# Random Access

spindle

platter

arm

(virtual) tracks

(disk) heads

# Cost of a Random Access

1. seek-time $t_s$ (arm movement)

2. rotational delay $t_r$ (wait for the right angle)

$$12000 \; RPM / 60$$

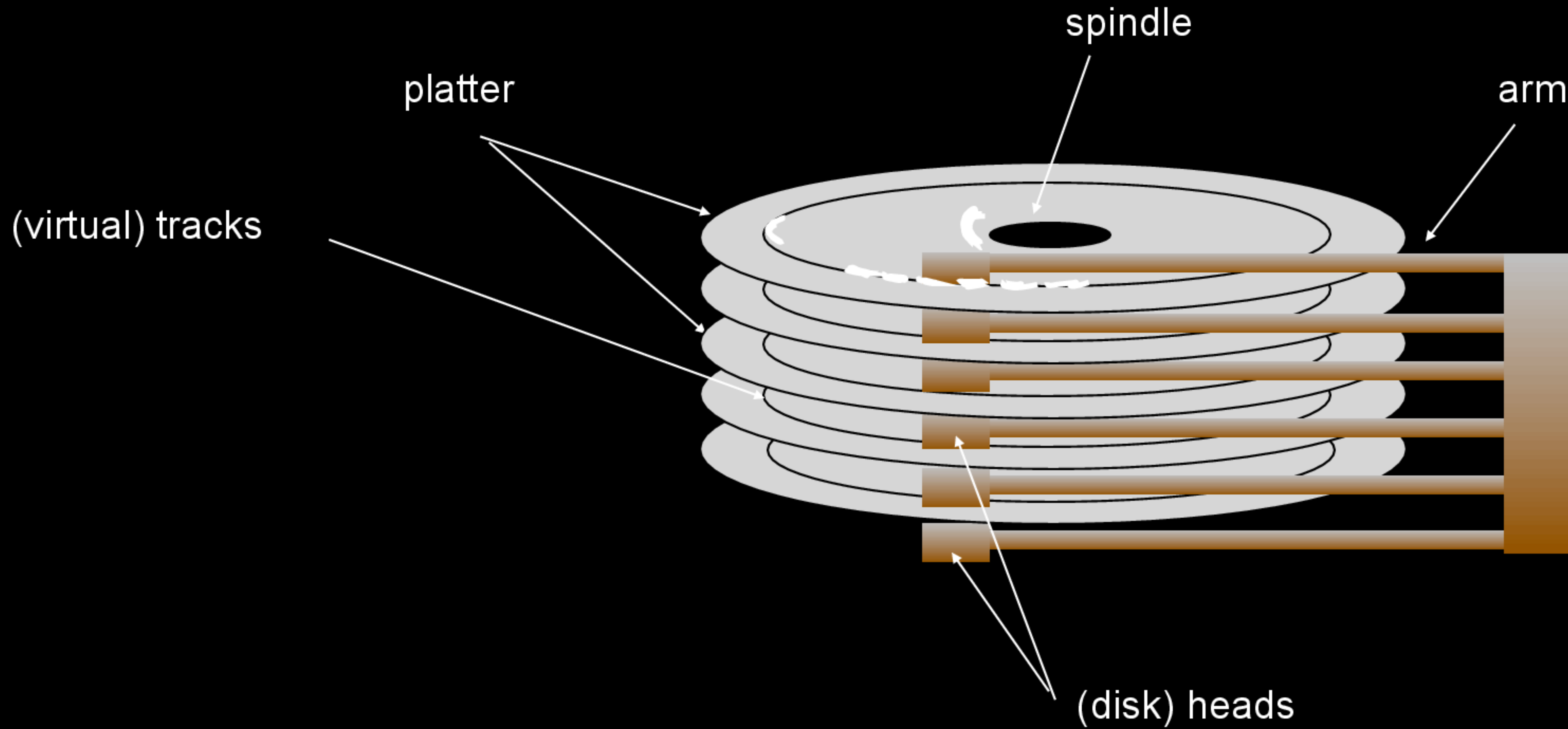$$\Rightarrow 200 \; RPS$$

$$\frac{1}{200} \; sec$$

$$t_r = \frac{1}{400} = \underline{2.5ms}$$

# Sequential Access

cylinder = set of similar tracks
for all platters

spindle

platter

arm

(virtual) tracks

(disk) heads

# Cost of a Sequential Access

1. seek to cylinder $t_s$ (arm movement)

2. rotational delay $t_r$ (wait for the right angle)

