CDROM, Floppy and Hard Disk Structure

Plus some basic concepts
History

• Compact Disc - Digital Audio (CD-DA), the original CD specification developed by Philips and Sony in 1980
• Specifications were published in Red Book, continued to be updated (lastest version in 1999)
• In 1985 a standard for the storage of computer data by Sony and Philips, CD-ROM (Compact Disc Read Only Memory)
• Developments in the technology have been ongoing and rapid
  – Compact disc Interactive (CD-I)
  – Compact Disc Television (CD-TV)
  – Compact Disc Recording (CD-R)
  – Digital Video Disc (DVD)
Structure

- The *thickness* of a CD can vary between 1.1 and 1.5mm
- CDROM can store 720 MB of data.
- A CD consists of four layers
  - The biggest part is clear polycarbonate (nominally 1.2mm)
  - There is a very thin layer of reflective metal (usually aluminum) on top of the polycarbonate
  - Then a thin layer of some protective material covering the reflective metal
  - A label or some screened lettering on top of protective material
CD Layers (cont’d)
A CDROM Drive uses a small plastic-encapsulated disk that can store data. This information is retrieved using a Laser Beam. A CD can store vast amounts of information because it uses light to record data in a tightly packed form.
Structure (cont’d)

- On surface of CDROM, laser beam to use to was be "punched" to according the spiral called the pits. These positions do not have "punch" as land.
  - The 0.12 micron deep pit, approximately 0.6 microns wide.
  - The pit and land length from 0.9 to 3.3 microns.
  - The distance between the spiral is 1.6 micron.
  - Track density on a CDROM is about 16,000 tracks per inch.
CD vs. Magnetic Media

• In Magnetic Media (like floppy/hard disk) the surface is arranged into concentric circles called “tracks”
• Number of sectors per track is constant for all tracks
• The CD has one single track, starts at the center of the disk and spirals out to the circumference of the disk
• This track is divided into sectors of equal size
CD Data Recording

- Information is recorded on a CD using a series of bumps

- In the recording, Lazer gun was used to write data to disk
  - Signal corresponding to 0 => laser off.
  - Signal corresponding to 1 => laser on => burned disk surface into a point of losing the ability to reflect
Data Recording (cont’d)

• The unmarked areas between pits are called "lands"
• Lands are flat surface areas
• The information is stored permanently as pits and lands on the CD-ROM. It cannot be changed once the CD-ROM is mastered, this is why its called CD-ROM
Data Reading

- Laser reflection on rotating disk surface, the pit will be lost reflected rays => that is “0” signal, the land they received reflected rays => that is “1” signal
How The CD Drive Works

• A motor rotates the CD
• The rotational speed varies so as to maintain a constant linear velocity (the disk is rotated faster when its inner "SPIRALS" are being read)
How The CD Drive Works (cont’d)

- A laser beam is shone onto the surface of the disk
- The light is scattered by the pits and reflected by the lands, these two variations encode the binary 0's and 1's
- A light sensitive diode picks up the reflected laser light and converts the light to digital data
How The CD Drive Works (cont’d)
CD-ReWrittable (CD-RW)

- It is essentially CD-R
- Allows discs to be written and re-written up to 1000 times
- The storage capacity is the same as that for CD-R
- Based on phase-change technology.
- The recording layer is a mixture of silver, indium, antimony and tellurium
CD-RW Recording Process

- The recording layer is polycrystalline
- The laser heats selected areas of the recording track to the recording layer's melting point of 500 to 700 degrees Celsius
CD-RW Recording (cont’d)

- The laser beam melts the crystals and makes them non-crystalline (amorphous phase)
- The medium quickly cools, locking in the properties of the heated areas
- The amorphous areas have a lower reflectivity than the crystalline areas
- This creates a pattern which can be read as pits and lands of the traditional CD
- To erase a CD-RW disc, the recording laser turns the amorphous areas back into crystalline areas
**DVD**

