Operating Systems

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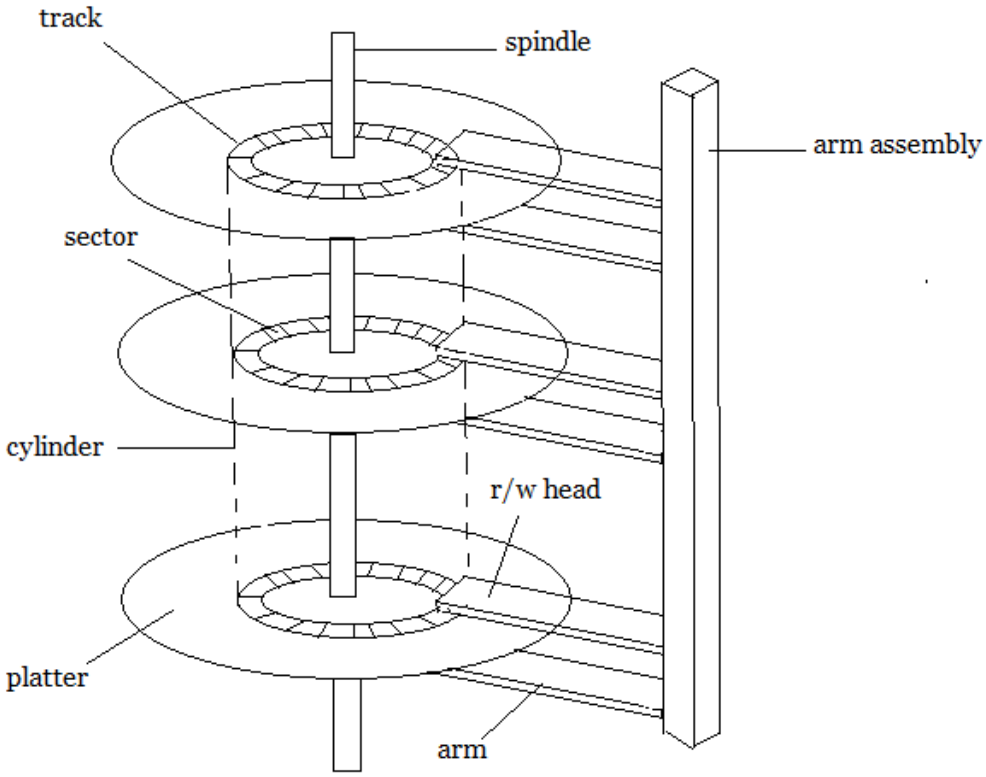
1956年，5MB IBM Hard Disk

Magnetic Disk

- Hard disks and floppy disks
- Organized into cylinders, tracks, and sectors.



