Storage Devices

IT Essentials Chapter 1

History of the Floppy Disk Drive

- The floppy disk drive (**FDD**) was invented at IBM by Alan Shugart in 1967. The first floppy drives used an 12-inch and then an 8-inch disk (later called a "**diskette**" as it got smaller), which evolved into the 5.25-inch disk that was used on the first IBM Personal Computer in August 1981. The 5.25-inch disk held 360 kilobytes compared to the 1.44 megabyte capacity of today's 3.5-inch diskette.
- The 5.25-inch disks were dubbed "**floppy**" because the diskette packaging was a very **flexible plastic envelope**, unlike the rigid case used to hold today's 3.5-inch diskettes.

History of the Floppy Disk Drive

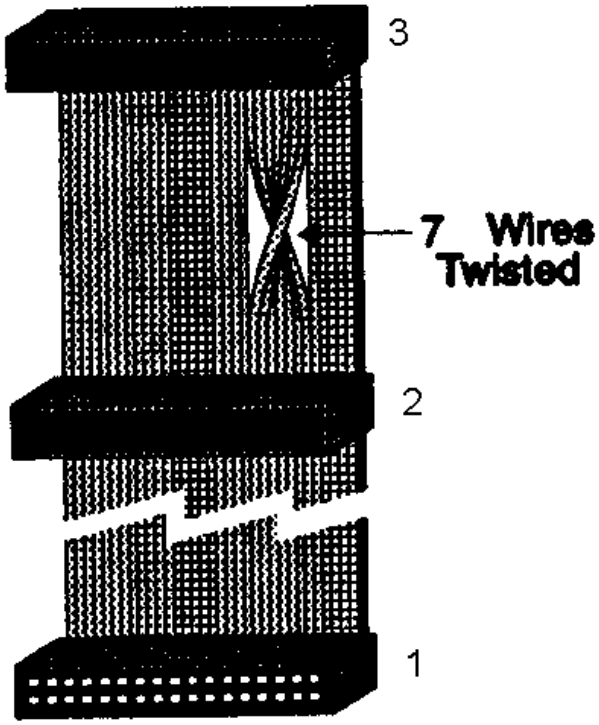
- By the mid-1980s, the improved designs of the read/write heads, along with improvements in the magnetic recording media, led to the less-flexible, 3.5-inch, 1.44-megabyte (MB) capacity FDD in use today.
- For a few years, computers had both FDD sizes (3.5-inch and 5.25-inch). But by the mid-1990s, the 5.25-inch version had fallen out of popularity, partly because the diskette's recording surface could easily become contaminated by fingerprints through the open access area.

Floppy Drive Connections

- All floppy drive cables allow you to connect 2 drives to each system
- Designated by A: and B:
- The position on the cable determines whether it is A: or B:
- Drive type set in CMOS
- Always connect pin 1 on the cable to pin 1 on the drive

Cable Positions

- Uses a Ribbon Type cable with 34 pins
- All drives after the twist are A: (#3)
- Drives in the middle are B: (#2)
- The end plugs into the motherboard (#1)



Floppy Cable

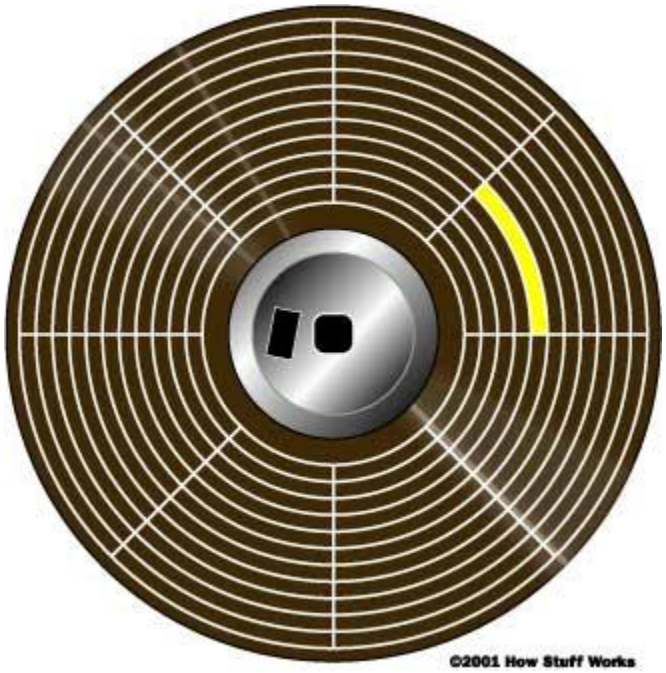
Maximum cable length is 24 inches

Power Connectors

- 5-1/4” drives use a Molex connector
- 3-1/2” drives use a Berg connector
- Can be inserted one way only
- Required 12v to operate

