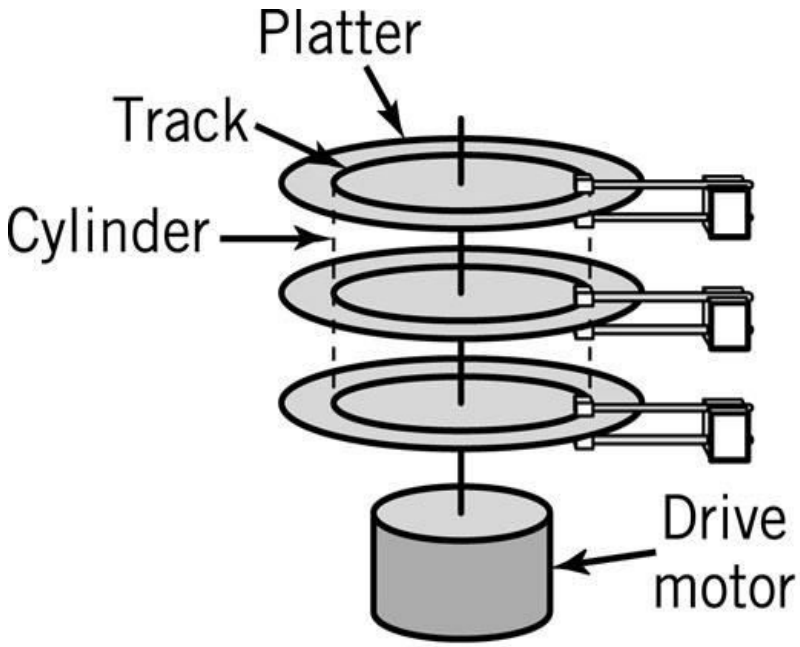
UNIT:2

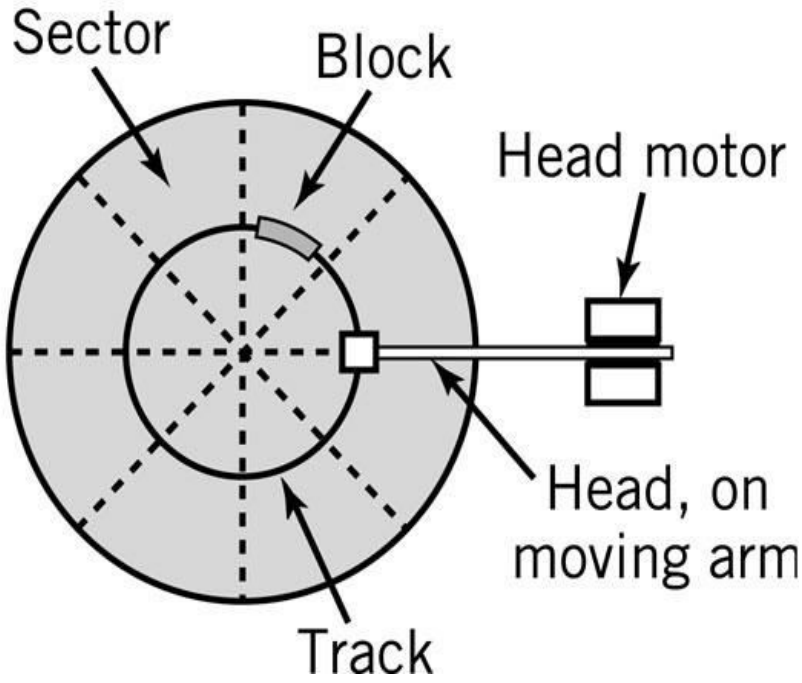
Hard Disk Drive and Controller, DVD Drives

HARD DISKS

- A **hard disk** contains one or more inflexible, circular platters that use magnetic particles to store data, instructions, and information

