

SECONDARY STORAGE DEVICES AND MEDIA

PRIMARY STORAGE

We have seen that **primary storage** such as **RAM** provides a small amount of temporary storage area for the data and instructions required by the CPU for processing. Before data can be processed or a program can be run, it must be in RAM. Computer systems also need to store larger amounts of data, and information more permanently than allowed with primary storage.

When a user issues a command to start application software, such as a word processing program or a Web browser, the operating system locates the program in secondary storage, such as on a hard disk, CD, or DVD, and loads it into memory.

Unfortunately most RAM provides only temporary or **volatile storage**. That is it loses all of its contents when power to the system unit is shut off or disrupted. This results in a need for more permanent or non **volatile storage**. Users need much more storage capacity than is typically available in the computer's primary or RAM memory. For this reason RAM is sometimes referred to as **Primary Storage**.

Data can either be stored temporary or permanent. RAM (computer memory) stores data temporarily while secondary storage devices store data permanently. The differences between these are explained below:

| RAM (computer memory) | Secondary storage devices |
|---|--|
| Data is temporarily stored | Data is permanently stored |
| Volatile – data is erased when computer is switched off | Non-Volatile – data is not erased when computer loses power |
| Used to only store data that is currently in use | Used to store long term data. Data is erased when we manually choose to delete it. |
| Very fast reading/writing of data | Slower reading/writing of data |
| | Examples of permanent storage devices include hard disk, flash memory sticks, optical disks, etc |

SECONDARY STORAGE

What is Secondary Storage?

Secondary storage also referred to auxiliary storage are devices that provide a long-term storage for programs, data and information i.e. are designed to store or retain data and instructions in a relatively permanent form.

STORAGE MEDIA

Storage media or medium is the physical material on which computers keep data, instructions and information.

Storage media can also be defined as the devices that are used to hold data.

Note: Storage media is not the same as a storage device.

Storage media is '**permanent storage**' and will **hold data** even when the computer is **powered off**. Storage media can either be:

- **Internal** – fixed inside the computer
- **External** - plugged into the computer from outside (e.g. USB stick)

Examples of storage media include floppy disks, zip disks, hard disks, compact disks, tapes, miniature mobile storage such as memory sticks or cards, flash drives, etc. Three main types of storage media include:

- 1) Magnetic storage media
- 2) Optical storage media and
- 3) Solid state storage media

1. MAGNETIC STORAGE MEDIA

Magnetic storage media holds data **magnetically**. The surface area of the media is **magnetized** so that they can hold '**bits**' of data. The device that reads the media can also read the bits held on the surface area.

The different types of magnetic storage media include

- **Fixed Hard Disk/Hard Disk Drive (HDD)**
- **Portable hard disk drive**
- **Floppy disk**
- **Magnetic tape**

A) Fixed Hard Disk Drives (Internal)

A hard disk also called a hard drive usually consists of several inflexible, circular metal disk surfaces called platters coated in a magnetic film where the data is stored. They are used on all computers and are the main method of storing data. This is because they are capable of offering a very fast direct access to files and have very large storage capacities.

The platters have read/write heads which allow data to be written to (saved) or read (used) from the disc. The read/write heads (along with direct data access) allow for very fast data access speeds. Hard discs are used to store operating systems, software applications and all other files. Typical storage spaces are 250 gigabytes up to 4 terabytes (4,096 gigabytes).

Depending on the type of hard disk, the speed of data transfer rates range from 15 MBps to 320 MBps. Access time for today's hard disks ranges from approximately 3 to 12 milliseconds. Hard disks improve their access time by using **disk caching**.

Disk cache, sometimes called a buffer, consists of a memory chips on a hard disk that stores frequently accessed items such as data, instructions, and information. It is similar to memory cache.

