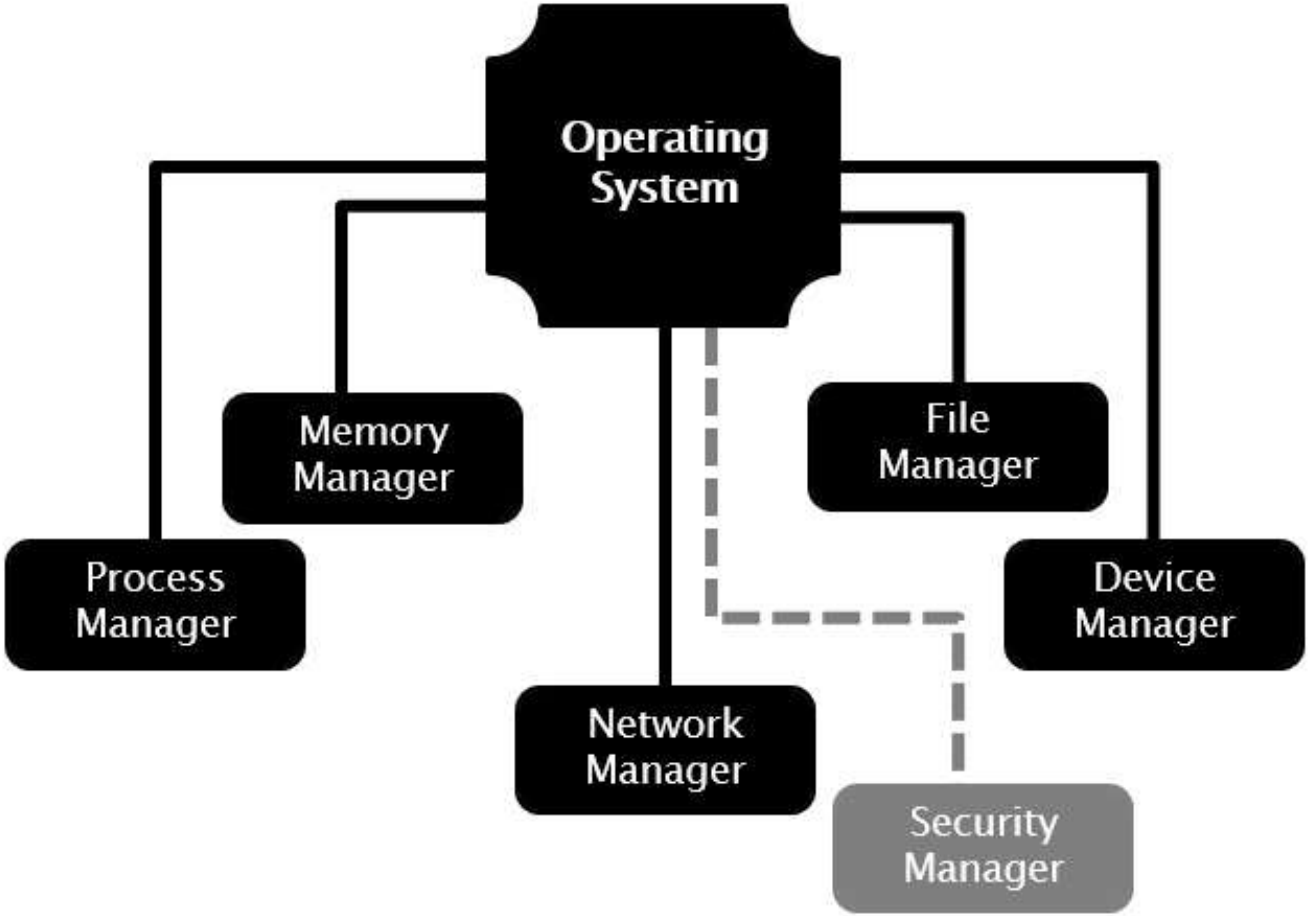
Device Management

Damian Gordon

Device Management

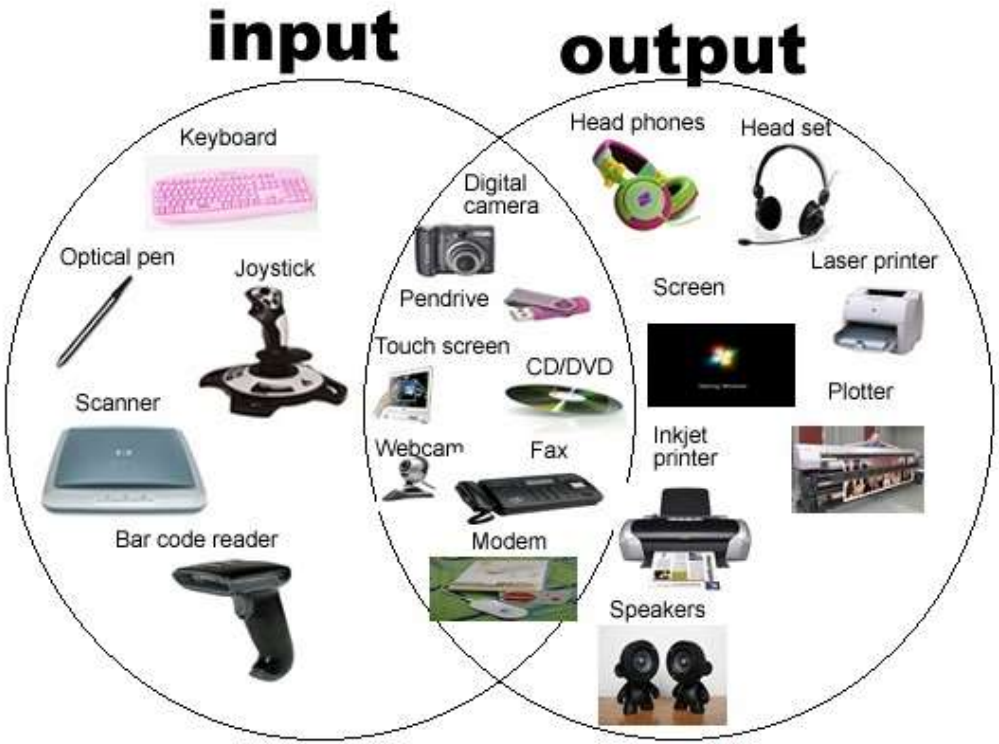


Device Management

- The main functions of the device manager are:
  1. Monitor the status of all devices, including storage drives, printers and other peripherals
  2. Enforce pre-set policies on which process gets which device for how long
  3. Deal with the allocation of devices to processes
  4. Deal with the de-allocation of devices to processes, both at a temporary basis (e.g. when the process is interrupted) and on a permanent basis (e.g. when the process is completed).

Device Management

- Examples of devices:
  - Keyboard
  - Mouse
  - Monitor
  - Scanner
  - Camcorder
  - CD-ROM
  - USB Ports
  - WebCam
  - Microphone
  - Printer

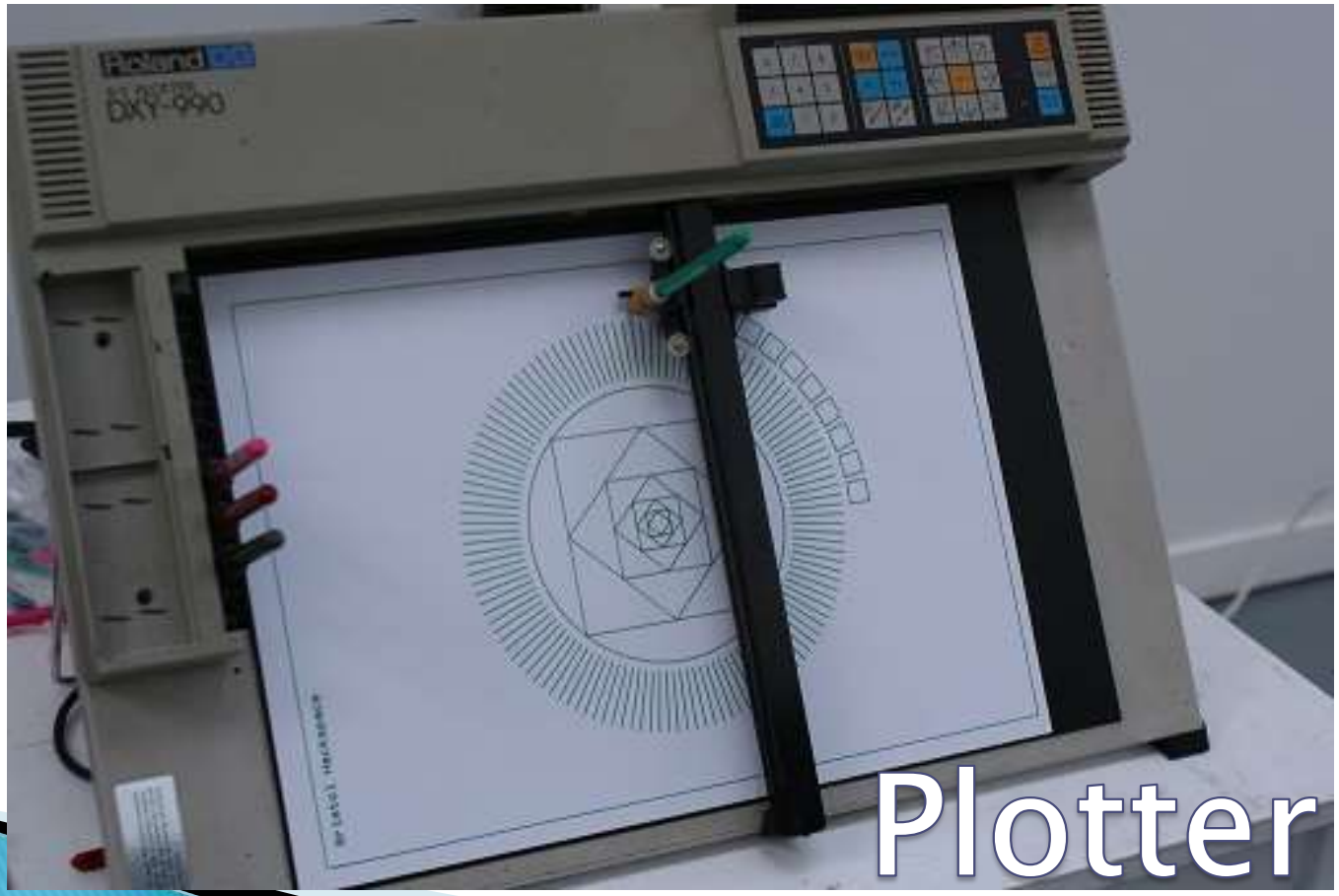


Device Management

- There are three main types of devices:
  - Dedicated Devices
  - Shared Devices
  - Virtual Devices

Device Management

- Dedicated Devices



Device Management

- Dedicated Devices
  - These are devices that are assigned to one process at a time, and the process only releases the device once it is completed.
  - This makes sense for devices like plotters, and tape drives.
  - The problem with this is that it means only one user is using it at a time, and it might be inefficient if the device isn't being used 100% of the time that it is being locked by the user.

Device Management

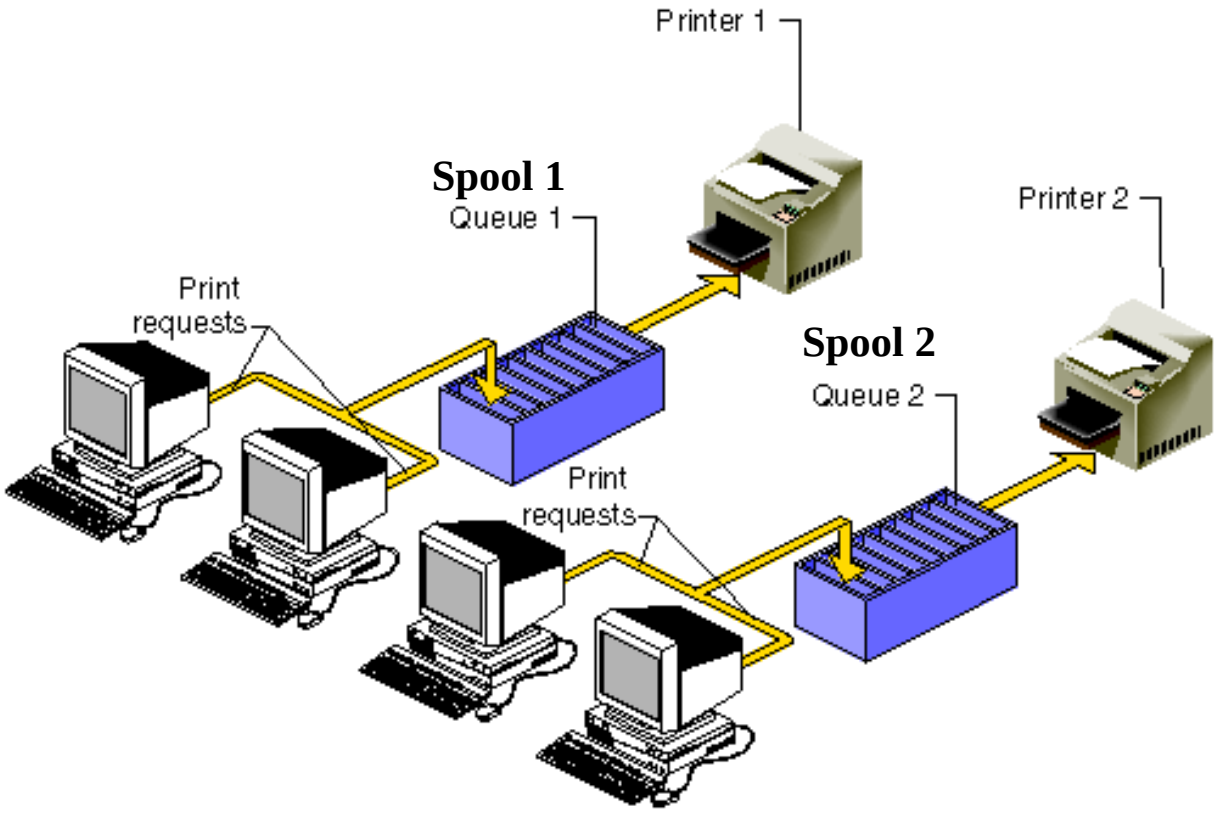
- Shared Devices

Device Management

- Shared Devices
  - These are devices that can be shared between several processes.
  - Considering an example like a hard disk, it is shared, but interleaving between different processes' requests.
  - All conflicts for device need to be resolved but pre-determined policies to decide which request is handled first.

