Storage Devices can be categorized into following categories:
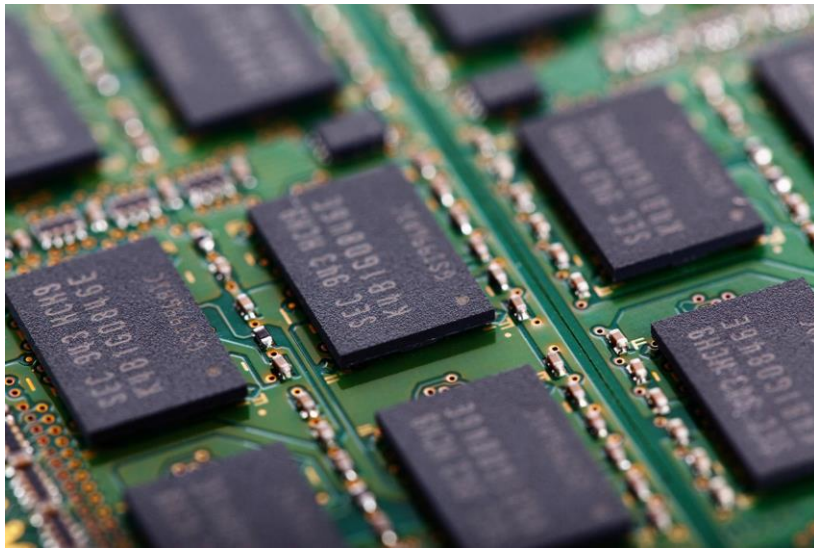
1. Primary storage and Secondary storage
2. Volatile and non-volatile
3. Mutable and immutable

Storage can be divided into two types:

1. Static Memory
2. Dynamic Memory

Storage Categories

Storage can be divided into two types:

1. Volatile Memory
2. Non - Volatile Memory

Storage can be divided into two types:

1. Primary Memory - Memory for short time
2. Secondary Memory - Memory for long time

Static Random Access Memory

Faster

Cost is high

retains data bits in its memory as long as power is being supplied.

does not have to be periodically refreshed.

provides faster access to data.

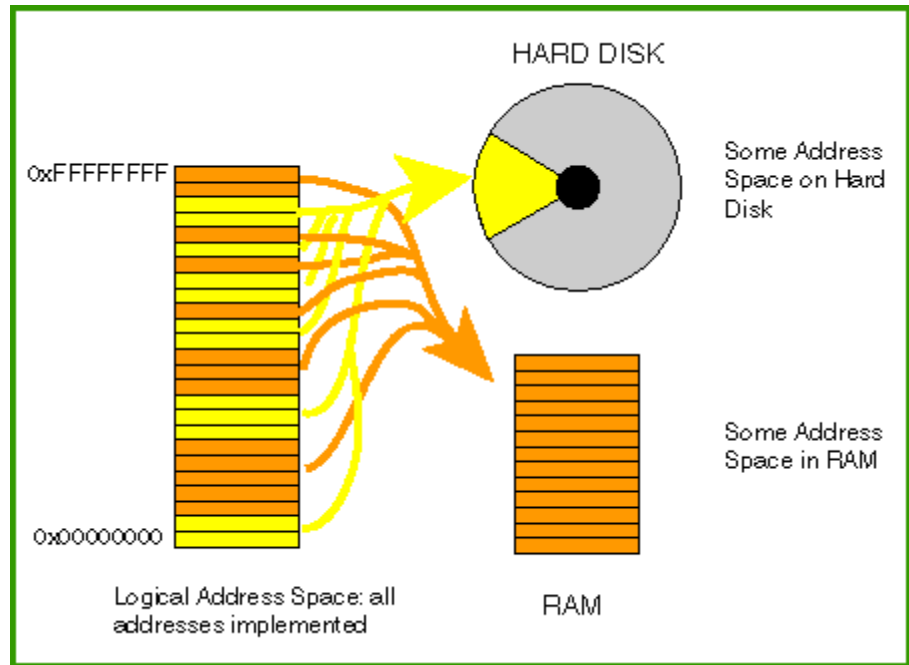Static RAM is used in Cache memroy

Typically used for CPU cache, hard disk buffers, router buffers

Virtual Memory

Method of extending RAM for running programs capacity

Virtual memory is a capability of operating system to manage the physical memory shortages with the help of hard disk storage(Disk Storage)

