COA

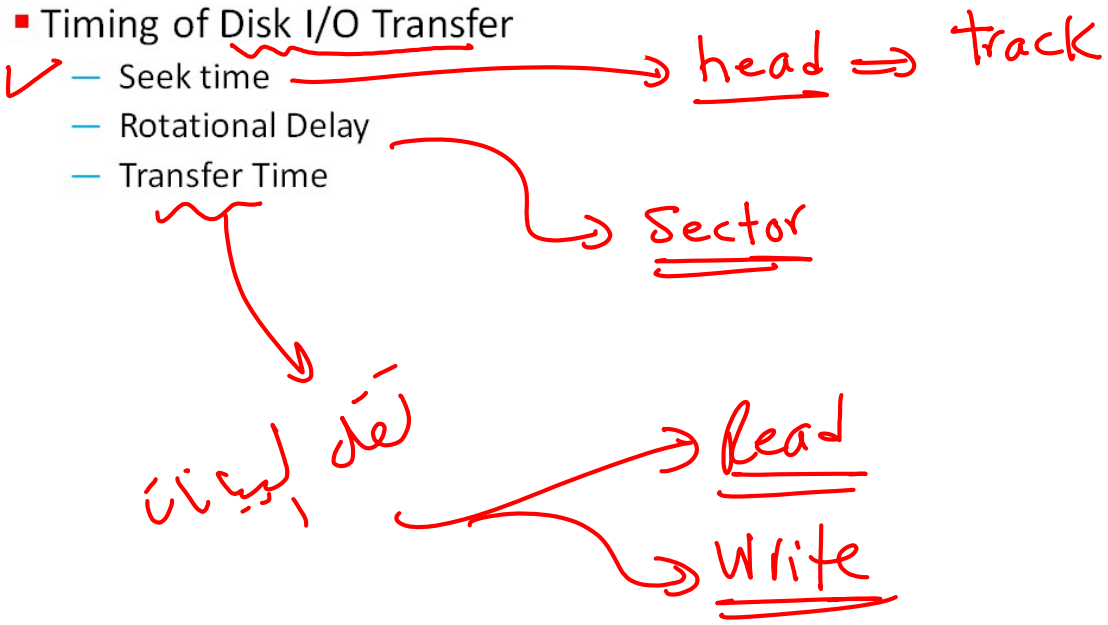
Chapter 06: | Disk Performance Parameters

Prof. Dr. Mostafa Elhosseini

https://youtube.com/drmelhosseini

AGENDA

- Timing of Disk I/O Transfer
  - Seek time
  - Rotational Delay
  - Transfer Time



Timing of Disk I/O Transfer

- The actual details of **disk I/O operation** depend on the **computer system**, the **operating system**, and the nature of the **I/O channel** and **disk controller** hardware

