Getting the Most Out of SSDs – IT System Optimization Best Practices

Mike Chenery, President and Co-Founder
Pliant Technology
Storage Myths & Facts

- Facts: Storage has always been sold on $/GB
  - HDDs are optimized for cheap $/GB
  - Storage performance has lagged market requirements
  - A SSD will not be less expensive than a HDD

- Myth: SSDs can be sold on performance (alone)

- Conclusion: Cost effective solutions are possible
  - And we will show how this can be done...
Filling the Performance Gap

HDD Attributes
- Higher RPM (10K/15K)
- Short stroke HDD’s
- Smaller FF drives
- Over provision HDD’s
- Low capacity HDD’s
- Striped data for MB/s

Consequences
- Increased power
- More drives required
- Reduced $/GB
- More drives required
- Increased $/GB
- Increased risk of data loss
Proposition: More for Lower Cost

Traditional: 1000s x HDDs

Efficient: Fewer HDD+EFD

Benefits:
- Lower Costs
- More Reliable
- Lower Power
- Better Performance
- Smaller Footprint
Innovation Improves Efficiencies

**HDD Attributes**
- Higher RPM (10K/15K)
- Short stroke HDD’s
- Smaller FF drives
- Over provision HDD’s
- Low capacity HDD’s
- Scattered Data
- “More Is Faster”

**HYBRID Approach**
- Storage tiers: ‘Hot’ data on SSD’s
- Dual port for performance
- Full stroke HDD’s
- High capacity HDD’s
- “Do More For Less”
Example: Order Entry System
*(TPC-C Benchmark)*

Order-entry system with transactions including entering and delivering orders, recording payments, checking the status of orders, and monitoring the level of stock at the warehouses

Requirements
- 640,000 transactions/minute
- 320,000 IOPS
- 18TB database
Current Solution: High Cost & TCO

- 40 Rack mount shelves
- 1000 36GB HDD’s
- 15K RPM
- >$450K Purchase price
- 8000 watts to operate
- 8000 watts to cool

Traditional: 1000s x HDDs
## EFD/HYBRID: Lowest Cost/GB

<table>
<thead>
<tr>
<th>Enterprise Rack Attributes</th>
<th>HDD Only Solution</th>
<th>EFD+HDD Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDDs</td>
<td>25 (15K RPM)</td>
<td>21 (10K RPM)</td>
</tr>
<tr>
<td>Capacity/Drive</td>
<td>36GB/18GB each</td>
<td>147GB each</td>
</tr>
<tr>
<td>EFDs</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Capacity/Drive</td>
<td>n/a</td>
<td>150GB each</td>
</tr>
<tr>
<td>Usable Capacity/Shelf</td>
<td>450GB</td>
<td>3500 GB</td>
</tr>
<tr>
<td>IOPS/shelf</td>
<td>8000</td>
<td>52,500</td>
</tr>
<tr>
<td>Cost per Shelf</td>
<td>$11,250</td>
<td>$37,500</td>
</tr>
<tr>
<td>Number of Shelves Req'd</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$450,000</td>
<td>$225,000</td>
</tr>
<tr>
<td>$/IOP</td>
<td>$1.49</td>
<td>$0.65</td>
</tr>
<tr>
<td>$/GB</td>
<td>$26.50</td>
<td>$10.05</td>
</tr>
<tr>
<td>Power to Operate &amp; Cool</td>
<td>16,000 watts</td>
<td>2,000 watts</td>
</tr>
<tr>
<td>Power Efficiency (Watts/GB)</td>
<td>0.44</td>
<td>0.059</td>
</tr>
</tbody>
</table>
## EFD/ HYBRID: Lowest Cost/ GB

<table>
<thead>
<tr>
<th>Enterprise Rack Attributes</th>
<th>HDD Only Solution</th>
<th>EFD+HDD Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDDs</td>
<td>25 (15K RPM)</td>
<td>21 (10K RPM)</td>
</tr>
<tr>
<td>Capacity/Drive</td>
<td>36GB/18GB each</td>
<td>147GB each</td>
</tr>
<tr>
<td>EFDs</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Capacity/Drive</td>
<td>n/a</td>
<td>150GB each</td>
</tr>
<tr>
<td>Usable Capacity/Shelf</td>
<td>450GB</td>
<td>3500 GB</td>
</tr>
<tr>
<td>IOPS/shelf</td>
<td>8000</td>
<td>52,500</td>
</tr>
<tr>
<td>Cost per Shelf</td>
<td>$11,250</td>
<td>$37,500</td>
</tr>
<tr>
<td>Number of Shelves Required</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$450,000</strong></td>
<td><strong>$225,000</strong></td>
</tr>
<tr>
<td>$/IOP</td>
<td>$1.41</td>
<td>$0.72</td>
</tr>
<tr>
<td>$/GB</td>
<td>$25.00</td>
<td>$11.00</td>
</tr>
<tr>
<td>Power to Operate &amp; Cool</td>
<td>16,000 watts</td>
<td>2,000 watts</td>
</tr>
<tr>
<td>Power Eff. (IOPS/Watt)</td>
<td>20</td>
<td>158</td>
</tr>
</tbody>
</table>
Proposition: More for Lower Cost

- **40** Rack mount shelves
- **1000** 36GB HDD’s
- **15K** RPM
- **>$450K** Purchase price
- **8000 watts** to operate
- **8000 watts** to cool

1000 x HDDs

EFD + Fewer HDD

- **6** Rack mount shelves
- **105** 147GB 10K RPM HDD’s
- **20** Pliant EFDs
- **<$225K** Purchase price
- **1000 watts** to operate
- **1000 watts** to cool

- **1000 x HDDs**
Reliability AND Performance

- Dual path for redundancy
- Fully independent ports
- Simultaneous Writing & Reading
- 4X the Link Bandwidth

SAS
Dual Port
Full Duplex

SATA
Single Port
Half Duplex
Desired Performance, Not ‘Droop’
Desired vs. Expected Profile

Random IOPs vs Read% (8K Blocks)

‘Free’ Performance Gain
EFDs Enable Better Solutions

Value = “Do More For Less”

- More Performance = Lower Cost
  - Lower cost = $$$, energy, space
  - Predictable across many workloads
- More Reliability = Lower TCO
  - Both data and device improvements
- No Changes Required = Easy Adoption
  - Use existing systems or software
Thank You...

Mike Chenery, President and Co-Founder
Pliant Technology