CS & IT ENGINEERING

COMPUTER ORGANIZATION AND ARCHITECTURE

Magnetic Disk

Lecture No.- 01

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Recap of Previous Lecture

Topic Multilevel Cache

Topic Dual Cache

Topic Cache Inclusion Policies

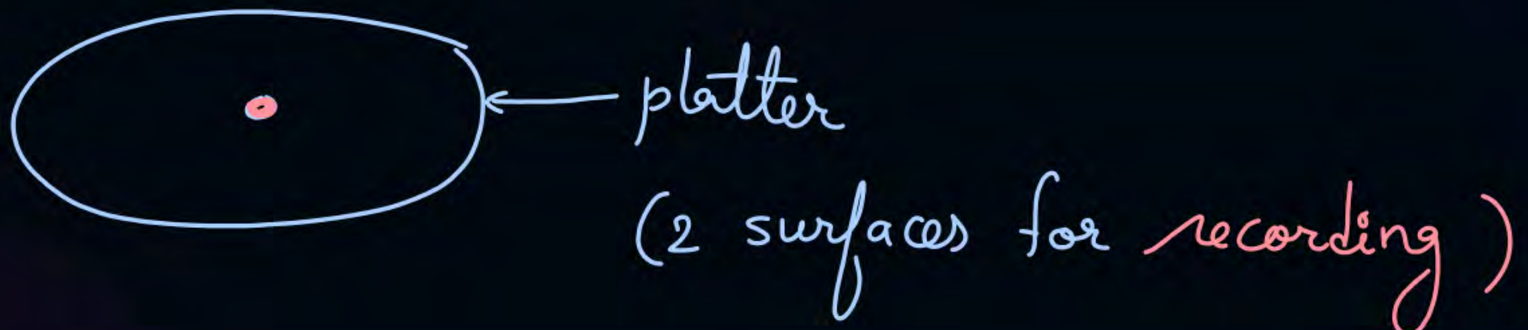
Topics to be Covered

Topic Magnetic Disk

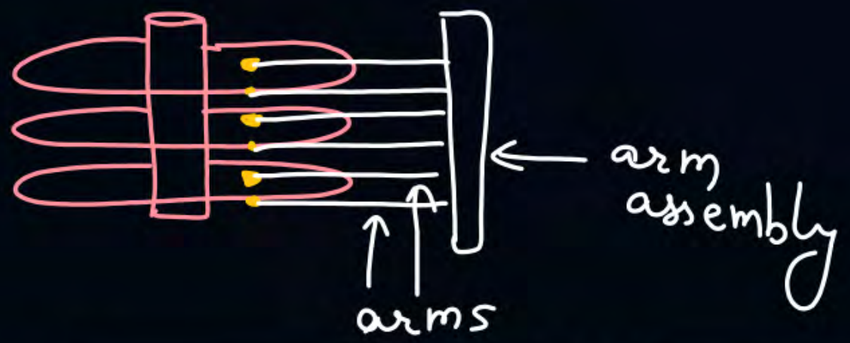
Topic Disk Capacity

