

COMPUTER HARDWARE

Storage Hardware

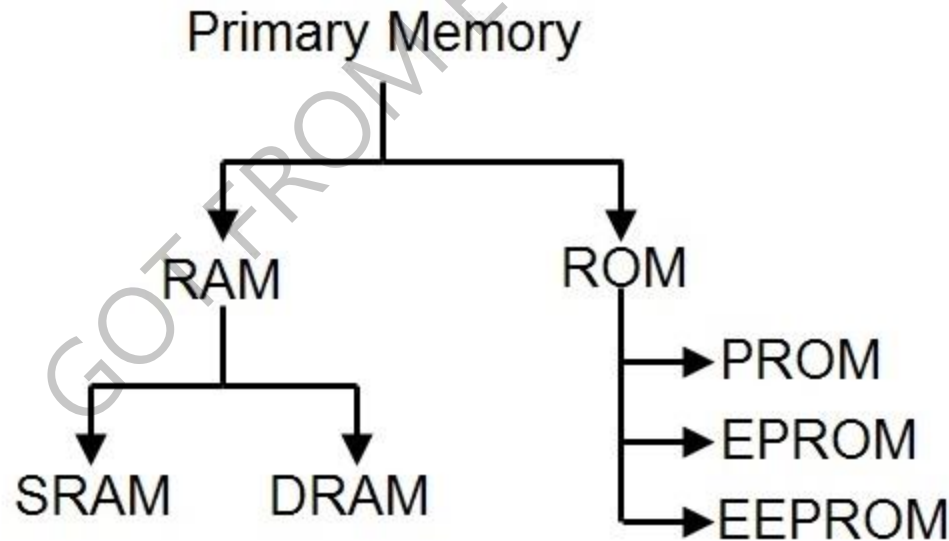
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Unit Introduction

- A computer uses primary memory and secondary memory to store data.
- (i) **PRIMARY MEMORY** is computer memory that a processor or computer accesses first or directly. It allows a processor to access running execution applications and services that are temporarily stored in a specific memory location. such as RAM.



SECONDARY MEMORY

- (ii) **SECONDARY MEMORY** is computer memory that is non-volatile and persistent in nature and is not directly accessed by a computer/processor..
- When a user issues a command to start an application program, the operating system locates the program in secondary storage, and loads it into primary memory.
- In this Unit, we shall focus on secondary memory

Definition of Terminologies

- **A Storage medium** is the physical material on which a computer keeps data. There is a variety of storage media available.
- **Capacity** is the number of bytes (characters) a storage medium can hold.
- **A Storage Device** reads and writes data to and from a storage medium.
- **Reading** is the process in which a storage device transfers data, from a storage medium into memory.
- **Writing** is the process in which a storage device transfers data from memory to a storage medium (saving).

Definition of Terminologies (cont)

- **Access time**, is a measure of the amount of time it takes a storage device to locate an item on a storage medium.
- **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)

Categories of Secondary Storage Media

- There is a wide variety of storage devices in the following categories.

(A) Magnetic media, or

(B) Optical media

(C) Solid state media

And others

- Punched Cards
- Photographic film
- Microfilm and Microfiche

(A) Magnetic media

- **Magnetic storage media** refers to a media on which data is represented as magnetic spots on the tape or disk, with a magnetized spot representing a 1 bit and the absence of such a spot representing a 0 bit. e.g.
 - i. Magnetic tape
 - ii. Floppy disk
 - iii. Zip disks and Jaz disks
 - iv. Hard disk
- **Magnetic storage device** refer to the device which is used to read and write data on a magnetic media. e.g.
 - a) Hard disk drive
 - b) floppy disk drive

(i) Magnetic tape

- **Magnetic tape** is a medium for magnetic recording, made of a thin, magnetizable coating on a long, narrow strip of plastic film.
- Magnetic tape storage requires sequential access, i.e. data must be accessed in the order in which it is stored. If the computer is to read data from the middle of a tape, all the tape before the desired piece of data must be passed over consecutively.
- Today, magnetic tape storage is no longer used for routine processing.

Advantages of Magnetic tape

- a) **Cost effective** – Coupled with its large capacity, magnetic tape storage is also cost-effective.
- b) **Magnetic tape portability.** It can easily be carried from one place to another securely.
- c) **Less Susceptible to Online Threats.** Magnetic tape systems live largely isolated from the internet. This helps in their protection from cyber-security threats
- d) **Generally Longer Lifespan** than Other Mediums at around 30 years

