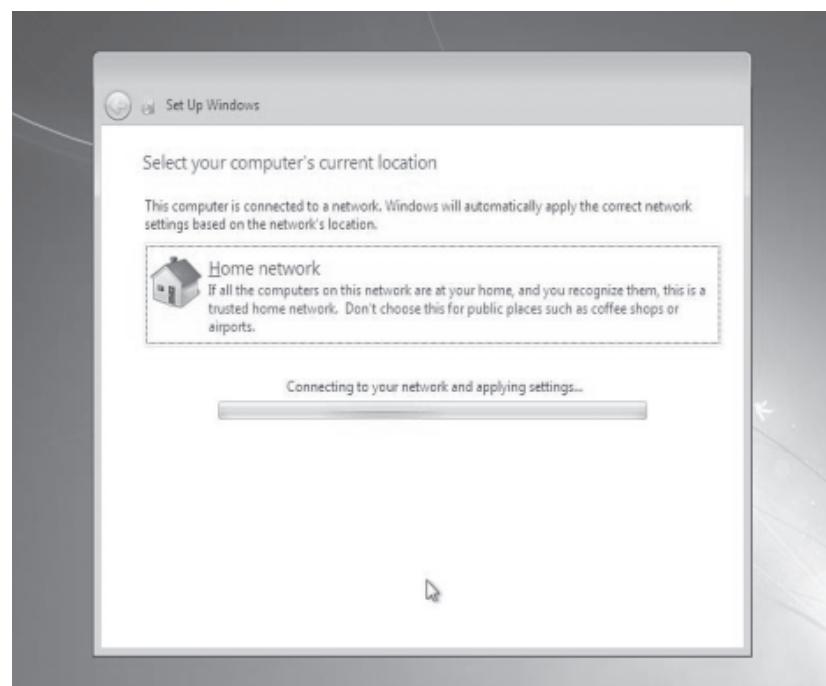


Fig. 8.18 Select Computer's current location



Notes

19. Then you get a key for the home devices sharing, then Welcome screen appears (refer Fig. 8.19).

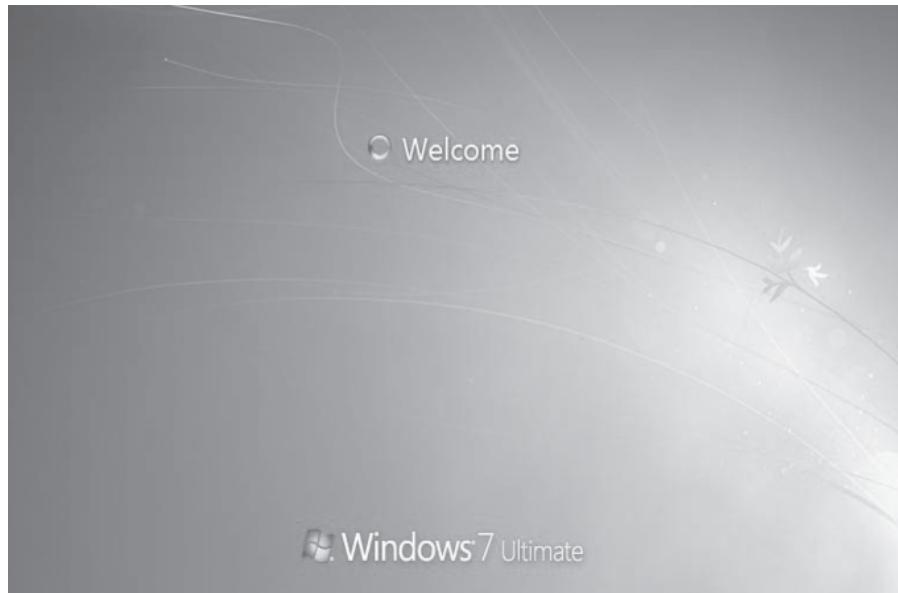


Fig. 8.19 Windows 7 Welcome screen

20. The Windows 7 installation is complete, now you can view the desktop. Fig. 8.20 depicts Windows 7 desktop.



Fig. 8.20 Windows Desktop



INTEXT QUESTIONS 8.1

1. was the default file system for all Windows Operating System prior to Windows 2000.
2. Windows 7 uses file system.

8.2 LINUX OPERATING SYSTEM

Linux is an open source operating system (means the original source code is freely available for modification or enhancement by anyone). It is a secured operating system.

8.2.1 LINUX File System

File system types used in Linux are Ext3 (Extended File System), Ext4 ,VFAT (Virtual File Allocation Table) and Swap.

8.2.2 Partitioning of Disk

You prefer to have partitions in your disk. If your hard disk failed / crashed only that particular partition will be effected, whereas other partitions will have your files. Objectives of having diverse partitions is to accomplish higher information security if some crash or hard disk failure occurs. When a mishap happens, only the concerned partition information will be effected, whereas other partitions are likely to survive.

Linux has two segments in it:

- **Data segment:** It is a typical Linux framework information, including the root part containing all the information to run the framework; and
- **Swap segment:** It is an extension of the machine's physical memory, additional memory on hard drive.

Mount Points

Windows operating system uses drives (C, D, E etc.,) to access disk space. Linux uses mount points. In Linux mounted disk space, all folders will be under the root of the file system. i.e., '/' forms the root of the file system. Examples of mount points : /bin, /root, /home.

Inode entry

For most clients and for most typical framework association errands, it can be recognized that records and lists are in a tree structure, whereas machine does not understand tree-structures.

In a record framework, which is simply the collection of records (inode numbers and hard links pointing to the actual data) a report is identified with an inode number, a kind of



serial number containing information about the genuine data that makes up the record: to which this archive has a spot, and it is set on the hard disk tracks. A special type of link called hard link is used to point to the actual contents of the file stored on disk tracks. Hard links are stored beside the inode number for a particular file in the inode entry.

Each part has its own specific set of inodes; all through a framework with different segments, records with the same inode number can exist.

Each inode depicts a data structure on the hard drive, securing the properties of a record, including the physical zone of the report data. Exactly when a hard drive is instated to recognize data stockpiling, generally in the midst of the starting framework foundation methodology or when adding extra plates to a current framework, a settled number of inodes is made. This number will be the best measure of records, of diverse sorts (tallying registries, one of a kind records, joins etc.) that can exist. We ordinarily have 1 inode, each 2 to 8 kilobytes of limit.

At the time another record is made, it gets a free inode. In inode, the accompanying data is:

- Holder and gathering manager of the file.
- File sort type (normal, catalog, ...)
- Contents of the file.
- Date and time of data created and changed in the inode.
- Number of connections to this file (see later in this section).
- File size.

8.2.3 Ubuntu Installation (Step-wise procedure)

To start the installation of Ubuntu on any supported PC, you must start with the following steps:

- (i) Modify your BIOS settings to make your PC boot from a CD/DVD or USB drive before it boots from the primary hard disk.
- (ii) Create a bootable copy of the Ubuntu disk image on a CD, USB flash drive and then insert it into the CD/DVD drive or USB port if using a USB drive.
- (iii) Finally, installation begins.

1. Start and selection screen

Select a language. This selection screen also offers several choices (refer Fig. 8.21). Start Ubuntu without any change.



Notes

Operating System Installation

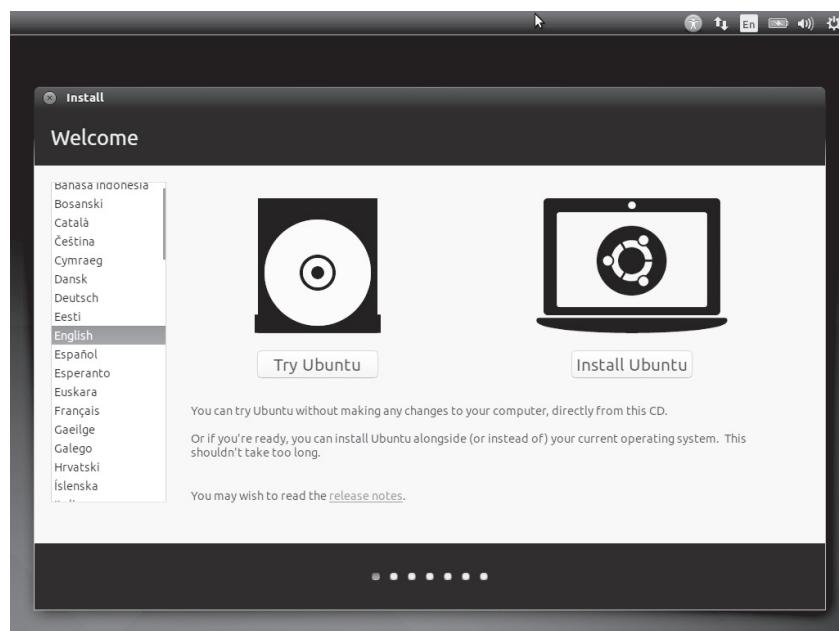


Fig. 8.21 Install Ubuntu

2. You can choose the time-zone manually (shown in Fig. 8.22) or let the system detect it based on your location.

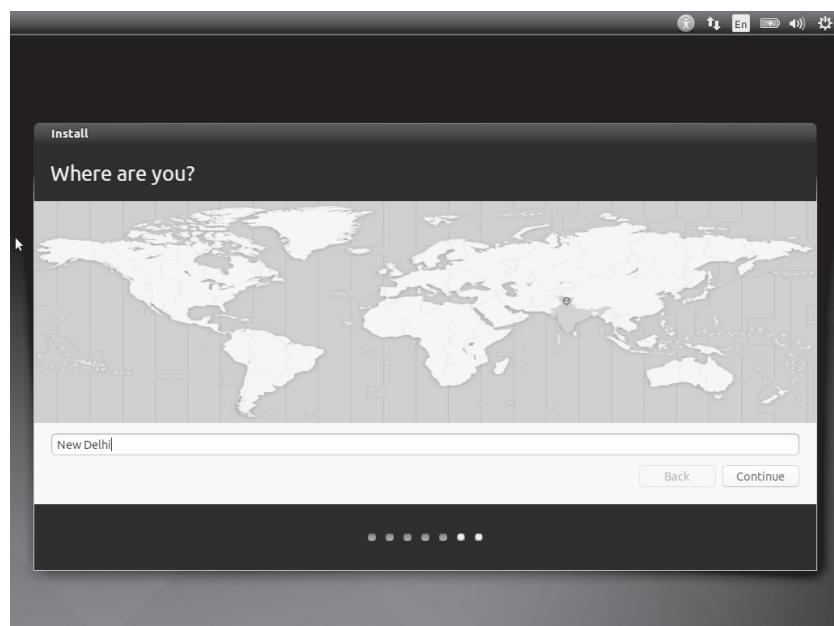


Fig. 8.22 Choose time zone

Opearting System Installation



3. You can choose your keyboard type/layout (shown in Fig. 8.23) or let the system detect it .

Notes

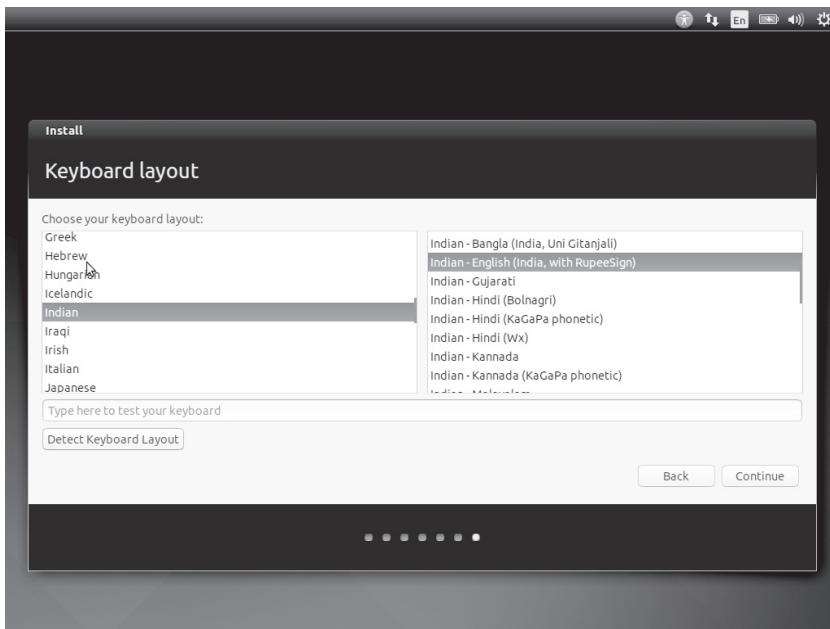


Fig. 8.23 Choose Keyboard Layout

4. Select the option “Erase and Use the Entire disk” (shown in Fig. 8.24) and click Forward button. All information on the drive chosen will be deleted.

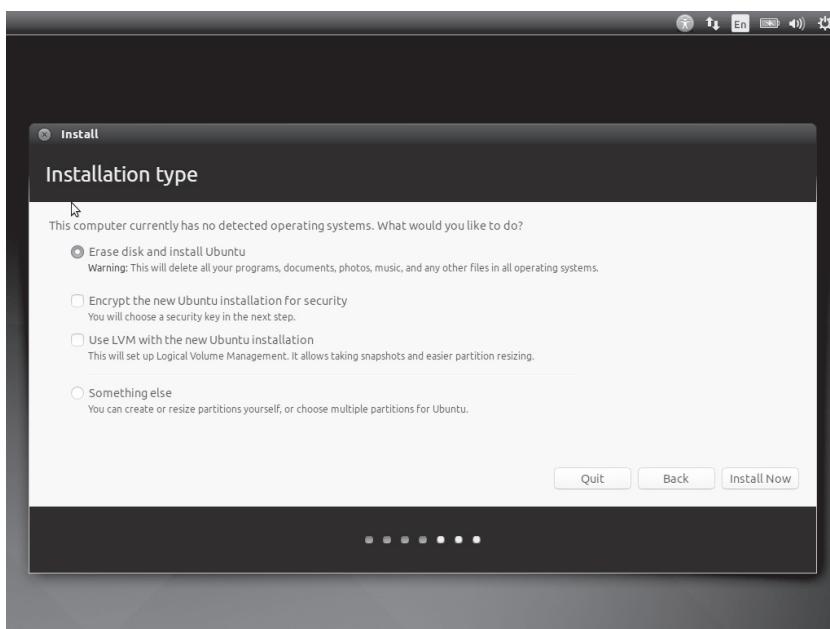


Fig. 8.24 Choose Installation Type

Notes

- Enter your details in the next screen. Fill the data (name, password, machine name, etc) and click on continue button (shown in Fig. 8.25).

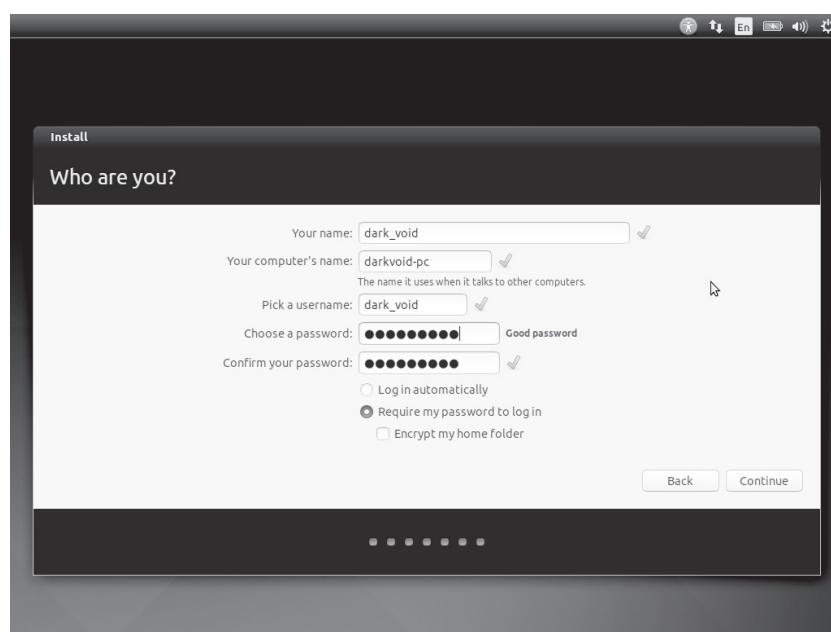


Fig. 8.25 Enter your name, Computer Name

- A Progress bar showing the status of Installation is displayed (shown in Fig. 8.26)



Fig. 8.26 Installing Ubuntu

Opearting System Installation



7. You may select Apt (Advanced Packaging Tool) if required.

Notes

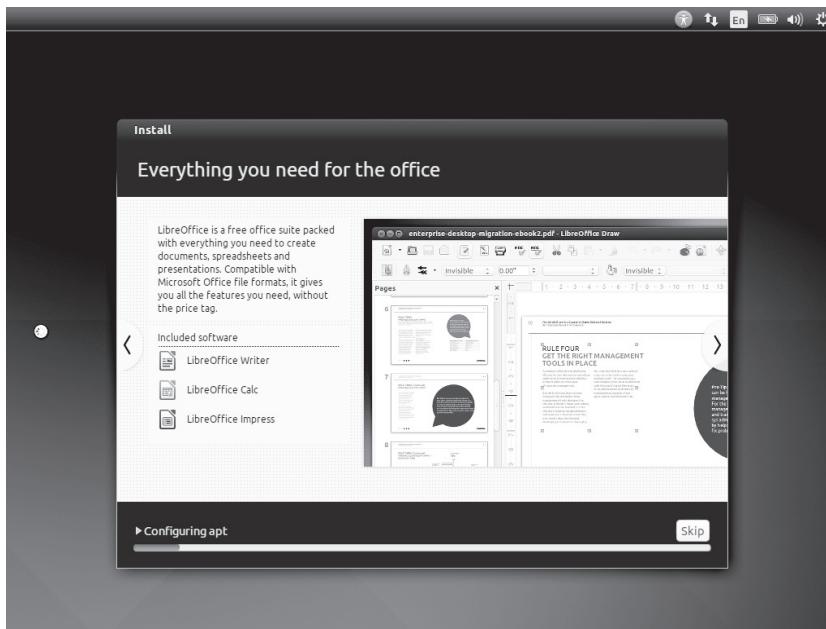


Fig. 8.27 Configuring apt

8. Configuring hardware screen appears.

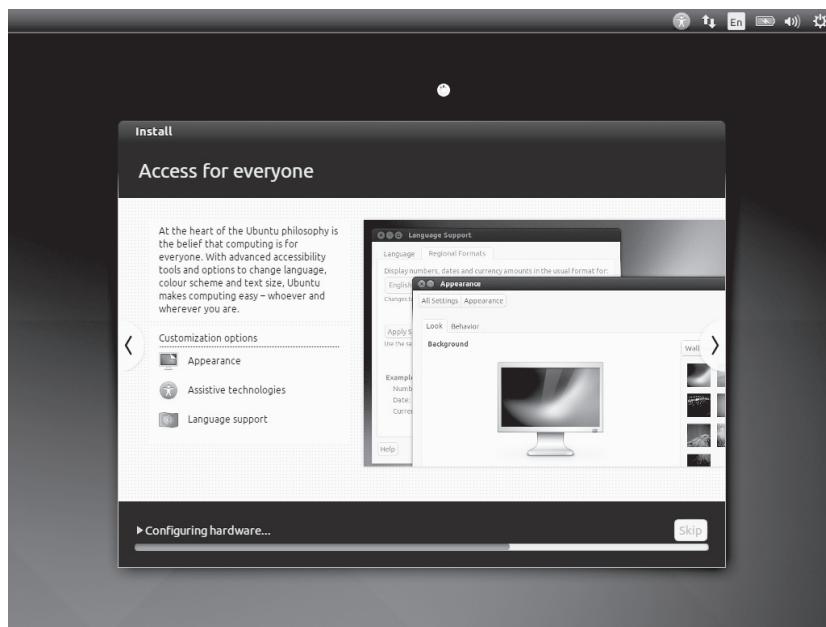


Fig. 8.28 Configuring hardware

Notes

9. Installation Complete – Dialog box confirming that “Installation is Complete” is displayed (shown in Fig. 8.29). Click “Restart Now” button to reboot the machine.

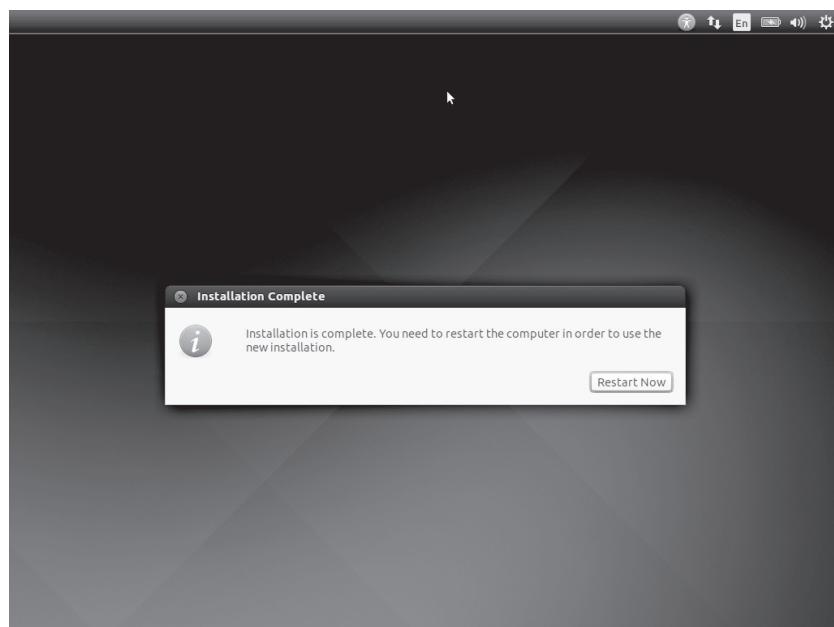


Fig. 8.29 Installation Complete

10. The login screen appears (shown in Fig. 8.30). Enter the password.

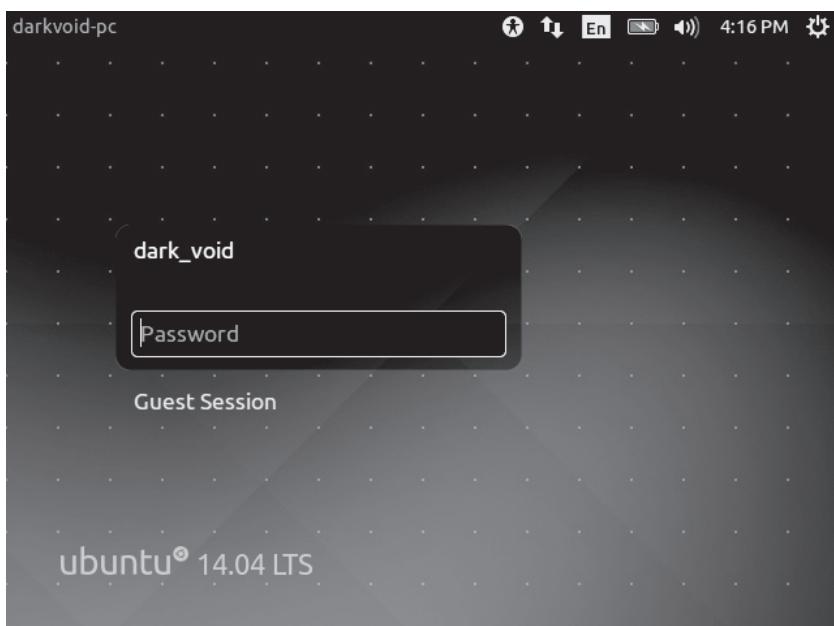
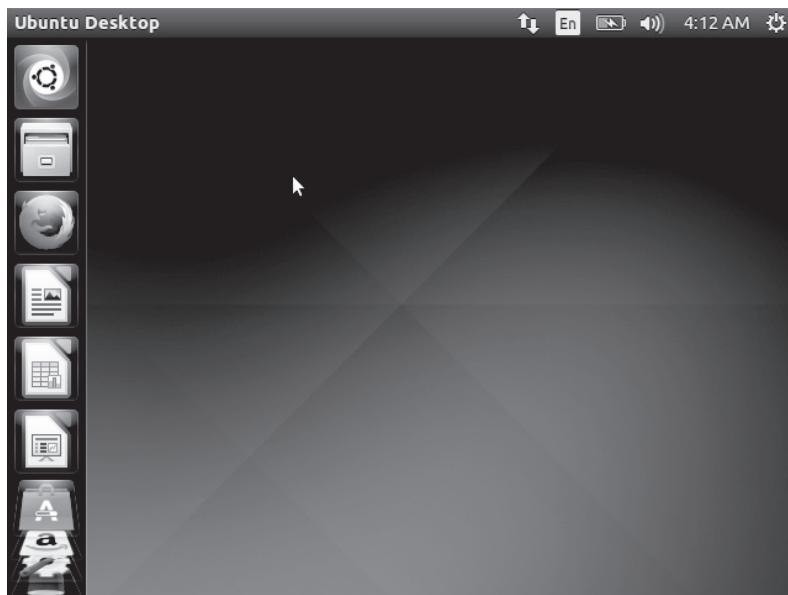


Fig. 8.30 Login screen

11. The desktop is now displayed for the first time.



Notes



Fig. 8.31 Ubuntu Desktop

12. Ubuntu 14.04 LTS(Long Term Support) is now installed.



INTEXT QUESTIONS 8.2

3. Linux has and segments in it.
4. is used to point to the actual contents of the file stored on disk tracks.



WHAT YOU HAVE LEARNT

In this lesson you have learnt about FAT & NTFS file system of Windows Operating System and LINUX file system. You have also learnt about the steps for installing Windows 7 and Linux Operating System.



