COMP 7970 Storage Systems

Disk Drive Modeling

Dr. Xiao Qin

Department of Computer Science and Software Engineering
Auburn University
http://www.eng.auburn.edu/~xqin
xqin@auburn.edu
Modeling Disk Drive

- Much research in I/O systems is based in disk trace-driven simulation
  - Accurate simulation is very important
- The structure of a disk drive
  - A mechanism
    - Recording components & positioning components
  - A controller
    - Microprocessor, buffer memory, and interface to SCSI bus
    - Manage storage/retrieval of data to/from the mechanism and perform mapping (LBN \(\rightarrow\) PBN)
A Seek Operation

- **Speedup**
  - Until reach half of the seek distance or a fixed maximum velocity
- **Coast for long seeks**
- **Slowdown**
  - Close to the destination
- **Settle**
  - Controller adjust head to access the desired location
Very short seeks (0-4 tracks) are dominated by settle times (1-3 ms)
Long seeks are dominated by seek times
Average seek times or 1/3 distance seek time are somehow misleading
- Short seeks are much more common
- Head switching also need times

Shorter seeks are much more common.
Modeling Seek Time

- Constant access time (say, 10 ms)
- Linear time
- More complex approximation
  - HP C2200A
  - Seek time = 3.45 + 0.597 \sqrt{D} \quad (D < 616 \text{ cylinders})
  - Seek time = 10.8 + 0.012 D \quad (D \geq 616 \text{ cylinders})
Disk Controller

- One or more micro-controllers
  - Firmware
  - Positioning system controller (critical to performance and capacity)
  - Spindle motor controller
- A built-in cache (64KB-4MB)
  - Important to the performance of some workloads
  - Speed-matching buffer and disk block caching
- Some buffers (such as a track buffer)
- An Interface (SCSI, EIDE, Fibre Channel, etc)
  - Transfer data between host and controller buffer
  - External transfer rate: 20-200 MB/sec
- A read channel
  - Internal transfer rate: 15-60 MB/sec
  - Transfer data between controller buffer and disk platter
  - Disk bandwidth is the total number of bytes transferred, divided by the total
time between the first request for service and the completion of the last
transfer.