Information Technology
Inside and Outside
- David Cyganski & John A. Orr

VI. Transmission and Storage Technology

17. Large -Capacity Storage

Hoon -Jae Lee
Http://cg.dongseo.ac.kr/~hjlee
hjlee@dongsoe.ac.kr

17. Large -Capacity Storage

- Objectives:
  - magnetic storage systems, including tapes and discs;
  - the Compact Disc (CD) which stores digital data optically, and which has found widespread use both for data and music storage; and
  - the DVD (Digital Versatile Disc or Digital Video Disc) which extends and enhances CD technology, allowing more data to be stored on one disc.

17.3 The Compact Disc

- A single **CD-ROM** containing computer data can accommodate up to **650 MB of data**, over 450 times the capacity of 1.44 MB floppy diskette, on a **1.2 mm thick disc** only **12 centimeters in diameter**
- **Audio-CD** technology has, for the most part, replaced analog phonograph technology among not only high-fidelity enthusiasts but the general populace.

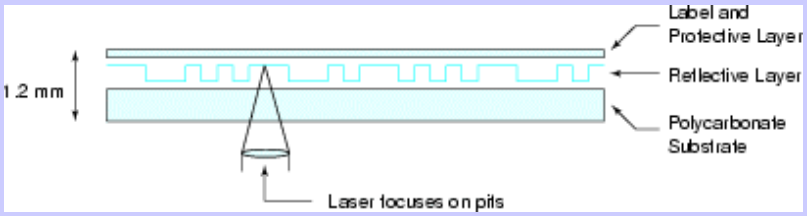
- **CD-ROMs** are identical to Audio-CDs, but to facilitate computer access, a different standard is used to arrange the data on the disc.

Figure 17.1: A Compact Disk.

17.3 The Compact Disc(2)

- **Audio-CD data** is divided into fixed-length units as follows:
  - **A frame consists of 24 bytes of user data (plus 1 byte of subchannel coding and 8 bytes of ECC code).**
  - **98 frames make up a block, each with bytes of user data.**
  - **75 blocks make up a larger storage unit called a ``second'' for reasons that will be obvious later.**
  - **60 seconds make up a ``minute.''**
  - **74 minutes make up one complete CD of storage for an audio CD.**

Figure 17.2: Physical composition of a standard CD.



17.3 The Compact Disc(3)

- **exactly 74 minutes saved as 783,216,000 bytes (747 MB)**

$$R = 44,100\frac{\text{samples}}{\text{sec} * \text{channel}} * 2\frac{\text{bytes}}{\text{sample}} * 2 \text{ channels} = 176,400\frac{\text{bytes}}{\text{second}}.$$

Table 17.1: Yellow Book CD-ROM Capacities

Minutes per disc	63	74
Sectors per second	75	75
Sectors per minute	4,500	4,500
Bytes per sector (EDC/ECC)	2,048	2,048
Sectors per disc	283,500	333,000
Bytes per disc	580,608,000	681,984,000
Disc capacity	553.71 MB	650.39 MB

17.3 The Compact Disc(4)

Table 17.2: Common CD Technology Standards

Medium	Specification	Features
Audio-CD	Red Book	defines fundamental parameters to CD technology
CD-ROM	Yellow Book ISO 9660	standardizes CD computer data storage, ensures interoperability across multiple vendors
CD-ROM XA	Yellow Book	provides both CD-I and CD-ROM capabilities
CD-I	Green Book	specification for interactive audio and video, provides for the interleaving of data
CD-Photo	Orange Book	write once capability, standardizes still photographs, supports a variety of resolutions
CD-R	Orange Book	write once capability
CD-RW	Orange Book	erase and write many times capability

17.4 Digital Versatile Disk

❑ In April 1997, the DVD Consortium renamed itself the DVD Forum. Currently, **over 100 companies** are members of the **DVD Forum**.
❑ Using **a smaller-wavelength laser (635/650 nm),** DVD offers increased data capacity over conventional CD technology by decreasing the pit size and track spacing.
❑ Further, additional capacity is gained by reducing the overhead of error detection and correction. Data can be recorded in as many as four layers, up to two layers per side.
❑A **single layer** is capable of holding approximately **4.7 billion bytes of data**, about seven times that of conventional CD technology.

17.4 Digital Versatile Disk(2)

❑

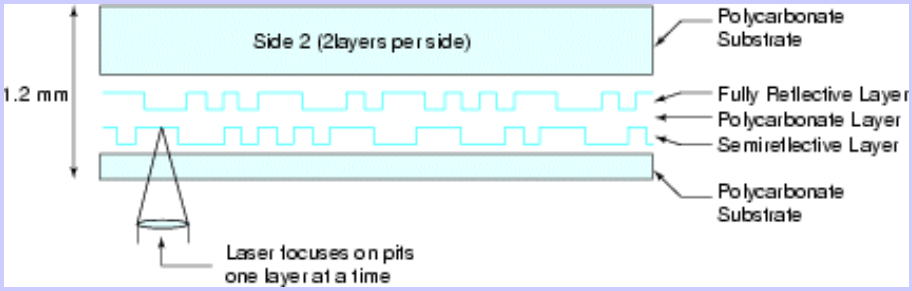
Table 17.3: Standardized DVD-ROM Capacities

DVD-ROM	Capacity (billions of bytes)
single sided, one layer	4.7
single sided, two layers	8.5
double sided, one layer per side	9.4
double sided, two layers per side	17

17.4 Digital Versatile Disk(3)

❑ A **single-sided DVD disc** with two layers for a total disc capacity of **8.5 billion bytes**.
❑ The second side of the disc is simply a **0.6 mm polycarbonate layer, resulting in a 1.2 mm thick disc.**

Figure 17.3: Physical composition of a single-sided DVD disc with two layers.



17.4 Digital Versatile Disk(4)

❑ A **single-sided DVD disc** with two layers for a total disc capacity of **8.5 billion bytes**.
❑ The second side of the disc is simply a **0.6 mm polycarbonate layer, resulting in a 1.2 mm thick disc.**

Table 17.4: CD and DVD Comparison

Characteristic	DVD	CD
Disc Diameter	120 mm	120 mm
Disc Thickness	1.2 mm	1.2 mm
Laser Technology	Red (635/650 nm)	Infrared (780 nm)
Minimum Pit Size	0.40 μm	0.83 μm
Track Spacing	0.74 μm	1.60 μm
Layers	1, 2, or 4	1
Capacity per Layer	4.38 GB	0.64 GB
Maximum Capacity	4.38-15.90 GB	0.64 GB