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STORAGE DEVICES

Prepared & presented by

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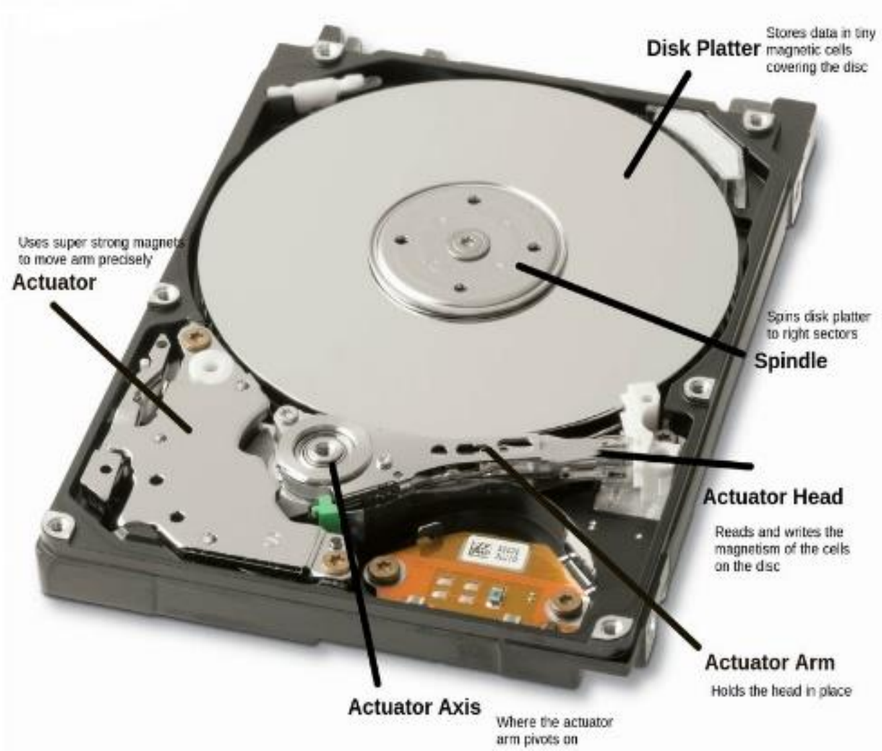

Hard Disk Drive (HDD)

- **Disk platter** – uses magnetism to store information, specifically by switching the magnetic coating on each aluminium disk between a magnetised state and a demagnetised state
- **Actuator head** – read and write information to and from the platter's surface
- **Armature** – has an electric motor that moves heads in and out so they can access every part of the disk
- Platters **spin at a high speed**
- **Heads do not touch the surface** of the platter

