CS & IT ENGINEERING

COMPUTER ORGANIZATION AND ARCHITECTURE

Disk

Lecture No.- 2

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Recap of Previous Lecture

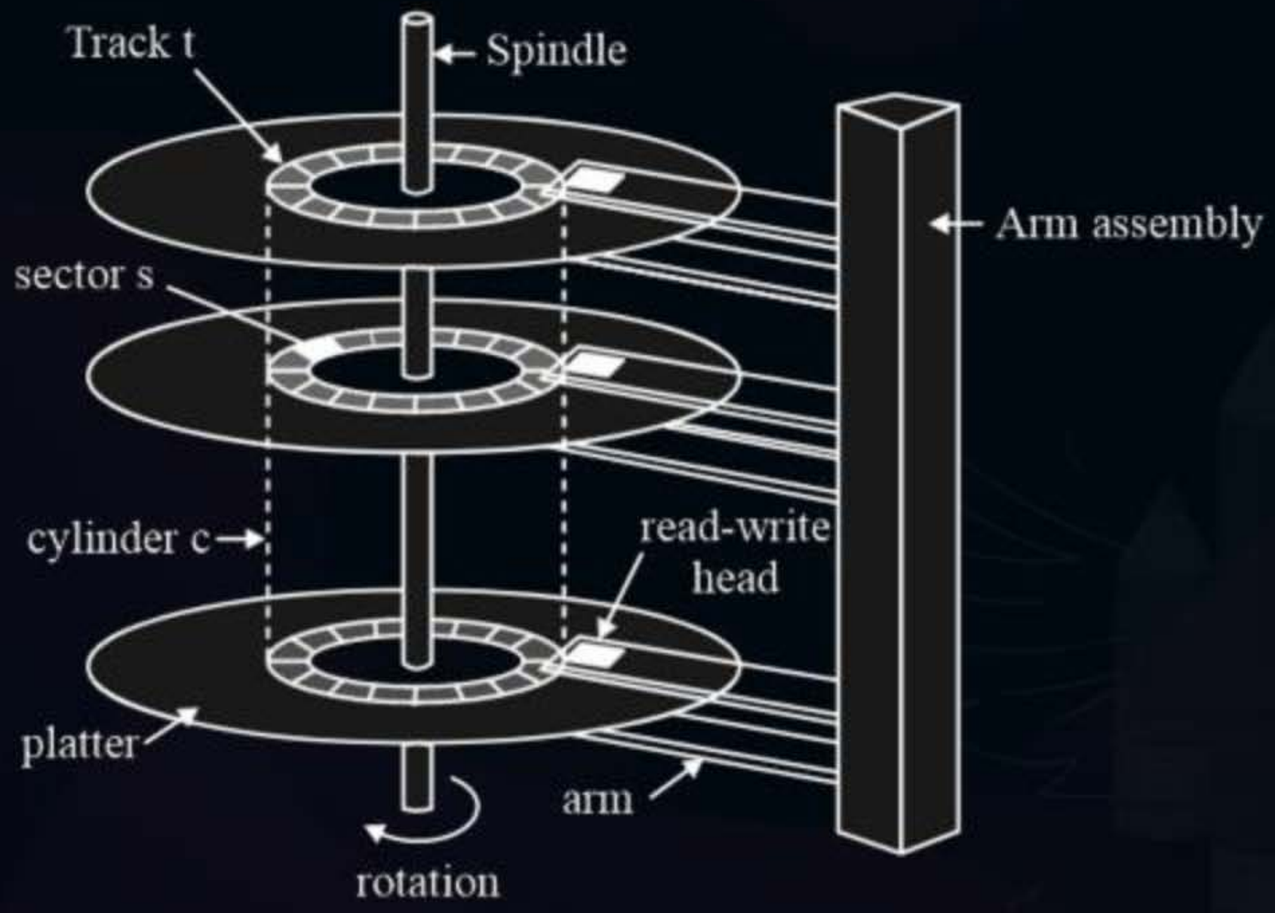
Topic Magnetic Disk

Topics to be Covered

Topic Disk Access Time

Topic Disk Addressing

Topic : Magnetic Disk



[NAT]

#Q. Consider a disk 2K tracks per surface, 1K sectors per track and 2K Bytes per sector. Disk rotates with 4000 rpm. Seek time is 10ms. Find disk access time?

