#Be ready … :D.. #will start in next 2.. Minutes

#Waiting Room

Storage

Storage is a process through which digital data is saved within a data **storage** device by means of computing technology. **Storage** is a mechanism that enables a computer to retain data, either temporarily or permanently

Data can be stored in many formats in any computer hardware.
This completely depends on the application that is creating this data.

Following are some of the well-known data storage formats and access mechanisms.

Disk Storage

Many of the disk operations like “read” and “write” involve disk storage. Disk storage is one of the most heavily used mechanisms as on today. In Disk storage, also many types and methods have evolved over a period.

- **Block Storage:** Data is stored in “logical blocks” these blocks are smallest units of storage with addresses attached to them in any storage subsystem. Disk level read/write operations can be used for block storage and block storage access.
- **File Storage:** Any data file is nothing but collection of “block of blocks” of data. Any file typically will contain two parts:
    1. **Metadata** of a file which stores the directory structure and information about the file.
    2. **File content** which contains the actual file content part of the data. File storage leads to **File Systems**, which will have directories, files, regular files and etc file related meta data inside them. These File Systems are logically arranged for ease of access and data operation.

Block

Specific location on disks / memory

Tracks

Sectors

File

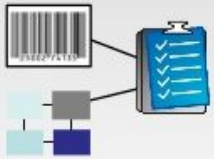
Specific folder in fixed logical order

File path

File name

Date

Object

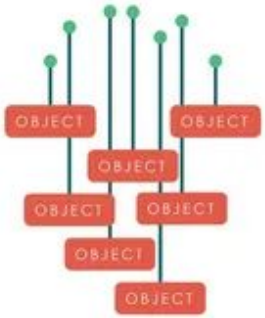


Flexible container size

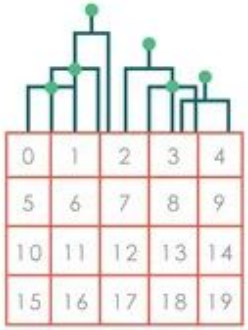
Data and Metadata

Unique ID

Object



File



Block

Database storage

DB storage is data storage for faster access with or without data relation. DB storage is at the software level of data storage and will involve SQL or No-SQL based data storage with Primary key and secondary key mechanisms. These data bases either will be relational and no-relational types.

