

PART IX

DELIVERY MEDIUMS

PART OVERVIEW

This last part in our exiting exploration of multimedia technology will focus on two famous delivery mediums meant for distributing multimedia contents to end consumers: Compact Discs and Digital Video Discs (DVD). The total discussions will span over three chapters.

Chapter 24 starts with a brief history of the evolution of CD ROMs in the multimedia scenario and proceeds with details on what constitutes the physical structure of a CD-ROM disc and how data is being reproduced with the help of a CD-Drive. We will also be looking at other varieties of compact discs like CD-RW.

Chapter 25 will deal with CD-ROM replication process and packaging issues. This chapter is important for those who want to take their multimedia works to end consumers via distribution channels.

The last chapter is on Digital versatile discs or DVDs that are replacing compact discs in many fronts – including computer multimedia data storage and feature film distribution.

Chapter 24

Compact Discs

CHAPTER OVERVIEW

CD-ROMs have been the most popular mediums for distributing multimedia contents. From PC games to presentations, entertainment to edutainment – CD-ROMs literally stand as a symbol for representing multimedia.

In this chapter, we learn all about the secrets of compact discs – available in various flavours like CD-ROM, CD-R, CD-RW and DVD. We will look at the physical construction of each type of disc and understand the principle behind their working.

24.1 Introduction

The need for storing and distributing large chunks of data came into being, in the last ten years. With the explosive growth of information technology and the data associated with it, it is not surprising that this need very much exists even today – inspiring the next generation storage mediums like DVD-Rewritables and Blu-ray disks.

The CD-ROM technology sprang up from the audio compact disc technology invented by Sony and Philips. While audio CDs could store only audio data, CD-ROMs were able to store all forms of computer data – including audio files, graphic images and video data formats. The 1990s saw explosive growth of CD-ROMs as the preferred medium for distributing - not just multimedia, but even all other kinds of application software. Though the Internet is now considered as a cheaper and easier alternative to CD-ROMs, the latter still holds its position tight in those areas where the volume of data distributed is reasonably large – such as multimedia.

With the introduction of CD-R (CD Recordable) and CD-RW (CD Rewritable) standards, CD-ROMs have also become one of the most popular forms of storage media.

Let us begin our discussions by understanding the physical constitution of a CD-ROM disc.

24.2 CD-ROM discs

Okay, let us hold this little round polycarbonate disc (with attractive rainbow tints on its surface) for a moment and try to understand its construction. It's mind boggling to note that this innocent looking cute silver platter can hold around 680 to 700 MB of data. If we were to distribute the same data in floppy disks, we will need roughly 475 floppy disks!

The enlarged side view appearance of a CD-ROM is shown in figure.

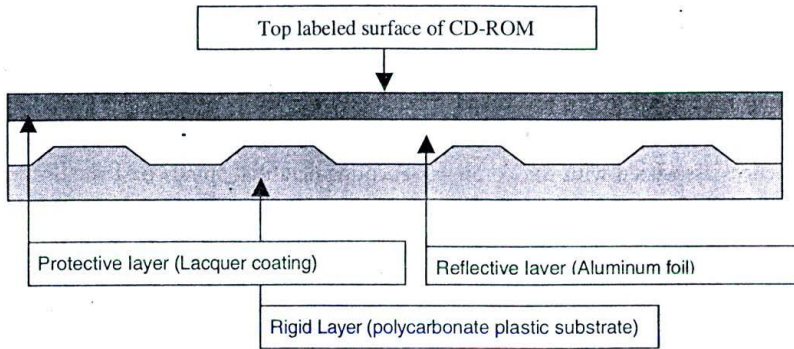


Figure 208: Composition of a CD-ROM

It is around 12 cm in diameter, 1 mm in thickness and around 16 grams by weight.

It has three different layers, made up of three different substances, plastered in-between:

- ❑ The rigid layer: The first layer from the bottom surface of a CD ROM, also called the rigid layer, is made of a polycarbonate substrate. It's this layer that gives the otherwise flexible CD ROMs, the required strength and rigidity for handling and hence the name - rigid layer.
- ❑ The reflective layer: The second layer from the top surface, also called the reflective layer, is made up of Aluminium. This layer is the one that holds the actual computer data in the form of microscopic pits and lands. Since it reflects the laser beam that's cast over the CD-ROM during the data retrieval process, it's called reflective layer.

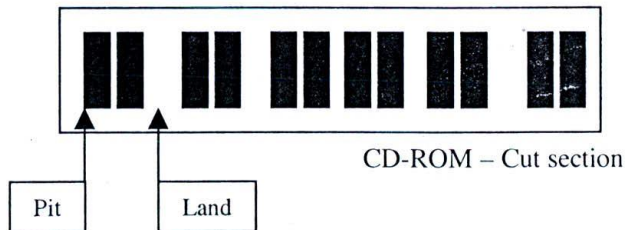


Figure 209: Microscopic pits and lands that save data

- ❑ The protective layer: The third layer, also called the protective layer, is a thin film of lacquer coating that safeguards the reflective layer, against scratches and other physical damages. The lacquer coated side is more often called the label side as it usually contains a label printed on its face.

Only one side of the disc i.e. the side adjacent to rigid layer contains data; the label side is left blank. Data is stored in the form of microscopic pits (which are 1 to 3 micron* long, about 1/2 micron wide and 1/10 micron deep) that run as a single spiral track from the inner diameter to the outer of a CD-ROM - the total length of the track being...hold your breath...around five kilometres!

A single CD-ROM can contain more than five billion pits! The pits and lands (absence of pits) represent ones and zeros respectively. To read back the stored data, a laser beam is focused on the surface of the disc and the reflected beam is read and understood.

At this point of time, let us understand why we are using lasers to read data from CD-ROMs.

* 1 micron is one thousandth of a millimetre!

24.3 Why laser?

Laser stands for light amplification by simulated emission of radiation. There are many types of lasers; the one being used in multimedia CD-ROM drives are called solid-state lasers.

By very nature, light is the fastest entity known so far in the universè. It is this speed that manages and retrieves the rapid on and off sequences associated with the computer-encoded data that spirals past the drive's read head, in the form of pits and lands.

And among the various coherent light sources, it is the laser that has the capability of being focused very tightly because it is made up of rays that are parallel to each other and do not intersect; without such a tight focus, it may not be possible to detect tiny reflections from the disc, caused by microscopic pits.

Hence, laser becomes the ideal choice for disc reading.

So, how data is read from the CD-ROM, using laser?

24.4 The CD reading technique

As soon as a CD-ROM disc is inserted into the CD drive and the data contained is being read, a laser beam is first produced from a laser source such as laser diode. The beam then passes through a prism (which is arranged in a particular position as shown in the figure, so that the source beam passes through the prism, unaffected), gets a very tight focus as it passes through the two lenses and is ultimately cast over the surface of the CD-ROM, which contains the recorded data. Remember that the label side, which is the top position as you keep a CD-ROM disc on the drive, doesn't contain any data and the laser beam actually falls only on the other side of the disc.

