UNIVERSITI TENAGA NASIONAL

CHAPTER 6 EXTERNAL MEMORY

CGMB143 COMPUTER SYSTEM

Types of External Memory

- Magnetic Disk
- Optical
- Magnetic Tape

MAGNETIC DISK

Magnetic Disk

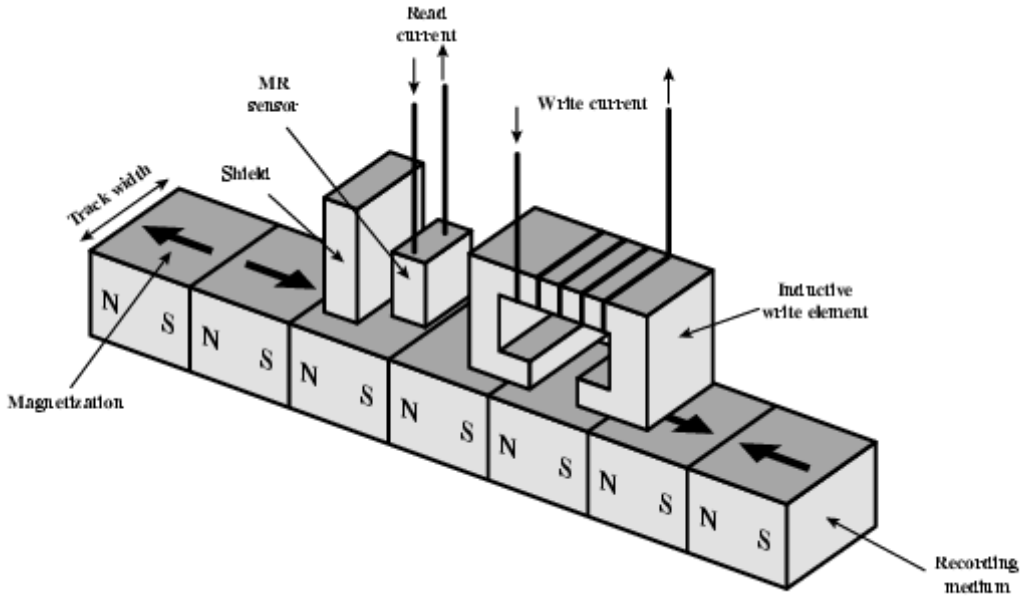
- Disk
  - A circular platter constructed of nonmagnetic material called **substrate**
    - Aluminium (old)
    - Glass (new)
  - Coated with a magnetisable material

Magnetic Disk (Cont.)

- Glass
  - Improved surface uniformity
    - Increases reliability
  - Reduction in surface defects
    - Reduced read/write errors
  - Better stiffness
  - Greater ability to withstand shock and damage

Magnetic Disk – Read/Write

- Mechanisms
  - Recording & retrieval via conductive coil called a head
  - May be single read/write head or separate ones
  - During read/write, head is stationary, platter rotates



Magnetic Disk – Read/Write (Cont.)

