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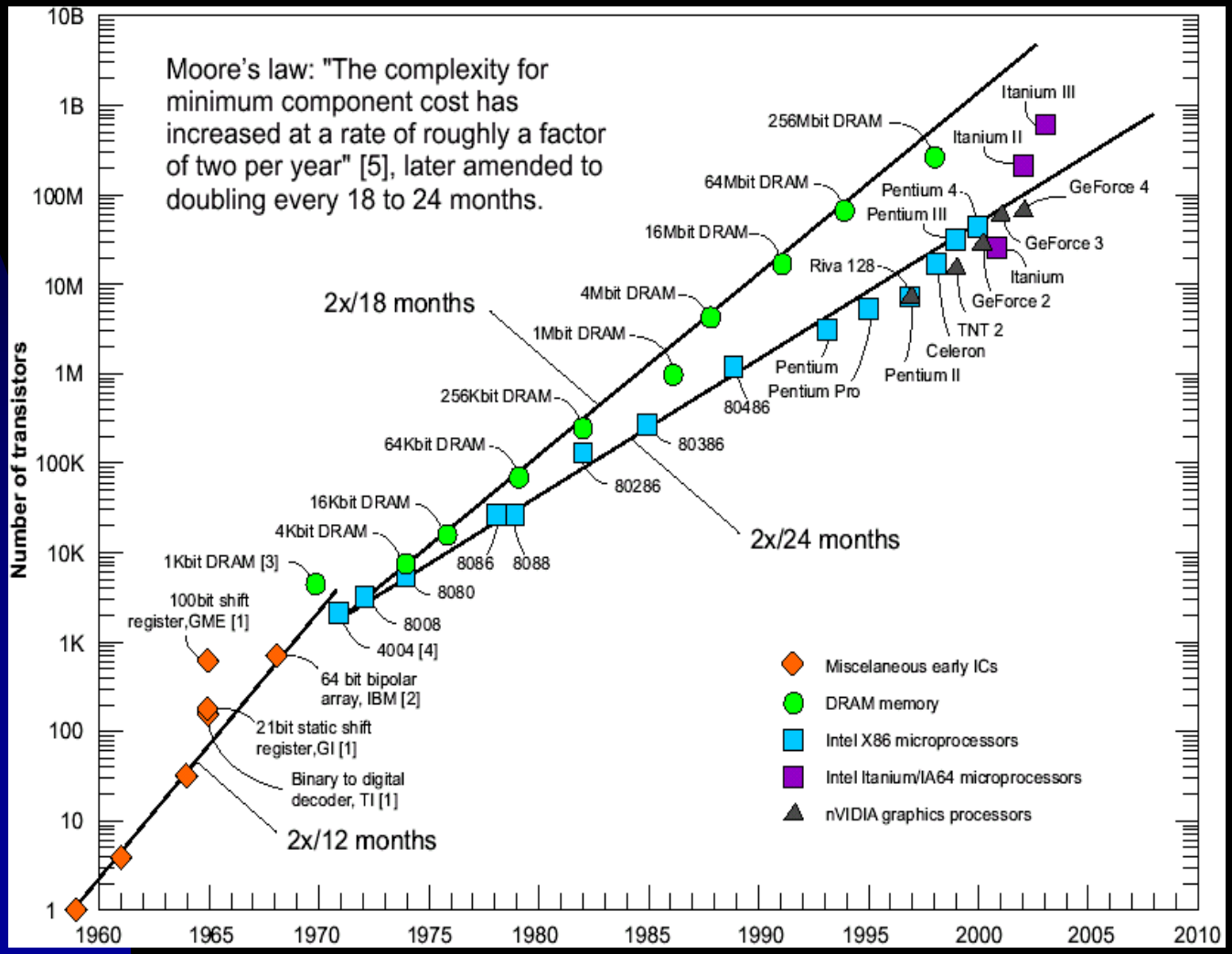
Overview of Mass-Storage Structures

