ENTERPRISE STORAGE STACK

ESS Can Radically Reduce Cost of Building Heavy Duty Storage Appliances

This catalog sheet analyzes how careful media selection together with ESS advantages can dramatically reduce the cost of building heavy duty high IOPS Enterprise mass storage.
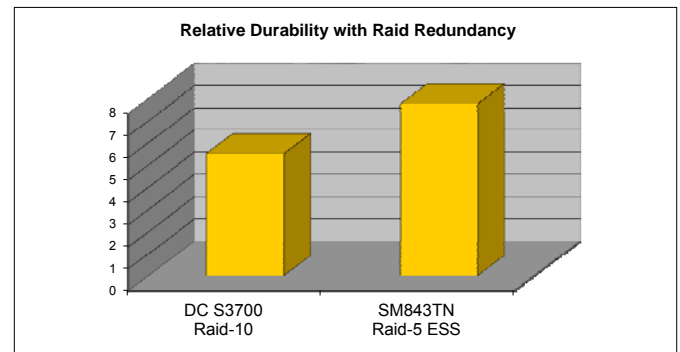
The Intel DC S3700 Enterprise SSD is built with eMLC memory with more than 20,000 erase cycle endurance Flash. Intel advertises that the S3700 will accept 11 overwrites per day for five years whether used in linear write mode or in random write mode. Intel S3700 drives are reasonably priced based upon their extra endurance. For instance, Newegg sells 800GB drives for $1,980.

The Samsung SM843TN Enterprise SSD is built with 20,000 erase cycle MLC Flash. Samsung advertises that the 843TN will accept at least 11 overwrites per day for five years if written to linearly, but will only accept about 1.4 overwrites a day when written to randomly. At Google, 960GB 843TN drives cost as little as $1,028.
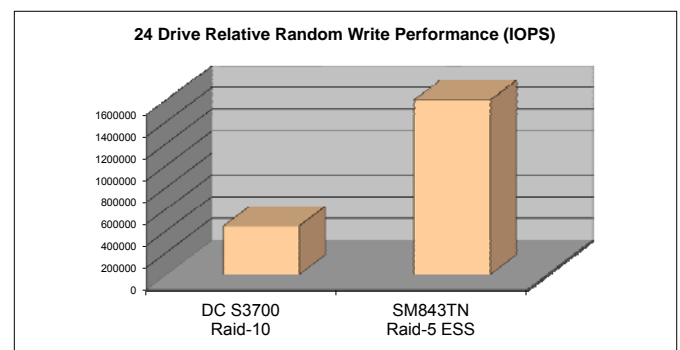
Enterprise Storage Stack is a block filter which converts randomly written IO into atomic FIFO linear writes bounded on both erase block and Raid-stripe boundaries. Intrinsic wear amplification is typically <1.3:1. ESS is also extremely fast. Writes occur at the linear write speed of the device, which is about five times the random write speed of the device.

When used with a Raid-set, the advantages of ESS increase. Because ESS writes only linearly, it avoids the 2x raid amplification inherent in both Raid-5 and Raid-10, reducing raid amplification to $1/(n-1)$. In large

24 SSD Raid-5 arrays, ESS can almost halve wear, and more than halve it for high security Raid-6 sets.
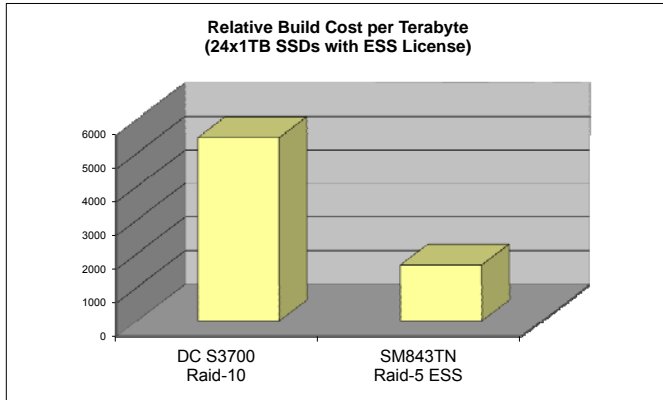

Relative Durability with Raid Redundancy

24 S3700 SSDs, managed by Linux Raid-5 will only write 40,000 IOPS – too slow for practical use in all-Flash devices. The same media, managed by Linux Raid-10, will deliver 444,000 write IOPS. But the ESS managed Raid-5 set of 24v SSDs will deliver far in excess of a million write IOPS.

24 Drive Relative Random Write Performance (IOPS)

But what is most compelling, as the following table shows, is that while ESS delivers more durability in terms of total writes per day as well as radically greater random write speed, ESS delivers these capabilities in our basic

topology at significantly lower total cost ... reducing manufacturing costs per terabyte 65%.

Relative Build Cost per Terabyte
(24x1TB SSDs with ESS License)

The possible cost savings and benefits do not end with our basic engine.

Our Enhanced Engine adds a number of both useful and cost-saving capabilities.
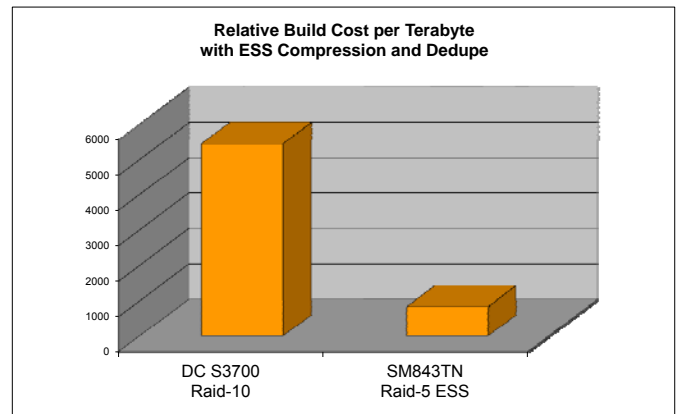
On the durability side, these include checksums and micro stripes. Checksums assure that all read and written data is correct, while micro stripes permit the intelligent repair of damaged data. These durability elements enhance durability elements already present in the basic product, such as the soundness of never overwriting existing data, and of writing FIFO to assure data continuity.

ESS's deduplication and compression engine is designed to create space efficiencies real time. The entire advanced engine, including appropriate compression and deduplication, normally writes at levels above a million IOPS.

Similarly, the advanced engine uses a virtual memory approach to reduce the amount of RAM required, and conversely to permit the construction of very large systems. With enhanced ESS, it is possible to build systems addressing a hundred terabytes of physical Flash, with logical addressing approaching a petabtye.

Compression commonly increases physically addressable space by a factor of two. In ordinary usage, Deduplication will improve space utilization by a further 15% to 20%. In VDI and similar environments, deduplication can reduce physical storage requirements by a factor of 5x to 10X.

The following table shows the relative cost of usable space if we assume that deduplication and compression can at least double addressable space. In such an environment, ESS systems with 843T's SSDs become seven times less expensive than S3700's used in a generic manner.

Relative Build Cost per Terabyte
with ESS Compression and Dedupe

While enhanced ESS cuts manufacturing costs per terabyte even further, it also improves media life by reducing the amount of data written to the media either through compression or the virtualization of deduplication. Accordingly, a 2x increase in logical space utilization decreases total wear by a factor of two, while increasing the number of supportable daily overwrites by a factor of two.

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