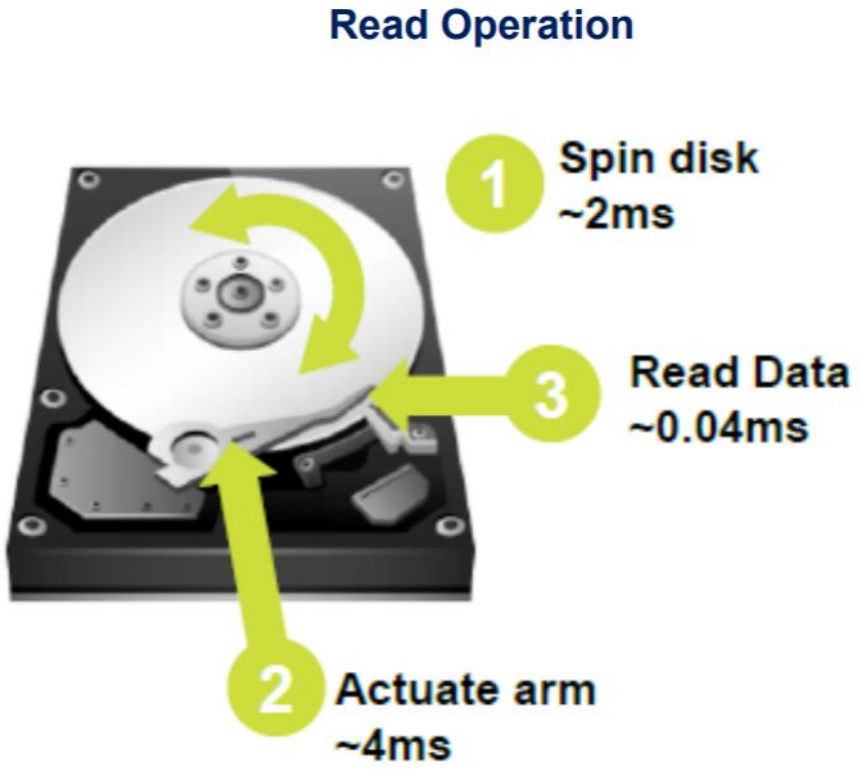
Secondary Storage

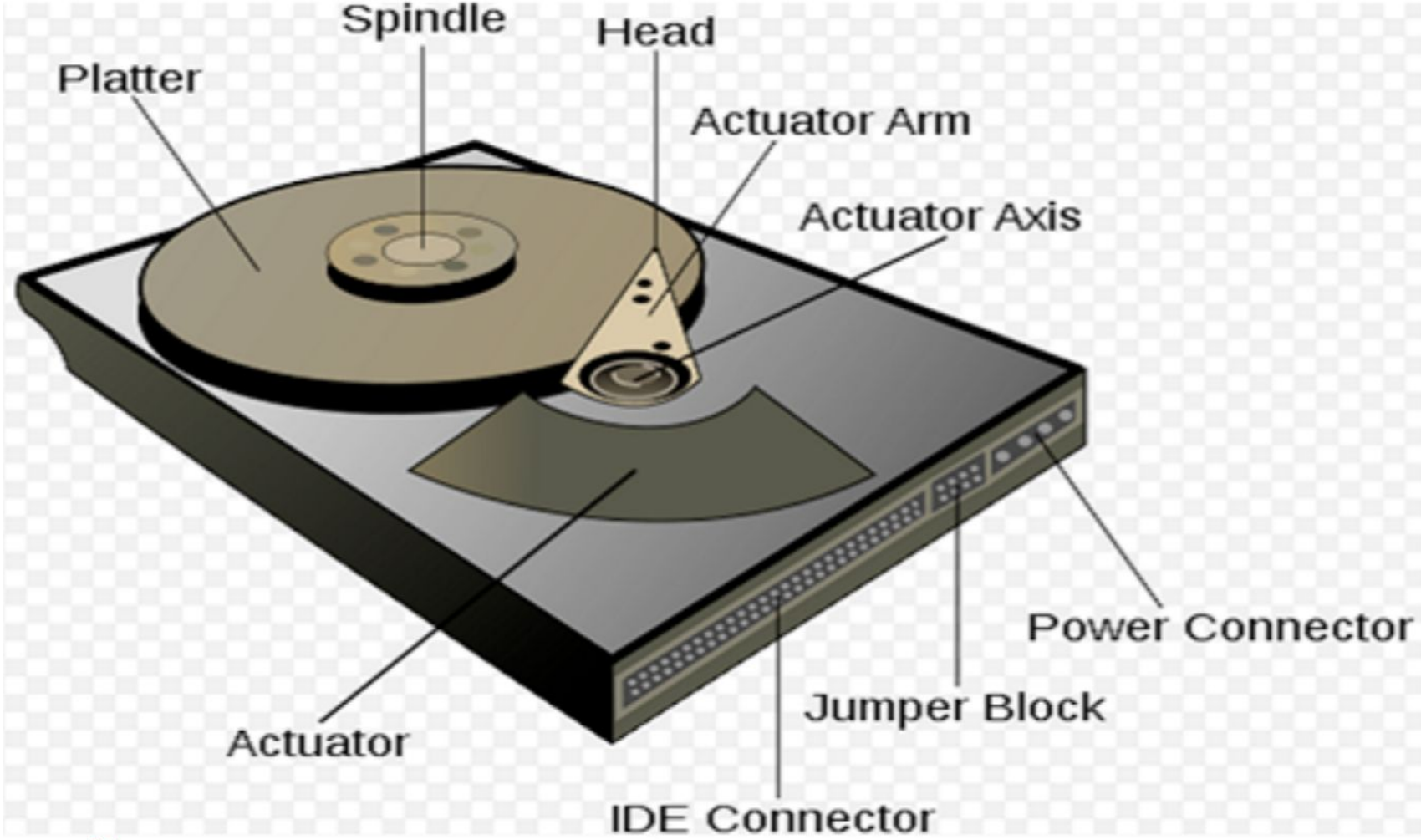
This mainly involves hard disk type of storage. As explained earlier, for last 20+ years or so, storage was hovering around **DASD** (**D**irect **A**ttached **S**torage **D**evice) or **JBOD** (**J**ust **B**unch **O**f **D**isks) types of primary storage mechanisms. DASD and JBOD were used for just read and write operations on disks. These are just collection of disks without involvement of data management or intelligence used.

- **Disk:** Disk is one of the storage units used for data storage.