1 rotation time = $\frac{60000}{4000}$ = 15 msec

$$= 10 + \frac{15}{2} + \frac{15}{1K}$$

$$= 10 + 7.5 + 0.015 \text{ ms}$$

$$= 17.515 \text{ ms}$$

[NAT]

400 MB/sec

#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

1 sector transfer time

$= \frac{10\ ms}{1k}$

$= 0.01\ ms$

In 10 msec, data transferred = 4MB

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

= 400 MB/sec

Ques) 400 MB/sec transfer rate

1 sector of 4KB

1 sector transfer time ?

Soln

400 MB, time = 1 sec

4KB, time = $\frac{1\ \text{sec}}{\frac{400\ \text{MB}}{10^3\ \text{K}}} * 4\text{KB}$

$= 0.01$ msec

[NAT]

#Q. Consider a disk with 16 platters, 2 surfaces per platter, 2K tracks per surface, 2K sectors per track and 4096 Bytes per sector. Disk rotates with 6000 rpm. Find the disk transfer rate?

Topic : Where Disk Transfer Rate can be use?

wherever in I/O org. I/O speed was needed

[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.

1 rotation = 20 msec

8B

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?

1 track = 2K * 2KB = 4MB

In 20 msec, data = 4MB

in 1 sec, —11— = $\frac{4MB}{20 * 10^{-3} sec}$

= 200 MB/sec

for 200 MB, time = 1 sec

for 8B, —11— = $\frac{1 sec}{200 MB} * 8B$

= $\frac{8}{200}$ μsec

= $\frac{8000}{200}$ ns = 40ns

another way :-

for 4MB, time = 20 msec

for 8 B, time = $\frac{20 \text{ msec}}{4\text{MB}} * 8\text{ B}$ (2)

= 40 nsec

% of time CPU blocked = $\frac{16}{40} * 100\%$

= 40 %.

Topic : Multiple Sectors Access Time: Sequential

Consider n sectors to be transferred: (in a single track)

file access time

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

Topic : Multiple Sectors Access Time: Random

Consider n sectors to be transferred:

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

[MCQ]

1 rotation time = $\frac{60000}{10000}$ = 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

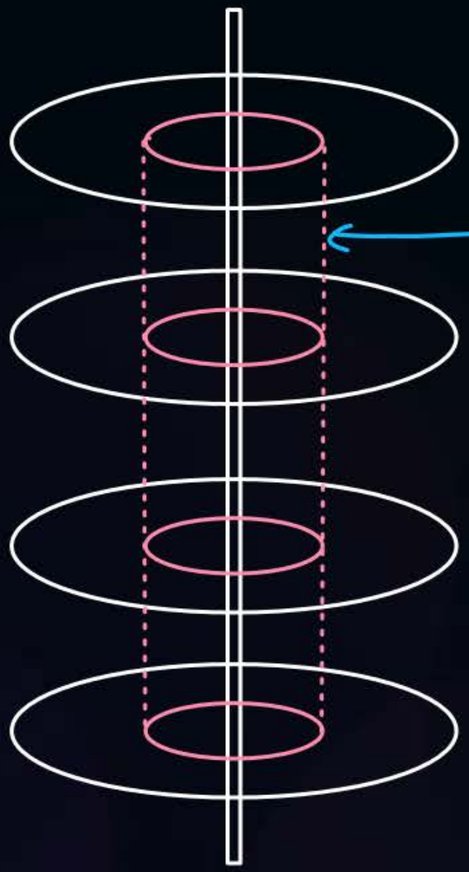
D 15000

$$= 2000\left[4 + \frac{6}{2} + \frac{6}{600}\right] ms$$

$$= 14020 \ ms$$

Topic : Cylinder

files are stored in disk cylinder wise to save seek time



Collection of same radius tracks from all surfaces form a cylinder

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no. of cylinders in disk = no. of tracks per surface