Device Management

- Virtual Devices

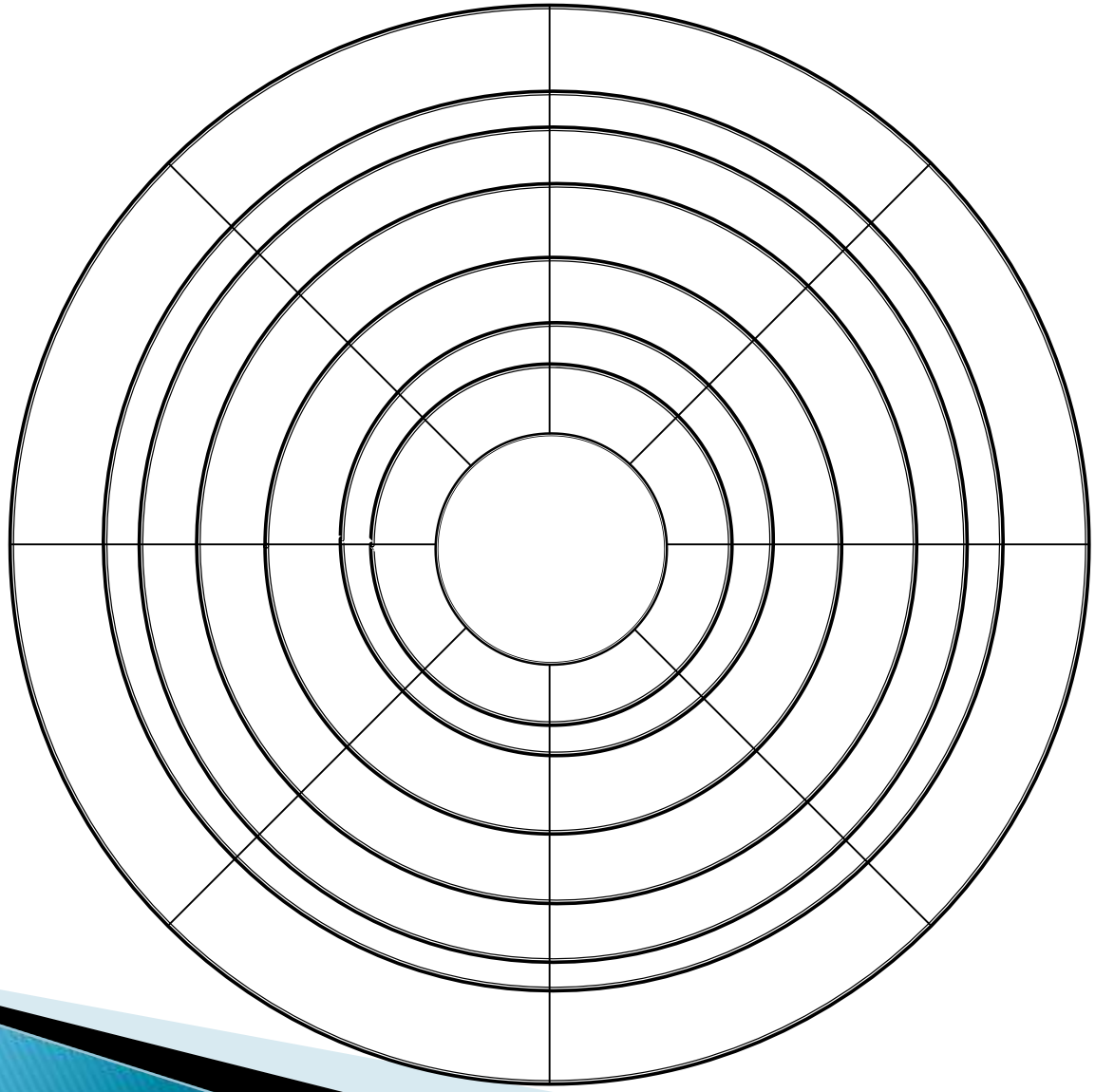


Device Management

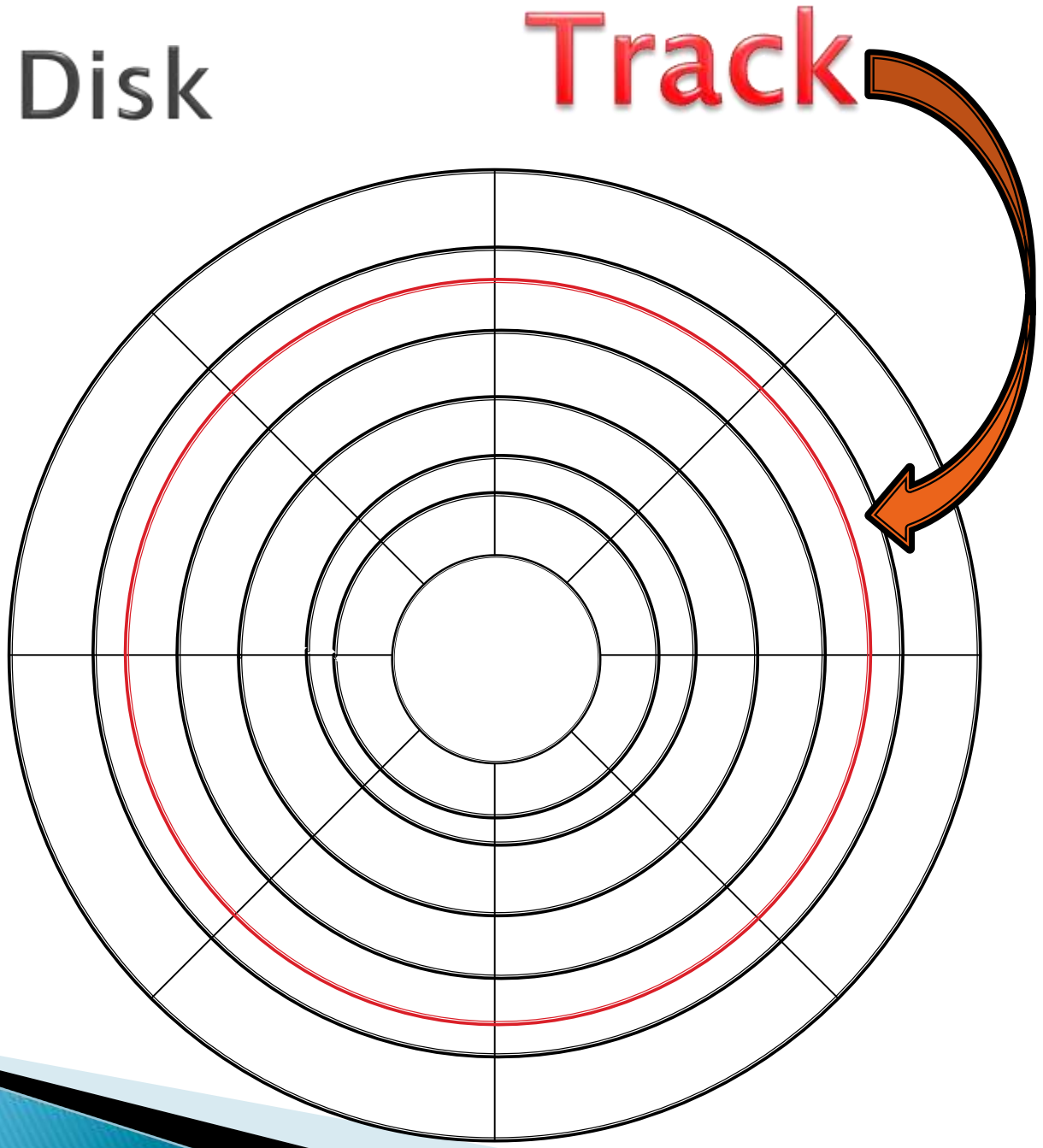
- Virtual Devices
  - These are devices are a combination of Dedicated and Shared Devices.
  - So a printer is a dedicated device, but using the spooling (queues) means it can be shared.
  - A print job isn't sent straight to the printer, instead it goes to the disk (spool) until it is fully prepared with all the necessary printer sequences and formatting, then it goes to the printer, ensuring that the printers (and all I/O devices) are used efficiently.

Hard Disks:
Direct Access Storage Devices

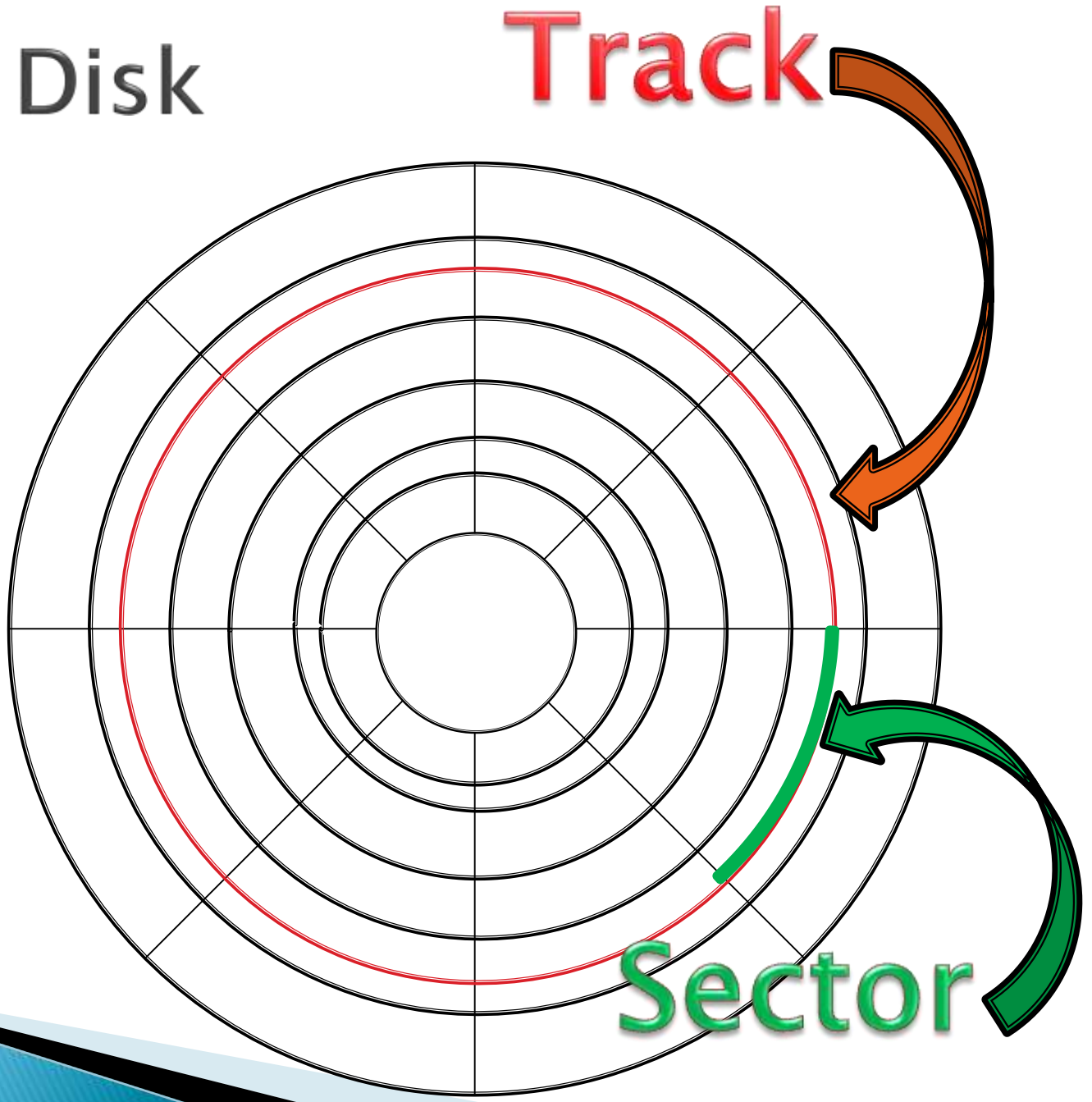
Hard Disk



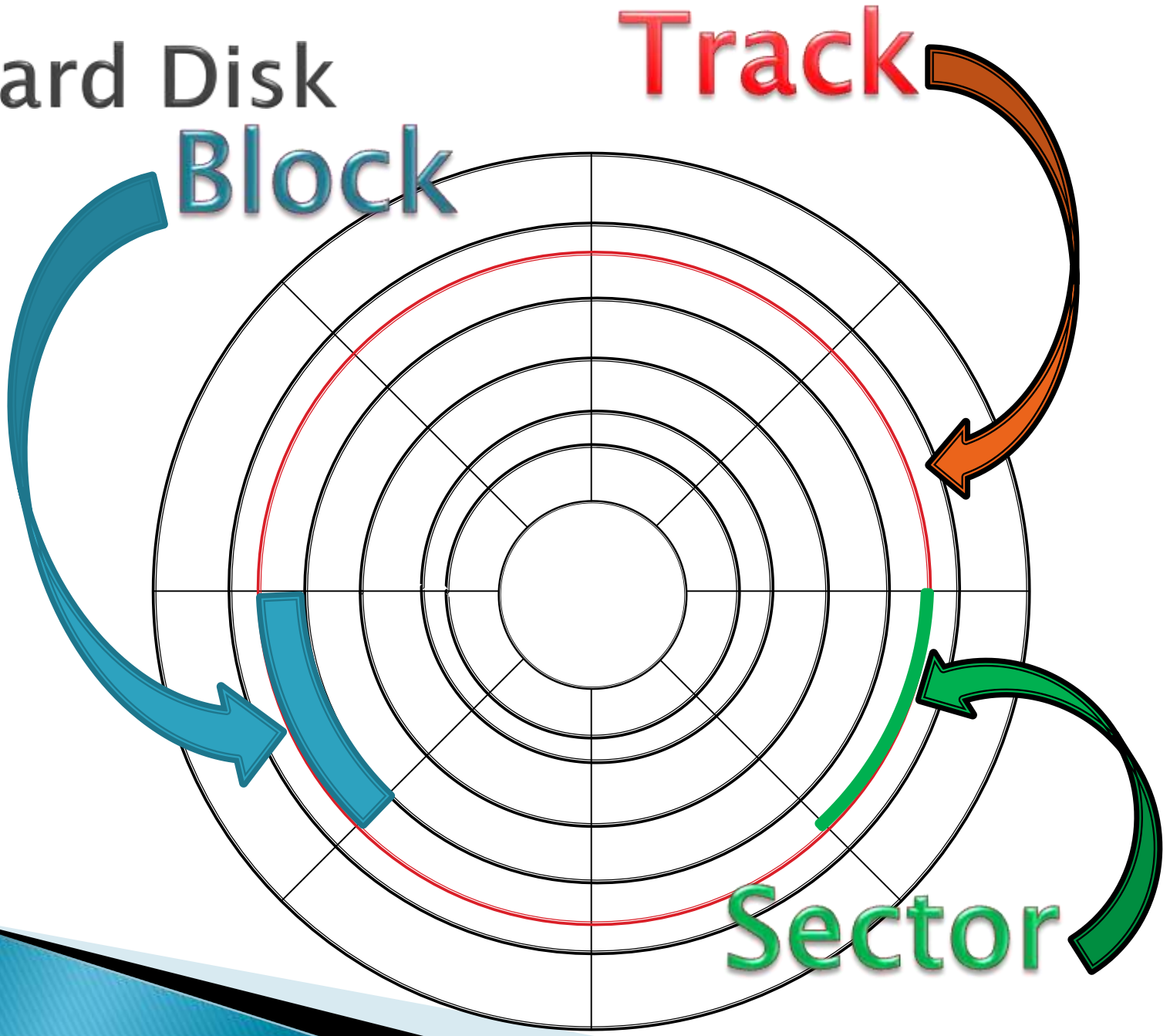
Hard Disk



Hard Disk

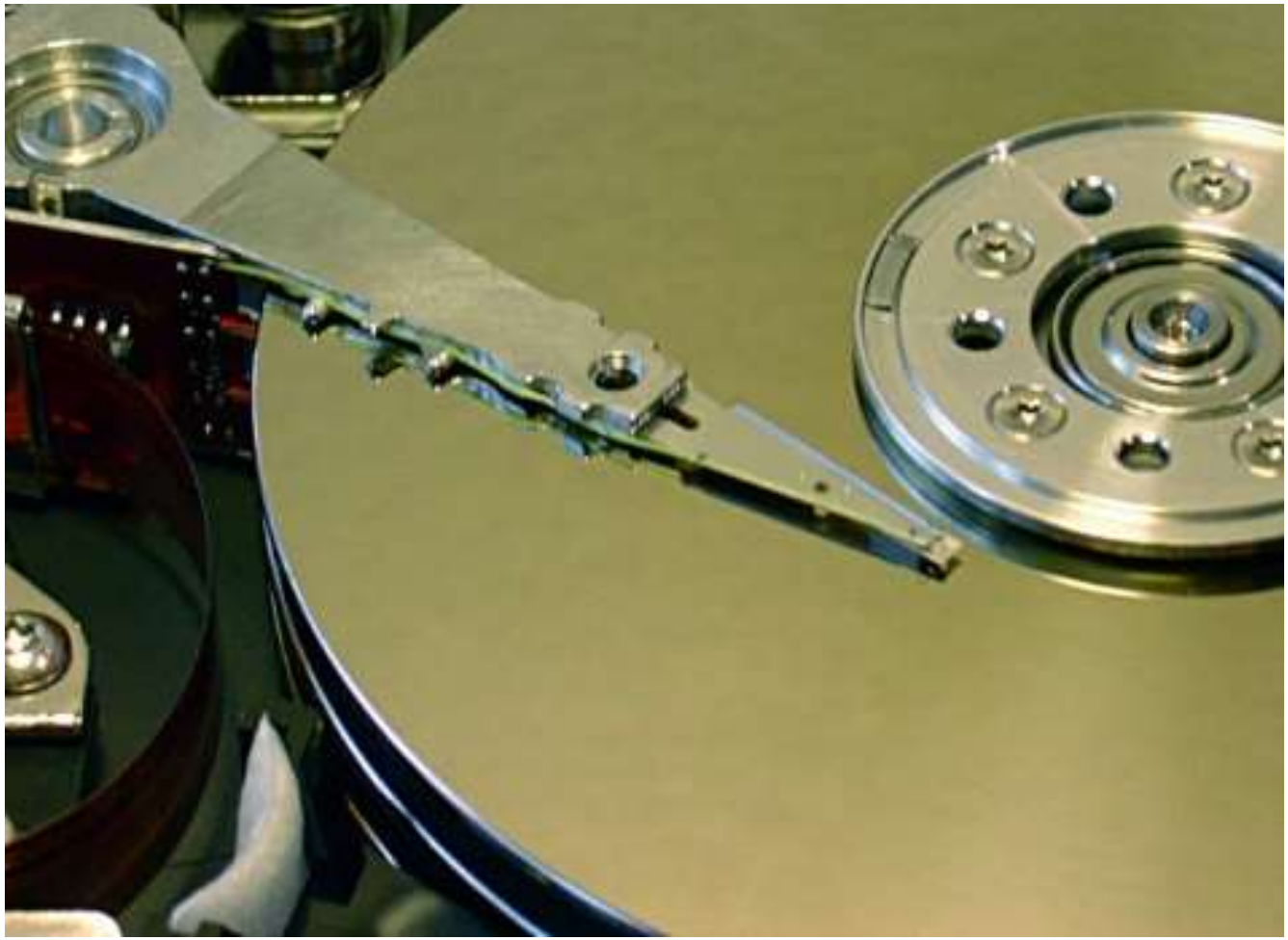


Hard Disk



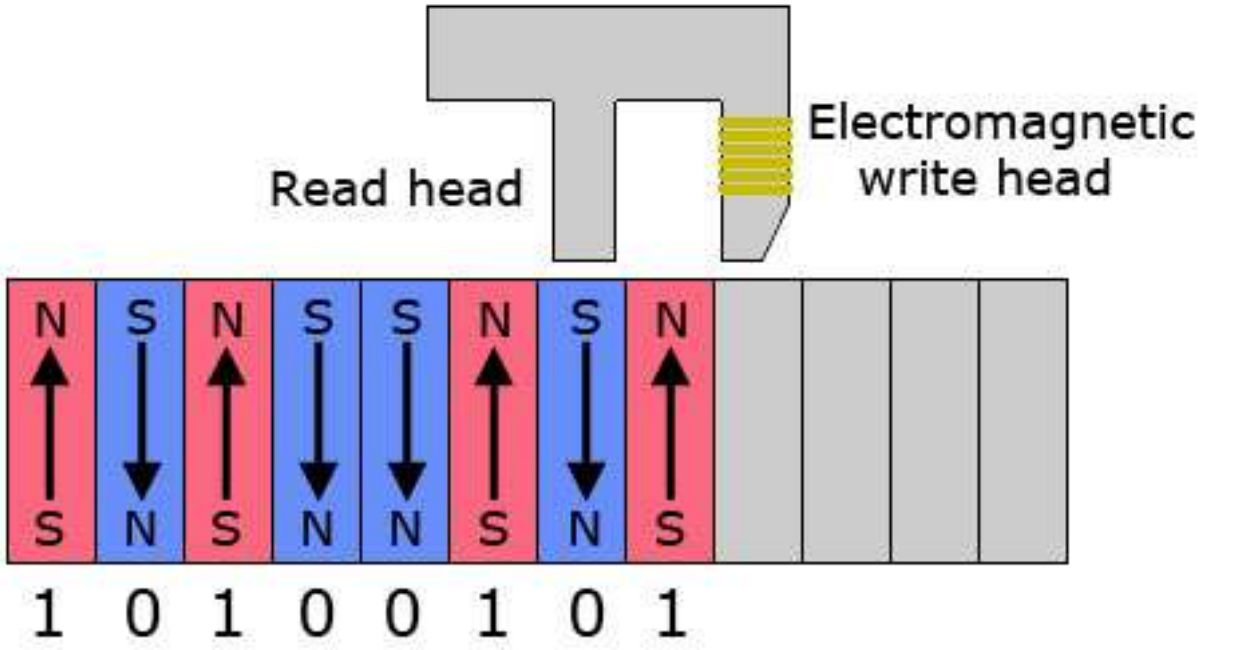
Device Management

Device Management



Device Management

Hard drive read/write head



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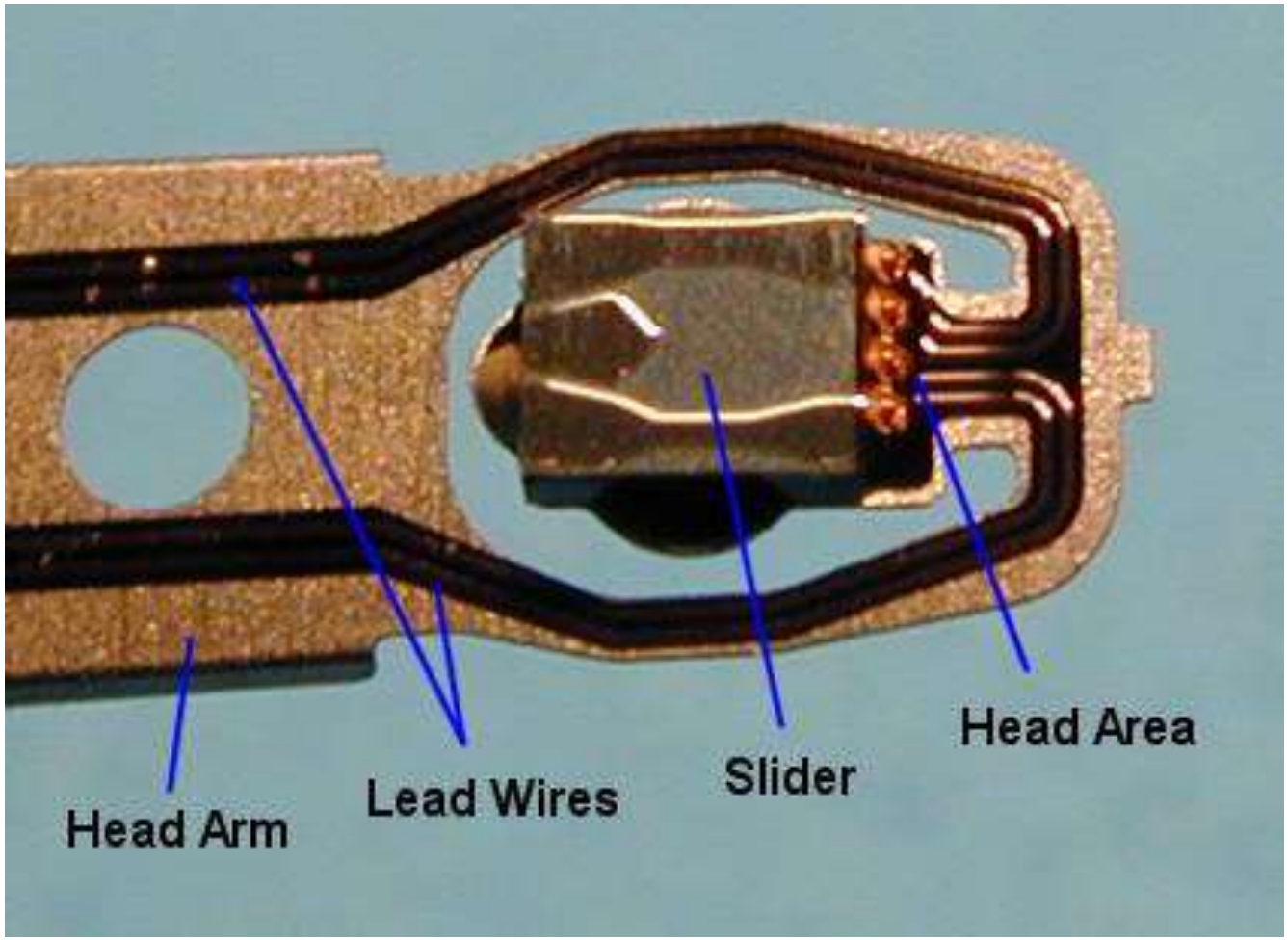
Device Management



