SSDs: Practical Ways to Accelerate Virtual Servers

Session B-101, Increasing Storage Performance

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Summary

- Market and Technology Trends
- Virtual Servers and Storage I/O
- Observed Performance Numbers
- SSD Caching and MicroTiering
Markets

**Servers**
- ~8M servers annually, 23% unit growth, 11% revenue (IDC)
- ~1.8m virtual machine enabled physical servers ship annually
- ~1.3m database servers ship annually
- 700K-1M servers new social network server build-outs
- ~$12BN spent on storage management software

**SSDs/Flash Storage**
- Server-storage performance gap widening
- 20-100x+ raw performance gains
- 2-10x+ transaction performance gains
- Reduction in power - 100-1000%
- Drives trend back to DAS storage
Virtual server environments behave very differently creating the infamous IO blender effect

SSDs are migrating back into the server creating several integration and reliability issues

Utility based computing and virtual machines have created a fluid computing environment making the setup more dynamic and unstructured

Growing trend toward smaller, lower cost clustered virtualized servers that are SAN-less

Storage virtualization strategies needed for these emerging systems and less sophisticated users
IO Blender Effect

Sequential Streams are turned to Random
Ideally would like the SSD to be servicing the highest activity OS
Live Machine Migration

Moving or Creating a New VM Changes the Storage IO Balance
SSD Integration – Today’s Options

- **Software Based Caching and Tiering**
  - Client OS only
  - Hypervisor + Client Driver
  - Hypervisor
  - SSD type agnostic e.g. SATA/SAS SSD or PCIe SSD

- **Hardware Accelerated**
  - RAID adapters with SSD caching
  - PCIe Hardware Accelerated SSDs
  - Intelligent Storage IO Processors – MicroTiering

- **Hybrid Hardware-Software**
  - PCIe SSDs with software based flash management
Raw SSD Performance

Source: Enmotus

Dell R515, Iometer 2006, 512B Random Read IOPs
Today’s Approach – Caching, SAN

- User Required to Install and Maintain Software Drivers
- Requires ongoing software maintenance
Hardware Accelerated Tiering

- User Drops in Virtual Storage Processor IO Card
- Minimal or no Drivers
- Presents a virtual tiered disk

SSDs transparently tiers beneath the standard hypervisor datastore and are load balanced across all OSes
Pros and Cons

Software based caching
- SSD used as a cache, usually accelerating read only
- Write-back cache modes existing but very high level SSD wear
- No incremental hardware, works with existing storage
- Higher maintenance with drivers at OS and hypervisor levels
- OS and Hypervisor dependent

Hardware accelerated tiering
- Presents a single virtual tiered disk to the host
- SSD is a cache or true data tier (depending on vendor) accelerating both reads and writes
- Easier to deploy – set and forget
- Bare metal deployment, OS and Hypervisor Agnostic
- Less sensitive to OS and Hypervisor “versioning”
Enmotus MicroTiering™

- A new class of high performance SSD optimized tiering for non-SAN and hybrid SSD-HDD tiering applications
- 100% transparent automated tiering at sub-hypervisor level
- No hypervisor or client software required
- Legacy volume migration support for upgrade markets
- Bare metal deployment for new installs
## Tiering vs. Caching

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<thead>
<tr>
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<th>Tiering</th>
<th>Caching</th>
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<tbody>
<tr>
<td><strong>Performance - reads</strong></td>
<td>Near native SSD speeds for data in fast tier consistently</td>
<td>Near native SSD speeds for cached data, lower when cache is near full or thrashing</td>
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<tr>
<td><strong>Performance - writes</strong></td>
<td>Near native SSD speeds</td>
<td>Write back cache mode only</td>
</tr>
<tr>
<td><strong>Overhead Wear Leveling</strong></td>
<td>Near zero e.g. &lt;1 % incremental writes measured</td>
<td>Generates significant number of overhead writes to SSD consistently</td>
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<td><strong>Migration to Fast Tier</strong></td>
<td>Policy driven, moved chunks at a time in the background after the IO event</td>
<td>Moved into SSD as part of the read IO event, and all write events in write back cache mode</td>
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<td><strong>Length of Time in SSD Tier</strong></td>
<td>Stays until displaced by more important data, persistent through power cycle</td>
<td>Removed once cache fills or at every scheduled inactivity flush event</td>
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Tiering data provides several benefits over SSD caching

- Faster primarily due to write performance
- Significantly lower SSD wear out, often negligible

Virtual servers benefit more from tiering than caching due to faster writes and more intelligent data movement

Enmotus Tiering Software
MSI Z77A-GD55, Intel i7 3770 3.5Ghz
8GBytes DDR3
2TB HDD Toshiba, 120GB SSD SanDisk Extreme
SysBench 0.4.12
128 files & Block size 16Kb
Read/Write ratio = 1.50
Thank you!