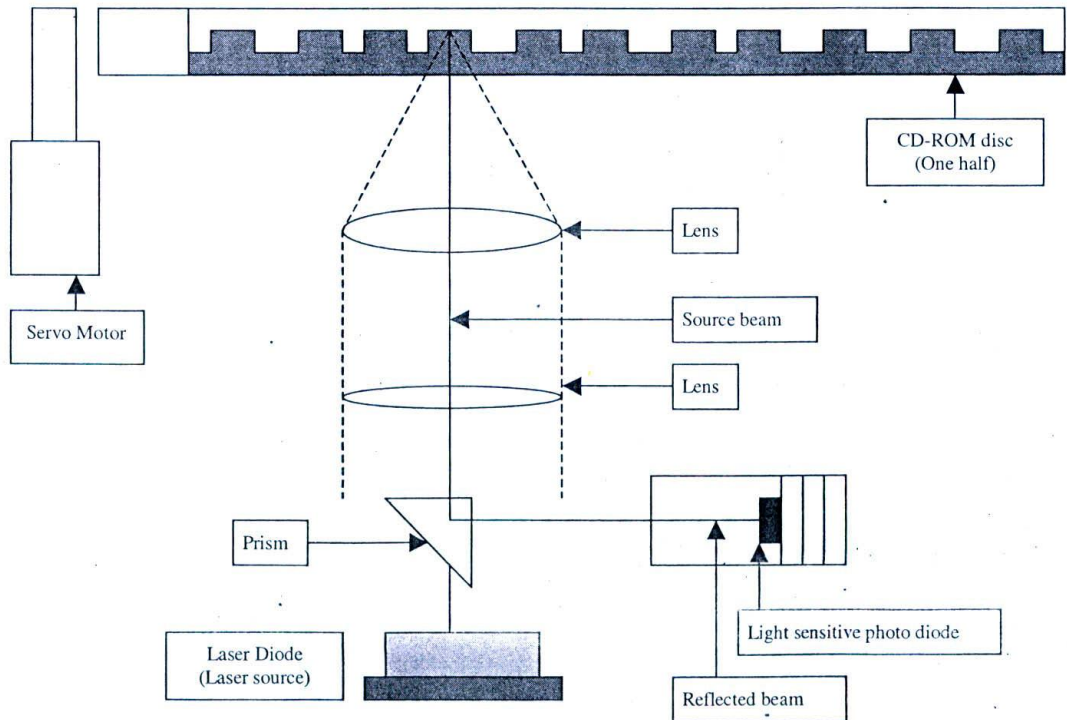


Figure 210: Laser beam reads the data reflected from pits and lands

Because of the microscopic pits and lands on the aluminium layer of the CD-ROM, this falling laser beam is promptly

reflected back. Without the tight focus as that of the laser's, it will be almost impossible to detect every reflect from the pits and lands, which are only microns away from each other.

When the source beam encounters a land - which is the flat surface and denotes just the absence of a pit, it essentially follows the same path after reflection, without getting deflected; and when it meets a pit, the reflected beam branches out at a small angle of incidence.

These two reflected beams are diverted over a light sensitive photo detector diode, by the prism. Note that position of the prism plays an important role in diverting the reflected beam, exactly perpendicular to the source beam. The beam reflected from a land is read as a binary one, and that from a pit as binary zero.

The story is still not over...as all of these ones and zeros themselves do not represent the final form of data! Because if multimedia or other types programs are directly stored in the computer data format on a CD, the total amount of data that could be stored could be much lesser. Hence, the producers adopt various compression and encoding techniques to compress the computer data, before storing them in a CD-ROM. A series of ISO colour book standards, which will be introduced in the following section, define these compressed data formats.

Hence, a micro controller that's inside the CD-ROM drive is used to decode the compressed data, before the data is fed into the computer for processing.

24.5 The colour book standards

A series of compact disc standards like 'The red book standard', 'The yellow book standard' and 'The green book standard', were evolved by the International Standards Organisation (ISO), to bring in some degree of standardisation into the new range of data storage mediums.

For example, ISO 9660 is the widely accepted format for storing digital data as files on a CD ROM. The table given below provides a snapshot of standards and the nature of media they control.

Table 35: CD Standards

Specification	Media
Red Book(System description CD Digital Audio)	Audio CD
Yellow Book(System description CD Read Only Memory)	CD-ROMs
White Book(System description Video CD)	VCD
Orange Book Part III(System description CD Rewritable)	CD-RW
Orange Book Part II(System description CD Write once CD-R)	CD-WO (also known as
Green Book(CD-i Full functional specification)	CD-interactive

It is interesting to note that CD media formats like DVD do not come under this umbrella - because DVD is controlled by another standards body called ECMA. Having to cope up with too many standard bodies is one of the problems faced by the information technology community today.

24.6 CD-ROM drives

The data inside a CD-ROM disc is read using a CD-ROM drive.

CD-ROM drives could be internal or external. Internal drives fit into the system cabinet. External drives are separate devices that sit outside the system and connect using USB or any other interface.

We usually notice letters like 24X or 48X in front of the CD tray. These numbers denote the speeds at which the CD discs rotate inside the drive and the corresponding data transfer rate (The rate at which information recorded inside the CD-ROM is transferred to the computer). The earliest drives transferred data at 150 KB per second

so called as 1X speed; the present day drive speeds are at least 24X to 48X – which is around 3.51 MB to 7.03 MB per second.

4.7 The interface cards

CD Controller card maintains the interface between computer and the CD-ROM drive. These controller cards are interface devices that provide two-way communication between the computer and the equipment; they convert signals from the computer to a form that's understandable by the CD drive and vice versa.

CD controllers come in two flavours:

1 An IDE card (Interface device electronics card) and

1 A SCSI card (Small computer system interface card)

SCSI cards are better than IDE in many respects – but are also very expensive. Hence most home users prefer IDE to SCSI.

4.8 Data tracking

As with other forms of computer storage, the data recorded on a CD-ROM disc is not contiguous. In other words, even a single program may be scattered in different sectors throughout the disc. To perform this complicated search, a detailed data layout of contents inside the CD-ROM is stored in the first track of the disc. It is by referring to this layout track – every now and then, that the CD-ROM drive is able to read a given file in the disc.

Thinking about 680 to 700 MB of data that is contained in a single CD-ROM disc, we can very well understand the difficulty in retrieving specific files for a particular task. This process is what is called as data tracking.

Data tracking is usually handled by four different mechanisms – powered by four independent servomotors.

- 1 One that governs the speed at which the disc rotates
- 1 One to position the laser read head in the specific location
- 1 One to calibrate the focusing apparatus accurately and
- 1 One more to retrieve the data patterns contained on the disc.