Disadvantages of Magnetic tape

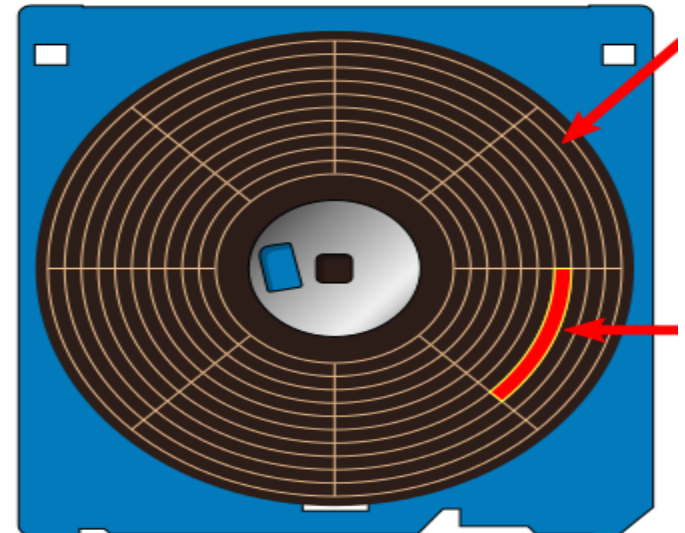
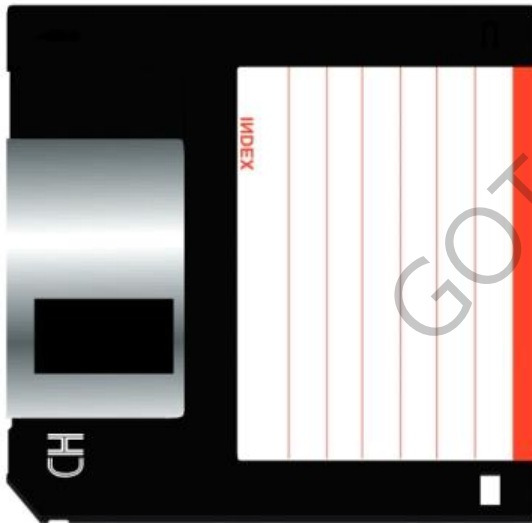
- a) High Initial Cost of equipment. A magnetic tape storage system generally requires purchasing costly, special equipment.
- b) Slow to find data. Data access is far slower than random access devices, such as hard disks. To find a specific block of data in magnetic tape, all data blocks before it need to be accessed first.
- c) Susceptible to physical and environmental damage. This may lead to data loss, data alteration, and/or permanent tape damage. In some cases, the entire tape role becomes useless after damage to some area/s of the tape.
- d) Possible damaging factors include:
 - a) High temperature
 - b) High humidity
 - c) Proximity to strong magnetic fields
 - d) Mechanical shock and improper handling dust.
- e) Difficult to recover specific/individual files. Magnetic tape storage is a sequential access device. It is difficult to find and/or recover a specific or individual file in a backup.

Illustration of Magnetic tapes



(ii) Floppy disk (diskette)

- A floppy disk, or diskette, is a portable, inexpensive storage medium that consists of a thin circular, flexible plastic disk with a magnetic coating enclosed in a square-shaped plastic shell.



Floppy disk (...cont)

- A standard floppy disk is 3.5-inches wide and has storage capacities up to 1.44 MB.
- A floppy disk drive is a device that can read from and write to a floppy disk. Before you can write on a new disk, it must be formatted.
- Formatting is the process of preparing a disk for reading and writing by organizing the disk into storage locations called tracks and sectors

Care for diskettes

- a) A floppy disk should not be exposed to heat, cold, magnetic fields and dust.
- b) Never leave diskettes in the disk drive. Diskettes should be rolled up and stored in pencil holders.
- c) Diskettes should not be inserted or removed from the drive while the red light is flashing.
- d) Avoid touching the inner magnetic strip of the diskette.

Advantages of Floppy Disks

- a) Floppy diskettes are portable
- b) Floppy diskettes are cheap
- c) Random Data Access on a diskette is possible
- d) A floppy diskette can be write-protected from being changed.

Disadvantages of Floppy Disks

- a) Floppy diskettes are not reliable – they need to be handled with a lot of care, else risk losing data.
- b) Floppy diskettes are not durable.
- c) Data Access time is relatively slow.
- d) They have limited Storage capacity (only 1.44MB)

(iii) Zip drive & The Jaz drive

- The Zip drive is a removable floppy disk storage system with capacities of 100 MB to 750 MB that was introduced by Iomega in late 1994.
- However it was never popular enough.
- Zip drives fell out of favor for mass portable storage during the early 2000s due to emergence of much better USB flash drives, CDs, and DVDs.

The Jaz drive

- Similar to the Zip drive, The Jaz drive was a removable disk storage system, introduced by the Iomega company in 1995.
- The Jaz disks were originally released with a 1 GB capacity .
- The rising popularity and decreasing price of CDs and DVDs greatly hurt the success of the Jaz Drive and the Jaz line was ultimately discontinued in 2002.

Zip and Jaz drives with media.



(v) Hard disks

- A hard disk is a spindle of magnetic disks, called platters, that record and store information magnetically. Because the data is stored magnetically, information recorded to the hard disk remains intact after you turn your computer off.
- The entire device is enclosed in an air-tight, sealed case to protect it from contamination. Hard disks come in a variety of sizes.
- The hard disk is housed inside the system unit save if its an external hard disk.

Strength of the Hard disk

- a) They have very large storage capacity
- b) Hard disks have short access speeds.
- c) Hard disks are safe from physical damages since most of them reside inside the system unit.
- d) Hard disks of standalone computers have less risks of virus infections.
- e) It's cheap in terms of data stored.

