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Flash Storage: What Do SLC MLC TLC and QLC Stand For?

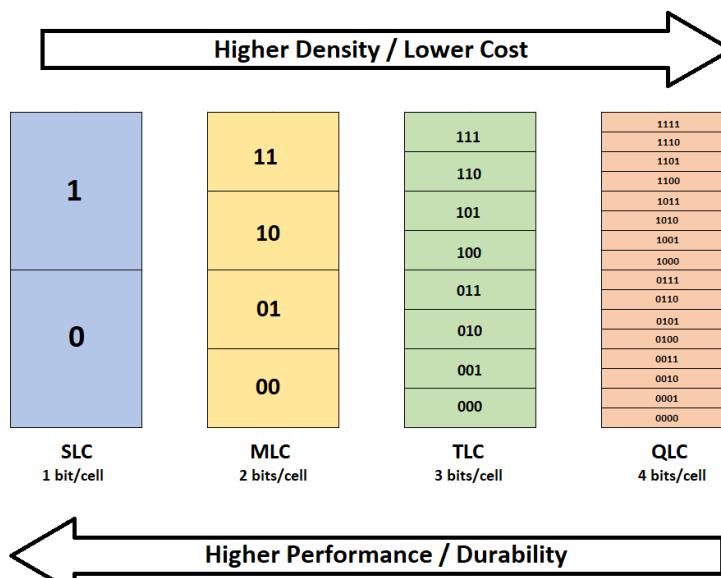
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You've probably heard a lot about the benefits of solid-state drives (SSDs) or flash storage, such as the higher speed, functionality, reliability or responsiveness they can provide over their magnetic storage counterparts – thereby removing the hard drive bottleneck.

But in choosing flash storage, we now have a growing number of options to choose from. In terms of flash memory, you've probably heard SLC, MLC, TLC or QLC being thrown around. But what do these acronyms mean?

The 'C' stands for the memory cells that store data in SSDs. Depending on the type of SSD, each cell is designed to hold different number of bits, the 0's and 1's that make up all digital data. The bits are turned either on or off through an electric charge.

Once you understand that, the names are pretty much self-explanatory. SLC stands for Single Level Cell, which means that each cell contains a single bit. MLC stands for Multi Level Cell (typically used to signify two bits per cell), TLC means Triple Level Cell (three bits per cell) while QLC is used to refer to Quad Level Cell (four bits per cell).



It's important to know what these mean because the number of cells could have significant impact on the drive's performance as well as several different attributes.

More bits in a cell equal to drives are able to provide higher capacities, while higher data densities also mean that they're cheaper to manufacture.

(So in terms of capacity, QLC>TLC>MLC>SLC, but in terms of price SLC>MLC>TLC>QLC.)

However, it's important to understand that SSDs have a limited number of write cycles in their lifetime before they start to degrade and eventually fail due to mechanical failure. Therefore, drives that contain more bits per cell also require more writes per cell to store data, which

makes their lifespan shorter. They can also be significantly slower, take longer to program and are prone to errors due to the smaller difference in voltage thresholds of each cell.

(Hence, lifespan and performance-wise, SLC>MLC>TLC>QLC. For comparison, SLCs are able to last up to 100,000 write cycles, while QLCs, even with improving technology, can only last up to 1,000 write cycles.)

Due to these characteristics:

- SLCs offer the best performance, speed, accuracy and longest lifespan over any other type of flash drive, however they also come at a higher cost and are often provided in smaller capacities. Therefore, they are mostly used in enterprise settings that require heavy reading/writing cycles, consistency and high reliability at the fastest speeds.
- MLCs and TLCs are typically found in consumer SSDs as they provide a balance between durability, reliability and affordability.
- While QLCs are probably much slower than TLCs and MLCs, they can still provide better performance than spinning disks. Therefore, QLCs can be used to provide a decent level of performance at a relatively low price. However, they can't be used for write-intensive workloads.

So now you know why SSDs with the same capacity may come at different prices. Choosing the right SSD drive, therefore, depends on not only the price factor but also your performance and longevity expectations as well as the use cases.

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