24.9 Data transfer rate

The rate at which a CD-ROM drive transfers data to the computer is usually referred to as the data transfer rate and is perhaps the most important parameter that governs the performance of a drive. In handling text-based information, this may not matter much – but with typical multimedia applications involving intensive audio or video data, the data transfer rate is of utmost importance. Higher data transfer rate results in better performance.

You can see the effect of data transfer rates, when you try to play complex multimedia CD-ROMs in some old CD drives – the application will take a long time to respond and there will be noticeable delay in playing video files.

The unit for measuring the data transfer rate is KB / sec. The earliest CD drives transferred data at the rate of 150 KB /Sec whereas the modern drives offer 3 to 6 MB transfer rate per second.

24.10 Seek-time

Seek-time or the data access time is the time taken by the CD drive to seek and retrieve specific piece of data associated with an application. It can also be defined as the average time taken by the laser's reading head to move from one part of the compact disc to another.

The unit for measuring seek-time is milliseconds.

Shorter seek times results in better performance because it takes lesser time to retrieve required data. Any drive with a seek time of 200 milliseconds or less can give a decent performance.

24.11 CD Recordable discs (CD-R)

The standard CD-ROM discs can be read – but no data can be recorded over it. As the name implies, CD-ROM represents a read only memory that cannot be erased. In order to record our own data in compact discs, we should make use of another breed of discs called CD Recordable or simply CD-Rs. The specification that dictates the grammar for CD-R discs is the orange book part II.

The CD -R disc has a dye-recording layer in between the protective layer (lacquer coating) and the reflective layers of the usual CD-ROM discs. In place of aluminium, gold or silver alloy is used as the reflective layer.

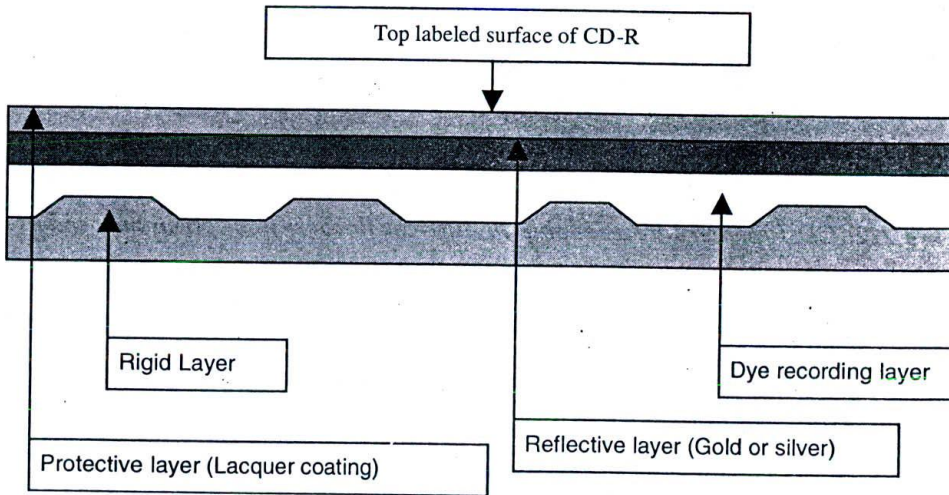


Figure 211: Cross section of CD-Recordable (CD-R) disc

To record data, a laser beam that is of higher intensity than that used for reading data, is sharply focused using the condenser lenses over the surface of the CD-R disc. The focusing is done whenever a pit is required on the disc. The dye-recording layer reacts to this intense laser assault, undergoing slight chemical fusion with the gold or silver layer near its surface and creates a pit. As we saw earlier, these pits and lands can together represent data.

Once the data is recorded on to the CD-R disc, it can be read back using any standard CD-ROM drive or any other CD Recorders. Note that data can be written only once over the total memory available – in case of CD-R discs. In order to erase and re-record data on the disc over and over again, you have to make use of another breed of discs called CD-Rewritable or CD-RW.

24.12 CD Recorders

The equipment, which is used for writing data over the CD-Rs, is called a CD writer or a CD Recorder. CD recorders can record data on disks in a variety of formats, apart from serving as standard CD-ROM drives. Apart from the recording equipment, we also need the necessary software for burning the data on the disc. Usually, this software is bundled with the equipment you buy.

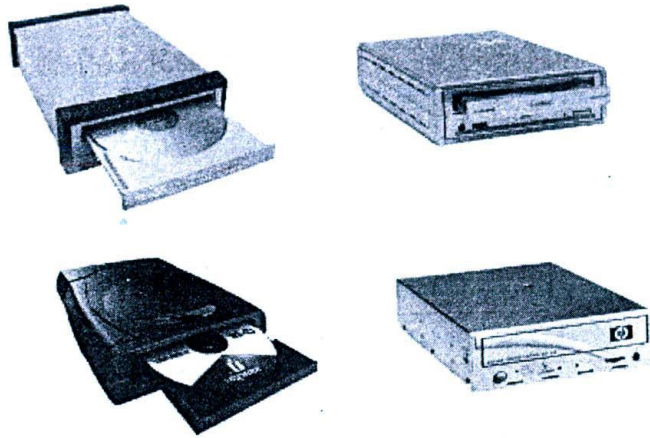


Figure 212: CD Recorders are available in different flavours from premium vendors

Today, most multimedia desktops and laptops come with CD Recorders instead of just CD-ROM drives. The brands include Hewlett Packard, Sony, Iomega, Philips, Creative, Yamaha, Pioneer, Ricoh and Mitsubishi. With their falling prices, it makes lot more sense to buy CD recorders instead of simple CD-ROM drives.

24.13 CD Rewritable discs (CD-RW)

CD-R discs can write data only once over the disc area and the recorded portions cannot be erased. In order to enable rewriting, companies came out with a new technology called CD-Rewritables or CD-RWs. The specification that governs this type of disc is orange book part III.

CD-R discs use a dye-based layer for recording data. Data recorded on this dye layer is permanent. In order to give the flexibility of erasing and rewriting on this layer, the CD-RW discs use a special crystalline compound sandwiched between two dielectric layers. This compound becomes crystalline or amorphous, based on the degree to which it is heated and subsequently cooled. The required degree of heat is achieved by controlling the power of laser beam that falls on the disc.

The CD-RW recorder equipment makes use of three different types of laser power, to achieve the desired effects:

- Write power:** Creates a non-crystalline state on the recording layer. The power of laser beam employed is the highest in this case.
- Erase power:** This melts down the recording layer and prepares the disc for rewriting. The recording layer regains its reflective crystalline state. The power of laser beam is less than that used for writing.
- Read power:** This does not alter the state of the recording layer, since the data is just read back and not recorded or erased. The required power of the laser is obviously very low.

Have a look at the diagram, which schematically represents the cross section of a typical CD-RW disc.