Topic Disk Access Time

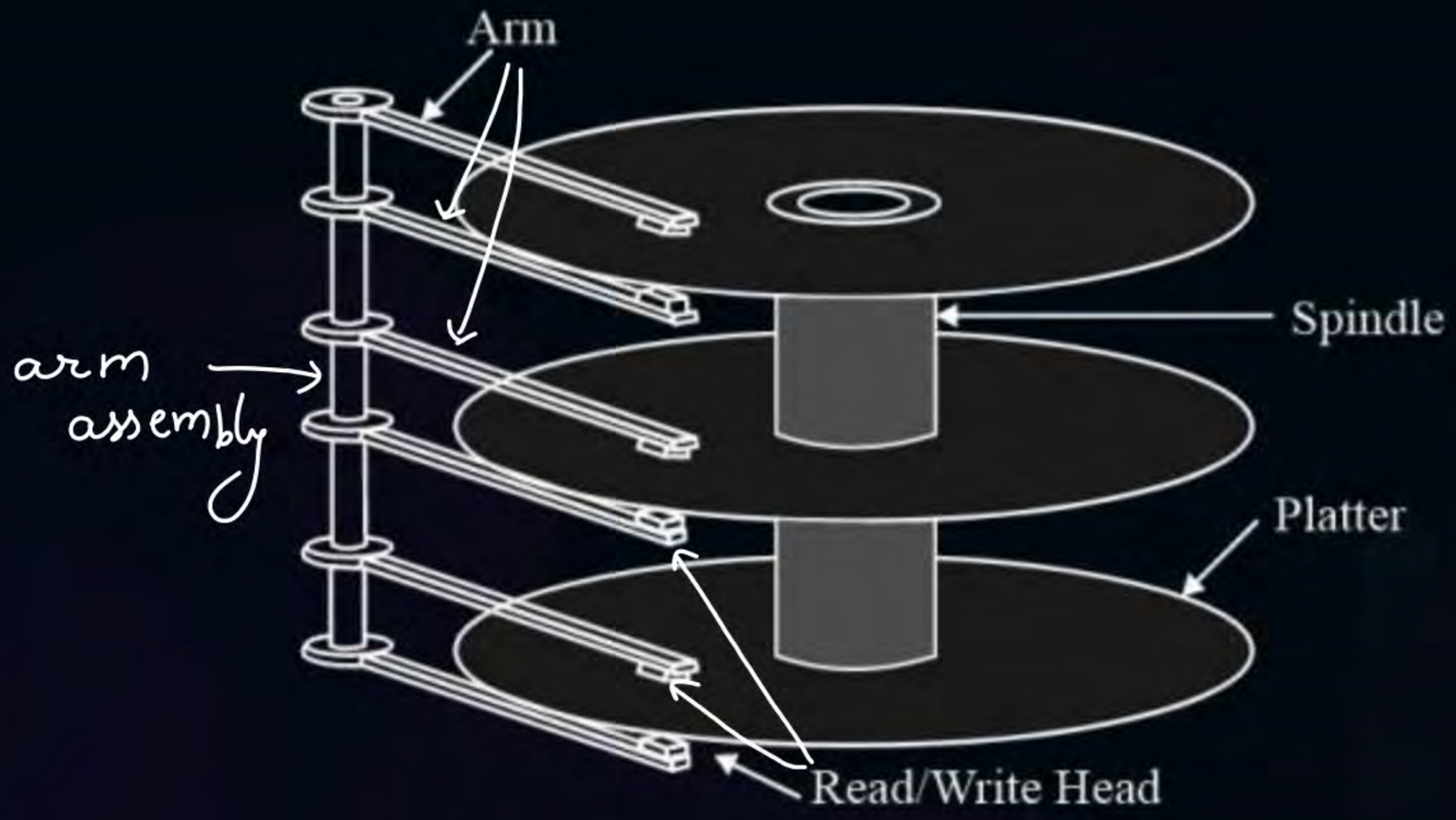
Topic : Magnetic Disk



Topic : Magnetic Disk



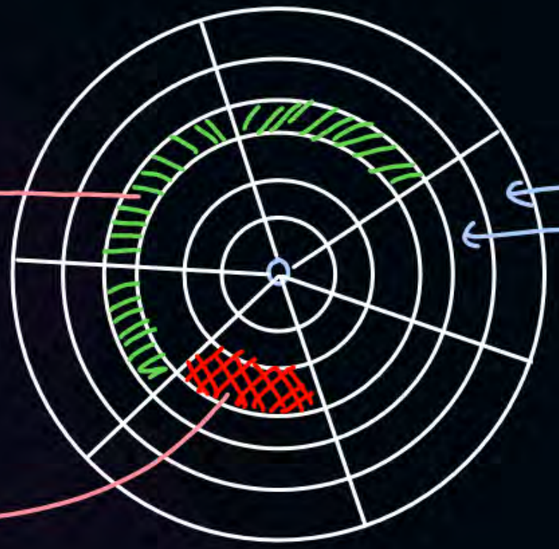
Topic : Magnetic Disk



Topic : Magnetic Disk

Number of surfaces in disk: 2 * no. of platters

Top View:-



sector is the smallest unit of the disk which can be read or written at once.

⇓

each sector in the disk gets an address.

