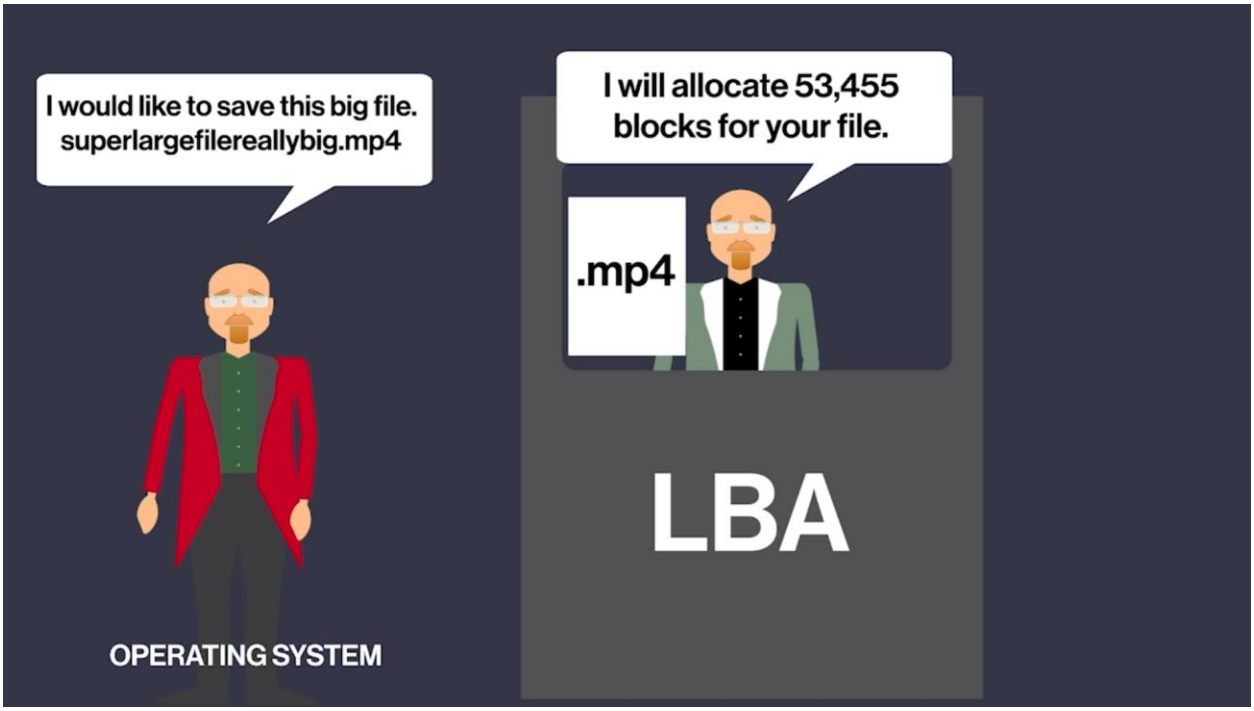
Introduction to Mass Storage

- There are many types of mass storage used today,
including hard drives, solid state drives, and optical media
- Regardless of the media your operating system sees
mass storage as a string of logical block addresses
- There is a difference between decimal values and IEC values

Storage Devices - Optical Media; Hard Drives (Magnetic Media); SSD (Solid State)

Old Hard Drive - TONS of Sectors. Each sector stores Blocks of 4096 bytes of data
(4TB of Storage is 1Bill Blocks)

LBA (Logic Block Addressing) - Controller circuitry (Hardware & Software)
that acts as an Interface between OS & All Storage Devices



If the OS needs to save a big file, the OS will interact with the LBA
and request to save the file. The LBA will take the file and allocate blocks

LBA in essence is the Device Driver for all the different types of Storage.
When you install a Storage Hardware, you don't have to put in a Device Driver,
because LBA handles this!

When installing Storage, just make sure it works in the BIOS. The OS will auto-detect it.

Capacity -
Decimal Values…….