The recording layer is a crystalline compound made of silver, indium, antimony and tellurium. This is sandwiched between two dielectric layers meant for drawing excess heat from the recording layer, during the writing process. The other layers like the reflective layer and the polycarbonate substrate (rigid layer) stay as usual.

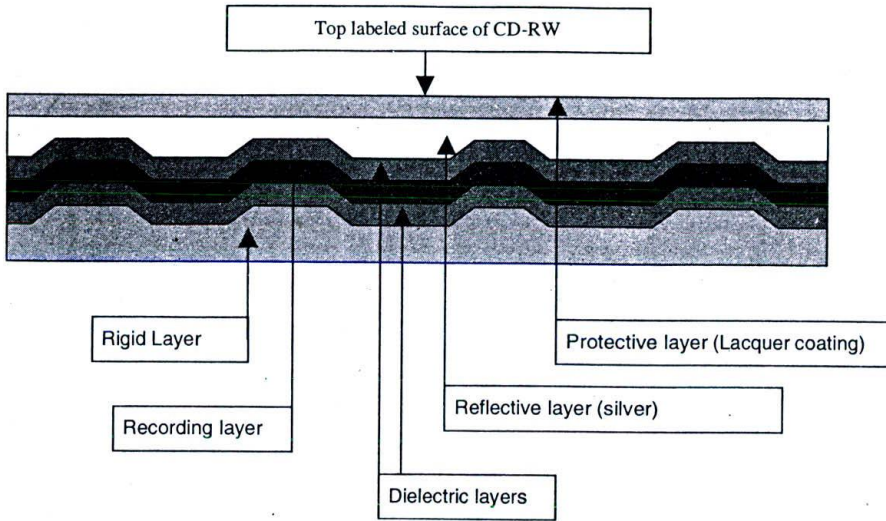


Figure 213: Cross section of CD-Rewritable (CD-RW) disc

During recording process, the laser beam at the write power heats up selective areas of the phase change material above the melting temperature. If it is then cooled, the amorphous state of the compound is obtained. This amorphous material shrinks, leaving pits in those places touched by laser beam. When a read power laser beam passes through these areas, the amorphous areas reflect less light, thus enabling the identification of pits and lands.

During erasing process, the laser beam at erase power heats the phase change layer below the melting temperature and above the crystalline temperature for a specific period of time. The atoms are rearranged in an orderly state – thus making the layer crystalline once again.

24.14 Data organization

When data is recorded on a compact disc, not all portions of the disc are available for storage. Apart from the user's data, the disc also has to store some system information and topic of contents file.

The following areas can be distinguished in all standard compact discs:

24.14.1 System use area

This can be called as the boot sector of a compact disc and it is 4 mm wide. It tells the reader device what kind of information to expect and what format the data will be in the disc. It is divided into 2 parts: PCA and PMA

- ❑ Power calibration area: This is meant as a testing ground for CD Recorder's laser beam. Every time a disc is inserted into a CD-R drive the laser is fired at the surface of the PCA to judge the optimum power setting for burning the CD.
- ❑ Program memory area: This is meant for storing sector addresses for the start of data files on the CDROM. If the compact disc is an audio CD, the PMA records the track numbers and their start and stop times.

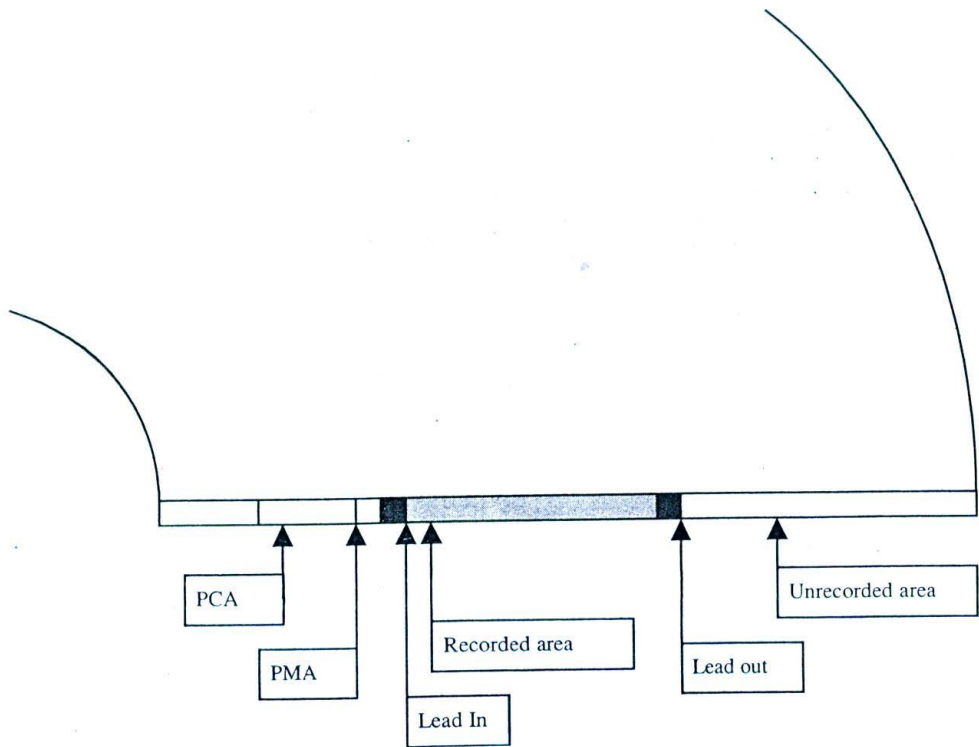


Figure 214: Data organization in a standard compact disc. Drawing not to scale.

24.14.2 Information area

Information area is divided into three portions.

- ❑ Lead in area: This area stores the latest table of contents. It allows the laser head to follow the pits and synchronize to audio or data before the start of program area.
- ❑ Program area: The program area contains the user's data – audio information or computer data. The storage of bytes of data is not a traditional eight bit – one byte formula. A complex algorithm called eight to fourteen modulations is employed to encode each of the 8 bit symbols to 14 bits plus three merging bits.
- ❑ Lead out area: The lead out defines the end of program area.

24.15 Summary

CD-ROMs evolved as a result of a dire need to store voluminous data – be it multimedia or otherwise. There are different kinds of compact discs – apart from CD-ROMs. These include CD-Recordable and CD-Rewritable.

A typical CD-ROM is made up of three different layers, the middle one being used to record the data. Laser beams are used to write and read back the data contained in a CD ROM.

A series of colour standards were introduced by the ISO, to standardise the recording and reproduction of data on compact discs.

The CD drive, used for reading CD-ROMs, can be external or internal drive, and can have either an IDE or SCSI interface. The two main parameters that ultimately govern the performance of CD drives are data transfer rate and seek time.

24.16 Keywords

- ❑ **LASER:** Light Amplification by Stimulated Emission of Radiation.
- ❑ **Data transfer Rate:** The rate at which the CD ROM Drive transfers data to the computer, measured in KB/Sec.
- ❑ **Seek Time:** The time taken by the CD Drive to seek and retrieve a specific piece of Data associated with an application, measured in Milliseconds.

