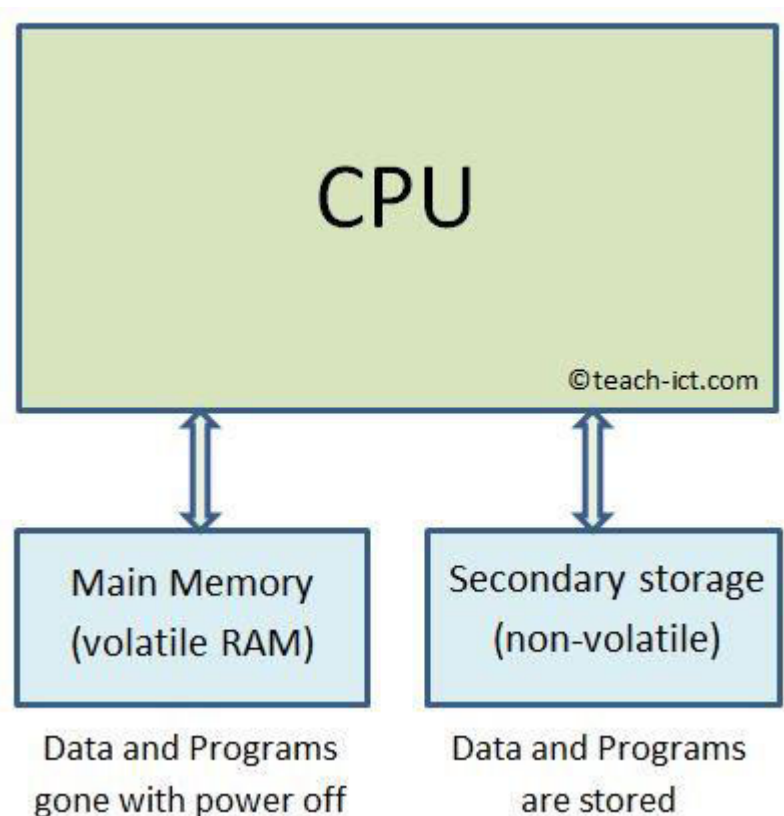


# Secondary storage

## 1. Need for secondary storage

Because main memory (RAM) is volatile, any data or programs currently being stored there will disappear once the power is lost i.e. the computer is switched off. And so secondary storage is used to retain a copy of programs and data that need to be kept long term.



# Secondary storage

## 2. Storage devices and media

Secondary Storage Device

A secondary storage device is the physical hardware that carries out the storage action. For instance a DVD writer is a 'storage device'.

A hard disk or a Solid State Drive are secondary storage devices.

## Storage Media

Some storage devices come with removable media. For example a DVD writer burns a blank DVD. The DVD itself is an example of storage media.

Storage media is the physical object used to actually store the data.

Another storage media example is a magnetic tape cartridge. This is loaded into the magnetic tape recorder / reader (the storage device). The storage media can be removed and kept somewhere else for safe-keeping.

Some secondary storage devices do not have separate media. For example a hard disk or a Solid State Drive are self-contained with no external media.

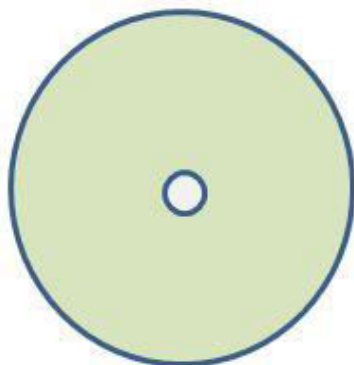
# Secondary storage

## 3. Magnetic storage

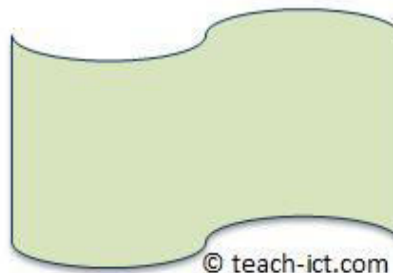
This uses minute magnetic particles or 'domains' to store data.

A hard disk is an example of a magnetic storage device. It contains several platters on a spindle, spinning at high speed, with read/write heads floating just above the surface.

Another example of magnetic storage is a magnetic tape cartridge.