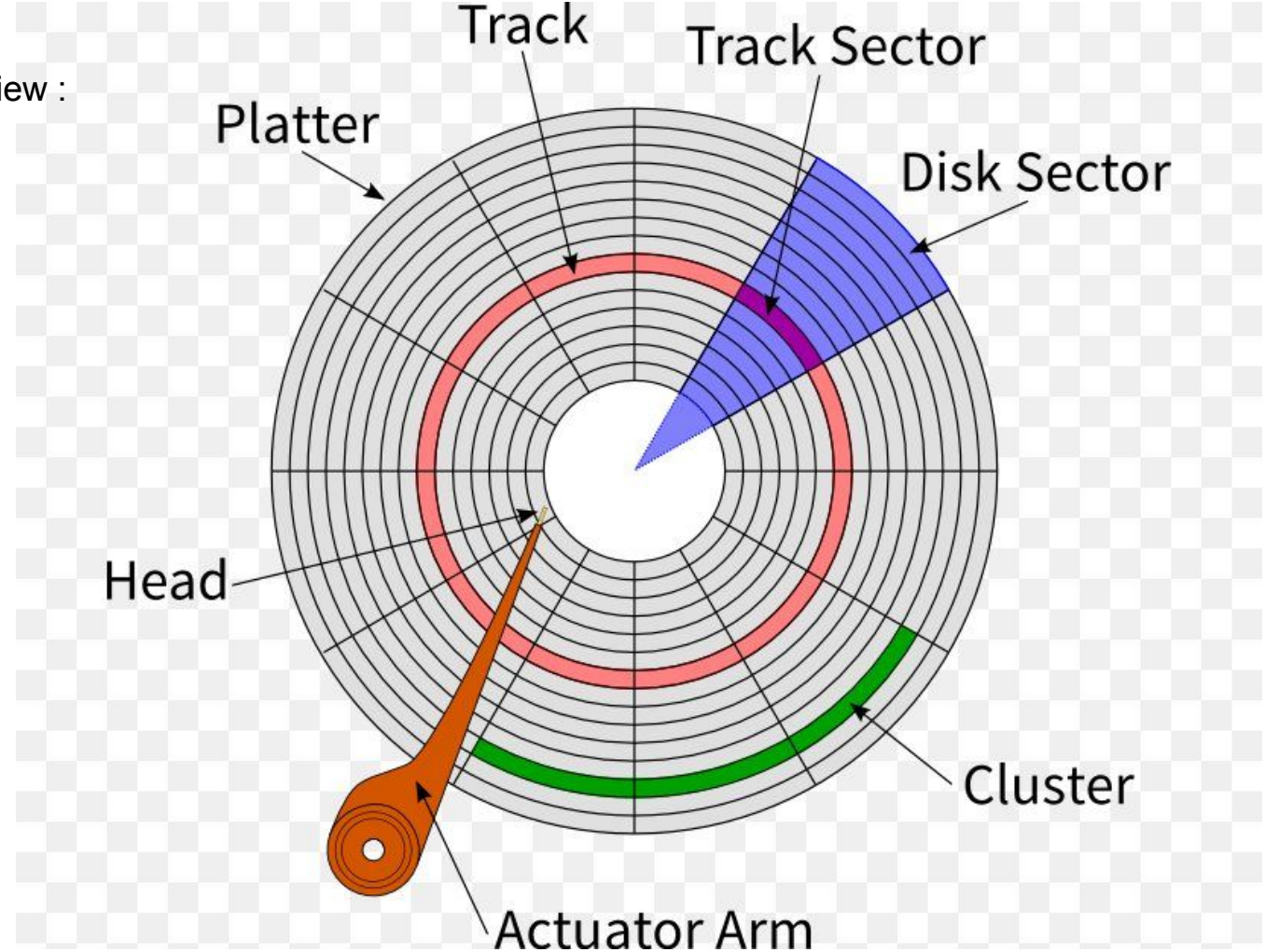
HARD DISK DRIVES

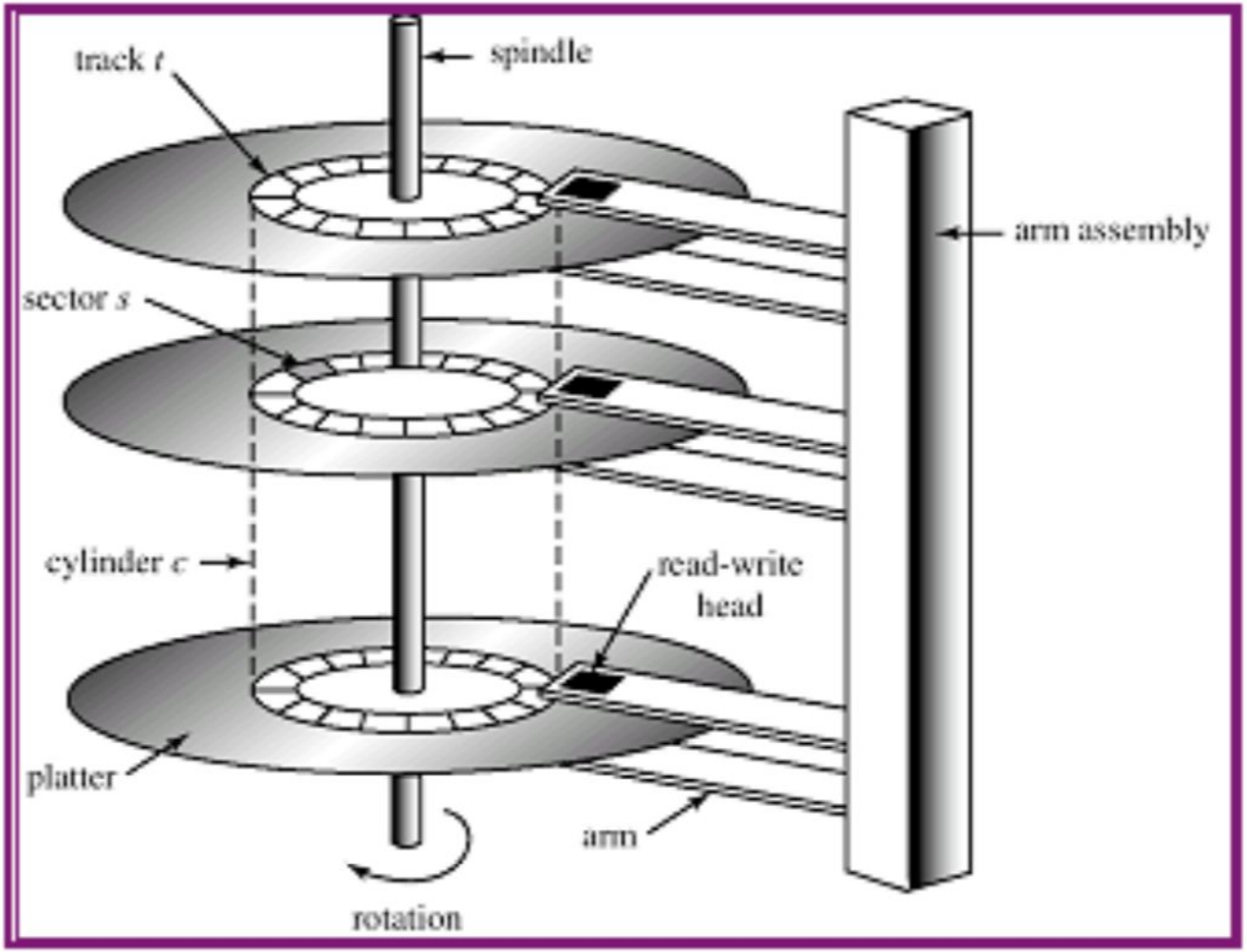
- Electro-mechanics
- Disk storage uses spin motors and actuators
- Electro mechanical devices are limited by the mechanics
- Mechanisms wear, generate heat, consume power