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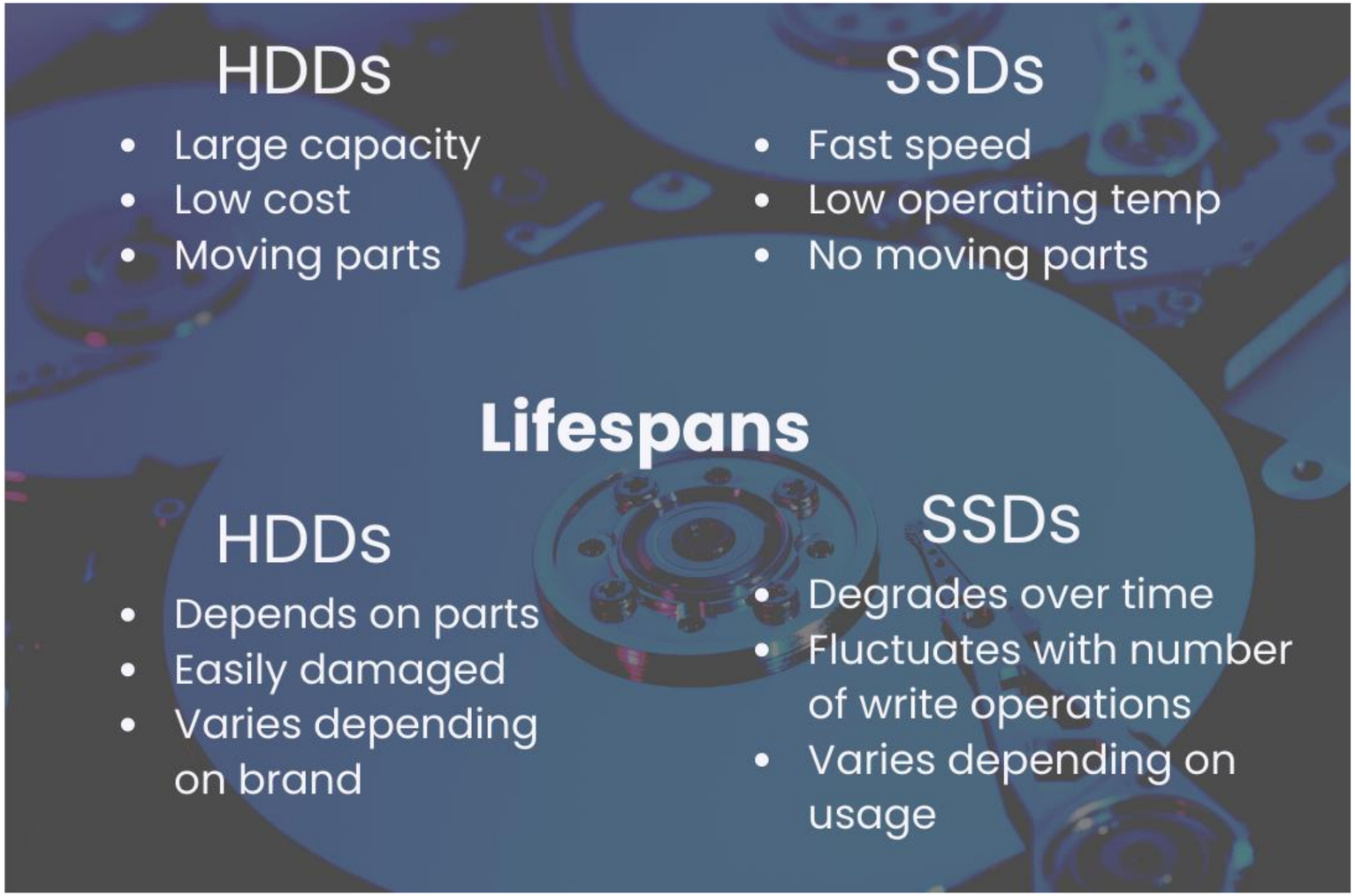
Hard Disk Drives

- Can store **huge types of information**
- Type of **non-volatile memory** (retain stored data when powered off)
- **Inexpensive**: 5,400 revolutions per minute (RPMs)
- **Good quality**: 7,200 RPMs
- **High-end**: 10,000 to 15,000 RPMs
- **High** revolution = **faster** access to data
- Not very portable.

Solid-State Drives (SSDs)

- **Long-term** storage device
- Uses **flash memory** instead of platters
- Designed to **replace** a standard HDD
- Found on **smaller** devices
- They **don’t create as much heat or consume as much energy** as HDDs
- More **expensive**.

Advantages and Disadvantages



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Non-Volatile Memory Express (NVMe)

- Made for **accessing non-volatile storage media through a PCI Express bus** (PCI-e)
- Well-suited for **highly demanding, compute-intensive** settings
- Large performance difference between NVMe and SATA (**NVMe experience less latency than SATA protocols**).

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NVMe Analysis

Advantages

- Send commands twice as fast compared to AHCI SATA drives
- Have a latency of only a few microseconds, while SATA SSDs have latency between 30 and 100 microseconds
- Work with all major Operating Systems regardless of form factor

Disadvantages

- Not all motherboards have an M.2 slot for an NVMe drive
- Not cost-effective at storing large volumes of data. It is more expensive compared to hard disk drive.