TERMINAL EXERCISE

1. What are the Windows 7 Home and Professional Editions system requirements?
2. What are the features of NTFS?
3. Follow the step-wise procedure and install Windows 7Home Edition.
4. Describe LINUX file system.

5. Differentiate between Data segment and Swap segment
6. Follow the step-wise procedure and install Ubuntu on your machine.



ANSWERS TO INTEXT QUESTIONS

8.1

1. FAT
2. New Technology File System (NTFS)

8.2

3. Data segments & swap segments
4. Hard links



NETWORK BASICS

In the 21st century, worldwide telephonic networks, growth of computer industry and launching of communication satellites, are integrating together. The merging of the computer technology with the communication system has given birth to a whole array of networking technologies. The use of a computer to serve a business need is rapidly being replaced by a network of computers, catering to various needs of a business organisation.

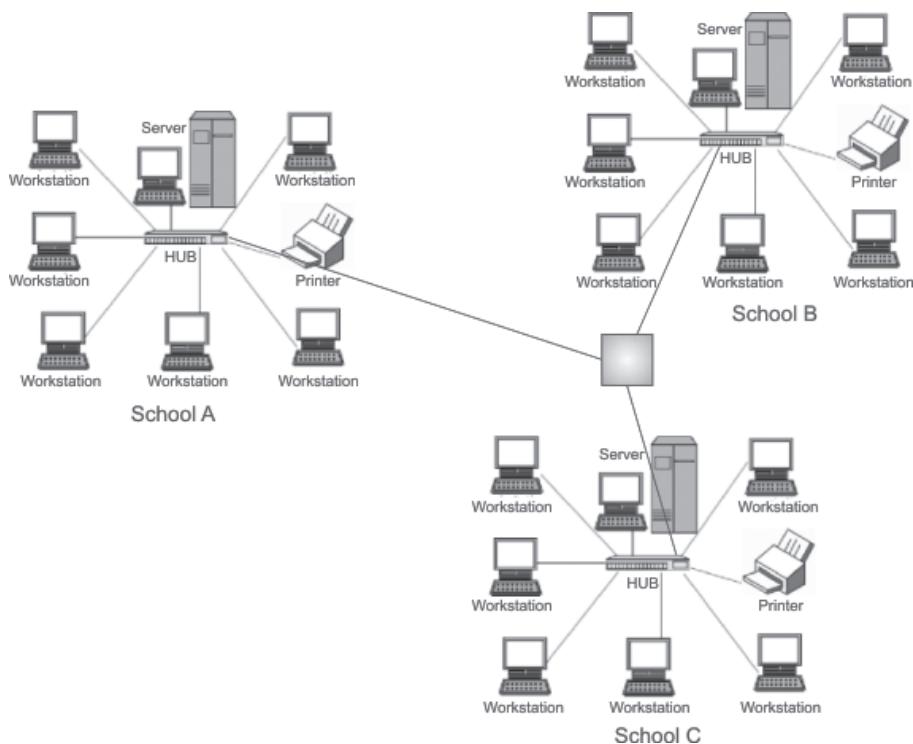


Fig. 9.1 Network of Computers

In this lesson you will learn about various types of networks, their topologies, communication media, addressing concepts, and network protocols.



Notes



OBJECTIVES

After reading this lesson, you will be able to

- identify various benefits and types of networks.
- types of transmission media.
- uses of switching techniques.
- understand various types of topologies.
- differentiate between OSI and TCP/IP model.

9.1 WHAT IS A NETWORK?

Independent computers, referred to as personal computers (PCs), gave users the ability to create and save documents with the help of different software. However, this was not adequate for large organisation where the volume of work and amount of documents created was high. These computers that are operated independently have a number of limitations, some of which are as follows:

- Small hard drive capabilities.
- Resources like data, printers, CD drive cannot be shared.
- Communication from one system to another can be done only by using portable storage devices.

To address these above mentioned problems, networks came into existence. It is a group of computers connected to each other physically or logically for data communication.

9.2 BENEFITS OF A NETWORK

The evolution of network was a boon to the mankind. The amount of time, money and energy saved was very high with the use of network. Benefits of a network are:

- **Resource sharing:** The main benefit of networking is "Resource sharing", and it is to make all programs, data and equipment available to anyone on the network without being influenced by the physical location of the resource and the user.
- **Reliability:** A second benefit is to provide high reliability by having alternative sources of the same information. For example, all files could be replicated on two or three machines, so if one of them is unavailable, the copies on the other machines could be accessed/used.
- **Lower cost:** Another benefit is saving money. Small computers have a much better price/performance ratio than larger ones. Mainframes are roughly ten times faster than the fastest single chip microprocessors, but mainframes cost thousand times



more. This imbalance has caused many system designers to build systems consisting of powerful personal computers, one per user, with data kept on one or more shared file server machines. This benefit leads to networks with many computers located in the same building. Such a network is called a LAN (local area network).

- **System performance:** Another closely related benefit is to increase the system's performance as the work load increases by just adding more processors. With central mainframes, when the system memory is full, it must be replaced by a larger one.

Computer networks provide a powerful communication medium. A file that was updated/modified on a network can be seen by the other users on the network immediately.

9.3 ORIGIN OF INTERNET: THE BIGGEST PUBLIC NETWORK

Do you know the origin of internet? Evolution of a computer network started way back in 1969 with the development of first network called ARPANET. It was created by the Advanced Research Projects Agency (ARPA) of the U.S. Department of Defence. ARPANET was one of the first general-purpose computer networks. It connected time-sharing computers at government-supported research sites, principally universities in the United States, and it soon became a critical piece of infrastructure for the computer science research community in the United States. In the 80's, another organisation called National Science Foundation(NSF) created an independent network called NSFnet, which was more advanced than ARPANET. It allowed only the students and educators of various universities to do their research related work. It did not allow any kind of private business related activities. Later US separated their defence related work in to a separate network called DARPNET. In the 90's ARPANET, NSFnet, and many more private networks across the world shook hands with each other and the combination of them gave birth to today's internet. So internet can be called as super network. Internet can be defined as the worldwide network of computer networks.

These networks have to follow certain rules and regulations to communicate among themselves. The set of rules that governs the communication between the computers in a network is called **protocol**. The ruling protocol standard followed by internet is TCP/IP (Transmission Control Protocol/Internet Protocol).

Other than the public networks, one can build up a private network which can be accessed if the user has access rights to it. There are business organisations which have their own networks where the users are authenticated using valid User Ids and passwords. Therefore, the benefits and applications of these networks can be enjoyed by only their employees who have access to these privileges.

9.4 NETWORK TERMINOLOGIES

To know more on computer networks, you need to learn few important terms of networks.

Workstation: The term workstation or a node refers to the computers that are attached to a network and share the resources in the network. On a network, there can be computers that do not have either a Hard disk (or Floppy disk drives) can not store any data or



software. Such computers are called dumb terminals. They get operated directly with the help of server. On the other hand the computers that can work independently on the network are called intelligent terminals.

Server: A server is a computer that provides data, software and hardware resources that are to be shared on the network. A network can have more than one server. Each server has a unique name in the network. All network users identify the server by its name. It is of two types: (1) Non dedicated server - It acts as a server and workstation (2) Dedicated server - It can be used as a server only.

Intranet: Intranet is a private network.

Inter space: It is client-server software that allows computers in a network to share online audio, video and text through dynamic 3D environment. It provides a real time communication platform on the Internet today.

9.5 CLASSIFICATION OF NETWORKS

Based on the area covered by the computer network, it is classified as

- LAN (Local Area Network)
- MAN (Metropoliton Area Network)
- WAN (Wide Area Network)

LAN: When a group of computers get connected in a *local area* like a building or a school campus for data sharing, then it is termed as a LAN. It usually uses *unshielded twisted pair (UTP)* cables for connectivity. A client server LAN is shown in Fig. 9.2

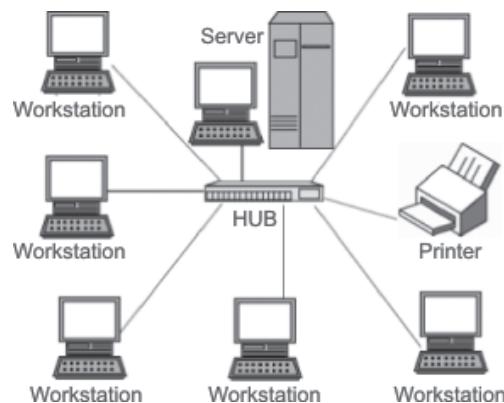


Fig. 9.2 LAN

Metropoliton Area Network (MAN): It covers an area larger than a LAN. Generally, when the network is spread across a city, then it is called a MAN. For example, a school having branches in different parts of the city are connected to form a network. The computers in each of these branches get connected to form separate LANs. These LANs get connected to each other to form a MAN as shown in Fig. 9.3. It usually uses microwave link for communication. It covers an area larger than LAN but smaller than WAN. e.g. cable television network available in many cities.

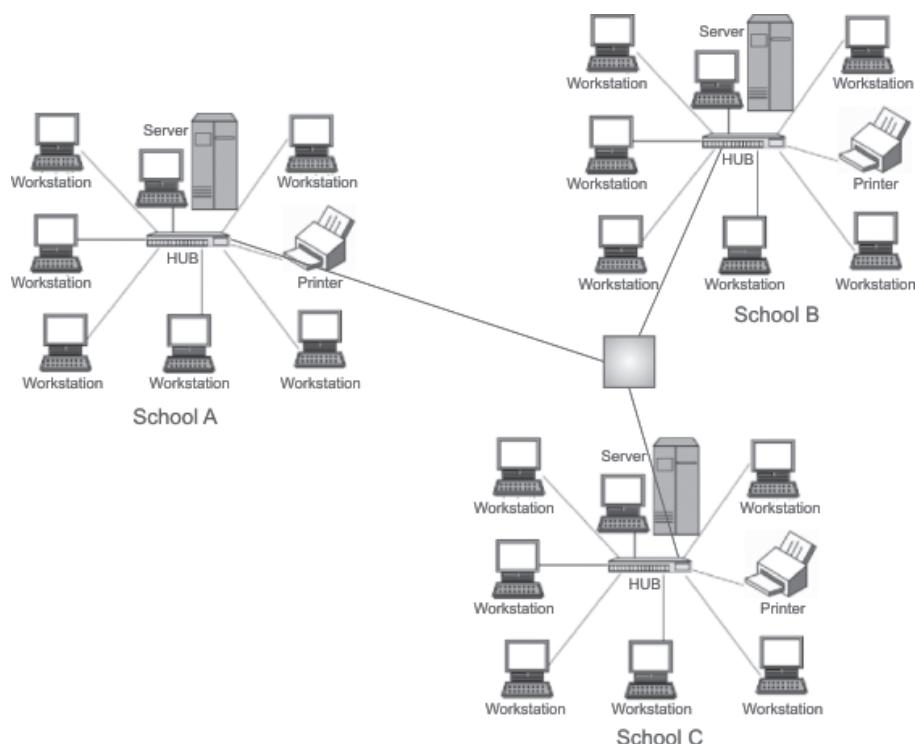


Fig. 9.3 MAN

Wide Area Network (WAN): It covers an area larger than a MAN. Various computer networks located in different countries can be connected with each other to share information through WAN. *It usually uses satellite for communication.* For example the computer network of a multi national organisation with the head office at California connects to a network of its branches in London. This forms a WAN as shown in fig 9.4

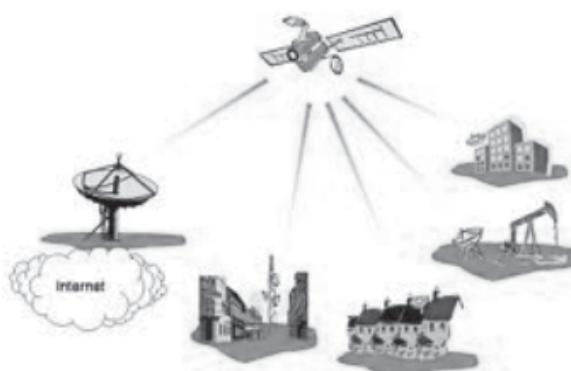


Fig. 9.4 Wide Area Network

Depending on processing capability and use of the connected computers, a network can be classified in to two types: peer-peer network and a client server network.

Peer to peer: Every computer on the network acts as a workstation as well as a server. Any computer on the network can access the shared resources. These networks provide low level security. Fig 9.5 shows an example of a peer to peer network.

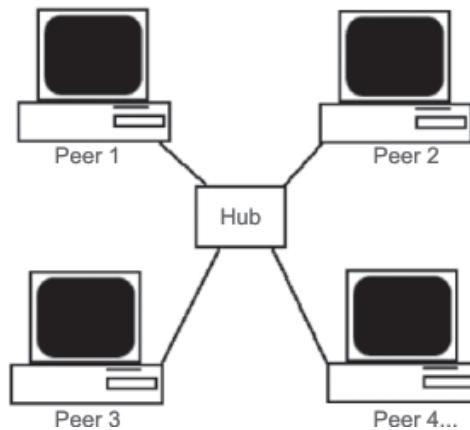


Fig. 9.5 Peer to Peer Network

Client Server: It consists of client computers and server computers as shown in fig 9.6. A workstation is generally known as a client. A server computer provides services for the client requests. It also handles the security and administrative responds to the tasks of the network. These networks provide high level security. The client computers are dependent on the server computer.

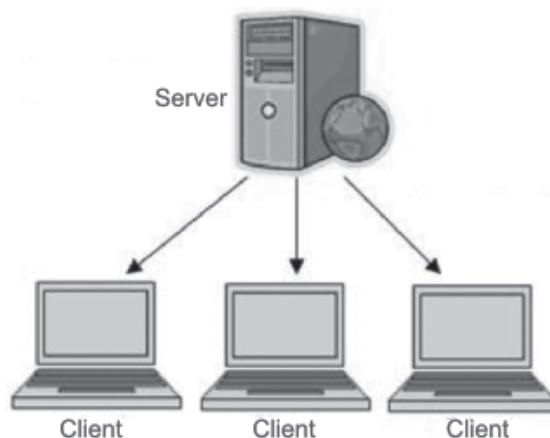


Fig. 9.6 Client Server

Q

INTEXT QUESTIONS 9.1



9.6 TRANSMISSION MEDIA

Transmission media is also known as communication channel. It describes the technologies connecting the computers in a network. It is of two types

- Wired media
- Wireless media

Wired media talks of the physical connectivity that takes place using cables while wireless media uses waves through air, water or vacuum. Now let us know about wired media.

9.6.1 Wired Media

1. **Twisted pair cable:** Twisted pair cabling comes in two varieties: shielded and unshielded.

Unshielded twisted pair (UTP) is the most popular and is generally the best option for small networks. The cable has four pairs of wires inside the jacket (Fig. 9.7) Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and from other electrical devices. The standard connector for unshielded twisted pair cabling is an RJ-45 connector.



Fig. 9.7 Twisted pair cable

Categories of Unshielded Twisted Pair

Category	Speed	Use
1	1 Mbps	Voice Only (TelephoneWire)
2	4 Mbps	Local Talk & Telephone (Rarely used)
3	16 Mbps	10BaseT Ethernet
4	20 Mbps	Token Ring (Rarely used)
5	100 Mbps (2 pair)	100 BaseT Ethernet
6.	1000 Mbps (4 pair)	Gigabit Ethernet

Although UTP cable is the least expensive cable, it may be susceptible to radio and electrical frequency interference (it should not be used too close to electric motors, fluorescent lights, etc.).

Shielded Twisted Cables (STP) is a better option than UTP. Each pair of wires in STP is individually shielded with foil. There is a shield around each individual pair, as well as around the entire group of wires. They have 16-155 Mbps of speed and



Notes

Network Basics

can be extended up to maximum 100 meters. Cables require special connectors for grounding but this cabling method resists electrical interference and is less susceptible to overhear.

2. **Coaxial cable:** It has a single copper conductor at its centre. A plastic layer provides insulation between the centre conductor and a braided metal shield. The metal shield helps to block any outside interference from fluorescent lights, motors, and other computers. An image of coaxial cable is shown in fig. 9.8. Although coaxial cabling is difficult to install, it is highly resistant to signal interference.

In addition, it can support greater cable lengths between network devices than twisted pair cable. The two types of coaxial cabling are thick coaxial and thin coaxial. Thin coaxial cable is also referred to as **thinnet**.

10Base2 refers to the specifications for thin coaxial cable carrying ethernet signals. 2 refers to the approximate maximum segment length being 200 meters. Thin coaxial cable has been popular in school networks, especially linear bus networks.



Fig. 9.8 Coaxial cable

Thick coaxial cable is also referred to as **thicknet**. 10Base5 refers to the specifications for thick coaxial cable carrying ethernet signals. The 5 refers to the maximum segment length being 500 meters. Thick coaxial cable has an extra protective plastic cover that helps to keep moisture away from the centre conductor. This makes thick coaxial a great choice when running longer lengths in a linear bus network. One disadvantage of thick coaxial is that it is difficult to install.

3. **Fiber optic cable:** Fiber optic cabling consists of a central glass core surrounded by several layers of protective materials as shown in Fig. 9.9. It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of electrical interference. It has also been made the standard for connecting networks between buildings, due to its immunity to the effects of moisture and lighting. It has the ability to transmit signals over much longer distances than coaxial and twisted pair cables. It also has the capability to carry information at vastly greater speeds. This capacity broadens communication possibilities to include services such as video conferencing and interactive services.



Fig. 9.9 Fibre optics cable



9.7 NETWORKING HARDWARE

Modem: A modem is a device that enables a computer to transmit data over telephone or cable lines. Computer information is stored digitally, whereas information transmitted over telephone lines is transmitted in the form of analog waves. A modem converts an analog signal to digital and vice versa. The conversion of data into analog data vice versa, allows two computers to communicate with one another. This is called **Modulation/Demodulation (MODEM)**.

Do you know the types of modem? Modems are of two types: **internal modem** and **external modem**. Internal modems are fixed inside the system box while the external modem connects CPU externally.

RJ-45 connector: It is the short form of Registered Jack - 45 and is an eight-wire connector. It is used to connect computers on a Local Area Network, especially Ethernet LANs. It looks similar to a RJ-11 connector which is used to connect telephone cables. A RJ-45 houses 8 wires while a RJ-11 houses 4 wires. This is a plastic connector that looks like a large telephone-style connector. A slot allows the RJ-45 to be inserted only one way. RJ stands for Registered Jack, implying that the connector follows a standard borrowed from the telephone industry. This standard designates which wire goes with each pin inside the connector.

Network Interface Controller: In computer networking, a network interface controller (NIC) (also known as a network interface card, network adapter, LAN adapter) is a computer hardware component that connects a computer to a network. It provides the hardware interface between a computer and a network. Some NIC cards work with wired connections while others are wireless. Most NICs support either wired Ethernet or Wifi standard. In new computers, many NICs are now pre-installed by the manufacturer. NIC contains connections for either twisted pair cable or coaxial cable or both.

Hub: It is a device for connecting multiple computers together and making them act as a single network segment. It has multiple Input/Ouput ports. The device is a form of multi port repeater. It is used for broadcasting. Hubs are commonly used to connect segments of a LAN. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets. Suppose 5 computers are connected through a hub. One of them sends a message to another. When the message arrives at the hub, it broadcasts to all the other computers which are connected. The computer for whom the message is sent receives it, while the others simply discard it. Data communications becomes very slow if more number of systems are busy in sending messages at the same time because of **collision and data loss**.

Hubs can be two types:

- **Active hubs:** These devices not only function as regenerator, but also provide multiple ports for several computers to connect in a network.
- **Passive hubs:** These devices only provide multiple ports for several computers to connect to a network.

Switch: It is a device for connecting multiple computers and networks together to form single network segment. The term commonly refers to a multi-port network bridge that



Notes

processes and routes data at the data link layer (layer 2) of the OSI model. A switch is a telecommunication device that receives a message from any device connected to it and then transmits the message only to the device for which the message was meant. Do you think switch is more intelligent than a hub? Yes. It is more intelligent than hub because hub simply broadcasts the message to all computers which are connected to it. An eight port switch is shown in Fig 9.10.



Fig. 9.10 Switch

Repeater: Repeaters are used in a network to regenerate digital signals distorted by transmission loss. It has the ability to reconstruct a signal to near its original quality. In a network, a repeater, can relay messages between sub networks that use different protocols or cable types. It works similar to amplifier in an analog network. When two computers are connected in a network using cables and the distance is greater than the specification, then to avoid data loss repeaters should be used in between.

Bridge: It is a device as shown in Fig. 9.11, which connects two networks segments. It basically filters data traffic at a network boundary. Bridges reduce the amount of traffic on a LAN by dividing it into two segments. Bridges inspect incoming traffic and decide whether to forward or discard it based on pre-defined rules.



Fig. 9.11 Bridge

Router: It is a device that forwards data packets between computer networks. A router is connected to two or more data lines from different networks. When a data packet comes in one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its routing table it directs the packet to the next network elements on its journey. It works with IP addresses. A router's image is shown in Fig. 9.12.



Fig. 9.12 Router

Gateway: It is a device as shown in Fig. 9.13 that connects dissimilar networks. It is an internetworking system capable of joining together two networks that use different base protocols. Depending on the types of protocols they support, network gateways can operate at any level of the OSI model (Refer 9.12.1 section). They are also called as **protocol converters** and **translators**. These activities of a gateway are more complex than that of the router or switch, as it communicates using more than one protocol.



Fig. 9.13 Gateway



Satellite: It is a device that works as a receiver as well as a transmitter. It is fitted with different transponders for communications. It uses microwaves for transmission. These are generally used for mobile applications such as communications to ships, vehicles, planes and hand-held terminals, and for TV and radio broadcasting.