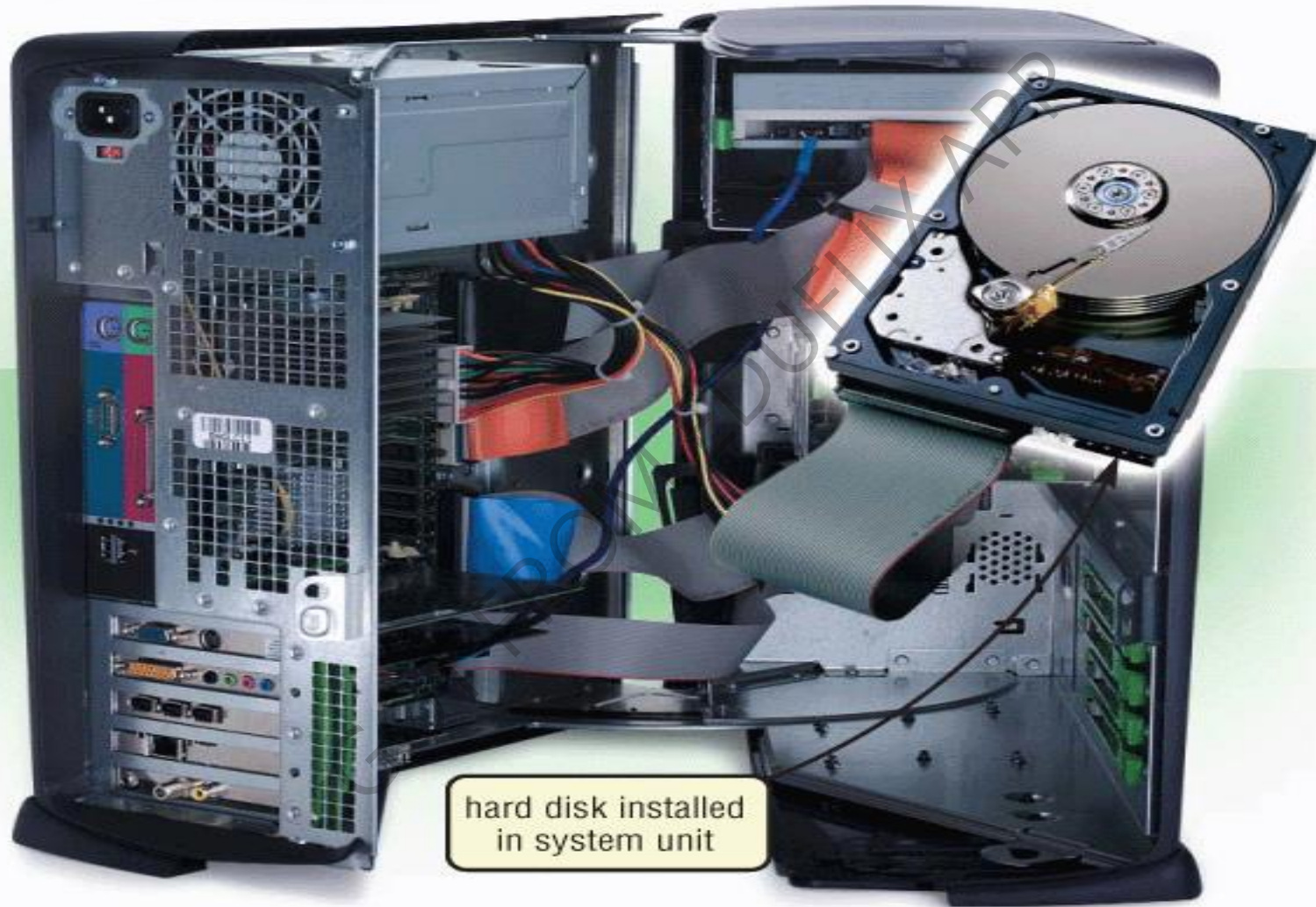
Advantages of Hard disks

- a) Hard disks have a very large storage capacity
- b) Hard disks have faster access speeds.
- c) Hard disks can be partitioned, hence increasing data security.
- d) Hard disks are cheap in terms of data stored.
- e) Hard disks of standalone computers have less risks of virus infections.
- f) Hard disks are more durable
- g) Hard disks are fixed(Always fixed in the system unit thus more protection)

Disadvantages of hard disks

- i. Hard disks are expensive in terms of cost.
- ii. Since hard disks hold large amount of data this may put valuable information at a risk in case of disc crash or disk failure.
- iii. Hard disks if housed in networked computers, are susceptible to virus.