It uses to copy inactive memory from RAM to hard disk

Volatile Memory

Volatile Memory is the memory which lost the data itself when there is a failure of the power supply to the memory

Data completely lost when there is a power failure

Examples :

RAM, Registers, Cache Memory

Non - Volatile Memory

Volatile Memory is the memory which does not lost the data itself when there is a failure of the power supply to the memory

Data is not going to lost in a power failure

Examples:

Hard Disk , Flash drives, CD , DVD, Magnetic tapes

Mutable

The data can be read from the memory and write to the memory

Examples :

Hard Disk , RAM and Cache Memory

Immutable

If the memory is a read only memory that memory is Immutable.

Data writing to a Immutable memory is a slow process
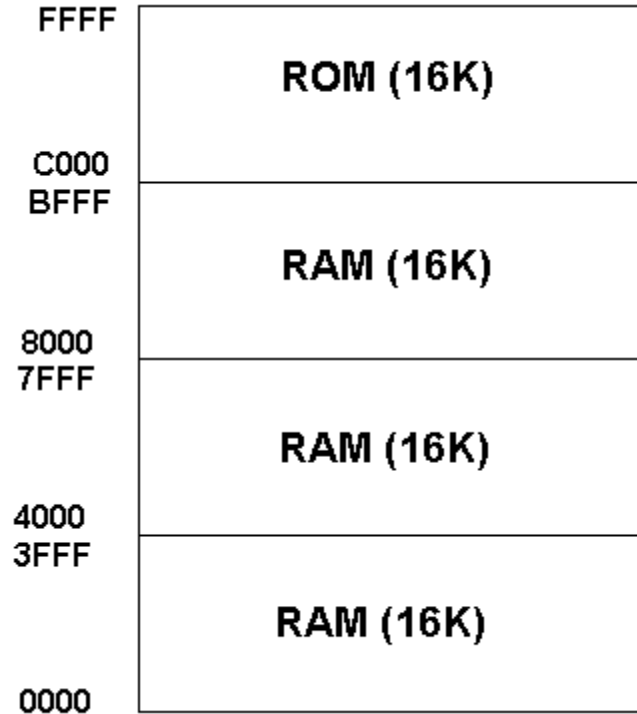
Example:

CD, DVD,

ROM

RAM (Random Access Memory) Module

RAM is a temporary memory in the computer. It is a module or a circuitry which consist of several memory chips to store data and instructions on temporary basis

Address	Memory
FFFF	ROM (16K)
C000	
BFFF	RAM (16K)
8000	
7FFF	RAM (16K)
4000	
3FFF	RAM (16K)
0000	

RAM as many memory locations

Each memory location can be access in same speed. This feature is called "Random"

Each location has a memory address

Each memory address is identified by a unique hexadecimal value

RAM

- Random Access Memory is a temporary memory which store the data and instruction of the computer
- Volatile
- Also called Primary or main memory
- Typically a computer RAM has a capacity of 4GB or 8 GB
- SIMM,DIMM,DDR 1,DDR2, DDR3 and DDR4 are some of the available technologies

DDR

DDR 2

DDR 3

DDR 4

cm.