Uses of Fixed Hard Disk Drives:

- a) Used to store the **operating system** and **applications software** (Windows, Word, Excel etc).
- b) Used for storing **files** and **documents** (music and homework for example).
- c) **Real-time systems** (robots, chemical plant control systems) and **online systems** (booking airline tickets etc) use hard disc drives to store data.
- d) Used in **file-servers** on **computer networks** to store files for example a student: drive in school used to store students work.

Fixed Hard Disk Drive interfaces

The hard disk interface defines the physical means by which the hard disk connects to the rest of the computer. There are many disk interfaces:

External hard disk interfaces include: USB, FireWire

Internal hard disk interfaces include:

- a) SATA, (Serial Advanced Technology Attachment)
- b) EIDE, (Enhanced Integrated Drive Electronics)
- c) SCSI, (Small Computer System Interface) and
- d) SAS (Serial-attached SCSI)

Types of Hard Disk

- a) An **Internal hard disk** is fixed in the system unit and usually stores the operating system required for the computer to work.
- b) An **External hard disk** is *a separate free-standing hard disk* that connects with a cable to a USB port or FireWire port.
- c) A **removable hard disk** is a hard disk that you insert and remove from either a dock or a drive.
- d) An **Internet hard drive**, also called online storage, is a service on the Web that provides storage to computer users, usually for a minimal monthly fee. Internet hard drive are used for the following reasons:
 - i) To access files from any computer that has Internet access.
 - ii) To save time by storing large audio, video, and graphics files instantly without downloading it to your computer.
 - iii) To allow others to access files on your Internet hard drive
 - iv) To view data and images immediately while away from the main office or location.
 - v) To store offsite backups of data.

Advantages of Fixed Hard Disks Drives

- a) Hard disks provide for larger storage capacities than floppy disks and other media
- b) Hard disks provide for faster read/write access times to data and information
- c) A hard disk is cheaper than a floppy disk per Megabyte stored
- d) Hard disk is usually more reliable because it has a better protection against dust and dirt.

Disadvantages of Fixed Hard Disk Drives

- a) Hard disks are not portable as they are designed to be 'fixed' into computer and not removed Data becomes less secure if left on a hard disk
- b) Head crush might occur due to extreme shock or contaminants
- c) Hard disks can be damaged easily when computer is not shut down properly (Disc crash!).

B) External/Portable Hard Disk Drive

Portable HDD works in a similar way to fixed hard discs but are connected to the computer externally via a Universal Serial Bus (USB) port. They use direct data access methods which makes reading/writing of data very fast. Portable Disc Drives are designed to be transportable.

They come with a USB Cable to allow for easy attachment to other computers which allows for easy backing up / sharing of files. Because they are used outside of the computer they come with protective casing to avoid physical damage to the disc drive. Typical storage spaces are 250 gigabytes up to 3 terabytes (3,072 gigabytes).

Uses of External/Portable Hard Disk Drives:

- a) Like fixed hard drives, they are used to store large files (such as video).
- b) They can be used as portable back-up systems to avoid loss of data.
- c) They are used to transfer data, files and software between computers via USB connectivity.

Advantages of External/Portable Hard Disks

- a) Fast read/write times (direct data access).
- b) Designed to plug into almost any computer via USB ports.
- c) Transports a large number of files.
- d) Back up important files or an entire internal hard disk.
- e) Easily store large audio and video files.
- f) Security for your data for example, when you save any task on it, you can remove the hard disk and lock it up, leaving no data in the computer.

- g) Added storage space to the desktop computer, notebook or laptop without having to open the system unit.
- h) Users can share the drive on multiple computers.

Disadvantages of External/Portable Hard Disks

- a) Small size makes them easy to misplace or have stolen.
- b) More expensive than other forms of storage
- c) Protective casing will only protect against minor bumps. If the device is dropped it can still become damaged.

C) Floppy Disk

A **floppy disk**, or **diskette**, is a portable, where information is held on a thin circular, flexible plastic disk called a Mylar film with a magnetic coating enclosed in a square-shaped plastic shell.

