

Unit 8

Storage Devices

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8.1 Introduction

In unit 2 we discussed about Memory and its features which is used to store data in the computer. We got to know that memory is divided into primary memory as well as secondary memory. Both the memory devices require an engine which helps in working of the storage devices. During all the evolution of computers we depend on the storage devices for storing data and information. Earlier computers used floppy disc to store the data. With

the improvement in technology the type of devices got its transformation towards Compact disc and DVDs. Now blue-ray disc and flash memory are becoming famous. With every introduction of the different types of discs the drive structure also saw its prominent change.

Disk Drives are the machine that reads and writes the data into the respective disks. Disk drive makes the disk to rotate and has head which reads or writes the data onto the disk.

In this unit 8 you will study the different types of disk drives that are used to read and write data into the disk and identify the different features of all the drives. This unit presents you the essential principles of hard disk drives and file systems. We will discuss about the basics of CD-ROM technologies. Here we will throw light on DVD background and explain its typical working. We can learn about the new technologies in the disk drives like Blue-ray disk and flash memory. We will get to know some of the guidelines to install and troubleshoot these different kinds of disk drives.

Objectives:

After studying this unit you will be able to:

- Identify the different types of disk drives and its use
- Elaborate the working of hard disk drive and its features
- Explain the concepts of CD-ROM drive and its construction.
- Describe DVD drive
- Describe Blu-ray disk drive
- Elaborate Flash memory
- Resolve the problems of various types of disk drives through troubleshooting.

8.2 The Hard Drive

The hard drive is also known as hard disk drive or fixed disk drive. It is the main and largest storage device on the computer. It is referred usually in the computer by C: drive. This consists of all the important programs and applications of the computer. Hard Drive is a non-volatile memory, random access device for electronic data in the computer. Hard drives are very much similar to the video tapes. Therefore the data is stored on the long, thin tape which is coated with some magnetic material of its surface.

8.2.1 Construction

Hard drive consists of magnetic read/write heads that reads the data from the rotating discs.

It consists of the different part which serves the different function of the hard disc. Hard disc consists of one or more rough and solid substrate called as *Platters*. *Platters* are made out of aluminium as it is a light material. They are circular in shape and magnetic substances are coated to both the sides of the platters for read/write the data. A two or more magnetic heads are connected to the platter in order to read/write the data into the disc. Platters move on the common axis and heads are allowed to move on the radius on the platter. Therefore it allows the heads to read all parts of the surface.

The information of each division of the platter is formed to represent a specific location. This forms a design of set of concentric circles which is used to record the data. Each concentric circle on a platter is called as *atrack* and these tracks are further divided into *sections*. When the head of one surface on one track, the head of the corresponding other surface is also on the respective track. All the tracks are together called as *cylinder*. Sometimes track and cylinder are used interchangeably you can see a typical assembly of platter and its data organization in the figure 8.1.

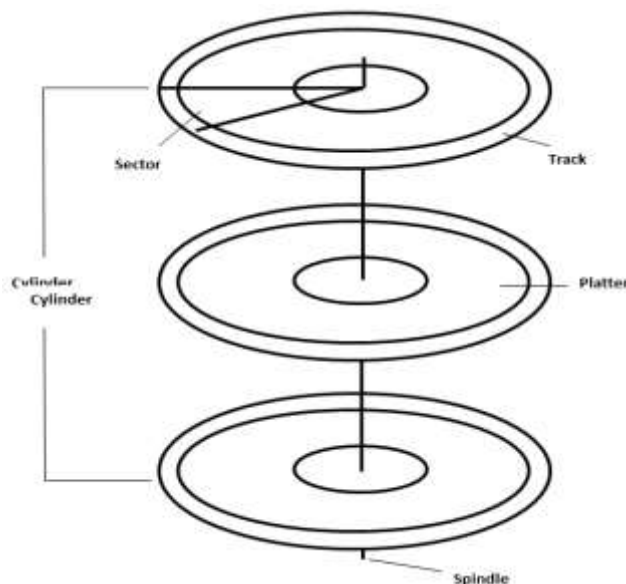


Figure 8.1: Data Organization on a hard disk drive

A platter contains thousands of tracks. Tracks are further divided into a smaller segment which is called as sector. Each sector holds a 512 byte of data which include error checking and housekeeping data that are used to identify sector, track and CRC (Cyclic Redundancy check) result. CRC is also called as polynomial code checksum is a function that is designed to detect the changes that occur to the computer data accidentally. The hard disk must be manufactured in high priority due to extreme smaller versions of the components. The main part of the hard disk is separated from the contact of external air so that no dust should enter the platter and avoid the damage caused to the read/write head.

- **Data Density Characteristics:** We should take care that all the information must be fact in the media of hard drive platter. We can get the maximum amount of capacity in terms of megabytes per square inch (MBSI) from areal density of the media. The following are the factors that affect the real density.
 1. The size of the magnetic particle is a barrier to areal density. Areal density is more if the coercivity (it is the magnetic field applied during magnetization of any Ferro magnetic material) of the hard drive is large and tighter magnetization field with smaller read/write head allow higher areal density.
 2. The altitude of a read/write head over the platter surface (which is also called as head height) affects density if the read/write head passes closer to the hard drive then areal densities will be more. If then read/write head passes away from the media then due to magnetic field areal densities will be reduced.
 3. Another major important limiting factor is surface smoothness because smoother surface allow read/write head to fly closer to the media.
- **Latency and Seek:** Latency is the time delay that exists between the moment that read/write command is initiated over the physical interface of the drive and the moment where the desired information is placed. Latency also refers to the time taken to pass the needed byte under a read/write head. If the read/write head has not quite reached the desired location there will be short latency. If the head has just missed the desired location then the head must wait for one full rotation. Therefore latency can be very long. Seek time is the time taken to step the

read/write head between another delay added by the track to the hard drive performance. There are number of ways in seek time listing they are track-to-tack seek, full stroke seek and average seek.

- **Track-to-track seek** is the time required to step between two adjacent tracks on the platter.
- **Full stroke** is the time required to step from inner most to the outer most tracks. This time is relatively longer. The average seek time is half the full stroke seek time.
- **Seek and latency** is together needed to load and save files. For example, while loading a file certain amount of seek time is taken to locate the track which contains starting of the file. There is some latency during the platter rotating around the necessary sector.