Parts of a Floppy Disk Drive

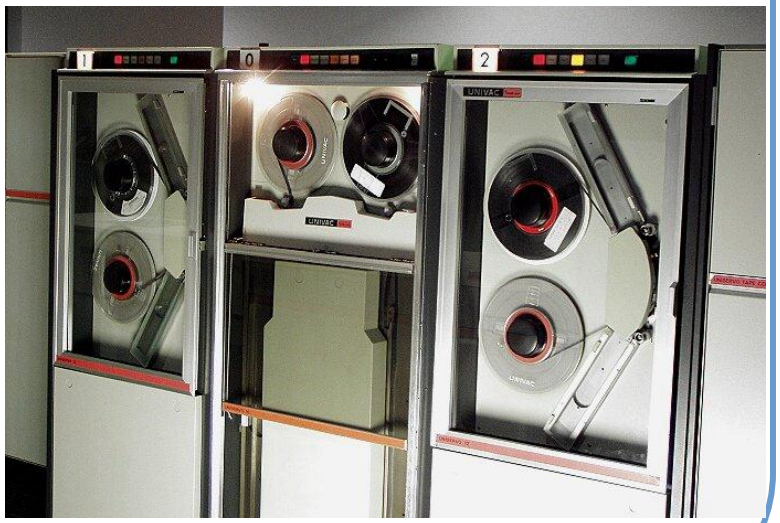
- A floppy disk is made from a thin piece of plastic coated with a magnetic material on both sides. The tracks are arranged in **concentric rings** so that the software can jump from "file 1" to "file 19" without having to fast forward through files 2-18. The diskette spins like a record and the heads move to the correct track, providing what is known as **direct access storage**.



In the illustration above, you can see how the disk is divided into tracks (brown) and sectors (yellow).

Tape Drives

- A **tape drive** is a data storage device that reads and performs digital recording, writes data on a magnetic tape.
- Typically used for offline, archival data storage.
- Tape media generally has a favorable unit cost, long archival stability and high capacity (up to 5000GB+).
- Common for company backups and archives.
- SCSI most common



Hard Disk History

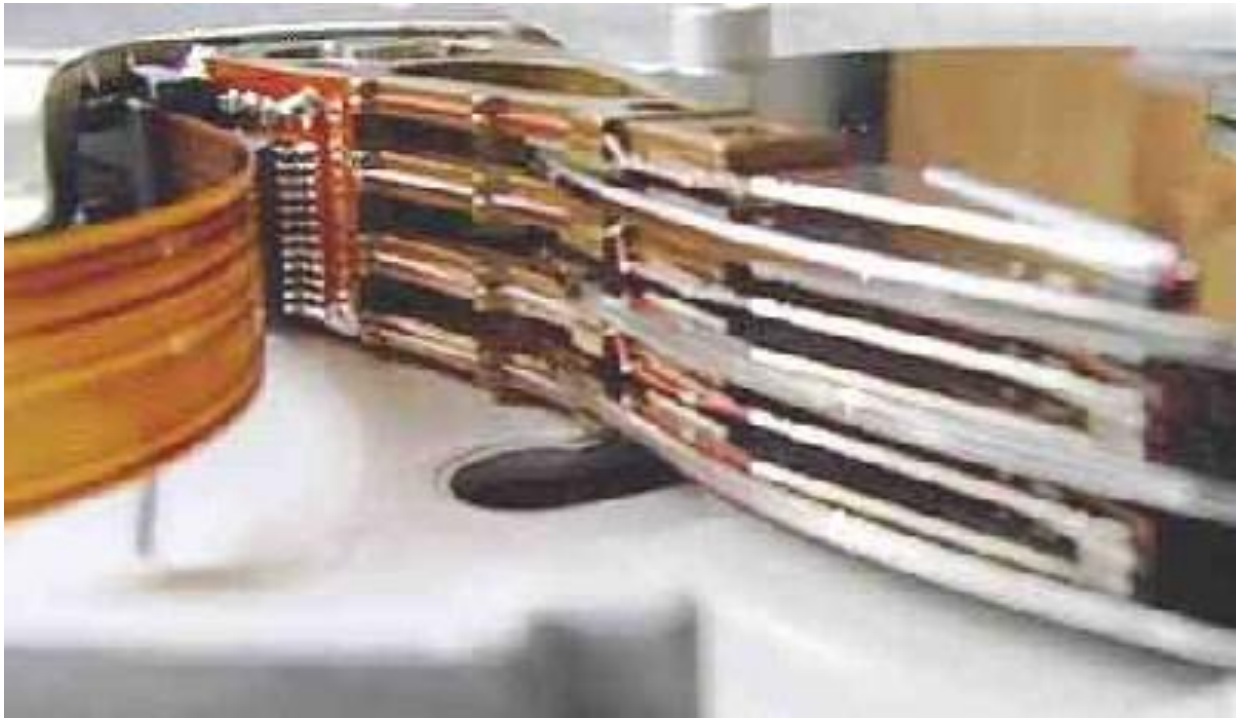
- Hard disks were invented in the 1950s. They started as large disks up to 20 inches in diameter holding just a few megabytes.
- They were originally called "fixed disks" or "Winchesters" (a code name used for a popular IBM product).
- They later became known as "hard disks" to distinguish them from "floppy disks."
- Hard disks have a hard platter that holds the magnetic medium, as opposed to the flexible plastic film found in tapes and floppies.

