Computer Architectures & Operating Systems

Lecture 8: Disk Drives/Optical Drives

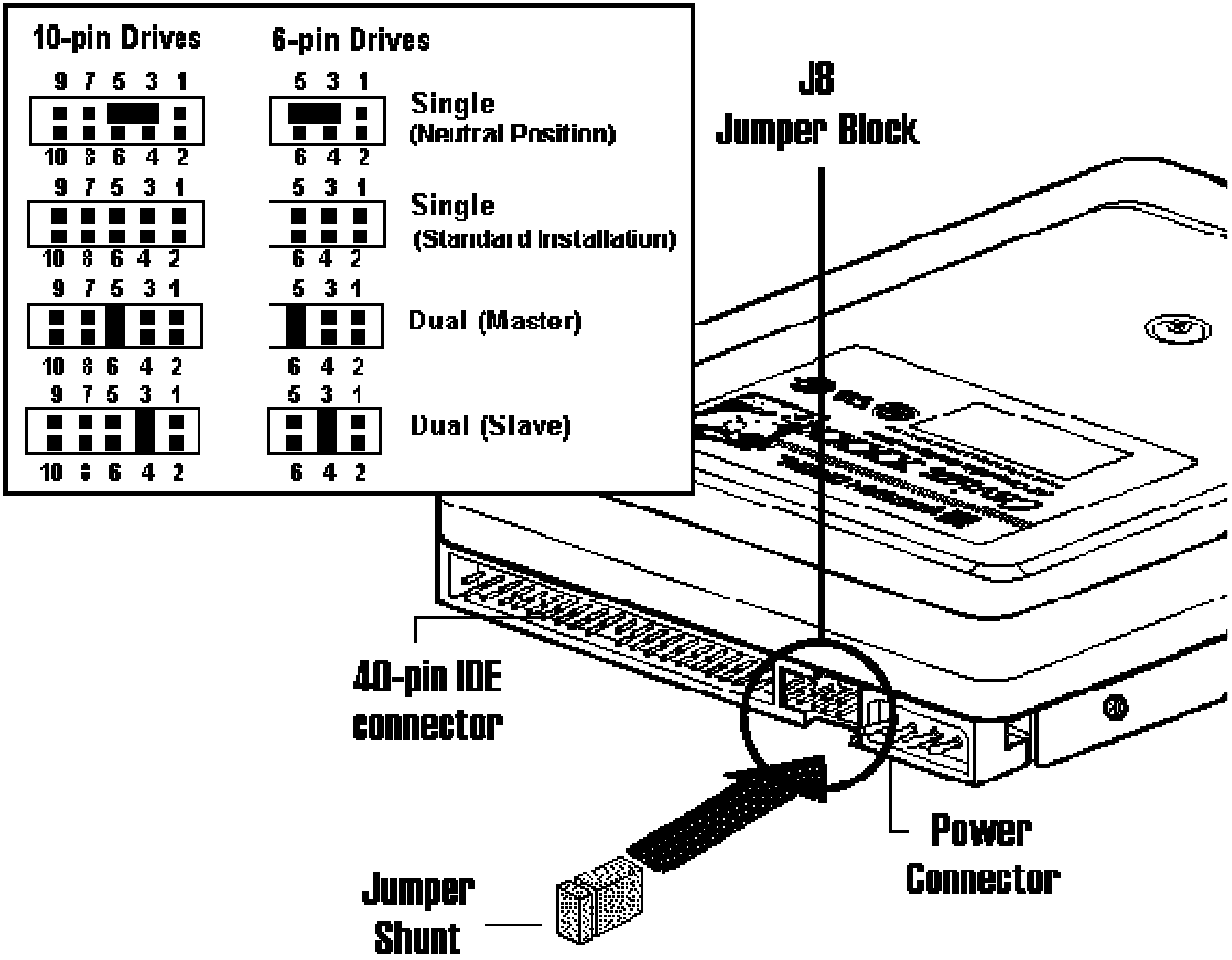
Introduction

This lecture looks at:

- Hard disk installation & configuration.
- Preparing a hard disk to store data, including partitioning and formatting.
- Hard disk features and specifications including spin speed, access time, reliability and S.M.A.R.T support.
- Disk drive limitations. Likely future developments.
- CD-ROM, CD-R, CD-RW
- DVD-R, DVD+R, DVD-RW, DVD+RW, DVD-RAM
- Media Formats: JPEG, MP3, MPEG, AVI

Before installing a hard drive, the jumper on the back of the drive must be configured.