9.8 SWITCHING TECHNOLOGIES

One of the major purpose and use of networks is sharing or transfer of information. Do you know how data is transmitted across the network? Well, for this, the switching techniques are used which are explained as under :

- **Circuit switching:** In this technique, communication medium is wired. A physical connectivity is established between the source and the destination computer before communication takes place. Messaging takes place one after another in a sequence. The telephone networks are generally based on circuit switching. The circuit or the connection may pass through a number of telephone exchanges in different parts of the country. At each stage the connection remains blocked until a link is made between the two ends. This communication is generally slow.
- **Message switching:** In this technique the message to be sent has no restriction in size and the computers use wireless connectivity between them. However, the traffic is more efficiently handled using the "store-and-forward" technique. Unlike circuit switching no physical link is established in it. Here the communication medium is wireless. The messages communicated can vary in size. A message is stored and then forwarded as soon as the destination is free to receive traffic. Messages can be entered regardless of whether the receiving terminal is busy or operational. The queuing of messages and the persistence of automatic dialling leads to better utilisation of lines reducing the call charges.
- **Packet switching:** With message switching there is no limit on block size. In contrast, packet switching places a tight limit on the block size. Data is divided in the form of packets stored in the main memory. The packet size is fixed and there is no limit on data. Communication medium is wireless. This type of system was originally designed to provide reliable transmission through a communications network where switches or lines may suddenly become unavailable or alternative routes may have to be chosen.

A packet consists of a "header" section which contains information such as the network address of the destination terminal, a data section containing the information to be transferred and a "tail" section containing checking information. A stream of data is therefore split into a number of packets when these techniques are employed. Packets may vary in length from a few bytes up to several thousand. Once a message has been transmitted, the packets which comprise it may take different routes through the communications system and arrive at the receiver at different times. In this scenario it is up to the receiver to reassemble the packets into the correct order, to obtain the complete message. This is done based on pre-defined identifiers/ headers and rules.



9.9 NETWORK TOPOLOGIES

This section will introduce you to a number of different network topologies with various types of network architecture. Network architecture is made up of a topology, a cable type, and an access method.

A network topology is the physical layout of computers, cables and other components of a network. There are number of network topologies, and a computer network may be built using multiple topologies. Various topologies of networks are given below:

- Bus topology
- Star topology
- Ring topology
- Mesh topology
- Hybrid topology
- Wireless topology

Bus topology: This topology uses one cable as the main trunk to connect all the computers together as shown in Fig. 9.14. It is very easy to set up and requires no additional hardware like hub. The cable is also called the *trunk*, a backbone, or a segment. With bus topology, when a computer sends out a signal, the signal travels the cable length in both directions from the source computer. When the signal reaches the end of the cable length, it bounces back and returns in the direction it came from. This is known as signal bounce. If another signal is sent from the opposite direction at the same time, the two signals collide and get destroyed. In such a situation, the signals get retransmitted. It happens till the signals get transmitted to the destination system. For this reason, terminators are placed at both the ends of the trunk.

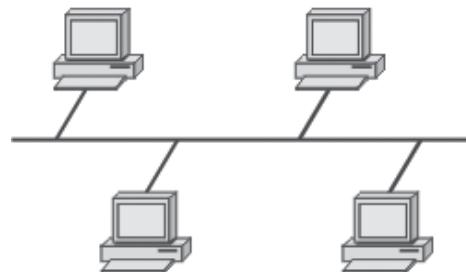


Fig. 9.14 Bus topology

The terminators are used to absorb the signal when it reaches the end of the trunk. This prevents signal bounce. There are two situations when the network collapses, first when there is no termination, due to signal bounce it happens and second when the cable breaks, even then the network goes down. A bus is a passive topology, which means the signal travels visiting each of the computers one by one without getting regenerated in any way by them. These have no role in functioning of the bus.

Advantages of bus topology:

1. **Cost is low** as it uses short cable lengths and no connecting hardware.
2. Installation is easy.
3. Failure of a computer does not affect the working of the network.



Disadvantages of bus topology

1. Troubleshooting is difficult - fault isolation and diagnosis is difficult.
2. Breaking of the trunk collapses the network.
3. It is not very scalable (easy to extend).

Star topology: In this topology, all the computers are connected through a central device known as **hub** or a **switch** as shown in figure 9.15. Each computer is connected to the hub, using a separate cable.

Advantages of star topology:

1. Easy to troubleshoot and isolate problems.
2. Cable failure affects only a single computer.
3. Easily scalable.

Disadvantages of a star topology

1. Requires **long cable length**.
2. A single connecting device allows for a single point failure.
3. Installation is difficult.

Ring topology: In this topology, all the computers are connected via a cable that loops in a ring or circle as shown in fig 9.16. It has no start and no end. Because there are no ends, terminators are not necessary in a ring topology. Signals travel in one direction on a ring. Here each computer contributes to the network by regenerating the signal.

Advantages of a ring topology

1. Cable faults are easily located, making troubleshooting easier.
2. Installation is easy.
3. Signal retransmission not required as it gets regenerated often.

Disadvantages of a ring topology

1. A single break in the cable can disrupt the entire network.
2. Expansion is not easy.
3. It is not very scalable.

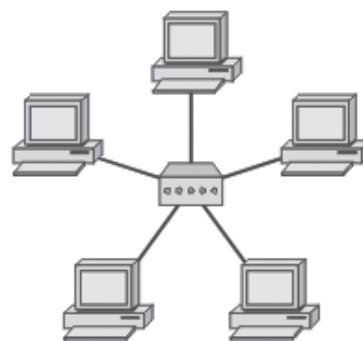


Fig. 9.15 Star topology

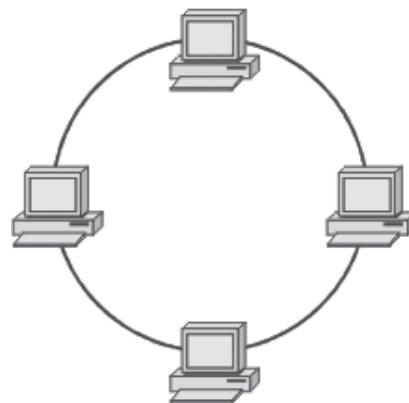


Fig. 9.16 Ring topology



Mesh topology: It is not very common in computer networking today. In a mesh topology, every computer has a connection to every other computer of the network.

Advantages of mesh topology

1. Provides multiple paths between computers. So even if one cable link breaks, communication takes place using the other links.
2. Network can be easily expanded.

Disadvantages of a mesh topology

1. Requires much more cable length than any other topologies.
2. Installation is difficult.

Hybrid topology: It is a mixture of the topologies discussed so far. A very popular hybrid topology is a star-bus topology, in which a number of star topologies are connected by a central bus. Another very popular topology is a star-ring topology. It looks like a star that acts like a ring.

Wireless topology : A wireless topology is one in which few cables are used to connect the computers. The network is made up of transmitters that broadcast the packets using radio frequencies. The network contains special transmitters called **cells** or **access points** which extend a radio sphere in the shape of a bubble around the transmitter. It can extend to multiple rooms and possibly floors in a building. The computers and network devices have a special transmitter-receiver, which allows them to receive broadcasts and transmit

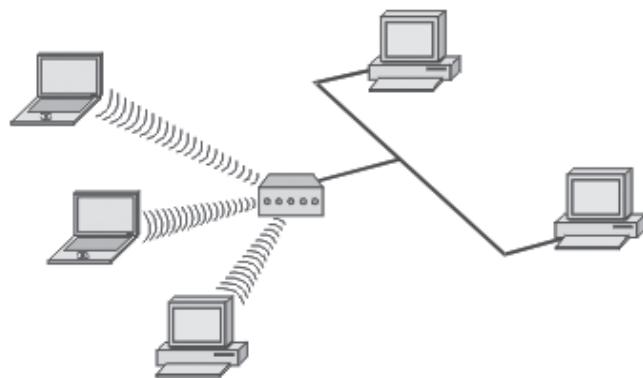


Fig. 9.17 Wireless topology

requested data back to the access point as shown in fig 9.17. The access point is connected to the physical network by a cable, which allows communicating with systems on the wired network.

Advantages of a wireless topology

1. Allows wireless remote access.
2. Network can be easily expanded.

Disadvantages of a wireless topology

1. Potential security issues.
2. Limited transmission speed.



INTEXT QUESTIONS 9.2



Notes

Choose the correct answer:

3. Repeater is
 - (i) regenerator of a signal
 - (ii) network connector
 - (iii) wave
 - (iv) software

4. Router is a device used to connect a
 - (i) LAN to LAN
 - (ii) WAN to WAN
 - (iii) LAN to WAN
 - (iv) None of these

9.10 NETWORK MODELS

There are two important network models: OSI and TCP/IP models. These two models will explain you about how communication between computers takes place.

9.10.1 The OSI Network Model

Open Systems Interconnection (OSI) reference model, developed by ISO (International Standards Organization) for understanding data communications between any two networked systems.

An OSI model is a conceptual seven layer architecture where each layer is considered to be responsible for a task of the communication session between two computers. It got introduced in the late 1970s. The layers are arranged here from the lower levels starting with the physical (hardware) to the higher levels. OSI Model comprises of seven layers. Suppose, computer A wants to send some message to computer B. At computer A, some task will take place before it is transmitted. Starting from layer 7, every layer from top to bottom, till layer 1 will do their respective job on the message and finally layer 7 i.e. the physical layer will do the transmission in the form of bits. The message is in its raw form when it reaches the destination computer B, it gets operated by all the seven layers but

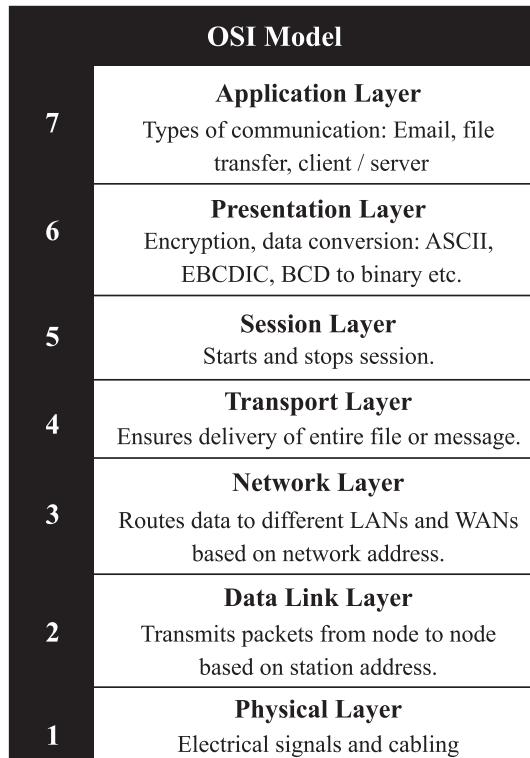


Fig. 9.18 OSI Model



in the reverse order i.e. from layer 1 to layer 7. Finally layer 7 will be responsible to get back the message into its original form to be read at the destination computer.

A summary of the function of each layer is given in the Fig. 9.18.

9.10.2 TCP/IP Network Model

This model describes a set of communication protocols that implement the protocol dependencies on which the Internet and most commercial networks run. The TCP/IP network model has four basic layers: Application layer, Transport layer, Internet layer and Link layer.

Link layer (layer 1): Deals with all physical components of network connectivity between the network and the IP protocol.

Internet layer (layer 2): The work in this layer is managed by IP. It contains all functionality that manage the movement of data between two network devices over a routed network.

Transport layer (layer 3): The work in this layer is managed by TCP. It manages the flow of traffic between two hosts or devices, ensuring that data arrives at the application on the host for which it is targeted.

Application layer (layer 4): Acts as final endpoint at either end of a communication session between two network hosts.

Now, let us know more on TCP and IP protocols.

Transmission Control Protocol: Transmission Control Protocol (TCP) supports the network at the transport layer. It provides a reliable connection oriented service. Connection oriented means both the client and server must open the connection before data is sent.

TCP provides:

1. End to end reliability.
2. Data packet re-sequencing.
3. Flow control.

Internet Protocol: Internet Protocol (IP) is responsible for exchanging information between routers so that routers can select the proper path for network traffic, while IP provides the method of distributed data in packets. Thus it can distribute packets to a destination via different routes and can handle congestion.

IP provides for:

1. Addressing.
2. Type of service specification.
3. Fragmentation and re-assembly.
4. Security.



9.13 NETWORK PROTOCOLS

A protocol means the rules that govern the communication process between two computers in a network. It defines standardized formats for data packets and techniques for identifying errors. You have already learnt about TCP / IP protocol in the previous section. Some other common protocols are being explained below:

- **Ethernet:** Provides transport of information between physical locations on UTP cable. Data is passed in packets.
- **SLIP:** Serial Line IP, a form of data encapsulation for serial lines.
- **PPP:** Point to Point Protocol is a form of serial line data encapsulation that is an improvement over SLIP.
- **ICMP:** Internet Control Message Protocol is a message control and error reporting protocol between a host server and a gateway to the Internet.
- **SNMP:** Simple Network Management Protocol, is used to manage all types of network elements based on various data, sent and received.
- **HTTP:** (Hyper Text Transmission Protocol is an application-level protocol intended for distributed, collaborative and hypermedia information system. It has various built-in request methods which allow users to read and save a web page.
- **FTP:** File Transfer Protocol allows secure file transfer between two computers with login required.
- **SMTP:** Simple Mail Transfer Protocol is a protocol that governs the e-mail system in a computer network.

Each protocol ultimately has its data packets wrapped in an ethernet, SLIP, or PPP packet (at the link level) in order to be sent over the UTP cable. Some protocol data packets are wrapped sequentially multiple times before being sent. For example FTP data is wrapped in a TCP packet which is wrapped in an IP packet, which is wrapped in a link packet (normally ethernet).



WHAT YOU HAVE LEARNT

In this lesson, you have learnt the fundamentals of computer networking, the communication channels, topologies and layers of computer network models.

Some major points to remember:

- Network can be defined as an interconnection of multiple computers.
- Internet is a public network across the globe governed by TCP/IP protocol.
- Bus topology does not need a hub but expansion is much easier.
- Star topology provides a better reliability as a collapsed system will not affect the rest of the computers connected in the network.



Notes

Network Basics

- A hub is a device used to connect several computers together.
- A switch is a device that works as an intelligent hub. It filters the message to the intended computer.
- A repeater is a device that regenerates a signal and joins two LANs of same protocol.
- A bridge is a device that joins two LANs.
- A router connects a LAN to a WAN. It does the work of routing.
- Network Card also known as NIC is used to connect a computer to a network.
- Network topology is the physical layout of computers, cables and other components of a network.
- A protocol means the rules that govern the communication process between two computers in a network.



TERMINAL EXERCISE

1. State the benefits of a computer network.
2. What is internet? Discuss the origin of internet.
3. Differentiate between peer to peer and client server network.
4. State the difference between LAN and MAN.
5. What is STP? How does it differ from UTP?
6. State any two differences between star topology and ring topology.
7. What are the seven layers of OSI network architecture?
8. Explain TCP/IP network architecture.



ANSWER TO INTEXT QUESTIONS

9.1

1. (i) real time communication platform
2. (ii) node

9.2

3. (i) regenerates a signal
4. (iii) LAN to WAN



Notes

10

NETWORK CONFIGURATION

In the previous lesson you have learnt the basics of network. Now you are ready for learning Network configuration. Network configuration describes a broad range of activities associated with establishing and maintaining a network. In this lesson you will understand how to configure wired and wireless networks on Windows and Unix operating systems and also on how to configure network applications like Outlook Express. This lesson will also explain how to connect smart devices such as smart TV and smartphone to your PC.



OBJECTIVES

After reading this lesson you will be able to:

- configure Windows operating system for networking.
- configure LINUX operating system for networking.
- configure network applications (Outlook Express).
- connect smart devices with the computer.

10.1 CONFIGURING WINDOWS OPERATING SYSTEM FOR NETWORKING

10.1.1 Set up a broadband connection for a personal computer

Broadband connection is used by most of us for using Internet. For setting up DSL (Digital Subscriber Line) broadband connection, you require a router, modem or a device that combines these two devices (modem and router).



Notes

Network Configuration

To connect your computer for Internet connection do the following steps:

Wired Internet connection:

- 1) Connect your device(modem and router) to phone card or cable provided by Internet service provider.
- 2) Supply electric power to your device (modem and router).
- 3) Plug Ethernet cable in to LAN port of device (modem and router) and other end of Ethernet cable plug in to networking port (LAN Port) of computer.
- 4) Turn on or start your computer and verify LAN driver of your computer if it is not installed then install LAN driver for your computer (use LAN driver setup file for your computer and double click on it and follow the steps and click ok).
- 5) Re-start your computer.
- 6) On command line type “ipconfig” if IP address is same as the IP address provided by ISP’s range of IP address. Then click ok.
- 7) Now your computer is connected to Internet.

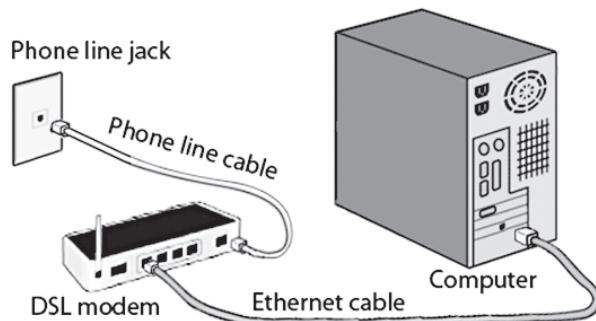


Fig.10.1 Internet connection

Wireless Internet connection:

- 1) Follow first two step of wired connection.
- 2) Your device (modem and router) and computer/laptop should have Wi-Fi facility.
- 3) Install Wi-Fi driver in your laptop/computer(Use Wi-Fi driver setup file for your laptop/computer and double click on it and follow the steps and click ok).
- 4) Enable Wi-Fi in your laptop/computer.
- 5) Open connect to a network by clicking the network icon (or) in the notification area.

Network Configuration

- 6) In list of network, select your device (Modem and Router) that you want to connect.
- 7) If security key required , enter key and connect to your device(modem and router).
- 8) On command line type “ipconfig” if IP address is same as IP address is provided by ISP’s range of IP address then ok.
- 9) Now your computer is connected to Internet.

Notes



10.1.2 Installation of Wired Network in Windows 7

In Windows 7 operating system, installation of a wired network is simpler than ever before.

Following is the process of establishing a network.

1. All the computers should be turned off and unplugged.
2. All the peripherals of computers should be turned off.
3. If required network adapters should be installed.
4. If required, computers cases should be replaced and connect a network cable between router and each computer’s adapter.
5. In the router’s WAN port, users of broadband Internet should plug their modems.
6. Select an appropriate network location.

All the newly attached network equipment are noticed by Windows 7 when it wakes up. The level of security is determined by your choice.

7. Windows enquires about the *Homegroup* by choosing Home as your network location.

Different files are shared between different PCs by the permission of Homegroup.

8. Run any necessary software for network adapter installation.

If things are not working properly, a new driver for your network adapter might be required. If new networks are not been recognized by any of the computers, try restarting them all again.

10.1.3 Network Configuration in Windows

Appropriate LAN driver should also be installed in computer for network configuration in Windows.



Notes

Network Configuration

There two methods for configuring network in Windows7.

- 1) Click on Start→Control Panel→Network and Sharing Centre→Local Area Network.
- 2) Open Connect to a Network by clicking the network icon (or) in the notification area→Local Area Network.

After clicking on Local Area Network, follow the steps given below for manual configuration of IP4 in Windows7 operating system.

- a) Click on properties.
- b) Select Internet Protocol Version 4 and click on properties.

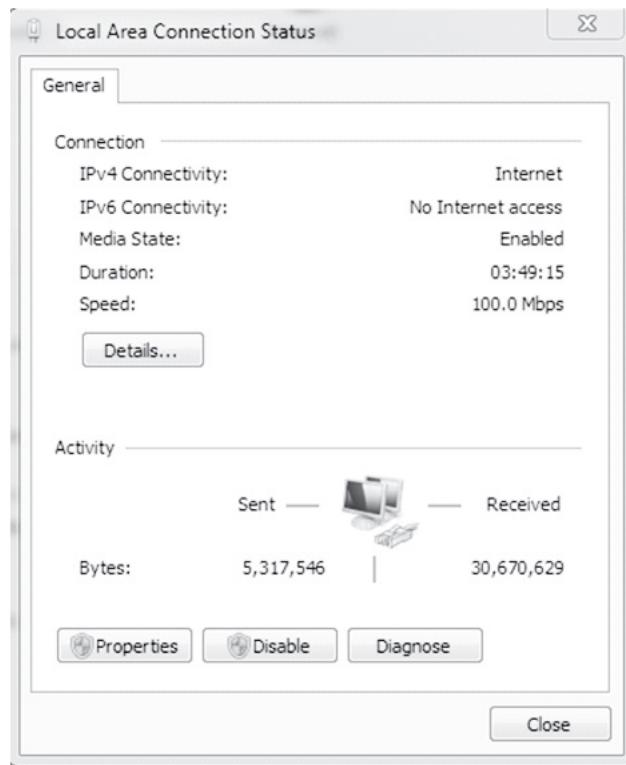


Fig. 10.2 LAN Status

- c) Select “use the following IP address” and enter IP address , Subnet Mask and Default Gateway for network configuration.
- d) Select “Use the following DNS server addresses” and enter preferred DNS server and alternate server for network configuration.

Network Configuration



Notes

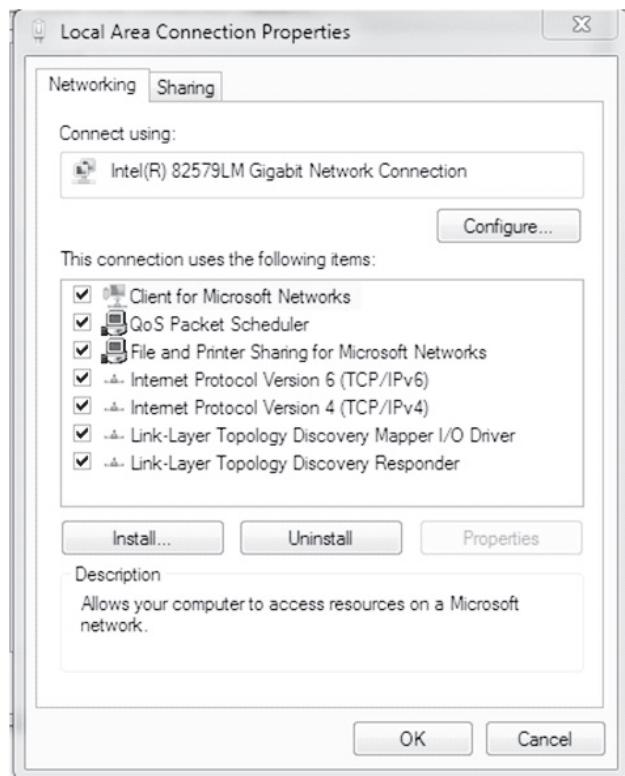


Fig.10.3 LAN properties

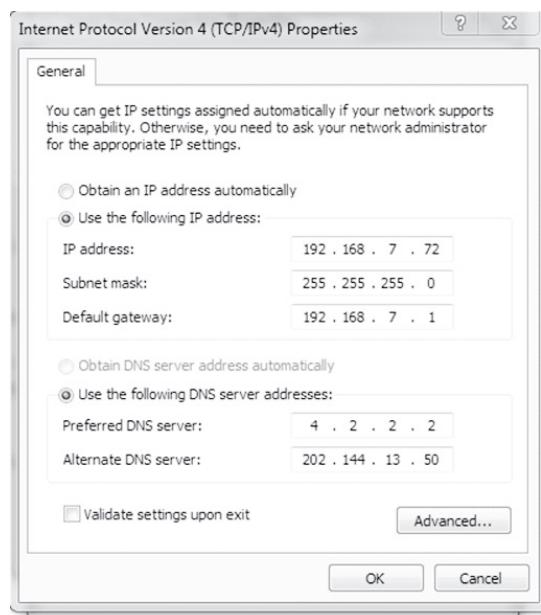


Fig.10.4 IPV4 properties

Now network is configured for wired network connection.