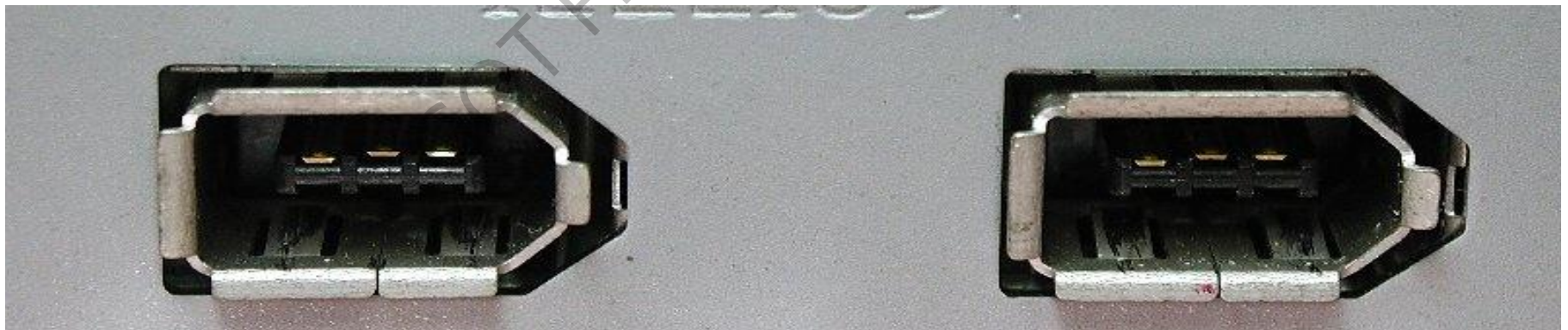
Hard disk inside the system unit



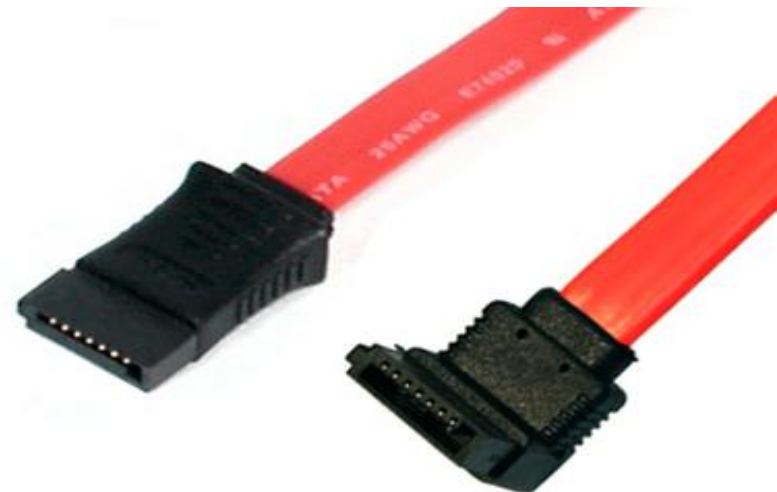
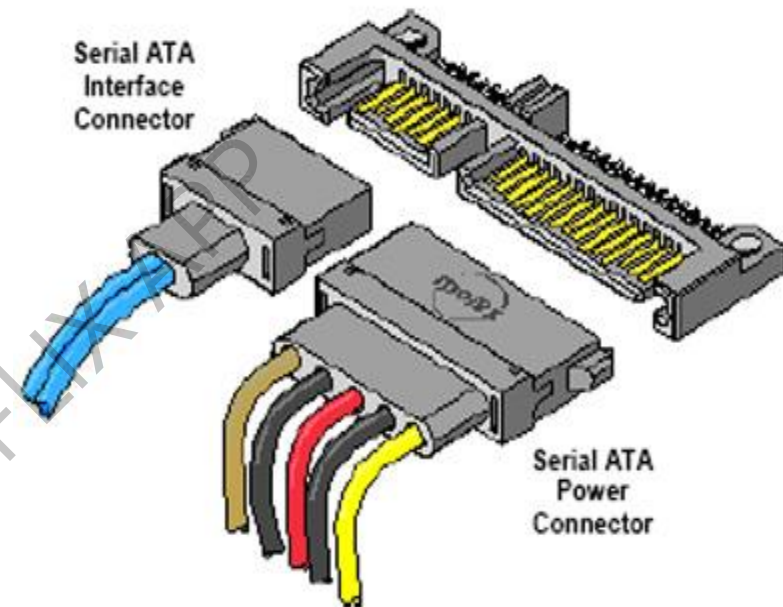
Hard disk interfaces

- 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)