The major parts of the hard disk are the frame, platters, read/write heads, head actuators, spindle motor and electronics package.

- **Frame:** The frame is also called as chassis which is an important part of the hard drive. This affects the structural thermal and electrical integrity of the drive. In order to mount the other components on the hard drive the frame must be strong and provide steady platform. Therefore cast aluminum is used in larger drives for chassis and the smaller drive in the laptop computer uses a plastic chassis.
- **Read/Write Heads:** Read/write head form the interface between the electronic circuitry and magnetic media of the hard drive. While writing, electronic signals are translated into the magnetic flux transitions with the help of a head which saturate points on the media where the transition takes place. The read operation works almost reverse to this process. Here flux transitions induce electrical signals in the head that are amplified, filtered and translated into respective logic signals.
- **Head Actuators:** Hard drives use voice coil motors which are also called as rotary coil motors which are used to actuate head moment. Voice coil motors work with the principal of analog meter moments that is a permanent magnet is enclosed within two opposing coils. When there is a current flow in the coil, it produces a magnetic field which opposes the permanent magnet. In order to cause a deflection

which is directly proportional to the amount of driving current, a force of opposition is maintained by attaching the head arms to the rotating magnet. The greater opposition and deflection is obtained by increasing current signals. You can choose the cylinder by incrementing the servo signal and maintaining the signal in a desired level. Voice coil motors are very small and light assemblies that are well suited to fast access times and small hard drive assemblies. The process of track following is called serving the heads.

- **Spindle motors:** The speed at which the media passes under the read/write heads is one of the major factors that are responsible for drives performance. Media is passed under the read/write heads by spinning the platter at a high rate of speed.

The spindle motor is a brushless, low profile DC motor (Direct Current) which is responsible for spinning the platter. An index sensor provides a feedback pulse signals which detects the spindle as it rotates. Index signals is used by control electronics of the drive which is used to regulate spindle speed as precisely as possible.

- **Drive electronics:** hard drives are made up of sophisticated circuitry. The drive electronics board which is mounted below the chassis contains all the necessary circuitry to communicate data and control signals with the particular physical interface, the read/write heads and spinning the platter

8.2.2 IDE drive standards

Integrated Drive Electronics (IDE) is a standard electronic interface used between a computer bus and the mass storage devices in which the controller is integrated into the disk or CD-ROM drive. It is also called as intelligent drive electronics.

- **Binary Megabyte Vs Decimal Megabytes:** there is a huge confusion between the different meanings of megabytes. Since the computer uses electronic signals, the data will be converted in to 0's and 1's which we called it as binary digits. Therefore, all the data, addresses, programs and calculations will be in form of binary numbers. As the computer works in the form of binary numbers it is measured as the collections of bits i.e. 1 byte = 8 bits, and in the power of 2. Therefore,

1 Kilobyte = 2^{10} = 1024 bytes

1 Megabyte = 2^{20} = 1,048,576 bytes

1 Gigabyte = 2^{30} = 1,073,741,824 bytes

- **IDE/ATA:** ATA stands for advanced technology attachment. Typically IDE and ATA are same and are developed to interface the controller to the harddrive mechanism. This avoids relaying on standalone computer boards, reduces interface costs and makes the drive easier for firmware implementation. As IDE has been proved to be low cost and easily configured system, it created revolution in the disc drive industry. IDE/ATA is used synonymously sometimes. But in actual ATA is the standard that defines the drive and its operations whereas IDE is the trademark which refers to the 40-pin interface and drive controller technology which is designed to implement the ATA standard.

The original IDE/ATA standard defines the following features and transfer modes.

1. The two devices that are configured as master and slave shares a single channel that called by a specification.
2. It includes support for PIO modes 0, 1 and 2. PIO stands for programmed Input/output is a mode of transferring data between the two peripherals. The different modes are used to transfer data between the CPU and a peripheral such as a network adapter. Mode 0 takes the longer time in transferring the data and the transfer rate increases gradually with decrease in time taken by the modes.
3. It includes support for single word DMA modes 0, 1 and 2 and multi word DMA mode 0. With the introduction of this mode, PIO mode is not used.

It does not support for enhancements for non-hard disk IDE/ATA devices, block mode transfers or any other advanced features.

- **Data transfer modes:** There are two measures of data transfer. They are,
 1. *The internal data transfer:* The rate at which data is taken from the platters.
 2. *The external data transfer:* The rate at which data is passed between the drive and the controller.

The modern standards of external data transfer are listed as PIO and DMA modes. The DMA data transfers mean that the data is transferred directly between the drive and the memory without using CPU as an intermediary whereas PIO data transfers uses CPU between the drive and the memory.

- **Drive Caching:** Hard disk contains an integrated cache which is also called as buffer. The purpose of the buffer is similar to other caches. It is not a part of PC cache hierarchy. Cache acts as a buffer between a fast device and a slow device. The results of the recent disk read or stored in cache and whenever it is requested it fetches the information.

Cache is used improve the performance of hard drives by reducing the number of physical access to the disk.

- **Troubleshooting:** The problem related to hard drives are very importantly resolved because if you lose some programs and data it is major lose for user but many drive problems are recoverable without replacing the drive.

You can follow the below guidelines for troubleshooting the problem in the hard drive.

- *Be careful for power and static discharge:* whenever you change the jumpers or unplug the cables and cards make sure that you have turn off the computer. Wear an antistatic wrist strap when you are working on your computer or handling drive.
- *Verify compatibly:* The drive controller and the drive must be verified so that they are matched to each other.
- *Check all cards:* You must ensure that all expansion cards are placed in their respective slots on the motherboard and securely mounted with screws.
- *Check all connectors and cables:* All the ribbons and power cables must be securely connected. The ribbon cables are prone to get damaged at the connectors. You need to try with a new cable which is good. You must ensure that no connector pins are bent. Pin one on the interface cable must be aligned with pin one on the drive and the controller.