Chapter 25

CD Replication Process

CHAPTER OVERVIEW

When multimedia projects need to be distributed to a sizable number of clients, it is best to replicate the CD-ROM discs. This replication process involves strategic decisions as well as a number of steps. This small chapter is meant to detail this process.

It also covers some of the packaging issues and how to design a good CD cover etc.

25.1 Introduction

Multimedia projects that need to be distributed to end consumers have to be replicated. Replication is advisable only when the numbers of clients are substantially large. For a lesser group of people – say ten or twenty, it is economical to take individual copies of the CD-ROM using a CD burner. But as the number of copies increases, this kind of copying becomes impossible and one is forced to think of alternatives.

CD replication is quite a complex process and here we are not going to discuss the whole process cycle in detail. We will lay more emphasis on the roles and responsibilities of the project developer and much less emphasis on the replication process itself.

The main responsibility of the project producer is to produce a master CD of the project and deliver it to the replication vendor – who takes over the replication process from then onwards. Auxiliary responsibilities of the producer include jewel case cover design, CD face design and box design – if any.

25.2 CD production and replication process

The steps involved in CD replication process are:

- Preparing the application for distribution
- Pre mastering
- Deciding upon the minimum system requirements
- Testing
- Mastering
- Locating the right replication vendor
- Signing the agreement for replication
- CD Replication
- Testing

Let us get into the details of these steps.

25.2.1 Preparing the application for distribution

Once the application under production is complete, it has to be prepared for distribution.

This may, in turn, involve the following steps:

- Developing and testing an installation utility for the application
- Deciding upon the program modules and executables to be installed on the user machine and those that are going to be retrieved from CD at runtime
- Compression schemes that are going to be adopted for various media files
- Creating application auto run and
- Other steps required if any.

When an application has to run on a machine different from that in which it was developed, it has to be installed on that machine. This installation is nothing but the process of copying the required executables and runtime libraries required for the application, making the required changes in the windows registry, creating program short cuts etc. Complexity arises when there are variations in client machines – for example, if you want your application to run on Windows 95, Windows 98, Windows 2000 and XP – you have to take care of quite a number of variables and settings before you can go ahead with the installation process. If you are trying to support multiple operating systems – for example, Windows and Mac or Windows and Linux – then the task is even more complex.

Depending upon the authoring program you have used to develop the project, you may either generate an installation utility automatically or depend on third party programs to generate the required installation utility for you. Third party utilities like Install shield (<http://www.installshield.com>) are quite famous among the application developers as it makes the complex process of installation relatively simple. These utilities come with easy to use installation wizards, which ask you a number of questions about the application you are trying to distribute and generate an installation utility automatically for you.

Though the utilities make the task of creating installation utility simple, they do demand quite a bit of knowledge about windows or other operating systems and application know how – in order to use them successfully. For example, there might be questions about changing certain settings in the windows registry, installing a particular active X or COM components etc. Technical persons with appropriate skill set are required to evaluate what choice is best suited for your application.

The second task is to evaluate and decide which are all the program modules that should be copied into the user's hard disk and what are all the files that are to be retrieved from the CD at run time. Usually, the practice is to copy the main executable file and all the required runtime libraries (dlls) on to the user's machine and keep all the multimedia files like audio, video and animations on the CD itself and retrieve them as and when necessary. The purpose behind copying the executable in the hard disk is to enable faster access to the program. Anyway, whether to copy the main program to the hard disk or not, it will be loaded into the memory of the system – as long as it is running.

One think to make note of here – is the minimum system requirements required by the user. For example, the user may not have sufficient space in the hard disk in order to copy all the required files. In this case you may have to decide whether you have to give alternative options to the user or just fail to load. We are going to discuss such issues in the next section.

If the total size of media files is very big – bigger than that which can be packaged in a single CDROM, then problem arises. We can go for two CD-ROMs instead of one – like Microsoft Encarta CDROM, but this may mean the user has to alternatively load the first CD and the second CD. Depending upon the nature of application, this may well become a nuisance from the user's perspective.

One alternative to this issue is to compress all the media files using certain compression algorithms and decompress the required files as and when necessary. However, this decompression process during runtime may take some time – depending upon the size of the media file and this delay will be passed on to the user as well. It also means that

user should have sufficient space in the hard disk for temporary decompression files. If you can tolerate these compromises, go ahead with this approach. One good parameter to see whether you can adopt this approach or not - is to look at the nature of your application.

Another alternative is to look and revisit the encoding methodologies you have used in your media files. The major memory consumers are the video and animation files. Probably you may decide to compromise on the quality of the video a bit, in order to achieve substantial savings in memory requirements. Remember: smaller video files load faster and run smoother than big chunks.

The last step in this exercise is to add relevant files, so that the application can run automatically, as soon as the user loads the CD in the CD-ROM drive. In windows, this can be easily achieved by adding a file called *autorun.inf* in the root directory of the CD-ROM. This file contains information about the program that should start up upon successful loading of the CD-ROM.

25.2.2 Pre-mastering

After preparation and conversion, the application software has to be transferred to a clean/virus-free hard disk with consolidated disk space.

By consolidated space, I mean 660 MB (or the size required for your application) of contiguous disk space, without any partitions or disk compression algorithms. It is a very good practice to scan the disk and defragment the same - before transferring the application data.

It is also important to write protect all the files that constitute the application, so that no files are modified accidentally. Once all these things are done, we have to burn an image of the application onto a CD-R disc. This CD will be called the pre-master and will be used for testing the application on various machines and deciding upon the minimum system requirements.

25.2.3 Deciding upon the minimum system requirements

When you have completed preparing the application for distribution, you should get a fairly good idea about the minimum system requirements that might be needed at the user's end in order to run the application at fair speeds.

The system requirements that need to be thought of, include the following parameters:

- Supported operating systems
- Processor speeds
- Minimum RAM required
- Minimum hard disk space required
- Accessories required (Sound card, graphics accelerator card etc.)

Care must be taken to find out what are all the versions of the operating systems that support your application. If it is windows platform, find out what versions support your application: Windows 95, 98, 2000 or Windows XP. Forward compatibility is generally built in with the operating system - but backward compatibility must be tested. For example, if you have developed an application in Windows 2000, chances are high that it might run without issues in Windows XP - but you have to test if it works in Windows 98 and do suitable modifications if necessary.

Hard disk space requirement might become a constraint, if you are trying to install too many files in the hard disk. This is particularly valid, if you are distributing the application via the Internet and not using CD-ROM media. As far as accessories are concerned, most multimedia applications require sound card and colour monitor. If your application is built to take advantage of graphic accelerator cards (like multimedia games) please say so.