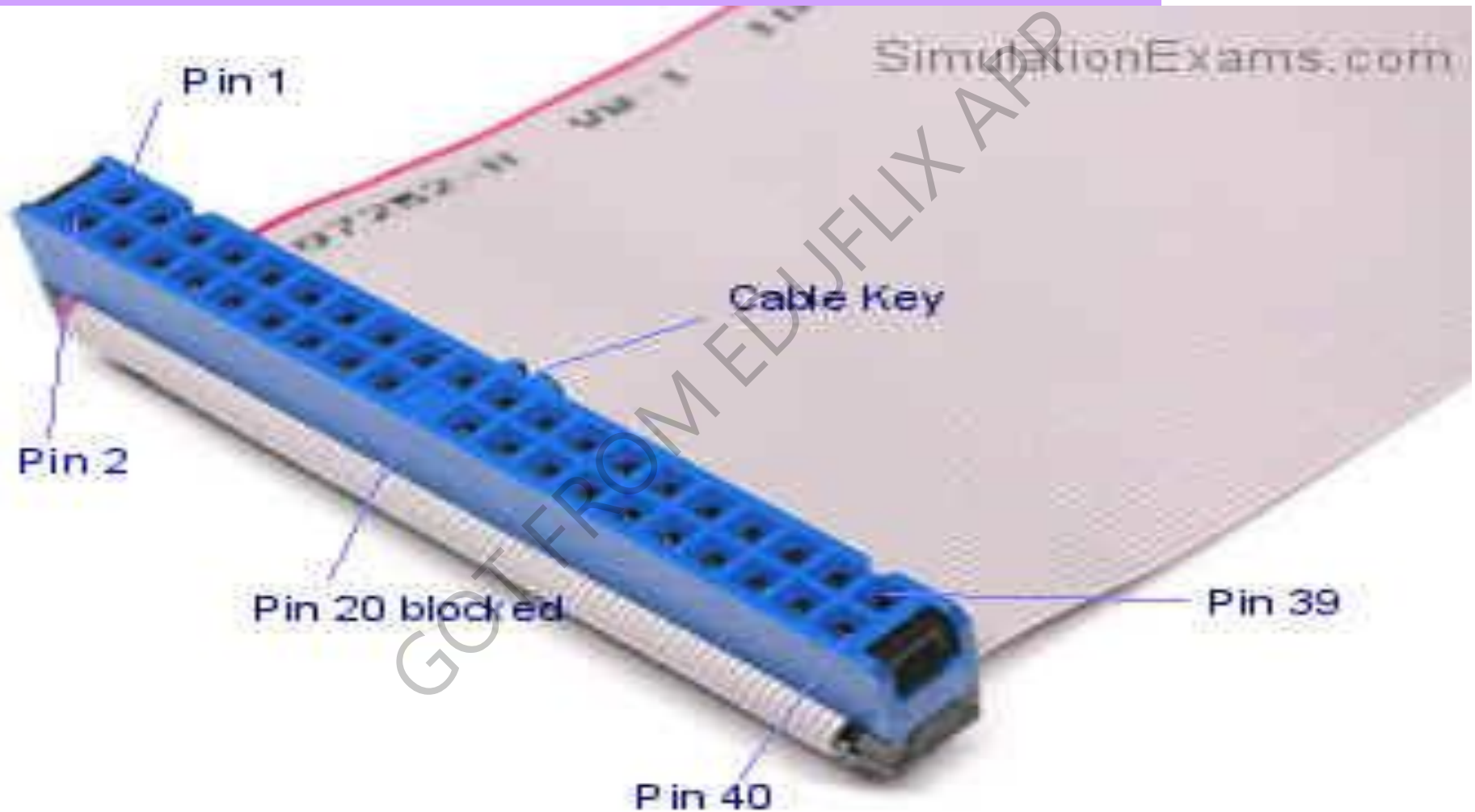
FireWire Interface



SATA Interface

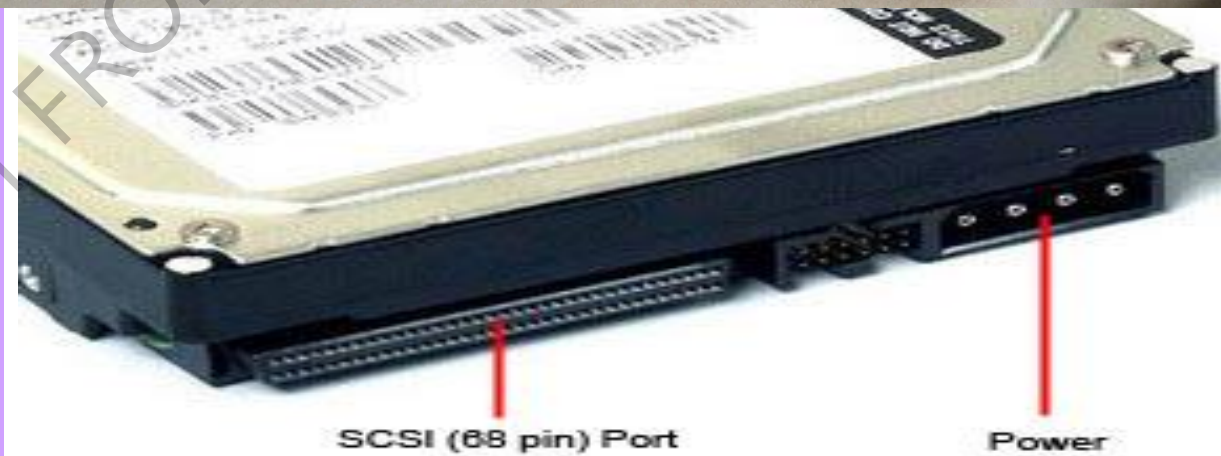


EIDE Interface





SCSI Interface





EIDE-SATA COMPARISON

Types of Hard Disks

- An Internal hard disk is fixed in the system unit and usually stores the operating system required for the computer to work.
- An *external hard disk* is a separate free-standing hard disk that connects with a cable to a USB port or FireWire port.
- A *removable hard disk* is a hard disk that you insert and remove from either a dock or a drive.
- 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.

DISTINGUISH BETWEEN HARD DISK AND A FLOPPY DISK

HARD DISK

- a) Has a bigger storage capacity.
- b) Most hard disk are fixed within the system unit.
- c) Hard disk has a greater speed of access .
- d) Hard disk is bulky.
- e) The hard disk organizes its data in a combination of tracks called cylinders.

FLOPPY DISK

- a) Has a small storage capacity
- b) Floppy disks are external storage media.
- c) Slow speeds of data access.
- d) Floppy disk is portable can easily be carried.
- e) Floppy disk organizes its data in concentric circles called sectors

(B) Optical Media

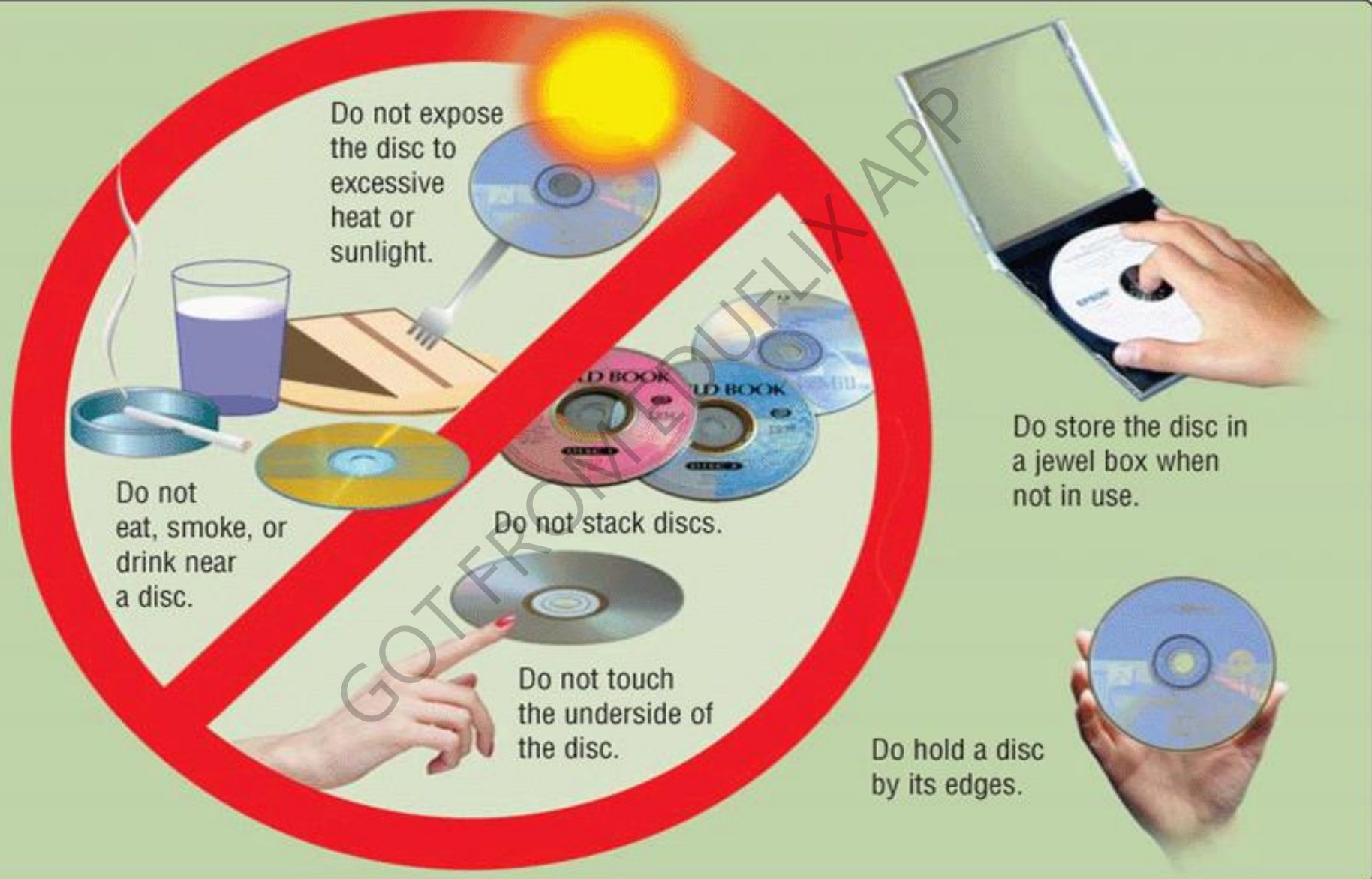
- **Optical storage media** refers to a store media on which data is recorded by making marks in a pattern that can be read back with the aid of light, usually a beam of laser light.
- The reflected light is converted into a series of bits that the computer can process.
- An optical disc is a flat, round, portable storage medium made of metal, plastic, and lacquer that is written and read by a laser.
- Optical discs used in personal computers are 4.75 inches in diameter. Smaller computers and devices use mini discs that have a diameter of 3 inches or less.