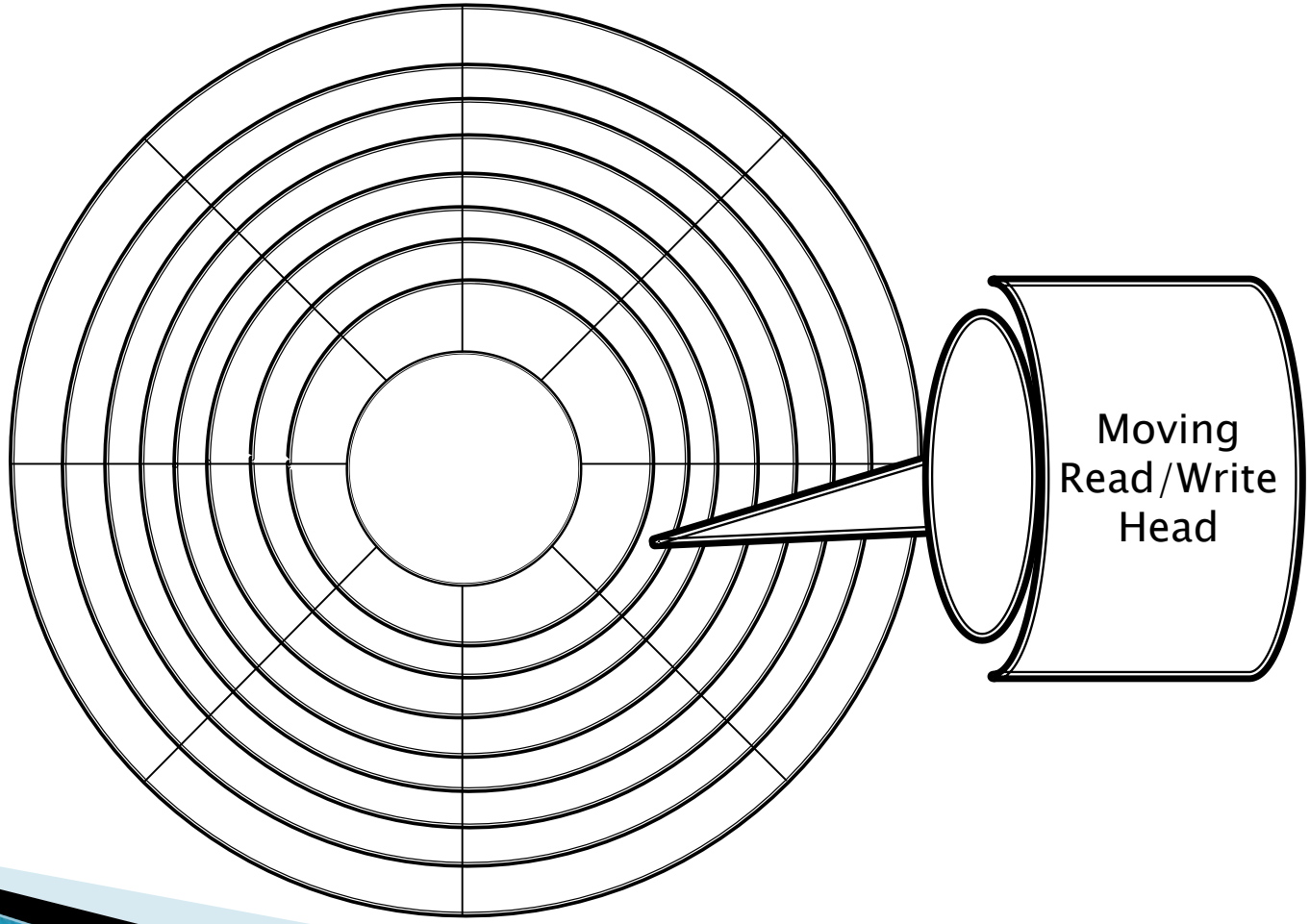
Device Management

- We'll look at two hard disk configurations:
  - Mobile-Head Magnetic Disk Storage
  - Fixed-Head Magnetic Disk Storage

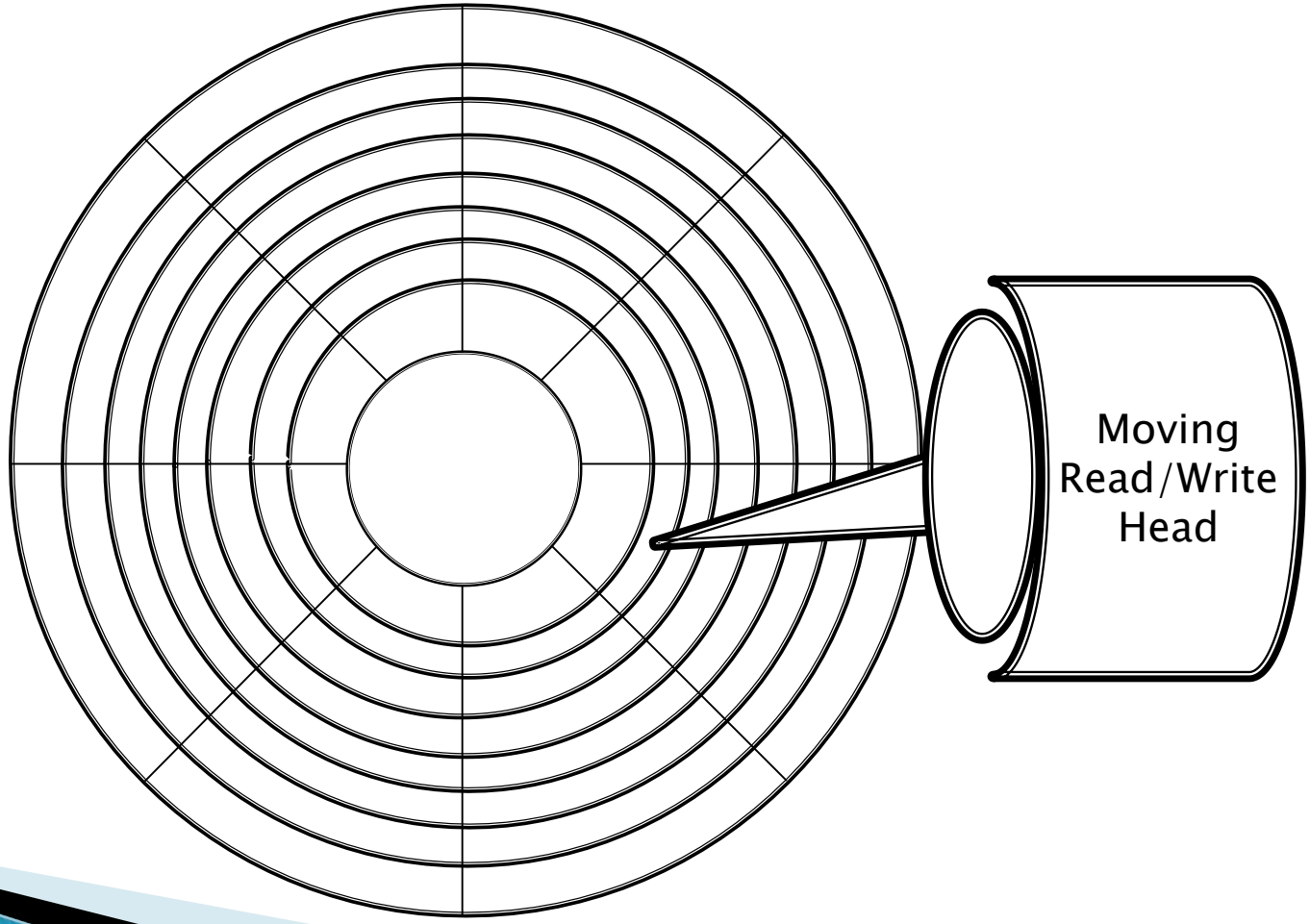
Device Management

- **Mobile-Head Magnetic Disk Storage**
  - Both the reading(/writing) head moves and the disk spins.
  - Usually formatted on both sides.
  - Data is recorded on tracks.

Device Management



Device Management



Device Management

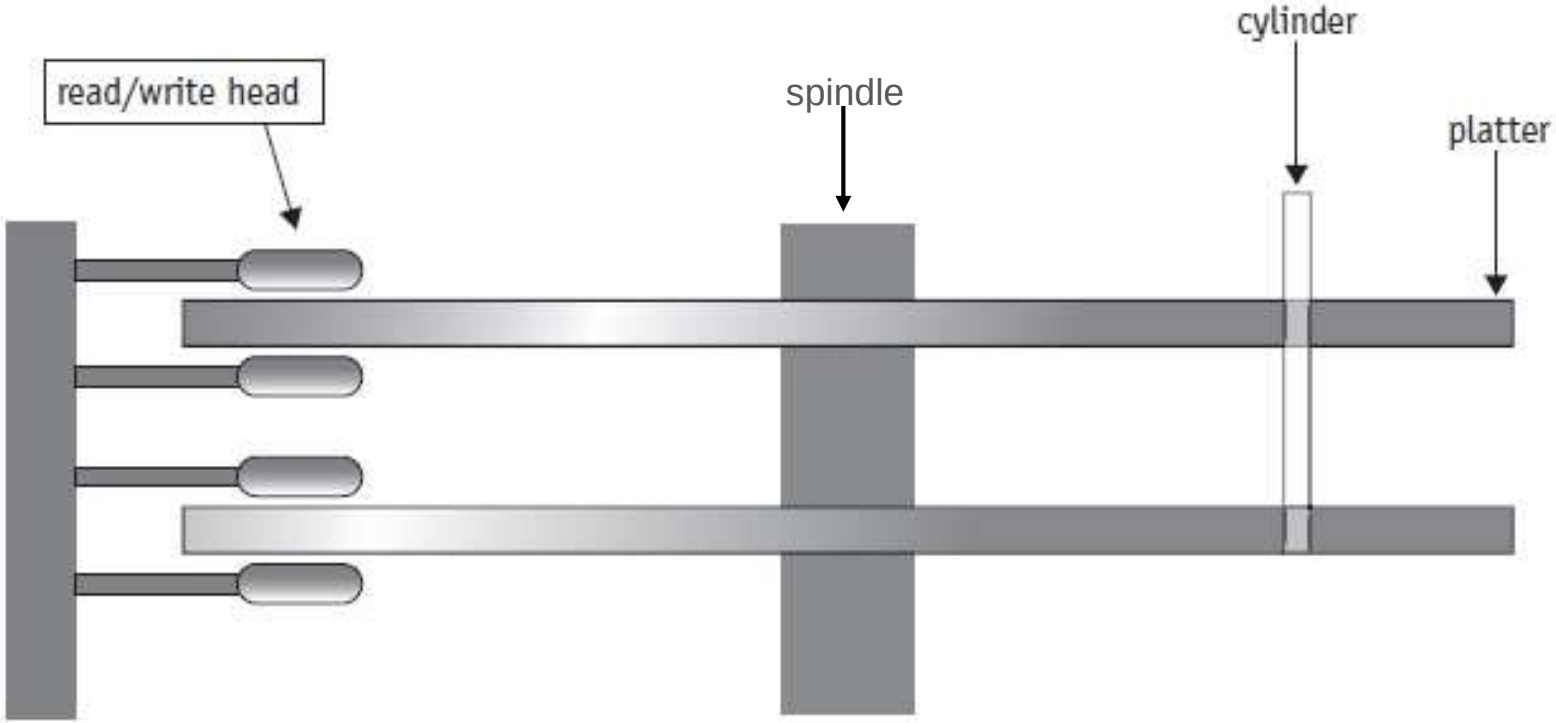
Device Management

- **Mobile-Head Magnetic Disk Storage**

- Typically there is more than one disk (platter), and they are arranged in a stack (we also call this as being part of a disk pack).
- The disks are stacked on a common spindle, and have Read/Write heads on both sides.
- All of the Read/Write heads are move in unison.

Device Management

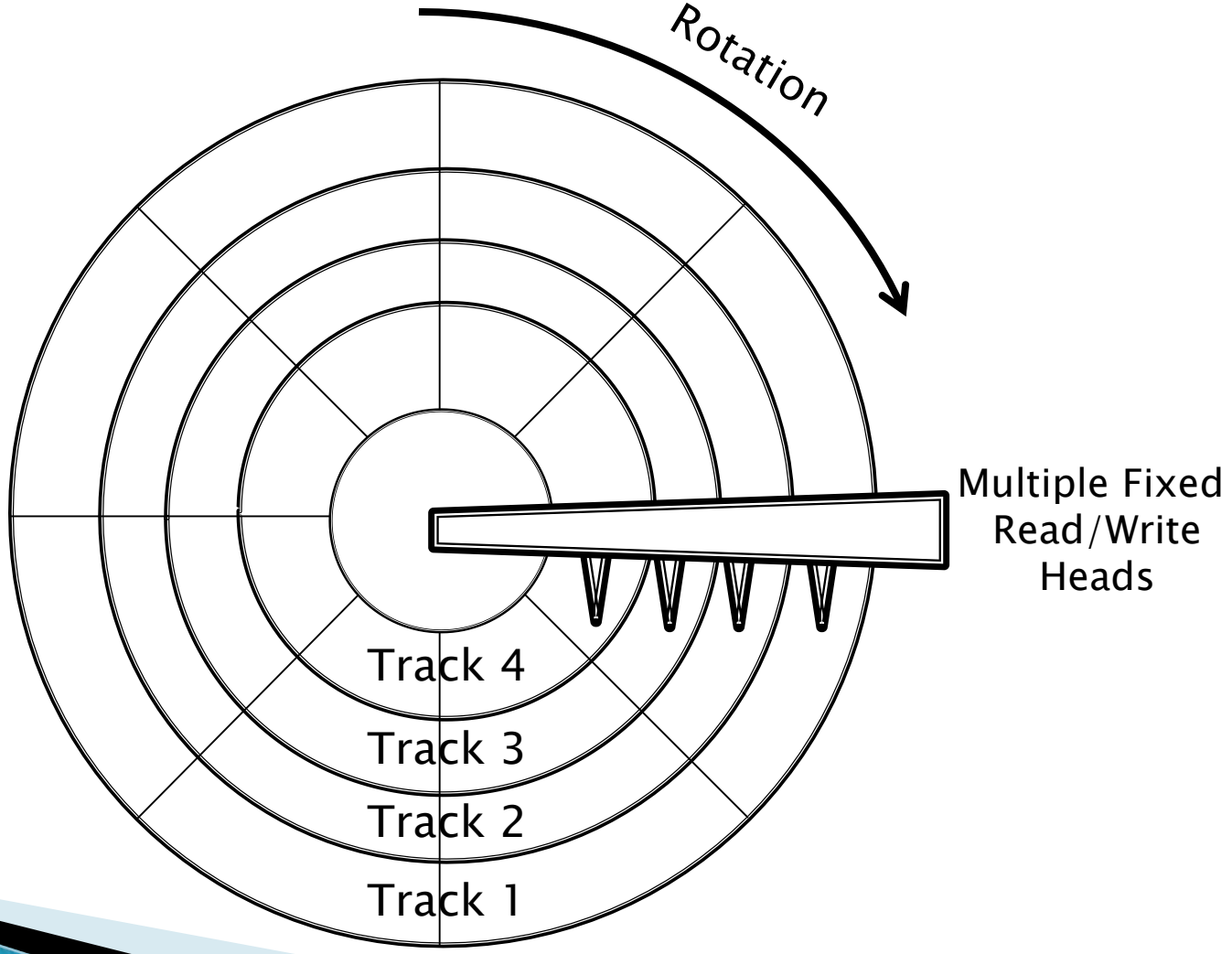
- **Mobile-Head Magnetic Disk Storage**



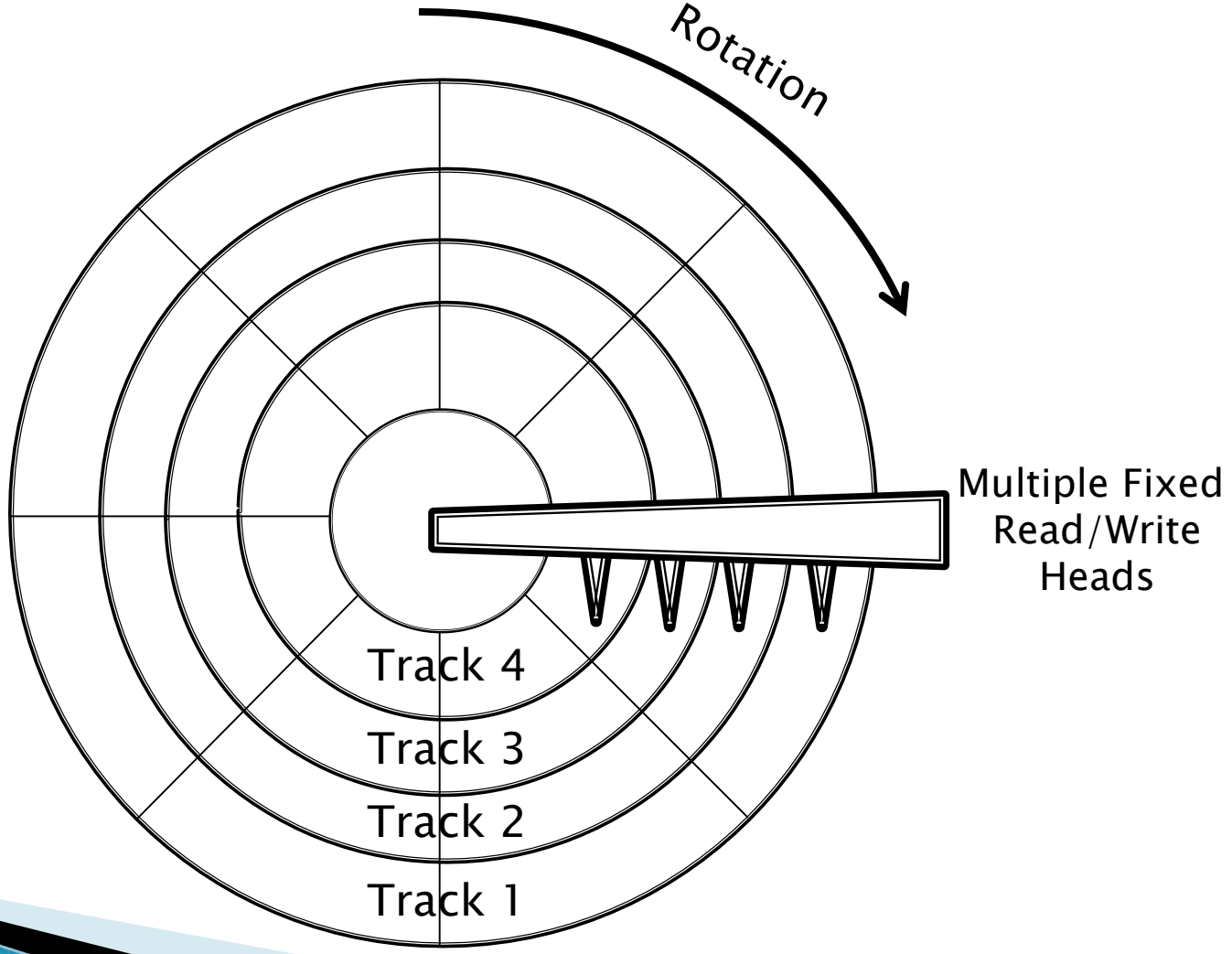
Device Management

- **Fixed-Head Magnetic Disk Storage**
- Works like a CD or DVD, the disk spins and the reading head stays stationary.
- Usually formatted on both sides.
- Data is recorded on tracks.