1,000 = kilo
1,000,000 = mega (1,000 kilo's)
1,000,000,000 = giga (1,000 mega's)
1,000,000,000,000 = tera (1,000 giga's)
1,000,000,000,000,000 = peta (1,000 giga's)
1,000,000,000,000,000,000 = exa (1,000 peta's)

$2^8=256$

EDB (External Data Bus) - provides communication from outside to inside the CPU
These On/Off Light Bulbs are Binary, which defines how many lines of code we're capable of communicating. 8 Light Bulbs = 256 patterns/codes

If an Address Bus (allows CPU to communicate with RAM) has 10 wires,
we have 2^{10} = 1024 patterns/codes

IEC Values…….

2^{10} = Kibi	"Kib-E"	1,024	(a "Kibi" is a made up unit, similar to a kilo)
2^{20} = Mebi	"Meh-be"	1,048,576	
2^{30} = Gibi	"Gib-E"	1,073,741,824	
2^{40} = Tebi	"Teb-E"		
2^{50} = Pebi	"Peb-E"		
2^{60} = Exbi	"Ex-be"		

A Storage Device may give a slightly different value based on the numbering system the manufacturer is using. Not a big deal, but this is the reason for that difference.

Physical Size of Storage -

Optical Media - 5.25” Wide

- 3.5” Wide

Laptop/Mobile Devices/Servers - 2.5” Wide

SSD - 1.8” Wide (m.2-format most dominate for SSD today)

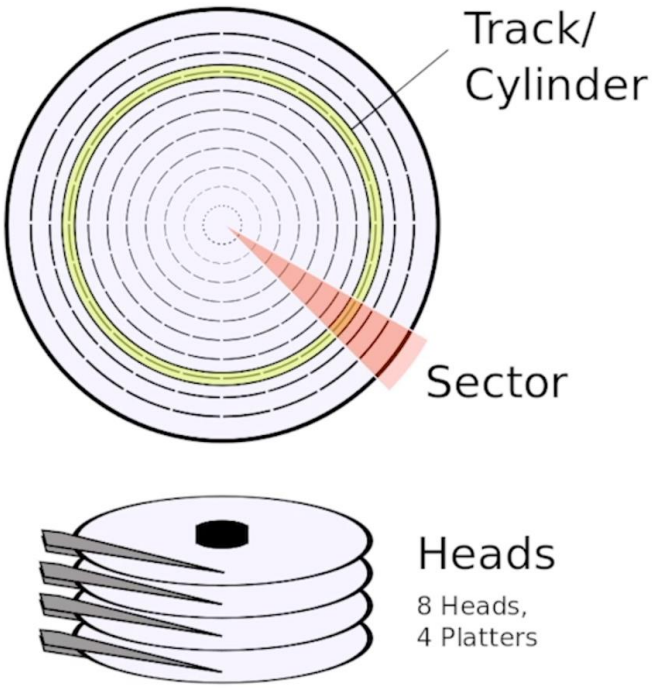
Magnetic Disk Drives

- Magnetic disk drives use spinning platters to store data via magnetism and read/write heads

- Hard disk drives come in 3.5", 2.5", and 1.8" physical sizes

- We use the Advanced Technology Attachment protocol to communicate with hard disk drives

- The dominant ATA is called Serial ATA (SATA)



HDD (Hard Disk Drive) - Big Round Shiny things are Platters,
which store 1’s & 0’s through incredibly small bits of Magnetism

The little arm that goes back & forth within nanometers of the platters with a Head that picks up the 1’s & 0’s, or sets them down. It stores it in a Sector.

