

- **SASD (Sequential Access Storage Device):**

The SASD is a computer storage device whose content is accessed sequentially, as opposed to directly. These devices do not allow the user to access any record directly. For example, if a user needs to read and record the number 50, they have to first bypass record 49, only after that they would be able to read the desired record. It works like a cassette of a tape recorder.

For example: Tape drive.

- **DASD (Direct Access Storage Device):**

A DASD is another name of secondary storage devices that store data in discrete locations with a unique address. Direct-access storage devices allow the host computer to access data directly from wherever it is stored within the storage device because each data chunk is saved in a discrete and separate location from other chunk, complete with a unique address. This allows the computer to directly point to that location to get the data. Access methods include indexed, sequential and direct.

Example: Hard disk, Optical drive, Magnetic devices, etc.

- **Punch Card:**

Punch cards are paper cards where holes may be punched by hand or machine to represent computer data and instructions. They were a widely-used means of inputting data into early computers. The cards were fed into a card reader connected to a computer, which converted the sequence of holes to digital information.

For example, an early computer programmer would write a program by hand, then convert the program to several punched cards using a punch card machine. The programmer would then take the stack of cards to a computer and feed the cards into a card reader to input the program.

- **Magnetic Tapes:**

In magnetic tape only one side of the ribbon is used for storing data. It is sequential memory which contains thin plastic ribbon to store data and coated by magnetic oxide. Data read/write speed is slower because of sequential access. It is highly reliable which requires magnetic tape drive writing and reading data.

Advantages of Magnetic Tapes:

- These are inexpensive, i.e., low cost memories.
- It provides backup or archival storage.
- It can be used for large files.
- It can be used for copying from disk files.
- It is a reusable memory.
- It is compact and easy to store on racks.

Disadvantages of Magnetic Tapes:

- Sequential access is the disadvantage, means it does not allow access randomly or directly.
- It requires caring to store, i.e., vulnerable humidity, dust free, and suitable environment.
- It stored data cannot be easily updated or modified, i.e., difficult to make updates on data.

- **Hard disk:**

Hard disks are used as secondary memory for mass storage of information permanently. A hard is made up of aluminium base with thin magnetic material coating over it. Digital information is stored on the magnetic film by applying current pulses of suitable polarity to the magnetizing coil of the R/W head. The logic 1 or 0 depends upon the direction of magnetisation of very small area of the magnetic film which comes under the R/W head.

Tracks: Concentric parts of the magnetic disk in hard disk is called tracks.

Sector: Small parts of tracks are known as sectors. Tracks and sectors do not have physical existence on the surface of a disk.

Seek time: The time required to move the R/W head from current position to the specified position.

Latency Time: The time required to rotate the specified sector under the head.

Access Time: The sum of latency time and seek time is called Access time.

Some features of Hard disks:

- a) Storage capacity of hard disks vary from few GBs to 2000 GBs.
- b) Storage capacity per platter varies from a few GBs to 500 GBs.
- c) Speed is about 3500 rpm to 15000 rpm.
- d) Data transfer rate is 25 to 100 MB/s.
- e) Access time is 5 ms to 20 ms.

- **Floppy disk:**

A floppy disk is a thin circular plastic disk coated with magnetic material on the surface. It is a removable disk and it is used as backup memory to store programs, data and other information. The standard size of a floppy disk is 3.5 inch diameter.

It has tracks and sectors as hard disk and have low rotating speed of about 360 rpm. Its storage capacity is 1.44 MB.

- **Formulas for numerical:**

- a) Capacity of disk pack  
= Total number of surfaces x Number of tracks per surface x  
Number of sectors per track x Number of bytes per sector.
- b) Total number of sectors  
= Total number of surfaces x Number of tracks per surface x  
Number of sectors per track
- c) Formatting overhead  
= Total number of sectors x overhead per sector

d) Amount of memory lost due to formatting

= Formatting overhead

= Total number of sectors x Overhead per sector

e) Recording density of innermost track

= Capacity of a track / Circumference of innermost track

f) Data transfer rate

= Number of heads x Capacity of one track x Number of rotations in one second

g) Average rotational delay

=  $1/2$  x Time taken for one full rotation

h) Average access time

= Average seek time + Average rotational delay + Transfer time + Controller overhead + queuing delay