Industrial Training Report
On
"Hardware & Networking"

Diploma In
Electronics & Communication Engineering
Year 2008-09.

Submitted By:

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Submitted To

Parul Institute of Engineering and Technology (Diploma Studies)
Diploma in Electronics and Communication Engg. Department
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CERTIFICATE

This is to certify that

Mr.Maulik Patel (S-133006102)

Is Student of Diploma in Electronics & Communication Engineering, has satisfactorily completed his Industrial Training work as a part of course curriculum in Diploma of Engineering semester VI th having a company name "Elecon Information Technology Limited"

योगः कर्मसु कौशलम्

PARUL TRUST

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PARUL INSTITUTE OF ENGINEERING & TECHNOLOGY
ELECTRONICS & COMMUNICATION DEPARTMENT LIMDA, VAGHODIA, VADODARA

COMPANY PROFILE

EITL is the IT division of the Elecon group of companies and has an experience of more than 13 years in the field of hardware, software and networking solutions. Situated in the heart of Vithal Udyognagar an Industrial Estate and in the proximity of the educational town of Vallabh Vidyanagar, EITL is all set to reach new heights in the field of IT solutions.

We are a professional team providing IT solutions to enable businesses and organizations to respond proactively to the demands of emerging global business scene. Through the intelligent and relevant application of technology in a diversity of situations, EITL plans to help businesses and organizations push the limits of excellence, optimizing their strengths to achieve their goals.

INTERNET SERVICE PROVIDER (ISP):

Design and Technology Consulting

ENGINEERING SERVICES:

Based on a combination of engineering knowledge, software services, and industrial experience, EITL offers a wide spectrum of engineering software services in the areas of CAD/CAM/CAE. We undertake Product Design and Analysis using C.A.D. software like:

- → SDRC IDEAS Master Series
- → AutoDesk Mechanical Desktop 2000 and AutoCAD 2000
- → SDRC PDM

TRAINING SERVICES:

- → Hands-on training (functional / tools)
- → Workflow Management
- → on ERP (Baan & Oracle)
- → Lotus Domino R5 Installation and Configure

NETWORKING SERVICES:

- → These services enable corporate to set up LAN/WAN/ MAN/VPN networks to connect various offices, branches, and users across various locations
- → The Network Solutions group has Cisco, AVAYA and Microsoft Certified Professionals who execute complex networking solutions - voice / data networks, leased lines, ISDN connectivity, network security, etc.
- → Network Performance & Security Audit

ACKNOWLEDGEMENT

We would like to express my deep sense of gratitude to ***Mr. Pankaj Patel*** and all engineers for giving me an opportunity to do training at **ELECON INFORMATION TECHNOLOGY LIMITED.**

We got the good knowledge of trouble shooting of hardware, networking related problems and connecting local area networking. We feel very lucky to undergo training in such organizing. They have shown us right path that we could follow in the future to reach maximum possible heights in my life.

Finally, we like to thanks all staff member of EITL for their very good support during my training.

PREFACE

The basic goal of the information technology is to efficiently capture and organize the available information in a manner that would avail the management to concretes more on decisional issue rather than daily business chores. This has been very important factor in the growth of computer technology and its quick amalgamation with the different business process.

ELECON INFORMATION TECHNOLOGY LIMITED (EITL) has most advancing computing facilities available at its hand to meet its business needs.

It has rich experience to work in a technically advance environment EITL. A student gets a valuable experience of various business processes, System development methodologies and strategies. This project is the part of the second semester study, which gives me valuable opportunity to implement theoretical knowledge into practical life.

The project duration was Three & Half month. This commenced from 9th February to 23rd May 2009.

COMPANY ABSTRACT

- Name: **Elecon Information Technology Limited**
- Address: **Anand- Sojitra Road, V.V.Nagar**
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- Contact: Tel.- **(02692) 230963,227299**
  Fax. - **(02692) 231792,236457**
- Internet: **www.eleconinfotech.com**
- Contact Person: **Mr. Jigar Patel , Manager**
  (Hardware & Networking)
- Date of Establishment: **1951**

I N D E X

HARDWARE

I N D E X

NETWOKING

Chapter 1

Introduction

INTRODUCTION

The term *computer* has been borrowed from compute that means – to calculate. Whereas, initially computer were use to perform arithmetic calculation as fast speed, now they are use to nearly every field. You can use computer for banking application, word processing, desktop publishing, weather forecasting, railway reservation, control of machines or robot in factories, scientific research, etc. in brief a computer may be define as a device that receive some kind of data, analysis it, and than applies a predefine set of instruction to it to produce some kind of output. For instant evasion in the computer. The computer then analysis the data fed by the operator and makes a reservation. Then it prints a ticked for you. The ticket is the output generated by the computer based on the reservation request entered by the operator. It is also said that the computer is a data processor, because it can receive, store, processes and retrieve any kind of data. For instant you can store the names and addresses of all employees working in a company in a computer file. Latter, you can ask the computer to print list of only those employees who work in the accounts department

Chapter 2

Classification Of Computers

CLASSIFICATION OF COMPUTERS

Although a clear cut classification of computer is difficult, computer can be broadly classified on the basis of purpose, components and size and processing power.

PURPOSE

- **Analog Computers**
- **Digital Computers**
- **Hybrid Computers**

ANALOG COMPUTER

Analog computers are computers that measure physical quantities (e. g. Pressure, temperature, length etc.) and the convert them to numeric values. For example a thermometer does not perform calculations but measures the temperature of the body by comparing the relative expansion mercury.

Uses: Analog Computer is used mainly for scientific and engineering purpose because they deal with quantities that very constantly. They give only approximate result.

DIGITAL COMPUTER

Most computers are digital device. i. e. they process information using numbers which is essentially in a binary or two state formats.

Uses: special purpose digital computers can be fixed permanently into the machine. For e.g. processor that are installed in automobiles to be control fuel, braking system etc.
General-purpose digital computers can be used in different application since they can be store different sets of instructions and programs.

HYBRID COMPUTERS

The features of analog and digital machines are combined to create a hybrid computing system. For e.g. analog devices measure a patient's vital signs like temperature, heart functions etc. these are then converted to numbers and supplied to the digital components that monitor the patient's vital signs. Any fluctuations can be thus noticed immediately.

Chapter 3

What Is Personal Computer?

WHAT IS A PERSONAL COMPUTER???

The typical personal computer (PC) is shown in figure 1.2. A typical PC Consist of the Following Units:

Motherboard

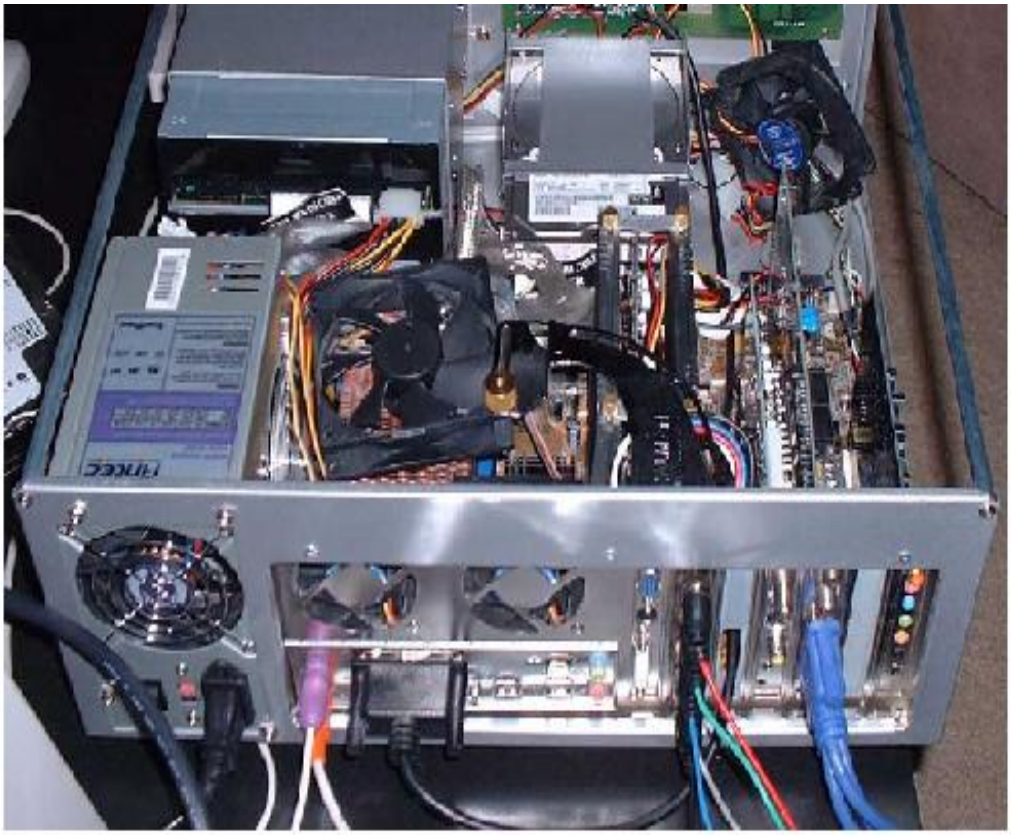
- System Cabinet
- Processor
- SMPS
- Keyboard
- Mouse
- Video Display Unit (Monitor)
- Floppy Disk Drive(s)
- Hard Disk Drive(s)
- Printer
- CD Drive

Normally a PC also has a Printer. Your PC may also have other devices such as the compact Disk (CD) Drive, Scanner, Zip Drive, etc

Figure 1.2 A Typical personal Computer

CPU BOX

The CPU box houses the heart and brain of the computer. All electronic circuit, power supply, floppy drive(s), and hard drive(s) are housed in this box. The shape and the size of the box may differ from the computer to computer. However, they all have the same electronic circuit and parts inside. The storage unit of the memory of the computer is also in the same box. The primary memory of the PC is housed on the electronic circuit board kept in this box. These boards are not visible from the outside. The CPU box also houses the floppy disk drive(s) and Hard disk drive(s) that from the secondary memory



CABINET

Computer cabinet are fitted with doors and side panels(Which may or may not be removable).Cabinets enclose a rack,which is a frame that provides a means for mounting electronic equipments come in a variety of styles,colors,and many contain baffles,fans and other features.

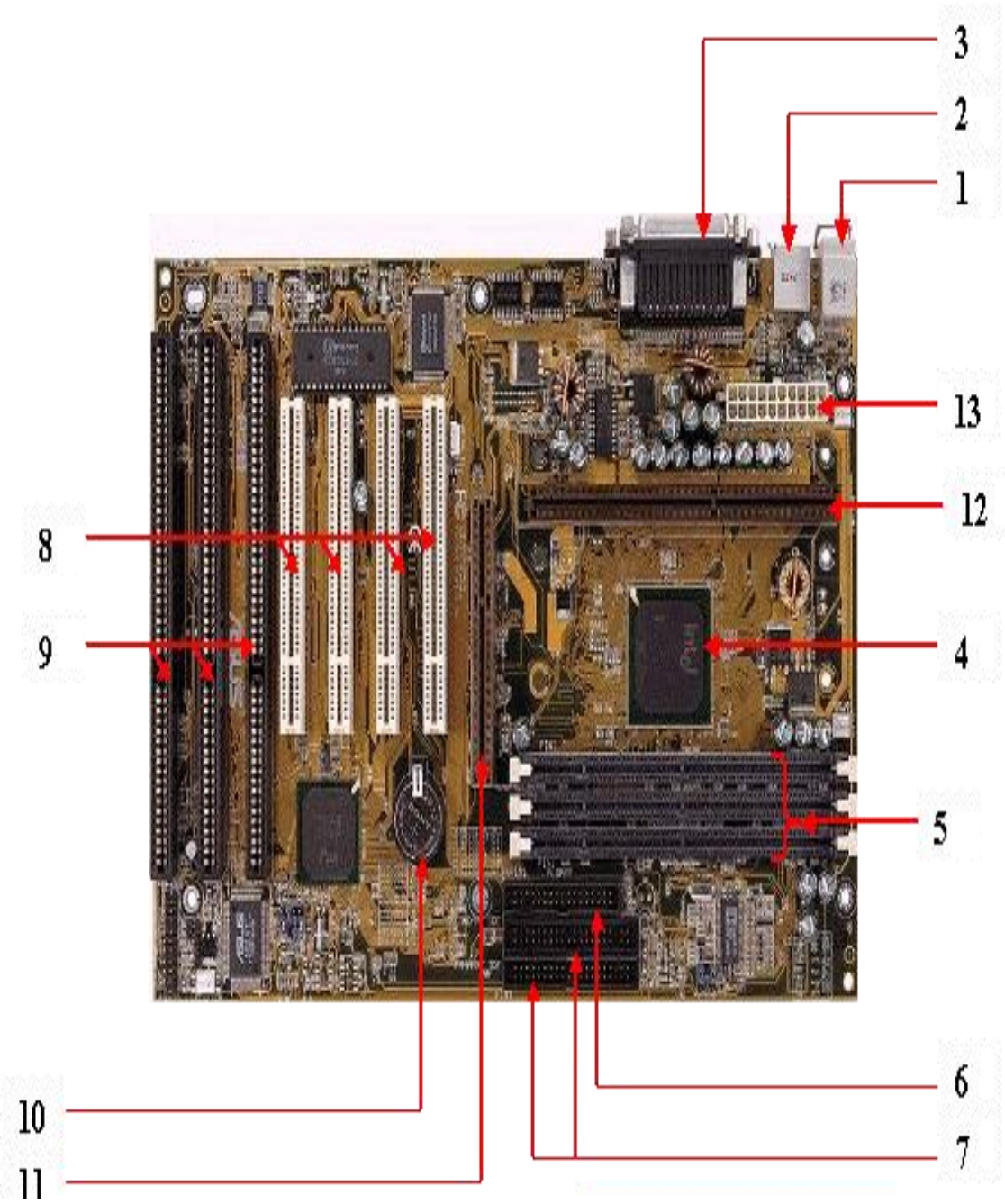
MOTHERBOARD

The motherboard is a circuit on which all the electronic components of computer are connected. This include both internal parts of the system unit like Processor, display card of the monitor, sound card, memory etc and the connector of external parts like mouse, keyboard, hard disk, floppy disk etc. The 'ports' and 'slots', which connect these components, also exist in the motherboard. The circuits in the motherboard help in data transfer among the components. Bios, RAM slots and Chipset are too mounted on the motherboard.