Device Management



Device Management



Device Management

- **Fixed-Head Magnetic Disk Storage**

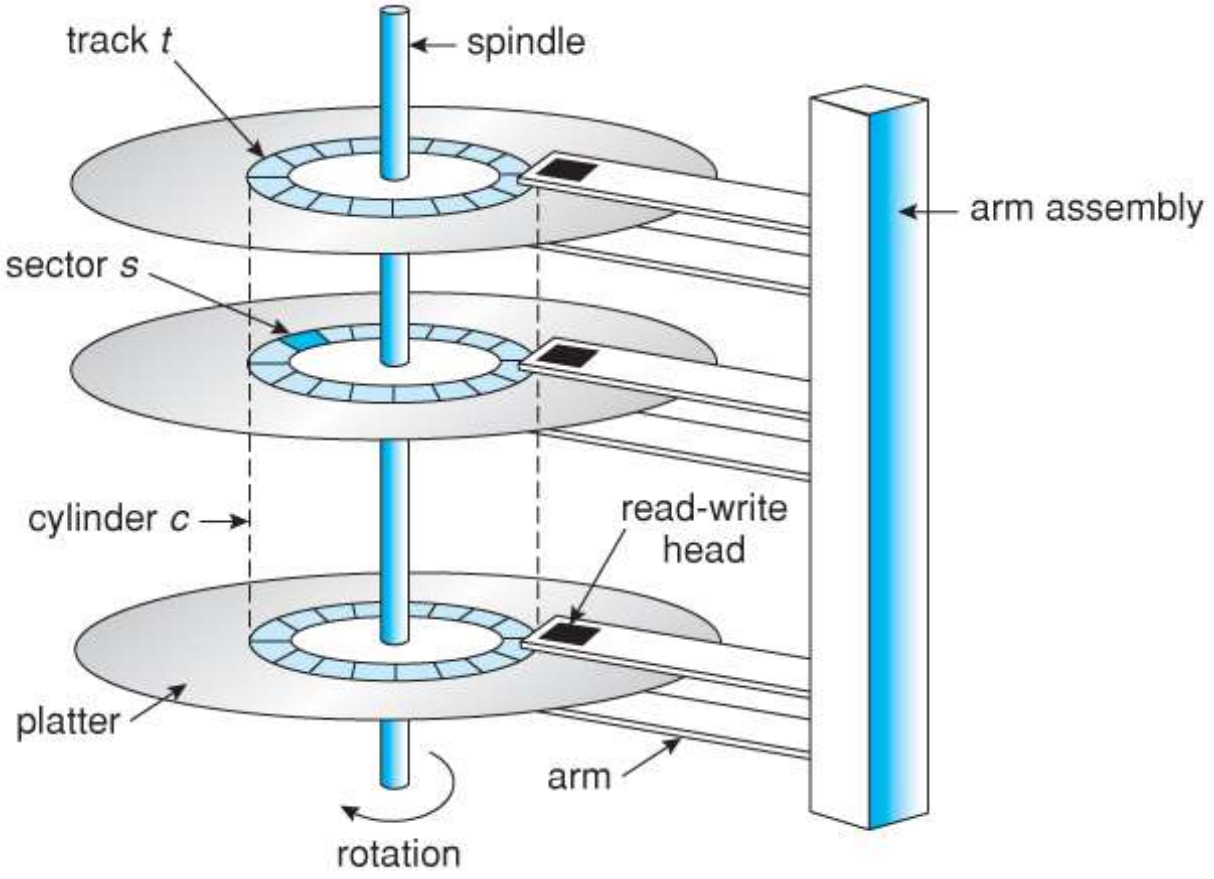
- This means it's very fast compared to a moving Read/Write head, however, it is more costly to manufacture, and it has less storage space as the tracks have to be positioned farther apart.
- These are often used in space flight and aircraft applications where speed is most important.

Device Management

- In either case we may have a disk pack:

Device Management

- Disk pack:

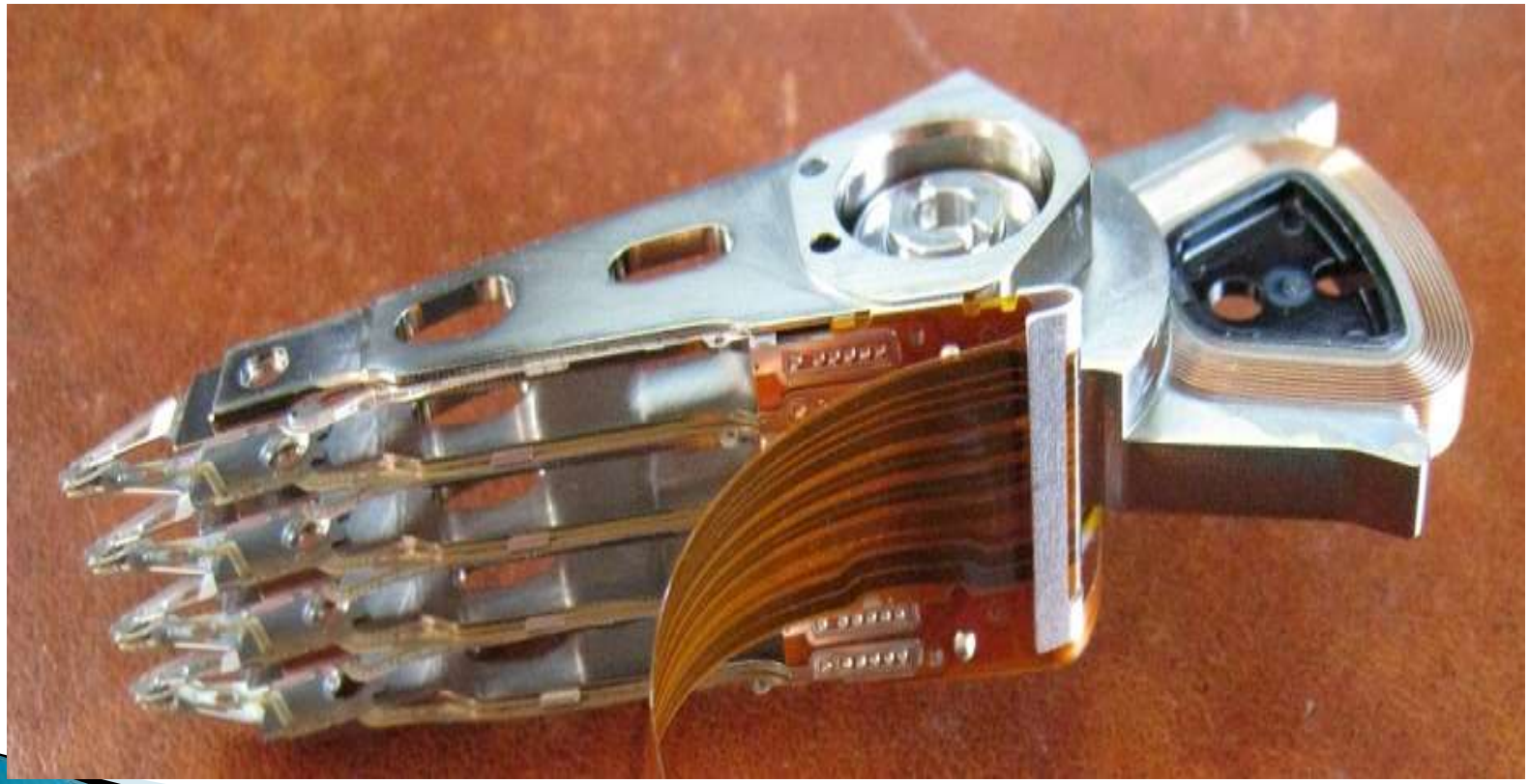


Device Management

- Disk pack:

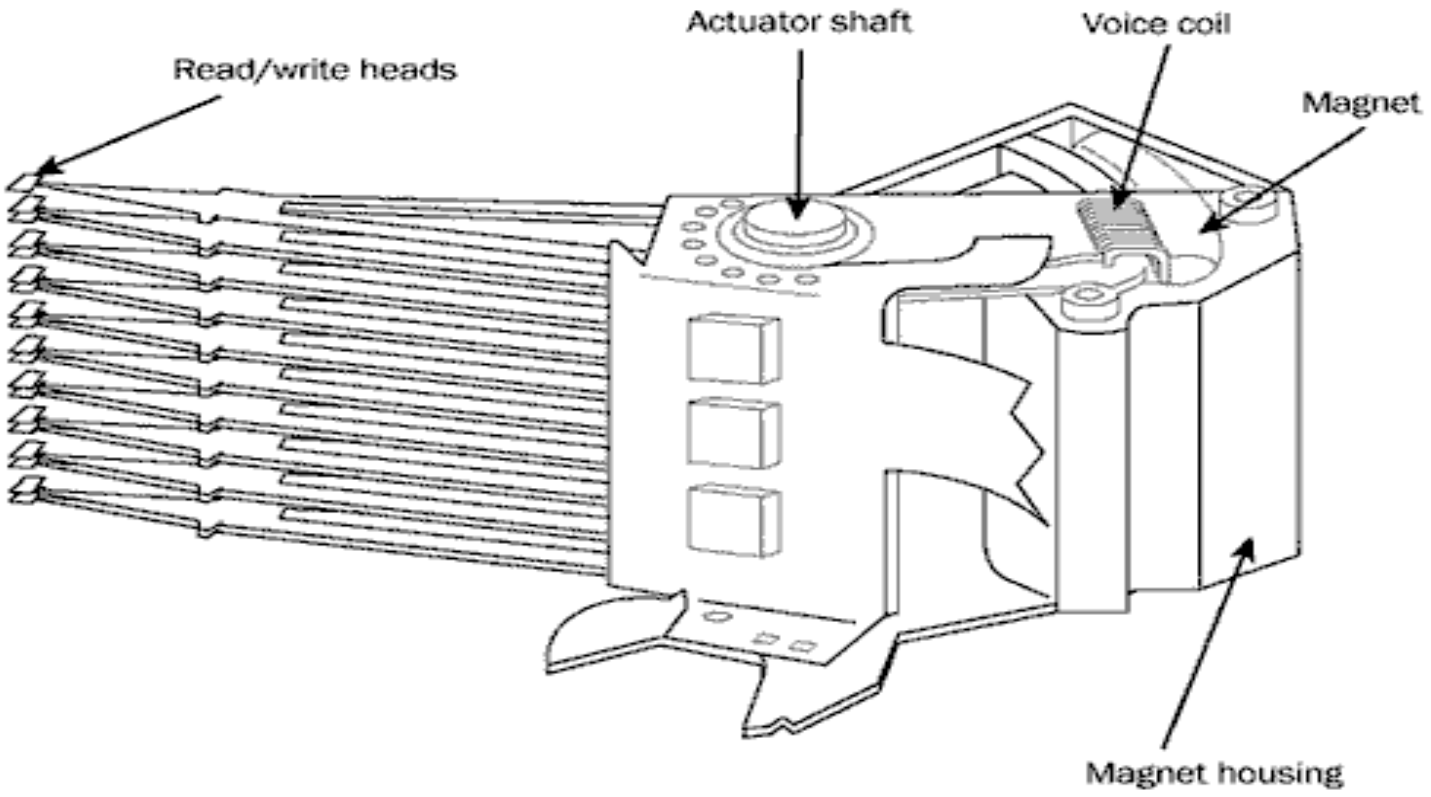
Device Management

- Disk pack:



Device Management

- Disk pack:

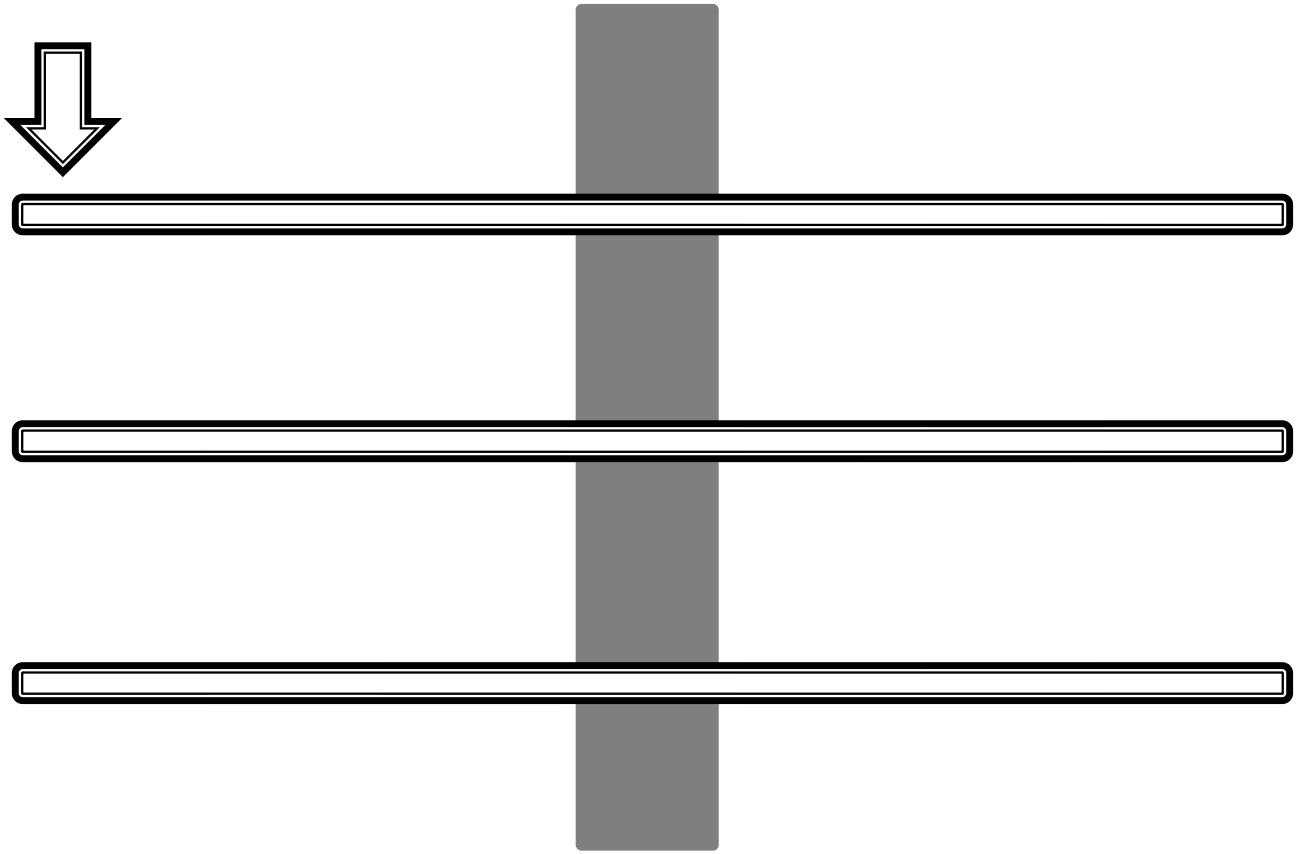


Device Management

- Disk pack:
  - An interesting question occurs about disk packs, is it more efficient to write a series of records on one surface of a disk and then the opposite surface of that disk, followed by the next disk, and the next one, and so on? Or is better to do fill the other surface of each surface of each disk, then the next track, then the next?