A Hard Disk Layout

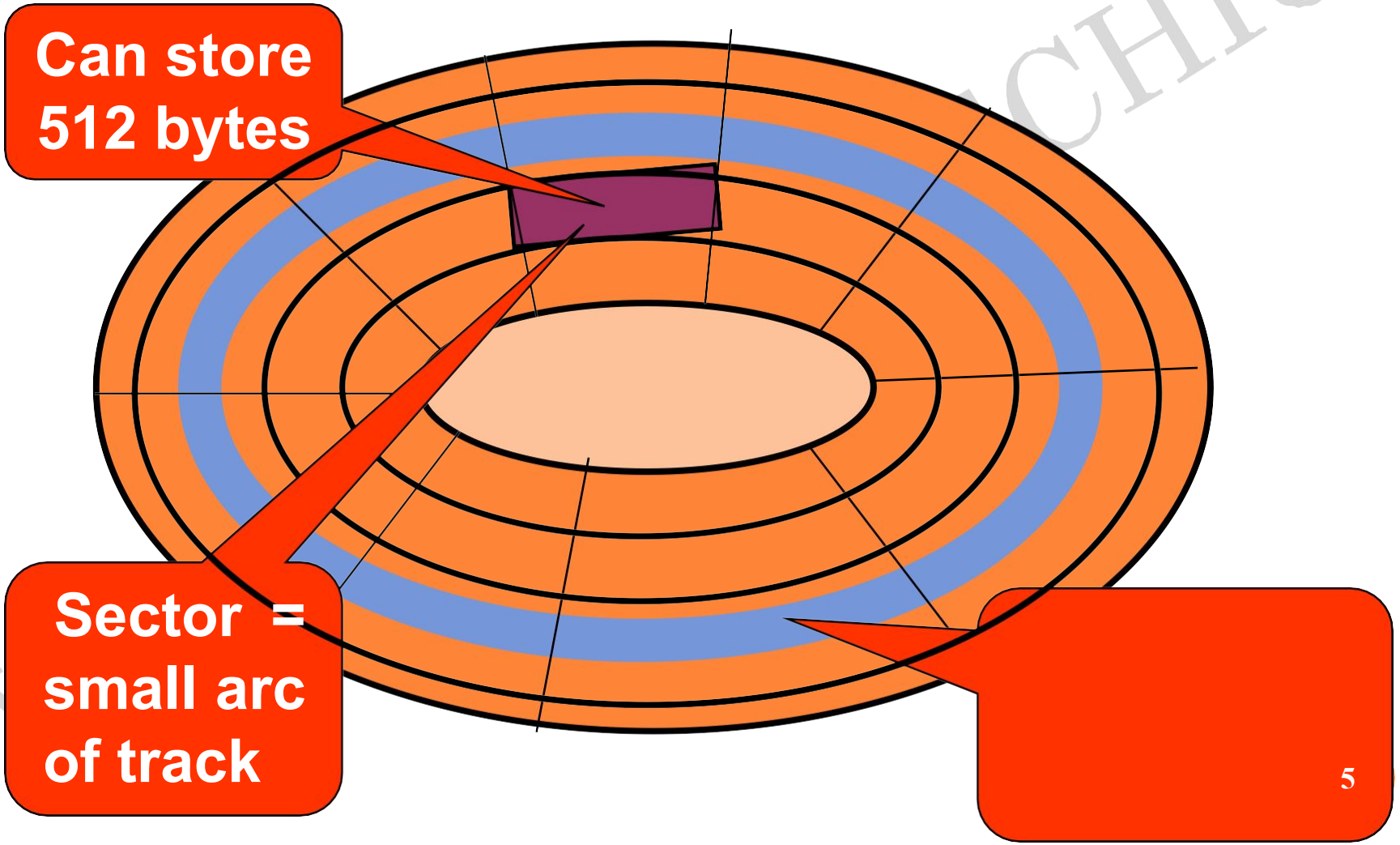




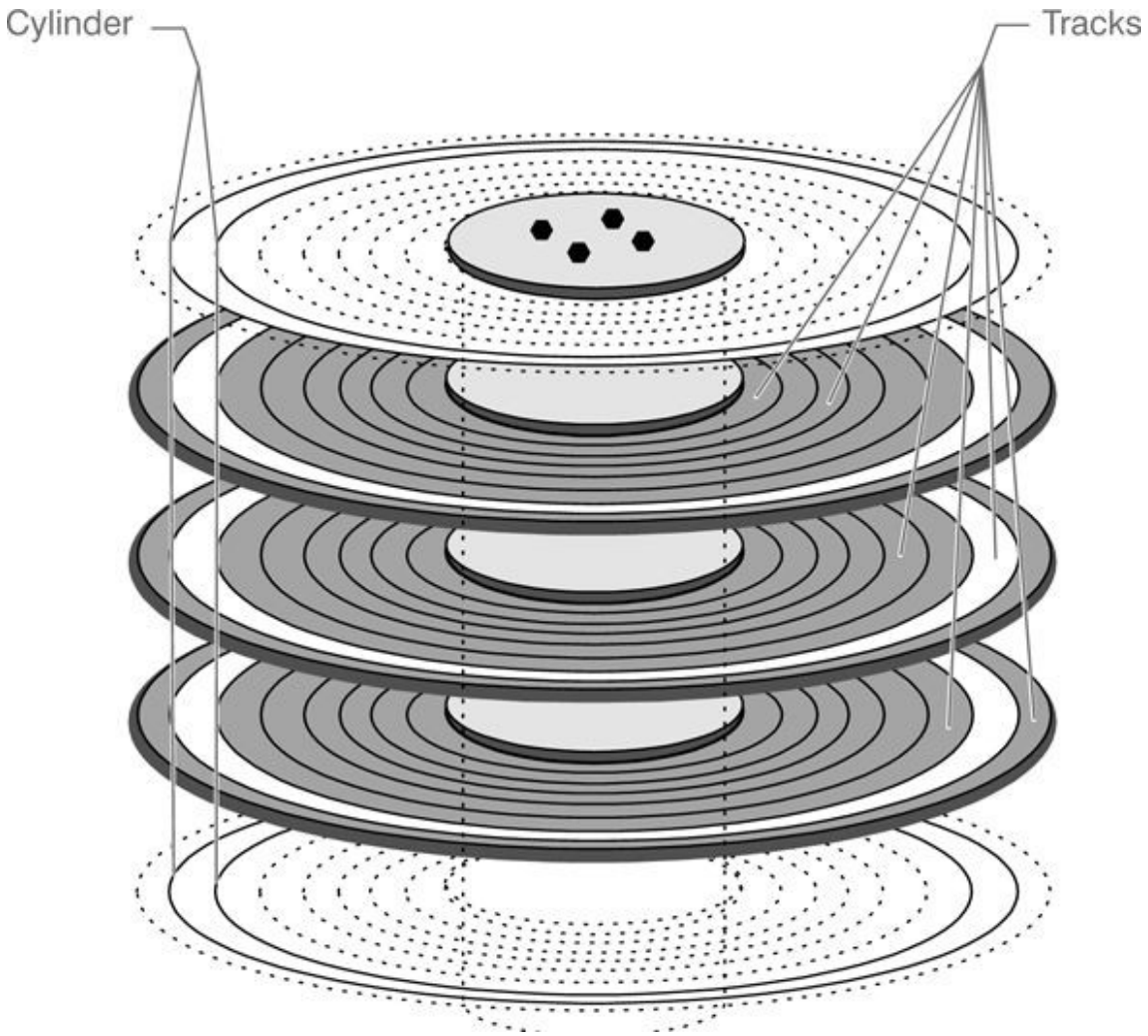
LOGICAL STRUCTURE OF A HARD DRIVE:

- Tracks-
  - circular areas of the disk
  - Length of a track one circumference of disk
  - Over 1000 on a hard disk
  - Data first written to outer most track
- Sectors-
  - Divides tracks sections
  - On a floppy 9 sectors exits
- Cylinders-
  - Logical groupings of the the same track on each disk surface in a disk unit
- Clusters-
  - Groups of sectors used by operating system
  - 64 sectors in one cluster