- A jumper is a small clip that connects pins on the back of the drive together (Figure 1).
- The jumper may be connected to configure the drive in one of three ways (Figure 2):
  - Master
  - Slave
  - Cable select


10-pin Drives
6-pin Drives
9 7 5 3 1
10 8 6 4 2
5 3 1
6 4 2
Single
(Neutral Position)
Single
(Standard Installation)
Dual (Master)
Dual (Slave)
J8
Jumper Block
40-pin IDE
connector
Power
Connector
Jumper
Shunt


SELECT
C.SEL
SLAVE
MASTER

Plug into master

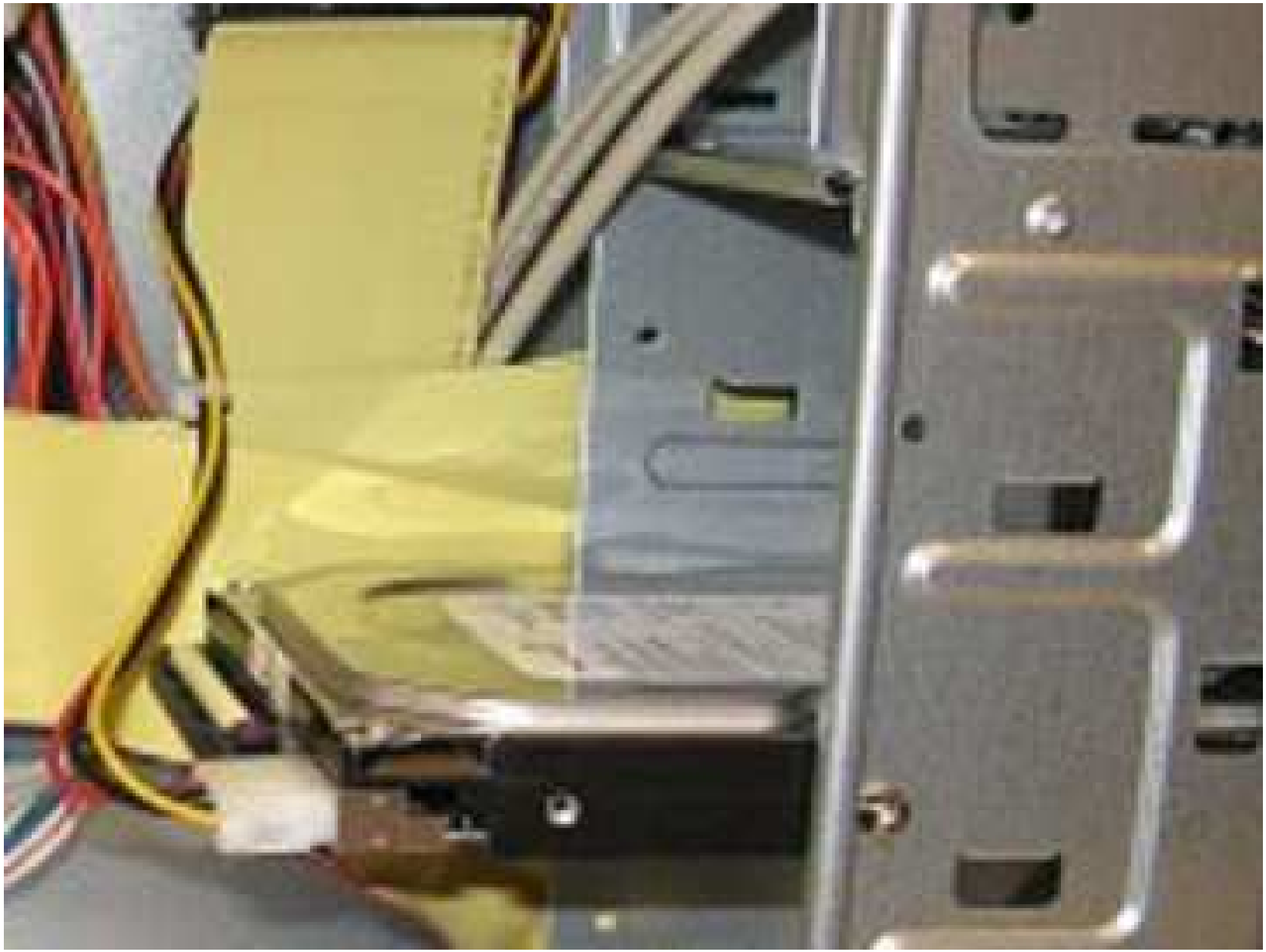
Plug into slave

Plug into controller card (or motherboard)

IDE Hard Disk Installation

A typical motherboard contains two IDE controllers.