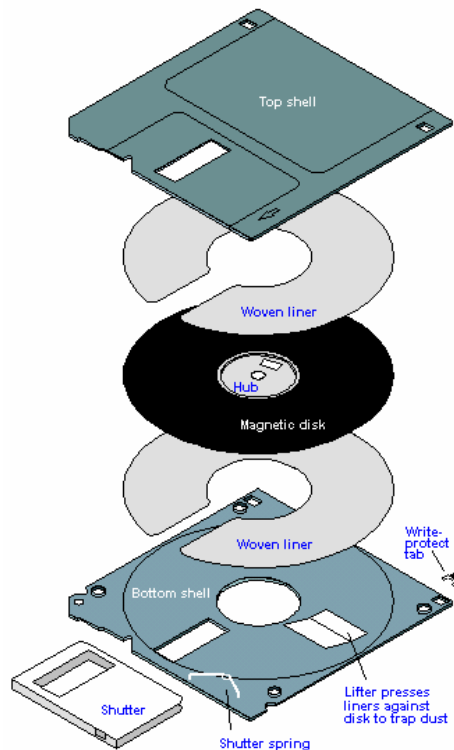
Data on a floppy disk is read or written by a floppy disk drive which rotates the disk. As the disc rotates, a read/write head is used to add or read data. The data is read or written using direct data access methods.

The disc of plastic is protected by a retractable metal sleeve called a **shutter** and a hard plastic casing. A small notch provides write protection which prevents accidentally copying over work. Maximum storage on a floppy disc is only about 1.44 MB (700 pages of text).

Uses of Floppy Disks:

- a) Floppy disks can still be used where very small files need to be transferred/stored (e.g. small word processed documents).
- b) Write protect facility is useful to prevent accidental overwriting of data.
- c) Diskettes can be used to create duplicate copies of documents, images from another storage medium such as a hard disk. This is called **backing up** data. The duplicate copy that is created is called a **Backup**.

Diagram showing components of a floppy disk



Care for Floppy Disks

- a) Do not touch the Mylar surface because it can easily get contaminated with dirty particles
- b) Do not place or put heavy objects on top of disks
- c) Don not put floppies near magnetic fields such as telephones. Data can be easily lost if exposed to the magnetic fields.
- d) Floppy disks should be kept away from dust and smoke. These can easily contaminate the storage surface.
- e) Floppy disks shouldn't be exposed to excessive sunlight, heat and cold conditions.
- f) Keep disks away from food and drinks. Once they get into contact with the storage surface, it is easily contaminated.
- g) Handle floppy disks by the edges while inserting it into the floppy drive.
- h) Do not eject the floppy from the drive when being read. This can easily damage the Mylar surface thereby creating bad sectors (surface area on a disk where data cannot be stored).

- i) In case of movement or storage, floppies should be kept in plastic floppy boxes and not in papers, envelopes or pockets.
- j) To prevent data loss through malicious or accidental erasure, always write protect your diskette using the **write protect notch**.

Advantages of Floppy Disks

- a) A floppy disk is very small, lightweight and easy to carry
- b) Costs very little to buy.
- c) Data on a floppy disk can be accessed randomly
- d) Data on a floppy disk can be write protected easily which protects it against accidental altering or erasing.
- e) Floppy disks can be used to transfer data from one computer to another

Disadvantages of Floppy Disks

- a) A floppy disk is not durable (due to dust and dirt) and can be destroyed by magnetic fields.
- b) Floppy disks have a very slow data transfer rate when saving or reading data.
- c) Very low storage capacity when compared to other media i.e. 1.44 MB.
- d) Floppy disks are very delicate and easy to damage.
- e) Very few modern computers today have floppy disc drives.