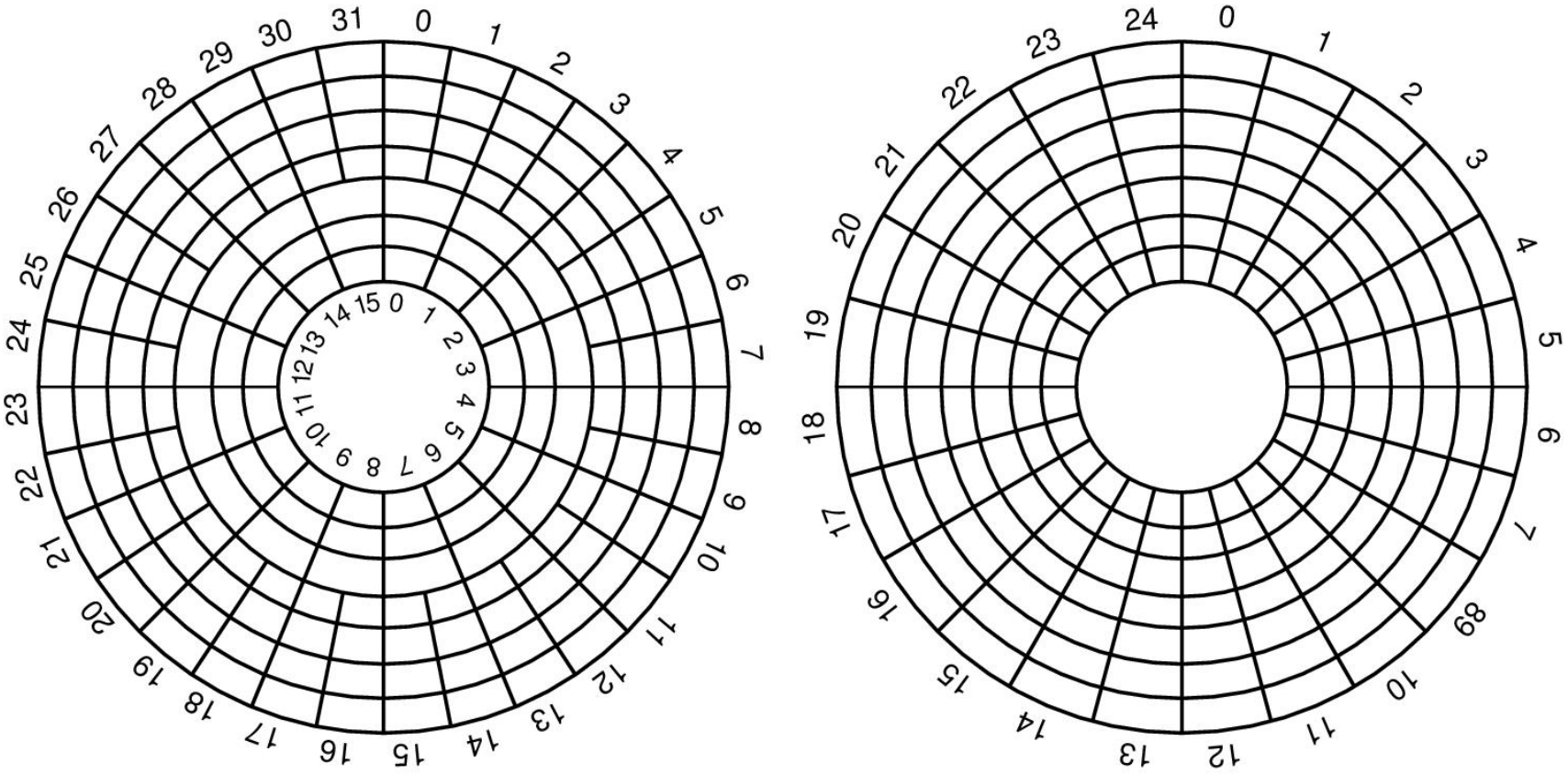
MAGNETIC DISKS

Disks

Parameter	IBM 360-KB floppy disk	WD 18300 hard disk
Number of cylinders	40	10601
Tracks per cylinder	2	12
Sectors per track	9	281 (avg)
Sectors per disk	720	35742000
Bytes per sector	512	512
Disk capacity	360 KB	18.3 GB
Seek time (adjacent cylinders)	6 msec	0.8 msec
Seek time (average case)	77 msec	6.9 msec
Rotation time	200 msec	8.33 msec
Motor stop/start time	250 msec	20 sec
Time to transfer 1 sector	22 msec	17 μsec

Disk parameters for the original IBM PC floppy disk and a Western Digital WD 18300 hard disk