- *Verify drive jumper settings:* You must ensure that you have installed all the necessary jumpers and removed the incorrect and duplicated jumper settings by reviewing the instructions in the manual.
- *Check your power supply capacity:* whenever you add a new device to your computer you must ensure that it gets sufficient power supply for that device.
- *Verify the drive settings in the CMOS setup:* The drive settings in the CMOS setup must not exceed the physical specification of the drive. It should also not exceed the limitation set by the operating system and the BIOS.
- *Check for viruses:* your system must be periodically scanned for viruses. Before using an unknown device in the computer for the first time scan it for viruses.

Self Assessment Questions

1. IDE standards for _____.
2. The two devices that are configured as master and slave share a single channel that called by a _____.
3. _____ is an adapter of the CD that is designed to store computer data in the form of text, graphics and stereo sound.

Activity 1:

How do you troubleshoot a hardware problem when you encounter an invalid command line error when using any kind of Nuts and Bolts.

Hint: Refer the concept of troubleshooting an hard drive from the book Troubleshooting, Maintaining and Repairing PC's by Stephen J. Bigelow

8.3 CD-ROM Drive

8.3.1 Basics of CD-ROM drive: CD-ROM (Compact Disc, read-only-memory) is an adaptation of the CD that is designed to store computer data in the form of text, graphics and stereo sound. The digital approach allowed excellent stereo sound quality which does not degrade the quality when the disk is played each time. CD-ROM drive is originated from digital audio recording. CD-ROM drive can

only read data and it cannot write. It is known for its low cost, good reliability and broad media compatibility.

- **CD Media:** CD's are produced by stamping the pattern of pits and lands onto a molded polycarbonate disc which is also known as substrate. The substrate is covered with a silvered coating which allows in reflecting the laser light. A tough scratch resistant is coated on a disc after silvering. Finished disc is labeled through silk screen (It is a printing technique in which artwork is converted onto films to create a fine mesh screens).
- **CD data:** CD's are recorded as single continuous spiral track running from the spindle area. Fig 8.4 shows an example of spiral pattern as it is recorded on the CD. The inside dots lines shows the relationship between the pits and lands. CD's use a highly focused laser beam and laser detector to sense a presence or absence of pits. When laser light strikes the land it reflects light towards the detector which produces a very strong output signal. When the laser light strikes a pit the light is slightly out of focus.
- **EFM Basics:** EFM stands for eight to fourteen modulations is a complex decoding process that convert sequence of pits and land into meaningful binary information. EFM is used by CD to obtain the ability of placing a large number of bits into a limited number of flux transitions, user data, error correcting information, address information and synchronization pattern are contained in the form of bits stream which is represented by pit and land. Flux transition is the bits encoded by magnetic media and it is not the discreet orientation of any magnetic area. The EFM encoding technique equates each byte (8 bits) with a fourteen bit sequence which is called a symbol. In this technique each binary one must be separated by atleast two binary zeros.
- **Data storage:** A CD-ROM contains twenty four synchronization bits, fourteen control bits, twenty four data symbols and eight complete error correction symbol (EC). You must always keep in mind that three merged additional bit separates each symbol by bringing the total number of bit in the frame to 588. Therefore 588 bit on the CD-ROM represent 24 bytes of data which can be expressed as a number of pit and land. There are ninety eight frames in a data block. Therefore each block carries 98x24 which is equal to 2048 bytes. The data delivered by

the basic CD-ROM to its host computer is equal to 153.6KB (75 blocks) of data per second.

As u know the CD-ROM disc is recorded as one continuous spiral track around the disk, the ordinary sector and track id information that we attach to the magnetic disc does not apply very well rather the information can be divided in terms of 0-59 minutes recorded initially at the beginning of each block. In normal production the CD-ROM run between 553 to 650 MB caring of compact disc. CD is reliable data storage medium for long term. The life of the CD is affected by its physical storage and handling. You can follow some of the following tips to protect and maintain the disc.

1. Avoid bending the disc
2. Never heat the disc
3. Avoid scratching the disc
4. Keep away chemicals from the disc

Excessive dust and finger print interfere with the laser beam can cause disc read error. When this happens it can be cleaned by a dry soft linen cloth. Do not wipe the circular motion with your hand fingers. Always store the disc in a cradle during storage or travel.

8.3.2 Construction

All the drives must be able to accept the standard size disc from variety of surfaces. Even then the drive must spin the disc at the constant linear velocity (CLV). CLV is a qualifier for the rated speed of an optical disc drive and the writing speed of recordable disc that means disc speed varies inversely with the tracking radius. Whenever the tracking comes almost near to the disc edge the disc speed slow down and vice versa. Typical working of the CD ROM can be shown with the help of a exploded diagram of CD drive as in the figure 8.2.