TRACKS AND SECTORS



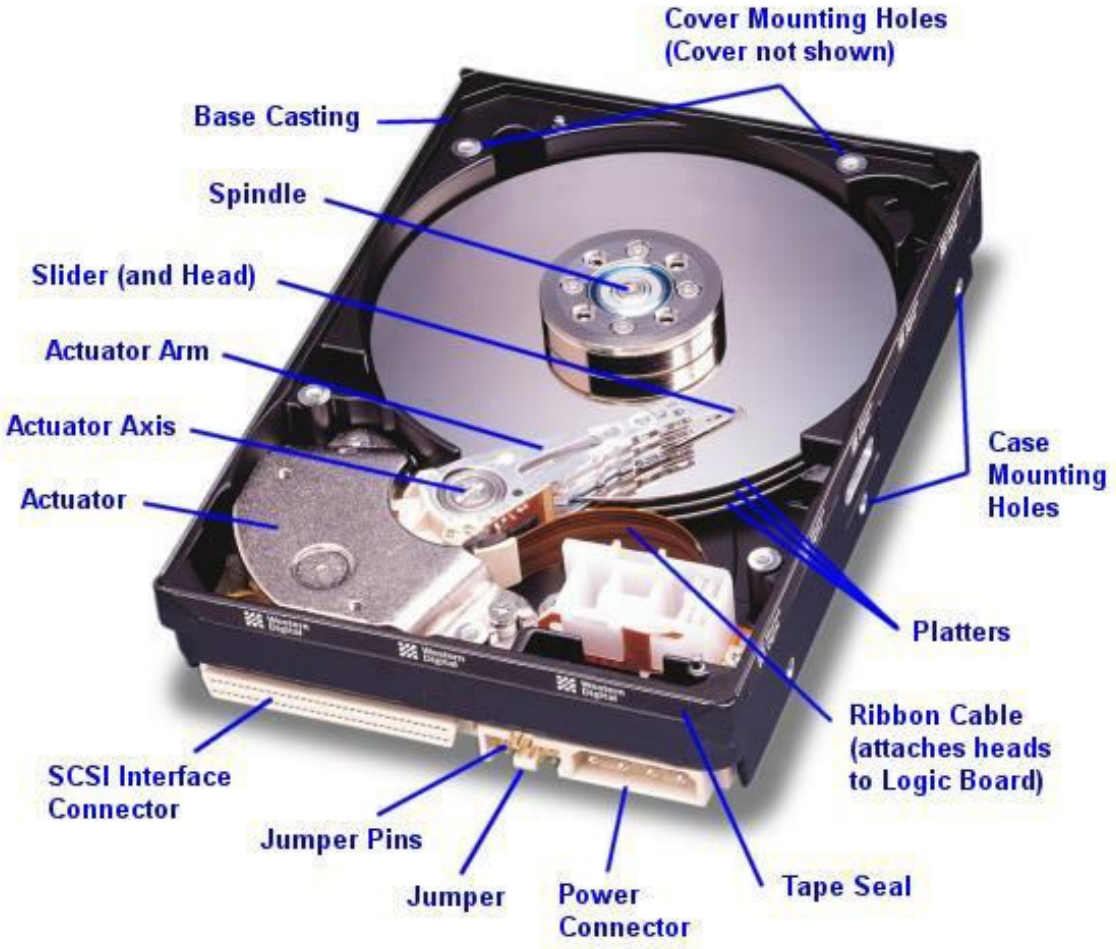
CYLINDER AND TRACKS

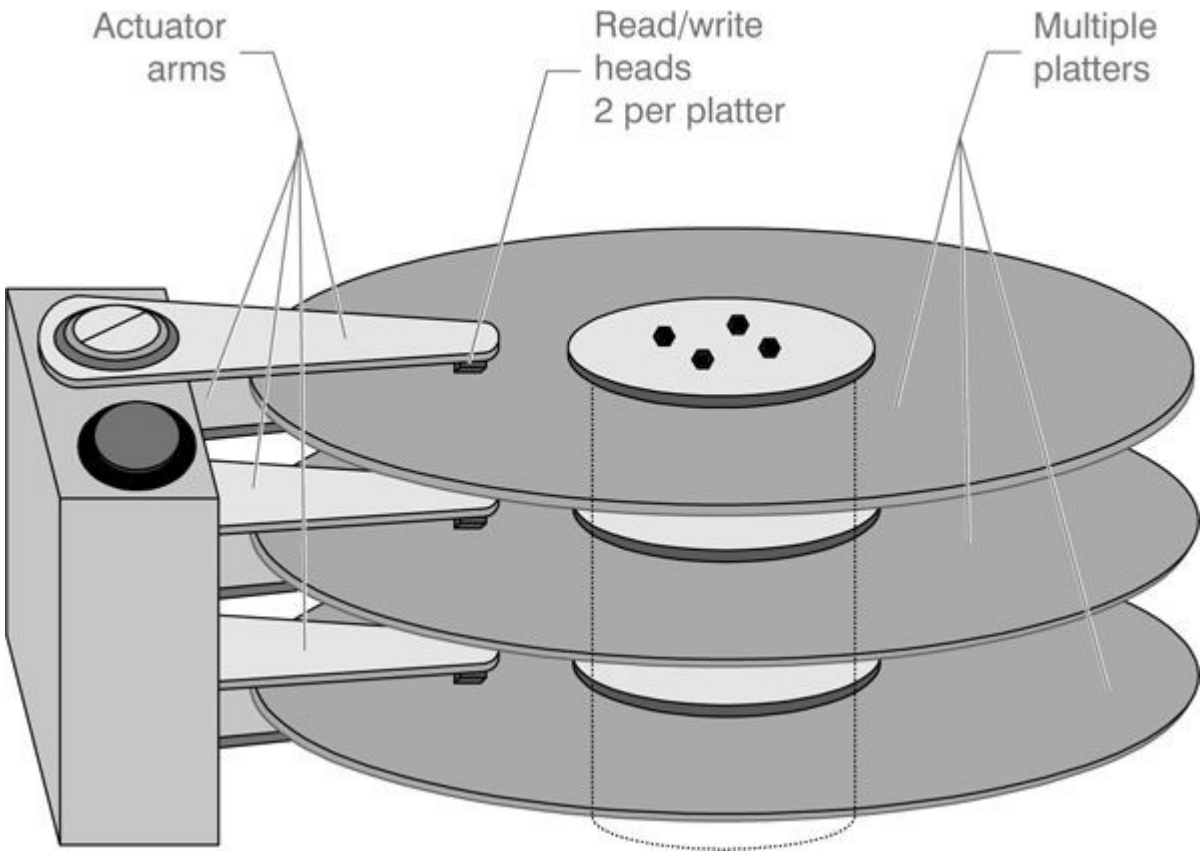


INTERLEAVING

- Allows the read/write head to use the rotation of the disk to its advantage
- One sector is written to and the disk skips to several sectors down

