Your Time Is Now
Cisco HyperFlex Deep Dive and Performance

Brian Everitt, Technical Marketing Engineer
BRKCOM-2004
Cisco HyperFlex 2.0 All Flash Systems Offer High Performance, Low Latency, and Consistent Results
Agenda

- Introduction
- What is HyperConverged?
- Cisco HyperFlex Overview
- What’s New in HX 2.0
- Architecture
- Performance and Benchmarks
- Conclusion
About Me…

Brian Everitt

• Technical Marketing Engineer with the CSPG BU
  • Focus on HX performance, benchmarking, quality and SAP solutions

• 5 years as a Cisco Advanced Services Solutions Architect
  • Focus on SAP Hana appliances and TDI, UCS and storage

• First time at Cisco Live EU
What Is Hyperconvergence?

Traditional Approach

Hyperconvergence

- On-Demand
- Agile
- Efficient
- Simple

- 1-3yr Planned
- Large Footprint
- Inefficient
- Complex

SERVERS

CPU

APP

MEM

CPU

APP

SERVER VIRTUALIZATION

STORAGE

Traditional NAS

Hybrid Storage

All Flash Storage

Vendor E

Vendor N

Vendor P

Hyperconvergence

- On-Demand
- Agile
- Efficient
- Simple
- Scalable
- Enterprise Ready
- Cost Effective

NO LEGACY STORAGE CONTRACTS
# HyperFlex Key Customer Benefits

<table>
<thead>
<tr>
<th>Agile</th>
<th>Efficient</th>
<th>Adaptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Hyperconvergence</td>
<td>Intuitive Management</td>
<td>Cloud Speed</td>
</tr>
<tr>
<td>All 3 Layers of Network, Compute and Storage Intelligently Integrated Into a Single Solution for &lt;60 Minute Deployment</td>
<td>Eliminate Infrastructure Silos and Use Existing Management Tools to Manage and Automate Operations</td>
<td>Instantly Provision, Clone or Snapshot Applications</td>
</tr>
<tr>
<td>Built on the UCS Platform</td>
<td>Flexible Deployment</td>
<td>Always-on Data Optimization</td>
</tr>
<tr>
<td>Unified Management Using Existing Skillsets in the Organization</td>
<td>Variety of Configurations to Handle Diversified Set of Workloads</td>
<td>Inline Dedupe and Compression Ensuring Hyper-Efficient Resource Utilization</td>
</tr>
<tr>
<td>Scale-As-You-Grow</td>
<td>Adaptive Scaling</td>
<td>Non-Stop Infrastructure</td>
</tr>
<tr>
<td>Add Resources Non-disruptively and Scale Performance Linearly in Small Increments</td>
<td>Scale Compute or Capacity to Match Application Needs</td>
<td>Self-Healing Fabric Based Hyperconvergence with Cloud Monitoring</td>
</tr>
</tbody>
</table>
What is HyperFlex?

1. Complete Hyperconvergence
   Unified Compute and Network Infrastructure

2. Cisco UCS: The Ideal Platform for Hyperconvergence
   - Integrated, High Performance Network Fabric
   - Programmable Automation of all Hardware
   - Wide Array of Rack and Blade Form Factors
What is HyperFlex?

1. **Complete Hyperconvergence**
   - Unified Compute and Network Infrastructure

2. **Next Gen Data Platform**
   - Designed for Distributed Storage

**Cisco HX Data Platform**
Data Services and Storage Optimization

**Cisco HyperFlex**
Cisco HyperFlex Systems

1. Complete Hyperconvergence
   Unified Compute and Network Infrastructure

2. Next Gen Data Platform
   Designed for Distributed Storage

3. Part of a Complete Data Center Strategy
   Elastic and Secure at Enterprise Scale

Cisco HX Data Platform
Data Services and Storage Optimization

Cisco ACI
Cisco Security
Cisco One Enterprise Cloud Suite
Cisco UCS: Platform for All Architectures

<table>
<thead>
<tr>
<th>UCS Manager</th>
<th>UCS Director</th>
<th>Enterprise Cloud Suite</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCS Mini E-Series</td>
<td>Fourth Generation UCS</td>
<td>UCS S-Series Storage</td>
</tr>
<tr>
<td>ROBO</td>
<td>Mainstream Computing</td>
<td>C-Series Rack Servers</td>
</tr>
<tr>
<td></td>
<td>Converged Infrastructure</td>
<td>Scale Out</td>
</tr>
</tbody>
</table>

