

Tutorial – Disk Management

1. A disk controller with enough memory can perform *read-ahead*, reading blocks on the current track into its memory before the CPU asks for them.

Should it also do *write-behind*, i.e. report back to the CPU that a block has been written once it is stored in the disk controller's memory?

2. Suppose that the current position of the disk arm is over cylinder 200. The disk request queue contains requests for sectors on the following cylinders:

400, 20, 19, 74, 899

In which order will the requests be handled under:

- a. the FCFS disk head scheduling policy?
- b. the SSTF policy?
- c. the SCAN policy?
- d. the C-SCAN policy?

Briefly describe the policies and their respective trade-offs.

2. Disk requests come in to the disk drive for tracks 10, 22, 20, 2, 40, 6, and 38, in that order. A seek takes 5 ms per track moved. In all cases, the arm is initially at track 20. How much seek time is needed for
 - a) First-come, first served
 - b) Shortest seek time first
 - c) Scan scheduling (initially moving upwards)
3. Consider the following parameters describing a disk:

Parameter	Description
C	Number of cylinders
T	Number of tracks per cylinder (number of platters)
S	Number of sectors per track
ω	Rotational velocity (rotations per second)
B	Number of bytes per sector

In terms of these parameters, how many bytes of data are on each disk cylinder?

Suppose that you are designing a disk drive, and that you hope to reduce the expected rotational latency for requests from the disk. Which of the parameters above would you attempt to change, and in what way would you change them?

Suppose you wanted to reduce the disk's data transfer time - which parameters would you attempt to change?

4. A disk drive has C cylinders, T tracks per cylinder, S sectors per track, and B bytes per sector. The rotational velocity of the platters is ω rotations per second.

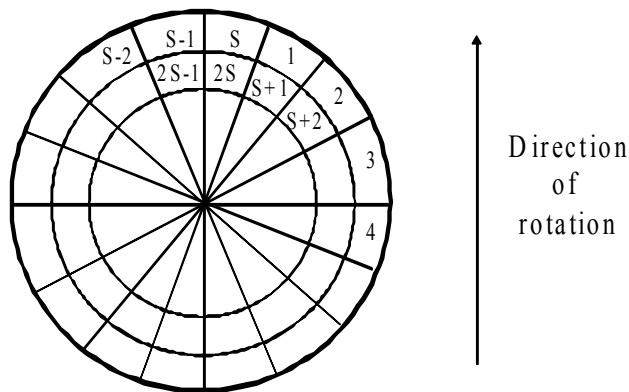
Consider s_1 and s_2 , consecutive sectors on the same track of the disk. (Sector s_2 will pass under a read/write head immediately after s_1 .) A read request for s_1 arrives at the disk and is serviced. Exactly d seconds ($0 < d < 1/\omega$) after the disk completes that request, a read request for sector s_2 arrives at the disk. (There are no intervening requests.)

How long will it take the disk to service the request for sector s_2 ?

5. A disk drive has S sectors per track and C cylinders. For simplicity, we will assume that the disk has only one, single-sided platter, i.e., the number of tracks per cylinder is one. The platter spins at ω rotations per millisecond. The following function gives the relationship between seek distance d , in cylinders, and seek time, t_{seek} , in milliseconds:

$$\begin{array}{ll} t_{\text{seek}} = 0 & d = 0 \\ t_{\text{seek}} = 5 + 0.05d & 0 < d \leq C \end{array}$$

The sectors are laid out and numbered sequentially, starting with the outer cylinder, as shown in the diagram below.



- a) Suppose the disk read/write head is located over cylinder 10. The disk receives a request to read sector S .

What is the expected service time for this request?

- b) Exactly d milliseconds after completing the request for S , the disk receives a request for sector $S + 1$.

What is the expected service time for this request?

6. A disk drive has $T = 1000$ tracks per surface and $S = 10$ sectors per track. The platters spin at a rate of $\omega = 100$ rotations per second. The following function relates seek distance, d , in cylinders, to the seek time (in milliseconds):

$$t_{\text{seek}} = 0.1d + 5$$

Sectors s_1 and s_2 are consecutive sectors on the same track of cylinder 100 (s_2 will pass under the read/write head immediately after s_1 does).

- a) The read/write heads are initially located over cylinder zero. The disk receives a request for sector s_1 . After servicing that request, it is idle for a time, and then receives a request for sector s_2 .

What is the sum of the expected service times for these two requests?

- b) The read/write heads are initially located over cylinder zero. The disk receives a single request to read sectors s_1 and s_2 .

What is the expected service time for this request?