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Flash Drive

- **Long-term storage** device that is portable
- Uses **flash** memory
- Sometimes called a **thumb drive**
- Relatively **fast and inexpensive**
- Read information **as fast as a standard HDD**
- Provide **a lot of storage space** (4GB to 2TB) in a **small physical device**
- Comprises of **programmable memory chips**
- Flash memory used in digital cameras, smart phones, and digital camcorders.

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Quiz: Storage Devices

1. You are the IT Technician at your place of employment. You often want to share information from your laptop quickly with your co-workers. Which of the following storage media would BEST allow you to quickly and inexpensively share your files with your colleagues?

a. Solid state drive (SSD)
b. Memory card
c. Hard disk drive (HDD)
d. Flash drive/Thumb drive

2. You have been tasked to purchase several new Windows-based computers to replace broken or outdated computers. You have heard that solid-state drives (SSDs) can significantly increase systems' overall performance. Which of the following BEST describe the features of solid-state drives compared to hard disk drives? (***Select two***)

a. SSD uses flash technology to store data.
b. SSD spindles move at a faster rate than those of an HDD.
c. SSD cheaply stores a large amount of data.
d. SSD can be adversely affected by magnetism.
e. SSD opens files faster than an HDD.

3. Which of the following is a magnetic storage device?

a. Hard disk
b. DVD
c. Flash device
d. Solid-state drive

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RAID ARRAYS

- **RAID:** redundant array of independent disks
- Connects two or more storage devices and one or more controller cards as a single system in order to improve system performance and create data redundancy.

RAID Implementations	
Hardware	Software
+ Requires a RAID controller to be installed into system (has its own processor)	+ Flexible and more affordable than hardware RAID
+ Better performance than software RAID	+ Utilises system processor and OS
- More expensive	+ Easier to implement
	- Performance dependent on the host system CPU

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Implementing RAID Arrays

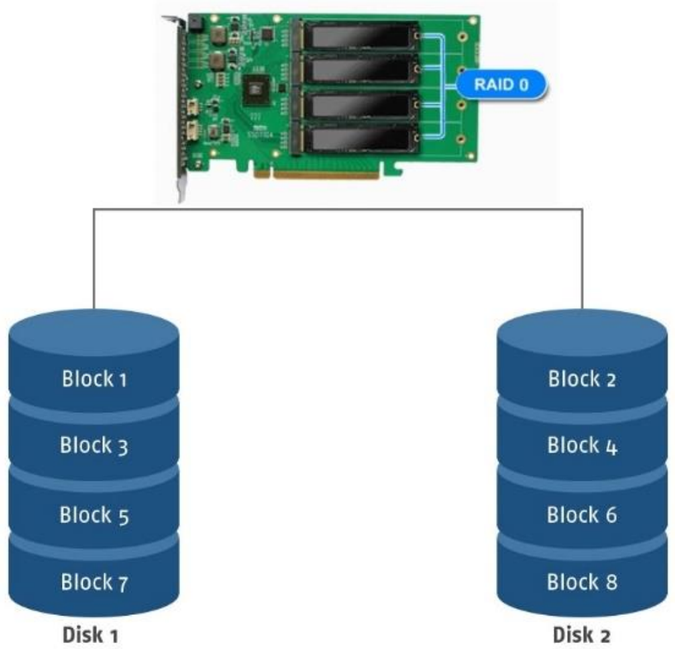
Hardware Installation or Software Installation

- Must use a system with a physical card known as a **RAID controller**
- RAID controllers have their **own processors** dedicated to managing RAID arrays resulting in **great flexibility** for different RAID configurations

- **System's CPU and operating system** create & manage the array
- Works **well** and numerous operating systems support it
- **Easy** to implement and **less expensive**
- Can be **slower**.