10.2 CONFIGURING LINUX SYSTEM FOR NETWORKING

10.2.1 LINUX Networking Setup

In order to enable networking, network interface cards must be configured. The kernel must have either modular or direct support for cards to compile in. The steps to configure NIC are :-

From your network administrator:

1. Find out your computer's **IP address**.
2. Determine **network mask**.
3. **Network address** is Internet Protocol address with network mask.
4. To deliver packets to every machine on your subnet your **broadcast address** is used.
5. The address of the computer is a gateway to the outside world is gateway address.
6. Conversion of host names into IP addresses is nameserver address.

Configuration Tools

Various interactive GUI network configuration tools are available on Linux operating system. Those are netconf, linuxconf, netconfig and ifconfig. These tools or programs modify values in /etc directory.

Analysis Tools

- netstat – provides information about the systems network connections, (including routing tables, port connections etc.).
- traceroute – It is used to find the network route from your machine to some other machine on your network or the internet.
- nslookup – It is used to find more information about hosts from DNS servers.
- arp – Users read or modify their arp cache, using this program.
- tcpdump - Helps the user to check TCP traffic on their network.
- dig(1) - For debugging or testing, it sends domain name query packets to name servers.



10.2.2 Network Configuration in Ubuntu

Following is an example of network configuration of latest Linux based operating system (UBUNTU)

1. Go to Network Connection by selecting system preferences → Network connection



Fig. 10.5 Network connections

2. Select the “Wired” tab and then click on “Auto eth0” and then click “Edit” to check the IPV4 settings.



Fig. 10.6 Wire network connections



Notes

Network Configuration

3. IPV4 Settings. As shown in the following image select the method as manual if you want to manually enter the DNS settings.

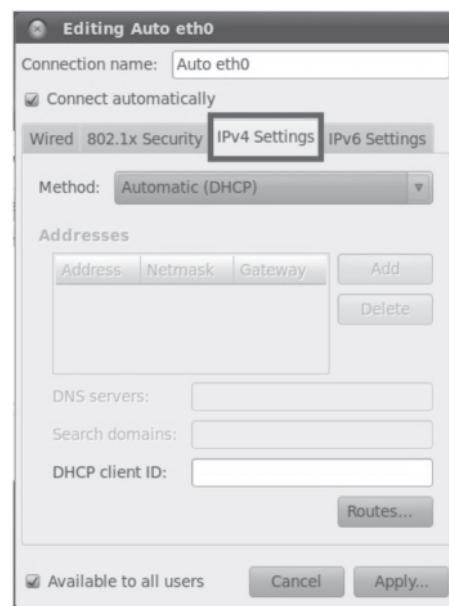


Fig. 10.7 IPV4 settings

DNS Server address is to be assigned. click on Add button to assign the address, network and gateway addresses. Then provide the DNS server address as shown below and click Apply.



Fig. 10.8 Assigning DNS server address

Network Configuration



For example to check the IP address settings.

1. Go to Applications → Accessories → Terminal

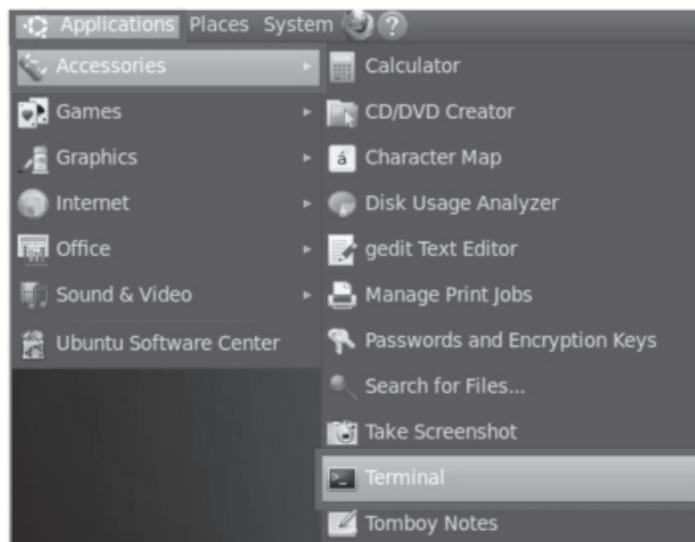


Fig. 10.9. IP address settings

2. Write "sudo ifconfig" (without quotes) command into terminal to find your new address. The inet address broadcast address, and mask address will be shown by Ifconfig command.

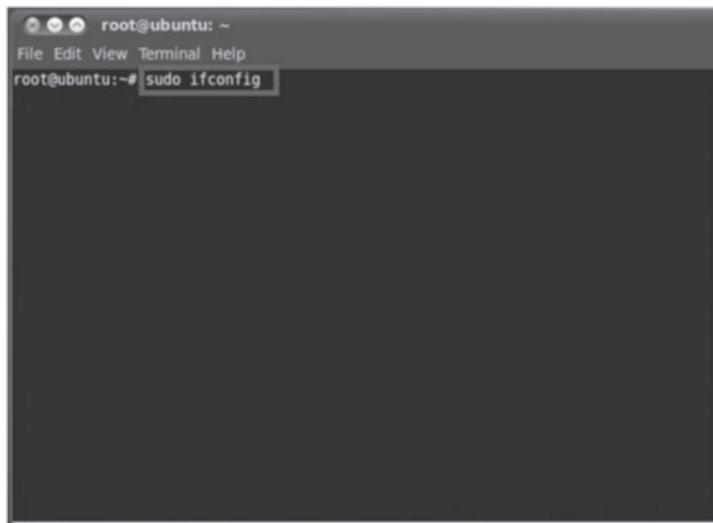


Fig. 10.10. Sudo command



Notes

Network Configuration

```

root@ubuntu:~# sudo ifconfig
root@ubuntu:~# ifconfig
eth0      Link encap:Ethernet HWaddr 00:0c:29:a3:dc:f3
          inet addr:192.168.74.149  Bcast:192.168.74.255  Mask:255.255.255.0
                  inet6 addr: fe80::20c:29ff:fe0c:a3f3/64 Scope:Link
                      UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
                      RX packets:10841 errors:0 dropped:0 overruns:0 frame:0
                      TX packets:4799 errors:0 dropped:0 overruns:0 carrier:0
                      collisions:0 txqueuelen:1000
                      RX bytes:13801926 (13.8 MB)  TX bytes:352463 (352.4 KB)
          Interrupt:19 Base address:0x2000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
              UP LOOPBACK RUNNING  MTU:16436  Metric:1
              RX packets:184 errors:0 dropped:0 overruns:0 frame:0
              TX packets:184 errors:0 dropped:0 overruns:0 carrier:0
              collisions:0 txqueuelen:0
              RX bytes:11264 (11.2 KB)  TX bytes:11264 (11.2 KB)

root@ubuntu:~#

```

Fig. 10.11 Ifconfig command

10.3 CONFIGURING A WIRELESS NETWORK WITH WINDOWS 7

To connect to a wireless network, each machine will need settings such as a network name and network security key.

Follow these steps to create wireless network on machine with Windows 7:

1. From Control Panel → Networking and Internet → Network and Sharing Centre → Manage Wireless Networks, then click Add.
2. Choose type of profile you want to create. Select the “Create an ad-hoc network profile” if you want to connect two computers (computer-to-computer) together. Choose “Manually create a network profile” to connect to machine to a wireless router or an access point. A screen will appear similar to the following figure.

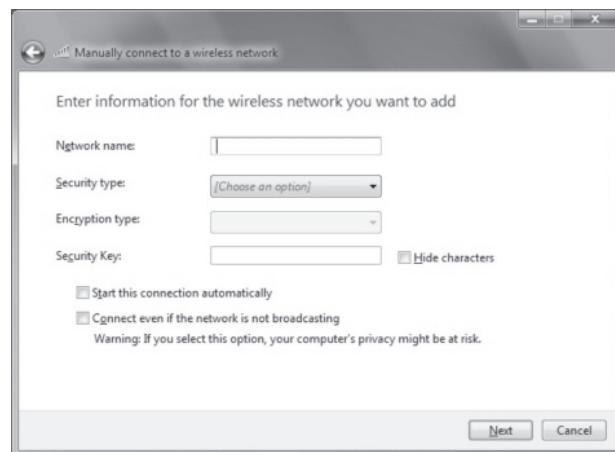


Fig. 10.12 Manually connecting to a wireless network

Network Configuration

3. Type the name of the access point (also called SSID) in the network name field, and select the settings.(ex: WAP)
4. Select the **Next** button.
5. When finished, select Close.

Notes



INTEXT QUESTIONS 10.1

1. What is the purpose of nslookup?
2. Why netstat tool is used?
3. Why do we use traceroute?

10.4 CONFIGURING NETWORK APPLICATIONS

10.4.1 Configuring Outlook Express for E-Mail Accounts

The following steps will explain how to configure outlook express.

1. Open Microsoft Outlook. Now select Accounts under Tools

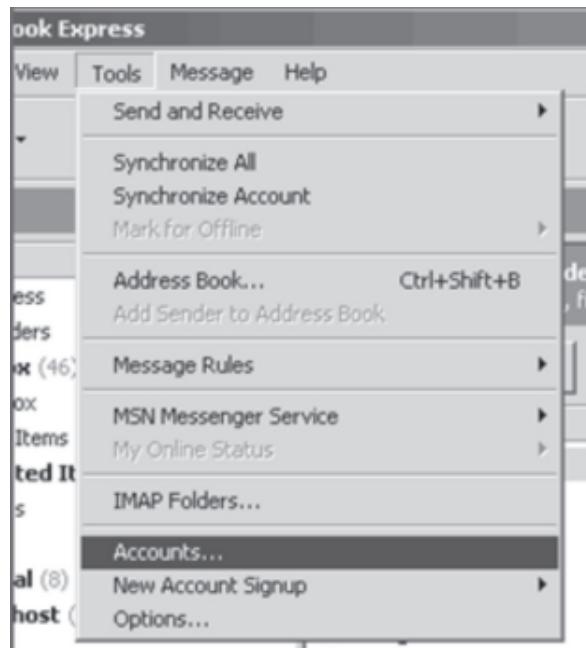


Fig. 10.13 Configuring Outlook Express



Notes

Network Configuration

2. Click Mail under Add



Fig. 10.14 Adding email

3. Enter your user name as you like.
4. Enter the email address.

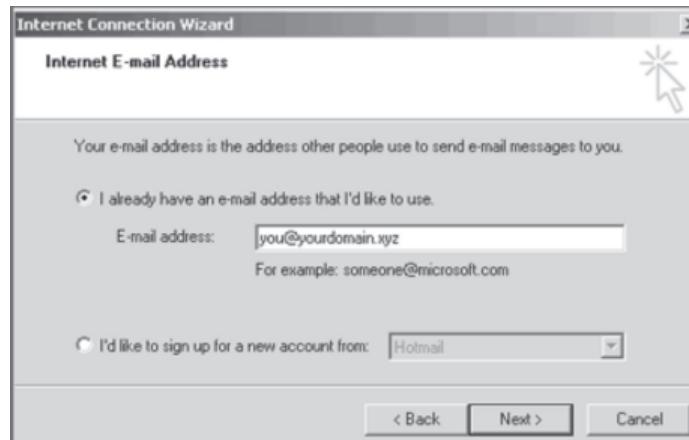


Fig. 10.15 Adding email address

5. Choose server type and enter incoming and outgoing mail servers.

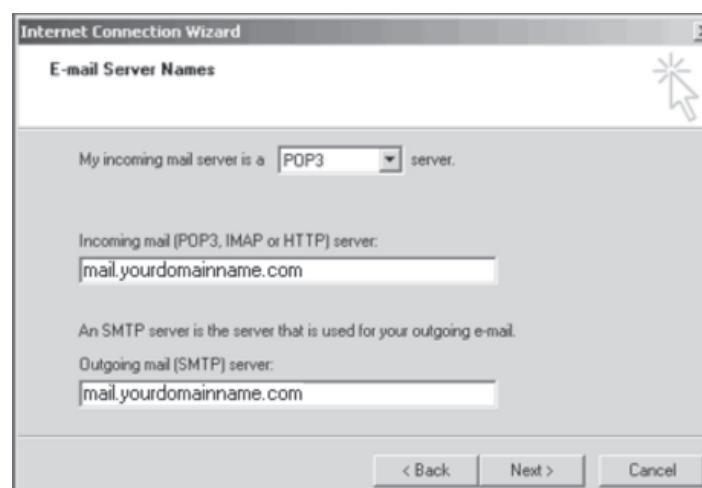
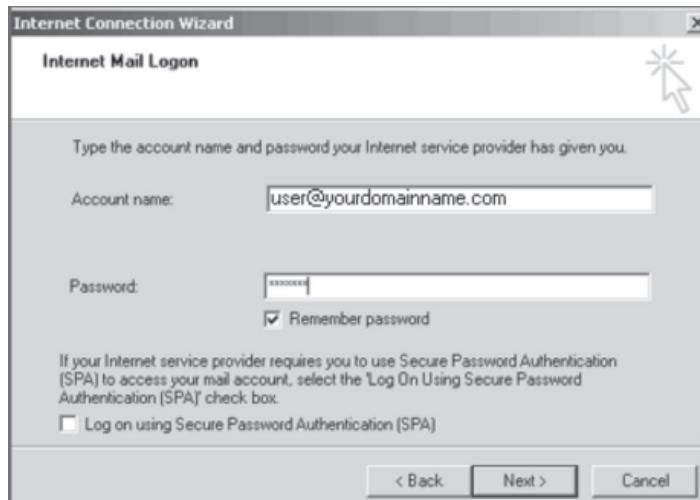


Fig. 10.16 Entering incoming and outgoing mail server details

Network Configuration



6. Enter Account Name and password.



Notes

Fig. 10.17 Adding account name and password

7. Next → Finish → Select domain → Properties

8. Select **My server requires authentication**.



Fig. 10.18 Properties window.

9. Click Ok. Now outlook configured your E mail address.
10. Repeat these steps again to set up multiple accounts.



Once you have completed these steps outlook will take some time for receiving all your emails to your Inbox. Once the process is completed your outlook is ready to send/receive any emails.

10.4.2 To enable sharing of file

Below steps are to be followed for network discovery and file sharing:

1. Open Network and Sharing Centre, (go to Control Panel, then Network and Internet, click on Network and Sharing Centre), Select option for Network Discovery and Enable File sharing. Select if you want to share files and turn on printer sharing.
2. Now do one of the following to share the file:
 - Select **Share** by right clicking the folder you want to share and then choose from the given list all those with whom you want to share, and then press **Share**.
 - In the public folder on your system, place all files and/or folders to be shared. Click **Start** button, and then click **Documents** to find the public folder. In the Navigation pane, under **Favorite Links**, click **Public**.

10.4.3 Internet Explorer 8 - Browser Configuration

For configuring internet explorer (8), Open Internet Explorer → Tools → Pop-up Blocker → Add web site → In blocking Level, Allow pop-ups from secure sites → Close.

1. Pop up management

- If you do not want the pop ups to come up then you can select the blocking level as high.
- If you want to allow pop-ups from secure sitls then keep the level as low: as shown in Fig. 10.19.



Fig 10.19 Pop-up Blocker Setting

Network Configuration



Notes

2. **Clean up / file system Management** – In order to experience better browsing it is recommended to keep deletion of copies at regular intervals (1 week).

You should also delete temporary internet files, history to clean up lone space.

Goto Cookies: Tools → Internet Options. In Browser History → Delete

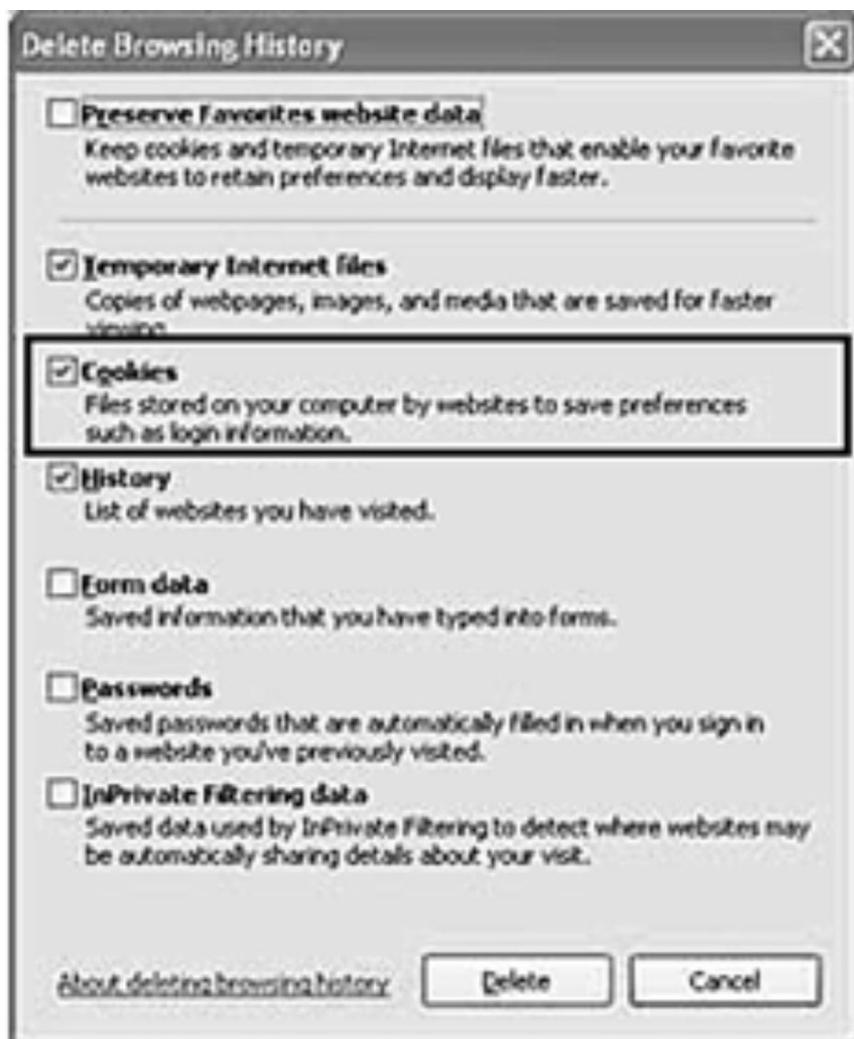


Fig 10.20 Deleting Browsing History

3. **Security Management** - Use security settings tab to define the level of security you want while browsing.

Choose Custom Level Security in Internet Options under Tools menu.



Notes

Network Configuration



Fig 10.21 Security Settings



Fig 10.22 Internet options - customs level



Select level by customising the level as shown in Fig. 10.22.

SSL Issue: While exploring a secured website on Internet Explorer 8 sometimes the message **Page cannot be displayed** popped up. To resolve this problem go to internet options of tools menu and select the content tab, after that select Clear SSL state button and press OK.

10.5 CONNECTING SMART DEVICES

10.5.1 Connecting Your TV to a PC

Now-a-days with smart TVs one can browse the Internet in the same way as on computers and are able to access all online features. Wireless technology provides simple solutions to connect your TV to a personal computer.

Connecting Wi-Fi PC and Wi-Fi TV

If you have Wi-Fi network and having a television with Wi-Fi and personal computer with Wi-Fi then you can connect both of them using the following steps:

1. Turn on the system and television.
2. Enable the Wi-Fi mode and select Wi-Fi as its input on the television.
3. Activate the Wi-Fi mode on your system.
4. On your computer, select WiFi connection to the TV. To connect the television with your Wi-Fi, if required provide the security key or password and re-boot the network.
5. Four-digit Pin that is generated by television is to be feed on the system. After this a connection is established between television and system.
6. Adjust screen resolution if needed.
7. Select extend desktop onto this monitor.
8. Windows desktop screen will be displayed on television. If required adjust the screen resolution.
9. If required drag the open windows of the system on television.

10.5.2 Connect Smartphone to Desktop

You can also connect your smartphone to computer/laptop by using a USB cable. Once you connected your smartphone to computer/laptop you will be able to view all the files present in your smartphone. And also you can transfer the files from your smartphone to your computer or laptop.

You can connect a smart phone to your computer with Bluetooth technology, if you do not want to use USB cable.



Notes



WHAT YOU HAVE LEARNT

In this lesson you have learnt how to configure wired networking systems running on Windows 7 and Ubuntu. It also illustrated how to configure various network applications such as outlook express, file sharing and Internet Explorer browser. You have also learnt about connecting smart devices such as smart TV to personal computer and smartphone to PC.



TERMINAL EXERCISE

1. Discuss the steps for installing a wired network in Windows 7.
2. Setup your machine running on Ubuntu for networking.
3. Discuss the steps for setting network in LINUX.
4. Configure your machine running on Windows 7 for wireless network.
5. Configure Outlook Express on your machine.
6. What are the various options to be set while configuring Internet Explorer?
7. How can we connect a Wi-Fi television to a Wi-Fi computer?
8. What should be done to connect Smartphone to desktop?



ANSWERS TO INTEXT QUESTIONS

10.1

1. nslookup is used to find more information about hosts from DNS servers.
2. Netstat is used for providing information about the system's network connection.
3. the network route from one machine to another machine.



Notes

11

PROBLEM DIAGNOSIS, TROUBLE-SHOOTING AND MAINTENANCE

While using computers many times we face problems. Sometimes the computer runs very slow, sometimes the system is not turning on, sometimes some external device is not working. As a hardware professional you have to be ready to solve these common problems. This lesson gives the knowledge and competency to diagnose the faults for systematic repair and maintenance of computers and computer peripherals.



OBJECTIVES

After reading this lesson you will be able to:

- recover the system.
- use Control Panel.
- troubleshoot hardware.
- troubleshoot software.
- perform network troubleshooting.
- secure your system.

11.1 SYSTEM RECOVERY

System restore is system utility provided by Microsoft Windows which can be used to recover from Windows faults or errors. It has been incorporated in all editions of Windows apart from the Windows Server. While operating windows if a serious error occurs then you can restore the data by using system restore option. To use this option, you must be using a Windows installation disc for restore. If you do not have a Windows installation disc you can use a system repair disc to restore the Windows.



Notes

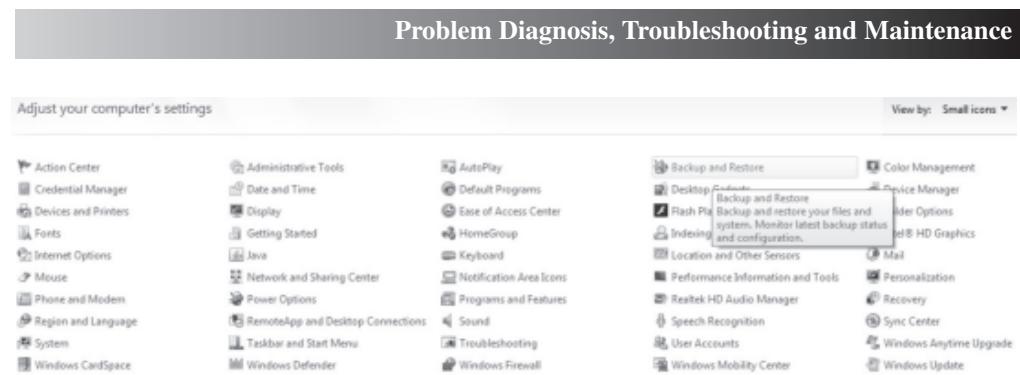


Fig. 11.1 Adjust computer's settings

To create a system repair disc

1. Open backup and restore option from Control Panel (adjust your Computer's settings).
2. Click on create system repair disc. You may be asked for username and password for authentication.
3. System repair point will be created.