- Magnetic Disks
  - Components: Disk Platters, A Disk Arm, and Heads.
  - Units: Cylinders, Tracks, and Sectors.
  - Performance: Transfer Rate, Seek Time, Rotational Latency.
  - I/O Bus: IDE, EIDE, ATA, SATA, USB, FC, SCSI, etc.
  - Controllers: Host and Disk Controllers
- Solid-State Disks – Flash-Memory Drives
  - Out-Place Updates, Bulk Erasing, Wear Leveling
- Magnetic Tapes
  - Problems: Random Access Time

Trends in Computing and Storage Technology



Source: www.icknowledge.com

Disk Structure and Attachment

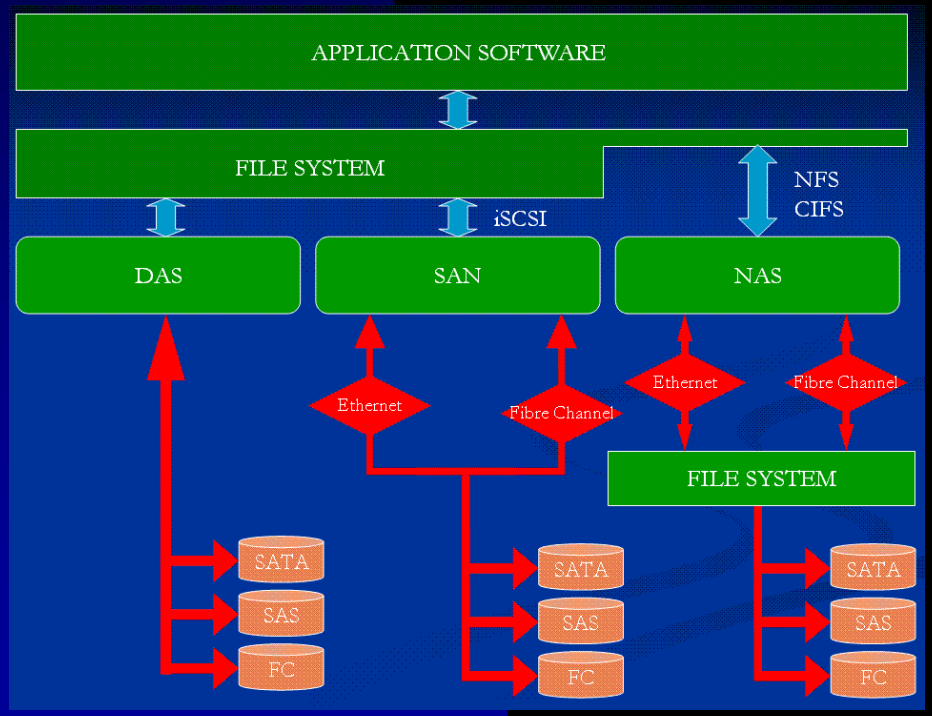
- Disk Structure
  - Sector addressing as large one-dimensional arrays of logical blocks
  - Difficulty in locating a logical block number: (1) the existence of defective sectors, and (2) non-constant over the number of sectors per track
    - Constant Linear Velocity (CLV) – CD-ROM and DVD-ROM
    - Constant Angular Velocity (CAV) – Hard Disks
- Disk Attachment
  - Host-Attached Storage
  - Network-Attached Storage