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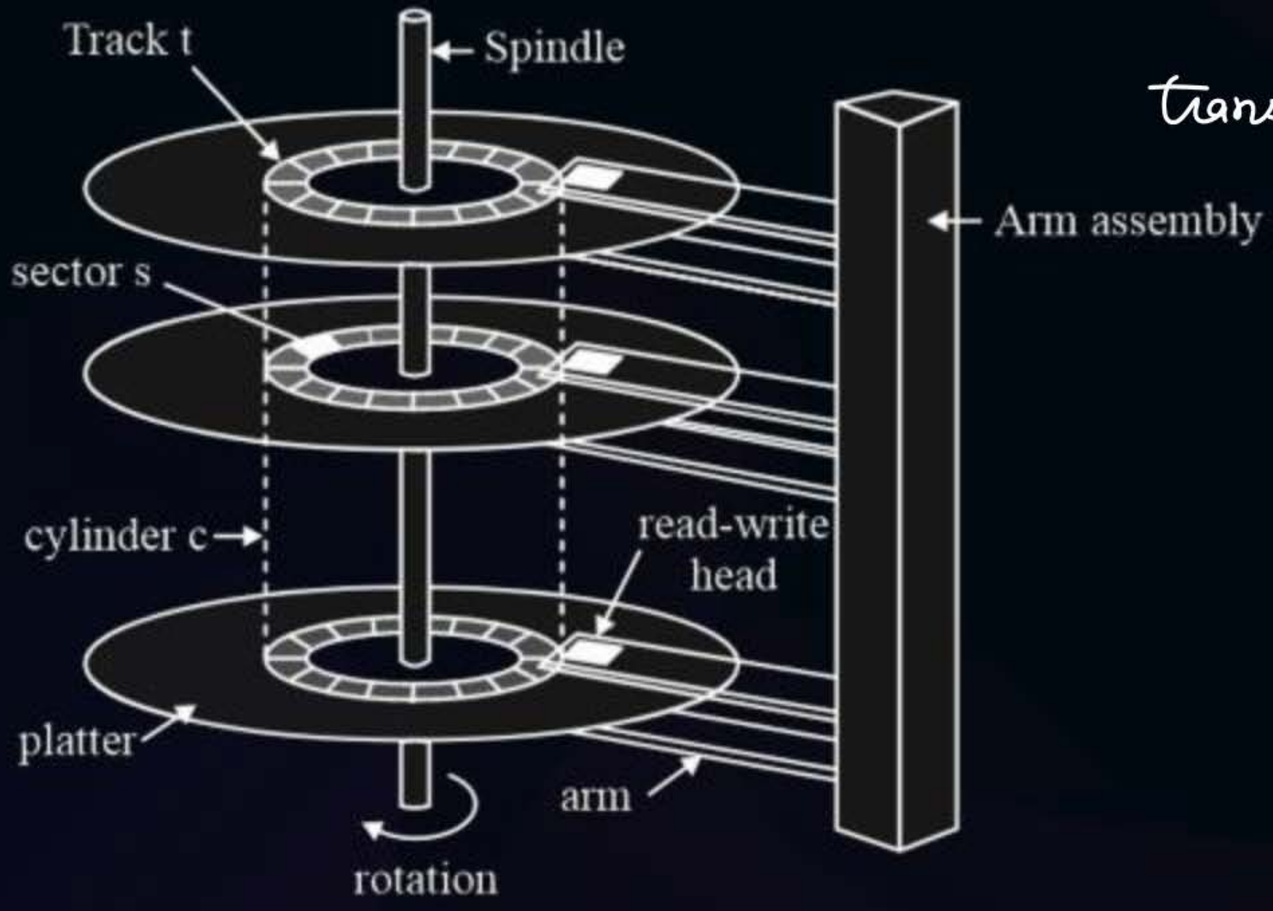
no. of sectors per cylinder = no. of surfaces * no. of sectors per track in disk

Topic : Cylinder



seek time = once per cylinder

rotational latency = once per track

transfer time = once per sector

Topic : Multiple Sectors Access Time: On One Cylinder

n sectors over t tracks

$$= \text{seek time} + t * \text{rotational latency} + n * \text{1 sector transfer time}$$

Topic : Multiple Sectors Access Time: On Multiple Cylinders

n sectors over t tracks which are on x no. of cylinders

$$= x * \text{seek time} + t * \text{rotational latency} + n * \text{sector transfer time}$$

[NAT]

1 rotation = 10msec

#Q. Consider a disk with an average seek time of 10ms, rotation speed of 6000 r.p.m. and 1K-byte sectors with 500 sectors per track. The disk has 20 recording surfaces. A file of size 843Kbytes ($K=2^{10}$) is stored on the disk sequentially cylinder wise. The time required in sequential organization to transfer the file will be nearly is ____ seconds??