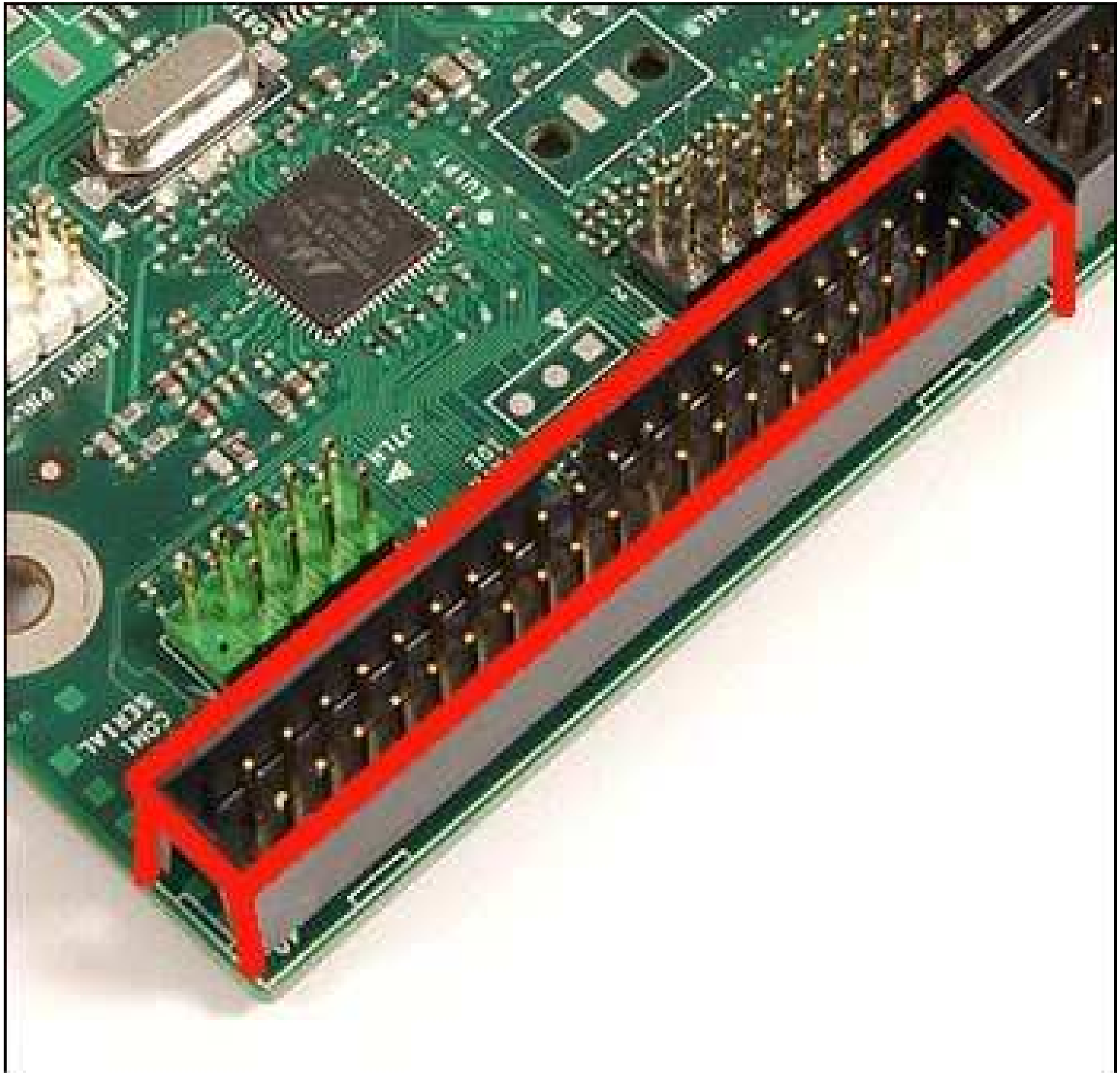
- Primary IDE controller and Secondary IDE controller.
- Two drives may be connected to the same IDE controller.
- If only one drive is required, it is connected to the end of the cable. It is configured, by means of the jumper, as either a single drive or master drive.
- If two drives are connected to the same IDE controller, they share one cable and must be configured as master and slave.
- The master drive is connected to the end of the IDE ribbon cable.



IDE Hard Disk Installation

Physical installation of an IDE hard disk drive:

- Select a drive bay. Pay attention to cooling requirements.
- Line up the threaded holes in the drive body with the slots in the drive bay. Fix in place with screws.
- Do not use screws that are too long.
- Do not handle the drive electronics. This may cause damage to the drive through static discharge.
- Attach the data cable. Line up the red trace on the cable with pin 1 on the IDE connector.
- Attach the power connector.