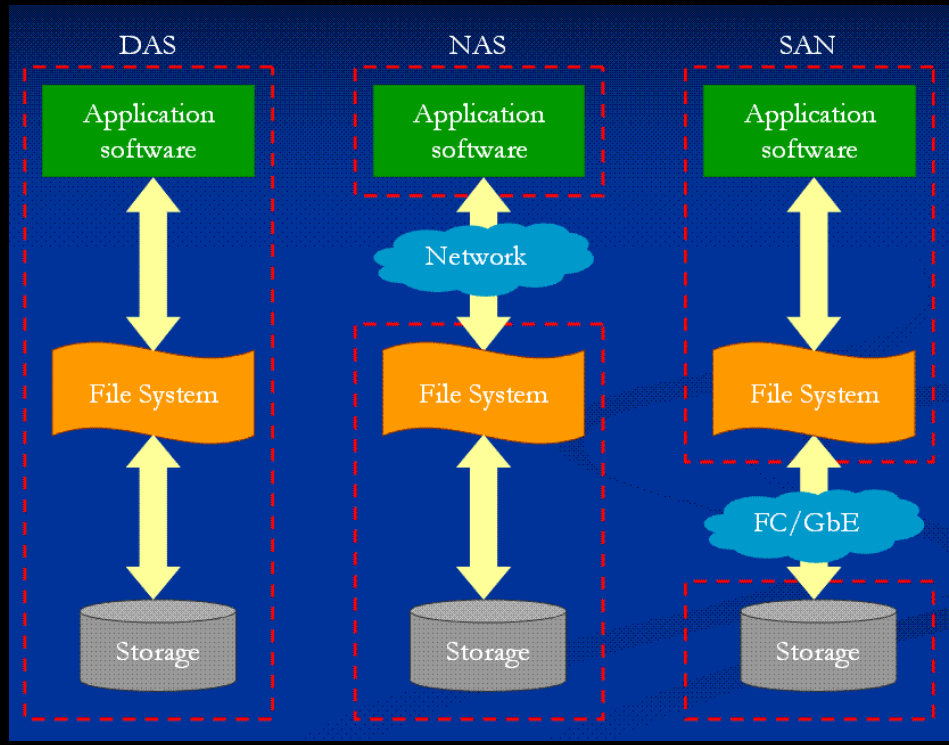
Host-Attached Storage

- Definition: Storage accessed through local I/O ports
  - I/O Bus: IDE, EIDE, ATA, SATA, USB, Fiber Channels, SCSI, etc.
    - Different Numbers of Disks per Bus
    - Different Speeds
  - Storage Devices: hard disk drives, RAID arrays, and CD, DVD, and tape drives

Network-Attached Storage

- Definition: Clients access NAS via a remote procedure call interface such as NFS (for UNIX) or CIFS (for Windows).
- Problems: Performance and Delay

