

SSD versus HDD

THE DIFFERENCE BETWEEN SOLID STATE DRIVES AND HARD DISK DRIVES



Whats the difference?

A hard drive is a hard drive – yes/no?

HDDs (Hard Disk Drive) have been the main secondary storage in all computers for years.

But now we see the arrival of SSD's
(Solid State Drive).

What are they?

SSD

- USB stick's are also called a Flash drive
 - Because they made from Flash memory, not hard disks
 - No moving mechanical components like a HDD has. (thus not as fragile)
 - Hence the name Solid State type device
- An SSD is a bigger version of a Flash drive
 - SSD = Solid State Drive
 - Significantly faster access time than HDD or USB keys
 - Much more reliable than USB drive.
 - Has evolved to be supplied as standard 2.5 inch HDD footprint for easy replacement of HDD in a laptop or PC
- A HDD is technology that uses magnetism to store data as 1 or 0.
- An SSD uses flash memory chips to store the 1 and 0's

SSD

- Advantages
 - Faster than HDD (to start up, shut down, and transfer data)
 - No fragmentation issues.
 - More durable, no moving parts
 - No noise
 - Can be made smaller than HDDs
- Disadvantages
 - More expensive
 - HDD are higher capacity (**No longer true!**)
 - Nimbus **SSD** ExaDrive DC100 **has 100 Terabytes** capacity (April 2023)
 - Samsung **SSD** PM1643a has **30.82 Terabytes capacity** (April 2023)
 - Possibly shorter life time due to the flash write cycle limit.
 - In reality, a desktop user will replace the PC before this may happen.
 - However, in a write-intensive server environment, this may be an issue.

Data Volatility

- Volatile memory
 - Loses data when powered off
- Non Volatile memory
 - Doesn't lose data when powered off
- Flash/SSD/HDD = Non Volatile
- DRAM = Volatile

Flash Memory Basics

- Flash cells start off at level 1 binary
- They are laid out in blocks, made up of pages
 - e.g: blocks of 128 kilo bytes would typically have page size of 2 kilo bytes
 - Subpages now also exist as memory sizes have increased significantly
- To change from 0 to 1 you have to erase the page where that bit is.
- To change from 1 to 0 doesn't require page erase
- The pages/blocks have **maximum** number of erase cycles (e.g. 100,000)
- So if we need to keep flicking a bit from 1 to 0 and back again then we have a problem? **What's the problem?**

Flash Memory, Wear Leveling

- If we keep writing to same page, we will wear the device out
 - So the memory devices have a controller that manages this by moving the page to a new page every time you go from 0 to 1
 - Therefore they spread the wearing out of the device
 - Hence the name: wear levelling
 - Hence the device takes years to wear out.
-
- All modern smart phones, tablets, mac laptops use SSDs
 - More and more windows desktop PCs come with the option to buy SSDs
 - They ARE more expensive, but much faster and much more reliable.

Flash File Systems

- SSDs have controllers built in to handle the flash memory chips and wear leveling.
- Therefore traditional file systems (e.g. NTFS, FAT32) can still be used as they are abstracted from the flash memory handling
- But... in a lot of cost sensitive embedded systems it doesn't make commercial sense to use expensive memory controllers and so the OS must handle the wear levelling.
- Fortunately there are specific file systems that do this
 - E.g. UBIFS for Linux (**U**nsorted **B**lock Image **F**ile **S**ystem)
 - But..... That's for another year.....