Timing of Disk I/O Transfer

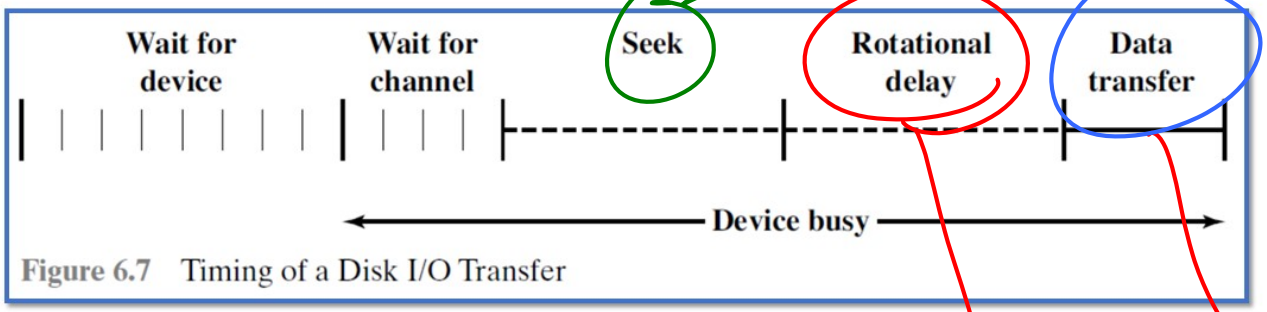


Figure 6.7 Timing of a Disk I/O Transfer

track

2

head

- desired track

Seek time

- desired sector

Rotational delay

Sector

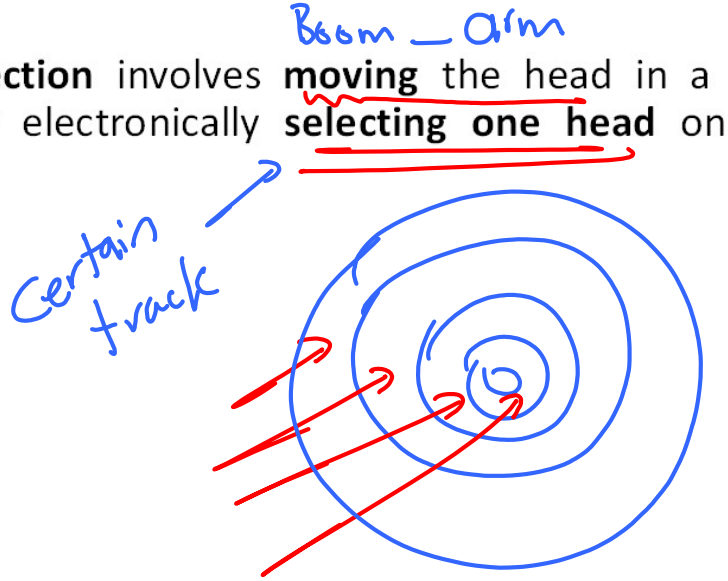
Read / write

1

Access time = Seek time + Rotational time

Timing of Disk I/O Transfer

- When the disk drive is operating, the **disk** is rotating at **constant speed**.
- To read or write, the **head** must be **positioned** at the desired **track** and at the **beginning of the desired sector** on that track
  - **Track selection** involves **moving** the head in a movable-head system or electronically **selecting one head** on a **fixed-head** system



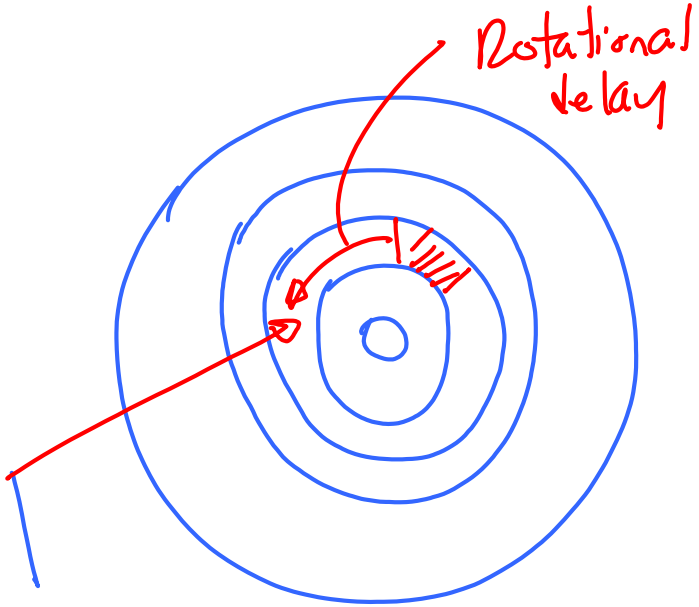
① Arm head / surface

② head / track

No Seek time

Timing of Disk I/O Transfer

- On a movable-head system, the **time it takes** to position the head at the track is known as **seek time**.
- The time **it takes** for the **beginning of the sector** to reach the head is known as **rotational delay**, or **rotational latency**.
- The **access time** is the time it takes to get into position to read or write



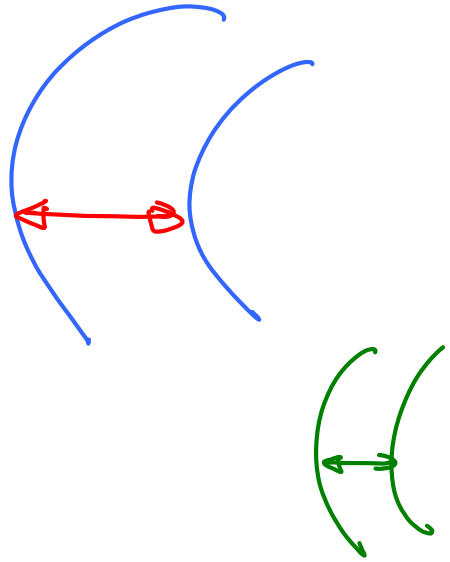
Access time = Seek time + Rotational delay

