Marketing Bulletin

Enterprise SSDs

Why All SSDs Are Not Created Equal

Solid state storage is an exciting technology area that offers the promise of high performance for a wide range of enterprise applications. Unfortunately, some solid state drive (SSD) vendors have caused confusion with bold claims and positioning of their solutions for the enterprise that have not always lived up to claimed expectations during actual use. In addition, a lack of testing standards in the enterprise space—an application-intensive environment for businesses which cannot tolerate excessive failures—has compounded this problem.

Designing an SSD: The Basics

The design of an SSD involves two key components which should be integrated to build a solid solution: the non-volatile memory and the controller.

The memory used most commonly in SSDs is non-volatile NAND flash memory and is produced in varying grades of quality. NAND is designed based on using either single-level cell (SLC) or multi-level cell (MLC) technology. SLC maintains one-bit-per-cell (1bpc), has longer endurance, but is significantly more costly to produce with higher capacities. Also, SLC holds a disadvantage of having high cost mixed with less overall capacity.

MLC NAND has lower endurance, as multiple data bits are shared in each cell, but MLC holds larger capacities and can be produced at much lower costs. MLC is offered in three-bit-per-cell (3bpc) and two-bit-per-cell (2bpc) varieties, with 3bpc varieties having the highest capacity available at the exchange of slower performance.

After the NAND, a critical component of an SSD will be its controller. The controller is the command center for the NAND memory, designating where each memory cell will read or write data, and communicating with the interface that connects to the computer. Because NAND itself is imperfect as a media, how the controller responds and works to correct errors is a critical part of the design. Additionally, NAND has a finite number of writes per cell that can be made before the cell wears out. A well-designed controller will incorporate one of several styles of wear-leveling, a technique that uses algorithms to manage the cell's usage and spread the data throughout the NAND to maximize the SSD's lifespan.

Lastly, the NAND and its controller are integrated into the electronics and ASIC assembly as the final components of the design. The ASIC and electronics design will supply the necessary power/voltages to the SSD. Designs can vary here, as well as the quality of components selected. A poor ASIC design can lead to premature component failure, so it's not an area to neglect.

MLC and SLC in the Enterprise

In early SSD design development, the positioning of SLC-based designs was meant for the highest-performance enterprise applications, but applied only to niche applications where storage cost itself was not a primary concern.

Most enterprise businesses have system cost and IT budget restraints; because of this, MLC-based solutions could potentially be a better fit. However, write endurance and reliability remain concerns with MLC use in the enterprise. SSD designers recognize that if the issues around MLC could be resolved, these would be ideally suited for the majority of storage systems at the upper Tier 0 transactional performance segments. To this end, Seagate and Samsung have formed a relationship to address these challenges. With the expertise of Seagate in media error correction technology and Samsung's knowledge of NAND, the two companies are taking on the development of an SSD solution based on MLC that can meet the needs of true enterprise environments.

Enterprise vs. Client Class

For traditional hard disk drive (HDD) storage, reliability for enterprise-class designs are tested 24x7 at full duty cycles. Enterprise-class is also based on multi-drive environments, with an emphasis on random access patterns and mixed workloads. Non-enterprise, or client-class, storage is tested based on typical 8-hour-per-day use cycles. In addition, client-class storage is focused on single-drive environments.

SSD storage needs are the same as HDDs in the enterprise, but standards have not existed until recently. Before that, there was a problem in the market because many SSDs being touted as enterprise-class did not function as true enterprise SSDs and experienced high failure rates during OEM qualifications and out in the field.

In September 2010, the JEDEC Solid State Association published two sets of standards for SSD endurance and reliability. JEDEC JESD218 and JESD219 addressed the standards needed to distinguish between SSD endurance in both enterprise and client application classes, the two fundamental classes that serve as the building blocks for present and future solid state standard development. Both standards documents are available for download at http://www.jedec.org/standards-documents/results/taxonomy%3A2506?order=field_doc_full_number_value&sort=asc. These standards define specific requirements for each application class, describe a test methodology, and create an SSD Endurance Rating that provides a standard comparison for SSD endurance based on application class.

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Seagate was actively involved in the development of the JEDEC standards, and chaired the JEDEC's JC-64.8 Subcommittee, which provided the platform for the much-needed solid state standards development. By actively participating in the development of these standards and delivering a test path, OEM storage makers and customers will be better served by finally having SSDs that can be tested, validated, and then confidently placed into the most appropriate storage environments.

MLC vs. SLC Technology

MLC Technology	SLC Technology
Multiple bits per cell (2bpc or 3bpc)	One bit per cell (1bpc)
Fast performance—but slower than SLC	Fastest performance
Shorter endurance	Longer endurance
Less cost	Higher cost
Higher capacity	Less capacity

For more details:

The information in this marketing bulletin first appeared as an article at enterprisestorage.com (December 2010) written by Teresa Worth, Seagate senior product marketing manager, and David Szabados, Seagate senior corporate communications manager.

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