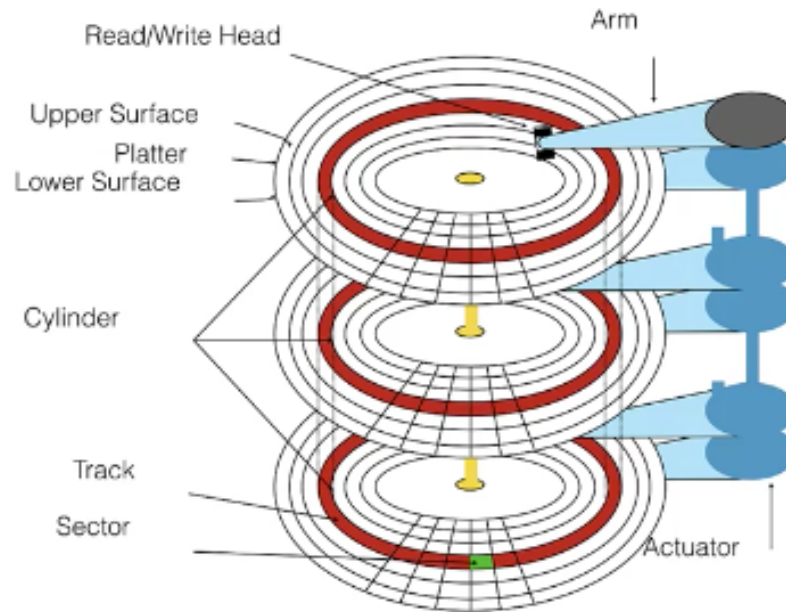


1. Secondary Storage Devices

-

2. Disk Components



- Parts
 - **Platter:**
 - * Data can be stored in both upper and lower parts of the platter
 - **Cylinder:**
 - * Is a set of tracks that can be read without moving the arm
 - **Sector:**
 - * Size of disk block is multiple of sectors
- Disk arm touching surface → disk surface crash

3. Disk Performance

IMPORTANT We should know the bulk part time of how this works

- **Seek:**
 - Is the time it takes to move the disk arm to correct cylinder
 - Depends on how fast disk arm can move
 - Typical time: 1-15ms, depending on distance (avg 5-6 ms)
 - Improves very slowly (7 - 10% per year)

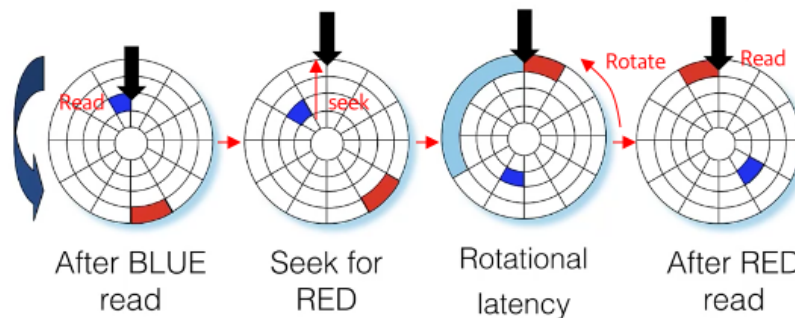
- **Rotation:**

- Is the time it takes to rotate under the head to get to correct sector
- Depends on rotation rate of disk
- Average latency of $\frac{1}{2}$ rotation

- **Transfer:**

- Is the time it takes to transfer data from surface to disk controller, electronics and sending it back to host
- Depends on density
- $\sim 100\text{MB/s}$, average sector transfer time of $\sim 5\mu\text{s}$
- Improves rapidly ($\sim 40\%$ per year)

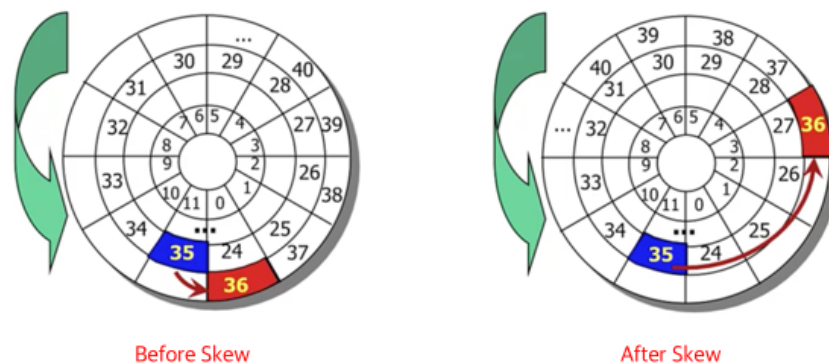
4. Traditional Service Time Component



- OS tries to minimize the cost of rotational latency, transfer time, and seek time
- Improvement attention especially on seek time and rotation latency

5. Some Hardware Optimizations

- **Track Skew**



- Has to do with numbering on tracks

- Is to reduce rotational latency
- **Zones**
- **Cache**