SRI VENKATESHWARAA COLLEGE OF ENGINEERING & TECHNOLOGY
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University, Puducherry.)
13-A, Villupuram – Pondy Main road, Ariyur, Puducherry – 605 102.
Phone: 0413-2644426, Fax: 2644424 / Website: www.svcetpondy.com

Department of Computer Science and Engineering

Subject Name: **COMPUTER HARDWARE AND NETWORK TROUBLESHOOTING**

Subject Code: **CS T72**

Prepared By :

Dr. N. Balaji, Professor & HOD / CSE

Verified by :   **Approved by :**

UNIT – I

Personal Computer: Introduction – History of the Personal Computers – System Components - Data flow inside the PC – Processor types and specifications – 16-bit to 64-bit evolution – specifications – Cache Memory – Processor Features: System Management Mode – Super scalar execution – Dynamic Execution - Dual independent bus architecture – Hyper threading – Dual and multi core technology - socket and slot types – Intel's Pentium and Core Processors – AMD K6 to K8 series processors.

2 Marks

1. **Define Personal Computer (PC)?**

   A personal computer (PC) is any general-purpose computer whose size, capabilities, and original sales price make it useful for individuals, and which is intended to be operated directly by an end-user with no intervening computer operator.

2. **Draw the data flow diagram inside the PC?**
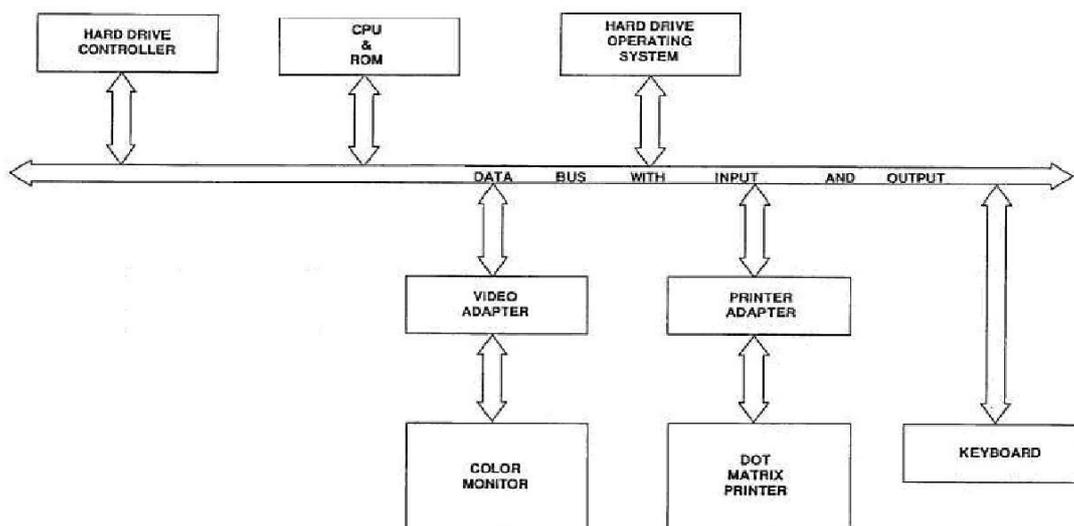
3. Define PC System Design Guide?

The PC System Design Guide (also known as the PC 97, PC 98, PC 99, or PC 2001 specification) is a series of hardware design requirements and recommendations for IBM PC compatible personal computers, compiled by Microsoft and Intel Corporation during 1997–2001.

4. What is UMA and HMA?

Upper Memory Area (UMA): This is the upper 384 KB of the first megabyte of system memory (immediately above conventional memory). It is reserved for use by system devices and for special uses such as ROM shadowing and drivers. It uses addresses A0000h to FFFFFh.

High Memory Area (HMA): This is the first 64 KB (less 16 bytes) of the second megabyte of system memory. Technically this is the first 64 KB of extended memory, but it can be accessed when the processor is in real mode, which makes it different from the rest of extended memory. It is usually used for DOS, to allow more conventional memory to be preserved. It occupies addresses 100000h to 10FFEFh.

5. Define Over clocking?

Over clocking is the process of making a computer or component operate faster than specified by the manufacturer by modifying system parameters.

6. What is Cache Memory? (NOV 2012)

Cache memory is random access memory (RAM) that a computer microprocessor can access more quickly than it can access regular RAM. As the microprocessor processes data, it looks first in the cache memory and if it finds the data there (from a previous reading of data), it does not have to do the more time-consuming reading of data from larger memory.

7. Clarify Super scalar execution?

A superscalar CPU can execute more than one instruction per clock cycle. Because processing speeds are measured in clock cycles per second (megahertz), a superscalar processor will be faster than a scalar processor rated at the same megahertz.

8. What is processor? (NOV 2013)

A *processor* is the logic circuitry that responds to and processes the basic instructions that drive a computer. The term *processor* has generally replaced the term central processing unit (CPU). The *processor* in a personal computer or embedded in small devices is often called a microprocessor.

9. Define system clock? (NOV 2013)

System clock that shows a time-of-day clock in a computer system. It is an electronic device in a computer that issues a steady high-frequency signal that synchronizes all the internal components.

10. Write the Microprocessor Types and Specifications? Processor Types

P1 (086) First-Generation Processors
P2 (286) Second-Generation Processors
P3 (386) Third-Generation Processors
P4 (486) Fourth-Generation Processors

P5 (586) Fifth-Generation Processors
Pseudo-Fifth-Generation Processors
P6 (686) Sixth-Generation Processors
Pseudo-Sixth-Generation Processors
P7 (786) Seventh-Generation Processors
Processor Upgrades
OverDrive Processors
OverDrive Processor Installation
OverDrive Compatibility Problems
Processor Benchmarks

Processor Specifications

Processor Speed Ratings
Data Bus
Internal Registers
Address Bus
Internal (Level 1) Cache
Processor Modes
Processor Features
Processor Manufacturing
Physical Packaging
Processor Sockets
CPU Operating Voltages
Heat and Cooling Problems
Math Coprocessors
Processor Bugs
Processor Update Features
Intel Processor Codenames

11. Define Dual Independent Bus (DIB)

Dual Independent Bus (DIB) is a processor architecture that includes two buses: one to the main system memory and another to the level 2 cache. The processor can access both simultaneously for improved performance. In Dual Independent Bus (DIB) architecture systems the single system bus is replaced by a back-side bus for accessing level 2 cache, and a front-side bus for communicating data between the CPU and main memory and input and output devices.

12. What is Hyper-threading?

Hyper-threading is a technology developed by Intel Corporation. It is used in certain Pentium 4 processors and all Intel Xeon processors. Hyper-threading technology, commonly referred to as "HT Technology," enables the processor to execute two threads, or sets of instructions, at the same time. Since hyper-threading allows two streams to be executed in parallel, it is almost like having two separate processors working together.

13. What is Dual-core Technology?

A single chip that contains two distinct processors that work simultaneously. IBM introduced dual cores in its Power 4 chips in 2000. In 2004, Sun and HP introduced their first dual core CPUs.

14. Define Processor Codenames?

Intel, AMD, and Cyrix have always used codenames when talking about future processors. The codenames usually are not supposed to become public, but they typically do. They can often be

found in online and print news and magazine articles talking about future-generation processors. Sometimes, they even appear in motherboard manuals because the manuals are written before the Processors are officially introduced.

15. **What is meant by Power Management?**

Power management is a feature of some electrical appliances, especially copiers, computers and computer peripherals such as monitors and printers, that turns off the power or switches the system to a low-power state when inactive. In computing this is known as PC power management

16. **Explain the history of PC?**

The **history of personal computers** began in the 1970s. A personal computer is one intended for individual use, as opposed to a mainframe computer where the end user's requests are filtered through operating staff, or a time sharing system in which one large processor is shared by many individuals. After the development of the microprocessor, individual personal computers were low enough in cost that they eventually became affordable consumer goods. Early personal computers – generally called microcomputers – were sold often in electronic kit form and in limited numbers, and were of interest mostly to hobbyists and technicians.

17. **Differentiate hardware and software?**

Hardware and software work together in digital devices and systems to provide computerized functionality. Hardware includes the physical components, such as the motherboard, chips, memory, and hard drives, while software includes the programs that run on the hardware.

18. **What are the two types of hardware interrupts (NOV 2010)**

There are two basic types of hardware interrupts: Non Maskable Interrupts (NMI) and (maskable)

Interrupt Requests (IRQ)

19. **What is BIOS? (APR 2011), (NOV 2012)**

BIOS (*basic input/output system*) is the program a personal computer's microprocessor uses to get the computer system started after you turn it on. It also manages data flow between the computer's operating system and attached devices such as the hard disk, video adapter, keyboard, mouse and printer.

20. **List any four components of Mother Board? (APR 2011)**

1. North Bridge
2. Soth Bridge
3. Chipset
4. Processor Sockets
5. Memory Slots
6. Power Connectors

21. **Expand SMPS, DMA? (APR 2012)**

SMPS - switched-mode power supply

DMA - Direct memory access

22. **What are the types of memory? (APR 2012)**

The types of memory in a computer system are:

Cache Memory - This is a small amounts of memory used to speed up system performance.

Main memory - This is the RAM (random access memory)

Secondary memory - This is a magnetic storage that keeps applications and data available to be used, and may also serves as virtual memory depending upon the operating system

23. List out the Hardware components of PC? (NOV 2012)

- Power Supply
- Motherboard
- Microprocessor.
- Memory
- Drive controllers
- Hard disk drive(s)
- CD-ROM drive(s)
- Floppy drive(s)
- Monitor
- Keyboard
- Mouse

24. Define computer? (NOV 2012)

A computer is a device that accepts information (in the form of digitalized data) and manipulates it for some result based on a program or sequence of instructions on how the data is to be processed. Complex computers also include the means for storing data (including the program, which is also a form of data) for some necessary duration. A program may be invariable and built into the computer (and called *logic circuitry* as it is on microprocessors) or different programs may be provided to the computer (loaded into its storage and then started by an administrator or user). Today's computers have both kinds of programming.

25. Why is the maximum value in decimal that can be represented by an eight bit binary number?(NOV 2014)

Each character can be converted to its equivalent ASCII code. That ASCII code will be stored in the memory in 8 bit form.

26. If the number of bits in MAR is 10, What is the maximum memory capacity? (NOV 2014)

2^{10} = 1024 locations

0000000000 -> location no. 0
0000000001 -> location no. 1
…..
1111111111 -> Location no.1023

So totally 1024 locations

11 MARKS

Personal Computer:

A personal computer (PC) is comprised of hardware, Operating system and software. Each of these components is fairly complex; However

The Hardware: The most fundamental elements of a PC's hardware are the central processing unit(CPU) and memory modules mounted on the motherboard. When the PC is powered on, the CPU begins communicating with motherboard and starts the basic input output system(BIOS) which is stored on a chip on the motherboard. After verifying that the required components are present and functioning, it may check the floppy drive, hard disk or CD ROM for the presence of an OS. Other common examples of hardware which may be a part of a PC include a modem, soundcard, network card and video card. The components attached outside of the computer such as the keyboard, mouse, printer and monitor are called peripherals.

The Operating System: The OS is responsible for everything from enabling hardware components to function to how to communicate with the internet as well as playing the role of traffic cop for all the software.

The OS allocates the resources of the PC to the software and hardware in an organized way. The resources include things like memory storage space, access to the hard disk and what is displayed on the monitor. Without the OS, the software programs might interface with each other, causing the PC to malfunction or crash continually. Even with the OS, many PCs have difficulty operating smoothly.

The software: While the OS is technically a software program it is distinct from other software specifically referred to as‖Application Software‖. Application software, we'll just call it software are programs that you install onto a PC that make the PC useful.

Software is a complex series of instructions telling the computer what to do. The instructions are very detailed because they have to tell the computer every single step to be performed. For example a word processing program has instructions for what to do when you press the letter _A'. The software tells the computer to take the letters you already typed and it tells he computer to display the letters on the screen so you can see what you have typed. The computer doesnot do anything without very explicit instructions.

1. Explain briefly about History of the PC

1617   -   John Napier creates ―Napier's Bones‖ wood (or) Ivory rods used for calculation.

1642   -   Blaise Pascal introduces the Pascaline digital adding machine.

1822   -   Charles Babbage introduces the difference engine and later the analytical engine, a true general purpose computing machine.

1937   -   John V Atanesoff begins work on the Atanasoff Berry Computer(ABC). First electronic computer,uses tubes, transistors,Selenoids and relays.

1945   -   John Von Neuman writes ―First draft of a report on the EDVAC‖, architecture of the modern stored program computer.

1946 -   ENIAC is introduced by John Mouchly and J.Prespe Eckert.

1949 -   Maurice wilkes assembles the EDSAC, First practical stored program computer at Cambridege University.

1953 -   IBM ships its first electronic computer the 701.

1955 -   Bell laboratories announces the first fully transistorised computer, TRADIC.

1956 - MIT researchers build TX-0, the first general purpose, programmable computer build with
              transistors.

1959 -   IBM's 7000 series mainframes are the company's first transitorised computer.

1960 - Bell labs designs its Dataphone, the first commercial modem specifically for converting digital
              data to analog signals for transmission across long distnce network.

1964 - Online transaction processing makes its debut in IBM's SABRE reservation system, setup for
              American Airlines.

1969 - Internet begins when the department of defence establishes 4 nodes on the ARPANET, two at
              University of Californiacampuses and one each at Sri international and the University of
              Utah.

1971 -   A team at IBM's Sanjose labortories invents 8‖ floppy disk.

1974 - Xerox Palo Alto research centre design the Alto, the first workstation with a built in mouse for
              input.

1975 - Telenet, the first commercial packet switching network and civilian equivalent of
              ARPANE is born.

1976 -   Steve Wozniak designs the Apple I, a single board computer.

1980 - Seagate technology creates the first hard disk drive for micro computers, ST-506. 1981 -

The first optical data storage disk has 60 times the capacity of 5¼‖ floppy disk. 1981 - Xerox

introduces PC with graphical user interface(GUI)

1981 -   Sony introduces the first 3 ½ ― FDD.

1981 - Adam Osborne completes the first portable computer OsborneJ, which weighs 24 lbs and cost
              $1,795.

1981 - Philips and Sony introduces the CD-DA format(Compact Disk Digital Audio) 1982 -

Sony is the first with a CD Player on the market.

1983 - Compaque introduces its first PC clone that uses the same software as the IBM PC. 1990 -

The world wide web is born when Tim Borners –Lee develops HTML.

1993 -   Intel releases Pentium 5 processor.

1995 -   Intel releases Pentium 6 processor.

1995 - Microsoft releases Windows 95, the first mainstream 32bit OS. 1997 -

Intel releases Pentium III processor.

1998 -   Microsoft releases Windows 98.

1998 -   AMD releases Athlon.

1999 - IEEE officially approves the 5Ghz band 802.11a 54mbps and 2.4Ghz band 802.11b
          11mbps wireless networking standards.

2000 - The first 802.11b wi-fi certified products are introduced. 2000 -

Microsoft releases Windows ME and Windows

2001 -   Microsoft releases Windows XP.

2006 -   Microsoft releases Windows Vista.

2009 -   Microsoft releases Windows 7.

2012 -   Microsoft releases Windows 8.

2013 -   Microsoft releases Windows 8.1

2015 -   Microsoft releases Windows 10

2. Draw the functional Block diagram of the PC and explain its parts (APR 2011)

A computer system consists of mainly four basic units; namely input unit, storage unit, central processing unit and output unit. Central Processing unit further includes Arithmetic logic unit and control unit, as shown in the figure:.

Block diagram of computer
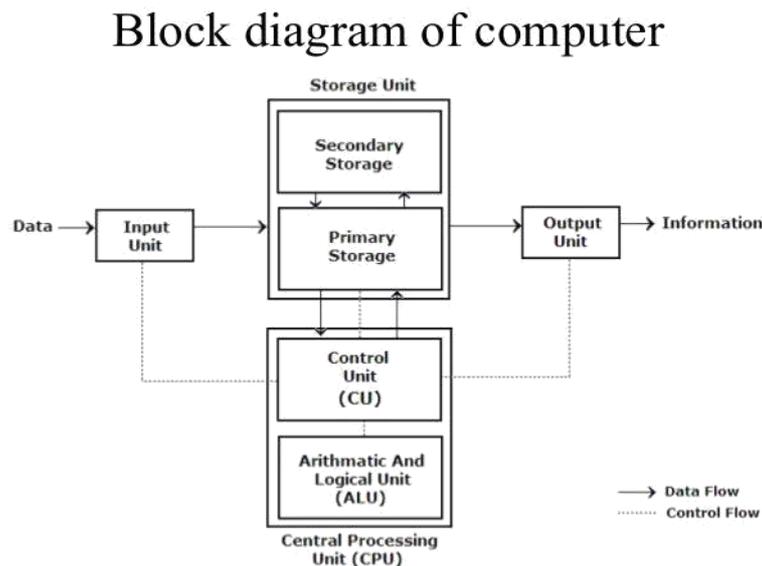
A computer performs five major operations or functions irrespective of its size and make. These are

- it accepts data or instructions as input,
- it stores data and instruction
- it processes data as per the instructions,
- it controls all operations inside a computer, and
- it gives results in the form of output.

Desktop Computer System

Functional Units:

a. Input Unit: This unit is used for entering data and programs into the computer system by the user for processing.

Basic Computer Organisation

b. Storage Unit: The storage unit is used for storing data and instructions before and after processing.

c. Output Unit: The output unit is used for storing the result as output produced by the computer after processing.

d. Processing: The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit. CPU includes Arithmetic logic unit (ALU) and control unit (CU)

Computer Chip

• **Arithmetic Logic Unit:** All calculations and comparisons, based on the instructions provided, are carried out within the ALU. It performs arithmetic functions like addition, subtraction, multiplication, division and also logical operations like greater than, less than and equal to etc.

• **Control Unit:** Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations in side the computer.

Memory

Computer's memory can be classified into two types; primary memory and secondary memory

RAM

a. Primary Memory can be further classified as **RAM and ROM**.

• **RAM** or Random Access Memory is the unit in a computer system. It is the place in a computer where the operating system, application programs and the data in current use are kept temporarily so that they can be accessed by the computer's processor. It is said to be ‗volatile' since its contents are accessible only as long as the computer is on. The contents of RAM are no more available once the computer is turned off.

• **ROM** or Read Only Memory is a special type of memory which can only be read and contents of which are not lost even when the computer is switched off. It typically contains manufacturer's instructions. Among other things, ROM also stores an initial program called the ‗bootstrap loader' whose function is to start the operation of computer system once the power is turned on.

b. Secondary Memory

RAM is volatile memory having a limited storage capacity. Secondary/auxiliary memory is storage other than the RAM. These include devices that are peripheral and are connected and controlled by the computer to enable permanent storage of programs and data.

Secondary storage devices are of two types; magnetic and optical. Magnetic devices include hard disks and optical storage devices are CDs, DVDs, Pen drive, Zip drive etc.

• **Hard Disk** are made up of rigid material and are usually a stack of metal disks sealed in a box. The hard disk and the hard disk drive exist together as a unit and is a permanent part of the computer where data and programs are saved. These disks have storage capacities ranging from 1GB to 80 GB and more. Hard disks are rewritable.

• **Compact Disk (CD)** is portable disk having data storage capacity between 650-700 MB. It can hold large amount of information such as music, full-motion videos, and text etc. CDs can be either read only or read write type.

• Digital Video Disk (DVD) is similar to a CD but has larger storage capacity and enormous clarity. Depending upon the disk type it can store several Gigabytes of data. DVDs are primarily used to store music or movies and can be played back on your television or the computer too. These are not rewritable.

Input / Output Devices:

These devices are used to enter information srd instructions into a computer for storage or processing and to deliver the processed data to a user. Input/Output devices are required for users to communicate with the computer. In simple terms, input devices bring information INTO the computer and output devices bring information OUT of a computer system. These input/output devices are also known as peripherals since they surround the CPU and memory of a computer system.

Input Devices

An input device is any device that provides input to a computer. There are many input devices, but the two most common ones are a keyboard and mouse. Every key you press on the keyboard and every movement or click you make with the mouse sends a specific input signal to the computer.

• **Keyboard**: The keyboard is very much like a standard typewriter keyboard with a few additional keys. The basic QWERTY layout of characters is maintained to make it easy to use the system. The additional keys are included to perform certain special functions. These are known as function keys that vary in number from keyboard to keyboard.

• **Mouse**: A device that controls the movement of the cursor or pointer on a display screen. A mouse is a small object you can roll along a hard and flat surface. Its name is derived from its shape, which looks a bit like a mouse. As you move the mouse, the pointer on the display screen moves in the same direction.

• **Trackball**: A trackball is an input device used to enter motion data into computers or other electronic devices. It serves the same purpose as a mouse, but is designed with a moveable ball on the top, which can be rolled in any direction.

• **Touchpad**: A touch pad is a device for pointing (controlling input positioning) on a computer display screen. It is an alternative to the mouse. Originally incorporated in laptop computers, touch pads are also being made for use with desktop computers. A touch pad works by sensing the user's finger movement and downward pressure. • Touch Screen: It allows the user to operate/make selections by simply touching the display screen. A display screen that is sensitive to the touch of a finger or stylus. Widely used on ATM machines, retail point-of-sale terminals, car navigation systems, medical monitors and industrial control panels.

• **Light Pen**: Light pen is an input device that utilizes a light-sensitive detector to select objects on a display screen.

• **Magnetic ink character recognition (MICR)**: MICR can identify character printed with a special ink that contains particles of magnetic material. This device particularly finds applications in banking industry.

• **Optical mark recognition (OMR)**: Optical mark recognition, also called mark sense reader is a technology where an OMR device senses the presence or absence of a mark, such as pencil mark. OMR is widely used in tests such as aptitude test.

• **Bar code reader**: Bar-code readers are photoelectric scanners that read the bar codes or vertical zebra strips marks, printed on product containers. These devices are generally used in super markets, bookshops etc.

Scanner Scanner is an input device that can read text or illustration printed on paper and translates the information into a form that the computer can use. A scanner works by digitizing an image.

Output Devices:

Output device receives information from the CPU and presents it to the user in the desired from. The processed data, stored in the memory of the computer is sent to the output unit, which then converts it into a form that can be understood by the user. The output is usually produced in one of the two ways – on the display device, or on paper (hard copy).

•**Monitor**: is often used synonymously with ―computer screen‖ or ―display.‖ Monitor is an output device that resembles the television screen (fig. 1.8). It may use a Cathode Ray Tube (CRT) to display information. The monitor is associated with a keyboard for manual input of characters and displays the information as it is keyed in. It also displays the program or application output. Like the television, monitors are also available in different sizes.

• **Printer**: Printers are used to produce paper (commonly known as hard copy) output. Based on the technology used, they can be classified as Impact or Non-impact printers.

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

Non-impact printers do not touch the paper while printing. They use chemical, heat or electrical signals to etch the symbols on paper. Inkjet, DeskJet, Laser, Thermal printers fall under this category of printers.

• **Plotter**: Plotters are used to print graphical output on paper. It interprets computer commands and makes line drawings on paper using multi colored automated pens. It is capable of producing graphs, drawings, charts, maps etc.

• **Facsimile (FAX)**: Facsimile machine, a device that can send or receive pictures and text over a telephone line. Fax machines work by digitizing an image.

• **Sound cards and Speaker(s)**: An expansion board that enables a computer to manipulate and output sounds. Sound cards are necessary for nearly all CD-ROMs and have become commonplace on modern personal computers. Sound cards enable the computer to output sound through speakers connected to the board, to record sound input from a microphone connected to the computer, and manipulate sound stored on a disk.

3. **Explain briefly about Data Flow inside the PC**

The flow of data through our computer and discover exactly what happens to the data along this journey. There are four devices involved in the flow of data through your computer.

Input Devices - These are devices used by the operator to send data into the computer. Some basic examples of input devices would be your keyboard and mouse.

CPU - (Central Processing Unit) This is the brain of your computer and where all the processing of data takes place.

Storage - This is a device used to store data either permanently or temporarily. Some examples of storage devices are Main Memory, ROM, RAM and floppy disc.

Output - An output device sends processed information from the computer to the operator. Some basic examples would be your monitor and your printer.

Now that we know the devices involved in our data flow lets start our journey. We can think of our data flow like a trip to the doctor.Our operator will input the letter d into his word processing program using his keyboard.This could be compared to our doctor's receptionist taking our information.Our keyboard contains a small chip that has the binary codes for each key stored. This binary code is then sent to our computers RAM.Think of this as the receptionist giving our information to the nurse.The easiest way to think of RAM is as a temporary storage bin where data waits to be processed. Our d is now sitting in our storage bin waiting for the computer to send it to the CPU.This would be much like our information being put into the pile until the doctor is ready to see us.
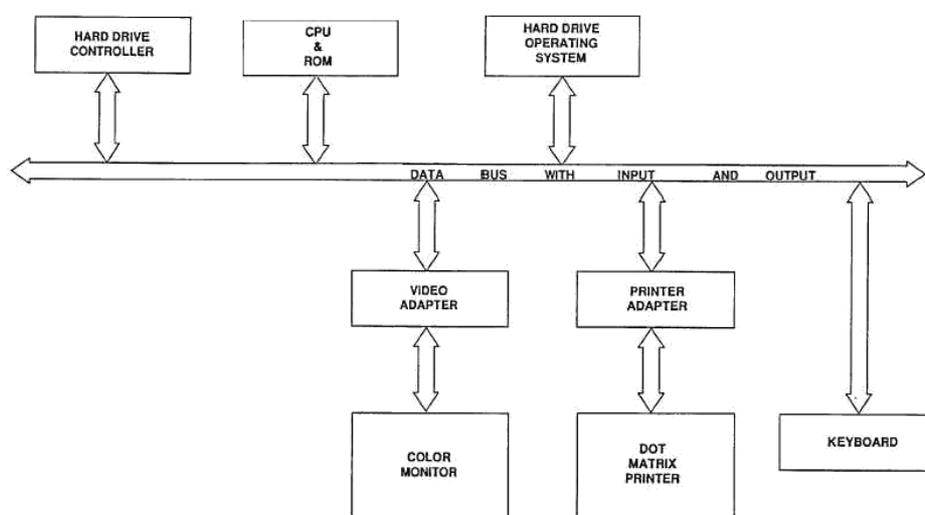
The CPU will read the binary code and follow the coded instructions. These instructions tell the CPU where to send the data next. In this case our d will be sent to our graphic card and then displayed on our screen.The CPU would be like our doctor examining us, deciding on a treatment, and carrying it out.

Input a Operator types the letter d on the keyboard. a The keyboard sends binary codes for our letter to our RAM a Our letter d waits in RAM until the CPU is ready to process it a Our CPU reads the binary code and sends it to our graphics card a Our graphic card displays our letter d on our monitor a Output

4. **Explain briefly about Microprocessor Types and Specifications**

5. **Explain the types of Microprocessor. (NOV 2013)**

6. **Describe the specifications of processors. (NOV 2014) Microprocessors**

The brain or engine of the PC is the processor (sometimes called microprocessor), or central processing unit (CPU). The CPU performs the system's calculating and processing. The processor is easily the most expensive single component in the system, costing up to four or more times greater than the motherboard it plugs into. Intel is generally credited with creating the first microprocessor in 1971 with the introduction of a chip called the 4004. Today Intel still has control over the processor market, at least for PC systems. This means that all PC-compatible systems use either Intel processors or Intel-compatible processors from a handful of competitors (such as AMD or Cyrix).

It is interesting to note that the microprocessor had only existed for 10 years prior to the creation of the PC! The microprocessor was invented by Intel in 1971. The PC was created by IBM in 1981. Now nearly 20 years later, we are still using systems based more or less on the design of that first PC (and mostly backward compatible with it). The processors powering our PCs today are still backward compatible in many ways with the 8088 selected by IBM in 1981.

Processor Specifications

Processors can be identified by two main parameters: how wide they are and how fast they are. The speed of a processor is a fairly simple concept. Speed is counted in megahertz (MHz), which means millions of cycles per second—and faster is better! The width of a processor is a little more complicated to discuss because there are three main specifications in a processor that are expressed in width. They are

- Internal registers
- Data input and output bus
- Memory address bus

Intel Processor Specifications

Processor	Process	Clock	Voltage	Registers	Data Bus	Max. Memory	L1	L2	L3	Mul. Instru.	Transistors
8088	3.0	1x	5v	16 bit	8 bit	1MB	-	-	-	-	29,000
8086	3.0	1x	5v	16 bit	16 bit	1MB	-	-	-	-	29,000
Pentium Pro	0.35	2x+	3.3v	32 bit	64 bit	64GB	2x8KB	256 KB, 512	-	-	5.5M

Processor	Process	Clock	Voltage	Registers	Data Bus	Max. Memory	L1	L2	L3	Mul. Instru.	Transistors
								KB, 1MB			
Pentium II	0.35	3.5x+	2.8v	32 bit	64 bit	64GB	2x16 KB	512 KB,	-	MMX	7.5M
Celeron	0.25	3.5x+	1.8v-2.8v	32 bit	64 bit	64GB	2x16 KB	0KB,	-	MMX	7.5M
Pentium III	0.25	4x+	2.0v-2.05v	32 bit	64 bit	64GB	2x16 KB	256 KB,	-	SSE	44M[5]
Pentium IV	0.18	3x+	1.7v	32 bit	64 bit	64GB	12+8 KB	256 KB,	-	SSE2	42M
Core 2 Duo	0.065	1.75 x+	0.9v-1.3v	64bit	64 bit	1TB	2x32 KB(x2)	1/2 MB(x2)	-	SSE3	291M

AMD Processor Specifications

| Processor	Process	Clock	Voltage	Registers	Data Bus	Max. Memory	L1	L2	L3	Mul. Instru.	Transistors
AMD K5	0.35	1.5x+	3.5v	32 bit	64 bit	4GB	16+8 KB	-	-	-	4.3M
AMD ATHLON	0.25	5x+	1.6v-1.8v	32 bit	64 bit	4GB	2x64 KB	512 KB,	-	Enh.3D now	32M
AMD ATHLON XP	0.13	5x+	1.5-1.8v	32 bit	64 bit	4GB	2x64 KB	256 KB,	-	3D Now! Pro	32.2M

7. **What is Cache memory? Explain in detail.**

   Cache memory is random access memory (RAM) that a computer microprocessor can access more quickly than it can access regular RAM. As the microprocessor processes data, it looks first in the

   cache memory and if it finds the data there (from a previous reading of data), it does not have to do the more time-consuming reading of data from larger memory.

   Cache memory is fast and expensive. Traditionally, it is categorized as "levels" that describe its closeness and accessibility to the microprocessor:

- **Level 1 (**L1**) cache** is extremely fast but relatively small, and is usually embedded in the processor chip (CPU).

- **Level 2 (L2) cache** is often more capacious than L1; it may be located on the CPU or on a separate chip or coprocessor with a high-speed alternative system bus interconnecting the cache to the CPU, so as not to be slowed by traffic on the main system bus.

- **Level 3 (L3) cache** is typically specialized memory that works to improve the performance of L1 and L2. It can be significantly slower than L1 or L2, but is usually double the speed of RAM. In the case of multicore processors, each core may have its own dedicated L1 and L2 cache, but share a common L3 cache. When an instruction is referenced in the L3 cache, it is typically elevated to a higher tier cache.
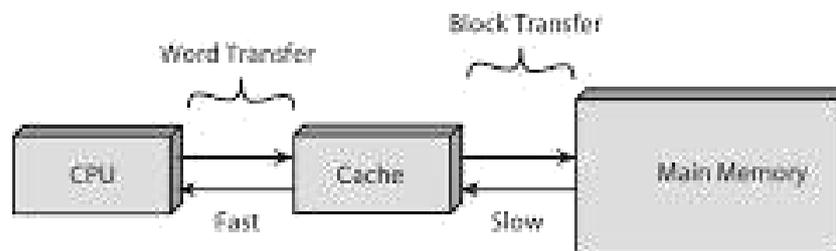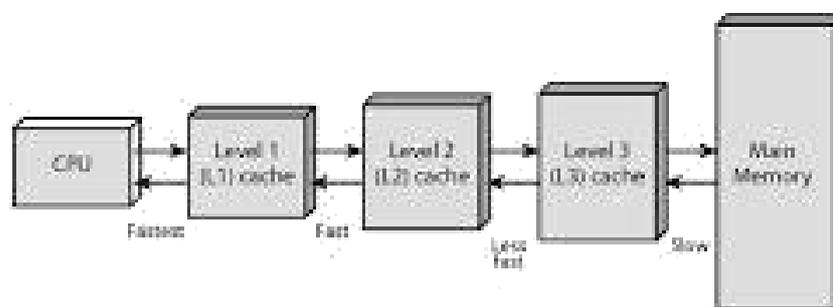
8. **Explain the features of Processors. (NOV 2014)**

9. **Explain the Following : a) System Management Mode b)Super Scalar Execution c) Dynamic Execution d) Dual Independent Bus (DIB) e)Hyper-Threading f)Dual and Multi-Core Technology**
System Management Mode:

System Management Mode (**SMM**, sometimes called **ring -2**) is an operating mode of x86 central processor units (CPUs) in which all normal execution, including the operating system, is suspended and special separate software, which is usually part of the firmware or a hardware-assisted debugger, is executed with high privileges.

It was first released with the Intel 386SL. While initially special SL versions were required for SMM, Intel incorporated SMM in its mainline 486 and Pentium processors in 1993. AMD implemented Intel's SMM with the Enhanced Am486 processors in 1994. It is available in all later microprocessors in the x86 architecture.

A Special mode of operation, where

- All the special tasks like power management, error handling and any specific platform related operations are performed.
- Entered in SMM by invoking SMI(System Management Interrupt).

- Saves all the context of current task in execution.

- Executes the handler located in SMRAM.

- SMRAM is a special memory which is accessible in SMM but not accessible in normal execution made.
- Returns to normal execution by executing instruction RSM.

- SMBASE is re locatable to SMRAM address spase.

SUPERSCALAR EXECUTION

The fifth-generation Pentium and newer processors feature multiple internal instruction execution pipelines, which enable them to execute multiple instructions at the same time. The 486 and all preceding chips can perform only a single instruction at a time. Intel calls the capability to execute more than one instruction at a time superscalar technology. This technology provides additional performance compared with the 486.

The super scalar technique is identifying characteristics:

❖ Instructions are issued from a sequential instruction stream.

❖ CPU hardware dynamically checks for data dependencies between instructions at runtime.

❖ CPU accepts multiple instructions per cycle.

DYNAMIC EXECUTION

First used in the P6 or sixth-generation processors, dynamic execution is an innovative combination of three processing techniques designed to help the processor manipulate data more efficiently. Those techniques are multiple branch prediction, data flow analysis, and speculative execution. Dynamic execution enables the processor to be more efficient by manipulating data in a more logically ordered fashion rather than simply processing a list of instructions, and it is one of the hallmarks of all sixth-generation processors.

The way software is written can dramatically influence a processor's performance. For example, performance will be adversely affected if the processor is frequently required to stop what it is doing and jump or branch to a point elsewhere in the program. Delays also occur when the processor cannot process a new instruction until the current instruction is completed. Dynamic execution allows the processor to not only dynamically predict the order of instructions, but execute them out of order internally, if necessary, for an improvement in speed.

DUAL INDEPENDENT BUS (DIB)

Dual Independent Bus (DIB) is a processor architecture that includes two buses: one to the main system memory and another to the level 2 cache. The processor can access both simultaneously for improved performance.

In Dual Independent Bus (DIB) architecture systems the single system bus is replaced by a back-side bus for accessing level 2 cache, and a front-side bus for communicating data between the CPU and main memory and input and output devices.

HYPER THREADING

Hyper-Threading is a technology used by some Intel microprocessor s that allows a single microprocessor to act like two separate processors to the operating system and the application program s that use it. It is a feature of Intel's IA-32 processor architecture.

With Hyper-Threading, a microprocessor's "core" processor can execute two (rather than one) concurrent streams (or thread s) of instructions sent by the operating system. Having two streams of execution units to work on allows more work to be done by the processor during each clock cycle . To the operating system, the Hyper-Threading microprocessor appears to be two separate processors. Because most of today's operating systems (such as Windows and Linux) are capable of dividing their work load among multiple processors (this is called symmetric multiprocessing or SMP), the operating system simply acts as though the Hyper-Threading processor is a pool of two processors.

DUAL AND MULTI-CORE TECHNOLOGY

Dual core technology is basically putting two processors on a single chip. Dual Core Processor is between a single core processor and a dual processor system for architecture. Dual core technology has two processors but it does not mean that it will be providing double performance in all the areas to the user. It has two cores but shares some of the hardware like the memory controller and bus while a dual processor system has completely separate hardware and shares nothing with the other processor.

Multi-core processors may have:

- two cores (dual-core CPUs, for example, AMD Phenom II X2 and Intel Core Duo)
- three cores (tri-core CPUs, for example, AMD Phenom II X3)
- four cores (quad-core CPUs, for example, AMD Phenom II X4, Intel's i5 and i7 processors)
- six cores (hexa-core CPUs, for example, AMD Phenom II X6 and Intel Core i7 Extreme Edition 980X)
- eight cores (octa-core CPUs, for example, Intel Core i7 5960X Extreme Edition and AMD FX- 8350)
- ten cores (deca-core CPUs, for example, Intel Xeon E7-2850)

10. Explain with neat diagram socket and slot types of Intel's Pentium and core processors and AMD K6 to K8 processors.

Intel and AMD have created a set of socket and slots for their processors. Each socket or slot is designed to support a different range of original and upgrade processors. The table below shows the designations for the various standard processor sockets/slots and lists the chips that drop into them.

Chip Class	Socket	Pins	Layout	Supported Processors	Introduced
Intel P4/Core	423	423	39x39 SPGA	Pentium 4 FC-PGA	Nov. 2000
	478	478	26x26 mPGA	Pentium 4/Celeron FC-PGA2, Celeron D	Oct. 2001
	T (LGA 775)	775	30x33 LGA	Pentium 4/Extreme Edition, Pentium D, Celeron D, Pentium dual-core, Core2	June 2004
	LGA 1156 (Socket H)	1156	40x40 LGA	Pentium, Core i3/i5/i7, Xeon	Sept. 2009
	LGA 1136 (Socket B)	1366	41x43 LGA	Core i7, Xeon	Nov. 2008
	LGA 1155 (Socket H2)	1155	40x40 LGA	Core i7, i5, i3	Jan. 2011
	LGA 2011	2011	58x43 hexLGA	Core i7	Nov. 2011
AMD K8	754	754	29x29 mPGA	Athlon 64	Sept. 2003
	939	939	31x31 mPGA	Athlon 64 v.2	June 2004
	940	940	31x31 mPGA	Athlon 64 FX, Opteron	Apr. 2003
	AM2	940	31x31 mPGA	Athlon 64/64FX/64 X2, Sempron, Opteron, Phenom	May 2006
	AM2+	940	31x31 mPGA	Athlon 64/64 X2, Opteron, Phenom X2/X3/X4, II X4	Nov. 2007
	AM3	9412	31x31 mPGA	Athlon II, Phenom II, Sempron	Feb. 2009
	AM3+	9412	31x31 mPGA	"Bulldozer" Processors	Mid-2011
	F (1207 FX)	1207	35x35 LGA	Athlon 64 FX, Opteron	Aug. 2006
AMD A	FM1	905	31x31 LGA	A4, A6, A8, Athlon II, E2, Sempron	Jul. 2011
	FM2	904	31x31 LGA	A4, A6, A8, A10	Sept. 2012

Sockets 1, 2, 3, and 6 are 486 processor sockets and are shown together in the figure below so you can see the overall size comparisons and pin arrangements between these sockets.

Socket 1   Socket 2   Socket 3   Socket 6

486 Processor Sockets
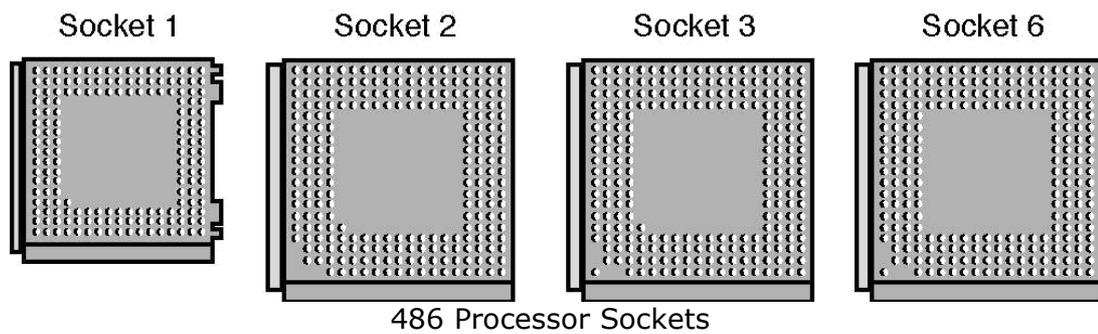
Sockets 4, 5, 7, and 8 are Pentium and Pentium Pro processor sockets and are shown together in the figure below so you can see the overall size comparisons and pin arrangements between these sockets.

Socket 4   Socket 5   Socket 7   Socket 8
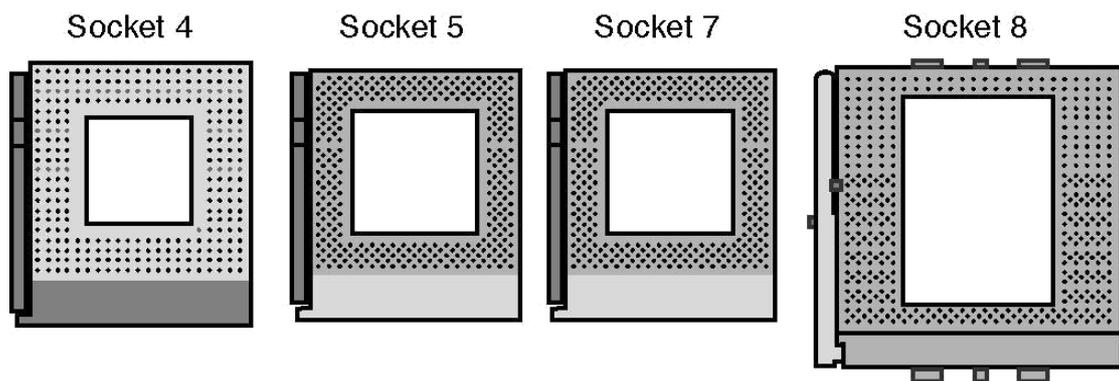
Pentium And Pentium Pro Processor Sockets

When the Socket 1 specification was created, manufacturers realized that if users were going to upgrade processors, they had to make the process easier. The socket manufacturers found that 100 lbs. of insertion force is required to install a chip in a standard 169-pin Socket 1 motherboard. With this much force involved, you easily could damage either the chip or the socket during removal or reinstallation. Because of this, some motherboard manufacturers began using low insertion force (LIF) sockets, which required a smaller 60 lbs. of insertion force for a 169-pin chip. Pressing down on the motherboard with 60–100 lbs. of force can crack the board if it is not supported properly. A special tool is also required to remove a chip from one of these sockets. As you can imagine, even the LIF was relative, and a better solution was needed if the average person was ever going to replace his CPU.

Manufacturers began using ZIF sockets in Socket 1 designs, and all processor sockets from Socket 2 and higher have been of the ZIF design. ZIF is required for all the higher-density sockets because the insertion force would simply be too great otherwise. ZIF sockets almost eliminate the risk involved in installing or removing a processor because no insertion force is necessary to install the chip and no tool is needed to extract one. Most ZIF sockets are handle-actuated: You lift the handle, drop the chip into the socket, and then close the handle. This design makes installing or removing a processor easy.

11. Describe the classification of computer. (NOV 2012)

Classification of computers:

- MICRO-COMPUTER
- MINI-COMPUTER
- MAINFRAME COMPUTER
- SUPER-COMPUTER

Micro computers: These computers use a microprocessor chip and this chip is used instead of CPU means that this microprocessor chip works as a CPU. These computers are also called personal computers. Two major types of these computers are laptop or Desktop computers. Only one user uses these computers at time that's why they are also known as personal computers.

Mini Computers: Minicomputers are much smaller than mainframe computers and they are also much less expensive. The cost of these computers can vary from a few thousand dollars to several hundred thousand dollars. They possess most of the features found on mainframe computers, but on a more limited scale. They can still have many terminals, but not as many as the mainframes. They can store a tremendous amount of information, but again usually not as much as the mainframe. Medium and small businesses typically use these computers.

Mainframe Computer: Mainframe computers are very large, often filling an entire room. They can store enormous of information, can perform many tasks at the same time, can communicate with many users at the same time, and are very expensive. The price of a mainframe computer frequently runs into the millions of dollars. Mainframe computers usually have many terminals connected to them. These terminals look like small computers but they are only devices used to send and receive information from the actual computer using wires. Terminals can be located in the same room with the mainframe computer, but they can also be in different rooms, buildings, or cities. Large businesses, government agencies, and universities usually use this type of computer.

Super Computers: As the name "super computer" specifies that these are most powerful computers even than mainframe. Actually, when we optimize a mainframe computer then we get super computer.

12. Briefly explain the terminologies for processor. (NOV 2012)

The brain or engine of the PC is the processor (sometimes called microprocessor), or central processing unit (CPU). The CPU performs the system's calculating and processing. The processor is easily the most expensive single component in the system, costing up to four or more times greater than the motherboard it plugs into.

Clock Speed

The digital chips on a motherboard are keep in sync with each other by the clock signal (a stream of pulses) of the motherboard. Clock speed is measured in units of cycles per second, which is called a Hertz (Hz). Computer boards and CPUs run at rates of millions and billions of Hertz, megahertz (MHz) and gigahertz (GHz).

CPU Speed

Clock speed is only one aspect that contributes to the overall processing speed of a microprocessor. The architecture of the chip also is a factor. This includes such considerations as the word size of the chip, which is how many bits it can input/output and process at a time. Early microprocessors used 8-bit word size; the newest microprocessors use 64-bit word size. Other aspects of chip architecture that affect speed include the ability of some CPUs to work on multiple instructions at the same time.

Data Bus

The data bus is the multi-lane electrical highway of connections that link the CPU to the other chips on the motherboard, such as the RAM memory and I/O controllers. It is also called the front side bus (FSB). The word size of the data bus determines how many bits can be moved simultaneously along it.

13. Describe in detail about the computer room preparation. (NOV 2013)

Influencing Factors

Purpose - The purpose of a computing facility will greatly impact most design aspects including room layout, computer hardware, printing systems, projection/presentation systems, etc. Consider what the primary use of this facility will be:

- Open computer use - users come and go to use the computers for assignments or projects
- Instructional computing facility - facility is used for instruction lead by a single person
- Collaborative work - facility is used by students in a group project setting
- Laboratory work - computers are used for data collection or in a laboratory setting

Specific application - The greatest influence on the computer hardware itself is the intended application and operating system. These will drive the need for more powerful computers, larger monitors, specific printing needs, and other technical decisions.

Budget - If everyone could afford to build the perfect lab they would, but there are always budget limitations. Find the limits and project priorities

Staffing/Maintenance - A computing facility requires staffing to install, configure, and maintain hardware and software. The size, complexity, and purpose of a computing facility will determine the staffing needs. The lack of proper staffing and maintenance may limit a facilities availability or usefulness.

Aspects for consideration

For all of the following hardware items, one should consider the reliability, serviceability, and warranty of the specific items. This can greatly impact the maintenance costs and headaches down the road. We recommend at least a three-year warranty on all computer hardware if available.

Workstation hardware - This central aspect of the facility is influenced by all of the previously mentioned factors. Consider the needs in the following areas

- CPU - What level of processing power is required by the applications?
- Memory - What amount of RAM is required by the applications?
- Primary storage space - How much storage space is required to install the local applications? Will users be storing documents on the local machines? Do applications require a great deal of swap space?
- Sub-systems - evaluate your needs for:
  - o Networking - generally only a 10/100 Ethernet card is required
  - o Audio - Sound card, speakers, headphones, microphones
  - o Video - Video card speed and memory
  - o Secondary storage - CD, CD-R, DVD, Zip, etc.
  - o Input - Keyboard and mouse variations
- Monitor - Is a large monitor needed for graphics or engineering work?
- Form factor - Is a small computer required due to furniture or space limitations? Is a small form factor monitor required for students to see the instructor or each other?

Server hardware - Most computing facilities rely on a server for application serving, print serving, or storage. This hardware can vary greatly depending on the specific use of the server.

Networking - Networking is a core component of computing facilities; it allows access to Internet resources, access to e-mail, and the ability to collaborate remotely. Potential networking costs include installation/activation of Ethernet jacks, hubs/switches for networking within the room, and cabling. Networking may represent a good portion of the cost of the facility.

Printing - Most computing facilities require some form of printing to be available. For most applications this simply means the ability to print black and white text documents, but there are a variety of printing needs. Another consideration is the quantity of printing expected in the facility. This greatly influences the specific model of printer within a type of printer. The following are the most popular forms of printing in campus computing facilities:

- Black and white laser printing
- Color printing (laser or inkjet)

- Plotting

Other peripherals - The purpose and specific application of a facility may require additional hardware not in a traditional computing lab. These are some common peripherals used in special applications:

- Scanning
- Special storage (CD-R, DVD-R, etc.)
- Special input (tablets, mapping, data acquisition, etc.)

Audio/Video systems (projector, sound, etc.) - Many computing facilities, especially instructional ones, benefit from the ability to display information for the entire room. This may include the ability to project computer screens, project television/video tapes/DVDs, play audio tapes/CDs, and amplify input from microphones. More advanced systems even allow instructors to project any of the workstation screens to a projector or to other computer screens on the fly.

Upgrade path - Any computer hardware and software will eventually have to be replaced as it becomes obsolete. Computing facilities should have an upgrade plan and budget for both hardware and software. In general, ITS uses a three-year replacement cycle for hardware in computing facilities. Software is replaced more frequently, usually as new, more useful, versions are released. Budgeting for new software is difficult due to the unpredictable nature of software development, but plan on spending about a third of your original software costs each year in upgrades.

Furniture - The purpose of a facility is the strongest influence on the furniture and layout of the facility. An open computer lab may simply be rows of computers on basic tables. An instructional facility may have rows all facing the front of the room for instruction. A collaborative facility may have single computers (or groups of computers) at large tables designed to seat many students. At least one workstation in each facility should be placed on an adjustable height table for accessibility by people using wheelchairs. In an instructional facility, the instructors workstation should also be placed on an adjustable height table.

Accessibility - In addition to placing accessible tables in the lab, one should also consider the accessibility of the computer applications(using special input/output hardware or software), other systems (printing, A/V equipment, etc.), and the accessibility of the room layout.

Power - Often the existing power circuit(s) in a room are not sufficient for a computing facility. Examine your power needs and resources, and contact facilities management regarding power system upgrades.

14. Describe the DMA Architecture of the PC in detail? (NOV 2010)

Direct memory access (DMA) is a feature of computerized systems that allows certain hardware subsystems to access main system memory independently of the central processing unit (CPU).
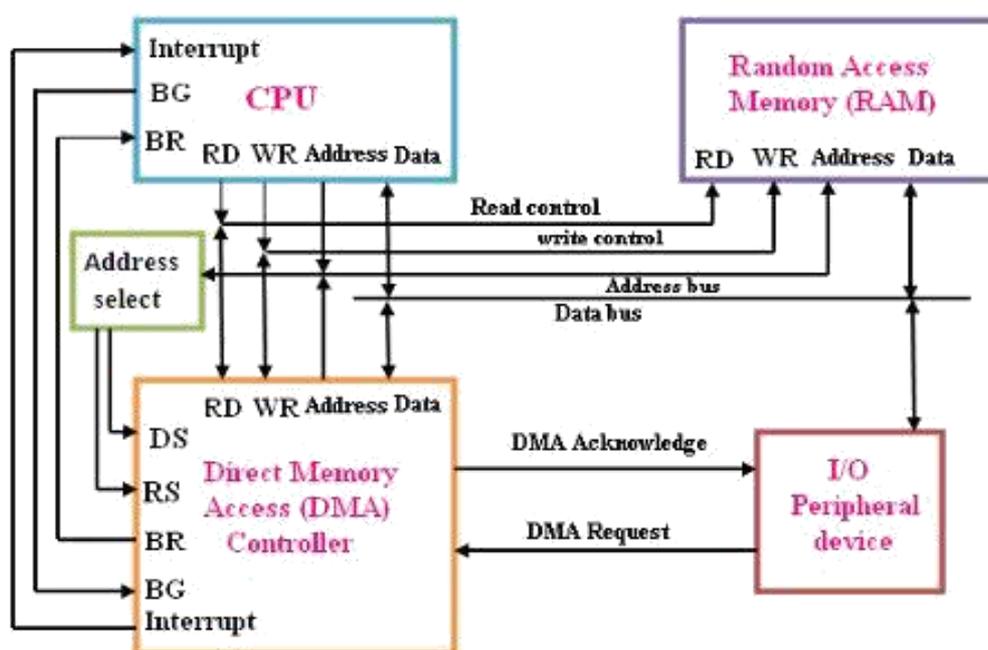
DMA Architecture

Without DMA, when the CPU is using programmed input/output, it is typically fully occupied for the entire duration of the read or write operation, and is thus unavailable to perform other work. With DMA, the CPU first initiates the transfer, then it does other operations while the transfer is in progress, and it finally receives an interrupt from the DMA controller when the operation is done. This feature is useful at any time that the CPU cannot keep up with the rate of data transfer, or when the CPU needs to perform useful work while waiting for a relatively slow I/O data transfer. Many hardware systems use DMA, including disk drive controllers, graphics cards, network cards and sound cards. DMA is also used for intra-chip data transfer in multi-core processors. Computers that have DMA channels can transfer data to and from devices with much less CPU overhead than computers without DMA channels. Similarly, a processing element inside a multi-core processor can transfer data to and from its local memory without occupying its processor time, allowing computation and data transfer to proceed in parallel.

DMA can also be used for "memory to memory" copying or moving of data within memory. DMA can offload expensive memory operations, such as large copies or scatter-gather operations, from the CPU to a dedicated DMA engine. An implementation example is the I/O Acceleration Technology.

A DMA controller can generate memory addresses and initiate memory read or write cycles. It contains several processor registers that can be written and read by the CPU. These include a memory address register, a byte count register, and one or more control registers. The control registers specify the I/O port to use, the direction of the transfer (reading from the I/O device or writing to the I/O device), the transfer unit (byte at a time or word at a time), and the number of bytes to transfer in one burst. [1]

To carry out an input, output or memory-to-memory operation, the host processor initializes the DMA controller with a count of the number of words to transfer, and the memory address to use. The CPU then sends commands to a peripheral device to initiate transfer of data. The DMA controller then provides addresses and read/write control lines to the system memory. Each time a byte of data is ready to be transferred between the peripheral device and memory, the DMA controller increments its internal address register until the full block of data is transferred.

DMA transfers can either occur one byte at a time or all at once in burst mode. If they occur a byte at a time, this can allow the CPU to access memory on alternate bus cycles – this is called cycle stealing since the DMA controller and CPU contend for memory access. In *burst mode DMA*, the CPU can be put on hold while the DMA transfer occurs and a full block of possibly hundreds or thousands of bytes can be moved. [2] When memory cycles are much faster than processor cycles, an *interleaved* DMA cycle is possible, where the DMA controller uses memory while the CPU cannot.

In a bus mastering system, the CPU and peripherals can each be granted control of the memory bus. Where a peripheral can become bus master, it can directly write to system memory without involvement of the CPU, providing memory address and control signals as required. Some measure must be provided to put the processor into a hold condition so that bus contention does not occur.

15. Explain in detail about computer mnemonics. (APR 2012)

In general, a mnemonic (from Greek *mnemon* or mindful) is a memory aid, such as an abbreviation, rhyme or mental image that helps to remember something. The technique of developing these remembering devices is called "mnemonics." Mnemonics can be used to remember phone numbers, all your new department colleagues' names or the years of the reigns of the Kings and Queens of England. A number of approaches are used.

A mnemonic is a term, symbol or name used to define or specify a computing function. Mnemonics are used in computing to provide users with a means to quickly access a function, service or process, bypassing the actual more lengthy method used to perform or achieve it. Assembly language also uses a mnemonic to represent machine operation, or opcode.

In computer programming, routine programming functions are assigned a mnemonic that is shorter in length but provides the same functionality as the original function. In assembly language, mnemonics are used to specify an opcode that represents a complete and operational machine language instruction. This is later translated by the assembler to generate the object code. For example, the mnemonic MOV is used in assembly language for copying and moving data between registers and memory locations.

Pondicherry University Questions

PARTA (2 Marks)

1. What is processor? (NOV 2013)
2. Define system clock? (NOV 2013)
3. What are the two types of hardware interrupts (NOV 2010)
4. List the type of switching logic control in SMPS? (NOV 2010)
5. What is BIOS? (APR 2011), (NOV 2012)
6. List any four components of Mother Board? (APR 2011)
7. Expand SMPS, DMA? (APR 2012)
8. What are the types of memory? (APR 2012)
9. List out the Hardware components of PC? (NOV 2012)
10. Define computer? (NOV 2012)
11. What is meant by cache memory? (NOV 2012)
12. Why is the maximum value in decimal that can be represented by an eight bit binary number?(NOV 2014)
13. If the number of bits in MAR is 10, What is the maximum memory capacity? (NOV 2014)

PART B (11 Marks)

1. Explain briefly about History of the PC. (Ref.Pg.No.6,Qn.No.1)
2. Draw the functional Block diagram of the PC and explain its parts (APR 2011) (Ref.Pg.No.8,Qn.No.2)
3. Explain briefly about data flow inside the PC. (Ref.Pg.No.11,Qn.No.3)
4. Explain briefly about Microprocessor Types and Specifications (NOV 2013) (NOV 2014). (Ref.Pg.No.12,Qn.No.4,5,6)
5. What is Cache memory? Explain in detail. (Ref.Pg.No.13,Qn.No.7)
6. Explain the features of Processors. (NOV 2014) (Ref.Pg.No.14,Qn.No.8)
7. Explain the Following : a) System Management Mode b) Super Scalar Execution c) Dynamic Execution d) Dual Independent Bus (DIB) e) Hyper-Threading f) Dual and Multi-Core Technology. (Ref.Pg.No.14,Qn.No.9)
8. Explain with neat diagram socket and slot types of Intel's Pentium and core processors and AMD K6 to K8 processors. (Ref.Pg.No.17,Qn.No.10)
9. Describe the classification of computer? (NOV 2012) (Ref.Pg.No.19,Qn.No.11)
10. Briefly explain the terminologies of the processor (NOV 2012) (Ref.Pg.No.19,Qn.No.12)
11. Describe in detail about computer room preparation (NOV 2013) (Ref.Pg.No.20,Qn.No.13).
12. Describe the DMA Architecture of the PC in detail? (NOV 2010) (Ref.Pg.No.21,Qn.No.14)
13. Explain in detail about computer mnemonics. (APR 2012) (Ref.Pg.No.22,Qn.No.15)

SRI VENKATESHWARAA COLLEGE OF ENGINEERING & TECHNOLOGY

(Approved by AICTE, New Delhi & Affiliated to Pondicherry University, Puducherry.)
13-A, Villupuram – Pondy Main road, Ariyur, Puducherry – 605 102.
Phone: 0413-2644426, Fax: 2644424 / Website: www.svcetpondy.com

Department of Computer Science and Engineering

Subject Name: **COMPUTER HARDWARE AND NETWORK TROUBLESHOOTING**

Subject Code: **CS T72**

Prepared By :

Dr.N.Balaji, Professor & Head / CSE

Verified by: **Approved by:**

UNIT – II

Mother board components: Chip sets – TraditionalNorth/South Bridge architecture–Sixth andSeventh generation Chipsets – VIA, SiS and NVIDIA chipsets. Desktop versus Laptop motherboards.

Bus standards: ISA–PCI–PCI Express–AGP–MCA–System Resources–Interrupts–DMAchannels – I/O Port addresses.

Power Supply: SMPS–Power specifications - Connectors–Switches–RTC/NVRAM batteries.

BIOS: Shadowing–Upgrading–CMOS setup–Plug and Play–Error messages.

2 Marks

1. **Write the Mother board Components?**
   ➤ Chipsets
   ➤ Northbridge
   ➤ Southbridge

2. **What is meant by Chipsets?**

   The chipset is the "glue" that connects the microprocessor to the rest of the motherboard and therefore to the rest of the computer. On a PC, it consists of two basic parts -- the **Northbridge** and the **Southbridge**.

3. **What is meant by Northbridge?**

   The north bridge connects directly to the processor via the front side bus (FSB). A memory controller is located on the north bridge, which gives the CPU fast access to the memory. The north bridge also connects to the AGP or PCI Express bus and to the memory itself.

4. **What is meant by Southbridge?**

   The south bridge is slower than the north bridge, and information from the CPU has to go through the north bridge before reaching the south bridge. Other busses connect the south bridge to the PCI bus, the USB ports and the IDE or SATA hard disk connections.

5. **Define Bus?**

A bus is a circuit that connects one part of the motherboard to another. The more data a bus can handle at one time, the faster it allows information to travel. The **speed** of the bus, measured in megahertz (MHz).

6. **What is ISA?**

Industry Standard Architecture (ISA) is a computer bus standard for IBM PC compatible computers introduced with the IBM Personal Computer to support its Intel 8088microprocessor's 8-bit external data bus and extended to 16 bits for the IBM Personal Computer/AT's Intel 80286 processor.

7. **What is EISA?**

The ISA bus was further extended for use with 32-bit processors as Extended Industry StandardArchitecture (EISA). For general desktop computer use it has been supplanted by later buses such as IBM Micro Channel, VESA Local Bus, Peripheral Component Interconnect and other successors. A derivative of the AT bus structure is still used in the PC/104 bus, and internally withinSuper I/O chips.

8. **What is PCI? (APR 2011)**

The PCI-Bus (Peripheral Component Interconnect) was originally designed to speed up the display of graphics on Intel-based personal computers, but the standard itself is processor independent and suitable for other hardware add-ons that require high bandwidth, including network, video and SCSI.

9. **Write about MCA? (NOV 2014)**

MCA stands for "Micro Channel Architecture." It is an expansion bus created by IBM that was used in the company's PS/2 desktop computers. An expansion bus allows additional cards to be connected to the computer's motherboard, expanding the number of I/O ports. These include SCSI, USB, Firewire, AGP, and DVI connections, as well as many others.

10. **State the purpose of SMPS. (NOV 2014)**

11. **Define SMPS?**

A switched-mode power supply (switching-mode power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a source, like mains power, to a load, such as a personal computer, while converting voltage and current characteristics. An SMPS is usually employed to efficiently provide a regulated output voltage, typically at a level different from the input voltage.

12. **Give the types of SMPS?**

Switched-mode power supplies can be classified according to the circuit topology.