D) Magnetic Tape

Magnetic tape is a thin strip of magnetic coated plastic which is wrapped onto a reel. Data is stored on the magnetic plastic in the form of 1's and 0's (binary numbers). Data is written to and read from in sequence (i.e. in order) which is also known as **serial access**. This type of storage media has a very slow data access rate. Because it is so slow, it is useless for real-time applications (where what is stored is constantly being updated).

Uses of Magnetic Tapes:

- a) Used where extremely large amounts of data need to be backed up.
- b) Used where speed of reading/writing of data is NOT a priority. For example in batch processing applications such as clearing bank cheques and producing pay slips.

c) Used for backups of computer networks in schools and business.

Advantages of Magnetic Tapes

- a) Less expensive than the equivalent capacity hard disk drive.
- b) Very robust. It cannot be easily damaged
- c) Very large storage capacities of up to 185 terabytes or 185 trillion characters.
- d) Can be setup to back up overnight or over the weekend.

Disadvantages of Magnetic Tapes

- a) Very slow data access/transfer. Reading data back from the tape is slow.
- b) Needs another tape to update data.
- c) Data may be corrupted if the tape is placed near a strong magnetic field e.g. a large speaker.

2. OPTICAL STORAGE MEDIA

Optical storage media includes all the mediums that use a light source to read/write data onto a disc.

Optical storage media stores data by **burning 'dots'** onto the disk surface that can be read using light usually a **laser beam**. Each dot represents 1's and 0's (Bits of information). Data is read by shining the laser beam onto the surface of the disc.

Some Optical Disks (such as CD-R's) allow you to write data to the disc as well as read it. This works by using the laser beam to **'burn'** dots onto the surface of the disk (creating the data) and then reading them back again. This process is known as **'burning'**.

In order to read/write data on a disc you need a **'disc drive'**. For example: CD Drive, DVD Drive, Blue-Ray Drive. The drive contains the following:

- A mount for the disc
- A laser (to read/write the data bumps)
- A motor (to spin the disc across the laser)

Examples of optical media include CD-ROM and DVD-ROM, CD-R and DVD-R, CD-RW and DVD-RW, DVD-RAM and Blue-ray Discs

Care for Optical Disks

The following measure should be followed for the safety of data on optical disks:

- a) Do not expose the optical disc to excessive heat or sunlight
- b) Do not eat, smoke or drink near an optical disc.
- c) Do not stack disks.
- d) Do not touch the underside of the disk.
- e) Always store the optical disc in a jewel box when not in use
- f) Always hold an optical disc by its edges.
- g) Do not drop the optical disk to the ground
- h) Don't bend the optical disk.

CATEGORIES OF OPTICAL STORAGE MEDIA

A. CD-ROM and DVD-ROM

CD-ROM's and DVD-ROM's are bought with pre-loaded data already on them. They are usually pre-loaded with software, music, movies and games. ROM stands for '**read only memory**'. This means that the data cannot be written over (added to) and can only be read. Whatever is already loaded onto the ROM cannot be removed or changed.

So if you purchase a music CD, you can listen to the tracks on the disc but you can't add more songs of your own. **CD-ROMs** have a maximum capacity of about **800MB** (about 400,000 pages of text) while **DVD-ROMs** have a maximum capacity of about **4.7GB** (about 2.4 million pages of text)

Uses of CD-ROMs and DVD-ROMs:

CD-ROMS are used by manufacturers to store smaller files (up to 800MB) such as:

- Music tracks
- Software (such as word processors, spreadsheets etc)
- Audio books
- etc

DVD-ROMS have much larger storage capacities (up to 4.7 GB) than CD-ROMS and are used to store bigger files such as:

- Movies
- Modern games (like grand theft auto, call of duty etc)
- Multimedia encyclopedias
- Etc

Advantages of CD-ROMs and DVD-ROMs:

- a) Hold far more data than Floppy Discs.
- b) Less expensive than Hard Disc Drives.
- c) Data stored on them is '**read only**' which means you cannot accidentally erase the files.
- d) They are very portable as they are small and light.