Spindle
Head
Platter
Actuator Arm
Actuator Axis
Power Connector
Jumper Block
Actuator
IDE Connector

Top View :


Track
Track Sector
Platter
Disk Sector
Head
Cluster
Actuator Arm


track t
spindle
arm assembly
sector s
cylinder c
read-write
head
platter
arm
rotation

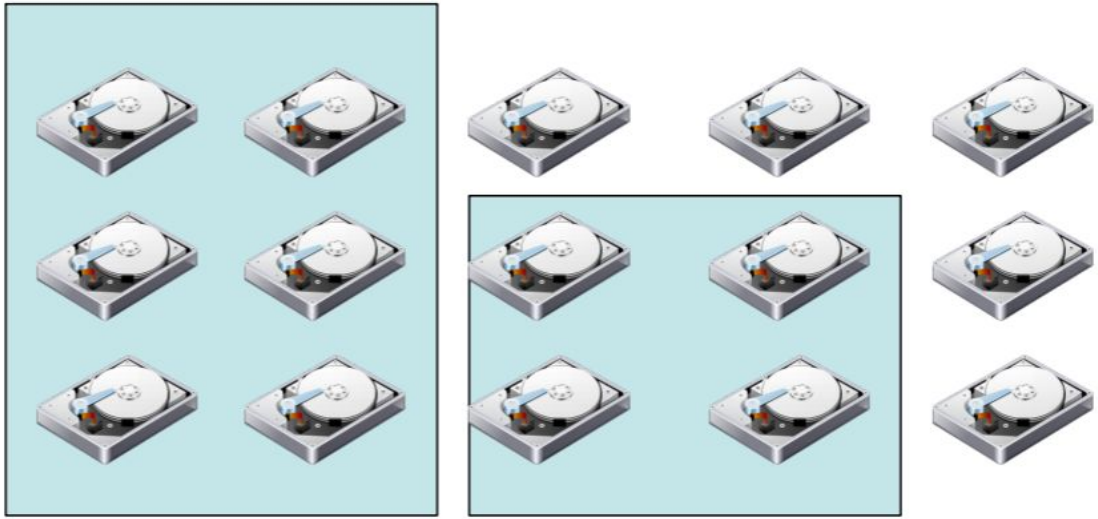
HDD
3.5”

