Flash Multiprotocol Storage and the End of Hard Drives in Primary Storage
Enterprise solid state shipments will double to 762,400 units and $800 million in 2011, growing to $2.5 billion by 2014.
## The Problem

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2005</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU speed</strong></td>
<td><strong>1 x</strong> Pentium 4 1.5 GHz</td>
<td><strong>5 x</strong> Pentium D 2.6 GHz</td>
<td><strong>15 x</strong> Nehalem Quad 2.6 GHz</td>
</tr>
<tr>
<td><strong>DRAM speed</strong></td>
<td><strong>1 x</strong> 2.1 GB/s DDR1 PC-2100</td>
<td><strong>4 x</strong> 8.4 GB/s DDR2 PC2-4200</td>
<td><strong>12 x</strong> 25.6 GB/s DDR3 PC3-8500</td>
</tr>
<tr>
<td><strong>Network speed</strong></td>
<td><strong>1 x</strong> 100Mb Ethernet</td>
<td><strong>10 x</strong> Gigabit Ethernet</td>
<td><strong>100 x</strong> 10 Gigabit Ethernet</td>
</tr>
<tr>
<td><strong>Bus speed</strong></td>
<td><strong>1 x</strong> 133 MB/s PCI 32/33 MHz</td>
<td><strong>15 x</strong> 2000 MB/s PCIe G1 x8</td>
<td><strong>30 x</strong> 4000 MB/s PCIe G2 x8</td>
</tr>
<tr>
<td><strong>Disk speed</strong></td>
<td><strong>1 x</strong> 3.8 ms seek Cheetah 15K.2</td>
<td><strong>1.2 x</strong> 3.6 ms seek Cheetah 15K.4</td>
<td><strong>1.2 x</strong> 3.6 ms seek Cheetah 15K.7</td>
</tr>
</tbody>
</table>
Unacceptable Alternatives

► Option #1: More spindles
  › Does not address latency, increases failure risk, and multiplies power, cooling, and datacenter rackspace costs

► Option #2: Short-stroke hard drives
  › Wastes 70% of storage capacity for limited speed gains

► Option #3: Caching
  › Caches are 1000:1 oversubscribed, offering inconsistent results

► Option #4: Tiering
  › Adds complexity, more hardware, does not improve performance
NAND Flash as 15K Disk Replacement

Huge Performance and Reliability Gains

<table>
<thead>
<tr>
<th></th>
<th>15K HDD</th>
<th>NAND Flash</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance (IOps)</td>
<td>350</td>
<td>30,000</td>
<td>86x greater</td>
</tr>
<tr>
<td>Latency (ms)</td>
<td>10 ms</td>
<td>0.3 ms</td>
<td>30x faster</td>
</tr>
<tr>
<td>Reliability (MTBF)</td>
<td>1.2 M</td>
<td>2.0 M</td>
<td>67% greater</td>
</tr>
<tr>
<td>Rebuild Times</td>
<td>10-20 hrs</td>
<td>20-30 min</td>
<td>40x faster</td>
</tr>
</tbody>
</table>
## NAND Flash as 15K Disk Replacement

### Significant Efficiency and Economic Gains

<table>
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<th>15K HDD</th>
<th>NAND Flash</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power (W / TB)</td>
<td>30</td>
<td>5</td>
<td>83% lower</td>
</tr>
<tr>
<td>Efficiency (IO / W)</td>
<td>15</td>
<td>6,500</td>
<td>433x higher</td>
</tr>
<tr>
<td>Density (TB / U)</td>
<td>3</td>
<td>5</td>
<td>67% higher</td>
</tr>
</tbody>
</table>
The Solution

► Nimbus S-Class
  › 100% NAND flash memory
  › 10 - 50x faster than disk arrays
  › 80% lower power usage
  › 70% greater rack density
  › Superior availability

► Game-changing Technology
  › Purpose-built hardware + smart software
  › Comparable acquisition cost to aging 15K rpm disk arrays
  › Significantly lower OpEx, enabling green datacenters
  › Unparalleled performance to increase QoS and slash TCO
System Architecture

▶ Nimbus Data Details
  › Modular 2.5, 5.0, and 10.0 TB rackmount systems
  › On-demand scalability to 250 TB via stacking
  › Up to 800,000 IOPs and 8 GBps throughput
  › 1 Gb/10Gb Ethernet, 8 Gb Fibre Channel, and 40 Gb Infiniband
  › SAN and NAS

▶ Enterprise Flash Modules
  › 24 hot-swap modules/shelf
  › 80% better MTBF than HDD
  › 10x more durable EMLC silicon
  › 28% additional reserve flash
  › TRIM and dynamic wear-leveling
Questions?

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