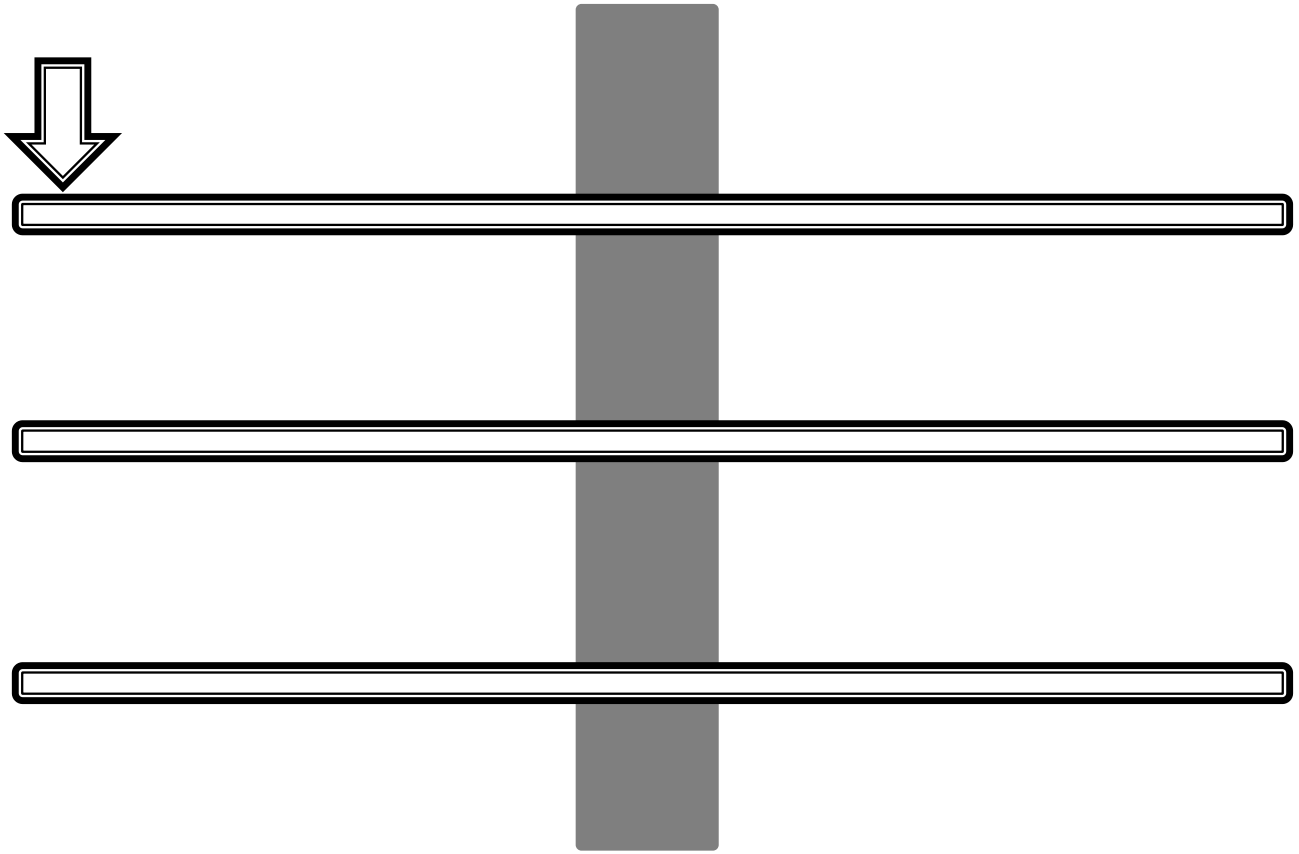
Device Management

- Disk pack (Case 1):



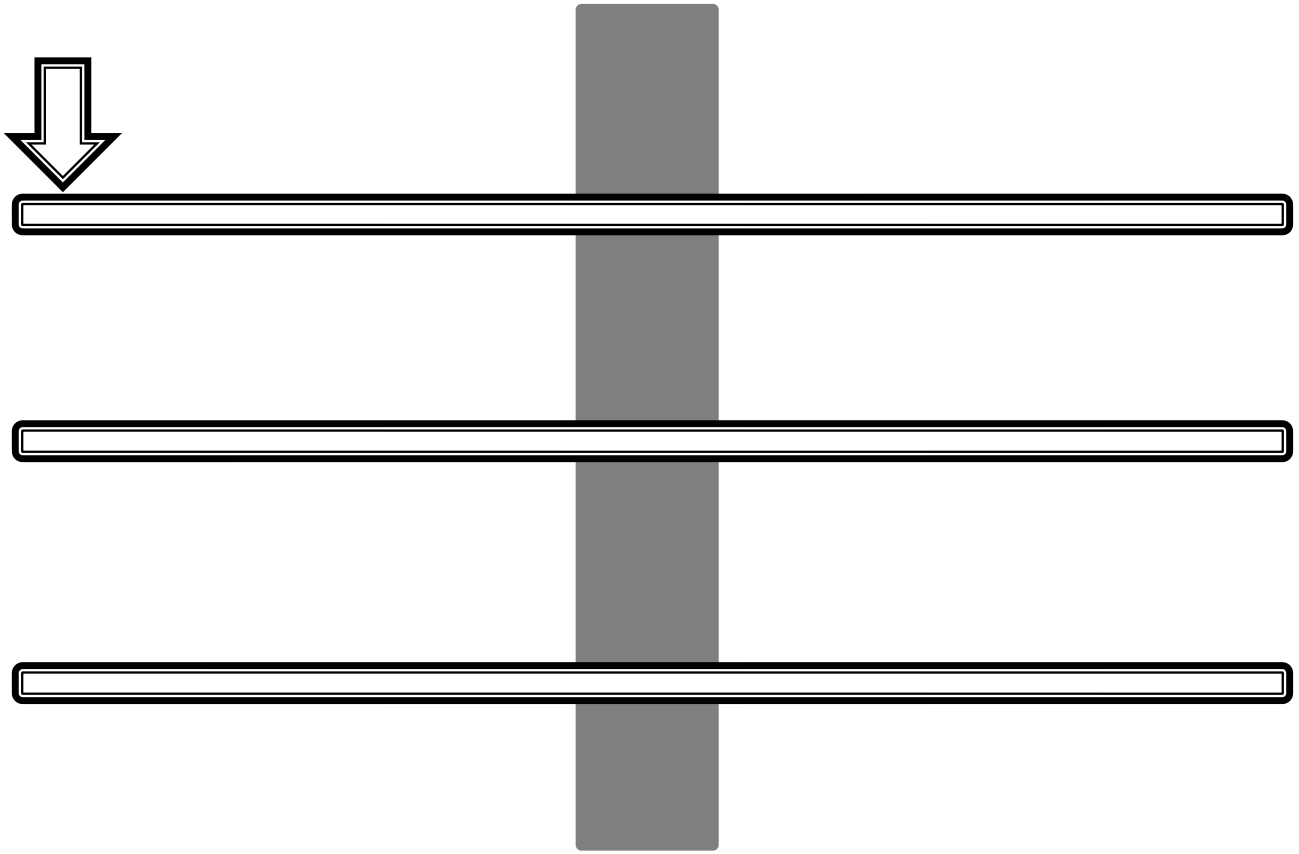
Device Management

- Disk pack (Case 2):



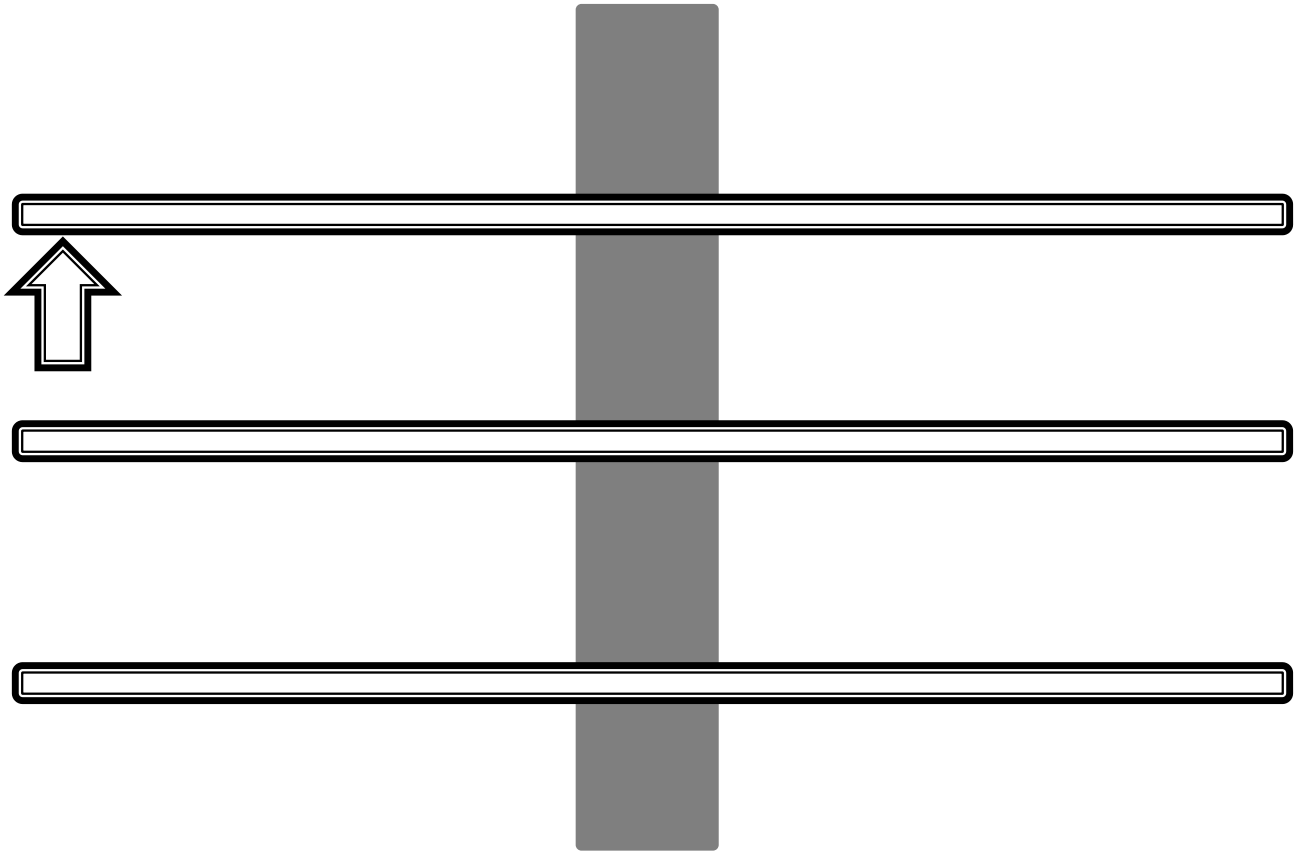
Device Management

- Disk pack (Case 2):



Device Management

- Disk pack (Case 2):



Device Management

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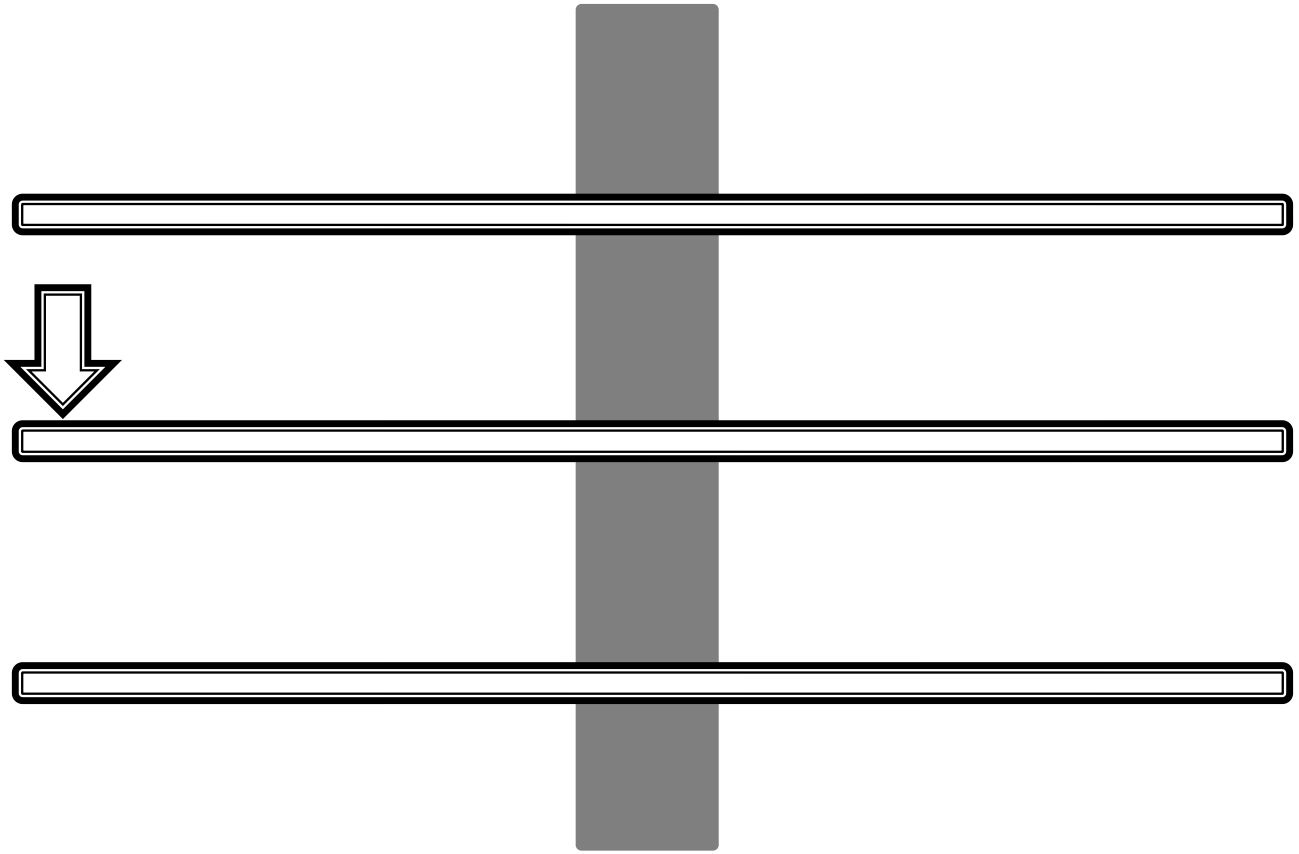

Device Management

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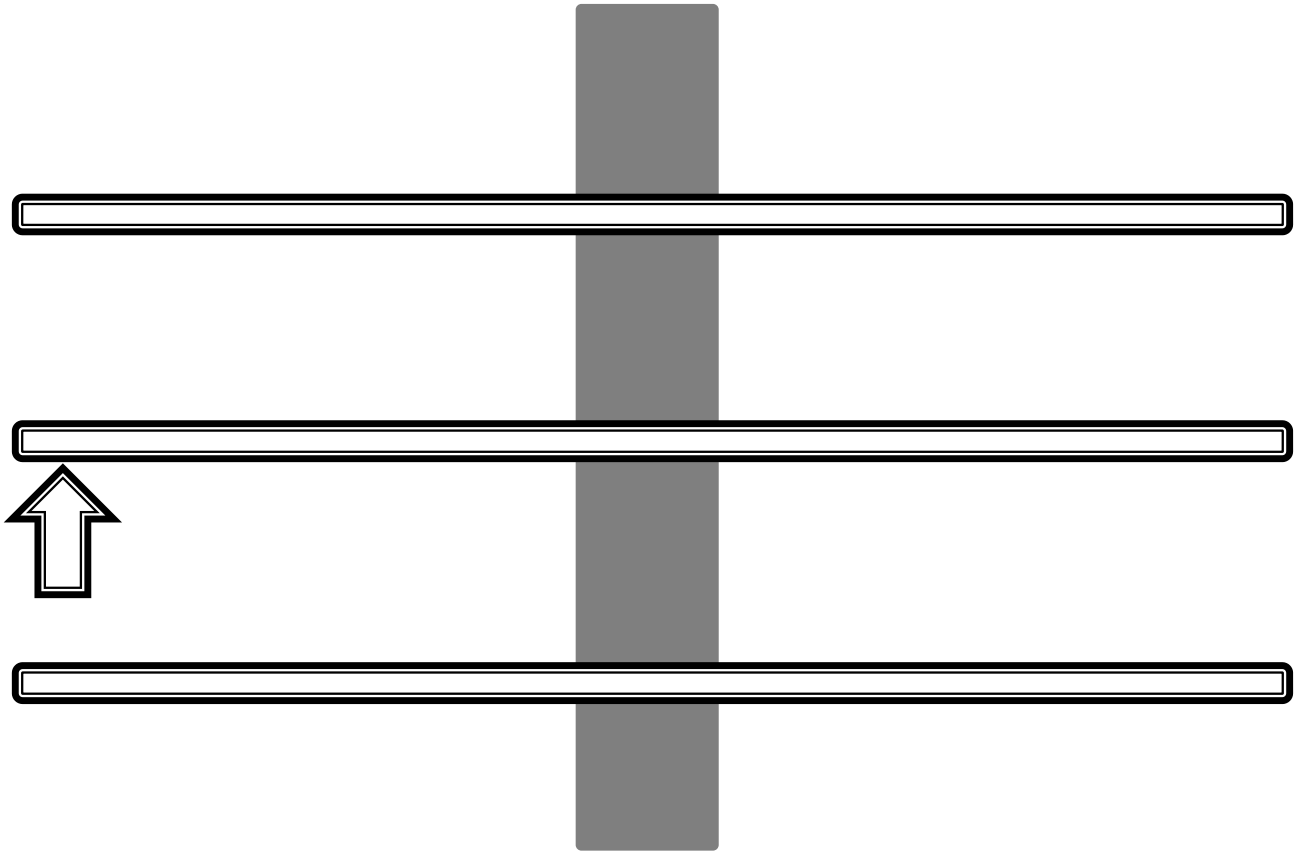