Shock resistant up to 350g/2ms

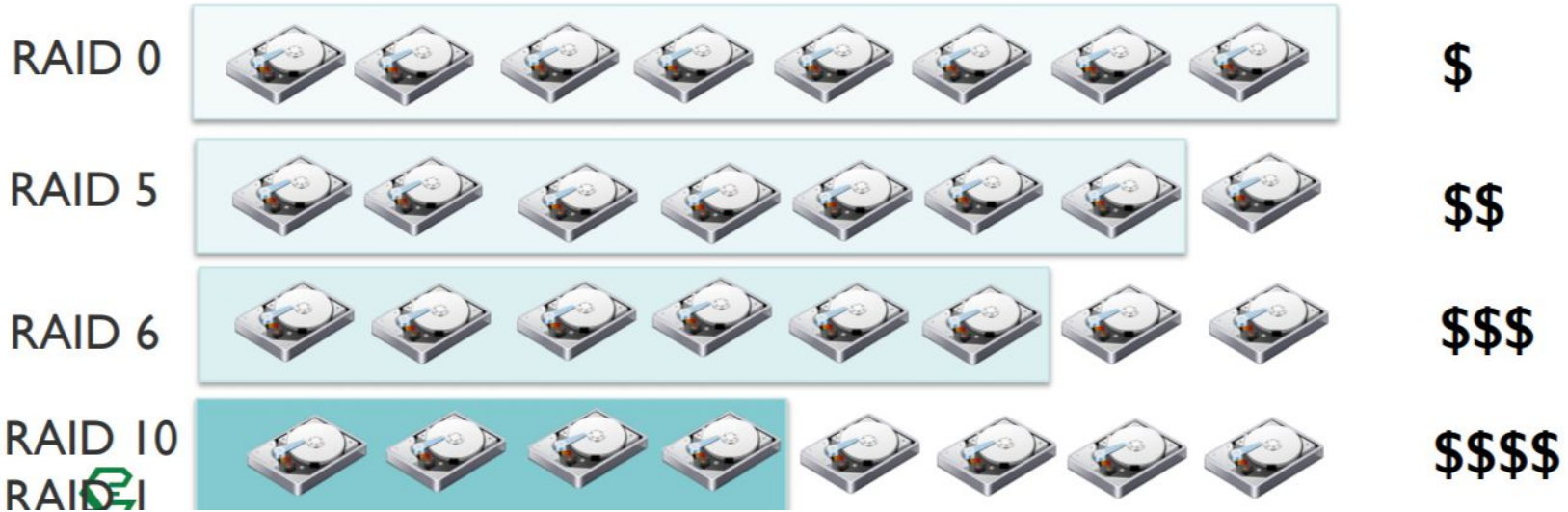
SSD
2.5”

Shock resistant up to 1500g/0.5ms

- Logical volume
  - Pool disks together
  - Create one virtual disk
- Created either at server or storage controller levels
- Easier Management
- Creating RAID groups to protect from data loss



- RAID – Redundant Array of Independent Disks
- RAID 0 - Striping
- RAID 1 - Mirroring
- RAID 3 – Striping + parity
- RAID 5 – Distributed Parity
- RAID 6 – Distributed Double Parity
- RAID 10 (0+1) – Combination of striping and mirroring



Primary Storage

It is also known as main storage mechanism will mainly involves Random Access Memory.

