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Storage Devices

Many years ago, a computer was very simple. It did not have any Floppy Disk Drives, Hard Drives or even CD-ROM Drives. Instead it used memory to store data temporarily. The problem with memory is that when the computer gets turned off, all of the data gets erased. Therefore, if a person wanted to use the same data on the computer again, he would have to re-enter all of the data instead of being able to open it from a storage area.

Luckily, permanent storage was introduced. It allowed people to work much more efficiently, because the data could be saved on disks or a hard drive, to be used later on the same computer, or on another computer. It did not stop there, though. CD-ROMs came along, later, allowing for high quality music and a lot of mobile storage space. Today, DVD-ROMs are starting to replace the CD, because they have some significant improvements over the older media.

Acer's new 16X DVD-ROM Drive delivers excellent performance.

Hard Drives

For a while, floppy disks were good enough for storing data. As time went by, more data was used by people. For computer users, this meant two things. Firstly, many more disks had to be used for one set of data. This made it a nuisance to save and load data, especially if the data was going to be used on the same computer at all times.

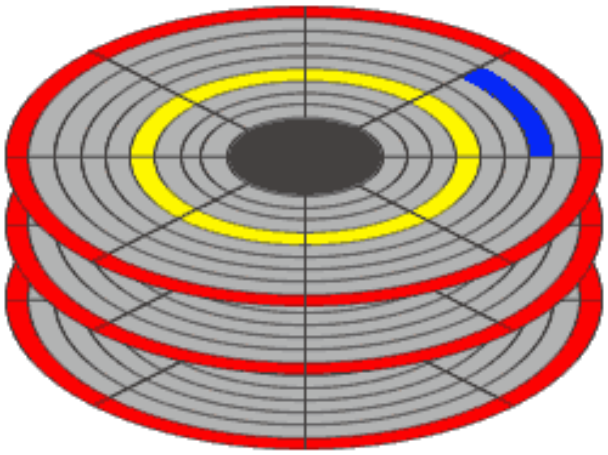
Secondly, more time was wasted. It took a lot of time to load all of the data, especially if it was spanning many diskettes. Everything would have to be loaded every time the computer was turned on. Floppy disk speeds could not advance greatly, simply because the floppy disk was an external diskette that was not in the computer permanently.

The answer was an internal device inside the computer, called the Hard Drive. The Hard Drive provides the same function as the Floppy Disk, with two distinct differences. It is much faster, and holds much more data. This provided an excellent solution to the storage problem. The Hard Drive could also advance at a much quicker pace than the Floppy Disk Drive.

Picture of a Maxtor Hard Drive

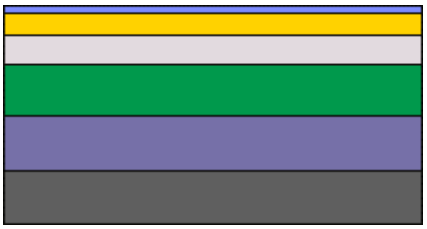
The Platter

The actual data which gets stored on the hard drive is stored on Platters. Here is an illustration of several platters and how they are divided:



Name	Description
Platter	A flat, circular disc, having a similar shape to a CD. It holds the physical data. Platters can usually store data on the top and bottom side at the same time. Most modern CD-ROM Drives have multiple platters in order to allow for more storage capacity.
Track	A concentric set of magnetic bits on a platter. The track is divided into many sectors.
Cylinder	A group of tracks with the same radius. On the above, one of the parts libelled red would be a track by itself, but all of the red parts would together be addressed as a cylinder.
Sector	A small part of a track. Every sector has its own unique ID number, as well as an error correction code. The error correction code ensures that if there is a data error on the sector, it can be repaired, and the data can be used.