Disadvantages of CD-ROMs and DVD-ROMs

- a) Hold far less data than hard disk drives or memory sticks.
- b) Very slow data transfer and access rates when compared to hard disk drives. Reading back from the disc is slow.
- c) You cannot add your own files to the discs because they are both read only.
- d) Optical disks can be easily damaged by breaking or scratching.

B. CD-R and DVD-R

The letter 'R' means that the disc is recordable once only. Once the disc has data recorded on it becomes a CD/DVD ROM (read only). Data can be added to the disc (once) but NOT erased when it is on there. Data is 'burnt' onto the discs using a disc burner.

A disc burner works in the same way as a regular disc drive but it uses a more powerful laser to burn data onto a CD/DVD-R disc. A disc burner can also read the data held on the disc using a less powerful laser that is not strong enough to burn. Thin layer of metallic dye is used to record the data onto.

When CD-R's and DVD-R's are burnt, the laser makes permanent marks (dots of data which represent 1's and 0's) onto the metallic dye. These marks cannot be erased (which is why what you add to the disc is

permanent). DVD-R's disks use a dye that allows for more dots to be burnt onto the disc's surface.

This is why DVD-R's can hold more data than CD-R's. CD-R disks have a maximum capacity of about 700MB (about 80 minutes of audio) while DVD-R disks have a maximum capacity of about 4.7GB (over 2 hours of video). DVD-R's are also available in 'dual-layer'. This means they have two layers of recordable surfaces which mean they can store more data (about 8.5GB) than a regular DVD-R.

Uses of CD-R and DVD-R:

- a) CD-R's are used to create personalized playlists of music.
- b) DVD-R's are used to store home recordings of video shot on digital cameras.
- c) They can be used to backup important data so that there are copies in case the originals get erased or deleted.
- d) They can be used to transfer data from one computer to another.

Advantages of CD-R and DVD-R:

- a) Once burned, data is impossible to accidentally delete because the disc becomes read only.
- b) They are cheaper than RW discs and Hard Disk Drives.
- c) It is easy to transport information from one computer to another. You can take the disc out of one machine and use in another.
- d) Needs to be protected from extremes of heat.
- e) Has a limited number of read/write cycles.

Disadvantages of CD-R and DVD-R

- a) They are recordable once. This means updating the disc is impossible.
- b) If an error occurs during burning the disc is damaged and must be thrown away (wasted).
- c) Very slow data transfer rate. Burning data onto a disc can take up to 15 minutes.

C. CD-RW and DVD-RW

The letters '**RW**' stand for **Re-Writeable**. This means that the disc can be recorded on over and over again. Unlike CD/DVD-R's these discs do not become ROMS (not read only) once burned. RW drives are used to burn data onto the dye on the RW disc (and also read from it). The dye used to record data is called 'phase changing dye' and it allows the bumps of data to be 'undone'. The bumps of data are really just flattened again which effectively erases any stored data.

Data can be added to the disc and can also be erased. CD-RW's and DVD-RW's can be reused around 1000 times. CD-RW's have a maximum capacity of about 700MB while DVD-RW's have a maximum capacity of about 4.7GB

Uses of CD-RW and DVD-RW:

- a) CD-RW's are used to create personalized playlists of music and then add/remove songs as you wish.
- b) DVD-RW's are used to record television programmes and can be recorded over many times.
- c) DVD-RW's are also used to record video content of closed circuit television (CCTV) to allow security to keep an eye on businesses and what is happening on the streets
- d) They can both also be used to make backups of computer files.

Advantages of CD-RWs and DVD-RWs:

- a) They can be re-used many times.
- b) Data stored on the discs can be updated.
- c) They are not as wasteful as the recordable format. Even if burning fails, the disk can still be recorded on later and not thrown away.

Disadvantages of CD-R and DVD-R

- a) They are more expensive to buy than CD/DVD-R discs.
- b) It is possible to accidentally overwrite data since RW discs can be updated.
- c) Data transfer to the discs is very slow compared to a hard disk drive.