Inside a Hard Disk

- The **platters**, which typically spin at 5,400, 7,200, 10,000, or 15,000 rpm when the drive is operating. (7,200 rpm = 170 mph)
- In order to increase the amount of information the drive can store, most hard disks have **multiple platters**. This drive has three platters and six read/write heads.

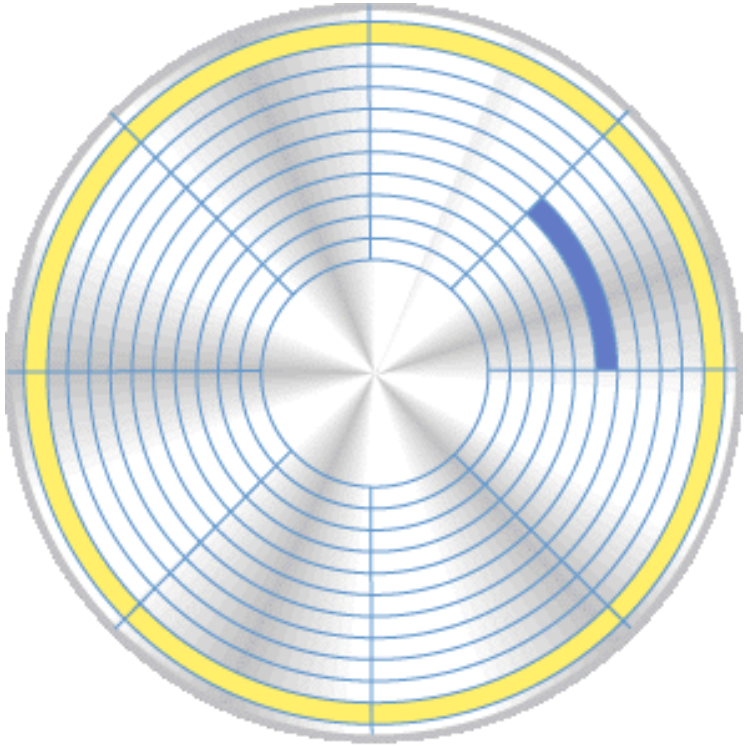
Inside a Hard Disk

- The mechanism that moves the arms on a hard disk has to be incredibly fast and precise. It can be constructed using a high-speed linear motor.



Storing the Data

- Data is stored on the surface of a platter in **sectors** and **tracks**.
- Tracks are concentric circles, and sectors are pie-shaped wedges on a track.
- A typical track is shown in yellow; a typical sector is shown in blue.
- Sectors are often grouped together into **clusters**.



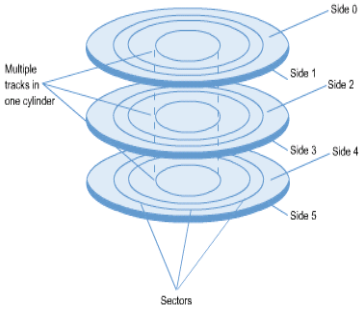
A typical track is shown in yellow; a typical sector is shown in blue.