25.2.4 Testing

The pre-master has to be tested on multiple systems to ensure that the application runs well on all types of systems that satisfy the minimum system requirements. Chances are very high that you may have to revise a parameter or two in the minimum requirements you predicted earlier. For example, you may feel that the RAM actually required

by your application is slightly more than what you have recommended or that the application does not run on Windows 95 as expected earlier.

The purpose of testing is to identify all such gaps and make sufficient changes by going back to step 1 or step 2 necessary. It is imperative that the application is thoroughly tested on all possible platforms and combinations in order to avoid any nasty little problems that go unnoticed and are irreparable after replication. Hence, thorough and comprehensive testing is necessary under all supported operating systems.

25.2.5 Mastering

After rigorous testing and fixing up all possible gaps, the data has to be transferred once again to a CD-R. As usual, one should take care of disk scanning, defragmentation and virus protection. The CD thus prepared is the final copy that will be delivered to the replicator for replication. This time, the disc is called 'the master'.

When the master is handed over to the replicator, the replicator does his own rounds of testing before proceeding with the replication. This double round testing ensures that the disc is free from all bugs and viruses.

It's always preferable to burn more than one copy of the master and keep it as a backup.

25.2.6 Locating the right replicator

CD replicators are available in all major cities. One can go through yellow pages or other commercial directories to find out their location. It is best to get quotations from all of them and do a comparative study of their offerings before taking the final decision.

Price per disk may vary with quantity – with the increase in number of disks, the price per disk obviously goes down. But price alone cannot be the deciding factor – there are many other things like the quality of discs, delivery etc. that need to be taken care of.

25.2.7 Signing the agreement

Before agreeing to replicate the discs, the replicator may ask you to sign an agreement with them just to ensure that you are the rightful copyright owner of the material you are trying to replicate. Hence it is important to ensure that before commencing the replication process. For your reference, there is my paper on copyrighting your work in the appendix of this book.

The agreement will detail that you are the rightful copyright owner of the said work and that you are liable for any copyright issues that may arise in the future and that the replicator is not responsible for this etc.

25.2.8 Replication

The replicator prepares an optical glass master and stamper from the master disc and goes ahead with the replication. Each master can replicate up to a certain number of discs – say 5000 for example, after which the master disc has to be replaced. This increases the overall cost of replication, as the preparation of master is the most expensive primary component in replication.

25.3 Packaging

Packaging the product is considered, sometimes – more important than the product itself! Though this statement looks a bit exaggerative, good packaging goes a long way in selling your multimedia CD-ROMs.

Packaging consists of the following tasks:

- Designing and printing the CD face
- Designing and printing CD Inner lay and outer lay covers
- Designing and printing box or covers if any

25.3.1 CD face - design and printing

CD face is the design that appears on the top of CD-ROM itself.

In the early days, the designs that were printed over CD-ROMs were pretty simple in nature – with one or two coloured screens. But now, multi-colour printing is possible and this cost is usually bundled by the replicators with the replication charge itself. Of course, you may choose not to print anything on the CD-ROM itself or just limit yourself to simple prints – it all depends on how you want to present the product.

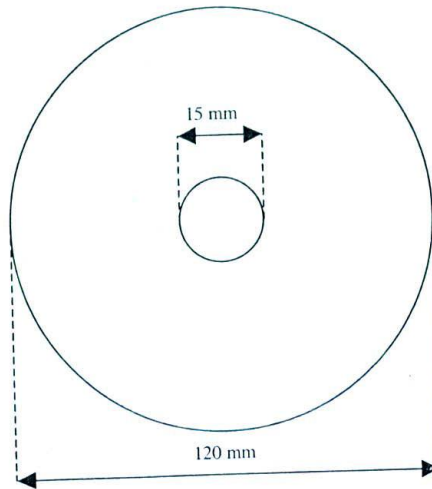


Figure 215: CD face dimensions

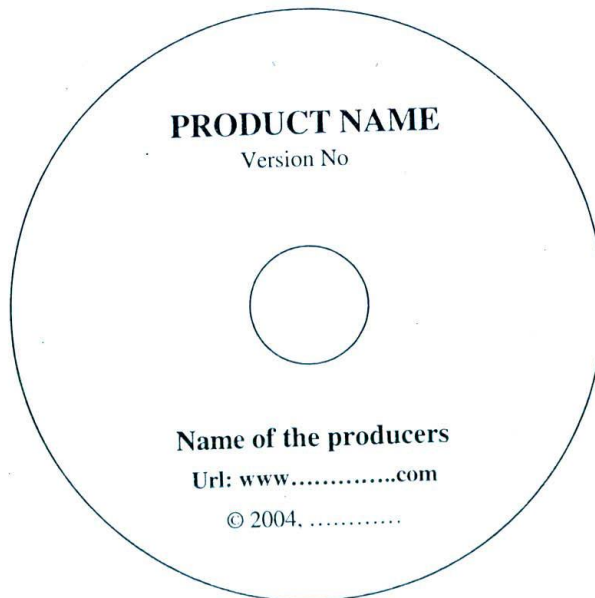


Figure 216: A simple CD face design

The figure shows the approximate dimensions of a standard compact disc. The area in between the outer rim and the inner rim is available for your design. It is always safer to leave a gap of one mm or two in the outer rim as well

as the inner rim – to give room for alignments. Thus the effective outer diameter should be taken as 118 mm at inner diameter as 17 mm.

The CD face design should include vital information like the name of the product, producers, web address if any and copyright information.

An example for multi colour complex design is also provided for your reference.

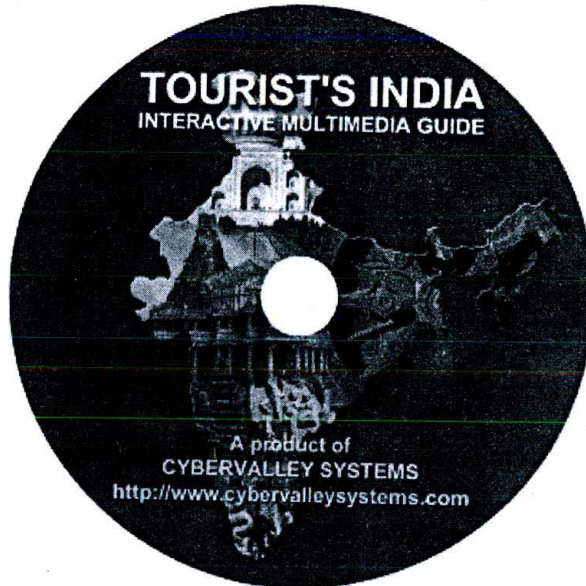


Figure 217: A complex multi-colour CD face design

25.3.2 CD Inner lay and outer lay covers - design and printing

Many CD-ROM products are sold on the jewel case boxes. For such products, the inner lay and outer lay covers that are laid beneath the glossy surface of the jewel box become the advertising medium that communicates with potential consumers. Hence it is important to do proper design of the same.