D. DVD-RAM (DVD-Random Access Memory)

With DVD-RAM writing and reading of data can happen at the same time. This means that you could watch a programme at the same time that another one is being recorded – (Read and write at the same time). DVD-RAM is much faster and easier than CD/DVD-RW at overwriting data.

DVD-RAM discs can be rewritten over many times (over 100,000). Data can be reliably stored on DVD-RAM for many years due to their high quality. DVD-RAM has a capacity of 4.7GB or 9.4GB with double sided discs.

Uses of DVD-RAM:

- a) Because DVD-RAM discs last so long they are used in video and data archiving as a safe store for important files and records.
- b) Used in DVD recorders to record TV programmes (on digital and satellite) to allow simultaneous recording and playback.
- c) Used in camcorders to store video reliably and for many years.

Advantages of DVD-RAM:

- a) They can be used for a long life. They last at least 30 years.
- b) They can be written over 100,000 times (RW Disks only allow 1,000 re-writes).
- c) They offer very fast access to stored files.
- d) They have a very large storage capacity compared to CD's.
- e) They can read data at the same time it is being written.

Disadvantages of DVD-RAM

- a) They don't work in as many devices as the recordable or – rewritable discs.
- b) They are expensive compared to DVD and CD recordable discs.

E. Blu-ray Disc

Blu-ray discs work in a similar way to DVD-ROMS but the laser used to read the data is blue rather than red. This blue laser colour is why the

name 'Blu-ray' was used. Blue lasers are capable of reading data dots that are positioned closer together on the disk surface.

As a result, more data dots (1's and 0's) can be stored and read. More data dots mean a higher storage capacity of up to 50 million pages of text. Blu-ray-RW discs can be rewritten to in much the same way as RW disks. Blu-ray's have **capacities of 25GB, 50 GB and 100GB**, depending on the disc

Uses of Blu-ray Discs:

- a) They are used to store high definition video like high quality movies. One 25GB Blu-ray disc can store 2 hours of HDTV.
- b) They are used in some home video consoles like Play station 3.
- c) They are used to back up hard disk drives in PC's.

Advantages of Blue-ray disks:

- a) Huge storage capacity. They are perfect for storage of high definition movies.
- b) Data can be read/transferred very fast when compared to other optical media.
- c) Sound and picture quality is excellent making them ideal for storing High Definition (HD) films.
- d) They are mass produced and relatively cheap to acquire.

Disadvantages of Blue-ray disks:

- a) They are very expensive compared to other optical media.
- b) They only work in Blu-ray drives/players which are expensive.
- c) Not all computers have Blue-ray drives which limits the use of the disks.
- d) They can be easily damaged by breaking or scratching

3. SOLID-STATE STORAGE MEDIA

Solid-state media holds data on devices that have no moving parts. SSEURE DIGITAL technology is known as 'flash memory' and this is the

smallest form of data storage. Examples include memory sticks, memory cards etc.

They store data as 1's and 0's within millions of electrical transistors instead of on films of magnetic substance or as dots on discs. If the transistor conducts an electric current, this equates a 1. If it does not conduct a current, this equates a 0

They hold several advantages over Magnetic Disc Drives:

- a) They are much smaller
- b) They use less power because with no moving parts it means less power is needed.
- c) They have a faster data access and transfer times.
- d) They are much more robust because they are harder to damage.

A. Solid State Hard Drives (SSD's)

Solid State Drives are used in desktop PC's and laptops in place of magnetic hard disk drives. They use solid state technology based on electrical circuits which means they have no moving parts. Magnetic hard disks have moving parts such as spinning disks and read/write heads. These store files permanently (non-volatile storage). They have a current capacity of about 1TB (approx 1 million thick books worth of text)

They offer advantages over magnetic hard drives such as:

- a) They run silently. Magnetic hard disk drives spin producing whirring sound.
- b) They have a longer life span
- c) Have a faster data access and transfer time.
- d) Use less power.
- e) Produce less heat.

