# **Lecture Assignment-2**

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**Q1: Compare the flash storage of SLC and MLC states. How are they different?**

MLC and SLC are some types of NAND flash memory which are used in SSDs, USB drivers and memory cards.

SLC (Single-Level Cell): is a NAND flash memory in which each cell holds only one bit of data, the cell either holds a 0 or 1 and therefore the writing and retrieving of data is faster, SLC provides the best performance and the highest endurance with 100,000 P/E cycles so it will last longer compared to other types of NAND, but the downside of SLCs is that they are so expensive with low capacity that’s why they are used for servers and other industrial applications that needs speed and endurance.

MLC (Multi-Level Cell) flash memory: is a form of NAND flash memory that can store more and various bits of data per memory cell, each cell holds 2 bits therefore MLCs has a higher data density than SLC which enables us to produce them in larger capacities, and MLC is cheaper than SLC however MLC is more sensitive to data errors with 10,000 P/E cycles which makes them have lower endurance, they are usually found in consumer products where endurance is less important.

**A screenshot of a computer

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**References: ([Tutorialspoint](https://www.tutorialspoint.com/difference-between-mlc-and-slc" \l ":~:text=MLC%20and%20SLC%20is%20a,only%20one%20bit%20of%20information.) ,[kingston](https://www.kingston.com/en/blog/pc-performance/difference-between-slc-mlc-tlc-3d-nand))**

**Q2: compare eMMC, SD, and PCI-SSD flash technology?**

**eMMC:** is an embedded version of MMC (Multi-Media Card) storage, which is found in smartphones and cheap laptops, these chips are usually soldered onto the motherboard instead of being available in the convenience and SD card offers, and because it’s embedded that means better performance and lower prices, eMMC storage is based on NAND flash memory, we find it common in producing/manufacturing devices, typically found in a few gigabytes to 128 GB capacities, eMMC are actually the most cost-effective option among the three technologies.

**SD:** secure digital is a type of a flash memory technology which comes as removable memory cards and its commonly used in cameras, tablets and other portable devices, in general has better performance compared to eMMC however its performance varies depending on the SD card class and generation such as (UHS-I & UHS-II) offer fast read/write speed \s suitable for demanding applications like 4K videos and high resolution photography, the capacity in SD cards ranges from few gigabytes to several terabytes, the cost of SD varies depending on the capacity, speed and brand but they tend to be more expensive compared to eMMC.

**PCI-SSD:** they are integrated directly on a server motherboard and PCIe interfaces, each PCI device connects to the host through its own serial link, which eliminates the need to share a bus, PCI-SSD is actually known as point-to-point architecture therefore this design lowers latency and boosts data transfer speeds between servers and storage, they are used in Data analytics, Graphics rendering, Machine learning, In-memory database applications, and data warehousing. It’s the most expensive option between the three due to higher performance and larger capacities.

**References: ([Makeuseof](https://www.makeuseof.com/emmc-vs-ssd-how-are-they-different-which-is-most-suitable-for-your-pc-laptop/),** [**TechTarget**](https://www.techtarget.com/searchstorage/definition/PCIe-SSD-PCIe-solid-state-drive#:~:text=PCIe%20SSDs%20integrate%20flash%20directly,speeds%20between%20servers%20and%20storage.)**)**