Storing the Data

- **Low-level formatting** a drive establishes the tracks and sectors on the platter. The starting and ending points of each sector are written onto the platter. This process prepares the drive to hold blocks of bytes.
- **High-level formatting** then writes the file-storage structures, like the file-allocation table, into the sectors. This process prepares the drive to hold files.
- The process of assigning part or all of a drive to the computer (formatting) is known as **partitioning**.

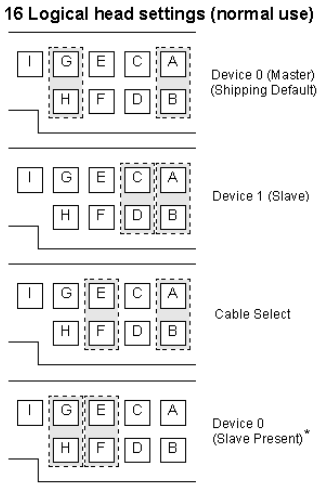
The Difference Between Tracks and Cylinders

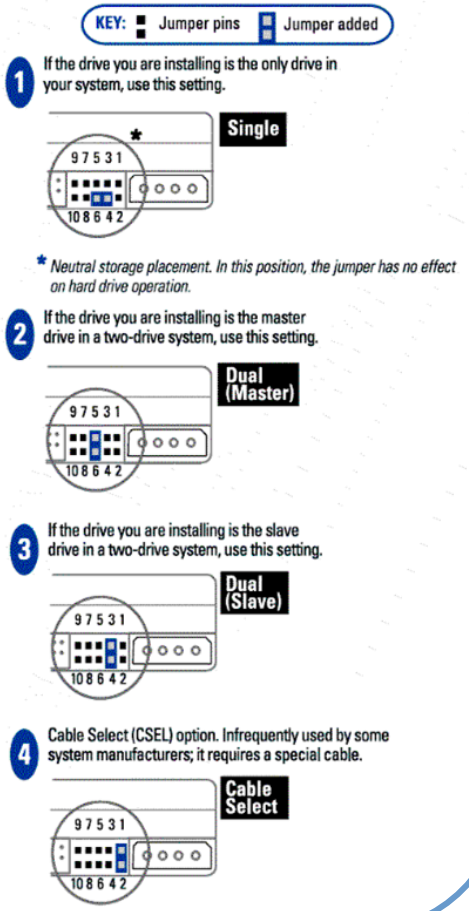
- A hard disk is usually made up of multiple platters, each of which use two heads to record and read data, one for the top of the platter and one for the bottom. The heads that access the platters are locked together on an assembly of head arms. This means that all the heads move in and out together, so each head is always physically located at the same track number. It is not possible to have one head at track 0 and another at track 1,000.
- Because of this arrangement, often the track location of the heads is not referred to as a track number but rather as a **cylinder** number.



Jumper Settings

- Most hard drives have 4 jumper settings:
  - Master with no Slave
  - Master with Slave present
  - Slave
  - Cable Select