   Buck converter (single inductor; output voltage < input voltage)

   Boost converter (single inductor; output voltage > input voltage)

buck-boost converter (single inductor; output voltage can be more or less than the input voltage)

fly back converter allows multiple outputs and input-to-output isolation

- Half-Forward Topology

Push-Pull Topology

- Half-Bridge Topology
- Full-Bridge Topology
- Resonance, zero voltage switched

13. What is meant by power supply unit (PSU)?

A **power supply unit** (**PSU**) converts mains AC to low-voltage regulated DC power for the internal components of the computer. Modern personal computers universally use a switched-mode powersupply. Some power supplies have a manual selector for input voltage, while others automatically adapt to the supply voltage.

14. Write some power supply connectors?

- PC Main power connector (usually called P1)
- 12V only power connector (labelledP1, with the ATX 20 or 24 pin connector)
- 12V only System monitoring (P10)
- ATX12V 4-pin power connector (also called the P4 power connector)
- 4-pin Peripheral power connectors
- 4-pin Molex (Japan) Ltd power connectors (usually called Mini-connector)
- Auxiliary power connectors

Serial ATA power connectors

- 6-pin and 6+2 pin

15. What is RTC/NVRAM Batteries (CMOS Chips)?

All 16-bit and higher systems have a special type of chip in them that combines a real-time clock (RTC) with at least 64 bytes (including the clock data) of Non-Volatile RAM (NVRAM) memory. This chip is officially called the RTC/NVRAM chip but is often referred to as the CMOS chip or CMOS RAM because the type of chip used is produced using a CMOS (Complementary Metal-Oxide Semiconductor) process.

16. What do you mean by BIOS? (NOV 2012)

BIOS, in computing, stands for Basic Input/output System also incorrectly known as Basic Integrated Operating System. BIOS refer to the software code run by a computer when first powered on.

17. What is Shadowing in BIOS?

A technique used to increase a computer's speed by using high-speed RAMmemory in place of slower ROM memory (RAM is about three times as fast as ROM). On PCs, for example, all code to control hardwaredevices, such as keyboards, is normally executed in a special ROM chip called

the *BIOS ROM*. However, this chip is slower than the general-purpose RAM that comprises mainmemory. Many PC manufacturers, therefore, configure their PCs to copy the BIOS code into RAM when the computer boots. The RAM used to hold the BIOS code is called *shadow RAM.*

18. **What is Upgrading?**

   A software upgrade is a purchase of a newer version of software you currently use of a more fully-featured version of your current software. There is usually a cost for a software upgrade, although you can often upgrade at a reduced price.

19. **What is CMOS?**

   A complementary metal oxide semiconductor (CMOS) is a type of integrated circuit technology. The term is often used to refer to a battery-powered chip found in many personal computers that holds some basic information, including the date and time and system configuration settings, needed by the basic input/output system (BIOS) to start the computer.

20. **What is PnP?**

21. **What is meant by Plug and Play? (NOV 2013)**

   In computing, plug and play is a term used to describe the characteristic of a computer bus, or device specification, which facilitates the discovery of a hardware component in a system, without the need for physical device configuration, or user intervention in resolving resource conflicts.

22. **Define Error Messages?**

An **error message** is information displayed when an unexpected condition occurs, usually on a computer or other device. On modern operating systems with graphical user interfaces, error messages are often displayed using dialog boxes.

23. **Define IDE. (NOV 2010)**

   Integrated Drive Electronics or **IBM Disc Electronics**, **IDE** is more commonly known as**ATA**or **Parallel ATA** (**PATA**) and is a standard interface for IBM compatible hard drives and CD or DVD drives. IDE is different from the Small Computer Systems Interface (SCSI) and Enhanced Small Device Interface (ESDI) because its controllers are on each drive, meaning the drive can connect directly to the motherboard or controller. IDE and its updated successor, Enhanced IDE (EIDE), are common drive interfaces found in IBM compatible computers. Below is a picture of the IDE connector on the back of a hard drive, a picture of what an IDE cable looks like, and the IDE channels it connects to on the motherboard.

24. **Differentiate LAN and WAN. (NOV 2010)**

   A **LAN** (local area network) is a group of computers and network devices connected together, usually within the same building. By definition, the connections must be high speed and relatively inexpensive (e.g., token ring or Ethernet).

   A **WAN**(wide area network), in comparison to a LAN, is not restricted to a geographical location, although it might be confined within the bounds of a state or country. A WAN connects several LANs, and may be limited to an enterprise (a corporation or an organization) or accessible to the

public. The technology is high speed and relatively expensive. The Internet is an example of a worldwide public WAN.

25. **Define MODEM. (APR 2011), (APR 2012)**

Modulator-demodulator. Electronic device that allows computers to communicate over telephonewires.One computer's modem converts its digital signals into analog signals. The other computer's modem reconverts the analog signals into digital signals. Conversion of one type of signals to another is called modulation, their reconversion to the original type is called demodulation.

26. **Expand SCSI. (APR 2012) , (NOV 2012)**

The Small Computer System Interface (SCSI) is a set of parallel interface standards developed by the American National Standards Institute (ANSI) for attaching printers, disk drives, scanners and other peripherals to computers. SCSI (pronounced "skuzzy") is supported by all major operating systems.

27. **Write an example of peripheral devices. (NOV 2012)**

A peripheral device connects to a computer system to add functionality. Examples are a mouse, keyboard, monitor, printer and scanner.

28. **What are the two types of system boards? (NOV 2012)**

AT Motherboard
ATX Motherboard

29. **Expand: ISA, PCI, MCA and SMPS. (NOV 2013)**
ISA– Industry Standard Architecture

PCI– Peripheral Component Interconnect

MCA – Micro Channel Architecture SMPS

– Switched-mode power supplies

11 MARKS

1. **What are the Components available in the Mother board? Explain Briefly.**

2. **Describe the detail about mother board architecture. (NOV 2012)**

COMPONENTS
1. System Case (with SMPS)
2. Motherboard
3. RAM
4. Processor
5. Processor Fan
6. Hard Disk Drive
7. Floppy Disk Drive
8. CD-ROM Drive
9. Power Cord
10. Mouse
11. Keyboard
12. Monitor
13. IDE and Floppy Data Cables
14. Power Cords
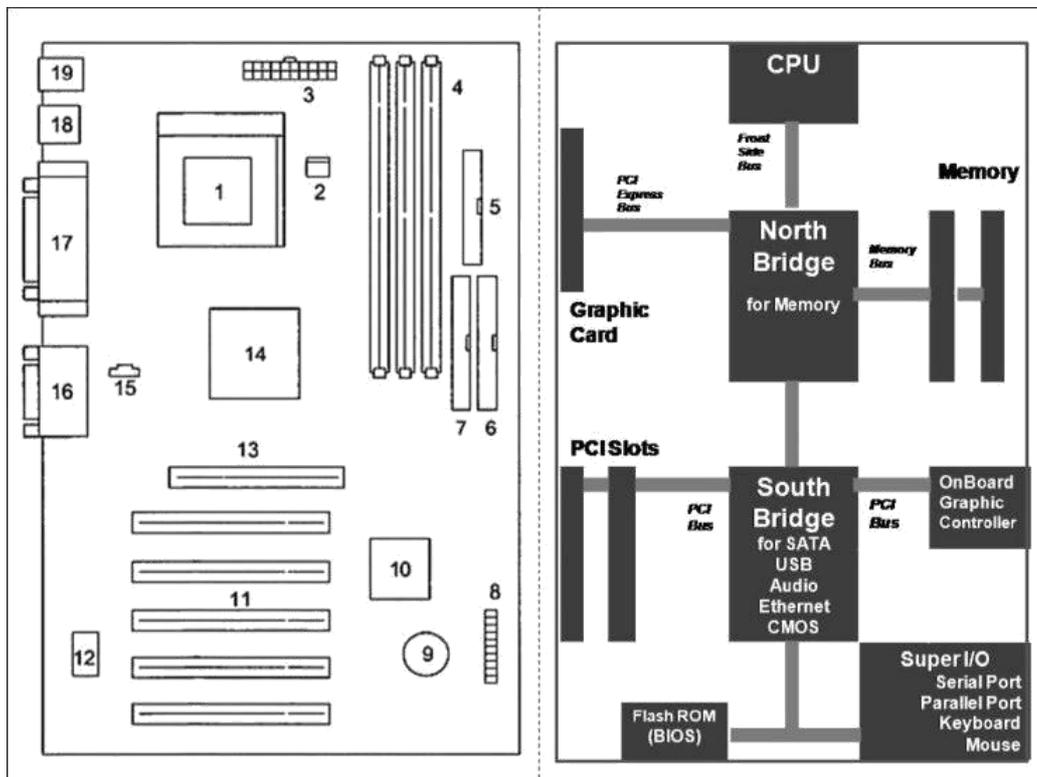
Mother board architecture diagram

A motherboard is one of the most essential parts of a computer system. It holds together many of the crucial components of a computer, including the central processing unit (CPU), memory and connectors for input and output devices. The base of a motherboard consists of a very firm sheet of non-conductive material, typically some sort of rigid plastic. Thin layers of copper or aluminum foil, referred to as *traces*, are printed onto this sheet. These traces are very narrow and form the circuits between the various components. In addition to circuits, a motherboard contains a number of sockets and slots to connect the other components.

- A CPU socket - the actual CPU is directly soldered onto this socket. Since high speed CPUs generate a lot of heat, there are heat sinks and mounting points for fans right next to the CPU socket.
- A power connector to distribute power to the CPU and other components.
- Slots for the system's main memory, typically in the form of DRAM chips.
- A chip forms an interface between the CPU, the main memory and other components. On many types of motherboards this is referred to as the Northbridge. This chip also contains a large heat sink.
- A second chip controls the input and output (I/O) functions. It is not connected directly to the CPU but to the Northbridge. This I/O controller is referred to as the Southbridge. The Northbridge and Southbridge combined are referred to as the *chipset*.
- Several connectors, which provide the physical interface between input and output devices and the motherboard. The Southbridge handles these connections.
- Slots for one or more hard drives to store files. The most common types of connections are Integrated Drive Electronics (IDE) and Serial Advanced Technology Attachment (SATA).
- A Read-only memory (ROM) chip, which contains the firmware, or startup instructions for the computer system. This is also called the BIOS.
- A slot for a video or graphics card. There are a number of different types of slots, including Accelerated Graphics Port (AGP) and Peripheral Component Interconnect Express (PCIe).
- Additional slots to connect hardware in the form of Peripheral Component Interconnect (PCI) slots.

3. Explain briefly about Chipset.
The chip set

The motherboard's busses are regulated by a number of controllers. These are small circuits which have been designed to look after a particular job, like moving data to and from EIDE devices (hard disks, etc.).

A number of controllers are needed on a motherboard, as there are many different types of hardware devices which all need to be able to communicate with each other. Most of these controller functions are grouped together into a couple of large chips, which together comprise the *chip set*.
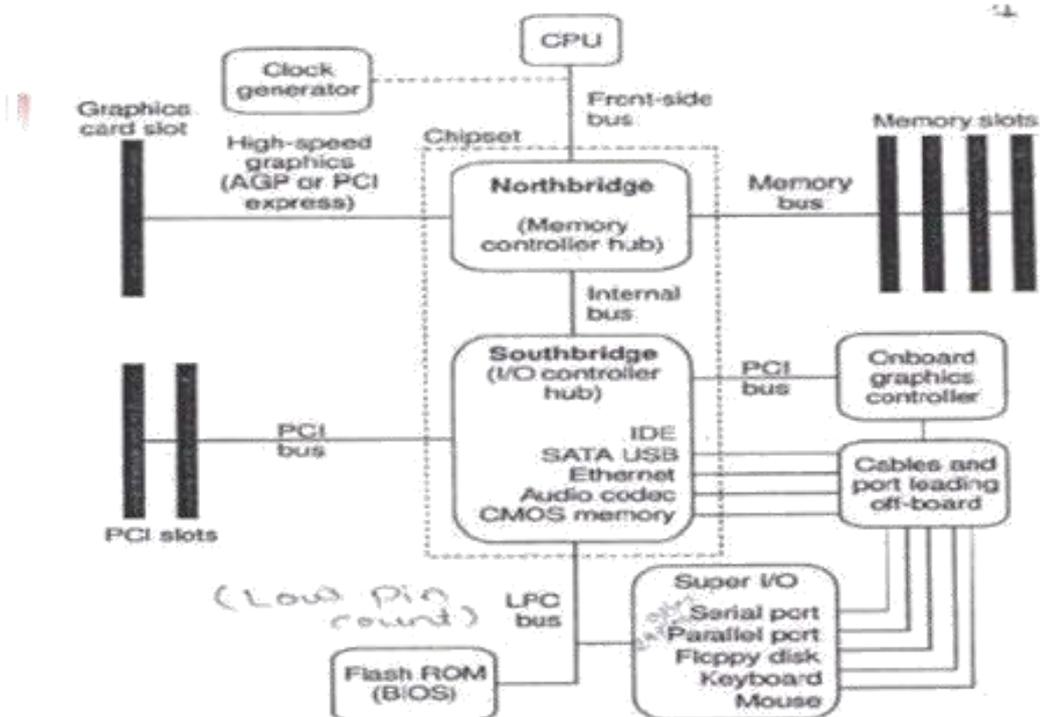

Fig. 2.1 The two chips which make up the chipset, and which connect the motherboard's busses.

The most widespread chipset architecture consists of *two* chips, usually called the *north* and *southbridges*. This division applies to the most popular chipsets from VIA and Intel. The north bridge andsouth bridge are connected by a powerful bus, which sometimes is called a *link channel*:
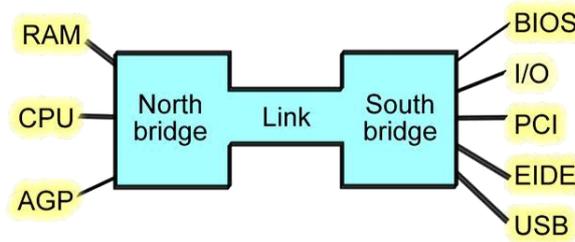

Fig. 2.2 The north bridge and south bridge share the work of managing the data traffic on the motherboard.

The north bridge

The north bridge is a controller which controls the flow of data between the CPU and RAM, and to the AGP port.

The north bridge, which has a large heat sink attached to it. It gets hot because of the often very large amounts of data traffic which pass through it.
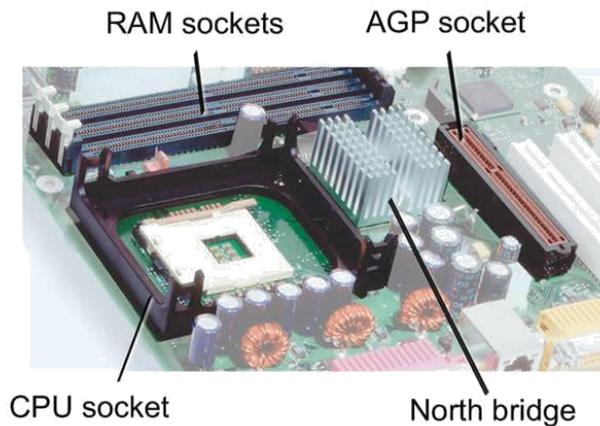
Fig. 2.3. The north bridge and its immediate surroundings. A lot of traffic runs through the north bridge, hence the heat sink.

The AGP is actually an I/O port. It is used for the video card. In contrast to the other I/Odevices, the AGP port is connected directly to the north bridge, because it has to be as close to the RAM as possible. The same goes for the PCI Express x16 port, which is the replacement of AGP in new motherboards.

The south bridge

The south bridge incorporates a number of different controller functions. It looks after the transfer of data to and from the hard disk and all the other I/O devices, and passes this data into the link channel which connects to the north bridge. The south bridge is physically located close to the PCI slots, which are used for I/O devices.
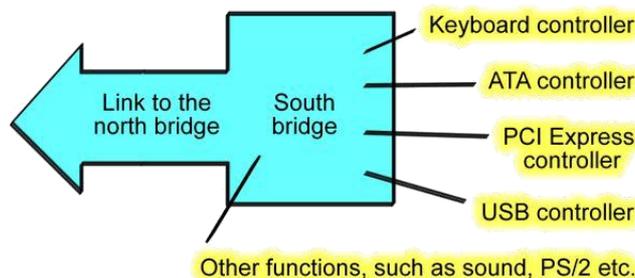

Fig.2.4 The chipset's south bridge combines a number of controller functions into a single chip.

4. Write about Sixth and Seventh generation Chipsets.

Sixth generation chipsets:

- P6
- Pentium Pro
- Pentium II
- Pentium III

Pentium Pro, Celeron and Pentium II/III were essentially the same processor with different cache designs and minor internal revisions, the same chipsets could be used for socket 8(Pentium Pro), Socket370 (Celeron /Pentium III) and Slot 1 (Celeron/Pentium II/III) designs.

Pentium Pro chipsets:

- 450KK(Orion)
- 450GX(Orion Server)
- 450FX(Natoma)

P6 Processor chipsets:

- 440 FX
- 440 LX
- 440 EX

P6 (Pentium III/Celeron) processor chipsets

- 810	- 440EX	- 820 E
- 810E	- 440 GX	- 840
- 815^3	- 440 NX	- 815 P
- 815 E^3	- 440 ZX	- 815 EG
- 815 EP	- 820	- 815 G

Seventh/ Eighth generation chipsets:

The Pentium 4 and Celeron processors using Socket 423 and those made for Socket 478 are essentially the same processors with different cache designs and minor internal revisions, So the same chipset can be used for both processors. The Pentium 4 processor in Socket 775 is different from its predecessors, consequently, most 9XX series chipsets support only the Socket 775 version of the Pentium 4 as well as the newer core 2 series of processors.

Pentium 4 8XX series chipsets:

- 850	- 865 PE	- 865 G
- 850E	- 845 GL	- 865 GV
- 845	- 845 G	- 875
- 845E	- 845 GE	- 848 P
- 848 P	- 845 GV	- 865 P
- 865 P	- 845 PE	- 865 PE

Intel 9XX series chipsets for Pentium 4:

- 910 GL
- 915 P
- 915 PL

Intel 9XX series chipsets for Core 2, Pentium D, Pentium Extreme Edition and Pentium 4:

- 975 X
- 955 X
- 915 G
- 915 GV

- 915 GL
- 925 X
- 925 XE
- 945 G

- 945 P
- 945 PL

5. Explain briefly about third party chipsets VIA, SiS and NVIDIA.

VIA chipsets

VIA Technologies, Inc., was the largest chipset and processor supplier outside of Intel and AMD. Originally founded in 1987, VIA is based in Taipei, Taiwan, and is the largest integrated cir- cuit design firm on the island. VIA is a fabless company, which means it farms out the manufacturing to other companies with chip foundry capability.

VIA Technologies produced a number of chipsets for Pentium 4 processors in its P4X, P4M, PT8 and PM8 series, as well as South Bridge chips (VT series). The PT8 and PM series also supported Intel's Core 2 processors.

SiS chipsets

SiS offered several chipsets for Intel processors, including integrated chipsets, chipsets for use with dis- crete video accelerator cards, and some that support Rambus RDRAM. SiS chipsets for the Pentium 4 and Pentium D use one of several high-speed South Bridge equivalents (SiS 96x series Media I/O chips) instead of integrating North and South Bridge functions into a single chip.

SiS has produced a variety of chipsets for the Athlon, Duron, Athlon XP and Athlon 64 processors, some of which use a single-chip design and others of which use a high-speed two-chip design similar to other vendors' chipsets.

NVIDIA chipsets

NVIDIA, although best known for its popular GeForce line of graphics chipsets, also became a popular vendor of chipsets for the AMD Athlon/Duron/Athlon XP processor family thanks to its nForce prod- uct families. The original nForce was a descendant of the custom chipset NVIDIA created for the Microsoft Xbox console game system.

NVIDIA produced chipsets for Intel processors from the Pentium 4 through the Core 2 Extreme series. Current offerings include the nForce 600 and nForce 700i series, and the GeForce 7 and GeForce 9000 series with integrated video.

6. Compare Desktop vs Laptop motherboards.

Personal computing began in the early 1970s and has since evolved to suit the needs and wishes of consumers of all types. The motherboard is the central nervous system of personal computers, and they differ greatly between desktops and laptops.

Layout

Modern desktop computers use a modular layout for the motherboard, which makes it easier to upgrade components such as video and sound cards and memory. Laptops, however, have precious little space to work with, so laptop motherboards are designed to fit each type of laptop specifically.

Expansion

Computer technology evolves rapidly, and the motherboards in desktop computers provide more expansion slots than those in laptops, allowing for easier upgrading to increase the longevity and performance of the computer. Each laptop, with its unique motherboard layout, sacrifices expansion to allow for ever-thinner and lighter models.

Compatibility

Laptop and desktop motherboards also differ in the type of components they are compatible with. Some laptop manufacturers use proprietary memory modules, which means you can only expand the memory capacity of the computer if you buy the memory stick from your computer's manufacturer. Desktops, on the other hand, support an extensive choice of component manufacturers.

7. **What is Bus? Explain the Bus Standards : ISA,PCI and MCA.**

8. **Explain the following: a) ISA, b) PCI, c) PCI Express, d) AGP, e)MCA(APR 2012)(NOV 2010)**

A bus is simply a circuit that connects one part of the motherboard to another. The more data a bus can handle at one time, the faster it allows information to travel. The **speed** of the bus, measured in megahertz (MHz), refers to how much data can move across the bus simultaneously.
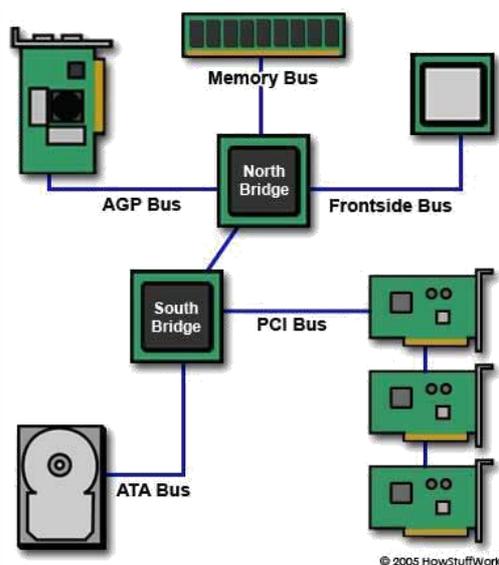
Bus speed usually refers to the speed of the **front side bus** (FSB), which connects the CPU to the northbridge. FSB speeds can range from 66 MHz to over 800 MHz. Since the CPU reaches the memory controller though the northbridge, FSB speed can dramatically affect a computer's performance. Here are some of the other busses found on a motherboard:

The **back side bus** connects the CPU with the level 2 (L2) cache, also known as secondary or external cache. The processor determines the speed of the back side bus.

- The **memory bus** connects the northbridge to the memory.

The **IDE**or **ATA** bus connects the southbridge to the disk drives.

The **AGP**bus connects the video card to the memory and the CPU. The speed of the AGP bus is usually 66 MHz.

The **PCI**bus connects PCI slots to the southbridge. On most systems, the speed of the PCI bus is 33 MHz. Also compatible with PCI is **PCI Express**, which is much faster than PCI but is still compatible with current software and operating systems. PCI Express is likely to replace both PCI and AGP busses.

The faster a computer's bus speed, the faster it will operate -- to a point. A fast bus speed cannot make up for a slow processor or chipset.

Industry Standard Architecture (ISA)

In the early days of microprocessor chip based microcomputers, all microcomputers were built using their own proprietary bus designs. Before long someone had the bright idea that if designers used the same design specifications, you could build a computer out of "boards" from different companies. This idea created the the S-100, a bus that is still in use today in some areas. About the middle of 1975 Apple used an expansion bus on their Apple II, and its success set the stage for the desk top computers that followed, including the IBM PC when it appeared in 1981. The original PC used Intel's 8088 processor which was a 16-bit CPU that spoke to the world through an 8-bit data path. The original PC 8-bit bus slot is still used by some simple I/O cards today. The 8088 ran at 4.77MHz, which was fine for the expansion cards, and running the expansion slots at the same clock speed as the CPU made the system boards easier to design and cheaper to build.

The IBM AT introduced a 16 bit data bus and the expansion slots had to handle 16 data bits. The industry wanted to be able to use existing 8-bit cards, so the new "AT" slot had to be designed to be backward compatible with the PC slots. The AT extension connector was added to the end of the **62 pinedge connector** of the original 8-bit bus slot. This **extension is a 36 pin edge connector**. This bus slotwas later given the name Industry Standard Architecture (ISA) and has survived to this day. One important aspect of this bus was that IBM never made any specification about bus speeds.

In the original 6MHz IBM AT, and the subsequent 8MHz version, the bus simply ran along at the same speed as the CPU. It was not surprising that as clone vendors started looking for a marketing edge over IBM, they simply kept the bus running at the CPU speed as they boosted speeds to 10MHz, 12MHz, and even faster. This lead to problems with users starting to run into problems. Boards that ran fine in a 6 or 8 MHz computer were not reliable in faster ones. The problem was especially severe with network cards. It turned out that they couldn't run at these higher clock speeds. The industry eventually settled on 8MHz as the standard maximum clock speed and the name **Industry Standard Architecture.PCI The Universal Bus**

PCI is platform independent and was soon used in computers built around the PowerPC chip. This is one of the few times a standard I/O bus has been used across platforms and so this has to be a big feature in it'sfavour. The various companies involved in the PowerPC development, including Apple and IBM adopted the PCI-Bus for PowerPC based computers. Apple had been using the Macintosh NuBus for many years, but switched to the PCI-Bus for it's PowerPC products. It is ironical that the largest user of Motorola based processors lined up to buy bus technology from Intel.

Other computer manufacturers are also using the PCI-Bus in there computer platforms with Digital Equipment Corp. (DEC) with their Alpha RISC-based systems, and Hewlett-Packard and SUN Microsystems all including PCI-Bus slots in there products. Intel licensed its patents on the PCI Bus free of royalties to all who wished to use it.
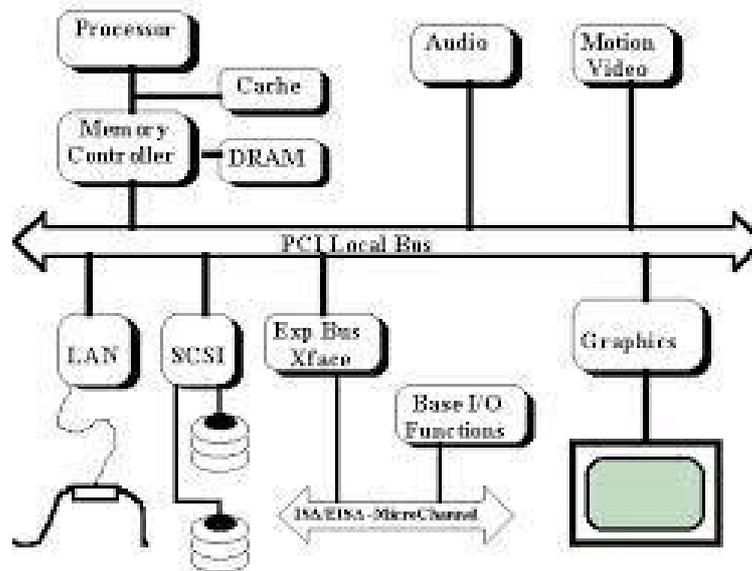
PCI BUS Structure

By adopting an established industry standard the manufacturers of the other computer platforms are ensuring lower costs and more options for both users and developers who are no longer locked into their own proprietary options. The wide range of cards that have followed the use of the PCI-Bus on PC systems are available for the first time to users of other hardware. All that should be required is alternative driver software for the various platforms.

Peripheral Component Interconnect Express

Peripheral Component Interconnect Express (PCIe or PCI-E) is a serial expansion bus standard for connecting a computer to one or more peripheral devices.

PCIe provides lower latency and higher data transfer rates than parallel busses such as PCI and PCI-X. Every device that's connected to a motherboard with a PCIe link has its own dedicated point-to-point connection. This means that devices are not competing for bandwidth because they are not sharing the same bus.

Peripheral devices that use PCIe for data transfer include graphics adapter cards, networkinterface cards (NICs), storage accelerator devices and other high-performance peripherals.

With PCIe, data is transferred over two signal pairs: two wires for transmitting and two wires for receiving. Each set of signal pairs is called a "lane," and each lane is capable of sending and receiving eight-bit data packets simultaneously between two points.

PCIe can scale from one to 32 separate lanes; it is usually deployed with 1, 4, 8, 12, 16 or 32 lanes. The lane count of a PCIe card is a determining factor in its performance and therefore in its price. For example, an inexpensive PCIe device like NICs might only use four lanes (PCIe x4). By comparison, a high-performance graphics adapter that uses 32 lanes (PCIe x32) for top-speed transmission would be more expensive.

PCIe bus slots are typically backward compatible with other PCIe bus slots, allowing PCIe links that use fewer lanes to use the same interface as PCIe links that use more lanes. For example, a PCIe x8 card could plug into a PCIe x16 slot. PCIe bus slots are not backwards compatible, however, with connection interfaces for older bus standards.

With PCIe, data center managers can take advantage of high-speed networking across server backplanes, and connect to Gigabit Ethernet, RAID and Infiniband networking technologies outside of the server rack. The PCIe bus also interconnects clustered computers that use HyperTransport.

For laptops and mobile devices, mini PCI-e cards can be used to connect wireless adaptors, solid state device storage and other performance boosters. External PCI Express (ePCIe) is used to connect the motherboard to an external PCIe interface. In most cases, designers use ePCIe when the computer requires an unusually high number of PCIe ports.

Accelerated Graphics Port (AGP)

In the mid 1990s, Intel created AGP as a new bus specifically designed for high-performance graphics and video support. AGP is based on PCI, but it contains several additions and enhancements and is physically, electrically, and logically independent of PCI. For example, the AGP connector is similar to PCI, although it has additional signals and is positioned differently in the system. Unlike PCI, which is a true bus with multiple connectors (slots), AGP is more of a point-to-point high-performance connection designed specifically for a video card in a system because only one AGP slot is allowed for a single video card. Intel originally released the AGP specification 1.0 in July 1996 and defined a 66MHz clock rate with 1x or 2x signaling using 3.3V. AGP version 2.0 was released in May 1998 and added 4x signaling as well as a lower 1.5V operating capability. The final revision for the AGP specification for PCs is AGP 8x, also called AGP 3.0. AGP 8x defines a transfer speed of 2,133MBps, which is twice that of AGP 4x. The AGP 8x specification was publicly announced in November 2000. Although AGP 8x (2,133MBps) is 16 times faster than 32-bit 33MHz PCI (133MBps), AGP 8x is only about half as fast as PCI Express x16 (4,000MBps). Starting in mid-2004, motherboard and system vendors began to replace AGP 8x with PCI Express x16 expansion slots in high-performance systems. By early 2006, most motherboards featured PCI Express x16 slots in place of AGP.

Micro Channel Architecture (MCA)

IBM tried to regain control of the PC computer market with it's PS/2 range and the Micro Channel(MCA) bus. The response from a number of influential clone manufacturers was to get together and design the Extended Industry Standard Architecture (EISA) bus, providing a 32-bit data path. The advantage of the EISA design over Micro Channel was that it remained backward compatible with ISA boards, right back to 8-bit cards. The cost of the computers using the MCA or EISA buses were high and so these new busses failed to get much of a market share. Computer purchasers went on buying more ISA Bus machines than anything else.

The PCI-Bus (Peripheral Component Interconnect) was originally designed to speed up the display of graphics on Intel-based personal computers, but the standard itself is processor independent and suitable for other hardware add-ons that require high bandwidth, including network, video and SCSI adaptors. PCI was developed by INTEL but it did take some time to get it to work reliably. By the middle of 1993 the VESA-Bus became firmly entrenched in the market place and almost all DOS computer systems had

VESA-Bus slots as standard. The wide acceptance of local bus technology only took a few months and by default, VESA-Bus become the first Local Bus standard.

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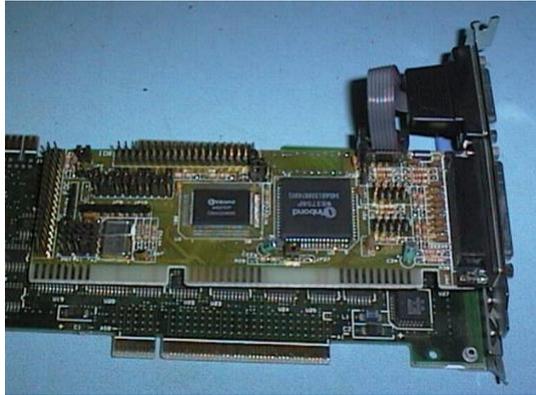
For a while, many people in the computer industry saw a local-bus war between the two competing local-bus standards (VESA-Bus and PCI-Bus) but in reality they were not in the same battlefield. The PCI and VESA Local-Busses did basically the same thing - both speed up PC computers by letting peripherals like graphics adaptors and hard disk controllers run at up to 33MHz, instead of the 8MHz that the ISA-Bus limited them to. The similarity breaks down when we start talking about how the two designs work.

The VESA-Bus bypassed the ISA bus by using the same bus the CPU is connected to it's RAM memory by and so it was relatively cheap and easy for system and peripheral makers to implement. Intel's PCI-Bus on the other hand, was a whole new bus, in much the same way the EISA and MCA busses were. The PCI bus gave only a slight speed improvement when used with 486 based systems, but it was far ahead when used with the Pentium chip.

9. **Describe the features of PCI Bus, also list out the pins and signals available in PCI bus.** (NOV 2014)

Features of PCI Bus:

The various features of PCI Architecture are given below:

Synchronous Bus Architecture: PCI is a synchronous Bus . All data transfers in PCI bus takes placeaccording to a system clock. The first PCI which was launched by Intel , supports 33 Mhz maximum clock rate while the newer PCI Buses now supports maximum clock frequency of 66 MHz.

64 Bit Addressing: PCI Bus also supports 64 bit addressing. With PCI Bus, 64 Bit addressing can beimplemented with the same 32 Bit connector. Dual address cycles are issued in which the lower order 32 bits addresses are driven onto during the first address phase and higher order 32 bits are driven onto during a second address phase. It does not requires a longer connector with additional 32 bit data signals.

Linear Burst Mode Data Transfer: PCI supports the feature of 'Burst Data Transfer'. With Burst DataTransfer, the data can be transferred at very high speeds. In Burst Data Transfer, a single address cycle can be followed by multiple data cycles. Thus , in Burst Data Transfer, Data is read and written to a single address location, which goes on automatically increment. In short, the data will be present on the bus, on each clock cycle. With this, we can achieve very high data transfer speeds that is 266 MB/sec for 32 bit data. With each clock cycle, a new data will be placed on the bus. If the cycle frame signal is active only for one data cycle, an ordinary transfer takes place. But if it is active for multiple clock cycles then the Burst Data Transfer takes place.

Large Bandwidth: PCI bus has much larger bandwidth than its previous buses (ISA, EISA and MCA).It can handle both 32 bit as well as 64 bit data. For 32 bit data, the maximum bandwidth will be 132 MB/sec which becomes more when Burst Data Transfer mode is used . It comes out to 364 MB/sec when Burst Data Transfer is used. Thus the bandwidth of PCI bus is very larger.
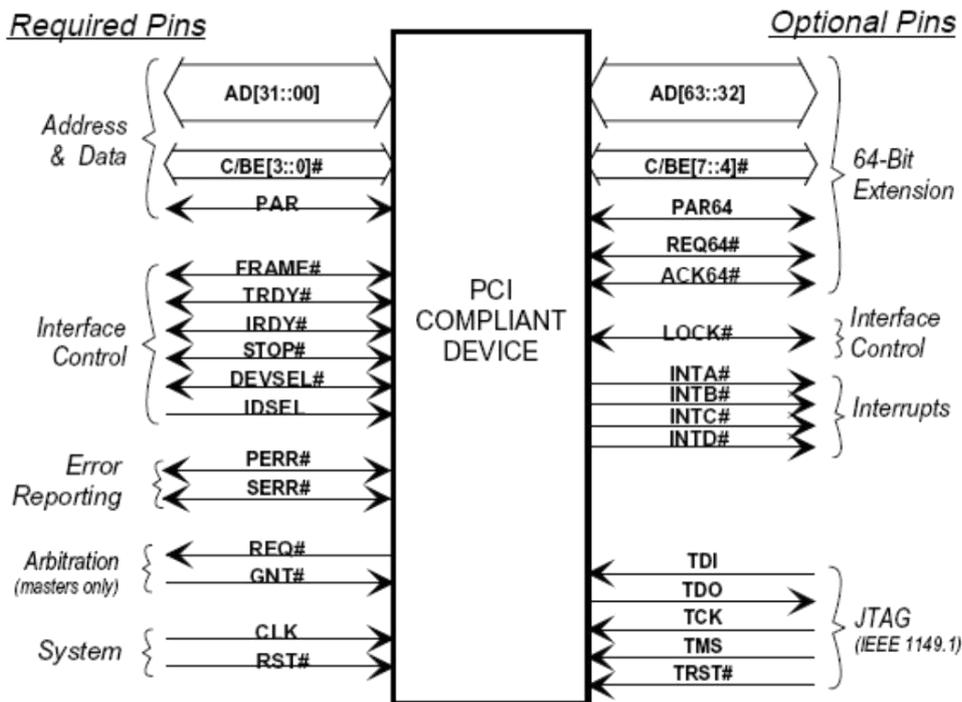

Figure 2-1: PCI Pin List

10. Explain briefly about the system resources Interrupts, DMA channels and I/O Port addresses

System resources are the communications channels, addresses, and other signals that hardware devices use to communicate on the bus. At their lowest level, these resources typically include the following:

- Memory addresses
- IRQ (interrupt request) channels
- DMA (direct memory access) channels
- I/O port addresses

These resources are required and used by many components of your system. Adapter cards need these resources to communicate with your system and accomplish their purposes. Not all adapter cards have the same resource requirements. A serial communications port, for example, needs an IRQ chan- nel and I/O port address, whereas a sound card needs these resources and at least one DMA channel. As systems increased in complexity from the late 1980s on, the chance for resource conflicts also increased. The configuration problem came to a head in the early 1990s, when manual configuration was the norm. Starting around that time, Microsoft and Intel developed PnP, which allowed for auto-matic detection, management and configuration of hardware, usually without user involvement. Windows 95 was the first PnP-aware PC operating system (OS), and by the time it was released, most hardware began supporting the PnP standard. Plug and Play was later superceded by Advanced Configuration and Power Interface (ACPI), which combined device configuration and power manage-

ment into a single specification. Modern systems with ACPI and modern buses such as PCI and PCI Express rarely have problems con- figuring these resources. In virtually all cases, the configuration will be automatic and trouble free.

INTERRUPTS

Interrupt request channels, or hardware interrupts, are used by various hardware devices to signal the motherboard that a request must be fulfilled. This procedure is the same as a student raising his hand to indicate that he needs attention.

These interrupt channels are represented by wires on the motherboard and in the slot connectors. When a particular interrupt is invoked, a special routine takes over the system, which first saves all the CPU register contents in a stack and then directs the system to the interrupt vector table. This vector table contains a list of memory addresses that correspond to the interrupt channels. Depending on which interrupt was invoked, the program corresponding to that channel is run. The pointers in the vector table point to the address of whatever software driver services the card that generated the interrupt. For a network card, for example, the vector might point to the address of the network drivers that have been loaded to operate the card; for a hard disk controller, the vector might point to the BIOS code that operates the controller. After the particular software routine performs whatever function the card needed, the interrupt-control software returns the stack contents to the CPU registers, and the system resumes whatever it was doing before the interrupt occurred. Through the use of interrupts, your system can respond to external events in a timely fashion. Each time a serial port presents a byte to your system, an interrupt is generated to ensure that the system reads that byte before another comes in. Keep in mind that in some cases a port device in particular, a modem with a 16550 or higher UART chip incorporates a byte buffer that allows multiple characters to be stored before an interrupt is generated. Hardware interrupts are generally prioritized by their numbers; with some exceptions, the highest-priority interrupts have the lowest numbers. Higher-priority interrupts take precedence over lower-priority interrupts by interrupting them. As a result, several interrupts can occur in your system con-currently, with each interrupt nesting within another. The ISA bus uses edge-triggered interrupt sensing, in which an interrupt is sensed by a changing signal sent on a particular wire located in the slot connector. A different wire corresponds to each possible hardware interrupt. Because the motherboard can't recognize which slot contains the card that used an interrupt line and therefore generated the interrupt, confusion results if more than one card is set to use a particular interrupt. Each interrupt, therefore, is usually designated for a single hardware device. Most of the time, interrupts can't be shared. Originally, IBM developed ways to share interrupts on the ISA bus, but few devices followed the nec- essary rules to make this a reality. The PCI bus inherently allows interrupt sharing; in fact, virtually all PCI cards are set to PCI interrupt A and share that interrupt on the PCI bus. The real problem is that there are technically two sets of hardware interrupts in the system: PCI interrupts and ISA interrupts. For PCI cards to work in a PC, the PCI interrupts are first mapped to ISA interrupts, which are then configured as non shareable. Therefore, in many cases you must assign a non conflicting

interrupt for each card, even PCI cards. The conflict between assigning ISA IRQs for PCI interrupts caused many configuration problems for early users of PCI motherboards and continued to cause problems even after the development of Windows 95 and its PnP technology. The solution to the interrupt sharing problem for PCI cards was something called PCI IRQ Steering, which has been supported in OSs (starting with Windows 95 OSR 2.x) and BIOSs for more than a decade. PCI IRQ Steering allows a plug-and-play operating system such as Windows to dynamically map or —steer‖ PCI cards (which almost all use PCI INTA#) to standard PC interrupts and allows several PCI cards to be mapped to the same interrupt. More information on PCI IRQ Steering is found in the section —PCI Interrupts,‖ later in this chapter. Hardware interrupts are sometimes referred to as maskable interrupts, which means you can mask or turn off the interrupts for a short time while the CPU is used for other critical operations. It is up to the sys- tem BIOS and programs to manage interrupts properly and efficiently for the best system performance.

DMA CHANNELS

Communications devices that must send and receive information at high speeds use direct memory access (DMA) channels. Conflicts between devices needing to use the same DMA channel were common on systems using ISA slots, but are no longer an issue on modern systems.

I/O PORT ADDRESSES

Computer's I/O ports enable communications between devices and software in the system. They are equivalent to two-way radio channels. If we want to talk to the serial port, we need to know on which I/O port (radio channel) it is listening. Similarly, if we want to receive data from the serial port, we need to listen on the same channel on which it is transmitting. Unlike IRQs and DMA channels, our systems have an abundance of I/O ports. There are exactly 65,536 ports numbered from 0000h to FFFFh which is a feature of the Intel x 86 processor designs. Even though most devices use up to eight ports for themselves, with that many to spare, you won't run out anytime soon. The biggest problem we have to worry about is setting two devices to use the same port. Most modern plug-and-play systems resolve port conflicts and select alternative ports for one of the conflicting devices. One confusing issue is that I/O ports are designated by hexadecimal addresses similar to memory addresses. They are not memory; they are ports. The difference is that when you send data to memory address 1000h, it is stored in your system's DIMM memory. If you send data to I/O port address 1000h, it is sent out on the bus on that —channel,‖ and anybody listening in could then —hear‖ it. If nobody is listening to that port address, the data reaches the end of the bus and is absorbed by the bus terminating resistors. Driver programs are primarily what interact with devices at the various port addresses. The driver must know which ports the device is using to work with it, and vice versa. That is not usually a prob- lem because the driver and device come from the same company. Motherboard and chipset devices usually are set to use I/O port addresses 0h–FFh, and all other devices use 100h–FFFFh.

11. Explain the working principle SMPS with functional block diagram. (APR 2012), (NOV 2012) (NOV 2013)

12. Explain the working principle of SMPS. What are the types of SMPS, Explain?

A switched-mode power supply (switching-mode power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a source, like mains power, to a load, such as a personalcomputer, while converting voltage and current characteristics. An SMPS is usually employed to efficiently provide a regulated output voltage, typically at a level different from the input voltage.

Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions (which minimizes wasted energy). Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

Switching regulators are used as replacements for the linear regulators when higher efficiency, smaller size or lighter weights are required. They are, however, more complicated, their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor powerfactor.

A switched-mode power supply, switch-mode power supply, or SMPS, is an electronic powersupply unit (PSU) that incorporates a switching regulator — an internal control circuit that switches power transistors (such as MOSFETs) rapidly on and off in order to stabilize the output voltage or current. Switching regulators are used as replacements for the linear regulators when higher efficiency, smaller size or lighter weights are required. They are, however, more complicated and their switching currents can cause noise problems if not carefully suppressed, and simple designs may have a poor power factor. The power output to cost crossover point between SMPS and linear regulating alternatives has been falling since the early 1980s as SMPS technology was developed and integrated into dedicated silicon chips. In early 2006 even very low power linear regulators became more expensive than SMPS when the cost of copper and iron used in the transformers increased abruptly on world markets.

SMPS can also be classified into four types according to the input and output waveforms, as follows.

AC in, DC out: rectifier, off-line converter

DC in, DC out: voltage converter, or current converter, or DC to DC converter

AC in, AC out: frequency changer, cycloconverter

DC in, AC out: inverter

AC and DC are abbreviations for alternating current and direct current.

SMPS compared with linear PSUs

There are two main types of regulated power supplies available: SMPS and Linear. The reasons for choosing one type or the other can be summarized as follows.

Size and weight — Linear power supplies use a transformer operating at the mains frequency of 50/60 Hz. This component is larger and heavier by several times than the corresponding smaller transformer in an SMPS, which runs at a higher frequency (always above the highest audiblefrequency, around 50 kHz to 200 kHz)

Efficiency — Linear power supplies regulate their output by using a higher voltage in the initial stages and then expending some of it as heat to improve the power quality. This power loss is necessary to the circuit, and can be reduced but never eliminated by improving the design, even in theory. SMPSs draw current at full voltage based on a variable duty cycle, and can increase or decrease their power consumption to regulate the load as required. Consequently, a well designed SMPS will be more efficient.

Heat output or powerdissipation — A linear supply will regulate the voltage or current by wasting excess voltage or current as heat, which is very inefficient. A regulated SMPS will regulate using Pulse Width Modulation or, at power ratings below 30W, ON/OFF control. In all SMPS topologies, the transistors are always fully on or fully off. Thus, an "ideal" SMPS will be 100% efficient. The only heat generated is because ideal components do not exist. Switching losses in the main switching transistors, non-zero resistance in the "on" state and rectifier voltage drop will produce a fair amount of heat. However, by optimizing SMPS design, the amount of heat produced can be minimized. A good design can have an efficiency of more than 95%.

Complexity — A linear regulator ultimately consists of a power transistor, voltage regulating IC and a noise filtering capacitor. An SMPS typically contains PWM controller, one or several power transistors and diodes as well as power transformer, inductor and filter capacitors. Multiple voltages can be generated by one transformer core. For this an SMPS has to use pulse width modulation on the primary winding and "post-regulating" such as phase control on the secondary windings, while the linear PSU normally uses independent voltage regulators for the auxiliary outputs. Both need a careful design for their transformers, which therefore are often produced in series and available in stock. Due to the high frequencies in SMPS the inductances and capacitances of the traces become important.

Radio frequency interference — The currents in a SMPS are switched at a high frequency. This high-frequency currents can generate undesirable electromagnetic interference. EMI filters and RFshielding are needed to reduce the disruptive interference. Linear PSUs, however, generally do not produce interference.

Electronic noise at the output terminals — Inexpensive linear PSUs with poor regulation may experience a small AC voltage "riding on" the DC output at twice mains frequency (100/120 Hz). These "ripples" are usually on the order of millivolts, and can be suppressed with larger filter

capacitors or better voltage regulators. This small AC voltage can cause problems in some circuits. Quality linear PSUs will suppress ripples much better. SMPS usually do not exhibit ripple at the power-line frequency, but do have generally noisier outputs than linear PSUs; the noise may be correlated with the SMPS switching frequency or it may also be more broad-band.

Acoustic noise — Linear PSUs typically give off a faint, low frequency hum at mains frequency, but this is seldom audible. (The transformer is responsible.) SMPSs, with their much higher operating frequencies, are not usually audible to humans (unless they have a fan, in the case of most computer SMPSs). A malfunctioning SMPS may generate high-pitched sounds, since they do in fact generate acoustic noise at the oscillator frequency.

Power factor — The current drawn by simple SMPS is non-sinusoidal and do not follow the supply's input voltage waveform, so the early SMPS designs have a mediocre power factor of about 0.6, and their use in personal computers and compact fluorescent lamps presented a growing problem for power distribution. Power factor correction (PFC) circuits can reduce this problem, and are required in some countries (European in particular) by regulation. Linear PSUs also do not have unity power factors, but are not as problematic as SMPSs.

Electronic noise at the input terminals — In a similar fashion, very low cost SMPS may couple electrical noise back onto the mains power line; Linear PSUs rarely do this.

How an SMPS works

If the SMPS has an AC input, then its first job is to convert the input to DC. This is called *rectification*. The rectifier circuit can be configured as a voltage doubler by the addition of a switch operated either manually or automatically. This is a feature of larger supplies to permit operation from nominally 120 volt or 240 volt supplies. The rectifier produces an unregulated DC voltage which is then sent to a large filter capacitor. The current drawn from the mains supply by this rectifier circuit occurs in short pulses around the AC voltage peaks. These pulses have significant high frequency energy which reduces the power factor. Special control techniques can be employed by the following SMPS to force the average input current to follow the sinusoidal shape of the AC input voltage thus the designer should try correcting the power factor. A SMPS with a DC input does not require this stage. A SMPS designed for AC input can often be run from a DC supply, as the DC passes through the rectifier stage unchanged.
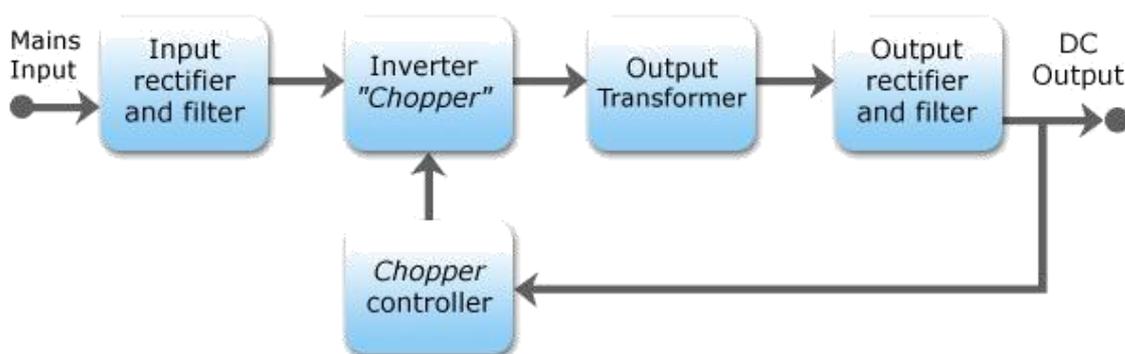
Block diagram of a mains operated AC-DC SMPS with output voltage regulation.

Input rectifier stage
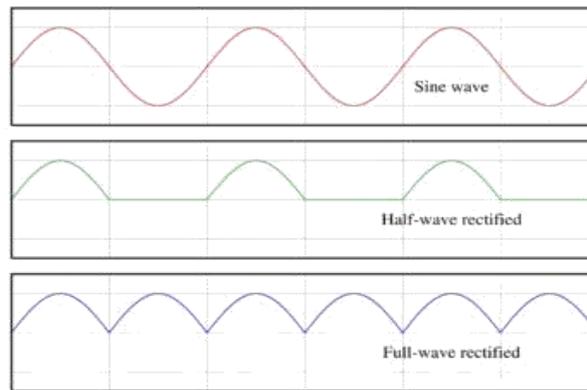
AC, half-wave and full wave rectified signals

If an input range switch is used, the rectifier stage is usually configured to operate as a voltagedoubler when operating on the low voltage (~120 VAC) range and as a straight rectifier when operating on the high voltage (~240 VAC) range. If an input range switch is not used, then a full-wave rectifier is usually used and the downstream inverter stage is simply designed to be flexible enough to accept the wide range of dc voltages that will be produced by the rectifier stage. In higher-power SMPSs, some form of automatic range switching may be used.

Inverter stage

The inverter stage converts DC, whether directly from the input or from the rectifier stage described above, to AC by running it through a power oscillator, whose output transformer is very small with few windings at a frequency of tens or hundreds of kilohertz (kHz). The frequency is usually chosen to be above 20 kHz, to make it inaudible to humans. Computer supplies run at 360 volts DC. The output voltage is optically coupled to the input and thus very tightly controlled. The switching is implemented as a multistage (to achieve high gain) MOSFETs amplifier. MOSFETs are a type of transistor with a low on-resistance and a high current-handling capacity. This section refers to the block marked "Chopper" in the block diagram.

Voltage converter and output rectifier

If the output is required to be isolated from the input, as is usually the case in mains power supplies, the inverted AC is used to drive the primary winding of a high-frequency transformer. This converts the voltage up or down to the required output level on its secondary winding. The output transformer in the block diagram serves this purpose.

If a DC output is required, the AC output from the transformer is rectified. For output voltages above ten volts or so, ordinary silicon diodes are commonly used. For lower voltages, Schottky diodes are commonly used as the rectifier elements; they have the advantages of faster recovery times than silicon diodes (allowing low-loss operation at higher frequencies) and a lower voltage drop when conducting. For even lower output voltages, MOSFET transistors may be used as synchronousrectifiers; compared to Schottky diodes, these have even lower "on"-state voltage drops.

The rectified output is then smoothed by a filter consisting of inductors and capacitors. For higher switching frequencies, components with lower capacitance and inductance are needed.

Simpler, non-isolated power supplies contain an inductor instead of a transformer. This type includes *boost converters*, *buck converters*, and the so called *buck-boost converters*. These belong to the simplest class of single input, single output converters which utilise one inductor and one active switch (MOSFET). The buck converter reduces the input voltage, in direct proportion, to the ratio of the active switch "on" time to the total switching period, called the Duty Ratio. For example an ideal buck converter with a 10V input operating at a duty ratio of 50% will produce an average output voltage of 5V. A feedback control loop is employed to maintain (regulate) the output voltage by varying the duty ratio to compensate for variations in input voltage. The output voltage of a *boost converter*is always greater than the input voltage and the buck-boost output voltage is inverted but can be greater than, equal to, or less than the magnitude of its input voltage. There are many variations and extensions to this class of converters but these three forms the basis of almost all isolated and non-isolated DC to DC converters. By adding a second inductor the Ćuk and SEPIC converters can be implemented or by adding additional active switches various bridge converters can be realised.

Other types of SMPS use a capacitor-diodevoltage multiplier instead of inductors and transformers. These are mostly used for generating high voltages at low currents. The low voltage variant is called charge pump.

Regulation

A feedback circuit monitors the output voltage and compares it with a reference voltage, which is set manually or electronically to the desired output. If there is an error in the output voltage, the feedback circuit compensates by adjusting the timing with which the MOSFETs are switched on and off. This part of the power supply is called the switching regulator. The "Chopper controller" shown in the block diagram serves this purpose. Depending on design/safety requirements, the controller may or may not contain an isolation mechanism (such as opto-couplers) to isolate it from the DC output. Switching supplies in computers, TVs and VCRs have these opto-couplers to tightly control the output voltage.

Open-loop regulators do not have a feedback circuit. Instead, they rely on feeding a constantvoltage to the input of the transformer or inductor, and assume that the output will be correct. Regulated designs work against the parasiticcapacity of the transformer or coil, monopolar designs also against the magnetic hysteresis of the core.

The feedback circuit needs power to run before it can generate power, so an additional non-switching power-supply for stand-by is added.

Power factor

Early switched mode power supplies incorporated a simple full wave rectifier connected to a large energy storing capacitor. Such SMPS draws current from the AC line in short pulses when the mains instantaneous voltage exceeds the voltage across this capacitor. During the remaining portion of the AC cycle the capacitor provides energy to the power supply. As the result, input current of such basic switched mode power supplies has high harmonics content and relatively low power factor. This

creates extra load on utility lines, increases heating of the utility transformers, and may cause stability problems in some applications such as in emergency generator systems or aircraft generators. In 2001 the European Union put into effect the standard IEC/EN61000-3-2 to set limits on the harmonics of the AC input current up to the 40th harmonic for equipment above 75W. The standard defines four classes of equipment depending on its type and current waveform. The most rigorous limits (class D) are established for personal computers, computer monitors, and TV receivers. In order to comply with these requirements modern switched-mode power supplies normally include an additional power factorcorrection (PFC) stage.

Types

Switched-mode power supplies can be classified according to the circuit topology.

Buck converter (single inductor; output voltage < input voltage)

Boost converter (single inductor; output voltage > input voltage)

buck-boost converter (single inductor; output voltage can be more or less than the input voltage)

fly back converter (uses output transformer; allows multiple outputs and input-to-output isolation)

- Half-Forward Topology

  Push-Pull Topology

- Half-Bridge Topology

- Full-Bridge Topology

- Resonance, zero voltage switched

Applications

Switched-mode PSUs in domestic products such as personal computers often have universal inputs, meaning that they can accept power from most mains supplies throughout the world, with rated frequencies from 50 Hz to 60 Hz and voltages from 100 V to 240 V (although a manual voltage "range" switch may be required). In practice they will operate from a much wider frequency range and often from a DC supply as well. In 2006, Intel proposed the use of a single 12 V supply inside PCs, due to the high efficiency of switch mode supplies directly on the PCB.

Cars, trucks, telecom lines, and production plants, but not planes, supply DC to avoid hum and ease the integration of capacitors and batteries used to buffer the voltage.

In the case of TV sets, for example, one can test the excellent regulation of the power supply by using a variac. For example, in some models made by Philips, the power supply starts when the voltage reaches around 90 volts. From there, one can change the voltage with the variac, and go as low as 40 volts and as high as 260, and the image will show absolutely no alterations.

13. Explain Power-Supply Connectors and switches.

Power supplies employ several types of connectors; all are easy to identify and use. On the outside of the computer enclosure, a standard male AC plug and three-conductor wire (two power wires and a ground) draws current from a wall outlet, with a female connection entering the receptacle in the back of the power supply. On the inside are three types of connectors: the power main to the motherboard (which differ, as mentioned, in AT and ATX models) and two types of four-pin fittings to supply 5 volts and 3.3 volts of power to peripherals such as the floppy disk and hard disk drives. Let's take a close look at each in turn.

AT-Style Connections to the Motherboard

A pair of almost identical connectors, designated P8 and P9, link the power supply to the motherboard (see Figure 5.1). These connectors are seated into a row of six pins and matching plastic guides, or "teeth," on the motherboard. The P8 and P9 connectors *must* be placed in the proper orientation. The motherboard manual will show which fitting is for P8 and P9. If the connectors are not marked, make sure that the two black wires on each plug are side by side and that the orange wire (on P8) and the two red wires (on P9) are on the outside as you push them into place.
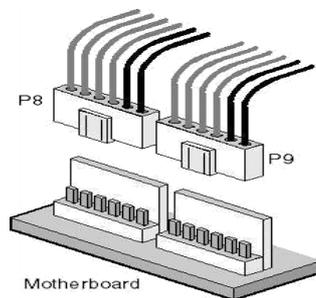

Fig :*P8 and P9 connectors and motherboard fitting*

The following table of power cables shows voltage values for each of the color-coded wires on P8 and P9. The ground wires are considered 0 volts; all voltage measurements are taken between the black wires and one of the colored wires.

Cable Color	Supply In	Tolerance
Yellow	+12	±10%
Blue	-12	±10%
Red	+5	±5%
White	-5	±5%

ATX Motherboard Connections

The newer ATX main power connection is much easier to install. A single 20-wire plug is set into a fitted receptacle and secured with a catch on the side of the plug that snaps over the fitting. Figure 5.3 shows the parts being seated. A small, flat-tip screwdriver is a handy tool for easing the pressure on the catch to remove the plug. In some cases, it can be used during installation as well.
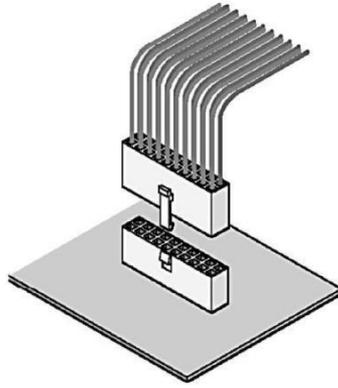
Figure:*Placing an ATX plug in its motherboard receptacle*

Connections to Peripheral Hardware

Two standard types of connectors can connect to peripheral hardware:

- **Molex connector:** This is the most commonly used power connector. It provides both 12-voltand 5-volt power. Hard disk drives, internal tape drives, CD-ROM drives, DVD (digital video disc) drives, and older 5.25-inch floppy disk drives all use this fitting. The Molex connector has two rounded corners and two sharp corners to ensure that it will be properly installed.
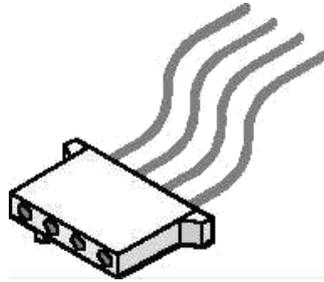
Figure :*Molex connector (not to scale)*

- **Mini connector:** Most power supplies provide one or more "mini" connectors (see Figure 5.5).The mini, shown in Figure 5.4, is used primarily on 3.5-inch floppy-disk drives. It has four pin-outs and, usually, four wires. Most are fitted with keys that make it difficult, but not impossible, to install upside down. Be sure to orient the connector correctly; applying power with the connector reversed can damage or destroy the drive.
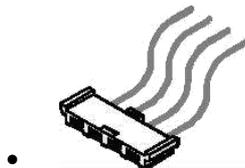

Figure :*Mini connector (not to scale)*

Two- and Three-Pin Mini Plugs

A less common type of power connector is used to connect the fan of a Pentium II or III processor to the motherboard for power, to connect a CD-ROM drive to a sound card, and to provide power for 3.5-inch floppy disk drives. These connectors have two or three wires which are usually red and black or red, yellow, and black.

Extenders and Splitters

PCs can run out of power connections, and large cases can have drives beyond the reach of any plug on the supply. A good technician has a quick solution on hand to both of these common problems: extenders and splitters.

Extenders are wire sets that have a Molex connector on each end; they are used to extend a powerconnection to a device beyond the reach of the power supply's own wiring. *Splitters* are similar to extenders, with the exception that they provide two power connections from a single power supply connector.

- Power supplies come in a variety of sizes and shapes.

- There are two types of main power connectors: AT and ATX.

- A power supply must be capable of handling the requirements of the computer and all internal devices.

- Be careful when attaching some connectors-if connected incorrectly, they can damage the computer.

- Do not open the power-supply housing!

- Keeping a few splitters and extenders in the repair kit can help the technician easily solve some common problems.