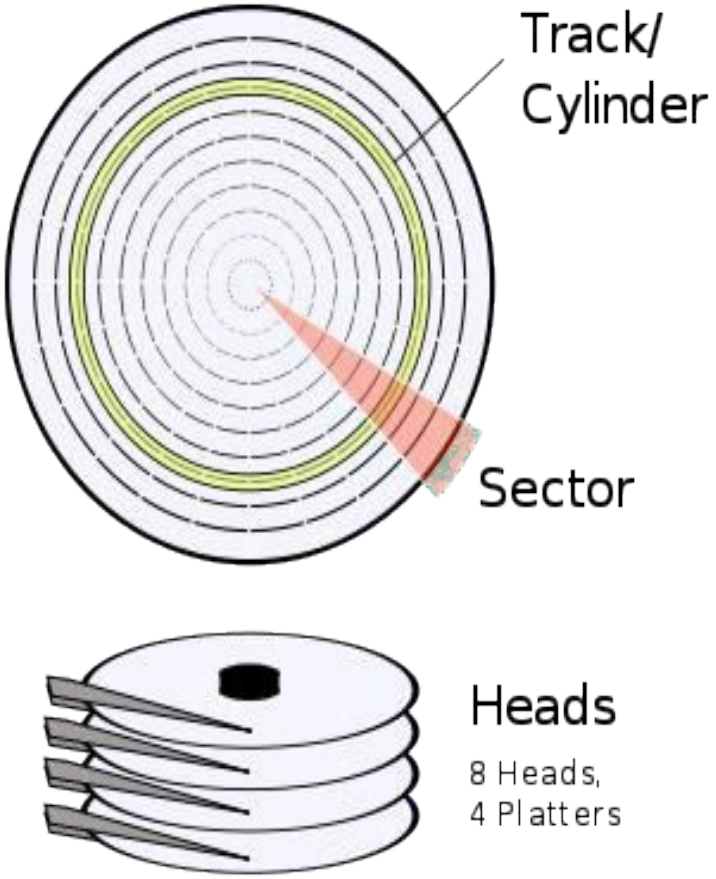
PHYSICAL STRUCTURE



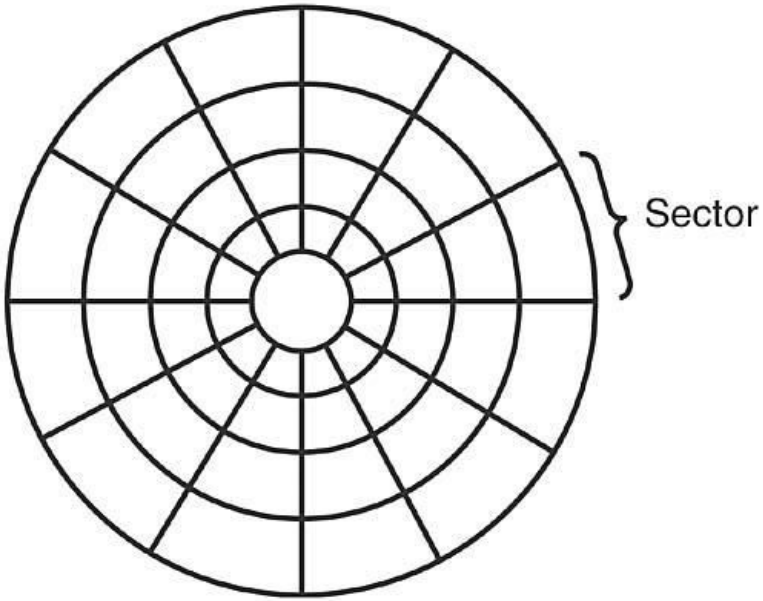

Actuator
arms
Read/write
heads
2 per platter
Multiple
platters

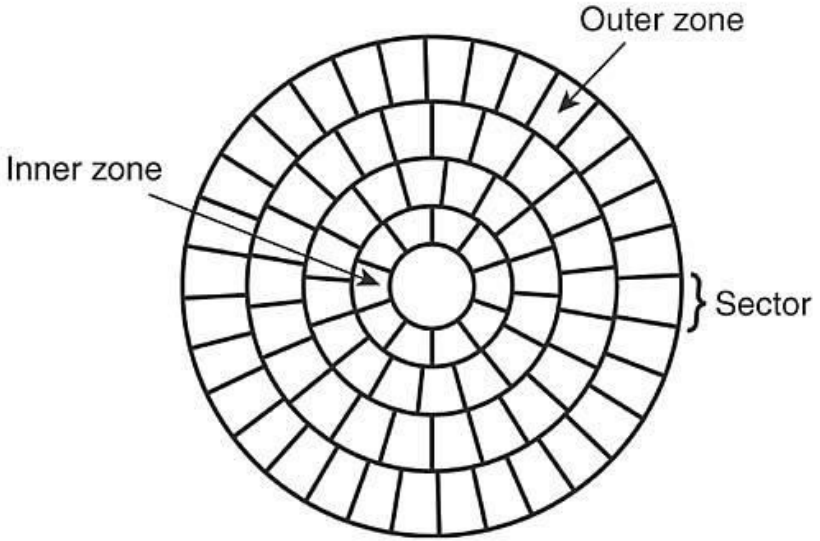
- The basic physical construction of a hard disk drive consists of spinning disks with heads that move over the disks and store data in tracks and sectors.
- The heads read and write data in concentric rings called *tracks*, which are divided up into segments called *sectors*, which normally store 512 bytes each.

- One side of a platter is called a “head”.
- Hard drives can have different numbers of platters, depending on their design and storage capacity.
- On the heads, you will see concentric rings (tracks) and pieces of rings (sectors) just like on the floppy disks



- Many hard drives today use a technology called “zone bit recording”
- Which enables the hard drive to have more sectors on the outer tracks, where there is more room than on the inner tracks.
- This allows more room for storage





How a Hard Disk Works

Step 1
The circuit board controls the movement of the head actuator and a small motor.

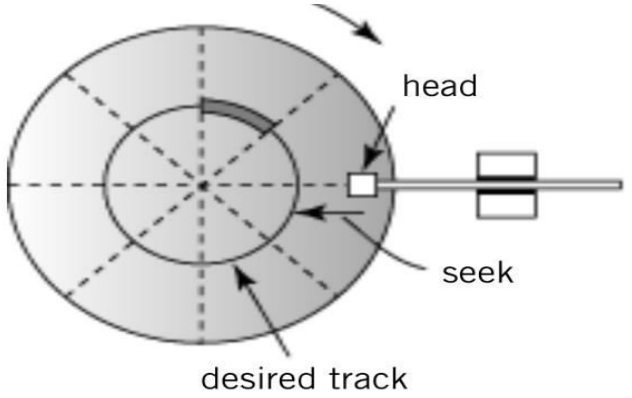
Step 2
A small motor spins the platters while the computer is running.

Step 3
When software requests a disk access, the read/write heads determine the current or new location of the data.

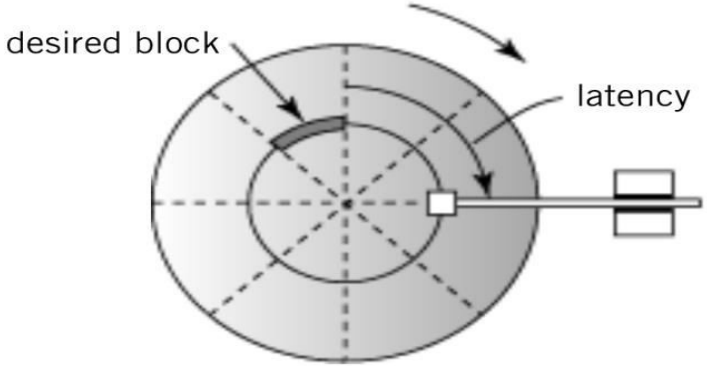
Step 4
The head actuator positions the read/write head arms over the correct location on the platters to read or write data.

DISC PERFORMANCE CHARACTERISTIC OF HDD

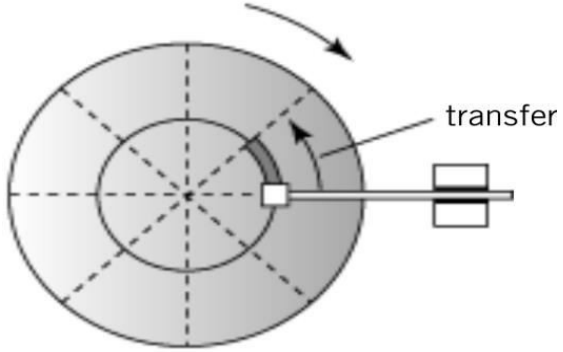
- Average seek time: time required to move from one track to another



- Latency: time required for disk to rotate to beginning of correct sector



- Transfer time: time required to transfer a block of data to the disk controller buffer

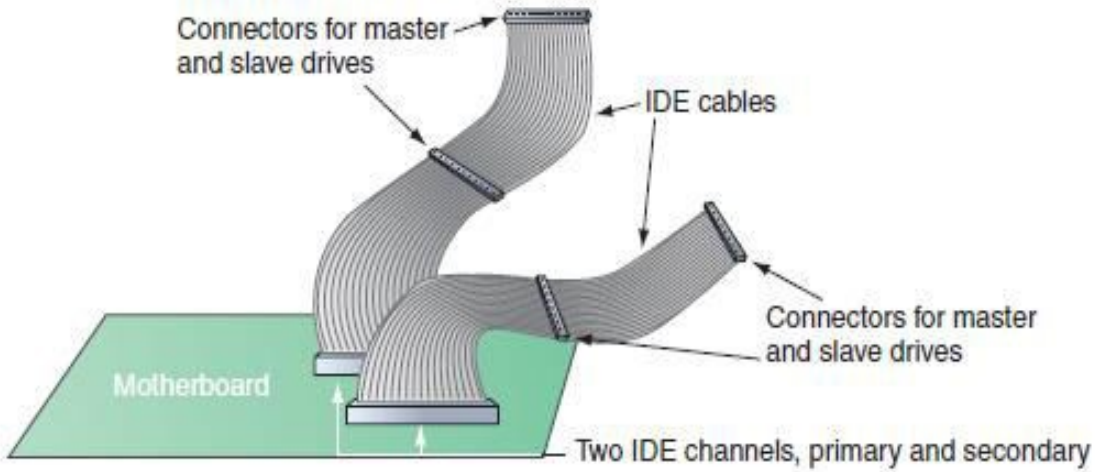


Disk Access Times

- Avg. Seek time
  - average time to move from one track to another
- Avg. Latency time
  - average time to rotate to the beginning of the sector
  - Avg. Latency time = ½ * 1/rotational speed
- Transfer time
  - 1/(# of sectors * rotational speed)
- Total Time to access a disk block
  - Avg. seek time + avg. latency time + avg. transfer time

Steps to Configure and Install a Parallel ATA Drive

- Configurations for four EIDE devices in a system:
  - Primary IDE channel, master device
  - Primary IDE channel, slave device
  - Secondary IDE channel, master device
  - Secondary IDE channel, slave device



A motherboard supporting PATA has two IDE channels; each can
support a master and slave device, using a single EIDE cable

Courtesy Course Technology/Cengage Learning

Steps to Configure and Install a Parallel ATA Drive (cont'd.)