Magnetic Disk



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Magnetic Tape

Advantages of magnetic storage	Disadvantages of magnetic storage
Huge capacity, offers up to several terabytes per device.	Not as portable as other technologies. But external hard disks are commonly available,

Advantages of magnetic storage	Disadvantages of magnetic storage
	but they need to be treated carefully.
Low cost per gigabyte - magnetic tape is the cheapest, but hard disk is very low as well.	Hard disk has mechanical moving parts, so less rugged than solid state storage.
Hard Disk offers high speed data access	Data can be lost near strong magnetic fields, such as being too near an audio speaker.
Hard Disk offers random access to data	Magnetic tape uses serial data access and so is very slow.
Magnetic tape can hold its data for up to thirty years in the correct environment.	Data read \ write is not as fast as flash technology

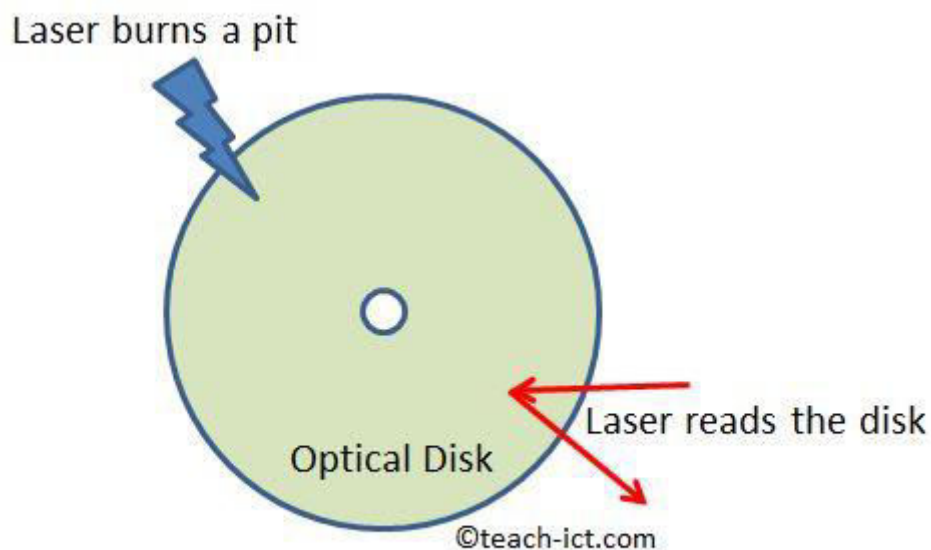
## Secondary storage

### 4. Optical Storage

Optical storage includes CD, DVD and Blu-ray disks.



A laser beam burns tiny dark pits on to the surface of the optical disk. If a pit is present, this can represent a data bit being '1' and if no pit is present, this can represent a data bit being '0'.



Advantages of optical storage	Disadvantages of optical storage
Cheap if less than 10GB needs to be stored per media item.	Not cheap if terabytes need to be stored
Very portable compared to hard disk	Not as portable as Flash media
Ideally sized (5 - 50GB) for storing movies and videos. Which is why they were created in the first place.	Slow to write (burn) to and much slower than hard disk to access.
Immune to magnetic fields.	Easily scratched
	Cannot write over stored data

## Secondary storage

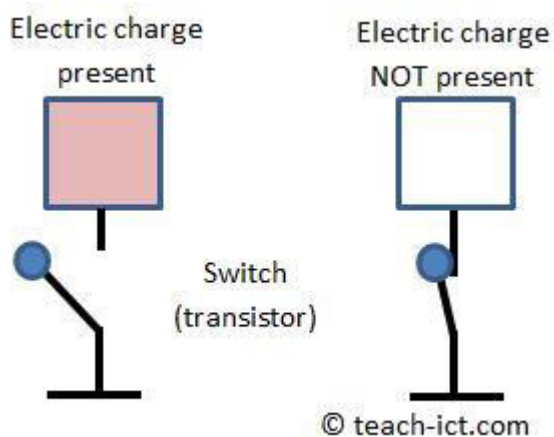
## 5. Solid state media (Flash)

Solid state media includes USB memory sticks, Solid State Drives and SDHC memory cards (as found in digital cameras)



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Solid state media hold data using electronic switches. If the switch is open, it represents a '1', since it retains an electric charge. If it is closed, it represents a '0'. It is an electrical form of storage, unlike magnetic or optical media. The technology is called 'Flash memory'.



Advantages of solid state storage	Disadvantages of solid state storage
Very portable in the form of SD memory cards and USB memory sticks.	Solid State Drives are expensive compared to a hard disk of similar capacity.

Advantages of solid state storage	Disadvantages of solid state storage
Large capacity, especially in the form of a solid state drive.	Less durable than a hard disk as it has a limited number of erase \ write cycles - maybe a 100,000 cycles before it wears out.
Very tough and rugged as it has no moving parts unlike a hard disk	
Faster than hard disk as no mechanical parts need to be moved to read / write data.	
Solid State Drives are silent unlike hard disks	



## Secondary storage

### 6. Data Capacity

Storage media have a capacity measured in bytes. The three common measures are:-

- Megabyte (MB) - a million bytes
- Gigabyte (GB) - thousand Megabytes
- Terabyte (TB) - thousand Gigabytes

The table below shows the typical capacity of various storage technologies and the type of applications they are used for.