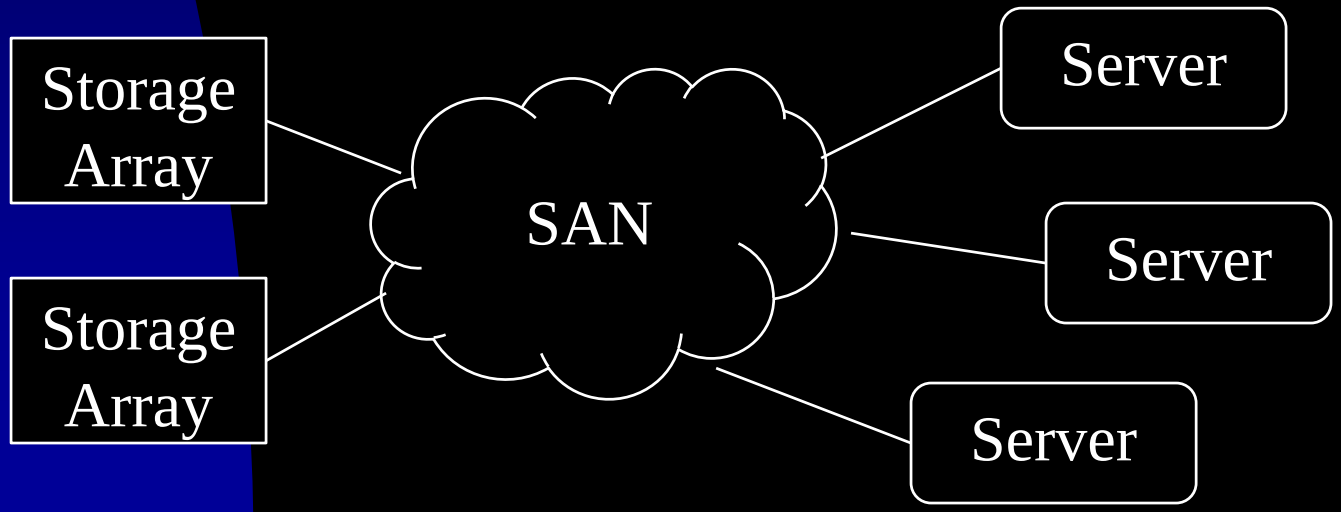




Source: wikipedia.org

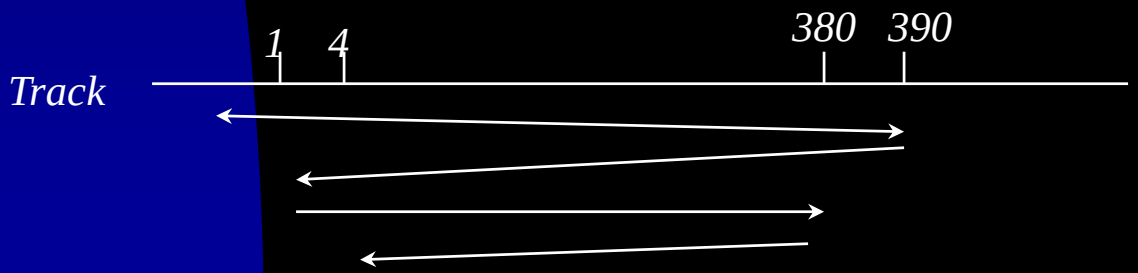
Storage-Area Network

- Definition: An architecture to attach remote computer storage devices to servers.
  - It is with a private network using storage protocols, instead of networking protocols.



Disk Scheduling

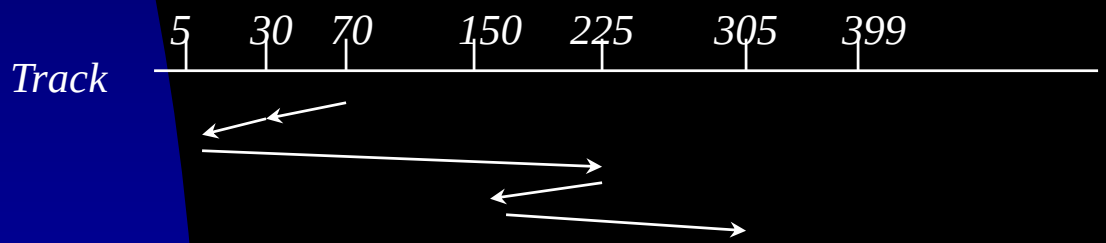
- Motivation: Disparity between CPU and disk speed.
  - Access time = queuing time + seek time + latency delay + transfer time
  - Bandwidth = # of bytes transferred / service time duration
- Strategies to improve the performance of disk service:
  - First-come-first-served (FCFS) algorithm*:
    - Poor because of no consideration in deadlines and arm movements.



Requests	Track
1	390
2	1
3	380
4	4

Disk Scheduling

- Shortest-seek-time-first (SSTF)algorithm:
  - A greedy algorithm which always selects the request with the minimum seek time from the current request queue.
  - Starvation of some requests...



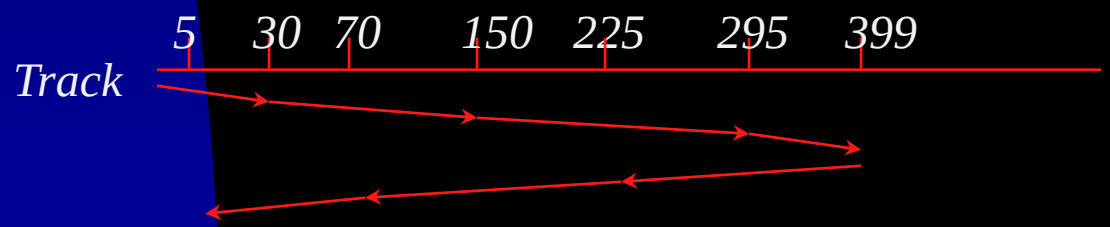
queue=305, 30, 5, 225

queue=305, 150

有可能一直沒有機會服務 305
一直在前面移動 –> starvation

Disk Scheduling

- Scan (or Elevator) Algorithm:
  - Start at one end of the disk, and moves toward the other end, servicing requests as it reaches each track, until it gets to the other end of the disk. At the other end, the direction of head movement is reversed and servicing continues.
  - Bad for service requests at either end of a disk.
  - An Extension – The C-Scan (Circle Scan) Algorithm