Motherboard Components:

1) Microprocessor
2) Interrupt Controller
3) Timer
4) PPI
5) Clock generator
6) Bus Controller
7) DMA Controller
8) DRAM
9) ROM
10) I/O Slots
11) Decoders, multiplexers, Gates,F/F
12) Jumpers and DIP
13) Transistors and Diodes
14) Ports and connectors
15) Built in Speakers
16) AGP Slot
17) CMOS battery
18) External Cache
19) PCI expansion slots

Motherboard Layout



The important constituent components of an ATX Motherboard are given below:

1.Mouse & keyboard

2. USB

3. Parallel port

4. CPU Chip

5. RAM slots

6. Floppy controller

7. IDE controller

8. PCI slot

9. ISA slot

10. CMOS Battery

11. AGP slot

12. CPU slot

13. Power supply plug in

Processor

➢ One of the most important parts of computer called as heart of computer. The brain of a computer is it processor. The processor in a modern computer is an Integrated Circuit (IC) chip.

➢ A chip of millions of transistors and capacitors which can process

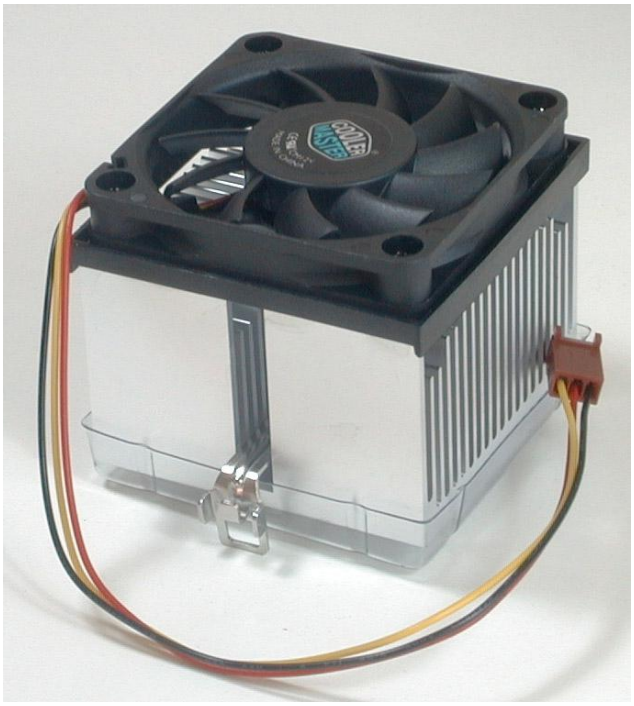
the data obtained through input devices and transfer the result to the output units. Processors from different companies are available today. Intel-PentiumIV, Xenon,Celeron,AMDAthlon, Cyrix M3 etc. are popular.

Arithmetic and Logic Unit & Control Unit (ALU & CPU)

➢ The two main parts of a processor are Ariyhmetic and Logic Unit(ALU) and Control Unoit(CU).The function of the ALU is to do the processing and mathematical calculations of the information obtained through input devices.

➢ The control unit sorts this information and sends it to the different parts of the computer like the manager of an office.The control unit organizes and coordinates various functions of a computer.The orderly and fast functioning of a computer indicates the efficiencyof the control unit.

CPU FAN WITH COOLING KIT



➢ A fan is often fixed on the processor to remove the heat generated by continuous activity. This is known as the processor fan.

Processor Socket: The processor socket is used ti fix the processor in a computer. Different kinds of motherboards are available today, depending upon the size and the no. of pins in a processor,

KEYBOARD

The keyboard of a computer looks quite similar to the keyboard of a typical typewriter. The keyboard may have 84, 101, or 104 keys. The keys on the computer keyboard are arranged in the same order as on the keyboard of an ordinary typewriter. There a few additional key on the computer keyboard.

The keyboard contains alphanumeric keys to enter the string and the numbers. For the frequent calculation and the numerical entries, numeric pad is provided. There are also function keys. Use of them is to perform specific function with a single key stroke.

KEYBOARD FUNCTION

Generally the key switches are connected in a matrix of rows and columns. Each key has fixed set of coordinates.

Function Of The Keyboard Are :

- Sending a key depression
- Encoding
- Sending the code to the computer.

A standard technique known as scanning is followed by the KB electronics. The rows are used as inputs to matrix. The keyboards electronics sends signals to the matrix through the rows. The columns are used as an output from the matrix. The column lines are sensed by the electronics circuit.

KEYBOARD INTERFACE

The keyboard interface receive the scan mode in the serial format from the keyboard, assemble the serial data in to a parallel d8 bit scan code, and generate the interrupt request to the interrupt to the logic, the system switch follows specific protocol with the microprocessor on board, for data transfer and the control sequences. The keyboard interface hardware consists of following functional section.

1. **Serial to parallel converter (shift Register)**
2. **interrupt generation logic**
3. **The scan code port of PPL on the mother board**

The serial to parallel converter is enabling by the switch. Once the scan mode is assembled interrupt, request and is generated. The request freezes the shift register. The interrupt service routine enabled the shift register output which is connected to the input of the motherboard PPI> subsequent the service routine reads this scan code through port A. the interrupt service routine also clear the shift register as to prepare it for next scan code.

KEYBOARD PROBLEM

→ **No Response Of Any Stroke From Keyboard.**

Check connection between keyboard and computer, the may be loose in the socket or the cable may be damaged. If connecting another keyboard does solve the problem the fault is supply line.

→ **Check Keyboard Massage Appears**

It means that the computer has not found usual code while checking the keyboard. This because of incapability between AT style and XT machine or vice versa.

→ **Any Character Stats Repeating While Machine Startup**

The connect for the key would have become jammed so open the keyboard and remove the key contact which has got stuck

→ **All Keys Produce Wrong Character**

If replacement of keyboard does not solve the problem to points to serious in the operating system. If problem is solving by the replacement could be in then keyboard electronics circuit.

→ **Optimal Pressure**

Although the computer keyboard is similar to the mechanical type writer keyboard. It is an electronic equipment and requires more gentle handling than a mechanical keyboard. The key switches are soft touch keys and the excessive pressure on the key top may cause damage to the computer keyboard.

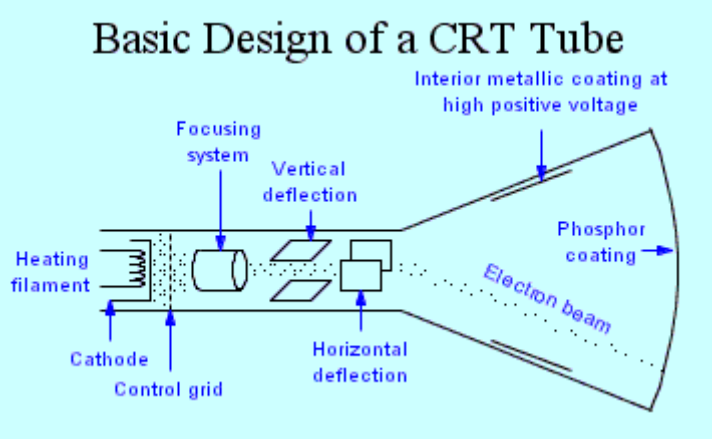
→ **Dust**

Most of the familiar occurs due to the minor problems like dust. These keys will not make proper contact due to dust. It is advisable to cover the keyboard when not in use and clean it once in the mouse with the small vacuum cleaner.

→ **Liquid**

This occurs when someone accidentally spills a liquid on the keyboard while the computer running. Cleaning the keyboard is not and easy job. And something this may result in damage to the electronic circuitry inside. If there is nay liquid spill, the computer should be switch off and the liquid cleaned immediately with a clean cloth. The computer should be switches ON only when the keyboard is dry.

VIDEO DISPLAY UNIT (VDU) / MONITOR



When you type text through the keyboard, it is not directly printed on the sheet of paper. Instead, it is display on a *Video Display Unit* (VDU) or *Monitor* that looks similar to an ordinary television screen. The current typing position on the screen is informed through a special character displayed on the screen. This special character is called *cursor*. The cursor can have different shapes in different programs. However, its usual shape is blinking / non-blinking vertical I beam, the underscore character (_) or the solid rectangle. The cursor is shown on the monitor where the next typed (Keyed-in) character will be accepted and displays. When you type a character, it is display at the cursor position and the cursor advances to the next position on the monitor.

A monitor is an output system. It main work is to display the characters. A video monitor is like and color television without the circuitry for receiving station and also audio section.

The IBM monochrome and the color displays are based on the CRT video technology. Inside there is electron gun that forces a stream of electrons at the screen to recharge each dot. The screen is coated with the phosphor substance that glows for a short time when hit by the electrons. The electrons beams scans in the horizontal direction across the screen one line at a time. As the line is scanned the scream of electron as turned ON or OFF at controlled times. When they on a small spot (pixel) are formed and screen glows. The pixels are used to create an image on the screen.

TYPES OF MONITORS

a. **Digital or TTL**

b. **Analog**

COMPARISON BETWEEN ANALOG AND DIGITAL MONITORS

It is difficult to distinguish a digital monitor from a analog monitor just by looking at the CRT type.

The Difference Between Them Is Follows:

Analog monitors have better quality of phosphors coating on the inside of CRT as compared to that of digital monitor.

The video signal is that the digital monitor is of TTL positive type while in analog monitors. It is of both type of TTL positive and TTL negative.

The horizontal frequency in the analog monitor is between 29 KHz and 38 KHz, which makes in usable in the various types of modes. In the digital monitor the frequency 18.432 KHz in CGA mode.

The vertical scanning frequency in analog monitors ranges from 49 to 95 Hz.

Analog monitors have a 40 MHz band.

MOUSE

Mouse is a device that is used in the window based program. The mouse acts as an interface between the PC and the User. You can move the mouse to move the cursor. Select option and to execute commands, as an alternative to entering command through the keyboard. The mouse can have a different shapes and sizes. Your mouse has two or three buttons.

The mouse is kept on a flat surface. When you move the mouse on the surface, the *Mouse Pointer* also moves in the same direction in the screen. Thus you can move the mouse pointer on the desired commands or option display on the monitor. To select command or option you can press the corresponding mouse button and then release it. Pressing mouse button is also called *Clicking*. Most of the time, you will also use the left mouse button to select the commands or option. The right mouse button is sometimes used by some programs to perform specific function.

For starting (Launching) a program, closing an open window, opening a directory or to select a word, you may be required to *Double-Click* the mouse buttons. Double clicking requires pressing the left mouse button rapidly twice. You might require some practice to get the feel of double clicking the mouse. We will tell you more about using the mouse later.

Ports (Connectors):

→ A computer system becomes complete only when different parts are put together and they communicate properly. The connection of the parts within and outside the system unit is done using ports or connectors. These ports are connected directly to the motherboard or through add-on cards. The internal communication in a motherboard takes place through the tiny circuits printed on it. we can connect a computer to another computer to an input-output device or to data storage device. Let us study different kind of ports.

1) IDE Port:

→ Integrated device electronics (IDE) is used to connect a hardisk, CDROM drive, CD-Writer or a DVD drive to a motherboard. There are two such ports in a motherboard-primary and secondary. Two devices can be connected to each port.

Fig.IDE Port

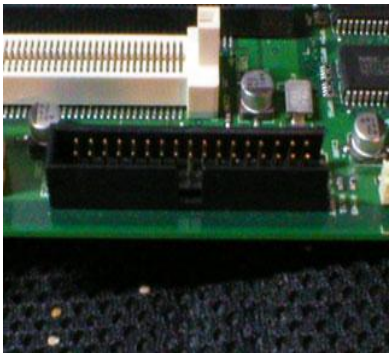


Fig. Floppy drive connector

2) Floppy Drive Connector:

→ The floppy disk drive connector is used to connect a floppy drive to the motherboard. The size of the FDD connector and the no. of pins in it are smaller than those of an IDE connector.

3) Serial port:

→ Serial Port is used to connect the mouse & modem. They are called COM1 & COM2.'COM' is the short form of communication. Usually in a communication port there are either 9 or 25 pins.

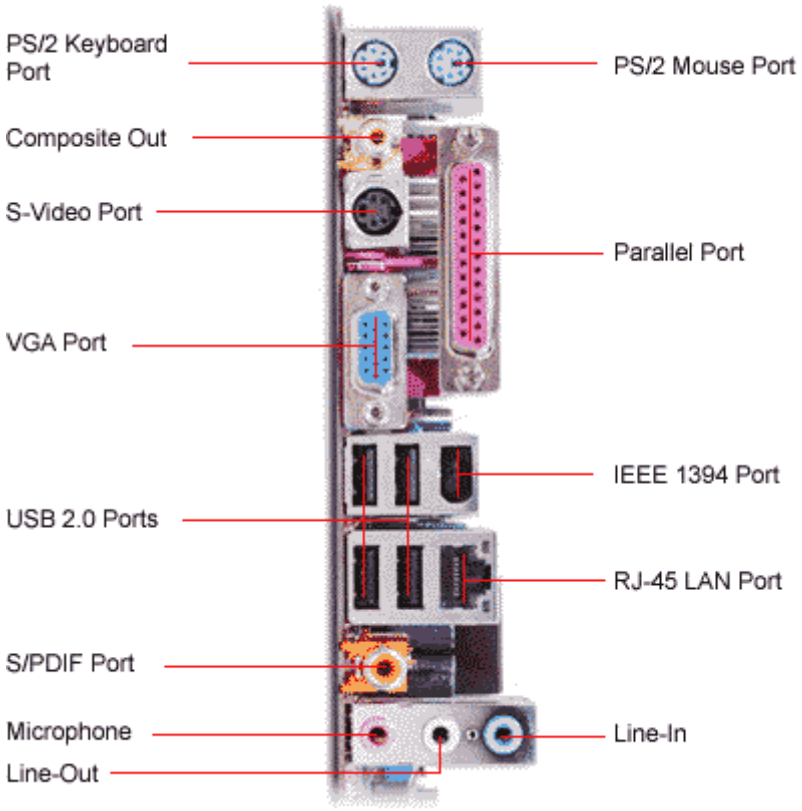


Fig. Ports on motherboard

4) Parallel Port:

→ In a parallel port, there are holes to connect pins. Subsidiary gadgets like printer, scanner etc. are connected through the parallel ports.