Device Management

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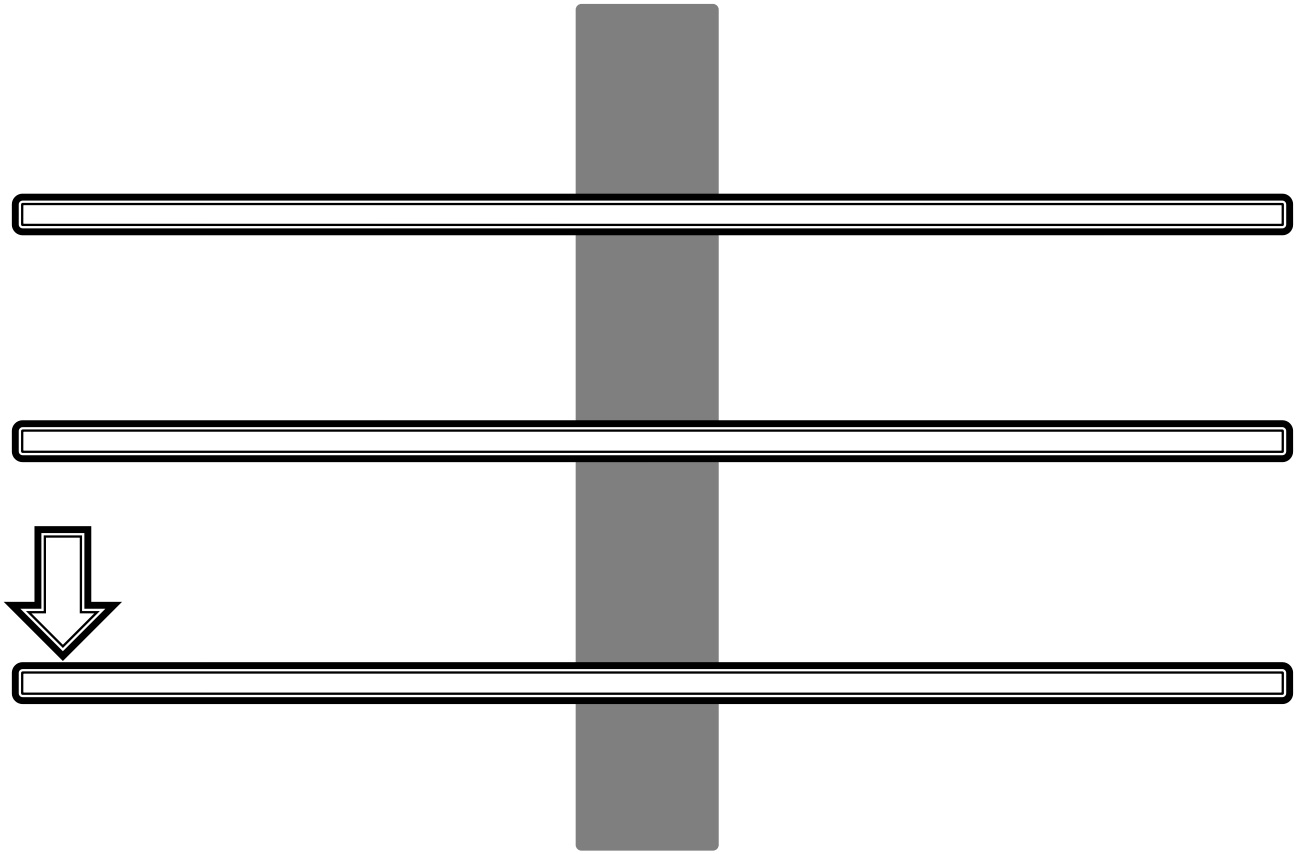
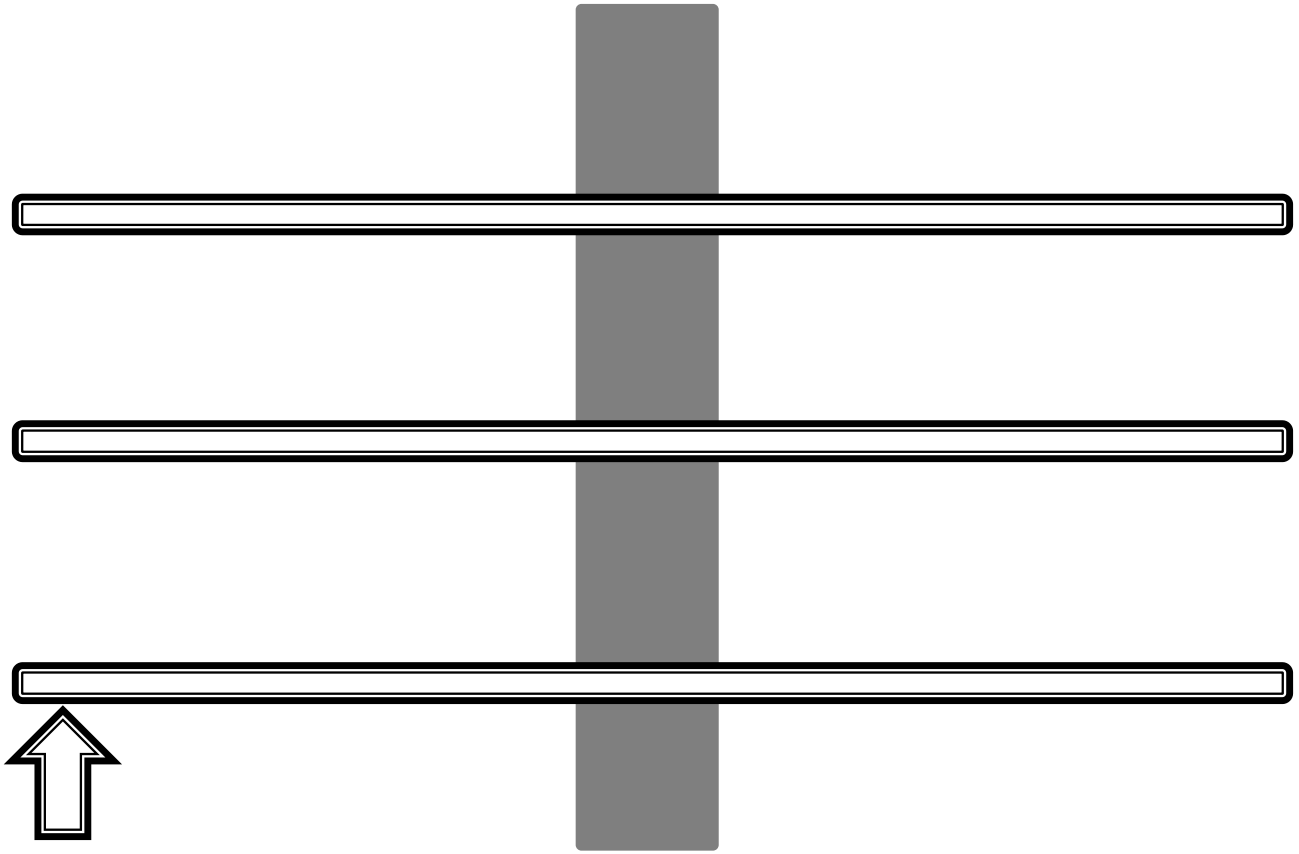


Device Management

- Disk pack (Case 2):



Device Management

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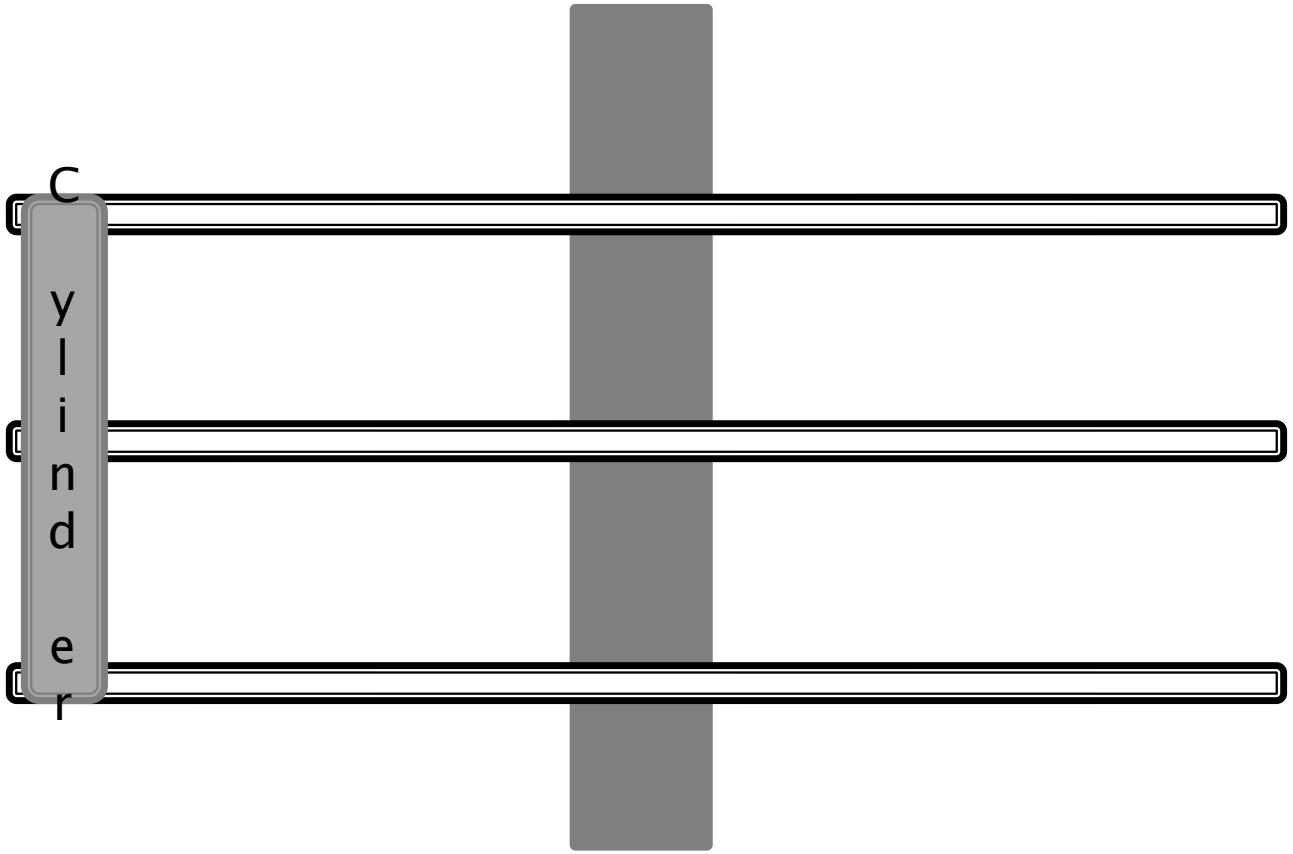
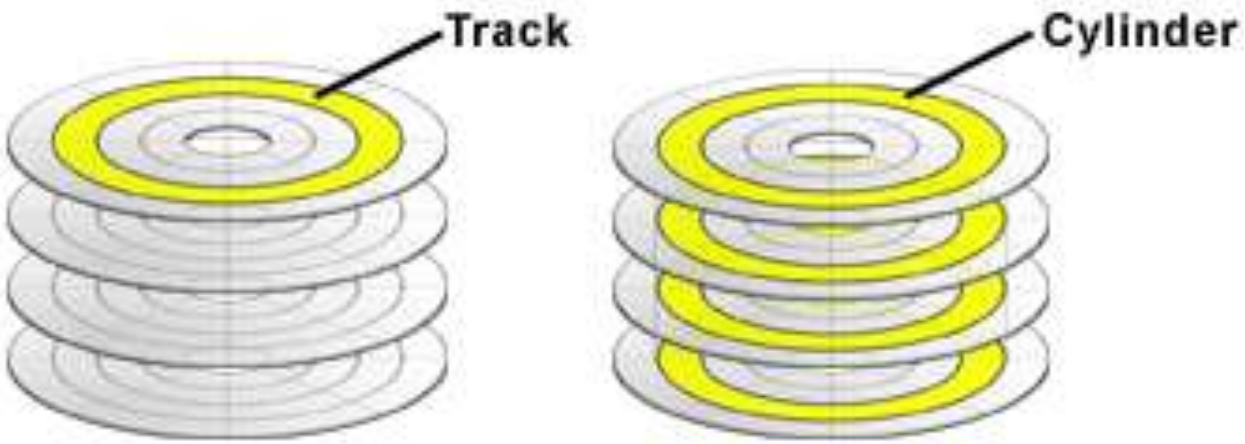


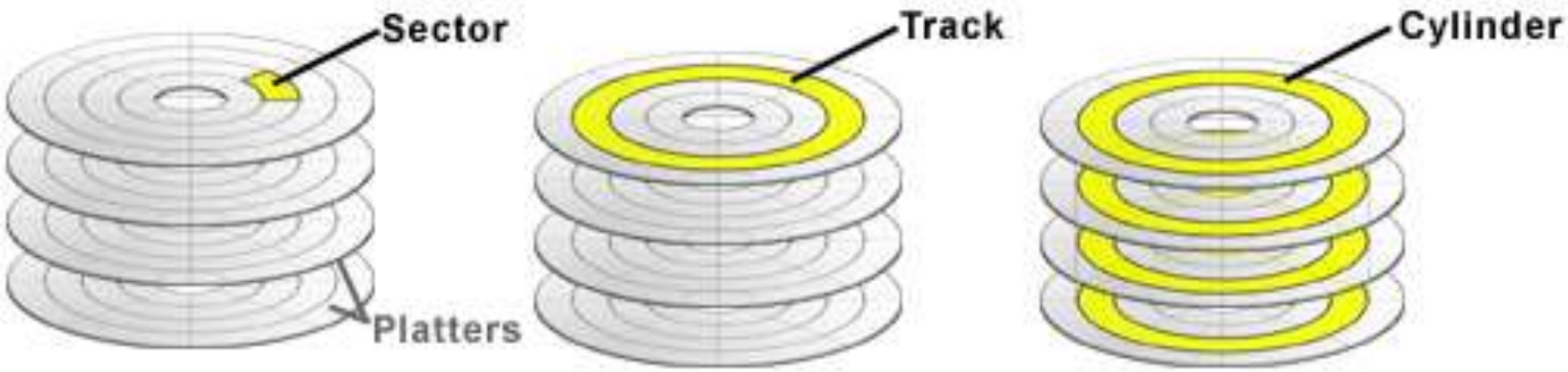
Device Management

- Disk pack:
  - It turns out it's faster to fill the disks a track at a time (case 2), and this leads up to the concept of a virtual cylinder of data.



Device Management

- Disk pack:
  - So to access a record, the device manager needs; the cylinder number, the surface number, and the sector number.



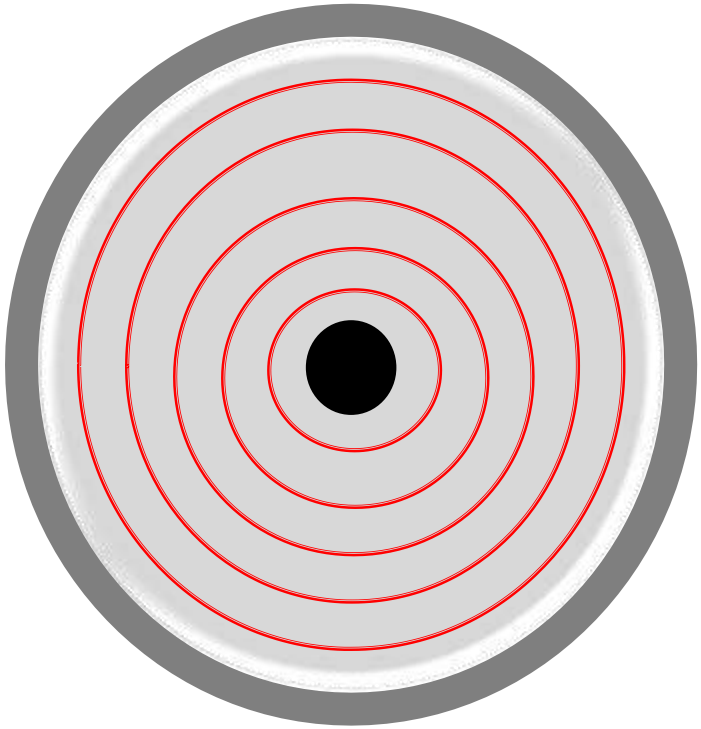
Optical Disk Storage

Device Management

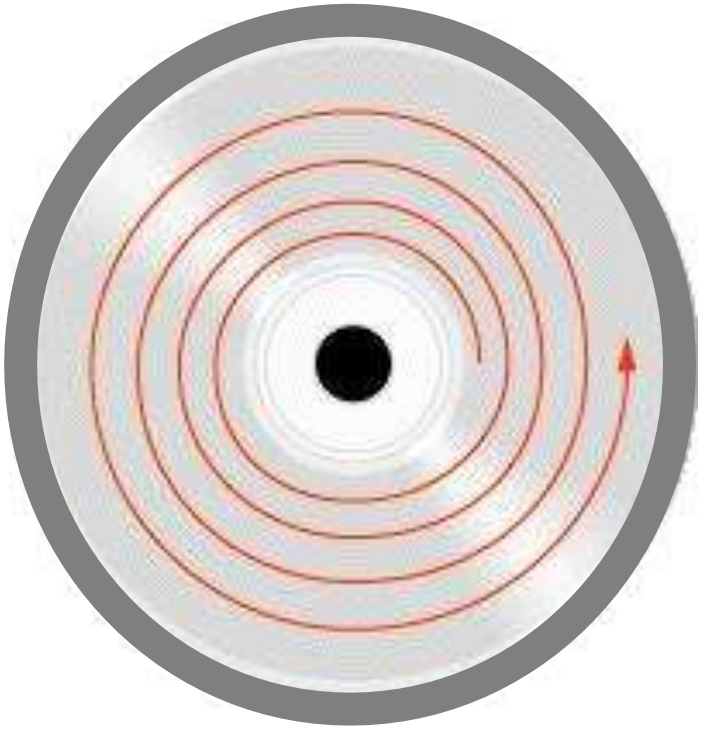
- Optical Disk Storage:
  - Because of advances in laser technology it is possible to store data optically rather than magnetically, and CDs and DVDs are examples of optical storage.
  - Unlike magnetic disks, which typically consist of tracks as a series of concentric circles, optical disks are usually a single continuous spiral track.

Device Management

- Magnetic Disks

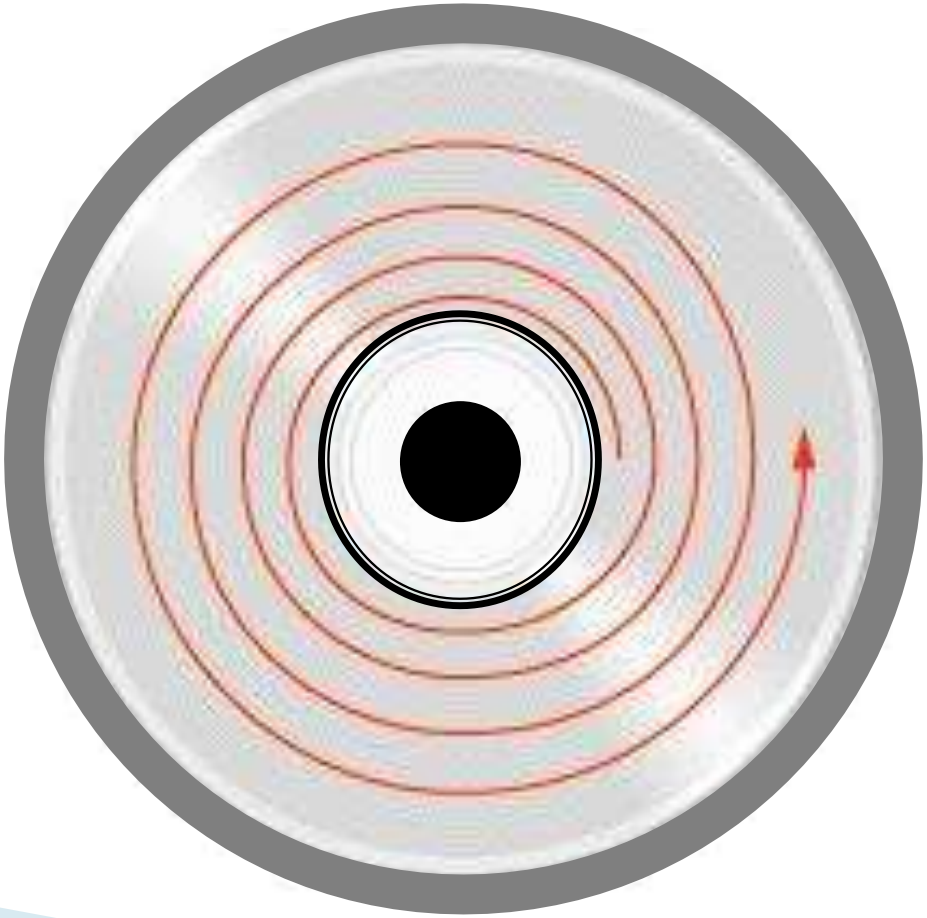


Optical Disks



Device Management

- Optical Disk Storage:



Device Management

- Optical Disk Storage:

Device Management

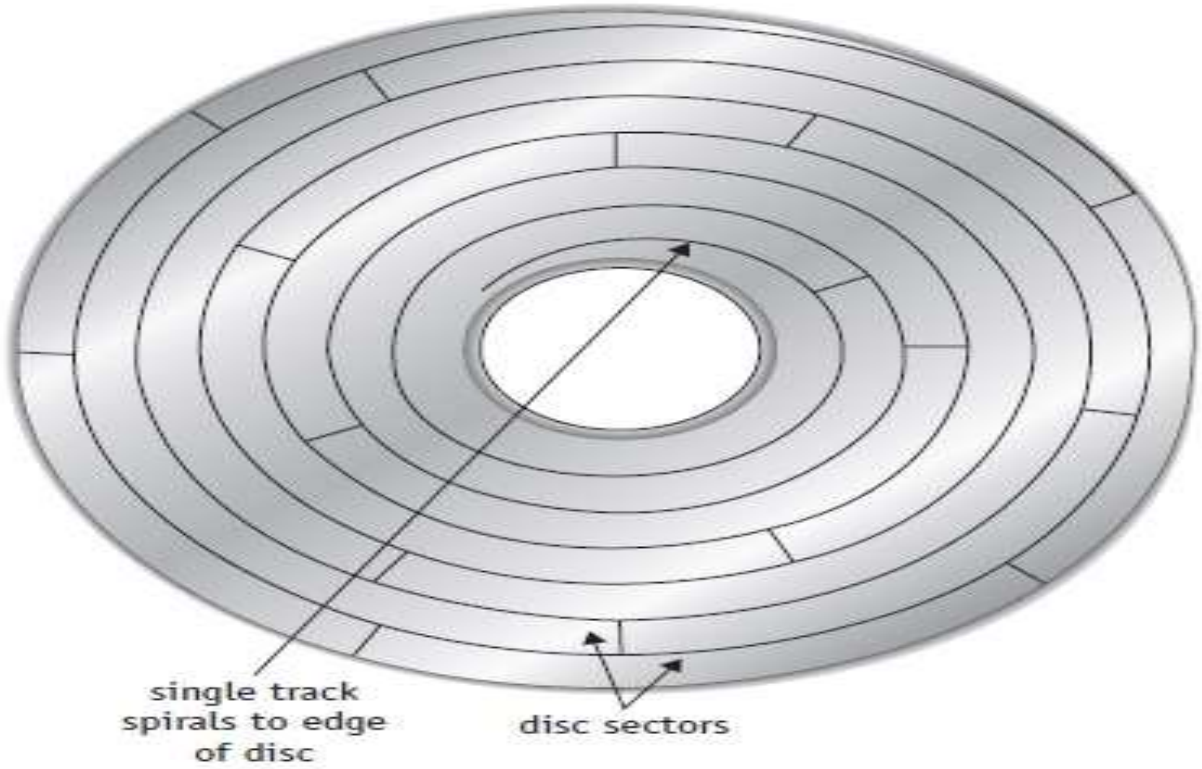
- Optical Disk Storage:
  - Another significant difference between magnetic and optical disks is that magnetic disks spin at a constant speed, so the tracks on other outer rings of magnetic disks have to have larger sectors, and those tracks nearer the centre have small tracks.
  - Optical disks can change the speed to reading, so the sector size is the same in the outside or inside.