Write

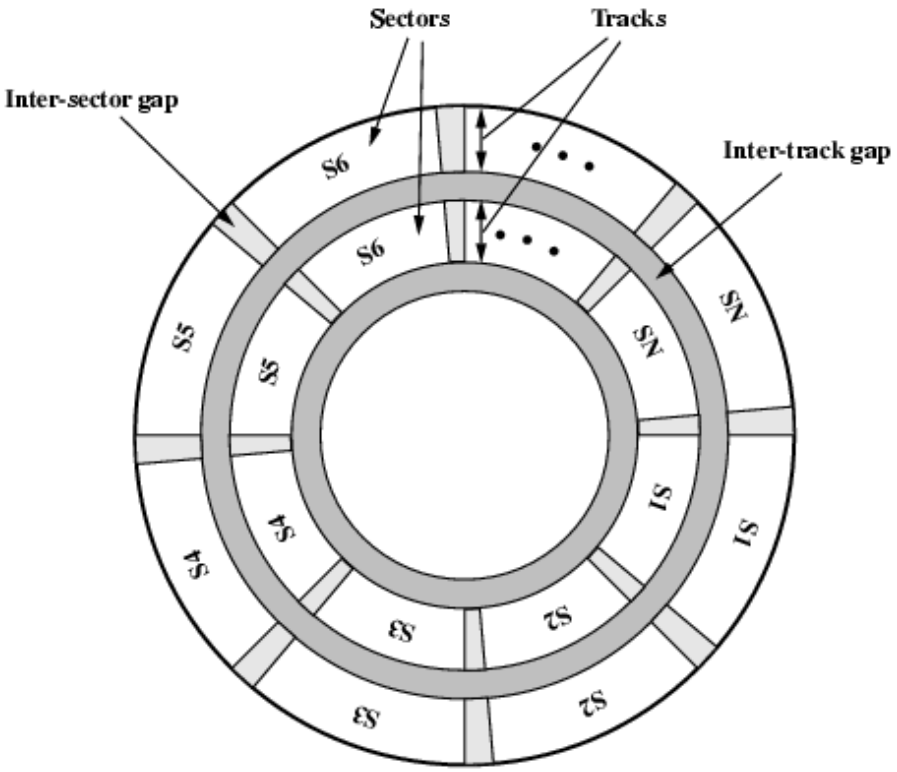
- Current through coil produces magnetic field
- Pulses sent to head
- Magnetic pattern recorded on surface below

Read

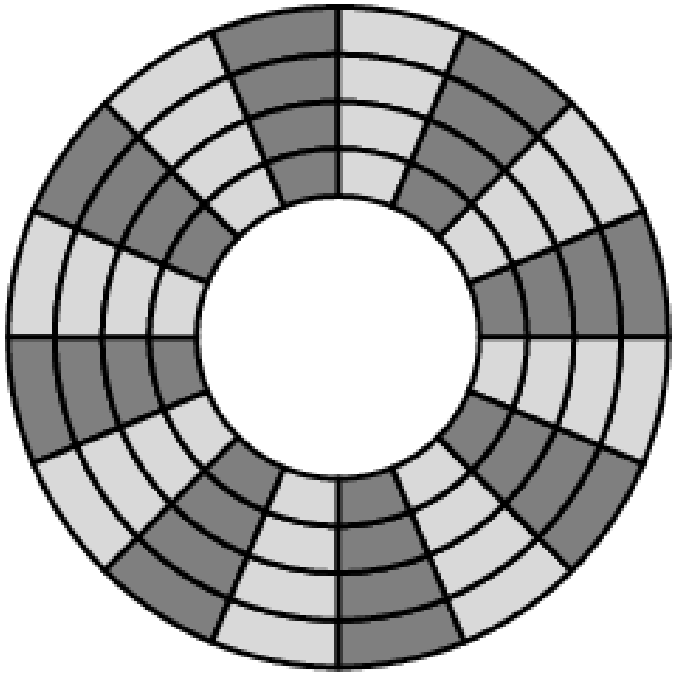
- Traditional
  - Magnetic field moving relative to coil produces current
  - Coil is the same for read and write
- Contemporary
  - Separate read head, close to write head
  - Partially shielded magneto resistive (MR) sensor
  - Electrical resistance depends on direction of magnetic field
  - High frequency operation
    - Higher storage density and speed