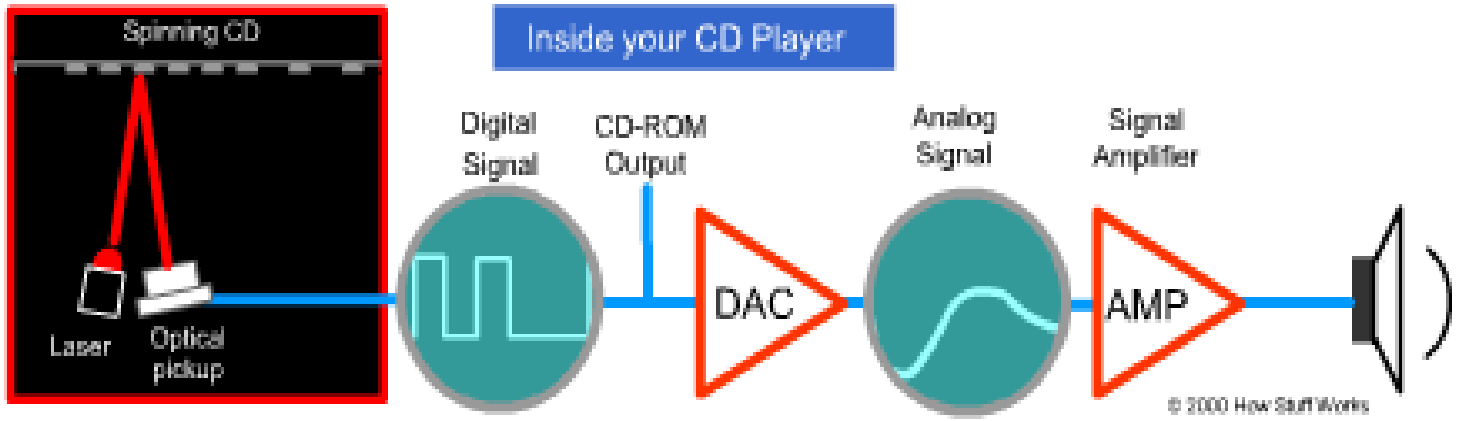


CD-ROM Basics

- In a few short years, the *Compact Disk - Read Only Memory* (CD-ROM) drive has gone from pricey luxury to inexpensive necessity on the modern PC. The CD-ROM has opened up new computing vistas that were never possible before, due to its high capacity and broad applicability.
- **The base unit of measurement for a CD Writer is 150KBps.** A 48x burner writes as 7,200 KBps.

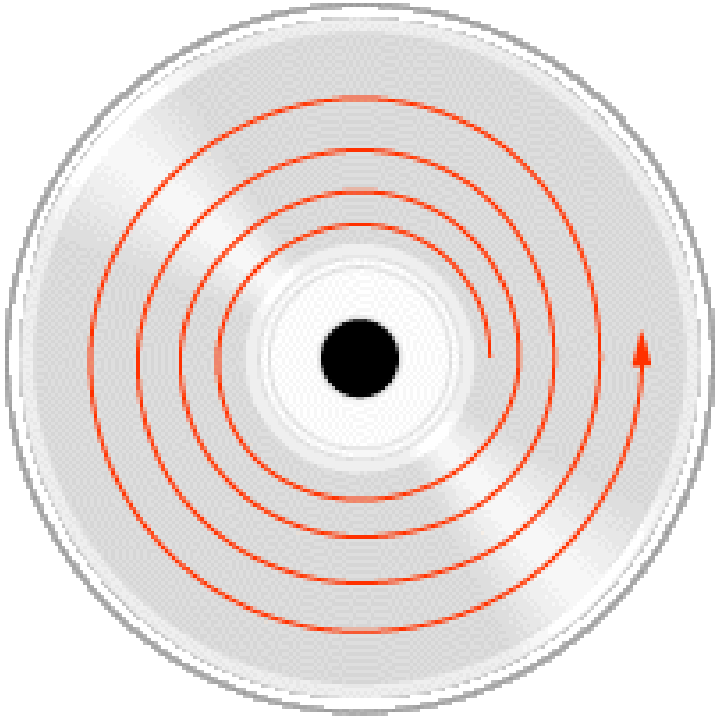
Reading the Disk

- The fundamental job of the CD player is to focus the laser on the track of bumps. The laser beam passes through the polycarbonate layer, reflects off the aluminum layer and hits an opto-electronic device that detects changes in light. The bumps reflect light differently than the "lands" (the rest of the aluminum layer), and the opto-electronic sensor detects that change in reflectivity. The electronics in the drive interpret the changes in reflectivity in order to read the bits that make up the bytes.



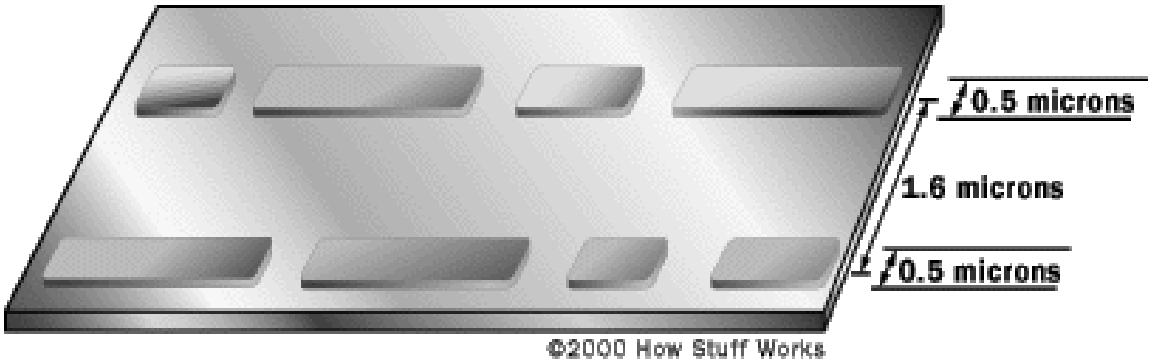
The CD Medium

- What the picture on the right does not even begin to impress upon you is how incredibly small the data track is -- it is approximately 0.5 microns wide, with 1.6 microns separating one track from the next. (A micron is a millionth of a meter.) And the elongated bumps that make up the track are each 0.5 microns wide, a minimum of 0.83 microns long and 125 nanometers high. (A nanometer is a billionth of a meter.)

