Optical Storage

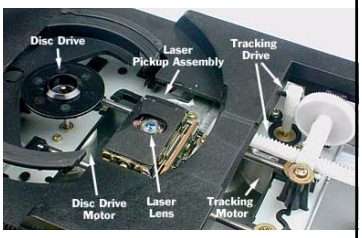
Overview

- **In this part, you will learn to**
  - Understand how CD/DVD stores data
  - Identify variations of CD media technology
  - Identify variants in DVD media technology
  - Install CD and DVD media drives
  - Troubleshoot CD and DVD media drives

Optical Storage

- Optical storage is similar to magnetic storage in basic operation but reads and records using light instead of magnetism.

CD ROM Drive



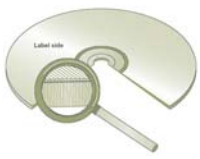
CD Media

CD Media

- **CD Media includes:**
  - CD-ROM (Compact Disc – Read Only Memory)
  - CD-R
  - CD-RW
  - DVD

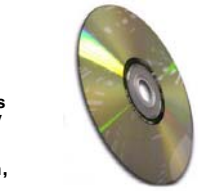
How CD-ROMs Work

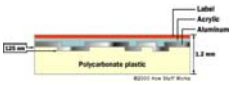
- **CD-ROMs store data using microscopic pits burned into a glass master CD-ROM with a powerful laser**
- **CD-ROMs store data on only one side of the disc, near the "top" of the CD-ROM, where the label is located**
  - Scratches on the label side are more serious
- **CD-ROM drives use a laser and mirrors to read data**



How CD-ROM Work

- Most of a CD consists of an injection-molded piece of clear polycarbonate plastic.
- During manufacturing, this plastic is impressed with microscopic bumps arranged as a single, continuous, extremely long spiral track of data.
- Once the clear piece of polycarbonate is formed, a thin, reflective aluminum layer is sputtered onto the disc, covering the bumps.
- Then a thin acrylic layer is sprayed over the aluminum to protect it. The label is then printed onto the acrylic.





How CD-ROMs Work

- The metallic covering on the CD-ROM makes a highly reflective surface
- The pits don't allow reflection, creating binary 1s, and the nonpitted spots (lands) make binary 0s
- These pits are densely packed on the CD-ROM enabling a vast amount of data to be stored

How CD-ROM Work

- A CD has a single spiral track of data, circling from the inside of the disc to the outside.

CD-ROM Formats

- The first CD-ROMs, and all music CD-ROMs, organize music in a special format called the CD-Digital Audio (CD-DA), known commonly as the CD-Audio
- CD-Audio divides the CD's data into variable length tracks
- No error checking – so not a good way to store data

CD-ROM Formats

- CD-ROM is also known as ISO 9660 and High Sierra
- Enables error checking
- Good for storing data

CD-ROM Formats

- The CD-Interactive (CD-I) format, enabled storage of sound and video, and simultaneous playback
- The CD-ROM/XA is a specialized format that takes most of the interesting features of CD-I
- Kodak's Photo-CD format is a compressed format that stores many photos on one CD-ROM
- A typical CD-ROM drive can read almost every type of format

CD-ROM Speeds

- The first CD-ROM drives processed data at roughly 150 KBps (150,000 Bytes per second)
- Each increase in speed is measured in multiples of the original 150 KBps drive and is denoted by 'X' to show speed relative to the first (1 X) drives

1x	150 KBps	10x	1,500 KBps	40x	6,000 KBps
2x	300 KBps	12x	1,800 KBps	48x	7,200 KBps
3x	450 KBps	16x	2,400 KBps	52x	7,800 KBps
4x	600 KBps	24x	3,600 KBps	60x	9,000 KBps
6x	900 KBps	32x	4,800 KBps	72x	10,800 KBps
8x	1,200 KBps	36x	5,400 KBps		

CD-R

- The CD Recordable (CD-R) standard, enabled inexpensive CD-R drives to add data to special CD-R discs
- Preceded by Write Once Read Many (WORM) technologies in an attempt to make inexpensive CD burners
- A CD-ROM drive can read the data stored on the CD-R, and all CD-R drives can read regular CD-ROMs
- CD-R discs come in 74-minute (650 MB) and 80-minute (700 MB) varieties

CD-R

- CD-R drives record data using special organic dyes embedded into the disc
- CD-R burners have a second burn laser, roughly ten times as powerful as the read laser, for creating the equivalent of CD-ROM's pits
- The data on the CD-R disc cannot be changed or erased once it is burned by the CD-R drive

CD-R

- Earlier CD-R drives had to burn the entire disc in one session, wasting unused parts of the disc. They were called single-session drives
- Modern CD-R drives are multisession drives that enable burning additional data onto the disc until it is full
  - Multisession drives also enable closing a partially filled disc
- A special burner software, which is usually provided with the CD-R drive, is used for burning data onto the disc
- CD-R drives have two speeds: record & read (2x4 for example)