HDD implies that there’s something spinning on the inside of the Drive

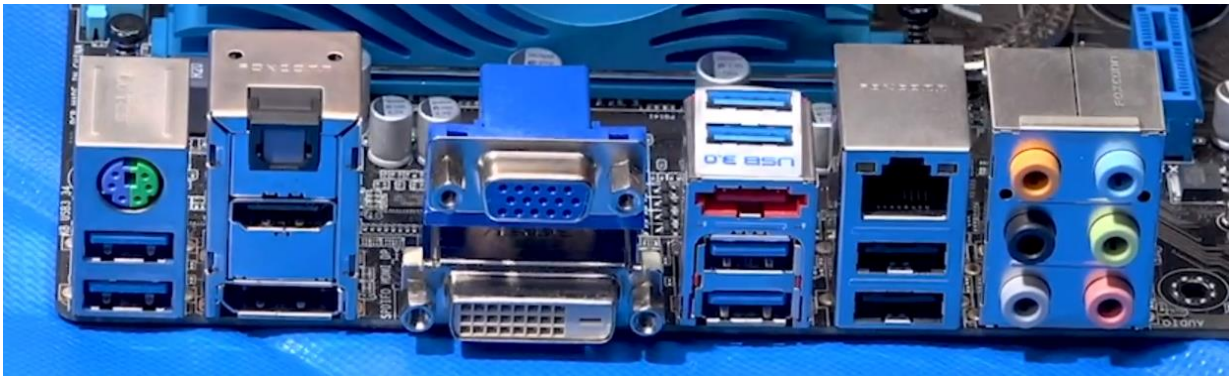
Sizes - 3.5” & 2.5” - most common 1.8” - very rare

Capacity - early 1990’s max of 20MB today max of 16TB

ATA (Advanced Technology Attachment) - Language of LBA (Logic Block Addressing)
Earliest & Latest Hard Drives speak this Language,
but the Physical Interfaces have changed.
PATA (Parallel ATA) - Original & No Longer in use
SATA (Serial ATA) - This is what’s used Today

2.5” HDD - SATA Connector (Center) & Power Connector (Right)
Power Connector plugs into the Power Supply

SATA Connectors plug into the Mobo (6 White & 1 Blue)



Version of SATA designed for External Devices with nothing but a bunch of SATA Drives