5) USB Port:

→ Universal serial bus(USB) port is a kind of port available in modern computers. Many devices can be connected in series on the same USB.In comparison with serial and parallel ports, a large amount of data can be transferred at a very high speed through USB ports. All peripherals like printer, modem and scanner are now available in versions that can be connected to the USB port.

Interface Cards

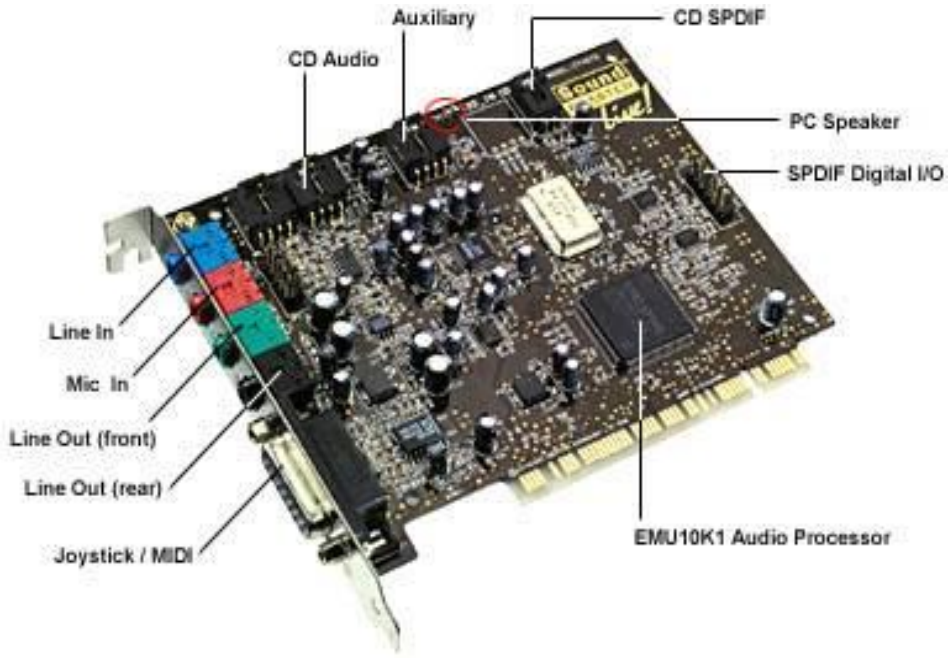
→ An Interface Card is a circuit board that fits into an expansion slot. Examples of Interface Cards are:

1) NIC (Network Interface Card):

- Also called as Network Adaptor Card.

- This is used for connecting the PC to LAN. Every PC is connected to the LAN by some cables, such as Twisted Pair cables, thick or thin coaxial cable, and fiber optic cable.
- Each LAN adapter card must have a connector compatible with the type of LAN cabling used.

2) Sound Card:

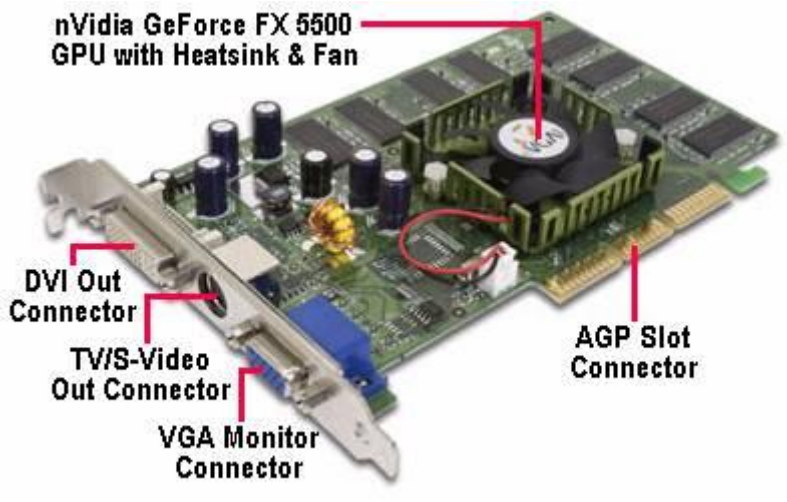


- It is used for connecting speakers, microphones and joystick.
- In a typical Audio Digitizer System, a microphone converts sound waves from air, into an encoded, analog electrical signal.
- This analog signal is applied to the audio input of the sound card.
- These signals are applied to an A/D converter circuit on the card, which in turn changes the signal into the corresponding

digital values.

- The sound card takes the analog waveform at predetermined intervals and converts them into corresponding digital values.

3) Video Card



- A 15-pin video card arranged in a three-line fashion, provides signals from Motherboard to monitor for proper display.

FLOPPY DISK DRIVE AND DISKETTE

The computer would be very incomplete without the floppy drives. A floppy disk allows information to be exchanged between two computers. All that needs to be done is to insert a floppy in the drive, copy the date from the hard disk to the floppy, and insert in it the machine where that data is required. It is still one of the easier and cost effective ways to exchange information or data between two computers.

The floppy is actually enclosed in a plastic jacket that protects if from heat, dust and electrical shocks. When a floppy is expressed to any of the above, two things can be happen :

→ The floppy can be physically damaged, which can lead to loss of the data which is on the floppy.

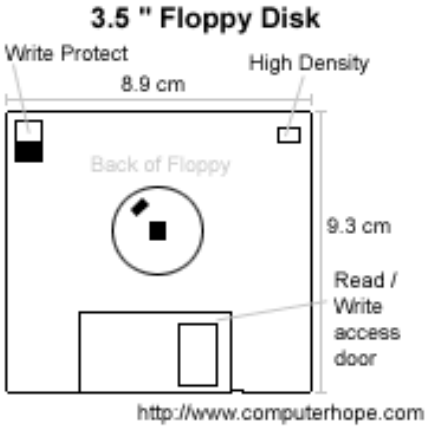
→ The floppy may remain intact, but there may still be a data loss.

The *Floppy Disk Drives* is an important input / output (I / O) device in the PC. (The I / O device is used for inputting (reading) and storing (Writing) information. The PC contains one or more floppy disk device. The floppy disk drives are a storage device. It stored the information (Documents) on the floppy diskettes. That is inserted in the floppy disk drives. The floppy diskette is usually called floppy disk or just disk (Disc). The PC stores all types of information, such as letters, computer programs, spreadsheet, databases, etc. in the floppy disk. When the PC requires the information stored in the floppy disk, it reads the information back through the floppy disk drives. On the other word, the floppy disk drives are a storage or

reading / writing device and the floppy disk is storage medium. If you do not need the information stored on a disk any more, you can erase it. In this way, you can make room to store new information on the same disk.

The floppy disk is flexible plastic that has magnetic coating on one or both sides. This plastic disk enclosed inside another square plastic jacket. Two of floppy disk is used in PCs. :

1. 5.25” Floppy Disk (Mini Floppy Disk)
2. 3.5” Floppy Disk (Micro Floppy Disk)

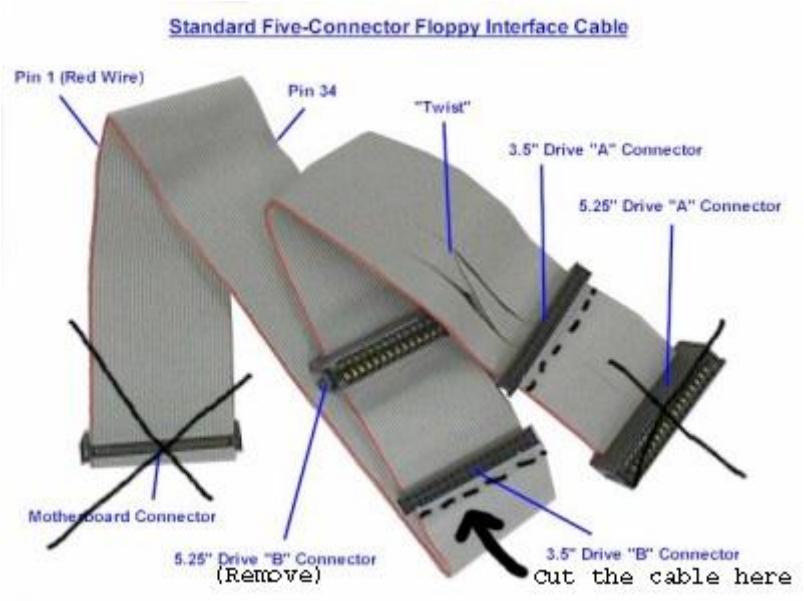


Beside the size, a micro floppy differs from a mini floppy disk in the following counts :

1. The micro floppy disk is more rugged than the mini floppy disk. Where as the mini floppy disk uses a flexible jacket (outside cover), the micro floppy disk uses a rigid plastic cover.
2. For the performing read or write operations, there is the small opening in the jacket of the mini floppy disk. Thus the magnetic disk in the mini floppy is always exposed to the environment through this opening in the micro floppy is covered with a shield. This shield protects the disk from the dust. When you insert the micro floppy disk in the floppy drive. The drive automatically opens the shield to perform the read or write operation.
3. the write protect notch in a micro floppy disk has a built-in tab. You can use this tab to disable writing on the disk.

Floppy Interface Cable

→ The floppy disk interface uses what is considered,by most people,a truly strange cable.It is similar to standard IDE cable in that it is usually a flat,gray ribbon cable.



HARD DISK

Unlike a floppy disk that is flexible and removable, the hard disk used in the PC is permanently fixed. The hard disk has storage capacity of 10 MB (10,000,000 bytes or character) or higher. The hard disk used in a higher end PC can have a storage capacity of up to 80 GB (Giga Bytes; 1GB = 1000 MB). Now-a-days, hard disk capacities of 540 MB, 1 GB, 1.6 GB, 2 GB, 4 GB, 8 GB, 10 GB, 20 GB, 40 GB are quite common. The data transfer rate between the CPU and hard disk is much higher as compared to that between the CPU and floppy disk Drives. The CPU can use the hard disk to load programs and data. As well as to store data, the hard disk is very important input/output (I / O) device. The hard disk drive does not require any special care except that one should operate the PC with a hard disk in a dust free and a cool room (preferably Air – Conditioned).

The head can read / write from a portion of platter rotating beneath it. Data id organized in a set of concentric rings called tracks. Each track is the same width as the head. The same numbers of bits are typically stored on each track. Thus the density increases towards the innermost tracks.

Data is stored and retrieved from the disk in blocks. Data is stored in block-size regions called sectors. The sector may be of fixed or variable length. Adjacent sector are separated by intra-track gaps. Certain control data is recorded on the disk to identify the start and end point of a sector. The data is recorded during formatting and is used only by the disk drive. It is not accessible to the user.

A number of characteristics are used to differentiate between disks :

The head may be fixed or movable. In a fixed-head disk there is one read/write head per track. The heads are mounted on a rigid arm. A shaft that rotates the disk and electronics required for the input and output of the binary data.

A set of corresponding tracks on all structure of the disk pack equidistant from the spindle is called a *cylinder*.

Commands to read or write are received from the computer by the disk controller. For writing on the disk pack the computer specifies the drive number, cylinder number, surface number and sector number. The disk controller position ate arm assembly so that the read / write head reaches the specified cylinder. The time taken to the reach the specified cylinder is called the **seek time.** Seek time varies depending on the position of the arms assembly when the read / write command is performed. Maximum seek time is taken when the arms assembly has to move from the outer most track to the inner most track. Minimum seek time is taken when the arms assembly is already positions over the required cylinder.