Care for Optical Disks

The following should be done for the safety of data on Optical disks:

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

Care for Optical Disks



Categories of Optical Disks

- Two general categories are CDs and DVDs, with DVDs having a much greater storage capacity than CDs.
- Examples of Optical Disks include:
 - (a) **CD-ROM (compact disc read-only memory)**

The contents of standard CD-ROMs are written by the manufacturer and only can be read and used. A typical CD-ROM holds from 650 MB to 1GB of data,

Picture CD

- (b) A Picture CD** is a compact disc that only contains digital photographic images saved in the jpg file format.
- You can purchase Picture CDs that already contain pictures. A Picture CD is a multisession disc, which means you can write additional data to the disc at a later time.

CD-R (compact disc-recordable)

- (c) **CD-R (compact disc-recordable)** is a technology that allows you to write and read on a compact disc using your own computer's CD-R drive.
- Once you have recorded the CD-R, you can read from it as many times as you desire. A CD-R is a multisession optical disc which allows you to write on part of the disc at one time and another part at a later time.
 - However, you cannot erase the disc's contents.

CD-RW (compact disc-rewritable)

(d) A CD-RW (compact disc-rewritable) is an erasable multisession disc that you can write & read on multiple times.

- Reliability of the disc tends to drop, however, with each successive rewrite. To write on a CD-RW, you must have a CD-RW drive and CD-RW software.
- A CD-RW drive has a lower read and write speed as compared to CD-Rs

Magneto-optical (MO) disk

- (e) Magneto-optical (MO) disk.** This is a hybrid disk, that combines the best features of magnetic and optical disk technologies.
- It has the erase and rewrite capabilities of magnetic disks, but it also has the very high-volume density capabilities of optical disks.
 - MO disks are not popular because they are too expensive, and not as reliable as magnetic media.

DVDs

- (f) **DVD-ROM (digital video disc-ROM).** A DVD-ROM is an extremely high capacity compact disc capable of storing from 4.7 GB to 17GB.
- In order to read a DVD-ROM, you must have a DVD-ROM drive, which can also read CDRoms.
 - DVDs are also available in a variety of recordable and rewritable versions and formats such as DVD-R and DVD+R DVD+RW, DVD+RE, and DVD+RAM.