Single Operational Model

- UCS Manager
- UCS Director
- HyperFlex Systems
- Hyperconverged Infrastructure

Unified Management
Single Control Plane
Single API

Edge

Cloud
Cisco HyperFlex Hybrid Configurations

**HX220c Cluster**
- Smallest Footprint 3–8 Node Cluster (VDI, ROBO)
- Per-Node
  - 1 x 480 GB Cache SSD
  - 6 x 1.2 TB HDDs
  - SD Card/120GB SSD (Boot/Housekeeping)

**HX240c Cluster**
- Capacity-heavy 3–8 Node Cluster (VSI: IT/Biz Apps, Test/Dev)
- Per-Node
  - 1 x 1.6 TB Cache SSD
  - up to 23 x 1.2 TB HDDs
  - SD Card/120GB Back SSD (Boot/Housekeeping)

**Hybrid Clusters**
- Compute-heavy Hybrid (Compute Bound Apps/VDI)
- 3-8 Node HX220 or HX240 Cluster
- Up to 8 Compute Nodes
  - Blade or Rack
  - B200 M4, C220 M4 or C240 M4 (Supported)
  - Local Disk, SD Card or SAN Boot
What’s New In HX 2.0
Introducing All Flash HyperFlex Systems

High Performance
High IOPS, High Throughput, Consistent, Low Latency

No Compromise Storage Efficiency
Always-on, inline dedupe and inline compression
Instantaneous, space optimized snapshots and clones

Performance Sensitive Workloads
Support for Databases other performance sensitive workloads
Cisco HyperFlex All Flash Configurations

**HXAF220c Cluster**
- Smallest Footprint 3–8 Node Cluster (VDI, ROBO)
- Per-Node
  - 1 x 800 GB WL Cache SSD
  - 6 x 960 GB/3.8 TB SSDs
  - SD Card/120GB SSD (Boot/Housekeeping)

**HXAF240c Cluster**
- Capacity-heavy 3–8 Node Cluster (VSI: IT/Biz Apps, Test/Dev)
- Per-Node
  - 1 x 800 GB WL Cache SSD
  - up to 10 x 960 GB/3.8 TB SSDs
  - SD Card/120GB Back SSD (Boot/Housekeeping)

**Hybrid Clusters**
- Compute-heavy Hybrid (Compute Bound Apps/VDI)
- 3-8 Node HXAF220 or HXAF240 Cluster
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  - Local Disk, SD Card or SAN Boot
HX All Flash Improvements

Pre-release Performance Data

- **Up to 6X IOPS**
- **6X** Better Perf Consistency
- **3.2X** Capacity / Density

Comparison between HX Hybrid and HX All Flash for 70/30 8K Random Read Write Workload with 4.8TB Working Set Size, vmdks were initialized with writes.
What’s New With Cisco HyperFlex 2.0?

- Unified UCS Architecture
- Support for adding HyperFlex to an existing UCS Domain
- New Hardware Qualifications for 3rd Gen Fabric Interconnects and VIC cards (Post FCS)
- HXAF220 and HXAF240 Converged Nodes
- Enhanced User Experience
- Improved Installer User Interface and Capabilities, Additional Snapshot API and Sizer improvements
Adding HX in an existing Cisco UCS Domain

- Adding HyperFlex to pre-existing UCS Domains with general UCS equipment and workloads
- Will be supported 2.0
- HyperFlex QoS requirements may conflict with existing config
- Consult your CSE and TAC for guidance and assistance
External Storage Configuration

Added sections for FC / iSCSI storage

- Automates creation of vNICs, vHBA and necessary profiles in UCSM
- Installer automatically fixes VMDirectpath PCI ordering
- Ready for storage configuration inside of ESXi
Sizer Improvements

- End to end sizing guidance: compute, capacity and performance
- Rapid iterative development: Lots of improvements / additions coming
- Next: Support for all flash nodes and support for DBs

Link: https://hyperflexsizer.cloudapps.cisco.com/ (CCO Logon Required)
Cisco HyperFlex Architecture Overview
Building on the Right Foundation
Cisco HX Data Platform

Unique Architecture

Distributed File system

Local Disks

Built From the Ground Up for Hyperconvergence
Distributed Log-Structured File System Designed for Scale-out, Distributed Storage

Advanced Data Services (Snapshots, Clones) and Data Optimization (Inline Dedupe, Compression) Without Trade-offs