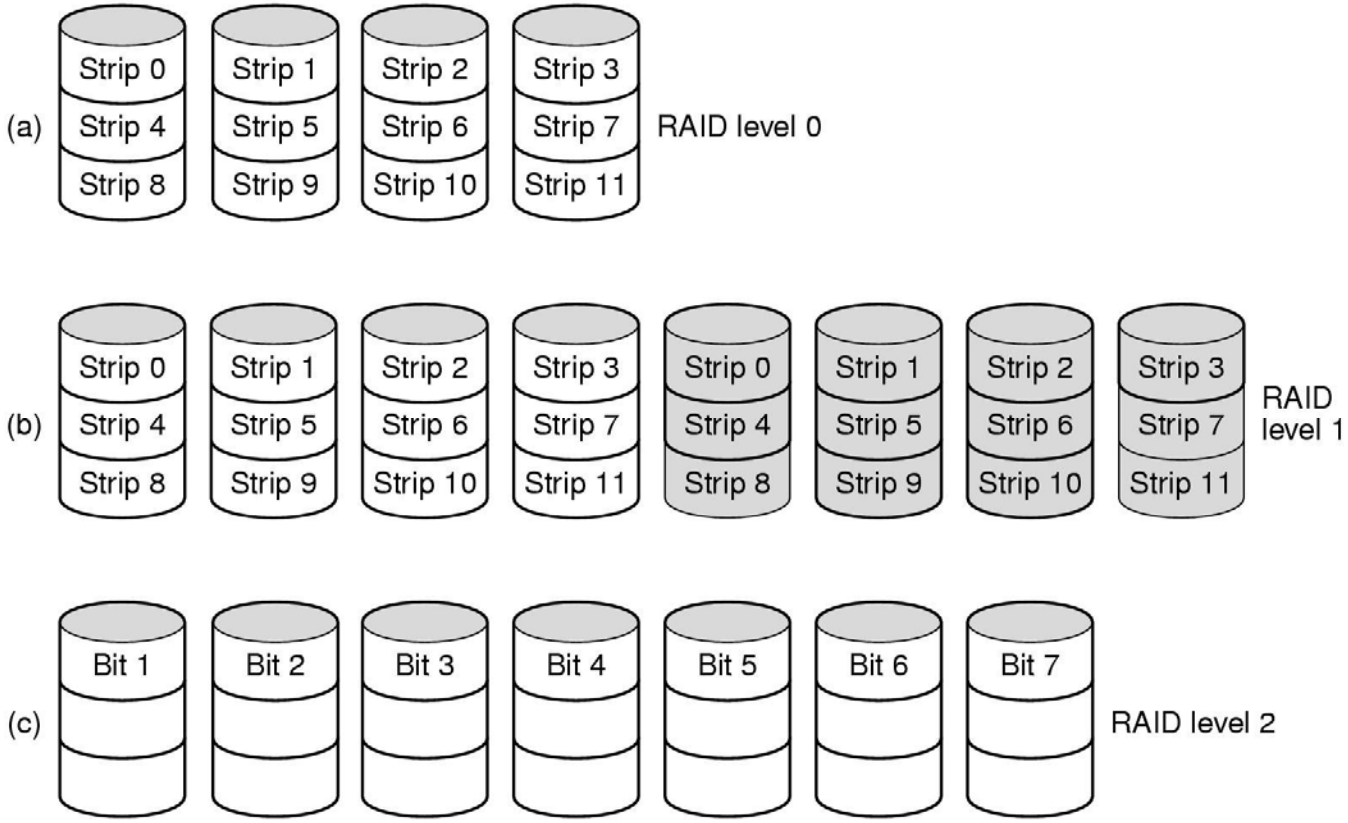
Disk Hardware

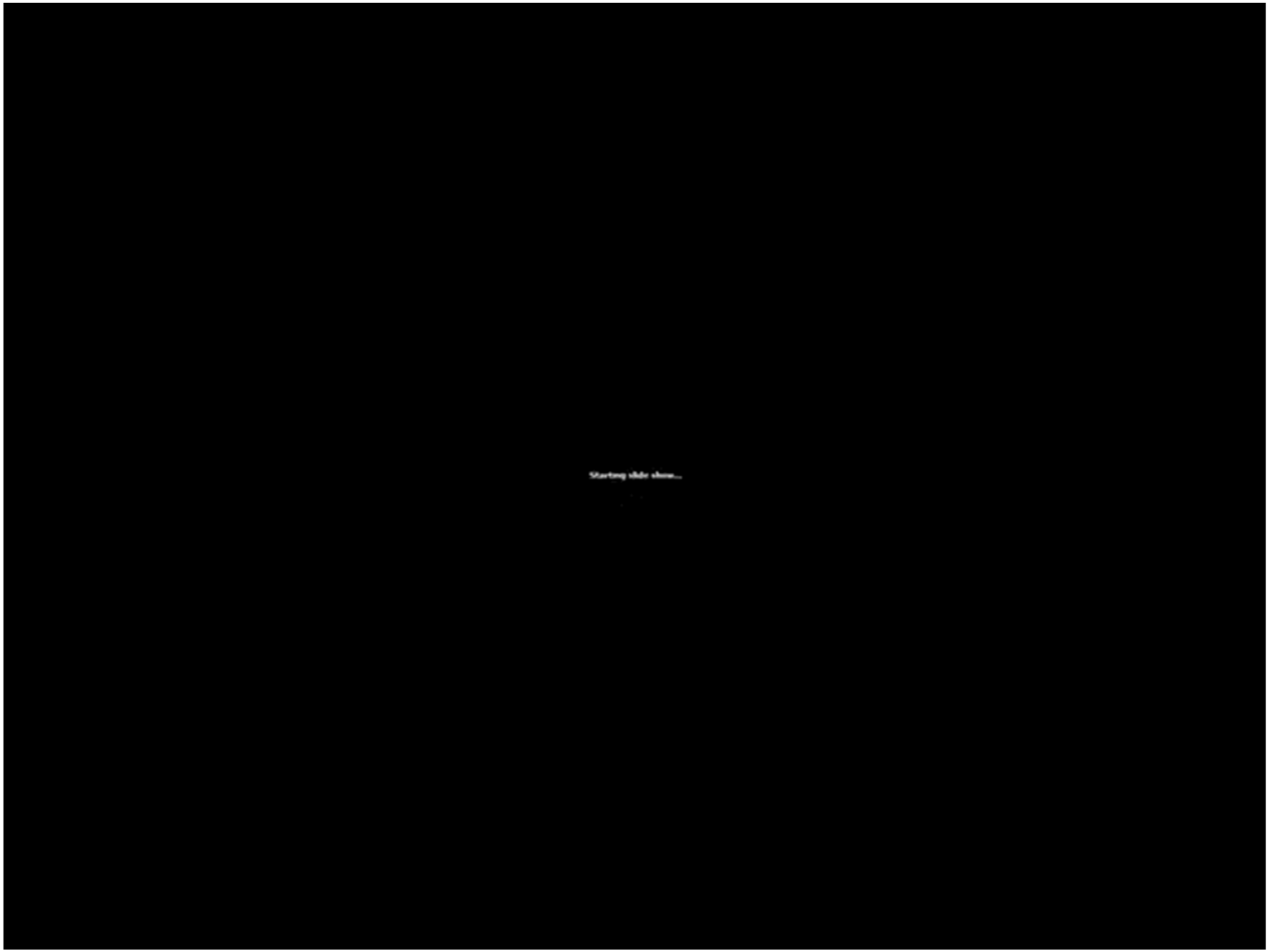


- Physical geometry of a disk with two zones
- A possible virtual geometry for this disk

Redundant Array of Independent Disk (RAID)

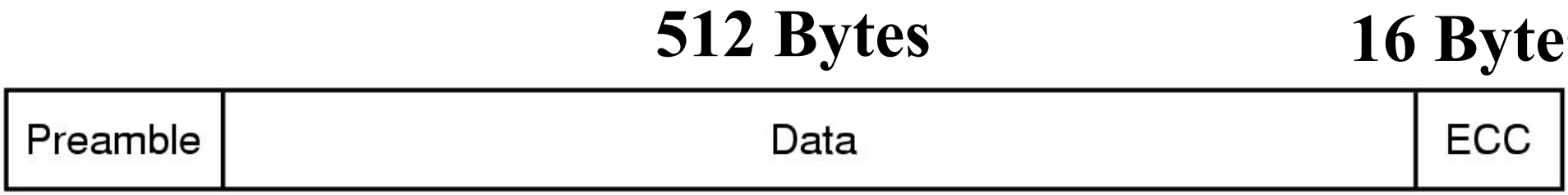
- Key idea: data are distributed over the drives, to allow parallel operation.




Starting slide show...