Topic : Magnetic Disk

Number of surfaces in disk: 2 * no. of platters

Number of tracks on disk: no. of surfaces in disk * no. of tracks per surface

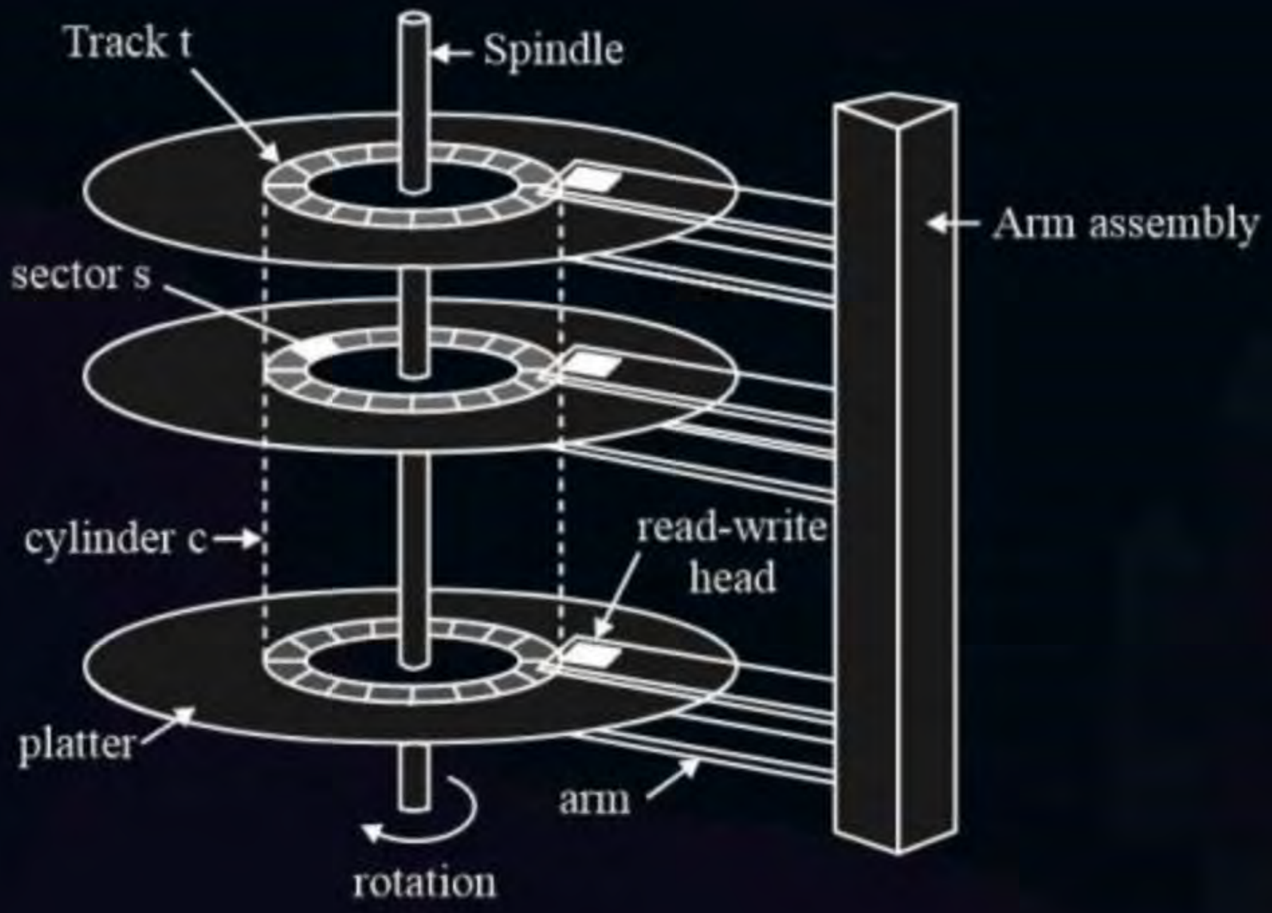
Number of sectors in disk: no. of tracks on the disk * no. of sectors per track

= 2 * # platters * #tracks/surface * #sectors per track

Number of bytes on disk:

disk capacity = 2 * no. of platters * no. of tracks per surface * no. of sectors per track * 1 sector capacity

Topic : Magnetic Disk



Topic : Sector Capacity

Disk

(default)

Constant sector capacity
or
Variable storage density
or
Constant angular velocity

Variable sector capacity
or
Constant storage density
or
Constant linear velocity

[NAT]

#Q. Consider a disk with 32 platters each with 2 recording surfaces. There are 128 tracks per surface and 32 sectors per track. Each sector has equal capacity of 1KBytes.

