ENTERPRISE STORAGE STACK

Enterprise Flash Storage For Less Than a Dollar a Gigabyte

Most Enterprise grade Flash mass storage systems still costs $5 to $20 a gigabyte. But with the Enterprise Storage Stack, you can build Flash based storage servers with more than a million IOPS for less than $1 per raw gigabyte. With real-time compression and deduplication, you can reduce storage costs to $0.40/GB in typical usage, and $0.05/GB in some.

ESS includes a patented Linux block layer which converts random writes into perfectly sized linear writes that are ideal for Flash media and Linux parity RAID.

ESS is ultra fast: ESS writes at the composite sequential write speed of the SSDs present. Systems with 24 drives typically write more than 1 million 4KB random blocks per second, even when compressing and/or deduplicating real-time.

Almost no wear amplification: While many flash drives have either undocumented or high wear amplification, ESS monitoring software typically reports wear amplification of <1.3:1 in server environments.

Significantly less wear in redundant arrays: ESS's linear design assures less data will be written to Raid-5 and -6 redundant arrays. In addition to its wear-amplification savings, ESS-enhanced Flash media typically lasts two times longer than traditional random writing to Raid-5 and Raid-10, and three times longer than traditional Raid-6.

Virtualized empty space: ESS sparse stores empty blocks and supports trim/discard functions. Virtualized space dramatically increases free space and dramatically reduces wear amplification. Combined with compression and deduplication, virtualization provides the space-saving basis for high levels of thin provisioning.

Real-time compression, when activated, typically reduces storage requirements of uncompressed media by more than 50%.

Real-time deduplication, when activated, consolidates repeated 4KB blocks of data into a single instantiation. This can save a profound amount of space when multiple systems are stored on the same storage device. For instance, in VDI, dedupe can reduce physical storage requirements by 80% to 90%. ESS's dedupe engine is unique because it is fast without requiring a huge memory footprint. While most systems have deduplication write rates expressed in megabytes per second, ESS measures throughput in gigabytes per second.

Error detection and correction: When data protection is activated, ESS adds its own Raid-layer and hash checks so that any hardware-caused errors can be transparently detected and repaired at read-time.

Works with all Raid Formats: PCIe cards and independent SSDs normally can only be effectively used in Raid-0 or Raid-10 settings, forcing users to either forgo Raid protection or to double expenditure. ESS works with Raid-0, -5, and -6, delivering redundancy with only marginal loss of either capacity or speed.

Works with all file systems: ESS is a block device and transparently supports all file systems and volume managers.

Local or Appliance use: ESS is suitable for small raid-sets as well as large scale storage appliance arrays with up to 100TB of physical

flash. Larger arrays can be built but current motherboards limit performance to just over 6GB per second.

Linearization of media: Specialized support for SandForce based SSDs is included. This avoids fragmentation issues associated with these drives.

Load and go: ESS can typically be installed and configured in less than an hour from cookbook instructions. Once installed, the use of ESS is transparent.

Works with standard hardware. From the day of first inception, ESS has been designed to work with low-cost, off-the-shelf computer hardware. Our reference platforms will advise you what the fastest and most cost effective components are, and criteria you should pay attention to in hardware selection, but the hardware you choose is up to you.

Inexpensive appliance hardware: ESS's low memory footprint and efficient CPU utilization let you build high-performance systems without breaking the bank. One million IOPS 2U storage shelves can be built supporting 30+ TB of Flash for less than $3,500 (plus the cost of the SSDs). Small storage appliances can be built for less than $400.

Encouraging modularity: With ESS, storage appliances don't need to be huge to be low cost. Smaller 1TB to 8TB devices with 100,000+ IOPS can be deployed throughout a data center with low chassis costs without upgrading networking capacity.

Inexpensive media: ESS typically has virtually no wear amplification. As a result, MLC based commercial grade SSDs costing less than $0.50/GB, are suitable in most Enterprise environments.

Also reduces costs of "Enterprise" media: When media costs per gigabyte increase, the economic advantages of ESS increase dramatically. This said, only a small proportion of enterprise solutions need extreme durability media.

All inclusive low cost licensing: In quantity, the license cost of ESS is negligible – less than five cents a gigabyte. The license includes all the features mentioned. For major users, a paid up license is available.

Further cost reductions through thin provisioning: ESS allows you to expand addressable storage to as much as ten times the physical space if compression, deduplication, and virtualization create adequate free-space. There is almost no supplemental hardware cost associated with thin provisioning due to ESS's sparse RAM design.

Low cost ownership: ESS Flash solutions cost significantly less than $1 per physical gigabyte of storage, and less than a dime a logical gigabyte with thin provisioning. In many instances, ESS based solutions will have a lower cost per addressable byte than does 7200 rpm media, while operating a thousand times faster.

ESS's History: Development of ESS (originally called Managed Flash Technology) began in 2006 as a project to improve the random write performance of Flash media in servers. Version 1.0 was introduced in 2007. Early copies of Version 1.0 were built with CF cards because affordably priced SSDs did not yet exist. Some of those units are still in operation. Version 2.0 has powered close to a thousand storage devices over the last four years. Version 3.0 achieved a 4x random write speed improvement and all the features mentioned here with the exception of sparse-memory management of deduplication. Version 4.0 adds sparse memory management structures and compression to deduplication. This, together with terabyte Flash SSDs, permits miniaturization while reducing the costs of Flash to the level of 7200 rpm media.

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