- **Digital Versatile Disk** (Formerly **Digital Video Disk**)
- Same size (120mm) and thickness (1.2mm) as CD
- Improvements in the logarithms used for error correction
- Much greater data accuracy using smaller Error Correction Codes (ECC)
- More effective use of the track space
DVD vs. CD

- DVD uses a tighter spiral (track or helix) with only 0.74 microns between the tracks (1.6 microns on CDs)
- DVD recorders use a laser with a smaller wavelength, 635nm or 650 nm (visible red light) vs. 780nm (infrared) for CDs
- DVD has smaller "burns" (pits) in the translucent dye layer (0.4 microns minimum vs. 0.83 microns minimum on CDs)
- These technologies allow DVDs to store large amounts of data
DVD (cont’d)

- Standard single-sided DVDs store up to 4.7GB of data
- Dual-sided discs hold about 8.5GB of data (9.4GB for back-to-back layers dual-sided discs)
- In back-to-back layers discs, it must be turned over to access the data on the reverse side
- DVD uses MPEG2 compression for high quality pictures
- DVD drives have a much faster transfer rate than CD drives
- DVD-ROM drives will read and play existing CD-ROM and CD-A disks
## DVD (cont’d)

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<th>Types</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>DVD-5</td>
<td>4.7GB Single-Side, Single-Layer capacity 4.7 GB.</td>
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<tr>
<td>DVD-9</td>
<td>8.5GB Single-Side, Dual-Layer Capacity 8.5 GB.</td>
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<td>DVD-10</td>
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<td>17.1GB Double-Side, Dual-Layer Capacity 17.1 GB.</td>
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PART 2

Blu-ray VS HD-DVD
Blu-ray disc

- Blu-ray Disc (official abbreviation BD) is an optical disc storage medium designed to replace the DVD format.
- The standard physical medium is a 12 cm plastic optical disc, the same size as DVDs and CDs.
- Blu-Ray Discs contain 25 GB per layer, with dual layer discs (50 GB) the norm for feature-length video discs and additional layers possible later.
HD - DVD

• HD DVD-ROM, HD DVD-R and HD DVD-RW have a single-layer capacity of 15 GB, and a dual-layer capacity of 30 GB.
• HD DVD-RAM has a single-layer capacity of 20 GB. Like the original DVD format, the data layer of an HD DVD is 0.6 mm below the surface to physically protect the data layer from damage.
• All HD DVD players are backward compatible with DVD and CD.
USB Flash drive

- A **USB flash drive** consists of a flash memory data storage device integrated with a USB (Universal Serial Bus) interface.
- USB flash drives are typically removable and rewritable, and physically much smaller than a floppy disk.
- Most weigh less than 30 gram. Storage capacities in 2010 can be as large as 256 GB with steady improvements in size and price per capacity expected.
USB speed

- USB 1.0 – speed 1.5 Mb/s
- USB 1.1 – speed 12 Mb/s
- USB 2.0 – speed 480 Mb/s
- USB 3.0 – speed 5 Gb/s
Hard disk drive

- Disk platter
- Read/Write head
- Head arm/Head slider
- Head actuator mechanism
- Spindle motor
- Logic board
- Air filter
- Cables & Connectors
Hard Disk

- Fixed and removable
- Fast (disk rotates at 60 to 200 times per second)
- Currently 20 – 2 TB (may be limited by the version of the operating system)
- Like floppies, uses the magnetic properties of the coating material, but the technology is different
Cluster

- Data units of disk must be addressed, which units belong to which file / are free / are damaged (bad sectors) / …
- On disks having large capacity, purposing one sector as a unit makes addressing table so large → Cluster is defined
- Represents the smallest amount of disk space that OS can be allocated
- The smaller the cluster size, the more efficiently disk space usage, the more number of bits to address one unit
- The number of sectors per cluster is stored in the Boot Record