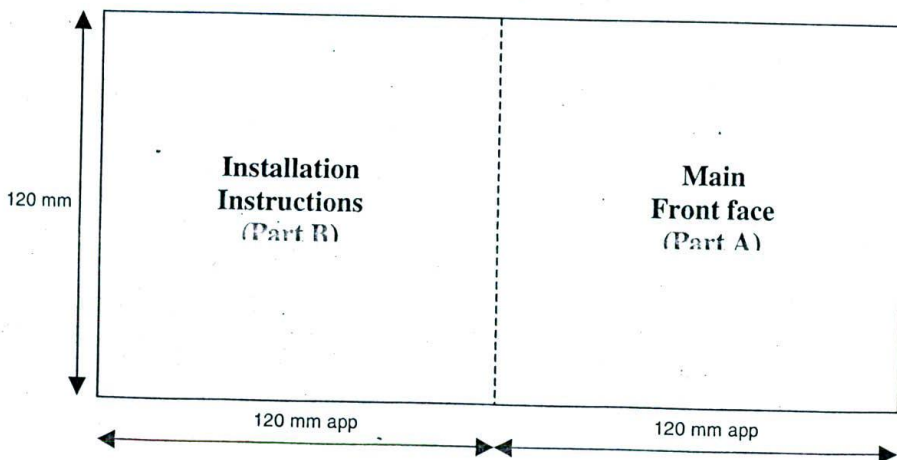


Figure 218: CD Jewel box - front cover

The front cover can be a single square (Part A) or can be a rectangle – folded to square (Part A and B). Part A contains the main design of the product and is the portion visible from the jewel box. It is almost the ‘face’ of your product – so give your best shot at it.

Here are some tips for good front face design:

- The area of this sheet is not very big – so don’t fill it with lot of information.
- Just have the main title of the product and tell what it is very clearly. Something like “PC CD-ROM” or “Multimedia CD for PC and Mac” would be clear enough.
- Do not have extensive graphics either – leave considerable empty space and have one solid graphic that will convey the central idea of the product to the user.
- Try to distinguish yourself in design. Remember that the product might be sitting with many other products in the end retailer shop – all of them craving for attention. A difference in design or title attracts a casual observer.
- The idea that this is meant for multimedia computers must be clearly conveyed. Otherwise users will think that this is an audio CD etc.

Having Part B in your design will not alter the printing cost that much – hence it is always preferable to have both parts. This portion will be folded inside the jewel case and will be visible to the user only after he opens the jewel case. Hence it is best to contain information pertaining to the CD-ROM like minimum system requirements, installation instructions etc on this portion.

If there are too many things to convey, most producers produce a small square booklet of size 120 mm by 120 mm – and insert it in the place of front cover.

The back cover contains information about the product and is visible to the user from the backside of jewel case. Only when the user is interested in a particular title, will he take the CD out and read the backside contents – to find out more information about the product. Hence, this portion should contain vital information about the product in short and crisp phrases.

Here are some tips coming out of my own experience:

- Do not try to speak much. Cut sentences short. Small phrases with clarity and legibility have more chances of being read by most observers, than paragraphs that tell stories.
- Do not use very small or very large fonts. Small fonts will not be legible and large fonts will consume lot of space. A casual reader should be able to read the texts without pain.
- Try to highlight what the product is and what is contained in it. Speak about the benefits the product brings to the user – it may be knowledge, fun or entertainment.
- Use catchy phrases to highlight the approximate duration of the application. Since the CD itself looks very small, the user may be unable to perceive the total value of the product. Alternatively, highlight some quantitative aspects like this: “500 photographs, 200 tunes, 50 video clippings and unlimited fun!”
- Try not to use much graphics in this page. The front face has got all the required graphics necessary – here it is time to ‘speak’ about the product. Small clippings and highlights are however, most welcome.
- Try to include the address of the developers / producers and copyright information. Provide the complete mailing address, email and web address. Apart from the users, this will also benefit dealers and retailers who might be interested in your product.

Be it front cover or back cover; always remember to leave 2 to 3 mm allowance on all sides. This allowance is for the cutting machines. The ultimate size of the covers may vary by 1 or 2 mm. So your design should always be slightly higher than the cutting expected – so that you do not have white spaces on the edges. The cutting point should be specified on the design itself – so that the printers know where to print and where to do the cutting.

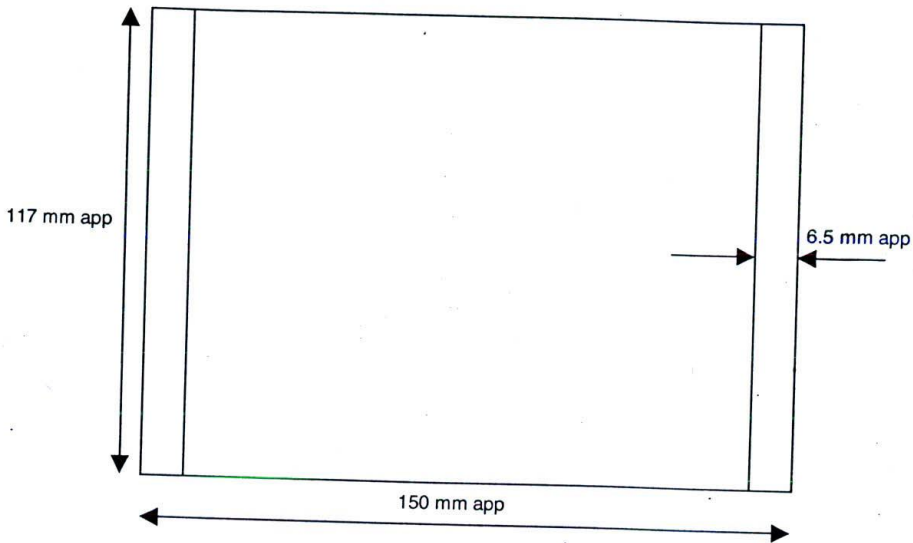


Figure 219: CD Jewel box - front cover

A typical example of a design with cutting edges is provided below.

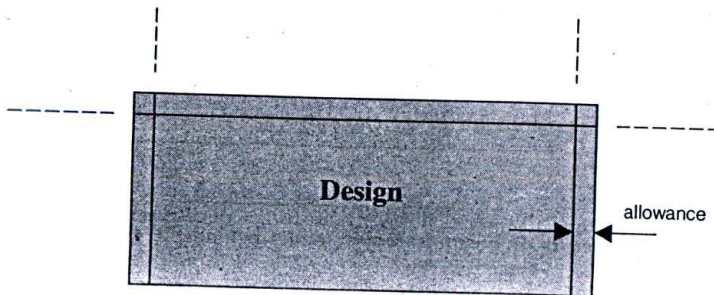


Figure 220: A typical design with cutting edges marked

25.4 Summary

For distributing CD-ROMs in the consumer market, the disc needs to be replicated using specialised equipments. The decision to go for replication is dictated by the quantity of CDs that need to be distributed. It is worthwhile to consider replication if the number of discs required cross 100 to 150.

