Is SSD Technology Ready for the Enterprise?

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After many years of being a niche solution, Solid State Disk (SSD) technology for the enterprise is finally gaining some momentum, and the price points are becoming interesting. Like virtualization, SSD technology has been around quite a while, but the current flash memory technologies in the consumer marketplace are gaining immense popularity.

The first SSD product that I'm aware of was made by Dataram Corp in 1976 for the mini-computer market. StorageTek introduced its 4305 mainframe SSD product in 1978, the same year that Texas Memory Systems, an SSD product company, was founded. Other SSD products and companies have emerged since then. I used a RAM disk in my first PC in the early 1980's. In all these cases, the SSD products were designed to appear to the system as one or more disk drives, but with significantly better performance than mechanical disk drives. These early products were quite expensive and were based on RAM technology.

Today, enterprise SSD products use either DRAM technology, enterprise NAND flash technology or a combination of both. DRAM is the same memory technology found inside servers. It is very fast but loses data when the electric power goes out. NAND Flash technology is non-volatile, retaining its data when the power goes out, but is not quite as fast as DRAM. Today's flash technology is available in two flavors: enterprise and consumer. The enterprise flash drives use single-level cell (SLC) technology which stores one bit per cell and have a typical life cycle of 100,000 writes per cell. Consumer flash drives use multi-level cell (MLC) technology that stores multiple bits per cell and has a typical life cycle of 10,000 writes per cell. SLC technology is faster than MLC, and as expected, is more expensive.

Enterprise flash drives are architected to provide at least five years of useful life by using wear-leveling algorithms and some self-healing capabilities. In addition, enterprise flash drives provide significant performance improvements when compared to mechanical disk drives. Typical enterprise flash drives provide 25x-30x IOPS performance, 10x faster response time, have no moving parts, and have significant benefits in terms of power, heat, space, noise and weight savings. In addition, administrators of mission-critical applications can spend significantly less time in activities focused on overcoming storage performance bottlenecks. Other obvious improvements include the ability to drive higher transaction volumes with existing servers, reduced disk-based backup times, reduced "rebuild" times, and other similar benefits.

Does this mean that we should now replace all our mechanical disk drives with enterprise flash drives? Probably not, for at least two fundamental reasons. One obvious reason is cost. The raw cost of enterprise flash drives on a total capacity basis is still significantly higher than for mechanical disk drives. However, the price points are now such that one could populate a disk array with a combination of flash drives, Fibre Channel (or SAS) drives and lower-cost SATA drives for the same price range as the disk array fully populated with Fibre Channel disk drives. Configuring an

array in this manner provides multiple tiers of storage, providing different performance levels for various applications, lower power consumption and potentially savings in open slots and possibly even price.

The second fundamental reason for not populating an entire disk array entirely with enterprise flash drives is that today's disk array controllers are architected for the performance characteristics of mechanical disk drives, with some headroom. Populating a disk array entirely with enterprise flash drives would overwhelm today's controllers, moving the bottleneck from the drives to the controllers.

So what are the short-term and long-term implications? In the short-term, enterprise flash drives should be viewed as complementary to mechanical disk drives. The 15K RPM mechanical disk drives are probably the fastest that we will see in mechanical disk drives and we should look to enterprise flash drives as the next higher performance category.

In the long-term, it will be probably five to ten years before enterprise flash drives become the preferred default choice for disk drives over mechanical disk drives. In addition to flash technology, there are other memory-based technologies in the research labs that may prove to be very cost effective as storage devices.

As these enterprise flash drives become more commonplace and we gradually move away from mechanical disk drives, we can now begin to re-think storage. A great deal of our storage thought processes are either directly or indirectly related to the fact that the basic storage device is a mechanical piece in an otherwise all-electronic system.

We will be testing SSDs in our test lab during the first half of 2009 and will be publishing various performance reports showing SSD performance for specific application workloads.

Action items: Today's large disk subsystems cannot support an array completely populated with enterprise flash drives. Ask your storage vendor to provide the maximum number of enterprise flash drives they support in the arrays that you are considering acquiring. Also, consider a configuration of storage array that has mixed flash, Fibre Channel (or SAS) and SATA disk drives and compute the potential cost and power savings as compared to an array of all one type of disk drive. Look for management software that can handle three tiers of disk storage.