Interfaced together through what's called eSATA

Pink eSATA Connector above the 2 USB Connectors

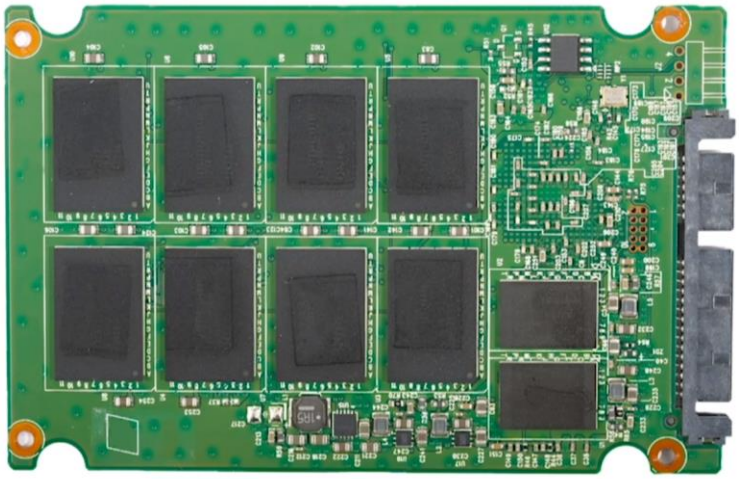
There are also eSATA expansion cards

Because of great advances with USB, eSATA is not used that much

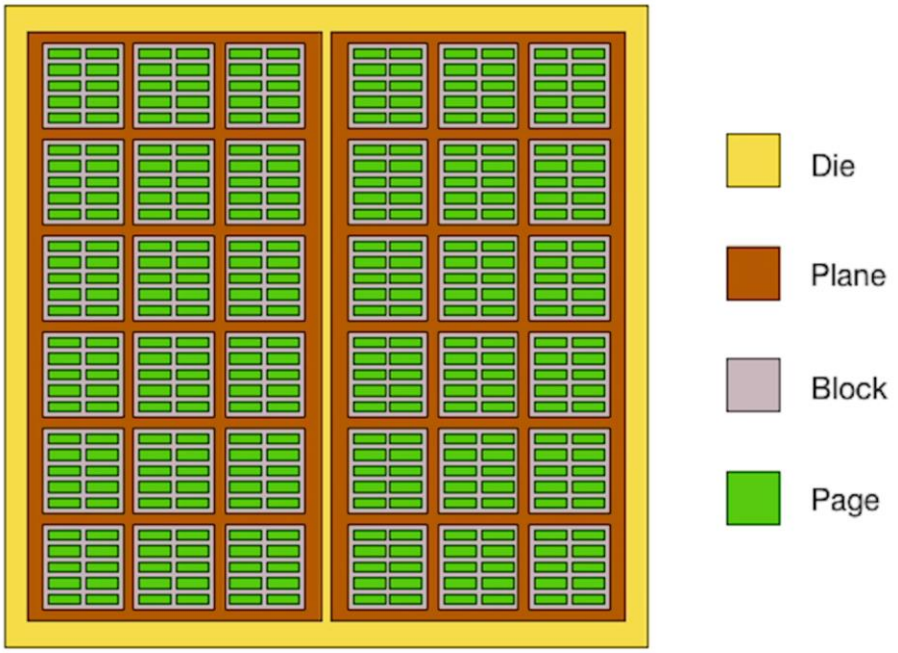
Solid State Drives

- Solid state drives (SSDs) store data using chips; there are no moving parts
- Data is stored in blocks and pages
- SSDs come in traditional 3.5" and 2.5" sizes, but also come in M2 format
- Some SSDs use the very fast NVMe protocol
instead of SATA for increased performance

SSD - Most common - Faster than HDD’s
Not uncommon to see a system with both SSD & HDD



Inside the SSD



Inside one of the Chips. 1 Chip may have 100's or 1,000's of Pages
Within a Page, we have a LOT of Blocks
Each Block is assigned an LBA Number

M.2 SSD (2 on the Left)

2.5" SSD Format (1 on the Right) - Data Connection (Left); Power Connection (Right)
HDD could easily be swapped out with a SSD using these same connections

SSD's use SATA Interface (just like HDD's)

SSD is faster than HDD, so we'd want to speed up the SATA Interface
Original SATA Interface runs at 6GBps