Magnetic Disk – Organization, Formatting & Layout

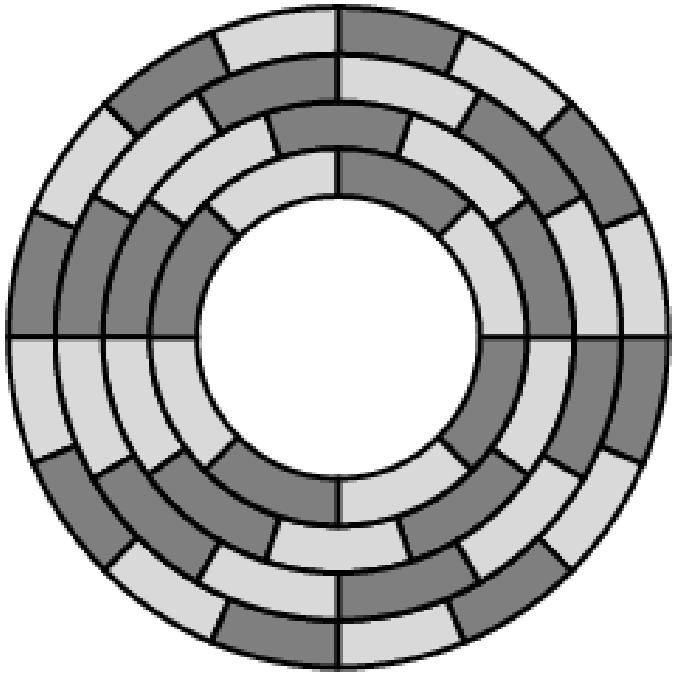
Term	Description
Head	A small device capable of reading from or writing to a portion of the platter rotating beneath it
Track	Organize data on the platter in a concentric set of rings
Width	Track width = head width
Gaps	separate the adjacent tracks
Sectors	Form of transferring the data Fixed length or variable length



Magnetic Disk - Layout Methods Diagram

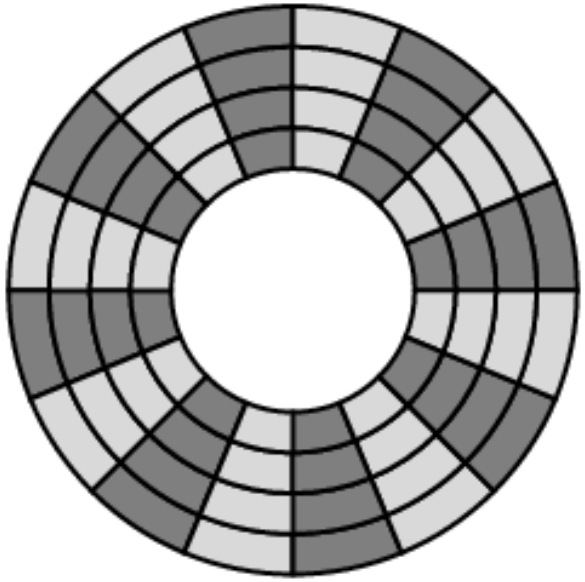


(a) Constant angular velocity



(b) Multiple zoned recording

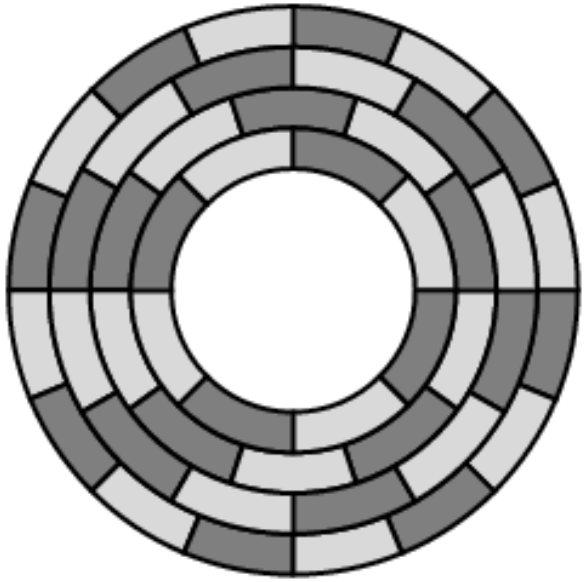
Magnetic Disk – Constant Angular Velocity