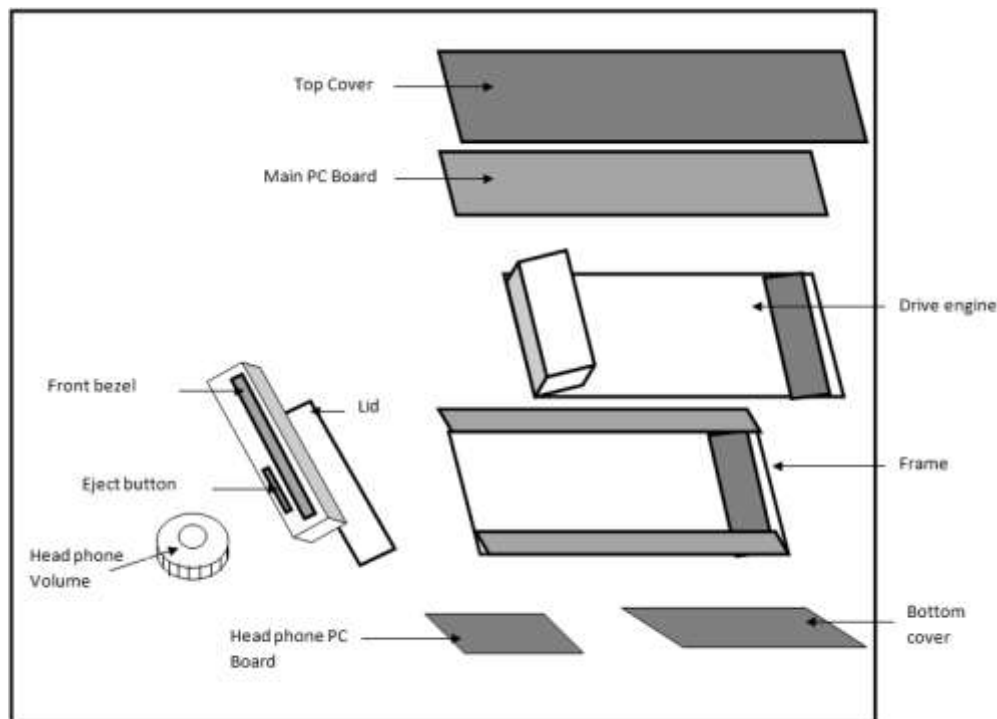


Figure 8.2: Exploded figure of a basic CD drive

- Working of CD-ROM:** CD-ROM is organized with cast aluminum or rigid stainless steel at the center of the drive. Similar to other drives, this drive also has a single primary structure for mounting the mechanical and electronic components of the drive. All together forms the frame of the hard disk. The frame is attached with the lid, front bezel; eject button and volume controller button in order to provide extreme and beautiful appearance for the drive. It offers fixed reference slot for CD insertion and removal. The electronic package of the disc drive is further divided into several PC board assemblies. They are, main PCB which handles drive control and interfacing and the head phone PCB, which provides the head phones with an audio amplifier and a jack. The actual physical of the drive is performed by the main CD sub assembly. If spindle motor performs the serious work of spinning and reading a disc, then sub frame is mounted with a spindle motor and connected to a spindle motor PC board. The drives main PC board manages the operations to position the sled motor.

- *CD-ROM electronics*: The electronics package can be further divided into two major areas; they are controller section and drive section. A controller section does the connection of the peripheral interface to the drive controller board. The drive section electronics manages the physical operation such as load or unload, spin the disc and move the sled etc. of the CD-ROM. It also does data decoding and error correction and the drive circuitry converts and analog output from the laser diodes into an EFM signal.
- *CD-ROM software*: A low level device driver allows programs to access the CD-ROM at the hardware level. If you change or upgrade the device the device drivers must also be upgraded.

8.3.3 Troubleshooting

CD-ROM installation is a very easy task. But the problems lie in the compatibility issues, poor media quality, outdated drivers, conflicting software applets, and operating system versions. In this section you will get to know few troubleshooting procedures for CD-ROM drives.

Changing the Drive letters: As you know that the windows will assign a specific letter for each CD drive in the system during the start time, we will have initially default letters for the drives. Though we may have the initial adjustments automatic we can change the Drive letter as per our name. but we should take few measures while changing the drive letter. The following will give you steps to change the drive letter.

1. you need to click start → settings → control panel
2. double click the system icon → click the Device Manager tab → click the settings tab
3. in the Reserved Drive Letters section, set Start Drive Letter and End drive letter to the specific drive letter you wish to use for your CD-ROM → click OK repeatedly till you return to the control panel.
4. Restart the computer to see your changes effected.

Auto Insert Notification (AIN): sometimes you may observe that the CD drive blinks for every few second even if there is no read/write operation is happening. This is due to the Auto Insert Notification (AIN) feature of windows that allows the disk to automatically identified and set ready when the disk is inserted in the drive. Normally there is no harm with AIN but

some programs may be very sensitive which can be affected by AIN. Therefore you can disable AIN using the following steps

1. Click start → settings → control panel
2. Double-click the device Manager, double click CD-ROM and then double-click the desired CD drive
3. Click settings tab → click the auto insert notification check box to clear it.
4. Click close button. Restart your computer to see the update.

CD drive Performance: sometimes you may observe that when you attempt to access the CD drive, it is not performing so well. This can occur when the cache size is configured properly. You can use the following steps to optimize the CD-drive settings

1. Click start → settings → control panel → Double-click system icon
2. On the performance tab, click file system
3. Click the CD-ROM tab
4. Move the supplemental cache size slider to the right to allocate more system RAM for caching data from the CD drive.
5. When reading continuous data use a higher settings in the optimize access pattern for box. When reading random data increase the supplemental cache size setting and decrease the optimize access pattern for setting
6. Click OK → close. Restart the computer when prompted.

Activity 2

Try to optimize your CD drive settings and give a broad overview of the result.

Hint: Refer the concept of CD drive performance under section 8.3.3

Self Assessment questions

4. _____ is a complex decoding process that convert sequence of pits and land into meaningful binary information.
5. _____ Driver allows programs to access the CD-ROM as the hardware level.
6. _____ allows the disk to automatically identify.

8.4 DVD Drive

The compact disc made a way for world of new evolution in the PC. Since these CDs disk could handle only 650MB of computer programs and data or one hour of music, it is found to be outdated medium of storage in case of multimedia applications, large databases and interactive games. DVD is a high density storage media which is low widely used in the computers. DVD stands for Digital Versatile Disk that can hold program, data, audio and video. It is capable of providing up to 17GB of external storage on your computer.

- *Access Time*: the time needed by the drive to locate the required information on the disk is called access time. These drives are very slow and can take up to hundreds of milliseconds (mS) to access information.
- *Data transfer rates*: it is defined as the time taken to read the data from the disk. Once you access data from the disk it has to be transferred off of the disk to the system. There are two ways of measuring of data rates. They are,
 1. Speed at the which the data is read into the onboard buffer of the drive
 2. Speed at which the data is transferred across the interface in the drive controller.

8.4.1 DVD media

The data is recorded in a spiral pattern as a series of pits and lands in to a plastic substrate. DVD looks in size and dimension very similar to compact disks. There are few key differences that make DVD more superior than CD. They are,

1. Data is very concentrated on the disk. The DVD tracks are 0.74 μ m apart where as in the CDs use the tracks that are 1.6 μ m apart. To locate these smaller geometries DVD sued very short wavelength laser light.
2. Multiple layers of pits and lands are employed in the DVD so that one disk can have several layers worth of data.
3. DVD-ROM disk use only one side of the disk at least for a while. Therefore DVD can offer upto 8.5GB of data storage for one sided disk and upto 17GB for double sided double layer disk.