Device Management

- Optical Disk Storage:

Device Management

- Optical Disk Storage:



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Device Management

- Optical Disk Storage:
  - Three important performance measures are:
    - Data Transfer Rate
    - Average Access Time
    - Cache Size

Device Management

- Data Transfer Rate
  - This measures the amount of data that can be read from the disk.
  - It is typically measured in megabytes per second (MB/s).

Device Management

- Average Access Time
  - This measures how long (on average) it takes to move the disk head to a specific place on the disk.
  - It is typically measured in milliseconds (ms).

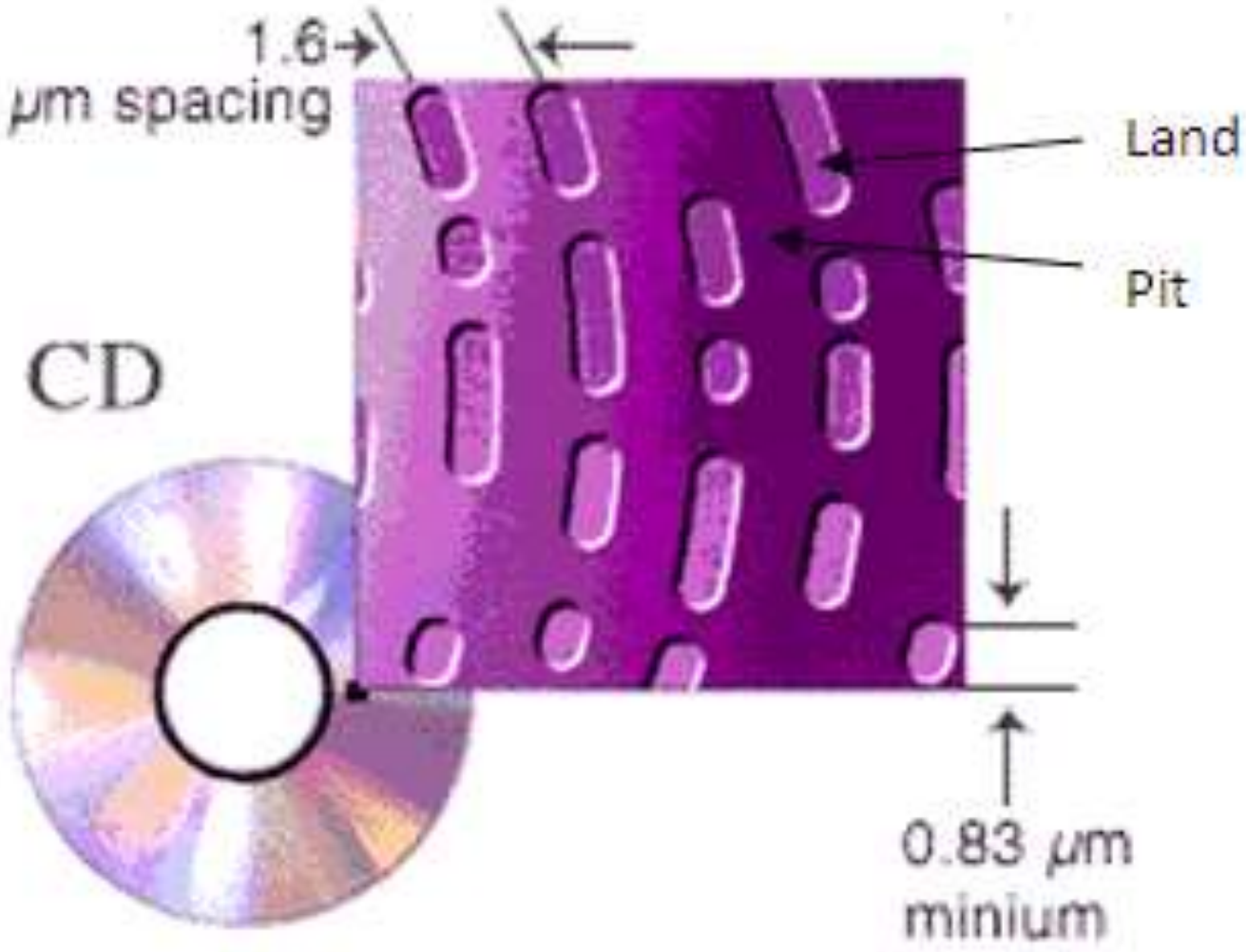
Device Management

- Cache Size
  - When reading and writing to disk, sometimes the user will wish to re-read data they have just read, if so, having it in the cache saves reading it again.
  - It is typically measured in kilobytes (KB).

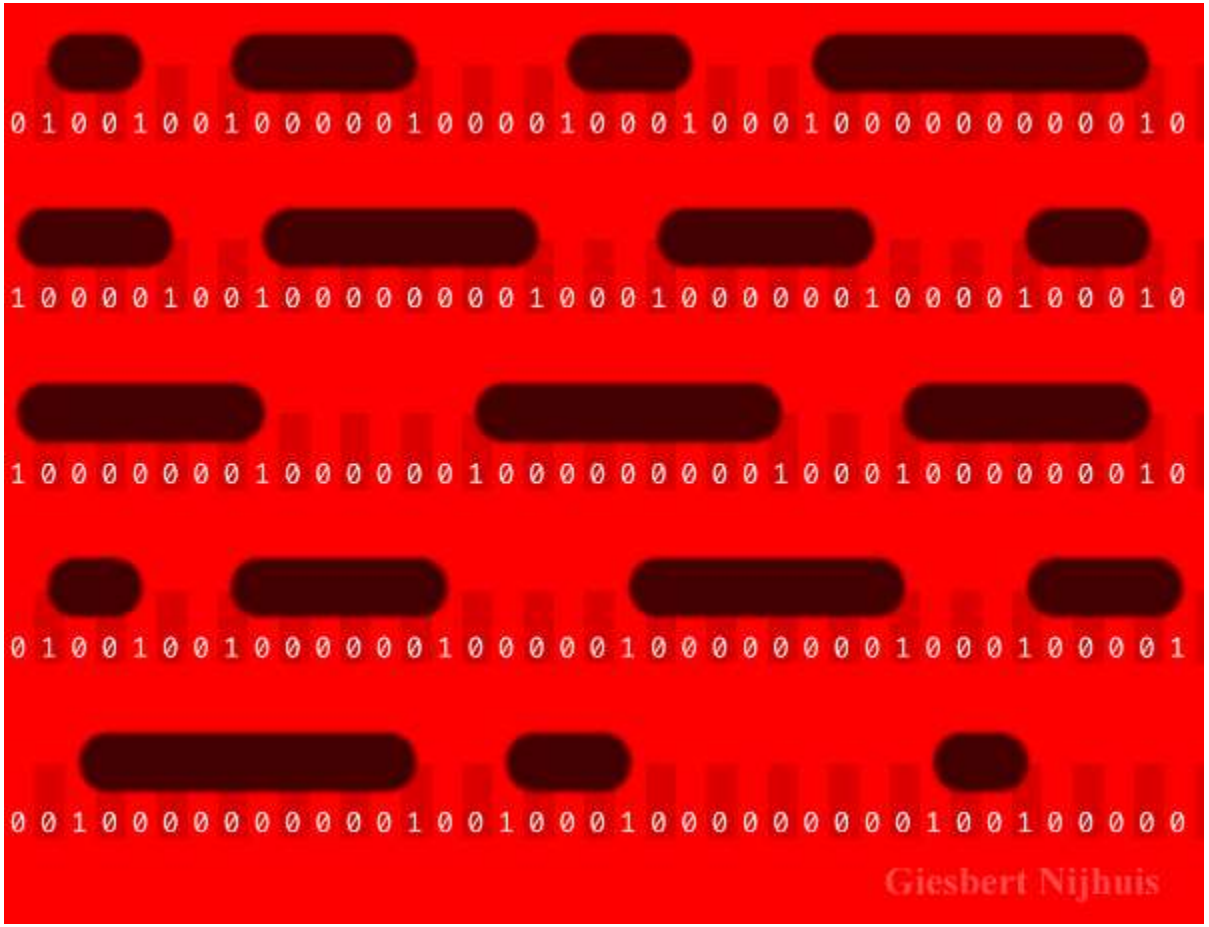
Device Management

- Optical Disk Storage:
  - To write to an optical disk, a high intensity laser beam burns indentations in the disk called **pits**. The pits represent zeros (0s).
  - The unburned flat areas are called **lands**, and represent ones (1s).

Device Management



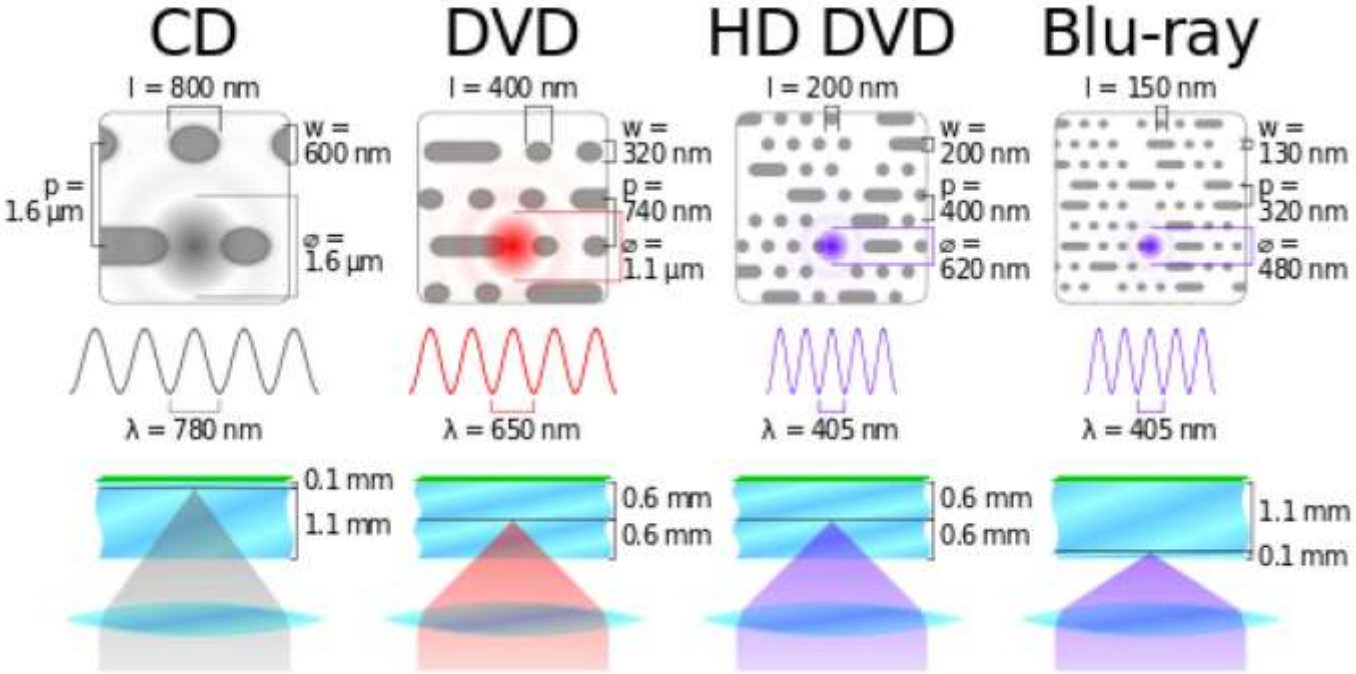
Device Management



Device Management

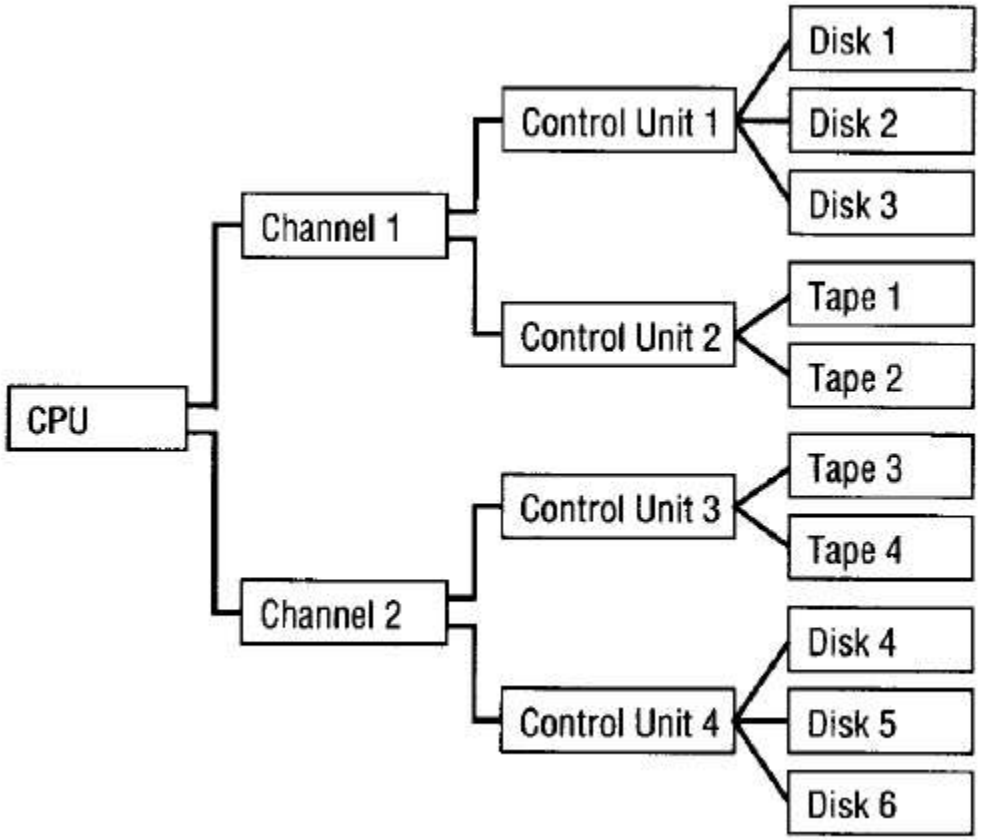
Tertiary Storage

Optical Disc



Components of an I/O System

Device Management



Device Management

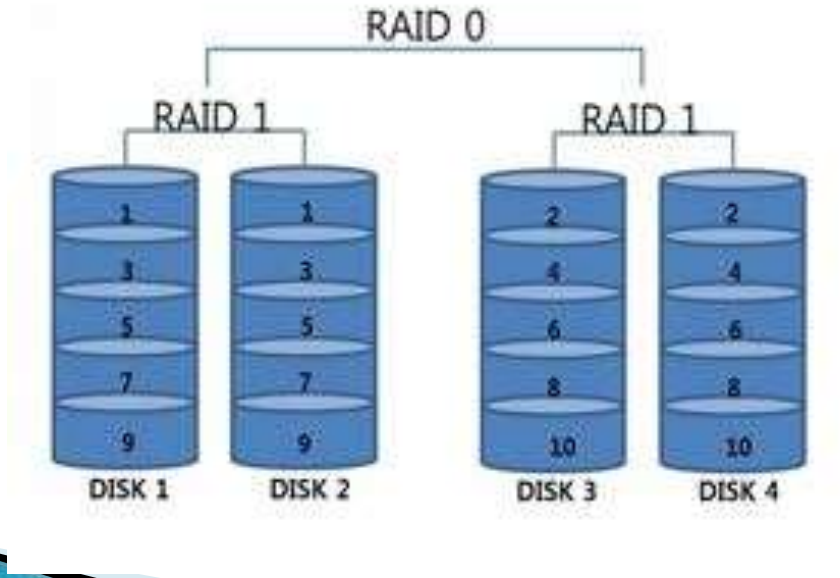
- The **CPU** makes a lot of I/O requests.
- The **I/O channels** work to co-ordinate the devices to synchronise the fast speed of the CPU with the slower speeds of the I/O devices.
- The **I/O control units** are attached to several similar devices and control these devices based on instructions from the channel.

RAID

(Redundant Array of Independent Disks)

Device Management

- RAID is a collection of physical disk drives that can be viewed as a single logical unit by the operating system.



Device Management

- RAID works on the basis that several small-capacity disk drives are more efficient than a few large-capacity disk drives.
- This is because by distributing the data among several smaller disks, the system can simultaneously access the requested data from the multiple drives, resulting in improved I/O performance.

Device Management

Device Management

- A RAID configuration could have five disk drives connected to a specialized controller.
- The controller houses the software that coordinates the transfer of data from the disks in the array to a large-capacity disk connected to the I/O subsystem.
- This configuration is viewed by the operating system as a single large capacity disk, so that no software changes are needed.