(a) Constant angular velocity

- The disk is divided into a number of pie-shaped sectors and into a series of concentric tracks
- Advantage of CAV:
  - The individual blocks of data can be directly addressed by tracks and sectors
- Disadvantage of CAV:
  - The amount of data that can be stored on the long outer tracks is the only same as what can be stored on the short inner tracks

Magnetic Disk – Multiple Zone Recording



(b) Multiple zoned recording

- The surface is divided into a number of concentric **zones** –
  - The number of bits per track is constant (Within the zone)
  - Zones farther from the center contain more bits (since more sectors) than zones closer to the center
- Advantage:
  - Increase density
- Disadvantage:
  - Require complex circuitry

Magnetic Disk – Physical Characteristics

- Head motion
  - Fixed head
    - One read write head per track
    - Heads mounted on fixed ridged arm
  - Movable head
    - One read write head per side
    - Mounted on a movable arm

Magnetic Disk – Physical Characteristics (Cont.)

- Removable disk
  - Can be removed from drive and replaced with another disk
  - Provides unlimited storage capacity
  - Easy data transfer between systems
- Non-removable disk
  - Permanently mounted in the drive

Magnetic Disk – Classifications

Head mechanism

- #1 Traditional head
  - Positioned a fixed distance above the platter-allowing an air gap
- #2 head mechanism that actually comes into physical contact with the medium during R/W operation
  - Used in floppy disk
    - 8”, 5.25”, 3.5”
    - Small capacity
    - Up to 1.44Mbyte (2.88M never popular)
    - Slow
    - Universal
    - Cheap

Magnetic Disk – Classifications (Cont.)

Head mechanism

- #3 Winchester
  - Aerodynamic gap
  - Generate or sense an electromagnetic field of sufficient magnitude - write/read
  - Used in sealed drive – free of contamination – able to reduce the risk of error
  - Operate closer to the disk's surface → greater data density
  - Material - Aerodynamic foil - rests lightly on the platter's surface

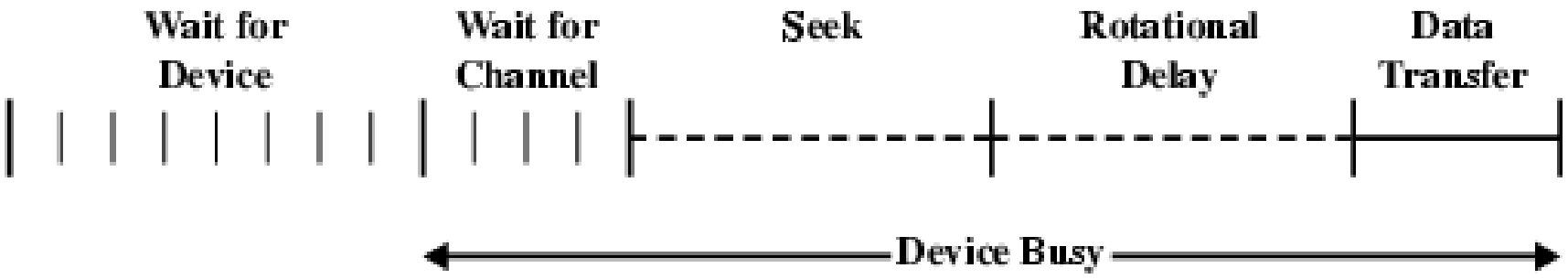
Magnetic Disk - Performance

- Depends on;
  - Computer system
  - OS
  - Nature of the I/O channel
  - Disk controller hardware

Magnetic Disk – Performance (Cont.)