Calculate:

1. Number of surfaces in disk: $2 * 32 = 64$
2. Number of tracks on disk: $64 * 128 = 2^{13}$
3. Number of sectors in disk: $2^{13} * 32 = 2^{18}$
4. Number of bytes on disk: $2^{18} * 1kB = 256MB$
5. Number of bits for disk addressing: 18 bits

Disk access time :-

Total time needed to access a sector from disk.

1 disk access time = seek time + rotational latency + 1 sector transfer time

Avg rotational latency = $\frac{1 \text{ rotation time}}{2}$

Topic : Disk Access Time

Seek Time: Time required to position the arm over the desired track

Rotational Latency: time required to rotate desired sector under R/W head

Transfer Time: Time required to read or write 1 sector

note :-
In one complete rotation, entire track can be transferred (read/written)

$$1 \text{ sector transfer time} = \frac{1 \text{ rotation time}}{\text{no. of sectors per track}}$$

ex:- rotation speed => 10000 Rotations Per Minute (R.P.M.)

for 10000 rotations disk takes = 1 min = 60 sec

for 1 —11— = $\frac{60 \text{ sec}}{10000}$

= $\frac{60 * 1000 \text{ msec}}{10000}$

= 6 msec

[NAT]

#Q. Consider a disk with 16 platters, 2 surfaces per platter, 2K tracks per surface, 4K sectors per track and 4096 Bytes per sector. Disk rotates with 6000 rpm. Seek time is 5ms. Find disk access time?

$$1 \text{ rotat}^n \text{ time} = \frac{60000}{6000} = 10 \text{ msec}$$

$$1 \text{ disk access time} = 5 \text{ ms} + \frac{10 \text{ msec}}{2} + \frac{10 \text{ msec}}{4k}$$

$$= 10.0025 \text{ ms}$$

1 track capacity = 4k * 4kB

= 16 MB

transfer rate of the disk

in 10 ms, disk can transfer = 16 MB

in 1 ms, —"— —— = $\frac{16\ MB}{10\ ms}$

in 1 sec, —"— —— = $\frac{16\ MB}{10 * 10^{-3}\ sec}$ ≅ 1.6 GBPS

= 1600 MBPS

for 1600 MB, time = 1 sec

for 4 KB, time = $\frac{1 \text{ sec}}{\frac{1600 \text{ MB}}{400 \text{ k}}} * 4\text{KB}$

$= \frac{1}{400} \text{ msec}$

$= 0.0025 \text{ ms}$ ← 1 sector transfer time

[NAT]

#Q. A disk has each track with 1k sectors each with 4KB capacity and it takes 10msec for 1 rotation. The transfer rate of the disk is?

1 track capacity = $1k * 4KB = 4MB$

In 10ms, data transferred = 4MB

in 1sec, — 11 — = $\frac{4MB}{10 * 10^{-3} sec}$

= 400 MBPS

$\cong$ 0.4 GBPS

Topic : Where Disk Transfer Rate can be use?

can be used to calculate data preparatn time for DMA transfer

[NAT]

#Q. Consider a disk with 16 platters, 2 surfaces per platter, 1K tracks per surface, 2K sectors per track and 2048 Bytes per sector. Disk rotates with 3000 rpm. Seek time is 10ms.

If the disk is used in cycle stealing mode of DMA, such that whenever 64-bits word is available, it will be transferred in 16ns. What is the % of time CPU is blocked?