0 1 2 3 4 5 6 7 8 9 10 11 12 13
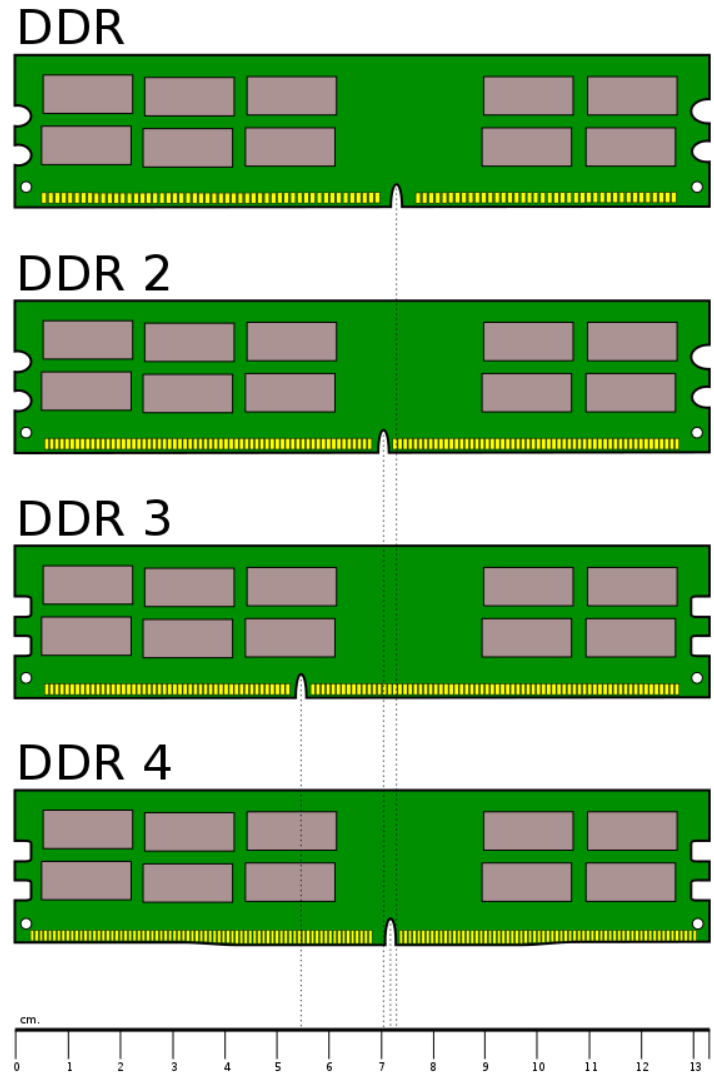
Dynamic RAM

Memory refresh timely

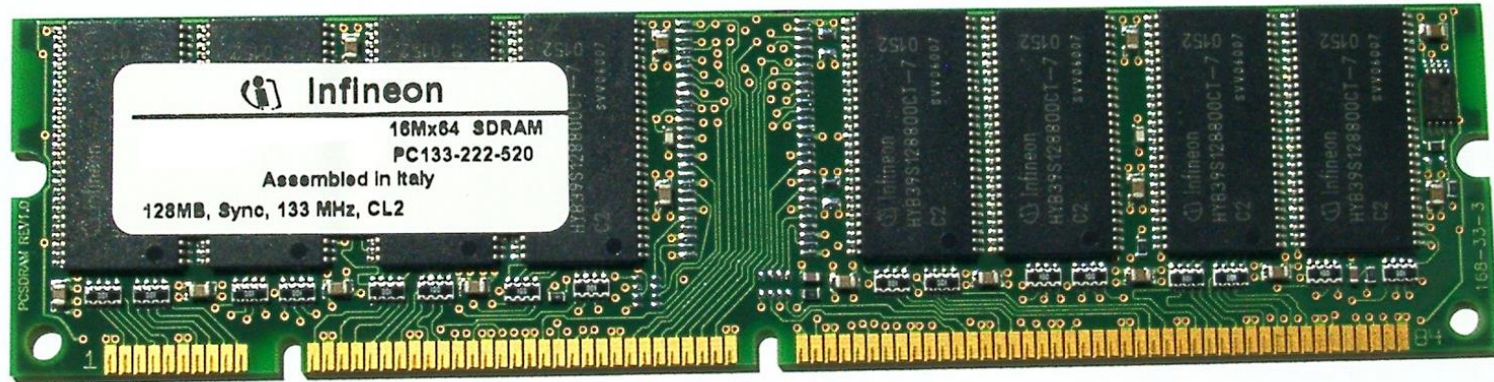Slower than statistic RAM

Used for main memory

Use in Personal Computers, Workstations and Servers

SDRAM (Synchronous DRAM)

Improved version of DRAM

Its external pin interface is coordinated by an externally supplied clock signal

The memory module is synchronized with the clock speed that the microprocessor is optimized for

DDR (Double Data Rate SDRAM)

Doubles the rate of data transfer of standard SDRAM by transferring data on the up and down tick of a clock cycle.