Better Flash Endurance and Disk Performance

Computing, Storage, Networking, and Hypervisor Integration

No Reliance on Legacy Filesystems or Technology
Software Modules Inside a Server

Controller VM Has Direct Access to Drives

VAAI Plugin Offloads Snapshots and Clone Operations

IO Visor Module Presents NFS to ESX and Stripes IO
Optimizing for All Flash: Read Path

Hybrid

L1 (DRAM) Cache:
- Metadata and data
- Helps with small bursts

L2 (SSD) Cache:
- De-duplicated Read Cache
- Use aggregate performance of all SSDs

No L2 (SSD) Cache:
- No flash on flash advantage
- Use aggregate performance of all SSDs

SCVM RAM:
- Unified capacity disk index cache
- Improvements by avoiding additional index reads

All Flash

L1 (DRAM) Cache:

Read Cache

Distributed Objects

Log FS

Distributed Objects

Log FS
Life of a Write IO: Write Log

1. Application writes data (A) to OS
2. VM writes to VMDK on datastore
3. Write intercepted by IOvisor and sent to primary controller
4. Primary data is committed to WL SSD
5. Simultaneously, data replicated to two other nodes (RF3) and committed to their WL SSD
6. Acknowledgement sent to VM
7. Data is successfully committed and protected
Life of a Write IO: Flush

1. When the active write log of a node is full, the active log becomes the secondary log and flushes
2. Primary data copies are deduplicated then compressed
3. Data is then three way written (RF3) to SSD / HDD on 3 separate nodes
4. After all data is successfully committed, data is purged from the secondary log on the caching SSD
5. In hybrid systems, recent writes are added to the read cache area of the SSD during flush
1. Application reads data from OS filesystem
2. VM reads from VMDK on datastore
3. Read intercepted by IOvisor and sent to primary controller
   a) First check active write log
   b) Next check passive write log (the duplicated write log of the other nodes)
   c) Look in L1 (DRAM) cache
   d) Look in L2 (SSD) cache [Not in AF models]
   e) Retrieve from SSD / HDD – Decompress, read into L1, returned to IOvisor, copied into L2 [Not in AF models]
4. Return data to VM
HyperFlex Design Principles

Independent Scaling of Compute and Capacity

Continuous Data Optimization

Dynamic Data Distribution

Integrated Management and Data Services
Independent Scaling of Compute and Capacity

HX Data Platform

Scale Compute

Scale Capacity Within Nodes

Add Nodes

Non-HyperFlex Hosts Can Connect to Storage with IOVisor
Dynamic Data Distribution

- HX Data Platform stripes data across all nodes simultaneously, leveraging cache across all SSDs for fast writes, and HDDs for capacity, via the low-latency UCS internal network.
- Balanced space utilization: no data migration required following a VM migration, and no hotspots.

Systems Built on Conventional File Systems Write Locally, Then Replicate, Creating Performance Hotspots

![Diagram of HX Data Platform]
Non-Disruptive Operations

- Stripe blocks of a file across servers
- Replicate one or two additional copies to other servers
- Handle entire server or disk failures

- Restore back to original number of copies
- Rebalance VMs and data post replacement
- Rolling “one-click” software upgrades
## Hybrid Capacity Options

### Usable Cluster Capacity

<table>
<thead>
<tr>
<th></th>
<th>3 Node</th>
<th>4 Node</th>
<th>5 Node</th>
<th>6 Node</th>
<th>7 Node</th>
<th>8 Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>HX220c</td>
<td>6.02 TiB</td>
<td>8.03 TiB</td>
<td>10.04 TiB</td>
<td>12.04 TiB</td>
<td>14.05 TiB</td>
<td>16.06 TiB</td>
</tr>
<tr>
<td>HX240c</td>
<td>23.09 TiB</td>
<td>30.79 TiB</td>
<td>38.48 TiB</td>
<td>46.18 TiB</td>
<td>53.88 TiB</td>
<td>61.58 TiB</td>
</tr>
</tbody>
</table>

Assumes: Full HDD population at RF3.  
Note: The above calculations are before deduplication & compression. Effective capacity will be higher.  
Consult with your Cisco CSE for the latest sizing & design guidance.
# All Flash Capacity Options