8 bytes

1 rotation time = 20msec

1 track capacity = 2k * 2kB = 4MB

for 4MB, time = 20msec

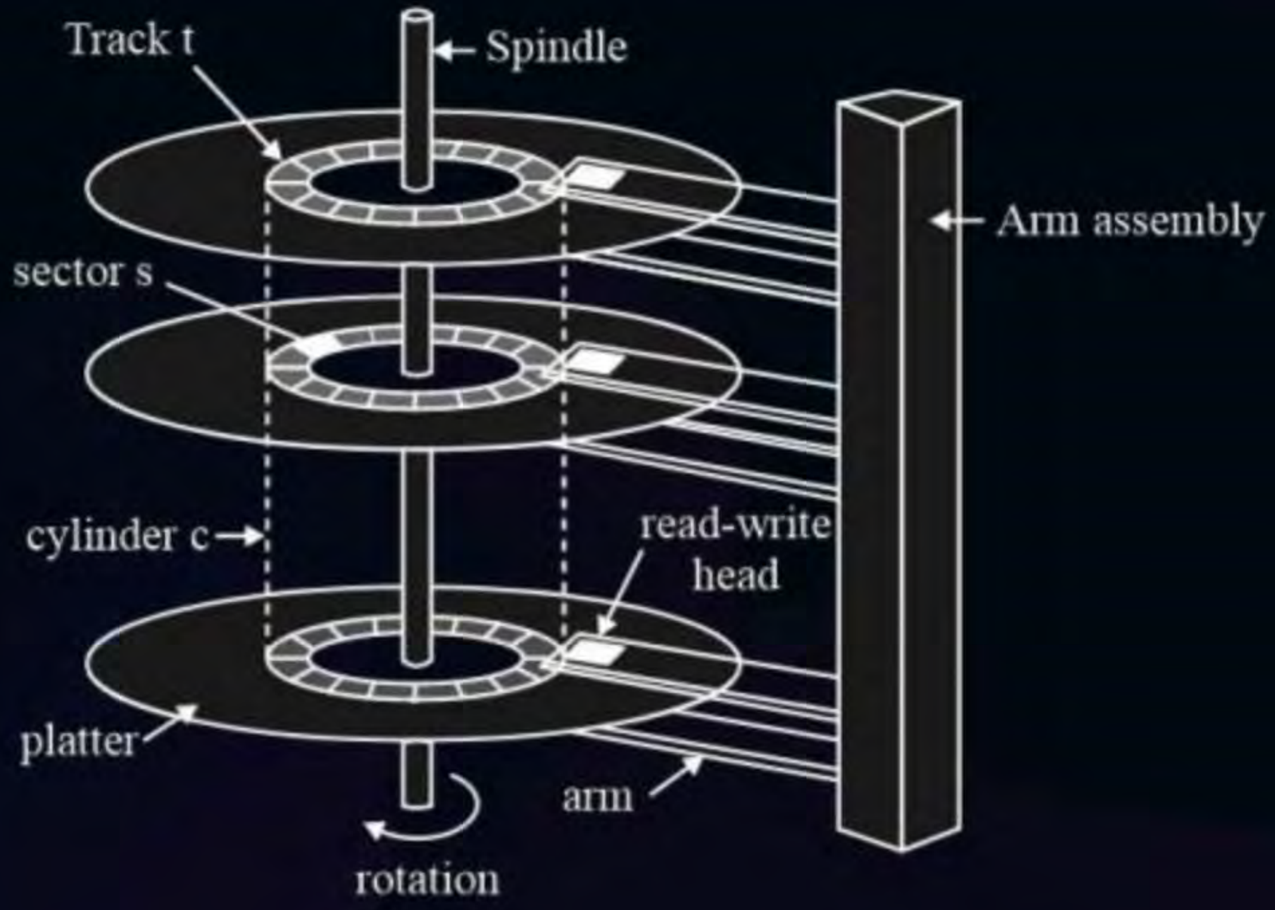
for 8B time = $\frac{20\ msec}{4MB} * 8B$