RAID 0 – Striping without Parity

The ‘0’ in RAID 0 literally means zero redundancy & zero fault tolerance



Data is **divided up** and written across two or more disks simultaneously

Advantages:

- Performance boost for read and write operations
- Space is not wasted as the entire volume of the individual disks are used up to store unique data

Disadvantages:

- No redundancy/duplication of data (if one disk fails, all data is lost).

RAID 1 – Mirroring

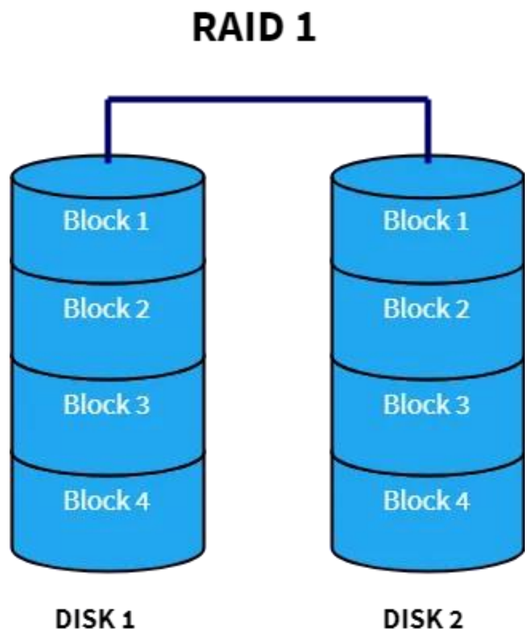
Protects data by providing redundancy

Advantages:

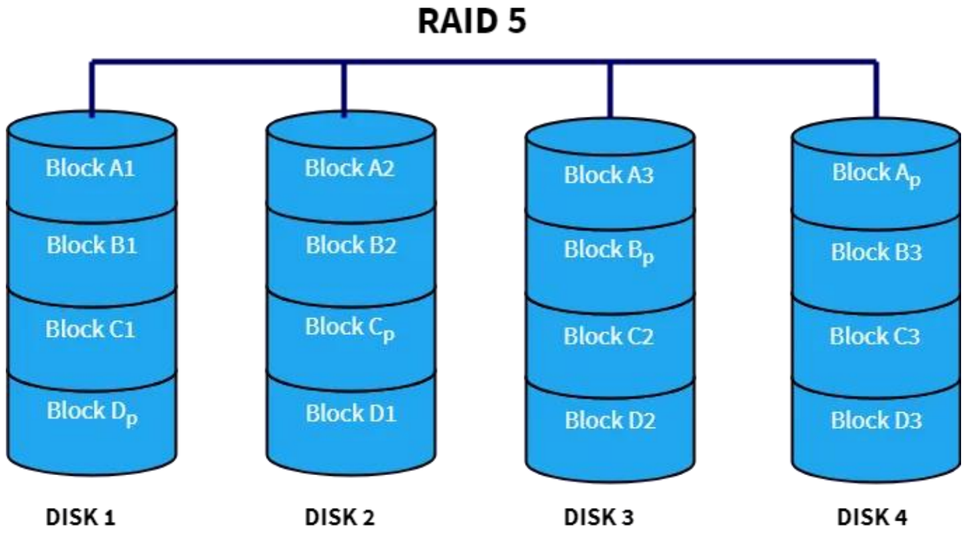
- Data can be recovered in case of disk failure
- Increased performance for read operation

Disadvantages:

- Slow write performance
- Space wasted by duplicating data which increases cost per unit memory



RAID 5 – Striping with Parity



- **Parity** – a calculated value that's used to mathematically rebuild data in case of a failure

- **RAID 5** – parity is striped across all drives for speed, redundancy, and fault tolerance (requires 3+ drives to implement)

- **Advantages**

1. High read performance
2. No loss of data if one physical disk fails
3. More usable disk capacity

- **Disadvantages**

1. Relatively low write performance
2. Data loss if a second disk fails before data from the fist failed disk is rebuilt

NB: If two drives fail, the RAID 5 array becomes completely corrupted and unrecoverable.