Capacity			
Storage media or device	Technology	Capacity	Holds typical content
Compact Disk (CD)	Optical	700MB	about 200 MP3 songs
Single layer DVD	Optical	4.7GB	about a 135 minute movie with a single language sound track
Double layer DVD	Optical	8.5GB	2 hour movie with three sound tracks (foreign languages) and bonus features.
SD memory cards	Flash	to 64 GB and more	Digital cameras. A card can hold thousands of jpg photographs
USB Memory stick	Flash	to 64 GB and more	Portable data storage
Hard Disk	Magnetic	300GB - 6TB	Secondary storage in computers and satellite TV set-top box.
Solid State Drives (SSD)	Flash	300GB - 1TB	Secondary storage where a hard disk would be at a disadvantage e.g. rugged

Capacity			
Storage media or device	Technology	Capacity	Holds typical content
			outdoor equipment or where fast access is important.
Magnetic Tape	Magnetic	to 185 TB and more	Data archiving

## Secondary storage

### 7. Calculating storage

In your exam you might be given a scenario and asked to work out how much data storage would be needed. Over the next two pages we work through a couple of examples to help you think about this.

*Example 1 - music storage on a smart phone*

You have a smart phone with 6GB of storage.

You want to store music and photos on the phone.

A typical mp3 encoded music file takes up 4MB.

How many tracks can be stored on the phone?

Convert GB into MB so you are using a common quantity. 6GB = 6000MB

**Answer:**  $6000 \text{ MB} / 4 \text{ MB} = 1,500$  music files

*Example 2 - photo storage on a smart phone*

Assume that a typical photo taken by a phone will be around 2MB

Convert GB into MB so you are using the same quantity. 6GB = 6000MB

**Answer:**  $6000 \text{ MB} / 2 \text{ MB} = 3,000$  photos



### Example 3: Storage in the cloud

On your PC, you currently have 2500 documents with an average file size of 50KB

You also have 5 movies using 2GB of space each.

You also have 1500 photos with an average file size of 3MB

If you wanted to store all of these things in the cloud, how much storage space would you need to purchase per month?

#### **Answer**

Because the storage of each file needs to be added up, you should keep to the same size of storage units. So for this example we will use megabytes.

Text files: 50KB is 0.05MB, so storage of text files is  $2500 \times 0.05\text{MB} = 125\text{ MB}$

Video files: 2 gigabytes is 2000 megabytes so they take  $5 \times 2000\text{MB} = 10,000\text{ MB}$

Photo files:  $1500 \times 3\text{MB} = 4,500\text{ MB}$

Adding them all up =  $125 + 10000 + 4500 = 14625\text{ MB}$

Convert the MB back into GB:  $14625\text{ MB} = 14.625\text{ GB}$ .

So you would need to purchase at least 15GB of storage space.

The typical cost of cloud storage is £5 per month for a 10GB allowance.



## Secondary storage

### 8. Choosing the best storage media

In the exam you might be given a scenario and then be asked to recommend the most suitable storage media to use.

When choosing an appropriate storage media to use you need to consider the following things :

#### **Capacity**

The amount of data that can be stored, and the maximum size of the files.

#### **Speed**

How quickly can the data be accessed from or written to the media

#### **Portability**

Can the media be easily moved about? This depends on both the size and weight of the media.

#### **Durability**

How resistant the media is to damage. Whether it is rugged enough to survive knocks, scratches, etc.

<b>Reliability</b>	The shelf life of the media. How long it will retain data so that it can be accessed reliably and without error in the format in which it was originally saved.
<b>Cost</b>	How expensive the media is in terms of cost per gigabyte of storage.

## Secondary storage

### 9. Example exam question

*A small company wants a system in place to archive their 10 TB of data. The security of their data is a priority, they need to be sure that they always have a copy in case of an emergency such as a fire.*

The key points to address in this question are:

10 TB of data - you need to choose something that can store this much data.

Archive data - they don't want to access it that often

Security of data - kept safe if there was an emergency, so it needs to be portable. It also needs to be reliable.

The first feature needed is **portability** as the data needs to be kept safe it would be a good idea to store it off site, away from the premises.

One choice would be store it on a few external hard drives. But these are relatively expensive compared to magnetic tape. And being mechanical devices they are more likely to break in the future

(**reliability**). Flash based SSD is a possibility but they are even more expensive and have a known limited life of ten years or so (**durability**), their higher **speed** compared to hard disk is not relevant in this case.

Magnetic tape is the lowest **cost per Gigabyte**, so a few cheap cartridges can easily store 10TB. Magnetic tape tends to degrade if used over and over again, but in this case the data will be stored once and no need to access it very often,



so that is not an issue. Magnetic tape is very slow compared to hard disk, but again that is not an issue in this situation.

Magnetic tape is thought to be able to hold its data for twenty to thirty years if kept in an ideal environment.

So a good choice for archiving the data would be to use magnetic tape.