= 40 nsec

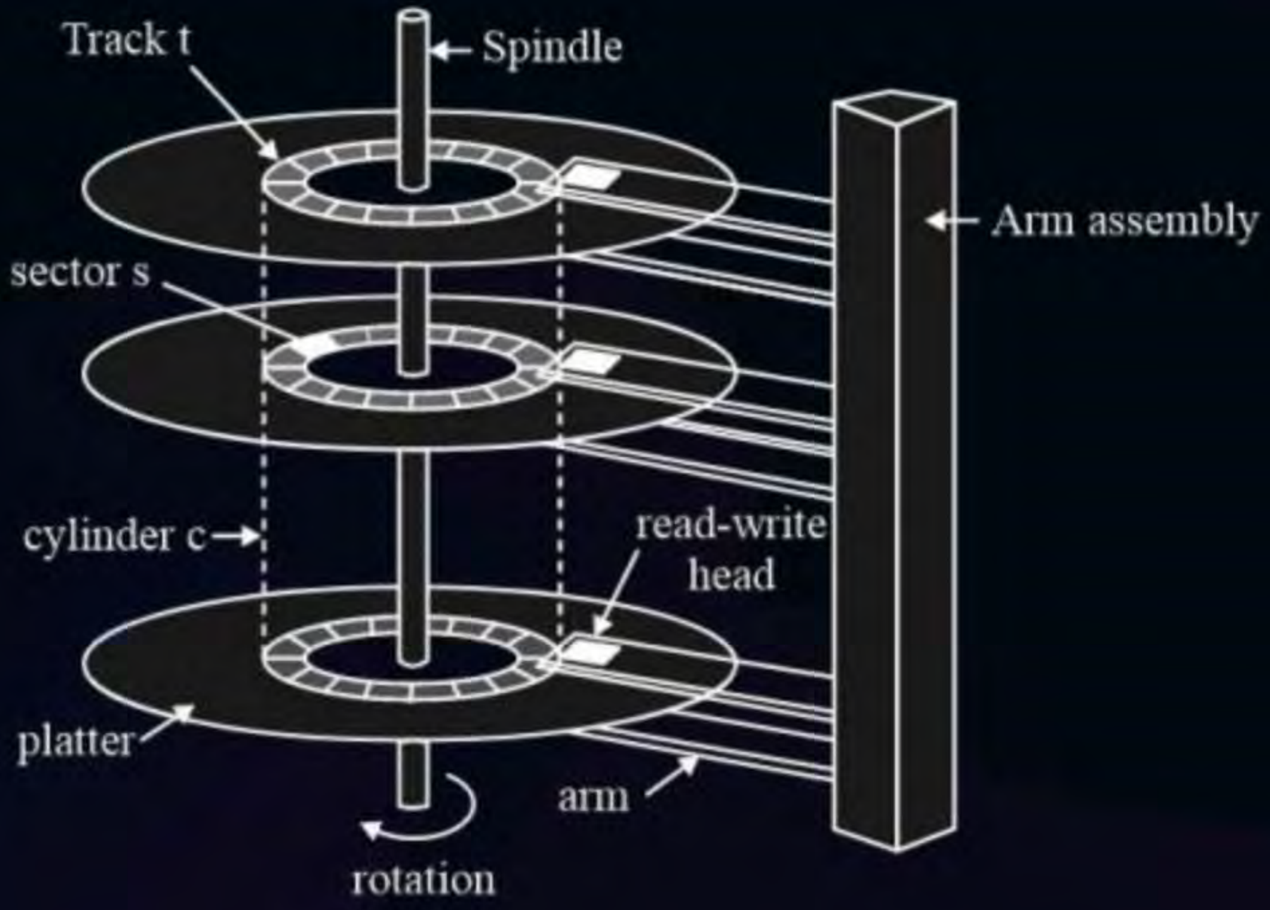
% of time CPU is blocked due to DMA = $\frac{16}{40} * 100\%$

$= 40\%$

Topic : Multiple Sector Access Time



Topic : Multiple Sectors Access Time: Sequential



Topic : Multiple Sectors Access Time: Sequential

↳ on same track

Consider n sectors to be transferred:

= seek time + rotational latency + n * 1 sector transfer time

Topic : Multiple Sectors Access Time: Random

Consider n sectors to be transferred:

$$= n * \left[\text{seek time} + \text{rotational latency} + \text{1 sector transfer time} \right]$$

If 4 consecutive tracks are having entire file.

file access time = 4 * seek time + 4 * rotational latency + n * 1 sector transfer time

all sectors to store file

[MCQ]

1 rotation time = 6 ms

#Q. Consider a disk pack with a seek time of 4 milliseconds and rotational speed of 10000 rotations per minute (RPM). It has 600 sectors per track and each sector can store 512 bytes of data. Consider a file stored in the disk. The file contains 2000 sectors. Assume that every sector access necessitates a seek, and the average rotational latency for accessing each sector is half of the time for one complete rotation. The total time (in milliseconds) needed to read the entire file is

A ✓ 14020

B 14000

C 25030

D 15000

Time needed to read file $= 2000 * \left[4 + \frac{6}{2} + \frac{6}{600} \right]$

$= 2000 * 7.01 \text{ ms}$

$= 14020 \text{ ms}$

2 mins Summary

Topic Magnetic Disk

Topic Disk Capacity

Topic Disk Access Time

Happy Learning

THANK - YOU