General timing of disk I/O transfer

- Seek time → Moving head to correct track
- (Rotational) latency/delay → Waiting for data to rotate under head
- Access time = Seek + Latency
- Transfer rate-the time required for the transfer data



OPTICAL STORAGE

CD-ROM

(Direct Access)

DVD-ROM

(Direct Access)

CD-R

(Direct Access)

DVD-R

(Direct Access)

CD-RW

(Direct Access)

DVD-RW

(Direct Access)

DVD-RAM

(Direct Access)

Blu-Ray Disc

(Direct Access)

Optical Storage

- Originally for audio
- 650Mbytes giving over 70 minutes audio
- The disk is formed from a resin such as polycarbonate.
- Record data digitally (music/computer data)
- Data recorded as a series of microscopic pits on the surface of the polycarbonate

Optical Storage (Cont.)

- Organized in a single spiral track in a sequence of blocks
- Sectors near the outside of the disk are the same length as those near the inside
- Info is packed evenly across the disk in segments of the same size - scanned at the same rate by rotating the disk as a variable speed
- The pits are then read by the laser as a **constant linear velocity (CLV)**

Optical Storage - Writing

Create a **master** disk – high-intensity laser

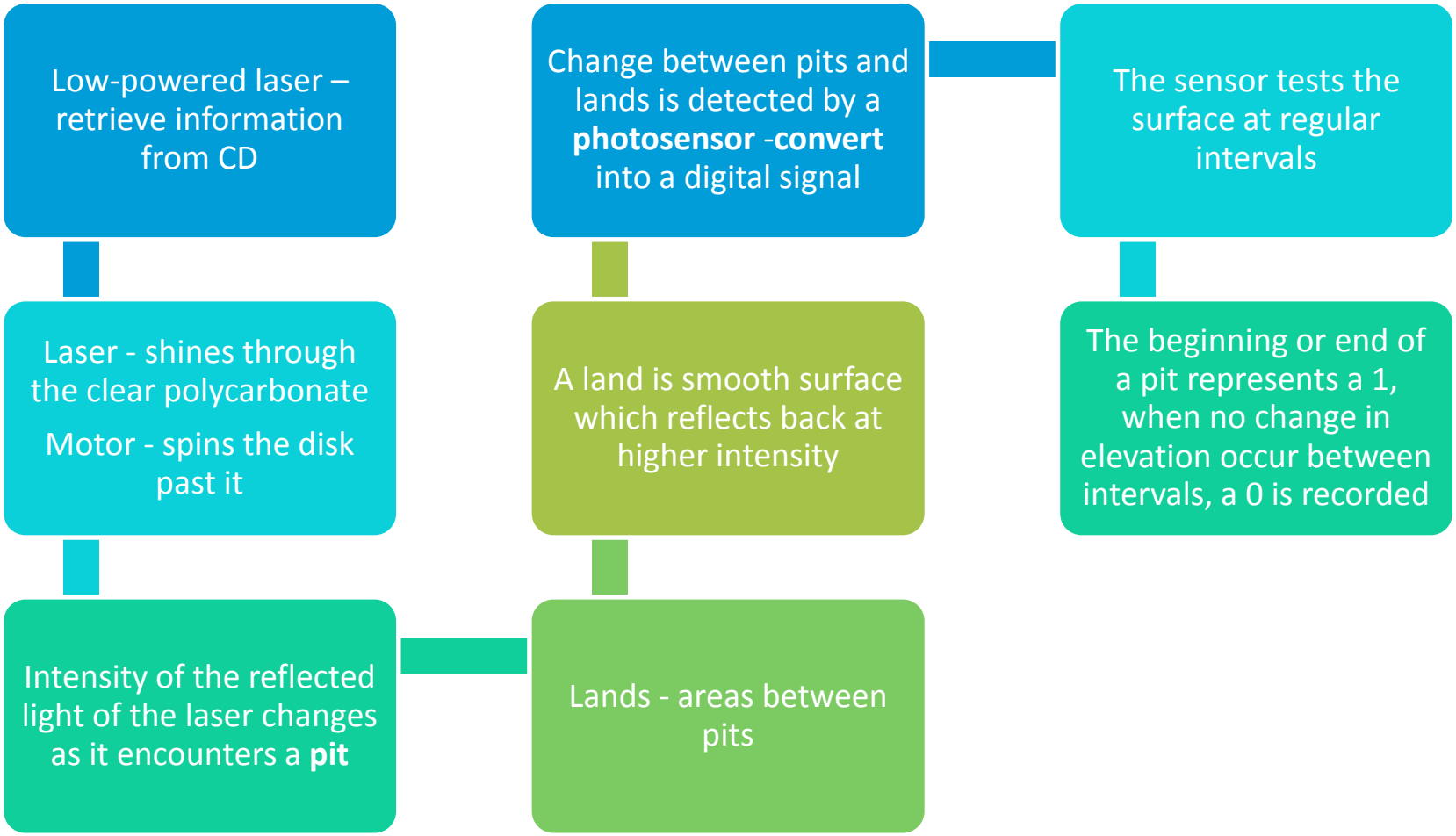
Use **master** to make a die to stamp out copies onto polycarbonate

