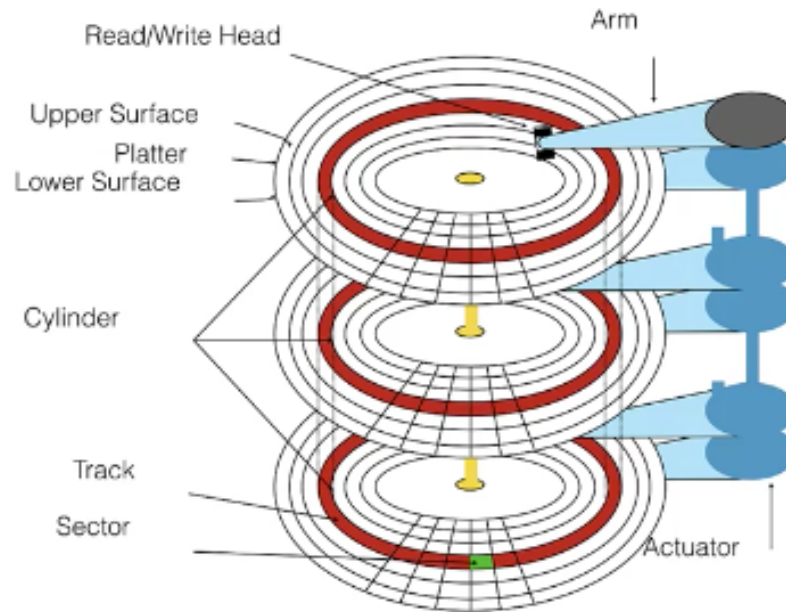1. **Secondary Storage Devices**

   •

2. **Disk Components**

   • Parts
     – **Platter:**
       * Data can be stored in both upper and lower parts of the platter
     – **Cyliner:**
       * 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 suface 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
  - ~ 100MB/s, average sector transfer time of $\sim 5\mu s$
  - Improves rapidly ($\sim 40\%$ per year)

4. **Traditional Service Time Component**

After BLUE read   Seek for RED   Rotational latency   After RED read
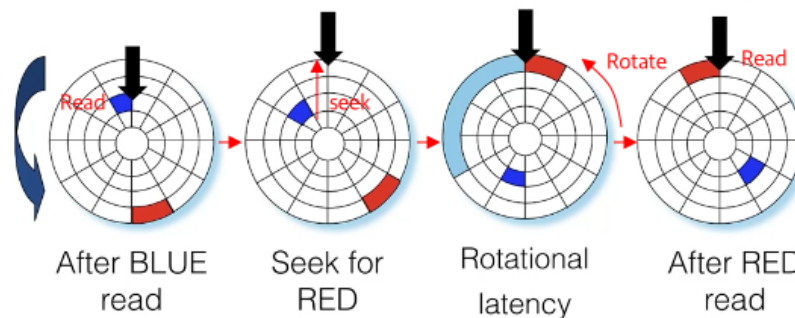
- OS tries to minimize the cost of rotational latency, transfer time, and seek time
- Improvement attention especially on seek time and rotation latency

5. **Track Skew**

- Is to reduce rotational latency