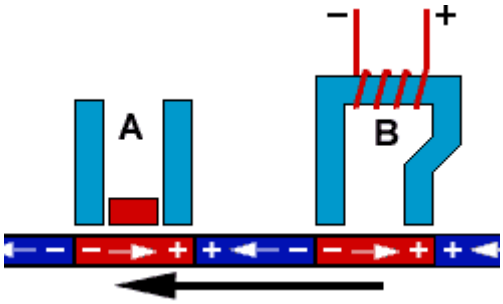
Although the platter is only a few millimetres thick, there are usually six layers to a platter. Before we get to the diagram, we need to know that 1 mm (millimetre) = 100,000 nm (nanometres). Keeping this in mind, here is the cross section of a small part of the platter (not to scale):



Color	Thickness	Layer Content
	1 nm	Lubricant - used to minimize the wear of the carbon layer
	30 nm	Magnetic Layer - Stores the bits of data
	15 nm	Carbon Overcoat - increases the corrosion of the Magnetic layer
	50 nm	Chromium - used as an under-layer for the magnetic layer
	10,000 nm	Nickel Phosphide Layer - separates the metal and the magnetic layer
	0.5 mm or more	Metal - used to give the platter strength

Writing\Reading Data

The illustration below shows an image of the Hard Drive's Read Head, Write Head, and a Platter.



Before we start with the Read and Write head, we need to establish the difference between how 0s and 1s are stored on the Hard Drive. Each bit of data on the hard drive is stored on one small particle of magnetic metal. Each of these pieces of metal has its own poles, the north pole and the south pole. When there is no data on the hard drive, the north and south poles of all of the magnetic particles are facing in the same direction. In other words, all the arrows in the diagram above would face the same way as the large arrow below the platter in the diagram. The Write head (B) acts as an electromagnet. If it wants the particle below it to store a 1, the wire wrapped around it sends current through it one way, causing the poles to shift one way. In contrast, if it wants to store a 0, the wire wrapped around it sends the current the opposite way, causing the poles to shift again. An opposite direction of the current causes the poles to switch, and the arrow to face the other way.

The Read Head (A) has a Magneto-Resistive sensor, along with two shields which shield out any potential interference.

Performance and Size

Today's Hard Drive performance is more than 50 times faster then when it debuted in the 80s. When they first came out, the Hard Drive could only spin at a mere 500 RPM (Rotations Per Minute). Today 7,200 RPM Hard Drives are a standard, which is faster than the RPM of most family cars. There are also high performance hard drives that go up to 15,000 RPM, which is faster than most, if not all of the sports cars in the world. Moreover, techniques have been developed to get more data from every rotation, allowing for even faster speeds.

As for Hard Drive storage capacity, this is also increasing. It is not rare anymore to see hard drives as big as 20-30 Gigabytes. Hard Drives over 100 GB are available on the market, while a few Terabyte Hard Drives do exist.

CD\DVD-ROM Drives

While computers have been evolving at a very rapid pace, so has computer software. Software has become much more complex, and much larger too. For a while, manufacturers faced problems, because they had to use 15 or more floppy disks in order to sell their programs to the public. This made the production costs higher, while also increasing the amount of time it took for a program to install.

The CD-ROM was introduced, storing up to 700 MB of information, which is more data than 400 standard floppy disks can hold. Moreover, one CD only costs less than $1 US to produce. With reduced costs and higher performance, computer industry was in good shape from a storage standpoint. The CD gave software all of the storage and performance they needed, for a while.

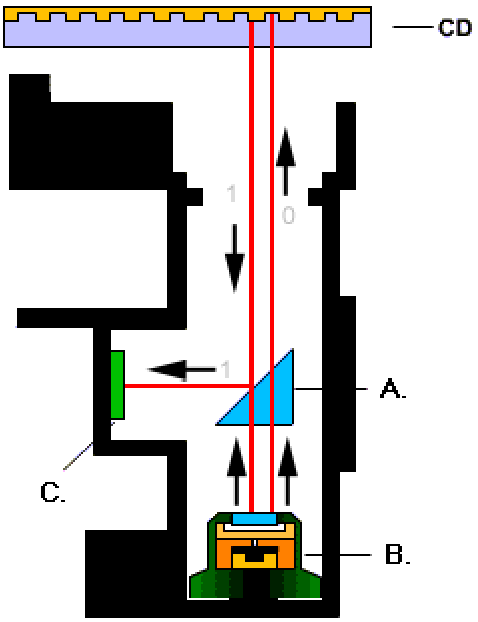
As programs kept advancing further, they started to take up even more space. At this time, for many programs, one CD is not enough. Some professional programs and games are spanning 5 or more discs. As we speak, CDs are becoming a less efficient way to store data. This is why we are slowly migrating to DVD media. Most people would recognize DVDs as the next generation of media for high-quality movies for the home. What most people do not know is that a DVD can also be used to store computer data. In fact, it can store more than 15GB of data, which is more data that 20 CDs can hold. Even though DVDs can store much more data than CDs, the two technologies are almost identical.

