Media Technology / Student Presentation

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DVD – Digital Versatile Disc

DVD is an optical storage media. In optical storage media, the underlying principle is that information is represented by using the intensity of laser light reflected during reading. In a polycarbonate substrate layer of a CD, there are pits (depressions) and lands (areas between pits), corresponding to the data to be encoded. The reflected laser beam has a stronger intensity at the lands than at the pits, and the change from pit to land or from land to pit corresponds to the coding of a 1. If there is no change, a 0 is coded.

The sequential arrangement of pits and lands on an optical disc is the track, which is in a form of a spiral.

The development of optical storage media started at 1982 with the Compact Disc Digital Audio (CD-DA). A CD-DA has a play time of 74 minutes and a capacity of about 750 Mbytes. Eight-to-fourteen modulation is applied on the data and there are some techniques for error detection and correction included.

In 1985 the Compact Disc Read Only Memory (CD-ROM) was introduced, with which it was possible to divide the tracks into audio (corresponding to CD-DA) and data types. A CD-ROM can contain both types of tracks, whereby the mode 1 is used to store computer data (with better error correction) and mode 2 to store other media.

With the Compact Disc Read Only Memory Extended Architecture (CD-ROM/XA) in 1988 it was now possible to store blocks of different media in one track. This was achieved by introducing a subheader that describes each block. For the first time interleaved storage and retrieval was allowed and also storage of different compressed media.

Based on this in 1990 the Compact Disc Write Once (CD-WO) respectively Compact Disc Recordable (CD-R) came up. From now on the users were allowed to write (once) on a CD by heating the absorption layer to above 250 ^oC. There are regular CDs, on which the user can write only in one session, and hybrid CDs, where multiple sessions can be written.

The Compact Disc Magneto Optical (CD-MO) can be written multiple times. The block to be written is heated to above 150 ⁰C and a strong magnetic field is applied. The materials dipoles are polarized against this magnetic field. A pit is coded with a downwards-facing magnetic north pole. A land is coded using the opposite orientation. A CD-MO has two areas: the recordable area, which is not compatible with any other CD technology, and the read only area, which is compatible.

In 1995 the Compact Disc Read Write (CD-RW) was introduced. It can be repeatedly written, achieved by using the reversible changeability of chrystalline structures. The phase changes are made by heating the chrystal layer using the laser. The reflectivity of a CD-RW is lower than the preceding ones.

The DVD is the logical refinement of the CD-ROM, CD-WO and CD-RW technologies. The first standards were passed in the framework of the DVD forum in 1996.

The DVD alliance has fulfilled all the desires of the computer industry, for example compatibility between computer and TV applications (without substantial additional cost), compatibility for all DVD-ROM(read-only), DVD-R(write-once), or DVD-RAM(rewritable) DVD discs, corresponding to the file system proposed by the software industry and the International Standards Organization (UDF, ISO9660), no additional caddy or cartridge required, most reliable error correction method system currently available, 4.73GB up to 17GB capacity and high-performance data access.

One main difference between a CD and a DVD is the higher capacity of a DVD. This was achieved by decreasing the track pitch (from 1,6 μ m to 0,74 μ m) and the track width (from 0,6 μ m to 0,24 μ m). High-density data storage is possible because now a red laser (in comparison to an infrared laser) with shorter wavelength is used and is able to read the narrowed pits and lands; additional focused through a large-aperture lens.

Another improvement concerning the capacity is the possibility to store data within two layers. This is achieved by having on one side two lasers and two parallel data streams within two substrate layers, one of them semi-transparent. Additional one DVD can contain two sides, both with two layers.

The picture quality is much better on a DVD, because an improved video compression standard is used: With this the image size is enhanced (720x480 pixels instead of 352x240) and the number of frames per second, 60, is double than on a CD.

	CD	DVD
Media Diameter	about 120 mm	120 mm
Media Thickness	about 1.2 mm	about 1.2 mm
Laser Wavelenght	780 nm (infrared)	650 and 635 nm (red)
Track Pitch	1,6 μm	0,74 μm
Minimum Pit/Land Length	0,83 μm	0,4 μm
Data Layers	1	1 or 2
Sides	1	1 or 2
Capacity	about 650 MB	about 4.7 GB (SLSS)
		about 8.5 GB (DLSS)
		about 9.4 GB (SLDS)
		about 17 GB (DLDS)
Video Data Rate	about 1.5 Mbit/s	1-10 Mbit/s (var.)
Video Compression Standard	MPEG-1	MPEG-2
Video Capacity	about 1 hour	Depending on format, 2 - 8 hours
Sound Tracks	2-channel MPEG	2-channel PCM
		5.1-channel AC-3
		Optional: up to 8 data streams
Subtitles	-	Up to 32 languages

An overview to the main differences between CD and DVD is shown in the table below.

There are three DVD application formats: DVD Video (superior picture and sound quality, additional versatile functions), DVD Audio (ultrahigh sound quality and long playback time) and DVD-ROM (large capacity and high speed). On one DVD all formats can be mixed. Additional there are three DVD recording types: DVD-ROM (Read Only), DVD-R (Write Once) and DVD-RAM (Rewritable).

4.7 GB capacity of just one side of a DVD-Video disc is ample for storage of a 133-minute movie with dubbing in three languages, subtitles in four languages and high-quality 5.1-channel digital surround sound. Indeed, there is enough capacity for more than 90% of the movies on the market. DVD-Video offers an entirely new experience in visual entertainment. Besides superior picture and sound quality, various powerful functions can be implemented for DVD. Fore example there are: Multilingual Function for languages galore, Multi-angle Function for the angle of your choice, Multistory Functions like Main Story and Sub-story, Multiversion, Highlight Scene Scan, Parental Lock Function, Branching Story, and other interactive functions.

The trends in DVD technology are:

- More and more DVD-ROM drives worldwide
- DVD-Player are getting cheaper and cheaper
- More efficient compression methods
- Capacity is growing
- Mini-DVDs for Mobiles and Digital Camcorder
- HD-DVD: High-density formats: use blue or violet lasers to read smaller pits, increasing data capacity to around 15 to 30 GB per layer (2005/2006)