To prepare the hard disk to store data, involves two steps:

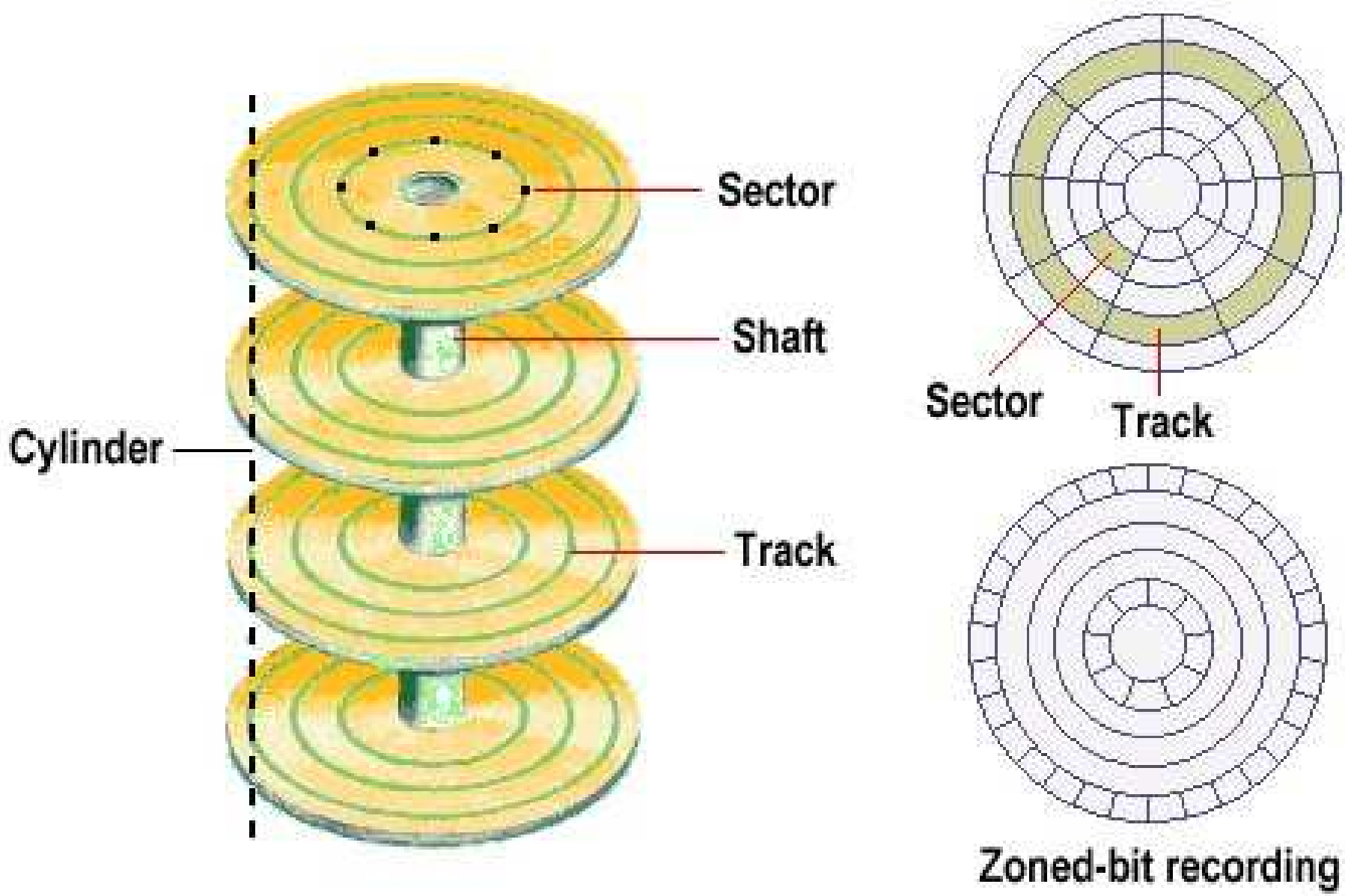
– Partitioning

– Formatting

- A partition is a logical space for use by a particular file system. File systems examples: FAT32, NTFS, ext2, ReiserFS.
- It is possible for example, to have a FAT32 and an ext2 partition on a single physical disk.
- DOS fdisk
- Disk utilities from drive manufacturers (Free downloads).

Hard Disk Preparation: Formatting

- Low level format. (Already performed by disk manufacturer.)
- High level format.
- DOS format command.
- Performs a high level format only.
- During the format, the OS writes the structure necessary for managing files and data on the disk.
- Creates a table of contents but does not create sectors and tracks.
- After formatting is complete, OS installation may be started from a CD.


Sector
Shaft
Cylinder
Track
Sector
Track
Zoned-bit recording

Hard Disk Utilities

- fdisk
- format
- ghost
- Partition Magic
- Utilities provided by manufacturers, eg. MaxBlast4 from

Seagate/Maxtor, Data Lifeguard from Western Digital

S.M.A.R.T.