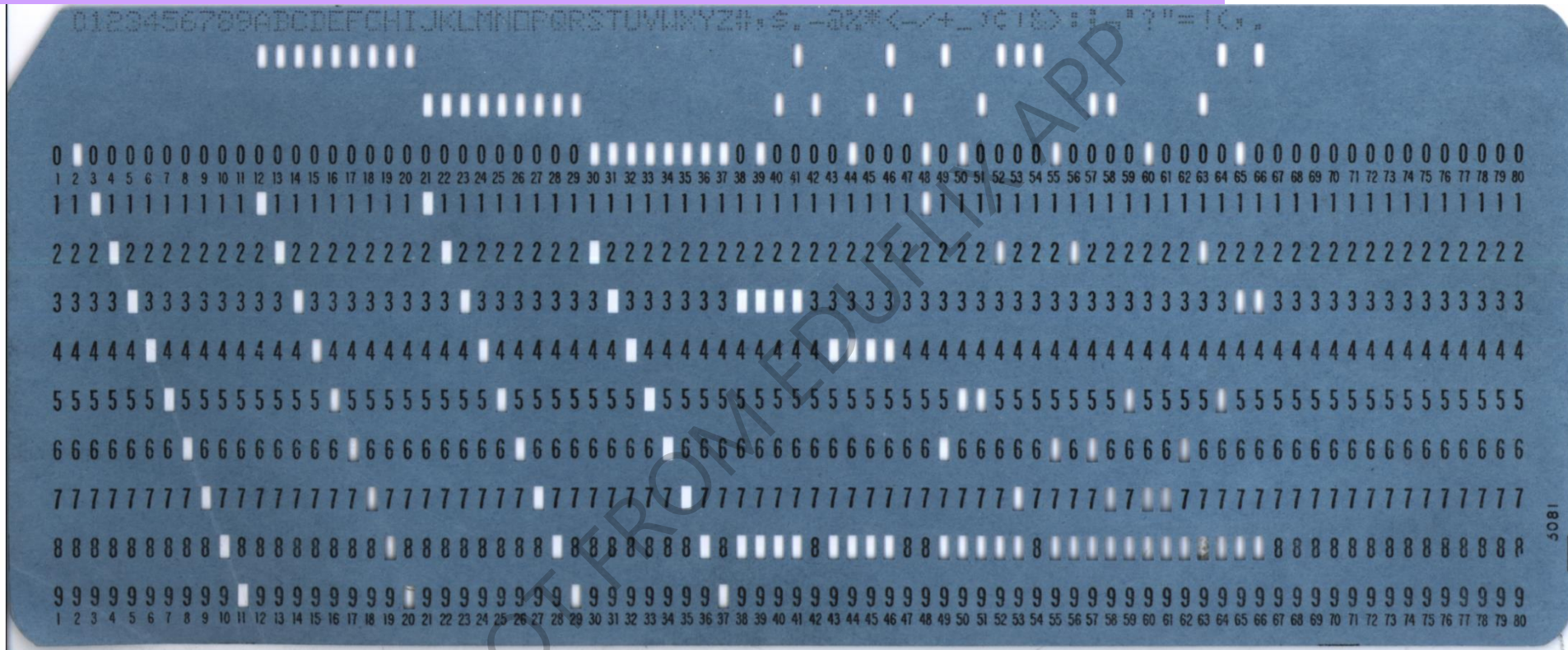
High Capacity DVD formats

- A Blu-ray Disc-ROM (BD-ROM) has storage capacities of up to 100 GB.
- The HD (high-density) DVD-ROM has storage capacities up to 60 GB.
- A mini-DVD that has grown in popularity is the UMD (Universal Media Disc), which can store up to 1.8 GB of games, movies, or music.

Other Types of Storage Media

- **Punched Cards.** A punched card, punch card, IBM card, or Hollerith card is a piece of stiff paper that contains digital information represented by the presence or absence of holes in predefined positions.
- They were used through the 20th century in unit record machines for input, processing, and data storage. Early digital computers used punched cards, often prepared using keypunch machines, as the primary medium for input and storage of both computer programs and data.

Punched cards



- An 80-column punched card of the type most widely used in the 20th century.

(C) Solid State Media

- **Solid state media** refers to storage media that stores data electronically and has no moving parts.

Solid state media is made from silicon microchips.

- They have no spinning platters that are expected read and write data to and from a storage media. Therefore they require less power and produce far lesser heat. They store information electronically.

SOLID STATE MEDIA

- They require less energy to operate which makes the battery of your device work for longer hours without need to be charged.

Example include;

- a) Flash disk or memory
- b) Memory card
- c) Solid state hard disk drive

(a) FLASH MEMORY

These are micro storage devices found in a wide range of devices such as phones, digital cameras, video cameras and radios.

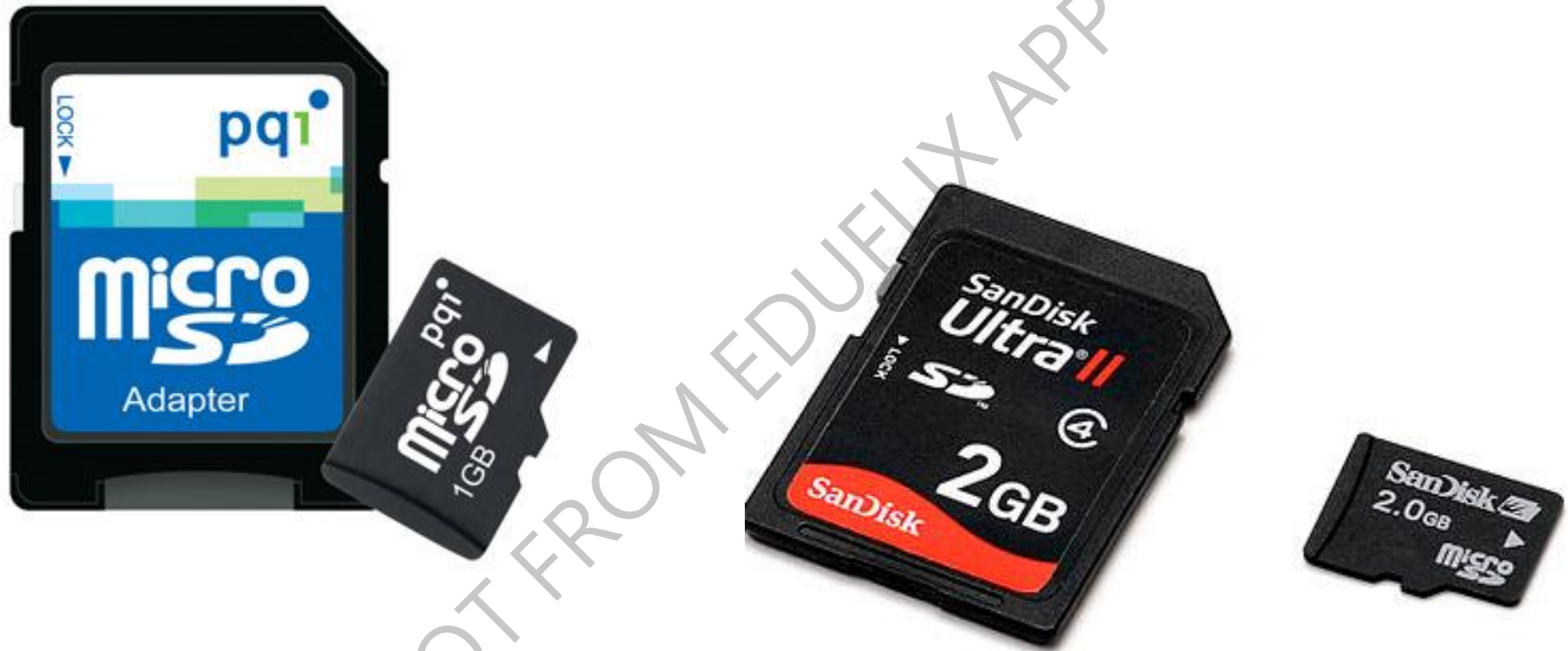
Advantages of Flash memory

- a) They are portable for easy carriage
- b) Relatively large storage capacity compared to floppies
- c) Access data randomly.

Disadvantages of flash memory

- a) Prone to viruses
- b) They can easily be misplaced due to their small size.
- c) They require memory card reader to be used on a computer.