Disk Formatting

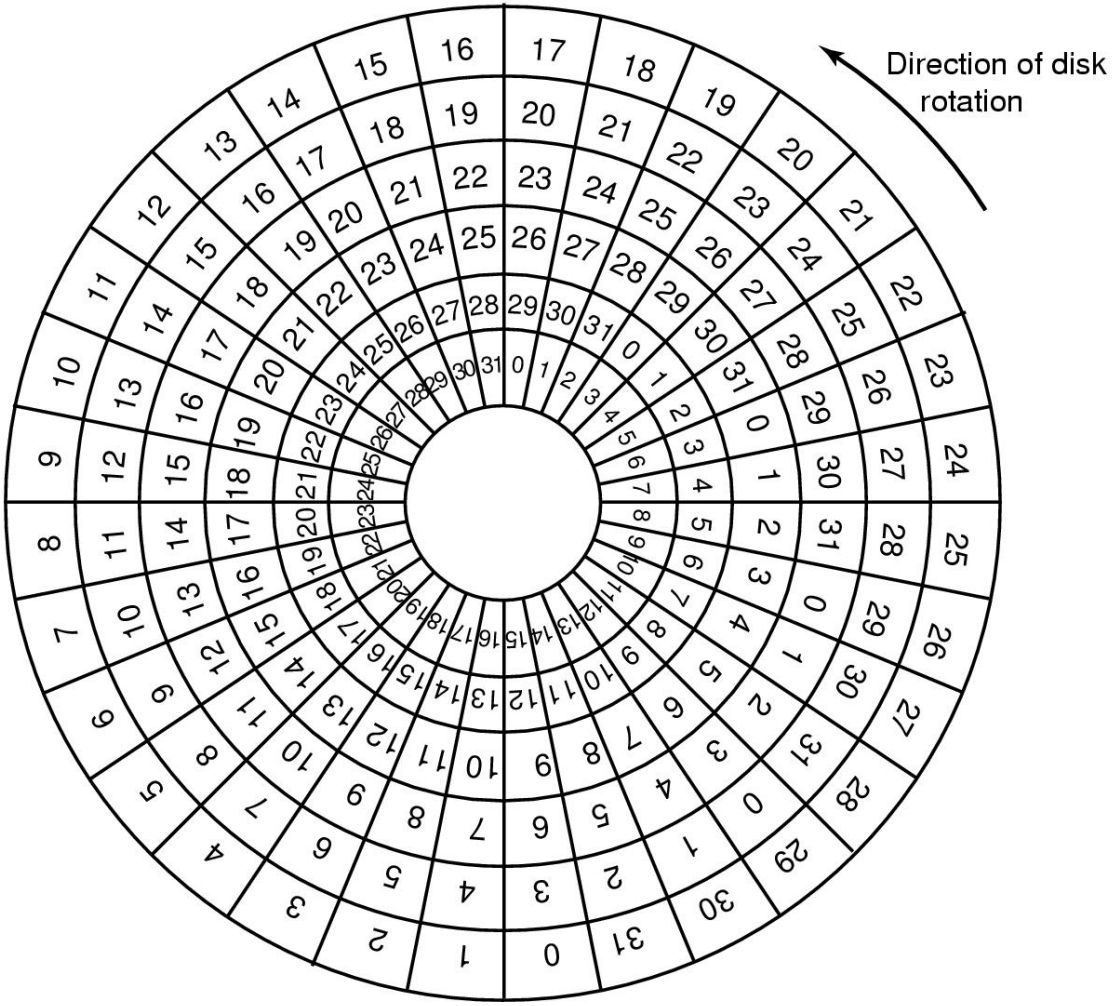
- A low-level format operation should be done on a disk before the disk can be used.
- Each track consists of a number of sectors, with short gaps between the sectors.



A disk **sector**

Cylinder Skew

Cylinder skew: the position of sector 0 on each track is offset from the previous track when the low-level format is laid down.

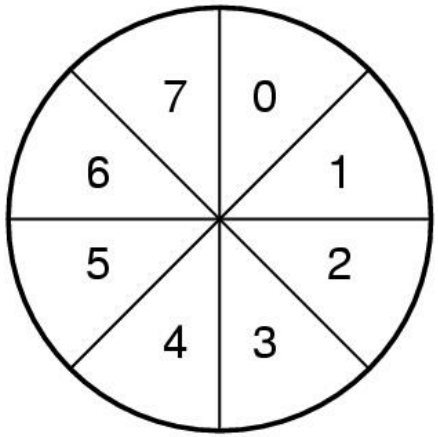


Problem

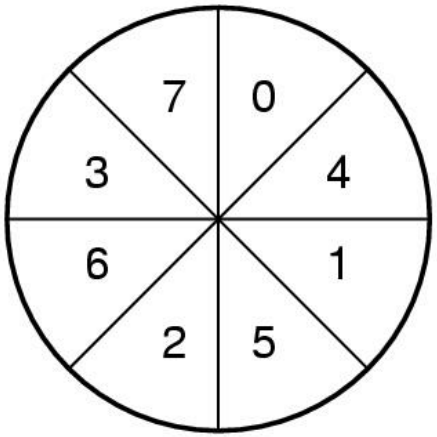
A drive rotates in 10msec, and each track contains 500 sectors. If the track-to-track seek time is 0.8msec, what should the cylinder skew set to?