Self-Monitoring Analysis & Reporting Technology

- Monitors indicators of drive degradation.
- Seagate: “60% of drive failures are mechanical.”
- Originated in technology called Predictive Failure Analysis (PFA) designed by IBM in 1992.
- ANSI S.M.A.R.T for SCSI drives.
- Extended to IDE by the S.M.A.R.T Working Group in 1995.
- Must be supported by BIOS and enabled in BIOS settings.

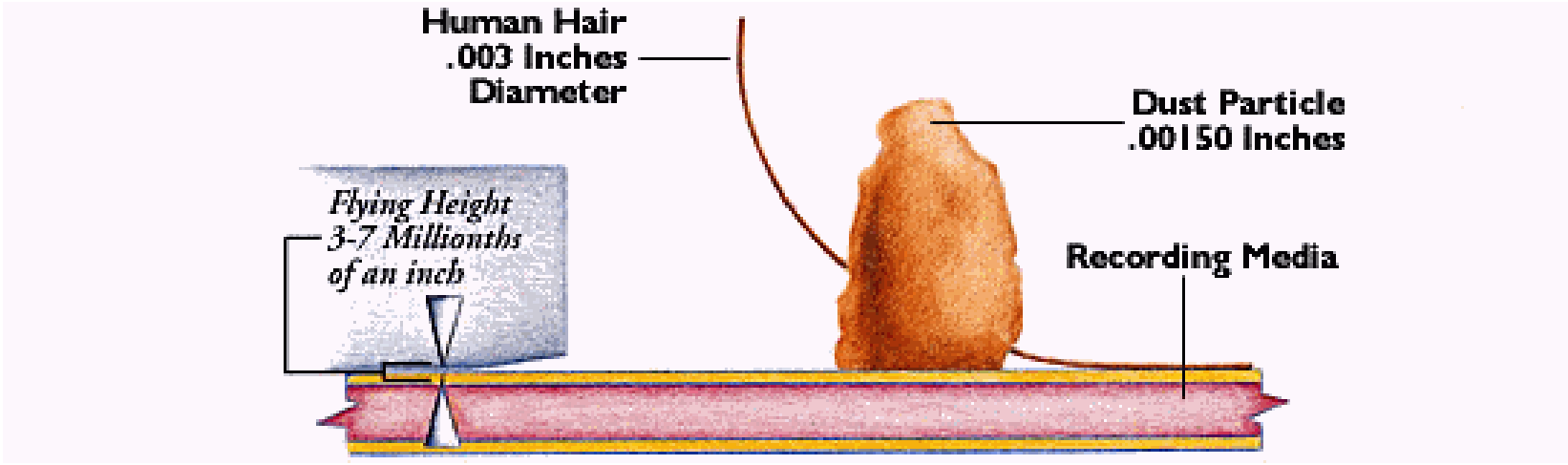
S.M.A.R.T.

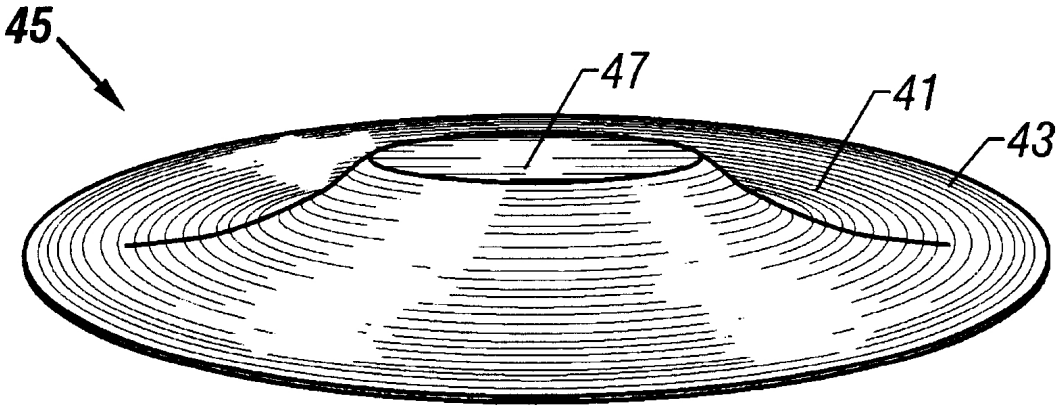
Monitors indicators of drive degradation.

– Head floating height
– Data throughput performance
– Spin-up time
– Re-allocated sector count
– Seek error rate
– Seek time performance

• Passes on warnings using OS support:
• ‘Immediately back up data and replace drive. Failure may be

imminent.’


Human Hair
.003 Inches
Diameter
Dust Particle
.00150 Inches
Flying Height
3-7 Millionths
of an inch
Recording Media


45
47
41
43

Hard Disk Features

Spin speed (4500r.p.m., 7200r.p.m.)