Flash memory cards



USB flash drive

- A **USB flash drive** is a flash memory storage device that plugs in a USB port on a computer used to read and write data onto the flash memory.

Advantages of USB flash drives

- a) USB flash drives are convenient for mobile users because they are small and lightweight enough to be transported in a pocket.
- b) Current USB flash drives have large data storage capacities ranging from 256 MB to 1 TB.
- c) USB flash drives have become the mobile user's primary portable storage device, making the floppy disk nearly outdated.

USB flash drive



Solid State Hard Disk Drive

- Is a non volatile storage device that uses intergrated circuits to store data persistently with the help of a flash memory.

Advantages of solid state hard disk

- a) Solid state hard disks are more resistant and durable in case of falling of a laptop where its housed.
- b) Solid state hard disks have great access speeds that is 35 to 100 microseconds.
- c) Solid state hard disks have light weight components which make the easy to carry.
- d) Solid state hard disks are easy to install
- e) Solid state hard disks have a very large storage capicity.

Disadvantages of solid state hard drive

- a) Solid state hard drives are more expensive than magnetic hard drives.
- b) Solid state hard drives due to the unique file system structure, data extraction can be an extremely difficult and lengthy process.
- c) The Solid state hard drive memory chips have a limited number of write cycles, which can lead to unrecoverable data loss.
- d) If the controller chip, memory cache, or one of the NAND type memory chips has been physically damaged, your data may be completely inaccessible.

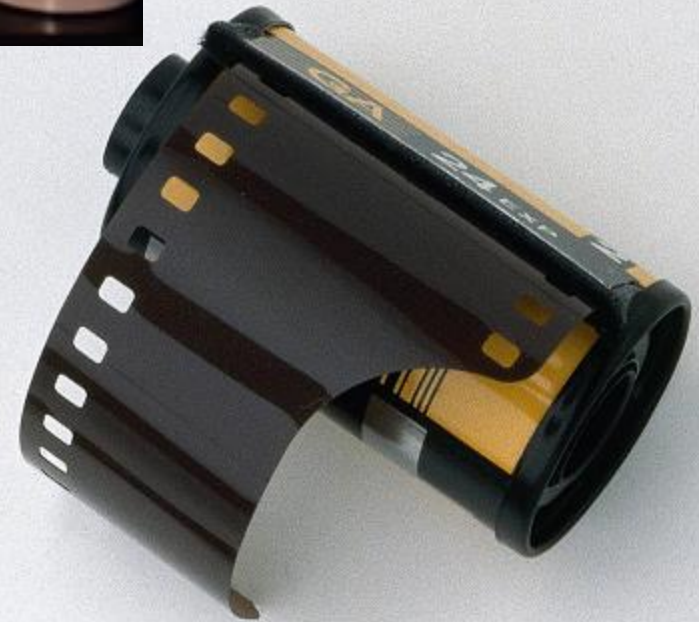
Flash memory cards

- Flash memory cards are a type of solid-state media, which means they consist entirely of electronic components and contain no moving parts.
- Common types of flash memory cards include Memory Stick, CompactFlash (CF), SmartMedia, microSD, miniSD, xD, Picture Card, etc.
- They are commonly used in electronic devices such as digital cameras and mobile phones. They are tiny, re-recordable, and able to retain data without power.
- Depending on the device, manufacturers claim these storage media can last from 10 to 100 years.

Photographic film

- **Photographic film** is a sheet of plastic such as polyester coated with a light sensitive emulsion, that is used to record and store photographs.
- Normal film is shipped in small canisters (boxes) that protect it from the light.
- When exposed to light, it forms an invisible image.
- Chemical processes can then be applied to the film to create a visible image, in a process called film developing.
- A normal photographic film can hold up to 40 pictures.

Photographic film



Microfilm and Microfiche

- These are media used to store microscopic images of documents on roll or sheet film.
- The images are recorded onto the film using a device called a computer output microfilm recorder.
- The stored images are so small they can be read only with a microfilm or microfiche reader.
- Microfilm and microfiche have the longest life of any storage medium.
- Libraries use these media to store back issues of newspapers, magazines, and genealogy records.

Microfilm and Microfiche



FACTORS TO CONSIDER BEFORE BUYING STORAGE MEDIA

- ❖ **Storage capacity**; one should consider the amount of information a particular storage device can accommodate for storage expressed in terms of bytes.
- ❖ **Brand or make**; one should consider the brand name as some manufacturers have built reputation in producing good quality products. Such as scandisk for flashes.
- ❖ **Portability**; one should consider ease of transferring a storage device containing information from one place to another.e.g flash discs are easier to carry.
- ❖ **Compatibility of the media with the system**; one should consider the provision of a particular storage device to be usable on a particular computer which can be a port provision or provision of drivers to enable effective use.

- ❖ **Price in relation to organization budget;** one should consider the cost of purchase in relation to the need and affordability of an organization
- ❖ **Data access speed;** one should consider the rate at which a CPU can be able to access the retrieved content on a particular storage device whenever needed and should be relatively faster the compact disc can be accessed faster
- ❖ **Durability and reliability;** one should consider the life span of a storage device and its reliability to retrieve its content whenever needed.
- ❖ **Safety of the media in relation to nature of the work to be stored;** one should consider the safety of information if it is to be stored on a particular storage device since some are prone to viruses hence exposing valuable information to a great risk of data loss.

UNITS OF DATA STORAGE

1 binary digit	=	1 bit
4 bits	=	nibble
8 bits	=	1 byte
1024 bytes	=	1 kilobyte
1024 kilobytes	=	1 megabyte
1024 megabytes	=	1 gigabyte
1024 gigabytes	=	1 terabyte
1024 terabytes	=	1 petabyte
1024 petabytes	=	1 exabyte
NB. 1024 is approximated to 1000 bytes		