## Usable Cluster Capacity with 960GB/3.8TB SSDs

<table>
<thead>
<tr>
<th></th>
<th>3 Node</th>
<th>4 Node</th>
<th>5 Node</th>
<th>6 Node</th>
<th>7 Node</th>
<th>8 Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>HXAF220c</td>
<td>4.82 TiB/19.28 TiB</td>
<td>6.43 TiB/25.71 TiB</td>
<td>8.03 TiB/32.14 TiB</td>
<td>9.64 TiB/38.56 TiB</td>
<td>11.25 TiB/44.99 TiB</td>
<td>12.85 TiB/51.42 TiB</td>
</tr>
<tr>
<td>HXAF240c</td>
<td>8.03 TiB/32.41 TiB</td>
<td>10.71 TiB/42.85 TiB</td>
<td>13.39 TiB/53.56 TiB</td>
<td>16.07 TiB/64.27 TiB</td>
<td>18.75 TiB/74.99 TiB</td>
<td>21.42 TiB/85.70 TiB</td>
</tr>
</tbody>
</table>

Assumes: Full SSD population at RF3.
Note: The above calculations are before deduplication & compression. Effective capacity will be higher. Consult with your Cisco CSE for the latest sizing & design guidance.
HyperFlex 2.0 Capacity Considerations

• SSD reliability is significantly better than HDD; from 2-10 times lower annual replacement rate in studies by major online providers.

• HyperFlex installer no longer defaults to RF3 for an all-flash system, forcing the end user to make a decision.

• Consider RF2 for all-flash systems that do not require triple data copies or multiple component redundancy.

• RF2 shows 15-40% reduced write latencies in lab testing.

• RF2 can provide clusters up to 128 TiB maximum capacity.

• Keep overall cluster capacity consumed below 70% for best performance.
HyperFlex Performance and Benchmarks
Performance With Varying Working Set

- AF offers performance improvements and lower latency even at small working sets.
- AF offers huge performance and latency improvements for working sets that do not fit in the hybrid model read cache.

Tests done on 4 x HX240

Effective Working Set Size per Node

- HX240 hybrid read cache 1.2 TB per node
### Benchmark 1
Base Performance Using vdbench Curve Tests

<table>
<thead>
<tr>
<th></th>
<th>HX-All Flash</th>
<th>HX Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Version</strong></td>
<td>HX 2.0.1</td>
<td>HX 1.8.1c</td>
</tr>
<tr>
<td><strong>HW Configuration</strong></td>
<td>4 x HXAF240, each with:</td>
<td>4 x HX240, each with:</td>
</tr>
<tr>
<td></td>
<td>• WL: 1 x 400G</td>
<td>• Cache/WL: 1 x 1.6TB SSD</td>
</tr>
<tr>
<td></td>
<td>• Data: 8 x 960G</td>
<td>• Data: 23 x 1.2TB 10Krpm SAS HDD</td>
</tr>
<tr>
<td><strong>Benchmark Setup</strong></td>
<td>• 3 VMs per host</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Each VM has 1 x 400GB vmdk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 4.8 TB working set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Priming: 1MB writes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Tests with 32 threads</td>
<td></td>
</tr>
</tbody>
</table>
Benchmark 1
Base Performance Using vdbench Curve Tests
8K, 100% Random Write Workload

8K, 100% Write

- HX Hybrid
- HX All Flash

3.3X Higher IOPS at 3.5X Lower latency
Benchmark 1
Base Performance Using vdbench Curve Tests
8K, 70% Read, 30% Write, 100% Random Workload

6.3X Higher IOPS at 5X Lower latency

8K, 70% Read, 30% Write

Latency (ms)

IOPS

HX Hybrid
HX All Flash
**Benchmark 1**

Base Performance Using vdbench Curve Tests

8K, 100% Random Read Workload

![Graph showing performance comparison between HX Hybrid and HX All Flash]

- 10.7X Higher IOPS at 5.7X Lower latency
## Benchmark 1
### Base Performance Using vdbench Curve Tests

Variability Measured By Standard Deviation of Latency

<table>
<thead>
<tr>
<th></th>
<th>HX Hybrid</th>
<th>HX All Flash</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>8K, 100% Write</td>
<td>39.4</td>
<td>11.6</td>
<td>3.4</td>
</tr>
<tr>
<td>8K, 70 / 30 RW</td>
<td>74.3</td>
<td>5.1</td>
<td>14.6</td>
</tr>
<tr>
<td>8K, 100% Read</td>
<td>16.2</td>
<td>1.1</td>
<td>14.2</td>
</tr>
</tbody>
</table>