- Access time
- Transfer rate
- Capacity
- Mean Time Before Failure (MTBF) statistic
- On board cache size
- Web site support, including disk utilities, FAQ, user and trouble-shooting guides.
- Unit cost and cost per Megabyte.
- Manufacturer warranty (Does not cover data loss)

P ATA vs S ATA

- Advanced Technology Attachment
- IDE (ATA) and EIDE (ATA-2) drives
- Parallel ATA: 40 to 80 conductors, ribbon cables, <= 45cm
- Serial ATA: High speed serial connection (1.5Gbit/s – 3 Gbit/s).
- No need for wide ribbon cables.
- Faster data transfer than PATA.
- Designed to be hot swappable but needs hardware and operating system support for this.

Drive Limitations & Future Developments

Current technology using moving parts is prone to failure due to:

– Wear

– Jamming/sticking parts

– Loss in precision due to external shock.

• Power requirements of spindle motor.

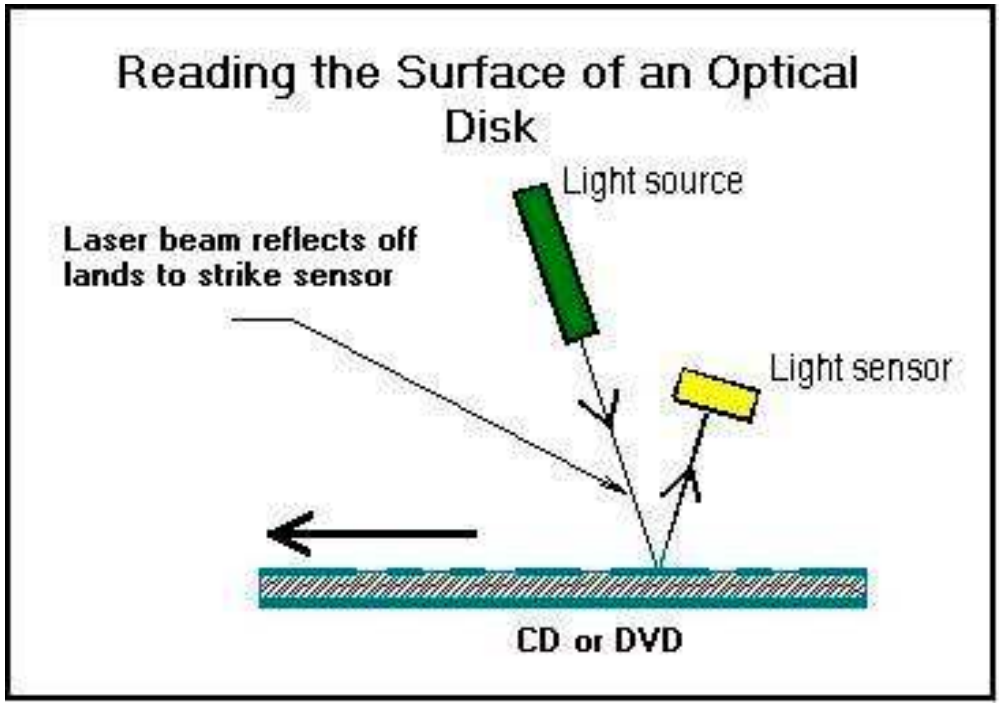
• Computer manufacturers such as Samsung are starting to bring Solid State Drive (SSD) equipped computers to market

The Samsung SSD with SSD palmtop and laptop.