Less power consumption

Less power consumption than early versions

DDR2

Higher bus speed by running the internal clock at half the speed of the data bus.

Less power consumption than early versions

Not backward compatible with DDR memory slots

DDR 3

Higher bus speed

Less power consumption than early versions

Not backward compatible with DDR2 memory slots

DDR4

Higher bus speed

Less power consumption than early versions

Not backward compatible with DDR3 memory slots

RAM Vs ROM

- RAM is used to **temporarily store information** that is **currently in use** by the computer. This can include anything from word documents to videos.

- RAM can be **read from and written to** and so the information stored in RAM can change all the time

- RAM is a **fast memory**. Data can be written to and read from RAM very quickly. RAM is generally measured in GB (Gigabytes).

- RAM is **Volatile Memory**. This means that information stored in RAM is deleted as soon as the computer is turned off.

- ROM is used to **permanently store instructions** that tell the computer how to **boot** (start up). It also **loads the operating system** (e.g. Windows).

- Information stored in ROM is known as **READ ONLY**. This means that the contents of ROM cannot be altered or added to by the user.

- ROM is **fast memory**. Data stored in ROM can be accessed and read very quickly.

- ROM is **Non-Volatile** memory. This means that stored information is not lost when the computer loses power.

- Other examples of ROM include:
  - **DVD/CD ROMS** bought in stores containing pre-recorded music and movie files. These are played back at home but cannot be altered.
  - **ROM** in printers which is used to store different font types.