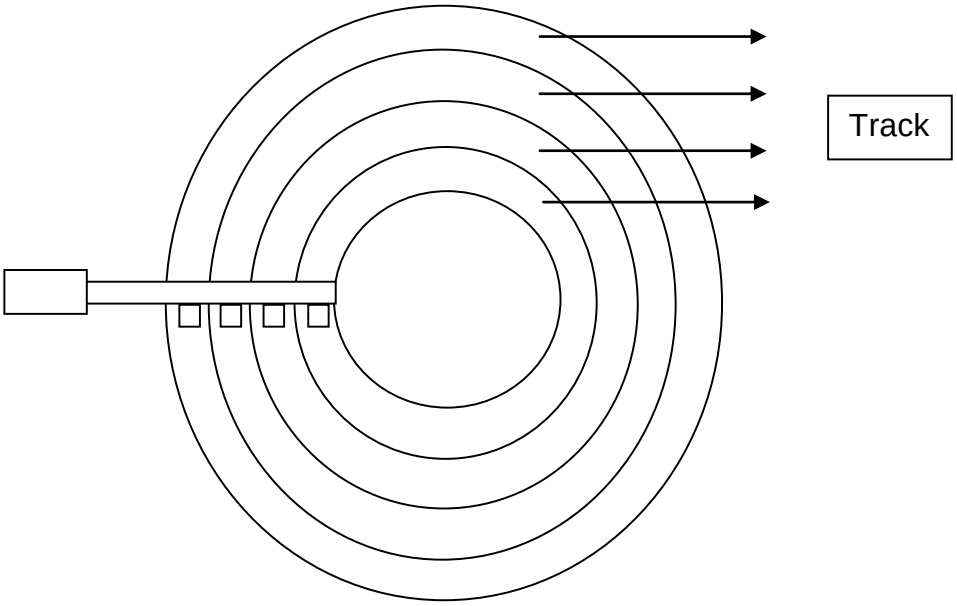


Figure 1 – Fixed Head

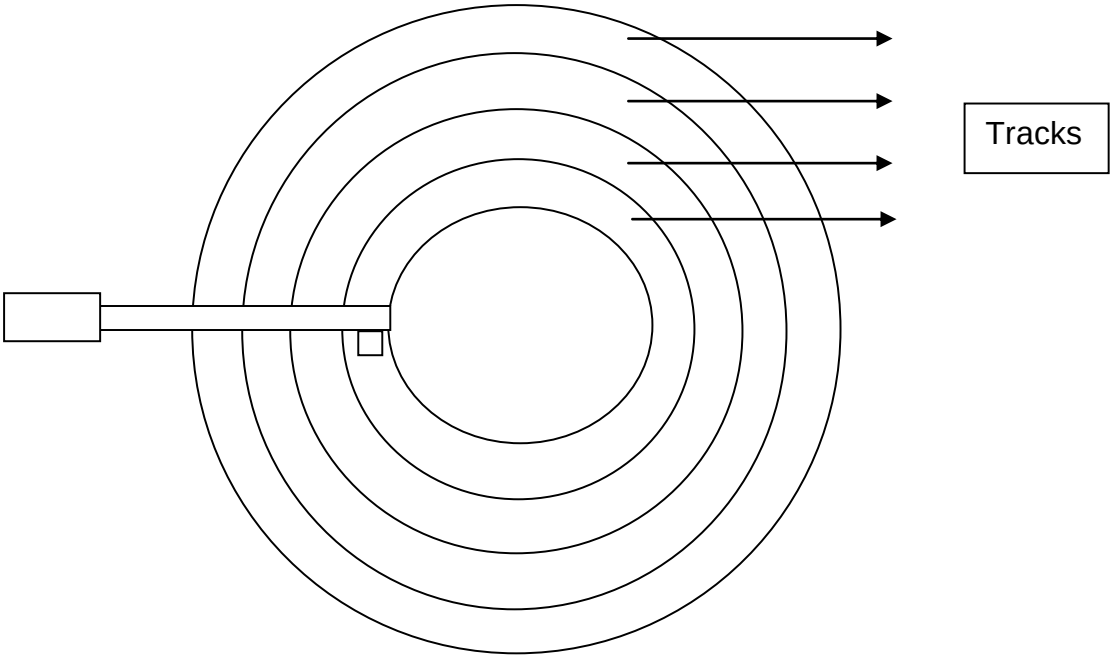


Figure 2 – Movable Head

Switching is the process of switching the read / write head from one sector to another and it is an electronic and instantaneous operation. After the head is selected there is further delay – **rotational latency**. Because the required sector must reach the read / write head.

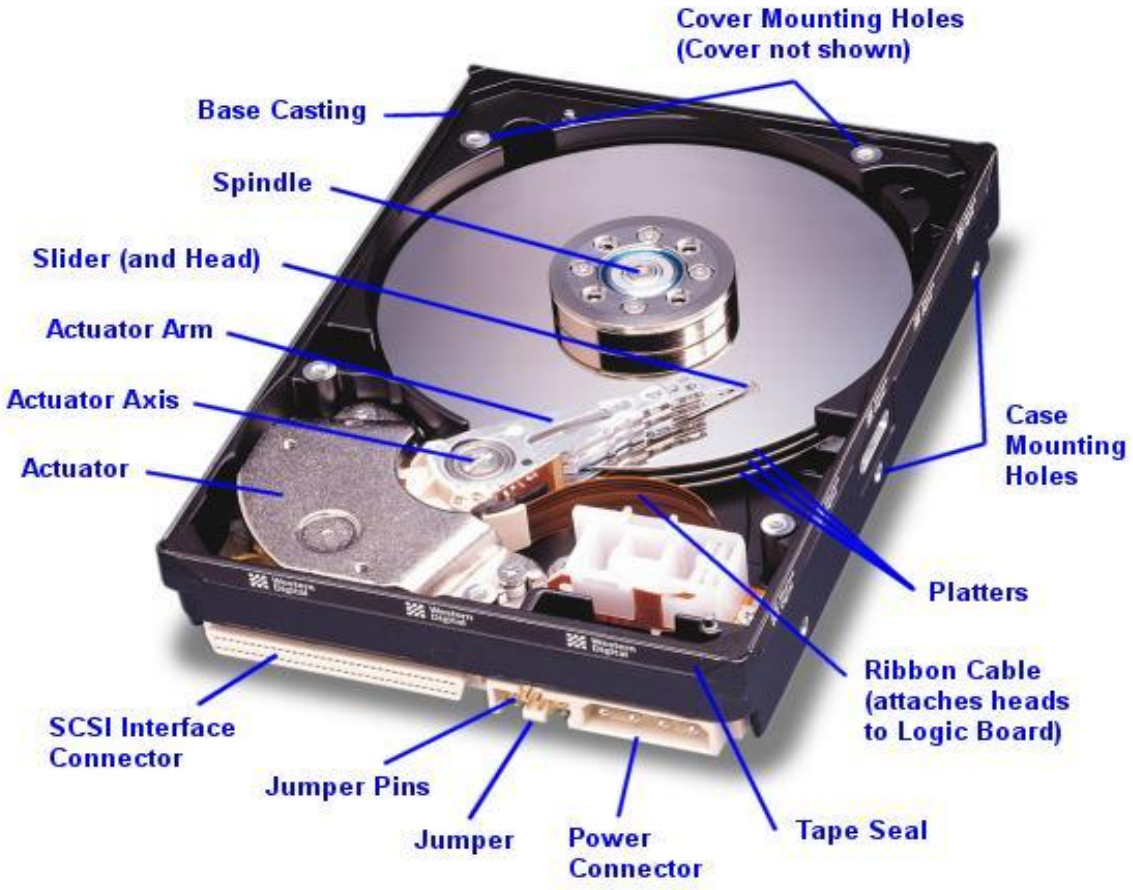
Thus,
Average access time = average latency + average seek time.

Once the sector is reached. Data is read at the speed determined by the rotational speed of the disk.

The full set of these platters and the read and write heads are enclosed in a vacuumed container, to protect it from dust and electric shocks. When the hard disk being accessed, it makes a peculiar groaning sound. This indicates that the hard disk drive is an example of a device that is both mechanical and electronic.

HARD DISK DRIVE ORGANIZATION

Hard disk is sealed unit that holds most of the in a computer system. A hard disk drive is made up of many components may be of various types such as **ESDI** (*Enhanced Small Device Interface*), **SCSI** (*Small Computer System Interface*) etc.



The main components are:

- → Disk Plotter
- → Read / write head
- → Head Actuator (Stepper or Voice Coil)
- → Spindle Motor
- → Logic Card
- → Cables & Connector

The plotters, spindle motor, head mechanism are usually contained in a shielded chamber, called hard disk assembly. A typical hard disk has one or more plotters. These entire plotters are mounted on a single shaft, and driven by the spindle motor. The plotter about 0.05 inch and coated with a magnetically retentive substance or media, which is actually responsible for storing the data. The thickness of this media is above 30 microns.

The hard disk drive has one read / writes head for each plotter surface. All the heads are mounted on a common movement mechanism. Each head is mounted on an arm that is spring loaded to force the heads on the plotters. At the rest the heads are in contact with the plotters. But when the drive is spinning at full speed air pressure is formed below the head which lefts it away from plotter.

The electromechanical mechanism that bends to move the head assembly is called the actuator. In a stepper motor type a stepper motor that used metal bend to move the head assembly from the outer edge of plotter to its inner edge achieves actuator the movements. In a voice coil type a actuator, the similar movement of head assembly by using the voice coil.

Hard disk Cable

IDE Cable

Sata Cable

REPAIRING OF HARD DISK DRIVE

The majority of the hard disk problems are of the “soft “type where a new low level format and detect mapping session will take care of the problem. These problems are characterized by a drive that sounds normal but gives a various read / write errors. “Head “problems and those that are machine such as when the drive sounds as touch marbles are inside the sealed hard disk assembly. When this kind of problem occurs it is advisable to send the disk back to the manufacture.

FORMATTING AND PARTITIONING HARD DISK

There are few steps users have to remember before formatting and partitioning a hard disk s listed bellows:

1. Boot a system with the bootable floppy or CD
2. The Fdisk command in command prompt.
3. Now you got a message :

Do you wish to enable large disk support (y/n)?[ ]

4. Press y then press enter
5. You got the screen having four option like:

(1) Create DOS partition or logical DOS drive.
(2) Set the active portion.
(3) Delete the partition or Logical drives
(4) Display the partition information.
(5) Enter your choice: []

6. Press 1 then Enter

7. Now you got the screen with Three option like :

(1) Create Primary Dos Partition

(2) Create Extended Dos Partition

(3) Create Logical Drive(s) in Extended Dos Partitions

(4) Enter Your Choice: [ ]

8. Enter 1 then Press Enter

Then System asks you how much size you want to specify for Primary Dos Partition. The user can give value size of Partition in to percentage or in Numeric Value.

9. After create a Primary Partition make this Partition active using 2 option on main screen.

10. Then Create Extended Dos Partition and Logical Drives in Extended drive into it. Enter Volume Label when Necessary.

11. After Creation of Primary and Extended Dos Drives, Format All Drives that you Created.

12. Then using Esc key goes out Fdisk command area.

13. Then find the volume label of CD – ROM, enter into and find setup path and write setup, press enter; now installation of OS will start automatically.

PRINTER

The printer is an output device that is used to print documents on paper. Various kinds of printers are used with PCs. The Dot Matrix Printer (DMP) contains a few tiny needles. There art 7 or 8 needles in a low quality DMP and up to 24 needles in a high quality DMP. At the time of printing, as the head moves from one end of the paper to other, these needles are fired selectively to print different character or graphics. Dot Matrix Printers usually have a printing speed of 100 to 500 characters per second.

DOT MATRIX PRINTER

Inkjet / DeskJet printer are also fast becoming a popular choice for the use with the PCs. These printer offers good quality and noiseless operation. These are non-impact types of printers that print character are graphics by spraying very tiny drops on ink directly on to paper. The print quality of these printers is much better as compared to DMPs. The typical print quality of these printers is from 300 dots per inch (DPI) to 720 DPI. These printers also print color.

DESKJET PRINTER

LASER PRINTER

Laser printer are also being commonly used with a high – end PCs; particularly those used for Desk-Top Publishing (DTP). The laser printers provides very high quality printout; typically in the range of 300 DPI to 2400 DPI. The typical printing speed of laser printers is between 3 to 12 pages per minute.

A printer interface links the printer with the computer. Commands and data from the computer are sent to the printer the through this interface. The printer produces character on the paper. One situation in which the printed output (known as hard copy) is required when the output produced at a distance from the user and may be at an undefined or inconvenient time as an off-line batch processing system. Such the printing required a high-speed printing in a large quantities and a typically employ a line printer.

TYPES OF PRINTER

1. Impact Printer
2. Non Impact Printer

PRINTER FUNCTION:

→ The printer receives the data from the computer and print the data form the computer.

→ Printer also receives the control character from the computer.

→ Control characters are not printable character. They will use to send some sort of control information to the printer.

→ Some high quality printers are also printing any types of image on the paper; also they can print the cards and such type of graphical pages.

→ Widely used control characters are :

1. Carriage Return (CR)
2. Line Feed
3. Form feed
4. Backspace
5. Space

COMPACT DISK (CD) DRIVES

The compact disk used in a Pc similar in shape and size to the audio CD. The computer CD can hold about 700 MB of data. The computer CD is used to load computer program and other data in a hard disk of PC. Most of the new computer programs are now only available on CDs. Some times the programs are directly run form the CD. Also, sometimes the PC may directly read the data store on the CD at the time of running a program.

Most of the CDs are read only type. That is, the CPU can information store on a CD, However it cannot store any information on CD. Moreover, most of the CD drives used in the PC do not have the capability to store the information on CDs. However, writable CDs are available. Therefore, if a PC has a CD Drive that has witting capability you can store the information on a writable CD so normally the CD drives works as a input device but it can also act as an input / output (I/O) device.

Chapter 4

What Is Hardware & Software?

WHAT IS HARDWARE AND SOFTWARE???

There are many physical devices, such as the monitor, floppy disk drive, hard disk drive, keyboard, printers etc. in your PC. These physical devices are called *Hardware*. The hardware does all operation in your PC, such as accepting and storing data, performing calculations and displaying or printing result.

The various physical devices or the hardware in the PC cannot work on their own. To make the hardware work, you required a set of programs. A set of program associated with the operation of a computer is called *Software*. Different Types of software (Also called software programs) are used on PCs. Software can be classified in to following major categories :

- → Operation System. E.g. DOS, Windows 98, Windows XP, UNIX, Linux etc.
- → Programming languages, such as Basic, FORTRAN, COBOL, C++ etc.
- → Application programs / packages, such as word processors, spreadsheet, database
- → Management System (DBMS), etc.
- → Other application programs doing a specific job, such as accounting payrolls, billing,
- → Weather forecasting, ticket reservation, etc.

Chapter 5

Memory

MEMORY

Memory is classified into two types:

- → Primary Memory
- → Secondary Memory

PRIMARY MEMORY

It is called the main memory or the central memory. It is of two types – *RAM* and *ROM*.

RAM is essentially a read / writes memory. Information can be written into and read from RAM. It is volatile in nature. i.e. It retains the stored information as long as power supply is not switch off. It is usually sold and installed to the standard adding board called a *Single In-Line Memory Module* or *SIMM*. Ram can be bought separately in case you want to expand the primary memory of your computer.