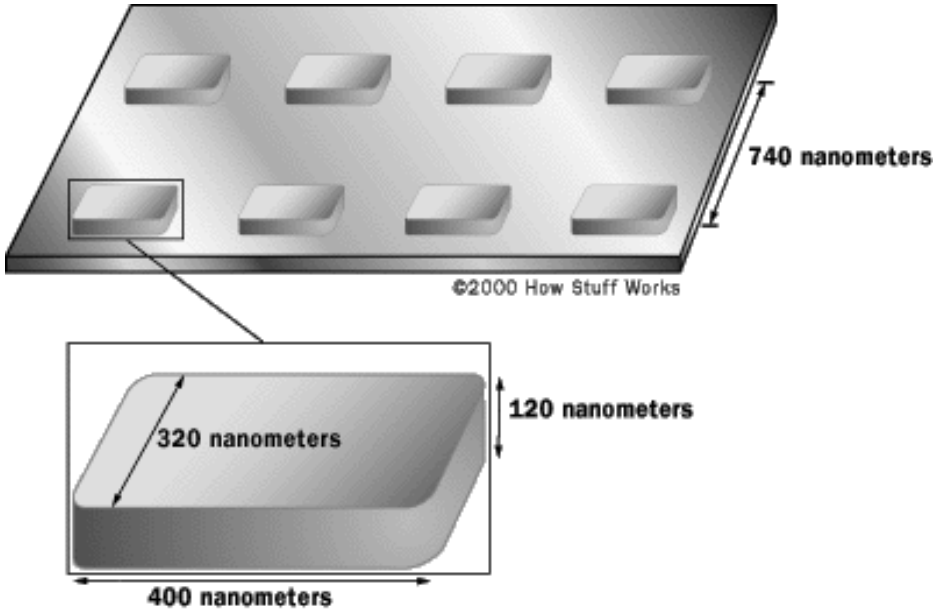


The CD Medium

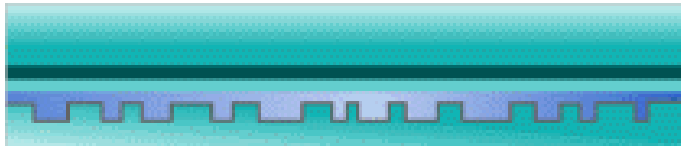
- You will often read about "pits" on a CD instead of bumps. They appear as pits on the aluminum side, but on the side the laser reads from, they are bumps.
- The incredibly small dimensions of the bumps make the spiral track on a CD extremely long. If you could lift the data track off a CD and stretch it out into a straight line, it would be 0.5 microns wide and almost 3.5 miles (5 km) long!



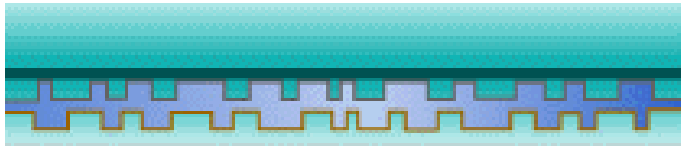
DVD Formats



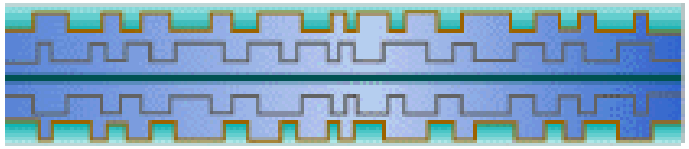
Single-sided, single layer (4.7GB)



Single-sided, double layer (8.5GB)



Double-sided, double layer (17GB)



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The microscopic dimensions of the bumps make the spiral track on a DVD extremely long. If you could lift the data track off a single layer of a DVD, and stretch it out into a straight line, it would be almost **7.5 miles** long! That means that a double-sided, double-layer DVD would have **30 miles** (48 km) of data!