CD-RW

- CD Rewrite (CD-RW) works by using a laser to heat an amorphous (crystalline) substance, which when cooled slowly becomes crystalline
- The crystalline areas are reflective whereas the amorphous areas are not
- The MultiRead method allows regular CD-ROM drives to read CD-RW discs

CD-RW

- Most CD-RW drives today utilize a function called 'packet writing' under a special format called the Universal Data Format (UDF)
- This gives true drag-and-drop capabilities to CD-RW drives
- CD-RW drive specifications have three multiplier values: write, rewrite, read (8x4x32)

Music CDs

- **Home recorders use a slightly different disc called the Music CD-R**
- **The Music CD-R disc restricts duplication**
- **You can record to a Music CD-R, but you cannot record from one**

DVD Media

DVD Overview

- **Developed by a consortium of electronics and entertainment firms and released as digital video discs (DVD) in 1995**
  - DVD uses smaller pits than CD media and packs them more densely…creating much higher data capacities
  - Both single-sided (SS) and dual-sided (DS) formats
  - Single-layer (SL) and dual-layer (DL) formats

DVD Versions/Capacities	
DVD Version	**Capacity**
DVD-5 (12 cm, SS/SL)	4.37 GB, more than two hours of video
DVD-9 (12 cm, SS/DL)	7.95 GB, about four hours of video
DVD-10 (12 cm, DS/SL)	8.74 GB, about four and a half hours of video
DVD-18 (12 cm, DS/DL)	15.90 GB, more than eight hours of video

DVD-Video

- **DVD-Video can store two hours of video on one side**
  - Supports TV-style 4:3 aspect ratio screens as well as 16:9 theatre screens
    - Some producers distribute both on opposite sides of the DVD
  - Uses MPEG-2 video and audio compression standard
    - Up to 1280x720 at 60 frames per second with CD-quality audio

Decoder

- **DVD-videos uncompress MPEG data on the fly using either hardware of software decoders**
  - Hardware decoders come as PCI cards
  - Software decoders require a faster CPU
    - 300 MHz CPU with lots of extra RAM

Monitor and Speakers

- **Monitor**
  - Computer monitors work fine but most people want to watch movies on their TV
  - To realize the full quality of DVD you'll need a high-definition television (HDTV) set
- **Speakers**
  - DVD-Video stores up to 8 audio tracks
    - Used for multiple languages in stereo
    - Used for surround sound

DVD Players

- **DVD players are readily available and relatively inexpensive today**

DVD-ROM & Recordable DVD

- **DVD-ROM**
  - Similar to CD-ROM data format
  - Can store up to 16 GB of data
  - Support DVD-video and most CD-ROM formats
- **Recordable DVD**
  - DVD-R and DVD+R
    - May write to them only like CD-R
  - DVD-RW, DVD+RW, DVD-RAM
    - Written and rewritten like CD-RW
  - Combo drives can do all of these-look for DVD Multi on the label
  - No standard format yet for recording

Installing CD and DVD Media Drives

Early CD-ROM Controllers

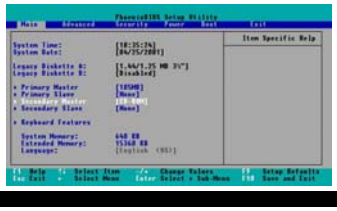
- **In the absence of a standard, the first CD-ROM makers had to provide their own controllers**
- **Panasonic, Sony, and Mitsumi were the three groups of first generation CD-ROM controllers**
  - Creative Labs saw CD-ROMs as a natural complement to their sound cards, so they built in CD-ROM controllers (sometimes including all three types)

Connections Using ATAPI

- **ATA Packet Interface (ATAPI):**
  - An extension of the EIDE standard that allows mass storage devices other than just EIDE to use the ATA interface
  - Treats a CD-ROM as an EIDE drive
  - Use regular 40-pin IDE connectors and master/slave jumpers
  - Unlike EIDE drives, ATAPI drives require no CMOS changes as a part of the installation process

Go Away!

- **No CMOS changes are required when installing an ATAPI drive, but techs used to installing hard drives swamped the help desks of CD-ROM makers searching for how to change the CMOS. To reduce these calls, manufacturers added a CD-ROM option in the CMOS, but this option really does nothing.**



Connections using SCSI

- **Small Computer System Interface (SCSI):**
  - SCSI predates ATAPI and in many ways is a superior way to use CD media
  - SCSI chain enables many CD-ROM drives to be installed on a single machine
  - SCSI CD media drives need to have a unique SCSI ID and need to be terminated if they are on the end of a SCSI chain
  - SCSI CD-ROMs are one of the most common external SCSI devices

Device Drivers/Software

- **CD drives need device drivers to operate**
- **The process of converting a CD-ROM drive into a device visible to the system, with its own drive letter, varies according to the CD-ROM connection and the computer operating system**

DOS Device Drivers

- **Microsoft developed a two way process to install the CD-ROM in DOS:**
  - First, a hardware specific device driver was installed via CONFIG.SYS to create an interface to the CD-ROM (provided by the manufacturer)
  - Second, a higher-level, hardware non-specific program called MSCDEX was run from the AUTOEXEC.BAT to assign the CD-ROM a drive letter (provided by Microsoft)

Config.sys

SCSI:

Device=a:\himem.sys
Device=a:\aspi2dos.sys
Device=a:\aspicd.sys /d:aspicd

The Win95 startup disk will contain himem.sys.