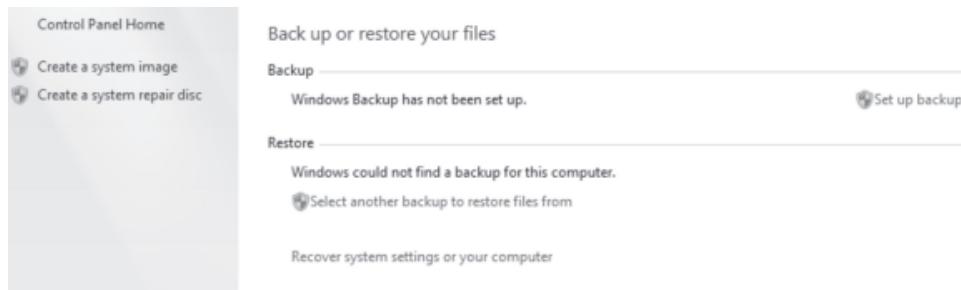


Fig. 11.2 Backup or restore our files

For reinstalling Windows, a System Image can be used as a copy of drive. A system restore image can be used anytime for restoring the Windows if the hard disk or Windows stops working. System restore option can be used for the complete restoration of the system, you can not choose a specific file for restoration, all your current data will be backed up in one go.

System Restore option can be used to restore the system to a point where the current setting of the system was running. You can actually restore your system to an earlier point by using the systems restore point which was created in your system by default. The restore point is always created automatically for the events such as Windows update etc.

To restore system files and settings using a recommended restore point:

1. Click to open system restore.
2. If prompted enter the password and username for authentication.
3. Choose the recommended restore point.
4. Review the restore point and click OK.



11.2 CONTROL PANEL

The purpose of Control Panel is to change the features of Windows Operating System in respect of display, security, handling peripherals, settings of networks, etc.

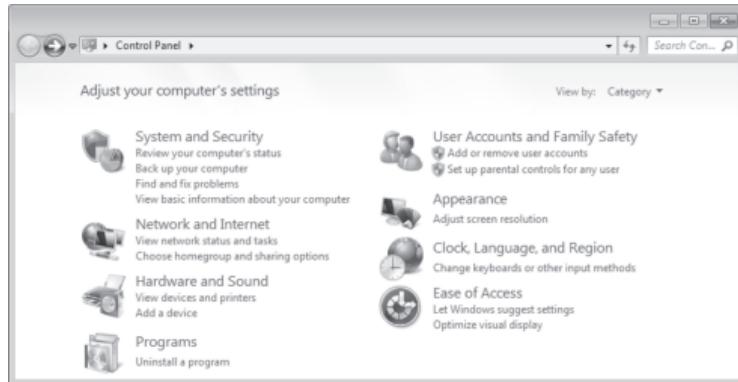


Fig. 11.3 Control panel

The table below explains some of the commonly used options of the Control Panel –

Category	Uses and options
System and Security	<p>To set and change System and Security settings.</p> <p>System settings include:</p> <ul style="list-style-type: none"> ● Action Center ● System ● Windows Update ● Power Options ● Backup and Restore ● Administrative Tools <p>Security settings include:</p> <ul style="list-style-type: none"> ● Windows Firewall ● Bit Locker Drive Encryption
User Accounts	<p>To create, maintain, and delete user accounts. This category includes:</p> <ul style="list-style-type: none"> ● User Accounts ● Windows Cardspace ● Credential Manager ● Mail (32-bit)



Notes

Problem Diagnosis, Troubleshooting and Maintenance

Network and Internet	To change the network and Internet settings like creating new network group or joining an existing network group, adding new Internet connection or removing an existing one. This category includes: <ul style="list-style-type: none">● Internet access Network and Sharing Center● Homegroup● Internet Options
Appearance and Personalization	To change the wall paper, screensaver, Folder options etc. This category includes: <ul style="list-style-type: none">● Personalization● Display● Desktop Gadgets● Taskbar and Start Menu● Ease of Access Center● Folder Options● Fonts
Hardware and Sound	To add or remove hardware devices and to change sound settings. This category includes: <ul style="list-style-type: none">● Devices and Printers● AutoPlay● Sound● Power Options● Display● Windows Mobility Center
Clock, Language, and Region	To change clock, date, and region settings. This category includes: <ul style="list-style-type: none">● Date and Time● Region and Language

Problem Diagnosis, Troubleshooting and Maintenance



Programs	To uninstall programs or Windows features, uninstall gadgets, get new programs from the network or online. This category includes: <ul style="list-style-type: none">● Programs and Features● Default Programs● Desktop Gadgets
Ease of Access	To adjust your computer settings for vision, hearing, and mobility, and use speech recognition to control your computer with voice commands. This category includes: <ul style="list-style-type: none">● Ease of Access Center● Speech Recognition

The Control Panel can also be displayed in other two views (i) Large Icons view, and (ii) Small Icons view.

Small Icons view of the control panel is displayed below:

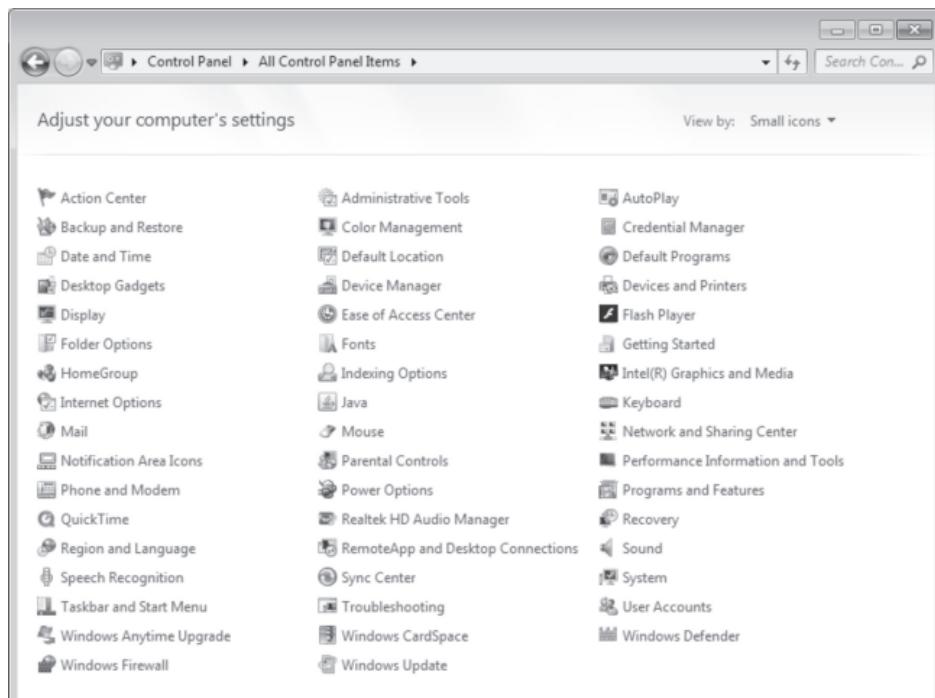


Fig. 11.4 Small icons view of control panel



11.3 HARDWARE TROUBLESHOOTING

When the computer is working unusually, turn off the computer and restart after a while.

Precautions before the diagnose or troubleshooting

1. Never replace a computer peripheral near the main power supply.
2. Never touch a computer peripheral with wet hands. Make sure your hands are clean and dry when you handle them.
3. You can, always use an anti-static computer repair kit.
4. Always use proper tools.
5. Never use your teeth to clean or cut wires or any other electronic and electric parts.
6. Always have good power cords/extension boards and earthing system.

Troubleshooting of Monitor

If your monitor is not working or not getting power, then first check whether the monitor is ON. Then verify whether the power switch is ON and also check if the monitor is in **power saving or sleeping mode**. In case it is not getting on then check it whether all peripherals are connected or not.

To change the display settings, select Start menu --> open Control Panel then choose Display. Then choose **Change Display Settings**. The following window will be displayed. Change the resolution, orientation, text size etc., from this window and click OK.

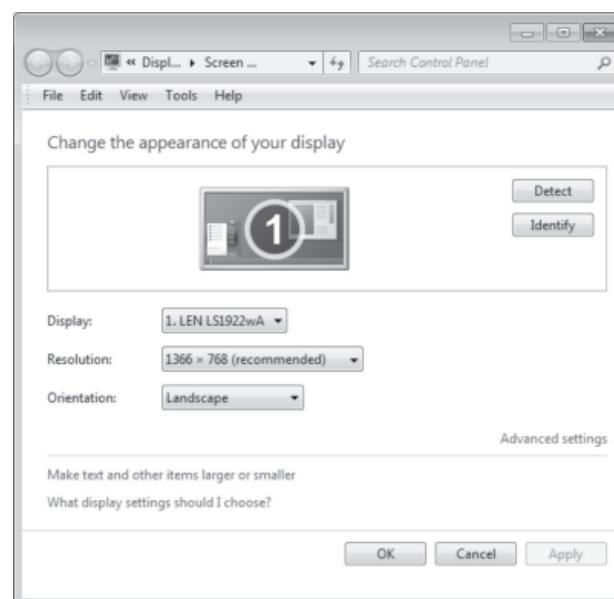


Fig. 11.5 Display settings



Notes

Printer Troubleshooting

There are lot of printers available in the market. If the printer is not functioning follow the troubleshooting steps given below.

- If your printer is not printing, then first check whether the printer cable is attached with your computer or not and, also check whether your printer is ON. In case the printer you are using is a network printer then check whether it is accessible in your network. In case, there is still a problem, then you try to update the printer driver.
- Load the paper in case your printer is not having paper on printer tray. Printers may have more than one tray, load the paper accordingly and take printouts.
- Also check if there is any paper jam in the printer, if yes then clear the paper jam and restart the printer.
- To test whether printer is working properly, open Control Panel → Devices and Printers. It will display devices and printers attached to your computer. Now right click on your printer name and choose Printer Properties. Printer Properties dialog box will be displayed. Choose Print Test Page

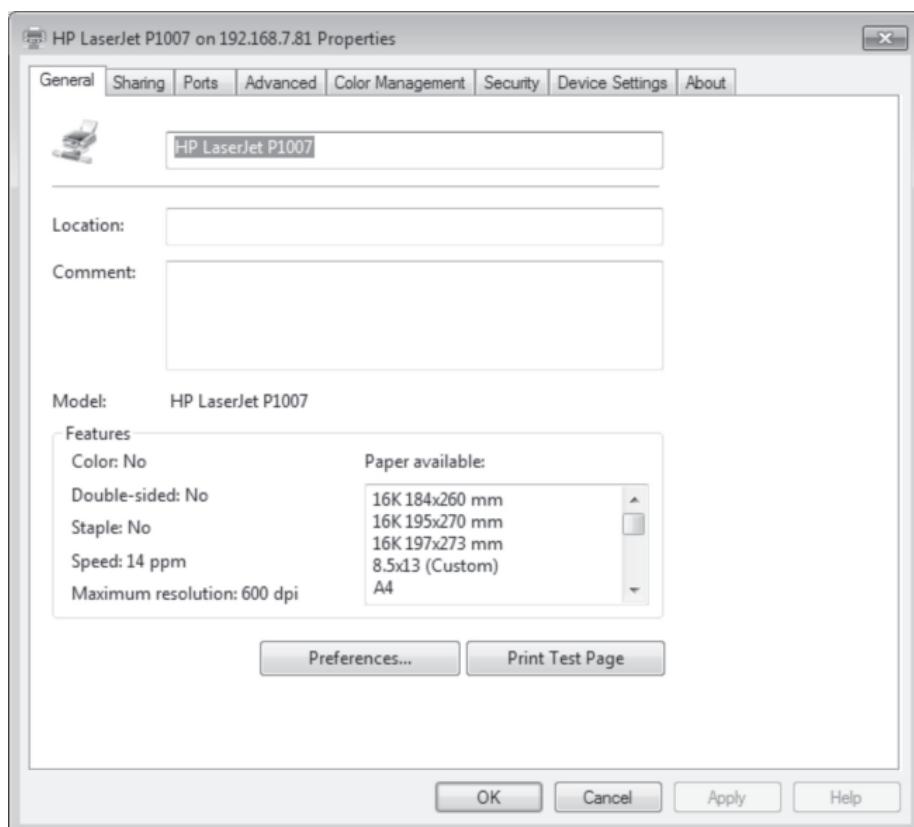


Fig. 11.6 Printer properties



Notes

Problem Diagnosis, Troubleshooting and Maintenance

It will display the message that "A test page has been sent to your printer". Your test page will be printed.

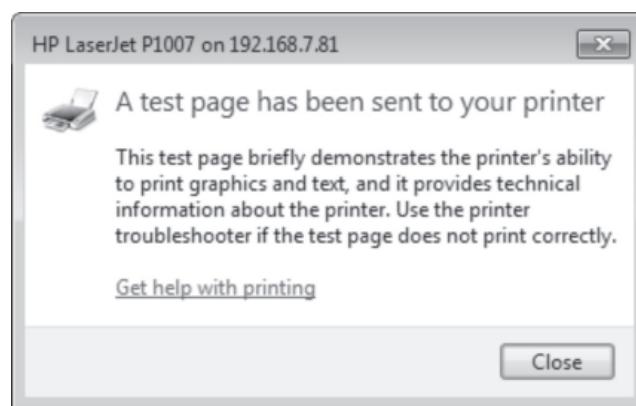


Fig. 11.7 Test page sent to printer

In case, the printer does not print the test page you can use Printer Troubleshooter. From start menu, select Devices and Printers → select Printer → Right click on the Printer Name and choose Troubleshoot . It will detect the printer problem and fix the problem if any.

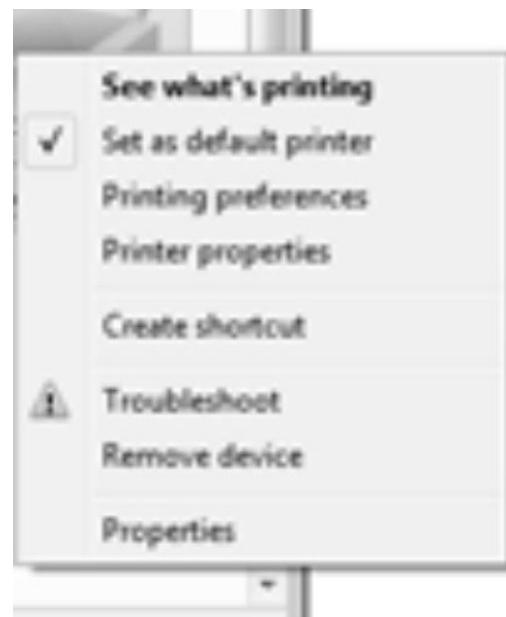


Fig. 11.8 Printer troubleshoot

CD Troubleshooting

In case if you inserted any CD or DVD on the drive, and it is not working:, then remove CD /DVD from your Computer, insert it again and check.

- Verify whether the CD is placed properly.



- Verify whether the CD can be used on the CD drive of an alternate machine.
- Verify whether the CD is scratched.
- Verify whether the CD is a CD-R or CD-RW that was copied.

Keyboard Troubleshooting

If your keyboard is not responding then try the following

- first check whether the keyboard cable is connected properly.
- Connect the keyboard into the different USB port.
- Disconnect your keyboard, clean it with dry cotton cloth. Connect it again and check if keyboard is getting power.

Mouse Troubleshooting

If your mouse is not responding then try the following

- First check whether the mouse cable is connected properly.
- Connect the mouse into the different USB port.
- Disconnect your mouse, clean it with dry cotton cloth.

If you are using wireless mouse/keyboard check whether you have placed correct type of batteries and whether the batteries are optimally charged.

Video Troubleshooting

If you get a black screen on your personal computer then perform the following checks:

- If monitor's light is on, check your screen's brightness. If your screen's brightness is turned down then turn it up.
- If the power cord is unplugged, then plug the power cable.
- If the display is not proper and unclear than it could be related to display settings or problem in graphics card.

Sound Troubleshooting

Suppose you are unable to hear any sound, from computer then perform the following steps-

- Check if external speakers (if you have) are connected to proper audio port.
- Check to see if the speakers are turned on, if not then turn them on.
- Check to see if the volume is turned up, if not then turn it up i.e., check whether the speaker is mute, if yes then unmute it.
- Try unplugging and re-plugging the speaker again.

If you still face problem then you should check the driver (sound device driver).



Notes

No Power

1. If the computer does not power up at all, reset the BIOS first and then try. This can be done by restarting/rebooting and immediately pressing F5/F8 keys on the keyboard. And it will go to BIOS. Then press / enter RESET.
2. If it still does not power up, disconnect all the peripherals and wires except processor and power supply, then try to switch it on from the motherboard's front panel connector.
3. If still does not power up, change the power supply and try.
4. If still does not power up, remove the motherboard with processor from casing and lay it on antistatic surface and plug a power supply and try.
5. If same problem still exists, replace the processor and try.
6. If even this does not solve the problem, the motherboard itself is faulty.

Reinstall/Update Drivers

Numerous hardware related issues happen due to driver clashes, degenerate driver parts, and drivers which need to be overhauled for utilization. At the point when something does not work, reinstall the appropriate driver.

11.4 SOFTWARE TROUBLESHOOTING

Update softwares

One general guideline to remember while doing programming related troubleshooting is to verify you have the latest adaptations of your applications, drivers and working framework. Additionally install good anti-virus software which automatically scans and cleans your computer as and when required.

The softwares you were using might be an old version. Check the current version and download application patches. Recently launched applications may have bugs. When the application developer or product maker gets to know about some bug in the application, they develops and posts patches, fixes, and administration packs on its site to rectify the same. When you have programs that contain bugs, check the site of your product maker - they may have posted the fix you require. You should download the patch(es) and install them on your computer.

Preliminary Measures

When you have any problem with your computer, the first thing you need to do is to restart the machine but before restarting please save your files (word, excel etc.).

Reinstall

If a specific program/software starts working in an unexpected manner (or) is not working properly even after a few attempts, reinstalling the particular program/software is required. Before re-installing a software, you have to uninstall it (through Control Panel → Add / Remove Programs).



Eliminate Troublesome Programs

If you notice that consistent problems began after you installed a particular software, then uninstall and re-install the software. If the problems arise again then either uninstall the software permanently (if you think that the software is unnecessary), or contact the software developer to get the issue resolved.

Defragment the Hard Drive

After a machine has been utilized for some time, the files on the hard disk get fragmented. We do not get to know about this fragmentation because we always get the correct data from the files. But fragmentation slows down the performance of the hard drive. Therefore, you should periodically defragment your hard disks. Defragmentation software is usually supplied as a utility with the operating system.

Formatting Your Hard Disk (HDD)

In the extreme situation, you may need to format your hard disk, and reinstall your operating system, drivers, and programs from scratch. This is the situation when machines have been hit by specific sorts of viruses. When you format your hard disk drive, everything will be permanently deleted. Before formatting you can take the important files/data into an external hard / flash drive by connecting it through USB port on your CPU via USB cable.

11.5 NETWORK TROUBLESHOOTING

You have learnt hardware troubleshooting and software troubleshooting. Now let us know about network troubleshooting.

When you are working in the network computers, sometimes you may not be able to access network files or unable to connect the network. In this situation you follow these steps.

- Check to see if the network cable is plugged, if not then plug it.
- Check to see if the light is blinking when the network cable is plugged.
- Check to see if username, password and domain are entered correctly.
- Re-enter new username, password and domain and try again.
- If you still get an error message then check the login credentials on other PCs, if it works correctly then the problem is solved.
- If it does not work on other PC then your login credentials could be incorrect. Otherwise your PC network hardware has to be checked.

Basic Network Troubleshooting Tools

Pinging

Ping command - to check the reachability of the host on an Internet protocol. i.e., to verify that computer can communicate with other computer (device) on the network. It displays



Notes

Problem Diagnosis, Troubleshooting and Maintenance

the time taken for the hop to connect, the number of packets received, the number of packets lost and the number of packets sent.

```
C:\> ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=2ms TTL=64
Reply from 192.168.1.1: bytes=32 time=2ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\>
```

Fig. 11.9 Use of ping command

Traceroute

Traceroute is a command used by a computer network administrator to check the number of hops and if the packet is being lost or the internet connection is unable to be established. As the command suggests, it traces the route completely and checks each and every hop of the route.

```
C:\> tracert www.google.com

Tracing route to www.google.com [173.194.36.114]
over a maximum of 30 hops:
1  35 ms     1 ms     40 ms  19.8.23.254
2  <1 ms     <1 ms     <1 ms  10.0.253.1
3  1 ms      1 ms     1 ms  202.12.103.13
4  27 ms     26 ms     25 ms  192.19.15.254
5  31 ms     32 ms     29 ms  22.14.228.66
6  31 ms     29 ms     29 ms  64.236.140.96
7  32 ms     33 ms     33 ms  299.85.248.17
8  32 ms     31 ms     31 ms  de101s07-in-f18.le100.net [173.194.36.114]

Trace complete.

C:\>
```

Fig. 11.10 Traceroute command



Notes

Ifconfig

Ifconfig is a system administration tool used for the configuration of interface mostly in Unix like architecture. By using this command a user can configure each and every interface connected to the hardware whether it is input/ output interface.

```

206.220.173.219 - PuTTY
zeus:~# ifconfig
eth0      Link encap:Ethernet HWaddr 08:00:27:59:84:63
          inet addr:206.220.173.219 Bcast:206.220.173.223 Mask:255.255.255.248
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:114578 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1008426 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:389028395 (371.0 MiB)  TX bytes:610687216 (562.3 MiB)

eth0:1    Link encap:Ethernet HWaddr 08:00:27:59:84:63
          inet addr:206.220.173.220 Bcast:206.220.173.223 Mask:255.255.255.248
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1

eth0:2    Link encap:Ethernet HWaddr 08:00:27:59:84:63
          inet addr:206.220.173.221 Bcast:206.220.173.223 Mask:255.255.255.248
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1

lo       Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          UP LOOPBACK RUNNING MTU:16436 Metric:1
          RX packets:392075 errors:0 dropped:0 overruns:0 frame:0
          TX packets:392075 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:3471173328 (1.3 GiB)  TX bytes:3471173328 (1.3 GiB)

zeus:~#

```

Fig. 11.11 Ifconfig command

Netstat

Netstat command, also known as the *network statistics* command is used to display the network connections for transmission of packets. It also displays the routing table with the complete network protocol statistics.

```

206.220.173.219 - PuTTY
zeus:~# netstat -l
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 *:imapd                *:*                  LISTEN
tcp        0      0 localhost:spamd           *:*                  LISTEN
tcp        0      0 *:www                 *:*                  LISTEN
tcp        0      0 *:webmin              *:*                  LISTEN
tcp        0      0 zeus.wilkinshouse.c:ftp  *:*                  LISTEN
tcp        0      0 zeus.sr-wconsulting:ftp *:*                  LISTEN
tcp        0      0 206.220.173.221:domain  *:*                  LISTEN
tcp        0      0 zeus.sr-wconsult:domain *:*                  LISTEN
tcp        0      0 zeus.wilkinshou:domain *:*                  LISTEN
tcp        0      0 localhost:domain        *:*                  LISTEN
tcp        0      0 *:ash                 *:*                  LISTEN
tcp        0      0 localhost:11000          *:*                  LISTEN
tcp        0      0 *:smtp                *:*                  LISTEN
tcp        0      0 localhost:953           *:*                  LISTEN
tcp        0      0 *:https               *:*                  LISTEN
tcp        0      0 *:20000              *:*                  LISTEN
tcp        0      0 localhost:10023          *:*                  LISTEN
tcp        0      0 localhost:mysql          *:*                  LISTEN
tcp        0      0 *:pop3                *:*                  LISTEN
zeus:~#

```

Fig. 11.12 Use of netstat command

Testing Speed

The broadband speed of the internet connection can be tested easily with various applications like speedtest.net. It tracks and displays the number of hops, the upload speed and the download speed. It works for both symmetric and asymmetric internet connections.