Uses of Solid State Hard Drives:

- a) Used in desktop PC's and laptops to permanently store data such as:
 - i) **Operating systems**
 - ii) **Software applications** (such as word processors, spreadsheets etc)
 - iii) **Music/Video files**
 - iv) **School work, photos**

Advantages of Solid State Hard Drives:

- a) Last longer than magnetic hard disks (no moving parts).
- b) Faster data access/transfer times. Computers even boot up faster using solid state hard drives.
- c) Use less power and produce less heat.
- d) Run silently.

Disadvantages of Solid State Hard Drives

- a) They are more expensive than magnetic hard disks.
- b) They have a smaller storage capacity than magnetic hard disks.

B. Memory Sticks / Pen Drives

Memory sticks are small, portable external storage devices. They are used to easily transfer data between computers. Memory sticks use solid state technology and are usually connected to the computer via USB ports.

Memory sticks are making other forms of portable storage (like CD's and DVD's) redundant as they are much easier and quicker to transfer data. Data access and transfer is very fast. Memory sticks are very cheap to buy. Current capacities of memory sticks are up to 512 GB (about 500,000 thick books).

Uses of Memory Sticks:

- a) Used for easily transporting files/data between computers.
- b) Used for backing up data quickly and easily.

Advantages of Memory Sticks/Flash Disks:

- a) They are very small and lightweight (portable).
- b) They are robust. They have no moving parts meaning they are less likely to become damaged. For example: CD's and DVD's can get scratched.
- c) They are compatible with almost any computer. Most computers have USB ports.
- d) Large storage capacities (up to 512 GB)

Disadvantages of Memory Sticks/Flash Disks:

- a) They have no write-protect feature. This means that it is possible to accidentally copy over data.
- b) Small physical size means that they are easy to misplace or lose.
- c) More expensive per GB than magnetic hard disks.

C. Flash Memory Cards and Micro Flash Memory Cards

Flash memory cards are also known as '**Secure Digital Cards**' (or Secure Digital Cards). Secure Digital cards are small and rectangular in shape. These are a form of Electronically Erasable Programmable Read Only Memory (EEPROM). Secure Digital cards use solid state technology (they have no moving parts).

Micro flash memory cards are just smaller versions of the regular flash memory cards. Micro flash memory cards are sometimes also called 'Micro Secure Digital Cards'.

A wide range of devices have slots to read flash memory cards including laptops, mobile phones, tablets and mp3 players. Secure Digital card readers can be used to transfer data from the cards onto a desktop PC. Secure Digital Cards have a maximum capacity of about 256GB. Micro SECURE DIGITAL Cards have a maximum capacity of about 128GB.

Uses of Flash Memory Cards:

- a) Secure Digital cards are used to store photos on digital cameras.
- b) Secure Digital cards are used in hand held devices (like PDA's and palmtop's) to store files and data.
- c) Micro Secure Digital cards are used in mobile phones as memory cards to store photos and music etc.
- d) Micro Secure Digital cards can be used by MP3 players to store music files.
- e) Main internal storage for tablet computers.

Advantages of Flash Memory Cards:

- a) They are very small so they are easy to transport files from one device to another for example from one digital camera to another.

- b) They are robust and not easily damaged.
- c) Easy to connect to mobile devices through Secure Digital Slots

Disadvantages of Flash Memory Cards:

- a) They are more expensive per GB than magnetic hard disk drives.
- b) They have a lower storage capacity than magnetic hard disks.
- c) Small size makes them easy to have them stolen or lost.
- d) Desktop PC's don't usually come with built-in memory card readers. To connect to a desktop PC you need to buy an Secure Digital card reader.

STORAGE TERMINOLOGIES

Storage medium:

Storage media is the physical material or devices that are used to hold data e.g. memory sticks, hard disk, Digital Versatile Disks (DVD), magnetic tape.