RAM chips may be classified as:

- → **Dynamic**
- → **Static**

DYNAMIC RAM CHIPS

The storage cell circuit contains:

- → A transistor (Function like mechanical on-off light switch)
- → A capacitor used to store an electric charge

Depending on the switching action of the transistor. The capacitor may have no charge (0 bit) or hold a charge. (1 bit). The change on the capacitor must be periodically refreshed or charged. In the event of power loss dynamic RAM loses its contents. It is thus called Volatile Storage.

TYPES OF DIFFERENT RAM CHIPS

DDR SDRAM

DDR SDRAM or Double-data-rate synchronous dynamic random access memory is a type of memory integrated circuit used in computers. It achieves greater bandwidth than ordinary SDRAM by transferring data on both the rising and falling edges of the clock signals (double pumped). This effectively doubles the transfer rate without increasing the frequency of the front side bus. Thus a 100 MHz DDR system has an effective clock rate of 200 MHz when compared to equivalent SDR SDRAM, the "SDR" being a retrospective designation.

Fig.

(DDR memory (front and back shown)

Has 184 pins and one notch)

With data being transferred 8 bytes at a time DDR RAM gives a transfer rate of (memory bus clock rate) × 2 (for dual rate) × 8 (number of bytes transferred). Thus with a bus frequency of 100 MHz DDR – SDRAM gives a max transfer rate of 1600 MB/s.

SDR SDRAM:

SDR SDRAM is Single Data Rate synchronous dynamic random access memory, a type of computer memory. The term is used to contrast with Double Data Rate SDRAM, or DDR SDRAM, but since single data rate SDRAM was the only sort available when SDRAM was introduced, is simply called "SDRAM", rather than "SDR SDRAM".

SDRAM has a synchronous interface, meaning that it waits for a clock pulse before responding to its control inputs- it synchonizes with the computer's system bus, and thus with the processor.

SDRAM has a synchronous interface, meaning that it waits for a clock pulse before responding to its control inputs- it synchonizes with the computer's system bus, and thus with the processor.

(FIG. SDR SDRAM)

Currently, 168-pin SDRAM type is not used in new PC systems, and PCs come with DDR or DDR2 SDRAM, with DDR2 quickly phasing out DDR.

Rambus DRAM

Short for ***R**ambus **DRAM***, a type of memory (DRAM) developed by Rambus, Inc. Whereas the fastest current memory technologies used by PCs (SDRAM) can deliver data at a maximum speed of about 100 MHz, RDRAM transfers data at up to 800 MHz.

RDRAM is already being used in place of VRAM in some graphics accelerator boards. As of late 1999, Intel has been using RDRAM in its Pentium III Xenon processors and more recently in its Pentium 4 processors. Intel and Rambus are also working a new version of RDRAM, called *nDRAM* that will support data transfer speeds at up to 1,600 MHz.

READ ONLY MEMORY:

ROM is permanent type of memory. Its contents are not lost when the power supplied is not switch off. Data is hard wired on to these chips at the time of manufacture. They cannot be change by the user.

While both RAM and ROM are storage devices and can be access randomly, they differ in that data can be written onto RAM while ROM does not permit the user to write onto it.

ROM retains the data in it even the absence of power and is thus non-volatile storage. Though data is hardwired, the user is able to program the following types of ROM

SECONDARY MEMORY

The secondary memory is found outside the CPU box and hence sometimes called the external memory of the external storage. Examples of secondary storage devices include floppies disks, tapes, cartridges, compact discs, etc.

POWER SUPPLY UNIT

The power supply unit checks the quality of the power supply and ensures that the right amount of power gets supplied to the various parts.

A power supply is the heart of computer system. As human being need proper circulation of the blood for human body to stay as live, a computer needs a well regulated 5 V and 12 V DC. Power supply for the proper functioning of its various parts. These DC powers are supplied by the power supply to the computers. As the power from mains is 240 V AC, with lots of interface, I cannot be directly fed to computer. So the power supply is used to the computer and mains to convert 240 V AC to current to well regulated 12 V and 5 V DC current. Usually hard disk is used 12 V Supply.

Chapter 6

Power Supply Unit

TYPES OF POWER SUPPLY

There are basically two types of power supply.

1. **Linear power supply**
2. **Switch mode power supply**

DEMERITS OF POWER SUPPLY

The main transfer in the power supply is bulky owing in the current rating and is also expensive.

The power is more wastage in power supply so efficiency is relatively lower.

The linear power supply dispatches a lot of heart, there by reduces the efficiency and increasing the size and cost due to requirement to the elaborate heat sink provisions.

In SMPS the O / P is not regulated the continuously but switch on and off at a relatively high frequency results in similar size transfer and filter capacitor. The input DC is chopped and high frequency (10 KHZ to 400 KHZ) using and active device and converter transfer the transfer high frequency wave form are rectify and filtered. A portion of output voltage is used as a feedback signal for drive circuit for regulator.

RELATIVE MERITS OF SMPS

1. Small in physical size since operating frequency is high.
2. Both low and high voltage derives from the power supply.
3. AC is isolated without using big power transfer.
4. Long life.
5. Highly Efficiency for every low and high voltage input.

WORKING OF SMPS

In SMPS the mains AC supply is first send to filter unit. This switching transistor, which generates very high frequency square wave pulses. The square pulses given to primary winding of a SM transfers. These plusses in to voltage at primary winding of transfer which will generate voltage at the secondary winding.

This secondary voltage is then rectified and filtered to produce the request output. To regulate the output generate output voltage is send back to switching section. This voltage is ‘ ON ‘ time of switching transistor, which reduces the output voltage. When there is a reduction in output voltage reverse action will increase the output voltage. The error voltage is then sending to control circuit, which controls the switching transistor to regulate the output voltage.

Bridge rectifier and filter circuit produce the DC current of high voltage by giving main power supply to line filter circuit, which is unregulated DC current. Now this unregulated DC current is switch at high frequency by switching transistor. Further it is converting in to DC current pulses.

This power supply works in on the AC signal. This signal is half wave rectified and given tot the output stage, which user to transistor for amplification.

This 50 C / S amplified signal are given to the primary coil a transfer which generates 25 V AC at the secondary winding of transfer. This 25 V supply is then give then the oscillator that uses IC KIA494 to create high frequency then the signal is given to the driver section through

oscillator section which amplified by transistor used in the section the amplified signal goes to output section through coupling transfer and then goes to the primary winding of SM transformer. This transformer works on this signal and generates the necessary supply at secondary winding of SM transformer.

TECHNICAL SPECIFICATION

INPUT: 180 to 260 AC at 50 to 60 Hz.

OUTPUT:

Voltage	Maximum Current
+ 5 V	15.0 Amp
- 5 V	1.1 Amp
+ 12 V	5.5 Amp
- 12 V	0.5 Amp

USES OF THE DIFFERENT VOLTAGES

+ 5 V: It is used by the logic chip in the system board, the disk drive electronic card and the adapter card that is installed in the dynamic memory chip.

- 5 V: It is used in the dynamic memory chips.

+ 12 V: The Disk drive motors use it.

- 12 V: Both + 12 V and – 12 V are used to power on the circuit of the communication adaptor card.

12-PIN MOTHERBOARD CONNECTOR FROM SMPS

1.	**+ 5 V**	**:**	**ORANGE**	**1.**	**GND**	**:**	**BLACK**
2.	**NC**	**:**	**-**	**2.**	**GND**	**:**	**BLACK**
3.	**+ 12 V**	**:**	**YELLOW**	**3.**	**- 5 V**	**:**	**WHITE**
4.	**- 12 V**	**:**	**BLUE**	**4.**	**+ 5 V**	**:**	**RED**
5.	**GND**	**:**	**BLACK**	**5.**	**+ 5 V**	**:**	**RED**
6.	**GND**	**:**	**BLACK**	**6.**	**+ 5 V**	**:**	**RED**

4 PIN PRRIFERIAL CONNECTOR

1.	**+ 5 V**	**:**	**RED**
2.	**GND**	**:**	**BLACK**
3.	**GND**	**:**	**BLACK**
4.	**+ 12 V**	**:**	**YELLOW**

CHECKING OF THE POWER SUPPLY

To check the power supply and check the voltage at the power good signal. If the measurement is between 2.4 to 5.4 DC ranges then the power supply is working but if it is not in this range the system will not run and hence the power supply must be serviced. Also check the voltages from the motherboard and drive power connecter. Connect black lead of the millimeter with ground and the other red with any voltage line. Now the red wire is known to carry + 5 V and the yellow wire is known to carry + 12 V DC. Now while measuring this voltage can very from 10.8 to 12.9 V in case of yellow wire, while case of red wire it may from 4.5 V to 5.5 V. if they are within above given range then the power supply is working properly.

Chapter 7

Maintaining A Computer Hardware

MAINTAINING A COMPUTER HARDWARE

The parts of the computer that are most likely to get the affected by the repeated use:

THE DISK DRIVES The disk drives need to be cleaned from time to time using the tools that are available for doing so.

THE PRINTER Printer creates a lots of paper dust. This needs to be cleaned once in every 15 days depending on the usage. If the printer is used very frequently, then it should be cleaned every week. This cleaning can be done using the thin nozzle of the vacuum cleaner. Care should be taken in doing this because the printer has delicate parts.

THE HARD DISK The computer should not be switch off when a program is working.

DISKS The computer should be never being switch off without removing the diskette from the drive. Doing this will cause the data on the disk to be lost or will damage the disk altogether.

MOUSE The mouse has to be cleaned every month. It is best to use the mouse on a firm and smooth pad. It becomes very easy to operate it that way.

A computer is also machine. It is also likely to have breakdowns. Sometimes an error may occur in the machines. This error has to be communicated to the engineer looking after the machines. To make sure that the right thing is communicated, it makes sense to keep a record of the exact nature of breakdown. Whenever a computer has problem, the exact message that it displays should be noted down. The application software that was working that should time is repairing the computer to have a better understanding of how the breakdown happened in the first place.

Chapter 8

Booting A Computer

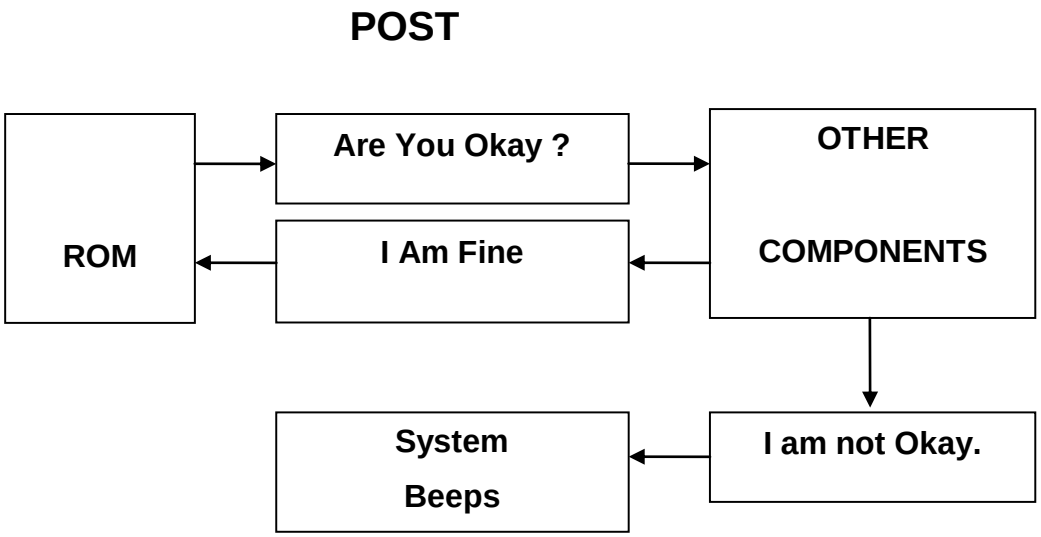
BOOTING A COMPUTER

When you switch on a computer, it goes through a complex set of the instruction. This it does tot ensure that all its components are working properly and to warn the user if something goes wrong. This is the first step of very complicated process called *booting*. Booting is the term derived from the word bootstrap. Bootstrap is the process of lifting one self up on its own. The computer also readies it self for you, therefore this process is called booting. The process of checking itself is called Power On Self Test or POST.

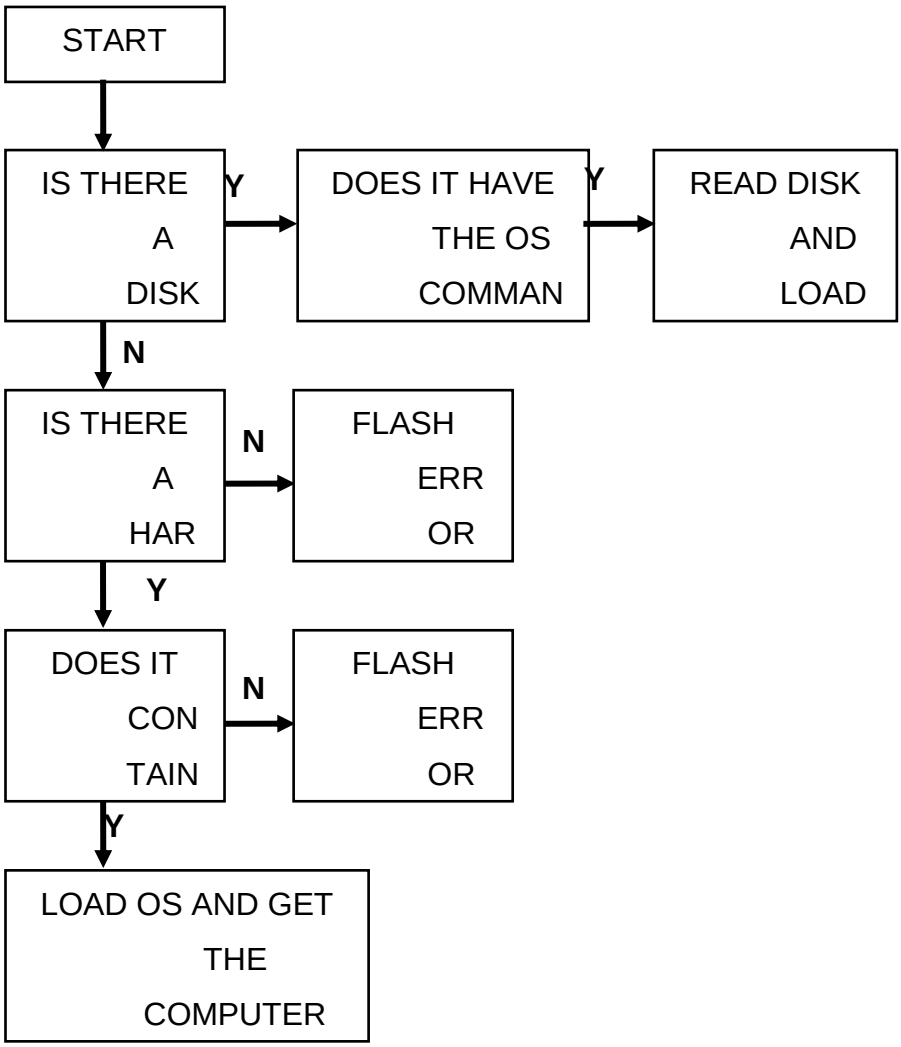
POST is the first thing the computer does when it switch on. If an error detected during the POST, it warns the user in the form of some message flashed on the screen accompanied with the series of beeps.