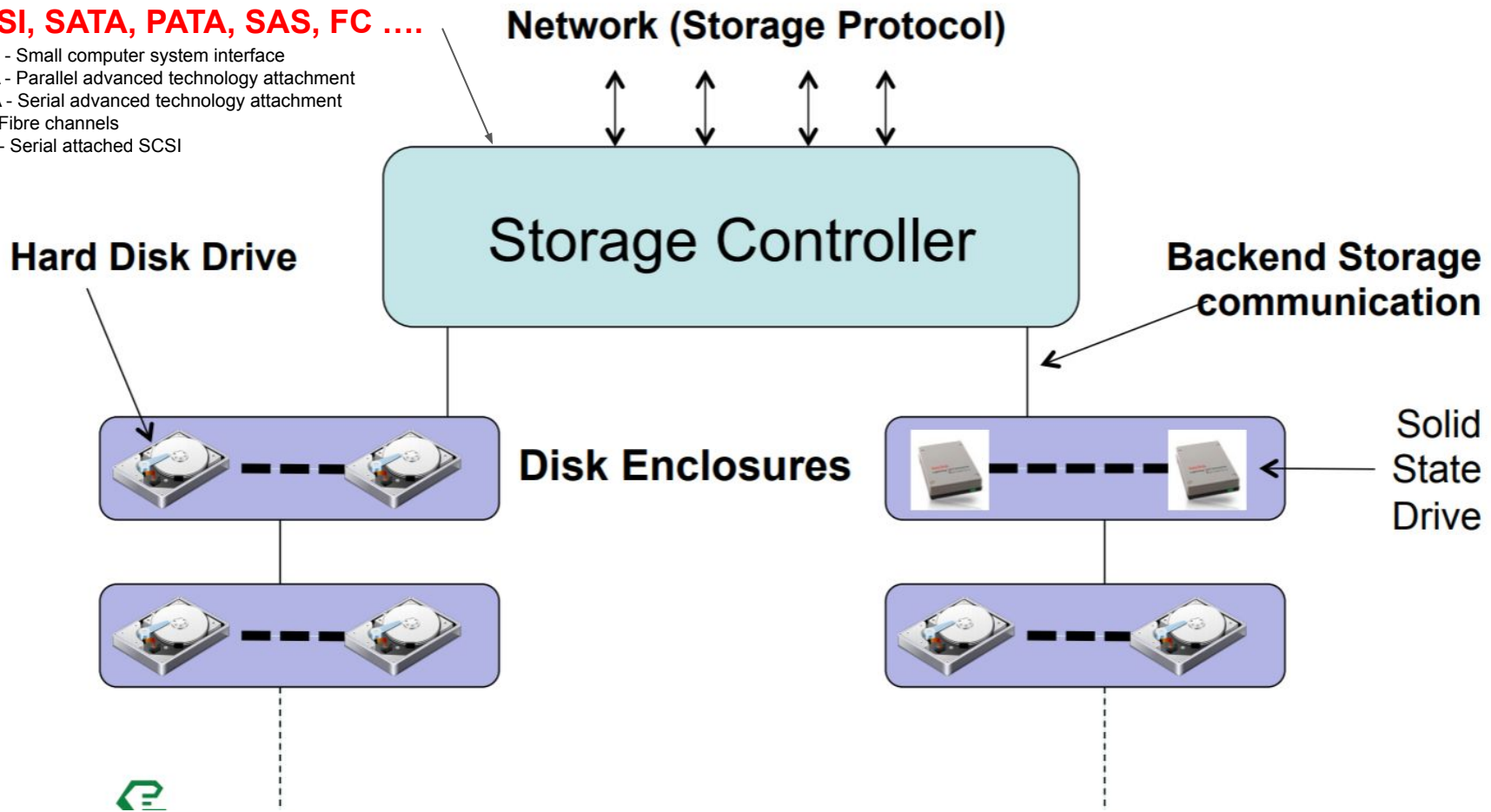
- **RAM - primary**

#Be ready … :D.. #will start in next 2.. Minutes

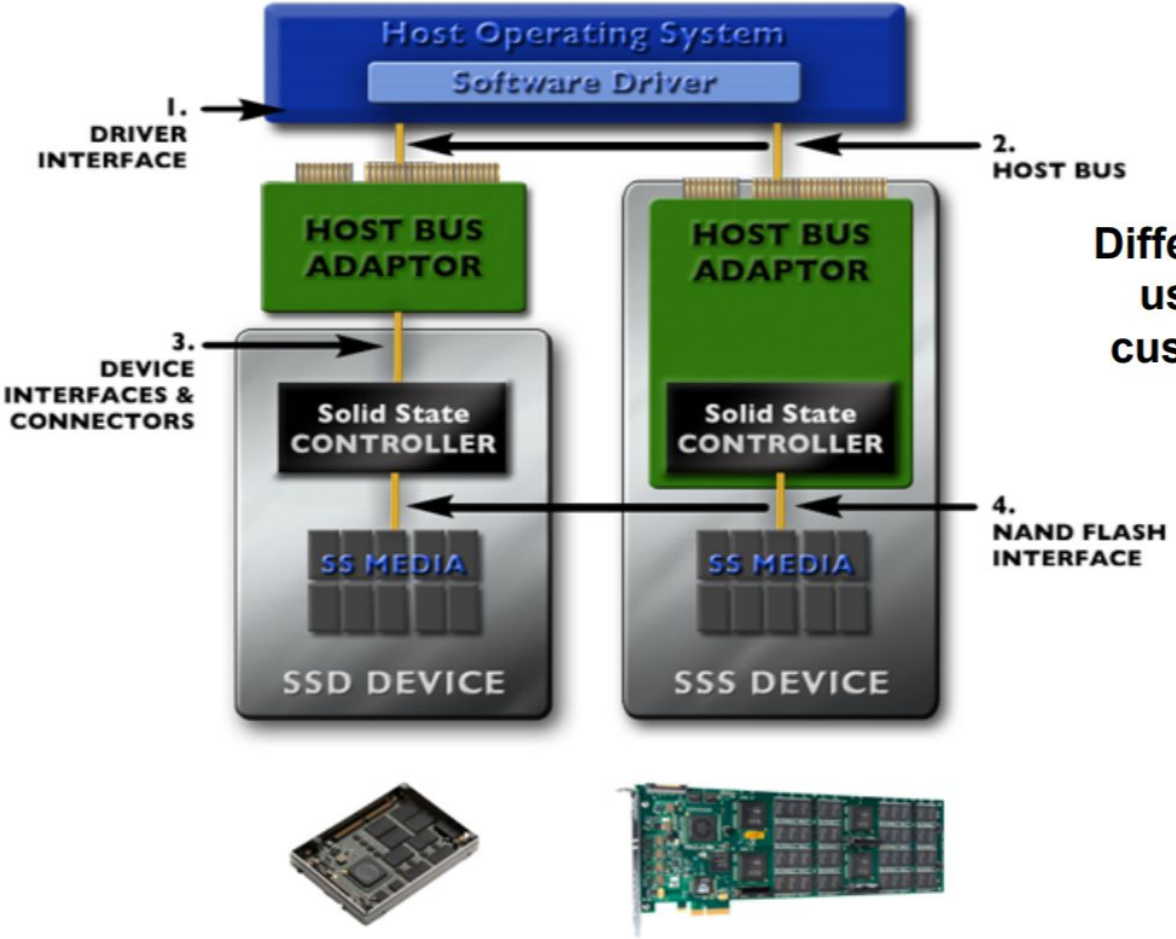
#Waiting Room

SCSI, SATA, PATA, SAS, FC ….