Notes

Problem Diagnosis, Troubleshooting and Maintenance

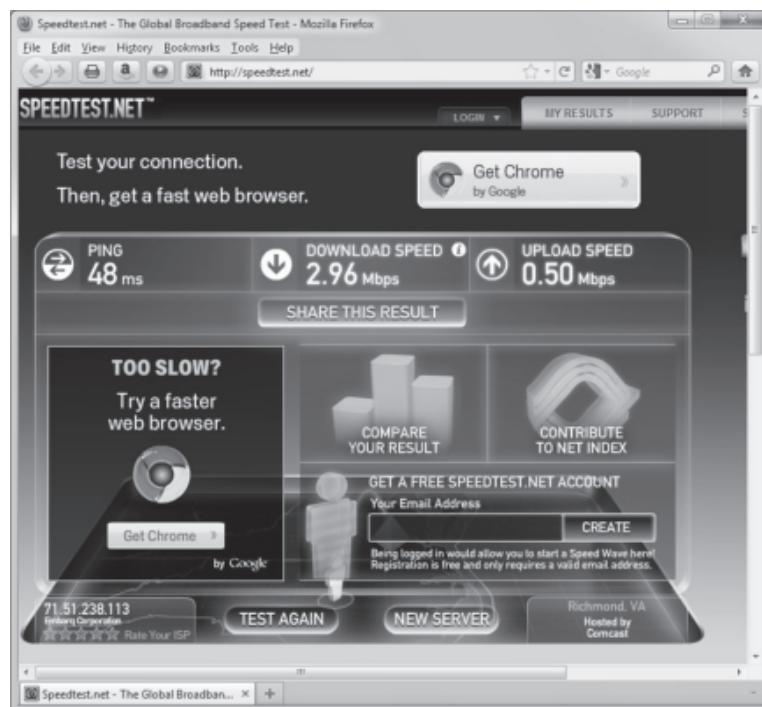


Fig. 11.13 Testing speed of internet



Fig. 11.14 Broadband quality test



Notes

11.6 INDICATIONS OF COMMONLY FOUND PROBLEMS

The following is some of the most well-known PC issues that are accounted by the customers and users:

"404" / "Page Not Found" Error

You may get this error because the requested page is not available on the server. Sometimes this error will be solved by refreshing the page or ensuring the correct spelling of the web page. If you are the owner of the website then contact your hosting provider to solve. Otherwise check the internet connection is there.

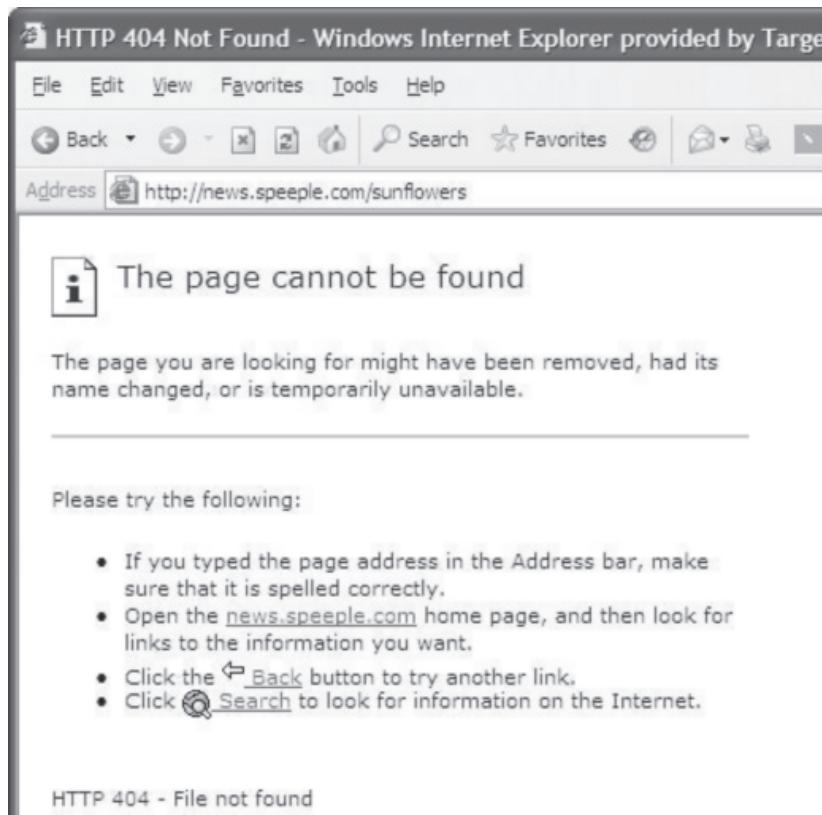


Fig. 11.15 “404” page not found error

Death of Screen

Sometimes the computer shows Blue Screen of Death." It is also called as STOP Error. STOP 0x0000008e and STOP 0x0000007b are two of the most basic mix-ups of this type.



Notes

Problem Diagnosis, Troubleshooting and Maintenance

A problem has been detected and windows has been shut down to prevent damage to your computer.

The end-user manually generated the crashdump.

If this is the first time you've seen this stop error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any Windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup options, and then select Safe Mode.

Technical information:

*** STOP: 0x000000E2 (0x00000000,0x00000000,0x00000000,0x00000000)

Beginning dump of physical memory

Physical memory dump complete.

Contact your system administrator or technical support group for further assistance.

Fig. 11.16 Blue screen

In this case, you can try rebooting your PC in safe mode and then it will try to AutoCorrect.

Abnormally Functioning Operating System or Software

Sometimes your operating system or software is not working or responding properly, then restart your machine and scan for virus in your system. If virus is found in your system, delete the virus. To prevent this, install antivirus software in your system.

Strange Noises

Sometimes your system makes strange noise due to harddrive problem or fan may be making noise. In this case, first check the CPU fan and case fans are working properly. If not then replace them. If hard drives makes noise, backup your data otherwise you may loss your data.



INTEXT QUESTIONS 11.1

1. What is "404/Page Not Found" Error?
2. command is used to display the network connections for transmission of packets.
3. In Control Panel will help in adjusting your computer settings for vision, hearing, and mobility.
4. command is used to verify that computer can communicate with other computer (device) on the network.



11.7 SYSTEM SECURITY

Computer system security guarantees that your machine does what it is desired to do. It secures the data from being lost or altered either intentionally or unintentionally. Also it ensures that no unauthorized person can access your data.

Encryption (system level security)

Most tools encrypt the information kept in the secret word document. Encryption guarantees that no matter even if the data could be accessed by unknown person, the intruder will not have the right to use the passwords in the document. Most tools perform one-way encryption of passwords.

Data Access: Protecting Your Data

When you are working alone on a PC, you do not have to think about access controls. When you start to work on a system that supports various clients or is in network, you will need to be careful over information security and access controls. You may not need each client to have the right to use your records or documents.

Network Level Security

A small flaw in the network can result in major financial damage or loss of sensitive data. Network security consists of authorization of data access in network. Users are assigned authenticated information which permits them access to information and programs based on permissions.

Firewall enforces access policies for e.g., services which will be allowed for access by the network users. Intrusion detection and prevention system helps in detecting such intrusions. Networks are prone to attacks from malicious sources. Network attacks can be of two types: Passive attack (attempts to make use of information from the system) and Active attack (modify system resources or affect their operation). Tools are to be used for preventing the intrusion on networks.



WHAT YOU HAVE LEARNT

After going through this lesson, you have learnt about how to recover your system, features of control panel, how to troubleshoot hardware, software and network. You have also learnt about the common problems in the computer and their remedies.

Some of the keypoints to remember

- Purpose of Control Panel is to change the features of Windows operating system in respect of display, security, handling peripherals etc.
- Ping command checks the reachability of the host on an Internet protocol.
- Traceroute is a command used by a computer network administrator to check the number of hops and if the packet is being lost or the internet connection is unable to be established.



Notes

Problem Diagnosis, Troubleshooting and Maintenance

- Ifconfig - by using this command a user can configure each and every interface connected to the hardware whether it is input/output interface..
- Types of network attacks are passive attack and active attack.



TERMINAL EXERCISE

1. How do you access the System Recovery options menu?
2. Discuss about the System Restore Utility.
3. What are the various causes for having No Power in the system?
4. Discuss the steps to be taken if power is there but display is not coming?
5. What are the preliminary measures to ensure that system is working properly?



ANSWER TO INTEXT QUESTIONS

11.1

1. Requested page is not available in server
2. Netstat
3. Ease of Access (Ease of Access Center)
4. ping



Notes

12

NEW TRENDS IN COMPUTING

This lesson is aimed to provide awareness about some of the latest technologies in the domain of computing and IT. With increase in usage of internet connectivity and need of high end computing, today's world is witnessing a shift from the era of mainframe computing and individual computing to a new era of mobile and green computing where the computing power, software and data are not necessarily located in office premises, rather, these can be stored somewhere in a "cloud" and can be accessed via internet at anytime and anywhere.



OBJECTIVES

After reading this lesson, you will be able to

- define virtualization.
- list the types of computing.
- describe cloud computing.
- explain mobile computing.
- explore grid computing.
- use green computing.

12.1 VIRTUALIZATION

Literal meaning of virtualization is simulation. Virtualization allows the pooling and sharing of the computational power (processor, server) and storage of multiple computers, network and other resources among multiple users. This simulation technique is adopted



to give user a feel that all infrastructure (whether hardware or software) belong to user only. This is achieved by simulating the computational facility by creating a virtual version of given resource like for hardware platform virtual version of storage device, network resources can be made, and for software platform virtual version of operating system and other software is created. This virtual version provides a complete execution environment. An user is able to interact with these virtual resources as if it were a real single logical resource.

A concept of virtualization can be made clear with a common example of division of hard disk into different partitions. A partition is a logical division of a hard disk and it creates an effect of two separate hard disks to the user. This partition makes the management of files easier.

Virtualization is the ability to create a virtual copy of a device or some type of resource like server, storage, device, network and even operating system, etc. It divides the multiple resources into different execution environments. Thus, one of the main objectives of virtualization is to centralize administrative tasks while improving scalability and workloads.

12.1.1 Architecture

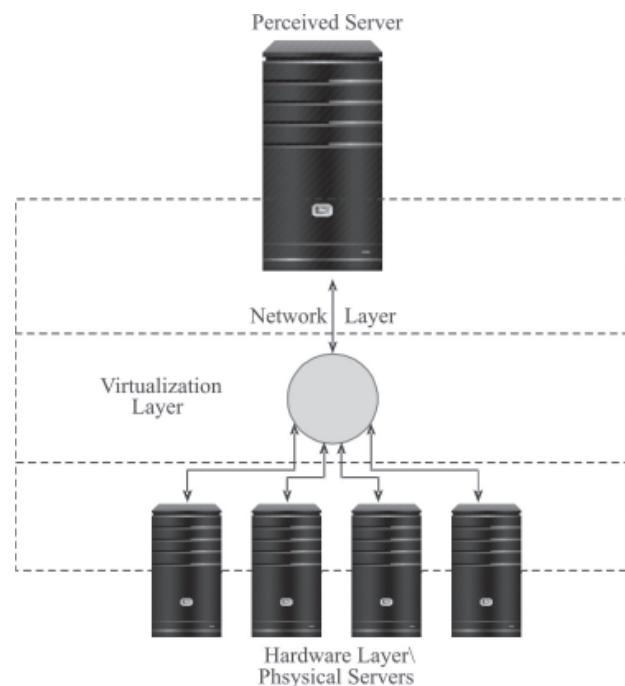
Virtualization can be achieved at different levels. If you consider hardware, the organization needs:

- A large data storage system where complete data of an organization can be kept with complete security. Further, there should be a secured and reliable intra department access to database as per the policy.
- A high end server that can retrieve the data from the storage and process it with fast speed.
- A fast and reliable internet connectivity.

All these are required with an objective that the process is completed almost at the same instant the user has entered the necessary input data. As discussed earlier it is not possible to provide dedicated resources to each user, however we can give an illusion of dedicated resource through virtualization. Let's see how the server, network and storage virtualization is done.

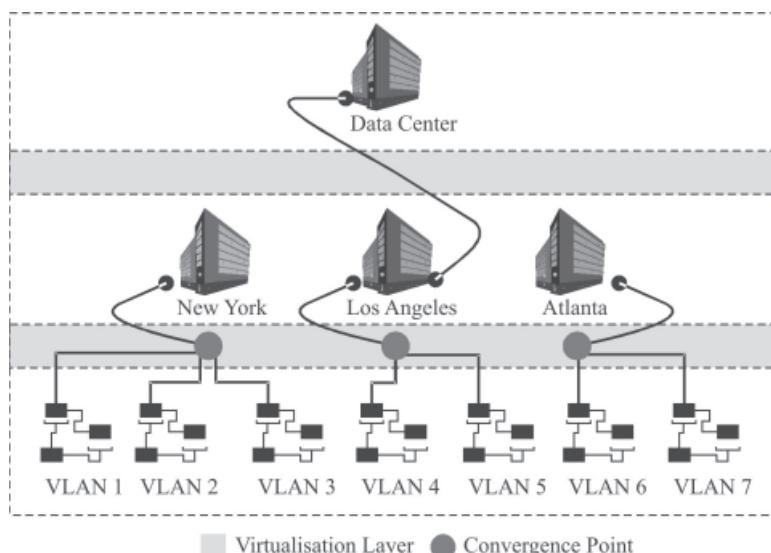
12.1.2 Server Virtualization

It is a partition of a physical server into smaller virtual server. i.e., logically server resources were divided into multiple copies. The idea is to present the illusion of one huge machine that looks like many machines or multiple machines tied together to look like a single system.

**Fig. 12.1** Server Virtualization

12.1.3 Network Virtualization

The bandwidth available in the network environment is much more than is needed for a single user. Thus, for complete utilization of this bandwidth, it is required to partition the available bandwidth into channels. Each of which is independent from the other and each of which can be assigned to a particular server or device in real time.

**Fig. 12.2** Network Virtualization



12.1.4 Storage Virtualization

This is perhaps the most widely deployed and highly used virtualization practice. Storage virtualization allows separate storage devices to be combined into a perceived single unit. Storage virtualization attempts to maximize the efficiency of storage devices in information architecture.

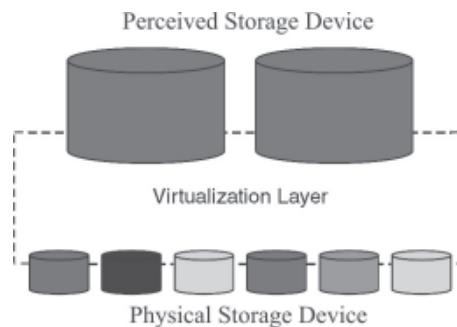


Fig. 12.3 Storage Virtualization

12.1.5 Software Virtualization

Operating system virtualization is to allow a piece of hardware to run multiple operating system images at the same time. It helps to accommodate multiple platforms simultaneously providing user more flexibility. Application software virtualization leads to create a logical image of application software to the user.

A system that provides both virtualizations of hardware as well as software is referred to as **Universal Virtualization**, as shown below:

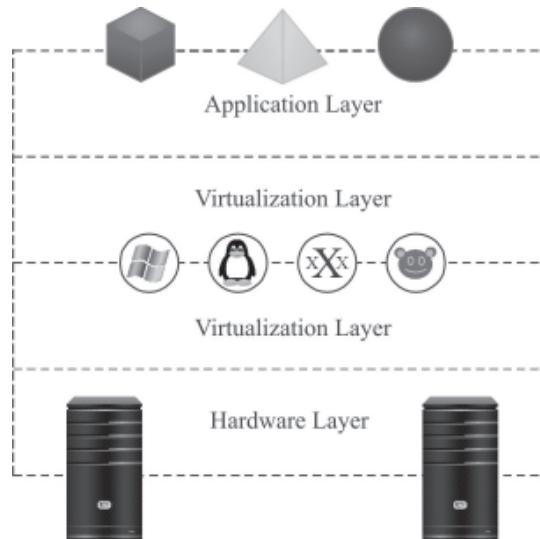


Fig. 12.4 Universal Virtualization



Advantages of Virtualization

- **Improved hardware utilization:** As the same resource is used by many users, utilization of resources is increased.
- **Lesser hardware cost:** You need lesser number of hardware resources, thus overall cost is reduced .
- **Increased operational agility and reduced downtime:** As more alternative resources are available, the system does not crash even if any one component goes out of order.
- As lesser resources are needed, this approach is considered to be more environment-friendly.
- Lower total cost of ownership.
- It improves overall efficiency and effectiveness of the system.
- **Increased network capacity:** channelizing the network increases the transmission capacity.

Disadvantages of Virtualization

- The various advantages of virtualization can be appreciated only if these benefits are achieved without compromising the overall security, reliability and availability of the IT infrastructure.
- The virtualized environment is considered more vulnerable as there are more chances of potential attack to gain unauthorized access to resources from guest operating systems.

12.2 CLOUD COMPUTING

As virtualization allows the user to access any resource by simulating a logical version of it, this technology gave an idea if you need any particular facility only for say one hour a day then why to pay for it for whole day or why to maintain the complete infrastructure if you can get this facility just by creating a logical version of it. Keeping these objectives in mind the idea of **pay-per-use** services was implemented through cloud computing. Cloud computing in simple words refers to selling any type of IT services including

- delivery of resources via creating a virtual simulation of the resource.
- selling of application software.
- platform on which we need to execute the application;

All of these services are delivered through internet.

- Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at some remote locations. Examples of cloud services include online file storage, social networking sites, webmail, and online business



applications. Thus, through cloud computing, one can increase its storage capacity, usage of high end server or add computational capabilities without investing in new infrastructure, training new personnel, or licensing new software.

The cloud computing model allows access to information and computer resources from anywhere where a network connection is available. Cloud computing provides a shared pool of resources, including data storage space, networks, computer processing power, and specialized corporate and user applications. Cloud computing encompasses any subscription-based or pay-per-use service, that too, in real time over the Internet, thereby it extends existing IT capabilities of any organization by letting organization to pay just for the service it needs. The best feature of cloud computing is that it provides the end user many flexibilities like:

- Anything (i.e., any IT related service)
- Anywhere (at any place via internet)
- Anytime(at any instant of time)
- With any device that is compatible with internet usage

The following definition of cloud computing has been developed by the U.S. National Institute of Standards and Technology (NIST):

“Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models.”

12.2.1 Essential Characteristics

The five essential characteristics that should be there in a computing environment so that it can be considered as cloud computing are:

1. On-demand self service
2. Broad network access
3. Resource pooling
4. Rapid elasticity
5. Measured service.

On-demand Self-service: As an user can request and manage your own computing resources as per your need i.e., the user can choose the computing capabilities, such as server time, network bandwidth, storage capacity etc. These requests are fulfilled automatically without requiring human interaction.



Broad Network Access: You can access the given service over the internet or private network. Thus it is required that all cloud services should be always available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

Resource Pooling: Pooled resources mean that user can select any resource from a pool of computing resources. Examples of resources include storage, processing, memory, network bandwidth, and virtual machines. The cloud service provider need pool all computing resources to serve multiple users using a multi-tenant model, with different physical and virtual resources. These resources are dynamically assigned and reassigned according to user demand. The user generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data centre). Thus, for the end user, resource usage is independent of its location.

Rapid Elasticity: The services, which are provided, can be rapidly and elastically changed. To the user all these services are available and can choose any one of them. It should appear to the user that all services are unlimited and can be purchased in any quantity at anytime from anywhere.

Measured Service: Cloud systems automatically control and optimize resource use by leveraging a metering capability according to the type of service (e.g., storage, processing, bandwidth, and active user accounts) i.e., the service provider will charge the user as per the usage of IT services. Resource usage can be monitored, controlled, and reported providing transparency for both the service provider and user who are utilizing the service. The resource service which is provided can be scaled larger or smaller; and according to the use of a service (type of service and amount of time which this service is used, also on number of user) the customers are billed.

You can say, through cloud computing, service provider provide access to software, platform or infrastructure on a basis of demand raised by user and user has to pay for it on a metered basis.

12.2.2 Three Services

The cloud computing can be accessed for usage of any particular software, platform or the complete infrastructure. Based on these the following three services are characterized:

Cloud Software as a Service (SaaS): This service provides user a capability to use any applications (which are developed by service provider) by executing it on a cloud infrastructure i.e., any pre-made application, along with the required software, operating system, hardware and network, is provided by the service provider. The applications are accessible from various client devices through Internet via a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.



Examples: Many of the most popular cloud-based applications are business productivity tools such as email (e.g., Gmail, Hotmail), online productivity software (e.g., Google Docs, Microsoft Office 365), conferencing services (e.g., Microsoft LiveMeeting, WebEx), and customer relationship management software (e.g., Salesforce).

Cloud Platform as a Service (PaaS): This service provides user a capability to deploy user-created or acquired applications onto the cloud infrastructure. This application is created using programming languages and tools supported by the cloud service provider. Thus cloud service provider provides an operating system, hardware, and network where the user installs or develops their own software and applications. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

Examples: Google App Engine allows developers to create and run web applications that run on top of a custom Google platform and use Google's computing resources.

Cloud Infrastructure as a Service (IaaS): This service provides user a provision processing, storage, networks, and other fundamental computing resources, such that, the user is able to deploy and run arbitrary software, which can include operating systems and applications. Thus IaaS model provides just the hardware and network, and the user can install operating systems, software and applications. Although here also user does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of selected networking components (e.g., host firewalls).

Examples: cloud storage (e.g., Data centres), providing users access to scalable online storage

12.2.3 Cloud computing Deployment Models

There are four different ways through which a cloud computing can be deployed

Private Cloud: The cloud infrastructure is used exclusively by an organization. These are usually used by large organizations which have multiple business units. It may be managed by the organization itself or by some other third party. It can be deployed either in premises (on-site) or off premises (off site).

Community Cloud: The cloud infrastructure is shared exclusively by a specific group of organizations, especially those, sharing common concern (e.g., business interest, mission or goal, security requirements, policy, and compliance considerations). Similar to private cloud, it may be managed by the organizations or a third party and may exist on premises or off premises.

Public Cloud: The cloud infrastructure is made available for the use to the general public or a large industry group and is owned by an organization selling cloud services. Examples of public clouds are Amazon EC2, Amazon S3, Google, Microsoft Azure etc.



Hybrid Cloud: The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., “cloud bursting” for “load-balancing” between clouds).

Advantages of Cloud Computing

- It creates a more flexible environment that allows organizations to "rent" computing power on requirement.
- An organization can scale up or down its IT usage, according to demand.
- No need to procure space for creating infrastructure.
- Provide more mobile solution i.e., it is not necessary for the user to be in office to access the information. He or she can access the information through mobile also.
- Organization can build its infrastructure on its actual use of IT resources, rather than creating an overbuilt capacity, based on potential demand. Potential demands can be met by renting services through cloud.
- Organizations can easily upgrade their applications as they can change platforms simply by switching cloud service providers.



INTEXT QUESTIONS 12.1

1. allows the pooling and shaing of resources among multiple users.
2. Which of the following is not a essential characteristics of cloud computing.
 - (a) On demand self service.
 - (b) Static environment.
 - (c) Resource pooling.
 - (d) Rapid elasitity.

12.3 MOBILE COMPUTING

The advancement in technology of portable computers, which are capable of accessing the wireless technology, has made a huge revolution in the domain of Information and Communication Technology. It has given birth to new era of mobile computing, a platform that allows mobile user to have a versatile communication with other people and notification of events, messages and allows continuous access to services and resources of land based network.

Mobile computing is an umbrella term used for describing the technologies that enable people to access network services any place, any time, and anywhere. It is an extension of mobile voice communication technology which is capable of sending and receiving data across the cellular network.



Mobile computing basically involves designing of application and resolving technical issues of the people who are on move around within a region or country, or travel between countries and continents. Mobile data communication has become a very important and rapidly evolving technology as it allows users to transmit data from remote locations to other remote or fixed locations. This proves to be the solution to the biggest problem of business people who are frequently on the move.

In simple terms Mobile computing can be defined as a computing environment over physical mobility.

OR

“A technology that allows transmission of data, via a computer, without having to be connected to a fixed physical link.”

OR

“Mobile computing is the ability to use computing capability without a pre-defined location and/or connection to a network to publish and/or subscribe to information.”