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RAID 10 – Stripe of Mirrors

- AKA **Raid 1 plus 0**

- Uses striping and mirroring & requires a minimum of 4 disks

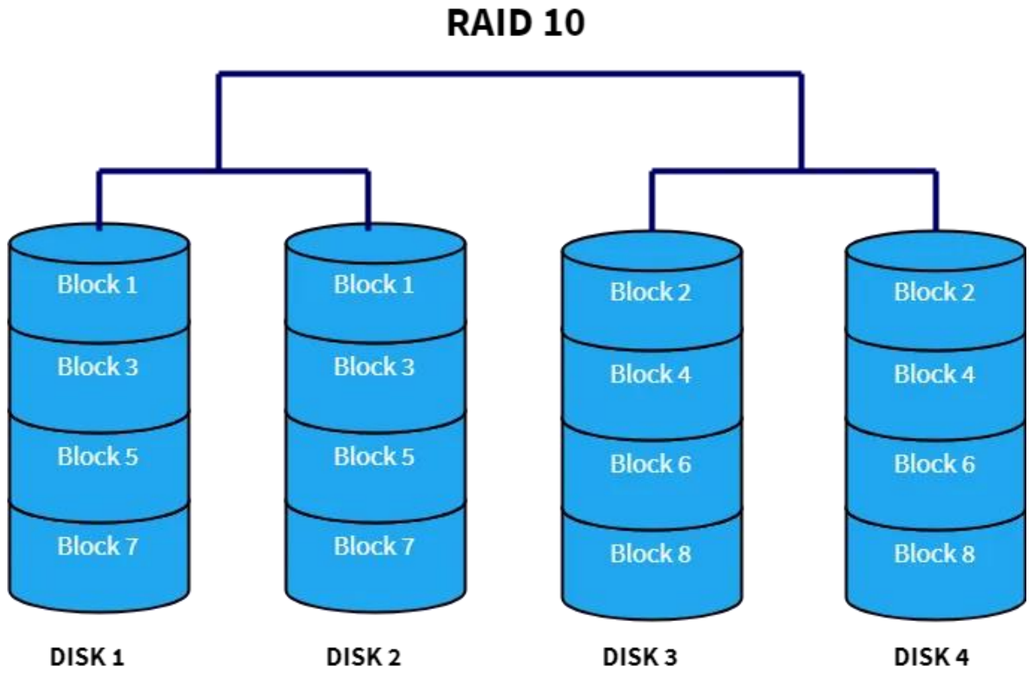
- Data is striped across mirrored pairs, providing redundancy and high performance

- **Advantages:**

1. Increased read speed compares to single drives
2. Increased fail-safety of integrated hard drives

- **Disadvantages:**

1. Maximum available storage capacity limited
2. Failure of two disks in a sub-array leads to whole system crashing.



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Quiz: RAID Arrays

1. Which of the following drive configurations uses striping with parity for fault tolerance?

a. RAID 10
b. RAID 1
c. RAID 0
d. RAID 5

2. One of your customers wants you to build a personal server that he can use in his home. One of his concerns is making sure that he has at least one data backup stored on the server in the event that a disk fails. You have decided to back up his data using RAID.
Since this server is for personal use only, the customer wants to keep costs down. Therefore, he would like to keep the number of drives to a minimum. Which of the following RAID systems would BEST meet the customer's specifications?

a. RAID 0
b. RAID 1
c. RAID 5
d. RAID 10

3. Jessica is concerned about losing data due to a hard disk failure. Her computer will only support a maximum of three disks. To protect her data, she has decided to use RAID (Redundant Array of Independent Disks).
Which of the following RAID types would give Jessica the BEST mirrored data protection?

a. RAID 0
b. RAID 1
c. RAID 5
d. RAID 10

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