Various connectors from a computer PSU.

Typically, power supplies have the following connectors:

> **PC Main** power connector (usually called **P1**): This is the connector that goes to themotherboard to provide it with power. The connector has 20 or 24 pins. One of the pins belongs to the PS-ON wire (it is usually green). This connector is the largest of all the connectors. In older AT power supplies, this connector was split in two: **P8** and **P9**. A power supply with a 24-pin connector can be used on a motherboard with a 20-pin connector. In cases where the motherboard has a 24-pin connector, some power supplies come with two connectors (one with 20-pin and other with 4-pin) which can be used together to form the 24-pin connector.

12V only power connector (labelled**P1**, though it is not compatible with the ATX 20 or 24 pinconnector): This is a 16-pin Molex connector supplying the motherboard with six 12V lines with common returns, a 'supply OK' signal, a 'PSU ON' signal and an 11V auxiliary supply. One pin is left unused.[15]

12V only System monitoring (**P10**): This is a 171822-8 AMP or equivalent connector carryinga supply to the PSU fan and sense returns.[16]

- **ATX12V** 4-pin power connector (also called the **P4 power connector**). A second connector thatgoes to the motherboard (in addition to the main 24-pin connector) to supply dedicated power for the processor. For high-end motherboards and processors, more power is required, therefore EPS12V has an 8-pin connector.

- **4-pin Peripheral** power connectors: These are the other, smaller connectors that go to the various disk drives of the computer. Most of them have four wires: two black, one red, and one yellow. Unlike the standard mains electrical wire color-coding, each *black wire* is a ground, the *red wire* is +5 V, and the *yellow wire* is +12 V. In some cases these are also used to provideadditional power to PCI cards such as FireWire 800 cards.

  4-pin Molex (Japan) Ltd power connectors (usually called **Mini-connector** or "mini-Molex"):This is one of the smallest connectors that supplies a 3 1/2 inch floppy drive with power. In some cases, it can be used as an auxiliary connector for AGP video cards. Its cable configuration is similar to the Peripheral connector.

- **Auxiliary** power connectors: There are several types of auxiliary connectors designed to provideadditional power if it is needed.

  Serial ATA powerconnectors: a 15-pin connector for components which use SATA power plugs. This connector supplies power at three different voltages: +3.3, +5, and +12 volts.

  6-pin Most modern computer power supplies include 6-pin connectors which are generally usedfor PCI Express graphics cards, but a newly introduced 8-pin connector should be seen on the latest model power supplies. Each PCI Express 6-pin connector can output a maximum of 75 W.

  6+2 pin For the purpose of backwards compatibility, some connectors designed for use withhigh end PCI Express graphics cards feature this kind of pin configuration. It allows either a 6-pin card or an 8-pin card to be connected by using two separate connection modules wired into the same sheath: one with 6 pins and another with 2 pins.

  AIEC 60320 C14 connector with an appropriate C13 cord is used to attach the power supply to the local power grid.

14. Explain briefly about RTC/NVRAM Batteries or (CMOS Chips)

All 16-bit and higher systems have a special type of chip in them that combines a real-time clock (RTC) with at least 64 bytes (including the clock data) of Non-Volatile RAM (NVRAM) memory. This chip is officially called the RTC/NVRAM chip but is often referred to as the CMOS chip or CMOS RAM because the type of chip used is produced using a CMOS (Complementary Metal-Oxide

Semiconductor) process. CMOS design chips are known for very low power consumption. This special RTC/NVRAM chip is designed to run off a battery for several years.

The original chip of this type used in the IBM AT was the Motorola 146818 chip. Although the chips used today have different manufacturers and part numbers, they all are designed to be compatible with this original Motorola part.

These chips include a real-time clock. Its function should be obvious: The clock enables software to read the date and time and preserves the date and time data even when the system is powered off or unplugged.

The NVRAM portion of the chip has another function. It is designed to store basic system configuration, including the amount of memory installed, types of floppy and hard disk drives, and other information. Some of the more modern motherboards use extended NVRAM chips with as much as 2KB or more of space to hold this configuration information. This is especially true for Plug and Play systems, which store not only the motherboard configuration but also the configuration of adapter cards. This system can then read this information every time you power on the system.

These chips normally are powered by some type of battery while the system is off. This battery preserves the information in the NVRAM and powers the clock. Most systems use a lithium-type battery because they have a very long life, especially at the low power draw from the typical RTC/NVRAM chip.

Some systems have a chip that has the battery embedded within it. These are made by several companies—including Dallas Semiconductor and Benchmarq. These chips are notable for their long lives. Under normal conditions, the battery will last for 10 years—which is, of course, longer than the useful life of the system. If your system uses one of the Dallas or Benchmarq modules, the battery and chip must be replaced as a unit because they are integrated. Most of the time, these chip/battery combinations are installed in a socket on the motherboard just in case a problem requires an early replacement. You can get new modules direct from the manufacturers for $18 or less, which is often less than the cost of the older separate battery alone.

Some systems do not use a battery at all. Hewlett-Packard, for example, includes a special capacitor in some of its systems that is automatically recharged anytime the system is plugged in. Note that the system does not have to be running for the capacitor to charge; it only has to be plugged in. If the system is unplugged, the capacitor will power the RTC/NVRAM chip for up to a week or more. If the system remains unplugged for a duration longer than that, the NVRAM information is lost. In that case, these systems can reload the NVRAM from a backup kept in a special flash ROM chip contained on the motherboard. The only pieces of information that will actually be missing when you repower the system will be the date and time, which will have to be reentered. By using the capacitor combined with an NVRAM backup in flash ROM, these systems have a very reliable solution that will last indefinitely.

Many systems use only a conventional battery, which can be either directly soldered into the motherboard or plugged in via a battery connector. For those systems with the battery soldered in,

normally a spare battery connector exists on the motherboard where you can insert a conventional plug-in battery, should the original ever fail. In most cases, you would never have to replace the motherboard battery, even if it were completely dead.

Conventional batteries come in many forms. The best are of a lithium design because they will last from two to five years or more. I have seen systems with conventional alkaline batteries mounted in a holder; these are much less desirable because they fail more frequently and do not last as long. Also, they can be prone to leak, and if a battery leaks on the motherboard, the motherboard can be severely damaged. By far, the most commonly used battery for motherboards today is the 2032 lithium coin battery, which is about the size of a quarter and is readily available.

Besides the various battery types, the chip can require any one of several voltages. The batteries in PCs are typically 3.0v, 3.6v, 4.5v, or 6v. If you are replacing the battery, be sure your replacement is the same voltage as the one you removed from the system. Some motherboards can use batteries of several voltages. Use a jumper or switch to select the various settings. If you suspect your motherboard has this capability, consult the documentation for instructions on changing the settings. Of course, the easiest thing to do is to replace the existing battery with another of the same type.

Symptoms that indicate that the battery is about to fail include having to reset the clock on your PC every time you shut down the system (especially after moving it) and problems during the system's POST, such as drive-detection difficulties. If you experience problems such as these, you should make note of your system's CMOS settings and replace the battery as soon as possible.

15. What is BIOS? How BIOS works?

BIOS, in computing, stands for Basic Input/Output System also incorrectly known as Basic Integrated Operating System. BIO refers to the software code run by a computer when first powered on. The primary function of the BIOS is to prepare the machine so other software programs stored on various media (such as hard drives, floppies, and CDs) can load, execute, and assume control of the computer. This process is known as booting up.

BIOS can also be said to be a coded program embedded on a chip that recognises and controls various devices that make up the computer. The term BIOS is specific to personal computer vendors. Among other classes of computers, the generic terms *boot monitor*, *boot loader* or *boot ROM* are commonly used.

The term first appeared in the CP/M operating system, describing the part of CP/M loaded during boot time that interfaced directly with the hardware (CP/M machines usually had a simple boot loader in ROM, and nothing else). Most versions of DOS have a file called "IBMBIO.COM" or "IO.SYS" that is analogous to the CP/M disk BIOS.

How the BIOS boots

The BIOS runs off the PROM, EPROM or, most commonly, flash memory when the computer is powered on and it initializes and sometimes performs the Power-on self-test (POST), a set of diagnostic tests on the hard drive, memory, video, chipset and other hardware. Subsequently, it typically

decompresses itself from the BIOS memory space into the system main memory and starts executing from there. Nearly all BIOS implementations can optionally execute a setup program interfacing the nonvolatile BIOS memory (CMOS). This memory holds user-customizable configuration data (time, date, hard drive details, etc.) accessed by BIOS code. The 80x86 source code for early PC and AT BIOS was included with the IBM Technical Reference Manual.

In most modern BIOS implementations, users select which device boots first: CD, hard disk,floppy disk, flash key drive and the like. This is particularly useful for installing operating systems or booting to Live CDs, and for selecting the order of testing for the presence of bootable media.

Some BIOSes allow the user to select the operating system to load (e.g. load another OS from the second hard disk), though this is more often handled by a second-stage boot loader.

The BIOS boot specification

If the expansion ROM wishes to change the way the system boots (such as from a network device or a SCSI adapter for which the BIOS has no driver code), it can use the BIOS Boot Specification (BBS) API to register its ability to do so. Once the expansion ROMs have registered using the BBS APIs, the user can select among the available boot options from within the BIOS's user interface. This is why most BBS compliant PC BIOS implementations will not allow the user to enter the BIOS's user interface until the expansion ROMs have finished executing and registering themselves with the BBS API.

The fall and rise of the BIOS

Older operating systems such as DOS called on the BIOS to carry out most input-output tasks within the PC; with the introduction of newer operating systems such as Microsoft Windows and Linux, the BIOS was relegated to principally providing initial hardware setup, and bootstrapping. Once it was up and running, the operating system does not have to rely on the BIOS for much.

In recent years, by way of systems such as ACPI, the BIOS has taken on more complex functions such as aspects of power management, hotplug, thermal management etc. This has led to renewed reliance on the BIOS by operating system producers, and an increase in complexity in the BIOS code. This in turn has led to invention of Intel's modern Extensible Firmware Interface (EFI) which in itself incorporates BIOS's extended options. Microsoft announced that support for EFI in Windows Vista will be dropped for the launch, but added in a later update for 64 bit version.

BIOS shadowing

The process of the contents of the ROM being copied to the RAM allowing the computer to access that information quicker. This process is also known as **Shadow BIOS ROM**, **Shadow Memory** and **Shadow RAM**.

Below are examples of messages commonly seen when the computer is first booting indicating that the portions of a ROM are being copied to the system RAM. System BIOS shadowed

Video BIOS shadowed

Some computer BIOS setups may allow the user to enable and disable this feature. We recommend that it is left enabled; disabling this option could cause problems with some computers.

BIOS Upgrading

Sometimes, especially when upgrading the PC, may need to perform a BIOS upgrade in order to update your system to accept a new hardware part or to fix a bug. This procedure is quite obscure. In this tutorial we will give step-by-step procedures on how to upgrade your system BIOS.

BIOS is a program stored inside the ROM memory of your motherboard. There are three programs stored there: BIOS, setup and POST. As they are physically stored in the same memory chip, the majority of users calls setup and POST ―BIOS,‖ even though this is wrong, as they are three distinct programs. BIOS (Basic Input/Output System) teach the system processor how to deal with basic things, like how to access the hard disk drive and how to write text on the screen. POST (Power On Self Test) is executed whenever you turn on your PC in order to test system. It is in charge of that memory counting that happens every time turn on PC. And setup is that program that run by pressing Del during POST (i.e., during memory counting) that is used to configure your motherboard.

So, ―BIOS upgrade‖ really means an upgrade on the programs stored on the motherboard ROM memory. Even though the procedure name is ―BIOS upgrade,‖ actually upgrade all three programs (BIOS, POST and setup).

The way to update the motherboard ROM depends on the type of memory chip used in your PC. There are two types of ROM chips used in PCs: Mask-ROM (only on very old motherboards that cannot be updated by software) and Flash-ROM (on almost all motherboards, which is able to be updated by software). In this tutorial we will cover Flash-ROM.If we have a very old motherboard (manufactured more than 10 years ago) that uses a Mask-ROM chip BIOS upgrade is only possible by replacing the chip with a new one containing the latest BIOS version. This chip can be bought on the motherboard manufacturer's web site.

16. Explain briefly about CMOS setup.

The computers for Carbon dedicated cabinets are being built with both Asus and Gigabyte motherboards. The BIOS settings are different for the two systems. To determine which motherboard is in your computer, check the audio ports on the computer rear panel. The Asus has four audio ports, and the Gigabyte has six audio ports.

If you are comfortable using the CMOS Setup Utility, connect a keyboard to the computer and press the **DEL** key during boot to run the Utility, select **Load Optimized Defaults** from the Main Menu, and then change the settings shown in the table below.

| Menu	Item	Setting
Standard CMOS Features	Drive A	None
	Halt On	No Errors
Advanced BIOS Features	First Boot Device	CDROM
	Second Boot Device	Hard Disk
	Third Boot Device	Disabled
Integrated Peripherals	USB Keyboard Support	Enabled
	USB Mouse Support	Enabled
Power Management Setup	AC Back Function	Full On
PC Health Status	CPU Smart FAN Control	Disabled

1. Power off the computer and connect a keyboard to the computer. Power on and press the **DEL** key during boot. The CMOS Setup Utility Main Menu will appear:
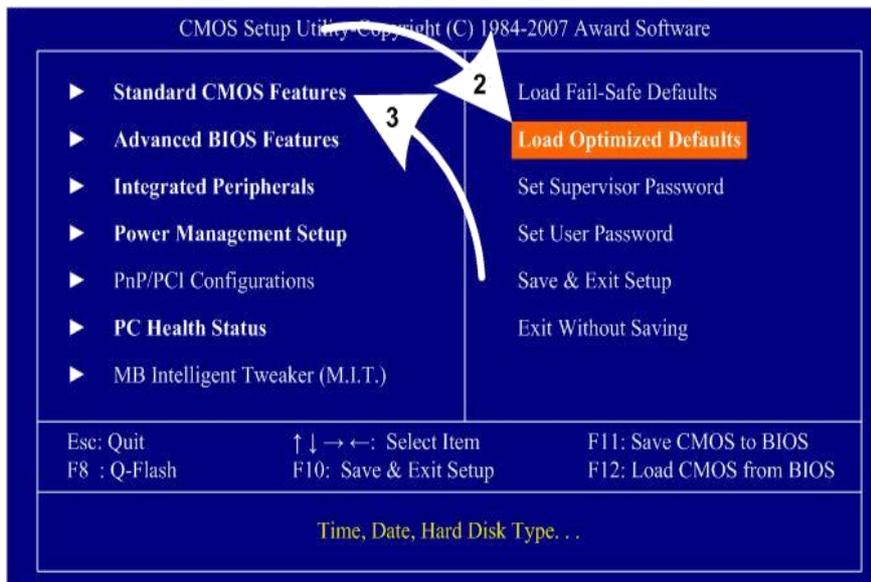
2. Use the Arrow keys (↑↓→←) to select **Load Optimized Defaults**, and press **Enter**.

Press **Y** and **Enter** when prompted to confirm the change.

3. Use the Arrow keys to highlight **Standard CMOS Features**, and then

press**Enter**.

4. A screen similar to the following will appear:
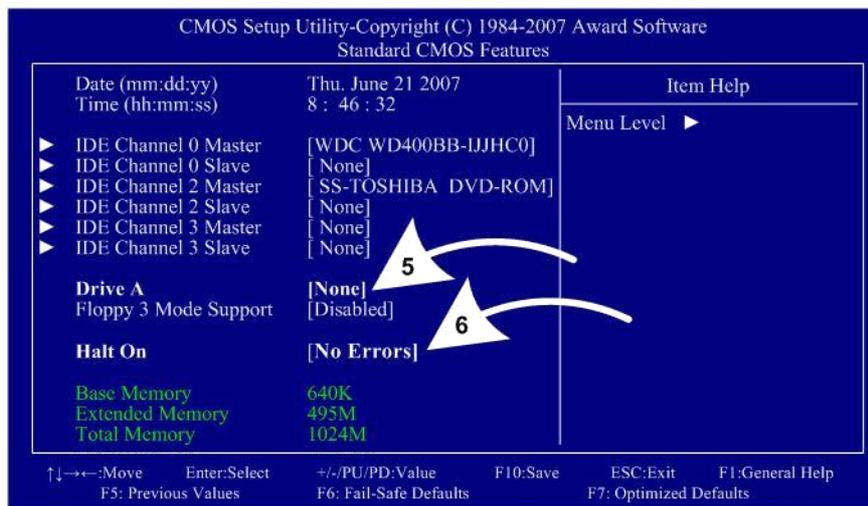
5. Use the Arrow keys to highlight the setting for **Drive A** and press **Enter**.

Use the **Page Up** and **Page Down** keys to change the setting to **None**.

6. Change the setting for **Halt On** to **No Errors** the same way.

Press **ESC** to go back to the Main Menu.

7. Now use the Arrow keys to highlight **Advanced BIOS Features** and press **Enter**. A screen similar to the following will appear:

8. Use the Arrow keys to highlight the setting for **First Boot Device** and press **Enter**. Use the **Page Up** and **Page Down** keys to change the setting to **DVDROM**.

9. Change the setting for **Second Boot Device** to **Hard Disk** the same way.

10. Change the setting for **Third Boot Device** to **Disabled**the same way. Press **ESC** to go back to the Main Menu.
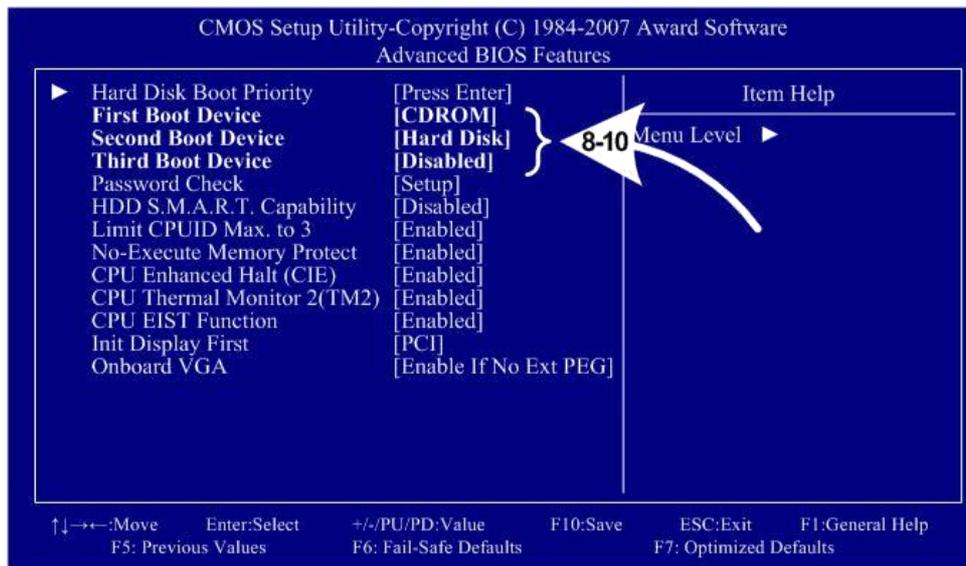
11. Now use the Arrow keys to highlight **Integrated Peripherals** and press **Enter**.

A screen similar to the following will appear:
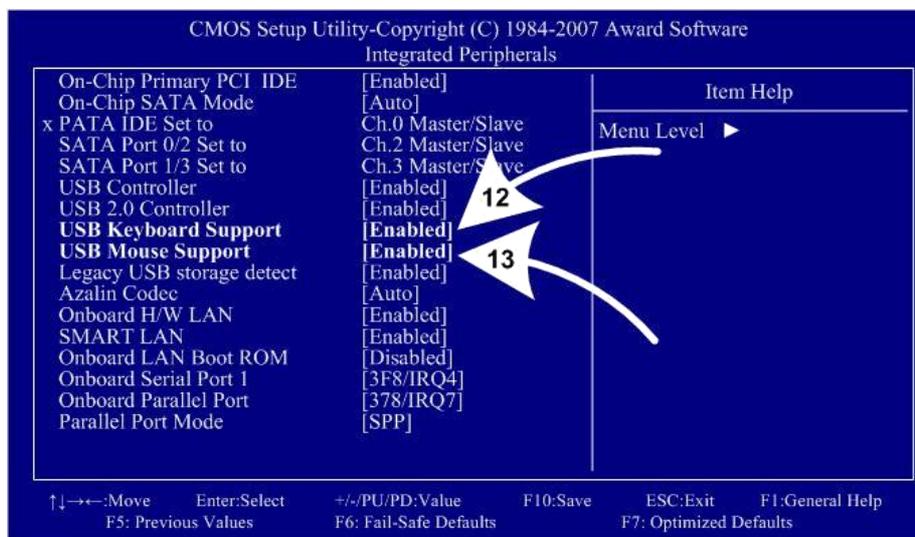
12. Use the Arrow keys to highlight the setting for **USB Keyboard Support** and press **Enter**. Use the **Page Up** and **Page Down** keys to change the setting to **Enabled**.

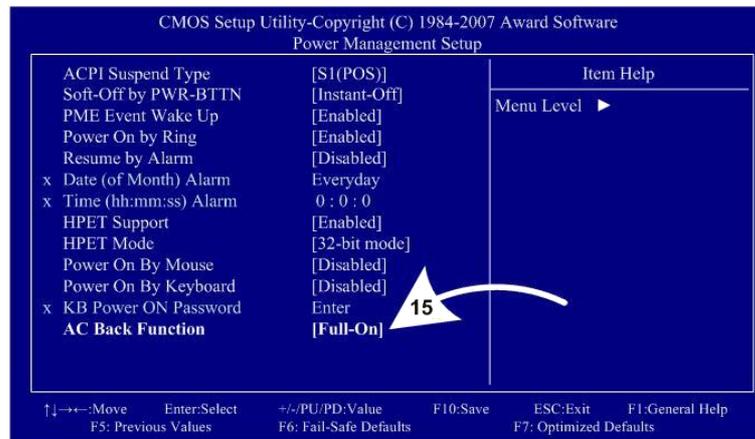13. Use the Arrow keys to highlight the setting for **USB Mouse Support** and press **Enter**.

Use the **Page Up** and **Page Down** keys to change the setting to **Enabled**. Press **ESC** to go back to the Main Menu.

14. Now use the Arrow keys to highlight **Power Management Setup** and press **Enter**.

A screen similar to the following will appear:

15. Use the Arrow keys to highlight the setting for **AC Back Function** and press **Enter**.

Use the **Page Up** and **Page Down** keys to change the setting to **Full-On**. Press **ESC** to go back to the Main Menu.

16. Now use the Arrow keys to highlight **PC Health Status** and press **Enter**. A screen similar to the following will appear:

17. Use the Arrow keys to highlight the setting for **CPU Smart FAN Control** and press **Enter**.

Use the **Page Up** and **Page Down** keys to change the setting to **Disabled**. Press **ESC** to go back to the Main Menu.

18. Now that all settings are correct, press F10. The following prompt will appear:

> Save to CMOS and EXIT (Y/N) Y

19. Make sure "Y" shows at the end of the prompt (use the arrow keys to select, if necessary), and press**Enter**to save the settings and exit.
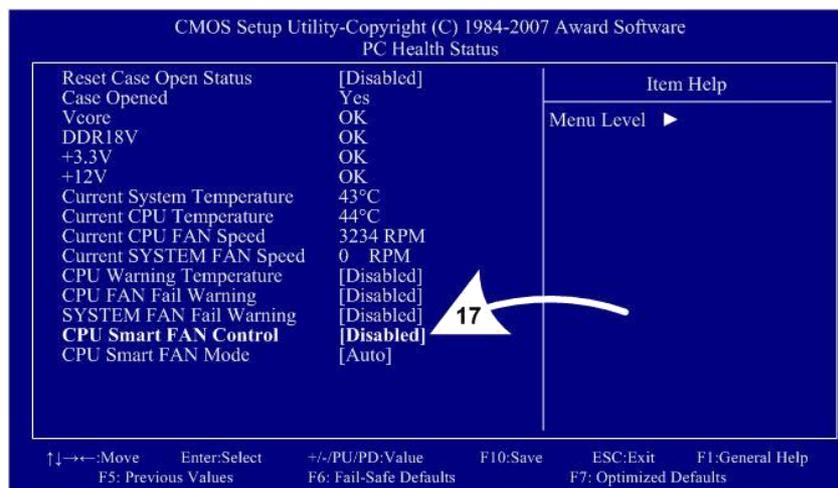
17. What is Plug and Play BIOS. Explain.

Plug and Play BIOS Specification defines new functionality to be provided in a PC compatible system BIOS to fulfill the goals of Plug and Play. To achieve these goals, several new components have been added to the System BIOS. Two key areas that are addressed by the System BIOS are resource management and runtime configuration. Resource management provides the ability to manage the fundamental system resources which include DMA, Interrupt Request Lines (IRQs), I/O and Memory addresses. These resources, termed *system resources,* are in high demand and commonly are over-allocated or allocated in a conflicting manner in ISA systems, leading to bootstrap and system configuration failures.

A plug and play system BIOS will play a vital role in helping to manage these resources and ensure a successful launch of the operating system. In its role as resource manager, a Plug and Play BIOS takes on the responsibility for configuring Plug and Play cards, as well as system board devices during the power-up phase. After the POST process is complete, control of the Plug and Play device configuration passes from the system BIOS to the system software. The BIOS does, however, provide configuration services for system board devices even after the POST process is complete. These services are known as Runtime Services. Runtime configuration is a concept that has not previously existed in a System BIOS before. The system BIOS has not previously provided the ability to dynamically change the resources allocated to system board devices after the operating system has been loaded. The Plug and Play BIOS Specification provides a mechanism whereby a Plug and Play operating system may perform this resource allocation dynamically at runtime. The operating system may directly manipulate the configuration of devices which have traditionally been considered static via a System BIOS device node structure. In addition, a Plug and Play System BIOS may also support event management. By means of the interfaces outlined in this document, the System BIOS may communicate the insertion and removal of newly installed devices which have been added to the system at runtime. The event management support defined by this specification are specific to devices controlled by the system BIOS, such as docking a notebook system to, or undocking it from, an expansion base. This event management does not encompass the insertion and removal of devices on the various expansion busses.

18. What are the available Error Messages in BIOS? Explain.

19. List out the BIOS / MBR error messages and Explan. (NOV 2014)

BIOS **(Basic Input and Output System) -** Error Codes/Beeps **-** Entering BIOS/CMOS

Software stored in a Read-Only Memory (ROM) chip on the motherboard (CMOS). It controls systems devices and test memory. It allows you to configure specific parameters about the hardware in your computer such as time, date, disk drive parameters and other device settings.

Beeps are emitted from a computer during the boot process when some problem is encountered and can be used to troubleshoot a dead computer. They indicate problems such as bad memory, bad keyboard or

bad motherboard. Usually if you hear beeps there is something real wrong and you should immediately turn off the computer and perform some troubleshooting. POST Beeping Error General Codes

- Bad Motherboard - 1 long and 1 short beep
- Disk drive related problem / Video card problem - 1 short beep then nothing happens
- Bad video card - 1 long and 2 short beeps
- Bad power supply - 1) continuous beeps, 2) non-stop short beeps
- Bad memory - 3 short beeps

These codes DO vary from one manufacturer to another. Almost all computers list the appropriate codes in the User's manual under technical information or the troubleshooting section, so be sure to check the manual and verify what the codes mean.

If no beeps are heard and no display is on the screen, it's most likely the power supply. Check for Keyboard lights or for hard drive/floppy drive lights. If lights come on then power supply is good. Next, inspect the motherboard for loose components. A loose or missing CPU, BIOS chip, Crystal Oscillator, or Chipset chip will cause the motherboard not to function. If there are lights, then it could be one of the I/O cards. Try removing each card one at a time and restarting the computer.

Error Codes/Beeps for AMI, Award, Compaq, IBM, Phoenix , BIOS's

AMI Beep Codes

Except for beep code #8, these codes are always fatal.

1 beep Refresh failure - try reseating the memory, if the error still occurs, replace the memory

2 beeps Parity error - try reseating the memory, if the error still occurs, replace the memory

3 beeps Base 64K memory failure - try reseating the memory, if the error still occurs, replace the memory

4 beeps Timer not operational, system board bad

5 beeps Processor error, system board bad

6 beeps 8042 - gate A20 failure, try reseating the keyboard controller chip

7 beeps Processor exception interrupt error, system board bad

8 beeps Display memory video card read/write failure error, replace video memory or video card

9 beeps ROM checksum error, faulty BIOS chip(s), must replace them

10 beeps CMOS shutdown register read/write error, system board bad

11 beeps Cache memory bad

Award BIOS Beep codes

One Long and Two Short Beeps	Video Error
Two Short Beeps	Any Non-Fatal Error
One Short Beep	No Error During Post

Phoenix BIOS Beep codes

These codes are presented in sets of beeps, for instance 1-2-2-3 means one beep followed by 2

beeps then 2 more beeps then 3 beeps

- 1-2-2-3 BIOS ROM checksum
- 1-3-1-1 Test DRAM refresh
- 1-3-1-3 Test 8742 Keyboard Controller
- 1-3-4-1 RAM failure on address line xxxx
- 1-3-4-3 RAM failure on data bits xxx of low byte of memory
- 1-4-1-1 RAM failure on data bits xxxx of high byte of memory bus
- 2-1-2-3 Check ROM copyright notice
- 2-1-3-1 Test for unexpected interrupts
- 1 ....Search for option ROMs
- 1 ....One short beep before boot, normal

Master Boot Record (MBR)

The MBR (stands for ―Master boot record‖) is a boot sector (a region of your hard disk) that holds information about the partitions of your hard drive and acts as a loader for the operating system you're running.

The Master boot record is created when you first install Windows, on the first partition you create. It's the first 512 bytes of your hard disk.

If the MBR is damaged, you won't be able to boot into Windows. All Windows versions – Windows XP, Vista, 7 or 8 – use MBR and, if damaged you won't be able to boot.

It can be damaged by certain viruses that target the MBR to replace it with their own code or in cases when you dual boot with a Linux distribution

Common errors

If the Master boot record is broken, your computer may show some of the following errors:

- Error loading operating system
- Operating System missing or Not found
- Invalid partition table
- Reboot and Select proper Boot device or Insert Boot Media in selected Boot device and press a key

Easy Recovery Essentials, bootable recovery and repair CD/USB, is guaranteed to repair most damages done to the Master boot record (MBR) using its Automated Repair feature for Windows XP, Vista,7 or 8.

Pondicherry University Questions

PART A

1. Define IDE. **(NOV 2010)**

2. Differentiate LAN and WAN. **(NOV 2010)**

3. What is PCI? **(APR 2011)**

4. Define MODEM. **(APR 2011), (APR 2012)**

5. Expand SCSI. **(APR 2012) , (NOV 2012)**

6. Write an example of peripheral devices. **(NOV 2012)**

7. What are the two types of system boards? **(NOV 2012)**

8. What do you mean by BIOS? **(NOV 2012)**

9. Expand: ISA, PCI, MCA and SMPS. **(NOV 2013)**

10. What is meant by Plug and Play? **(NOV 2013)**

11. State the purpose of SMPS. **(NOV 2014)**

12. List out the sections available in MCA connector? **(NOV 2014)**

PART B

1. What are the Components available in the Mother board? Explain Briefly. (Ref.Pg.No.6,Qn.No.1).
2. Describe the detail about mother board architecture. (NOV 2012) (Ref.Pg.No.6,Qn.No.2).
3. Explain briefly about Chipset. (Ref.Pg.No.7,Qn.No.3).
4. Write about Sixth and Seventh generation Chipsets. (Ref.Pg.No.9,Qn.No.4)
5. Explain briefly about third party chipsets VIA, SiS and NVIDIA(Ref.Pg.No.10,Qn.No.5)
6. Compare Desktop vs Laptop motherboards. (Ref.Pg.No.10,Qn.No.6)
7. What is Bus? Explain the Bus Standards : ISA,PCI and MCA. (Ref.Pg.No.11,Qn.No.7)
8. Explain the following: a) ISA, b) PCI, c) PCI Express, d) AGP, e)MCA(APR 2012)(NOV 2010) (Ref.Pg.No.11,Qn.No.8)
9. Describe the features of PCI Bus, also list out the pins and signals available in PCI bus. (NOV 2014) (Ref.Pg.No.15,Qn.No.9)
10. Explain briefly about the system resources Interrupts, DMA channels and I/O Port addresses. (Ref.Pg.No.16,Qn.No.10)
11. Explain the working principle SMPS with functional block diagram. (APR 2012), (NOV 2012) (NOV 2013) (Ref.Pg.No.19,Qn.No.11).
12. Explain the working principle of SMPS. What are the types of SMPS, Explain? (Ref.Pg.No.19, Qn.No.12)
13. Explain Power-Supply Connectors and switches. (Ref.Pg.No.25,Qn.No.13).
14. Explain briefly about RTC/NVRAM Batteries or (CMOS Chips) (Ref.Pg.No.28,Qn.No.14).
15. What is BIOS? How BIOS works? (Ref.Pg.No.30,Qn.No.15).
16. Explain briefly about CMOS setup. (Ref.Pg.No.32,Qn.No.16)
17. What is Plug and Play BIOS. Explain. (Ref.Pg.No.36,Qn.No.17)
18. List out the BIOS / MBR error messages and Explain. (NOV 2014) (Ref.Pg.No.36,Qn.No.18,19)

Department of Computer Science and Engineering

Subject Name: **COMPUTER HARDWARE AND NETWORK TROUBLESHOOTING**

Subject Code: **CS T72**

Prepared By :

Dr. N. Balaji, Professor & HOD/CSE

Verified by :   **Approved by :**

UNIT – III
Primary Memory: Basics- RAM types and performance – Fast page mode DRAM – EDO RAM – SDRAM – DDRx RAM – RDRAM - Memory modules: SIMM, DIMM, DDR DIMM – Memory banks – Parity and ECC – logical memory layout.
Secondary Storage: Magnetic Storage: Data Encoding Schemes - Hard disk drive – SATA. Flash memory devices: CompactFlash, MMC, SecureDigital, SSD, RAMdisk, USB Flash disks. Optical Storage - CD, DVD, BD – Disk formats - Optical Drive Performance specifications - Troubleshooting memory problems.

2 Marks

1. **Write few memory types?**
   RAM: Read Access Memory
   ROM: Read Only Memory
   PROM: Programmable Read Only Memory
   EPROM: Erasable Programmable Read Only Memory
   EEPROM: Electrically Erasable Programmable Read Only Memory
   Flash Memory

2. **What are two categories of Memory?**
   Volatile memory: The data stored in the memory will be erased once the supply voltage removed. **Non volatile memory:** The data stored in the memory will Not be erased if the supply voltage removed.

3. **What are the two types of semiconductor memory? (NOV 2014)**
   • Static RAM (SRAM)
   • Dynamic RAM (DRAM)

4. **Define RAM?**
   Random access memory (usually known by its acronym, **RAM**) is a type of data store used in computers that allows the stored data to be accessed in any order —at random, not just in sequence.

5. **What is Memory Module?**
   Memory module is a broad term used to refer to a series of dynamic random access memory integrated circuits modules mounted on a printed circuit board and designed for use in personal computers, workstations and servers.

6. **What are the types of RAM module? (NOV 2013)**
   DIP 18-pin (DRAM chip, usually pre-FPRAM)[Dual in-line package memory]
   SIPP (usually FPRAM)[Single in-line pin package memory]
   SIMM 30-pin (usually FPRAM)[single in-line memory module]
   SIMM 72-pin (so-called "PS/2 SIMM", usually EDO RAM)

DIMM 168-pin, 184-pin, etc., (SDRAM)[dual in-line memory module]

7. How to troubleshoot memory problems?
> Back up your system.
> Check your hardware and system configuration.
> Reinstall the computer memory modules.

8. What is Floppy?
A floppy disk, like a cassette tape, is made from a thin piece of plastic coated with a magnetic material on both sides. However, it is shaped like a disk rather than a long thin ribbon. The tracks are arranged in **concentric rings** so that the software can jump from "file 1" to "file 19" without having to fast forward through files 2-18. The diskette spins like a record and the heads move to the correct track, providing what is known as **direct access storage**.

9. What is mean by disk and diskette? (APR 2012)
A diskette is a random access, removable data storage medium that can be used with personal computers. The term usually refers to the magnetic medium housed in a rigid plastic cartridge measuring 3.5 inches square and about 2millimeters thick. Also called a "3.5-inch diskette,"
These were sometimes called "floppy disks" or "floppies" because their housings are flexible. 5.25-inch

10. What is Floppy Disk Drive?
The floppy disk drive (**FDD**) was invented at IBM by Alan Shugart in 1967. The first floppy drives used an 8-inch disk (later called a "**diskette**" as it got smaller), which evolved into the 5.25-inch disk that was used on the first IBM Personal Computer in August 1981. The 5.25-inch disk held 360 kilobytes compared to the 1.44 megabyte capacity of today's 3.5-inch diskette. The 5.25-inch disks were dubbed "**floppy**" because the diskette packaging was a very **flexible plastic envelope**, unlike the rigid case used to hold today's 3.5-inch diskettes.

11. Write the parts of a Floppy?
A floppy disk is a lot like a cassette tape:
> Both use a thin plastic base material coated with iron oxide. This oxide is a **ferromagnetic** material, meaning that if you expose it to a magnetic field it is permanently magnetized by the field.
> Both can record information instantly.
> Both can be erased and reused many times.
> Both are very inexpensive and easy to use.

12. Differentiate hard sector and soft sector disk. (APR 2011)

13. Classify the floppy diskette according to the sector organisation. (NOV 2014)
Depending on the sector organisation, the floppy diskette is classified into two types:
1. Hard sectored floppy diskette – the no. of sectors on each track is physically fixed while manufacturing
2. Soft Sectored floppy diskette - tracks are divided into sectors while formatting the disk

14. What are the two formats for recording on a magnetic disk? (APR 2011)
The *constant linear velocity* (CLV) format optimizes utilisation of the usable recording area by having an uniform recording density throughout the disk.
Zoned constant angular velocity (ZCAV) reduces the inefficiencies of the CAV format by dividing the disk into typically five zones.

15.Differentiate single and dual head assembly drive. (NOV 2010)
In a single head assembly drive, there is one head for each surface. All these are mounted on one spindle and always move together. At a given time all the heads are positioned on same cylinder.
In a dual head assembly drive, there are two heads for each surface. One set of heads covers the first half of the cylinder and the second set of heads covers the second half of cylinder.

16. What is the hard disk and how does it work? (NOV 2012)
A **hard disk** (commonly known as a *hard disk drive* or *hard drive* and formerly known as a *fixed disk*) is a digitally encoded non-volatile storage device which stores data on rapidly rotating platters with magnetic surfaces.

17.Write any two common aspects between HDD and FDD. (NOV 2012)
Both are having Magnetic Disks

Both disks having tracks and sectors
HDD and FDD to spindle disks using spindle motor
Heads are used to read and write datas on the disk

18. Write about serial ATA. (NOV 2013)

Serial ATA (Serial Advanced Technology Attachment or SATA) is a new standard for connecting hard drives into computer systems. As its name implies, SATA is based on serial signaling technology, unlike current IDE (Integrated Drive Electronics) hard drives that use parallel signaling.

19. What is PATA?

Parallel ATA (PATA) is an IDE standard for connecting storage devices like hard drives and optical drives to the motherboard. PATA generally refers to the types of cables and connections that follow this standard.

20. Define SCSI?

Small Computer System Interface (SCSI is a set of standards for physically connecting and transferring data between computers and peripheral devices. The SCSI standards define commands, protocols, and electrical and optical interfaces. SCSI is most commonly used for hard disks and tape drives, but it can connect a wide range of other devices, including scanners and CD drives.

21. Define CD?

The **Compact Disc** (also known as a **CD**) is an optical disc used to store digital data. It was originally developed to store and play back sound recordings only, but the format was later adapted for storage of data (CD-ROM), write-once audio and data storage (CD-R), rewritable media (CD-RW), Video Compact Discs (VCD), Super Video Compact Discs (SVCD), PhotoCD, PictureCD, CD-i, and Enhanced CD. Standard CDs are available in two sizes. By far, the most common is 120 millimetres (4.7 in) in diameter, with a 74- or 80-minute audio capacity and a 650 or 700 MB data capacity.

22. What is DVD? (APR 2012)

DVD (commonly "**Digital Versatile Disc**", previously "**Digital Video Disc**") is an optical disc storage media format that can be used for data storage, including movies with high video and sound quality. DVDs resemble compact discs as their physical dimensions are the same (120 mm (4.72 inches) or occasionally 80 mm (3.15 inches) in diameter), but they are encoded in a different format and at a much higher density.

23.Write the DVD disc capacity.

Physical size	Single layer capacity		Dual/Double layer capacity	
	GB	GiB	GB	GiB
12 cm, single sided	4.7	4.38	8.5	7.92
12 cm, double sided	9.4	8.75	17.1	15.93
8 cm, single sided	1.4	1.30	2.6	2.42
8 cm, double sided	2.8	2.61	5.2	4.84

24.Difference between CD and DVD?

CD is short for compact disc. DVD initially stood for digital video disc, then digital versatile disc, but today the term DVD is often used without referring to a specific set of words. Both CDs and DVDs are optical media, meaning media that use light technology (more specifically, laser light) for data retrieval. A disc drive focuses a laser light beam into the CD or DVD to ‒read‖ the bits (data) in the disc. The drive can also ‒write‖ bits by focusing the laser beam into recordable CDs or DVDs. The laser reads and writes data starting from the center of the disc and proceeding in a spiral direction toward the outer edge. A pre-groove is stamped in all blank recordable and rewritable CDs and DVDs to guide the laser as it writes.

CD- CD-ROM	DVD-	Type	Data Layer	Metal Layer
Audio/Video and PC use	DVD-ROM Video/Audio and PC use	Read only	Molded	Aluminum (also silicon, gold, or silver in double layered DVDs)
CD-R	DVD-R DVD+R	Recordable (Write once only)	Organic dye	Gold, silver, or silver alloy

| CD-RW | DVD-RW DVD+RW DVD-RAM | Rewritable (Write, erase, and re-write) | Phase-changing metal alloy film | Aluminum |

25.What is the function of the memory? (NOV 2012)

The computer memory is a temporary storage area. It holds the data and instructions that the Central Processing Unit (CPU) needs. Before a program can be run, the program is loaded from some storage medium into the memory. This allows the CPU direct access to the program. Memory is a need for any computer.

11 MARKS

1. **What is Memory? Explain the types of memory.**
2. **How memory works with the processor? Discuss. (NOV 2012)**

Basics of Memory

Memory is the workspace for the processor. It is a temporary storage area where the programs and data being operated on by the processor must reside.

Main memory is called RAM which can randomly access any location.

Primary memory workspace the processor uses to run programs called dynamic RAM (DRAM) DRAM chip store data dynamically. Information in DRAM can be written repeatedly at any time. It requires the data to be refreshed every few milliseconds.

SRAM static RAM does not require the periodic refreshing.

Thus RAM stores data as long as the memory has electrical power.

1. **Memory cell** : A device or electrical circuit that can store a bit (0 or 1). A group of cells or bits in a memory that represents instructions or data.
2. **Memory word** :
3. **Byte** : A byte is a group of 8 bits. A number which identifies the location of a word in the memory. Each word location has a specific unique binary address.
4. **Address** :
Read (Fetch) : Take the data out from the memory.
5. **Write operation** : Store the data in to the memory. A way to specify how many bits can be stored in a memory.
6. **Capacity (Density)** : A memory capacity will be written in form of 4096 X 20 4096 is number of words & 20 is number of bits per word.
Where : That means this memory has a total of 81920 bit. In computer knowledge kilo equals to 1024, so 1 kw means 1024 word, we can write 4096 X 20 as 4K X 20.
7. **Memory Enable (ME)** : Used to disable or enable the operation of the Memory.

	Memory cells	**Addresses**
Word 1	0 1 1 0	0 0 0 0 0
Word 2	1 0 0 1	0 0 0 0 1
Word 3	1 1 1 1	0 0 0 1 0
Word 4	0 0 0 0	1 0 0 1 1
..		
Word 32	0 1 1 1	1 1 1 1 1

Fig(1). memory R/W Operation

The above is representation of a memory system and how bits are stored in it. Each word has its own address in which we refer to it for write or read operations. For example Word 1 consists of data 0110 and stored in location 00000, word 2 consists of data 1001 and stored in location 00001 and so on. The above figure is example for 32 X 4 Memory system..

Memory Categories

Basically memories divided in to two categories,

Volatile memory: The data stored in the memory will be *erased* once the supply voltage removed.

Non volatile memory: The data stored in the memory will *Not be erased* if the supply voltage removed.

Memory Types

1. **RAM: R**ead **A**ccess **M**emory. R/W Operation can be performed at any selected address at any sequence. It is used in place that has a fix operation such as start-up of the PC, game players..etc. Most RAM is volatile.

2. **ROM: R**ead **O**nly **M**emory. They are programmed at the factory at the time of manufacture. Once data has been written onto a ROM chip, it cannot be erased and can only be read. ROM is a Nonvolatile memory.

3. **PROM: P**rogrammable **R**ead **O**nly **M**emory. It is a one time use, once the data stored in the PROM you cannot wipe it and use it to store something else. PROMs are Nonvolatile.

4. **EPROM: E**rasable **P**rogrammable **R**ead **O**nly **M**emory. EPROM is a special type of memory that retains its contents until it is exposed to ultraviolet light through its glass window on the top.

5. **EEPROM: E**lectrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory. It is a special type of PROM that can be erased by exposing it to an electrical charge.

6. **Flash Memory**: It is type of EEPROM memory except that EEPROM Read and Write operations are performed in bytes. However, Flash memory Read and Write operations are performed in blocks, this feature makes it faster for data update.

Random Access Memory

Random access memory (usually known by its acronym, **RAM**) is a type of data store used in computers that allows the stored data to be accessed in any order — that is, at random, not just in sequence. In contrast, other types of memory devices (such as magnetic tapes, disks, and drums) can access data on the storage medium only in a predetermined order due to constraints in their mechanical design.

Common Manufacturers:

> Corsair Memory
> Kingston Technology
> Micron Technology
> Samsung
> Others

It costs practically the same time to access any piece of data stored in a RAM chip. In contrast, disks and the like need a short time to retrieve a piece of data if it happens to be close to the current position of the read head, and a long time if the data is far away and the head needs to be repositioned considerably.

Generally, RAM in a computer is considered *main memory* or primary storage: the working area used for loading, displaying and manipulating applications and data. This type of RAM is usually in the form of integrated circuits (ICs). These are commonly called *memory sticks* or *RAM sticks* because they are manufactured as small circuit boards with plastic packaging and are about the size of a few sticks of chewing gum. Most personal computers have slots for adding and replacing memory sticks.

Most RAM can be both written to and read from, so "RAM" is often used interchangeably with "read-write memory." In this sense, RAM is the "opposite" of ROM, but in a more true sense, of sequential access memory.

Overview

Computers use RAM to hold the program code and data during computation. A defining characteristic of RAM is that all memory locations can be accessed at almost the same speed. Most other technologies have inherent delays for reading a particular bit or byte.

Many types of RAM are *volatile*, which means that unlike some other forms of computer storage such as disk storage and tape storage, they lose all data when the computer is powered down. Modern RAM generally stores a bit of data as either a charge in a capacitor, as in dynamic RAM, or the state of a flip-flop, as in static RAM.

Software can "partition" a portion of a computer's RAM, allowing it to act as a much faster hard drive that is called a RAM disk. Unless the memory used is non-volatile, a RAM disk loses the stored data when the computer is shut down. However, volatile memory can retain its data when the computer is shut down if it has a separate power source, usually a battery. Some types of RAM can detect or correct random faults called *memory errors* in the stored data, using RAM parity.

Shadow RAM

Shadow RAM is RAM whose contents are copied from read-only memory (ROM) to allow shorter access times, as ROM is in general slower than RAM. The original ROM is disabled and the new location on the RAM is write-protected. This process is called **shadowing**.

DRAM packaging

For economical reasons, the large (main) memories found in personal computers, workstations, and non-handheld game-consoles (such as playstation and Xbox) normally consist of dynamic RAM (DRAM). Other parts of the computer, such as cache memories and data buffers in hard disks, normally use static RAM (SRAM).

Table PC Memory Types and Performance Levels

Memory Type	Years Popular	Desktop Module Type	Laptop Module Type	Voltage	Max. Clock Speed	Max. Throughput Single-Channel	Max. Throughput Dual-Channel	Max. Throughput Triple-Channel
Fast Page Mode (FPM) DRAM	1987–1995	30/72-pin SIMM	72/144-pin SODIMM	5V	22MHz	177MBps	N/A	N/A
Extended Data Out (EDO) DRAM	1995–1998	72-pin SIMM	72/144-pin SODIMM	5V	33MHz	266MBps	N/A	N/A
Single Data Rate (SDR) SDRAM	1998–2002	168-pin DIMM	144-pin SODIMM	3.3V	133MHz	1,066MBps	N/A	N/A
Double Data Rate (DDR) SDRAM	2002–2005	184-pin DIMM	200-pin SODIMM	2.5V	400MTps	3,200MBps	6,400MBps	N/A
DDR2 SDRAM	2005–2008	240-pin DDR2 DIMM	200-pin SODIMM	1.8V	1,066MTps	8,533MBps	17,066MBps	N/A
DDR3 SDRAM	2008+	240-pin DDR3 DIMM	204-pin SODIMM	1.5V	2,133MTps	17,066MBps	34,133MBps	51,200MBps

MHz = Million cycles per second

MTps = Million transfers per second

MBps = Million bytes per second

DIMM = Dual inline memory module

SODIMM = Small outline DIMM

SIMM = Single inline memory module

RIMM = Rambus inline memory module.

FAST PAGE MODE DRAM

Standard DRAM is accessed through a technique called *paging*. Normal memory access requires that a row and column address be selected, which takes time. Paging enables faster access to all the data within a given row of memory by keeping the row address the same and changing only the column. Memory that uses this technique is called *Page Mode* or *Fast Page Mode* memory.

Paged memory is a simple scheme for improving memory performance that divides memory into pages ranging from 512 bytes to a few kilobytes long. The paging circuitry then enables memory locations in a page to be accessed with fewer wait states. If the desired memory location is outside the current page, one or more wait states are added while the system selects the new page.

One important change was the implementation of burst mode access. After setting up the row and column addresses for a given access, using burst mode, you can then access the next three adjacent addresses with no additional latency or wait states. A burst access usually is limited to four total accesses. A burst mode access of standard DRAM is expressed as x-y-y-y; x is the time for the first access and y represents the number of cycles required for each consecutive access.

Standard 60ns-rated DRAM normally runs 5-3-3-3 burst mode timing. This means the first access takes a total of five cycles (on a 66MHz system bus, this is about 75ns total, or 5 × 15ns cycles), and the consecutive cycles take three cycles each (3 × 15ns = 45ns).

DRAM memory that supports paging and this bursting technique is called Fast Page Mode (FPM) memory. Most 386, 486, and Pentium systems from 1987 through 1995 used FPM memory, which came in either 30-pin or 72-pin SIMM form.

Another technique for speeding up FPM memory is called interleaving. In this design, two separate banks of memory are used together, alternating access from one to the other as even and odd bytes. While one is being accessed, the other is being precharged, when the row and column addresses are

being selected. Then, by the time the first bank in the pair is finished returning data, the second bank in the pair is finished with the latency part of the cycle and is now ready to return data. While the second bank is returning data, the first bank is being precharged, selecting the row and column address of the next access. This overlapping of accesses in two banks reduces the effect of the latency or precharge cycles and allows for faster overall data retrieval.

EXTENDED DATA OUT RAM

Extended data out (EDO) RAM is also called as hyper page mode. EDO was invented and patented by Micun Technology.

EDO memory consists of specially manufactured chips that allow a timing overlap between successive accesses. the data output drivers on the chip are not turned off when the memory controller removes the column address to begin the next cycle. This enables the next cycle to overlap the previous one, saving approximately 10ns per cycle.

The effect of EDO is that cycle times are improved by enabling the memory controller to begin a new column address instruction while it is reading data at the current address. This is similar to older systems but EDO didn't need to install two identical banks of memory in the system at a time.

EDO RAM allows for burst mode cycling of 5-2-2-2, compared to the 5-3-3-3 of standard fast page mode memory. To do four memory transfers, then, EDO would require 11 total system cycles, compared to 14 total cycles for FPM. This is a 22% improvement in overall cycling time.

EDO uses the same basic DRAM chip design as FPM, and thus no additional cost over FPM. Thus EDO cost less and offers higher performance. EDO RAM generally came in 72-pin SIMM form. To use EDO memory, motherboard chipset had to support it.

EDO memory chips cost the same to manufacture as standard chips, combined with Intel's support of EDO. EDO RAM was used in systems with CPU bus speeds of up to 66MHz, upto 1998. After, 1998, with the advent of 100MHz and faster system bus speeds declined EDO by faster SDRAM.

Later EDO was extended by BEDO as burst EDO(BEDO). BEDO added burst capabilities for even speedier data transfers than standard EDO. But BEDO was overridden by SDRAM quickly.

SDRAM

SDRAM is short for synchronous DRAM, runs in synchronization with the memory bus. SDRAM delivers information in very high-speed bursts using a high-speed clocked interface. SDRAM removes most of the latency involved in asynchronous DRAM because the signals are already in synchronization with the motherboard clock.

SDRAM performance is improved over that of FPM or EDO RAM. In SDRAM the initial latency is the same, but burst mode cycle times are much faster than with FPM or EDO. This is 20% faster than EDO.

SDRAM is sold in DIMM form and is normally rated by clock speed (MHz) rather than cycling time (ns).

Table SDRAM Timing, Actual Speed, and Rated Speed

Timing	Rated Chip Speed	Standard Module Speed
15ns	66MHz	PC66
10ns	100MHz	PC66
8ns	125MHz	PC100
7.5ns	133MHz	PC133
7.0ns	143MHz	PC133

The Joint Electron Device Engineering Council (JEDEC) created a specification called PC133. It achieved this 33MHz speed increase by taking the PC100 specification and tightening up the timing and capacitance parameters.

These faster chips were still used on PC133 modules, but they allowed for improvements in column address strobe latency (abbreviated as CAS or CL), which improves overall memory cycling time. Table shows the standard single data rate SDRAM module speeds and resulting throughputs.

Table JEDEC Standard SDRAM Module (168-pin DIMM) Speeds and Transfer Rates

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)
PC66	10ns	66	1	66	8	533
PC100	8ns	100	1	100	8	800
PC133	7ns	133	1	133	8	1,066

MTps = Megatransfers per second   MBps = Megabytes per second

ns = Nanoseconds (billionths of a second)   DIMM = Dual inline memory module

DDR SDRAM

Double data rate (DDR) SDRAM memory is a JEDEC standard that is an evolutionary upgrade in which data is transferred twice as quickly as standard SDRAM. Instead of doubling the actual clock rate, DDR memory achieves the doubling in performance by transferring twice per transfer cycle: once at the leading (falling) edge and once at the trailing (rising) edge of the cycleas shown in figure.
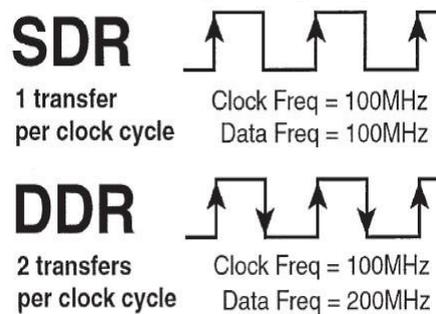
Figure SDR (single data rate) versus DDR (double data rate) cycling.

This effectively doubles the transfer rate, even though the same overall clock and timing signals are used. From 2002 through 2005, DDR was the most popular . DDR SDRAM uses a DIMM module design with 184 pins.

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)	Dual-Channel Transfer Rate (MBps)
PC1600	DDR200	100	2	200	8	1,600	3,200
PC2100	DDR266	133	2	266	8	2,133	4,266
PC2700	DDR333	166	2	333	8	2,667	5,333
PC3200	DDR400	200	2	400	8	3,200	6,400

Table JEDEC Standard DDR Module (184-pin DIMM) Speeds and Transfer Rates

MTps = Megatransfers per second   MBps = Megabytes per second

DIMM = Dual inline memory module   DDR = Double data rate

The major memory chip and module manufacturers normally produce parts that conform to the official JEDEC standard speed ratings. To support overclocking, several memory module manufacturers purchase unmarked and untested chips from the memory chip manufacturers, then independently test and sort them by how fast they run. These are then packaged into modules with unofficial designations and performance figures that exceed the standard ratings. Table 6.7 shows the popular unofficial speed ratings

Table Overclocked (non-JEDEC) DDR Module (184-pin DIMM) Speeds and Transfer Rates

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)	Dual-Channel Transfer Rate (MBps)
PC3500	DDR433	216	2	433	8	3,466	6,933
PC3700	DDR466	233	2	466	8	3,733	7,466
PC4000	DDR500	250	2	500	8	4,000	8,000
PC4200	DDR533	266	2	533	8	4,266	8,533
PC4400	DDR550	275	2	550	8	4,400	8,800
PC4800	DDR600	300	2	600	8	4,800	9,600

MTps = Megatransfers per second   *MBps = Megabytes per second*
DIMM = Dual inline memory module   *DR = Double data rate*

The bandwidths listed in these tables are per module. Most chipsets that support DDR also support dual-channel operation—a technique in which two matching DIMMs are installed to function as a single bank, with double the bandwidth of a single module.

Dual-channel operation optimizes PC design by ensuring that the CPU bus and memory bus both run at exactly the same speeds so that data can move synchronously between the buses without delays.

DDR2 SDRAM

DDR2 is simply a faster version of DDR memory: It achieves higher throughput by using differential pairs of signal wires to allow faster signaling without noise and interference problems. The modified signaling method enables higher clock speeds to be achieved with more immunity to noise and crosstalk between the signals. DDR2 DIMMs have 240 pins, which is more than the 184 pins of DDR. DDR2 starts at 400MHz and goes up to an official maximum of 1,066MHz. Table shows the various official JEDEC-approved DDR2 module types and bandwidth specifications.

Table JEDEC Standard DDR2 Module (240-pin DIMM) Speeds and Transfer Rates

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)	Dual-Channel Transfer Rate (MBps)
PC2-3200	DDR2-400	200	2	400	8	3,200	6,400
PC2-4200	DDR2-533	266	2	533	8	4,266	8,533
PC2-5300	DDR2-667	333	2	667	8	5,333	10,667
PC2-6400	DDR2-800	400	2	800	8	6,400	12,800
PC2-8500	DDR2-1066	533	2	1066	8	8,533	17,066

MTps = Megatransfers per second   *MBps = Megabytes per second*
DIMM = Dual inline memory module   *DDR = Double data rate*

Many of the module manufacturers produce even faster modules designed for overclocked systems. Table shows the popular unofficial speed ratings on the market.

Table Overclocked (non-JEDEC) DDR2 Module (240-pin DIMM) Speeds and Transfer Rates

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)	Dual-Channel Transfer Rate (MBps)
PC2-6000	DDR2-750	375	2	750	8	6,000	12,000
PC2-7200	DDR2-900	450	2	900	8	7,200	14,400
PC2-8000	DDR2-1000	500	2	1000	8	8,000	16,000
PC2-8800	DDR2-1100	550	2	1100	8	8,800	17,600
PC2-8888	DDR2-1111	556	2	1111	8	8,888	17,777
PC2-9136	DDR2-1142	571	2	1142	8	9,136	18,272
PC2-9200	DDR2-1150	575	2	1150	8	9,200	18,400
PC2-9600	DDR2-1200	600	2	1200	8	9,600	19,200
PC2-10000	DDR2-1250	625	2	1250	8	10,000	20,000

MTps = Megatransfers per second   *MBps = Megabytes per second*
DIMM = Dual inline memory module   *DDR = Double data rate*

It uses lower Voltage, power consumption and heat generation are reduced. DDR2 uses finepitch ball grid array (FBGA) packaging rather than the thin small outline package (TSOP) chip package.

DDR3

DDR3 is the latest JEDEC memory standard. It enables higher levels of performance along with lower power consumption and higher reliability than DDR2.

During 2009, with full support from both Intel and AMD, DDR3 finally began to achieve price parity with DDR2.

DDR3 modules use advanced signal designs, including self-driver calibration and data synchronization, along with an optional onboard thermal sensor. DDR3 memory runs on only 1.5V, which is nearly 20% less than the 1.8V used by DDR2 memory. The lower voltage combined with higher efficiency reduces overall power consumption by up to 30% compared to DDR2.

DDR3 is most suited to systems where the processor and/or memory bus runs at 1,333MHz or higher, which is faster than the 1,066MHz maximum supported by DDR2.

Table JEDEC Standard DDR3 Module (240-pin DIMM) Speeds and Transfer Rates

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)	Dual-Channel Transfer Rate (MBps)	Tri-Channel Transfer Rate (MBps)
PC3-6400	DDR3-800	400	2	800	8	6,400	12,800	19,200
PC3-8500	DDR3-1066	533	2	1066	8	8,533	17,066	25,600
PC3-10600	DDR3-1333	667	2	1333	8	10,667	21,333	32,000
PC3-12800	DDR3-1600	800	2	1600	8	12,800	25,600	38,400

MTps = Megatransfers per second   *MBps = Megabytes per second*
DIMM = Dual inline memory module   *DDR = Double data rate*

Table 6.11 Overclocked (non-JEDEC) DDR3 Module (240-pin DIMM) Speeds and Transfer Rates

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)	Dual-Channel Transfer Rate (MBps)	Tri-Channel Transfer Rate (MBps)
PC3-11000	DDR3-1375	688	2	1375	8	11,000	22,000	33,000
PC3-13000	DDR3-1625	813	2	1625	8	13,000	26,000	39,000
PC3-14400	DDR3-1800	900	2	1800	8	14,400	28,800	43,200
PC3-14900	DDR3-1866	933	2	1866	8	14,933	29,866	44,800
PC3-15000	DDR3-1866	933	2	1866	8	14,933	29,866	44,800
PC3-16000	DDR3-2000	1000	2	2000	8	16,000	32,000	48,000

MTps = Megatransfers per second   *MBps = Megabytes per second*
DIMM = Dual inline memory module   *DDR = Double data rate*

RDRAM

Rambus DRAM (RDRAM) was a proprietary (non-JEDEC) memory technology found mainly in certain Intel systems. Intel had signed a contract with Rambus ensuring it would both adopt and support RDRAM memory. Using or producing RDRAM would require licensing from RAMBUS and Intel.

RDRAM is a chip-to-chip memory bus, with specialized devices that communicate at very high rates of speed. SDRAM are known as wide-channel systems.

The dual inline memory module (DIMM) is a 64-bit wide device, meaning data can be transferred to it 64 bits at a time.

RDRAM modules, on the other hand, are narrow-channel devices. They transfer data only 16 bits at a time but at faster speeds.