Memory Hierachy
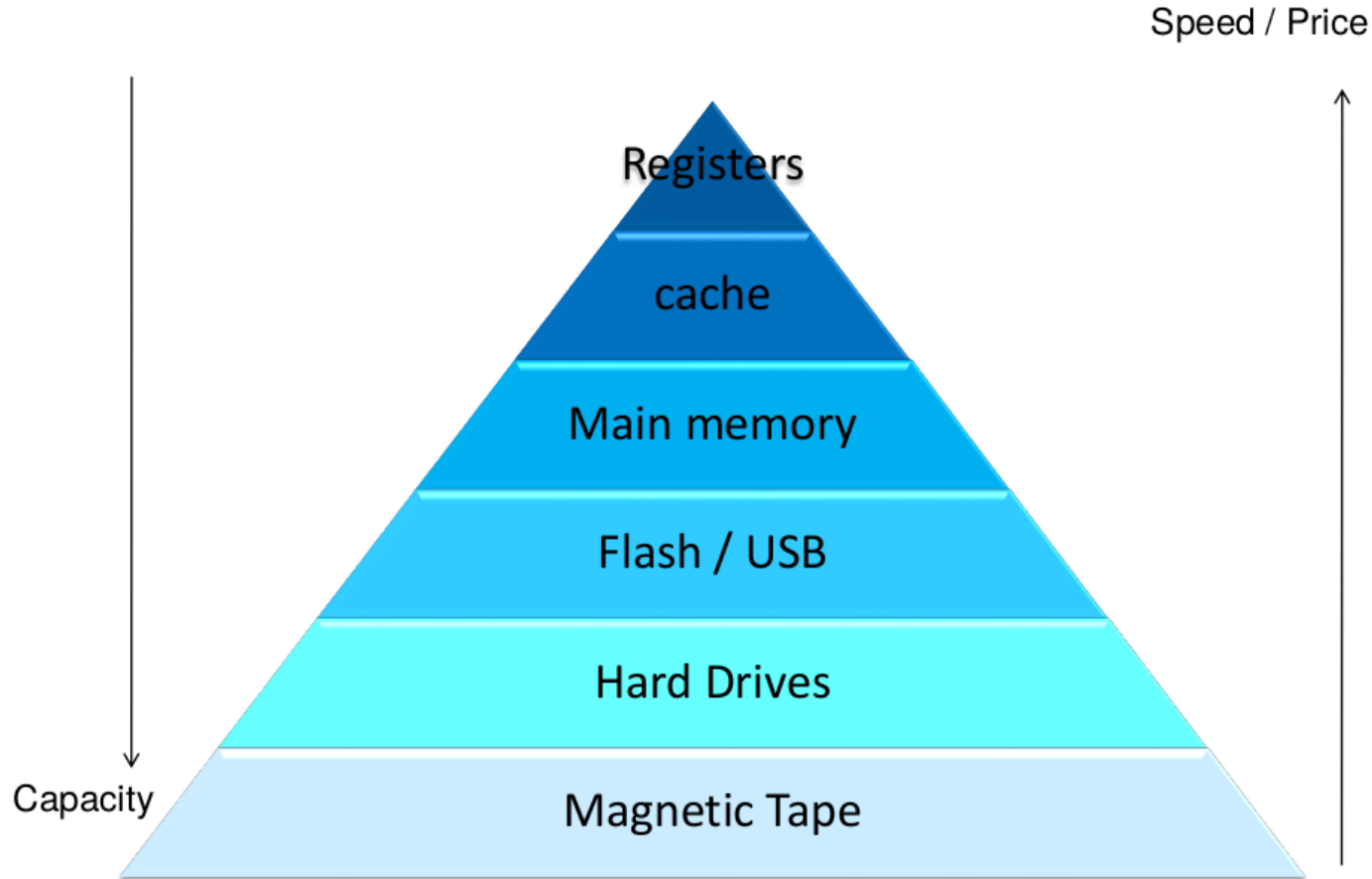
Hard Disk

Hard disk is a Secondary Storage device.

Uses a mechanical system to store the data in magnetic form.

