Data Efficiency Appliances and Flash Storage Arrays

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For over 50 years, storage was dominated by spinning disk.

- In the HDD world of 2005:
  - Capacity was cheap
  - Performance was scarce

- In flash world of 2015:
  - Capacity costs 8x as much
  - Performance is plentiful
Vendors are seeing typical 6:1 data reduction rates across a wide range block storage applications.

The benefits of data reduction techniques are multiplicative:

\[(10:1 \text{ dedupe}) \times (5:1 \text{ compression}) = 50:1 \text{ savings}\]
Integrated Data Reduction

- **Pros:**
  - No additional latency introduced from additional hops
  - Single point of management

- **Cons:**
  - Data reduction is competing for resources
    - *Memory*: large (>4K) chunk sizes result in significantly lower deduplication rates over time
    - *CPU*: contention encourages deferred processing which complicates capacity planning, interferes with ongoing data management
  - “Always-on” implementations
Dedicated Reduction Appliance

**Pros:**
- No impact on storage array resources
- Don’t have to buy a new flash array to use it today
- Flexibility/modularity means you can apply where it makes sense and not use where it doesn’t

**Cons:**
- Latency introduced by gateway, cables, HBAs, switch
- Higher cost to equipment: motherboards, adapters, et al.
- LUN configuration managed separately
# Data Reduction Appliance Examples

<table>
<thead>
<tr>
<th>Product</th>
<th>Example: IBM® SVC</th>
</tr>
</thead>
</table>
| Data Reduction  | • IBM Real-Time Compression™  
                    • Thin Provisioning                                                                                                                                                                                        |

Goes beyond data reduction to incorporates many enterprise storage virtualization features including: tiering, snapshots, clones, replication

<table>
<thead>
<tr>
<th>Product</th>
<th>Example: Permabit SANblox™</th>
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</table>
| Data Reduction  | • Permabit Albireo™ deduplication  
                    • HIOPS compression™  
                    • Thin Provisioning                                                                                                                                              |

Focused 100% on data reduction
Appliance Performance

**Random Read Performance**

![Graph showing 4K IOPS vs. Latency uSecs for random read performance.]

**Random Write Performance**

![Graph showing 4K IOPS vs. Latency uSecs for random write performance.]

**Performance per node***

<table>
<thead>
<tr>
<th>Metric</th>
<th>Read</th>
<th>Write</th>
<th>Mixed RW70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random IO (4K IOPS)</td>
<td>230,000</td>
<td>111,000</td>
<td>180,000</td>
</tr>
<tr>
<td>Min Latency (uSecs)</td>
<td>300</td>
<td>400</td>
<td>-</td>
</tr>
<tr>
<td>Latency at peak load (avg)</td>
<td>1,200</td>
<td>2,100</td>
<td>-</td>
</tr>
</tbody>
</table>

* Performance measured using fio w/100% unique data
## Comparison of Approaches

<table>
<thead>
<tr>
<th></th>
<th>Data Reduction Appliance + AFA</th>
<th>Integrated Data Reduction AFA*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Latency @ peak load</td>
<td>1.2 ms</td>
<td>4 ms</td>
</tr>
<tr>
<td>Write Latency @ peak load</td>
<td>2.1 ms</td>
<td>5 ms</td>
</tr>
<tr>
<td>Mixed Latency @ peak load</td>
<td>3.0 ms</td>
<td>7 ms</td>
</tr>
<tr>
<td>4K IOPS Mixed RW70</td>
<td>170,000</td>
<td>150,000</td>
</tr>
</tbody>
</table>

*Testing performed across two leading AFAs, both with integrated data reduction*

**Source:** Permabit Labs  
**Tools:** fio, vmbench, LoadDynamix
Appliance Scalability

- Compression is a *performance* challenge
- Deduplication is a *scale* challenge
- For deduplication, current appliances address up to 256 TB of provisioned storage in a single pool
- Admins can start off with 25 TB of provisioned storage, presented as 2.5 PB of logical storage, then grow the backend capacity as needed
- Multiple appliances can be used to address larger capacities
What about cost?

- Data reduction appliances do introduce extra cost of a motherboard and HBAs
- However, they can utilize CPU and RAM resources more efficiently as a dedicated resource
- Street price per effective GB* comes down as low as $0.89/GB for high-end AFAs that ship with data reduction appliances

That’s 1/3rd the street price of the leading AFA*

* Source: Gartner
Conclusions

- Greater flexibility in deployment doesn’t have to come with a higher performance penalty.
- When compared to integrated data reduction solutions, traditional AFA’s and data reduction appliances with dedicated resources deliver:
  - Superior performance
  - Lower latency
  - Greater scalability
  - Lower cost