- Master or slave designations are made by:
  - Setting jumpers or DIP switches
  - Use special cable-select data cable
  - Color-coded connectors
    - Blue end connects to motherboard; black end connects to drive

80-conductor cable connectors are color-coded
Courtesy: Course Technology/Cengage Learning

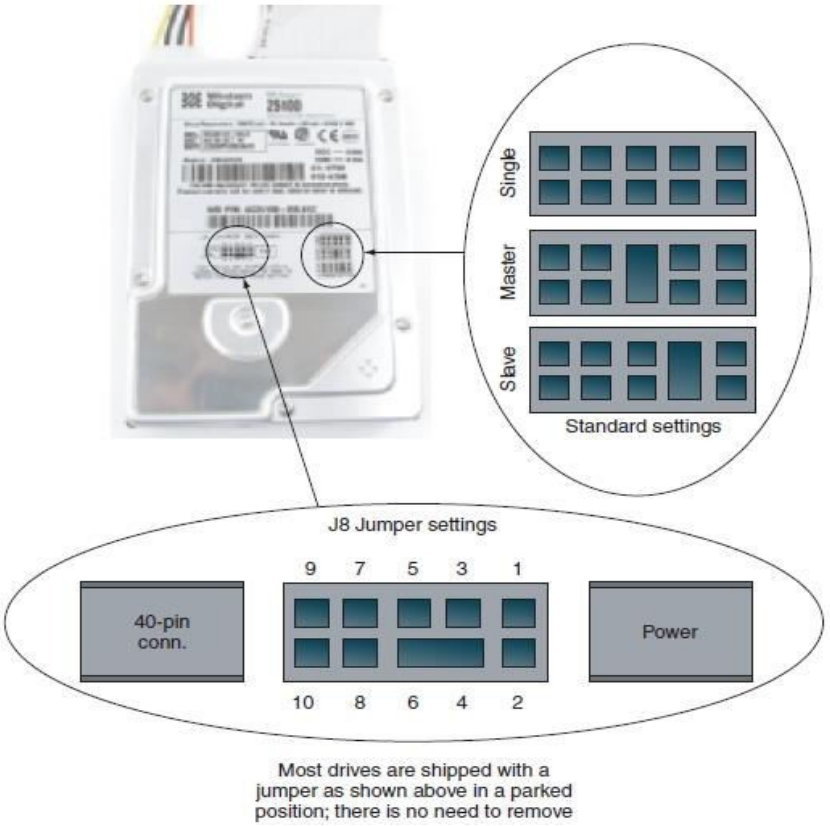
Steps to Configure and Install a Parallel ATA Drive (cont'd.)

- Motherboard color-coding
  - Primary channel connector: blue
  - Secondary channel connector: black
  - Ensures ATA/66/100/133 hard drive installed on the primary IDE channel

The primary IDE channel connector is often color-coded as blue
Courtesy: Course Technology/Cengage Learning

Steps to Configure and Install a Parallel ATA Drive (cont'd.)

- Step 1: Open case, decide how to configure drives
- Step 2: Set the jumpers on the drive



A PATA drive most likely will have diagrams of jumper settings for master and slave options printed on the drive housing
Courtesy: Course Technology/Cengage Learning

Configuration	Description
Single-drive configuration	This is the only hard drive on this EIDE channel. (This is the standard setting.)
Master-drive configuration	This is the first of two drives; it most likely is the boot device.
Slave-drive configuration	This is the second drive using this channel or data cable.
Cable-select configuration	The cable-select (CS or CSEL) data cable determines which of the two drives is the master and which is the slave.

Table 8-4 Jumper settings on a parallel ATA hard drive

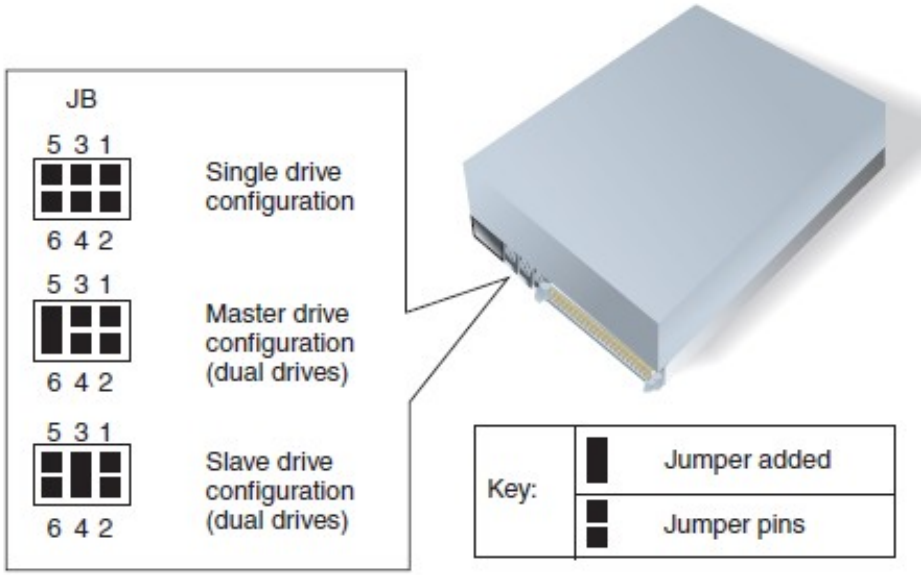
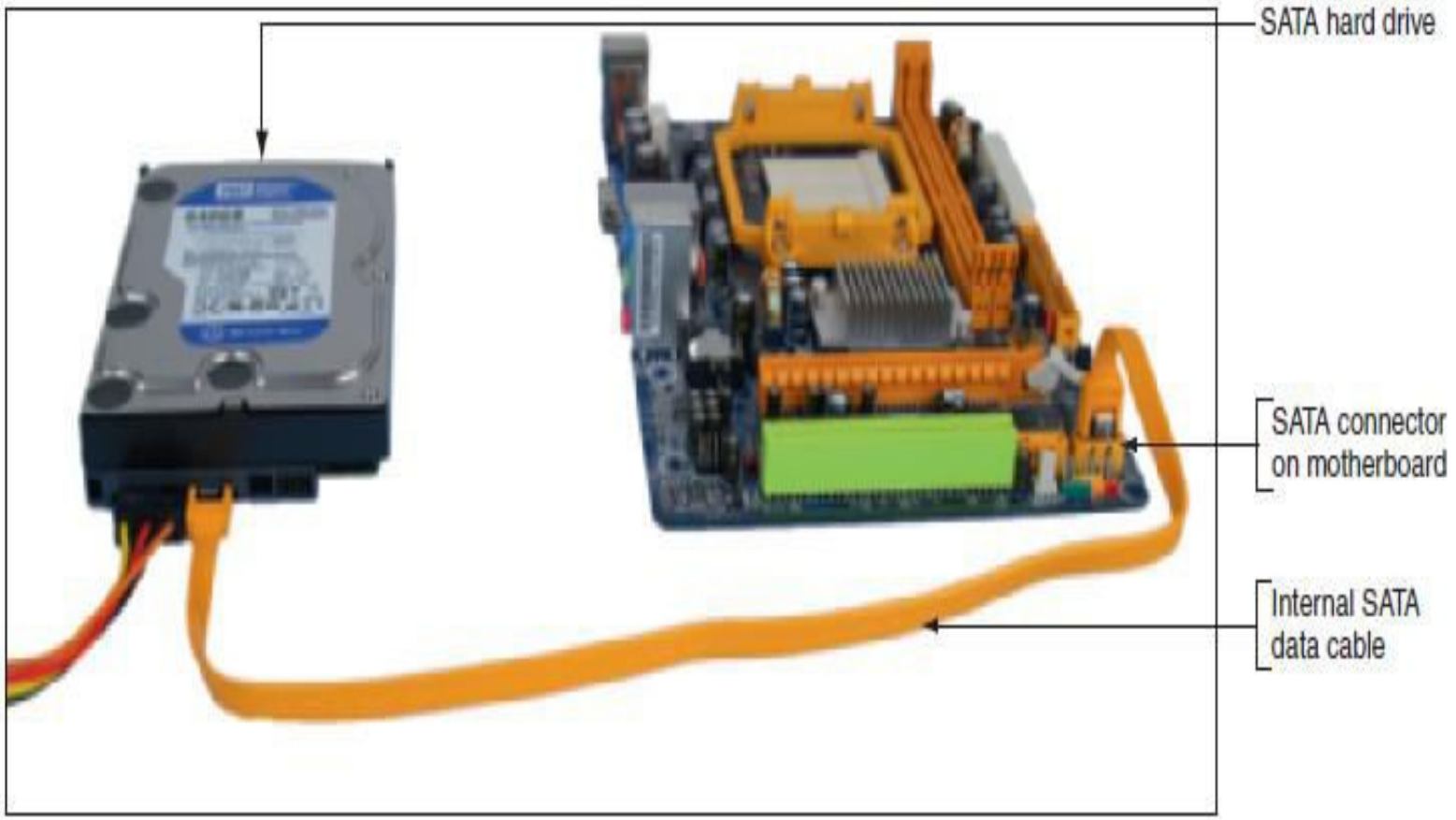