IMPORTANT If there is no beeps, it is no guarantee, that the hardware if fine, because there may be some error in that even the POST cannot detect.

The following diagram explained the process that the computer goes through before it comes ready for the user :



Next, the ROM searches for the operating system and loads it tots complete the process of booting. Take a look at the next schematic.



The figure above describe the way the operating system is ‘ searched’ for the loaded in the RAM for the computer to be ready to use. After the POST, the ROM searches for the operating system. First it checks or a disk in the disk drive. If a disk is found in drive A, ROM searches the operating system on it. If found, they are loaded in the RAM and the computer gets ready for use. If the operating system files are not found, the computer flashes an error message across the screen.

After this, the user has to replace the disk and press the ‘ Return ‘ key. If the return key is press without replacing the disk, the operating system files are searched on the hard disk, the computer cannot get ready to accept commands form the user. If the files are not found on the hard disk, they are copied to the RAM and the computer can be used.

BOOTABLE DISK It is very common and convenient to have the operating system files on the hard disk. However, sometimes due to some error the hard disk does not get ready. This is why; a backup of the operating system files should always be maintained. A floppy containing the back up of the operating system files called a ‘ bootable disk ‘. A bootable disk allows the computer’s operating system to get loaded. At least two bootable disks prepare and maintained.

Chapter 9

Basic Trouble Shooting

BASIC TROUBLE SHOOTING

MY COMPUTER WON'T TURN ON

→ Check the power supply switch on the back of the computer.

→ Check that power cord is properly connected to computer and plugged in.

MY COMPUTER WON'T TURN OFF

→ Press the **Ctrl** key, the **Alt** key and the **Delete** key at the same time

→ You may need to repeat this 2 or 3 times before you get a dialog box that asks if you want to End Task, Shutdown or Cancel. Choose to **End Task**

→ Try to Shutdown your computer again.

→ If your computer will still not shutdown, repeat the task again.

COMPUTER JUST BEEPS BUT NEVER TURNS ON

➢ Perhaps a key on the keyboard is stuck. Check to make sure the mouse and keyboard

➢ Plugs are properly connected in the back of the computer.

THE MONITOR IS BLANK

→ Make sure the monitor is on by checking for a green light on the bottom, front. Also, make sure the monitor cable is plugged in correctly on the back of the computer.

→ Check that power cord is plugged in.

→ Shutdown two computers one with non-working monitor and one with working monitor.

→ Disconnect the monitors and connect them to the opposite computer.

→ Reboot both computers.

→ This should help you to determine if the monitor is not working or the video card on the computer is not working properly.

HOW DO I KNOW IF MY COMPUTER HAS CRASHED?

CHECK FOR THESE SIGNS:

→ The mouse pointer doesn't move.

→ When you move the mouse or type you hear a "beep".

→ Your screen changes to all blue white text that describes an error. Try to follow the directions.

→ You get an error dialog box, or you see the words "not responding".

MY COMPUTER IS "FROZEN"

→ Try Ctrl + Alt + Del keys.

→ Hold all three keys down at once.

→ A window appears with the problem area highlighted.

→ Click on **End Task**.

→ You may have to go through this several times and then shut down your computer.

I KNOW THE PROGRAM HAS BEEN INSTALLED ON MY COMPUTER BUT I CANNOT FIND IT

→ Left click on Start.

Select Programs.

→ Find the name of the software program and double click on it.

→ A program is available even if the icon is not found on the computers desktop.

→ *NOTE: you may not be able to see programs this way on all computers.

→ It may be necessary for you to go through Explorer or My Computer – then Program Files before you can see your program.

I CAN'T FIND A FILE I SAVED

→ Left click on Start

→ Point to Find, and then click on Files or Folders

→ Type in file name or click on Browse to search C: drive for file name, or date of file creation.

MY MOUSE WON'T WORK

→ Remove the ball from the mouse.

→ Clean it with a Q-tip and alcohol.

→ Inside the mouse, the guide bars may need to be cleaned.

→ Carefully remove any lint or dust particles, but use no water or alcohol!

I CANNOT GET ON THE INTERNET

CHECK THESE THINGS:

→ An Internet cable is connected to your computer/laptop and is plugged into to the wall drop (looks like a phone jack).

→ The Internet cable is free of kinks and the end connector is securely fastened.

→ The icon "plug", located on the bottom left corner of your screen is connected.

→ If not, left click on it to connect to the Internet.

BE SURE TO :

→ First connect the VGA cord from the projector to the laptop.

→ Turn on the projector.

→ Boot ups the laptop.

→ On the laptop, press keys Fn (on the bottom left) and F5 (top row) at the same time.

→ You may need to do this several times to have images on both the laptop screen and the projected surface.

→ Or "Press the Mode button on the top of the projector so it will "recognize" the computer connection.

→ May need to press the Mode button several times.

MY PRINTER WON'T PRINT FROM MY COMPUTER / LAPTOP

→ Make sure the printer software has been properly installed.

→ To check, go to **File**, **Print**, look for the name of the printer in the top textbox.

→ You should see the name of the printer as an available choice.

→ If you do not, then the printer needs to be installed.

→ If you see the name of the printer, click on that printer to place a check mark beside it.

→ Check that the printer cable is properly connected to both the computer and printer.

THE NETWORKED PRINTER WILL NOT PRINT FROM MY COMPUTER

THE SEQUENCE THAT MUST BE FOLLOWED IS:

- → Turn on printer
- → Boot up computer that is connected to printer
- → Boot up all other computers on network
- → If the connected computer was not booted up before turning on the printer, shut it down.

FOLLOW THE ABOVE SEQUENCE

- → If you are trying to print from a network computer not connected to the printer.
- → You will still need to make sure that the above sequence is followed before sending your file to the printer.

Chapter 11

Introduction

Introduction

- A *LAN* is a high-speed data network that covers a relatively small geographic area.
- It typically connects workstations, personal computers, printers, servers, and other devices.
- LANs offer computer users many advantages, including shared access to devices and applications, file exchange between connected users, and communication between users via electronic mail and other applications.
- LAN protocols function at the lowest two layers of the OSI reference mode.
- LAN topologies define the manner in which network devices are organized. Four common LAN topologies exist: bus, ring, star, and tree.
- These topologies are logical architectures, but the actual devices need not be physically organized in these configurations.
- Logical bus and ring topologies, for example, are commonly organized physically as a star.
- A *bus topology* is a linear LAN architecture in which transmissions from network stations propagate the length of the medium and are received by all other stations.
- Devices commonly used in LANs include repeaters, hubs, LAN extenders, bridges, LAN switches, and routers.

Chapter 12

Networking Basics

NETWORKING BASICS

→ **W**hen networks first came into being, computers could typically communicate only with computers from the same manufacturer. For example, companies ran either a complete DEC net solution or an IBM solution—not both together.

→ In the late 1970s, the *OSI (Open Systems Interconnection) model* was created by the International Organization for Standardization (ISO) to break this barrier. The OSI model was meant to help vendors create interoperable network devices. Like world peace, it'll probably never happen completely, but it's still a great goal.

→ The OSI model is the primary architectural model for networks. It describes how data and network information are communicated from applications on one computer, through the network media, to an application on another computer.

→ The OSI reference model breaks this approach into layers.

→ A *reference model* is a conceptual blueprint of how communications should take place. It addresses all the processes required for effective communication and divides these processes into logical groupings called *layers*. When a communication system is designed in this manner, it's known as *layered architecture*.

2.1 The OSI Reference Model:

→ **T**he OSI reference model was created in the late 1970s to help facilitate data transfer between network nodes.

→ One of the greatest functions of the OSI specifications is to assist in data transfer between disparate hosts.

→ This means you can transfer data between a Unix host and a PC, for example. The OSI is not physical; rather, it is a set of guidelines that application developers can use to create and implement applications that run on a network.

→ It also provides a framework for creating and implementing networking standards, devices, and internetworking schemes.

→ The OSI has seven different layers, which are divided into two groups.

→ The top three layers define how the applications within the end stations will communicate with each other and with users.

→ The bottom four layers define how data is transmitted end-to-end. Figure 2.1 shows the three upper layers and their functions, and Figure 2.2 shows the four lower layers and their functions.

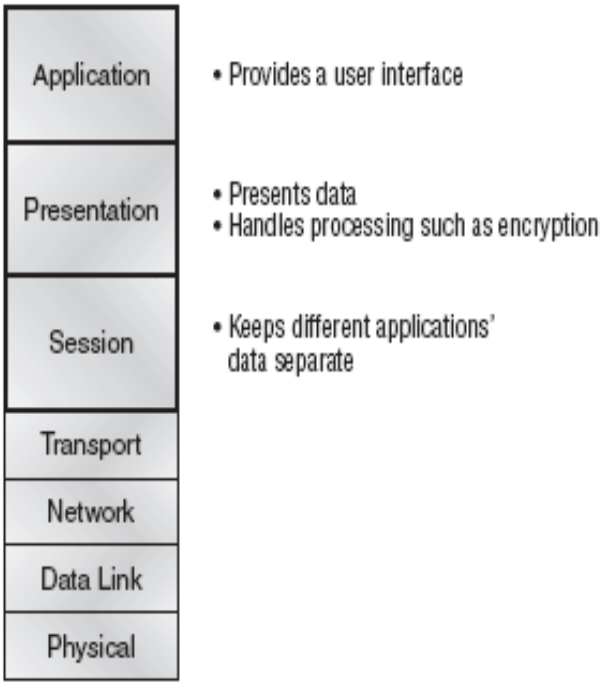


Figure 2.1 The Upper Layers

→ In Figure 2.1, you can see that the user interfaces with the computer at the application layer, and also that the upper layers are responsible for applications communicating between hosts. Remember that none of the upper layers know anything about networking or network addresses. That is the responsibility of the four bottom layers, which are shown in Figure 2.2.

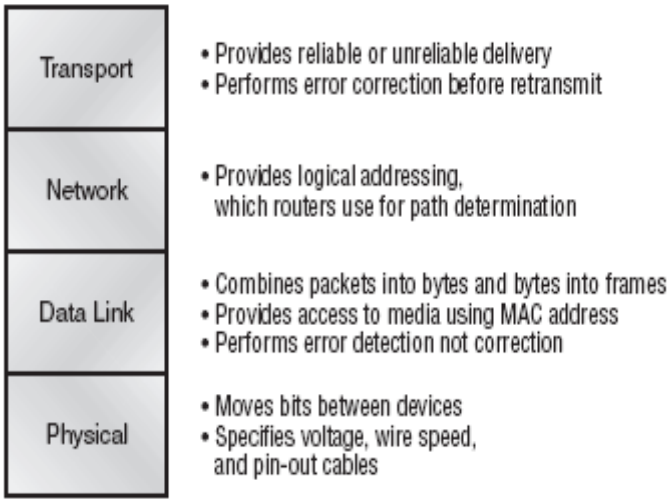


Figure 2.2 the Lower Layers

→ The four bottom layers define how data is transferred through a physical wire or through switches and routers, and how to rebuild a data stream from a transmitting host to a destination host's application.

→ The OSI reference model has seven layers:

⇒ The Application layer

⇒ The Presentation layer

⇒ The Session layer

⇒ The Transport layer

⇒ The Network layer

⇒ The Data Link layer

⇒ The Physical layer

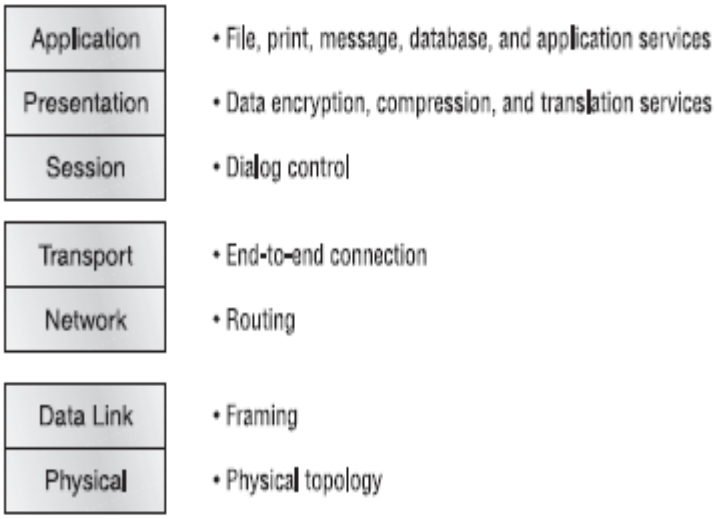


Figure 2.3 Layer Functions.