Blu-ray Formats

- Developed by Sony
- Uses a 405 nm laser
- Largest storage capacity

CD vs. DVD vs. Blue-ray

Specification	CD	DVD	Blu-ray
Track Pitch (Height)	1.6 microns	740 nanometers	320 nanometers
Minimum Pit Length	.83 microns	400 nanometers	
Minimum Pit Width	.5 microns	320 nanometers	

Format	Capacity	Approx. Movie Time
Standard CD	700MB	80 minutes
DVD Single-sided/single-layer	4.7GB	2 hours
DVD Single-sided/double-layer	8.5 GB	4 hours
DVD Double-sided/single-layer	8.75 GB	4.5 hours
DVD Double-sided/double-layer	17 GB	Over 8 hours
Blu-ray Single-layer	25 GB	
Blu-ray Dual-layer	50 GB	

Troubleshooting

- Use a paper clip to eject a CD that is inoperable or dead.

Troubleshooting

- You must have an audio cable connect to the CD and motherboard to use the CD drive as an audio device.

IDE, EIDE, Ultra, and SCSI Controllers

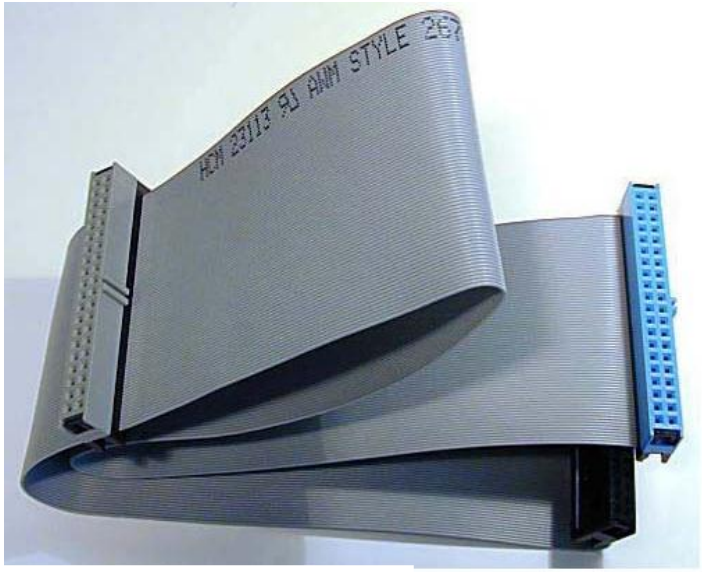
- Integrated Drive Electronics (IDE) is a type of hardware interface widely used to connect hard disks, CD-ROMs, and tape drives to a PC.
- The IDE interface is officially known as the AT Attachment (ATA) specification.
- Enhanced IDE (EIDE) or ATA-2 disk drives can handle up to 8.4 GB or more.
- Ultra ATA disk drives are typically much faster than the older ATA and ATA-2 disk drives. Ultra drive sizes can go up to 50 GB or more.

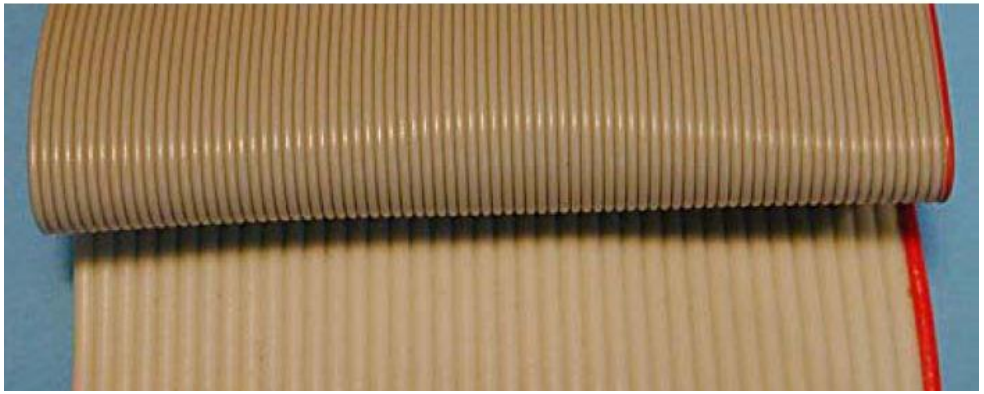
IDE, EIDE, Ultra, ATAPI, and SCSI Controllers

- **AT Attachment with Packet Interface** (**ATA/ATAPI**) is currently the standard interface used to connect storage devices such as hard disks and CD-ROM drives inside personal computers.
- The original ATA was retroactively renamed **Parallel ATA** (PATA) when Serial ATA or SATA was released.
- Parallel ATA standards allow cable lengths up to only 18 inches (46 centimeters).
- SCSI devices have the controlling electronics on each of the drives. However, SCSI is a much more advanced interface controller than ATA-2/EIDE. It is ideal for high-end computers, including network servers.