CD-ROM replication involves a number of steps like pre-mastering, mastering, replicating and packaging. While third-party vendors execute many of these processes, the application developers still need to provide sufficient inputs for the vendors to execute their tasks.

Packaging the CD-ROM is a different ballgame altogether and is a mandatory exercise for all end consumer multimedia products.

25.5 Keywords

- Pre-mastering:** The process of transferring the application software to a CD-ROM for testing
- Mastering:** The process of producing a final master CD that has been thoroughly tested – to be given to the replicator for mass replication

Chapter 26

Digital Versatile Discs

CHAPTER OVERVIEW

This final chapter of our book discusses Digital Versatile Discs or DVDs, which are the new digital storage, and distribution mediums that are capable of voluminous storage of data. DVDs have taken quite some time to hit the mainstream market, but they look very promising and are set to dominate the digital disc landscape for quite some time to come.

We will first discuss the physical structure of DVDs and try to understand how they are able to store higher volume of data. Then we will focus on some of the physical variations that are allowable in DVDs, extending the total volume of data stored.

We will conclude with high-level discussions on DVD standards and Universal disc format (UTF).

26.1 Introduction

There were two major motivating factors or business requirements behind the evolution of disc mediums above and beyond CD-ROMs:

- The increasing need in the computer industry to store voluminous gigabytes of data
- The need for distributing digital movies in a single disc instead of multiple discs

This led to the evolution of Digital versatile disc or DVDs as we call them today.

Unlike the evolution of CDs whose specifications were cooked primarily in the kitchen of two companies – Philips and Sony, the evolution of DVD specification is a painful and long drawn one, which companies want to forget today.

It all started when two different groups of people started working on two different specifications for addressing the business requirements we saw earlier. Matsushita electric, Toshiba and Time Warner were the first group working on a format called Super Disc technology while the earlier pioneers Sony and Philips were going forward with another different format called Multimedia CD technology. Worried about having to cope up with two completely different hybrid disc formats, the computer industry majors forced the competing sides to form a consortium for evolving a single standard. This consortium, called the DVD Forum (<http://www.dvdforum.org>) evolved as a membership organization devoted to defining DVD standards for all kinds of DVD.

Though the first DVD specification was released in 1996 – but it took quite a while for the industry to work out the details and hit the mainstream. Today, DVD is being touted as the ultimate distributable disc storage technology available in the market, boasting a capacity of 4.7 GB, which can grow, to even 17 GB!

Making such back up copies, it should be stressed, for expected and possible data losses doesn't constitute infringement of Copyright, according to the Law, but distributing them by any means to any other individuals or organisations is undoubtedly a crime and is punishable under section 63 A, section 63 B, section 63 C and section 69 of the Indian Copyright (Amendments) act, 1994. It should also be noted that this exception to copy is allowed only in case of computer programs that are sold to the consumers as individual titles, and is not applicable to other forms of usages such as licensing. In case of licensed software, the license agreement comes into the picture and it's the agreement that decides whether a licensee can have back up copies or not.

Copyright is applicable to both published and unpublished works. The original creator of the work automatically becomes the copyright holder of the work, the moment his or her work is recorded in any tangible medium (say a Hard Disk or the Floppy Disk, in case of Software). It's interesting to note that his or her rights over the work are corroborated even without a formal registration. Registration comes into picture only in case of an infringement suit - when somebody claims that the work one is distributing is actually a replication of his original - and the whole matter ends up in the court. (In such cases, The Registrar of Copyrights can come out with a copy of the original registered Work and prove the authenticity of the original creator.)

The Copyright Law treats all computer programs as "Literary Works" and all protection extends to almost all kinds of software by means of this phrase. The 1994 amendments include necessary instructions that clearly recognise that computer programs are Literary Works. In the Court of Law, a Computer Program is defined as "a set of instructions expressed in words, codes, schemes or in any other form, including a machine readable Medium, capable of causing a computer to perform a particular task or achieve a particular result".

It's advisable to indicate that the Work is indeed a copyrighted material, in case you are distributing your work to the public or publishing it, in a prominent place that will not skip the viewer's attention. (Letter 'c' encircled with the year of creation and the name of the creator). By displaying this notification, you are informing without ambiguity that the literary work is a copyrighted material and cannot be reproduced without your permission.

If more than one author is involved in a creation, they enjoy joint authorship, and hence correspondingly, multiple copyright ownerships. If you are working for a firm, however, the software created by you belongs to the concern and there's no way to claim any authority over the work. In case a third party develops particular software, it's necessary for the client to insist on a written deed of agreement, transferring the copyright to the clients, from the sub-contractor.

Copyright Infringement

When the copyright of the software is considered infringed? The following words have exactly been reproduced from section 51 of The Copyright Amendment Act, 1994:

"Copyright in a work shall be deemed to be infringed -

- (a) When any person without a license granted by the owner of the copyright or the Registrar of Copyrights under this act or in contravention of the conditions of a licence so granted or of any conditions imposed by a competent authority under this act -
 - (i) Does anything, the exclusive right to do which is by this act conferred upon the owner of copyright, or
 - (ii) Permits for profit any place to be used for the communication of the work to the public where such communications constitutes an infringement of the copyright in the work, unless he was not aware and had no reasonable ground for believing that such communication to the public would be an infringement of copyright; or
- (b) When any person -
 - (i) Makes for sale or hire or sells or let for hire, or by way of trade displays or offers for sale or hire, or
 - (ii) Distributes either for the purpose of trade or to such an extent as to affect prejudicially the owner of the copyright, or

- (iii) By way of trade exhibits in the public, or
- (iv) Imports to India,

Any infringing copies of work:

Provided that nothing sub clause (iv) shall apply to the import of two copies of any work, other than a cinematograph film or record, for private and domestic use of the importer."

The Law clearly mentions the punishments in case of proven infringements:

A jail term of minimum six months but which may extend to three years and with a fine of minimum fifty thousand rupees, which may extend to two lakh rupees! In case the infringement happens inside an organisation, all of those who were in charge of the crime, as well as the organisation itself, is liable to be punished. (In case there are no other persons to take the responsibility, the General Manager or Managing Director or any highest authority is convicted)

Intellectual Property Rights, though applicable only on territorial basis, are extended to other parts of the world through two International Treaties:

1. **The Universal Copyright Convention**, adopted in 1952 and administered by UNESCO and
2. **The Berne Convention**, established in 1886 and being maintained by the World Intellectual Property Organisation (WIPO).

India is a member country of both these treaties, and thus, software created by an India Author or first published in India is automatically protected in a convention member country to the extent that the member's current copyright status protects software.

Courtesy: "Nasscom's Guide to IPR Laws in India" published by NASSCOM.