2.1.1 The Application Layer:

⇒ The *Application layer* of the OSI model is where users communicate to the computer.

⇒ The Application layer is responsible for identifying and establishing the availability of the intended communication partner and determining if sufficient resources for the intended communication exist.

⇒ Although computer applications sometimes require only desktop resources, applications may unite communicating components from more than one network application; for example, file transfers, e-mail, remote access, network management activities, client/server processes, and information location.

⇒ Many network applications provide services for communication over enterprise networks, but for present and future internetworking, the need is fast developing to reach beyond their limits.

2.1.2 The Presentation Layer:

⇒ The *Presentation layer* gets its name from its purpose: It presents data to the Application layer.

⇒ It's essentially a translator and provides coding and conversion functions. A successful data transfer technique is to adapt the data into a standard format before transmission.

⇒ Computers are configured to receive this generically formatted data and then convert the data back into its native format for actual reading (for example, EBCDIC to ASCII). By providing translation services, the Presentation layer ensures that data transferred from the Application layer of one system can be read by the Application layer of another host.

⇒ The OSI has protocol standards that define how standard data should be formatted.

⇒ Tasks like data compression, decompression, encryption, and decryption are associated with this layer.

⇒ Some Presentation layer standards are involved in multimedia operations. The following serve to direct graphic and visual image presentation:

PICT This is picture format used by Macintosh or PowerPC programs for transferring QuickDraw graphics.

TIFF The Tagged Image File Format is a standard graphics format for high-resolution, bitmapped images.

JPEG The Joint Photographic Experts Group brings these photo stand- darts to us.

Other standards guide movies and sound:

MIDI The Musical Instrument Digital Interface is used for digitized music.

MPEG The Moving Picture Experts Group's standard for the compression and coding of motion video for CDs is increasingly popular. It pro- vides digital storage and bit rates up to 1.5Mbps.

QuickTime This is for use with Macintosh or PowerPC programs; it manages audio and video applications.

2.1.3 The Session Layer:

⇒ The *Session layer* is responsible for setting up, managing, and then tearing down sessions between Presentation layer entities.

⇒ The Session layer also provides dialog control between devices, or nodes.

⇒ It coordinates communication between systems and serves to organize their communication by offering three different modes: *simplex*, *half-duplex*, and *full-duplex*.

⇒ The Session layer basically keeps different applications' data separate from other applications' data.

The following are some examples of Session-layer protocols and inter- faces (according to Cisco):

Network File System (NFS) Was developed by Sun Microsystems and used with TCP/IP and Unix workstations to allow transparent access to remote resources.

Structured Query Language (SQL) Was developed by IBM to provide users with a simpler way to define their information requirements on both local and remote systems.

Remote Procedure Call (RPC) Is a broad client/server redirection tool used for disparate service environments. Its procedures are created on clients and performed on servers.

X Window Is widely used by intelligent terminals for communicating with remote Unix computers, allowing them to operate as though they were locally attached monitors

2.1.4 The Transport Layer:

⇒ Services located in the *Transport layer* both segment and reassemble data from upper-layer applications and unite it onto the same data stream.

⇒ They provide end-to-end data transport services and can establish a logical connection between the sending host and destination host on an internetwork.

⇒ Some of you might already be familiar with TCP and UDP and know that TCP is a reliable service and UDP is not.

⇒ Application developers have their choice of the two protocols when working with TCP/IP protocols.

⇒ The Transport layer is responsible for providing mechanisms for multiplexing upper-layer application, session establishment, and teardown of virtual circuits.

⇒ It also hides details of any network-dependent information from the higher layers by providing transparent data transfer.

Flow Control

Data integrity is ensured at the Transport layer by maintaining flow control and allowing users the option of requesting reliable data transport between systems. *Flow control* prevents a sending host on one side of the connection from overflowing the buffers in the receiving host—an event that can result in lost data. Reliable data transport employs a connection-oriented communications session between systems, and the protocols involved ensure the following will be achieved:

The segments delivered are acknowledged back to the sender upon their reception.

Any segments not acknowledged are retransmitted.

Segments are sequenced back into their proper order upon arrival at their destination.

A manageable data flow is maintained in order to avoid congestion, overloading, and data loss.

2.1.5 The Network Layer:

⇒ The *Network layer* is responsible for routing through an internetwork and for network addressing. This means that the Network layer is responsible for transporting traffic between devices that are not locally attached. *Routers*, or other layer-3 devices, are specified at the Network layer and provide the routing services in an internetwork.

⇒ When a packet is received on a router interface, the destination IP address is checked. If the packet is not destined for the router, then the router will look up the destination network address in the routing table.

⇒ Once an exit interface is chosen, the packet will be sent to the interface to be framed and sent out on the local network.

⇒ If the entry for the destination network is not found in the routing table, the router drops the packet.

⇒ Two types of packets are used at the network layer: data and route updates.

Data packets Are used to transport user data through the internetwork, and protocols used to support data traffic are called routed protocols. Examples of routed protocols are IP and IPX.

Route update packets Are used to update neighbor routers about net- works connected to routers in the internetwork. Protocols that send route update packets are called routing protocols and examples are RIP, EIGRP, and OSPF, to name a few. Routing update packets are used to help build and maintain routing tables on each router.

2.1.6 The Data Link Layer:

⇒ The *Data Link layer* ensures that messages are delivered to the proper device and translates messages from the Network layer into bits for the Physical layer to transmit.

⇒ It formats the message into *data frames* and adds a customized header containing the hardware destination and source address.

⇒ This added information forms a sort of capsule that surrounds the original message in much the same way that engines, navigational devices, and other tools were attached to the lunar modules of the Apollo project.

⇒ These various pieces of equipment were useful only during certain stages of space flight and were stripped off the module and discarded when their designated stage was complete.

⇒ Data traveling through networks is similar. Figure shows the Data Link layer with the Ethernet and IEEE specifications. Notice in the figure that the IEEE 802.2 standard is used in conjunction with the other IEEE standards, adding functionality to the existing IEEE standards.

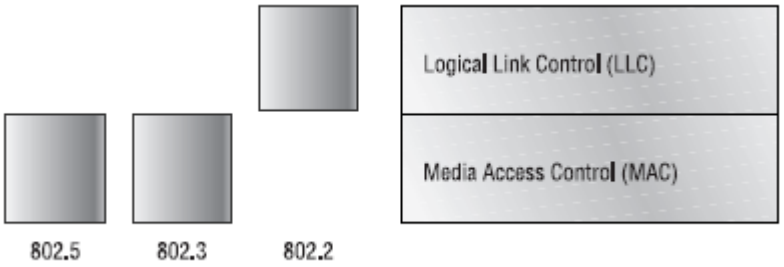


Figure 2.4 Data Link Layer

⇒ You need to understand that routers, which work at the Network layer, do not care about where a host is located but only where networks are located.

⇒ They also keep track of the best way to get to a remote network.

⇒ The Data Link layer is responsible for uniquely identifying each device on a local network.

2.1.7The Physical Layer:

⇒

⇒ The Physical layer has two responsibilities: it sends bits and receives bits.

⇒

⇒ Bits come only in values of 1 or 0—a Morse code with numerical values.

⇒

⇒ The Physical layer communicates directly with the various types of actual communication media. Different kinds of media represent these bit values in different ways.

⇒ Some use audio tones, while others employ state transitions— changes in voltage from high to low and low to high. Specific protocols are needed for each type of media to describe the proper bit patterns to be used, how data is encoded into media signals, and the various qualities of the physical media's attachment interface.

⇒ The Physical layer specifications specify the electrical, mechanical, procedural, and functional requirements for activating, maintaining, and deactivating a physical link between end systems.

⇒ At the Physical layer, the interface between the Data Terminal Equipment, or DTE, and the Data Circuit-Terminating Equipment, or DCE, is identified. The DCE is usually located at the service provider, while the DTE is the attached device. The services available to the DTE are most often accessed via a modem or Channel Service Unit/Data Service Unit (CSU/DSU).

⇒ The Physical layer's connectors and different physical topologies are defined by the OSI as standards, allowing disparate systems to communicate. The CCNA course and exam are only interested in the Ethernet standards.

2.2 TCP/IP and the DoD Model:

→ **T**he Department of Defense (DoD) model is a condensed version of the OSI model. It is comprised of four, instead of seven, layers:

⇒ The Process/Application layer

⇒ The Host-to-Host layer

⇒ The Internet layer

⇒ The Network Access layer

→ Figure 2.5 shows a comparison of the DoD model and the OSI reference model. As you can see, the two are similar in concept, but each has a different number of layers with different names.

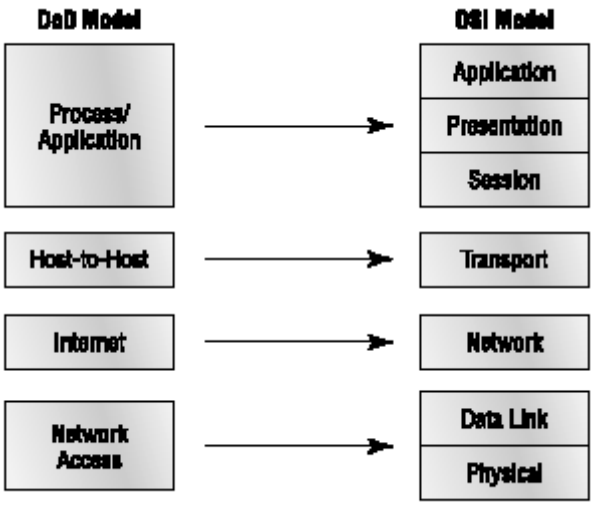


Figure 2.5 The DoD and OSI Models

→ A vast array of protocols combine at the DoD model's *Process/Application layer* to integrate the various activities and duties spanning the focus of the OSI's corresponding top three layers (Application, Presentation, and Session). The Process/Application layer defines protocols for node-to-node application communication and also controls user-interface specifications.

→ The *Host-to-Host layer* parallels the functions of the OSI's Transport layer, defining protocols for setting up the level of transmission service for applications. It tackles issues like creating reliable end-to-end communication

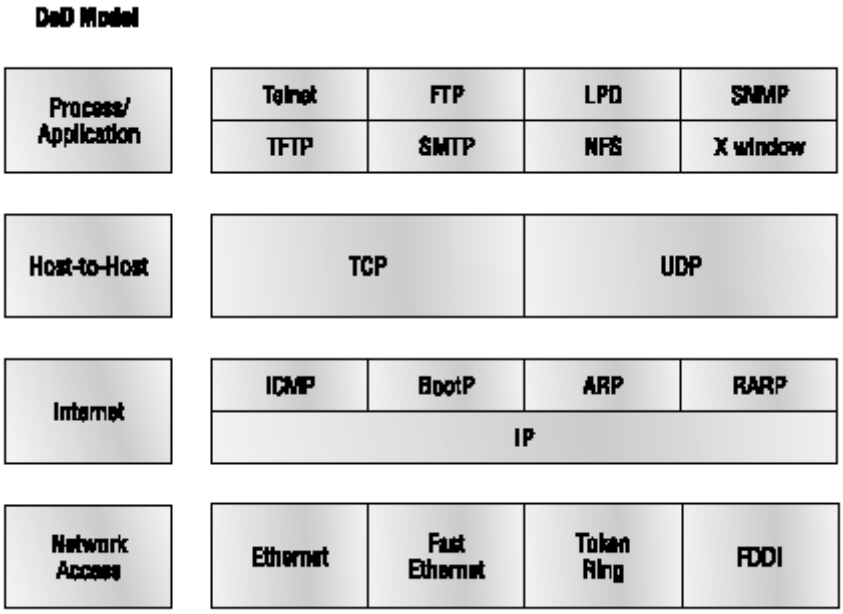


Figure: 2.6 The TCP/IP Protocol Suite

2.3 Routing Basics:

2.3.1 The Definition of a Routing Protocol:

⇒ In simple terms, a protocol is an agreed set of rules that determine how something will operate.

⇒ A routing protocol is a set of rules that describes how Layer 3 routing devices will send updates between each other about the available networks. If more than one path to the remote network exists, the protocol also determines how the best path or route is selected.

2.3.2 The Purpose of a Routing Protocol:

⇒ A routing protocol is the mechanism used to update the Layer 3 routing devices. When they all have the same accurate understanding of the network, they can route the data across the best path.

2.3.3 How the Routing Protocol Works:

⇒ Participating routers advertise the routes that they know about to their neighbors in routing updates. Routes learned from routing updates are held in the routing table.

2.3.4 Routing and Routed:

⇒ It is important to distinguish between the datagram and the routing protocol used to determine the path of the datagram.

⇒ The distinction is between the *routed* and the *routing* protocol.

⇒ The routed protocol is the Layer 3 protocol used to transfer data from one end device to another across the network. The routed protocol is the Layer 3 datagram that carries the application data as well as the upper-layer information.

⇒ The routing protocol is the protocol used to send updates between the routers about the networks that exist in the organization, thereby allowing the routing process to determine the path of the datagram across the network.

2.3.5 Routing Protocol Metrics:

⇒ The metric is a value that is assigned to each path based on the criteria specified in the routing protocol. The Metric field is used to determine which path to use if there are

multiple paths to the remote network. The metric used depends on the routing protocol.

⇒ This value is used to choose between different paths to the same destination network, to select the best path. If the values are the same, either the router selects the path that it heard first, or it uses both paths, sending the datagrams across each route.

⇒ It is the responsibility of the end device to reassemble the datagrams before sending them to the application.

Routing Protocol	Metric
RIPv1	Hop count.
IGRP	Bandwidth, delay, load, reliability, MTU.
EIGRP	Bandwidth, delay, load, reliability, MTU.
OSPF	Cost. (The Cisco default states that the cost of an interface is inversely proportional to the bandwidth of that interface. A higher bandwidth indicates a lower cost.)
IS-IS	Cost.

