Tiering for Converged Flash Storage

Andy Mills, Co-founder/CEO Enmotus, Inc.
Data Center Trends

• Convergence of Compute and Storage
  • Big Data, Scaleout - networked commodity storage-servers
  • Collapsed SAN - all in a single node - looking more like DAS again

• Software Defined Everything
  • SDS - Software Defined Storage

• Device Level Convergence
  • Virtualization at device level within a node
  • Creation of virtual devices from flash, fast HDDs, slow HDDs
**Scaleout vs Scaleup**

**Typical Enterprise Data Center**

- Clients
- Network/Web
- Server(s) + CPU
- Private SAN or LAN/VPN

**Distributed, Clustered or Hybrid Data Center**

- Clients
- Network/WebAPI
- Gateway
- Private SAN or LAN/VPN

- Server + Storage
- CPU
- SSD
- Disk

- Server + Storage
- CPU
- SSD
- Disk

“Scaleup”

“Scaleout”

- Better suited to handle large unstructured data environments e.g. Web search, data analytics
Flash in Data Centers

**Memory Class**
- **NVDIMM**: 1 million IOPs+

**PCIe SSDs**: 150-700K IOPs

**Small Form Factor**
- **SAS, SATA**: 20-90K IOPs

**Embedded**
- **mSATA/M.2**: 20-90K IOPs

(Hard Disk Drives range from 80-350 IOPs)
Flash Integration in Data Centers

• Early Solutions Focused on Ease of Integration
  • SAS/SATA SSDs emulate hard disk drives
  • Drop into existing or modified disk arrays
  • Preserve legacy controllers and storage management tools

• Introduction of PCIe SSDs
  • 20x+ improvement over first generation
  • Server based SSD acceleration/caching
  • New island of storage, new management tools

• NVDIMM memory class
  • Another new island of storage…
**Converged Flash-Legacy Storage Generations**

- **1st generation**
  - SSD Caching
  - SSD caching in Disk Arrays
  - Server side SAN caching
  - Flash is look aside

- **2nd generation**
  - SSD Caching Mark II
  - Increased intelligence to address application behavior
  - Flash is look aside

- **3rd generation**
  - Software Defined Storage
  - Full virtualization model
  - Flash is primary storage
  - Higher performance, broader flash device support
Third Generation Flash Convergence Technology

- **1st/2nd Gen SSD caching challenges**
  - Size restrictions
  - As cache capacity increases, performance tails off
  - Larger cache capacities do not contribute to usable storage pool
  - Effectiveness is increasingly hard to measure

- **3rd Gen SSD Virtualization and Auto Flash Tiering**
  - Full virtualization abstracts several types of flash media
  - SSDs become usable as primary storage OR cache
  - Achieve full SSD performance for both reads AND writes
  - No capacity limits, any ratio of storage may be used
Software Defined Flash Convergence

Hybrid Storage Manager

Windows, Linux, OpenStack, ....

Virtual Disk

Virtual Disk

Block device Virtualization

Statistics, Load Balancing and Tiering Engines

Block Management Engine

Device Pooling

Fast Devices

Slow Devices

Fast Devices

Slow Devices

Fast Devices

Slow Devices

HDD

Raw Block or Memory Devices

NVDIMM

PCle SSD

SAS/SATA SSD

M.2 PCle /SATA

Dual Drive

RAID/JBOD

HDD

Fast Devices

Slow Devices

Fast Devices

Slow Devices
Monitoring and Visual Mapping

- Visual at-a-glance tools are important to ensure active data is truly on the flash portion of the storage tier
Monitoring Flash Activity Levels vs. Hard Drives

- Ability to monitor activity over time to ensure most activity is being served off the fast tier
Wrap up

- Industry moving to third generation software defined storage that is flash friendly
- Fully virtualized, fully transparent
- Fully automated load balancing across all flash components and legacy storage
- Performance, improved visibility and management tools are key elements of the third generation