Each individual chip is serially connected to the next on a package called a Rambus inline memory module (RIMM),

The 16-bit single-channel RIMMs originally ran at 800MHz with the throughput is 800×2, or 1.6GB per second for a single channel

The RDRAM design features less latency between transfers because they all run synchronously in a looped system and in only one direction.

Another important feature of RDRAM is that it is designed for low power consumption. RIMMs are available in four primary speed grades and usually run in a dual-channel environment, so they have to be installed in pairs, with each one of the pairs in a different set of sockets.

RDRAM quickly disappeared from the PC marketplace. It is generally not cost effective to upgrade them by adding more memory.

Table 6.12 RDRAM Module Types and Bandwidth

Module Standard	Chip Type	Clock Speed (MHz)	Cycles per Clock	Bus Speed (MTps)	Bus Width (Bytes)	Transfer Rate (MBps)
RIMM1200	PC600	300	2	600	2	1,200
RIMM1400	PC700	350	2	700	2	1,400
RIMM1600	PC800	400	2	800	2	1,600
RIMM2100	PC1066	533	2	1,066	2	2,133

MTps = Megatransfers per second   *MBps = Megabytes per second*
RIMM = Rambus inline memory module

3. Explain briefly about Memory modules. Explain briefly: SIMM,DIMM,DDR

Common DRAM modules
Common DRAM packages as illustrated to the right, from top to bottom:
1. DIP 18-pin (DRAM chip, usually pre-FPRAM)
2. SIPP (usually FPRAM)
3. SIMM 30-pin (usually FPRAM)
4. SIMM 72-pin (so-called "PS/2 SIMM", usually EDO RAM)
5. DIMM 168-pin (SDRAM)
6. DIMM 184-pin (DDR SDRAM)
7. DIMM 240-pin (DDR2 SDRAM) - (DRAM not pictured to the r

Memory Modules:
There are many types of **computer memory** modules available. In this day and age, computers (laptops, PCs, etc.) generally do not use a single type of memory; rather, a combination of memory chips and modules are normally found in today's computers, depending on requirements and applications. The following is an overview of the types of computer memory:

SIMM (Single In-Line Memory Module) Dating back to the days of 286, 386, and 486 PCs, SIMMs are generally plug-in memory modules that are inserted into the CPU motherboard (or an extender memory board). A SIMM can be comprised of BEDO (Burst Extended Data Out Dynamic Random Access Memory), DRAM (Dynamic Random Access Memory) or EDO (Extended Data Out Dynamic Random Access Memory), with the memory chips (one or more) soldered on a PCB (printed circuit board). As mentioned above, it is the SIMM that is plugged into the CPU motherboard or memory extend card to expand the memory capability of the computer. Generally, when one is adding memory to a computer, it is in the form of a SIMM. Early SIMMs handled 8 data bits at a time in a 30-pin configuration; later, when CPUs were processing 32-bits, newer generation SIMMs were constructed in a 72-pin configuration.

72-pin SIMM

DIMM (Dual In-Line Memory Module) DIMMs have two rows of DRAM, BEDO, or EDO memory chips. DIMMS allow for double the memory on the same size printed circuit board. A typical DIMM would be constructed in a 168-pin configuration and handle 64 data bits at a time.

168-pin DIMM

240-pin DIMM

SODIMM (Small Outline Dual In-Line Memory Module) SODIMMs are generally found in notebook computers and are smaller than standard DIMMs. In general, there are 2 types of SODIMMs – the first handling 32 data bits at a time with a 72-pin configuration, and the second handling 64 data bits with a 144-pin configuration. RIMM (Rambus In-Line Memory Module) Rambus Inc. in coordination with Intel developed a new memory technology called Direct RDRAM, with the in-line modules known as RIMMs. RIMMs have a 184-pin configuration and deliver a peak transfer rate of 1.6 Gigabytes per second (in 16 data bit segments). SORIMM (Small Outline Rambus In-Line Memory Module) SORIMMs have a similar outline as a SODIMM, but use the Rambus memory technology. Different Types of Memory Chips:


144-pin SODIMM

Double data rate synchronous dynamic random-access memory (DDR SDRAM)

DDR is a class of memory integrated circuits used in computers. DDR SDRAM (sometimes referred to as **DDR1 SDRAM**) has been superseded by DDR2 SDRAM and DDR3 SDRAM, neither of which are either forward or backward compatible with DDR SDRAM, meaning that DDR2 or DDR3 memory modules will not work in DDR equipped motherboards, and vice versa.

Compared to single data rate (SDR) SDRAM, the DDR SDRAM interface makes higher transfer rates possible by more strict control of the timing of the electrical data and clock signals. Implementations often have to use schemes such as phase-locked loops and self-calibration to reach the required timing accuracy.[1][2] The interface uses double pumping (transferring data on both the rising and falling edges of the clock signal) to lower the clock frequency. One advantage of keeping the clock frequency down is that it reduces the signal integrity requirements on the circuit board connecting the memory to the controller. The name "double data rate" refers to the fact that a DDR SDRAM with a certain clock frequency achieves nearly twice the bandwidth of a single data rate (SDR) SDRAM running at the same clock frequency, due to this double pumping.
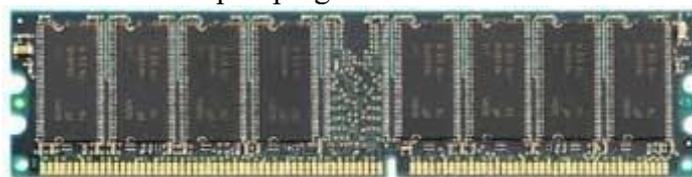
184-pin DIMM DDR

With data being transferred 64 bits at a time, DDR SDRAM gives a transfer rate of (memory bus clock rate) × 2 (for dual rate) × 64 (number of bits transferred) / 8 (number of bits/byte). Thus, with a bus frequency of 100 MHz, DDR SDRAM gives a maximum transfer rate of 1600 MB/s.

"Beginning in 1996 and concluding in June 2000, JEDEC developed the DDR (Double Data Rate) SDRAM specification (JESD79)."JEDEC has set standards for data rates of DDR SDRAM, divided into two parts. The first specification is for memory chips, and the second is for memory modules.

DRAM (Dynamic Random Access Memory) The most common type of computer memory. DRAMs hold data for a relatively brief period of time and need to be refreshed at regular intervals. DRAMs are measured by access time (in nanoseconds, or ns) and storage capacity (in megabytes, or MB). EDO (Extended Data Out) Memory Higher-performing memory than DRAM, with a gain in performance of roughly 10-15% over DRAM. BEDO (Burst Extended Data Out) Memory Higher-performing memory than EDO, with a gain in performance of roughly 13% over EDO. SDRAM (Static Dynamic Random Access Memory) A memory chip that retains memory and does not need refreshing. Another advantage of SDRAM is that it synchronizes with the CPU timing. Although faster than DRAM, it is also more expensive; available in speeds from 66 to 266 MHz. DDR SDRAM (Double Data Rate Synchronous Dynamic Random Access Memory) A memory integrated circuit that permits transactions on the rising as well as the falling edges of the clock cycle, with a bus clock speed of 100 MHz with a data transfer rate of 200 MHz.

OTHER MEMORY TYPES VRAM (Video Random Access Memory) VRAM is a video version of fast page mode memory and is found primarily in video accelerator cards.

Flash Memory A memory chip that is non-volatile, re-writable that functions like a combination random access memory and a hard disk drive. In the case of power being lost, data is retained in memory. Advantages of flash memory include low voltage, durability and high speed; for this reason, flash memory is used in printers, pagers, digital cameras, audio recorders and cell phones.

Shadow RAM (Random Access Memory) During the booting up of a computer, a minimal set of instructions to start the computer and video are stored in ROM (read only memory), known as BIOS (basic input output system). Since ROM normally executes slowly, Shadow RAM allows for the transfer of selected segments of the BIOS code from ROM to RAM memory (which is faster).

4.Explain about Memory Banks

Memory chips (DIPs, SIMMs, SIPPs, and DIMMs) are organized in banks on motherboards and memory cards.

The bank layout when adding memory to the system.

Memory diagnostics report error locations by byte and bit addresses, use these numbers to locate which bank in your system contains the problem.

The banks usually correspond to the data bus capacity of the system's microprocessor. Table shows the widths of individual banks based on the type of PC.

Table   Memory Bank Widths on Various Systems

Processor	Data Bus	Memory Bank Width	Memory Bank Width (Parity/ECC)	30-Pin SIMMs per Bank	72-Pin SIMMs per Bank	DIMMs per Bank
8088	8-bit	8 bits	9 bits	1	—	—
8086	16-bit	16 bits	18 bits	2	—	—
286	16-bit	16 bits	18 bits	2	—	—
386SX, SL, SLC	16-bit	16 bits	18 bits	2	—	—
486SLC, SLC2	16-bit	16 bits	18 bits	2	—	—
386DX	32-bit	32 bits	36 bits	4	1	—
486SX, DX, DX2, DX4, 5x86	32-bit	32 bits	36 bits	4	1	—
x86 and x86-64 running single-channel mode	64-bit	64 bits	72 bits	—	—	1
x86 and x86-64 running dual-channel mode	64-bit	128 bits	144 bits	—	—	2
x86 and x86-64 running tri-channel mode	64-bit	192 bits	216 bits	—	—	3

Each DIMM represents an individual bank, and these can be added or removed one at a time.–Dual-channel‖ and –tri-channel‖ designs treat two or three matched modules as a single bank of memory.

5. Explain about Parity and ECC in detail.

Memory modules have traditionally been available in different basic flavors:
Non-parity
Parity
ECC

Non-parity is "regular" memory it contains exactly one bit of memory for every bit of data to be stored. 8 bits are used to store each byte of data. Parity memory adds an extra single bit for every eight bits of data, used only for error detection and correction. 9 bits of data are used to store each byte. The table below shows a summary of the different common module sizes and their bit widths:

Module Type	Bit Width of Non-Parity SIMM	Bit Width of Parity SIMM
30-Pin SIMM	8 bits	9 bits
72-Pin SIMM	32 bits	36 bits
168-Pin DIMM	64 bits	72 bits

Parity memory can be used for parity checking, a basic form of error detection, on PCs that support it. It can also be used for an advanced form of error detection and correction called ECC on Pentium class or later systems that support ECC. Non-parity memory provides no error detection capabilities at all unless these are provided through external circuitry

ECC memory As the name implies, this is memory specifically designed to allow the use of ECC on modern systems that have a chipset that supports it, much the way that parity memory can on some systems. Due to the fact that both types of memory support ECC, there has been a great deal of confusion about the difference between ECC and parity memory, especially since they often are quoted with the same specifications.

The biggest difference between the two types of memory is that ECC memory works in ECC mode and so does parity memory, but ECC memory does not work in plain parity checking mode. The reason is that while an ECC module contains one extra bit per byte the way parity ones do, the extra bits cannot be individually accessed, which is required for parity operation.

Module Type	Parity Operation	ECC Operation
True Parity	Yes	Yes
ECC	No	Yes

6. Explain about Logical Memory Layout.

The design decisions made in the earliest PCs, memory is broken into the following four basic pieces:

Conventional Memory: The first 640 KB of system memory is the (in)famous conventional memory that every PC user has over time grown to know and hate. This is the area that is available for use by standard DOS programs, along with many drivers, memory-resident programs, and most anything else that has to run under standard DOS. It is found at addresses 00000h to 9FFFFh.

Upper Memory Area (UMA): This is the upper 384 KB of the first megabyte of system memory (immediately above conventional memory). It is reserved for use by system devices and for special uses such as ROM shadowing and drivers. It uses addresses A0000h to FFFFFh.

High Memory Area (HMA): This is the first 64 KB (less 16 bytes) of the second megabyte of system memory. Technically this is the first 64 KB of extended memory, but it can be accessed when the processor is in real mode, which makes it different from the rest of extended memory. It is usually used for DOS, to allow more conventional memory to be preserved. It occupies addresses 100000h to 10FFEFh.

Extended Memory: This is all the memory above the high memory area until the end of system memory. It is used for programs and data when using an operating system running in protected mode, such as any version of Windows. Extended memory is found from address 10FFF0h to the last address of system memory. (Technically, the high memory area is part of extended memory, it all depends on how you are looking at things).

Extended Memory upto   4 GB of total memory
High Memory area – 64K
Upper Memory area   (Reserved Memory 384K)
Conventional Memory   640K

7. Explain about data-encoding schemes.

Magnetic storage is an analog medium. The data in PC is digital information.

When the drive sends digital information to a magnetic recording head, the head creates magnetic domains on the storage medium with specific polarities corresponding to the positive and negative voltages the drive applies to the head.

The flux reversals form the boundaries between the areas of positive and negative polarity that the drive controller uses to encode the digital data onto the analog medium.

During a read operation, each flux reversal the drive detects generates a positive or negative pulse that the device uses to reconstruct the original binary data.

The drive passes the raw digital input data through a device called an encoder/decoder (endec), which converts the raw binary information to a waveform designed to optimally place the flux transitions on the media.

During a read operation, the endec reverses the process and decodes the pulse train back into the original binary data.

The three basic types are:

Frequency Modulation

Modified Frequency Modulation

Run Length Limited

Frequency Modulation Encoding

One of the earliest techniques for encoding data for magnetic storage is called Frequency Modulation

Encoding and also called as Single-Density encoding.

It was used in floppy disk drives, which stored about 80KB of data on a single disk.

It was used until 1970's.

Modified FM Encoding

It reduces the number of flux reversals used in the original FM encoding scheme to pack more data onto the disk.

It records clock transitions only when a stored 0 bit is preceded by another 0 bit; in all other cases, a clock transition is not required.

It minimizes the use of clock transitions, it can double the clock frequency used by FM encoding, which enables it to store twice as many data bits in the same number of flux transitions.

It is also called double-density recording.

Table MFM Data-to-Flux Transition Encoding

Data Bit Value	Flux Encoding
1	NT
0 preceded by 0	TN
0 preceded by 1	NN

T = Flux transition
N = No flux transition

Run Length Limited Encoding

Encoding scheme for hard disks, called Run Length Limited, packs up to twice the information on a given disk than MFM.

The drive combines groups of bits into a unit to generate specific patterns of flux reversals.

Because the clock and data signals are combined in these patterns, the clock rate can be further increased while maintaining the same basic distance between the flux transitions on the storage medium.

During the late 1980s, the PC hard disk industry began using RLL.

The term Run Length Limited is derived from the two primary specifications of these codes, which are the minimum number (the run length) and maximum number (the run limit) of transition cells allowed between two actual flux transitions.

Table. RLL 2,7 Data-to-Flux Transition Encoding

Data Bit Values	Flux Encoding
10	NTNN
11	TNNN
000	NNNTNN
010	TNNTNN
011	NNTNNN
0010	NNTNNTNN
0011	NNNNTNNN

T = Flux transition
N = No flux transition

Encoding Scheme Comparisons

Figure shows an example of the waveform written to store the ASCII character X on a hard disk drive by using three encoding schemes.
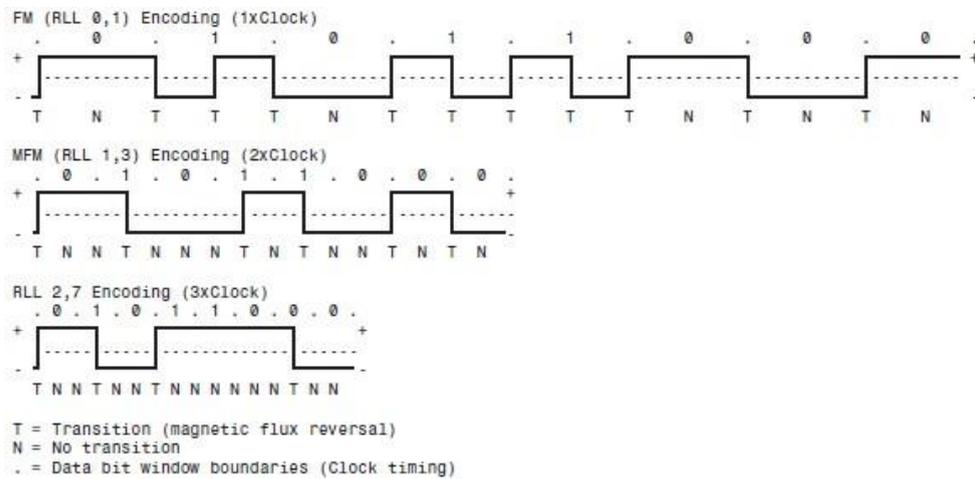
```
FM (RLL 0,1) Encoding (1xClock)
        0      1      0      1      1      0      0      0
```

```
MFM (RLL 1,3) Encoding (2xClock)
    0   1   0   1   1   0   0   0
```

```
RLL 2,7 Encoding (3xClock)
   0   0   1   0   1   1   0   0   0
```

```
T = Transition (magnetic flux reversal)
N = No transition
. = Data bit window boundaries (Clock timing)
```

Figure ASCII character X write waveforms using FM, MFM, and RLL 2,7 encoding.

The top line shows the individual data bits (01011000b, for example) in their bit cells separated in time by the clock signal, which is shown as a period (.).

Below that line is the actual write waveform, showing the positive and negative voltages as well as head voltage transitions that result in the recording of flux transitions.

The bottom line shows the transition cells, with T representing a transition cell that contains a flux transition and N representing a transition cell that is empty.

The FM example, Each bit cell has two transition cells: one for the clock information and one for the data.

All the clock transition cells contain flux transitions, and the data transition cells contain a flux transition only if the data is a 1 bit.

No transition is present when the data is a 0 bit.

Starting from the left, the first data bit is 0, which decodes as a flux transition pattern of TN.

The next bit is a 1, which decodes as TT. The next bit is 0, which decodes as TN, and so on.

In MFM, the clock transition cells carry a flux transition only when a 0 bit is stored after another 0 bit.

Starting from the left, the first bit is a 0, and the preceding bit is unknown , so the flux transition pattern is TN for that bit.

The next bit is a 1, pattern is NT. The next bit is 0, which was preceded by 1, so the pattern stored is NN.

The RLL 2,7 pattern encodes groups of bits rather than individual bits.

Starting from the left, the first group is the first three bits 010, translated to pattern TNNTNN.

The next two bits, 11, are translated to TNNN; and the final group, 000 bits, to NNNTNN to complete the byte.

Partial-Response, Maximum-Likelihood Decoders

Read channel circuits using Partial-Response, Maximum-Likelihood (PRML) technology enable disk drive manufacturers to increase the amount of data stored on a disk platter by up to 40%.

The controller analyzes the analog data stream it receives from the heads by using digital signal sampling, processing, and detection algorithms (this is the partial response element) and predicts the sequence of bits the data stream is most likely to represent.

8. Briefly explain about Hard Disk Drive. (APR 2011)
9. Discuss in detail about auxiliary storage device. (NOV 2012)
10.Explain components available in hard disk. (NOV 2013)
11.Describe the function of HDD. (APR 2012)

A **hard disk** (commonly known as a *hard disk drive* or *hard drive* and formerly known as a *fixed disk*) is a digitally encoded non-volatile storage device which stores data on rapidly rotating platters with magnetic surfaces. Strictly speaking, "drive" refers to an entire unit containing multiple platters, a read/write head assembly, driver electronics, and motor while "hard disk" (sometimes "platter") refers to the storage medium itself.

Hard disks were originally developed for use with computers. In the 21st century, applications for hard disks have expanded beyond computers to include digital video recorders, digital audio players, personal digital assistants, and digital cameras. In 2005 the first mobile phones to include hard disks were introduced by Samsung Group and Nokia. The need for large-scale, reliable storage, independent of a particular device, led to the introduction of configurations such as RAID, hardware such as network attached storage (NAS) devices, and systems such as storage area networks (SANs) for efficient access to large volumes of data.

Technology

Hard disks record data by magnetizing a magnetic material in a pattern that represents the data. They read the data back by detecting the magnetization of the material. A typical hard disk design consists of a spindle which holds one or more flat circular disks called platters, onto which the data is recorded. The platters are made from a non-magnetic material, usually glass or aluminum, and are coated with a thin layer of magnetic material. Older disks used iron(III) oxide as the magnetic material, but current disks use a cobalt-based alloy.

The platters are spun at very high speeds. Information is written to a platter as it rotates past mechanisms called read-and-write heads that fly very close over the magnetic surface. The read-and-write head is used to detect and modify the magnetization of the material immediately under it. There is one head for each magnetic platter surface on the spindle, mounted on a common arm. An actuator arm (or access arm) moves the heads on an arc (roughly radially) across the platters as they spin, allowing each head to access almost the entire surface of the platter as it spins.

The magnetic surface of each platter is divided into many small sub-micrometre-sized magnetic regions, each of which is used to encode a single binary unit of information. In today's hard disks each of these magnetic regions is composed of a few hundred magnetic grains. Each magnetic region forms a magnetic dipole which generates a highly localised magnetic field nearby. The write head magnetizes a magnetic region by generating a strong local magnetic field nearby. Early hard disks used the same inductor that was used to read the data as an electromagnet to create this field. Later, metal in Gap (MIG) heads were used, and today thin film heads are common. With these later technologies, the read and write head are separate mechanisms, but are on the same actuator arm.

The inside of a hard disk drive with the disk itself removed. To the left is the read-write arm. In the middle the electromagnets of the platter's motor can be seen.

Hard disks have a mostly sealed enclosure that protects the disk internals from dust, condensation, and other sources of contamination. The hard disk's read-write heads fly on an air bearing which is a cushion of air only nanometers above the disk surface. The disk surface and the disk's internal environment must therefore be kept immaculate to prevent damage from fingerprints, hair, dust, smoke particles and such, given the sub-microscopic gap between the heads and disk.

Using rigid platters and sealing the unit allows much tighter tolerances than in a floppy disk. Consequently, hard disks can store much more data than floppy disk and access and transmit it faster. In 2006, a typical workstation hard disk might store between 80 GB and 750 GB of data (as of local US market by December 2006), rotate at 7,200 to 10,800 revolutions per minute (RPM), and have a

sequential media transfer rate of over 100 MB/s. The fastest workstation and server hard disks spin at 15,000 RPM, and can achieve sequential media transfer speeds up to and beyond 300 MB/s. Laptop hard disks, which are physically smaller than their desktop counterparts, tend to be slower and have less capacity. Most spin at only 4,200 RPM or 5,400 RPM whereas the newest top models spin at 7.200 RPM.

Capacity

The capacity of hard disks has grown dramatically over time. The first commercial disk, the IBM RAMAC introduced in 1956, stored 5 million characters (about 5 megabytes) on fifty 24-inch diameter disks. (*See* early IBM disk storage.) With early personal computers in the 1980s, a disk with a 20 megabyte capacity was considered large. In the latter half of the 1990s, hard disks with capacities of 1 gigabyte and greater became available. As of 2006, the lowest-capacity desktop computer hard disk still in production has a capacity of 20 gigabytes, while the largest-capacity internal disks are a 3/4 terabyte (768 gigabytes), with external disk enclosures at or exceeding one terabyte by using multiple internal disks. These new internal disks increased their storage capacities with perpendicular recording.

The exponential increases in disk space and data access times for hard disks has enabled the commercial viability of consumer products that require large storage capacities, such as the Apple iPod digital music player, the TiVo personal video recorder, and web-based email programs.

This is also gradually but significantly altering how programmers think; in many programming tasks there is a time-space tradeoff, so as space becomes cheaper and cheaper relative to CPU cycles the appropriate choice about time versus space changes. For instance in database work it is now common practice to store precomputed views, transitive closures, and the like on disk in order to speed up queries; 20 years ago such profligate use of disk space would have been impractical.

A vice president of Seagate projects a future growth in disk density of 40% per year. Access times have not kept up with throughput increases, which themselves have not kept up with growth in storage capacity. The main way to increase either is to increase the number of read-write heads in a hard disk. Since flying heads are the most expensive component of hard disks, increasing their number per hard disk wouldn't help the situation. Currently, the most promising way to reduce access times and increase throughput are to replace rotating disks with nonvolatile random access memory (NVRAM) or, possibly, holographic memory technology.

Capacity measurements

Hard disk manufacturers typically specify disk capacity using the SI definition of the prefixes "mega" and "giga." This is largely for historical reasons. Disks with multi-million byte capacity have been used since 1956, long before there were standard binary prefixes. The International Electrotechnical Commission (IEC) only standardized binary prefixes in 1999. Many practitioners early on in the computer and semiconductor industries used the prefix kilo to describe 2^{10} (1024) bits, bytes or words because 1024 is close to 1000. Similar usage has been applied to the prefixes *mega, giga, tera*, and even *peta*. Often this non-SI conforming usage is noted by a qualifier such as "1 kB = 1,024 bytes" but the qualifier is sometimes omitted, particularly in marketing literature.

Operating systems, such as Microsoft Windows, frequently report capacity using the binary interpretation of the prefixes, which results in a discrepancy between the disk manufacturer's stated capacity and what the system reports. The difference becomes much more noticeable in the multi-gigabyte range. For example, Microsoft's Windows 2000 reports disk capacity both in decimal to 12 or more significant digits and with binary prefixes to 3 significant digits. Thus a disk specified by a disk manufacturer as a 30 GB disk might have its capacity reported by Windows 2000 both as "30,065,098,568 bytes" and "28.0 GB." The disk manufacturer used the SI definition of "giga," 10^9. However utilities provided by Windows define a gigabyte as 2^{30}, or 1,073,741,824, bytes, so the reported capacity of the disk will be closer to 28.0 GB. For this reason, many utilities that report capacity have begun to use the aforementioned IEC standard binary prefixes (e.g. KiB, MiB, GiB) since their definitions are unambiguous.

Some people mistakenly attribute the discrepancy in reported and specified capacities to reserved space used for file system and partition accounting information. However, for large (several GiB) filesystems, this data rarely occupies more than a few MiB, and therefore cannot possibly account for the apparent "loss" of tens of GBs.

The capacity of a hard disk can be calculated by multiplying the number of cylinders by the number of heads by the number of sectors by the number of bytes/sector (most commonly 512).

History

IBM 62PC "Piccolo" HDD, circa 1979 - an early 8" disk

For many years, hard disks were large, cumbersome devices, more suited to use in the protected environment of a data center or large office than in a harsh industrial environment (due to their delicacy), or small office or home (due to their size and power consumption). Before the early 1980s, most hard disks had 8-inch (20 cm) or 14-inch (35 cm) platters, required an equipment rack or a large amount of floor space (especially the large removable-media disks, which were often referred to as "washing machines"), and in many cases needed high-current or even three-phase power hookups due to the large motors they used. Because of this, hard disks were not commonly used with microcomputers until after 1980, when Seagate Technology introduced the ST-506, the first 5.25-inch hard disk, with a capacity of 5 megabytes. In fact, in its factory configuration, the original IBM PC (IBM 5150) was not equipped with a hard disk.

Most microcomputer hard disks in the early 1980s were not sold under their manufacturer's names, but by OEMs as part of larger peripherals (such as the Corvus Disk System and the Apple ProFile). The IBM PC/XT had an internal hard disk, however, and this started a trend toward buying "bare" disks (often by mail order) and installing them directly into a system. Hard disk makers started marketing to end users as well as OEMs, and by the mid-1990s, hard disks had become available on retail store shelves.

While internal disks became the system of choice on PCs, external hard disks remained popular for much longer on the Apple Macintosh and other platforms. Every Mac made between 1986 and 1998 has a SCSI port on the back, making external expansion easy. External SCSI disks were also popular with older microcomputers such as the Apple II series, and were also used extensively in servers, a usage which is still popular today. The appearance in the late 1990s of high-speed external interfaces such as USB and FireWire has made external disk systems popular among PC users once again, especially for users who move large amounts of data between two or more locations, and most hard disk makers now make their disks available in external cases.

Hard disk characteristics

5.25" MFM 110 MB hard disk (2.5" IDE 6495 MB hard disk, US & UK pennies for comparison)

Capacity, usually quoted in gigabytes. (older hard disks used to quote their smaller capacities in megabytes)

Physical size, usually quoted in inches:

- o Almost all hard disks today are of either the 3.5" or 2.5" varieties, used in desktops and laptops, respectively. 2.5" disks are usually slower and have less capacity but use less power and are more tolerant of movement. An increasingly common size is the 1.8" disks used in portable MP3 players and subnotebooks, which have very low power consumption and are highly shock-resistant. Additionally, there is the 1" form factor designed to fit the dimensions of CF Type II, which is also usually used as storage for portable devices including digital cameras. 1" was a de facto form factor led by IBM's Microdrive, but is now generically called 1" due to other manufacturers producing similar products. There is also a 0.85" form factor produced by Toshiba for use in mobile phones and similar applications. The size designations are more nomenclature than descriptive: for example, a 3.5" drive is named for the size of the floppy disk whose drive bay size it was originally designed to occupy; the drive itself is actually 4" wide. Server-class hard disks also come in both 3.5" and 2.5" form factors.

Reliability, usually given in terms of mean time between failure (MTBF):

- o SATA 1.0 disks support speeds up to 10,000 RPM and MTBF levels up to 1 million hours under an eight-hour, low-duty cycle.
- o Fibre Channel (FC) disks support up to 15,000 RPM and an MTBF of 1.4 million hours under a 24-hour duty cycle.

Number of I/O operations per second:

- o Modern disks can perform around 50 random access or 100 Sequential access operations per second.

Power consumption (especially important in battery-powered laptops).

audible noise in dBA (although many still report it in bels, not decibels).

G-shock rating (surprisingly high in modern disks).

Transfer Rate:
- o Inner Zone: from 44.2 MB/s to 74.5 MB/s.
- o Outer Zone: from 74.0 MB/s to 111.4 MB/s.

Random access time: from 5 ms to 15 ms.

Integrity

The hard disk's spindle system relies on air pressure inside the enclosure to support the heads at their proper *flying height* while the disk is in motion. A hard disk requires a certain range of air pressures in order to operate properly. The connection to the external environment and pressure occurs through a small hole in the enclosure (about 1/2 mm in diameter), usually with a carbon filter on the inside (the *breather filter,* see below). If the air pressure is too low, there will not be enough lift for the flying head, the head will not be at the proper height, and there is a risk of head crashes and data loss. Specially manufactured sealed and pressurized disks are needed for reliable high-altitude operation, above about 10,000 feet (3,000 m). This does not apply to pressurized enclosures, like an airplane pressurized cabin. Modern disks include temperature sensors and adjust their operation to the operating environment.

Very high humidity for extended periods can cause accelerated wear of the heads and platters by corrosion. If the disk uses "Contact Start/Stop" (CSS) technology to park its heads on the platters when not operating, increased humidity can also lead to increased stiction (the tendency for the heads to stick to the platter surface). This can cause physical damage to the platter and spindle motor and can also lead to head crash. Breather holes can be seen on all disks — they usually have a warning sticker next to them, informing the user not to cover the holes. The air inside the operating disk is constantly moving too, being swept in motion by friction with the spinning platters. This air passes through an internal recirculation (or "recirc") filter to remove any leftover contaminants from manufacture, any particles or chemicals that may have somehow entered the enclosure, and any particles or outgassing generated internally in normal operation.

Due to the extremely close spacing between the heads and the disk surface, any contamination of the read-write heads or platters can lead to a head crash — a failure of the disk in which the head scrapes across the platter surface, often grinding away the thin magnetic film. For giant magnetoresistive (GMR) heads in particular, a minor head crash from contamination (that does not remove the magnetic surface of the disk) will still result in the head temporarily overheating, due to friction with the disk surface, and can render the data unreadable for a short period until the head temperature stabilizes (so called "thermal asperity," a problem which can partially be dealt with by proper electronic filtering of the read signal). Head crashes can be caused by electronic failure, a sudden power failure, physical shock, wear and tear, corrosion, or poorly manufactured platters and heads. In most desktop and server disks, when powering down, the heads are moved to a *landing zone,* an area of the platter usually near its inner diameter (ID), where no data is stored. This area is called the CSS (Contact Start/Stop) zone. However, especially in old models, sudden power interruptions or a power supply failure can sometimes result in the device shutting down with the heads in the data zone, which increases the risk of data loss. In fact, it used to be procedure to "park" the hard disk before shutting down your computer. Newer disks are designed such that either a spring (at first) or (more recently) rotational inertia in the platters is used to safely park the heads in the case of unexpected power loss.

The hard disk's electronics control the movement of the actuator and the rotation of the disk, and perform reads and writes on demand from the disk controller. Modern disk firmware is capable of scheduling reads and writes efficiently on the platter surfaces and remapping sectors of the media which have failed. Also, most major hard disk and motherboard vendors now support self-monitoring, analysis, and reporting technology (S.M.A.R.T.), by which impending failures can be predicted, allowing the user to be alerted to prevent data loss.

Landing zones

Around 1995 IBM pioneered a technology where the landing zone is made by a precision laser process (*Laser Zone Texture* = LZT) producing an array of smooth nanometer-scale "bumps" in the ID landing zone, thus vastly improving stiction and wear performance. This technology is still widely in use today (2006). A few years after LZT, initially for mobile applications (i.e. laptop etc.), and later also for the other HDD types, IBM introduced "head unloading" technology, where the heads are lifted off the platters onto plastic "ramps" near the outer disk edge, thus eliminating the risk of stiction

altogether and greatly improving non-operating shock performance. All HDD manufacturers use these two technologies to this day. Both have a list of advantages and drawbacks in terms of loss of storage space, relative difficulty of mechanical tolerance control, cost of implementation, etc.

IBM created a technology for their Thinkpad line of laptop computers called the Active Protection System. When a sudden, sharp movement is detected by the built-in motion sensor in the Thinkpad, internal hard disk heads automatically unload themselves into the parking zone to reduce the risk of any potential data loss or scratches made. Apple later also utilized this technology in their Powerbook, iBook, MacBook Pro, and MacBook line, known as the Sudden Motion Sensor.

Spring tension from the head mounting constantly pushes the heads towards the platter. While the disk is spinning, the heads are supported by an air bearing and experience no physical contact or wear. In CSS drives the sliders carrying the head sensors (often also just called *heads*) are designed to reliably survive a number of landings and takeoffs from the media surface, though wear and tear on these microscopic components eventually takes its toll. Most manufacturers design the sliders to survive 50,000 contact cycles before the chance of damage on startup rises above 50%. However, the decay rate is not linear—when a disk is younger and has fewer start-stop cycles, it has a better chance of surviving the next startup than an older, higher-mileage disk (as the head literally drags along the disk's surface until the air bearing is established). For example, the Maxtor DiamondMax series of desktop hard disks are rated to 50,000 start-stop cycles. This means that no failures attributed to the head-platter interface were seen before at least 50,000 start-stop cycles during testing.

Access and interfaces

Hard disks are generally accessed over one of a number of bus types, including ATA (IDE, EIDE), Serial ATA (SATA), SCSI, SAS, IEEE 1394, USB, and Fibre Channel.

Back in the days of the ST-506 interface, the data encoding scheme was also important. The first ST-506 disks used Modified Frequency Modulation (MFM) encoding (which is still used on the common "1.44 MB" (1440 KiB) 3.5-inch floppy), and transferred data at a rate of 5 megabits per second. Later on, controllers using *2,7 RLL* (or just "RLL") encoding increased the transfer rate by half, to 7.5 megabits per second; it also increased disk capacity by half.

Many ST-506 interface disks were only certified by the manufacturer to run at the lower MFM data rate, while other models (usually more expensive versions of the same basic disk) were certified to run at the higher RLL data rate. In some cases, the disk was overengineered just enough to allow the MFM-certified model to run at the faster data rate; however, this was often unreliable and was not recommended. (An RLL-certified disk could run on a MFM controller, but with 1/3 less data capacity and speed.)

Enhanced Small Disk Interface (ESDI) also supported multiple data rates (ESDI disks always used 2,7 RLL, but at 10, 15 or 20 megabits per second), but this was usually negotiated automatically by the disk and controller; most of the time, however, 15 or 20 megabit ESDI disks weren't downward compatible (i.e. a 15 or 20 megabit disk wouldn't run on a 10 megabit controller). ESDI disks typically also had jumpers to set the number of sectors per track and (in some cases) sector size.

SCSI originally had just one speed, 5 MHz (for a maximum data rate of 5 megabytes per second), but later this was increased dramatically. The SCSI bus speed had no bearing on the disk's internal speed because of buffering between the SCSI bus and the disk's internal data bus; however, many early disks had very small buffers, and thus had to be reformatted to a different interleave (just like ST-506 disks) when used on slow computers, such as early IBM PC compatibles and early Apple Macintoshes.

ATA disks have typically had no problems with interleave or data rate, due to their controller design, but many early models were incompatible with each other and couldn't run in a master/slave setup (two disks on the same cable). This was mostly remedied by the mid-1990s, when ATA's specification was standardised and the details began to be cleaned up, but still causes problems occasionally (especially with CD-ROM and DVD-ROM disks, and when mixing Ultra DMA and non-UDMA devices).

Serial ATA does away with master/slave setups entirely, placing each disk on its own channel (with its own set of I/O ports) instead.

FireWire/IEEE 1394 and USB(1.0/2.0) hard disks are external units containing generally ATA or SCSI disks with ports on the back allowing very simple and effective expansion and mobility. Most

FireWire/IEEE 1394 models are able to daisy-chain in order to continue adding peripherals without requiring additional ports on the computer itself.

Disk families used in personal computers

Notable disk families include:

MFM (Modified Frequency Modulation) disks required that the controller electronics be compatible with the disk electronics.

RLL (Run Length Limited) disks were named after the modulation technique that made them an improvement on MFM. They required large cables between the controller in the PC and the hard disk, the disk did not have a controller, only a modulator/demodulator.

ESDI (Enhanced Small Disk Interface) was an interface developed by Maxtor to allow faster communication between the PC and the disk than MFM or RLL.

Integrated Drive Electronics (IDE) was later renamed to ATA, and then PATA. The name comes from the way early families had the hard disk controller external to the disk. Moving the hard disk controller from the interface card to the disk helped to standardize interfaces, including reducing the cost and complexity. In 2005/2006 parlance, the 40 pin IDE/ATA is called "PATA" or parallel ATA, which means that there are 16 bits of data transferred in parallel at a time on the data cable. The data cable was originally 40 conductor, but UDMA modes from the later disks requires using an 80 conductor cable (note that the 80 conductor cable still uses a 40 position connector.) The interface changed from 40 pins to 39 pin. The missing pin acts as a key to prevent incorrect insertion of the connector, a common cause of disk and controller damage.

SCSI (Small Computer System Interface) was an early competitor with ESDI, originally named SASI for Shugart Associates. SCSI disks were standard on servers, workstations, and Apple Macintosh computers through the mid-90s, by which time most models had been transitioned to IDE (and later, SATA) family disks. Only in 2005 did the capacity of SCSI disks fall behind IDE disk technology, though the highest-performance disks are still available in SCSI and Fibre Channel only. The length limitations of the data cable allows for external SCSI devices. Originally SCSI data cables used single ended data transmission, but server class SCSI could use differential transmission, and then Fibre Channel (FC) interface, and then more specifically the Fibre Channel Arbitrated Loop (FC-AL), connected SCSI hard disks using fibre optics. FC-AL is the cornerstone of storage area networks, although other protocols like iSCSI and ATA over Ethernet have been developed as well.

SATA (Serial ATA). The SATA data cable has one data pair for differential transmission of data to the device, and one pair for differential receiving from the device, just like EIA-422. That requires that data be transmitted serially. The same differential signaling system is used in RS485, LocalTalk, USB, Firewire, and differential SCSI.

SAS (Serial Attached SCSI). The SAS is a new generation serial communication protocol for devices designed to allow for much higher speed data transfers and is compatible with SATA. SAS uses serial communication instead of the parallel method found in traditional SCSI devices but still uses SCSI commands for interacting with SAS

EIDE was an unofficial update (by Western Digital) to the original IDE standard, with the key improvement being the use of DMA to transfer data between the disk and the computer, an improvement later adopted by the official ATA standards. DMA is used to transfer data without the CPU or program being responsible to transfer every word. That leaves the CPU/program/operating system to do other tasks while the data transfer occurs.

Acronym	Meaning	Description
SASI	Shugart Associates System Interface	Predecessor to SCSI
SCSI	Small Computer System Interface	Bus oriented that handles concurrent operations.
ST-412		Seagate interface
ST-506		Seagate interface (improvement over ST-412)
ESDI	Enhanced Small Disk Interface	Faster and more integrated than ST-412/506, but still backwards compatible

ATA	Advanced Technology Attachment	Successor to ST-412/506/ESDI by integrating the disk controller completely onto the device. Incapable of concurrent operations.

12. What is SATA? Explain.

Serial ATA (SATA or Serial AT Attachment) is a computer bus interface for connecting host bus adapters to mass storage devices such as hard disk drives and optical drives. Serial ATA was designed to replace the older parallel ATA (PATA) standard (often called by the old name IDE), offering several advantages over the older interface: reduced cable size and cost (7 conductors instead of 40), native hot swapping, faster data transfer through higher signaling rates, and more efficient transfer through an (optional) I/O queuing protocol.

SATA host-adapters and devices communicate via a high-speed serial cable over two pairs of conductors. In contrast, parallel ATA (the redesignation for the legacy ATA specifications) used a 16-bit wide data bus with many additional support and control signals, all operating at much lower frequency. To ensure backward compatibility with legacy ATA software and applications, SATA uses the same basic ATA and ATAPI command-set as legacy ATA devices.

SATA has replaced parallel ATA in consumer desktop and laptop computers, and has largely replaced PATA in new embedded applications. SATA's market share in the desktop PC market was 99% in 2008.PATA remains widely used in industrial and embedded applications that use CompactFlash storage, though even there, the new CFast storage standard is based on SATA.

13. Explain Flash Memory Devices.

Flash memory is a special type of solid-state memory chip that requires no power to maintain its contents.

Flash memory cards can easily be moved from digital cameras to laptop or desktop computers.

Flash memory is a type of nonvolatile memory that can be electrically programmed and erased.

It is programmed or erased by special equipment outside of the motherboard.

The system cannot rewrite Flash memory; it must always erase it first.

When erased, flash memory cells are in a low-voltage state that carries a logical 1 value.

Programming flash places a charge in the transistor's floating gate, which changes the 1 to a 0.

Changing o back to 1 is by erasing it.

The two major types of flash memory technology are called NOR and NAND.

NOR flash works more like dynamic RAM (DRAM), providing high-speed random-access capabilities with the ability to read or write data in single byte quantities.

NAND flash works more like a storage device, reading and writing data in pages or blocks instead of individual bytes.

Several types of flash memory devices have been popular, including the following:

        CompactFlash (CF)
        SmartMedia (SM)
        MultiMediaCard (MMC)

SecureDigital (SD)
Memory Stick
ATA Flash
xD-Picture Card
Solid-state drive (SSD)
USB flash devices

CompactFlash

CompactFlash was developed by SanDisk Corporation in 1994 and uses the ATA (AT Attachment) architecture to emulate a disk drive.

The original size was Type I (3.3mm thick); a newer Type II size (5mm thick) accommodates higher capacity devices.

Both CompactFlash cards are 1.433-inch wide by 1.685-inch long, and adapters allow them to be inserted into laptop computer PC Card slots.

MultiMediaCard

The MultiMediaCard (MMC) was co-developed by SanDisk and Infineon Technologies AG in 1997 for use with smart phones, MP3 players, digital cameras, and camcorders.

The MMC uses a simple 7-pin serial interface to devices and contains low-voltage flash memory.

The MultiMediaCard Association was founded in 1998.

In November 2002, MMCA announced the development of the Reduced Size MultiMediaCard (RS-MMC), which reduces the size of the standard MMC by about 40% and can be adapted for use with standard MMC devices.

SecureDigital

A SecureDigital (SD) storage device is about the same size as an MMC, but it's a more sophisticated product.

It was codeveloped by Toshiba, Matsushita Electric (Panasonic), and SanDisk in 1999,with two special features.

The first is encrypted storage of data for additional security, meeting current and future Secure Digital Music Initiative (SDMI) standards for portable devices.

The second is a mechanical write-protection switch.

Reduced-size versions of SD include MiniSD and MicroSD.

Both are popular choices for smart phones and can be adapted to a standard SD slot.

MicroSD is compatible with the TransFlash standard for mobile phones.

SDHC (High Capacity) supports cards from 4GB to 32GB in capacity.

The SDXC (eXtended Capacity) format was released in 2009.

SDXC supports capacities of up to 2TB.

SSD (Solid-State Drive)

A solid-state drive (SSD) is any drive using solid-state electronics.

People believe that SSDs are a recent advancement in computer technology, but in actuality they have been around in one form or another since the 1950s, even before PCs existed.

Virtual SSD (RAMdisk)

These drives are available in both physical and virtual form.

A virtual SSD is traditionally called a RAMdisk because it uses a portion of system RAM to act as a disk drive.

The benefits are incredible read/write performance, whereas the drawbacks are the fact that all data is lost when the system powers down or reboots, and that the RAM used for the RAMdisk is unavailable for the operating system (OS) and applications.

These DOS- or Windows-based RAMdisk programs are useful for creating high-speed SSDs using existing RAM.

USB Flash Drives

As an alternative to floppy removable-media drives, USB-based flash memory devices are preferred way to move data between systems.

They can be plugged into any USB port or hub.

Typical read/write performance of USB 1.1–compatible drives is about 1MBps.

Hi-Speed USB 2.0 flash drives are much faster, providing read speeds ranging from 5MBps to 15MBps and write speeds ranging from 5MBps to 13MBps.

Some USB flash drives have a mechanical write-protect switch.

They also support password-protected data encryption as an option.

14.Explain briefly about Compact Disk (CD)

15.What are the criteria to be considered when selecting a CD / DVD drive? Explain them. (NOV 2014)

16.Explain the structure and operating principles of CD-ROM in detail. (NOV 2010)

17. Explain in detail about CD and DVD technologies. (APR 2012)

18. What are the types of Disk Drives? Explain it. (NOV 2012)

CD-ROM (an abbreviation "Compact Disc read-only memory") is a Compact Disc that contains data accessible by a computer. While the Compact Disc format was originally designed for music storage and playback, the format was later adapted to hold any form of binary data. CD-ROMs are popularly used to distribute computer software, including games and multimedia applications, though any data can be stored (up to the capacity limit of a disc). Some CDs hold both computer data and audio with the latter capable of being played on a CD player, whilst data (such as software or digital video) is only usable on a computer. These are called Enhanced CDs.

Optical disc authoring

Optical disc

Optical disc image

Recorder hardware

Authoring software

Recording technologies
- o Recording modes
- o Packet writing

Optical media types

Laserdisc

Compact Disc/**CD-ROM**: CD-R, CD-RW

DVD: DVD-R, DVD-R DL, DVD+R, DVD+R DL,

DVD-RW, DVD+RW, DVD+RW DL, DVD-RAM

Blu-ray Disc: BD-R, BD-RE

HD DVD: HD DVD-R

Standards

Rainbow Books

File systems
- o ISO 9660

Joliet

Rock Ridge

Amiga extensions to Rock Ridge

El Torito

Apple ISO9660 Extensions
- o Universal Disk Format
    - Mount Rainier

Although many people use lowercase letters in this acronym, proper presentation is in all capital letters with a hyphen between CD and ROM.

Media

CD-ROM discs are identical in appearance to audio CDs, and data is stored and retrieved in a very similar manner (only differing from audio CDs in the standards used to store the data). Discs are made from a 1.2 mm thick disc of polycarbonate plastic, with a thin layer of aluminium to make a reflective surface. The most common size of CD-ROM disc is 120 mm in diameter, though the smaller Mini CD standard with an 80 mm diameter, as well as numerous non-standard sizes and shapes (e.g. business card-sized media) are also available.

Data is stored on the disc as a series of microscopic indentations ("pits", with the gaps between them referred to as "lands"). A laser is shone onto the reflective surface of the disc to read the pattern of pits and lands. Because the depth of the pits is approximately one-quarter to one-sixth of the wavelength of the laser light used to read the disc, the reflected beam's phase is shifted in relation to the incoming beam, causing destructive interference and reducing the reflected beam's intensity. This pattern of changing intensity of the reflected beam is converted into binary data.

Standards

There are several formats used for data stored on compact discs, known collectively as the Rainbow Books. These include the original Red Book standards for CD audio, White Book and Yellow Book CD-ROM. The ECMA-130 standard, which gives a thorough description of the physics and physical layer of the CD-ROM, inclusive of CIRC and Eight-to-Fourteen Modulation, can be downloaded from.

ISO 9660 defines the standard file system of a CD-ROM, although it is due to be replaced by ISO 13490. UDF format is used on user-writable CD-R and CD-RW discs that are intended to be extended or overwritten. The bootable CD specification, to make a CD emulate a hard disk or floppy, is called El Torito. Apparently named this because its design originated in an El Torito restaurant in Irvine, California.

CD-ROM format

A CD-ROM *sector* contains 2352 bytes, divided into 98 24-byte frames. The CD-ROM is, in essence, a data disk, which cannot rely on error concealment, and therefore requires a higher reliability of the retrieved data. In order to achieve improved error correction and detection, a CD-ROM has a third layer of Reed-Solomon error correction. A Mode-1 CD-ROM, which has the full three layers of error correction data, contains a net 2048 bytes of the available 2352 per sector. In a Mode-2 CD-ROM, which is mostly used for video files, there are 2336 user-available bytes per sector. The net byte rate of a Mode-1 CD-ROM is $44.1k \times 2048/(6 \times 98) = 153.6$ kB/s. The playing time is 74 minutes, or 4440 seconds, so that the net capacity of a Mode-1 CD-ROM is 682 MB.

A 1x speed CD drive reads 75 consecutive sectors per second.

CD sector contents

A standard 74 min CD contains 333,000 sectors.

Each sector is 2352 bytes, and contains 2048 bytes of PC (MODE1) Data, 2336 bytes of PSX/VCD (MODE2) Data, or 2352 bytes of AUDIO.

The difference between sector size and data content are the Headers info and the Error Correction Codes, that are big for Data (high precision required), small for VCD (standard for video) and none for audio.

If extracting the disc in RAW format (standard for creating images) always extract 2352 bytes per sector, not 2048/2336/2352 bytes depending on data type (basically, extracting the whole sector). This fact has two main consequences:

- o Recording data CDs at very high speed (40x) can be done without losing information. However, if done the same with PlayStation or Audio CD it will result in an unreadable PlayStation disc or an audio CD with lots of clicks because there are no error correction codes and the errors are more likely to occur at high speed recording.
- o On a 74 minute CD can fit very large RAW images, up to $333,000 \times 2352 = 783,216,000$ bytes (747 MiB). This should be the upper limit for a RAW image created from a 74 min CD. If the stored standard data (backup files), it can burn only $333,000 \times 2048 = 681,984,000$ bytes (650 MiB).

Please note that an image size is *always* a multiple of 2352 bytes (the size of a block) when extracting in RAW mode.

Manufacture

Pre-pressed CD-ROMs are mass-produced by a process of stamping, where a glass master disc is created and used to make "stampers", which in turn are used to manufacture multiple copies of the final disc with the pits already present. Recordable (CD-R) and rewritable (CD-RW) discs are manufactured by a similar method, but the data is recorded on them by a laser changing the properties of a dye or phase change material in a process that is often referred to as "burning".

Capacity

A standard 120 mm CD-ROM holds 650 or 700 MiB of data. To put this storage capacity into context, the average novel contains 60,000 words. Assume that average word length is 10 letters and that each letter occupies one byte. A novel therefore might occupy 600,000 bytes (600 kB, without layout information). One CD can therefore contain over 1,000 novels. If each novel occupies at least one centimetre of bookshelf space, then one CD can contain the equivalent of over ten metres of bookshelf. However, textual data can be compressed by more than a factor of ten, using compression algorithms, so a CD-ROM can accommodate at least 100 metres of bookshelf space.

In comparison a single layer DVD contains 4.4 GiB of data, nearly 7 times the amount of a CD-ROM.

Capacities of Compact Disc types

Type	Sectors	Data max size (MB)	(MiB)	Audio max size (MB)	(MiB)	Time (min)
8 cm	94,500	193.536	≈ 184.6	222.264	≈ 212.0	21
	283,500	580.608	≈ 553.7	666.792	≈ 635.9	63
650 MB	333,000	681.984	≈ 650.3	783.216	≈ 746.9	74
700 MB	360,000	737.280	≈ 703.1	846.720	≈ 807.4	80
800 MB	405,000	829.440	≈ 791.0	952.560	≈ 908.4	90
900 MB	445,500	912.384	≈ 870.1	1,047.816	≈ 999.3	99

Note: Megabyte (MB) and minute (min) values are exact.

CD capacities are always given in binary units, although decimal SI prefixes are usually used: A "700 MB" CD has a nominal capacity of about 700 MiB. A DVD capacities on the other hand are given in decimal units: A "4.7 GB" DVD has a nominal capacity of about 4.38 GiB.

Durability

Stability Study Care, Handling and Storage of Removeable Media.

CD-ROM drives

CD-RW drive

CD-ROM discs are read using CD-ROM drives, which are now almost universal on personal computers. A CD-ROM drive may be connected to the computer via an IDE (ATA), SCSI, S-ATA, Firewire, or USB interface or a proprietary interface, such as the Panasonic CD interface. Virtually all modern CD-ROM drives can also play audio CDs as well as Video CDs and other data standards when used in conjunction with the right software.

Transfer rates

The rate at which CD-ROM drives can transfer data from the disc is gauged by a speed factor relative to music CDs: 1x or 1-speed which gives a data transfer rate of 150 kilobytes per second in the most common data format. By increasing the speed at which the disc is spun, data can be transferred at greater rates. For example, a CD-ROM drive that can read at 8x speed spins the disc at up to 4000 rpm (compared to the 500 rpm maximum for 1x speed), giving a transfer rate of 1.2 megabytes per second. Above 12x speed, vibration and heat can become a problem. CD-ROM drives above this speed tackle the problem in several ways. Constant angular velocity (CAV) drives spin the disc at a constant rate, leading to faster data transfer when reading from the outer parts of the disc, but slower towards the centre. 20x was thought to be the maximum speed due to mechanical constraints until Samsung Electronics introduced the SCR-3230, a 32x CD-ROM drive which uses a ball bearing system to balance the spinning disc in the drive to reduce vibration and noise. As of 2004, the fastest transfer rate commonly available is about 52x or 10,350 rpm and 7.62 megabytes per second, though this is only when reading information from the outer parts of a disc. Future speed increases based simply upon spinning the disc faster are particularly limited by the strength of polycarbonate plastic used in CD manufacturing, though improvements can still be obtained by the use of multiple laser pickups as demonstrated by the Kenwood TrueX 72x which uses seven laser beams and a rotation speed of approximately 10x.

CD-Recordable drives are often sold with three different speed ratings, one speed for write-once operations, one for re-write operations, and one for read-only operations. The speeds are typically listed in that order; ie a 12x/10x/32x CD drive can, CPU and media permitting, write to CD-R disks at 12x speed (1.76 megabytes/s), write to CD-RW discs at 10x speed (1.46 megabytes/s), and read from CD discs at 32x speed (4.69 megabytes/s).

The 1x speed rating for CDs (150 kilobytes/s) is not to be confused with the 1x speed rating for DVDs (1.32 megabytes/s).

Common transfer speeds:

Data Transfer Speeds

Transfer Speed	Megabytes/s	Megabits/s	Mebibits/s
8x	1.2	9.6	9.1553
10x	1.5	12.0	11.4441

12x	1.8	14.4	13.7329
20x	3.0	24.0	22.8882
32x	4.8	38.4	36.6211
36x	5.4	43.2	41.1987
40x	6.0	48.0	45.7764
48x	7.2	57.6	54.9316
50x	7.5	60.0	57.2205
52x	7.8	62.4	59.5093

Loading mechanisms

Current CD-ROM drives use either a tray-loading mechanism, where the disc is loaded onto a motorised or manually-operated tray, or a slot-loading mechanism, where the disc is slid into a slot and drawn in by motorised rollers. Slot-loading drives have the disadvantage that they cannot usually accept the smaller 80 mm mini CDs or any non-standard sizes; however, the Nintendo Wii seems to have defeated this problem, for it will be able to load standard size DVDs and smaller size GameCube discs in the same slot-loading drive. A small number of CD-ROM drive models, mostly compact portable units, have a top-loading mechanism where the drive lid is opened upwards and the disc is placed directly onto the spindle (similar to most portable CD players).

Some early CD-ROM drives used a mechanism where CDs had to be inserted into special cartridges or caddies, somewhat similar in appearance to a 3.5" floppy diskette. Although the idea behind this – a tougher plastic shell to protect the disc from damage – was sound, it did not gain wide acceptance among disc manufacturers due to the increased cost of production and the concern that the discs would not be compatible with drives that did not use caddies. One exception is the PSP (Play Station Portable), which uses an 80 mm DVD inside a unopenable caddie. This was partly as a copy protection system as well as damage prevention. Unspecialised drives that used the caddy format required "bare" discs to be placed into an openable cartridge before use, negating most of the protection offered by having discs in a permanent, integrated protective cartridge, as well as making the drives less convenient to use.

19. Explain briefly about Digital Versatile Disc (DVD)

DVD (commonly "Digital Versatile Disc", previously "Digital Video Disc") is an optical disc storage media format that can be used for data storage, including movies with high video and sound quality. DVDs resemble compact discs as their physical dimensions are the same (120 mm (4.72 inches) or occasionally 80 mm (3.15 inches) in diameter), but they are encoded in a different format and at a much higher density.

Optical disc authoring

Optical disc
Optical disc image
Recorder hardware
Authoring software
Recording technologies
- o Recording modes
- o Packet writing

Optical media types

Laserdisc
Compact Disc/CD-ROM: CD-R, CD-RW

DVD: DVD-R, DVD-R DL, DVD+R, DVD+R DL, DVD-RW, DVD+RW, DVD+RW DL, DVD-RAM

Blu-ray Disc: BD-R, BD-RE

HD DVD: HD DVD-R

Standards

Rainbow Books

File systems

- ISO 9660

    Joliet

    Rock Ridge

        Amiga extensions to Rock Ridge

    El Torito

    Apple ISO9660 Extensions

- Universal Disk Format

Mount Rainier

In the early 1990s two high-density optical storage standards were being developed; one was the MultiMedia Compact Disc, backed by Philips and Sony, and the other was the Super Density disc, supported by Toshiba, Time-Warner, Matsushita Electric, Hitachi, Mitsubishi Electric, Pioneer, Thomson, and JVC. IBM's president, Lou Gerstner, acting as a matchmaker, led an effort to unite the two camps behind a single standard, anticipating a repeat of the costly format war between VHS and Betamax in the 1980s.

Philips and Sony abandoned their MultiMedia Compact Disc and fully agreed upon Toshiba's SuperDensity Disc with only one modification, namely EFMPlus. EFMPlus was chosen as it has a great resilience against disc damage such as scratches and fingerprints. EFMPlus, created by Kees Immink, who also designed EFM, is 6% less efficient than the Toshiba's code, which resulted in a capacity of 4.7 GB as opposed to the original 5 GB. The result was the DVD specification Version 1.5, announced in 1995 and finalized in September 1996. In May 1997, the DVD Consortium was replaced by the DVD Forum, which is open to all other companies.

"DVD" was originally an initialism for "Digital Video Disc." Some members of the DVD Forum believe that it should stand for "Digital Versatile Disc" to reflect its widespread use for non-video applications. Toshiba, which maintains the official DVD Forum site, adheres to the latter interpretation, and indeed this appeared within the copyright warnings on some of the earliest examples. However, the DVD Forum never reached a consensus on the matter, and so today the official name of the format is simply "DVD"; the letters do not officially stand for anything.

DVD disc capacity

Physical size	Single layer capacity		Dual/Double layer capacity	
	GB	GiB	GB	GiB
12 cm, single sided	4.7	4.38	8.5	7.92
12 cm, double sided	9.4	8.75	17.1	15.93
8 cm, single sided	1.4	1.30	2.6	2.42
8 cm, double sided	2.8	2.61	5.2	4.84

Note: GB here means gigabyte, equal to 10^9 (or 1,000,000,000) bytes. Many computers will display gibibyte (GiB), equal to 2^{30} (or 1,073,741,824) bytes.

Example: A disc with 8.5 GB capacity is equivalent to: $(8.5 \times 1,000,000,000) / 1,073,741,824 \approx 7.92$ GiB.

Capacity Nomenclature

The four basic types of DVD are referred to by their capacity in gigabytes, rounded to the nearest integer.

DVD type	Name
Single sided, single layer	DVD-5
Single sided, dual layer	DVD-9
Double sided, single layer	DVD-10
Double sided, dual layer	DVD-18

Another format in use (while remaining quite uncommon) is a double sided DVD with one side comprising a single layer of data while the opposite side comprises two layers of data. This format holds approximately 13.2 GB of data and is therefore known as DVD-14. However this format is limited in availability due to its infrequent use.

DVD recordable and rewriteable

DVD-R read/write side

HP initially developed recordable DVD media from the need to store data for back-up and transport. DVD recordable are now also used for consumer audio and video recording. Three formats were developed: -R/RW (dash), +R/RW (plus), -RAM (random access memory).

Note: in other countries, such as the United Kingdom and Australia, "DVD-R/RW" is pronounced "minus", not "dash" (the full sentence being pronounced as: DVD minus R, with the 'R' rhyming with car, not the 'ruh' format).

Dual layer recording

Dual Layer recording allows DVD-R and DVD+R discs to store significantly more data, up to 8.5 Gigabytes per disc, compared with 4.7 Gigabytes for single-layer discs. DVD-R DL (dual layer — see figure) was developed for the DVD Forum by Pioneer Corporation, DVD+R DL (double layer — see figure) was developed for the DVD+RW Alliance by Philips and Mitsubishi Kagaku Media (MKM).

A Dual Layer disc differs from its usual DVD counterpart by employing a second physical layer within the disc itself. The drive with Dual Layer capability accesses the second layer by shining the laser through the first semi-transparent layer. The layer change mechanism in some DVD players can show a noticeable pause, as long as two seconds by some accounts. More than a few viewers have worried that their dual layer discs were damaged or defective.

DVD recordable discs supporting this technology are backward compatible with some existing DVD players and DVD-ROM drives. Many current DVD recorders support dual-layer technology, and the price point is comparable to that of single-layer drives, though the blank media remains significantly more expensive.

DVD-Video

DVD-Video is a standard for storing video content on DVD media. As of 2003, DVD-Video has become the dominant form of consumer video formats in the United States, Europe, and Australia and now in the whole world.

Though many resolutions and formats are supported, most consumer DVD-Video disks utilize either 4:3 or 16:9 aspect ratio MPEG-2 video, stored at a resolution of 720x480 (NTSC) or 720x576 (PAL). Audio is commonly stored using the Dolby Digital (AC-3) and/or Digital Theater System (DTS) formats, ranging from monaural to 5.1 channel "Surround Sound" presentations. DVD-Video also supports features like selectable subtitles, multiple camera angles and multiple audio tracks.