Optical Drives

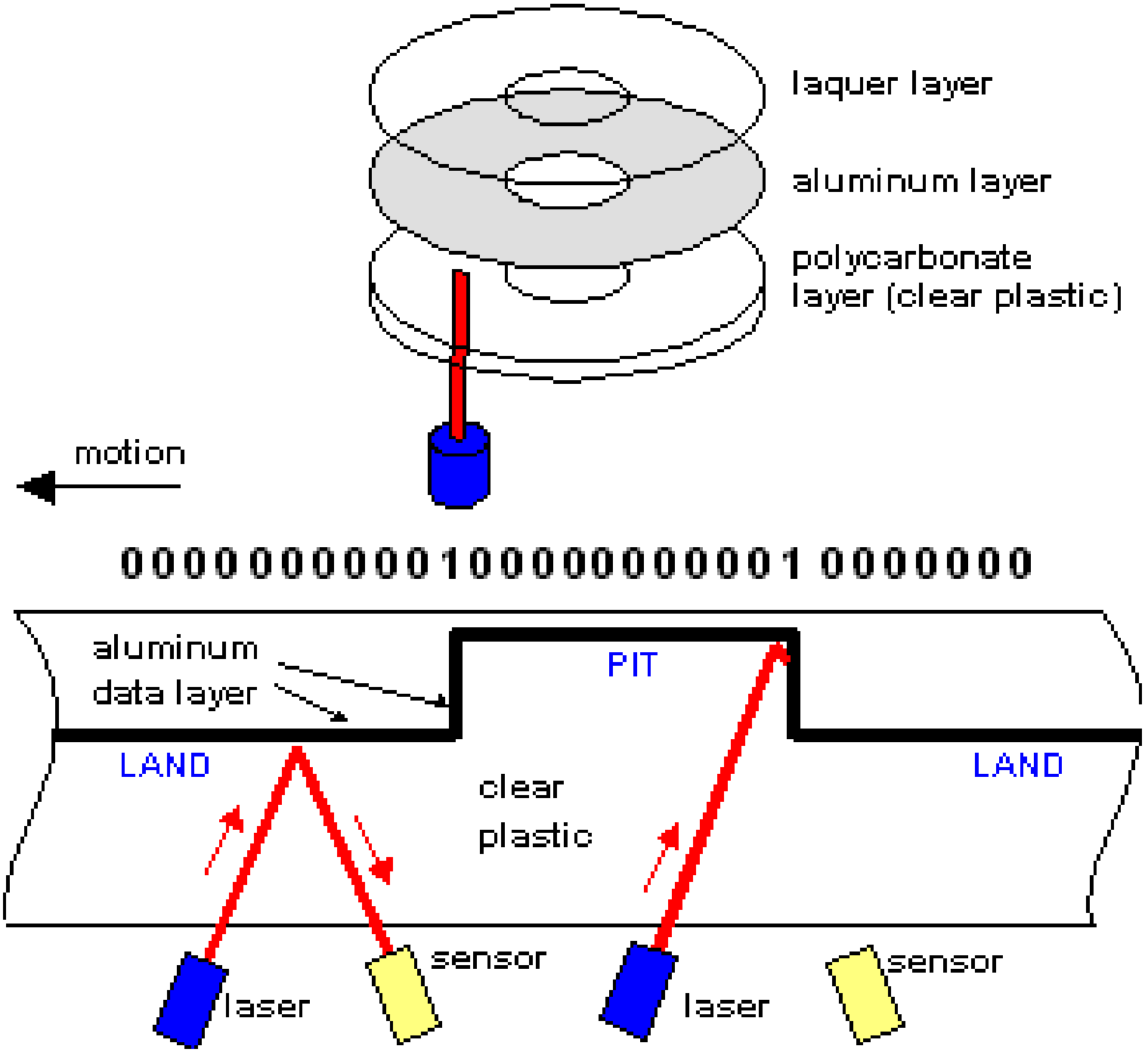
Include CD & DVD devices.

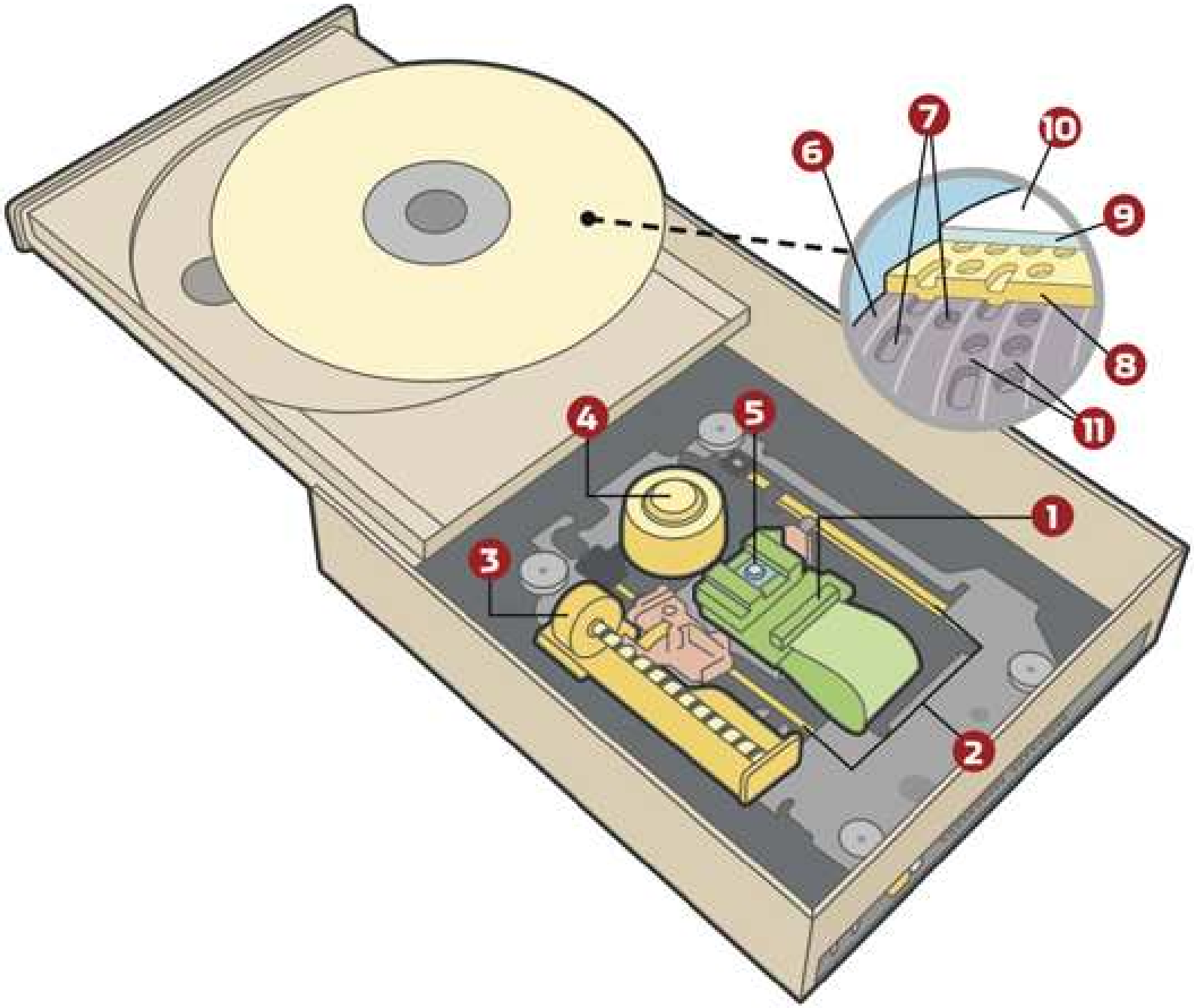
- Read by a laser beam which is directed at the surface
- Pits and lands: The laser beam either reflects off a land, registering 1 or strikes a pit and doesn't