NVMe (Non-Volatile Memory Express) - Standard Interface much faster than SATA

Small M.2 with 2 Notches - SATA

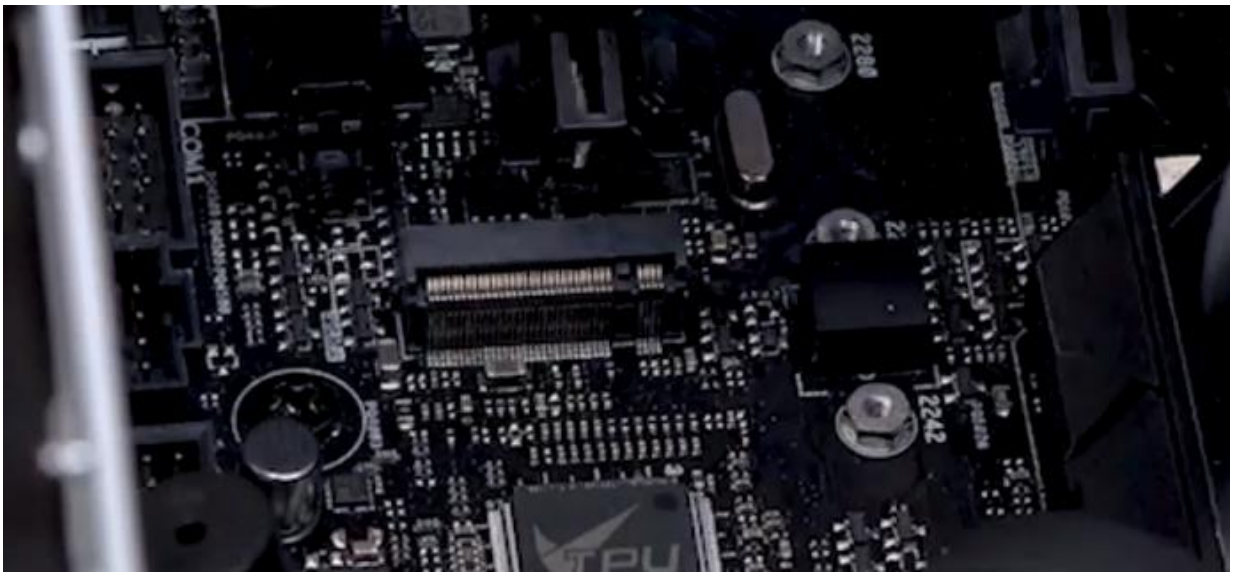
M.2 with 1 Notch - NVMe

NVMe Interface System takes the job of the LBA,

so there isn't an Interface between the CPU & Mass Storage,

which makes it a lot faster (and better!)

Make sure your Mobo has the right type of Connector (SATA or NVMe)



Unscrew HeatSink to access M.2 Connector

We can see the Connector has a spot for only 1 Notch,

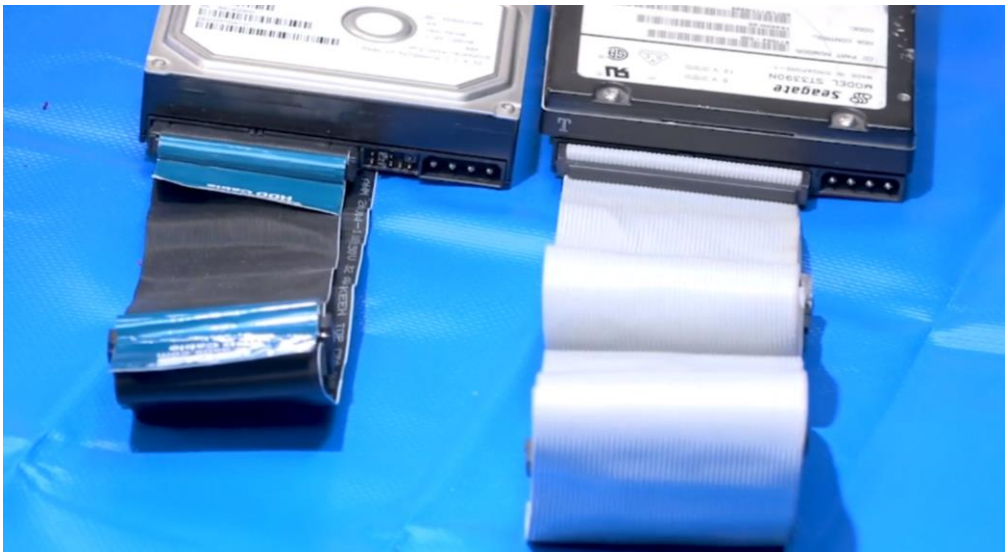
therefore we know this is for a NVMe M.2 SSD

Need to screw down the SSD, and put the HeatSink back on,

go into the System Setup to see that the M.2 SSD appears

SCSI

- Small Computer Systems Interface (SCSI) is an ancient standard
that still has great support
- The old parallel SCSI is long gone, but the SCSI language lives on
in serial SCSI versions
- Two modern SCSI standards are SAS (Serial Attached SCSI) and iSCSI



Parallel ATA (left) - Wires are all talking at the same time
SCSI (Small Computer System Interface -on the right) - Parallel Interface having its own connection

SCSI “skuzzy” - Developed the same time as ATA.
They were competing languages.
Not compatible with each other.
If wanting to use iSCSI, you need a iSCSI Controller.
If wanting to use Parallel ATA, you need a Parallel ATA Controller.

Parallel ATA - could put 2 to 4 Hard Drives in a system
SCSI - 7 to 15 Drives

Both of these types of drives are dead.
Today we use Serial Connection.
ATA Language is the same, but instead of going through Parallel Cables,
it goes through a Serial Connection
Same thing happened with SCSI

Serial Attached SCSI (SAS) - looks very similar to a SATA Connection
Not very popular (Servers)

ISCSI - SCSI Devices connected to your computer through Ethernet Cable