You can increase the life of your disk by following some of the rules given below:

1. You should not bend the disk.
2. You should never heat the disk as the material used is plastic.
3. Avoid scratches on the disk. Circular scratch can entirely wipe the data from the DVD.
4. Avoid using chemicals to clean the disk.

8.4.2 The DVD drive and decoder

DVD drive looks very similar to any CD-ROM drive. You can recognize the DVD drive only with the “DVD” logo on the drive. A typical front view of the DVD drive is as shown in the figure 8.3

DVD drive of a motorized disk tray that loads and unloads the disk. This tray can be closed and opened by using the load/unload button in the drive. The LED lights indicate the activity of the drive i.e. it shows a light blinking when the data is being read from the disk. It is also called as busy indicator. There is headphone jack since the DVD also serves as CD audio and also it has volume controller that can be used to adjust volume directly from the front panel.

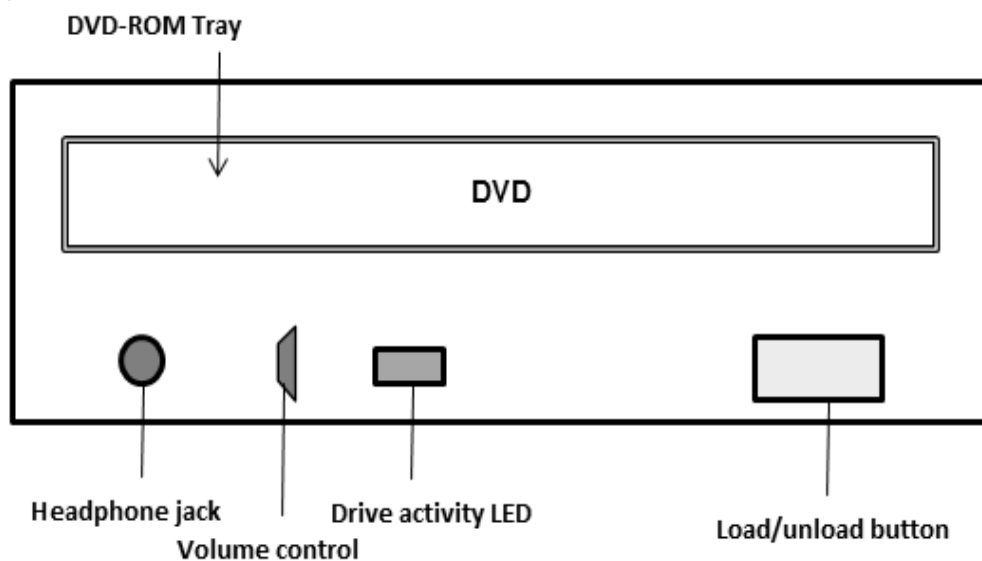


Figure 8.3: Front view of DVD drive

The rear view of the DVD drive looks similar to the one given in figure 8.4.

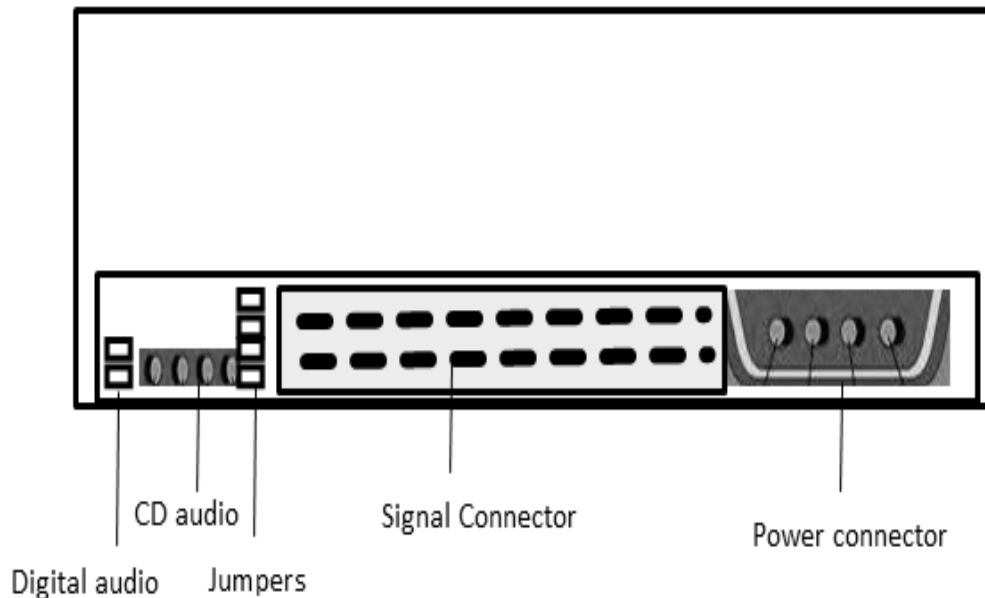


Figure 8.4: Rear view of DVD drive

It used 4-pin connector to connect to the power. The signal connector may be SCSI that can be directly connected to existing drive adapter. You can set a series of small jumpers to set the drive identify. There are two audio output connectors. One is 4-pin connectors that attaches to the sound board and the other 2-pin connectors that's supplies sound to a digital recording system.

The MPEG-2 decoder: though DVD disk can easily provide 4 GB of storage which is still not enough space to hold the audio and video data required for an average- length movie. Movie data are highly compressed during being recorded. This creates problems while playing as while decoding it may give broken audio or dropped video frames. Therefore to ensure smooth real time playback of the DVD movie, hardwarebased MPEG-2 decoder card is added to an available PCI slot and connector directly to the monitor. The decoder decompresses the MPEG-2 information relieving a tremendous amount of work from the system processor. Decoded audio from the movie is also passed from the decoder card to the sound card using CD audio

connection. Decoding can be finished by using software applications. Not necessarily all the time we need to decode hardware components. Software decoding is much simpler than hardware decoding.

Decoder board connections: there are five major connections on the MPEG-2 decoder card.

- *Analog input jack:* analog input is used for mixing in an auxiliary audio signal to the decoder card.
- *Analog output jack:* provides the master audio signal that is fed to the line input of your existing sound card.
- *Digital output jack:* it is used to drive an external digital device.
- *Monitor connector:* the MPEG-2 decoder card will drive the video graphic adapter (VGA) through monitor connector.
- *Video input connector:* the video input is put to the decoder card, so that while decoder card is idle the video signal is passed through the MPEG-2 card to the monitor.

