

Storage Management – Mass Storage Structure

Dr Rahul NagpalComputer Science



Storage Management – Mass Storage Structure

Dr. Rahul NagpalComputer Science

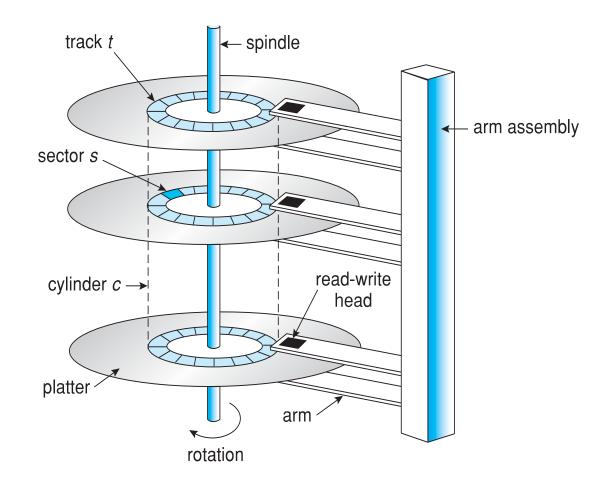
Overview of Mass Storage Structure

PES UNIVERSITY ONLINE

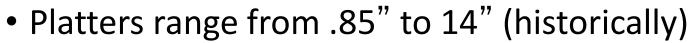
- Magnetic disks provide bulk of secondary storage of modern computers
 - Drives rotate at 60 to 250 times per second
 - Transfer rate is rate at which data flow between drive and computer
 - Positioning time (random-access time) is time to move disk arm to desired cylinder (seek time) and time for desired sector to rotate under the disk head (rotational latency)
 - Head crash results from disk head making contact with the disk surface -- That's bad
- Disks can be removable
- Drive attached to computer via I/O bus
 - Busses vary, including EIDE, ATA, SATA, USB, Fibre Channel, SCSI, SAS, Firewire
 - Host controller in computer uses bus to talk to disk controller built into drive or storage array

Moving-head Disk Mechanism





Hard Disks



- Commonly 3.5", 2.5", and 1.8"
- Range from 30GB to 3TB per drive
- Performance
 - Transfer Rate theoretical 6 Gb/sec
 - Effective Transfer Rate real 1Gb/sec

(From	Wikipedia)

Spindle [rpm] Average latency [ms]

7.14 5.56

4.17

4200

5400

7200 10000

15000

- Seek time from 3ms to 12ms 9ms common for desktop drives
- Average seek time measured or calculated based on 1/3 of tracks
- Latency based on spindle speed
 - 1/(RPM/60) = 60/RPM
- Average latency = ½ latency



Hard Disk Performance



- Access Latency = Average access time = average seek time + average latency
 - For fastest disk 3ms + 2ms = 5ms
 - For slow disk 9ms + 5.56ms = 14.56ms
- Average I/O time = average access time + (amount to transfer / transfer rate) + controller overhead
- For example to transfer a 4KB block on a 7200 RPM disk with a 5ms average seek time, 1Gb/sec transfer rate with a .1ms controller overhead =
 - 5ms + 4.17ms + 0.1ms + transfer time =
 - Transfer time = 4KB / 1Gb/s * 8Gb / GB * 1GB / 1024^2 KB = 32 / (1024^2) = 0.031 ms
 - Average I/O time for 4KB block = 9.27ms + .031ms = 9.301ms

Solid-State Disks



- Nonvolatile memory used like a hard drive
 - Many technology variations
- Can be more reliable than HDDs
- More expensive per MB
- Maybe have shorter life span
- Less capacity
- But much faster
- Busses can be too slow -> connect directly to PCI for example
- No moving parts, so no seek time or rotational latency

Magnetic Tape



- Was early secondary-storage medium
 - Evolved from open spools to cartridges
- Relatively permanent and holds large quantities of data
- Access time slow
- Random access ~1000 times slower than disk
- Mainly used for backup, storage of infrequently-used data, transfer medium between systems
- Kept in spool and wound or rewound past read-write head
- Once data under head, transfer rates comparable to disk
 - 140MB/sec and greater
- 200GB to 1.5TB typical storage
- Common technologies are LTO-{3,4,5} and T10000



THANK YOU

Dr Rahul Nagpal

Computer Science

rahulnagpal@pes.edu