Array of magnetic disks and heads are available for read and write data

Typical data capacities are 320GB,500GB, 1TB etc

Typical rotational speed of a hard disk is 5400 and 7200rpm (revolutions per second)
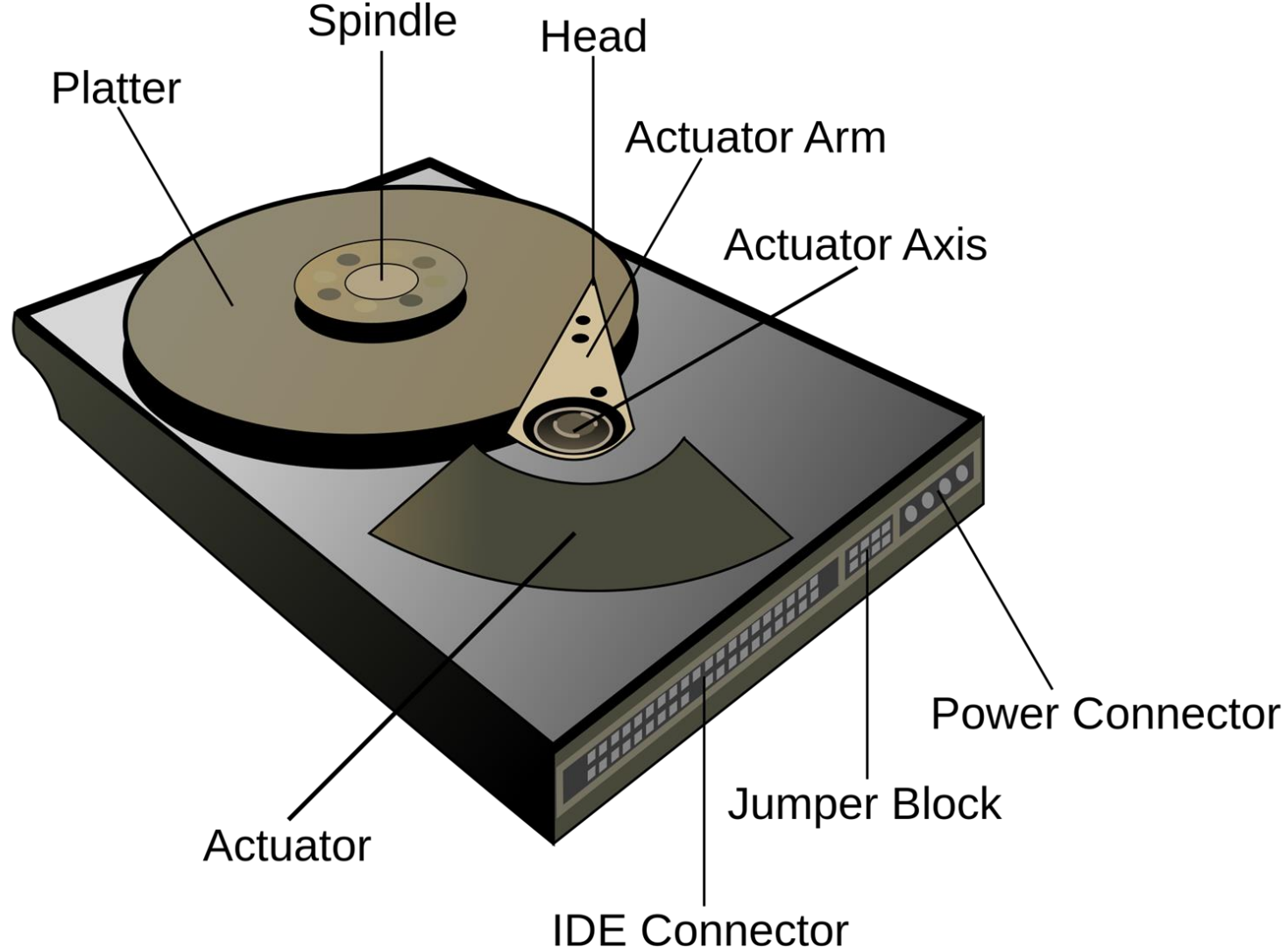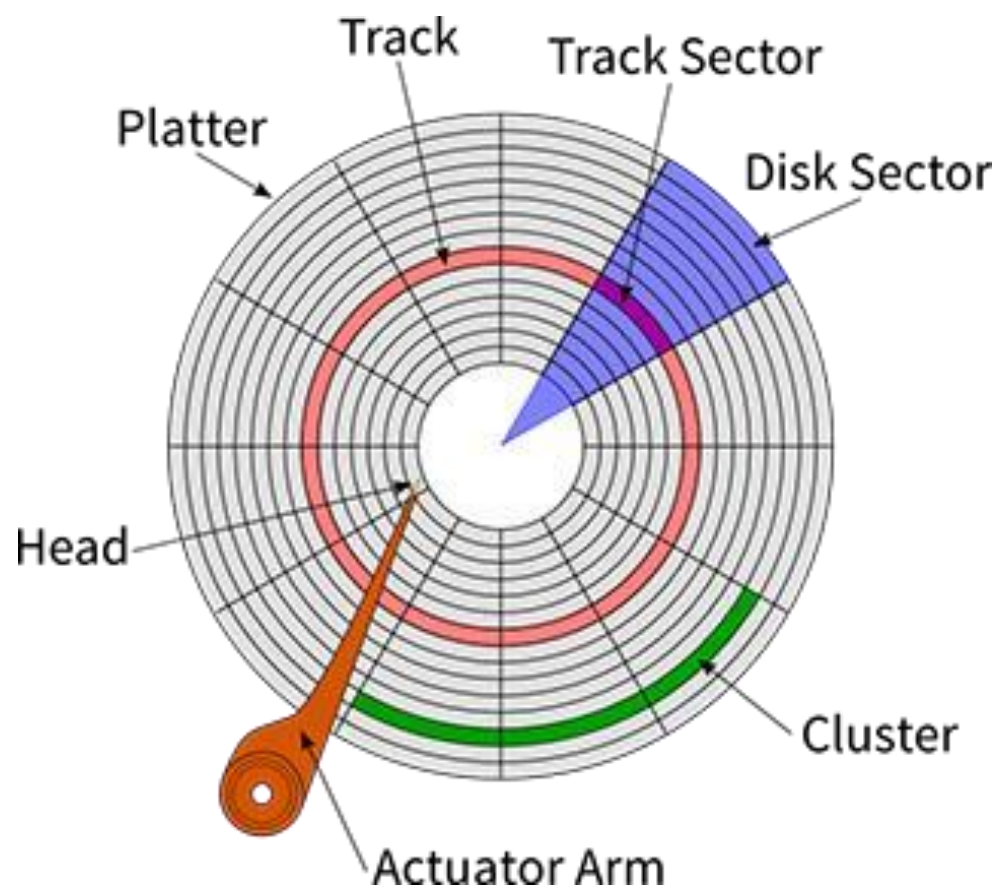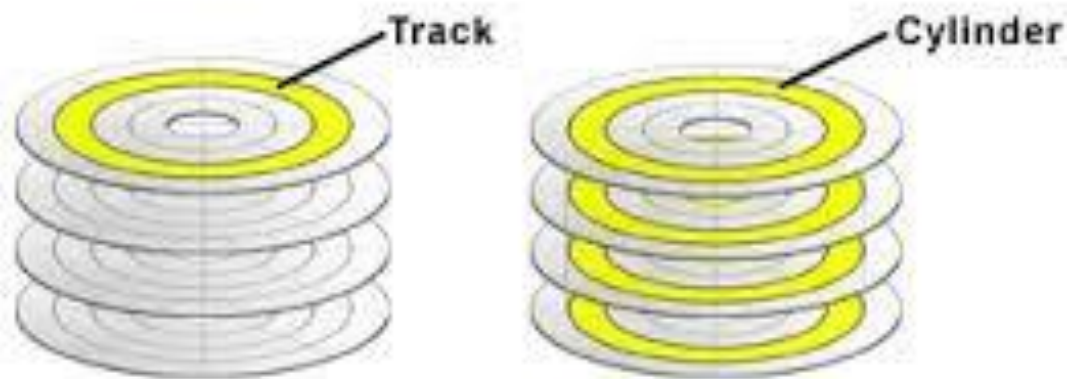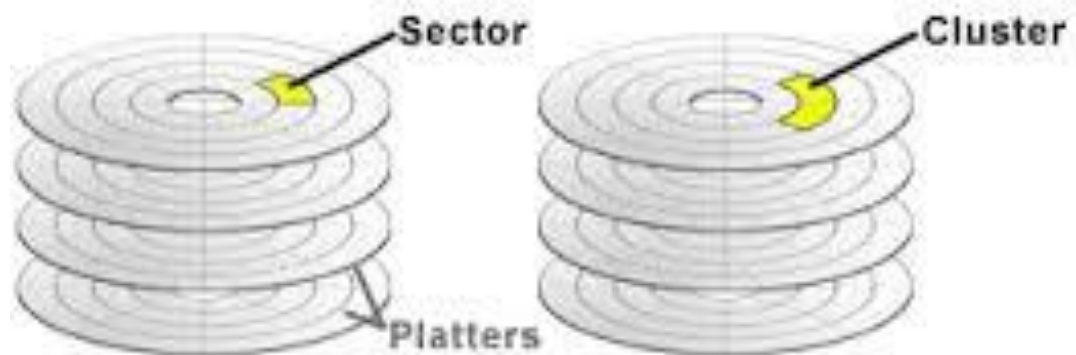
Hard Disk Internal Structure