Pitted surface - coated with a highly reflective surface (aluminium / gold)

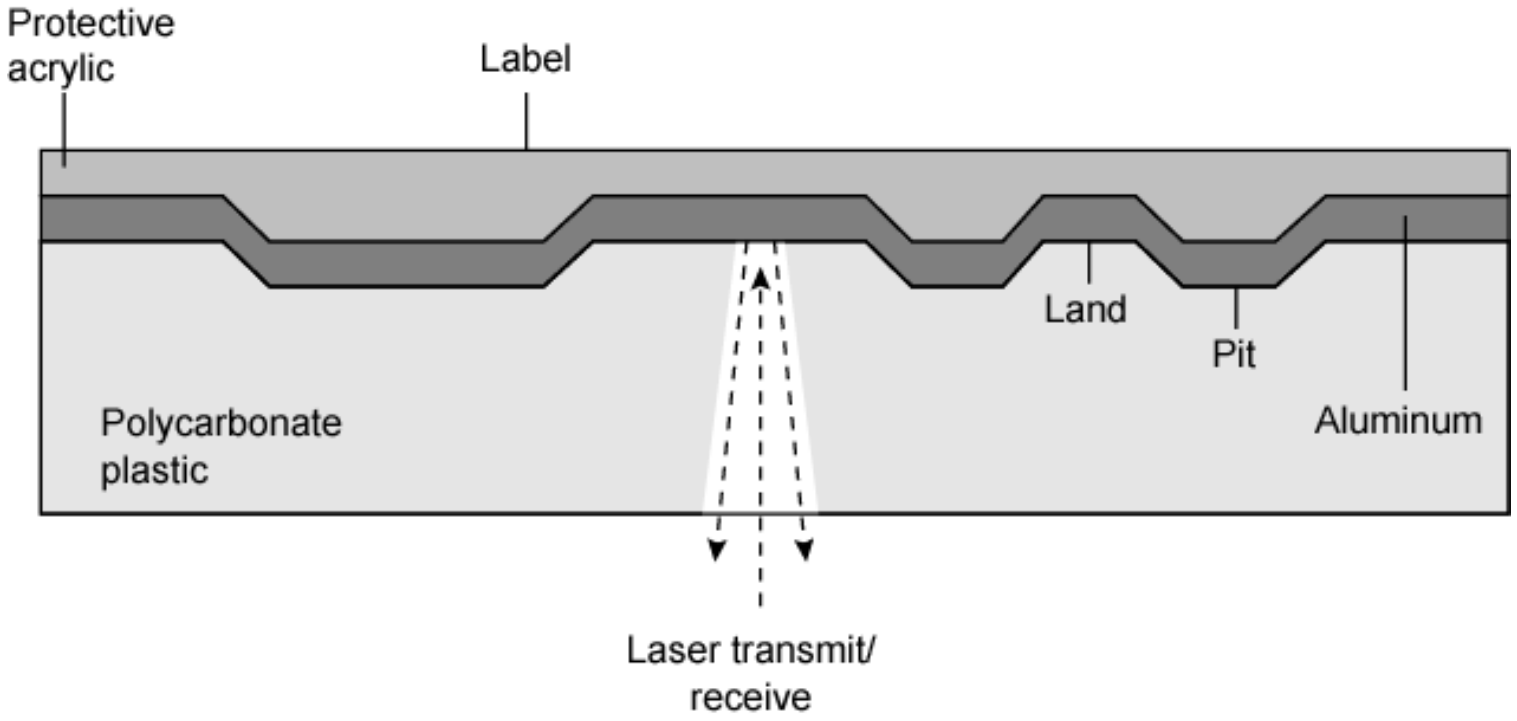
Shiny surface - protected against dust and scratches by suing a top coat of clear **acrylic**

