Consider a disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double-sided platters, and average seek time of 10 msec. Suppose that a block size of 1024 bytes is chosen. Suppose that a file containing 100, 000 records of 100 bytes each is to be stored on such a disk and that no record is allowed to span two blocks.

1. What is the capacity of a track in bytes? What is the capacity of each surface? What is the capacity of the disk?

bytes/track= bytes/sector × sectors/track =512×50=25 ,600 bytes ≈ 25K

bytes/surface= bytes/track×tracks/surface =25 ,600×2000=51 ,200 ,000 bytes ≈ 50 ,000K

bytes/disk=bytes/surface×surfaces/disk =51 ,200 ,000×5×2=512 ,000 ,000 bytes

2. How many records fit onto a block?

Block size/ Record size = 1024/100 = 10. We can have size at most 10 records in a block.

3. How many blocks are required to store the entire file?

File size = # Record × Record size

File size = 100 ,000 × 100 = 10 ,000 ,000 bytes

We need [File size size / block size = 10,000,000 /1024 = 9765.625 ≈ 10 ,000 blocks to store

4. If the file is arranged sequentially on the disk, how many surfaces are needed

Sectors/Tracks = 50, Sector size = 512 bytes , Block size = 1024 One track has 25 blocks , One cylinder has 25 × 5 × 2 = 250 blocks. One cylinder has 25 × 5 × 2 = 250 blocks. We need 10 ,000 blocks to store this file. So , we need 10,000/ 250 = 40 cylinders We need 10 surfaces to store the file.

5. How many records of 100 bytes each can be stored using this disk?

capacity of the disk is 512 ,000 ,000 bytes ≈ 500 ,000K, which has ≈ 500 ,000 blocks. Each block has 10 records.

this disk can store no more than 512 ,000 ,000 ≈ 5 ,000 ,000 records.

On the average, the desired sector will be about half way around the circle when the heads arrive at its cylinder.

Average rotational delay is time for $\frac{1}{2}$ revolution

Example: Given a total revolution of 7200 RPM

- One rotation $= \frac{60s \times 1000}{7200} = 8.33$ ms
- Average rotational latency $= 4.16$ ms

Suppose a disk with an actual (formatted) capacity of 8 gigabytes (2 33 bytes). The disk has 16 surfaces and 1024 tracks per surface. The disk rotates at 7200 rpm (rotations per minute). The average seek time is 9 ms. The block size is 8 KB.

1. What is the capacity (in bytes) of a single track?

$$\text{Capacity of a single surface} = \frac{Disk\ Capacity}{\#\ Surfaces} = \frac{8GB}{16} = \frac{2^{33}}{2^4} = 2^{29}\ \text{bytes}$$

$$\text{Capacity of a single track} = \frac{Single\ Surface\ Capacity}{\#\ Tracks/Surface} = \frac{2^{29}}{2^{10}} = 2^{19} bytes = 0.5MB$$

2. Suppose we are reading a file that occupies exactly one entire track. How long does it take to read the entire file sequentially?

$\text{Transfer time for one track} = \text{time for one rotation} = \frac{60s}{7200} = 8.3 \text{ ms}$
$Read\ time = average\ seek\ time + rotational\ delay + transfer\ time\ for\ track$
$= 9 + \frac{8.3}{2} + 8.3ms = 21.5ms$

Consider a hard disk with the following specifications:
• 6000 RPM• 3.5in in diameter• 250GB usable capacity• 100 cylinders, numbered from 1 (innermost) to 100 (outermost).• Takes τ/ (1 + 100)milliseconds to move the heads across τ cylinders (e.g., from i to i + τ).• Block size is 32 MB.• transfer rate is 16 GB/sec.• For this problem 1GB is 10 9 bytes, 1MB is 10 6 bytes.
(a) Based on the specifications, calculate the average rotational delay (in milliseconds) of this disk.

The average rotational delay is half of the maximum rotational delay.
$\rightarrow \frac{1}{2} \times \frac{60s}{6000} = 5ms$

(b) Suppose that we have just finished reading a block at track 50, and we next want to read a block at track 10. What is the total read time (time for the desired block to appear in memory)?

We will only consider seek time, rotational delay, and transfer time:
$1 + \frac{50-10}{100} + 5 + \frac{32 \times 10^6}{16 \times 10^9} \times 10^3 = 8.4ms$