DVD-Audio

DVD-Audio is a format for delivering high-fidelity audio content on a DVD. It offers many channel configuration options (from mono to 5.1 surround sound) at various sampling frequencies and sample rates. Compared with the CD format, the much higher capacity DVD format enables the inclusion of either considerably more music (with respect to total running time and quantity of songs) or far higher audio quality (reflected by higher linear sampling rates and higher vertical bit-rates, and/or additional channels for spatial sound reproduction).

Despite DVD-Audio's superior technical specifications, there is debate as to whether or not the resulting audio enhancements are distinguishable to typical human ears. DVD-Audio currently forms a niche market, probably due to its dependency upon new and relatively expensive equipment.

Security

DVD-Audio discs employ a robust copy prevention mechanism, called Content Protection for Prerecorded Media (CPPM) developed by the 4C group (IBM, Intel, Matsushita, and Toshiba).

CPPM can be circumvented on a PC by capturing decoded audio streams in PCM format, but the underlying protection mechanism, encryption algorithms, and keys have not yet been cracked.

Players and recorders

Modern DVD recorders often support additional formats, including DVD+/-R/RW, CD-R/RW, MP3, WMA, SVCD, JPEG, PNG, SVG, KAR and MPEG-4 (DivX/Xvid). Some also include USB ports or flash memory readers. Player prices range from as low as $20 to as high as $3,800.

DVD drives for computers usually come with one of two kinds of Regional Playback Control (RPC), either RPC-1 or RPC-2. This is used to enforce the publisher's restrictions on what regions of the world the DVD can be played. See Regional lockout.

Windows XP lacks the ability to burn rewritable DVDs; additional software is required. However, Windows Vista natively supports DVD RW discs. Newer Mac computers can burn DVD+RW, DVD-RW, and DVD-RAM natively from the OS X operating system.

Competitors and successors

There are several possible successors to DVD being developed by different consortiums: Sony/Panasonic's Blu-ray Disc (BD), Toshiba's HD DVD and Maxell's Holographic Versatile Disc (HVD).

The first generation of holographic media with 300 GB of storage capacity and a 160 Mbit/s transfer rate was scheduled for release in late 2006 by Maxell and its partner, InPhase.

On November 18, 2003, the Chinese news agency Xinhua reported the final standard of the Chinese government-sponsored Enhanced Versatile Disc (EVD), and several patents for it. Shortly thereafter the development of the format was halted by a licensing dispute between Chinese companies and On2 Technologies, but on December 6, 2006, 20 Chinese electronic firms unveiled 54 prototype EVD players and announced their intention for the format to completely replace DVDs in China by 2008.

On November 19, 2003, the DVD Forum decided by a vote of eight to six that HD DVD will be its official HDTV successor to DVD. This had no effect on the competing Blu-ray Disc Association's (BDA) determination that its format would succeed DVD, especially since most of the voters belonged to both groups.

On April 15, 2004, in a co-op project with TOPPAN Printing Co., the electronics giant Sony Corp. successfully developed the paper disc, a storage medium that is made out of 51% paper and

offers up to 25 GB of storage, about five times more than the standard 4.7 GB DVD. The disc can be easily cut with scissors and recycled, offering foolproof data security and an environment-friendly storage media.

As reported in a mid 2005 issue of *Popular Mechanics*, it is not yet clear which technology will win the format war over DVD. HD DVD discs have a lower capacity than Blu-ray discs (15 GB vs. 25 GB for single layer, 30 GB vs. 50 GB for dual layer).

In April, 2000, Sonic Solutions and Ravisent announced hDVD, an HDTV extension to DVD that presaged the HD formats that debuted 6 years later. This situation—multiple new formats fighting as the successor to a format approaching purported obsolescence—previously appeared as the "war of the speeds" in the record industry of the 1950s. It is also, of course, similar to the VHS/Betamax war in consumer video recorders in the late 1980s.

Blu-ray Disk

The leading optical storage companies formed the Blu-ray Disc Founders (BDF) and announced the initial specifications for BD, a high-capacity optical disc format.

Blu-ray is a fully rewritable format that enables recording up to 25GB of data or up to 11.5 hours of standard-definition video on a single-sided, single-layer 12cm diameter disc (which is the same as existing CDs and DVDs) using a 405nm blue-violet laser.

Dual-layer BD-R DL recorders are also available and can record up to 50GB or 23 hours of standard definition video. The latest BD specifications, BDXL (recordable) and BD-RE XL (rewritable), can store up to 100GB or 128GB at 2x or 4x speeds.

Blu-ray uses the industry-standard MPEG-2 compression technology.

The BD specification includes the following formats:

BD-ROM—Read-only for prerecorded content

BD-R—Recordable

BD-RE—Rewritable

BD-RE XL—Rewritable

The data transfer speed of a BD depends on the speed rating of the drive and media.

The time to read or write an entire single- or dual-layer disc at various BD drive/media speeds is shown in Table.

Table   BD Drive/Media Speeds and Disc Read/Write Times

Drive Speed	Data Rate	Single-Layer Disc Read/Write Time	Dual-Layer Disc Read/Write Time
1×	4.5 MBps	90 minutes	180 minutes
2×	9 MBps	45 minutes	90 minutes
4×	18 MBps	23 minutes	45 minutes
6×	27 MBps	15 minutes	30 minutes
8×	36 MBps	12 minutes	23 minutes
12×	54 MBps	8 minutes	15 minutes

Blu-ray uses a much shorter 405nm (blue-violet) laser with a 0.85 numerical aperture lens.

Numerical aperture is a measurement of the light-gathering capability of a lens, as well as the focal length and relative magnification.

The numerical aperture of a lens is derived by taking the sine of the maximum angle of light entering the lens.

The higher the aperture, the shorter the focal length and the greater the magnification.

20. Discuss about Optical Disc Format.

Optical Disc File Systems

Manufacturers of early data CDs did not deal with how data should be stored in files and how these should be formatted for use by PCs with different OSs.

In 1985–1986, several companies got together and published the High Sierra file format specification, the first industry-standard CD-ROM file system that made CD-ROMs universally usable in PCs.

Several file systems are used on optical discs:

High Sierra
ISO 9660 (based on High Sierra)
Joliet
UDF (Universal Disk Format)
Mac HFS (Hierarchical File Format)
Rock Ridge
Mount Rainier

High Sierra

To make optical discs readable on all systems without having to develop custom file systems and drivers.

Adoption of this standard also enabled disc publishers to provide cross-platform support for their software and easily manufacture discs for DOS, UNIX, and other OS formats.

The High Sierra format was submitted to the International Organization for Standardization (ISO).

It was enhancements and republished as the ISO 9660.

ISO 9660

The ISO 9660 standard enabled full cross-compatibility among different computer and operating systems.

It has three levels of interchange that dictate the features that can be used to ensure compatibility with different systems.

ISO 9660 Level 1 is the lowest common denominator of all CD file systems and is capable of being read by almost every computer platform, including UNIX and Macintosh.

It is very limited with respect to filenames and directories.

Level 1 interchange restrictions include the following:

Only uppercase characters A–Z, numbers 0–9, and the underscore (_) are allowed in filenames.
Only 8.3 characters maximum for the name.extension (based on DOS limits).
Directory names are eight characters maximum (no extension allowed).
Directories are limited to eight levels deep.
Files must be contiguous.

Level 2 interchange rules have the same limitations as Level 1, except that the filename and extension can be up to 30 characters long (both added together, not including the . separator).

Finally, Level 3 interchange rules are the same as Level 2 except that files don't have to be contiguous.

Joliet

It is an extension of the ISO 9660 standard developed by Microsoft.

In general, Joliet features the following specifications:

File or directory names can be up to 64 Unicode characters (128 bytes) in length.

Directory names can have extensions.

Directories can be deeper than eight levels.

Multisession recording is inherently supported.

Universal Disk Format

UDF is a file system created by the Optical Storage Technology Association (OSTA) as an industry standard format for use on optical media, but it can also be used by other types of removable-media drives.

If it is unable to read a disc written with UDF on another system, return it to the original system and close the media.

This option is usually displayed as part of the Eject Settings dialog box.

Closing the disc converts the filenames to Joliet format and causes them to be truncated to 64 characters.

Macintosh HFS

HFS is the file system used by the Macintosh OS.

HFS can also be used on optical discs; but they will not be readable on a PC.

A hybrid disc can be produced with both Joliet and HFS or ISO 9660 and HFS file systems, and the disc would then be readable on both PCs and Macs.

Rock Ridge

The Rock Ridge Interchange Protocol (RRIP) was developed by an industry consortium called the Rock Ridge Group.

It was officially released in 1994 by the IEEE CD-ROM File System Format Working Group and specifies an extension to the ISO 9660 standard for CD-ROM that enables the recording of additional information to support UNIX/POSIX file system features.

Mount Rainier

Mount Rainier was designed to enable native OS support for data storage on rewritable optical discs.

Mount Rainier's main features include these:

Integral defect management

Direct addressing at the 2KB sector level to minimize wasted space

Background formatting so that new media can be used in seconds after first insertion

Standardized command set.

Standardized physical layout

21. Discuss in detail about Optical drive performance specifications

Performance figures published by manufacturers are the data transfer rate, the access time, the internal cache or buffers (if any), and the interface the drive uses.

CD Data Transfer Rate

The data transfer rate for a CD drive tells you how quickly the drive can read from the disc and transfer to the host computer.

The one most commonly quoted with optical drives is the ‖x‖ speed, which is defined as a multiple of the particular standard base rate.

CD Drive Speed

The speed at which the drive reads the data had to be constant.

To maintain this constant flow, CD data is recorded using a technique called constant linear velocity (CLV).

For greater performance, drive manufacturers began increasing the speeds of their drives by making them spin more quickly.

A drive (such as most rewritables) that combines CLV and CAV technologies is referred to as Partial-CAV or P-CAV.

Table CLV Versus CAV Technology Quick Reference

	CLV (Constant Linear Velocity)	CAV (Constant Angular Velocity)
Speed of CD rotation	Varies with data position on disc. Faster on inner tracks than on outer tracks.	Constant.
Data transfer rate	Constant.	Varies with data position on disc. Faster on outer tracks than on inner tracks.
Average noise level	Higher.	Lower.

Vibration problems can cause high-speed drives to drop to lower speeds to enable reliable reading.

If a vibration is detected, it slows down the disc, thereby reducing the transfer rate performance. Many of the faster optical drives come with auto-balancing or vibration control mechanisms to overcome these problems.

Most recent optical drives use Z-CLV (zoned CLV) or P-CAV (partial CAV) designs, which help increase average performance while keeping rotational speeds under control.

DVD Drive Speed

DVDs rotate counter-clockwise and are recorded at a constant data rate called CLV.

To maintain a CLV, the disk must spin more quickly when the inner track area is being read and more slowly when the outer track area is being read.

DVD drives actually spin at a rate that is just under three times faster than a CD drive of the same speed.

To increase the performance, faster DVD drives spin the disc at a fixed rotational speed rather than linear speed. This is termed CAV.

Having a faster drive can reduce or eliminate the pause during layer changes when playing a DVD video disc, but having a faster drive has no effect on video quality.

Access Time

The access time is the delay between the drive receiving the command to read and its actual first reading of a bit of data.

Buffer/Cache

The buffers are actual memory chips installed on the drive's circuit board that enable it to stage or store data in larger segments before sending it to the PC.

It ranges from 2MB up to 8MB.

Faster rewritable drives come with more buffer memory to handle the higher transfer rates.

Direct Memory Access and Ultra-DMA

Busmastering PATA controllers use Direct Memory Access (DMA) or Ultra-DMA transfers to improve performance and reduce CPU utilization.

Virtually all modern PATA drives support Ultra-DMA utilization.

Most motherboards refuse to enable Ultra-DMA modes faster than 33MBps if an 80-conductor cable is not detected.

These cabling issues affect only parallel ATA drives.

If the drives are Serial ATA (SATA) models, these cabling issues are not applicable.

Interface

Four types of interfaces are normally used for attaching an optical drive to your system:

SATA (Serial ATA)— Many recent systems featuring support for as little as one PATA (Parallel ATA) drive, but support for eight or more SATA drives, most optical drive vendors are now producing SATA versions of their drives.

PATA (Parallel AT Attachment)—The PATA interface is the same interface most older computers use to connect to their hard disk drives. It is also called as ATA (AT Attachment) or IDE (Integrated Drive Electronics).

USB port—Universal serial bus (USB) is normally used for external drives, and provides benefits such as hot-swappability, which is the capability to be plugged in or unplugged without removing the power or rebooting the system.

FireWire (IEEE 1394)— A few external optical drives are available with a FireWire (also called IEEE 1394 or i.LINK) interface instead of, or in addition to USB 2.0

Loading Mechanism

Three distinctly different mechanisms exist for loading a disc into an optical drive: the tray, caddy, and slot.

Most current drives use a **tray-loading mechanism**. This is similar to stereo system. Each disc has to be handled every time it is inserted or removed. The main advantage of the tray mechanism over the others is cost.

Caddy systems have been used on several types of optical drives. The caddy system requires that you place the disc into a special caddy, which is a sealed container with a metal shutter. The caddy has a hinged lid you open to insert the disc, but after that the lid remains shut. The drawbacks to the caddy system include the expense and the inconvenience of having to put the discs into the caddies.

Some drives use a **slot-loading mechanism**, identical to that used in most automotive players. This is convenient because the disc can be slip into the slot, where the mechanism grabs it and draws it inside. The drawback is that if a jam occurs, it is more difficult to repair. It can't handle the smaller 80mm discs, card-shaped discs, or other modified disc physical formats or shapes.

Other Drive Features

Although drive specifications are of the utmost importance, you should consider other factors and features when evaluating optical drives.

Dust or dirt, when it collects on the lens portion of the mechanism, can cause read errors or severe performance loss.

Either the lens is scaled or has double dust doors to prolong the life of your drive.

Some drives are sealed, which means no air flows through the chamber in which the laser and lens reside.

Best for industrial or commercial environments than office or home environment.

22. Explain how can you test and troubleshoot the memory. (NOV 2014)
23.What are the problems occurred in memory and how to troubleshoot it.
24.Troubleshooting memory using BIOS Beep Codes

The BIOS on the motherboard will always perform a power-on-self-test –POST‖ during power up, usually this test is perform to ensure proper system function and if a failure occurs – the –POST‖ will identify the failure and emits a beeping sound to prompt the service technician to take corrective action ASAP.

The exact meaning of the beeping codes varies from different BIOS developers, there are 3 basic BIOS developer today, the most popular BIOS is made by –American Mega-trend‖ - AMI, Award and

Phoenix BIOS. The beep codes for this AMI & Award BIOS developer are provided in this memory troubleshooter guide, we do not provide beep code reference for Phoenix BIOS and custom BIOS written by other companies other than the two mention.

Beep codes are not entirely consistent sometimes to detect the exact failures, but generally it is still the most dependent methods to diagnose a fault without opening up the PC system or using any diagnostic software

The normal procedure is to power up the PC system, watch for error message on the monitor screen and listen to the PC beep tone. A single beep during boot-up process is normal and does not indicate a failure if the system continues to boot-up.

1 Long Beep tone - Memory Problem

1 Long Beep and 2 Short Beeps - DRAM Parity failure

1 Long Beep and 3 Short Beeps - Video error

Continuous Beep tone - Memory or Video memory failures

25. What is SCSI? Discuss the eight bus phases of SCSI. (APR 2011)

Serial ATA (SATA or Serial AT Attachment) is a computer bus interface for connecting host bus adapters to mass storage devices such as hard disk drives and optical drives. Serial ATA was designed to replace the older parallel ATA (PATA) standard (often called by the old name IDE), offering several advantages over the older interface: reduced cable size and cost (7 conductors instead of 40), native hot swapping, faster data transfer through higher signaling rates, and more efficient transfer through an (optional) I/O queuing protocol.

SATA host-adapters and devices communicate via a high-speed serial cable over two pairs of conductors. In contrast, parallel ATA (the redesignation for the legacy ATA specifications) used a 16-bit wide data bus with many additional support and control signals, all operating at much lower frequency. To ensure backward compatibility with legacy ATA software and applications, SATA uses the same basic ATA and ATAPI command-set as legacy ATA devices.

SATA has replaced parallel ATA in consumer desktop and laptop computers, and has largely replaced PATA in new embedded applications. SATA's market share in the desktop PC market was 99% in 2008.PATA remains widely used in industrial and embedded applications that use CompactFlash storage, though even there, the new CFast storage standard is based on SATA.

Small Computer System Interface, SCSI, pronounced as *"Scuzzy"*, is the second most commonly used interface for disk drives that was first completed in 1982. Unlike competing standards, SCSI is capable of supporting eight devices, or sixteen devices with Wide SCSI. However, with the SCSI host adapter located on ID number 07 and boots from the ID 00. This leaves the availability of six device connections.

SCSI-1 is the original SCSI standard developed back in 1986 as ANSI X3.131-1986. SCSI-1 is capable of transferring up to eight bits a second.

SCSI-2 was approved in 1990, added new features such as Fast and Wide SCSI, and support for additional devices.
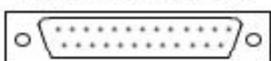
SCSI-3 was approved in 1996 as ANSI X3.270-1996.

SCSI is a standard for parallel interfaces that transfers information at a rate of eight bits per second and faster, which is faster than the average parallel interface. SCSI-2 and above supports up to seven peripheral devices, such as a hard drive, CD-ROM, and scanner, that can attach to a single SCSI port on a system's bus. SCSI ports were designed for Apple Macintosh and Unix computers, but also can be used with PCs. Although SCSI has been popular in the past many users are switching over to SATA drives.
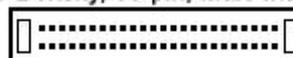
SCSI connectors

The below illustrations are examples of some of the most commonly found and used SCSI connectors on computers and devices and illustrations of each of these connections.

DB-25 Male External
http://www.computerhope.com

Low-Density, 50-pin, Male Internal
http://www.computerhope.com

Low-Density, 50-pin, Male External

http://www.computerhope.com

High-Density,50-pin, Male External

http://www.computerhope.com

High-Density, 68-pin, Male External

http://www.computerhope.com
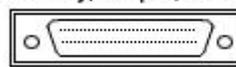
High-Density, 68-pin, Male Internal

http://www.computerhope.com
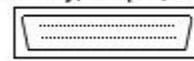
26. Discuss both FM and RLL recording methods of a magnetic disk drive. (NOV 2010)
27. Explain the following : a) Double Density Format, b) RLL Recording standards. (NOV 2012)
Physical Organization of Disk Drives

Disk think of them are actually better described as *disk packs*. Each disk pack contains several disks, called *platters*, stack on top of each other. Each platter has two *surfaces*, the top and the bottom. Data is stored on these surfaces, each of which has a separate *head* for reading and writing the data.

Each of these surfaces is divided into concentric circles called *tracks*. Each track is further divided into *sectors* by *sector boundaries*. These sector boundaries are pie-like divisions along the radious of the platter. The sector is the fundamental unit of disk storage. Disks are sector addressable; each time the disk is accessed, a whole sector is read or written. Typically each sector holds 512 bytes, but this can vary.

One consequence of this sector based organization is that the full storage density of the media is only realized at the center of the disk where the sectors are physically smallest. Many modern drives cast the illusion of sectors to the operating system, while implementing *zones* at the physical level. Like the sector, each zone has the same storage capacity. But unlike the sector, more zones are placed on the outer tracks than the inner tracks.

All of the heads on most disk drives move from track-to-track together. For this reason it is often useful to consider those tracks in corresponding locations on all surfaces. We call this collection of tracks a *cylinder*.

There are three types of delay experienced in access data stored on disk (in order of significance):

> *seek latency*: the amount of time it takes to move the heads to the correct cylinder
> *rotational latency*: the amount of time it takes for the disk to rotate so that the correct secotor(s) can be read
> *transfer latency*: the amount of time it takes for the sector(s) to completely pass under the heads so that they can be read.
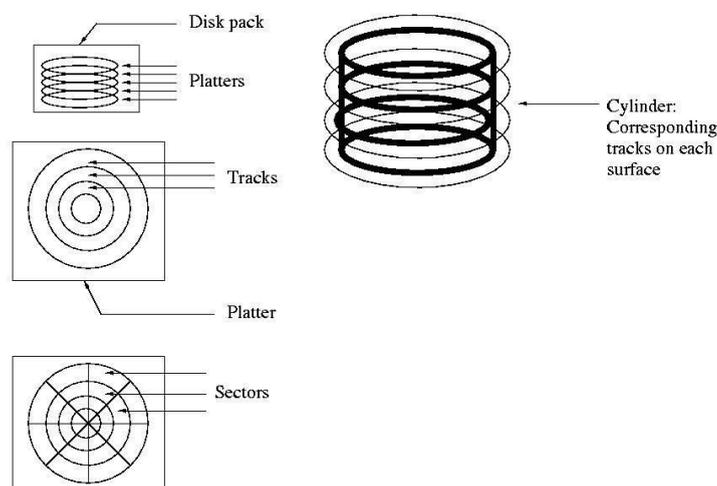
Information on Disks: From Magnetism to 0's and 1's

The heads used to read data from a disk drive are essentially coils of wire. As they pass through a magnetic fields, they sense the change in the field as a current flow through the wire. This means that the heads cannot sense a "1" or a "0" encoded as a north pole or south pole. Instead, they can only sense the *transition* from one pole to another. It is this transition that creates the current flow in the head. Regions encoded with multiple 1's or multiple 0's would not generate any current and would not be sensed by the heads.

Frequency Modulation (FM)

For this reason, the earliest disks were encoded using *Frequency Modulation*. This technique was used on what are now called *single-density* disks. Each bit of data was encoded in a cell that contained two bits of information -- two potential transitions.

The first part of the cell, called the *clock transition* always contained a transition. If the prior cell contained a north-pole, it would contain a south-pole and vice-versa. The second part of the cell contained the data transition. The cell would contain a transition if the bit was a one or no transition if the bit was a zero.

It is important to note that we are discussing transitions, changes in polarity, not the polarity of the media itself. It is also important to note that the limiting factor in the storage of informations is the maximum rate of transitions, not the density of the data bits on the disk. This will become important in our discussion f the next technique.

Data bit	Clock Transition	Data Transition
0	T	N
1	T	T

T = Transition
N = No Transition

Modified Frequency Modulation (MFM)

Modified Frequency Modulation (MFM) recording is a technique, based on FM recording, that reduces the number of transitions and as a consequence increases the rate and density (holding all other factors constant, increasing density increases rate). Magnetic media encoded using MFM are often known as *double denity (DD)*. This is because they can store twice as much information as media encoded with FM, holding all other factors constant.

Like FM, MFM encoding uses both clock and data transitions. But MFM encoding recognizes that in many cases the transition is not necessary, because it is preceded by another transition, anyway. MFM reduces the number of transtions required in the code by requiring a clock transition only if one did not previously occur naturally. Specifically, a clock transition only occurs for a data bit of zero preceded by a data bit of 0.

Data bit	Clock Transition	Data Transition
0 preceded by 0	T	N
0 preceded by 1	N	N
1	N	T

T = Transition
N = No Transition

Run Length Limited (RLL)

Run length limited (RLL) encoding schemes include a collection of encodings that can be categorized by two parameters: *run length* and *run limit*. The run length is the minimum number of cells (potential transitions) that can occur between transitions and the run limit is the maximum number of cells (potential transisitions) that can occur between transitions.

It is actually possible to consider FM encoding to be RLL (0,1) and MFM encoding to be RLL (1, 3). An FM encoding of 111 (NTNTNT) shows the minimum run length of 0 and the encoding of 101 (NTNNNT) shows the maximum run limit of 3.

But the more interesting cases are the other encodings that are possible when we consider encodings with these parameters. One RLL (2,7) encoding, first used by IBM, is shown below. It allows for 1.5x the density and throughput of MFM. Notice that groups of bits, not single bits, are encoded.

The minimum run length of 3 can be observed as follows:

1. No flux encoding pattern, by itself, contains less than two N's next to each other.
2. Some encoding patterns, when placed next to each other can generate exactly 7 N's next to each other (consider 0011 0010).
3. The greatest number of trailing N's is 3 (0011) and the greatest number of leading N's is 4 (0011). Back-to-back, this creates a maximum run length of 7.

Data Bit Values	Flux Encoding
10	NTNN
11	TNNN
000	NNNTNN
010	TNNTNN
011	NNTNNN
0010	NNNTNNTNN
0011	NNNNTNNN

T = Transition
N = No Transition

RLL (3,9), which allows for an even greater data density, has also been used, but some implementations proved to be somewhat unreliable, because of the increased transition density. RLL (1,7), which allows for a compression density of 1.27 x MFM is also popular, because of the increased robustness of a lower transition density.

Pondicherry University Questions

PART A

1. What is the function of the memory? **(NOV 2012)**
2. What is the hard disk and how does it work? **(NOV 2012)**
3. What are the types of RAM module? **(NOV 2013)**
4. Write about serial ATA. **(NOV 2013)**
5. What are the two types of semiconductor memory? **(NOV 2014)**
6. Classify the floppy diskette according to the sector organisation. **(NOV 2014)**
7. Differentiate hard sector and soft sector disk. **(APR 2011)**
8. What are the two formats for recording on a magnetic disk? **(APR 2011)**
9. What is mean by disk and diskette? **(APR 2012)**
10. Differentiate single and dual head assembly drive. **(NOV 2010)**
11. What is DVD? **(APR 2012)**
12. Write any two common aspects between HDD and FDD. **(NOV 2012)**

PART B

1. What is Memory? Explain the types of memory. (Ref.Pg.No.5,Qn.No.1)
2. How memory works with the processor? Discuss. **(NOV 2012)** (Ref.Pg.No.5,Qn.No.2)
3. Explain briefly about Memory modules. Explain briefly: SIMM,DIMM,DDR (Ref.Pg.No.12,Qn.No.3)
4. Explain about Memory Banks (Ref.Pg.No.14,Qn.No.4)
5. Explain about Parity and ECC in detail. (Ref.Pg.No.15,Qn.No.5)
6. Explain about Logical Memory Layout. (Ref.Pg.No.15,Qn.No.6)
7. Explain about data-encoding schemes. (Ref.Pg.No.16,Qn.No.7)
8. Briefly explain about Hard Disk Drive. **(APR 2011)** (Ref.Pg.No.19,Qn.No.8)
9. Discuss in detail about auxiliary storage device. **(NOV 2012)** (Ref.Pg.No.19,Qn.No.9)
10. Explain components available in hard disk. **(NOV 2013)** (Ref.Pg.No.19,Qn.No.10)
11. Describe the function of HDD. (APR 2012) (Ref.Pg.No.19,Qn.No.11)
12. What is SATA? Explain. (Ref.Pg.No.25,Qn.No.12)
13. Explain Flash Memory Devices. (Ref.Pg.No.25,Qn.No.13)
14. Explain briefly about Compact Disk (CD) (Ref.Pg.No.27,Qn.No.14)
15. What are the criteria to be considered when selecting a CD / DVD drive? Explain them. **(NOV 2014)** (Ref.Pg.No.27,Qn.No.15)
16. Explain the structure and operating principles of CD-ROM in detail. **(NOV 2010)** (Ref.Pg.No.27,Qn.No.16)
17. Explain in detail about CD and DVD technologies. **(APR 2012)** (Ref.Pg.No.27,Qn.No.17)
18. What are the types of Disk Drives? Explain it. **(NOV 2012)** (Ref.Pg.No.27,Qn.No.18)
19. Explain briefly about Digital Versatile Disc (DVD) (Ref.Pg.No.31,Qn.No.19)
20. Discuss about Optical Disc Format. (Ref.Pg.No.36,Qn.No.20)

21. Discuss in detail about Optical drive performance specifications (Ref.Pg.No.37,Qn.No.21)

22. Explain how can you test and troubleshoot the memory. **(NOV 2014)** (Ref.Pg.No.39,Qn.No.22)

23. What are the problems occurred in memory and how to troubleshoot it.

    (Ref.Pg.No.39,Qn.No.23)

24. Troubleshooting memory using BIOS Beep Codes (Ref.Pg.No.39,Qn.No.24)

25. What is SCSI? Discuss the eight bus phases of SCSI. **(APR 2011)** (Ref.Pg.No.40,Qn.No.25)

26. Discuss both FM and RLL recording methods of a magnetic disk drive. **(NOV 2010)**

    (Ref.Pg.No.41,Qn.No.26)

27. Explain the following : a) Double Density Format, b) RLL Recording standards. **(NOV 2012)**

    (Ref.Pg.No.41,Qn.No.26)

SRI VENKATESHWARAA COLLEGE OF ENGINEERING & TECHNOLOGY

(Approved by AICTE, New Delhi & Affiliated to Pondicherry University, Puducherry.)
13-A, Villupuram – Pondy Main road, Ariyur, Puducherry – 605 102.
Phone: 0413-2644426, Fax: 2644424 / Website: www.svcetpondy.com

Department of Computer Science and Engineering

Subject Name: **COMPUTER HARDWARE AND NETWORK TROUBLESHOOTING**
Subject Code: **CS T72**

Prepared By : Dr. N. Balaji, Professor & HOD / CSE

Verified by :   **Approved by :**

UNIT – IV

Input and Output Devices: Keyboard – Signals and Interface standards – Pointing devices: Mouse - mechanical and optical – Joystick.

Video hardware: Video Display Adaptors – Interfaces – 3D graphics accelerators – LCD and LED monitors

Printers: dot matrix – laser jet - ink jet – Pen plotters – BIOS and DOS Interrupt services for I/O devices – Troubleshooting I/O related problems.

2 Marks

1. **Give the layouts of a keyboard?**
2. **What are the four basic types of keyboard? (NOV 2012)**

    83-key PC/XT keyboard
    84-key AT keyboard
    Enhanced 101-key keyboard
    Windows 104- key keyboard

3. What is meant by Ergonomic keyboard?

    Ergonomics is the study of how equipment and furniture can be arranged in order that people can do work or other activities more efficiently and comfortably. This type of keyboard is used to provide the user with a more natural hand position while typing.

4. How many connectors are there in a keyboard? What are they?

5. What are the two types keyboard interfaces. (NOV 2010)

PC keyboards connect to the motherboard on the computer using one of three connectors. They are:

    5-pin DIN Connector
    6-pin MINI DIN Connector
    USB Connector

6. What is the use of Connector? (NOV 2012)

    Connector used to connect keyboard and CPU

7. Write the types of switches in a keyboard?

  Pure mechanical switches: The most basic mechanical switch design is one which depressing the key forces metal contacts together, completing the circuit. A spring forces the key back up to tis original position. The nature of the spring mechanism used in most keyboards.

  Foam element switches: Similar to pure mechanical switches in so far they use an electric circuit between each key and the circuit board below a spring to pop the key back up. Here each

keytop is connected with a cushion of foam gives the keyboard softier, quieter and more cushiony feeling.

Rubber-dome switches: In this design each key is sits a top rubber dome with an electric contact on its concave underside. The shape of the dome then forces the key back up into its original position. This is easier and cheaper comparing to other models. This is the most common type of keyboard used today. Here the rubber domes form a solid sheet.

Membrane switches: Similar to rubber-dome switches, except the keytop are all joined into a solid sheet that rest on top of the rubber domes. This provides s a greater amount of protection against the outside environment.

8. Define USB?

Universal Serial Bus (USB) is a serial bus standard to interface devices to a host computer. USB was designed to allow many peripherals to be connected using a single standardized interface socket and to improve the Plug and play capabilities by allowing hot swapping, that is, by allowing devices to be connected and disconnected without rebooting the computer or turning off the device.

9. Define Mouse?

A mouse (plural mice or mouses) is a computer pointing device; it is designed to detect two-dimensional motion relative to its supporting surface and consists of a small case, to be held under one of the user's hands, and one or more buttons.

10. What are the types of Mouse? (APR 2012)

Mechanical Mouse

Ball Mouse

Laser Mouse

Optical Mouse

11. What is the Joystick? (APR 2011)

Joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles and zero turning radius lawn mowers.

12. What is Track Ball? (APR 2012)

A trackball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball. The user rolls the ball with the thumb, fingers, or the palm of the hand to move a pointer.

13. What is RS-232C?

RS-232C is a long-established standard ("C" is the current version) that describes the physical interface and protocol for relatively low-speed serial data communication between computers and related devices. It was defined by an industry trade group, the Electronic Industries Association (EIA), originally for teletypewriter devices.

14. Define Parallel Port?

A parallel port is a type of interface found on computers (personal and otherwise) for connecting various peripherals. In computing, a parallel port is a parallel communication physical interface. It is also known as a printer port or Centronics port. The IEEE 1284 standard defines the bi-directional version of the port, which allows the transmission and reception of data bits at the same time.

15. What is SPP?

Compatibility Mode, also known as Centronics standard or **SPP**, is a uni-directional implementation with only a few differences from the original Centronics design. This mode is almost exclusively

used for printers. The only signals that the printer can send back to the host are some fixed-meaning status lines that signal common error conditions, such as the printer running out of paper.

16. What is EPP?

Enhanced Parallel Port (**EPP**) is a half-duplex bi-directional interface designed to allow devices like printers, scanners, or storage devices to transmit large amounts of data while quickly being able to switch channel direction. EPP can provide up to 2 MByte/s bandwidth, approximately 15 times the speed achieved with normal parallel-port communication with far less CPU overhead.

17. What is ECP?

Extended Capability Port (**ECP**) is a half-duplex bi-directional interface similar to EPP, except that PC implementations use direct memory access (usually ISA DMA on channel 3) to provide even faster data transfer than EPP by having the ISA DMA hardware and the parallel port interface hardware handle the work of transferring the data instead of letting the CPU do this work.

18. Write about NIC?

A network card, network adapter or NIC (network interface controller) is a piece of computer hardware designed to allow computers to communicate over a computer network. It is both an OSI layer 1 (physical layer) and layer 2 (data link layer) device, as it provides physical access to a networking medium and provides a low-level addressing system through the use of MAC addresses.

19. Define MODEM?

A **modem** (**mo**dulator-**dem**odulator) is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.

20. What is Winmodem?

A Winmodem or Softmodem is a stripped-down modem for Windows that replaces tasks traditionally handled in hardware with software. In this case the modem is a simple digital signal processor designed to create sounds, or voltage variations, on the telephone line.

21. List the types of Video controllers?

Video shifters, or "Video shift register based systems"
A CRTC, or Cathode Ray Tube Controller
Video interface controllers
Video coprocessors

22. List some of the display adapters. (APR 2011)

Monochrome Display Adapter(MDA)
Color/Graphics Adapter (CGA)
Enhanced Graphics Adapter(EGA)
Super Video Graphics Array(SVGA)

23.Define SVGA?

Super Video Graphics Array, SVGA is a set of video standards that is one step above VGA. SVGA monitors are capable of displaying up to 16 million colors with a resolution of 800 x 600 on 14" monitors or up to a 1200 x 1600 resolution on a 20" monitor. In the picture to the right, is what the typical VGA/SVGA connection looks like. Today, this connection and cable is being replaced by the DVI connection.

24.What is meant by AGP?

The **Accelerated Graphics Port** (often shortened to **AGP**) is a high-speed point-to-point channel for attaching a video card to a computer's motherboard, primarily to assist in the acceleration of 3D computer graphics.

25.What is a Printer?

A **computer printer**, or more commonly just a **printer**, is a device that produces a hard copy (permanent human-readable text and/or graphics) of documents stored in electronic form, usually on physical print media such as paper or transparencies. A printer which is combined with a scanner can

essentially function as a photocopier. The printing speed of early printers was measured in units of **characters per second**. More modern printers are measured in **pages per minute**.

Printers are generally slow devices (10 pages per minute is considered fast; and many consumer printers are far slower than that), and the cost-per-page is relatively high.

26.Explain Dot Matrix Printer?

In the general sense many printers rely on a matrix of pixels, or dots, that together form the larger image. However, the term dot matrix printer is specifically used for impact printers that use a matrix of small pins to create precise dots. The advantage of dot-matrix over other impact printers is that they can produce graphical images also. Dot matrix printers can either be character-based or line-based (that is, a single horizontal series of pixels across the page), referring to the configuration of the print head. At one time, dot matrix printers were one of the more common types of printers used for general use - such as for home and small office use. Such printers would have either 9 or 24 pins on the print head. 24 pin print heads were able to print at a higher quality.

27.What is Laser Jet Printer?

The LASER Printer produces a printed document using a focused beam of laser light and a rotating mirror to reproduce the image. A laser printer is a page printer. It produces a finished page on each cycle. This is in contrast to the other types of printers that print single characters (daisy wheel, dot matrix) or all the text and graphics of one full page at one time. This has different printing technologies. They are:

Electrophotographic (EP) process: The EP process, developed by Xerox and Canon, was the first laser printer technology used. It is the print process used by virtually all laser printers in one form or another.

Hewlett- Packard (HP) process: The HP process is essentially the same as the EP process only in some minor operating procedures.

Light-Emitting Diode (LED) process: LED printers are not technically laser printers. An LED printer uses an array of around 2,500 light-emitting diodes (like very small light bulbs) place of a laser as the light source used to condition the photosensitive drum.

Liquid Crystal Display (LCD) process: LCD printers use light shone through an LCD panel in place of the laser to condition the photosensitive drum. This is also called as –LCD Shutter printers‖.

28.Define Pen Plotter?

A graphics printer that draws images with ink pens. It actually draws point-to-point lines directly from vector graphics files. The plotter was the first computer output device that could print graphics as well as accommodate full-size engineering and architectural drawings. Pen plotters are still the most affordable printing device for CAD use and offer resolution unlike any other printer. The lines are not made up of dots. They are actually drawn, providing infinite resolution.

29.What are the different types of Scanner? (NOV 2012)

Flatbed

Handheld

30.Define Scanner? (NOV 2010)

A scanner is a device that captures images from photographic prints, posters, magazine pages, and similar sources for computer editing and display. Scanners come in hand-held, feed-in, and flatbed types and for scanning black-and-white only, or color. Very high resolution scanners are used for scanning for high-resolution printing, but lower resolution scanners are adequate for capturing images for computer display. Scanners usually come with software, such as Adobe's Photoshop product, that lets you resize and otherwise modify a captured image.

11 MARKS

INPUT/OUTPUT DEVICES

In computing, **input/output**, or **I/O**, refers to the communication between an information processing system (such as a computer), and the outside world, possibly a human, or another information processing system. Inputs are the signals or data received by the system, and outputs are the signals or data sent from it. The term can also be used as part of an action; to "perform I/O" is to perform an input or output operation. I/O devices are used by a person (or other system) to communicate with a computer. For instance, a keyboard or a mouse may be an input device for a computer, while monitors and printers are considered output devices for a computer. Devices for communication between computers, such as modems and network cards, typically serve for both input and output.

1. **Explain different layouts of keyboard.**
2. **Explain the two types of keyboards and the functions performed by the keyboard electronics with suitable diagram. (APR 2011)**

Keyboard:

The basic functionality of the PC keyboard has changed little in the almost 20 years since the release of the original IBM PC. The number of keys has increased, from **83** to **84** to **101** and now it is **104**. You can plug a keyboard from virtually any PC to other.

Keyboard Layouts:

The four keyboard layouts used for most desktop PCs are as follows:

83-key PC/XT keyboard
84-key AT keyboard
Enhanced 101-key keyboard
Windows 104- key keyboard

The PC/XT keyboard :(Personal Computer/eXtended Technology)

Original IBM PC/XT Keyboard

This is different from the later design keyboard. Here only 83 keys are used and placed in the keyboard. Function keys are only 10 (i.e.) F1 to F10. Those keys are placed in the left side. Only one CTRL key and one ALT key is available. Keys like PRINT SCREEN and CAPS LOCK are located in a strange place. Cursor keys like HOME, END, PAGE UP & PAGE DOWN are not available.

There is no LED's for NUM LOCK, CAPS LOCK and SCROLL LOCK. Because here the communication between the keyboard and computer's motherboard is unidirectional. Nowadays it is bidirectional.

The AT keyboard :(Advanced Technology)

This 84- AT keyboard has 84 keys and a step closer to the standard keyboard layout which is using today. Here also the function keys are only 10 (i.e.) F1 to F10. Those keys are placed in the left side. Cursor keys like HOME, END, PAGE UP & PAGE DOWN are integrated into the keypad, which is now separated on the right side of the keyboard and activated using NUM LOCK key. The size and spacing of the key is better than on the PC/XT keyboard.
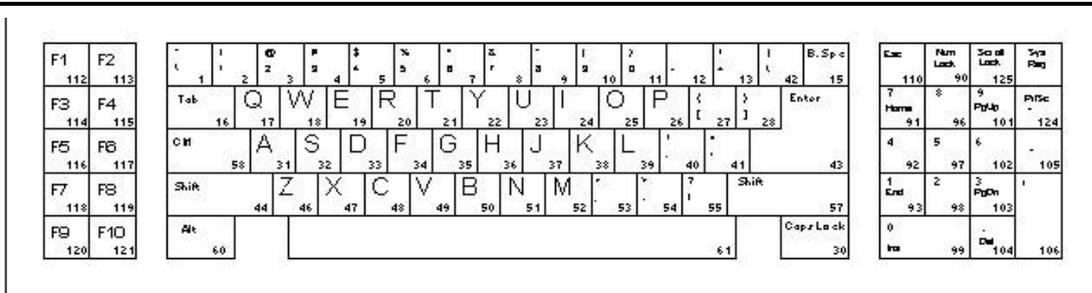
This keyboard does have LED's for NUM LOCK, CAPS LOCK and SCROLL LOCK, because this can communicate bidirectionally to the motherboard. This AT keyboard is completely compatible with all the models that came later, except the connector used to attach the keyboard to the computer.

Typematic rate: The speed at which the character repeats when you hold a key down.
Repeat delay: The interval between a key press and first repetition of the character.

The Enhanced 101-key keyboard:

The Enhanced 101-key keyboard is the most familiar to computer used today. Here only 101 keys are used and placed in the keyboard. Function keys are increased into 12 (i.e.) F1 to F12. Those keys are placed in the horizontal row above the number keys, with a ESC key in its upper left corner position. A second CTRL and second ALT key is added to the bottom of row. Here cursor keys are available in an inverted –T‖ formation and the other navigation keys.

Keys such as PRINT SCREEN, SCROLL LOCK and PAUSE are at the top, and a second ENTER key is added on the right side of the keypad. The main ENTER key also reduced in size for all touch typists.

The windows 104-key keyboard:

This is identical to the 101 – key layouts, except for the addition of three keys: Two windows keys which is located between the CTRL and ALT keys on both sides and an Application key on the right side, next to the window key. By pressing the window key at any time we can open the start menu, and pressing the application key displays the context menu for currently highlighted item.

Nowadays we are using some key combination i.e. using the windows key (WIN). Some of them are as follows:

Key combination	Function
WIN	Open the Start Menu
WIN-R	Opens the Run dialog box
WIN-M	Minimizes all open windows
WIN-F1	Opens a help window

Ergonomic keyboard:

Ergonomics is the study of how equipment and furniture can be arranged in order that people can do work or other activities more efficiently and comfortably. This type of keyboard is used to provide the user with a more natural hand position while typing.

Laptop keyboards:

On portable systems, such as laptops and notebooks, the keyboard can be a crucial part of the product evaluation process for two reasons: the keyboard is integrated into the unit and is not easily replaceable and the smaller size of the keyboard often forces to fit all the keys into the space provided in it. The function keys are here integrated with the alphabetic key itself. Using NUM LOCK, we can use those keys.

3. **Explain Signals and interface standards for keyboard.**
4. **Explain briefly about keyboard connectors and switches.**

A keyboard consists of a set of switches mounted in a grid or an array called the *key matrix*.
When a switch is pressed, a processor in the keyboard identifies which key is pressed by determining which grid location in the matrix shows continuity.
The keyboard processor, which also interprets how long the key is pressed, can even handle multiple keypresses at the same time.
A 16-byte hardware buffer in the keyboard can handle rapid or multiple keypresses, passing each one to the system in succession.
When a key is pressed, the contact bounces slightly in most cases, meaning that several rapid on/off cycles occur just as the switch makes contact. This is called *bounce*.
The processor in the keyboard is designed to filter this, or ─debounce‖ the keystroke.
The keyboard communicates with the main system in one of two ways:
Through a special serial data link if a standard PS/2 keyboard connector is used
Through the USB port

6-pin mini- DIN (PS/2) connector

The 6-pin MINI-DIN Connector also called as PS/2 connector is smaller than the 5-Pin DIN and this is the 5/16 inch in diameter. This mini-Din connector is designed to use six pins arranged in a circular pattern. Here mostly the two unused pins are omitted from keyboard connectors. The same 6 – pin is used for mice also. So, we should be connecting the cable to the relevant socket. Then only it functions properly.
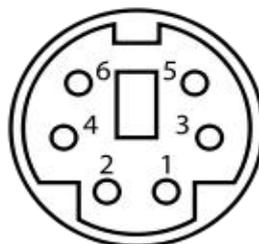
6-pin MINI-DIN Connector

Pin 1	Keyboard Data	Data
Pin 2	Not connected	Not connected*
Pin 3	Ground	GND
Pin 4	+5V power	Vcc
Pin 5	Keyboard Clock	CLK
Pin 6	Not connected	Not connected**

USB Connector

Universal Serial Bus (USB) is a serial bus standard to interface devices to a host computer. USB was designed to allow many peripherals to be connected using a single standardized interface socket and to improve the Plug and play capabilities by allowing hot swapping, that is, by allowing devices to be connected and disconnected without rebooting the computer or turning off the device.

USB is intended to replace many legacy varieties of serial and parallel ports. USB can connect computer peripherals such as mice, keyboards, PDAs, gamepads and joysticks, scanners, digital cameras, printers, personal media players, flash drives, and external hard drives. For many of those devices USB has become the standard connection method.

The USB *trident* logo

USB1.1 maximum cable length is 3m and USB2.0 maximum cable length is 5m. A maximum hub connected in series is 5. A maximum device connected in total is 127. Although a single cable is limited to 5 meters, the USB2.0 specification permits up to five USB hubs in a long chain of cables and hubs. This allows for a maximum distance of 30 meters between host and device, using six 5-meter cables and five hubs. In actual use, since some USB devices have built-in cables for connecting to the hub, the maximum achievable distance is 25 meters + the length of the device's cable.

Keyboards switch Types:

Pure mechanical switches: The most basic mechanical switch design is one which depressing the key forces metal contacts together, completing the circuit. A spring forces the key back up to tis original position. The nature of the spring mechanism used in most keyboards.

Foam element switches: Similar to pure mechanical switches in so far they use an electric circuit between each key and the circuit board below a spring to pop the key back up. Here each keytop is connected with a cushion of foam gives the keyboard softier, quieter and more cushiony feeling.

Rubber-dome switches: In this design each key is sits a top rubber dome with an electric contact on its concave underside. The shape of the dome then forces the key back up into its original position. This is easier and cheaper comparing to other models. This is the most common type of keyboard used today. Here the rubber domes form a solid sheet.

Membrane switches: Similar to rubber-dome switches, except the keytop are all joined into a solid sheet that rest on top of the rubber domes. This provides s a greater amount of protection against the outside environment.

5. Explain the working principles of keyboard and mouse. (APR 2012)

Keyboard

The keyboard work as: Inside the keyboard, there are metallic plate, circuit board (key matrix) and processor, which are responsible for transferring information from the keyboard to the computer. Depending upon the working principle, there are two main types of keys, namely, capacitive and hard-contact. Let's discuss in brief about the functioning of capacitive and hard contact key.

Capacitive Key

On the underside of a capacitive key, a metal plunger is fixed, which helps in activating the circuit flow. When a capacitive key is pressed, the metal plunger applies a gentle pressure to the circuit board. The pressure is identified by the computer and the circuit flow is initiated, resulting in the transfer of information from the circuit to the currently installed software.

Hard Contact Key

A hard contact key is attached with a metallic plate that helps in connecting the circuit board. When the hard contact key is pressed, it pushes a metallic plate, which in turn touches the metallic portion of the circuit plate. This overall process of completing a circuit results in a circuit flow, allowing the transfer of the message to the central processing unit (CPU), which is further transmitted to the software.

In both the key types, the circuit signals the processor to read and/or identify the character that has been pressed. For example, in a hard contact key, the processor reads that pressing 'shift' and 'a' keys at the same time corresponds to 'A'. Hence accordingly, the letter, sign or symbol is displayed on the screen. Releasing the pressed key breaks the circuit flow, after which the key retains its original position. The communication between a computer keyboard and main computer is bi-directional, meaning that message or information can be sent within each other.

Mouse

With most of the system you will find mechanical mouse.The primary mechanical part of a mouse is a ball on the bottom of the mouse. There are these little wheels which turn/rotate when the ball moves against them. The wheels are monitored electronically. When they trun or rotate they transmit how much they have turned to the computer. Out of these three wheels the two wheels perpendicular to each other are used for tracking the motion on X-axis and Y-axis. The third one just balances the two. When the mouse is moved on a flat surface the roller ball moves in the locking ring. When the mouse is positioned on the desktop the actuators register the mouse balls movement in X-axis and Y-axis direction. The sensors attached to it generate a series of pulses representing movement on both axis. The pulse generated are in same ratio as the mouse movement i.e. More pulse mean more movement. Normally a mouse is used along with a mouse pad. Place the mouse pad on a flat surface and place the mouse on it. Move the mouse pad and the pointer moves in the direction of the movement of mouse.

 Various terms related to the use of mouse are :-

>Click

>Doubleclick

>Drag

1. When the left button of mouse is pressed and released quickly then this we can say ' clicking the mouse'.

2. The double clicking is used to initiate some action on the selected item. Basically it selects and initiases the action. For this the enter key is pressed and released sticky twice.

3. If AN object is to be moved from one part of screen to other part then dragging is used. For this bring the pointer to the required object, press the key and hold it while moving to other place. When the mouse pointer reaches at required position, release the button.

6. **Explain about Mouse.**
7. **What are the different point devices available explain. (NOV 2012)**

A **mouse** (plural **mice** or **mouses**) is a computer pointing device; it is designed to detect two-dimensional motion relative to its supporting surface and consists of a small case, to be held under one of the user's hands, and one or more buttons. It sometimes features other elements, such as "wheels", which allow the user to perform various system-dependent operations, or extra buttons or features can add more control or dimensional input. The mouse's motion typically translates into the motion of a pointer on a display.

The first computer mouse, held by inventor Douglas Engelbart, showing the wheels that make contact with the working surface.Douglas Engelbart of the Stanford Research Institute invented the mouse in 1964 after extensive usability testing. The first mouse, a bulky device (pictured) used two gear-wheels perpendicular to each other: the rotation of each wheel translated into motion along one axis. "X-Y Position Indicator for a Display System". At the time, the user would hold the mouse continuously in one hand and type on a five-key chord keyset with the other.

Early mice

Mechanical mice
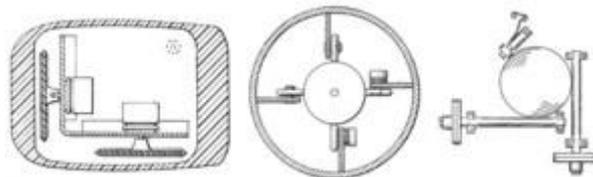
Early mouse patents. From left to right: Opposing track wheels by Engelbart, Nov. 1970, U.S. Patent 3,541,541 . Ball and wheel by Rider, Sept. 1974, U.S. Patent 3,835,464 . Ball and two rollers with spring by Opocensky, Oct. 1976, U.S. Patent 3,987,685 .

Bill English invented the so-called **ball mouse** in the 1972 while working for Xerox PARC. The ball-mouse replaced the external wheels with a single ball that could rotate in any direction and came as part of the hardware package of the Xerox Alto computer. Perpendicular chopper wheels housed inside the mouse's body chopped beams of light on the way to light sensors, thus detecting in their turn the motion of the ball.

Modern computer mice took form a single ball and two buttons and remained a common design until the mainstream adoption of the scroll-wheel mouse during the 1990s. Honeywell produced another short-lived type of mechanical mouse. Instead of a ball, it had two plastic "feet" on the bottom which sensed movement.

Another type of mechanical mouse is the **trackball** mouse, which operates like an inverted mouse. Users rotate a large ball in the mouse with their fingertips instead of moving the mouse itself. The trackball is usually located where a centre mouse button would be, with the buttons on either side. The first trackball mouse was invented in 1991 by Logitech, and was launched with the Apple Power book. Trackballs required less wrist movement than traditional mice, and thus decrease the risk of strain injuries.

Optical mice

An **optical mouse** uses a light-emitting diode and photodiodes to detect movement relative to the underlying surface, rather than moving some of its parts — as in a mechanical mouse. Early optical mice, circa 1980, came in two different varieties:

1. Some, such as those invented by Steve Kirsch of Mouse Systems Corporation, used an infrared LED and a four-quadrant infrared sensor to detect grid lines printed on a special metallic surface with infrared absorbing ink. Predictive algorithms in the CPU of the mouse calculated the speed and direction over the grid.

2. Others, invented by Richard F. Lyon and sold by Xerox, used a 16-pixel visible-light image sensor with integrated motion detection on the same chip and tracked the motion of light dots in a dark field of a printed paper or similar mouse pad.

These two mouse types had very different behaviors, as the Kirsch mouse used an x-y coordinate system embedded in the pad, and would not work correctly when rotated, while the Lyon mouse used the x-y coordinate system of the mouse body, as work like a mechanical mice.

Modern surface-independent optical mice work by using an optoelectronic sensor to take successive pictures of the surface on which the mouse operates. Most of these mice use LEDs to illuminate the surface that is being tracked; LED optical mice are often mislabeled as "laser mice". Changes between one frame and the next are processed by the image processing part of the chip and translated into movement on the two axes using an optical flow estimation algorithm. The optical mouse sensor processes 1512 frames per second: each frame is a rectangular array of 18×18 pixels, and each pixel can sense 64 different levels of gray.

Optomechanical mice detect movements of the ball optically, giving the precision of optical without the surface compatibility problems, whereas optical mice detect movement relative to the surface by examining the light reflected off it.

Laser mice

As early as 1998, Sun Microsystems provided a laser mouse with their servers and workstations. However, laser mice did not enter the mainstream market until 2004, when Logitech, in partnership with Agilent Technologies, introduced the **laser mouse** with its MX 1000 model. This mouse uses a small infrared laser instead of an LED, which increases the resolution of the image taken by the mouse. This leads to around $20 \times$ more sensitivity to the surface features used for navigation compared to conventional optical mice, via interference effects.

Engineers designed the laser mouse — as a wireless mouse — to save as much power as possible. In order to do this, the mouse blinks the laser when in standby mode (8 seconds after the last motion). This function also increases the laser life.

Optical versus mechanical mice

Operating a mechanical mouse.

1. Moving the mouse turns the ball.
2. X and Y rollers grip the ball and transfer movement.
3. Optical encoding disks include light holes.

4. Infrared LEDs shine through the disks.

5. Sensors gather light pulses to convert to X and Y velocities.

Optical mice supporters claim that optical rendering works better than mechanical mice, that it requires no maintenance and that optical mice last longer due to having no moving parts. Optical mice do not normally require maintenance other than removing debris that might collect under the light-emitter. Supporters of mechanical mice point out that optical mouse generally cannot track on glossy and transparent surfaces.

Buttons

Engelbart's very first mouse had a single button; Xerox PARC soon designed a three-button model, but reduced the count to two for Xerox products. Apple reduced it back to one button with the Macintosh in 1984, while Unix workstations from Sun and others used three buttons. Commercial mice usually have between one and three buttons, although in the late 1990s some mice had five or more.

Additional buttons

Manufacturers have built mice with five or more buttons. Depending on the user's preferences, the extra buttons may allow forward and backward web navigation, scrolling through a browser's history, or other functions. As with similar features in keyboards, however, these functions may not be supported by all software. The additional buttons are generally more useful in computer games, where quick and easy access to a wide variety of functions (for example, weapon-switching in first-person shooters) can be very beneficial.

Wheels

The scroll wheel, a notably different form of mouse-button, consists of a small wheel that the user can rotate to provide immediate one-dimensional input. Usually, this input translates into "scrolling" up or down within the active window or GUI-element. This is especially helpful in navigating a long document. The scroll wheel can often be pressed too, thus being in fact a third (center) button. Under many Windows applications, the wheel pressure activates auto scrolling and in conjunction with the control key (Ctrl) may zoom in and out (applications which support this feature include Adobe Reader, Microsoft Word, Internet Explorer, Opera and Mozilla Firefox).

3D mice

In the late 1990s Kantek introduced the 3D Ring Mouse. This wireless mouse was worn on a ring around a finger, which enabled the thumb to access three buttons. The mouse was tracked in three dimensions by a base station. Despite a certain appeal, it was finally discontinued because it did not provide sufficient resolution.

8. **Explain Joy stick with neat diagram.**

Joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles and zero turning radius lawn mowers. Joysticks are used mostly for computer games and other applications.

Most joysticks are two-dimensional, having two axes of movement (similar to a mouse), but one and three-dimensional joysticks do exist. A joystick is generally configured so that moving the stick left or right signals movement along the X axis, and moving it forward (up) or back (down) signals movement along the Y axis. In joysticks that are configured for three-dimensional movement, twisting the stick left (counter-clockwise) or right (clockwise) signals movement along the Z axis. The name "joystick" is introduced by French pilot Robert Esnault-Pelterie. He is alleged to have invented the "George Stick" which became more popularly known as the joystick.
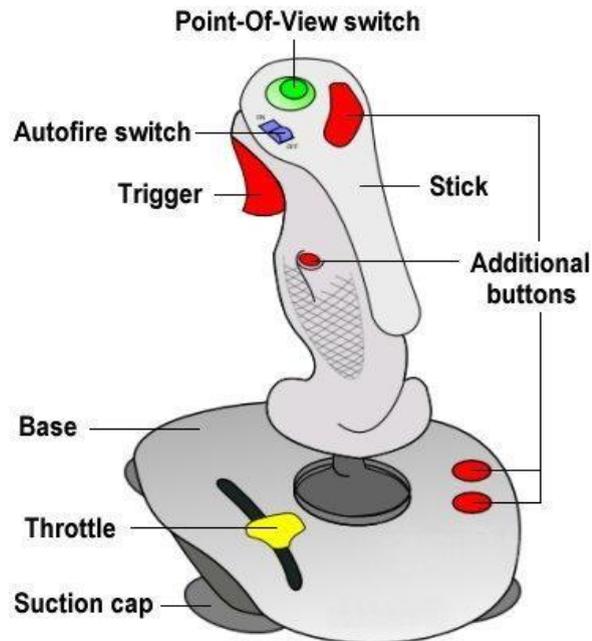
Different types of joysticks:

Digital Joysticks

The most common joystick type in home computers have been Atari-style digital joysticks. The joystick itself consisted of five switched which are arranged to that four of them told about the joystick direction (UP, DOWN, LEFT, RIGHT) and one was for fire button. The joystick connector was 9 pin D-shell connector. Normally all of those switches are open, but when joystick is turned from the center position, one or two position switches are closed (according to what direction the stick is turned). The fire button worked so that it closes when button is pressed.

Paddle controllers

Paddle controller is a simple controller which consists of one knob which is used to control the game. Paddle controllers were used in videogames since the first TV-games to control the racket on the screen. Paddle controllers use analogue principle for control, and they simply consist of one potentiometer and button in one controller.

Analogue Joysticks

Analogue joysticks were like a combination of ideas of both joystick and paddle. The idea was that potentiometers were used to measure the movement of stick (instead of switches like in digital joystick).

PC analogue joystick interface

Nowadays the most common analogue joystick type is PC analogue joystick. This joystick model was presented by IBM together with their first IBM PC computer. The joystick is just a basic analogue joystick with two buttons. The original joystick interface had circuit for connecting two joysticks, but had only one joystick connector. A special Y-cable was needed if there was need for two joysticks at the same time. Later time some manufacturers put two connectors to their interface card and some card manufacturers implemented only one joystick input. Fortunately most of the card nowadays has option for two joysticks like the original IBM joystick card.

9. Explain briefly about Video Display Adapters.

A video display adapter (aka video card) provides the interface between your computer and your monitor and transmits the signals that appear as images on the display.

The following list of standards can serve as an abbreviated history of PC video-display technology:

MDA (Monochrome Display Adapter)

HGC (Hercules Graphics Card)
CGA (Color Graphics Adapter)
EGA (Enhanced Graphics Adapter)
VGA (Video Graphics Array)
SVGA (Super VGA)
XGA (Extended Graphics Array) and beyond

Video Adapter Types

A monitor requires a source of input. The signals that run to your monitor come from one or more video display adapters in the system. There are four basic types of video display adapters:

Discrete plug-in video cards—These cards require the use of an expansion slot but provide the highest possible level of features and performance.

Discrete video on the motherboard—The same discrete circuitry that can be found on a video card can also be directly built in or mounted on the motherboard.

Motherboard chipset integrated video—This is video circuitry integrated into the motherboard chipset. Because it shares the system random access memory (RAM) and other components, it provides an economical solution that also uses less power (ideal for laptops).

Processor integrated video—This is video circuitry integrated into the processor, either as a separate die within the processor package or directly in the processor die. This form of integrated video also shares the system RAM and requires a motherboard with specific chipsets and video interface connectors on-board. It has the lowest cost of any video solution. It is economical on power, integrated video is used in many laptops for improved battery life.

Integrated Video/Motherboard Chipsets

Silicon Integrated Systems (SiS) pioneered chipsets with integrated video in 1996 and 1997 for laptop and desktop systems.

Table   Intel Chipset Integrated Video

Processor Family	Chipset	Video Type	Features
PII, PIII, Celeron	810, 815	3D with Direct AGP	Basic 2D and 3D acceleration.
PII, PIII, Celeron	845	Extreme Graphics	Supports alpha blending, fog, anisotropic filtering, hardware motion compensation, and advanced textures.
PII, PIII, Celeron	865	Extreme Graphics 2	Enhanced version of Extreme Graphics, adding better memory management, zone rendering, and faster pixel and texturing rendering.
P4, Celeron	910, 915	GMA 900	An enhanced version of Extreme Graphics 2, adding support for most DirectX 9 features (does not support vertex shaders), optional dual-display support (requires ADD2 card), and support for widescreen LCD panels.
P4, PD, Celeron	945	GMA 950	A faster version of GMA 900 with support for DirectX 9.0c (Windows Aero capable), Shader Model 2.0, and Open GL 1.4 + Extensions.
Core 2, PD, P4	946, Q963, Q965	GMA 3000	Based on GMA 950. Adds execution units that can perform vertex and pixel shading for 3D graphics or video processing for video playback.
Core 2, P-dual	G31, G33, Q33, Q35	GMA 3100	Based on GMA 3000, but with reduced clock rates for somewhat lower performance and power consumption.
Core 2, P-dual, PD	G965	GMA X3000	Substantial redesign of GMA 3000 despite having a similar name. Includes support for DirectX 9.0c, Shader Model 3.0, hardware T&L (Transform & Lighting), OpenGL 1.5, hardware-based VC-1 decode, and Clear Video Technology for better video playback.
Core 2, P-dual, PD	GL960, GM965	GMA X3100	Enhanced version of GMA X3000 for mobile applications with upgraded support for DirectX 10 and Shader Model 4.0.