Figure 8-37 Jumper settings on a hard drive and their meanings
Courtesy: Course Technology/Cengage Learning

Steps to Configure and Install a Parallel ATA Drive (cont'd.)

- Step 3: Mount the drive in the bay
  - Remove bay from case and insert hard drive in bay
  - Securely mount drive in the bay
  - Decide whether to connect data cable before or after inserting bay inside the computer case
  - Place bay back into position, secure bay with screws
  - Install a power connection to each drive
  - Connect data cable to motherboard IDE connector
  - Connect hard drive light wiring if necessary
  - Before replacing case cover verify installation



A SATA hard drive subsystem uses an internal SATA data cable

RAID

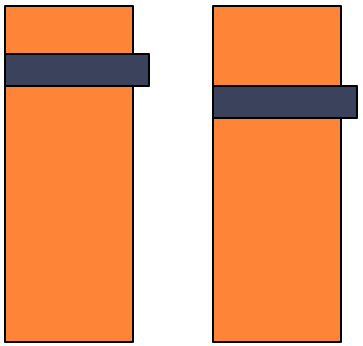
- Redundant Array of Independent Disks
- RAID: two or more hard drives work together as an array of drives
  - Improves fault tolerance and performance
- 10 levels of RAID
- 3 on test will be:
- RAID 0, RAID 3, RAID 5

RAID CONTINUED

- RAID 0- Striped disk without parity
- RAID 3- Parallel transfer with parity
- RAID 5- Data striping with parity

RAID 0

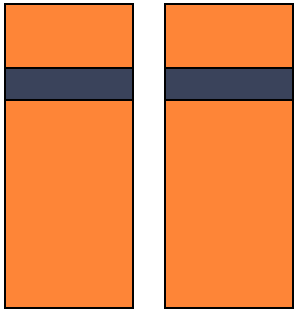
- RAID 0 – Striping
  - Two or more drives
  - Writes alternate between drives for speed
  - Both drives get same drive letter from system
  - Fast but not safe; one failure and all fails

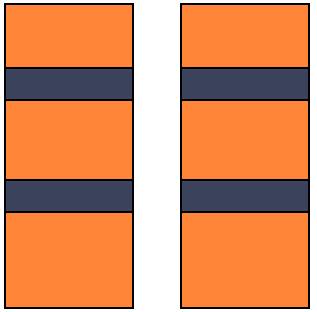


25

RAID 1

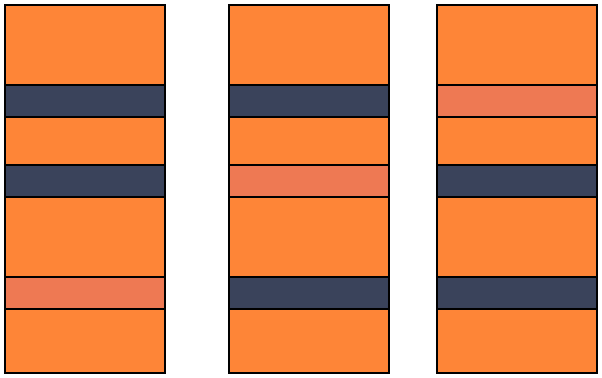
- RAID 1 (Mirror)
  - Two drives, one controller
  - same drive letter
  - writes are to both drives
  - Safe, one drive can fail, but slow
- RAID 1 (Duplexing)
  - Two drives, two controllers
  - Writes are to both drives
  - Same drive letter
  - Faster and safer





RAID 5

- RAID 5 – Striping with Parity
  - Three or more drives
  - Writes alternate Data, Data, Parity; Data, Parity, Data; Parity, Data, Data
  - Any one drive can fail and system can “heal” itself



27

INTERFACES / STANDARDS OF HDD

- Serial ATA
  - Motherboard or expansion card can provide external SATA (eSATA) ports for external drives
  - External SATA (eSATA)
    - Up to six times faster than USB or FireWire
    - eSATA drives use special external shielded serial ATA cable up to 2 meters long
  - Purchasing considerations
    - SATA standards for the drive and motherboard need to match for optimum speed
    - If no match, system runs at the slower speed

SCSI

- Pronounced Scuzzy
- Small Computer Systems Interface
- For wide range of peripheral devices, including hard disks, tape drives, optical drives, CD- ROMs and disk arrays.
- 8 devices can connect to a daisy chain
- This chain must be terminated at both ends
- Each device on chain is assigned unique device ID number that is determined by jumpers or DIP switches

- IDE drives-
  - originally developed as alternative to more expensive SCSI drives.
  - Modern versions called EIDE drives.
  - Support up to 4 multigigabyte drives.
  - If you want more devices, use SCSI or USB
  - Low-level formatted at the factory