Disk Interleaving

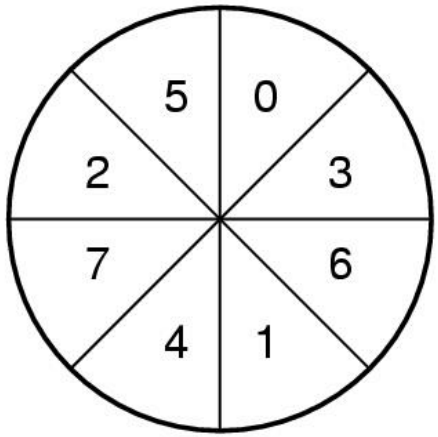
Motivation: when the copy to memory is complete (need some time cost), the controller will have to wait almost an entire rotation time for the second sector to come around again.



(a)



(b)



(c)

(a) No interleaving; (b) Single interleaving; (c) Double interleaving.

Problem

Consider a magnetic disk consisting of 16 heads and 400 cylinders. This disk has four 100-cylinder zones with the cylinders in different zones containing 160,200,240, and 280 sectors, respectively. Assume that each sector contains 512 bytes, average seek time between adjacent cylinders is 1 msec, and the disk rotates at 7200 RPM. Calculate the :

(a) disk capacity;

(b) optimal track skew;

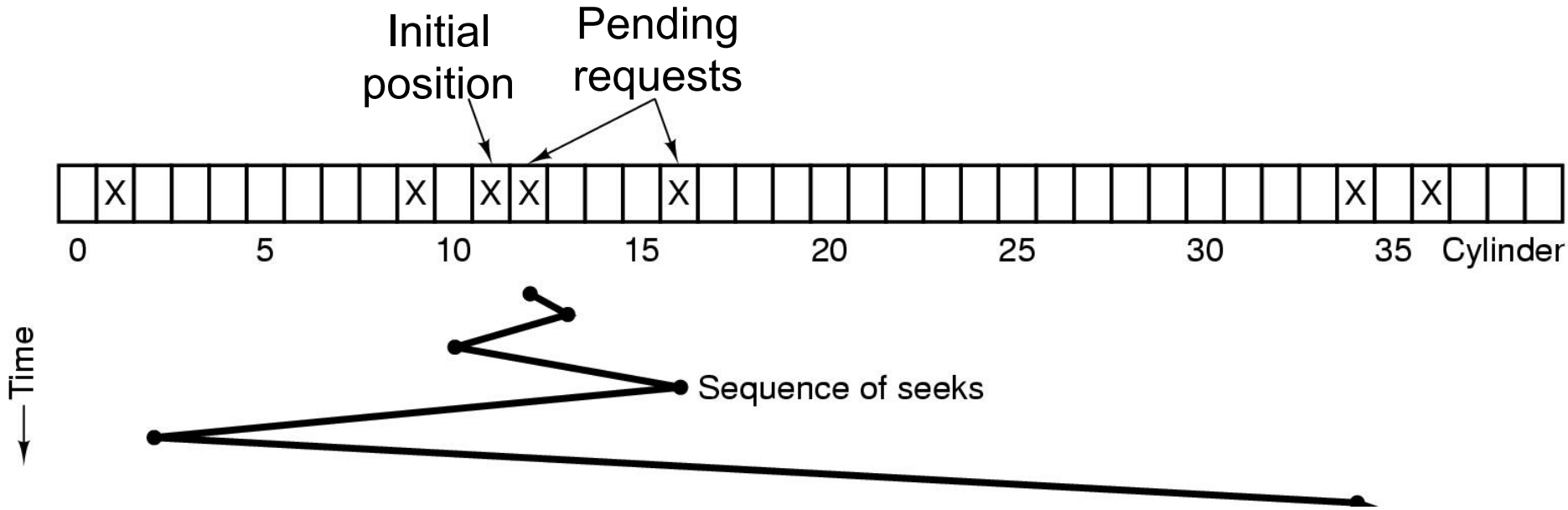
(c) maximum data transfer rate.

