The Hyperscale Challenge: Flash Deployed in a Disaggregated Model

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One or more Large common infrastructure

- Limited HW SKU serving primary usecase, designed to be reused in ‘general’ use cases.
  - i.e; Search, Reused /shared SKU with Cloud
  - i.e; OLTP, Reused / shared SKU with online analytics
  - i.e; Offline Analytics, Reused/ shared SKU with Archival or Media serving

- Most have DevOps capability
- Mixture of Traditional IT (usually small) and Scale out/Web scale
- Tech Friendly, Risk Adverse
Challenges - Infrastructure

- Networking
  - Tech Transitions (1,10,25-100,400)
- Real Estate (100’s of Racks 10’s/100’s of thousands servers)
- ‘Golden’ SKU’s (usually less then 20)
  - Compute, Memory, Storage
    - SSD(PCIE, NVME) Poor man’s memory
    - SSD (SAS, SATA) Enables use case overlay
  - Large Infrastructure drivers not necessarily T0 or T1 application
  - Everyone always believe they contribute to bottom line
Challenges - Storage

- Overlaying ‘Other Use Cases’ to Cloud or even Bare Metal with common SKU potential of high inefficiencies
  - Common SKU built to hold minimum requirements
    - Optimized for primary use case (cloud, search, big data, etc.)
  - Requires disaggregated storage through some orchestration means to ‘normalize’ other use cases.
    - i.e. OpenStack Cinder
- Cost of inefficiencies very high
  - 30% storage utilization (2TB per server across a rack of 40 servers @ $1/GB enterprise flash) for 10 racks == $½ Mil unused
## Storage Disaggregation

**Data is Generalized, not specific to any vendor**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Throughput</th>
<th>Latency (micro)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1Gbe</td>
<td>80MB/s</td>
<td>400+</td>
<td>Each side based on load/TOE</td>
</tr>
<tr>
<td>10Gbe</td>
<td>800MB/s</td>
<td>400+ (40+ RDMA)</td>
<td></td>
</tr>
<tr>
<td>6G SAS/SATA</td>
<td>500+MB/s</td>
<td>NA</td>
<td>Based on device</td>
</tr>
<tr>
<td>25Gbe</td>
<td>2GB/s</td>
<td>400+ (40+ RDMA)</td>
<td></td>
</tr>
<tr>
<td>40Gbe</td>
<td>3+GB/s</td>
<td>400+ (40+ RDMA)</td>
<td></td>
</tr>
<tr>
<td>HDD</td>
<td>30-100MB/s</td>
<td>6ms</td>
<td></td>
</tr>
<tr>
<td>6G SSD</td>
<td>500+MB/s</td>
<td>300-800</td>
<td>Based on vendor</td>
</tr>
<tr>
<td>12G SSD</td>
<td>700MB-1GB/s</td>
<td>250-600</td>
<td>Based on vendor (per port)</td>
</tr>
<tr>
<td>PCIE/NVME SSD</td>
<td>800-2GB/s</td>
<td>50-200</td>
<td>Based on vendor</td>
</tr>
</tbody>
</table>
Storage Disaggregation Protection

- Replicated Data
  - Fastest (no computation or remote data fetches)
  - Most expensive (whole number multiplier, 2x, 3x, etc)
  - Replication count based on resilience of data and origin
- Erasure Coded Data
  - Slowest (relative)
  - Least expensive (1.n multiplier)
  - Most resilient (done correctly, data can survive rack level or even data center failure)
  - Assumed Archival due to speed (on HDD)
- Local Raid / Rack Replicated
  - Fast
  - Moderate expense (2.n multiplier)
  - Expensive rebuild (limited n to y due to local raid)
Models of Storage Disaggregation

- Top of Rack Storage
  - Ignores Network OP (usually 1:3, 1:6 or more)
- Rack Adjacent Storage
  - Requires Line Rate Networking (1:1 to storage rack)
- Distributed Storage/Compute (local storage shared remotely)
  - Used local, protected by neighbor.
  - Used remote, protected by remote
- Centralized Storage Bubble
  - Network Bubble with Storage only.
  - Routed to Compute
Use Case: NoSQL

- **Deployment Model**
  - Dedicated HW (Bare Metal), Local Flash, App replicated
    - May require traditional ‘storage array’ perform data protection (usually snap and enough capacity for days of recovery)
  - Cloud Enabled or Containers
    - Most NoSQL are low thread count limited io depth
    - Requires flash, but barely utilizes it
    - Cloud ‘stamp’ of S,M,L inefficient, requires shared storage through some type of storage disaggregation
    - Storage Disaggregation can right size VM and increase efficiencies
Use Case: Virtualization

- Optimized for primary use case (search, web, ecommerce, etc.)
  - Usually guarantees some IOPS (IOPS per size, Fixed IOPS per VM, Advanced models have QoS – ceilings and/or floors)
- Single or dual networking (Important consideration when deploying flash)
  - Separation due to
    - Customer vs data traffic
    - Compliance
    - Management
- High performance requirement potentially waste entire server to serve single VM.
  - Disaggregated Flash can minimize these waste
Use Case: Analytics

- Hadoop
  - Primary Challenge
    - Co$T
    - Perceived Endurance issue due to Shuffle/Map Reduce
    - Networking
  - Value
    - Flash in Shuffle and Map Reduce for IO bound 3-6x faster
    - Resilience (Operational Fatigue with at scale HDD)
    - Allows Orthogonal scaling of compute and storage
  - Solution
    - Erasure Coding on Flash
    - Tier to lower cost media (consumer grade hdd/ smr)
    - Remove Networking Overprovisioning (at least on Storage side)
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>HDD</th>
<th>SSD</th>
<th>PCIE/NVME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication vs EC (6,2) Media Latency lined up</td>
<td>EC: 48ms</td>
<td>EC: &lt; 8ms</td>
<td>EC: &lt; 2ms</td>
</tr>
<tr>
<td></td>
<td>Rep: 6-20ms</td>
<td>Rep: &lt; 1ms</td>
<td>Rep: &lt; 1ms</td>
</tr>
<tr>
<td>Throughput (2GB/s) Large Blk Seq</td>
<td>12-16+</td>
<td>~4</td>
<td>1 (2 NVME)</td>
</tr>
<tr>
<td>Saturate 1Gbe port</td>
<td>1</td>
<td>0.16</td>
<td>0.04</td>
</tr>
<tr>
<td>Saturate 10Gbe port</td>
<td>7</td>
<td>~2</td>
<td>0.5</td>
</tr>
<tr>
<td>Saturate 40Gbe port</td>
<td>25</td>
<td>6</td>
<td>1.5</td>
</tr>
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