Significantly more consistent performance
# Benchmark 2

## SQL Performance Using vdbench Curve Tests

<table>
<thead>
<tr>
<th></th>
<th>HX-All Flash</th>
<th>HX Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Version</strong></td>
<td>HX 2.0.1</td>
<td>HX 1.8.1c</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>• WL: 1 x 400G</td>
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<tr>
<td></td>
<td>• Data: 8 x 960G</td>
<td>• Data: 23 x 1.2TB 10Krpm SAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HDD</td>
</tr>
<tr>
<td><strong>Benchmark Setup</strong></td>
<td>• 3 VMs per host</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Each VM has 1 x 400GB vmdk</td>
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</tr>
<tr>
<td></td>
<td>• 4.8 TB working set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Priming: 1MB writes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Test with 32 threads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Read Block Size Mix: 4k 2.39%, 8k 53.57%, 16k 4.84%, 28k 2.64%, 64k 28.75%, 120k 1.79%, 220k 1.41%, 492k 4.24%, 524k 0.37%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Write Block Size Mix: 4k 27.85%, 8k 35.24%, 16k 4.82%, 28k 2.58%, 64k 26.35%, 116k 0.6%, 244k 1.28%, 488k 0.38%, 536k 0.89%, 1032k 0.01%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Overall Avg Blocksize: 43.4K; Overall Read %: 68.5%</td>
<td></td>
</tr>
</tbody>
</table>
Benchmark 2

SQL Performance Using vdbench Curve Tests

SQL Profile Using vdbench

4.5X Higher IOPS at 4.6X Lower latency with 7.3X better consistency
# SQL Performance Using HammerDB

<table>
<thead>
<tr>
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<th>HX-All Flash</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Version</strong></td>
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</tr>
<tr>
<td></td>
<td>• Data: 10 x 960G</td>
</tr>
<tr>
<td><strong>Benchmark Setup</strong></td>
<td>1 SQL Server 2014 VM</td>
</tr>
<tr>
<td></td>
<td>• Windows Server 2012 R2</td>
</tr>
<tr>
<td></td>
<td>• 28 vCPU</td>
</tr>
<tr>
<td></td>
<td>• 64 GB RAM</td>
</tr>
<tr>
<td></td>
<td>• ~500 GB DB created by HammerDB with 5000 warehouses</td>
</tr>
<tr>
<td></td>
<td>• 500 User Test</td>
</tr>
<tr>
<td></td>
<td>• 5 minute ramp up, 60 minute test</td>
</tr>
</tbody>
</table>
HammerDB SQL TPC-C OLTP Test Results

<table>
<thead>
<tr>
<th></th>
<th>HX All-Flash</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Transactions Per Minute</td>
<td>1.475 million</td>
</tr>
<tr>
<td>Average IOPs</td>
<td>15,141</td>
</tr>
<tr>
<td>Average Read Latency</td>
<td>0.78 ms</td>
</tr>
<tr>
<td>Read Latency Standard Deviation</td>
<td>0.32</td>
</tr>
<tr>
<td>Average Write Latency</td>
<td>1.36 ms</td>
</tr>
<tr>
<td>Write Latency Standard Deviation</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Performance limited by CPU power, all CPU cores running at ~100% long before storage performance or latency becomes an issue.
Competitive Performance and Benchmarks
Cisco HyperFlex Hybrid
Runs more VMs per Cluster

- Cisco HyperFlex can run more VMs per cluster than other vendors
- Tests found the number of VMs other vendors can run with similar Write Latency as HX
- Simulates heavy VM load

Total VMs per 4 node cluster 70/30 R/W 4K

- Up to 3X the VMs on HX
Cisco HyperFlex Hybrid
140 VMs per 4 Node Cluster Latency Averages

- Cisco HyperFlex has lower R/W latency for 140 VMs per cluster than other vendors
- Simulated heavy VM load
- Vendor Z could not run the load @ 140 VMs
### Benchmark 3
Base Performance Using vdbench Curve Tests