8.4.3 Trouble shooting

Here we will provide you with a series of guidelines to resolve wide range of problems and troubleshooting issues.

if you want to set the DVD system configuration to a default state while installing or correcting the problems in DVD-ROM you can do it using the below criteria.

1. *Video configuration:* irrespective of the amount of video RAM provided by your video adapter, try to set the display to 640 X 480 using 16-bit color. Set the monitor type to standard VGA.
2. *DVD drivers:* update your drivers regular to provide better hardware compatibility. You should ensure that you have latest drivers.
3. *Video drivers:* video drivers are also updated regularly for better video performance and compatibility. Check for the webpage for your video card vendor for updated video drivers.

Self Assessment Questions

7. _____ is the time recorded by the drive to locate required information on the disk.

8. State whether the following statements are true/false.
 - a. MPEG-2 decoder is used to compress and decode movie data.
 - b. Analog output is used for mixing in an auxiliary audio signal to the decoder card.
 - c. Digital output jack is used to drive an external digital device.

Activity 3

How to troubleshoot when your DVD drivers refuse to get installed?

Hint: Refer the concept of troubleshooting DVD drive from the book Troubleshooting, Maintaining and Repairing PC's by Stephen J. Bigelow

8.5 Blu Ray Disk Drive

Blu-Ray Disk is often referred shortly as BD. BD is the advanced version of DVD which is made out of smaller pits and lands. Single Layer BD can store about more than five times the DVD capacity (almost 25 billion bytes) and double layer BD can store upto 50 billion bytes. The name is because it uses blue-violet laser light to read or write the data from the disk.

BD uses 0.1mm(milli-meter) cover layer which is used to move the data closer to the lens. Through this we can achieve higher density. To read the smaller pits it requires a blue laser of wavelength at 405 nm (nano-meter). The technology used in BD is HDMV. HDMV (High Definition Movie) is a technology that is used to provide functionality of high definition graphics planes, animated and popup menu buttons and sound effects for the selection of menu buttons

8.5.1 Physical Media

The working of the Blu ray disk drive is as shown in the figure 8.5.

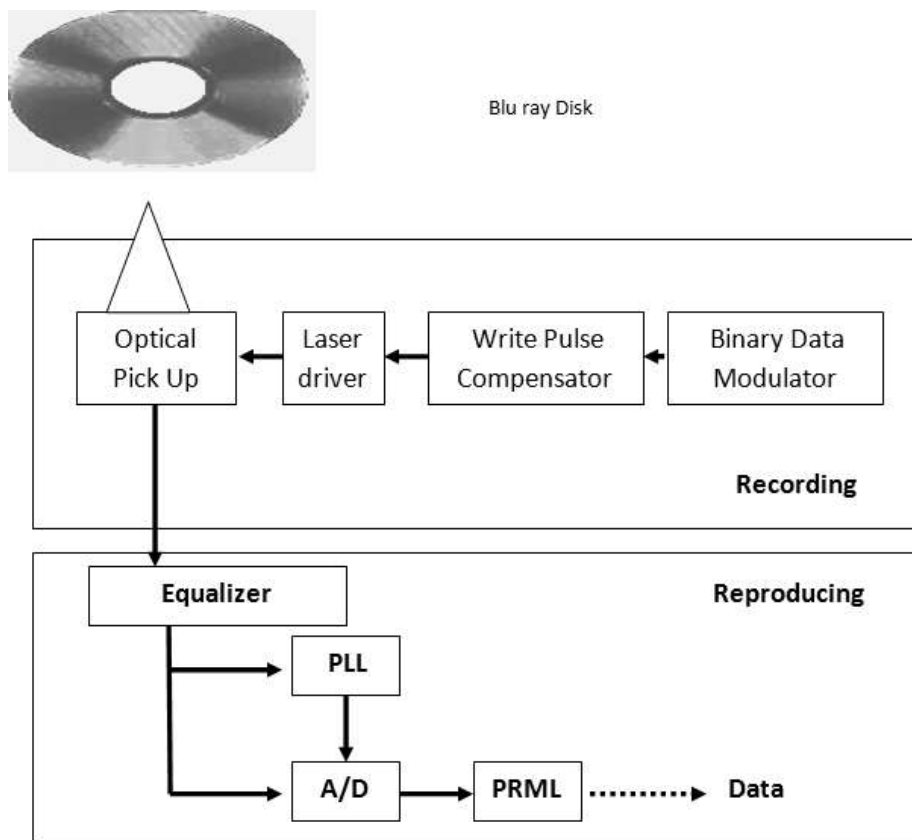


Figure 8.5: The block diagram of Blu Ray Disk Drive

The signal that is encoded is sent to a write pulse compensator (device which converts the analog pulse into multiple pulse or waves) where the signal is modulated to multi-pulse. By adjusting the leading edge of the first pulse and the trailing edge of the cooling pulse of the multi-pulse signal, we can control the accumulation amount in accordance with the Mark length, enabling the Mark edge position precisely. The pulse waveform thus modulated is sent to a laser driver circuit, which modulates the power of laser beam to record Mark/Space data on a Blu-ray Disc™. To play-back recorded data, the reproduced signal through an Equalizer is fed to the Phase Locked Loop (PLL). The output signal of the Equalizer is also fed to the Analog to Digital converter (A/D) converted to a digital signal at the clock timing of PLL, then passed through a PRML channel to correct the initial bit error, and output as signal to the subsequent digital signal processing circuit. The modulated binary data is sent to the Write Pulse Compensator to

control the Mark edge position precisely. The output signal of Write Pulse Compensator goes through Laser Driver and Optical Pick-up. The optical pick-up has a spherical aberration compensator to focus on the both layers of the Dual Layer disc. The reproduced signal was equalized and filtered and passed through PRML decoder to correct the initial bit error.

The standard disk size is of 12 cm in size. The single layer blu-ray disk can handle up to 25GB of data and dual layer disk can handle up to 50GB of data.