Device Management

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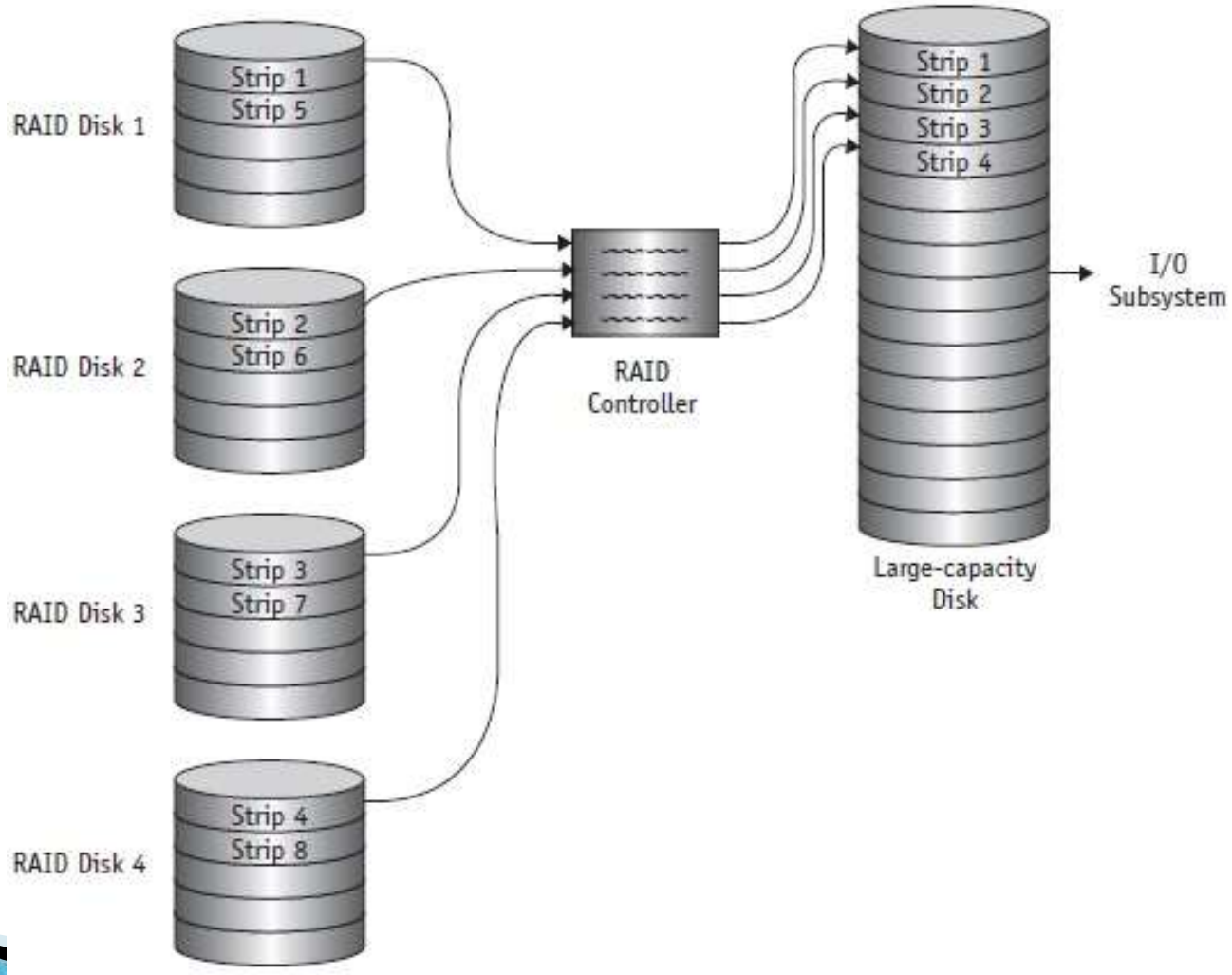
Device Management



Device Management

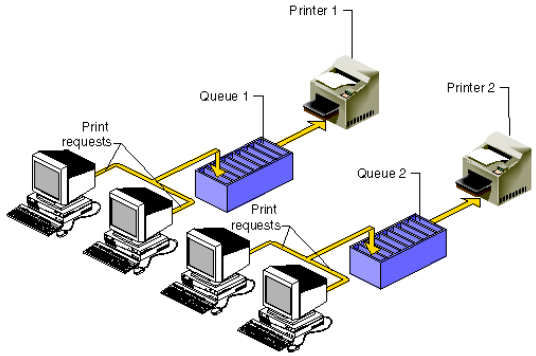
- Data is divided into segments called **strips**, which are distributed across the disks in
- the array.
- A set of consecutive strips across disks is called a **stripe** and the whole process is called **striping**.
- The previous figure shows how data strips are distributed in an array of four disks

Device Management (Summary)

Damian Gordon

Device Management

- There are three main types of devices:
  - Dedicated Devices
  - Shared Devices
  - Virtual Devices



Device Management

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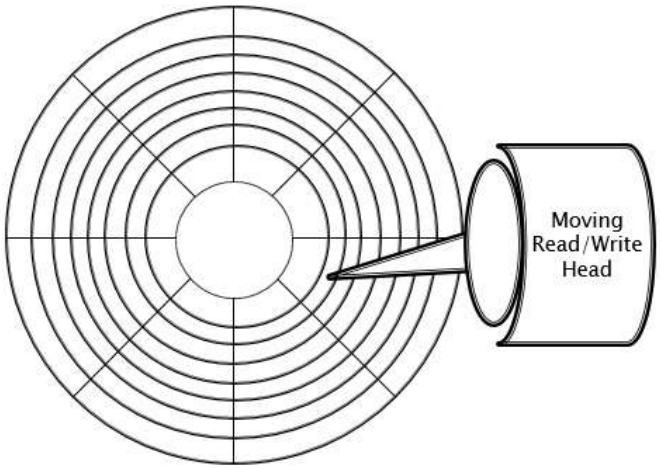
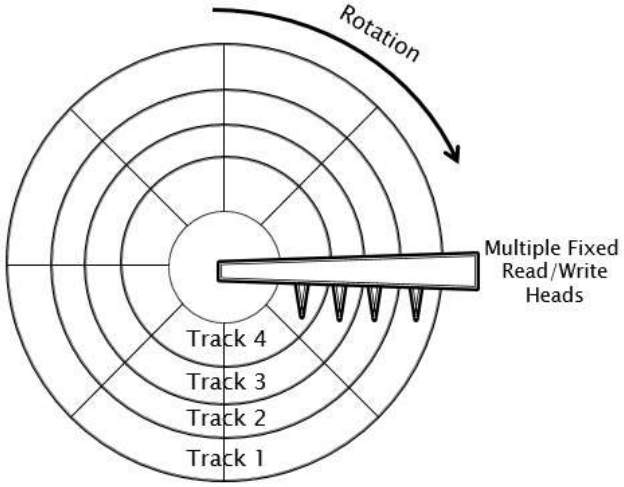
  - Mobile-Head Magnetic Disk Storage
  - Fixed-Head Magnetic Disk Storage



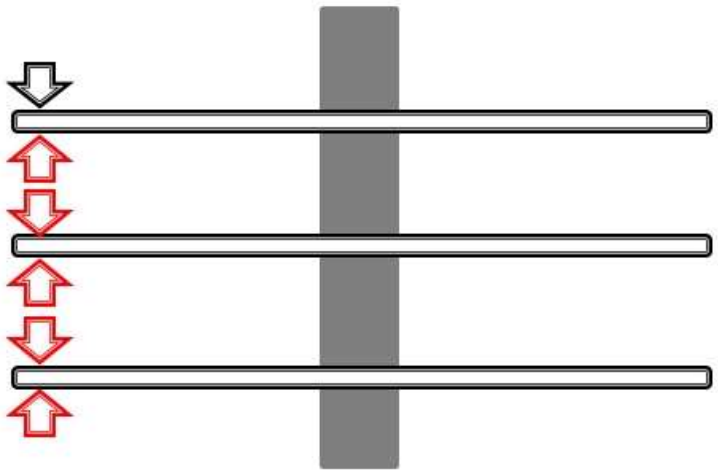


Device Management

- Writing to disk:
  - One surface at a time (Case 1)
  - One track at a time (Case 2)

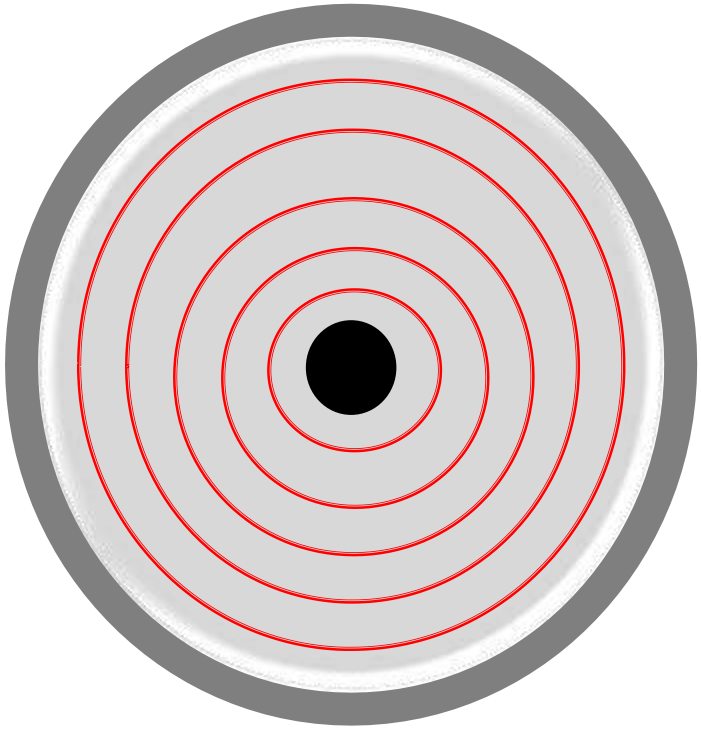
- Disk pack (Case 1):

- Disk pack (Case 2):

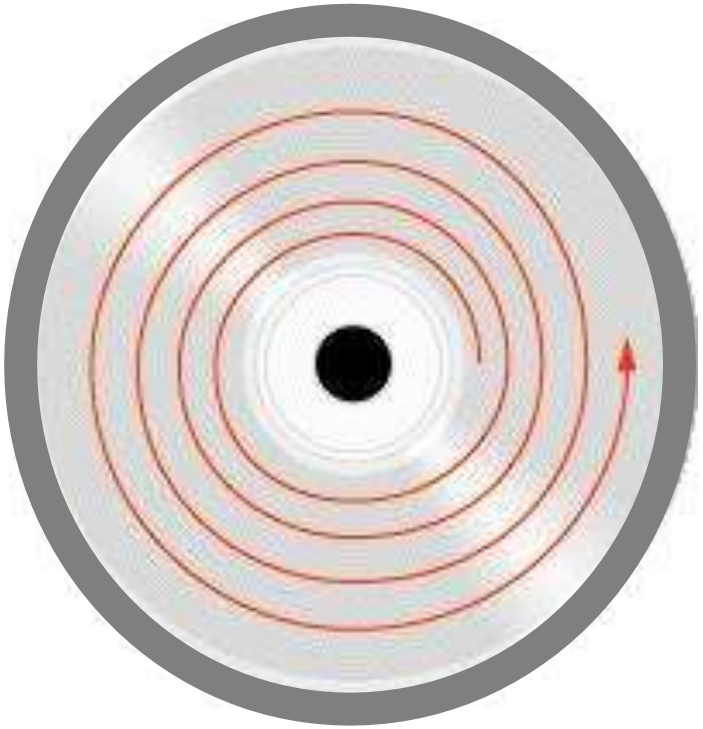


Device Management

- Magnetic Disks

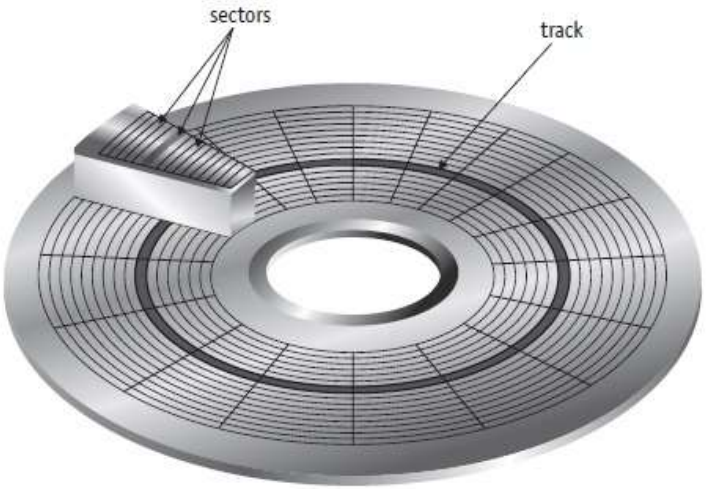


Optical Disks

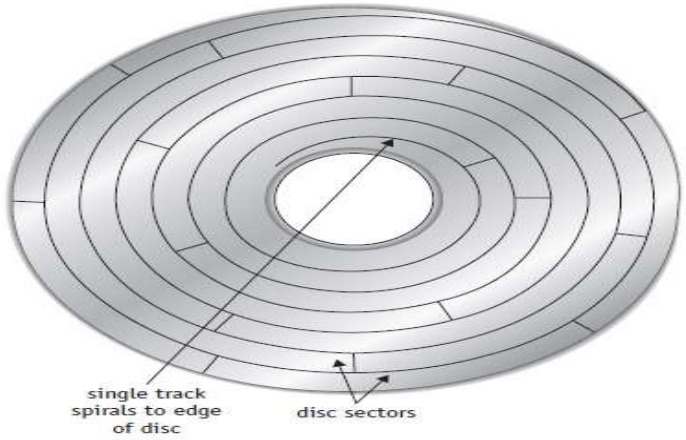


Device Management

- Magnetic Disks



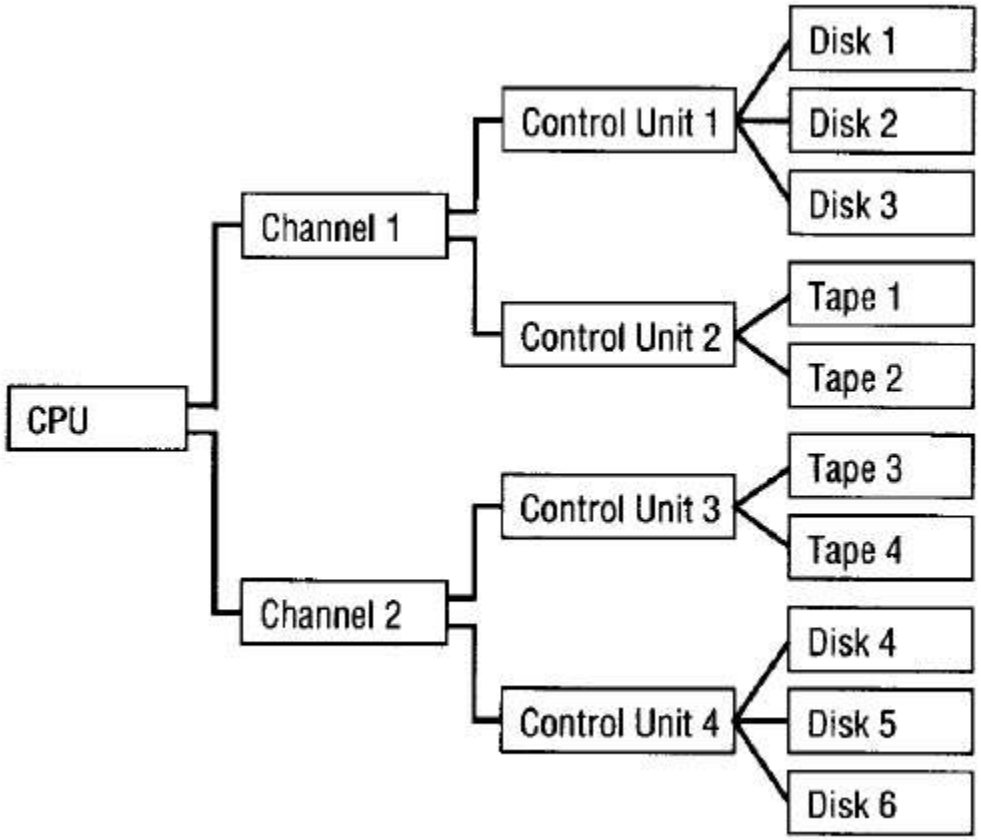
Optical Disks



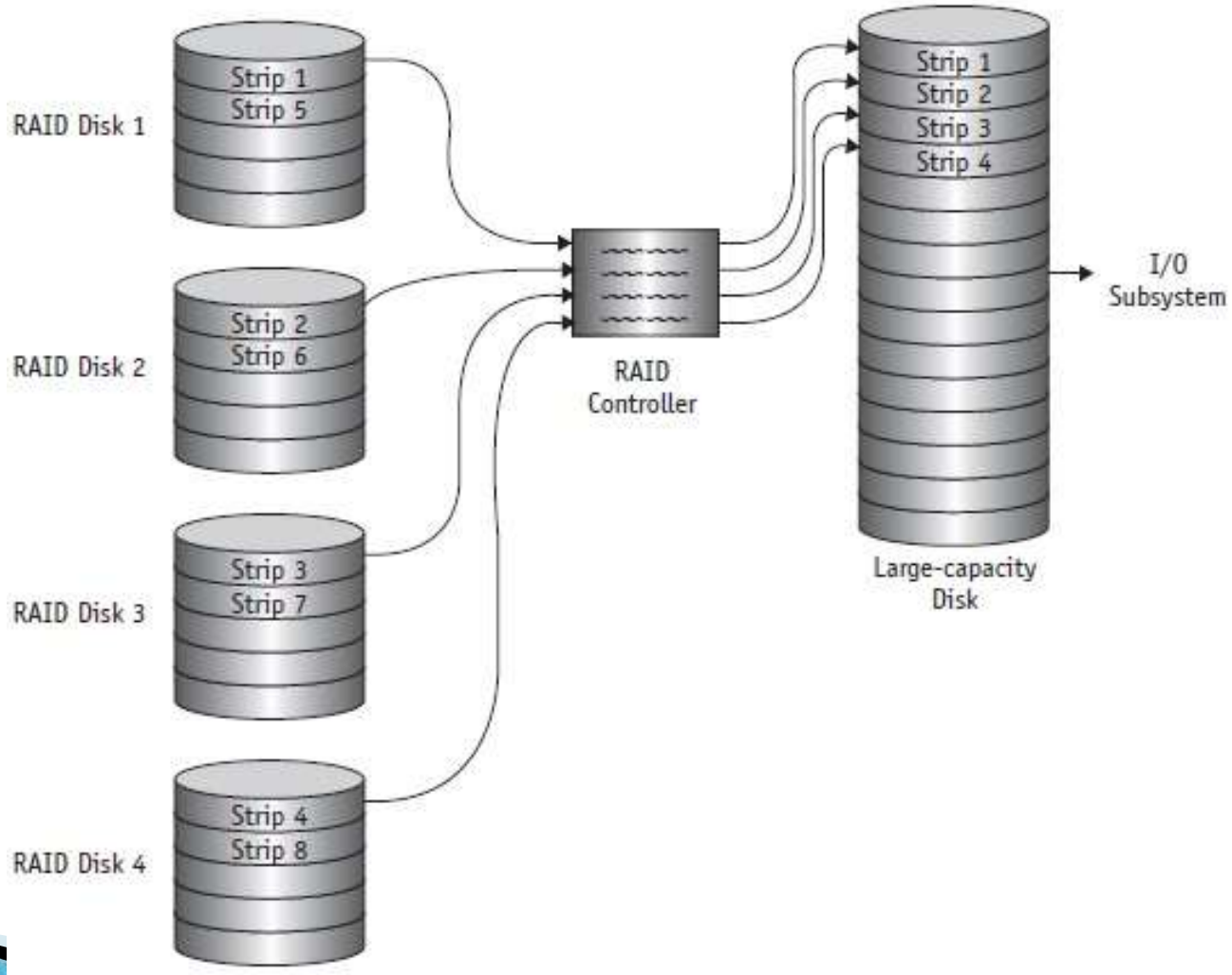
Device Management

- Optical Disk Storage:
  - Three important performance measures are:
    - Data Transfer Rate – amount of data that can be read from the disk.
    - Average Access Time – how long (on average) it takes to move the disk head to a specific place on the disk.
    - Cache Size – measures re-read ability.

Device Management



Device Management



Thanks.