no. of sectors to store file $= \frac{843\,KB}{1\,KB} = 843$

no. of tracks to store file $= \left\lceil \frac{843}{500} \right\rceil = 2$

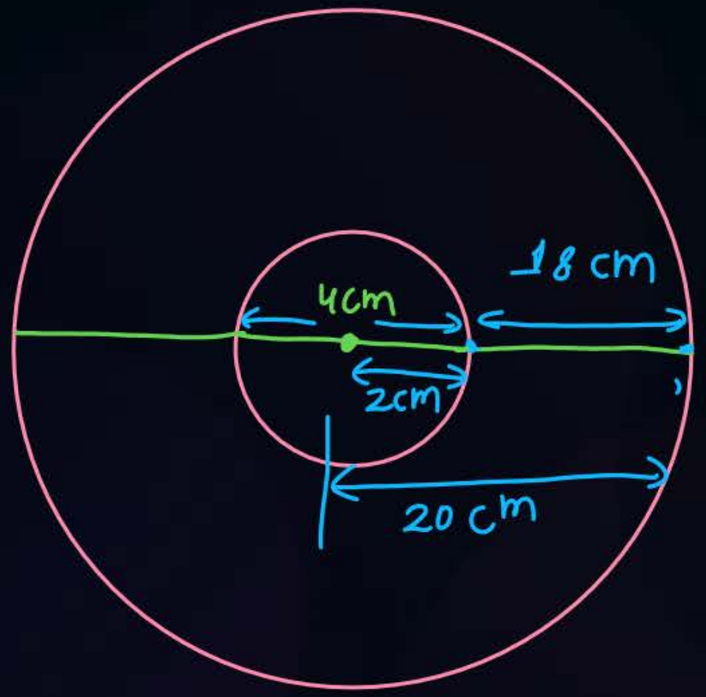
File access time

$= 10ms + 2 * \frac{10}{2} + 843 * \frac{10}{500}$

$= 36.86$ ms

[NAT]

#Q. A disk has 10 equidistant tracks. The diameters of the innermost and outermost tracks are 4 cm and 40 cm respectively. The head can move at a speed of 5 meters/sec. The seek time to move the head from inner-most to outer-most cylinder is 36 milliseconds?



for 500 cm, time = 1 sec

for 18 cm, time = $\frac{1\,sec}{500\,cm} * 18\,cm$

$= \frac{1 * 1000\,msec * 18}{500}$

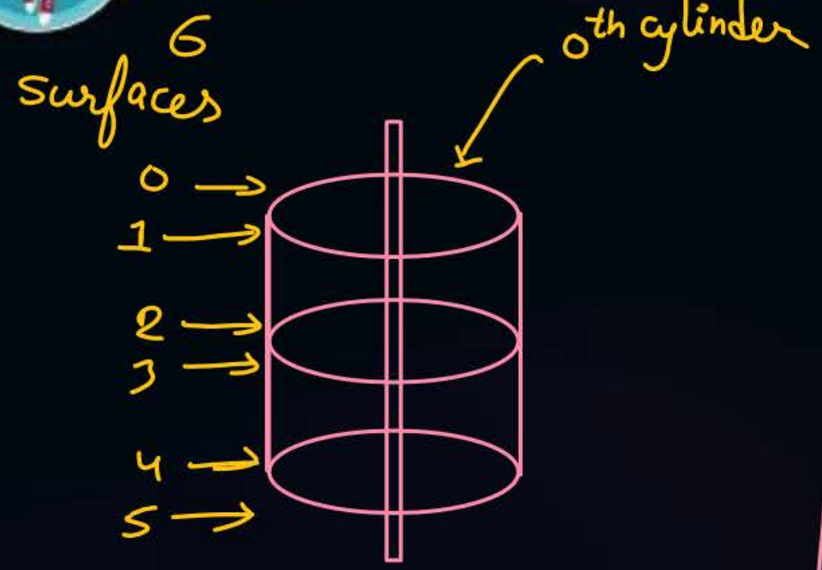
$= 36\,msec$

[NAT]

H.W.

#Q. A disk has 10 equidistant tracks. The diameters of the innermost and outermost tracks are 2 cm and 20 cm respectively. The track has a storage capacity of 20MB. If the disk has 20 sectors per track and is currently at the start of the 5th sector of the inner-most track and the head can move at a speed of 10 meters/sec and it is rotating at constant angular velocity of 3000 RPM, how much time will it take to read 1 MB contiguous data starting from the sector 3 of the outer-most track?