Cables

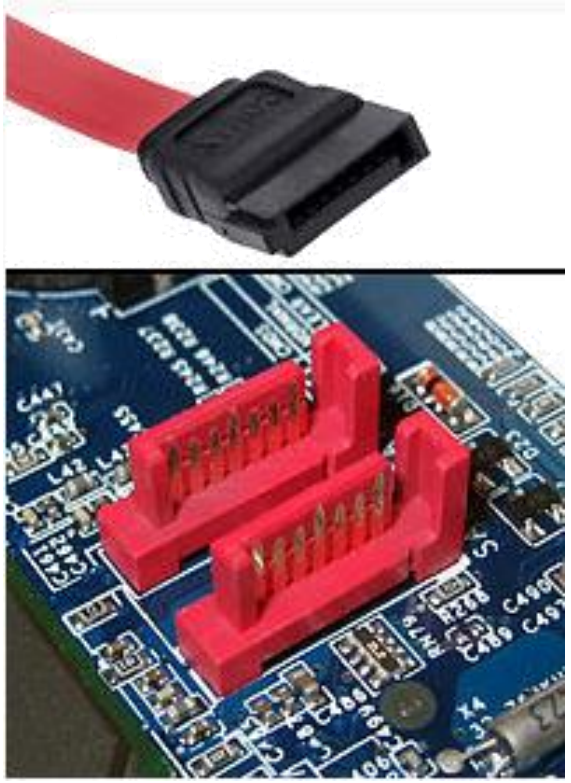
- ATA/33 cable has 40 wires.
  ATA/66 cable 80 wires.
  Both use the same 40 pin keyed connectors to attach the device to the controller.





Serial ATA

- **SATA** or **Serial Advanced Technology Attachment**
- Designed to replace the older ATA (AT Attachment) standard or parallel ATA (PATA) interface
  - 7 conductors
  - Native hot swapping
  - Faster data transfer
  - 1 device per controller
  - Cables up to 36” long
  - Transfer speeds
    - SATA 1 – 1.5 Gbps
    - SATA 2 – 3 Gbps
    - SATA 3 – 6 Gbps
- Has a shorter life because of excessive reads and writes.

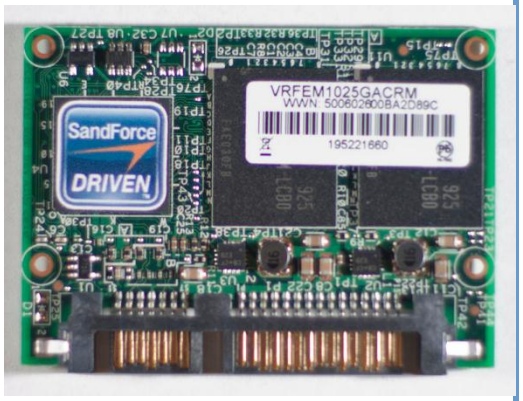


Flash or Thumb Drives

- Data storage device that consists of flash memory with an integrated USB interface.
- Up to 256GB are available
- Some allow up to 100,000 write/erase cycles and 10 years shelf storage time.
- Durable and reliable because of their lack of moving parts.
- Draw power from the computer via the USB connection.

Solid State Drive (SSD)

- SSDs use microchips which retain data in non-volatile memory chips and contain no moving parts.
- Typically less susceptible to physical shock
- Silent
- Lower access time and latency
- More expensive
- Same interface as hard disk drives
- A hybrid drive combines the features of an HDD and an SSD into one unit, containing a large HDD, with a smaller SSD cache to improve performance of frequently accessed files.



Cabling

- Data cables connect drives to the drive controller, which is located on an adapter card or on the motherboard. Here are some common types of data cables:
  - **Floppy disk drive (FDD) data cable** – Data cable has up to two 34-pin drive connectors and one 34-pin connector for the drive controller. 6”-24” lengths available.
  - **PATA (IDE) data cable** – Parallel ATA data cable has 40 conductors amd 40 wires, up to two 40-pin connectors for drives, and one 40-pin connector for the drive controller. 12”-18” lengths.
  - **PATA (EIDE) data cable** – Parallel ATA data cable has 40 conductors and 80 wires, up to two 40-pin connectors for drives, and one 40-pin connector for the drive controller. 12”-18” lengths.
  - **SATA data cable** – Serial ATA data cable has seven conductors, one keyed connector for the drive, and one keyed connector the drive controller. 4”-36” lengths available.