A label can be silkscreened onto the acrylic

Optical Storage - Reading



Optical Storage - Reading



Optical Storage – Types

- CD-ROM
- CD-R
- CD-RW
- DVD

Optical Storage – CD-ROM

- Appropriate for large amount of data
- Removable
- Disadvantages:
  - Read only-cannot be updated
  - The access time is longer compared to magnetic disk drive

Optical Storage – CD-R

- CD-Recordable
- Write Once Read only Memory (WORM)
- Compatible with CD-ROM drives

Optical Storage – CD-RW

- Erasable
- Getting cheaper
- Mostly CD-ROM drive compatible
- Can be rewritten and can used as secondary storage similar to magnetic disk

Optical Storage – DVD

- Digital Video Disk
  - Used to indicate a player for movies
    - Only plays video disks
- Digital Versatile Disk
  - Used to indicate a computer drive
    - Will read computer disks and play video disks

Optical Storage – DVD

Technology

- Multi-layer
- Very high capacity (4.7G per layer)
- Full length movie on single disk
  - Using MPEG compression

Optical Storage – DVD (Cont.)

High Definition

- Designed for high definition videos
  - Much higher capacity than DVD
    - Shorter wavelength laser
      - Blue-violet range
  - Smaller pits
- HD-DVD
  - 15GB single side single layer
- Blu-ray
  - Data layer closer to laser
    - Tighter focus, less distortion, smaller pits
  - 25GB on single layer
  - Available read only (BD-ROM), Recordable once (BR-R) and re-recordable (BR-RE)

MAGNETIC TAPE

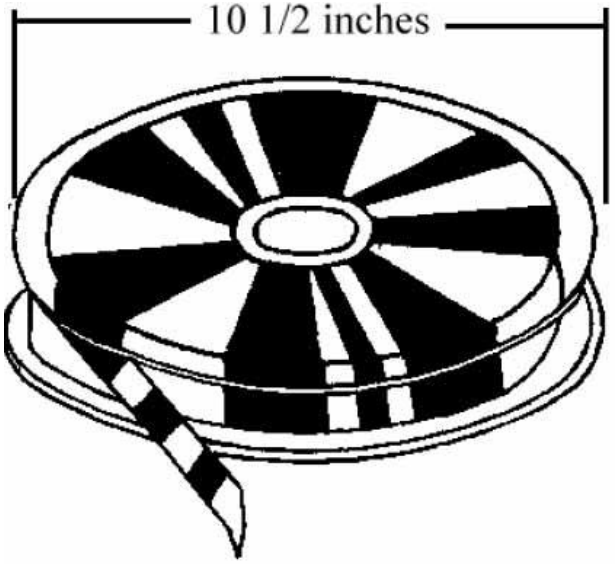


Fig. 2.3 Magnetic Tape

Magnetic Tape

- Tape system use the same reading/writing technique as disk system
- Made from polyester tape coated with magnetizable material
- Data on the tape are structured as a number of parallel tracks running lengthwise
- Serial access
- Slow
- Very cheap
- Backup and archive