

# I/O Management

A wide variety of I/O devices.

Data rates

Data Sizes

Errors.

Unit of transfer

:

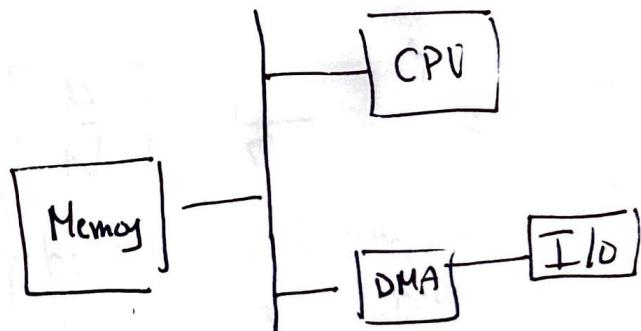
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\* Device drivers.

## Direct Memory Access (DMA)

DMA controls the data exchange between the I/O device and memory.



Only interrupt the CPU when the operation is done.

1 Read / Write.

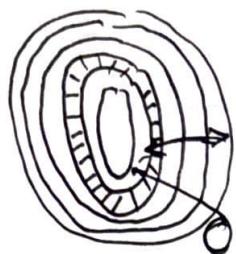
2 Address in memory.

3 the address of the I/O device

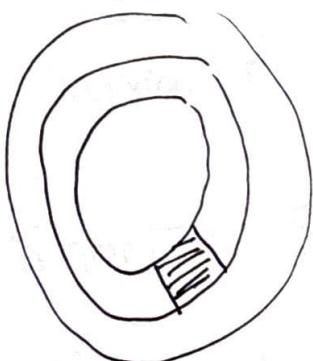
4 Size (number of bytes to read/write).

## Disk Scheduling

(2)



- \* Disk rotating at a constant speed.
- \* To read/write, the head must be positioned over the right track and wait for the right sector



Average Access Time =

$$\text{Seek Time} + \text{Rotational Delay} + \text{Transfer Time} + \text{Queuing delay}$$

✓  
Time it takes for the head arm to move to the right track

{ Time taken for the desired sector to be in position beneath the head  
 $\sim \frac{1}{2}$  rotation time

$$\left\{ \left[ \frac{b}{N} \right] * \frac{1}{r} \right\}$$

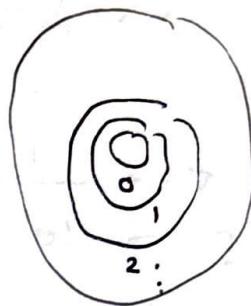
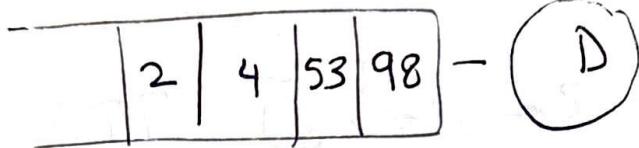
b: # of bytes to read/write  
N: # of bytes on a track  
r: rotation speed r/s.

due to other process requests.

Order of tracks makes a big difference.  
(optimizes seek time).

OS maintains a queue for requests to disk from various processes.

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## 1 FIFO

Service Requests in the order received.

Scan (Elevator)

## 2 Shortest Seek Time First (SSTF).

Select the disk I/O request that requires the least movement of the disk arm.

Optimal or not?