2.4 Types of Routing Protocols:

→ Although the switching and routing functions within the router are set, there are many differences to be seen among the different routing protocols.

→ The routing protocols are essentially applications on the router. Their purpose is to ensure the correct and timely exchange of information about the network between the routers so that the routers can successfully perform the routing and switching functions described previously.

→ IP routing protocols can be divided into several distinct groups. The first is the difference between protocols that send the mask in the updates and the older protocols that do not. These are labeled classless and classful protocols, respectively.

2.4.1 Classful and Classless Routing Protocols:

⇒ *Classful routing* protocols do not carry the subnet or routing mask in the update. The older distance vector protocols tend to be classful. This incapability to carry the subnetting information leads to design constraints in the IP network.

2.4.2 Classful Routing:

⇒ Classful IP routing protocols include RIPv1 and IGRP. The characteristics of a classful routing protocol are listed here:

- Summarization occurs at the network boundary.
- Routes exchanged between foreign networks are summarized to the NIC number network boundary.
- Within the same network (NIC number), subnet routes are exchanged by routers, without the mask.
- The subnet mask is assumed to be consistent for a NIC number used within a network, so all router interfaces must share the subnet mask for interfaces in the same NIC network.
- The utilization of address space may be inefficient.
- VLSM is not possible within the network.

2.4.3 Classless Routing:

⇒ *Classless routing* protocols were designed to overcome the constraints listed previously. The routing protocols that can do this are OSPF, EIGRP, RIPv2, IS-IS, and BGP.

⇒ The characteristics of a classless routing protocol are listed here:

- Router interfaces within the same network can have different subnet masks (VLSM).
- Some of the classless routing protocols, including BGP-4 and RIP v2, support the use of classless interdomain routing (CIDR).
- Some routes can be summarized within the major NIC number. This is done manually.

→ A summary of IP routing protocols and the update timers.

Protocol	Update Timer	Technology
RIPv1	Every 30 seconds, for entire routing table.	Distance vector.
OSPF	Incremental, with only the network change. However, 30 minutes after the last update was received, a compressed version of the table is propagated.	Link state.
EIGRP	Incremental updates, with network change only.	Advanced distance vector.
IGRP	Updates every 90 seconds, with incremental updates as needed.	Distance vector.
BGP-4	Incremental, with only the network change.	Path vector (an exterior routing protocol). The term refers to the list of autonomous system numbers that are carried in the BGP-4 updates, and the vector indicates the direction to send the traffic to find the path to a remote network.
IS-IS	Incremental, with only the network change. However, approximately 15 minutes after the last update was received, a compressed version of the table is propagated.	Link state.

2.5 Virtual LANs:

→ **I**n a layer-2 switched network, the network is flat. Every broadcast packet transmitted is seen by every device on the network, regardless of whether the device needs to receive the data.

→ Because layer-2 switching creates individual collision domain segments for each device plugged into the switch, the Ethernet distance constraints are lifted, which means larger networks can be built. The larger the number of users and devices, the more broadcasts and packets each device must handle.

→ Another problem with a flat layer-2 network is security, as all users can see all devices. You cannot stop devices from broadcasting and users trying to respond to broadcasts.

→ Your security is passwords on the servers and other devices. By creating VLANs, you can solve many of the problems associated with layer-2 switching.

1. Broadcast Control
2. Security.
3. Flexibility & Scalability.

2.5.1 VLAN Membership:

VLANs are typically created by an administrator, who then assigns switch ports to the VLAN. These are called static VLANs. If the administrator wants to do a little more work up front and assign all the host devices' hardware addresses into a database, the switches can be configured to assign VLANs dynamically.

→ Static VLANs

⇒ Static VLANs are the typical way of creating VLANs and the most secure.

⇒ The switch port that you assign a VLAN association always maintains that association until an administrator changes the port assignment.

⇒ This type of VLAN configuration is easy to set up and monitor, working well in a network where the movement of users within the network is controlled. Using network management software to configure the ports can be helpful but is not mandatory.

→ Dynamic VLANs

⇒ *Dynamic VLANs* determine a node's VLAN assignment automatically. Using intelligent management software, you can enable hardware (MAC) addresses, protocols, or even applications to create dynamic VLANs. For example, suppose MAC addresses have been entered into a centralized VLAN management application. If a node is then attached to an unassigned switch port, the VLAN management database can look up the hardware address and assign and configure the switch port to the correct VLAN. This can make management and configuration easier for the administrator. If a user moves, the switch will automatically assign them to the correct VLAN. However, more administration is needed initially to set up the database.

⇒ Cisco administrators can use the VLAN Management Policy Server (VMPS) service to set up a database of MAC addresses that can be used for dynamic addressing of VLANs. VMPS is a MAC address–to–VLAN map- ping database.

2.6 ACCESS CONTROL LIST:

→ There are mainly two kinds of access lists.

→ The first kind of access list is the *standard access list*, used to build policy sets of IP addresses or IP networks. In describing the standard access list, we will examine the

basic syntax used in all Cisco access lists, including the basic permit/deny operation for including or excluding network objects from a policy set, address specification and masking, and the sequence used in processing access lists. The standard access list cannot cover all the policies we may wish to specify, particularly when we want to do packet filtering.

→ This leads us to the second type of access list: the extended access list. This kind of list extends the format of the standard access list to specify packet filtering policies. Once we have learned to build the basic access list types, the chapter covers how to optimize, build, and maintain access lists.

2.6.1 Standard Access Control List:

⇒ A network administrator typically uses standard access lists to implement three types of policy controls:

- Access to router resources
- Route distribution
- Packets passing through a router

⇒ These policy controls require policy sets of IP addresses or network numbers, so the standard access list is used to build policy sets of either IP addresses or network numbers.

⇒ Once policy sets are defined with standard access lists, the access list can restrict access to network resources, determine which routes are accepted and distributed, and change routing metrics to influence traffic behavior.

⇒ We defined Policy Set #1, consisting of the hosts allowed to log into the router, as follows:

Policy Set #1: IP address 192.168.30.1

Policy Set #1: IP address 192.168.33.5

Policy Set #1: No other IP addresses

How does this policy set map to actual access lists? Here is the mapping:

access-list 1 permit 192.168.30.1
access-list 1 permit 192.168.33.5
access-list 1 deny 0.0.0.0 255.255.255.255

Router logins: Only from hosts with IP addresses defined in Policy Set #1

In Cisco router configuration language, this maps to be:

line vty 0 4
access-class 1 in

2.6.2 Extended Access Control List:

⇒ One type of access list is designed to build policy sets for that type of control: the *extended access list*.

⇒ This kind of access list extends the standard access list to include the ability to specify protocol type, protocol port, and destination in a certain direction. Of our three key motivations for building access policies, the main motivation for using extended access lists is security.

⇒ It is often used for firewall purposes—specifying the packets that can pass through a router between networks of various degrees of trust. Thus, we'll speak in terms of allowing or denying packets through a router in our discussions of matching extended access lists.

⇒ To implement a policy allowing only web packets to the web server, we need to define a policy set that includes only packets for web protocols. The policy set specification looks like this:

Policy Set #101: HTTP packets to the host at 192.168.35.1

Policy Set #101: SSL packets to the host at 192.168.35.1

Policy Set #101: No other packets

How does this map into an extended access list? Here is the translation:

access-list 101 permit tcp 0.0.0.0 255.255.255.255 192.168.35.1 0.0.0.0 eq 80

access-list 101 permit tcp 0.0.0.0 255.255.255.255 192.168.35.1 0.0.0.0 eq 443

access-list 101 deny ip 0.0.0.0 255.255.255.255 192.168.35.1 0.0.0.0

The Cisco configuration commands to do implement this are:

```
interface Ethernet 0
ip access-group 101 out
```

→ Thus with the use of standard and extended access control list we can apply different kinds of security features to the router.

Chapter 13

Designing Of Ethernet Network

DESIGNING of an ETHERNET NETWORK

→ Designing of an Ethernet network includes following features.

3.1 Designing Polices:

→ We have to consider following requirements first.

- Type of Network
- Main Access points.
- Type of Network Media.
- Type of protocols to be used as per applications.
- Type of Security features to be added.
- No. of users to access Internet Traffic.
- Type of routing parameters to be used.
- And many other…

3.2 Requirements:

→Here we have the following specified requirements.

⇒ There are main 12 departmental buildings in a campus.
⇒ Each and every department should be connected with everyone.
⇒ Everyone should able to access central resources.
⇒ 3 manufacturing departments can't access to the Internet.
⇒ Only N/W department can log on to the router and can change the IOS.
⇒ Every router should be connected with fiber links.
⇒ Corporate house can able to access internet 24*7.
⇒ Also outsiders can't destroy or damage the internal network and data.
⇒ And many more…

3.3 Implementation:

Here we have all the designing policies & the requirements now we have to start designing the network.

⇒ We have provided to use 12 departmental buildings. So we are supposed to use 12 routers because all the 12 departments are physically separated.

⇒ Now all the 12 routers are well separated from each other so we are supposed to use fiber links rather than serial link to connect the routers.

⇒ 3 manufacturing units are controlled by SAP server so the link between SAP and the manufacturing unit must not be broken.

⇒ So, all the manufacturing units and Purchase department is directly connected to the SAP department.

⇒ Also all the departments are connected in a ring topology so if one of the links breaks than also the communication between all the departments can be possible.

⇒ Corporate Offices are directly connected to the N/W department so that client from corporate office can access the internet and all the data with higher b/w and easily.

⇒ Here Manufacturing units are not provided enough privileges to access the internet.

⇒ Other departments like Engineering and R&D are not provided all time internet facility, they are provided their time slots in which they can access internet, and this feature enhances b/w utilization.

⇒ This is big firm and the future expansion may take place in the campus, so keep this idea in mind we have used EIGRP as a routing protocol.

⇒ EIGRP is a dynamic routing protocol. It creates routing table by updating the information with the neighbor router. So thus it has whole topology in its routing topology.

⇒ We also have only 10 global IPs provided by ISP for the internet access.

⇒ So, we have used NAT (Network Address Translation) for the internet access for all the departments in the N/W router from where campus is connected to the outside world.

⇒ In the access control list of all the routers we have also provided that no other than N/W department can log on to router and cant establish a telnet session.

⇒ Only n/w department can establish a telnet session.

⇒ All the Departments are connected with intranet and they can communicate through it.

⇒ Now, Finance and Marketing department is sharing the same building so they are given connections from a single router.

⇒ But in this case if broadcast takes place than all the pcs and other devices will be affected.

⇒ So, for the precaution VLAN has been created in the switch of the Finance & Marketing Dept. Router.

⇒ Vlan prevents the broadcast packets to flow from vlan1 to vlan2 and vice-versa.

⇒ Also all the pc in the network can't access the printer.

⇒ If and only if server shares the network printer to that pc than only client can access the printer.

⇒ That's how all the policies for the implementation get defined.

⇒ Now on the simulator first we have implement whole topology and than the actual implementation on the physical devices done.

⇒ For the simulation purpose we will use PACKET TRACER 4.0.

⇒ It is a user friendly simulator to work with and also it's freely available. There is no license cost for the same.

Chapter 14

Simulation

SIMULATION

- Here in a simulation part first we have make the whole virtual topology in the packet tracer and then start the implementing the different polices and configuring the different n/w devices.

- Here we have used 12 routers for the 12 departments and uses same no of switches to connect the end devices to the router.

- For the simplicity we have put in 5 pcs and a printer in a single department, actual n/w vary from this.

- We have connected all the routers by fiber optic cable with other routers.

- The end devices are connected to switch using straight through utp cat-5 cable. And the switches are also connected to the router with the same.

- The whole network is configured using IEEE 802.3b standards.

- Here in the figure the topology is shown.

- Thus the topology seen in the simulator.

- When the all physical connections are made the configuration of devices starts.

4.1 Routing:

- Routing in the whole network is done using EIGRP protocol.
- EIGRP is a dynamic routing protocol so it is used for the same purpose.
- Bandwidth, Delay, Load, Reliability, MTU are the metric parameters for the EIGRP to count the distance between hopes.
- For using EIGRP we have put whole system in a single autonomous system.
- The autonomous number for the system is 100.

4.2 Access Lists:

- We have created the access lists in the each and every router to provide some privileges and to put some restrictions in access the n/w resources.
- Here we have use only extended access list rather than standard access list to provide more filtering features.
- With the help of access lists telnet session for the normal user has been restricted.

4.4 Router Configurations:

- Here are the router configurations for all the routers have been displayed.
- Running configuration of any router can be seen by writing show running-configuration on the global configuration mode.
- Different router's running configurations are shown here.

Chapter 15

Conclusion

CONCLUSION

By designing such a complex topology we came to know many things such as,

⇒ To communicate between far situated two different stations fiber is more reliable than serial communication.

⇒ In a real network where expansion is not known for routing purpose IGRP or EIGRP is preferable.

⇒ In a network of any professional firm security is important so access control list is necessary in such case.

⇒ When you have two different departments in the same place than you can use switch and can create VLANs rather than using a Router for the same purpose. VLANs can solve the problem of broadcasting.

⇒ For communication between outside world (e.g. Internet) you have limited public IPs for your many private IPs. So you can use NAT or PAT for internet access for the whole internal network.

⇒ IGRP & EIGRP are the Cisco property protocols so if one want to use them. There must be Cisco devices at both ends.

Chapter 15

Bibliography

BIBLIOGRAPHY

- Computer Networks 3rd. Edition By, Andrew S. Tanenbaum
- Cisco CCNP routing exam Certification Guide By, Clare Gough (e-book)
- Cisco IOS Access Lists By, Jeff Sedayao (e-book)
- CCNA Study Guide 2nd Edition. By, Todd Lammle
- www.google.com
- www.howstuffworks.com
- www.cisco.com
- www.cs.vu.nl/~ast/
- www.freezit.com

SOFTWARE

- Packet Tracer 4.0..

Notes

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Thanking You