3. transfer time $t_{tr}$ (transfer the actual data)

# Cost of a Sequential Access

1. seek to cylinder $t_s$ (arm movement)

2. rotational delay $t_r$ (wait for the right angle)

3. transfer time $t_{tr}$ (transfer the actual data)

4. switch to different head on the same track

5. rotational delay $t_r$ (wait for the right angle)

6. transfer time $t_{tr}$ (transfer the actual data)

] repeat

]] repeat

# Track Skewing



rotation done while moving disk head

next block read

last block read
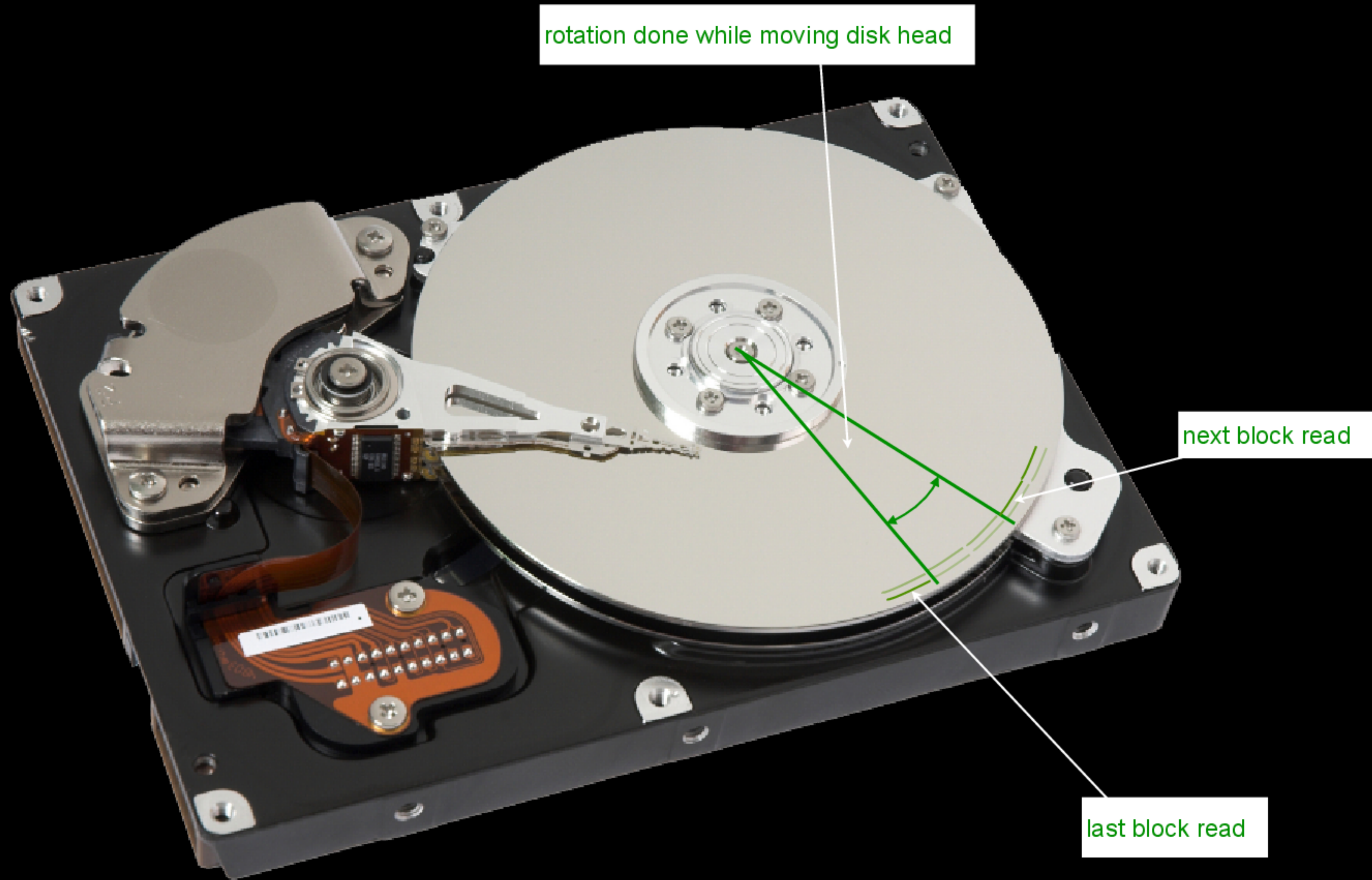
# Hard Disk Evolution

| | 1970 | 2012 | improvement factor |
|---|---|---|---|
| | IBM 3330 | Seagate Savvio 15K.3 | |
| average access time | 30ms | 5ms | 6 |
| sequential | 0.8MB/sec | 174MB/sec | 218 |