Not optimal

Head on track 10

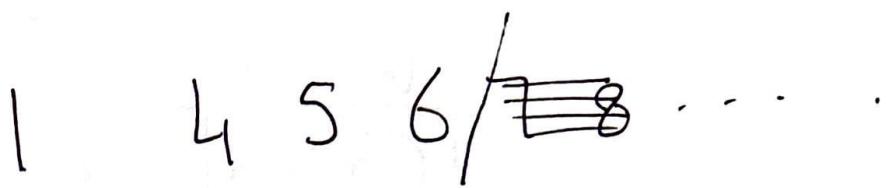
requests: 5 3 67 21 14 16

10  $\xrightarrow{3}$  7  $\xrightarrow{2}$  5  $\xrightarrow{2}$  3  $\xrightarrow{11}$  14  $\xrightarrow{2}$  16  $\xrightarrow{5}$  21

$$\text{Avg Seek time} = \frac{3+2+2+11+2+5}{6} = 2.5$$

10  $\rightarrow$

4

Head = 3

SSTF  $3 \xrightarrow{1} 4 \xrightarrow{1} 5 \xrightarrow{1} 6 \xrightarrow{1} 7 \xrightarrow{1} 1 \dots = 3+5$

counter example.

$3 \xrightarrow{2} 1 \xrightarrow{3} 4 \xrightarrow{4} 5 \xrightarrow{5} 6 \dots = 7$

## 2] SCAN (Elevator):

Arm moves in one direction servicing requests until it reaches the last track. Then it switches direction and service requests.

LOOK: stop at the last request. (not last track).

## 3] C-SCAN (Circular SCAN).

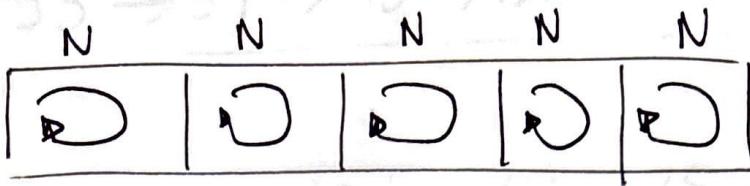
Like SCAN but we only service requests in one direction.

(look)

When the arm reaches one end, it moves to the ~~the~~ other end without serving requests.

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## 5] N-Step SCAN



break the queue into block of size N.

Perform a SCAN on each block.

### Example

head 53

200 tracks.

98      183      37      122 } 14      124      65      67

SSTF:  $53 \rightarrow 65 \rightarrow 67 \rightarrow 37 \rightarrow 14 \rightarrow 98 \rightarrow 122 \rightarrow 124 \rightarrow 183$ .

Assume we move to lowest track first

SCAN :  $53 \rightarrow 37 \rightarrow 14 \rightarrow 65 \rightarrow 67 \rightarrow 98 \rightarrow 122 \rightarrow 124 \rightarrow 183$ .

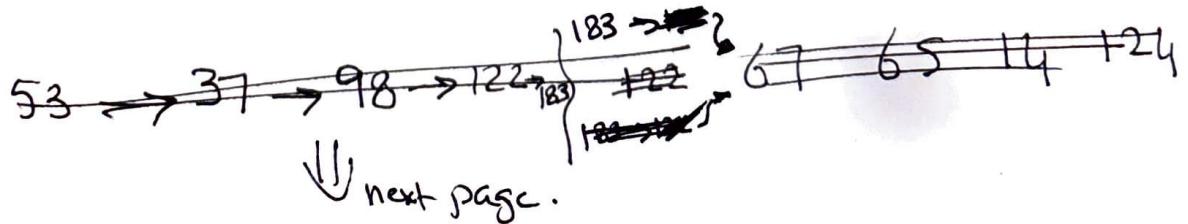
(Look)

SCAN :  $53 \rightarrow 37 \rightarrow 14 \rightarrow 0 \rightarrow 65 \rightarrow 67 \rightarrow \dots$

Service requests in increasing tracks.

CSCAN :  $53 \rightarrow 65 \rightarrow 67 \rightarrow 98 \rightarrow 122 \rightarrow 124 \rightarrow 183 \rightarrow 199 \rightarrow 0 \rightarrow 14 \rightarrow 37$ .

4-Step  
(SCAN)  
(Look)



↓ next page.

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53 → 37 → 98 → 122 → 183

N-STEP  
SCAN  
(Look)

183 → 124 → 67 → 65 → 14

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RAID