Software and Enterprise Storage

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Linux Storage Servers

Xeon rack mount servers directly support:

- Modern Hardware including SSDs
- RAID
- NAS / SAN Functionality

The Magic of Storage Software

- Storage Performance
- Flash Endurance Management
- Volume Management
- Error Correction
- Thin Provisioning

The Enterprise Storage Stack

ESS is EasyCo's unbundled software solution for managing arrays of Flash storage elements.

- Applicable to SSDs and PCIe Flash storage.
- Scalable from mobile devices to 100+ TB arrays.

ESS, a Linear Write Engine

- Writes clusters of writes as linear stream.
- Writes occur on erase-block and raid-stripe boundaries, assuring maximum speed and minimum wear.
- Memory table retains current location.
- Memory table extensions support enhanced functionality.

ESS, an Extremely Fast Engine

- Runs at the composite linear speed of SSD array subject to chassis limitations.
- > 1.1 million 4KB random writes with just 16 SSDs.
  - > 10x faster than RAID-10
  - > 20X faster than RAID-5

ESS Dramatically Improves Media Life

- Basic ESS has wear amplification of only 1.3:1 in typical use.
- Linear writes eliminate raid generated wear.
- Single instance storage (deduplication) further reduces wear amplification.

ESS Error Detection/Correction

- End to end error detection.
  - Uses fast hash functions
  - No overlap with CRC
- Detects block corruption.
- Detects missing writes.
- Detects misdirected writes.
- Uses micro-stripes to fix errors.

ESS Deduplication and Thin Provisioning

- Transparent block-level (4K) deduplication.
  - Real-time operation
- Extremely fast.
  - > 1M 4K writes/sec, no overhead on reads
- 100% accurate.
  - Not reliant on crypto hash collisions
- Reasonable memory footprint.

ESS Is Media Agnostic

- Use 3,000 (or even 1,000) endurance “commercial media” when one or fewer overwrites per day are anticipated.
- Use 18,000 endurance “enterprise media” when six or fewer overwrites per day are needed.
- Freely use SATA or SAS media, or even PCIe media, without conflict.

High Efficiency ESS Has a Low Hardware Footprint

- Designed to run with commodity hardware.
  - Fast local storage arrays using MB SATA ports
- 6TB 1U 11” deep mini storage appliances.
  - $750 BOM, 6 2.5” drive bays, mobile Pentium dual-core, 16GB RAM, 6 GigE ports
- 24TB 2U servers in a white-box chassis.
  - $3K BOM, 24 2.5” drive bays, 6-core Xeon CPU, 64GB ECC Ram, plus SAN interfaces.

ESS Storage Can Be Built For Less than $1 per Gigabyte

- High efficiency software reduces CPU and memory costs.
- ESS works best with Raid-5/6.
  - Raid-10 is not needed.
- Reduced wear amplification makes commercial grade media viable in most situations.

ESS Thin Provisioning Reduces Costs Even Further

- Sparse storage of empty blocks.
- Single instance storage of duplicated 4K blocks.
- Drive effective storage costs below $0.20/GB.

ESS is Available Now For:

- Linux Kernel 2.6.9 and later
  - 32 and 64 bit
  - x86 and ARM
- DAS applications
- NAS applications
- SAN applications

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