SATA

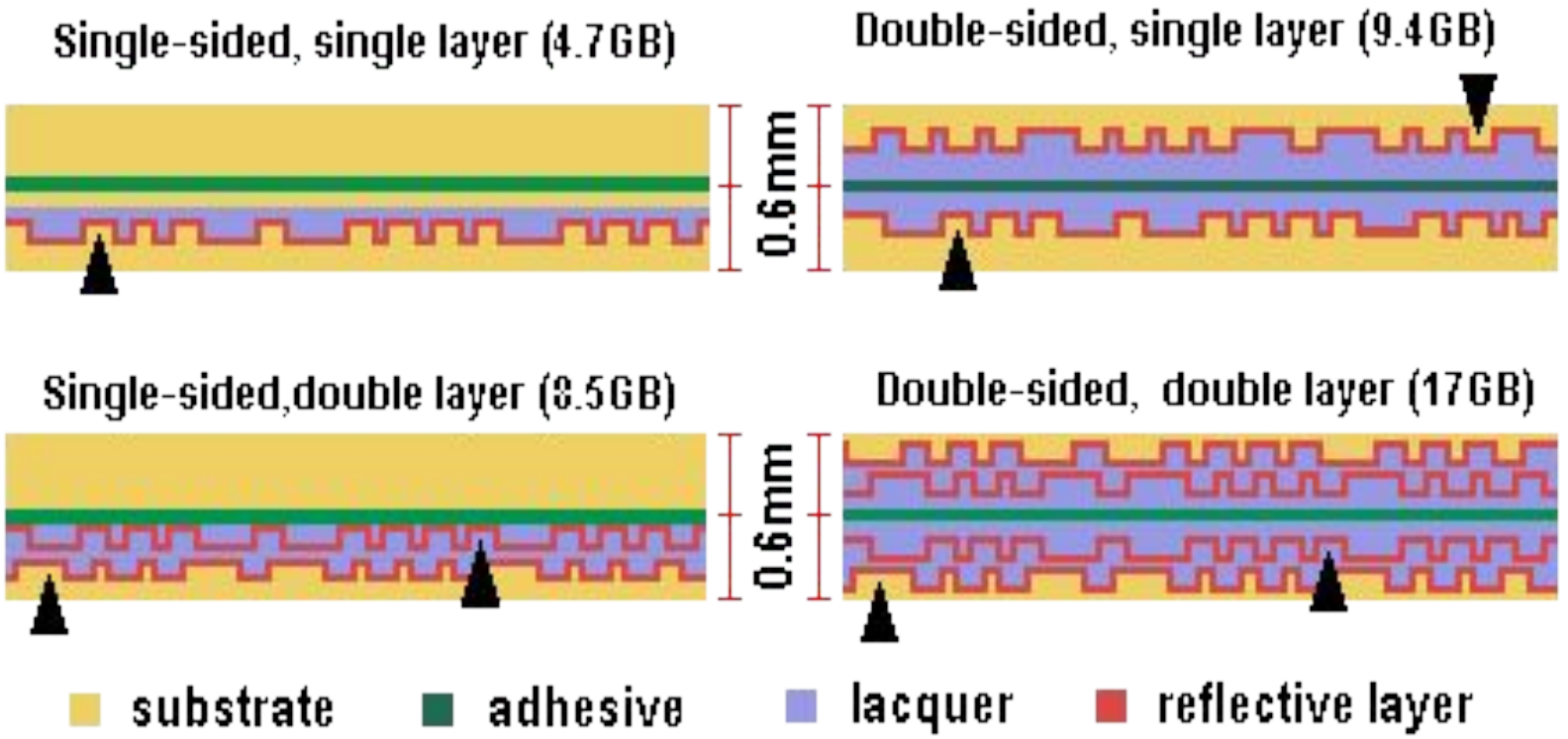
- Serial ATA was designed to replace the older ATA (AT Attachment) standard (also known as EIDE).
- It is able to use the same low level commands, but serial ATA host-adapters and devices communicate via a high-speed serial cable over two pairs of conductors.
- Serial ATA has distinct key advantages over its predecessor. Cables are very thin with small 7-pin connectors. They can be up to 3 feet (1 meter) in length, and are easily routed to stay out of the way allowing maximum airflow inside the case.
  - ATA cables limited to 18 inches (46 cm) in length often made connections difficult and also clogged cases blocking airflow, while cooling has become crucial.
- SATA also has a far lower power requirement of just 250 mV compared to PATA's 5-volt requirement, and with chip core voltages declining, this speaks well of SATA's future.

HARD DRIVE CONTROLLERS

hard disks were interfaced to a PC motherboard via an expansion board known as a hard disk controller. The drive did most of the mechanical stuff and performed basic electronic/servo functions; the controller told it in detail what to do.

XT Hard Disk Controller
circa 1987

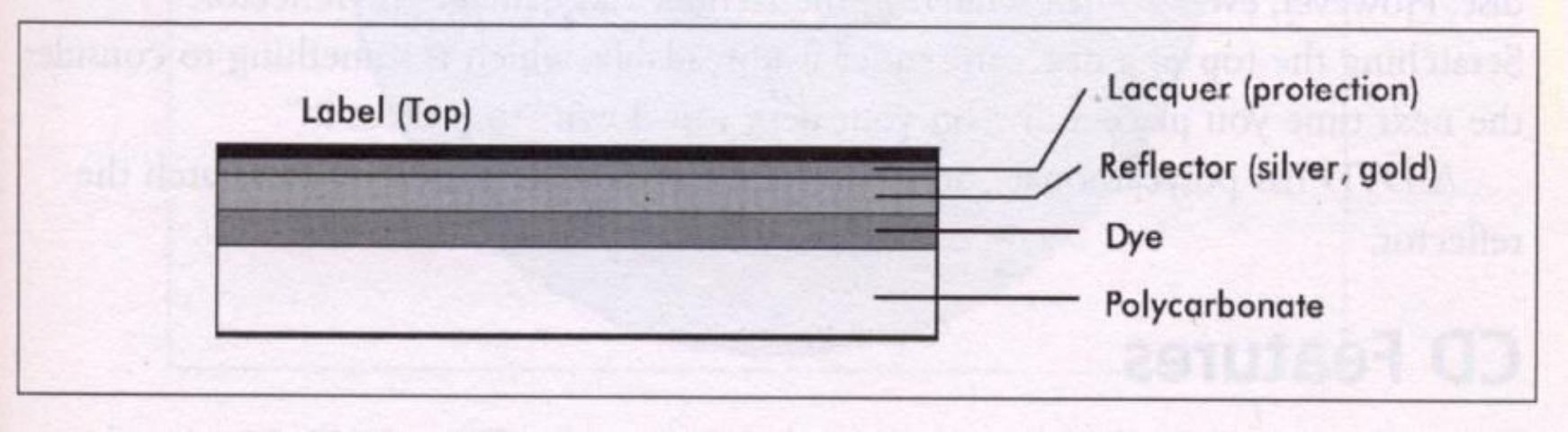
Different Types of DVD



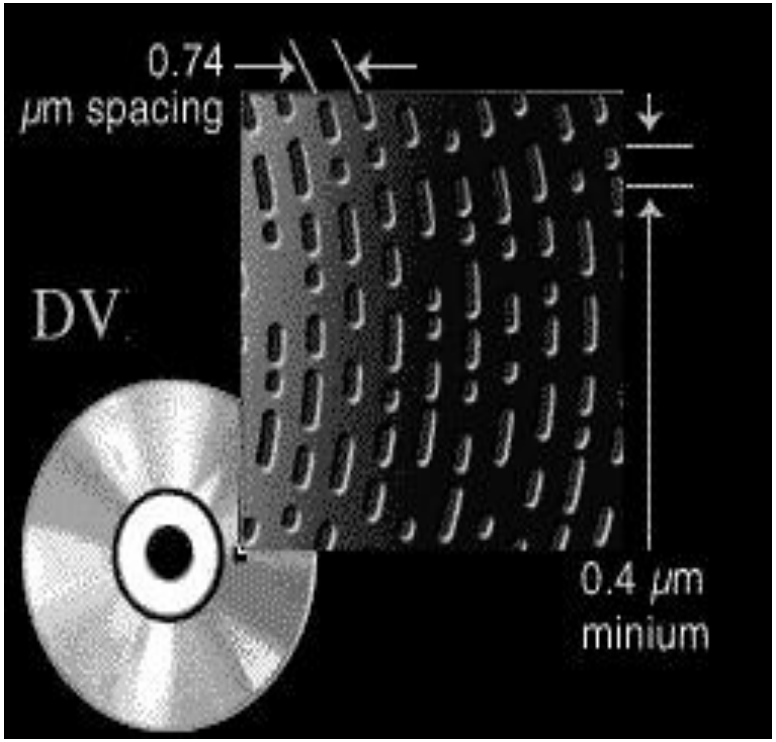
Sizes

- CDs
  - 5.25 “ – 120 mm
  - 3.15” – 80 mm
  - Business Card
- DVDs
  - 5.25” - 120 mm
  - Could be different
  - None so far

CD Construction



DVD



- DVD uses Smaller pit and land dimensions, therefore the laser must me exponentially more accurate than with CD's.
- More closely-spaced tracks, called "track pitch"
- A shorter-wavelength laser

- DVD Players and DVD-ROM drives use a laser that emits high intensity red light at 650 and 635nm vs the 780 nanometers for CD technology

- These shorter wavelengths are better at reading the smaller, densely packed together pits and lands.