Here you need a computing environment which is mobile and moves along with the user. For that you need a computing environment which fulfils the three important needs namely:

- Wireless communication
- Mobility
- Portability

Wireless Communication: In mobile computing platform, information between processing units flows through wireless channels. The demand for mobile communication creates the need for integration of wireless networks and existing fixed networks

- **Local Area Networks:** standardization of IEEE 802.11 or HIPERLAN for handling interoperability and issues between different wireless LANs.
- **Wide Area Networks:** GSM and ISDN for global access.
- **Internet:** Mobile IP extension of the Internet protocol (IP).

Common technologies used are IR (Infrared Receivers), BlueTooth, W-LANs, Cellular, W-Packet Data networks, SAT. etc

Mobility: Mobile computing needs that device should be able to remain connected with network while changing its location. Different aspects of mobility are:

- **User Mobility:** users communicate “any time, anywhere, with anyone” (example: read/write email on web browser).
- **Device Mobility:** a small battery driven devices that can be connected any time, anywhere to the network.



- **Session Mobility:** A user session should be able to move from one user-agent environment to another.
- **Service Mobility:** User should be able to move from one service to another.

Portability: It is not feasible to carry a desktop because of its size, weight and heat dissipation. You need a portable device that is small, light weighted, durable, capable to be operational under wide environmental conditions and having a battery with long life.

To develop a mobile computing environment, you need a wireless communication facility, a mobile PC or mobile device and software which is specially designed keeping the needs of mobile device and user of mobile device.

Mobile Data Communication: Whenever a user is using a mobile, he / she will be using different networks at different places at different times as discussed earlier. Some common examples are GSM, CDMA, Ethernet, Wireless LAN, Bluetooth etc.

Mobile laptop and notebook computers can use one of two types of wireless access services when away from the home or office. The most commonly used and least expensive is Wireless Fidelity also known as WiFi. The WiFi uses radio waves to broadcast an Internet signal from a wireless router to the immediate surrounding area. An alternative to WiFi is cellular broadband. This type of mobile computing technology utilizes a cellular modem to connect to cell towers for Internet access.

Mobile Device: Mobile telephony took off with the introduction of cellular technology which allowed the efficient utilization of frequencies, enabling the connection of a large number of users. There are many different types of mobile computing devices designed to make it easier to travel and conveniently access technology on the go. Notebooks are small laptop computers that typically feature built-in wireless networking, and are great choices for those who want to work even while travelling. Mobile computing devices with a smaller size, such as smart phones or tablet computers, are becoming very popular as they are much easier to carry and now-a-days, these devices include many advanced features of computing, even comparable to those found on a laptop computer. Common devices that are used in mobile computing are

- Notebook PCs
- Personal digital assistant/enterprise digital assistant
- Smartphone
- Tablet computer
- Ultra-Mobile PC
- Wearable computer
- Palmtops
- Cell phones
- Pagers
- Sensors



Mobile Software: Mobile applications commonly called mobile apps are the applications that run on a mobile device. These usually run on web browser (HTML, JavaScript, Flash, server-side components, etc). Designing software of mobile application is a challenging task.

One of the major constraint is that user of this technology demands intuitive user interfaces, fast response times, and deep relevant content, high processing (specially for gaming and multimedia application) but the device which are used for mobile applications usually have limited processing speed, storage, power backup and display facilities.

Mobile computing is widely used in:

- **Vehicles:** use of GPS in vehicles for identifying the area.
- **Nomadic User:** user usually uses laptop and connects to network.
- **Smart mobile phone:** widely used for playing games, up-to date information, e-mail facility.
- **Invisible computing, Wearable computing:** These are tiny embedded "computers" that can be worn by the user as an accessory and use Bluetooth over cable connections, for providing connectivity.
- **Intelligent house or office:** Using mobile computing control various functions of computers and embedded systems that are used in office or home.

Various common usage of this computing are:

- Finding a local printer in the office even without being physically plugged.
- House recognizes inhabitants.
- House regulates temperature according to the need of person by adjusting the temperature of AC which can be achieved even without entering the house.
- **Meeting Room/Conference:** Share data instantly, send a message to someone else in the room or secretly vote on controversial issues.
- **Taxi/Police/Fire Squad Fleet:** use this computing facility for remaining connected, for controlling and communicating.
- **Emergency Services:** Received information regarding the address, type and other details of an incident can be dispatched quickly, via a CDPD (Cellular Digital Packet Data) system using mobile computers, to one or several appropriate mobile units which are in the vicinity of the incident.
- **Disaster Relief:** After earthquake, tsunami, volcano eruption, etc. infrastructure cannot be established immediately but mobile communication is established via Satellite or Ad-Hoc network and proves very advantageous for relief and early transmission of patient data to hospital.



- **Disaster Alarm:** With help of satellite communication and sensors one might be able to alarm disaster early Example: Tsunami.
- **Military / Security:** can be widely used during war for communication and controlling the weapons in real time environment.

Advantages of Mobile Computing

- As devices used in mobile computing are portable, it can be easily carried by the user. Hence it provides an opportunity to develop an environment, where user always has a computing facility.
- As these devices have Internet access, these provide the user a facility to seek any information at any time.
- These devices are typically GPS enabled.
- Usually devices are multimedia enabled and typically have cameras & microphones
- Apps are free or low-cost.

Disadvantages of Mobile Computing

The following are not exactly disadvantages; rather these are some of the limitations of mobile computing:

- Limited screen size.
- Limited battery life.
- Limited processor speed.
- Limited and sometimes slow network access.
- Limited or awkward input: soft keyboard, phone keypad, touch screen, or stylus.
- Limited web browser functionality.
- Range of platforms & configurations across devices.

12.4 GRID COMPUTING

Grid computing applies the resources of numerous computers in a network to work on a single problem at the same time. Usually this environment is used for solving large scientific or technical problem where huge amount of computing is involved. A large project is divided among multiple computers to make use of their resources. However, in cloud computing, small applications run on different systems, simultaneously. Enables communities (“virtual organizations”) to share geographically distributed resources as they pursue common goals.

The prime objective of grid computing are:

- Sharing computing resources between organisations.



- Solving complex and other software applications that demand high computing by providing widespread access to powerful computers and storage.
- Integrating existing systems together.

“A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational facilities”.

As explained in the beginning of the lesson, this decade has emphasized on community learning, which used to develop a low cost high performance computing system, popularly called clusters. These clusters share their resources to overcome the resource related problems in application domains. Grid is an infrastructure that involves the integration of different application such that they collaborate with each other to get complex problem solved with an ease. It involves integration of various resources of computers, networks, database and scientific instruments, owned and managed by multiple organizations. This is an environment which provides a secure resource sharing across organizational boundaries i.e., through intra cluster communications.

Solving complex problems can be achieved through grid computing by:

- Simulation of large complex systems.
- Large scale multi site data mining, distributed data sets.
- Sharing the resources by simulating their virtual version.
- Interactive collaboration.
- Real-time access to remote resources.

Grid resources are registered within one or more **grid information services**. The end users submit their application requirements to the **Grid brokers**, who then discover the suitable resources, by querying the information services, schedules the application jobs for execution on these resources and then monitors their processing until they are complete. Software tools and services, providing these capabilities to link computing facilities and data sources in order to support distributed analysis and collaborations, are collectively known as grid middleware.

Common grid applications are

- Distributed supercomputing
- High-throughput computing
- On-demand computing
- Data-intensive computing
- Collaborative computing

Advantages of Grid Computing

Cost effective way to utilize the given amount of computing resources by

- Virtualizing resources across an enterprise.



- Enabling collaboration of all virtual resources across the organizations or community.
- Identifying the underutilized resources.
- Performing load balancing of resources so that all resources are used equally.

12.5 GREEN COMPUTING

Popularity of Information and Communication Technology (ICT) has increased among common man and the hardware devices used in it have become an integral part of daily routine activities. Hence, it is very important to analyse the impact of this technology on the environment. Also, to make an attempt to develop a system which is environment friendly. The relationship of ICTs and the environment is studied in terms of three distinct kinds of effects:

- **Direct Effects:** This effect includes issues related to environmental changes that arise because of the design, production, distribution, maintenance and disposal of ICT goods and services.
- **Indirect Effects:** This effect includes issues related to environmental changes that arise because of the application and use of ICTs in different domains of society.
- **Systemic Effects:** This effect includes issues related to environmental changes that arise because of the changes in economic and social structures due to use of ICT products and services.

Impact of computer on environment needs to be studied from its manufacturing to its usage and disposal stages. As thousands of computers are used in every domain of life, great amount of power is used and a great amount of both paper and electronic wastes are produced.

Common hazards that arise as result of massive usage of computers and other computing devices in our life are:

1. Computers and office equipment play an increasingly large role in energy consumption. Desktop computers, fan, screen savers, scanners and other electronic technology account for the fastest growing source of energy consumption. Even in presently, people do not use energy saving CRT and processor. Further, they keep the computer "ON" even when not in use and also do not adopt power saving strategies such as 'sleep' and 'standby' modes. As a result, such a system remains active 24 hours per day, 7 days per week.

Possible solution: all computers in offices or home or any organization should have

- LCD energy saving monitors,
- CPUs that are ENERGY STAR. (ENERGY STAR certified technology allows computers to automatically switch to standby mode when inactive for a certain amount of time) and allowing for energy savings.
- Making a practice of Switching off equipments when not in use. The usual usage should be 8 hours per day, 5 days per week.



- 2. Paper usage:** Eventhough it is believed that using an automated system will reduce the paper work in any organization but practically it is observed that it has increased the paper consumption as

- printing is often wasteful
- It is common practice that the people take print outs of emails or meeting agendas
- printing out partial drafts
- maintain a hardcopy backup of entire data which often becomes obsolete once data changes

Possible Solutions:

- Do not print unless not very urgent
- Awareness should be provided to the users that all information is stored in the computer and can be retrieved any time hence they need not maintain a hardcopy backup of every partial drafts also

- 3. Manufacturing and packing of computing devices:** Pollution is increased because there are toxic chemicals used in the manufacturing of computers and components

Solution: manufactures should use non toxic and recyclable material for manufacturing the products

- 4. Disposal of unused devices:** The hardware technology changes very fast and as a result often people feel to replace their existing system. Disposal of these devices constitutes 20-50 million tons per year (about 5% of the total waste of the planet). This waste is also known as e-waste. The improper disposal of computers and components may lead to entry of these toxic material in our food chain and water

Solution: proper reuse and recycling of the products.

- **Reuse:** Organizations like play way schools, libraries etc may not need a high end latest configuration system, and instead of disposing the entire system, one can donate a computer or even its components to organizations who need lesser quality computers
- **Refurbish:** Rather than discarding the computer completly on release of the next generation. One can even upgrade the system by just replacing the processor and memory chips. Hence, many components like monitor, cables, UPS, speakers, keyboard, mouse etc., can be used (i.e., need not be replaced). This results in upgrading of computing facility without increasing the e-waste.
- **Recycle:** The companies that can recycle the plastics and other components, can also recycle the e-waste components.



The prime objective of green computing is study and practice of environmentally sustainable computing through Information Technology.

The objectives of green computing are similar to green chemistry i.e.,

- It should reduce the usage of hazardous materials for manufacturing any product.
- Enhance the energy efficiency of any product by reducing the power consumption of that product.
- Promote the recyclability.
- Usage of biodegradable products and factory waste.

Many corporate IT departments have taken lot of green computing initiatives to reduce the environmental impact. Green ICT and its services present opportunities to deliver low carbon footprints and mitigate carbon emissions because of the unique ability to make energy consumption and green house gas emissions visible through its products and services.



INTEXT QUESTIONS 12.2

3. computing allows transmission of data via computer without having to be connected to a fixed physical link.
4. Solving complex problems can be achieved through computing.
5. Prime objective of computing is study and practice of environmentally sustainable computing through Information Technology.



WHAT YOU HAVE LEARNT

In this lesson you have got familiarized with recent trends and future world of IT. You have learnt the basic concept and architecture of future technologies like virtualization, cloud computing, mobile computing, grid computing and green computing. You have also learnt that advantages, disadvantages and future prospects of these technologies.

Some of the keypoints to remember

- Virtualization allows pooling and sharing of the computational power and storage of multiple computers, network and other resources among multiple users.
- Cloud computing model allows access to information and computer resources from anywhere where a network connection is available.
- Mobile computing is the ability to use computing capability without a pre-defined location and /or connection to a network to publish and / or subscribe to information.



Notes

New Trends in Computing

- Grid computing applies the resources of numerous computers in a network to work on a single problem at the same time.
- Objective of green computing is study and practice of environmentally sustainable computing through information technology.



TERMINAL EXERCISE

1. What is cloud computing?
2. What is virtualization and how does it improve resource utilization?
3. How we can develop eco-friendly environment for computing?
4. What is mobile computing and what are its applications?
5. What is grid computing and in which environment it is found very useful?



ANSWER TO INTEXT QUESTIONS

12.1

1. Virtualization
2. (b) Static Environment.

12.2

3. Mobile
4. Grid
5. Green



Notes

13

ENGAGE WITH CUSTOMERS

For many organizations active and productive engagement of customers is a big challenge. It involves additional effort, skill and design on top of keeping the business running. However, many challenges businesses face can be resolved through better relationships with customers enabled by engaging them at the right moment with the right offer. Today's consumers, however are much more empowered than in the past and are forcing companies to build plans that more perfectly cater to their actual wants and needs. This means that businesses must start doing a lot more to ensure the customer experience by living up to the demands of the modern consumer, both from a product perspective and, importantly, a customer service viewpoint.

In this lesson, the details and best practices of customer engagement and interactions are being discussed in detail. It will serve as a guide for employees who handle where customer interaction and engagement.



OBJECTIVES

After reading this lesson you will be able to:

- effectively interact with the customer prior to the visit.
- explain customer's requirements prior to and on visit.
- suggest possible solutions for customers.
- understand the documentation process involved in customer engagement.
- improve productivity and quality based on customer feedback.



13.1 INTERACTING WITH CUSTOMERS

The way you interact with your customers will determine how your customers identify you, your business and your products or services. It is important that you promote your company at every turn and this does not necessarily only involve times when you are meeting customers. Networking is something that you are doing every time you leave your house, you should always be as prepared as possible for meeting prospective clients and dealers. The interaction between a company and its customers is becoming more and more important. Interacting with your customers can go a long way in not only helping you develop your brand, but also in bringing in additional customers as well.

For effective engagement and interaction with customers, you need to look into following aspects:

- **Call the customer based on inputs logged into customer care**

Check in the details of complaints, suggestions, feedbacks logged in by the customer. Try to understand the customer profile. Call the customer and discuss with them all the relevant issues with an open mind. A key element of delivering excellent customer service is the way that you interact and communicate with your customers.

- **Greet the customer and listen to their problems attentively**

Greet customers in a courteous, friendly, and professional manner using agreed upon procedures. Listen attentively to customer needs and concerns; demonstrate empathy. Clarify customer requirements; probe for and confirm understanding of the problem customer is facing. Avoid prejudice - think about the words you are hearing and not the person saying them.

- **Check with customer about time for visit, field work and confirm location**

The customer visit should be well planned. There should be clear communication with respect to the time of visit, place and date. Meeting space should be booked well in advance. It's always a good idea to communicate the agenda of the meeting well in advance.

- **Follow etiquette when interacting with customers**

Everyone person who is supposed to interact with customers should be aware of company policies regarding the same. People interacting with customers reflect the image of the company. Give time to customer to explain the problem. Be patient whenever you hear the same question again and again. Be responsible by taking the responsibility for helping the customer.

- **Seek feedback from customers after completion of work**

Project feedbacks are often ignored by the vendors or project teams, which are valuable in building a successful team and company. After completing each project, feedback from the customers becomes a self-evaluating tool for the team, more often they trigger process changes within the company. So for long term success of the organization, seeking feedback from the customers is key aspect after completion of the assigned task.



13.2 UNDERSTANDING CUSTOMER'S REQUIREMENTS

Understanding customer requirements is the first step towards customer satisfaction. Understanding user requirements is a difficult task in any Industry. More so in new age technology driven companies, where the field is growing and customer expectations are changing fast. Changing technology makes the process of satisfying customers more difficult. Customer requirements are dynamic and can change very quickly depending on market conditions, the economy, the competition, etc. Address your customers the way they want to be perceived: as people who can be identified by names, phone numbers and email addresses.

A business cannot survive without conducting ongoing efforts to better understand customer needs. To discover if your product or service is having a positive effect and creating customer loyalty, take time to determine your customer's emotional and material needs, then offer valuable incentives for remaining loyal to your company. Getting customer feedback does not have to be expensive; from creating simple email surveys to taking an extra minute to engage on the sales floor, you can learn a lot about what customers want just by asking and listening. Also to learn more, you could even ask them for a little bit of time just to fill out a questionnaire.

"What do our customers expect from us?" "What aspects of production could be changed while not affecting the satisfaction level of customers?" These are the questions to ask oneself when defining customer requirements and expectations. In our market-based economy, there is nothing more important than satisfying customer expectations and establishing long-term business relationships with clients, which is why meeting or exceeding the requirements of customers, with precision, time and time again, is essential to a successful or flourishing enterprise.

Understanding the basic needs and a requirement of the customer is vital to managing a successful business. It's a competitive world out there, and attention to detail and being helpful goes a long way. The needs and requirements for service and support differ greatly, by customer, by site, by usage, and by many other aspects too numerous to mention.

For effective understanding of customer's requirement, you need to look into following aspects:

- **Understand location requirements of customers.**

The Customer Support Executive should ensure optimum operational performance for hardware systems installed at the customers' site. They deliver technical service to customers including installation, relocation, repair and preventative maintenance. They optimize system performance to minimize equipment downtime and ensure maximum overall customer satisfaction.

- **Seek inputs to understand symptoms for the problem faced**

Seeking input from customers is an important component of effective customer service. Take the time to ask questions. Give customers the opportunity to express their opinions (both positive and negative) about the quality of the products and services.



Notes

Engage with Customers

Use problem situations to obtain information from customers. A customer concern or complaint is really just a request for action. If you seek inputs from the customer, the symptoms of the problems faced will be more clear.

- **Ask open and close ended questions to understand the problem faced**

Specific questions such as how or why questions, will invite positive interactions and will lead to better understanding of problem faced by the customer. Open ended questions are easy for the responder to answer and can lead to more specific questions. Closed questions, which require only a simple yes or no answer, yield less but specific information. Both are important and employees should develop the skill to ask right questions for effective resolution of problems faced by the customer.

- **Inform customer about the replacement or repair process**

After a product or service is delivered to a customer, there are continued opportunities to service the customer. This is a troubleshooting, repair and replacement, data collection and communications activity. These services are critical to customer satisfaction and provide excellent opportunities for long term engagement with customers. Customers should be politely and clearly communicated about the replacement or repair process if there are problems with the service or product being delivered. Be clear about the relevant company policy and communicate the same to the customer. Apologize for the issue if required.

- **Enquire about warranty coverage**

Customer relation executives should clearly understand the warranty clauses for various products sold to the customers. They should enquire about the warranty coverage from the customers. In case there is a mismatch in the customers version and what the company policy is, the executive should inform the customer about it and ask him for the next steps (paid visits, purchase, extended warranty) etc.

- **Educate about other useful products and maintenance contract**

While interacting with customers, it's a good opportunity to educate them about various other products of the organization without making it sound like a sales pitch. Also inform them about the annual maintenance contract. These are agreements with customers to maintain and service equipment located at customers end. Such agreements are typically and preferably conveyed at the time the product is purchased. Service may initially be provided without separate charge during the warranty period, and then made available at pre-set rates in the years after any warranty has expired.

13.3 SUGGESTING SOLUTIONS

Customers, buyers and clients want to pay a fair price for quality service or products, and feel satisfied they have paid for a service/product and received what they have paid for in return. They also want someone to take care of them. They need someone to understand their needs and help to answer them. Customer service starts with the ability to listen to the customer and find out through polite questioning to know their expectations.

Engage with Customers



Notes

Customer service and contact with a client mean that the customer will be heard and their problems will not go unanswered or ignored. It also means getting to know your client, likes-dislikes, ideas, background, etc. The other most important aspect to do is to listen to what the customer is saying. If people do not understand what is appealing the customer, they will not be successful in handling them. Do research on customers, their habits, and what they want and expect.

One commonality among all companies or organizations that provide good service is the development of a system and attitude promoting customer friendly service. By “customer friendly” we mean viewing the customer as the most important part of your job. The saying, “The customer is always right” is derived from this customer friendly environment. The two main tasks of successful customer relations are to communicate and develop relationships. Positive dialogue/communication with your customers and developing ongoing relationships with your customers are perhaps the two most important qualities to strive for in customer service.

When a customer asks you to do something that you do not know how to do or do not have the authority to do, become a facilitator by leading the customer to the person or department who can help them in solving the problem. Many inexperienced customer service representatives think by sympathizing with the customer’s trouble, he/she will win over the customer rather than actually doing something to solve the customer’s problem. If a customer expresses annoyance or frustration, do not make it worse by consoling with him/her. Understand the customer problem but seek to solve the problem.

Suggesting appropriate solutions to customers takes some training and experience:

- **Summarize the problem and suggest possible solutions**

Summarize the problem in a problem statement and get it validated by the customer so that it is clear that you are solving the right problem.

If you can suggest a solution, do it. If not tell the customer what actions you will take and what actions will follow. Never make the mistake of promising something you are not able to do. Suggest the customer alternative solutions, if they exist. Customers appreciate the opportunity to choose the ways of problem solving. Make sure that the promised measures are taken. If you do not fulfill what was promised and ignore the customer’s complaint, the problem will grow. Next time it will be more difficult to solve.

Emphasizing what you can do for the customer and what’s unique about your solution creates a perception of value that can raise your proposal above the rest, even if other solutions might cost less.

- **Inform customers whether module needs to be replaced or repaired**

If the customer is facing a problem with a particular product module which requires replacement or repair, the customer service executive should apologize for the trouble caused to the customer. Any such problem should be prioritized so that the customer feels comfortable. It should be resolved as soon as possible as it is impacting the customer experience about the product as well as the organization.



Notes

Engage with Customers

- **Explain to the customer about repair process, time taken and charges if any**

Having good systems in place ensures repairs are carried out correctly, within a reasonable time, and that the customer is kept informed. This is essential to ensuring the customer has confidence in your work. Where there are no legal obligations, offer a solution that in the circumstances best meets the needs of your business. For example, if the law says a customer is entitled to a repair, you may be willing to offer a replacement if that is what the customer wants and is not causing too much financial burden.

- **Seek customer's approval for further service**

If there are value added services, inform and educate the customer about it and the applicable charges. Take customer's approval before putting extra financial burden on the customer. If the customer is not ready to take the additional services, do not force the argument further.

13.4 COMPLETING DOCUMENTATION

- **Provide note to customer and retain a copy**

The executives dealing with customers must provide a detailed note to customers about the problems and issues encountered by customer, what actions the company has taken to rectify the problem and the cost involved which needs to be paid by the customer. A copy of the same shall be retained by the company after taking signatures from the customer.

- **Provide invoice for purchased parts**

Proper invoice and bills shall be provided to the customer for all the parts purchased by the company or by the customer. It should include parts replaced or add on components/parts purchased.

13.5 ACHIEVING PRODUCTIVITY AND QUALITY

- **Interact with customers within specified time agreements**

Every company has a detailed policy on customer interaction, clearly outlining the timelines for servicing a customer initiated complaint in Service Level Agreement (SLA). It's a major objective for quality improvement for customer service agreement and must be tracked properly for improving the customer experience.

- **Identify the customer's requirement and available resources**

For new customers, the requirements shall be accurately identified to streamline the purchase process and enhance customer experience. Also executives shall be able to identify the resources and records at their end to let the customers know about the availability and timelines in a crisp manner.



- **Accurately assess the problem and suggest solutions**

Understanding the customer viewpoint on problems faced by him is very important to serve and suggest the possible solutions. It goes a long way to establish a relationship with customers. So the quality matrix must ensure that this assessment is properly measured.