queue=295, 30, 150

queue=5, 70, 225

Disk Scheduling

- LOOK and C-LOOK Algorithms
  - They are SCAN and C-SCAN, respectively, except that the arm only goes as far as the final request in each direction.
- Selection of a Disk-Scheduling Algorithm
  - Performance? SSTF is better than FCFS.
  - Starvation Prevention or Heavy Loads? SCAN and C-SCAN are preferred.
  - Light Loads? Any one is good.
  - Optimal Order??? Justification of the Overhead…

Disk Scheduling

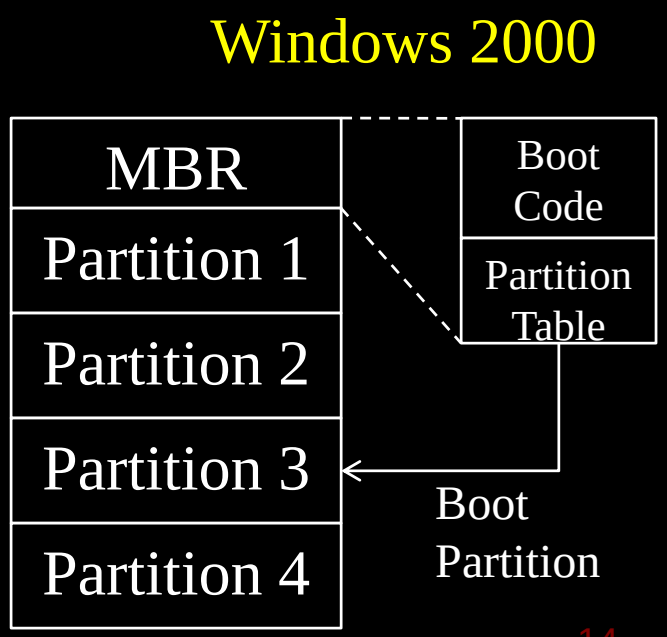
- Factors that affect the performance of disk request services
  - Disk Scheduling Algorithms
  - File Allocation Methods
    - Contiguous Allocation, Linked Allocation, and Indexed Allocation
    - Locations of directories and index/file blocks
- Conflicts between OS scheduling and disk scheduling
  - Importance of a request?
  - Robustness?

Disk Management

- Disk Formatting
  - Low-Level/Physical Formatting
    - It fills the disk with a special dat structure for each sector: (header [sector#, ECC]; data area; trailer)
  - Partitioning
    - Each partition is a group of cylinders – a disk
  - Logical Formatting
    - The OS stores the initial file-system data structure – maps of free and allocated space (a FAT or inodes)
- Clusters – Groups of Blocks.

Disk Management

- Raw Disks
  - A partition as a large sequential array of logical blocks
  - Raw I/O – I/O to This Array
- Boot Block
  - ROM – A Bootstrap Program
  - Master Boot Record (MBR)
    - Boot Code
    - Partition Table
  - Boot Partition
    - OS and Drivers
    - Boot Sector (1st Sector)



Disk Management

- Handling of Bad Blocks
  - Logical Formatting → Marking of Bad Blocks in Mapping Tables (such as FAT)
  - Manual Scanning – *chkdsk*
  - Sector Sparing or Forwarding
    - Low-Level Formatting → A List of Bad Blocks & Spare Blocks for Replacement
      - Transparent to the OS
    - Invalidation of Disk-Scheduling Optimization
  - Sector Slipping
    - Defect Sector 17 results in 17-202 → 18-203
- A Hard Error → Data Loss