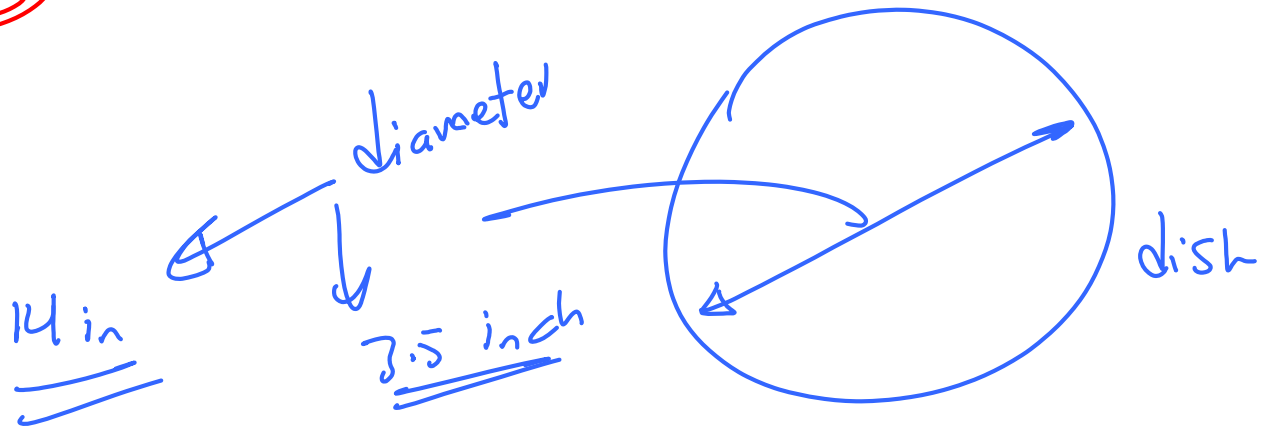
Timing of Disk I/O Transfer

- Once the head is in position, the read or write operation is then performed as the **sector moves under the head**; this is the **data transfer portion** of the operation
  - **Transfer time**
- There are **several queuing delays**
  - wait in a queue for the **device to be available**.
  - wait for the **channel to be available**.

Seek time

- **Seek time** is the time required to move the disk arm to the required track
  - Much **improvement** comes from smaller and lighter disk components
  - A typical **average seek time** on contemporary hard disks is under **10 ms**





Rotational Delay ⇒ Sector ⇒ disk speed → RPM

- Disks, **other than floppy disks**, rotate at speeds ranging from **3600 rpm** up to, as of this writing, **20,000 rpm**; at this latter speed, there is **one revolution per 3 ms**. Thus, on the average, the rotational delay will be **1.5 ms**

RPM → Revolution per Minute

$\frac{1}{2r}$

20,000 Revolution / Minute

$\frac{20{,}000}{60}$ RPS $= \frac{1}{\frac{20{,}000}{60} * 1000}$

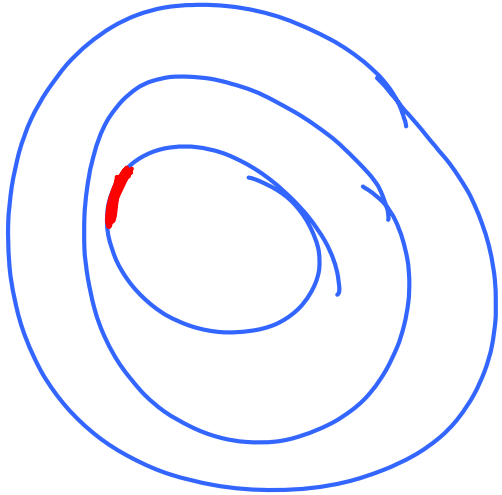
1/3 → Rp (ms)

1 Revolution ⇒ 3 ms

Average latency period ⇒ 1.5 ms

Transfer Time

- The **transfer time** to or from the disk **depends** on the **rotation speed** of the disk:
- $T = \frac{b}{r\,N}$



$b \Rightarrow$ # bytes to be transferred

$N \Rightarrow$ # bytes on track

$r \Rightarrow$ Rotation speed

Total Average Access Time

$$T_a = T_s + \frac{1}{2\,r} + \frac{b}{r\,N}$$

Average Seek time ↓ track

Rotationaly delay ↓ Sector

transfer time ↓ R/W

Example

- Consider a disk with an advertised average **seek time** of 4 ms, **rotation speed** of 15,000 rpm, and 512-byte sectors with 500 sectors per track. Suppose that we wish to **read a file consisting of 2500 sectors for a total of 1.28 Mbytes**. We would like to **estimate the total time for the transfer**

Note…

- The **order** in which sectors are read from the disk has a tremendous **effect** on **I/O performance**
- we **have some control over the way in which sectors of data are deployed**.
- **Multiprogramming environment**, there will be I/O requests competing for the same disk.
- **Disk scheduling algorithms**