- **Communicate problem effectively**

Customer executives not only need to assess the problem faced by customer but also need to communicate their understanding back to customer. A clearly understood problem wins customer's confidence, so it's an important measure of quality for customer service executives.

- **Gauge customer satisfaction during service visits**

A cordial discussion with customer regarding location, placement and other details about the module or equipment (product) sold to customer is important to understand their satisfaction with the product as well as service being provided.

- **Achieve good feedback and customer satisfaction**

Every organization must strive hard to achieve 100% customer satisfaction and good feedback from the customers. It is important to win new clients for your products and services. It gives you a good starting point to sell your services and products to new customers.

13.6 KNOW ABOUT YOUR COMPANY

From organizational perspective, the concerned individuals dealing with customers should be aware of following aspects:

- **Company's policies on customer care**

Every organization has clearly defined policies on how a customer service executive should deal with customers. Customer service executives as well as all those people who need to deal with customers like marketing executives should be aware of the company policy regarding the same.

- **Company's code of conduct**

Employees should be aware of company's code of conduct, both in terms of internal code of conduct and external code of conduct.

- **Organization culture and typical customer profile**

Employees should be well versed with the organization culture and values. They should also be acquainted about the typical customer profile to serve them better.

- **Company's reporting structure**

Employees should know the reporting structure of the organization in order to escalate the matters which need immediate attention.



Notes

Engage with Customers

- **Company's documentation policy**

Employees should be properly trained in documentation policy being followed by the organization vis-a-vis engagement with customers and clients. This is very handy in case of issues arising at a future date.

From technical knowledge perspective, the concerned individuals requiring customer engagement roles should be aware of following aspects:

- **Companies products and recurring problems reported**

Executives should be thoroughly aware of the products being sold by the company. They should also know about the recurring problems faced by many different customers and should suggest appropriate feedback for such issues to the satisfaction of customers.

- **Communication etiquettes**

Customer service executives should be well trained in the etiquettes of communication with customers. They should be polite and good listeners. They should empathize with customers in case of severe problems faced by them.

- **Functionalities of various parts and modules**

Customer service executives should be aware of various functions being performed by the modules and different parts of the system or product being sold to the customer.

- **Behavioral aspects at customers premise**

Customer service executives dealing with on the field roles, should be well behaved and should interact with customers in a cordial manner whenever they are visiting the customer premise.

- **Precautions to be taken while dealing with customers**

Many a times, executives are faced with rowdy customers or phone calls. They should be patient and be well trained to take appropriate precautions while handling such calls or customers.

- **Appropriate reference sheets and manuals**

Field service executives should carry appropriate reference sheets, manuals and other relevant documents at customer location which can make their task much easier.

13.7 SKILLS

Apart from important aspects as discussed in above sections while engaging with customers, there are certain generic and professional skills which can enhance the customer experience and engagement further.

- **Generic Skills**

Field executives dealing with customers should be able to read the product and module serial numbers and interpret the details like manufacturing date, model number etc. in an easy and fluid way. They should be able to document the issues on job sheet and also enter the details of work being done.



- **Professional Skills**

Professional skills include interpersonal skills which will help in developing the rapport with the customers. It improves the listening capabilities and executives are more aware about the problems and possible solutions. Communication skills are very important in order to seek inputs and assess the problem, making customer bit more relaxed about the issues and informing them about the contractual obligations in an easy manner. Behavioral skills include personal grooming, etiquettes on maintaining appropriate physical distance during conversation, being patient and courteous with customers. Decision making skills are also very important in situations where supervisor is not available or customer is being restless.



INTEXT QUESTIONS 13.1

1. Which of the following is important for good customer engagement?
 - A. Understand the issues faced by customer
 - B. Speaking without listening
 - C. Having dinner with customer
 - D. Suggest problems at customer's end
2. Documentation is important for customer initiated complaints because:
 - A. It creates an agreed upon reasons, solutions and cost to customer
 - B. It gives promotion to customer service executives
 - C. Customers always lie
 - D. Customer service executives always lie
3. Which of the following is not a professional skill required for customer engagement:
 - A. Interpersonal skill
 - B. Communication skill
 - C. Decision making skill
 - D. Computer Programming
4. Service Level Agreement (SLA) contains:
 - A. Details of products or modules
 - B. Timelines to close service requests from customers
 - C. Costing for the product
 - D. Competitors details



Notes

Engage with Customers

5. Suggesting solutions does NOT include:
 - A. Summarize the problem
 - B. Suggest possible solutions
 - C. Explain time required to rectify the problem
 - D. Companies policy on customer care



WHAT YOU HAVE LEARNT

In this lesson you have learnt about important skills required for effective and long term engagement with customer which are required to enhance customer delight and cause repeated business opportunities for the organization. You have also learnt

- effectively interact with customers
- understanding customer's requirements
- to suggest possible solutions to customer's issues
- the importance of documentation in customer dealings
- the importance of company policies and processes
- various professional skills required for efficient delivery of customer service



TERMINAL EXERCISE

1. Suggest important ways in which customer service executives should interact with customers.
2. What best practices should be followed while suggesting solutions to the customers.
3. Elaborate four professional skills which are required for effective customer engagement.
4. What is the importance of documentation while dealing with customer initiated complaints or requests?



ANSWERS TO INTEXT QUESTIONS

13.1

1. A 2. A 3. D 4. B 5. D



Notes

14

COORDINATE WITH COLLEAGUES

The organizations of today have become lean with minimal hierarchical structures defined within the organization. This has lead to increased importance of inter personal skills, both with our colleagues and superiors in order to obtain smooth work flow and achieve the company targets in an efficient way. This lesson is about the salient points which are required for individual's level of communication with colleagues and other departments within the organization. It lays down objectively the qualities and abilities which determine the ability to work as a team member to achieve the required deliverables on schedule.



OBJECTIVES

After reading this lesson you will be able to:

- interact with superiors smoothly.
- coordinate with colleagues efficiently.
- explain teamwork and multitasking.
- make decisions.

14.1 INTERACTING WITH SUPERIORS OR SUPERVISORS

In the workplace, interacting with other employees is one of the most critical aspects of synergy. When it comes to interacting with your immediate supervisor, the quality of your relationship can have an impact on every aspect of your job and the surrounding workplace. It can impact you and other employees in several ways.

The immediate supervisor of a department helps to set the tone for everything that goes on there. When you interact with your supervisor, the way that she/he treats you will determine how you work. So it's important to develop a cordial relationship with the supervisor. This will lead to a much more soothing and cooperative environment in the organization. It will also lead to excellent results for the organization as well as individual.

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To have a good coordination and communication with the supervisor, the individual must proactively focus on following aspects:

- Understand and assess work requirements
- Understand the targets and incentives
- Understand new operating procedures and constraints
- Report problems in the field
- Resolve personnel issues
- Receive feedback on work standards and customer satisfaction
- Communicate any potential hazards at a particular location
- Meet given targets
- Deliver work of expected quality despite constraints
- Receive positive feedback on behavior and attitude shown during interaction

Understand and Assess Work Requirements

All employees need to know what is expected from them at work and know how they are doing. No one can do their best without clear direction and ongoing, constructive feedback on their work performance. An employee has the responsibility to ensure that she/he understands the work objectives and strive to meet them.

Understand the Targets and Incentives

Fully participate in performance discussions and meetings, welcoming them as opportunities to discuss your achievements, areas where you can improve, and your career interests.

Understand new Operating Procedures and Constraints

In general, employees should thoroughly undergo training programs that have very specific and quantifiable goals, such as operating a particular piece of machinery, understanding a specific process, or performing certain procedures with great precision. They should interact with the supervisors if some part of the process or procedure is not clear to them.

Report Problems in the Field

When a problem pops up or a mistake occurs, respond to it proactively and don't keep your supervisor in the dark. Communicate your own proposed solutions when you present the problem so that you and your supervisor have basis to start a problem solving conversation.

Resolve Personal Issues

To share a personal problem with your supervisor, you need to ensure the situation is something you should share. Before you disclose personal information, you need to ask

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yourself whether the details you are about to convey would be better left unsaid. After analyzing the matter beforehand, you find that you must express problems of a personal nature to your superior, then be polite and ask for an appointment and thank your supervisor for the help and time he has provided.



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Receive Feedback and Customer Satisfaction Findings

Your manager/supervisor will monitor your progress in achieving the required improvements by the deadlines specified in your action plan. At the end of this period, she/he will indicate in the action plan whether you have succeeded in achieving these improvements and will provide his or her comments on your efforts. As an employee, it's always good to ask your supervisor to provide timely feedback. The feedback should be discussed and one should be open towards both criticism and suggested improvements.

Communicate any Potential Hazards

Every employee has the responsibility to bring notice of their supervisors any potential hazard or unwanted effect on surroundings and environment due to procedures, processes or unexpected events in their working location. It will prevent potential damage to the organization and supervisors in general will be very receptive towards such suggestions from employees.

Meet given Targets

Although discussions about your performance should occur throughout the year, take advantage of your mid-year review to discuss with your manager/supervisor whether your work objectives and/or learning and development plan should be adjusted. Once the targets are set after mutual discussion and agreement, employee should try her/his level best to achieve those targets as that will reflect positively for the supervisor. In case there are issues in achieving the targets even after putting up his/her best effort, the employee should consult the supervisor and discuss the future plan.

Deliver Quality Work even under Constraints

You should clearly understand that in organizations, things are many times not perfect or ideal to execute a project. There can be different constraints, in terms of resources, cost, technology, skill set etc. As an employee, you should strive hard to deliver quality work under these given constraints. You should be upfront in discussing these constraints with the supervisor and get insights from them regarding best possible approach under the given circumstances. Normally, supervisor will be able to provide guidance which will be very useful as he/she might have faced similar situation earlier.

Receive Positive Feedback for Behavior and Attitude

Most often supervisors do recognize the hard work, good attitude and positive behavior in the employees. A frank and open discussion should be done by the employee with their superiors as far as an honest feedback is concerned. They should clearly communicate the times when they have shown good or ideal performance in terms of attitudes and behaviors.



14.2 COORDINATING WITH COLLEAGUES

Business organizations are, by definition, groups of people, but the formal use of teams as a way of organizing work has grown tremendously in the past half-century. The implication for anyone who wants a career in business is clear: it is virtually impossible to be successful in business without being successful in groups. Team communication is consistently named as a key skill for business success.

Many employers define “good communication” as an ability to get along with others and behave pleasantly in the workplace. This attribute might seem more a personality trait than a communication skill, but for many employers it counts for more. Fortunately, you can learn to project a positive attitude, regardless of how you actually feel, and that in itself is an important business communication skill.

Willingness to communicate and coordinate with colleagues is a developed skill, not something most people are born with. Even when they are busy with important work, you will find them more willing to work with you if they are comfortable with the personal relationships.

In turn, you should consistently show that you are willing to help others, get their work done. Some people worry more about being taken advantage of others than they do about the welfare of the group. Most co-workers consider this kind of an attitude as a “negative” one, and it will virtually always lose you the support of others—and often your job.

Apart from above mentioned general guidelines, to have an effective coordination and communication with the colleagues, the individual must proactively focus on following aspects:

- Interact with colleagues from different functions and understand the nature of the work.
- Pass on customer complaints to colleagues in respective geographical area.
- Assist colleagues with resolving problems.
- Resolve conflict for smooth work flow.
- Follow company policy for cross functional interactions.

Interact with Colleagues from Different Functions

When coordinating at the organization level, you need to reach out to other departments, request comments and negotiate approval. The challenge is to overcome opposition and gain acceptance. You won’t win them all. If not, get a written explanation from the dissenter. Present the objections to the supervisor for a decision on how to proceed.

Pass on Customer Complaints to Colleagues in respective geographical area

Many contact centers exist to provide information and support to customers using a range of services or products. Providing that support requires detailed knowledge and

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understanding of the services and / or products together with the communication skills to deal with customers. It also involves teamwork so that colleagues learn from each other as the organization gains experience and services and/or products develop.



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Assist Colleagues with Resolving Problems

One of the most important hiring criteria for many companies is the ability to work as a team player. Teamwork in general is part of performance management system. So it's important for anyone not only to seek help of peers and superiors but also to readily offer help to colleagues who are in need for resolution of technical and other problems in the organization. Although some people believe it is best to keep work life and personal life separate, and therefore avoid making friends with colleagues, for most people, having strong friendships makes work more fun.

Look forward at work by supporting and developing your colleagues. You can begin with showing genuine interest in their lives, asking them for opinions and caring about them. Share about yourself and build trust. Involve others in your projects or collaborate on ideas. Share your knowledge and proficiency while learning from your colleagues. You will make work a better place to be.

Resolve Conflict for Smooth Work Flow

Coordination helps to minimize the conflicts, wastages, delays and other organizational problems. It ensures smooth working of the organization. Therefore, with the help of coordination an organization can achieve its objectives easily and quickly. Handling and resolving conflicts that arise in the workplace is one of the biggest challenges managers and employees face. Typically there are two responses to conflict: run away (avoidance) or 'battle it out'. In either case, you often feel uncomfortable or dissatisfied with the results because no resolution has been achieved. By learning to constructively resolve conflict, you can turn a potentially destructive situation into an opportunity for creativity and enhanced performance.

Arriving at a positive resolution of conflict is always the ultimate goal. In resolving conflict, it is important to make sure you do the following:

- Clearly express the causes of the conflict – openly acknowledging there will be differing perceptions of the problem(s).
- Make a clear statement of why you want the conflict resolved and reasons to work on conflict.
- Communication of how you want the conflict resolved.
- Address the issues face-to-face (notes, email correspondence, memos are not a productive way to resolve differences).
- Stick to the issues. In trying to resolve conflict, it is tempting to resort to name calling or bring up issues from the past. It is important to address specific behaviors and situations if change is to take place.



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- Take time out if necessary. In the resolution of a conflict, our emotions may interfere with arriving at a productive resolution. If this transpires, take a time-out and resume resolving the conflict at another designated time.

Follow Company Policy for Cross Functional Interaction

Cross-functional teams provide an organization with some significant advantages. You can greatly increase creativity and problem solving with the use of cross-functional teams because of their composition. Members of cross-functional teams come with a diversity of experiences, expertise and knowledge. This diversity can help broaden perspectives and create a synergy - where interaction of the members create a greater effect than the sum effects of each member acting alone - leading to a high level of creativity. Companies have consciously developed policies and incentives for cross functional roles. One should be aware of these policies and should discuss the same with colleagues and supervisors if anything is not clear.

Receive Feedback and Customer Satisfaction Findings

Check with your superior and colleagues from quality department, about the ratings, feedbacks, comments and observations you and your team has got from customers, clients and other groups dependent on you. Take the feedback in positive spirit, both good and bad. Appreciate your team for the good feedback being received, discuss the negative feedback with a sense of improving the quality of services and deliverables. Do not try to argue or start blame game in case the feedback received in not on expected lines. It does not serve any purpose. There is always a scope of improvement and you along with your team should focus on that.

14.3 ORGANIZATIONAL CONTEXT

While most employees are aware of a company's general mission upon getting hired, the precise details should be spelled out and distributed to each employee. Mission statements include things such as sales goals and marketing initiatives, where a company has been and where it hopes to go. This should include top management's vision of the company.

Employees should orient themselves towards companies goal while understanding the company policies and also improving upon their knowledge with respect to the skill set required to accomplish the tasks effectively.

14.4 UNDERSTANDING COMPANY POLICIES

All employers set general policies regarding employee conduct. This includes guidelines on what is considered appropriate behavior between two employees, as well as employees and managers and employees and customers.

Employees have a wide range of pay, but those who work for the same company are often paid on the same day. Policies and procedures are outlined when employees will be paid. Employees should also be aware if direct deposit is available, as well as the guidelines on bonus pay and reimbursement for mileage and other work-related expenses.

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Companies that offer health benefits also include key aspects, such as pricing for individuals and families, in their list of employee policies and procedures. Many companies also have a mandatory waiting period of anywhere from 30 to 90 days before benefits become available to an employee. Employees should be aware of these policies and should discuss with HR or other concerned department in case of any confusion.

Employee policies and procedures consist of every imaginable situation and topic, ensuring that employees understand all aspects of working for a company. That includes policies on acceptable attire, safety, termination and resignation, working from home and overtime. It is important that employees are trained on these aspects from time to time and it's the responsibility of the employees to discuss these with colleagues and superiors if required.

14.5 INDIVIDUALS ROLE IN WORKFLOW

Understanding your job role and description is the most important aspect when starting a new job. This will ensure that you ultimately understand the tasks and duties that you are expected to fulfill in order to earn your remuneration and also add value to the company you work for.

Make sure you understand:

- The job duties you are expected to perform;
- Your supervisor's expectations for your job performance; and
- The performance review process that will be used for your position.

Talk to your supervisor if you are unsure of the work that you are expected to perform or the standards you are expected to meet in order to gain a better understanding of his or her expectations. If there are things you think you need help with to be successful, discuss them with your supervisor. These could be instructions, training, support/cooperation from coworkers, etc.

14.6 REPORTING STRUCTURE

Reporting structure refers to the authority relationships in a company — who reports to whom. For small businesses with only a couple of employees, that structure is often self-evident: Everyone reports to the owner. With enough new employees, though, coordinating everyone's efforts will likely demand a formal organizational structure. This framework establishes who is in charge of different tasks, departmental areas and the organization as a whole. These authority boundaries and the relationships among people in authority serve to create the reporting structure.

Organizational structure provides guidance to all employees by laying out the official reporting relationships that govern the workflow of the company. A formal outline of a company's structure makes it easier to add new positions in the company, as well, providing a flexible and ready means for growth.



14.7 EFFECTIVE COMMUNICATION

The success of an individual in a team depends greatly on the extent to which she/he can engage in effective communication. Faulty communication in organizations can lead to lowered efficiency and effectiveness at the organizational as well as individual level.

Skill to communicate depends on the capacity of an individual to convey ideas and feelings to another to evolve a desired response. In management, communication is a mixture of personal attributes and organizational aspects. Good communication is necessary for all organizations as management functions in organizations are carried out through communication.

Effective management is a function of effective communication. Interpersonal communication takes places every time we interact with others. Communication is considered effective when it succeeds in evoking a desired response from the other person. Moreover failures in communication can be very costly for the organization by way of reduced co-operation and subsequent ill feeling between employees. Communication, to be effective, cannot be a random process. It has to be planned and executed so that it evokes the desired response.

Communication in organizations has the following role

- Helps in fostering motivation function of control
- Aids in the function of control
- Provides information for making decisions
- Gives vent to one's feelings
- Helps in the satisfaction of social needs

Measuring the effectiveness of your communication is just as important as delivering it. Measurement is key to understanding the success of your communications and an opportunity to invite feedback.

You can measure communications in many ways using informal and formal channels. A good communicator makes use of the measurement systems available within your organization, but also uses the most powerful form of measurement – feedback. By inviting feedback you can not only measure the success of the communication, but also enter into valuable two-way dialogue, which will help your future communications and engage the audience with your message and the company.

14.8 BUILD TEAM COORDINATION

Coordination is the act of organizing and enabling different people to work together to achieve an organization's goals. It is a managerial function in which different activities of the business are properly adjusted and interlinked.

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Employees within the functional divisions of an organization tend to perform a specialized set of tasks, such as engineering. This leads to operational efficiency within that group. However, it can also lead to a lack of communication between various functional groups within an organization, rendering the organization slow and inflexible.

Increasing coordination internally can be accomplished by keeping all moving parts of the organization on the same page. There are a number of ways to improve upon the coordination of different departments, work groups, teams, or functional specialists. These include creating a well-communicated and accurate mission statement; clearly defining strategic objectives; monitoring and evaluating each functional group; providing company-wide updates and communications from each department; and, wherever possible, promoting cross-departmental meetings and projects.

Structure is a central determinant of effective coordination across an organization as it enables communications, underlines responsibilities, and provides concrete authority in decision-making.

14.9 TEAM WORK AND MULTITASKING

Team projects often arise in the workplace whether one likes it or not. Being successful with this skill means working productively with a variety of people, utilizing the various skills within the group, and overcoming any differences between members. Being able to communicate and relate effectively with your coworkers is not only beneficial to you but your employer as well. Relationship building with coworkers makes work more enjoyable for you and saves your supervisors from having to resolve conflicts between employees.

Businesses are always happy to drive down costs, and the best way to do this is by hiring fewer individuals who can multi-task. It is often the case that one efficient employee can do the work of two typical employees. Employees are paid for the hours they work, and employers want to get the most out of what they pay. An employee who can complete multiple tasks at once is the solution.

The best way to use multitasking skill is:

- Use your past experience while carrying out a new task even if the previous task was not related to the current assignment, there's always the scope of applying past learning in the current situation. Look out for such opportunities.
- Prepare a list of projects that required you to separate tasks into clusters that could be addressed simultaneously. Use these to carry out multi-tasking assignments.
- Show a willingness to take on many responsibilities. Any worker can pick up one or two, but if you can pick up more without getting spread too thin, you become a valuable asset.

14.10 DECISION MAKING

Decision making can be defined as the process of making choices among possible alternatives. The skills considered important to effective decision making are based on a standard model of decision making, which prescribes how decisions should be made. These skills include: 1) identifying the possible options; 2) identifying the possible

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consequences that follow from each option; 3) evaluating the desirability of each of the consequences; 4) assessing the likelihood of each consequence; and 5) making a choice using a “decision rule”.

Problem solving and decision-making are important skills for business and life. Problem-solving often involves decision-making, and decision-making is especially important for management and leadership. There are processes and techniques to improve decision-making and the quality of decisions.

- Define and clarify the issue.
- Gather all the facts and understand their causes.
- Think about or brainstorm possible options and solutions.
- Consider and compare the ‘pros and cons’ of each option - consult others if necessary or useful - and for bigger complex decisions where there are several options, create a template which enables measurements according to different strategic factors.
- Select the best option - avoid vagueness and weak compromises in trying to please everyone.
- Explain your decision to those involved and affected, and follow up to ensure proper and effective implementation.

An important area where decision making process becomes critical is at the time of unforeseen disruptions in the work flow. Employees should be able to take informed decisions at such times. Normally, every organization develops its own set of best practices to deal with such emergency situations. Employees should be aware of such best practices and should be able to communicate to the supervisor if that is required. They should be aware of their responsibilities and should make appropriate judgment regarding whether to inform the superior or to handle the situation along with other colleagues.



INTEXT QUESTIONS 14.1

1. Which of the following is important for good coordination with supervisor?
 - A. Understand and Assess Work Requirements
 - B. Meet Given Targets
 - C. Resolve Personal Issues
 - D. All of the above.
2. Resolving conflict for smooth workflow requires:
 - A. Articulating the causes of the conflict
 - B. Reading company policy
 - C. Understanding compensation policy
 - D. Deliver quality work

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3. Reporting structure defines:
 - A. Nearby police station telephone numbers
 - B. Who reports to whom in organization
 - C. Details guidelines for employees
 - D. Peer to peer interaction

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WHAT YOU HAVE LEARNT

In this lesson you have learnt about important skills on coordination and communication which are required for effective workflow in the organizations. In particular the learning include:

- How to effectively interact with supervisors.
- Efficient coordination with colleagues.
- Importance of understanding company policies, delivery standards, ethics.
- Reporting structure and individual's role in workflow.
- Effective communication tips.
- Teamwork and multitasking.

After going through this lesson, you can apply these principles at their respective workplace to make it more robust, dynamic and interesting place to work.



TERMINAL EXERCISE

1. Suggest important ways in which organizations can foster team work and team coordination skills within the employees.
2. What are the important aspects which are required for smooth work flow for cross functional interaction?
3. Suggest best practices for fruitful interaction with supervisors.
4. Briefly elaborate the three important professional skills.



ANSWER TO INTEXT QUESTIONS

14.1

1. D
2. A
3. B