Flash on the Memory Bus

Session 202-A
9:45am to 10:50am Aug 6, 2014
Sean Stead, Viking Technology
THE HIGH COST OF LATENCY

“...every 100ms of latency cost them 1% in sales”

“...an extra 500ms in search page generation time dropped traffic by 20%”

“...a broker could lose $4M per millisecond if their electronic trading platform is 5ms behind the competition”

Source: http://highscalability.com/
The Memory / Storage Problem: Latency

- As CPU technology scales, storage I/O creates performance bottlenecks
- The latency gap in memory / storage hierarchy needs to be bridged
- NVDIMM offers a solution today (Storage with low DRAM Latency)
Memory/Storage Hierarchy

- Data-Intensive Applications Need Fast Access To Storage
- Large Performance Gap Between Main Memory And HDD
- SSDs Have Narrowed The Gap, But a Big Gap Still Exists
**Benchmark**: VDBENCH, Platform: Intel Sandybridge, Linux, Two DDR3-1333 NVDIMMs as interleaved pair (channel interleaving)
NVDIMM’S – WHAT & WHY

- Resides on the Memory Channel (DDR3/DDR4)
- Retains data in the event of an unexpected power loss
- Combines memory technologies (DRAM & Flash)
- Requires unique power source for main memory persistence
- Delivers high levels of storage throughput performance
- Databases can run faster & recover quicker
- Can enhance both SSD endurance and reliability
Ecosystem performance gap between compute & storage

- Nanoseconds latency (1000x faster than Flash)
- 1.4 million IOPS (3x better)
Performance vs. Cost ($ per I/O) trade-off

Best in Class SSD: $100.00 / PB versus. NVDIMM: $0.40 (250x cost savings)
Several alternatives solutions in the market, all for different usage and applications. Each solution has its purpose, the questions is “finding the right tool for the job”.

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>HDD</th>
<th>NVDIMM</th>
<th>Std. SSD</th>
<th>PCIe SSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction (IOPS)</td>
<td>350</td>
<td>1.4 Million</td>
<td>60K – 250K</td>
<td>70K – 300K</td>
</tr>
<tr>
<td>Capacity</td>
<td>Up to 4TB</td>
<td>2GB – 16GB</td>
<td>60GB - 4TB</td>
<td>400GB – 8TB</td>
</tr>
<tr>
<td>Latency</td>
<td>10,000,000 ns</td>
<td>10 ns</td>
<td>100,000 ns</td>
<td>10,000 ns</td>
</tr>
<tr>
<td>Ease of Integration</td>
<td>Plug n’ Play (Low)</td>
<td>DDR4 availability &amp; NVDIMM enabled Server (High)</td>
<td>Plug n’ Play (Low)</td>
<td>Drivers (Medium)</td>
</tr>
<tr>
<td>Availability</td>
<td>Now</td>
<td>DDR3 Now DDR4 Q4-2014</td>
<td>Now</td>
<td>Now</td>
</tr>
<tr>
<td>Scalability</td>
<td>Easy (24 per 2U)</td>
<td>DDR3/4 Socket (Medium)</td>
<td>Drive bays not always available (low – med)</td>
<td>PCIe Sockets (Very Low)</td>
</tr>
<tr>
<td>Market/Audience</td>
<td>All</td>
<td>OEMs</td>
<td>All</td>
<td>VARs / Integrators OEMs / Client</td>
</tr>
</tbody>
</table>
## NEW STORAGE ECOSYSTEM

Storage hierarchy and synergistic ecosystem

<table>
<thead>
<tr>
<th></th>
<th>CPU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NVDIMM</td>
</tr>
<tr>
<td>High Cost</td>
<td>SSD (high-performance)</td>
</tr>
<tr>
<td></td>
<td>SSD (mainstream)</td>
</tr>
<tr>
<td>Lowest Cost</td>
<td>HDD</td>
</tr>
<tr>
<td></td>
<td>TAPE</td>
</tr>
</tbody>
</table>

- Caching
- Flash Array
  - High - Tier 0 Performance
- Cluster
  - Low-Med Performance
- Archive
The SNIA NVDIMM-SIG is developing product categories:

- DRAM Modules
- NVDIMM
- MCS (ULLtraDIMM)
- SATADIMM
- HDIMM (Hybrid DIMM)
- SCM (MRAM, ReRAM etc)
OPTIONS – FLEXIBILITY – PRO’S & CON’S

- Flash is cheaper than DRAM $/GB
- NVDIMM has 1000x lower latency than Flash
- DRAM has practically infinite endurance
- Hyperscale want “Dense & Cheap” (WORM)
- Financial want low & predictable latency
- Storage wants higher I/O performance & increased data security
- No individual “BEST” choice – There are OPTIONS….
THANK YOU

www.vikingtechnology.com