Topic : Disk Addressing



assume no. of sectors per track = 8

sectors per cylinder = 6 * 8 = 48

0th cylinder

address ⇒ c, h, s

c → cylinder no.
h → surface no.
s → sector no

0	surface 0	<0, 0, 0>
1		<0, 0, 1>
⋮		⋮
7		<0, 0, 7>
8	1	<0, 1, 0>
⋮		⋮
15		<0, 1, 7>
	2	<0, 2, 0>
		⋮
		<0, 2, 7>
⋮		⋮
	5	<0, 5, 0>
		⋮
47		<0, 5, 7>

cylinder 1

48 <1, 0, 0>

<1, 0, 7>

<1, 5, 0>

95 <1, 5, 7>

add. <c, h, s>

no. of sectors per track = n_t

— " — per cylinder = n_c

sector no. = $(c * n_c) + (h * n_t) + s$

$= 48 + (5 * 8) + 7$

$= 95$

$$c = \lfloor \text{sector no.} / n_c \rfloor$$

$$h = \lfloor (\text{sector no.} \% n_c) / n_t \rfloor$$

$$s = (\text{sector no.} \% n_c) \% n_t$$

[NAT]

Ans = 2524

#Q. A hard disk has 16 sectors per track, 4 platters each with 2 recording surfaces and 32 cylinders. The address of a sector is given as a triple ⟨c,h,s⟩, where c is the cylinder number, h is the surface number and s is the sector number. Thus, the 0^{th} sector is addressed as ⟨0,0,0⟩, the 1st sector as ⟨0,0,1⟩, and so on.

The address ⟨19, 5 ,12⟩ corresponds to sector number?

$n_t = 16$

$n_c = 8 * 16 = 128$

sector no. $= (19 * 128) + (5 * 16) + 12$

$= 2524$

[NAT]

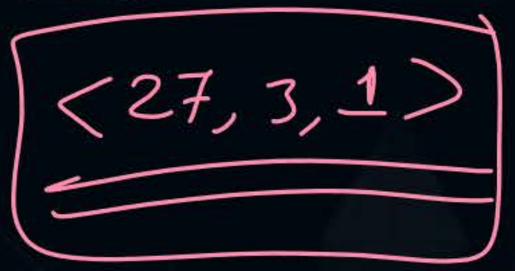
#Q. A hard disk has 16 sectors per track, 4 platters each with 2 recording surfaces and 32 cylinders. The address of a sector is given as a triple ⟨c,h,s⟩, where c is the cylinder number, h is the surface number and s is the sector number. Thus, the 0^{th} sector is addressed as ⟨0,0,0⟩, the 1st sector as ⟨0,0,1⟩, and so on.

The address of 3505^{th} sector?

$c = \lfloor 3505 / 128 \rfloor = 27$

$h = \lfloor (3505 \% 128) / 16 \rfloor = 3$

$s = ((3505 \% 128) \% 16) = 1$



Ans.

[NAT]

#Q. Consider a hard disk with 36 recording surfaces (0-35) having 10000 cylinders (0-9999) and each track contains 64 sectors (0-63). Data in disk are organized cylinder-wise and the addressing format is <cylinder no., surface no., sector no.>. A file in the disk is stored starting from address <1151, 27, 17>. What is the sector number of the first sector of the file in the disk?

$n_t = 64$

$n_c = 64 * 36 = 2304$

$= (1151 * 2304) + (27 * 64) + 17$

$= 2653649$

[NAT]

#Q. In above questions if a file is stored on 43716 sectors in contiguous manner then what is the sector number of the last sector of the file?

$= 2653649 + 43716 - 1$

$= 2697364$

[NAT]

#Q. Calculate the address in format <c, h, s> for the last sector of the file?

$c = \lfloor 2697364 / 2304 \rfloor = 1170$

$h = \lfloor (2697364 \% 2304) / 64 \rfloor = 26$

$s = (2697364 \% 2304) \% 64 = 20$

Ans = <1170, 26, 20>

[NAT]

H.W.

#Q. Consider a hard disk with 16 recording surfaces (0-15) having 16384 cylinders (0-16383) and each track contains 64 sectors (0-63). Data storage capacity of in each sector is 512 Bytes. Data are organized cylinder-wise and addressing format is <cylinder no., surface no., sector no.>. A file of size 42797 KB is stored in the disk and the starting disk location of the file is <1200, 9, 40>. What is the cylinder number of the last sector of the file, if it is stored in a contiguous manner?

2 mins Summary

Topic Magnetic Disk

Happy Learning

THANK - YOU