CD-ROM

- Compact Disk Read Only Memory (CD-ROM)
  - Capacity 650MB or 700MB
  - Read only
- Transfer rate: 1x speed is 150k, 4x speed is 600k etc.
- CD-ROMs complete with data can be produced in large numbers by pressing.


laquer layer
aluminum layer
polycarbonate layer (clear plastic)
motion
0000000000100000000001 0000000
aluminum data layer
PIT
LAND
LAND
clear plastic
laser
sensor
laser
sensor


1
2
3
4
5
6
7
8
9
10
11

CD-R

CD-R -Recordable CD 650MB or 700MB

- Writing: A photo-sensitive dye changes its properties from reflective to non-reflective when exposed to a laser light.
- Sunlight can erase data quickly.
- Great variance. However, Mitsui MAM-A CD-R specify shelf-life of 250 years.
- Typically, drives can read at a faster rate than they can write.
- Multi-session writing possible

CD-RW

- CD-RW -Re-writable
- Sessions extend rather than selectively overwrite.
- Can be blanked and re-written.
- Re-writable approximately 1000 times.
- Higher per-unit price than CD-R
- Lower recording and reading speeds than CD-R
- For better portability use CD-R

Digital Versatile Disk (DVD)

- Physical dimensions the same as CD (120mm diameter)
- Higher density than CD and data encoding is different.
- 4.7GB capacity (single side, single layer)
- 8.5GB (single side, dual layer)
- DVD-R, DVD-RW -Recordable, re-writable
- DVD+R, DVD+RW -Competing standard not approved by the DVD-Forum. Incorporated improvements in Tracking, speed control, error detection.
- Super-Multi drives.
- The first film release on DVD is Twister (1996)

Media Formats

- JPEG Joint Photographic Experts Group (Pictures & photographs)
  – Uses compression to achieve smaller file sizes.
- MPEG1/2/3/4 Motion Picture Experts Group
- MPEG uses several compression techniques to reduce the file size required for motion pictures.
- AVI Audio Video Interleave (Microsoft 1992)
- DivX -Essentially an enhanced AVI format
- MP3 -Audio recording

Questions (1)

1. Distinguish between primary and secondary storage.
2. What are:

   (a) Tracks (b) Cylinders
3. How can the access time for a hard disk be determined?
4. How can the maximum transfer rate for a hard disk be determined?
5. What is the boot sector of a hard disk?
6. What is S.M.A.R.T?

Questions (2)

7. Describe with the aid of a diagram, how data is read from the surface of an optical disk.
8. Write a short note on the types of photo-sensitive dyes used to encode data in optical disks.
9. CDs and DVDs are the same size and are made from the same substrate material. In what ways is a DVD different to a CD?
10. Samsung currently use Solid State Disk (SSD) storage devices in portable computers. Are SSDs suitable for use in such computers? Why?