# Simulation: Read 1,000 blocks of size 8 KB

TR: transfer rate in MB/sec

(1) each block **randomly** read:
$t_{random} = 1{,}000 \times ( \text{avg access time} + 8KB/TR )$

# Simulation: Read 1,000 blocks of size 8 KB

TR: transfer rate in MB/sec

each block **randomly** read:
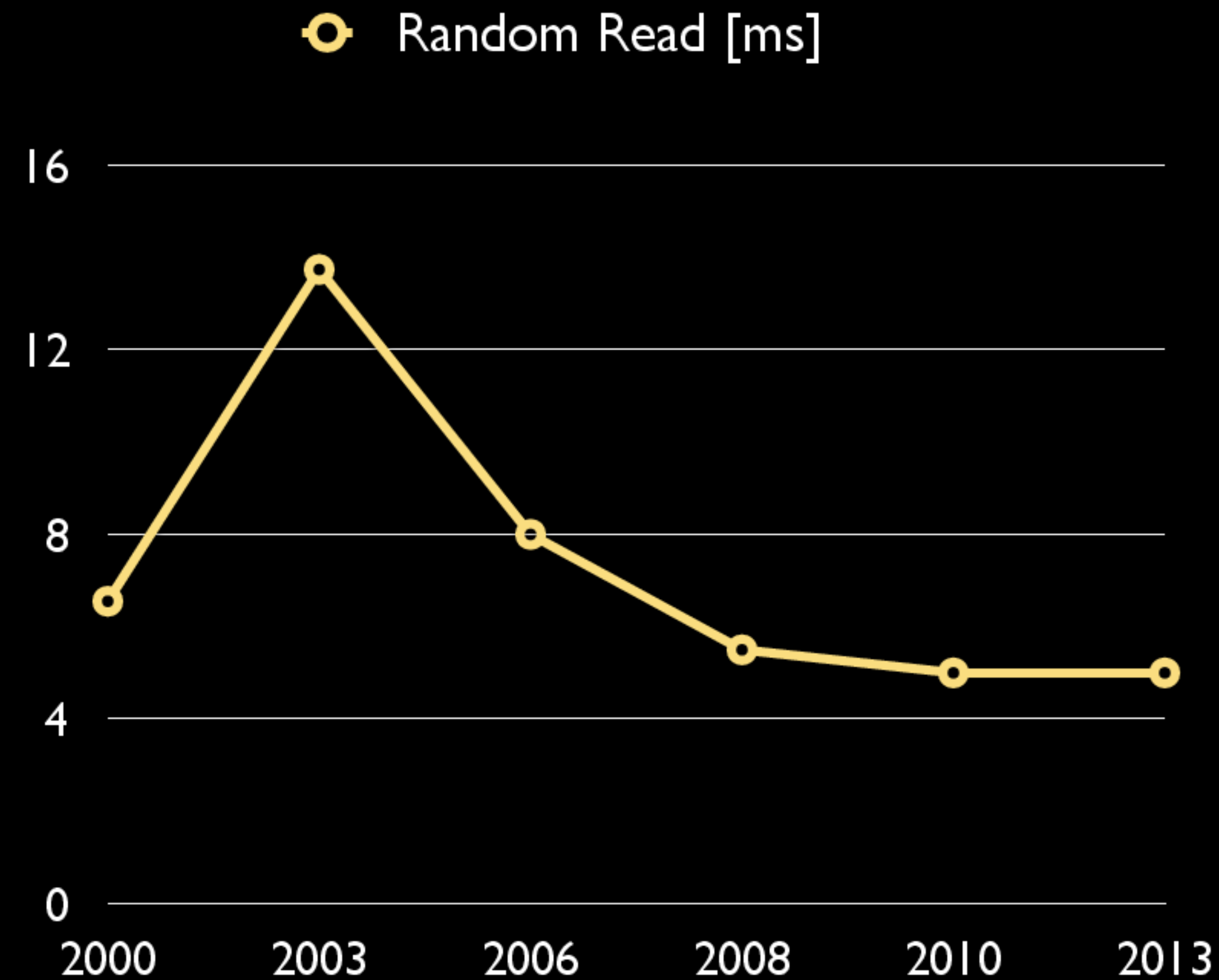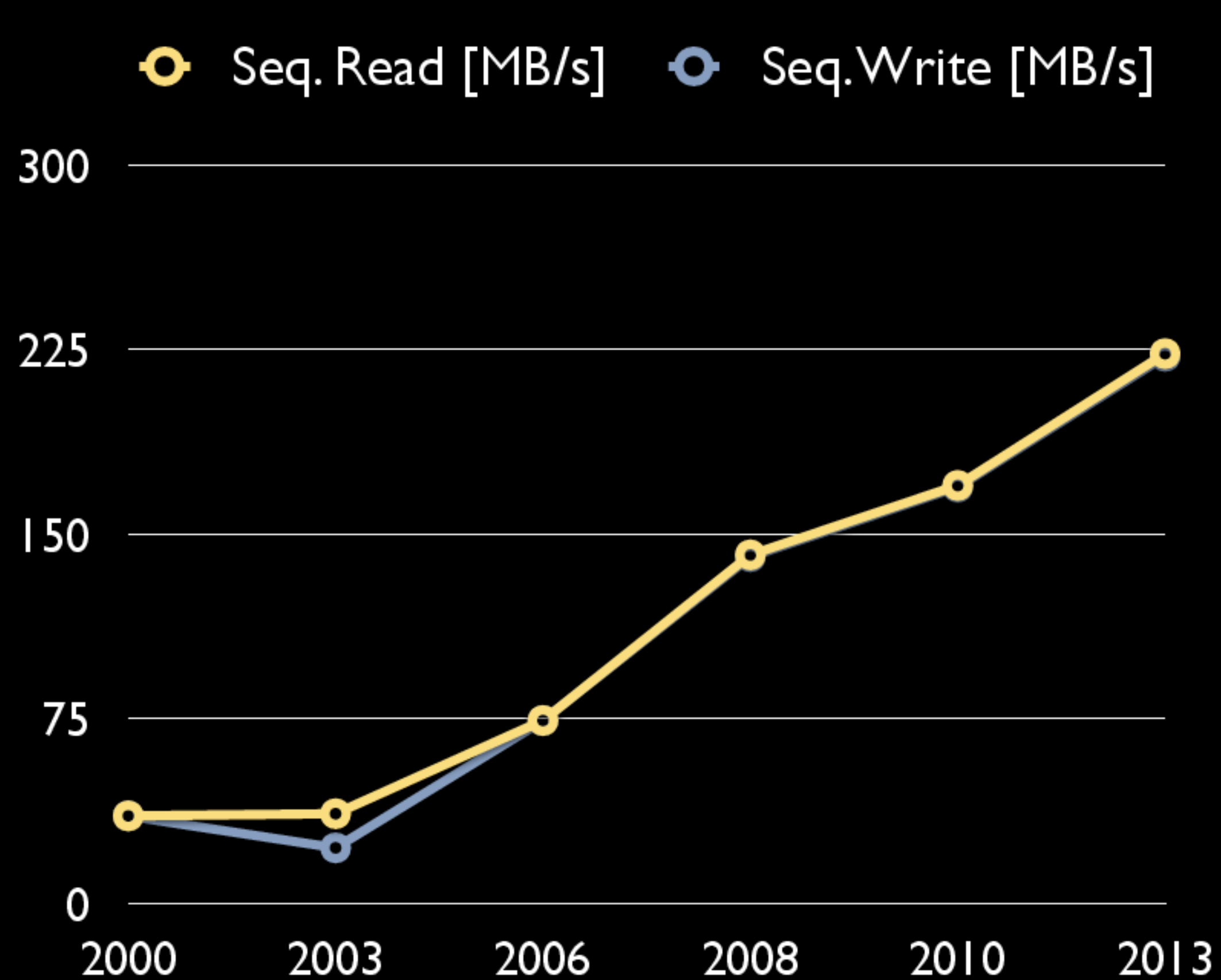$$t_{random} = 1{,}000 \times ( \text{avg access time} + 8KB/TR )$$

**sequential** read:
$$t_{seq} = 1 \times \text{avg access time} + 1{,}000 \times 8KB/TR$$

# Simulation Results

| | 1970 | 2012 | **improvement factor** |
|---|---|---|---|
| | IBM 3330 | Seagate Savvio 15K.3 | |
| each block randomly read | 40,410ms | 5,046ms | **8** |
| sequential read | 10,440ms | 51ms | **205** |
| **improvement factor** | 4 | 99 | |

# Hard Disk Evolution for Enterprise Disks



Source: http://www.tomshardware.com/charts/hard-drives-and-ssds,3.html

# Copyrights