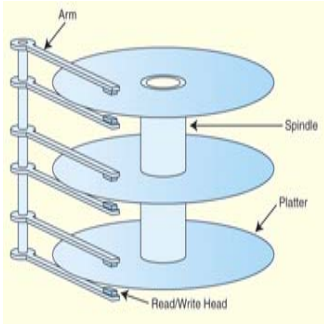
Disk Storage

CIT 595
Spring 2008

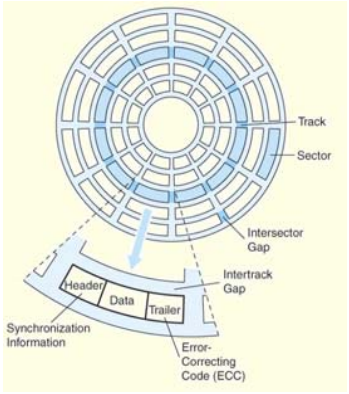
Magnetic Disk – Physical Structure

- Each *platter* (disc-shaped) is coated with magnetic material on both surfaces
- Each platter surface has *arm* extended from fixed position
- Tip of the arm contains read/write *head* for reading or writing data
- The arm moves the heads from the spindle edge to the edge of the disc



Magnetic Disk: Physical Structure

Low-Level Disk Formatting



Platter Surface View

- Track Width is 1-2 microns (micrometer)
- A sector contains fixed number of bytes
  - E.g. 512 bytes
  - Divided in header (stores sector number), data and ECC
- Width of 1 bit in a sector is 0.1 to 0.2 microns
- Cylinder: is a set of tracks on all the surfaces at a fixed arm position

Block Transfer

- Because the physical structure of the disk data read or written in *blocks*
- A block comprises of one or more sectors
  - E.g. sector size is 512 bytes and file requires 4096 bytes, then we need 8 sectors to store the file
  - The allocation of data may or may not be on contiguous i.e. on the same track
    - this something that is managed by the OS File System (later in discussion)

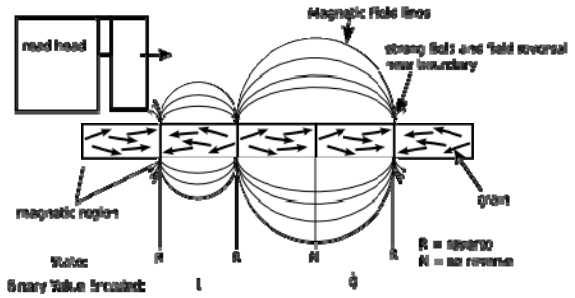
How is data read/written ?

- Each Block is identified (i.e. block address contains)
  - Cylinder Number
  - Surface Number
  - Sector Number
- Based on the block address the *disk controller (digital circuit)*
  - Moves the arm to designated track
  - Platter is rotated (spins angularly) until the desired sector is located
- Once the head is aligned with header section, the reading or writing mechanics is performed

Read/Write Mechanics

- Disks record data by magnetizing a magnetic material in a pattern that represents the data
  - Magnetic material is *ferromagnetic* substance such as iron oxide
- Write: head contains an induction coil through which will current passes
  - This magnetizes the iron oxide
  - Depending on the current direction, the magnetic particles align either in left or right direction
- Read: Head passes over the bit region to detect the magnetization of the material
  - a current is generated in the coil, which is measured and value is measured determines with bit is 0 or 1

Read/Write Mechanics (contd..)



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Access Time

- *Seek* time is the time that it takes for a disk arm to move into position over the desired cylinder
  - Quoted by disk manufactures to be between 4-5ms
  - Also depends disk schedule i.e. in what order do you access the blocks (done by OS or disk controller)
- *Rotational* delay is the time that it takes for the desired sector to move into position beneath the read/write head
  - On Avg: Half the rotational Speed
  - Current rotational speed is 7200 RPM (revolutions/min) giving us ~4.2 ms
- *Access Time* = Seek time + Rotational delay

Transfer Time

- *Transfer Time* = Time for read/write + Access Time
  - Calculation for read or write time can be derived from specified transfer rate given in data/sec
- Example: What is transfer time for reading 1KB?
  - seek time on average is 4.5 ms
  - 7200 RPM
  - 256 sectors per track
  - 1KB per sector
- Transfer T = Time for Read + Seek Time + Rotational
  = data / (data rate) + 4.5ms + 4.2ms

Transfer Time

- Data rate per track (rough estimate)

$$= \frac{7200 \text{ rev}}{60 \text{ sec}} \times \frac{1 \text{ track}}{\text{rev}} \times \frac{256 \text{ sectors}}{1 \text{ track}} \times \frac{1 \text{ KB}}{\text{sector}}$$

$$= \mathbf{30720\ KB/second}$$

- Transfer T = Time for Read + Seek Time + Rotational
  = 1KB/ (30720 KB/sec) + 4.5ms + 4.2 ms
  = 0.0325 + 4.5 + 4.2
  = 8.70325 ms