SCSI - Small computer system interface
PATA - Parallel advanced technology attachment
SATA - Serial advanced technology attachment
FC - Fibre channels
SAS - Serial attached SCSI



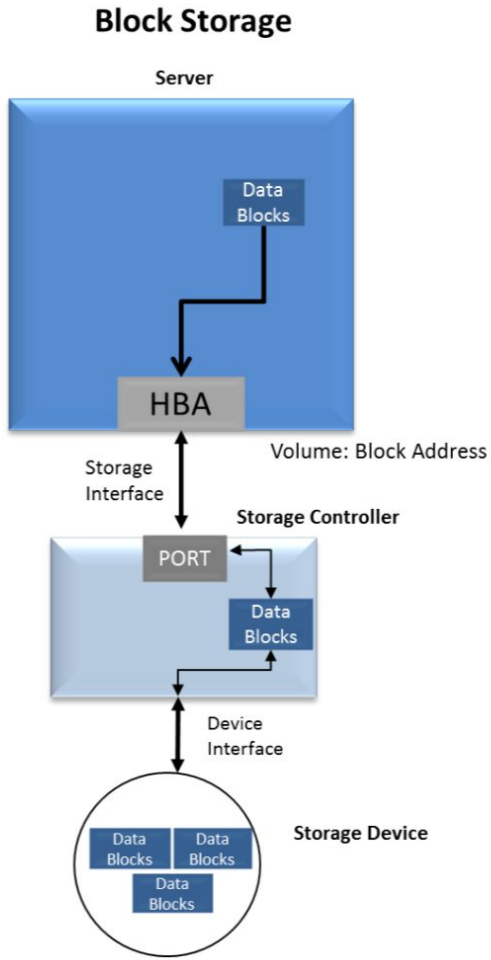
STORAGE CONTROLLER



Difference between use of SSD's and custom solid state designs

Block I/O

- Application writes data block
- Block goes to HBA and over storage interface
- Storage controller receives block
- Data written to device as data block



Protocol Used by Storage Subsystem

Protocol used by Storage Subsystems

SCSI - Small computer system interface
PATA - Parallel advanced technology attachment
SATA - Serial advanced technology attachment
FC - Fibre channels
SAS - Serial attached SCSI
iSCSI - SCSI over internet …….

Overview of Storage System

DAS (Direct Attached storage)