As you can see, DVD-ROM discs are very reflective.

How a CD-ROM Works

While you are reading on how the CD-ROM Drive works, remember that DVD Drives work almost the same way. So much of the information under this heading also applies for DVD-ROM Drives (DVD-unique information is covered lower down on this page).

The CD-ROM is very simple. There is a reflective surface, with indented parts which are not reflective. When a laser is fired at the reflective surface, it bounces back and gets picked up as a binary 1. Otherwise, if the laser is fired at the non-reflective part, it is not bounced back, and this indicates a binary 0. Here is a Flash presentation to show you how the binary 1 and 0 are picked up by the CD-ROM. Press the button marked "1" to see how a binary 1 is read. Press the button marked "0" to see how a binary 0 is read.



A. Prism
B. Laser
C. Photocell

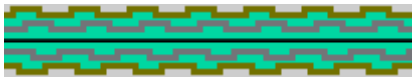
As you can see, the CD-ROM has a very simple mechanism to read the data from a Compact Disc.

DVD

Although the DVDs are closely related to CDs, there are a few differences between the two types of media. The first difference is that they can store more data. One way that this is achieved is by making the pieces of data more tightly packed. There are also two other ways that allow special DVD Discs to store 2X or even 4X as much data as a regular DVD Disc. DVD Discs can be made double-sided, as well as double-layered. Either of these two gives the DVD twice as much storage capacity, but when a DVD is made double-layered as well as double-sided, it allows fore 4X as much data. Here are some illustrations to show you what each variation of a DVD Disc would look up-close:

The typical DVD Disc, able to hold roughly 4.5 GB of data. The light grey represents plastic. The dark grey represents aluminium, while the green indicates acrylic plastic, and the black represents the label on the top. The laser can go through the plastic, but when it gets to the aluminium, it either reflects or disperses depending on the reflectiveness of the aluminium surface.

A double-layered DVD Disc. The inside layer is still coated with aluminium just like the typical DVD Disc. The difference is that there is an outer layer, which is made from a semi-reflective layer of gold. This layer lets the laser read the data from the outer layer when it focuses on it. It also lets the laser pass through it and read the inner layer when it refocuses. The extra layer gives the DVD Disc twice as much capacity as a typical DVD Disc.



Here is a double-sided and double-layered DVD Disc. It basically has the same qualities as the double-layered DVD Disc, except it holds data on the front and the back, allowing it to hold four times as much data as a typical DVD Disc. One negative thing about the double-sided DVD Disc is that labels cannot be printed on the whole DVD, making it harder to identify. There is usually a very small label near the middle of the DVD where the hole is located, and where no data is stored.

Floppy Disk

With the invention of the Hard Drive and the CD-ROM Drive, it would seem that Floppy Disk Drives are too out of date to still be useful. So why are they still on every computer that we buy?

Well, there are a number of reasons, but the main reason is that it is very practical for small files. Although the low capacity of the floppy disk makes it impractical for storing programs, they are still ideal for storing other data. For example, you can store thousands of pages of word processing files on a single floppy. You can also store hundreds of small images, as well as a few high-quality images or photos.

A Standard Floppy Disk

There are also some minor reasons. One of them is that since the Floppy Disk is the only form of storage that is auto-detected by the computer when it is first installed. This makes it useful for installing the drivers (small software that allows other hardware to function in the computer) for the CD-ROM and the Hard Drive. The Operating System and other programs can then be installed from CD-ROMs to the Hard Drive.

How it Works

Essentially, the Floppy Disk works the same way as the Hard Drive. There are some differences, though. The most noticeable difference is that a Floppy Disk holds much less data, it is much slower. Also, Floppy disks can be taken out of the Drives and replaced by other ones, while the Hard Drive platters cannot. The Floppy Disk is mostly made out of plastic, while the Hard Drive is mostly metal.


The Floppy Disk Drive