Disk Arm Scheduling Algorithms

- Time required to read or write a disk block determined by 3 factors
  - ✓ Seek time
  - ✓ Rotational delay
  - ✓ Actual transfer time
- Seek time dominates
- Error checking is done by controllers

Disk Arm Scheduling Algorithms: (Shortest Seek First, SSF)

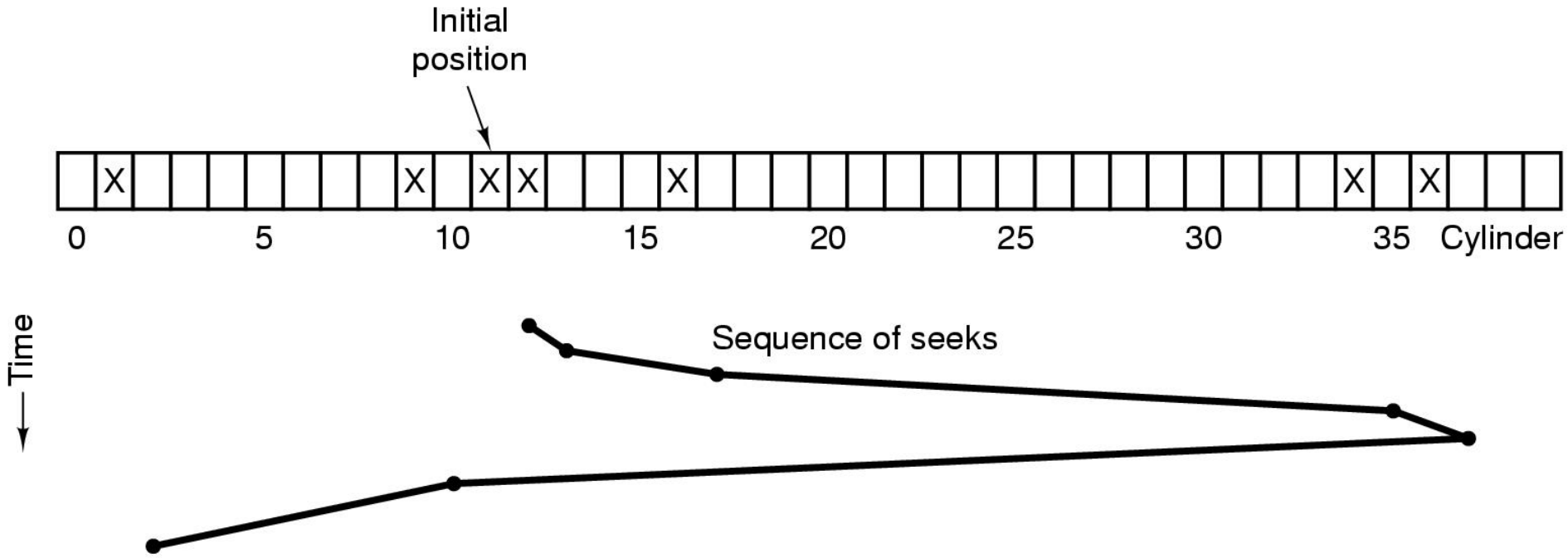
Requests: 11, 1, 36, 16, 34, 9, and 12



Shortest Seek First (SSF) disk scheduling algorithm

Disk Arm Scheduling Algorithms: (Elevator Algorithm)

Requests: 11, 1, 36, 16, 34, 9, and 12



The elevator algorithm for scheduling disk requests

Problem

Disk requests come in to the disk driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. A seek takes 6 msec per cylinder moved. How much seek time is needed for:

(a)First-come, first served.

(b)Closest cylinder next.

(c)Elevator algorithm (initially moving upward).

In all cases, the arm is initially at cylinder 20.

Check Points

① Briefly describe the structure of a disk.

② What is cylinder skew?

③ What is interleaving?

④ What are the three factors that determine the time of reading data from disk?

⑤ Briefly describe two disk arm scheduling algorithms?