Intel introduced motherboard chipsets with integrated graphics in 1999.

Intel has offered versions of both desktop and mobile chipsets with integrated graphics and has become the world's largest supplier of graphics chips.

Table shows the types and features for the integrated graphics available in Intel motherboard chipsets over the years.

Most other chipset vendors supporting Intel processors have also made versions with integrated graphics.

There are many AMD and third-party chipsets with integrated video for AMD processors, including the most recent models.

CPUs with Integrated Video

Placing video and 3D rendering within the processor itself, is both on Intel and AMD platforms.

By moving video functions within the processor itself, improvements in processor speed, memory speed, and bus speed directly affect video and 3D speeds.

Video Adapter Components

Video display adapters contain certain basic components, usually including the following:

Video basic input/output system (BIOS). Provides the firmware controlling the video card.

Video processor/video accelerator. Places text or graphics information on-screen, and provides 3D acceleration.

Video memory. Holds the information.

Digital-to-analog converter (DAC). Formerly a separate chip, the DAC is usually incorporated into the video processor/accelerator chip. The DAC is not necessary on a purely digital subsystem (digital video card and display); however, most display subsystems still include analog VGA support.

Bus connector. Connects a discrete video card to the motherboard.

Video driver. Software that communicates with the OS to control the card.

On mid-range and high-performance video cards, such as the card shown in Figure, most of the components are underneath the cooling system.

This card uses a combination of a fan and a heatsink to cool its GPU and memory modules.
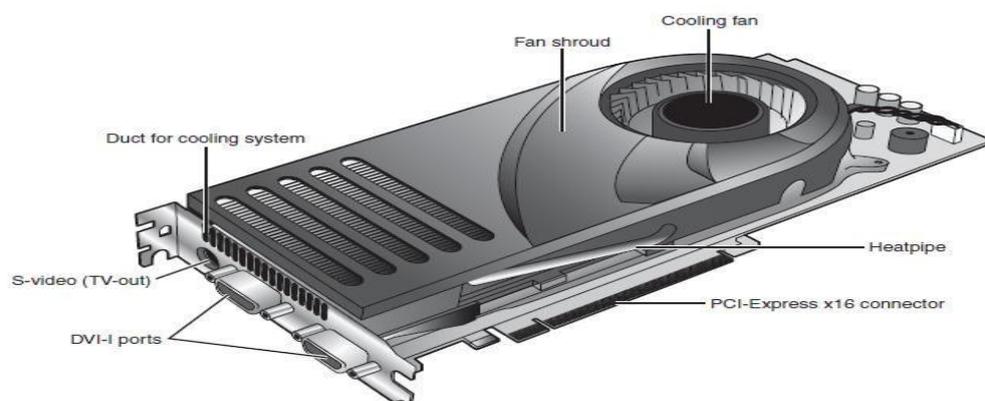
Fig. A typical example of a mid-range video card optimized for dual-GPU gaming (NVIDIA SLI) and HDTV support.

Identifying the Video and System Chipsets

The system which uses the integrated video will have the following:

A better comparison of the card or system to others

Access to technical specifications

Access to reviews and opinions

The ability to make a better buying decision

The choice of card manufacturer or chipset manufacturer support and drivers

Video RAM

Many types of memory have been used with video adapters. Some of them are as shown in table.

Memory Type	Definition
FPM DRAM	Fast Page-Mode RAM
VRAM	Video RAM
WRAM	Window RAM
EDO DRAM	Extended Data Out DRAM
SDRAM	Synchronous DRAM
MDRAM	Multibank DRAM
SGRAM	Synchronous Graphics RAM
DDR SGRAM	Double-Data Rate SGRAM
GDDR2 SGRAM	Graphics DDR version 2 SGRAM
GDDR3 SGRAM	GDDR version 3 SGRAM
GDDR4 SGRAM	Graphics DDR version 4 SGRAM
GDDR5 SGRAM	GDDR version 5 SGRAM

VRAM and WRAM

VRAM and WRAM and WRAM are dual-ported memory types that can read from one port and write data through the other port.

SGRAM

It differs from SDRAM by including circuitry to perform block-writes to increase the speed of graphics fill and 3DZ-buffer operations.

DDR SGRAM

DDR SGRAM is designed to transfer data at speeds twice that of conventional SGRAM by transferring data on both the rising and falling parts of the processing clock cycle.

GDDR2 SGRAM

The several variations are 2.5V DDR SDRAM with some enhancements, with some enhancements, and 1.8V DDR2 SDRAM with much higher performance and cooler operation.

GDDR3 SGRAM

GDDR3 SGRAM is based on DDR2 memory, but with two major differences:

GDDR3 separates reads and writes with a single-ended unidirectional strobe.

GDDR3 uses an interface technique known as pseudo-open drain, which uses voltage instead of current.

GDDR4 SGRAM

GDDR4 has the following features:

Higher bandwidth. GDDR4 running at half the speed of GDDR3 provides

Greater memory density, enabling fewer chips to be needed to reach a particular memory size.

GDDR5 SGRAM

The main differences is

> Signal optimization using data/address bit inversion, adjustable driver strength, adjustable voltage, and adjustable termination
>
> Adaptive interface timing using data training that is scalable per bit or byte
>
> Error compensation, including real-time error detection on both read/write and fast resending

10. Explain briefly about Video Display Interfaces.

> Video display adapters connect a PC to a display and therefore must work through two main interfaces.
>
> The first is the system interface, meaning the connection between the video adapter and the PC, and the second is the display interface, meaning the connection between the video adapter and the display.

The System Interface

Peripheral Component Interconnect (PCI)-based adapters are still found in some old systems or AGP-based systems that utilize a second adapter.

AGP

> The AGP, an Intel-designed dedicated video bus introduced in 1997, delivers a maximum bandwidth up to 16 times greater than that of a comparable PCI bus.
>
> AGP has been replaced by the more versatile and faster PCIe standard.
>
> Systems with AGP have only one AGP slot.
>
> Windows 98 and later versions support AGP's Direct Memory Execute (DIME) feature.

PCIe

> PCIe began to show up in systems in mid-2004 and has filtered down to all systems that use discrete video cards or have integrated video that can be upgraded.
>
> Despite the name, PCIe uses a high-speed bidirectional serial data transfer method, and PCIe channels can be combined to create wider and faster expansion slots.
>
> Most PCIe implementations include one x16 slot for video and two or more x1 slots for other add-on cards, as well as legacy PCI slots.

The Display Interface

> The display interfaces have been analog and others have been digital.
>
> Earlier PCs were all digital interfaces.
>
> The video interfaces (and connectors) you are likely to encounter in PCs dating from the late 1980s to the present include the following:
>
> VGA
>
> DVI
>
> HDMI
>
> DisplayPort

The connectors for these interfaces are shown in Figure.
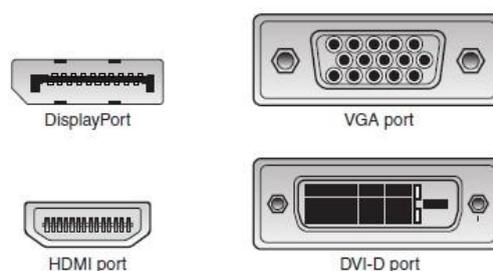
Figure Video interface connectors used in PCs from the late 1980s to the present.

VGA

IBM introduced the VGA interface and display standard on April 2, 1987, along with a family of systems it called PS/2.

VGA is an analog design.

VGA was designed to be addressed through the VGA BIOS interface, a software interface that forced programs to talk to the BIOS-based driver rather than directly to the hardware.

VGA also describes a 15-pin analog interface connection that can support a variety of modes.

The VGA connector is shown in Figure, the pinouts are shown in Table.

Table 15-Pin Analog VGA Connector Pinout

Pin	Function	Direction
1	Red Analog Video	Out
2	Green Analog Video	Out
3	Blue Analog Video	Out
4	Monitor ID 2	In
5	TTL GND (monitor self-test)	—
6	Red Analog GND	—
7	Green Analog GND	—
8	Blue Analog GND	—
9	Key (unused)	—
10	Sync GND	—
11	Monitor ID 0	In
12	Monitor ID 1	In
13	Horizontal Sync	Out
14	Vertical Sync	Out
15	Monitor ID 3	In
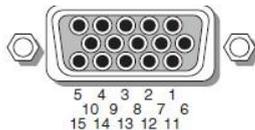
Figure The standard 15-pin analog VGA connector

The mating VGA cable connector that plugs into this connector normally has pin 9 missing.

Pin 5 is used only for testing purposes, and pin 15 is rarely used.

In addition to the connector and electrical interface, the original VGA standard also defined a number of text and graphics display modes with various resolutions and colors.

DVI

DVI was introduced on 1999 by the Digital Display Working Group (DDWG).

DVI uses Transition Minimized Differential Signaling (TMDS), which was developed by Silicon Image and trademarked under the name PanelLink.

TMDS is designed to support cables up to 10 meters (32.8 feet) in length, although the limits may be shorter or longer depending on cable quality.

If more bandwidth is necessary, the DVI standard supports a second TMDS link in the same cable and connector.

This uses three additional TMDS signal pairs and shares the same clock and DDC signals as the primary link.
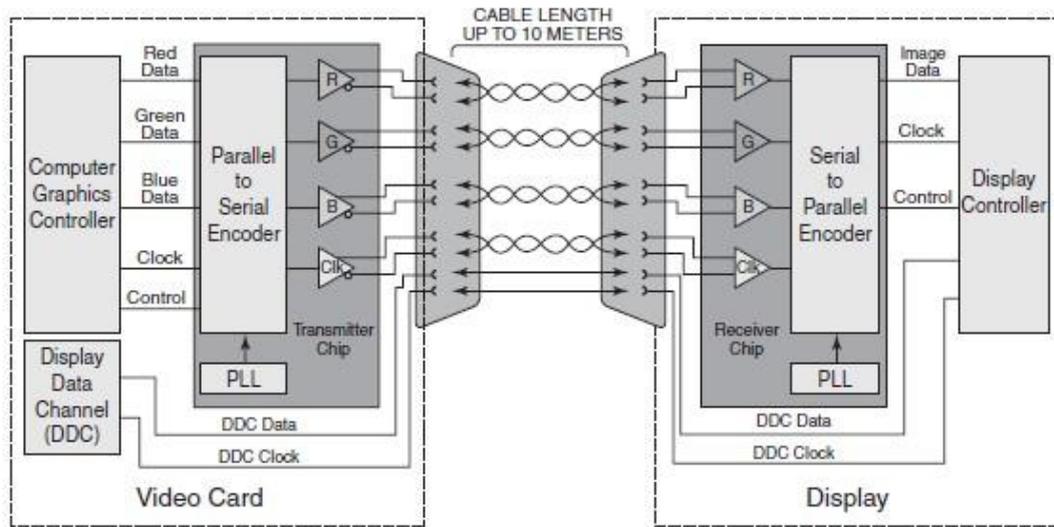
Figure A single-link TMDS connection.

This is called dual-link DVI, and it increases the maximum raw bandwidth and the true data bandwidth.

The DVI-D (digital) connector supports only digital devices, whereas the DVI-I (integrated) connector supports both digital and analog devices via the addition of extra pins.

Table 12.10 show the DVI-I (integrated) connector and pinout and pinout.

Pin	Signal	Pin	Signal
1	TMDS Data2-	13	TMDS Data3+
2	TMDS Data2+	14	+5V Power
3	TMDS Data2/4 Shield	15	GND
4	TMDS Data4-	16	Hot Plug Detect
5	TMDS Data4+	17	TMDS Data0-
6	DDC Clock	18	TMDS Data0+
7	DDC Data	19	TMDS Data0/5 Shield
8	Analog Vert. Sync	20	TMDS Data5-
9	TMDS Data1-	21	TMDS Data5+
10	TMDS Data1+	22	TMDS Clock Shield
11	TMDS Data1/3 Shield	23	TMDS Clock+
12	TMDS Data3-	24	TMDS Clock-
—	—	—	—
C1	Analog Red	C3	Analog Blue
C2	Analog Green	C4	Analog Horiz. Sync
—	—	C5	Analog GND

Table DVI-I Connector Pinout

HDMI

HDMI was designed by a group of multimedia companies as a way to provide a single-cable connection for transporting digital video and audio signals between consumer electronics hardware such as big-screen TVs, video games, DVD players, and home theater systems. HDMI uses the DDC to identify the capabilities of an HDMI display, such as resolutions, color depth, and audio.

HDMI Version	Release Date	Notes
1.0	December 2002	Original release.
1.1	May 2004	Added DVD audio support.
1.2	August 2005	Added Super Audio CD support, PC support for Type A connector and native sRGB color-space, and requirement for displays to support low-voltage sources.
1.2a	December 2005	Added specifications for CEC features.
1.3	June 2006	Increased single-link bandwidth to 10.2Gbps raw (8.16Gbps actual data). Added support for 30/36/48-bit color, Dolby TrueHD and DT-HD Master Audio support, auto lip sync, and compact Type C connector.
1.3a	November 2006	Made minor adjustments to CEC and other specifications. Added new compliance test.
1.4	June 2009	10/100 Ethernet support (requires new cable); audio return channel; 3D input/output protocols; support for future 4K resolutions; new color spaces: sYCC601, Adobe RGB, and Adobe YCC601; HDMI Micro connector (also known as Type D); cable speed and feature standards.
1.4a	March 2010	Support for additional Side-by-Side and Top-and-Bottom broadcast 3D standards.

Table 12.11 HDMI Versions

HDMI is essentially a superset of DVI, it is backward-compatible with DVI.

DisplayPort

DisplayPort is the latest digital display interface standard.

DisplayPort is designed both as an internal and an external interface, meaning it can replace the FPD-Link (Flat Panel Display-Link) interface used internally in most laptops as well as providing connections to external displays.

As it is a license-free, royalty-free design, DisplayPort has seen rapid adoption throughout the industry.

DisplayPort is a high-speed serial interface with up to four main data lanes carrying multiplexed video and audio data, each of which supports a raw data.

Table 12.13 compares the versions of DisplayPort.

Table DisplayPort Versions

Version	Release Date	Notes
DisplayPort 1.0	May 2006	Initial release
DisplayPort 1.1	March 2007	Introduced "hybrid device" class, added support for HDCP content protection, and increased connector power requirements
DisplayPort 1.1a	January 2008	Corrected errata and clarified minor items
DisplayPort 1.2	Late-2009	Doubled performance, multiple data streams, a high-speed auxiliary channel, and the Mini DisplayPort connector

TV Display Interfaces

To display computer screens on standard TV or to record them to videotape, you can use the TV-out connector on your video card or integrated motherboard video.

To connect your PC to an HDTV monitor, it is preferable to use a digital signal via a DVI, HDMI, or DisplayPort connection.

11. How 3D Graphics Accelerators work?

3D acceleration designed for hardcore game players in the PC world.

Low-cost integrated chipsets offer some 3D support, virtually any user of a recent model computer can enjoy 3D lighting, perspective, texture, and shading effects.

Working of 3D Accelerators

The basic function of 3D software is to convert image abstractions into the fully realized images that are then displayed on the monitor.

The image abstractions typically consist of the following elements:

Vertices—Locations of objects in three-dimensional space, described in terms of their x, y, and z coordinates on three axes representing height, width, and depth.

Primitives—The simple geometric objects the application uses to create more complex constructions, described in terms of the relative locations of their vertices.

Textures—Two-dimensional bitmap images or surfaces designed to be mapped onto primitives. The software enhances the 3D effect by modifying the appearance of the textures, depending on the location and attitude of the primitive.

The abstract image descriptions must then be rendered, meaning they are converted to visible form.

The standard functions performed in rendering are as follows:

Geometry—The sizing, orienting, and moving of primitives in space and the calculation of the effects produced by the virtual light sources that illuminate the image

Rasterization—The converting of primitives into pixels on the video display by filling the shapes with properly illuminated shading, textures, or a combination of the two

Most chipsets with 3D acceleration perform the following rasterization functions right on the adapter:

Scan conversion—The determination of which onscreen pixels fall into the space delineated by each primitive

Shading—The process of filling pixels with smoothly flowing color using the flat or Gouraud shading technique

Texture mapping—The process of filling pixels with images derived from a 2D sample picture or surface image

Visible surface determination—The identification of which pixels in a scene are obscured by other objects closer to the viewer in three-dimensional space

Animation—The process of switching rapidly and cleanly to successive frames of motion sequences

Antialiasing—The process of adjusting color boundaries to smooth edges on rendered objects

APIs

APIs provide hardware and software vendors a means to create drivers and programs that can work quickly and reliably across a variety of platforms.

When APIs exist, drivers can be written to interface with the API rather than directly with the OS and its underlying hardware.

Currently, OpenGL and Direct3D are available for virtually all leading graphics cards.

OpenGL

Windows XP and newer can support OpenGL either through software or through hardware acceleration.

For a particular graphics card to support hardware acceleration of OpenGL, the driver developer must include an installable client driver (ICD).

The ICD is distributed as part of the driver package that the video card or GPU vendor provides.

Thus, driver updates can improve OpenGL performance as well as DirectX (Direct3D) performance.

Microsoft DirectX

Direct3D is part of Microsoft's comprehensive multimedia API, DirectX.

DirectX 9.0c uses separate pixel and vertex shaders to create 3D objects.

DirectX 10, developed for Windows Vista, includes a completely rebuilt Direct3D rendering engine with a brand-new shader design.

DirectX 11 was originally developed for Windows 7 (and is also available for Windows Vista) and adds several new features:

Tessellation—Provides additional pipeline stages that increase the number of visible polygons at runtime.

Multithreaded rendering—Enables the execution of Direct3D commands on multiple processor cores.

Compute shaders—Provides an additional stage independent of the Direct3D pipeline that enables general-purpose computing on the graphics processor.

Dynamic shader linkage—A limited runtime shader linkage that allows for improved shader specialization during application execution.

Dual-GPU Scene Rendering

The ability to connect two cards to render a single display more quickly.

The long-defunct 3dfx Voodoo 2 offered an option called scan-line interfacing (SLI) that pairs two Voodoo 2 cards on the PCI bus, with each card writing half the screen in alternating lines.

NVIDIA SLI

NVIDIA uses the term SLI to refer to scalable link interface.

The scaling refers to load-balancing, which adjusts how much of the work each card performs to render a particular scene, depending on how complex the scene is.
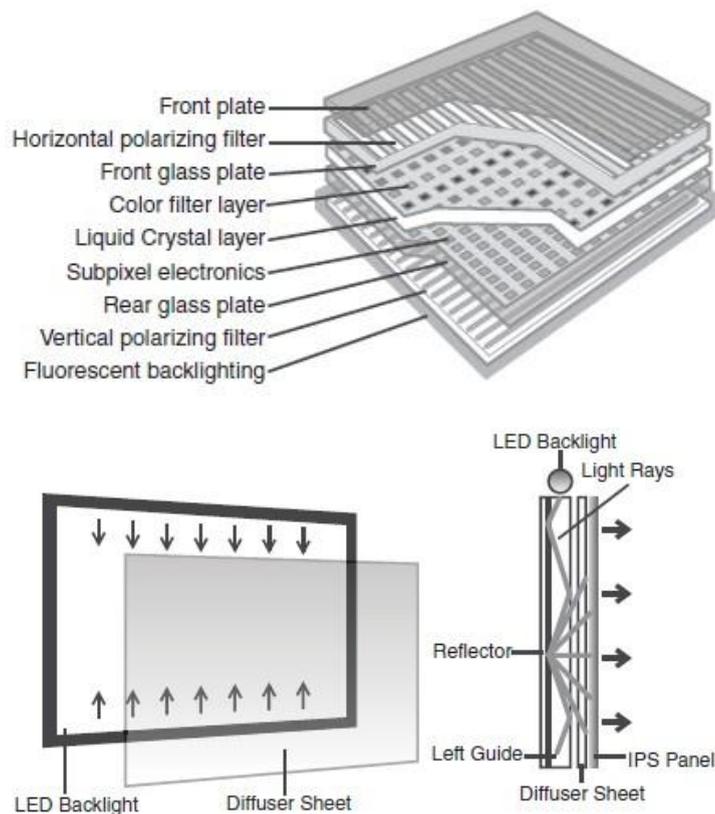
12. Explain briefly about LCD and LED Monitors.

LCD Monitors:

A **liquid-crystal display** (**LCD**) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly.

LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in nearly all applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence.

The LCD screen is more energy-efficient and can be disposed of more safely than a CRT can. Its low electrical power consumption enables it to be used in battery-powered electronic equipment more efficiently than CRTs can be. It is an electronically modulated optical device made up of any number of segments controlling a layer of liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. Liquid crystals were first discovered in 1888. By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes.
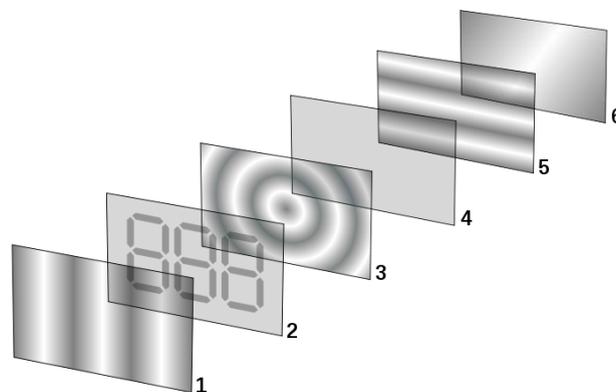
Reflective twisted nematic liquid crystal display.

1. Polarizing filter film with a vertical axis to polarize light as it enters.
2. Glass substrate with ITO electrodes. The shapes of these electrodes will determine the shapes that will appear when the LCD is turned ON. Vertical ridges etched on the surface are smooth.
3. Twisted nematic liquid crystal.
4. Glass substrate with common electrode film (ITO) with horizontal ridges to line up with the horizontal filter.
5. Polarizing filter film with a horizontal axis to block/pass light.
6. Reflective surface to send light back to viewer. (In a backlit LCD, this layer is replaced with a light source.)

LED Monitors:

In the previous decade, the display technology has changed significantly. LED displays are one of the latest developments in this field. LED monitors use light emitting diodes that acts as a performance booster in the monitors. Basically LED monitors are the LCD monitors with a LED backlight to power up the LCD panel. It means that LEDs are placed behind or around the LCD panel to enhance the luminosity and video definition of the monitor screen.
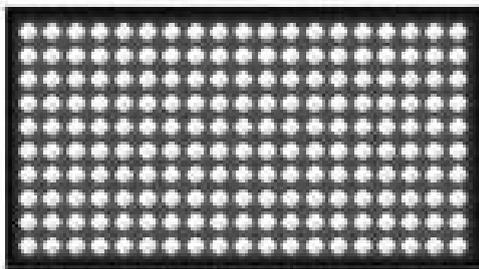
LCD monitors, use a cold cathode light as backlight. In the LED monitors all the concepts are same except this backlight, which is replaced by LEDs.

There are three different types of LED monitors available based on the manner how the diodes are arranges in the monitor. These are – Direct LEDs, Edge LEDs and RGB LEDs. Both Edge and Direct LED display monitors use white diodes that are used to illuminate the LCD panel to produce the improved picture quality.

The arrangement of LEDs in the monitor is shown in the below image:

Side by side comparison of Direct LED and Edge LED Technology
Direct LED Monitor   Edge LED Monitor
LEDmonitors.info
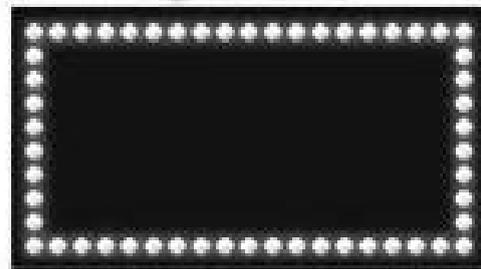
In the Direct LEDs display, white diodes are placed all over the panel to produce higher quality image while the Edge LEDs display uses LEDs only on the borders of the LCD panel. Direct LEDs are generally used in the production of high definition TV whereas the Edge LEDs is mainly used in the production of computer screens. RGB LEDs display is better among the three types of LED monitors as it uses red, green and blue diodes to produce the lifelike images with amazing contrast ratio.

Comparison between LCD and LED Monitors / Why LED displays are better than the LCD displays:

Both types of monitors work on the same technology. LED monitors are LCD monitors with replaced cold cathode backlight to LED backlight. Here are the differences that make the LED displays better than the LCDs:

Contrast and Black level of the LED screen is better than the LCD screens because the liquid crystals cannot stop 100% of the backlight from cold cathode backlight and hence when the black screen is to be shown on the monitor, it is not completely black (as shown in the below image). But Edge LED screens perfectly show the black screen as there is no backlight at all.

Color accuracy for direct and edge LED displays and LCD displays are almost same but the RGB LEDs display has quite better color accuracy.

When comparing the LED and LCD monitors with respect to viewing angle, they are same as backlight has nothing to do with viewing angles. LED displays consume less power. It is reported that they consume up to 40% less power than the LCD displays.

LED displays do not use mercury (used in cathode lamps in LCD backlight) so they are environment friendly.

The size of Edge and RGB monitors is slight thinner than the LCD monitors while prices are slight higher.

13. **What are the types of printer.**
14. **Explain any three types of printing mechanism in detail. (NOV 2010)**
15. **Discuss any three types of printer in detail and point out the functions and characteristics. (APR 2011)**
16. **What are the major output devices for a computer? (NOV 2013)**
17. **Explain in detail about peripheral devices. (NOV 2012)**
18. **What are the major difference between an impact printer and non-impact printer discuss.(NOV 2012)**

A **computer printer**, or more commonly just a **printer**, is a device that produces a hard copy (permanent human-readable text and/or graphics) of documents stored in electronic form, usually on physical print media such as paper or transparencies. A printer which is combined with a scanner can essentially function as a photocopier. The printing speed of early printers was measured in units of **characters per second**. More modern printers are measured in **pages per minute**.

Printers are generally slow devices (10 pages per minute is considered fast; and many consumer printers are far slower than that), and the cost-per-page is relatively high. The world's first computer printer was a 19th-century mechanically driven apparatus invented by Charles Babbage for his Difference Engine.

Toner-based printers

Toner-based printers work using the Xerographic principle that is at work in most photocopiers i.e. by adhering toner to a light-sensitive print drum, then using static electricity to transfer the toner to the printing medium to which it is fused with heat and pressure.

The most common type of toner-based printer is the laser printer, which uses precision lasers to cause adherence. Laser printers are known for high quality prints, good print speed, and a low cost-per-copy; they are the most common printer for many general-purpose office applications. They are far less commonly used as consumer printers due to a high initial cost. Laser printers are available in both color and monochrome varieties.

The LASER Printer produces a printed document using a focused beam of laser light and a rotating mirror to reproduce the image. A laser printer is a page printer. It produces a finished page on each cycle. This is in contrast to the other types of printers that print single characters (daisy wheel, dot matrix) or all the text and graphics of one full page at one time. This has different printing technologies. They are as follows:

Electrophotographic (EP) process: The EP process, developed by Xerox and Canon, was the first laser printer technology used. It is the print process used by virtually all laser printers in one form or another. Its characteristics are the use of a laser beam to produce an electrostatic charge and a dry toner to create the printed image.

Hewlett- Packard (HP) process: The HP process is essentially the same as the EP process only in some minor operating procedures.

Light-Emitting Diode (LED) process: LED printers are not technically laser printers. An LED printer uses an array of around 2,500 light-emitting diodes (like very small light bulbs) place of a laser as the light source used to condition the photosensitive drum.

Liquid Crystal Display (LCD) process: LCD printers use light shone through an LCD panel in place of the laser to condition the photosensitive drum. This is also called as ‒LCD Shutter printers‖.

Liquid inkjet printers

Inkjet printers spray very small, precise amounts (usually a few picolitres) of ink onto the media. Inkjet printing (and the related bubble-jet technology) are the most common consumer print technology; as high-quality inkjet printers are inexpensive to produce.

Inkjet printers consist of nozzles that produce very small ink bubbles that turn into tiny droplets of ink. The dots formed are the size of tiny pixels. Ink-jet printers can print high quality text and graphics. They are also almost silent in operation. Inkjet printers have a much lower initial cost than do laser printers, but have a much higher cost-per-copy, as the ink needs to be frequently replaced.

Inkjet printers are also far slower than laser printers. Inkjet printers also have the disadvantage that pages must be allowed to dry before being aggressively handled; premature handling can cause the inks (which are adhered to the page in liquid form) to run.

Solid Ink printers

This is also known as **phase-change printers**, are a type of thermal transfer printer. They use solid sticks of CMYK colored ink (similar in consistency to candle wax), which are melted and fed into a piezo crystal operated print-head. The print head sprays the ink on a rotating, oil coated drum. The paper then passes over the print drum, at which time the image is transferred, or transfixed, to the page. Acquisition and operating costs are similar to laser printers. Drawbacks of the technology include high power consumption and long warm-up times from a cold state.

Dye-sublimation printers

A **dye-sublimation printer** (or **dye-sub printer**) is a printer which employs a printing process that uses heat to transfer dye to a medium such as a plastic card, paper or canvas. The process is usually to lay one color at a time using a ribbon that has color panels. Dye-sub printers are intended primarily for high-quality color applications, including color photography; and are less well-suited for text. While once the province of high-end print shops, dye-sublimation printers are now increasingly used as dedicated consumer photo printers.

Typewriter-derived printers

Several different computer printers were simply computer-controlable versions of existing electric typewriters. The Friden Flexowriter and IBM Selectric typewriter were the most-common examples. The Flexowriter printed with a conventional type bar mechanism while the Selectric used IBM's well-known "golf ball" printing mechanism. In either case, the letter form then struck a ribbon

which was pressed against the paper, printing one character at a time. The maximum speed of the Selectric printer (the faster of the two) was 15.5 characters per second.

Teletypewriter-derived printers

The common teleprinter could easily be interfaced to the computer and became very popular except for those computers manufactured by IBM. Some models used a "typebox" that was positioned (in the X- and Y-axes) by a mechanism and the selected letter from was struck by a hammer. Others used a type cylinder in a similar way as the Selectric typewriters used their type ball. In either case, the letter form then struck a ribbon to print the letterform. Most teleprinters operated at ten characters per second although achieved 15 CPS.

Daisy wheel printers

Daisy-wheel printers operate in much the same fashion as a typewriter. A hammer strikes a wheel with petals (the daisy wheel), each petal containing a letter form at its tip. The letter form strikes a ribbon of ink, depositing the ink on the page and thus printing a character. By rotating the daisy wheel, different characters are selected for printing. These printers were also referred to as letter-quality printers because, during their heyday, they could produce text which was as clear and crisp as a typewriter (though they were nowhere near the quality of printing presses). The fastest letter-quality printers printed at 30 characters per second.

Dot-matrix printers

In the general sense many printers rely on a matrix of pixels, or dots, that together form the larger image. However, the term dot matrix printer is specifically used for impact printers that use a matrix of small pins to create precise dots. The advantage of dot-matrix over other impact printers is that they can produce graphical images also.

Dot matrix printers can either be character-based or line-based (that is, a single horizontal series of pixels across the page), referring to the configuration of the print head. At one time, dot matrix printers were one of the more common types of printers used for general use - such as for home and small office use. Such printers would have either 9 or 24 pins on the print head. 24 pin print heads were able to print at a higher quality. Once the price of inkjet printers dropped to the point where they were competitive with dot matrix printers, dot matrix printers began to fall out of favor for general use.

Some dot matrix printers, such as the NEC P6300, can be upgraded to print in color. This is achieved through the use of a four-color ribbon mounted on a mechanism. Dot matrix printers are still commonly used in low-cost, low-quality applications like cash registers.

Line printers

This Line printer, as the name implies, print an entire line of text at a time. Three principle designs existed. In drum printers, a drum carries the entire character set of the printer repeated in each column that is to be printed. In chain printers (also known as train printers), the character set is arranged multiple times around a chain that travels horizontally past the print line. In either case, to print a line, precisely timed hammers strike against the back of the paper at the exact moment that the correct character to be printed is passing in front of the paper. The paper presses forward against a ribbon which then presses against the character form and the impression of the character form is printed onto the paper.

Comb printers represent the third major design. These printers were a hybrid of dot matrix printing and line printing. In these printers, a comb of hammers printed a portion of a row of pixels at one time (for example, every eighth pixel). By shifting the comb back and forth slightly, the entire pixel row could be printed (continuing the example, in just eight cycles). The paper then advanced and the next pixel row was printed. Because far less motion was involved than in a conventional dot matrix printer, these printers were very fast compared to dot matrix printers and were competitive in speed with formed-character line printers while also being able to print dot-matrix graphics.

Printing mode

The data received by a printer may be:

1. a string of characters
2. a bitmapped image
3. a vector image

Some printers can process all three types of data, others not.

Daisy wheel printers can handle only plain text data or rather simple point plots.

Plotters typically process vector images.

Modern printing technology, such as laser printers and inkjet printers, can adequately reproduce all three.

Monochrome, color and photo printers

A monochrome printer can only produce an image consisting of one color, usually black. A monochrome printer may also be able to produce various hues of that color, such as a grey-scale.

A color printer can produce images of multiple colors.

A photo printer is a color printer that can produce images that mimic the color range (gamut) and resolution of photographic methods of printing. Many can be used autonomously (without a computer), with a memory card or USB connector.

19. Explain the working principle of Laser Printer.

A **laser printer** is a common computer peripheral that rapidly produces high quality text and graphics on plain paper. As with digital photocopiers and multifunction printers (MFPs), laser printers employ a xerographic printing process, but differ from analog photocopiers in that the image is produced by the direct scanning of a laser beam across the printer's photoreceptor.

When you print something, your computer sends a vast stream of electronic data (typically a few megabytes or million characters) to your laser printer. An electronic circuit in the printer figures out what all this data means and what it needs to look like on the page. It makes a laser beam scan back and forth across a drum inside the printer, building up a pattern of static electricity. The static electricity attracts onto the page a kind of powdered ink called toner. Finally, as in a photocopier, a fuser unit bonds the toner to the paper.

1. Millions of bytes (characters) of data stream into the printer from your computer.
2. An electronic circuit in the printer (effectively, a small computer in its own right) figures out how to print this data so it looks correct on the page.
3. The electronic circuit activates the corona wire. This is a high-voltage wire that gives a static electric charge to anything nearby.
4. The corona wire charges up the photoreceptor drum so the drum gains a positive charge spread uniformly across its surface.
5. At the same time, the circuit activates the laser to make it draw the image of the page onto the drum. The laser beam doesn't actually move: it bounces off a moving mirror that scans it over the drum. Where the laser beam hits the drum, it erases the positive charge that was there and creates an area of negative charge instead. Gradually, an image of the entire page builds up on the drum: where the page should be white, there are areas with a positive charge; where the page should be black, there are areas of negative charge.
6. An ink roller touching the photoreceptor drum coats it with tiny particles of powdered ink (toner). The toner has been given a positive electrical charge, so it sticks to the parts of the photoreceptor drum that have a negative charge (remember that opposite electrical charges

attract in the same way that opposite poles of a magnet attract). No ink is attracted to the parts of the drum that have a positive charge. An inked image of the page builds up on the drum.
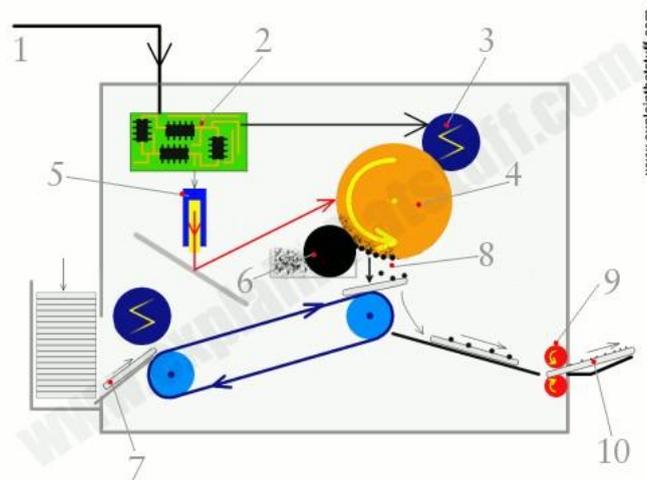
7. A sheet of paper from a hopper on the other side of the printer feeds up toward the drum. As it moves along, the paper is given a strong positive electrical charge by another corona wire.
8. When the paper moves near the drum, its positive charge attracts the negatively charged toner particles away from the drum. The image is transferred from the drum onto the paper but, for the moment, the toner particles are just resting lightly on the paper's surface.
9. The inked paper passes through two hot rollers (the fuser unit). The heat and pressure from the rollers fuse the toner particles permanently into the fibers of the paper.
10. The printout emerges from the side of the copier. Thanks to the fuser unit, the paper is still warm. It's literally hot off the press.

20. Explain the working principle of Inkjet Printer.

An **inkjet printer** is a type of computer printer that creates a digital image by propelling droplets of ink onto paper. Inkjet printers are the most commonly used type of printer[1] and range from small inexpensive consumer models to very large professional machines that can cost tens of thousands of dollars.

The concept of inkjet printing originated in the 19th century, and the technology was first extensively developed in the early 1950s. Starting in the late 1970s inkjet printers that could reproduce digital images generated by computers were developed, mainly by Epson, Hewlett-Packard (HP), and Canon.

Inkjet printers contain hundreds of parts all working together to put millions of microscopic dots onto paper. There are five main components of an inkjet printer: print head, paper feeder, circuit board, power supply, and the case. Of these, the print head and paper feeder are the most interesting.

The Print Head

The print head contains an array of microscopic nozzles that fire drops of ink onto the paper. In some cheap printers, the print head is not even part of the printer, but part of the ink cartridge. There are two main types of print head: thermal ("Bubblejet") and piezoelectric.

Thermal print heads have an array of microscopic nozzles with a small heater filament in each one. When a dot needs to be placed on the paper, current is passed through a filament to boil the ink in that nozzle and create a steam bubble. When the bubble pops, ink is shot out the nozzle end while more ink is sucked into the nozzle, ready for the next firing. This process is repeated thousands of times for every page printed. The term "Bubblejet" is actually a brand name owned by Canon, a major printer manufacturer, and is just another name for these inkjets.

Piezoelectric print heads use a special crystal that vibrates when electrified. This vibrating crystal acts like a plunger, pushing ink out of the nozzles and drawing more ink in. The main advantage over the thermal print heads is the larger range of inks they can use. It also allows for higher resolutions because the ink nozzles are closer together. Almost all inkjet printers made today use a piezoelectric print head.

Both types of print head are stabilized by a solid metal bar, and belt driven by a stepper motor. A stepper motor is special type of electric motor that moves in a precise amount for each electrical pulse it receives. As the print head moves back and forth, the printer fires the ink drops at the right time to form the array of dots that make up a printed shape.

The Paper Feeder

The paper feeder consists of the paper tray, pickup rollers, main rollers, and the stepper motors which drive the rollers. The pickup rollers lift a sheet of paper from the tray and move it into the main rollers. These long rollers, along with a fixed guide, keep the sheet align while it is moving. With each pass of the print head, the rollers move the sheet forward a little, until finally ejecting it after printing has finished.

The print quality depends as much on the type of paper as it does on the resolution. Photo paper has a waxy surface that prevents "feathering", which is the spreading out of ink dots as they are absorbed by the paper. It is important to note that, why many printers have high resolutions, low grade paper can never reach these resolutions due to feathering. Uncoated paper has about half the maximum resolution of coated paper.

21. What is Pen Plotters? Explain.

A graphic printer that draws images with ink pens. It actually draws point-to-point lines directly from vector graphics files. The plotter was the first computer output device that could print graphics as well as accommodate full-size engineering and architectural rawings. Pen plotters are still the most affordable printing device for CAD use and offer resolution unlike any other printer. The lines are not made up of dots. They are actually drawn, providing infinite resolution.
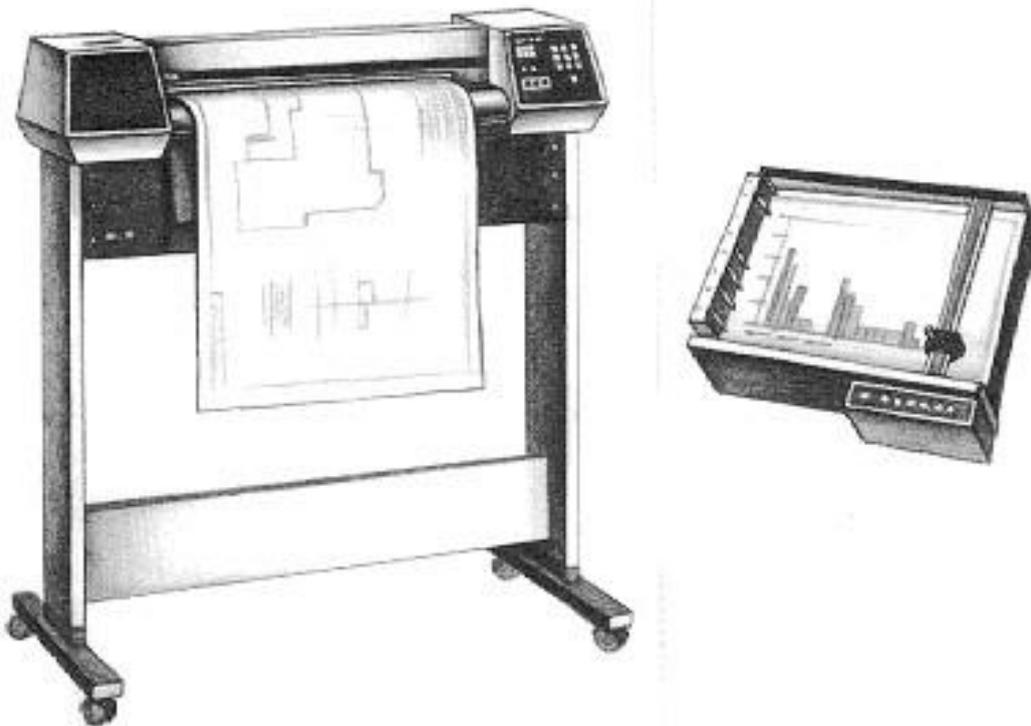
Pen plotters print by moving a pen or other instrument across the surface of a piece of paper. This means that plotters are restricted to line art, rather than raster graphics as with other printers. Pen

plotters can draw complex line art, including text, but do so slowly because of the mechanical movement of the pens. They are often incapable of efficiently creating a solid region of color, but can hatch an area by drawing a number of close, regular lines.

Plotters offered the fastest way to efficiently produce very large drawings or color high-resolution vector-based artwork when computer memory was very expensive and processor power was very limited, and other types of printers had limited graphic output capabilities.

Pen plotters have essentially become obsolete, and have been replaced by large-format inkjet printers and LED toner based printers. Such devices may still understand vector languages originally designed for plotter use, because in many uses, they offer a more efficient alternative to raster data.

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22. What are the service routines provided by BIOS to handle mouse and printers? Explain. (NOV 2014)

BIOS interrupt calls are a facility that operating systems and application programs use to invoke the facilities of the Basic Input/Output System on IBM PC compatible computers. Traditionally, BIOS calls are mainly used by MS-DOS programs and some other software such as boot loaders. BIOS only runs in the real address mode (Real Mode) of the x86 CPU, so programs that call BIOS either must also run in real mode or must switch from protected mode to real mode before calling BIOS and then switch back again. For this reason, modern operating systems that use the CPU in Protected Mode generally do not use the BIOS to support system functions, although some of them use the BIOS to probe and initialize hardware resources during their early stages of booting.

In all computers, software instructions control the physical hardware (screen, disk, keyboard, etc.) from the moment the power is switched on. In a PC, the BIOS, preloaded in ROM on the mainboard, takes control immediately after the processor is reset, including during power-up or when a hardware reset button is pressed. The BIOS initializes the hardware, finds, loads and runs the boot program (usually, but not necessarily, an OS loader), and provides basic hardware control to the

operating system running on the machine, which is usually an operating system but may be a directly booting single software application.

Many modern operating systems (such as newer versions of Windows and Linux) bypass the built-in BIOS interrupt communication system altogether, preferring to use their own software to control the attached hardware directly. The original reason for this was primarily that these operating systems run the processor in protected mode, whereas calling BIOS requires switching to real mode and back again, and switching to real mode is slow. However, there are also serious security reasons not to switch to real mode, and the BIOS code has limitations both in functionality and speed that motivate operating system designers to find a replacement for it. In fact, the speed limitations of the BIOS made it common even in the MS-DOS era for programs to circumvent it in order to avoid its performance limitations, especially for video graphics display and fast serial communication. The problems with BIOS functionality include limitations in the range of functions defined, inconsistency in the subsets of those functions supported on different computers, and variations in the quality of BIOSes (i.e. some BIOSes are complete and reliable, others are abridged and buggy). By taking matters into their own hands and avoiding reliance on BIOS, operating system developers can eliminate some of the risks and complications they face in writing and supporting system software. On the other hand, by doing so those developers become responsible for providing "bare-metal" driver software for every different system or peripheral device they intend for their operating system to work with (or for inducing the hardware producers to provide those drivers). Thus it should be apparent that compact operating systems developed on small budgets would tend to use BIOS heavily, while large operating systems built by huge groups of software engineers with large budgets would more often opt to write their own drivers instead of using BIOS—that is, even without considering the compatibility problems of BIOS and protected mode.

For IBM's part, they provided all the information needed to use their BIOS fully or to directly utilize the hardware and avoid BIOS completely, when programming the early IBM PC models (prior to the PS/2). From the beginning, programmers had the choice of using BIOS or not, on a per-hardware-peripheral basis. Today, the BIOS in a new PC still supports most, if not all, of the BIOS interrupt function calls defined by IBM for the IBM AT (introduced in 1984), along with many more newer ones, plus extensions to some of the originals (e.g. expanded parameter ranges). This, combined with a similar degree of hardware compatibility, means that most programs written for an IBM AT can still run correctly on a new PC today, assuming that the faster speed of execution is acceptable (which it typically is for all but games that use CPU-based timing). Despite the considerable limitations of the services accessed through the BIOS interrupts, they have proven extremely useful and durable to technological change.

Purpose of BIOS calls

BIOS interrupt calls perform hardware control or I/O functions requested by a program, return system information to the program, or do both. A key element of the purpose of BIOS calls is abstraction—the BIOS calls perform generally defined functions, and the specific details of how those functions are executed on the particular hardware of the system are encapsulated in the BIOS and hidden from the program. So, for example, a program that wants to read from a hard disk does not need to know whether the hard disk is an ATA, SCSI, or SATA drive (or in earlier days, an ESDI drive, or an MFM or RLL drive with perhaps a Seagate ST-506 controller, perhaps one of the several Western Digital controller types, or with a different proprietary controller of another brand). The program only needs to identify the number of the drive it wishes to access and the address of the sector it needs to read or write, and the BIOS will take care of translating this general request into the specific sequence of elementary operations required to complete the task through the particular disk

controller hardware that is connected to that drive. The program is freed from needing to know how to control at a low level every type of hard disk (or display adapter, or port interface, or real-time clock peripheral) that it may need to access. This both makes programming operating systems and applications easier and makes the programs smaller, reducing the duplication of program code, as the functionality that is included in the BIOS does not need to be included in every program that needs it; relatively short calls to the BIOS are included there instead. (In operating systems where the BIOS is not used, service calls provided by the operating system itself generally fulfill the same function and purpose.)

The BIOS also frees computer hardware designers (to the extent that programs are written to use the BIOS exclusively) from being constrained to maintain exact hardware compatibility with old systems when designing new systems, in order to maintain compatibility with existing software. For example, the keyboard hardware on the IBM PCjr works very differently than the keyboard hardware on earlier IBM PC models, but to programs that use the keyboard only through the BIOS, this difference is nearly invisible. (As a good example of the other side of this issue, a significant share of the PC programs in use at the time the PCjr was introduced did not use the keyboard through BIOS exclusively, so IBM also included hardware features in the PCjr to emulate the way the original IBM PC and IBM PC XT keyboard hardware works. The hardware emulation is not exact, so not all programs that try to use the keyboard hardware directly will work correctly on the PCjr, but all programs that use only the BIOS keyboard services will.)

In addition to giving access to hardware facilities, BIOS provides added facilities that are implemented in the BIOS software. For example, the BIOS maintains separate cursor positions for up to eight text display pages and provides for TTY-like output with automatic line wrap and interpretation of basic control characters such as carriage return and line feed, whereas the CGA-compatible text display hardware has only one global cursor and cannot automatically advance the cursor or interpret control characters.

Keyboard

Interrupt vector Description	Interrupt vector Description		
17h	Printer services		
		AH	**Description**
		00h	Print Character to Printer
		01h	Initialize Printer
		02h	Check Printer Status

Cursor Control

Each display of the current time by INT 21h, function 9, will advance the cursor

- o   If a new time is displayed, it appears at a different screen position
- o   So, to view the time updated at the same screen position we must restore the cursor to its original position before we display the time
- o   This is achieved by first determining the current cursor position; then, after each print string operation, we move the cursor back

We use INT 10h, functions 2 and 3, to save the original cursor position and to move the cursor to its original position after each print string operation

INT 10h, Function 2

Described in I/O module, repeated here for convenience

Move Cursor

Input:
- o AH = 2
- o DH = new cursor row (0-24)
- o DL = new cursor column (0-79 for 80x25 mode)
- o BH = page number

Output: none

INT 10h, Function 3

Described in I/O module, repeated here for convenience

Get Cursor Position and Size

Input:
- o AH = 3
- o BH = page number

Output:
- o DH = cursor row
- o DL = cursor column
- o CH = cursor starting scan line
- o CL = cursor ending scan line

23. How to troubleshoot Input/Output related problems.

Keyboard Troubleshooting and Repair

The most frequent problems are as follows:

    Defective cables

    Stuck keys

  If the keyboard stops working altogether or every keystroke results in an error or incorrect character, simply replace it.

Most modern keyboards have nonreplaceable cables, at least from the outside.

The only source for one would be another keyboard as a replacement.

Replacement keyboards are so inexpensive, it's almost always cheaper to replace the entire unit than to get a new cable.

 Many times you first discover a problem with a keyboard because the system has an error during the POST.

Many systems use error codes in a 3xx numeric format to distinguish the keyboard.

 Some BIOS versions do not use cryptic numeric error codes; they state something such as the following:

        Keyboard stuck key failure

This message is usually displayed by a system with a Phoenix BIOS if a key is stuck.

But, the message does not identify which key it is.

 If your system displays a 3xx (keyboard) error preceded by a two-digit hexadecimal number, the number is the scan code of a failing or stuck keyswitch.

Look up the scan code in the tables provided in the Technical Reference section on the book's DVD to determine which keyswitch is the culprit.

By removing the keycap of the offending key and cleaning the switch, can solve the problem.

Cleaning a Keyboard

One of the best ways to keep a keyboard in top condition is periodic cleaning.

As preventive maintenance, you should vacuum the keyboard weekly, or at least monthly.

When vacuuming, you should use a soft brush attachment to dislodge the dust.

Use a small, handheld vacuum cleaner made for cleaning computers.

Repairing Monitors

Although a display often is replaced as a whole unit, some larger displays might be cheaper to repair than to replace.

If decided to repair the monitor, best bet is to either contact the company from which you purchased the display or contact one of the companies that specialize in monitor depot repair.

Depot repair means sending a display to a repair specialist who either fixes your particular unit or returns an identical unit it has already repaired.

The price is the same no matter what the company has done to repair your actual unit.

Late-model monitors have built-in self-diagnostic circuitry.

Check your monitor's manual for details.

If available, helps you determine whether the problem is really in the monitor, in a cable, or somewhere else in the system.

If self-diagnostics produce an image onscreen, look to other parts of the video subsystem.

24. What is a scanner? Explain its different types. (APR 2012)

A scanner is an input device that scans documents such as photographs and pages of text. When a document is scanned, it is converted into a digital format. This creates an electronic version of the document that can be viewed and edited on a computer.

Most scanners are flatbed devices, which means they have a flat scanning surface. This is ideal for photographs, magazines, and various documents. Most flatbed scanners have a cover that lifts up so that books and other bulky objects can also be scanned. Another type of scanner is a sheet-fed scanner, which can only accept paper documents. While sheet-fed scanners cannot scan books, some models include an automatic document feeder, or ADF, which allows multiple pages to be scanned in sequence.

Scanners work in conjunction with computer software programs, which import data from the scanner. Most scanners include basic scanning software that allows the user to configure, initiate, and import scans. Scanning plug-ins can also be installed, which allow various software programs to import scanned images directly. For example, if a scanner plug-in is installed for Adobe Photoshop, a user can create new images in Photoshop directly from the connected scanner.

While Photoshop can edit scanned images, some programs like Acrobat and OmniPage can actually recognize scanned text. This technology is called optical character recognition, or OCR. Scanning software that includes OCR can turn a scanned text document into a digital text file that can be opened and edited by a word processor. Some OCR programs even capture page and text formatting, making it possible to create electronic copies of physical documents.

Flatbed Scanners

Flatbed scanners will take up some desktop space but provide a lot of bang for the buck. They look like miniature printers with a flip-up cover protecting the glass platen.Depending on its size, a flatbed scanner can fit standard or legal-sized documents, and the flexible cover allows you to scan large items such as books. These scanners are great for scanning the occasional newspaper article, book

chapter, or photograph; or for those who may need to scan or bulky items such as the cover of a DVD. Flatbed scanners are often built into multifunction printers (MFPs).

Photo Scanners

Scanning documents doesn't require high resolution or color depth; but scanning photos does. Many all-purpose scanners can also scan photos, meaning that you don't need a separate device to handle your photographs. But if you need a scanner primarily to digitize film negatives or slides, a photo scanner is a better deal (even if it is considerably more expensive than an all-purpose scanner). Photo scanners include specialized technology so that they can deal with slides and negatives; they also have built-in software to clean up old photos.

Sheetfed Scanners

Sheetfed scanners are smaller than flatbed scanners; as the name implies, you feed a document or photo into the scanner rather than place it on top. You'll win back some of that desktop space with a sheetfed scanner but you may sacrifice some resolution in the process. If you're only scanning documents, however, it may be a worthwhile trade, especially if you've got a lot of them since you can feed them in bunches. With a flatbed scanner, you'll have to scan one page at a time.

Portable Scanners

Portable scanners are small enough to bring on the road. In fact, some are small enough to put in your pocket; pen scanners are just a bit bigger than fountain pens and can scan the text of a document line by line. Some are as wide as a page and roll easily down the page. They're not going to give high-resolution scans and so aren't good for scanning photographs or other applications where you need a high-quality result. Since they're not cheaper than flatbed scanners.

Pondicherry University
Questions

PART A

1. What are the four basic types of keyboard? **(NOV 2012)**
2. What are the two types keyboard interfaces. **(NOV 2010)**
3. What is the use of Connector? **(NOV 2012)**
4. What are the types of Mouse? **(APR 2012)**
5. What is the Joystick? **(APR 2011)**
6. What is Track Ball? **(APR 2012)**
7. What are the different types of Scanner? **(NOV 2012)**
8. List some of the display adapters. **(APR 2011)**
9. Define MTBF. **(NOV 2010)**
10. Define Scanner? **(NOV 2010)**
11. What are the print directions? **(NOV 2014)**
12. Expand MFM. **(NOV 2012)**
13. What do you mean by SVGA? **(NOV 2012)**
14. What is PPP? **(NOV 2013)**
15. What are the services included in LANE? **(NOV 2013)**
16. What is the function of modem?

PART - B

1. Explain different layouts of keyboard. (Ref.Pg.No.5,Qn.No.1)
2. Explain the two types of keyboards and the functions performed by the keyboard electronics with suitable diagram. **(APR 2011)** (Ref.Pg.No.5,Qn.No.2).
3. Explain Signals and interface standards for keyboard. (Ref.Pg.No.7,Qn.No.3).
4. Explain briefly about keyboard connectors and switches. (Ref.Pg.No.7,Qn.No.4).
5. Explain the working principles of keyboard and mouse. (APR 2012) (Ref.Pg.No.9,Qn.No.5).
6. Explain about Mouse. (Ref.Pg.No.10,Qn.No.6).
7. What are the different point devices available explain. (NOV 2012) (Ref.Pg.No.10,Qn.No.7).
8. Explain Joy stick with neat diagram. (Ref.Pg.No.12,Qn.No.8).
9. Explain briefly about Video Display Adapters. (Ref.Pg.No.13,Qn.No.9).
10. Explain briefly about Video Display Interfaces. (Ref.Pg.No.17,Qn.No.10).
11. How 3D Graphics Accelerators work? (Ref.Pg.No.20,Qn.No.11).
12. Explain briefly about LCD and LED Monitors. (Ref.Pg.No.23,Qn.No.12).
13. Explain any three types of printing mechanism in detail.(NOV 2010) (Ref.Pg.No.25,Qn.No.14).
14. Discuss any three types of printer in detail and point out the functions and characteristics.(APR 2011) (Ref.Pg.No.25,Qn.No.15).
15. What are the major output devices for a computer? (NOV 2013) (Ref.Pg.No.25,Qn.No.16).
16. Explain in detail about peripheral devices. (NOV 2012) (Ref.Pg.No.25,Qn.No.17).
17. What are the major difference between an impact printer and non-impact printer discuss. (NOV 2012) (Ref.Pg.No.25,Qn.No.18).
18. Explain the working principle of Laser Printer.(Ref.Pg.No.28,Qn.No.19).
19. Explain the working principle of Inkjet Printer. (Ref.Pg.No.29,Qn.No.20).
20. What is Pen Plotters? Explain. (Ref.Pg.No.30,Qn.No.21).
21. What are the service routines provided by BIOS to handle mouse and printers? Explain. (NOV 2014) (Ref.Pg.No.31,Qn.No.22).
22. How to troubleshoot Input/Output related problems. (Ref.Pg.No.34,Qn.No.23).
23. What is a scanner? Explain its different types. (APR 2012) (Ref.Pg.No.35,Qn.No.24).

SRI VENKATESHWARAA COLLEGE OF ENGINEERING & TECHNOLOGY
(Approved by AICTE, New Delhi & Affiliated to Pondicherry University, Puducherry.)
13-A, Villupuram – Pondy Main road, Ariyur, Puducherry – 605 102.
Phone: 0413-2644426, Fax: 2644424 / Website: www.svcetpondy.com

Department of Computer Science and Engineering

Subject Name: **COMPUTER HARDWARE AND NETWORK TROUBLESHOOTING**
Subject Code: **CS T72**

Prepared By : Dr. N. Balaji, Professor & HOD / CSE

Verified by :   **Approved by :**

UNIT – V

External I/O Interfaces: Serial versus Parallel - USB: system, data transfer, and controller – Hot plugging – Low speed connections: RS232C and Parallel port: SPP, EPP, ECP – Local Area Networking: Requirements – Wired – Wireless – Bluetooth – Network Interface Cards – Wired Topologies – Switches/Access Points – Wireless Ethernet hardware – Network Protocols: IP and TCP/IP, IPX, NetBEUI. – Cables and Connections. Troubleshooting network problems.

PC Diagnostics, Testing & Maintenance: POST – Boot process – Maintenance tools – Preventive Maintenance.

2 Marks

1. **What are the two types of Partitioning?**
   Primary and Extended Partitioning are the two major types of hard disk partitioning.

2. **Define Extended Partitioning?**
   An extended partition is secondary to the primary partition. A hard disk may contain only one extended partition, which can then be sub-divided into logical drives each of which (under dos and windows) assigned additional drive letters. Extended partition is useful if you want more than four partitions on a single physical drive.

3. **Define Unix Partitioning?**
   An extended partition is secondary to the primary partition. A hard disk may contain only one extended partition, which can then be sub-divided into logical drives each of which (under dos and windows) assigned additional drive letters. Extended partition is useful if you want more than four partitions on a single physical drive.

4. **How to install the LinuX?**
   To install Linux, you follow a simple, step-by-step procedure that has three main phases:
   - Installing the operating system kernel and base system
   - Configuring the new Linux system
   - Installing applications

   WARNING**:** Although the Linux installation procedure is generally trouble free, errors or malfunctions that occur during the installation of an operating system can result in loss of data. You should not begin the installation procedure until you have backed up all data on your system and determined that your backup is error-free.

5. **What are the two types of computer for faults based on the frequency occurrence of the problem? (NOV 2010)**
   1. Permanent (or) Solid fault
   2. Intermittent fault

Permanent (or) Solid fault: When there is a permanent fault in a computer, the misbehaves consistently. Any number of times the program is run, the result or symptoms will be the same.

Intermittent fault: When there is an intermittent fault in a computer, the computer's behavior is not consistent. Sometimes it works properly and suddenly it malfunction. After a certain period of time, it recovers from the fault automatically and again starts functioning properly.

6. **List some of the symptoms of computer faults? (APR 2011)**
   Peripherals are not working properly
   Computer will not properly boot.
   Long beep when power on the PC.
   Noisy when power on the system.

7. **How to Install Network Hardware and Software?**
   If there is no hardware installed for networking, you will need to purchase a PCI networking card for a wired network or a PCI card for wireless networking. If it has a networking card already installed for a wired network and you are changing to a wireless networking, you can leave the old card in and disable it or remove the card.

   If your network is not installed, you will need to install it. If you are using Windows, you should be the following Network components are installed:
   - Client for Microsoft Windows
   - Internet Protocol (TCP/IP)
   - Adapter card software driver

8. **What do you mean by spyware? (NOV 2012)**
   Spyware is any technology that aids in gathering information about a person or organization without their knowledge. On the Internet (where it is sometimes called a *spybot* or *tracking software*), spyware is programming that is put in someone's computer to secretly gather information about the user and relay it to advertisers or other interested parties. Spyware can get in a computer as a software virus or as the result of installing a new program.

9. **Define Virus Scanner?**
   A Virus Scanner is a program that searches files or storage devices for Viruses. It is a useful preventative measure to avoid contagion.

10. **Define Interrupt?**
    An interrupt is a signal from a device attached to a computer or from a program within the computer that causes the main program that operates the computer (the operating system) to stop and figure out what to do next. Almost all personal (or larger) computers today are *interrupt-driven* - that is, they start down the list of computer instruction s in one program.