The ASPI driver for your host adapter (aspi2dos.sys) and a copy of aspicd.sys is provided by every host adapter supplier for free.

ATAPI:

Device=a:\oakcdrom.sys /d:mscd001

Oakcdrom.sys is on the Win98 startup disk and also available on many Internet sites for free. Many ATAPI drivers like oakcdrom.sys work with any ATAPI CD media device.

Note: What comes after the /d is immaterial...just use the same thing in autoexec.bat.

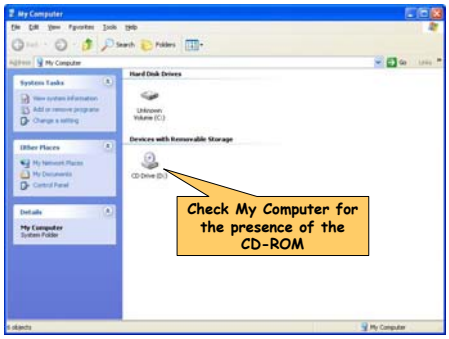
Autoexec.bat

- **Use the Microsoft CD-ROM Extensions program (MSCDEX.EXE) with the /D option (match the name from config.sys)**
  - Mscdex /d:mscd001

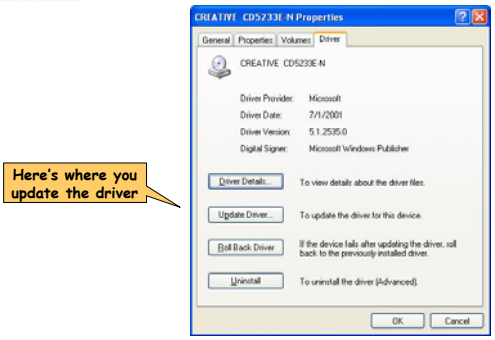
Win9x and Win2000 Device Drivers

- **Windows replaced MSCDEX with the protected-mode CD File System (CDFS) driver**
  - Part of the Windows Installable File System (IFS) family of cooperative drivers for storage devices
  - Windows also contains built-in drivers for all CD-ROMS

Verifying Installation



CD-ROM Properties



Auto Insert Notification

- Called AutoRun in Windows 9x/Me
- Called AutoPlay in Windows 2000/XP
- Windows will automatically detect the presence of a CD and search for autorun.inf to start the CD

CD-ROM Applications

- A regular CD-ROM installation involves no applications
- CD-R and CD-RW drives require applications to enable their burning feature
  - Roxio's Easy CD Creator (subsidiary of Adaptec) is the most popular
  - Nero Burning ROM is also popular

Booting to CD-ROMs

- Modern operating systems come with bootable CDs
- The boot order settings in CMOS enable booting from the bootable CD

Troubleshooting

Troubleshooting

- **Connectivity problems are common problems and can occur if the power connector is not plugged in, cables are inserted incorrectly, or the jumpers have been misconfigured**
- **A DOS-level device driver could be used if no BIOS support is present**
  - ATAPI drives usually show up during boot up in text on the screen
  - SCSI drives usually give you an option to choose the SCSI BIOS, and you can then get a list of SCSI devices

Troubleshooting

- **Most modern CD media drives have a built-in cleaning mechanism**
- **CD media disks can be easily cleaned using a damp cloth, and occasionally a mild detergent**
- **Problems such as stuck discs occur from user error and are not due to faulty drives**
  - There is a small hole on the front of the CD drive. Insert a small wire like an extended paper click in the hole to manually eject the CD media from the drive.

Burning Issues

- **Know What It Can Do**
  - Check out technical documentation before making a purchase
  - Type "review" and the model number in a search engine to get other opinions
- **Media Issues**
  - Media quality is based on speed and inks
    - Check for a manufacturer guarantee on speed

Buffer Underrun

- **Most often occurs when copying from CD-ROM to CD-R or CD-RW**
  - Inability of the source device to keep the burner loaded with data
  - Make sure your CD-RW drive has 2MB or larger buffer
  - Create an image file – one big file on the hard drive first because any hard drive can keep up with a CD burner

Firmware Updates

- **Most drives come with an upgradeable flash ROM chip**
- **Check the manufacturer's website for an update**

Books

CD Media Book Colors

Application	Book	Subtypes
Audio CDs	Red Book	N/A
Data CDs	Yellow Book	Mode 1 Original Format Mode 2 Form 1 and Form 2
CD-I	Green Book	N/A
Recordable CDs	Orange Book	Part I CD-MO (Magneto-Optical) Part II CD-R, includes Photo-CD Part III CD-RW
Video CD	White Book	N/A
CD Extra	Blue Book	N/A