- The laser assembly has been re-engineered to produce a more tightly focused laser beam

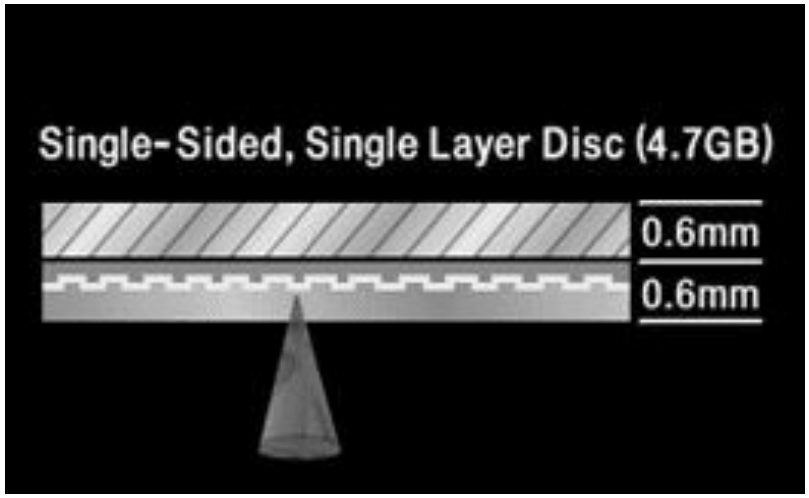
LAYERS

- As an interesting consequence of using the new lasers and the new DVD design elements, they found that multiple sides and layers could be stacked onto a single DVD disk. A total of 4 configurations were found to be viable:

  - Single Side, Single Layer
  - Single Side, Dual Layer
  - Double Side, Single Layer
  - Double Side, Dual Layer

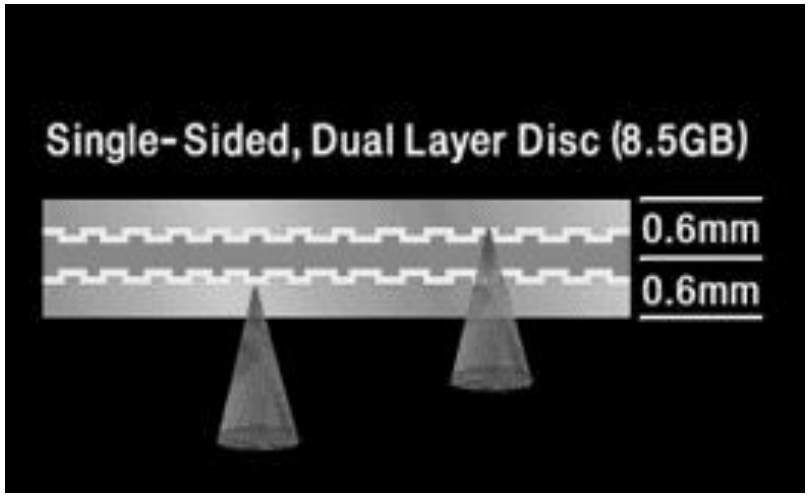
SINGLE SIDE, SINGLE LAYER DVD

- Accounts for most DVD's
- 4.7 GB of data capacity
- "7 times" the data capacity of today's music CDs and CD-ROMs

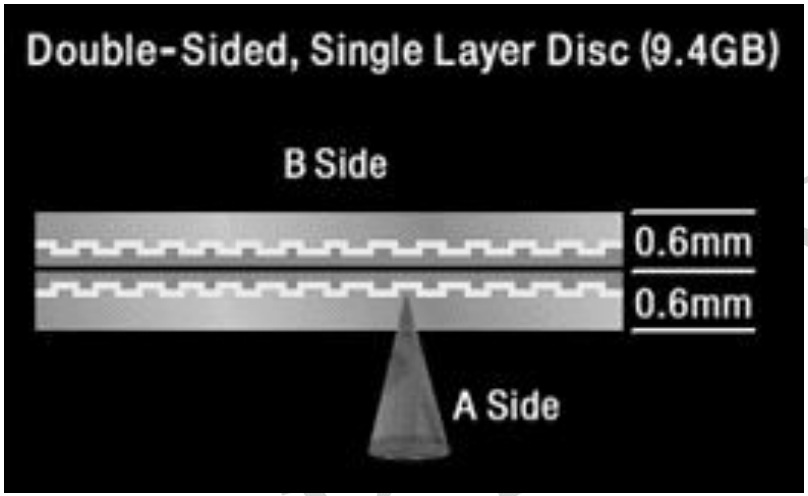


SINGLE SIDE, DUAL LAYER DVD

- 8.5 GB on one side
- additional 3.8 GB on the second layer
- more than "13 times" the capacity of today's music CDs and CD-ROMs



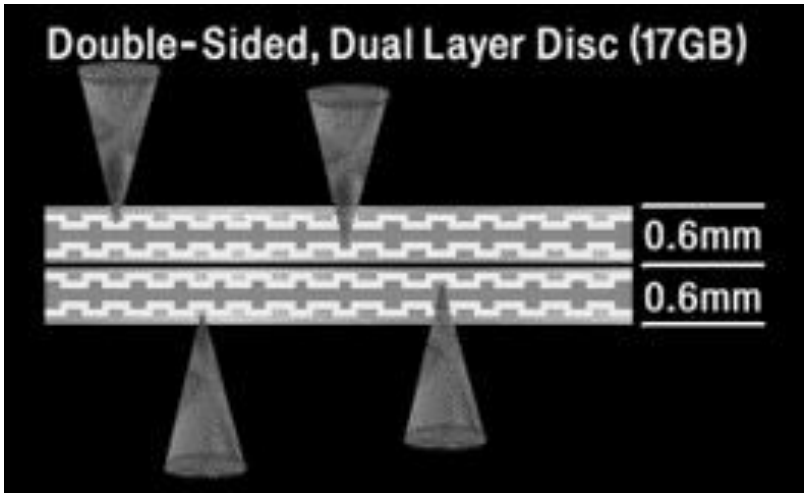
DUAL SIDE, SINGLE LAYER DVD



- 9.4 GB (4.7 on each side)
- provides a little more capacity
- Flipping the disc or having a DVD Player capable of two-sided playback is required

Dual Side, Dual Layer DVD

- Maximum capacity of 17GB (8.5GB on each side)
- Flipping the disc or having a DVD Player capable of two-sided playback is required



CD VERSUS DVD

- Both discs are the same physical size (120 mm diameter & 1.2 mm thickness, which makes CDs compatible with DVD players.
- Both discs are made with the same basic technology and production processes
- Both technologies read discs in the same manner
- DVD software can be replicated from existing CD production facilities

ADVANTAGES OF DVD

- DVD can hold exponentially more data than a CD can
- DVD has Higher density data storage where smaller pits and smaller tracks in DVDs provide seven times storage alone compared to CDs
- DVD has less overhead & more area because the DVD's error-correction scheme is more efficient and requires less storage space that can be used for other information

- DVD can have Multi-layer storage whereas CD stores data on one layer on one side of disc. DVD can store up to two layers on up to two sides of the disc

Logical Structure

- Track-at-once
  - CD – data discs
- Disc-at-once
  - Audio discs
  - DVDs
- Packet writing
  - Used with drag & Drop writing software
    - Dangerous for forensic workstations
  - Non-video DVDs

Interfaces

- ATAPI or SATA
- SCSI
- USB
- 1394 Firewire