11. **List out the different types of Hardware Interrupts? (NOV 2012)**
    Hardware interrupts are used by devices to communicate that they require attention from the operating system. Some common examples are a hard disk signalling that is has read a series of data blocks, or that a network device has processed a buffer containing network packets. Interrupts are also used for asynchronous events, such as the arrival of new data from an external network. Hardware interrupts are delivered directly to the CPU using a small network of interrupt management and routing devices.
    - Level-signalled interrupts
    - Message-signalled interrupts

- Non-maskable interrupts
- System management interrupts
- Advanced programmable interrupt controller

12. What are the four levels of troubleshooting approaches? (APR 2011)

The systematic trouble shooting approaches can be divided in to the following steps:

1. Symptoms observation
2. Symptoms analysis
3. Fault diagnosis
4. Fault rectification

13. Categorize the type of trouble shooting tools? (NOV 2010), (APR 2012), (NOV 2012)

There are two types of trouble shooting tools

1. Nodal Testers
2. System Testers

The nodal testers are simple conventional test equipment to probe in and around the circuit. These tester include oscilloscope, logic probe, logic clip, logic pulser, current tracer and comparator.

14. Define Multimeter?

A multimeter or a multitester is an electronicmeasuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter. Analog multimeters are sometimes referred to as "volt-ohm-meters", abbreviated VOM. Digital multimeters are usually referred to as "digital-multi-meters", abbreviated DMM.

15. Define Oscilloscope?

A typical oscilloscope can display alternating current (AC) or pulsating direct current (DC) waveforms having a frequency as low as approximately 1 hertz (Hz) or as high as several megahertz (MHz). High-end oscilloscopes can display signals having frequencies up to several hundred gigahertz (GHz). The display is broken up into so-called horizontal divisions (hor div) and vertical divisions (vert div). Time is displayed from left to right on the horizontal scale. Instantaneous voltage appears on the vertical scale, with positive values going upward and negative values going downward.

16. What is meant by Logic analyzer?

A **logic analyzer** displays signals in a digital circuit that are too fast to be observed by a human being and presents it to a user so that the user can more easily check correct operation of the digital system.

17. Define In-Circuit Emulator?

An **in-circuit emulator** (ICE) also called **on-circuit debugger** (OCD) or **background debug module** (BDM) is a hardware device used to debug the software of an embedded system. Embedded systems present special problems for a programmer, because they usually lack keyboards, screens, disk-drives and other helpful user interfaces and storage devices that are present on business computers.

18. What are the troubleshooting problems of CD-ROM drive?(APR 2012)

- ❖ Disk error problem
- ❖ CD not recognized
- ❖ Noise Problem
- ❖ Motor Problem
- ❖ Laser Light Problem
- ❖ Reader/Writer Problem

19. Define Operating System? (NOV 2012)

The operating system is the most important program that runs on a computer. Every general-purpose computer must have an operating system to run other programs and applications. Operating systems perform basic tasks, such as recognizing inputfrom the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.

20. What are the major functions OS? (NOV 2013)

An operating system manages hardware, runs applications, provides an interface for users, and stores, retrieves, and manipulates files.

It manages the hardware and software resources of the system.

It provides a stable, consistent way for applications to deal with the hardware without having to know all the details of the hardware.

System tool (programs) used to monitor computer performance,debug,problems, or maintain parts of the system.

A set of libraries or functions which may use to perform specific tasks especially relating to interfacing with computer system components.

21. What is mean by network? (NOV 2013)

A network is a group of two or more computer systems linked together. There are many types of computer networks, including the following:

local-area networks (LANs): The computers are geographically close together (that is, in the same building).

wide-area networks (WANs): The computers are farther apart and are connected by telephone lines or radio waves.

metropolitan-area networks MANs): A data network designed for a town or city.

22. What is the use of logic probe? (NOV 2014)

A **logic probe** is a hand-held pen-like test probe used for analyzing and troubleshooting the logical states (Boolean 0 or 1) of a digital circuit. While most are powered by the circuit under test, some devices use batteries. They can be used on either TTL (transistor-transistor logic) or CMOS (complementary metal-oxide semiconductor) integrated circuit devices.

23. What do you mean by Boot virus? (NOV 2014)

A boot sector virus is a computer virus that infects a storage device's master boot record (MBR). It is not mandatory that a boot sector virus successfully boot the victim's PC to infect it. As a result, even non-bootable media can trigger the spread of boot sector viruses. These viruses copy their infected code either to the floppy disk's boot sector or to the hard disk's partition table. During start-up, the virus gets loaded to the computer's memory. As soon as the virus is saved to the memory, it infects the non-infected disks used by the system.

24. What does Hot Plugging mean?

Hot plugging is the ability to replace or install a device without shutting down the attached computer. Hot plugging is implemented when a peripheral device is added or removed; a device or working system requires reconfiguration; a defective component requires replacement or a device and computer require data synchronization. Hot swapping allows easy accessibility to equipment and the convenience of uninterrupted systems. Also known as hot swapping. True hot plugging device includes USB, high end SCSI devices and FireWire.

11 MARKS

## 1. Compare Serial Port Vs. Parallel Port

Serial ports are generally built into the mother board, which is why the connectors behind the casing and connected to the mother board by a wire cable can be used to connect an exterior element. Serial connectors generally have 9 or 25 pins and take the following form (DB9 and DB25 connectors respectively):
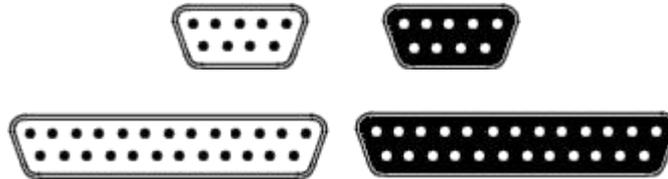
A personal computer generally has between one and four serial ports.

Parallel port

Parallel data transmission involves sending data simultaneously on several channels (wires). The parallel ports on personal computers can be used to send 8 bits (one octet) simultaneously via 8 wires.
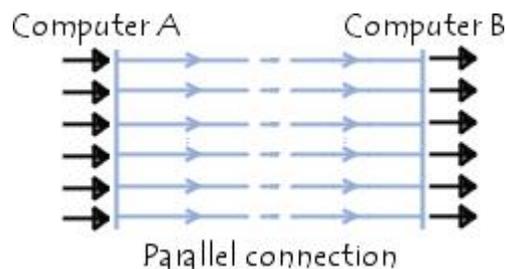
The first two-way parallel ports allowed for speeds of 2.4Mb/s. Enhanced parallel ports have been developed however to achieve higher speeds:

- **The EPP** (*Enhanced Parallel Port*) achieves speeds of 8 to 16 Mbps
- **The ECP** (*Enhanced Capabilities Port*), developed by *Hewlett Packard* and *Microsoft*. It has the same characteristics as the EPP with in addition a *Plug and Play* feature, allowing the computer to recognise the connected peripherals.

Parallel ports, like serial ports, are built into the mother board. DB25 connectors allow connection to an exterior element (e.g. a printer).

2. Explain briefly about USB.

Universal Serial Bus (USB) is a set of interface specifications for high speed wired communication between electronics systems peripherals and devices with or without PC/computer. The USB was originally developed in 1995 by many of the industry leading companies like Intel, Compaq, Microsoft, Digital, IBM, and Northern Telecom.

The major goal of USB was to define an external expansion bus to add peripherals to a PC in easy and simple manner. The new external expansion architecture, highlights,

1. PC host controller hardware and software
2. Robust connectors and cable assemblies
3. Peripheral friendly master-slave protocols
4. Expandable through multi-port hubs.

USB offers users simple connectivity. It eliminates the mix of different connectors for different devices like printers, keyboards, mice, and other peripherals. That means USB-bus allows many peripherals to be connected using a single standardized interface socket. Another main advantage is that, in USB environment, DIP-switches are not necessary for setting peripheral addresses and IRQs. It supports all kinds of data, from slow mouse inputs to digitized audio and compressed video.

USB also allows hot swapping. The "hot-swapping" means that the devices can be plugged and unplugged without rebooting the computer or turning off the device. That means, when plugged in, everything configures automatically. So the user needs not worry about terminations, terms such as IRQs and port addresses, or rebooting the computer. Once the user is finished, they can simply unplug the cable out, the host will detect its absence and automatically unload the driver. This makes the USB a plug-and-play interface between a computer and add-on devices.

The loading of the appropriate driver is done using a PID/VID (Product ID/Vendor ID) combination. The VID is supplied by the USB Implementer's forum

Fig 1: The USB "trident" logo

The USB has already replaced the RS232 and other old parallel communications in many applications. USB is now the most used interface to connect devices like mouse, keyboards, PDAs, game-pads and joysticks, scanners, digital cameras, printers, personal media players, and flash drives to personal computers. Generally speaking, USB is the most successful interconnect in the history of personal computing and has migrated into consumer electronics and mobile products.

USB sends data in serial mode i.e. the parallel data is serialized before sends and de-serialized after receiving.

The benefits of USB are low cost, expandability, auto-configuration, hot-plugging and outstanding performance. It also provides power to the bus, enabling many peripherals to operate without the added need for an AC power adapter.

Various versions USB:

As USB technology advanced the new version of USB are unveiled with time. Let us now try to understand more about the different versions of the USB.

USB1.0: Version 0.7 of the USB interface definition was released in November 1994. But USB 1.0 is the original release of USB having the capability of transferring 12 Mbps, supporting up to 127 devices. And as we know it was a combined effort of some large players on the market to define a new general device interface for computers. This USB 1.0 specification model was introduced in January1996. The data transfer rate of this version can accommodate a wide range of devices, including MPEG video devices, data gloves, and digitizers. This version of USB is known as full-speed USB.

Since October-1996, the Windows operating systems have been equipped with USB drivers or special software designed to work with specific I/O device types. USB got integrated into Windows 98 and later versions. Today, most new computers and peripheral devices are equipped with USB.

USB1.1: USB 1.1 came out in September 1998 to help rectify the adoption problems that occurred with earlier versions, mostly those relating to hubs.

USB 1.1 is also known as full-speed USB. This version is similar to the original release of USB; however, there are minor modifications for the hardware and the specifications. USB version 1.1 supported two speeds, a full speed mode of 12Mbits/s and a low speed mode of 1.5Mbits/s. The 1.5Mbits/s mode is slower and less susceptible to EMI, thus reducing the cost of ferrite beads and quality components.

USB2.0: Hewlett-Packard, Intel, LSI Corporation, Microsoft, NEC, and Philips jointly led the initiative to develop a higher data transfer rate than the 1.1 specifications. The USB 2.0 specification was released in April 2000 and was standardized at the end of 2001. This standardization of the new device-specification made backward compatibility possible, meaning it is also capable of supporting USB 1.0 and 1.1 devices and cables.

Supporting three speed modes (1.5, 12 and 480 megabits per second), USB 2.0 supports low-bandwidth devices such as keyboards and mice, as well as high-bandwidth ones like high-resolution Web-cams, scanners, printers and high-capacity storage systems.

USB 2.0, also known as hi-speed USB. This hi-speed USB is capable of supporting a transfer rate of up to 480 Mbps, compared to 12 Mbps of USB 1.1. That's about 40 times as fast! Wow!

USB3.0: USB 3.0 is the latest version of USB release. It is also called as Super-Speed USB having a data transfer rate of 4.8 Gbit/s (600 MB/s). That means it can deliver over 10x the speed of today's Hi-Speed USB connections.

The USB 3.0 specification was released by Intel and its partners in August 2008. Products using the 3.0 specifications are likely to arrive in 2009 or 2010. The technology targets fast PC sync-and-go transfer of applications, to meet the demands of Consumer Electronics and mobile segments focused on high-density digital content and media.

USB 3.0 is also a backward-compatible standard with the same plug and play and other capabilities of previous USB technologies. The technology draws from the same architecture of wired USB. In addition, the USB 3.0 specification will be optimized for low power and improved protocol efficiency.

USB system overview:

The USB system is made up of a host, multiple numbers of USB ports, and multiple peripheral devices connected in a tiered-star topology. To expand the number of USB ports, the USB hubs can be included in the tiers, allowing branching into a tree structure with up to five tier levels.

The tiered star topology has some benefits. Firstly power to each device can be monitored and even switched off if an overcurrent condition occurs without disrupting other USB devices. Both high, full and low speed devices can be supported, with the hub filtering out high speed and full speed transactions so lower speed devices do not receive them.

The USB is actually an addressable bus system, with a seven-bit address code. So it can support up to 127 different devices or nodes at once (the "all zeroes" code is not a valid address). However it can have only one host: the PC itself. So a PC with its peripherals connected via the USB forms a star local area network (LAN).

On the other hand any device connected to the USB can have a number of other nodes connected to it in daisy-chain fashion, so it can also form the hub for a mini-star sub-network. Similarly it is possible to have a device, which purely functions as a hub for other node devices, with no separate function of its own. This expansion via hubs is possible because the USB supports a tiered star topology. Each USB hub acts as a kind of traffic cop. for its part of the network, routing data from the host to its correct address and preventing bus contention clashes between devices trying to send data at the same time.

On a USB hub device, the single port used to connect to the host PC either directly or via another hub is known as the upstream port, while the ports used for connecting other devices to the USB are known as the downstream ports. USB hubs work transparently as far as the host PC and its operating system are concerned. Most hubs provide either four or seven downstream ports or less if they already include a USB device of their own.

The host is the USB system's master, and as such, controls and schedules all communications activities. Peripherals, the devices controlled by USB, are slaves responding to commands from the host. USB devices are linked in series through hubs. There always exists one hub known as the root hub, which is built in to the host controller.

A physical USB device may consist of several logical sub-devices that are referred to as device functions. A single device may provide several functions, for example, a web-cam (video device function) with a built-in microphone (audio device function). In short, the USB specification recognizes two kinds of peripherals: stand-alone (single function units, like a mouse) or compound devices like video camera with separate audio processor.
The logical channel connection host to peripheral-end is called pipes in USB. A USB device can have 16 pipes coming into the host controller and 16 going out of the controller.

The pipes are unidirectional. Each interface is associated with single device function and is formed by grouping endpoints.
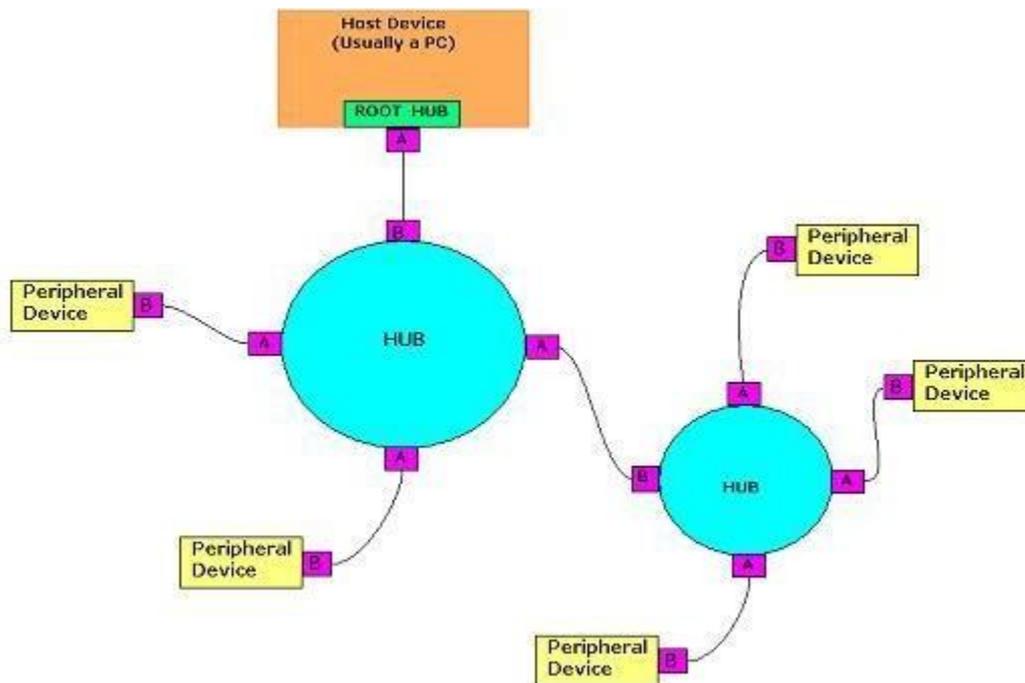
The hubs are bridges. They expand the logical and physical fan-out of the network. A hub has a single upstream connection (that going to the root hub, or the next hub closer to the root), and one to many downstream connections.

Hubs themselves are considered as USB devices, and may incorporate some amount of intelligence. We know that in USB users may connect and remove peripherals without powering the entire system down. Hubs detect these topology changes. They also source power to the USB network. The power can come from the hub itself (if it has a built-in power supply), or can be passed through from an upstream hub.

USB connectors & the power supply:

Connecting a USB device to a computer is very simple -- you find the USB connector on the back of your machine and plug the USB connector into it. If it is a new device, the operating system auto-detects it and asks for the driver disk. If the device has already been installed, the computer activates it and starts talking to it.

The USB standard specifies two kinds of cables and connectors. The USB cable will usually have an "A" connector on one end and a "B" on the other. That means the USB devices will have an "A" connection on it. If not, then the device has a socket on it that accepts a USB "B" connector.
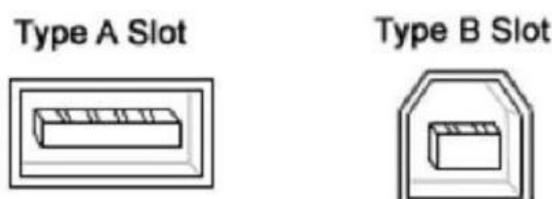
Fig 3: USB Type A & B Connectors

The USB standard uses "A" and "B" connectors mainly to avoid confusion:

1. "A" connectors head "upstream" toward the computer.
2. "B" connectors head "downstream" and connect to individual devices.

By using different connectors on the upstream and downstream end, it is impossible to install a cable incorrectly, because the two types are physically different.

Individual USB cables can run as long as 5 meters for 12Mbps connections and 3m for 1.5Mbps. With hubs, devices can be up to 30 meters (six cables' worth) away from the host. Here the high-speed cables for 12Mbps communication are better shielded than their less expensive 1.5Mbps counterparts. The USB 2.0 specification tells that the cable delay to be less than 5.2 ns per meter

Inside the USB cable there are two wires that supply the power to the peripherals-- +5 volts (red) and ground (brown)-- and a twisted pair (yellow and blue) of wires to carry the data. On the power wires, the computer can supply up to 500 milliamps of power at 5 volts. A peripheral that draws up to 100ma can extract all of its power from the bus wiring all of the time. If the device needs more than a half-amp, then it must have its own power supply. That means low-power devices such as mice can draw their power directly from the bus. High-power devices such as printers have their own power supplies and draw minimal power from the bus. Hubs can have their own power supplies to provide power to devices connected to the hub.

Pin No:	Signal	Color of the cable
1	+5V power	Red
2	- Data	White / Yellow
3	+Data	Green / Blue
4	Ground	Black/Brown

Table - 1: USB pin connections

USB hosts and hubs manage power by enabling and disabling power to individual devices to electrically remove ill-behaved peripherals from the system. Further, they can instruct devices to enter the suspend state, which reduces maximum power consumption to 500 microamps (for low-power, 1.5Mbps peripherals) or 2.5ma for 12Mbps devices.
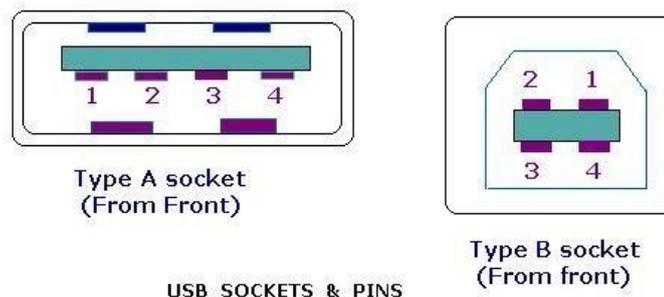
Fig 3: USB Type A & B Connectors

the USB is a serial protocol and physical link, which transmits all data differentially on a single pair of wires. Another pair provides power to downstream peripherals.

Note that although USB cables having a Type A plug at each end are available, they should never be used to connect two PCs together, via their USB ports. This is because a USB network can only have one host, and both would try to claim that role. In any case, the cable would also short their 5V power rails together, which could cause a damaging current to flow. USB is not designed for direct data transfer between PCs. But the "sharing hubs" technique allows multiple computers to access the same peripheral device(s) and work by switching access between PCs, either automatically or manually.

USB Data transfer

When a USB peripheral device is first attached to the network, a process called enumeration process gets started. This is the way by which the host communicates with the device to learn its identity and to discover which device driver is required. The enumeration starts by sending a reset signal to the newly connected USB device. The speed of the USB device is determined during the reset signaling. After reset, the host reads the USB device's information, and then the device is assigned a unique 7-bit address (will be discussed in next section). This avoids the DIP-switch and IRQ headaches of the past device communication methods. If the device is supported by the host, the device drivers needed for communicating with the device are loaded and the device is set to a configured state. Once a hub detects a new peripheral (or even the removal of one), it actually reports the new information about the peripheral to the host, and enables communications with it. If the USB host is restarted, the enumeration process is repeated for all connected devices.

In other words, the enumeration process is initiated both when the host is powered up and a device connected or removed from the network.

Technically speaking, the USB communications takes place between the host and endpoints located in the peripherals. An endpoint is a uniquely addressable portion of the peripheral that is the source or receiver of data. Four bits define the device's endpoint address; codes also indicate transfer direction and whether the transaction is a "control" transfer (will be discussed later in detail). Endpoint 0 is reserved for control transfers, leaving up to 15 bi-directional destinations or sources of data within each device. All devices must support endpoint zero. Because this is the endpoint, which receives all of the devices control, and status requests during enumeration and throughout the duration while the device is operational on the bus.

All the transfers in USB occur through virtual pipes that connect the peripheral's endpoints with the host. When establishing communications with the peripheral, each endpoint returns a descriptor, a data structure that tells the host about the endpoint's configuration and expectations. Descriptors include transfer type, max size of data packets, perhaps the interval for data transfers, and in some cases, the bandwidth needed. Given this data, the host establishes connections to the endpoints through virtual pipes.

Though physically configured as a tiered star, logically (to the application code) a direct connection exists between the host and each device.

The host controller polls the bus for traffic, usually in a round-robin fashion, so no USB device can transfer any data on the bus without an explicit request from the host controller.

USB can support four data transfer types or transfer mode, which are listed below.

1. Control
2. Isochronous
3. Bulk
4. Interrupt

Control transfers exchange configuration, setup and command information between the device and the host. The host can also send commands or query parameters with control packets.

Isochronous transfer is used by time critical, streaming device such as speakers and video cameras. It is time sensitive information so, within limitations, it has guaranteed access to the USB bus. Data streams between the device and the host in real-time, and so there will not be any error correction.

Bulk transfer is used by device like printers & scanners, which receives data in one big packet. Here the timely delivery is not critical. Bulk transfers are fillers, claiming unused USB bandwidth when nothing more important is going on. The error correction protects these packets.

Interrupt transfers is used by peripherals exchanging small amounts of data that need immediate attention. It is used by devices to request servicing from the PC/host. Devices like a mouse or a keyboard comes in this category. Error checking validates the data.

As devices are enumerated, the host is keeping track of the total bandwidth that all of the isochronous and interrupt devices are requesting. They can consume up to 90 percent of the 480 Mbps of bandwidth that is available. After 90 percent is used up, the host denies access to any other isochronous or interrupt devices. Control packets and packets for bulk transfers use any bandwidth left over (at least 10 percent).

The USB divides the available bandwidth into frames, and the host controls the frames. Frames contain 1,500 bytes, and a new frame starts every millisecond. During a frame, isochronous and interrupt devices get a slot so they are guaranteed the bandwidth they need. Bulk and control transfers use whatever space is left.

3. Explain about RS232C.

RS-232C is a long-established standard ("C" is the current version) that describes the physical interface and protocol for relatively low-speed serial data communication between computers and related devices. It was defined by an industry trade group, the Electronic Industries Association (EIA), originally for teletypewriter devices.

RS-232C is the interface that your computer uses to talk to and exchange data with your modem and other serial devices. Somewhere in your PC, typically on a Universal Asynchronous

Receiver/Transmitter (UART) chip on your motherboard, the data from your computer is transmitted to an internal or external modem (or other serial device) from its Data Terminal Equipment (DTE) interface. Since data in your computer flows along parallel circuits and serial devices can handle only one bit at a time, the UART chip converts the groups of bits in parallel to a serial stream of bits. As your PC's DTE agent, it also communicates with the modem or other serial device, which, in accordance with the RS-232C standard, has a complementary interface called the Data Communications Equipment (DCE) interface.

4. **Explain briefly about Parallel Port.**
5. **Describe the structure, operating modes and features of enhanced capabilities port. (NOV 2014)**
6. **Explain parallel and serial interface with block diagram? (NOV 2010)**

   A **parallel port** is a type of interface found on computers (personal and otherwise) for connecting various peripherals. In computing, a parallel port is a parallel communication physical interface. It is also known as a **printer port** or Centronics port. The IEEE 1284 standard defines the bi-directional version of the port, which allows the transmission and reception of data bits at the same time.

   - **Compatibility Mode**, also known as Centronics standard or **SPP**, is a uni-directional implementation with only a few differences from the original Centronics design. This mode is almost exclusively used for printers. The only signals that the printer can send back to the host are some fixed-meaning status lines that signal common error conditions, such as the printer running out of paper.

   - **Enhanced Parallel Port** (**EPP**) is a half-duplex bi-directional interface designed to allow devices like printers, scanners, or storage devices to transmit large amounts of data while quickly being able to switch channel direction. EPP can provide up to 2 MByte/s bandwidth, approximately 15 times the speed achieved with normal parallel-port communication with far less CPU overhead.[1]

   - **Extended Capability Port** (**ECP**) is a half-duplex bi-directional interface similar to EPP, except that PC implementations use direct memory access (usually ISA DMA on channel 3) to provide even faster data transfer than EPP by having the ISA DMA hardware and the parallel port interface hardware handle the work of transferring the data instead of letting the CPU do this work. Many devices that interface using this mode support RLE compression. ECP can provide up to 2.5 MByte/s of bandwidth, which is the natural limit of 8-bit ISA DMA.[2] An ECP interface on a PC can improve transfers to pre-IEEE-1284 printers as well,

by reducing the CPU load during the transfer ; however, the transfer in that case is unidirectional.

7. What are the required components to build LAN

A Local Area Networks connects computers together to exchange data. Apart from the computers, and other devices like printers and faxes, a LAN has to have six essential components to function

Network Adapter

A computer needs a network adapter to connect to a network. It converts computer data into electronic signals. It listens for silence on the network cable and applies the data to it when it has an opportunity. The network access element of its job is called Media Access Control, or MAC. The physical address of every computer on a network is called its MAC address. The MAC address is the network adapter's serial number. Most computers are shipped with the network adapter integrated into the motherboard. However, early PCs didn't include this function and computer owners had to buy it separately and fit it into an expansion slot on the motherboard. These were called "network cards" because they were sold on a separate card. Although network adapters are now integrated, the name network card is still used. The wireless equivalent is called a Wireless Network .

Network Medium

Wired networks need cable. The most common form of cable used in networks is called the "Unshielded Twisted Pair." In PC shops, it is generally just referred to as "network cable" or "Ethernet cable." Ethernet is the most widely implemented set of standards for the physical properties of networks. UTP is so closely identified with Ethernet that it is often given that name. Other cable types used for networks are twin-axial, Shielded Twisted Pair and single-mode and multi-mode fiber optic cable. Wireless networks don't need cable; they send data on radio waves generated by the WNIC.

Cable Connectors

In wired networks, the most common form of connector is the RJ45. Every computer with networking capabilities has an RJ45 port. This is sometimes called a "network port" or an "Ethernet port." The RJ45 plug looks like a slightly larger telephone plug and connects the Unshielded Twisted Pair or the Shielded Twisted Pair cable.

Power Supply

Both wired and wireless networks need a power supply. A wireless network uses the current to generate radio waves. A cabled network sends data interpreted as an electronic pulse.

Hub/Switch/Router

In wired networks, one computer cannot connect to many others without some form of splitter. A hub is little more than a splitter. It repeats any signals coming into one of its ports out onto all its other ports. A cable leads from each port to one computer. A switch is a more sophisticated version of a hub. It only sends the signal on to the computer with the address written in the arriving message. Routers are much more complicated and are able to forward messages all over the world. Larger networks sometimes use routers for their LAN traffic. The wireless networking device is called a "wireless router."

Network Software

Software on a communicating computer packages data into segments and puts that data into a structure called a "packet." The source and destination addresses of the packet are written into the header of the packet. The receiving computer needs to interpret these packets back into meaningful data and deliver it to the appropriate application.

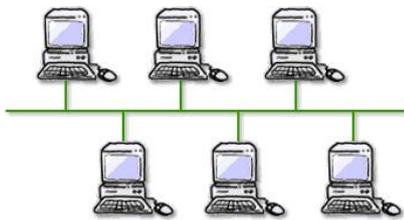## 8. Explain briefly about Wired and Wireless Networks.

Wired networks, also called Ethernet networks, are the most common type of local area network (LAN) technology. A wired network is simply a collection of two or more computers, printers, and other devices linked by Ethernet cables. Ethernet is the fastest wired network protocol, with connection speeds of 10 megabits per second (Mbps) to 100 Mbps or higher. Wired networks can also be used as part of other wired and wireless networks. To connect a computer to a network with an Ethernet cable, the computer must have an Ethernet adapter (sometimes called a network interface card, or NIC). Ethernet adapters can be internal (installed in a computer) or external (housed in a separate case). Some computers include a built-in Ethernet adapter port, which eliminates the need for a separate adapter (Microsoft). There are three basic network topologies that are most commonly used today. (Homenthelp.com)
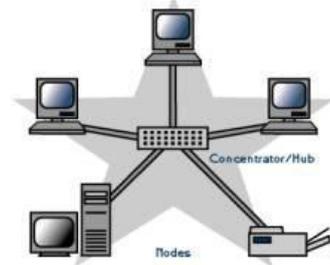
The star network, a general more simplistic type of topology, has one central hub that connects to three or more computers and the ability to network printers. This type can be used for small businesses and even home networks. The star network is very useful for applications where some processing must be centralized and some must be performed locally. The major disadvantage is the star network is its vulnerability. All data must pass through one central host computer and if that host fails the entire network will fail.

On the other hand the bus network has no central computer and all computers are linked on a single circuit. This type broadcasts signals in all directions and it uses special software to identify which computer gets what signal. One disadvantage with this type of network is that only one signal can be sent at one time, if two signals are sent at the same time they will collide and the signal will fail to reach its destination. One advantage is that there is no central computer so if one computer goes down others will not be affected and will be able to send messages to one another. (Laudon)

The third type of network is the ring network. Similar to the bus network, the ring network does not rely on a central host computer either. Each computer in the network can communicate directly with any other computer, and each processes its own applications independently. A ring network forms a closed loop and data is sent in one direction only and if a computer in the network fails the data is still able to be transmitted.
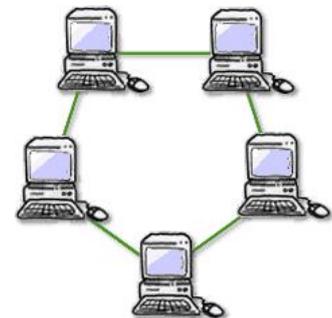
Typically the range of a wired network is within a 2,000-foot-radius. The disadvantage of this is that data transmission over this distance may be slow or nonexistent. The benefit of a wired network is that bandwidth is very high and that interference is very limited through direct connections. Wired networks are more secure and can be used in many situations; corporate LANs, school networks and hospitals. The biggest drawback to this type of network is that it must be rewired every time it is moved. (Laudon)
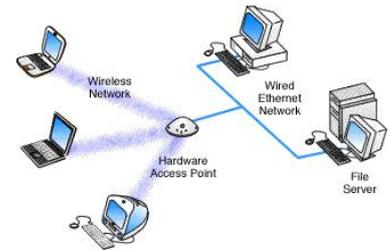
Wireless Networks

A wireless network, which uses high-frequency radio waves rather than wires to communicate between nodes, is another option for home or business networking. Individuals and organizations can use this option to expand their existing wired network or to go completely wireless. Wireless allows

for devices to be shared without networking cable which increases mobility but decreases range. There are two main types of wireless networking; peer to peer or ad-hoc and infrastructure. (Wi-fi.com)

An ad-hoc or peer-to-peer wireless network consists of a number of computers each equipped with a wireless networking interface card. Each computer can communicate directly with all of the other wireless enabled computers. They can share files and printers this way, but may not be able to access wired LAN resources, unless one of the computers acts as a bridge to the wired LAN using special software.

An infrastructure wireless network consists of an access point or a base station. In this type of network the access point acts like a hub, providing connectivity for the wireless computers. It can connect or bridge the wireless LAN to a wired LAN, allowing wireless computer access to LAN resources, such as file servers or existing Internet Connectivity. (compnetworking.about.com)

There are four basic types of transmissions standards for wireless networking. These types are produced by the Institute of Electrical and Electronic Engineers (IEEE). These standards define all aspects of radio frequency wireless networking. They have established four transmission standards; 802.11, 802.11a, 802.11b, 802.11g.

The basic differences between these four types are connection speed and radio frequency. 802.11 and 802.11b are the slowest at 1 or 2 Mbps and 5.5 and 11Mbps respectively. They both operate off of the 2.4 GHz radio frequency. 802.11a operates off of a 5 GHz frequency and can transmit up to 54 Mbps and the 802.11g operates off of the 2.4 GHz frequency and can transmit up to 54 Mbps. Actual transmission speeds vary depending on such factors as the number and size of the physical barriers within the network and any interference in the radio transmissions. (Wi-fi.com)

Wireless networks are reliable, but when interfered with it can reduce the range and the quality of the signal. Interference can be caused by other devices operating on the same radio frequency and it is very hard to control the addition of new devices on the same frequency. Usually if your wireless range is compromised considerably, more than likely, interference is to blame. (Laudon)

A major cause of interference with any radio signals are the materials in your surroundings, especially metallic substances, which have a tendency to reflect radio signals. Needless to say, the potential sources of metal around a home are numerous--things like metal studs, nails, building insulation with a foil backing and even lead paint can all possibly reduce the quality of the wireless radio signal. Materials with a high density, like concrete, tend to be harder for radio signals to penetrate, absorbing more of the energy. Other devices utilizing the same frequency can also result in interference with your wireless. For example, the 2.4GHz frequency used by 802.11b-based wireless products to communicate with each other. Wireless devices don't have this frequency all to themselves. In a business environment, other devices that use the 2.4GHz band include microwave ovens and certain cordless phones. (Laundon)

On the other hand, many wireless networks can increase the range of the signal by using many different types of hardware devices. A wireless extender can be used to relay the radio frequency

from one point to another without losing signal strength. Even though this device extends the range of a wireless signal it has some drawbacks. One drawback is that it extends the signal, but the transmission speed will be slowed.

There are many benefits to a wireless network. The most important one is the option to expand your current wired network to other areas of your organization where it would otherwise not be cost effective or practical to do so. An organization can also install a wireless network without physically disrupting the current workplace or wired network. (Wi-Fi.org) Wireless networks are far easier to move than a wired network and adding users to an existing wireless network is easy. Organizations opt for a wireless network in conference rooms, lobbies and offices where adding to the existing wired network may be too expensive to do so.

9. What is Bluetooth?

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Invented by telecom vendor Ericsson in 1994, it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 25,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics.[6] The IEEE standardized Bluetooth as **IEEE 802.15.1**, but no longer maintains the standard. The Bluetooth SIG oversees development of the specification, manages the qualification program, and protects the trademarks.[7] A manufacturer must make a device meet Bluetooth SIG standards to market it as a Bluetooth device.[8] A network of patents apply to the technology, which are licensed to individual qualifying devices.

10. Explain the detail about network interface card (NIC) with neat diagram. (APR 2012)

A **network card**, **network adapter** or **NIC** (network interface controller) is a piece of computer hardware designed to allow computers to communicate over a computer network. It is both an OSI layer 1 (physical layer) and layer 2 (data link layer) device, as it provides physical access to a networking medium and provides a low-level addressing system through the use of MAC addresses. It allows users to connect to each other either by using cables or wirelessly.

Every network card has a unique 48-bit serial number called a MAC address, which is stored in ROM carried on the card. Every computer on a network must have a card with a unique MAC address. No two cards ever manufactured share the same address. This is accomplished by the Institute of Electrical and Electronics Engineers (IEEE), which is responsible for assigning unique MAC addresses to the vendors of network interface controllers.

Whereas network cards used to be expansion cards that plug into a computer bus, the low cost and ubiquity of the Ethernet standard means that most newer computers have a network interface built into the motherboard. These motherboards either have Ethernet capabilities integrated into the motherboard chipset, or implemented via a low cost dedicated Ethernet chip, connected through the PCI (or the newer PCI express bus). A separate network card is not required unless multiple interfaces are needed or some other type of network is used. Even newer motherboards may have built-in dual network (Ethernet) interfaces.

The card implements the electronic circuitry required to communicate using a specific physical layer and data link layer standard such as Ethernet or token ring. This provides a base for a full network protocol stack, allowing communication among small groups of computers on the same LAN and large-scale network communications through routable protocols, such as IP. There are four techniques used to transfer data, the NIC may use one or more of these techniques.

- Polling is where the microprocessor examines the status of the peripheral under program control.

- Programmed I/O is where the microprocessor alerts the designated peripheral by applying its address to the system's address bus.

- Interrupt-driven I/O is where the peripheral alerts the microprocessor that it's ready to transfer data.

- DMA is where the intelligent peripheral assumes control of the system bus to access memory directly. This removes load from the CPU but requires a separate processor on the card.

A network card typically has a twisted pair, BNC, or AUI socket where the network cable is connected, and a few LEDs to inform the user of whether the network is active, and whether or not there is data being transmitted on it. The Network Cards are typically available in 10/100/1000 Mbits/s(Mbps). This means they can support a transfer rate of 10 or 100 or 1000 Megabits per second.

11. Explain briefly about network topology.

Each computer on the network is connected to the other computers with cable (or some other medium, such as wireless using radio frequency signals). The physical arrangement of the cables connecting computers on a network is called the **network topology**.

The three basic topologies used in computer networks have been as follows:
- **Bus**—Connects each computer on a network directly to the next computer in a linear fashion. The network connection starts at the server and ends at the last computer in the network.
- **Star**—Connects each computer on the network to a central access point.
- **Ring**—Connects each computer to the others in a loop or ring.

Bus Topology

The earliest type of network topology was the bus topology, which uses a single cable to connect all the computers in the network to each other, as shown in the image below. This network topology was adopted initially because running a single cable past all the computers in the network is easier and uses less wiring than other topologies. Because early bus topology networks used bulky coaxial cables, these factors were important advantages. Both 10BASE-5 (thick) and 10BASE-2 (thin) Ethernet networks are based on the bus topology.

However, the advent of cheaper and more compact unshielded twisted-pair cabling, which also supports faster networks, has made the disadvantages of a bus topology apparent. If one computer or cable connection malfunctions, it can cause all the stations beyond it on the bus to lose their network connections. Thick Ethernet (10BASE-5) networks often failed because the vampire tap connecting the AUI device to the coaxial cable came loose.

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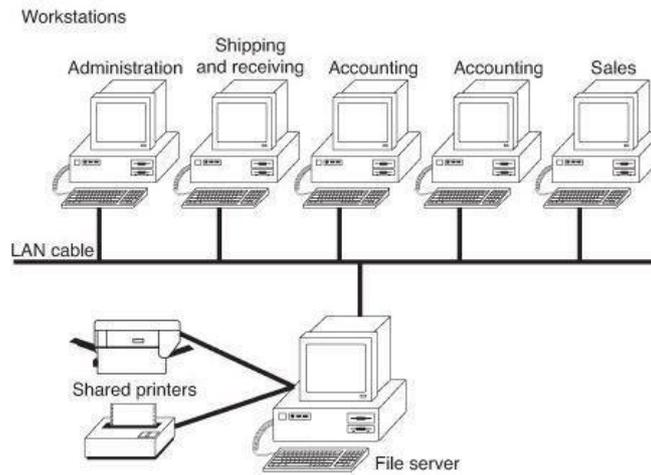
A 10BASE-2 network is an example of a linear bus topology, attaching all network devices to a common cable.

In addition, the T-adapters and terminating resistors on a 10BASE-2 Thin Ethernet network could come loose or be removed by the user, causing all or part of the network to fail. Another drawback of Thin Ethernet (10BASE-2) networks was that adding a new computer to the network between existing computers might require replacement of the existing network cable between the computers with shorter segments to connect to the new computer's network card and T-adapter, thus creating downtime for users on that segment of the network.

Ring Topology

Another topology often listed in discussions of this type is a ring, in which each workstation is connected to the next and the last workstation is connected to the first again (essentially a bus topology with the two ends connected). Two major network types use the ring topology:

- **Fiber Distributed Data Interface (FDDI)**—A network topology used for large, high-speed networks using fiber-optic cables in a physical ring topology
- **Token-Ring**—Uses a logical ring topology

A Token-Ring network resembles a 10BASE-T or 10/100 Ethernet network at first glance because both networks use a central connecting device and a physical star topology. Where is the ‒ring‖ in Token-Ring?

The ring exists only within the device that connects the computers, which is called a multistation access unit (MSAU) on a Token-Ring network (see the following image).
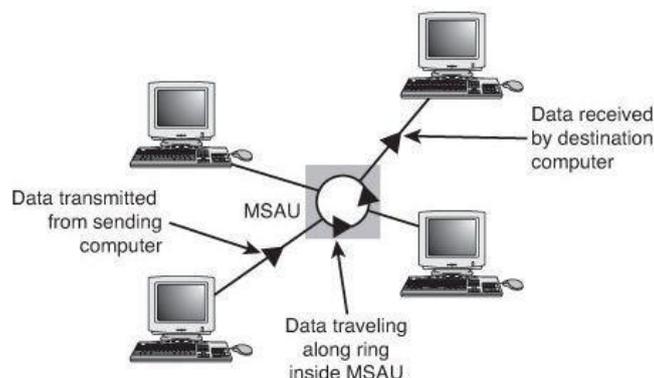
A Token-Ring network during the sending of data from one computer to another.

Signals generated from one computer travel to the MSAU, are sent out to the next computer, and then go back to the MSAU again. The data is then passed to each system in turn until it arrives back at the

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computer that originated it, where it is removed from the network. Therefore, although the physical wiring topology is a star, the data path is theoretically a ring. This is called a logical ring.

A logical ring that Token-Ring networks use is preferable to a physical ring network topology because it affords a greater degree of fault tolerance. As on a bus network, a cable break anywhere in a physical ring network topology, such as FDDI, affects the entire network. FDDI networks use two physical rings to provide a backup in case one ring fails. By contrast, on a Token-Ring network, the MSAU can effectively remove a malfunctioning computer from the logical ring, enabling the rest of the network to function normally.

Star Topology

By far the most popular type of topology in use today has separate cables to connect each computer to a **central wiring nexus**, often called a **switch** or **hub**. The following figure shows this arrangement, which is called a star topology.
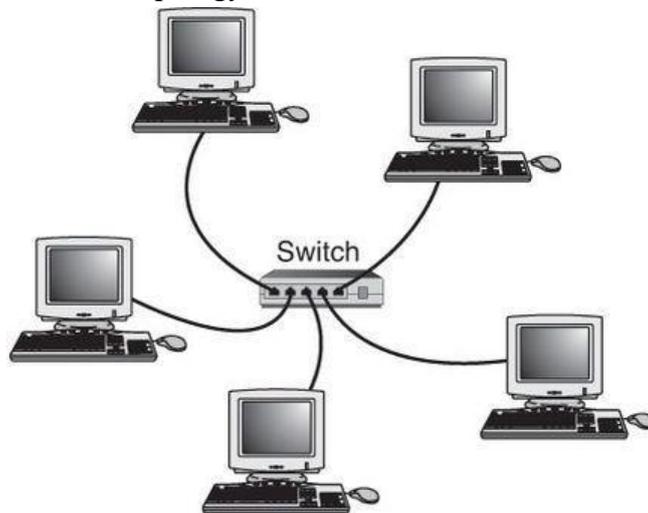
The star topology, linking the LAN's computers and devices to one or more central hubs, or access units.

Because each computer uses a separate cable, the failure of a network connection affects only the single machine involved. The other computers can continue to function normally. Bus cabling schemes use less cable than the star but are harder to diagnose or bypass when problems occur. At this time, Fast Ethernet and gigabit Ethernet in a star topology are the most commonly implemented types of wired LAN.

12. What are the hardware requirements needs to form wireless Ethernet.

The most common type of network technology is wireless. When choosing network technology considers the location of the computer, speed of the network and the cost of these technologies are similar.

Need	Purpose
DSL or Cable Modem	A DSL or cable modem connects your computer to a high-speed DSL or cable Internet connection. Although dial-up modems are still available for slower dial-up Internet connections, the connection speeds are far too slow for a home network.
Wired or wireless router	A wired or wireless router connects your DSL or cable modem to your home network. Many DSL/cable modems now have built-in routers that

	allow you to connect your network directly to your Internet connection.
Wired or wireless network adapters	A wired or wireless network adapter is the device in your computer (or printers, gaming consoles, and other networking equipment) that connects your computer to your network.
Ethernet cabling	Ethernet cabling is used to connect your wired network adapters to a router or network switch. Even if you are using a wireless router, you will need at least one Ethernet cable to connect your wireless router to your DSL or cable modem.

13. What is access point and switch or Hub?

Access Point (AP):

1. Access points, also called as **Base Stations**, provide wireless access to a wired Ethernet network

2. An access point plugs into a hub, switch, or wired router and sends out wireless signals

3. This enables computers and devices to connect to a wired network wirelessly

4. Some routers are equipped with a wireless access point capability, in this case you don't need a wireless access Point

5. Access points by themselves don't have any built-in technology for sharing Internet connections. To share an Internet connection, you must plug an access point into a router or a modem with a built-in router - this is what you get whenever you buy a wireless router

Remember, a hub or switch is just to create a network without any back-haul... By using a router, you connect to a back-haul.

Hub:

1. Works within the same network - connect multiple computers within one network to each other

2. Each computer plugs into the hub with a cable, and information sent from one computer to another passes through the hub

3. A hub doesn't know have any information of who's sending info or requesting info and whom it is intended to. It can't identify the source or destination of the information it receives, so it sends the information to all of the computers connected to it, including the one that sent it

4. A hub can send or receive information but it can't do both at the same time, so hubs are the slowest and cheapest of all network devices, especially comparing with switches

Switch:

1. Works within the same network - connect multiple computers within one network to each other

2. Each computer plugs into the switch with a cable, and information sent from one computer to another passes through the switch

3. A switch knows who's sending info or requesting info and whom it is intended to. So, it identifies the source and destination of the information it receives. So it intelligently sends the correct info to the right requester

4. Switches can send and receive information at the same time, and faster than hubs can

5. Switches are best recommended on a home or office network where you have more computers and want to use the network for activities that require passing a lot of information between computers

So, using only a hub or switch, you'll NOT be able to connect to the internet or go beyond your own network

Router:

1. Routers are better known as intermediary devices that enable computers and other network components to communicate or pass information between two networks e.g. between a home network and the Internet

2. The wonderful thing about routers is their capability to direct network traffic, which is why, the name Router. Routers can be wired (using cables) or wireless

3. Routers also typically provide built-in security, such as a firewall

4. Routers are more expensive than hubs and switches

14. Explain briefly about network Protocols.

When two humans converse, they may have to use the same language but they generally understand each other without having to adhere to rigid rules of grammar or formal language frameworks. Computers, on the other hand, have to have everything explicitly defined and structured. If computers wish to communicate with one another, they have to know in advance exactly how information is to be exchanged and precisely what the format will be. Therefore, standard methods of transmitting and processing various kinds of information are used and these methods are called "protocols". Protocols are established by international agreement and ensure that computers everywhere can talk to one another. There are a variety of protocols for different kinds of information and functions. This article will discuss some of the common protocols that the average PC user is likely to encounter.

IP and TCP/IP

TCP (Transmission Control Protocol) and IP (Internet Protocol) are two different procedures that are often linked together. The linking of several protocols is common since the functions of different protocols can be complementary so that together they carry out some complete task. The combination of several protocols to carry out a particular task is often called a "stack" because it has layers of operations. In fact, the term "TCP/IP" is normally used to refer to a whole suite of protocols, each with different functions. This suite of protocols is what carries out the basic operations of the Web. TCP/IP is also used on many local area networks. The details of how the Web works are beyond the scope of this article but I will briefly describe some of the basics of this very important group of protocols. More details can be found in the references in the last section.

When information is sent over the Internet, it is generally broken up into smaller pieces or "packets". The use of packets facilitates speedy transmission since different parts of a message can be sent by different routes and then reassembled at the destination. It is also a safety measure to minimize the chances of losing information in the transmission process. TCP is the means for creating the packets, putting them back together in the correct order at the end, and checking to make sure that no packets got lost in transmission. If necessary, TCP will request that a packet be resent.

Internet Protocol (IP) is the method used to route information to the proper address. Every computer on the Internet has to have its own unique address known as the IP address. Every packet sent will contain an IP address showing where it is supposed to go. A packet may go through a number of computer routers before arriving at its final destination and IP controls the process of getting everything to the designated computer. Note that IP does not make physical connections between computers but relies on TCP for this function. IP is also used in conjunction with other protocols that create connections.

IPX/SPX

IPX/SPX and NetBEUI are two alternatives to TCP/IP for communication across a network. However, they are proprietary and limited in their use to networks running the software on each host. They are not used on the Internet at large, only on private LANs that have instigated them. IPX (Internetwork Packet Exchange) is a networking protocol from Novell that interconnects networks that use Novell's NetWare clients and servers. IPX is a datagram or packet protocol. IPX works at the network layer of communication protocols and is connectionless (that is, it doesn't require that a connection be set up before packets are sent to a destination as, for example, a regular voice phone call does). Packet acknowledgment is managed by another Novell protocol, the Sequenced Packet Exchange(tm) (SPX). Other related Novell NetWare protocols are: the Routing Information Protocol (RIP), the Service Advertising Protocol (SAP), and the NetWare Link Services Protocol(NLSP).

NetBEUI

NetBEUI (NetBIOS Extended User Interface) is a new, extended version of NetBIOS, the program that lets computers communicate within a local area network. NetBEUI (pronounced net-BOO-ee) formalizes the frame format (or arrangement of information in a data transmission) that was not specified as part of NetBIOS. NetBEUI was developed by IBM for its LAN Manager product and has been adopted by Microsoft for its Windows NT, LAN Manager, and Windows for Workgroups products. Hewlett-Packard and DEC use it in comparable products. NetBEUI is the best performance choice for communication within a single LAN. Because, like NetBIOS, it does not support the routing of messages to other networks, its interface must be adapted to other protocols such as IPX or TCP/IP. A recommended method is to install both NetBEUI and TCP/IP in each computer and set the server up to use NetBEUI for communication within the LAN and TCP/IP for communication beyond the LAN.

15. Discuss about various types of cables and connectors. (NOV 2012)

Cable is the medium through which information usually moves from one network device to another. There are several types of cable which are commonly used with LANs. In some cases, a network will utilize only one type of cable, other networks will use a variety of cable types. The type of cable chosen for a network is related to the network's topology, protocol, and size. Understanding the characteristics of different types of cable and how they relate to other aspects of a network is necessary for the development of a successful network.

The types of cables used in networks are:

Unshielded Twisted Pair (UTP) Cable
Shielded Twisted Pair (STP) Cable
Coaxial Cable
Fiber Optic Cable

Unshielded Twisted Pair (UTP) Cable

Twisted pair cabling comes in two varieties: shielded and unshielded. Unshielded twisted pair (UTP) is the most popular and is generally the best option for school networks.

Unshielded twisted pair

The quality of UTP may vary from telephone-grade wire to extremely high-speed cable. The cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices. The tighter the twisting, the higher the supported transmission rate and the greater the cost per foot. The EIA/TIA (Electronic Industry Association/Telecommunication Industry Association) has established standards of UTP and rated six categories of wire (additional categories are emerging).

Categories of Unshielded Twisted Pair

Category	Speed	Use
1	1 Mbps	Voice Only (Telephone Wire)
2	4 Mbps	LocalTalk & Telephone (Rarely used)
3	16 Mbps	10BaseT Ethernet
4	20 Mbps	Token Ring (Rarely used)
5	100 Mbps (2 pair)	100BaseT Ethernet
	1000 Mbps (4 pair)	Gigabit Ethernet
5e	1,000 Mbps	Gigabit Ethernet
6	10,000 Mbps	Gigabit Ethernet

Unshielded Twisted Pair Connector
The standard connector for unshielded twisted pair cabling is an RJ-45 connector. This is a plastic connector that looks like a large telephone-style connector. A slot allows the RJ-45 to be inserted only one way. RJ stands for Registered Jack, implying that the connector follows a standard borrowed from the telephone industry. This standard designates which wire goes with each pin inside the connector.

RJ-45 connector

Shielded Twisted Pair (STP) Cable

Although UTP cable is the least expensive cable, it may be susceptible to radio and electrical frequency interference (it should not be too close to electric motors, fluorescent lights, etc.). If you must place cable in environments with lots of potential interference, or if you must place cable in

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extremely sensitive environments that may be susceptible to the electrical current in the UTP, shielded twisted pair may be the solution. Shielded cables can also help to extend the maximum distance of the cables.

Shielded twisted pair cable is available in three different configurations:

   Each pair of wires is individually shielded with foil.

   There is a foil or braid shield inside the jacket covering all wires (as a group).

   There is a shield around each individual pair, as well as around the entire group of wires (referred to as double shield twisted pair).

Coaxial Cable

Coaxial cabling has a single copper conductor at its center. A plastic layer provides insulation between the center conductor and a braided metal shield. The metal shield helps to block any outside interference from fluorescent lights, motors, and other computers.
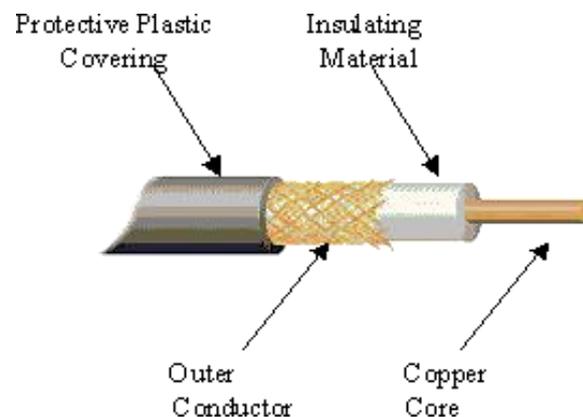
Coaxial cable

Although coaxial cabling is difficult to install, it is highly resistant to signal interference. In addition, it can support greater cable lengths between network devices than twisted pair cable. The two types of coaxial cabling are thick coaxial and thin coaxial.

Thin coaxial cable is also referred to as thinnet. 10Base2 refers to the specifications for thin coaxial cable carrying Ethernet signals. The 2 refers to the approximate maximum segment length being 200 meters. In actual fact the maximum segment length is 185 meters. Thin coaxial cable has been popular in school networks, especially linear bus networks.

Thick coaxial cable is also referred to as thicknet. 10Base5 refers to the specifications for thick coaxial cable carrying Ethernet signals. The 5 refers to the maximum segment length being 500 meters. Thick coaxial cable has an extra protective plastic cover that helps keep moisture away from the center conductor. This makes thick coaxial a great choice when running longer lengths in a linear bus network. One disadvantage of thick coaxial is that it does not bend easily and is difficult to install.

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Coaxial Cable Connectors

The most common type of connector used with coaxial cables is the Bayone-Neill-Concelman (BNC) connector (See fig. 4). Different types of adapters are available for BNC connectors, including a T-connector, barrel connector, and terminator. Connectors on the cable are the weakest points in any network. To help avoid problems with your network, always use the BNC connectors that crimp, rather screw, onto the cable.

BNC connector

Fiber Optic Cable

Fiber optic cabling consists of a center glass core surrounded by several layers of protective materials. It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of electrical interference. It has also made it the standard for connecting networks between buildings, due to its immunity to the effects of moisture and lighting.

Fiber optic cable has the ability to transmit signals over much longer distances than coaxial and twisted pair. It also has the capability to carry information at vastly greater speeds. This capacity broadens communication possibilities to include services such as video conferencing and interactive services. The cost of fiber optic cabling is comparable to copper cabling; however, it is more difficult to install and modify. 10BaseF refers to the specifications for fiber optic cable carrying Ethernet signals.

The center core of fiber cables is made from glass or plastic fibers (see fig 5). A plastic coating then cushions the fiber center, and kevlar fibers help to strengthen the cables and prevent breakage. The outer insulating jacket made of teflon or PVC.

Fiber optic cable

Computer Hardware and Network Troubleshooting
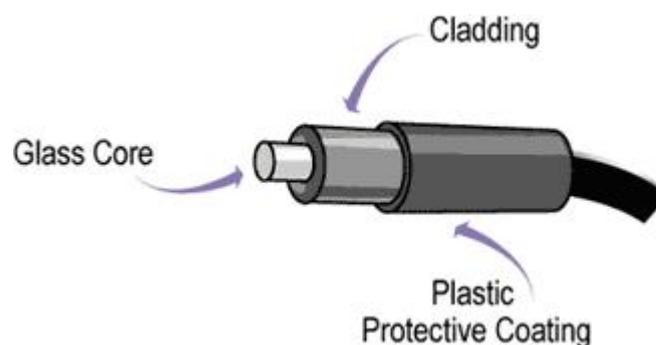
There are two common types of fiber cables -- single mode and multimode. Multimode cable has a larger diameter; however, both cables provide high bandwidth at high speeds. Single mode can provide more distance, but it is more expensive.

Specification	Cable Type
10BaseT	Unshielded Twisted Pair
10Base2	Thin Coaxial
10Base5	Thick Coaxial
100BaseT	Unshielded Twisted Pair
100BaseFX	Fiber Optic
100BaseBX	Single mode Fiber
100BaseSX	Multimode Fiber
1000BaseT	Unshielded Twisted Pair
1000BaseFX	Fiber Optic
1000BaseBX	Single mode Fiber
1000BaseSX	Multimode Fiber

16. How to troubleshoot network problems?

Because of the variety of network hardware, network configurations, operating systems, and setups, not all of the below information may apply to your network or operating system.

Adapter resources

Verify that the network adapter is properly installed and detected by the computer with no conflicts. In Microsoft Windows, open the Device Manager and verify there are no errors. "Network adapters" should be present for each network adapter installed in the computer, similar to the example on the right.

If conflicts exist or the network adapter is being detected as an "Other device", the network card has likely not been properly installed in the computer. Try letting Windows re-detect and install the network card by removing the network adapter and any other conflict devices from Device Manager and then rebooting the computer. If Windows re-detects the card but does not find the drivers, download the latest network card drivers from the computer manufacturer's website or the network card manufacturer's website.

Verify connections

Wired Network

If this is a wired network, verify that the network cable is properly connected and make sure the LEDs next to the network jack are properly illuminated. For example, a network card with a **solid** green LED or light usually indicates that the card is either connected or receiving a signal. If the green light is flashing, this is an indication of data being sent or received. The picture to the right is an example of a LAN port with two LED indicators next to the RJ-45 port. With this port, one LED will light up if connected properly and the other will flash when transmitting data.

http://www.computerhope.com

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If there are no lights or the lights are orange or red, the card may be bad, not connected properly, or may not be receiving a signal from the network. If you are on a small or local network and have the capability of checking a hub, switch, or router, verify that the cables are properly connected and that it has power. If after checking the connections, the LED indicators appear bad, the network adapter, port, or cable may be defective.

Wireless Network

If you're using a laptop with a wireless network, look for the laptop's Wi-Fi button and make sure it is turned on. Many laptops have a Wi-Fi button that allows the wireless network to be turned on and off. The Wi-Fi button is often located just above the keyboard or on the front edge of the laptop, but it also may be integrated with a F key as well. The pictures to the right are examples of a Wi-Fi button and Wi-Fi indicator on a F key that are enabled.

Laptop Wi-Fi button

Laptop Wi-Fi Function key

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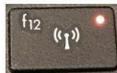
If the button is turned on, make sure you're using the correct Wi-Fi hotspot by right-clicking on the Network icon in the Windows Notification Area and clicking "Connect to a network". Usually, the network with the strongest connection (the most bars) will be your wireless router.

Finally, when connecting to most wireless networks, you need to enter the proper SSID password to connect to the network. If the incorrect password has been entered, you will not be able to access the network.

Adapter functionality

Verify that the network card is capable of pinging itself by using the ping command. Windows users can ping the computer from a Windows command line. Unix and Linux users can ping from the shell. To ping the card or the localhost, type either of the following commands:

    ping 127.0.0.1
            or
    ping localhost

Executing either of the above commands should get replies from the network card. If you receive an error, or the transmission fails, the network card is not physically installed into the computer correctly, has the incorrect or outdated drivers installed, or is defective.

Make sure the network card is physically installed in the computer correctly by removing it and re-inserting it again. Check the network card manufacturer's website for the latest drivers and install those drivers. If the network card is defective, it needs to be replaced.

Connect to the router

If all of the above steps have been checked, and your network has a router, make sure the computer can connect to the router by performing the below commands.

> **Determine the routers address**

Using the ipconfig command (or ifconfig command for Linux), determine the router's address by looking at the Gateway address. Below are the steps for Microsoft Windows users. Linux users can substitute ipconfig for ifconfig.

1. Open the Windows command line.

2. At the command prompt, type **ipconfig** and press Enter. You should see output similar to the example below.

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . :

IP   Address.   .   .   .   .   :   192.168.1.103
Subnet   Mask   .   .   .   .   :   255.255.255.0

Default Gateway . . . . : 192.168.1.1

The Default Gateway is the address of your router. Most home routers have a gateway address that starts with 192.168, like the address shown above. Assuming your gateway address is 192.168.1.1, attempt to ping the router to see if it can send and receive information by running the below command.

ping 192.168.1.1

If you get replies back from the router, the connection between your router and computer are good, and you can skip to the next step.

If you do not receive any replies back from the router, either the router is not set up properly, or your connection between the router and the computer is not correct. Reset your router to make sure it is not a problem with your router by following the steps below.

1. Turn off the power to the computer and leave it off.
2. Unplug the power to your router and cable modem or DSL modem.
3. Leave the power cables disconnected for 10-15 seconds and then plug in your modem and then your router again.
4. Finally, turn on your computer again and repeat this step to see if you can ping your router.

If you have a wireless network and followed the above steps, but cannot ping the router, turn the computer off again and connect the computer to the router using a network cable instead of wirelessly. If a wire also does not work, contact the manufacturer of the router for additional support or replacement.

Firewall

If your computer network utilizes a firewall, make sure all required ports are open, especially port 80, which is the HTTP port. If possible, disable the firewall software or disconnect the computer from the firewall to make sure it is not causing the network problems.

The Internet is not working

If you're able to ping the router, but are still unable to connect to the Internet, either your router is improperly configured, or the ISP is having issues.

Note: Some ISPs, such as Comcast, require special software to be installed. Make sure any software included with your Modem or other hardware has been installed on at least one computer if you are setting up a new Internet connection.