It has array of magnetic disks

Each disk has a head to read and write data

Sector   Cluster

Platters

Track   Cylinder

File System

- Database to store data about files in a disk

  - File name
  - Location / address

- File allocation Table maintain the physical location of the files

FAT 16

DOS and Windows 3.x

Originally designed for use on small partitions up to 4GB

File names are limited to 8 characters

FAT 32

Introduced with Win98

No limitations for file name length

Support drives up to 2 TB

Weak in error recovery

No built-in file security

NTFS(New Technology File System)

– Introduced with Windows NT

– Secure and robust than FAT16 or FAT32

– Permission control

– Encryption

– Compression

– Offers better recovery from errors

– Support extremely large storage media

– Capable of long file names

NFS

– Distributed file system or Network File System

– Multiple users on multiple machines to share files

CDFS

– Compact Disk filing system

– Used with Linux

Hierarchical File System (HFS)

– Developed by Apple Inc. for Mac OS

HFS Plus

– Apple Inc. to replace Hierarchical File System (HFS)

– Used in Macintosh

UNIX file system (UFS)

– Unix and Unix-like operating systems

File Systems

Operating System	File System
Windows 2000/XP/ Server 2003	FAT12, FAT16, FAT32 & NTFS
Windows NT 4.0	FAT12, FAT16, & NTFS
Windows 95 SR2/98/ 98SE/Me	FAT12, FAT16 and FAT32
Windows 95	FAT12 & FAT16