Storage Medias can be either;

- **Internal or Fixed** - Located inside the computer e.g. hard disk drives
- **External or removable** - Plugged into the computer via USB (not found inside the system unit) e.g. CDs, memory sticks, memory card, DVDs, external hard disk drives.

Storage Capacity

Storage capacity is the maximum amount of data measured in bytes (characters) a storage medium can hold.

Storage Device

A **storage device** is the hardware that reads or writes (saves) data from a storage medium.

Reading

Reading is the process in which a storage device transfers (retrieves or opens) data, from a storage medium into memory.

Writing

Writing is the process in which a storage device writes (saves) data from memory to a storage medium.

Media Failure

Media failure is a problem that affects the storage media resulting in data loss. Magnetic storage media are mostly affected when they lose their magnetic charge, hence leading to data loss.

Device Failure:

A device failure is a problem with a mechanical device such as a disk drive. Storage devices fail as a result of power or circuitry problems.

CHARACTERISTICS OF STORAGE DEVICES and MEDIA

- a) **Storage capacity** is the maximum amount of data measured in bytes (characters) a storage medium can hold.
- b) **Storage media or medium:** is the physical material or devices that are used to hold data.
- c) **Access time:** is a measure of the amount of time it takes a storage device to retrieve data and programs from a storage medium.
- d) **Transfer rate** is the speed with which data, instructions, and information move to and from a device. Transfer rates for storage are stated in KBps (kilobytes per second).
- e) **Method of Access:** ways in which data is accessed, stored and read either direct access (random) or serial access (sequential)

WAYS IN WHICH DATA IS STORED AND READ

There are two main ways in which data is stored and then read from the different storage devices:

- a) Serial Access (Sequential Access)
- b) Direct Access (Random Access)

a) Serial Access

This method is also called **sequential access**. Data is accessed by starting at the beginning and then searched through in order, until the required information is found. Serial access is used on magnetic tape systems and is very slow. Examples of storage medium that use serial access are video cassettes, music cassettes, and backup tape cartridges.

b) Direct Access

The computer can calculate exactly where the data has been stored and can access it directly or instantly. This method is used with storage devices such as: Hard Disk Drives, Optical Media (such as re-writable CD's and DVD's). This method is much faster than Serial Access.

FORMATTING A DISK:

Formatting is the process of preparing a storage media usually a disk for storage purposes. The formatting process creates tracks, sectors, clusters and cylinders on the storage surface.

A **track** is narrow concentric circle (a ring) formed around the storage surface of the disk for recording data. Tracks are further divided into sectors.

A **sector** is a pie shaped segment (subdivision) of a track on the storage surface of the disk for data storage. Each sector stores 512 bytes of data. Larger files are stored in more than one sector. Each sector is sequentially numbered. Sectors are further grouped into clusters.

A **cluster** is a group of two to eight sectors. The size of a cluster depends on the operating system that was used to format the disk. A cluster is the smallest unit of space used to store data.

A **cylinder** is a set of tracks that occupy the same position at the top and bottom surface of storage on a disk with the same track number.

When you format a disk, the operating system performs the following tasks.

- a) Root folder: This enables the user to store data on the disk in a logical way.
- b) Data area: the portion of the disk that actually holds data and is divided into tracks and sectors.
- c) Any data on the disk surface is erased.
- d) The storage surface is checked and marked for bad sectors.
- e) An internal address table called a **File Allocation Table (FAT)** for Windows 95 OS is created on the surface of the disk and is used to locate files on a disk. For Windows XP and above the file system created is referred to as the **New Technology File System (NTFS)**.

The FAT or NTFS records the following:

- a) The name of the file stored on the disk
- b) The size of the file stored on the disk
- c) The tracks and sectors where the file is stored on the disk
- d) The date and time the file was created or last modified.

A diagram showing a formatted disk surface