- **Types of Blu-ray disk:** the Blu-ray disk can be differentiated based on storage capacity of the disk. They are,
 - *Mini Blu-ray Disk:* Mini disk size has the physical size of 8 cm. In this type, the single layer Blu-ray disk can handle 7.8 GB of data and dual layer disk has handled 15.6 GB of data. This version has been designed for compact recording devices like compact camcorders
 - *Blu-ray disk recordable:* this refers to two types of optical disk format that is used with an optical disk recorder. They are BD-R and BD-RE. BD-R disk can be written only once. BD-RE is a recordable and can be re-used by erasing the existing data for multiple numbers of times.
 - *BD9 and BD5:* this was proposed as a cost-effective to 25/50 GB BD-ROM disks. In this type it used the same codecs and instructions pattern as the Blu-ray Disk video to record at a low cost. BD5 is the lower capacity version with an idea of using inexpensive DVD media for recording using single-layer 4.7 GB DVDs.
 - Later multilayered recordable disk in BDAV format (Blu Ray Disk Audio/ Video is a format that support Audio and video) with a speed of 2X (72 Mbps) and 4X (144Mbps) that was capable of 100/128GB called BD-R 3.0 came into existence. (Blu-ray Disc recordable (BD-R) refers to two optical disc formats that can be recorded with an optical disc recorder. BD-R discs can be written to once. BD RE is the ideal format for making sequential backups, or recording video for time shifting purposes. BD-RE can be erased and re-recorded multiple times. Along with a multi layered disc rewritable in BDAV with the speed of 2X and 4X, capable of 100GB called BD-RE 4.0 (upgraded version of BD-RE) also became in use.

8.5.2 Software standards

- *File system:* The file format used in Blu-Ray disk is UDF. UDF stands for Universal Disk Format, is a convergent friendly format for the computer and other electronic devices like TV, Music Player, etc. this format is used in the latest versions of Blu-ray disk such as BD-ROM, BD-RE, and BD-R. The application used for BD is BDAV for recording the digital broadcasting. Blu-Ray Audio/Video application is a consumer- oriented Blu-ray video format. It is used for audio /video recording.
- *Directory and file structure:* Blu-ray disk files are stored in a directory called BDMV. BDMV stands for Blu-ray Disk Movie is a container that stores the audio, video and other streams in BDAV format such as MPEG, etc. it also has interactive menus with the help of java implementation in blu-ray disk program instructions. BDMV contains the following which must be present in the folder while playing.
 - *BACKUP:* stores a copies of “index.bdmv” file, the “MovieObject.bdmv” file, all the files in the PLAYLIST directory and all files in the CLIPINF directory.
 - *INDEX.BDM:* the information of the contents of BDMV directory is stored in this file. One BDMV directory has only one index.bdm file.
 - *MOVIEOBJ.BDM:* the information of one or more Movie objects is stored in this file. One BDMV directory has only one Movieobj.bdm file.
 - *PLAYLIST:* Movie Playlists are stored in the database files. The files are stored with an extension .MPLS.
 - *CLIPINF:* contains the Database files for Clips. The clip files are stored with a file name with an extension .CLPI. these files contains the information about the audio/video clip stream file
 - *STREAM:* this directory contains the stream files. It stores the file names with an extension .M2TS which support MPEG 2 transport stream. They store BDAV MPEG 2 files. The file name is made up of 5-digit number associated with the Audio/Video stream file and its CLIP information file.

8.5.3 Troubleshooting

- *No Power on the Blu-ray drives:* If you find difficult even to power up your Blu-ray player, then you must, check for the secure connection of the power cord. Check the outlet by plugging any other device like lamp or clock. Even then if your Blu-ray drive does not turn on, then servicing may be required.
- *No Picture from the Blu-ray drive:* if the power light is on and you are able to see the picture then, you need to check to make sure all cables are securely connected to the television and that they are in the correct ports. Check the input settings on the television to make sure you are set to the right channel or selection. For example, your TV may need to be on channel 2 or have the HDMI input option selected. Refer to your television's user manual if you are unsure which settings apply. You can also check by restarting the TV. If still the picture don't appear then, output video format is not correct. You can hold the stop button for more than ten seconds so that the setting are reset and may correct the problem.
- *Some disk is not playing on the drive:* suppose any disk is not playing on the Blu-ray disk drive, you must remove the disk and clean the disk for any dirt. Cleaning may sometimes help you in solving the problem. You must be sure that you are placing the disk in a proper direction and not upside down. You must always use the original disk and appropriate disk format which the drive is able to support.

Self Assessment Questions

9. The data layer in the Blu-ray disk is closer to the surface of the disk (true/false).
10. The two types of Blu-ray optical disk recorder are _____.
11. BDMV stands for _____.

8.6 Flash Memory Drive

Flash Memory drive is an external storage device which can be used to read and write the flash memory. Flash drive is also called as USB flash drive or thumb drive or pen drive. You can see a typical figure as shown in figure 8.6.

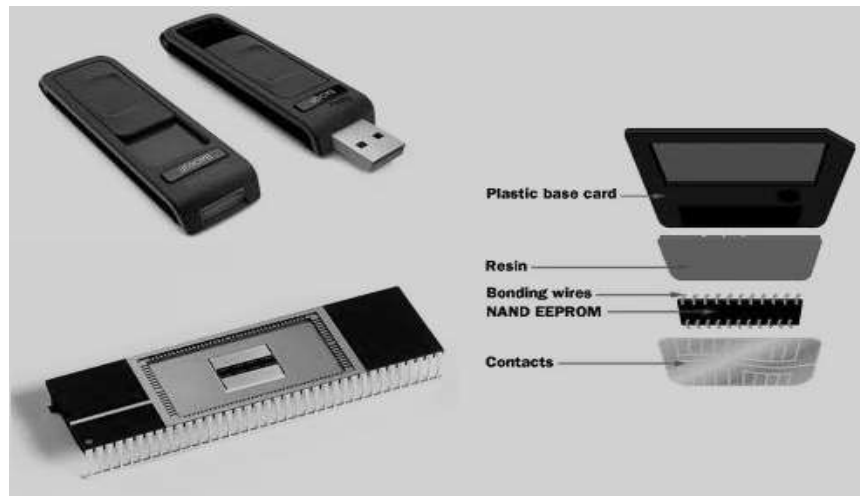


Figure 8.6: Flash Memory disk drive

This device is less expensive and very reliable and durable source of storage media. The flash drive is used for the same purpose like CD-ROM and floppy disks.