**HX All Flash vs Vendor Y All Flash (Unprimed Dataset)**

#### Dataset with no dedupe and no compression savings

<table>
<thead>
<tr>
<th></th>
<th>4K Random 70% RD/ 30% WR</th>
<th>R/W Latency</th>
<th>8K Random 70% RD/ 30% WR</th>
<th>R/W Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>HX</td>
<td>136243</td>
<td>1.216 / 4.166</td>
<td>120901</td>
<td>1.208 / 4.936</td>
</tr>
<tr>
<td>Vendor Y</td>
<td>121463</td>
<td>1.467 / 5.997</td>
<td>97437</td>
<td>1.704 / 7.148</td>
</tr>
<tr>
<td>HX vs Vendor Y</td>
<td>12.2%</td>
<td>20.4 / 30%</td>
<td>24.1%</td>
<td>29.3 / 30.8%</td>
</tr>
</tbody>
</table>

#### Dataset with dedupe and compression

<table>
<thead>
<tr>
<th></th>
<th>4K Random 70% RD/ 30% WR</th>
<th>R/W Latency</th>
<th>8K Random 70% RD/ 30% WR</th>
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<td>136243</td>
<td>1.216 / 4.166</td>
<td>120901</td>
<td>1.208 / 4.936</td>
</tr>
<tr>
<td>Vendor Y</td>
<td>99951</td>
<td>1.355 / 6.682</td>
<td>70409</td>
<td>2.889 / 7.910</td>
</tr>
<tr>
<td>HX vs Vendor Y</td>
<td>36.3%</td>
<td>7.4 / 37.4%</td>
<td>71.7%</td>
<td>58.8 / 37.9%</td>
</tr>
</tbody>
</table>

- 2.8TB Working Set
- HX significantly better at write Latency
- HX much better IOPs with dedupe and compression
- HX better performance at 8K block sizes
- As the working set increases the performance continues to drop

**Dataset with no dedupe and no compression savings**

**Dataset with dedupe and compression**
**Benchmark 3**

Base Performance Using vdbench Curve Tests

8K, 100% Random Write Workload

- 61% Higher IOPS
- 42% Lower latency
- 60% lower standard deviation
Benchmark 3
Base Performance Using vdbench Curve Tests
8K, 70% Read, 30% Write, 100% Random Workload

- 11% Higher IOPS
- 24% Lower latency
- 59% lower standard deviation

8K, 70% Read, 30% Write

Latency (ms)

IOPS

HX All Flash
Competitor Y
Benchmark 3
Base Performance Using vdbench Curve Tests

8K, 100% Random Read Workload

- 43% Higher IOPS
- 34% Lower latency
- 59% lower standard deviation
Benchmark 3
Base Performance Using vdbench Curve Tests
IOPS in a 70/30 Workload – 1 Hour Duration
All Flash POC Best Practices

All Flash Performance Test Setup

1. Initialize the disks
   - More realistic - Applications don’t read data they haven’t written

2. Longer Test Duration:
   - SSDs / All flash systems show very high performance initially – which not realistic
   - Tests should be long running (12 – 24 hours depending on write load)

3. Larger Working set size
   - Ability to support larger working set size (several TBs / node) is a key differentiator for all flash
   - For smaller working set size hybrid will perform similar to all flash (as data is coming from flash)

4. Enable Dedupe and compression on competition (On by default on HX)
   - Most enterprise workloads see significant storage efficiency savings – this is not optional
   - Expecting users to choose this on a workload by workload basis is not realistic with 100s of VMs
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5. Workload Read / Write Mix:
   • Reasonable write percentage (20-35% at least) in the workload
   • 100% - 95% read workloads are not realistic in most environments

6. Similar hardware configuration:
   • Pay careful attention to the BOM – CPU, Memory and SSD (type and count for cache/WL and persistent data SSDs)
   • Additional performance may come at a trade-off: cost or manageability

7. Similar software configuration:
   • Pay careful attention to the resiliency setting – that needs to be identical
   • Comparing Replication Factor = 2 performance with Replication Factor = 3 performance is not comparing apples to apples
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1. What to look for in performance results:
   - IOPS / Throughput
   - Latency – not all workloads show sub millisecond latencies (even on all flash!)
   - Consistent Latency / standard deviation of latency

Which one would you rather have?

Write Latency as measured by esxtop for similar workloads
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2. Variance in performance seen across VMs

3. Compare Cost:
   - Especially important when comparing different hardware configurations
   - Metrics: $/GB Effective And $/IOPS
Performance Summary

- HX All Flash performance significantly better than both HX Hybrid and other HCI Competitor’s all flash
- All Flash performance is more consistent in comparison to HX Hybrid and competition
- HX All Flash, unlike competition, shows highly consistent performance across VMs
- All realistic workloads should see significantly better performance with all flash than hybrid
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