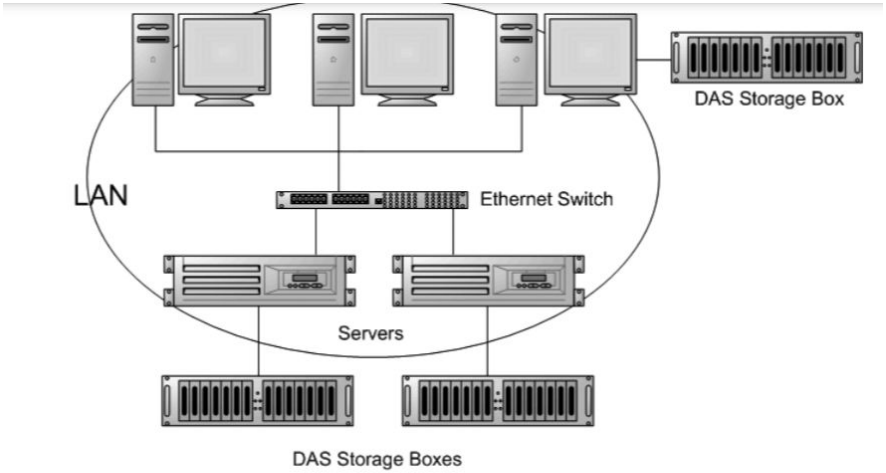
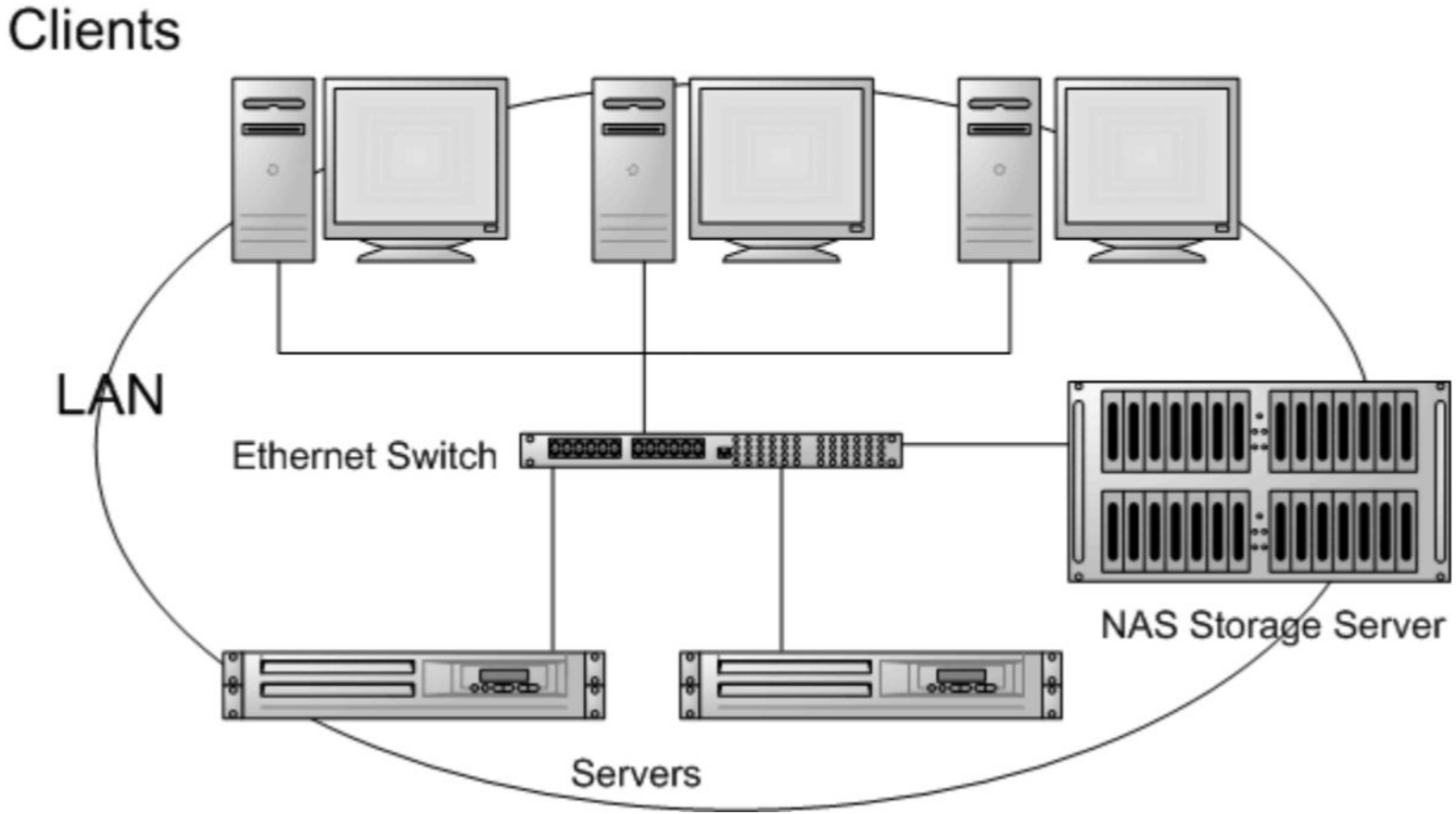
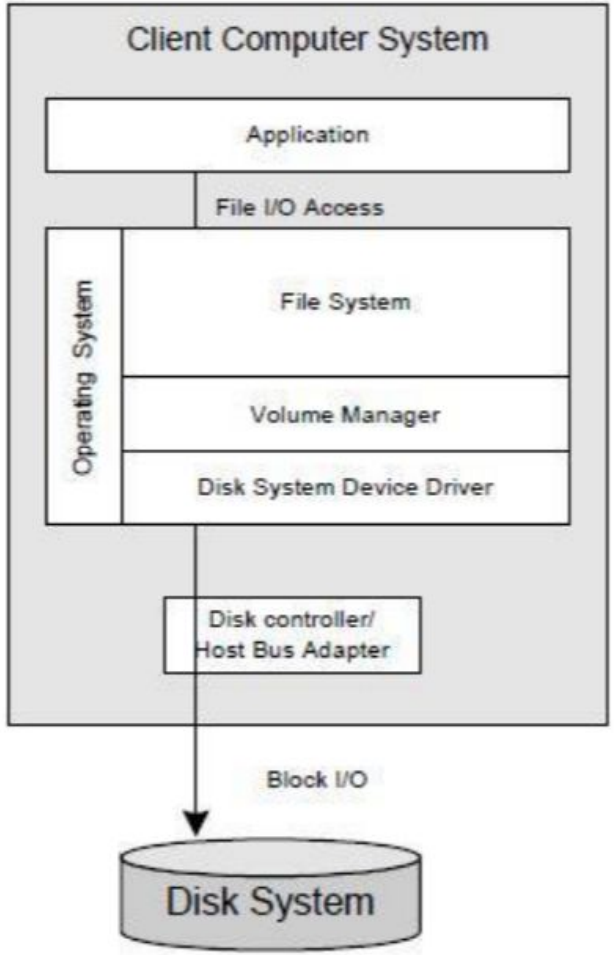


Figure 2 - Example 1 with DAS

Network Based Storage - NAS - Network Attached storage and SAN - Storage Area Network

Network Attached Storage




Client Computer System
Application
File I/O Access
Operating System
File System
Volume Manager
Disk System Device Driver
Disk controller/
Host Bus Adapter
Block I/O
Disk System

SAN [Storage Area Network]

Storage Area Network