8.6.1 Essential component of flash drive

Flash drive consists of four parts. They are,

- *Male type-A USB connector:* this connector is used to connect the flash drive to any computer available in the computer world. Male type-A USB connector provides a physical interface to the host computer. This is similar to the contact shown in the figure 8.6
- *USB mass storage controller:* This controller implements the USB host controller. USB mass storage controller contains a small microcontroller along with a small amount of on-chip ROM and RAM.
- *NAND flash memory chip:* is a nonvolatile data storage medium that requires no power to retain the stored data. These are mostly used in digital cameras, memory cards, USB flash drives, etc. it is shown in the figure 8.6 labeled as NAND EEPROM and bonding wires.
- *Crystal oscillator:* .A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of electric material to create an electrical signal with a very precise frequency. It is a very important part of the device.
- *LEDs:* These are small lights that indicate the data transfers.

The other components are jumpers, write-protect switches and USB connector cover or cap.

8.6.2 Size and style of packaging

Flash drives come in large number of variety, size and shapes. Some drives are big and some are very tiny. Some drives are so much big in size because the manufacturers use large housing to cover the drive which makes the USB device difficult to plug in the port. This may block the adjacent port to be connected to another device. If such devices have to be used it needs to be connected through an extended cable. The features of smaller size, robustness and cheaper price of flash drive make it very popular among all the case mod. (Computer case is modified in any non-standard way is taken as case mod). Heavy packaging will not work reliably when plugged directly unless you use USB extension cable. The format used in the Flash drive is FAT (File Allocation Table) file system

8.6.3 Troubleshooting

USB flash drives are the wonderful tools to store massive data into small portable device and extremely easy to use. Still there are few solvable damages that can occur in flash drives. When troubleshooting a USB flash drive, there are few things you need to follow. They are,

1. Check for the lights in flash drives is activated as it is plugged in to the USB port. If it is not turned on as soon as you plugged in then it means your drive is not plugged properly or the device is damaged.
2. Ensure that you have downloaded the correct and necessary device drivers and installed properly. You must enquire with the manufacturer that the right driver must be downloaded and installed from the manufacturer's website so that they get the original and complete drivers.
3. Ensure that you are identifying the correct drive for your flash drive. Like the hard drive as got "C:" as default drive, each drives are identified by a specific letter. There may be more than one flash drives in a computer each of them are differentiated by a specific Alphabet. You must ensure that the intended drives identity is observed in the space of your my computer.
4. Whenever you are not able to recognize your flash drive on your computer, try the drive on other computer to check whether it is working

fine with other computer. if it does then it is the problem of your computer.

5. If you observe that your flash drive is seriously damaged and it cannot be repaired then before discarding it contact a professional so that they retrieve the data contained in the flash drive.

Self Assessment Questions

12. _____ is used to connect the flash drive to computer.

8.7 Summary

Disk Drives are the machine that reads and writes the data into the respective disks. The different types of disk drives are hard drives, CD drives, DVD drives and the latest Blu-ray disk drives and Flash memory drive. *The hard drive* is also known as hard disk drive or fixed disk drive. It is the main and largest storage device on the computer. It is referred usually in the computer by C: drive. CD-ROM (Compact Disc, read-only-memory) is an adaptation of the CD that is designed to store computer data in the form of text, graphics and stereo sound. DVD stands for Digital Versatile Disk that can hold program, data, audio and video. It is capable of providing up to 17GB of external storage on your computer. Blu-Ray Disk is often referred shortly as BD. BD is the advanced version of DVD which is made out of smaller pits and lands. Single Layer BD can store about more than five times the DVD capacity (almost 25 billion bytes) and double layer BD can store up to 50 billion bytes. The standard disk size is of 12 cm in size. The single layer Blu-ray disk can handle up to 25GB of data and dual layer disk can handle up to 50GB of data. Flash Memory drive also called as USB flash is an external storage device which can be used to read and write the flash memory. This device is less expensive, very reliable and durable source of storage media. The flash drive is used for the same purpose like CD-ROM and floppy disks. And in this unit we have discussed on the troubleshooting tips for various types of disk drives.

8.8 Glossary

Term	Description
C: Drive	It is the default drive in the computer which is basically used to store the program files.
Disk Drive	It is a device that holds and spins an optical disk and reads information from it.
Floppy Disk	It is a magnetic storage media that is made up of a thin flexible magnetic storage medium sealed in a square or rectangular plastic carrier lined with fabric that removes dust particle.
Case Mod	Computer case is modified in any non-standard way is called as case mod.
MPEG	Moving Picture Experts Group is an organization of experts to sets standards for audio and video compression and transmission.
MPEG-2	It is a standard used for the generic coding of moving pictures and related audio information.

8.9 Terminal Questions

1. Explain the working of hard drive with a neat diagram.
2. Describe the construction of CD-ROM
3. How to troubleshoot CD-ROM?
4. Explain the DVD drive & decoder.
5. Provide the guidelines for DVD drive troubleshooting.
6. What are the different types of Blu-ray disk?
7. Elaborate the flash memory drive.
8. List the guidelines for troubleshooting flash memory drive.

8.10 Answers

Self Assessment questions

1. Integrated Drive Electronics
2. Specification
3. CD-ROM
4. EFM
5. Low level device
6. Auto Insert
7. Access time

8. a. True
b. False
c. True
9. True
10. BD-R and BD-RE
11. Blu-ray disk movie
12. Male type-A USB connector

Terminal Questions

1. Refer section 8.2.1: The hard drive construction, fig 8.1, typical diagram.
2. Refer section 8.3.1: Basics of CD-ROM drive.
3. Refer section 8.3.3: Troubleshooting.
4. Refer section 8.4.2: The DVD drive and decoder.
5. Refer section 8.4.3: Troubleshooting of DVD drive.
6. Refer section 8.5.1: Physical media types of Blu-ray disk.
7. Refer section 8.6: Flash memory drive.
8. Refer section 8.6.4: Troubleshooting a USB flash drive.

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