If your Internet has been working but recently stopped working, give it a few minutes to make sure it is not a temporary outage. If after waiting a few minutes, you still have problems, and you have not already disconnected the power to your router and modem, follow the steps below.

1. Turn off the power to the computer and leave it off.
2. Unplug the power cable to your router and cable modem or DSL modem.
3. Leave the power cables disconnected for 10-15 seconds, plug in your modem again, and then plug in your router again.
4. Finally, turn on your computer and see if you can ping your router.

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If after following the above steps, the Internet is still not working, open the Windows command line and run the below command.

ping google.com

Running the above command should get a reply from Google. If you get a reply, this is an indication that the Internet is working, but you may be encountering a problem with the Internet browser you are using to browse the Internet. Try an alternative browser, such as Firefox or Chrome.

If you're getting no reply from Google, your router or modem is not reaching the Internet. If you have a router, make sure your router has DHCP enabled and that the WAN or Gateway address is the proper ISP address.

Finally, if trying the above steps has not helped, contact your ISP to make sure there is no problem on their end and to assist you further with any special configurations.

Additional troubleshooting

Another method of determining network issues is to use the tracert command if you are a Windows user or the traceroute command if you are a Linux or Unix variant user. This command gives you an overview of each of the devices (routers) a packet travels (hops) over a network and can give you an idea of where a problem exists in your network or outside of your network.

To use this command, you must be at the command line and type one of the below commands depending on your operating system.

tracert google.com

or

traceroute google.com

If successful, you should begin to see each hop between the computer and network devices. When the connection fails, determine what device is causing the issue by reviewing the traceroute listing.

17. List and explain the various test performed by POST sequence? (APR 2011), (NOV 2012)

When the computer's power is first turned on, the CPU initializes itself, which is triggered by a series of clock ticks generated by the system clock. Part of the CPU's initialization is to look to the system's ROM BIOS for its first instruction in the startup program. The ROM BIOS stores the first instruction, which is the instruction to run the power-on self test (POST), in a predetermined memory address.

POST (Power-On Self-Test) is the diagnostic testing sequence that a computer's basic input/output system (or "starting program") runs to determine if the computer keyboard, random access memory, disk drives, and other hardware are working correctly.

If the necessary hardware is detected and found to be operating properly, the computer begins to boot. If the hardware is not detected or is found not to be operating properly, the BIOS issues an error message which may be text on the display screen and/or a series of coded beeps, depending on the nature of the problem. Since POST runs before the computer's video card is activated, it may not be possible to progress to the display screen. The pattern of beeps may be a variable numbers of short beeps or a mixture of long and short beeps, depending on what type of BIOS is installed.

The patterns of beeps contain messages about the nature of the problem detected. For example, if the keyboard is not detected, a particular pattern of beeps will inform you of that fact. An error found in the POST is usually fatal (that is, it causes current program to stop running) and will halt the boot process, since the hardware checked is absolutely essential for the computer's functions.

Once the POST has determined that all components are functioning properly and the CPU has successfully initialized, the BIOS looks for an OS to load.

18.   Explain about BIOS Services.

BIOS:

ROM-BIOS is a set of programs built into the computer that perform the most basic, low level and intimate control and supervision operations for the computer. The basic purpose of the ROM-BIOS is to take care of the immediate needs of the computer's hardware and to isolate all other programs from the details of how the hardware works. BIOS is partly software and partly hardware. It is a bridge between the computer hardware and other software.

BIOS Services

ROM-BIOS is divided into three functional parts:

1. Startup routines

2. Service handling and

3. Hardware interrupt handling
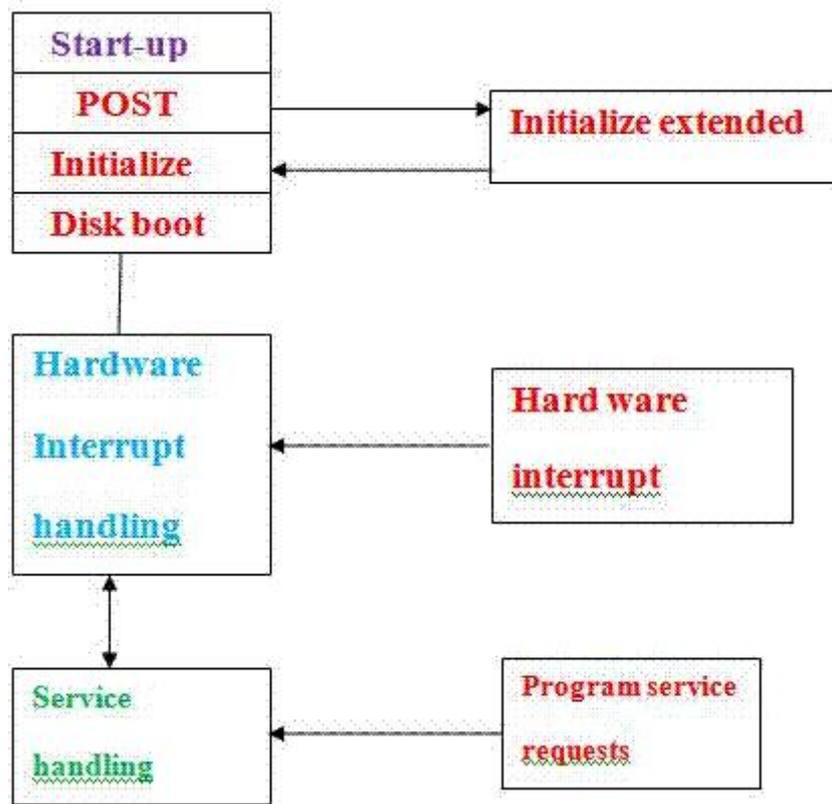
Startup routines:

The start-up-routines get the computer going when power is turned on. The main parts of start-up-routines are POST and initialization. POST (Power On Self Test) routines test that the computer is in good working order. The initialization involves routines like creating the interrupt vectors so that when interrupts occur, the computer switches to the proper interrupt-handling routine. Many of the parts of the computer need to have registers set, parameters loaded and other things done to get them in their ready-to-go condition. All these are handled by the initialization routine.

The last part of the start-up-routine. The boot-strap process involves the ROM-BIOS attempting to read a boot record from the beginning of a disk. The BIOS first tries drive A and if that doesn't succeed it tries to read a boot record from the hard disk if the computer has a hard disk, and then hands over the control of the computer to the short program on the boot record. The boot program begins the process of loading DOS into the computer.

Service handling:

The service handling routines are there to perform work for the programs. The programs may seek service request to clear the display screen, or to switch the screen from text mode to graphics mode or to read information from the disk or write information onto the printer. To carry out the service requests the ROM-BIOS has to work directly with the computer's I/O devices.

Hardware interrupt handling:

The hardware interrupt handling part takes care of the independent needs of the PC hardware. It operates separately, but in co-operation with the service handling portion. When a key is pressed on the keyboard, the keyboard raises an interrupt. The hardware interrupt routines service the interrupt and keep ready the character pressed. When out programs send a request to display the character, the service routine passes the request to the hardware interrupt handling routine. The character is then displayed. ROM BIOS services are organized in groups with each group having its own dedicated interrupt.

19. What are the service routines provided by BIOS to handle mouse and printers? Explain. (NOV 2014)

BIOS interrupt calls are a facility that operating systems and application programs use to invoke the facilities of the Basic Input/Output System on IBM PC compatible computers. Traditionally, BIOS calls are mainly used by MS-DOS programs and some other software such as boot loaders. BIOS only runs in the real address mode (Real Mode) of the x86 CPU, so programs that call BIOS either must also run in real mode or must switch from protected mode to real mode before calling BIOS and then switch back again. For this reason, modern operating systems that use the CPU in Protected Mode generally do not use the BIOS to support system functions, although some of them use the BIOS to probe and initialize hardware resources during their early stages of booting.

In all computers, software instructions control the physical hardware (screen, disk, keyboard, etc.) from the moment the power is switched on. In a PC, the BIOS, preloaded in ROM on the mainboard, takes control immediately after the processor is reset, including during power-up or when a hardware reset button is pressed. The BIOS initializes the hardware, finds, loads and runs the boot program (usually, but not necessarily, an OS loader), and provides basic hardware control to the operating system running on the machine, which is usually an operating system but may be a directly booting single software application.

Many modern operating systems (such as newer versions of Windows and Linux) bypass the built-in BIOS interrupt communication system altogether, preferring to use their own software to control the attached hardware directly. The original reason for this was primarily that these operating systems run the processor in protected mode, whereas calling BIOS requires switching to real mode and back again, and switching to real mode is slow. However, there are also serious security reasons not to switch to real mode, and the BIOS code has limitations both in functionality and speed that motivate operating system designers to find a replacement for it. In fact, the speed limitations of the BIOS

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made it common even in the MS-DOS era for programs to circumvent it in order to avoid its performance limitations, especially for video graphics display and fast serial communication. The problems with BIOS functionality include limitations in the range of functions defined, inconsistency in the subsets of those functions supported on different computers, and variations in the quality of BIOSes (i.e. some BIOSes are complete and reliable, others are abridged and buggy). By taking matters into their own hands and avoiding reliance on BIOS, operating system developers can eliminate some of the risks and complications they face in writing and supporting system software. On the other hand, by doing so those developers become responsible for providing "bare-metal" driver software for every different system or peripheral device they intend for their operating system to work with (or for inducing the hardware producers to provide those drivers). Thus it should be apparent that compact operating systems developed on small budgets would tend to use BIOS heavily, while large operating systems built by huge groups of software engineers with large budgets would more often opt to write their own drivers instead of using BIOS—that is, even without considering the compatibility problems of BIOS and protected mode.

For IBM's part, they provided all the information needed to use their BIOS fully or to directly utilize the hardware and avoid BIOS completely, when programming the early IBM PC models (prior to the PS/2). From the beginning, programmers had the choice of using BIOS or not, on a per-hardware-peripheral basis. Today, the BIOS in a new PC still supports most, if not all, of the BIOS interrupt function calls defined by IBM for the IBM AT (introduced in 1984), along with many more newer ones, plus extensions to some of the originals (e.g. expanded parameter ranges). This, combined with a similar degree of hardware compatibility, means that most programs written for an IBM AT can still run correctly on a new PC today, assuming that the faster speed of execution is acceptable (which it typically is for all but games that use CPU-based timing). Despite the considerable limitations of the services accessed through the BIOS interrupts, they have proven extremely useful and durable to technological change.

Purpose of BIOS calls

BIOS interrupt calls perform hardware control or I/O functions requested by a program, return system information to the program, or do both. A key element of the purpose of BIOS calls is abstraction—the BIOS calls perform generally defined functions, and the specific details of how those functions are executed on the particular hardware of the system are encapsulated in the BIOS and hidden from the program. So, for example, a program that wants to read from a hard disk does not need to know whether the hard disk is an ATA, SCSI, or SATA drive (or in earlier days, an ESDI drive, or an MFM or RLL drive with perhaps a Seagate ST-506 controller, perhaps one of the several Western Digital controller types, or with a different proprietary controller of another brand). The program only needs to identify the number of the drive it wishes to access and the address of the sector it needs to read or write, and the BIOS will take care of translating this general request into the specific sequence of elementary operations required to complete the task through the particular disk controller hardware that is connected to that drive. The program is freed from needing to know how to control at a low level every type of hard disk (or display adapter, or port interface, or real-time clock peripheral) that it may need to access. This both makes programming operating systems and applications easier and makes the programs smaller, reducing the duplication of program code, as the functionality that is included in the BIOS does not need to be included in every program that needs it; relatively short calls to the BIOS are included there instead. (In operating systems where the BIOS is not used, service calls provided by the operating system itself generally fulfill the same function and purpose.)

The BIOS also frees computer hardware designers (to the extent that programs are written to use the BIOS exclusively) from being constrained to maintain exact hardware compatibility with old systems when designing new systems, in order to maintain compatibility with existing software. For example, the keyboard hardware on the IBM PCjr works very differently than the keyboard hardware on earlier IBM PC models, but to programs that use the keyboard only through the BIOS, this difference is nearly invisible. (As a good example of the other side of this issue, a significant share of the PC programs in use at the time the PCjr was introduced did not use the keyboard through BIOS

exclusively, so IBM also included hardware features in the PCjr to emulate the way the original IBM PC and IBM PC XT keyboard hardware works. The hardware emulation is not exact, so not all programs that try to use the keyboard hardware directly will work correctly on the PCjr, but all programs that use only the BIOS keyboard services will.)

In addition to giving access to hardware facilities, BIOS provides added facilities that are implemented in the BIOS software. For example, the BIOS maintains separate cursor positions for up to eight text display pages and provides for TTY-like output with automatic line wrap and interpretation of basic control characters such as carriage return and line feed, whereas the CGA-compatible text display hardware has only one global cursor and cannot automatically advance the cursor or interpret control characters.

Keyboard

Interrupt vector Description	Interrupt vector Description
17h	Printer services

AH	Description
00h	Print Character to Printer
01h	Initialize Printer
02h	Check Printer Status

Cursor Control

- Each display of the current time by INT 21h, function 9, will advance the cursor
  - If a new time is displayed, it appears at a different screen position
  - So, to view the time updated at the same screen position we must restore the cursor to its original position before we display the time
  - This is achieved by first determining the current cursor position; then, after each print string operation, we move the cursor back
- We use INT 10h, functions 2 and 3, to save the original cursor position and to move the cursor to its original position after each print string operation

INT 10h, Function 2
Described in I/O module, repeated here for convenience

- **Move Cursor**
- Input:
  - AH = 2
  - DH = new cursor row (0-24)
  - DL = new cursor column (0-79 for 80x25 mode)
  - BH = page number
- Output: none

INT 10h, Function 3
Described in I/O module, repeated here for convenience

- **Get Cursor Position and Size**
- Input:
  - AH = 3
  - BH = page number
- Output:
  - DH = cursor row

- o DL = cursor column
- o CH = cursor starting scan line
- o CL = cursor ending scan line

20. **Write short notes on the following the network interfaces: i) Ethernet ii) Token Ring. (NOV 2010)**

Token ring interfaces

Cabling is generally IBM "Type-1" shielded twisted pair, with unique hermaphroditic connectors, commonly referred to as **IBM data connectors** in formal writing or colloquially as **Boy George connectors**. The connectors have the disadvantage of being quite bulky, requiring at least 3 x 3 cm panel space, and being relatively fragile. The advantages of the connectors being that they are genderless and have superior shielding over standard unshielded RJ45. Connectors at the computer were usually DE-9 female.

In later implementations of Token ring RJ45 connectors were used on both of the MAUs, CAUs and NICs; with many of the network cards supporting both RJ45 and DE-9 for backwards compatibility.

Ethernet networking interface

Ethernet networking interface refers to a circuit board or card installed in a personal computer or workstation, as a network client. A networking interface allows a computer or mobile device to connect to a local area network (LAN) using Ethernet as the transmission mechanism.

There are many Ethernet standards that an Ethernet networking interface must comply with with varying transmission speeds and error correction types/rates available. Ethernet is a standard for the transmission of binary data and although the hardware characteristics are defined, it is hardware independent so an Ethernet networking interface can use all manner of transmission hardware from fiber optic, to co-axial copper to wireless, depending on the capabilities of the hardware that the interface is sending to/receiving from and the network transfer rates required.

21. **Explain parallel and serial interface with block diagram? (NOV 2010)**

parallel interface

A parallel interface refers to a multiline channel, each line capable of transmitting several bits of data simultaneously. Most commonly, personal computers (PCs) have at least one parallel interface for connecting a printer using a parallel port. In contrast, a "serial interface" uses a serial port, a single line capable of only transmitting one bit of data at a time; a computer mouse connection is a good example.

Parallel Ports

A **parallel port** is a type of interface found on computers (personal and otherwise) for connecting various peripherals. In computing, a parallel port is a parallel communication physical interface. It is also known as a **printer port** or Centronics port. The IEEE 1284 standard defines the bi-directional version of the port, which allows the transmission and reception of data bits at the same time.

Compatibility Mode, also known as Centronics standard or **SPP**, is a uni-directional implementation with only a few differences from the original Centronics design. This mode is almost exclusively used for printers. The only signals that the printer can send back to the host are some fixed-meaning status lines that signal common error conditions, such as the printer running out of paper.

Enhanced Parallel Port (EPP) is a half-duplex bi-directional interface designed to allow devices like printers, scanners, or storage devices to transmit large amounts of data while quickly being able to switch channel direction. EPP can provide up to 2 MByte/s bandwidth, approximately 15 times the speed achieved with normal parallel-port communication with far less CPU overhead.[1]

Extended Capability Port (ECP) is a half-duplex bi-directional interface similar to EPP, except that PC implementations use direct memory access (usually ISA DMA on channel 3) to provide even faster data transfer than EPP by having the ISA DMA hardware and the parallel port interface hardware handle the work of transferring the data instead of letting the CPU do this work. Many devices that interface using this mode support RLE compression. ECP can provide up to 2.5 MByte/s of bandwidth, which is the natural limit of 8-bit ISA DMA.[2] An ECP interface on a PC can improve transfers to pre-IEEE-1284 printers as well, by reducing the CPU load during the transfer ; however, the transfer in that case is unidirectional.

Parallel Interface block diagram

Serial Port
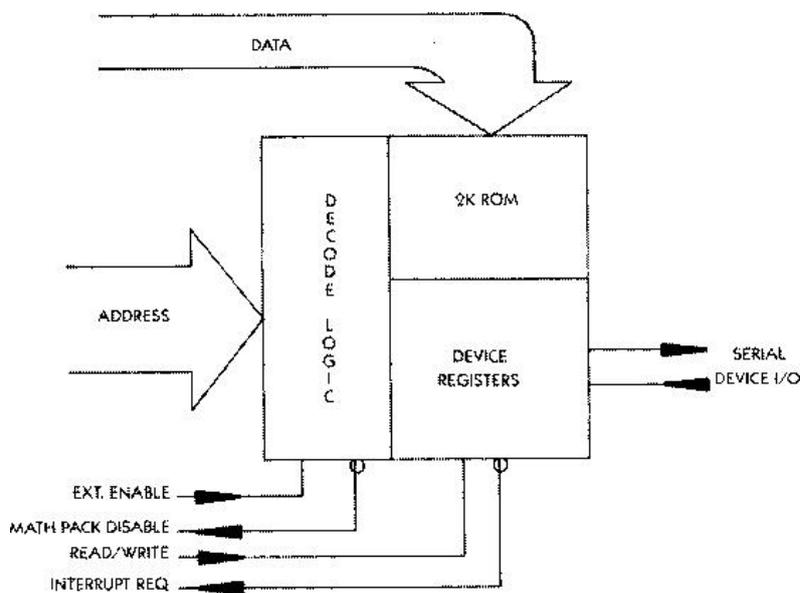
Figure 1.

Serial Interface Block Diagram

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In serial transmission, bits are sent **sequentially** on the same channel (wire) which reduces costs for wire but also slows the speed of transmission. Also, for serial transmission, some overhead time is needed since bits must be assembled and sent as a unit and then disassembled at the receiver.

Serial transmission can be either synchronous or **asynchronous** . In synchronous transmission, groups of bits are combined into frames and frames are sent continuously with or without data to be transmitted. In asynchronous transmission, groups of bits are sent as independent units with start/stop flags and no data link synchronization, to allow for arbitrary size gaps between frames. However, start/stop bits maintain physical bit level synchronization once detected.

22. Write short notes on: i) windows, ii) Unix, iii) Linux (NOV 2012)

i) Windows

Microsoft Windows is a metafamily of graphical operating developed, marketed, and sold by Microsoft. It consists of several families of operating systems, each of which cater to a certain sector of the computing industry. Active Windows families include Windows NT, Windows Embedded and Windows Phone; these may encompass subfamilies, e.g. Windows Embedded Compact(Windows CE) or Windows Server.Defunct Windows families includeWindows 9x and Windows Mobile.

Microsoft introduced an operating environment named *Windows* on November 20, 1985 as a graphical operating system shell for MS-DOSin response to the growing interest in graphical user interfaces (GUIs).Microsoft Windows came to dominate the world's personal computermarket with over 90% market share, overtaking Mac OS, which had been introduced in 1984. However, since 2012, it sells less thanAndroid, which became the most popular operating system in 2014, when counting all of the computing platforms Windows runs on (same as Android); in 2014, the number of Windows device sold were less than 25% of Android devices sold.As of April 2014, the most recent versions of Windows for personal computers, smart phones, server computers and embedded devices are respectively Windows 8.1, Windows Phone 8.1, Windows Server 2012 R2 and Windows Embedded 8. A specialized version of Windows runs on the Xbox One game console.

The next version of Windows is Windows 10 and is currently available as a technical preview; it is set for release for phones, tablets, laptops, and PCs on July 29, 2015. The next server version of Windows isWindows Server 2016, which is expected to be released in early 2016.

ii) Unix

Unix is a family of multitasking, multi user computer operating systems that derive from the original AT&T Unix, developed in the 1970s at the Bell Labs research center by Ken Thompson, Dennis Ritchie, and others.

Initially intended for use inside the Bell System, AT&T licensed Unix to outside parties from the late 1970s, leading to a variety of both academic and commercial variants of Unix from vendors such as the University of California, Berkeley (BSD), Microsoft (Xenix), IBM (AIX) and Sun Microsystems (Solaris). AT&T finally sold its rights in Unix to Novell in the early 1990s, which then sold its Unix business to the Santa Cruz Operation (SCO) in 1995,[4] but the UNIX trademark passed

to the industry standards consortium The Open Group, which allows the use of the mark for certified operating systems compliant with the Single UNIX Specification. Among these is Apple's OS X, which is the Unix version with the largest installed base as of 2014.

From the power user's or programmer's perspective, Unix systems are characterized by a modular design that is sometimes called the "Unix philosophy", meaning that the operating system provides a set of simple tools that each perform a limited, well-defined function, with a unified file system as the main means of communication and a shell scripting and command language to combine the tools to perform complex workflows. Aside from the modular design, Unix also distinguishes itself from its predecessors as the first portable operating system: almost the entire operating system is written in the C programming language that allowed Unix to reach numerous platforms.

Many clones of Unix have arisen over the years, of which Linux is the most popular, having overtaken the popularity of "true" Unix on server platforms since its inception in the early 1990s.

iii) Linux

Linux is a Unix-like and mostly POSIX-compliant computer operating system (OS) assembled under the model of free and open-source softwaredevelopment and distribution. The defining component of Linux is the Linux kernel an operating system kernel first released on 5October 1991 by Linus Torvalds The Free Software Foundation uses the name *GNU/Linux* to describe the operating system, which has led to some controversy.

Linux was originally developed as a free operating system for personal computers based on the Intel x86 architecture, but has since been ported to more computer hardware platforms than any other operating system.[13]Thanks to its dominance on smart phones, Android, which is built on top of the Linux kernel, has the largest installed base of all general-purpose operating systems. Linux, in its original form, is also the leading operating system on servers and other big iron systems such as mainframe computers and super computers, but is used on only around 1.5% of desktop computers. Linux also runs on embedded systems, which are devices whose operating system is typically built into the firmware and is highly tailored to the system; this includes mobile phones, tablet computers, networkrouters, facility automation controls, televisions, video game consolesand smart watches.

The development of Linux is one of the most prominent examples of free and open-source software collaboration. The underlying source code may be used, modified, and distributed— commercially or non-commercially—by anyone under licenses such as the GNU General Public License. Typically, Linux is packaged in a form known as a *Linux distribution*, for both desktop and server use. Some popular mainstream Linux distributions include Debian, Ubuntu,Linux Mint, Fedora, openSUSE, Arch Linux, and the commercial Red Hat Enterprise Linux and SUSE Linux Enterprise Server. Linux distributions include the Linux kernel, supporting utilities and libraries and usually a large amount of application software to fulfill the distribution's intended use.

Distributions oriented toward desktop use typically include X11, a Wayland implementation or Mir as the windowing system, and an accompanying desktop environment such as GNOME or the KDE Software Compilation. Some of such distributions may include a less resource intensive desktop such as LXDE orXfce, for use on older or less powerful computers. Distributions intended to run on servers may omit all graphical environments from the standard install, and instead include other software to set up and operate a solution stack such asL AMP. Because Linux is freely redistributable, anyone may create a distribution for any intended use.

23. **What is virus? List out the actions and its types. What are the precautions to be taken against virus? (NOV 2014)**

A **computer virus** is a malware program that, when executed, replicates by inserting copies of itself (possibly modified) into other computer programs, data files, or the boot sector of the hard drive; when this replication succeeds, the affected areas are then said to be "infected". Viruses often perform some type of harmful activity on infected hosts, such as stealing hard disk space or CPU time, accessing private information, corrupting data, displaying political or humorous messages on the user's screen, spamming their contacts, logging their keystrokes, or even rendering the computer useless. However, not all viruses carry a destructive payload or attempt to hide themselves—the defining characteristic of viruses is that they are self-replicating computer programs which install themselves without user consent.

Virus writers use social engineering and exploit detailed knowledge of security vulnerabilities to gain access to their hosts' computing resources. The vast majority of viruses target systems running Microsoft Windows, employing a variety of mechanisms to infect new hosts, and often using complex anti-detection/stealth strategies to evade antivirus software. Motives for creating viruses can include seeking profit, desire to send a political message, personal amusement, to demonstrate that a vulnerability exists in software, for sabotage and denial of service, or simply because they wish to explore artificial life and evolutionary algorithms.

Computer viruses currently cause billions of dollars' worth of economic damage each year, due to causing systems failure, wasting computer resources, corrupting data, increasing maintenance costs, etc. In response, source antivirus tools have been developed, and a multi-billion dollar industry of antivirus software vendors has cropped up, selling virus protection to users of various operating systems of which Windows is often the most victimized, partially due to its extreme popularity. No currently existing antivirus software is able to catch all computer viruses (especially new ones); computer security researchers are actively searching for new ways to enable antivirus solutions to more effectively detect emerging viruses, before they have already become widely distributed.

Types of Virus
Boot Sector Virus
The term ‒boot sector‖ is a generic name that applied generally to the boot information used by any operating system that is on your Hard Drive. In modern computers this is usually called the ‒master

boot record,‖ and it is the first sector on a partitioned storage device. Boot sector viruses became popular because of the use of floppy disks to boot a computer. The widespread usage of the Internet and the death of the floppy has made other means of virus transmission more effective. While not as popular as it once was it is still used.

Browser Hijacker

This type of virus, which can spread itself in numerous ways including voluntary download, effectively hijacks certain browser functions, usually in the form of re-directing the user automatically to particular sites. It's usually assumed that this tactic is designed to increase revenue from web advertisements. There are a lot of such viruses, and they usually have ‒search‖ included somewhere in their description. A program called ‒CoolWebSearch‖ may be the most well known example, but others are nearly as common.

Direct Action Virus

This type of virus, unlike most, only comes into action when the file containing the virus is executed. The payload is delivered and then the virus essentially becomes dormant – it takes no other action unless an infected file is executed again. Most viruses do not use the direct action method of reproduction simply because it is not prolific, but viruses of this type have done damage in the past. The Vienna virus, which briefly threatened computers in 1988, is one such example of a direct action virus.

File Infector Virus

Perhaps the most common type of virus, the file infector takes root in a host file and then begins its operation when the file is executed. The virus may completely overwrite the file that it infects, or may only replace parts of the file, or may not replace anything but instead re-write the file so that the virus is executed rather than the program the user intended. Although called a ‒file virus‖ the definition doesn't apply to all viruses in all files generally – for example, the macro virus below is not referred to by the file virus. Instead, the definition is usually meant to refer only to viruses which use an executable file format, such as .exe, as their host.

Macro Virus

A wide variety of programs, including productivity applications like Microsoft Excel, provide support for Macros – special actions programmed into the document using a specific macro programming language. Unfortunately, this makes it possible for a virus to be hidden inside a seemingly harmless document. Macro viruses very widely in terms of payload. The most well known macro virus is probably a Word document supposedly containing the passwords to various websites. The virus also exploited Word's link to Microsoft Outlook feature in order to automatically email copies of itself to others on your contact list.

Multipartite Virus

While some viruses are happy to spread via one method or deliver a single payload, Multipartite viruses want it all. A virus of this type may spread in multiple ways, and it may take different actions on an infected computer depending on variables, such as the operating system installed or the existence of certain files.

Polymorphic Virus

Another jack-of-all-trades, the Polymorphic virus actually mutates over time or after every execution, changing the code used to deliver its payload. Alternatively, or in addition, a Polymorphic virus may guard itself with an encryption algorithm that automatically alters itself when certain conditions are met.The goal of this trickery is evasion. Antivirus programs often find viruses by the specific code used. Obscuring or changing the code of a virus can help it avoid detection.

Resident Virus

This broad virus definition applies to any virus that inserts itself into a system's memory. It then may take any number of actions and run independently of the file that was originally infected. A resident

virus can be compared to a direct payload virus, which does not insert itself into the system's memory and therefore only takes action when an infected file is executed.

Web Scripting Virus

Many websites execute complex code in order to provide interesting content. Displaying online video in your browser, for example, requires the execution of a specific code language that provides both the video itself and the player interface. Of course, this code can sometimes be exploited, making it possible for a virus to infect a computer or take actions on a computer through a website. Although malicious sites are sometimes created with purposely infected code, many such cases of virus exist because of code inserted into a site without the webmaster's knowledge.

Antivirus software

Many users install antivirus software that can detect and eliminate known viruses when the computer attempts to download or run the executable (which may be distributed as an email attachment, or on USB flash drives, for example). Some antivirus software blocks known malicious web sites that attempt to install malware. Antivirus software does not change the underlying capability of hosts to transmit viruses. Users must update their software regularly to patch security vulnerabilities("holes"). Antivirus software also needs to be regularly updated in order to recognize the latest threats. The German AV-TEST Institute publishes evaluations of antivirus software for Windows and Android.

Examples of Microsoft Windows anti virus and anti-malware software include the optional Microsoft Security Essentials(for Windows XP, Vista and Windows 7) for real-time protection, the Windows Malicious Software Removal Tool (now included with Windows (Security) Updates on "Patch Tuesday", the second Tuesday of each month), and Windows Defender (an optional download in the case of Windows XP).[49] Additionally, several capable antivirus software programs are available for free download from the Internet (usually restricted to non-commercial use). Some such free programs are almost as good as commercial competitors. Common security vulnerabilities are assignedCVE IDs and listed in the US National Vulnerability Database. Secunia PSI is an example of software, free for personal use, that will check a PC for vulnerable out-of-date software, and attempt to update it. Ransomware and phishing scam alerts appear as press releases on the Internet Crime Complaint Center noticeboard.

Other commonly used preventative measures include timely operating system updates, software updates, careful Internet browsing, and installation of only trusted software.[53] Certain browsers flag sites that have been reported to Google and that have been confirmed as hosting malware by Google.

There are two common methods that an antivirus software application uses to detect viruses, as described in the antivirus software article. The first, and by far the most common method of virus detection is using a list of virus signature definitions. This works by examining the content of the computer's memory (its RAM, and boot sectors) and the files stored on fixed or removable drives (hard drives, floppy drives, or USB flash drives), and comparing those files against a database of known virus "signatures". Virus signatures are just strings of code that are used to identify individual viruses; for each virus, the antivirus designer tries to choose a unique signature string that will not be found in a legitimate program. Different antivirus programs use different "signatures" to identify viruses. The disadvantage of this detection method is that users are only protected from viruses that

are detected by signatures in their most recent virus definition update, and not protected from new viruses (see "zero-day attack").

A second method to find viruses is to use a heuristic algorithm based on common virus behaviors. This method has the ability to detect new viruses for which antivirus security firms have yet to define a "signature", but it also gives rise to morefalse positives than using signatures. False positives can be disruptive, especially in a commercial environment.

Recovery strategies and methods

One can also reduce the damage done by viruses by making regular backups of data (and the operating systems) on different media, that are either kept unconnected to the system (most of the time), read-only or not accessible for other reasons, such as using different file systems. This way, if data is lost through a virus, one can start again using the backup (which will hopefully be recent).

If a backup session on optical media like CD and DVD is closed, it becomes read-only and can no longer be affected by a virus (so long as a virus or infected file was not copied onto the CD/DVD). Likewise, an operating system on a bootable CD can be used to start the computer if the installed operating systems become unusable. Backups on removable media must be carefully inspected before restoration. The Gammima virus, for example, propagates via removable flash drives.

Virus removal

Many websites run by antivirus software companies provide free online virus scanning, with limited cleaning facilities (the purpose of the sites is to sell antivirus products). Some websites—like Google subsidiary VirusTotal.com—allow users to upload one or more suspicious files to be scanned and checked by one or more antivirus programs in one operation. Additionally, several capable antivirus software programs are available for free download from the Internet (usually restricted to non-commercial use). Microsoft offers an optional free antivirus utility called Microsoft Security Essentials, aWindows Malicious Software Removal Tool that is updated as part of the regular Windows update regime, and an older optional anti-malware (malware removal) tool Windows Defender that has been upgraded to an antivirus product in Windows 8.

Some viruses disable System Restore and other important Windows tools such as Task Manager and CMD. An example of a virus that does this is CiaDoor. Many such viruses can be removed by rebooting the computer, entering Windows safe modewith networking, and then using system tools or Microsoft Safety Scanner. System Restore on Windows Me, Windows XP,Windows Vista and Windows 7 can restore the registry and critical system files to a previous checkpoint. Often a virus will cause a system to hang, and a subsequent hard reboot will render a system restore point from the same day corrupt. Restore points from previous days should work provided the virus is not designed to corrupt the restore files and does not exist in previous restore points.

24. What is the use Multimeter? Explain.

A **multimeter** or a **multitester** is an electronicmeasuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter.

Analog multimeters are sometimes referred to as "volt-ohm-meters", abbreviated **VOM**. Digital multimeters are usually referred to as "digital-multi-meters", abbreviated **DMM**.

A multimeter can be a handheld device useful for basic fault finding and field service work or a bench instrument which can measure to seven or eight and a half digits of accuracy. Such an instrument will commonly be found in a calibration lab and can be used to characterise resistance and voltage standards or adjust and verify the performance of multi-function calibrators.

A Digital Multimeter

Current, voltage, and resistance measurements are considered standard features for multimeter. AVO multimeters, a manufacturer of early multimeters, derived their name from amperes, volts, and ohms, the units used for the measurement of current, voltage, and resistance.

A Low Cost Digital Multimeter

An Analog Multimeter

Newer equipment can measure many other quantities. Some common additional measured quantities and the units in which they are measured:

- Inductance in henrys.
- Capacitance in farads.
- Conductance in siemens.
- Temperature in degrees Celsius or Fahrenheit.
- Frequency in hertz.

- Duty cycle as a percentage.

A multimeter may be implemented with an analog meter deflected by an electromagnet, as a classic galvanometer; or with a digital display such as an LCD or Vacuum fluorescent display.

Analog multimeters are not hard to find in the used market, but are not very accurate because of errors introduced in zeroing and reading the analog meter face.

Analog meters may be implemented with vacuum tubes to precondition and amplify the input signal. Such meters are known as vacuum tube volt meters (VTVM) or vacuum tube multimeters (VTMM).

The resolution of a multimeter is often specified in "digits" of resolution. The term "digits" dates back to the 1970's when multimeter vendors were very proud of how many digits their products could display (this was important, because readout displays were costly). The vendors started to specify the maximum resolution of the multimeter based on the digital display. For example, the term 5½ digits refers to the number of digits displayed on the readout of a multimeter. A 5½ digit multimeter would have five full digits that display values from 0 to 9 and one half digit that could only display 0 or 1. This digital multimeter could show positive or negative values from 0 to 199,999. For a modern DMM, such as a PC-based multimeter, the term "digits" actual maps to the noise performance of the device.

Modern multimeters are exclusively digital, and identified by the term **DMM** or **digital multimeter**. In such an instrument, the signal under test is converted to a digital voltage and an amplifier with an electronically controlled gain preconditions the signal. Since the digital display directly indicates a quantity as a number, there is no risk of parallax causing an error when viewing a reading.

Similarly, better circuitry and electronics have improved meter accuracy. Older analog meters might have basic accuracies of five to ten percent. Modern portable DMMs may have accuracies as good as ±0.025%, and bench-top instruments have accuracies in the single-digit parts per million figures.

The inclusion of solid state electronics, from a control circuit to small embedded computers, has provided a wealth of convenience features in modern digital meters. Commonly available measurement enhancements include:

- Current-limited tests for voltage drop across semiconductor junctions. While not a replacement for a transistor tester, this facilitates testing diodes and a variety of transistor types.
- A graphic representation of the quantity under test, as a bar graph. This makes go/no-go testing easy.
- A continuity tester that beeps when a circuit conducts.
- A low-bandwidth oscilloscope.
- A telephone test set.
- Automotive circuit testers, including tests for automotive timing and dwell signals.

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- Simple data acquisition features to record maximum and minimum readings over a given period, or to take a number of samples at fixed intervals.

- Sample and hold, which will latch the most recent reading for examination after the instrument is removed from the circuit under test.

- Autoranging, which selects the correct range for the quantity under test without any risk of damaging the instrument.

Digital meters often feature circuitry or software to accurately measure AC voltages at any frequency. These meters integrate the input signal using the root mean square method, and will correctly read the true voltage of an input signal even if it isn't a perfect sine wave.

Modern meters may be interfaced with a personal computer by IrDA links, RS-232 connections, USB, or an instrument bus such as IEEE-488. The interface allows the computer to record measurements as they are made or for the instrument to upload a series of results to the computer.

As modern appliances and systems become more complicated, the multimeter is becoming less common in the technician's toolkit. More complicated and specialized equipment replaces it. Where a service man might have used an ohmmeter to measure resistance while testing an antenna, a modern technician may use a hand-held analyzer to test several parameters in order to determine the integrity of a network cable.

25. Describe the working principle of CRO with diagram? (NOV 2012), (NOV 2012)

An **oscilloscope** (sometimes abbreviated **CRO**, for cathode-ray oscilloscope, or commonly just **scope** or **O-scope**) is a piece of electronic test equipment that allows signal voltages to be viewed, usually as a two-dimensional graph of one or more electrical potential differences (vertical axis) plotted as a function of time or of some other voltage (horizontal axis).

Oscilloscope

Features and uses
Description

Exterior

A typical oscilloscope is usually box shaped with a display screen, numerous input connectors, control knobs and buttons on the front panel. To aid measurement, a grid called the *graticule* is drawn on the face of the screen. Each square in the graticule is known as a *division*.

Inputs

The signal to be measured is fed to one of the input connectors, which is usually a coaxial connector such as a BNC or N type. If the signal source has its own coaxial connector, then a simple coaxial cable is used; otherwise, a specialised cable called a 'scope probe', supplied with the oscilloscope, is used. General-purpose oscilloscopes have a standardised input resistance of 1 megohm in parallel with a capacitance of around 20 picofarads. This allows the use of standard oscilloscope probes. Scopes for use with very high frequencies may have 50-ohm inputs, which must be either connected directly to a 50-ohm signal source or used with Z_0 or active probes. It is used for measuring voltage.

The trace

In its simplest mode, the oscilloscope repeatedly draws a horizontal line called the *trace* across the middle of the screen from left to right. One of the controls, the *timebase control*, sets the speed at which the line is drawn, and is calibrated in seconds per division. If the input voltage departs from zero, the trace is deflected either upwards or downwards. Another control, the *vertical control*, sets the scale of the vertical deflection, and is calibrated in volts per division. The resulting trace is a graph of voltage against time (the present plotted at a varying position, the less recent past to the left, the most recent past to the right).

If the input signal is periodic, then a nearly stable trace can be obtained just by setting the timebase to match the frequency of the input signal. For example, if the input signal is a 50 Hzsine wave, then its period is 20 ms, so the timebase should be adjusted so that the time between successive horizontal sweeps is 20 ms. This mode is called *continual sweep*. Unfortunately, an oscilloscope's timebase is not perfectly accurate, and the frequency of the input signal is not perfectly stable, so the trace will drift across the screen making measurements difficult.

Trigger

To provide a more stable trace, modern oscilloscopes have a function called the *trigger*. When using *triggering*, the scope will pause each time the sweep reaches the extreme right side of the screen. The scope then waits for a specified event before drawing the next trace. The trigger event is usually the input waveform reaching some user-specified threshold voltage in the specified direction (going positive or going negative). The effect is to resynchronise the timebase to the input signal, preventing horizontal drift of the trace. In this way, triggering allows the display of periodic signals such as sine waves and square waves. Trigger circuits also allow the display of nonperiodic signals such as single pulses or pulses that don't recur at a fixed rate.

Types of trigger include:

- *external trigger*, a pulse from an external source connected to a dedicated input on the scope.
- *edge trigger*, an edge-detector that generates a pulse when the input signal crosses a specified threshold voltage in a specified direction.
- *video trigger*, a circuit that extracts synchronising pulses from video formats such as PAL and NTSC and triggers the timebase on every line, a specified line, every field, or every frame. This circuit is typically found in a waveform monitor device.
- *delayed trigger*, which waits a specified time after an edge trigger before starting the sweep. No trigger circuit acts instantaneously, so there is always a certain delay, but a trigger delay circuit extends this delay to a known and adjustable interval. In this way, the operator can examine a particular pulse in a long train of pulses.

X-Y mode

Other features

Some oscilloscopes have *cursors*, which are lines that can be moved about the screen to measure the time interval between two points, or the difference between two voltages. Oscilloscopes may have two or more input *channels*, allowing them to display more than one input signal on the screen. Usually the oscilloscope has a separate set of vertical controls for each channel, but only one triggering system and timebase.

Sometimes the event that the user wants to see may only happen occasionally. To catch these events, some oscilloscopes, known as "storage scopes", preserve the most recent sweep on the screen. This was originally achieved by using a special CRT, a "storage tube", which would retain the image of even a very brief event for a long time.

Some digital oscilloscopes can sweep at speeds as slow as once per hour, emulating a strip chart recorder. That is, the signal scrolls across the screen from right to left. Most oscilloscopes with this facility switch from a sweep to a strip-chart mode right around one sweep per ten seconds. This is because otherwise, the scope looks broken: it's collecting data, but the dot cannot be seen.

Oscilloscopes were originally analog devices. In more recent times digital signal sampling is more often used for all but the simplest models. Many oscilloscopes have different plug-in modules for different purposes, e.g., high-sensitivity amplifiers of relatively narrow bandwidth, differential amplifiers, amplifiers with 4 or more channels, sampling plugins for repetitive signals of very high frequency, and special-purpose plugins.

26. What is the use Logic Analyzer? Explain.

A **logic analyzer** displays signals in a digital circuit that are too fast to be observed by a human being and presents it to a user so that the user can more easily check correct operation of the digital system. Logic analyzers are typically used for capturing data in systems that have too many channels to be examined with an oscilloscope. Software running on the logic analyzer can convert the captured data into timing diagrams, protocol decodes, state machine traces, assembly, or correlate assembly with source-level software.

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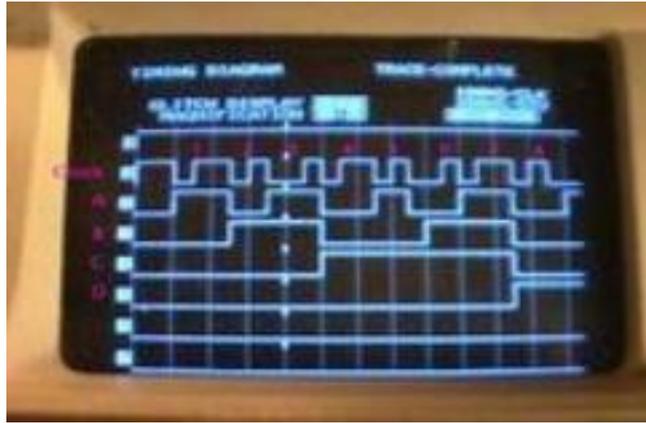
A HP 1615A Logic Analyzer (from 1980)showing a timing diagram.
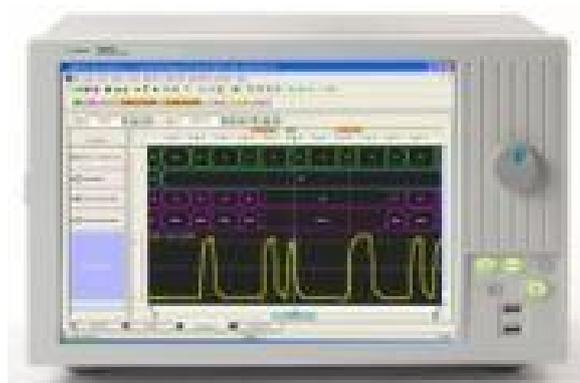
A Agilent 16801A Logic Analyzer (from 2006)showing a timing diagram with imported scope signals.

Current analyzers are either mainframes, which consist of a chassis containing the display, controls, control computer, and multiple slots into which the actual data capturing hardware is installed, or standalone units which integrate everything into a single package, with options installed at the factory. Recent mainframe models include the Agilent 16900 and Tek TLA7000, and recent standalone models include the Agilent 16800-series and Tek TLA5000.

Agilent and Tektronix make up over 95% of the industry's revenue.

Operation

A logic analyzer can trigger on a complicated sequence of digital events, and then capture a large amount of digital data from the system under test (SUT). The best logic analyzers behave like software debuggers by showing the flow of the computer program and decoding protocols to show messages and violations.

When logic analyzers first came into use, it was common to attach several hundred "clips" to a digital system. Later, specialized connectors came into use. The evolution of logic analyzer probes has led to a common footprint that multiple vendors support, which provides added freedom to end users. Since 2004, connectorless technology, known as Soft Touch, has become popular. These

probes provide a durable, reliable mechanical and electrical connection between the probe and the circuit board with less than 0.7 pF loading per signal.

Once the probes are connected, the user programs the analyzer with the names of each signal, and can group several signals into groups for easier manipulation. Next, a capture mode is chosen, either *timing* mode, where the input signals are sampled at regular intervals based on an internal or external clock source, or *state* mode, where one or more of the signals are defined as "clocks," and data is taken on the rising or falling edges of these clocks, optionally using other signals to qualify these clocks.

After the mode is chosen, a *trigger condition* must be set. A trigger condition can range from simple (such as triggering on a rising or falling edge of a single signal), to the very complex (such as configuring the analyzer to decode the higher levels of the TCP/IP stack and triggering on a certain HTTP packet).

At this point, the user sets the analyzer to "run" mode, either triggering once, or repeatedly triggering. Once the data is captured, it can be displayed several ways, from the simple (showing waveforms or state listings) to the complex (showing decoded Ethernet protocol traffic). The analyzer can also operate in a "compare" mode, where it compares each captured data set to a previously recorded data set, and stopping triggering when this data set is either matched or not. This is useful for long-term empirical testing. Recent analyzers can even be set to email a copy of the test data to the engineer on a successful trigger.

Uses

Many digital designs, including those of ICs, are simulated to detect defects before the unit is constructed. The simulation usually provides logic analysis displays. Often, complex discrete logic is verified by simulating inputs and testing outputs using boundary scan. Logic analyzers can uncover hardware defects that are not found in simulation. These problems are typically too difficult to model in simulation, or too time consuming to simulate and often cross multiple clock domains.

Field-programmable gate arrays have become a common measurement point for logic analyzers.

27. What is the use In-Circuit Emulator? Explain.

An **in-circuit emulator** (ICE) also called **on-circuit debugger** (OCD) or **background debug module** (BDM) is a hardware device used to debug the software of an embedded system. Embedded systems present special problems for a programmer, because they usually lack keyboards, screens, disk-drives and other helpful user interfaces and storage devices that are present on business computers.

In-circuit emulation can also refer to the use of hardware emulation, when the emulator is plugged into a system (not always embedded) in place of a yet-to-be-built chip (not always a processor). These in-circuit emulators provide a way to run the system with "live" data while still allowing relatively good debugging capabilities.

Function

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The basic idea of an "in-circuit emulator" is that it provides a window into the embedded system. The programmer uses the emulator to load programs into the embedded system, run them, step through them slowly, and see and change the data used by the system's software.

An "emulator" gets its name because it often "emulates" the central processing unit of the embedded system's computer. Often, it literally has a plug that plugs into the same socket as the CPU chip. Emulating the main computer lets it do anything that the main computer can do, but under the control of a programmer.

ICEs are always tools that attach a terminal or PC to the embedded system. The terminal or PC provides an interactive user interface for the programmer to investigate and control the embedded system.

Notably, when their program fails, most embedded systems simply become inert lumps of nonfunctioning electronics. Embedded systems often lack basic functions to detect signs of software failure, such as an MMU to catch memory access errors. Without an ICE, the development of embedded systems can be extremely difficult, because there is usually no way to tell what went wrong. With an ICE, the programmer can usually test pieces of code, then isolate the fault to a particular failing piece of code, and then inspect the failing code and rewrite it to solve the problem.

In usage, an ICE provides the programmer with execution breakpoints, memory display & monitoring, and input/output control. Beyond this, the ICE can be programmed to look for any range of matching criteria to pause at, hopefully catching the failure's origin.

Advantages

Virtually all embedded systems have a hardware element and a software element, which are separate but tightly interdependent. The ICE allows the software element to be run and tested on the actual hardware on which it is to run, but still allows programmer conveniences to help isolate faulty code, such as "source-level debugging" (which shows the program the way the programmer wrote it) and single-stepping (which lets the programmer run the program step-by-step to find errors).

Most ICEs consist of an adaptor unit that sits between the ICE host computer and the system to be tested. A header and cable assembly connects the adaptor to a socket where the actual CPU or microcontroller mounts within the embedded system. Recent ICEs enable a programmer to access the on-chip debug circuit that is integrated into the CPU via JTAG in order to debug the software of an embedded system.

The ICE emulates the CPU. From the system's point of view, it has a real processor fitted, but from the programmer's point of view the system under test is under full control, allowing the developer to load, debug and test code directly.

Most host systems are ordinary commercial computers unrelated to the CPU used for development - for example, a WindowsPC might be used to develop software for a system using a Freescale 68HC11 chip, which itself could not run Windows.

The programmer usually edits and compiles the embedded system's code on the host system, as well. The host system will have special compilers that produce executable code for the embedded system. These are called cross compilers or cross assemblers.

28. **Explain the diagnostic programs and troubleshooting tools in detail. (NOV 2010), (APR 2011)**

29. **Describe the tools available for troubleshooting. (NOV 2014)**

   Diagnostic Program

   A diagnostic program is a program written for the express purpose of locating problems with the software, hardware, or any combination there of in a system, or a network of systems. Preferably, diagnostic programs provide solutions to the user to solve issues.

   Diagnostics that are run on-demand when a user needs assistance, typically within the primary operating system of the computer (e.g.Windows)

   "Off-line diagnostics" that are run outside the primary operating system, typically to reduce the masking influence of software on hardware issues

   Background diagnostics that monitor the system for failures and marginal events, and provide statistical data for failure prediction, and root cause analysis of actual failure conditions

   Solutions-oriented diagnostics, that diagnose and resolve user-perceived issues with a computer system.

   Multimeter

   A multimeter can be a handheld device useful for basic fault finding and field service work or a bench instrument which can measure to seven or eight and a half digits of accuracy. Such an instrument will commonly be found in a calibration lab and can be used to characterise resistance and voltage standards or adjust and verify the performance of multi-function calibrators.

   Oscilloscope

   An **oscilloscope** (sometimes abbreviated **CRO**, for cathode-ray oscilloscope, or commonly just **scope** or **O-scope**) is a piece of electronic test equipment that allows signal voltages to be viewed, usually as a two-dimensional graph of one or more electrical potential differences (vertical axis) plotted as a function of time or of some other voltage (horizontal axis).

   Logic analyzer

   A **logic analyzer** displays signals in a digital circuit that are too fast to be observed by a human being and presents it to a user so that the user can more easily check correct operation of the digital system. Logic analyzers are typically used for capturing data in systems that have too many channels to be examined with an oscilloscope. Software running on the logic analyzer can convert the captured data into timing diagrams, protocol decodes, state machine traces, assembly, or correlate assembly with source-level software.

   In-Circuit Emulator (ICE)

An **in-circuit emulator** (ICE) also called **on-circuit debugger** (OCD) or **background debug module** (BDM) is a hardware device used to debug the software of an embedded system. Embedded systems present special problems for a programmer, because they usually lack keyboards, screens, disk-drives and other helpful user interfaces and storage devices that are present on business computers.

30. Explain the various problems associated with the mother board. (APR 2011), (APR 2012), (NOV 2012)

31. How to Trouble ShootPC problems? Justify.

Troubleshooting Motherboard

More than 70% of all computer problems are related to cabling and connections. Ensure all cables are connected and connected firmly. IDE and floppy ribbon cables and power cables can often go loose. Ensure microprocessor, memory modules, and adapters such as video card are inserted correctly and didn't "pop-up" due to vibration.

System has no power at all. Power light does not illuminate, fan inside the power supply does not turn on, and indicator light on keyboard does not turn on.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Power cable is unplugged.	Visually inspect power cable.	Make sure power cable is securely plugged in.
Defective power cable.	Visual inspection, try another cable.	Replace cable.
Power supply failure.	Power cable and wall socket are OK, but system is still dead.	Contact technical support
Faulty wall outlet;circuit breaker or fuse blown.	Plug device into socket know to work and test.	Use different socket, repair outlet, reset circuit breaker or replace fuse.

System inoperative. Keyboard lights are on, power indicator lights are lit, and hard drive is spinning.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Expansion card is partially dislodged from expansion slot on the motherboard.	Turn off computer. Take cover off system unit. Check all expansion cards to ensure they are securely seated in slots.	Using even pressure on both ends of the expansion card, press down firmly on expansion card.
Defective floppy disk drive or tape drive.	Turn system off. Disconnect the cables from one of the floppy drives. Turn on the system, check to see if the keyboard operates normally. Repeat until you have located defective unit.	Contact Technical Support.
Defective expansion card.	Turn computer off. Remove an expansion card.	Make sure expansion card is secure in expansion socket.

System does not boot from hard disk drive, can be booted from floppy disk drive.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Connector between hard drive and system board unplugged.	When attempting to run the FDISK utility described in the	Check cable running form disk to disk controller on the board.

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	HARD DISK section of the manual you get a message, INVALID DRIVE SPECIFICATION.	Make sure both ends are securely plugged in; check the drive type in the Standard CMOS Setup (in your motherboard manual).
Damaged Hard Disk or Disk Controller.	Format hard disk; if unable to do so, the hard disk may be defective.	Contact Technical Support.
Hard Disk directory or FAT is scrambled.	Run the FDISK program, format the hard drive(See HARD DRIVE section of manual). Copy your backup data back onto hard drive.	Backing up the hard drive is extremely important. All Hard Disks are capable of breaking down at any time.

System only boots from Floppy Disk. Hard Disk can be read and applications can be used, but booting from Hard Disk is impossible.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Hard Disk boot program has been destroyed.	A number of causes could be behind this.	Back up data and applications files. Reformat the Hard Drive as described in the Hard Drive section of the manual. Re-install applications and data using backup disks.

Error message reading "SECTOR NOT FOUND" or other error messages indication certain data is not allowed to be retrieved.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
A number of causes could be behind this.	Use a file by file backup instead of an image backup to backup the Hard Disk.	Back up any salvageable data. Then do a low level format, partition, and high level format of the hard drive(see Hard Disk section of your manual for instructions). Re-install all saved data when completed.

Disk formatted on IBM PS/2 will not operate with this system.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
The IBM PS/2 uses a different format than other computers.	IBM PS/2 disk format will not work in an AT type computer.	Format disk in the AT type computer insert disk into the IBM PS/2 and copy the files you wish.

After install an expansion card (network card, tape drive card, etc.) the system no longer works properly.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
No power to monitor.	All or part of the system may be inoperable. The new card may work but a mouse or COM port may not work.	Change the interrupt or RAM address on the new expansion card. See the documentation that came with the new card in order to change pin settings. many expansion devices come with proprietary software that will assist you in doing this.

Screen message says "Invalid Configuration" or "CMOS Failure."

PROBABLE CAUSE	DIAGNOSIS	SOLUTION

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Incorrect information entered into the configuration (setup) program.	Check the configuration program. Replace any incorrect information.	Review system's equipment. Make sure correct information is in setup.

Screen is blank.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
No power to monitor.	Power connectors may be loose or not plugged in.	Check the power connectors to monitor and to system. Make sure monitor is connected to display card, change I/O address on network card if applicable.
Monitor not connected to computer.		See instructions above.
Network card I/O address conflict.		See instructions above.

System does not boot from hard disk drive, can be booted from floppy disk drive.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Connector between hard drive and system board unplugged.	When attempting to run the FDISK utility described in the HARD DISK section of the manual you get a message, INVALID DRIVE SPECIFICATION.	Check cable running form disk to disk controller on the board. Make sure both ends are securely plugged in; check the drive type in the Standard CMOS Setup (in your

Problem

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Memory problem, display card jumpers not set correctly.		Reboot computer. Re-install memory, make sure that all memory modules are installed in correct sockets. Check jumper and switch settings on display card. See display card section for information of settings.
Computer virus.		Use anti-virus programs (McAfee/PC-cillin, E-port, etc) to detect and clean viruses.

Screen goes blank periodically.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Screen saver is enabled.		Disable screen saver.

Keyboard failure.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Keyboard is disconnected.		Reconnect keyboard. Check keys again, if no improvement, replace keyboard.

No color on screen.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Faulty Monitor.		If possible, connect monitor to another system. If no color, replace monitor.
CMOS incorrectly set up.		Call technical support.

Floppy drive lights stays on.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Floppy Drive cable not connected correctly.		Reconnect floppy cable making sure PIN1 on the Floppy Drive corresponds with PIN1 on floppy cable connector.

Error reading drive A:

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Bad floppy disk.		Try new floppy disk.
Floppy disk not formatted		Format floppy disk(type ENTER)

C: drive failure.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
SETUP program does not have correct information.		Boot from drive A: using DOS system disk. Input correct information to SETUP program.
Hard Drive cable not connected properly.		Check Hard drive cable.

Cannot boot system after installing second hard drive.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Master/Slave jumpers not set correctly.		Set master /Slave jumpers correctly.
Hard Drives not compatible / different manufacturers.		Run SETUP program and select correct drive types. Call drive manufactures for compatibility with other drives.

Missing operating system on hard drive.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
CMOS setup has been changed.		Run setup and select correct drive type.

Certain keys do not function.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Keys jammed or defective.		Replace keyboard.

Keyboard is locked, no keys function.

PROBABLE CAUSE	DIAGNOSIS	SOLUTION
Keyboard is locked.		Unlock keyboard

Pondicherry University Questions

Unit – V

1. What are the two types of computer for faults based on the frequency occurrence of the problem? **(NOV 2010)**

2. Categorize the type of trouble shooting tools? **(NOV 2010), (APR 2012), (NOV 2012)**

3. List some of the symptoms of computer faults? **(APR 2011)**

4. What are the four levels of troubleshooting approaches? **(APR 2011)**

5. What are the troubleshooting problems of CD-ROM drive? **(APR 2012)**

6. List out the different types of Hardware Interrupts? **(NOV 2012)**

7. Define Operating System? **(NOV 2012)**

8. What do you mean by spyware? **(NOV 2012)**

9. What are the major functions OS? **(NOV 2013)**

10. What is mean by network? **(NOV 2013)**

11. What is the use of logic probe? **(NOV 2014)**

12. What do you mean by Boot virus? **(NOV 2014)**

PART B

1. Compare Serial Port Vs. Parallel Port (Ref.Pg.No.5,Qn.No.1)

2. Explain briefly about USB. (Ref.Pg.No.5,Qn.No.2)

3. Explain about RS232C. (Ref.Pg.No.12,Qn.No.3)

4. Explain briefly about Parallel Port. (Ref.Pg.No.13,Qn.No.4)

5. Describe the structure, operating modes and features of enhanced capabilities port. (NOV 2014) (Ref.Pg.No.13,Qn.No.5)

6. Explain parallel and serial interface with block diagram? (NOV 2010) (Ref.Pg.No.13,Qn.No.6)

7. What are the required components to build LAN (Ref.Pg.No.14,Qn.No.7)

8. Explain briefly about Wired and Wireless Networks. (Ref.Pg.No.15,Qn.No.8)

9. What is Bluetooth? (Ref.Pg.No.17,Qn.No.9)

10. Explain the detail about network interface card (NIC) with neat diagram. **(APR 2012)** (Ref.Pg.No.17,Qn.No.10)

11. Explain briefly about network topology. (Ref.Pg.No.18,Qn.No.11)

12. What are the hardware requirements needs to form wireless Ethernet. (Ref.Pg.No.20,Qn.No.12)

13. What is access point and switch or Hub? (Ref.Pg.No.21,Qn.No.13)

14. Explain briefly about network Protocols. (Ref.Pg.No.22,Qn.No.14)

15. Discuss about various types of cables and connectors. **(NOV 2012)** (Ref.Pg.No.23,Qn.No.15)

16. How to troubleshoot network problems? (Ref.Pg.No.27,Qn.No.16)

17. List and explain the various test performed by POST sequence? **(APR 2011), (NOV 2012)** (Ref.Pg.No.30,Qn.No.17)

18. Explain about BIOS Services. (Ref.Pg.No.31,Qn.No.18)

19. What are the service routines provided by BIOS to handle mouse and printers? Explain. **(NOV 2014)** (Ref.Pg.No.32,Qn.No.19)

20. Write short notes on the following the network interfaces: i) Ethernet ii) Token Ring. **(NOV 2010)** (Ref.Pg.No.35,Qn.No.20)

21. Explain parallel and serial interface with block diagram? **(NOV 2010)** (Ref.Pg.No.35,Qn.No.21)

22. Write short notes on: i) windows, ii) Unix, iii) Linux **(NOV 2012)** (Ref.Pg.No.37,Qn.No.22)

23. What is virus? List out the actions and its types. What are the precautions to be taken against virus? **(NOV 2014)** (Ref.Pg.No.39,Qn.No.23)

24. What is the use Multimeter? Explain. (Ref.Pg.No.42,Qn.No.24)

25. Describe the working principle of CRO with diagram? **(NOV 2012), (NOV 2012)** (Ref.Pg.No.45,Qn.No.25)

26. What is the use Logic Analyzer? Explain. (Ref.Pg.No.47,Qn.No.26)

27. What is the use In-Circuit Emulator? Explain. (Ref.Pg.No.49,Qn.No.27)

28. Explain the diagnostic programs and troubleshooting tools in detail. **(NOV 2010), (APR 2011)** (Ref.Pg.No.51,Qn.No.28)

29. Describe the tools available for troubleshooting. **(NOV 2014)** (Ref.Pg.No.51,Qn.No.29)

30. Explain the various problems associated with the mother board. **(APR 2011), (APR 2012), (NOV 2012)** (Ref.Pg.No.52,Qn.No.30)

31. How to Trouble ShootPC problems? Justify. (Ref.Pg.No.52,Qn.No.31)