Evaluator Group

INTEL NEXT GENERATION TECHNOLOGY - POWERING NEW PERFORMANCE LEVELS

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Enabling you to make the best technology decisions

EXECUTIVE OVERVIEW*

The new Intel® Xeon® Scalable platform is designed to support today's enterprise application needs; specifically workloads requiring high I/O combined with intensive processor and memory access found in virtualized data centers. However, improving the processing performance without also improving the storage would lead to an unbalanced system, one unable to achieve optimal performance.

One trend that has been enabled by increasing processing capabilities is the emergence of Hyperconverged systems that utilize server platforms together with internal storage hardware and software defined storage to deliver an integrated platform for virtual applications. While many organizations have evaluated Hyperconverged appliances, some found that the performance of first generation systems was not suitable for their most demanding workloads.

Working with Intel and VMware, Evaluator Group tested several next generation Hyperconverged configurations based on VMware vSAN and Intel technologies, including a new class of storage media known as Optane™ for extreme performance levels. The systems used during testing utilized Intel's new scalable system architecture together with Intel Optane and 3D NAND NVMe storage.

In this paper we show both the performance and price / performance benefits achievable by using next generation Hyperconverged systems based on Intel Xeon Scalable processor systems with Intel Optane and 3D NAND Flash storage, running VMware ESXi and vSAN software to provide the Hyperconverged environment.

KEY INSIGHTS

Findings

Evaluator Group utilized the latest Intel Xeon Scalable processor systems and Intel storage, together with VMware ESXi and vSAN to construct a Hyperconverged cluster. Testing utilized the IOmark-VM benchmark to run a virtual server workload. Results show dramatic performance and price / performance increases compared to the previous generation of Hyperconverged systems.

Intel Xeon Scalable systems with Optane storage provided the following benefits vs. the previous generation systems:

- Up to 2.5 X more VM's per cluster
- Up to 2.3 X better price / performance
- Record IOmark-VM-HC of $302 / VM

Take-away

Intel Xeon Scalable processors together with Optane and 3D NAND enable increased VM density, better performance and efficiency. The tested performance exceeded that of most all-flash storage tested to date, enabling these systems to run I/O intensive applications previously reserved for all-flash SAN storage.

EVALUATION OVERVIEW

Evaluator Group analyzed Intel based Hyperconverged systems running virtual server workloads. The test scenarios were designed to recreate typical application environments seen in enterprise environments. The IOmark-VM benchmark was chosen to measure the storage performance of typical server virtual machine workloads. This benchmark has published results for earlier generation of Hyperconverged appliances, including previous results for Intel hardware based vSAN systems.

Note: ***This paper references previous Evaluator Group testing of Intel based Hyperconverged system performance in 2016.[1] New benchmark results for Configuration "B" below are available at IOmark.org.[2]***

Test Configurations and Results

The metrics captured included performance and price / performance for each configuration. Performance was measured using the IOmark-VM benchmark, with validated performance results noted below. Each of the configurations was tested using VMware ESXi and vSAN in a 4-node cluster configuration running the IOmark-VM benchmark.

Additional configuration details along with pricing for each configuration is provided in Appendix A.

- Configuration "A" (Optane + SATA SSD's - no Deduplication)
  - IOmark-VM-HC validated configuration
  - Storage: Media: 1 x Intel Optane DC P4800x+ 8 x Intel DC S3520 SSD's
  - Performance: 800 IOmark-VM-HC
  - Price / Performance: $293 / IOmark-VM-HC
- Configuration "B" (Optane + NVMe - with Deduplication)
  - IOmark-VM-HC validated configuration
  - Storage: Media: 2 x Intel Optane DC P4800x + 4 x Intel DC P4500
  - Performance: 800 IOmark-VM-HC
  - Price / Performance: $302 / IOmark-VM-HC *(**Note**: This configuration used for IOmark-VM-HC results)*
- Configuration "C" (Optane + NVMe - no Deduplication)
  - Not IOmark-VM-HC validated (Insufficient processing)
  - Storage: Media: 2 x Intel Optane DC P4800x+ 4 x Intel DC P4500
  - Performance: 1,120 IOmark-VM's (***Note:*** *Measured as a storage system, not Hyperconverged*)
  - Price / Performance: $237 / IOmark-VM (***Note:*** *Measured as a storage system, not Hyperconverged*)

> ***Evaluator Group comments: Performance improvements of 50% between generations is considered to be a significant performance achievements. The achieved 2X and greater improvements in both performance and price - performance represents significant enhancements.***

The results for configurations "A" and "B" are reported as IOmark-VM-HC, denoting the configuration supported all server and storage requirements necessary to run the reported workload. One configuration had storage performance that exceeded the server requirements for hyper converged, and therefore the storage only results are reported as IOmark-VM for configuration "C" above.

Comparison to Previous Systems

Comparing the new Intel Xeon Scalable processor systems using Optane and 3D NAND flash storage to earlier test results, as referenced in the paper "Evaluating Server-Based Storage Performance" there are several important results.

1 "Evaluating Server-Based Storage Performance", Evaluator Group 2016: www.evaluatorgroup.com/document/evaluating-server-based-storage-performance-enterprise-workloads/

2 IOmark.org: www.iomark.org/sites/default/files/IOmark-VM_report_Intel-vSAN_170711a.pdf

Performance Comparison

Shown below in Figure 1 are the performance results for three tests previously reported on the left, along with three new results to the right. See Appendix B for details on the previous and new configurations details.

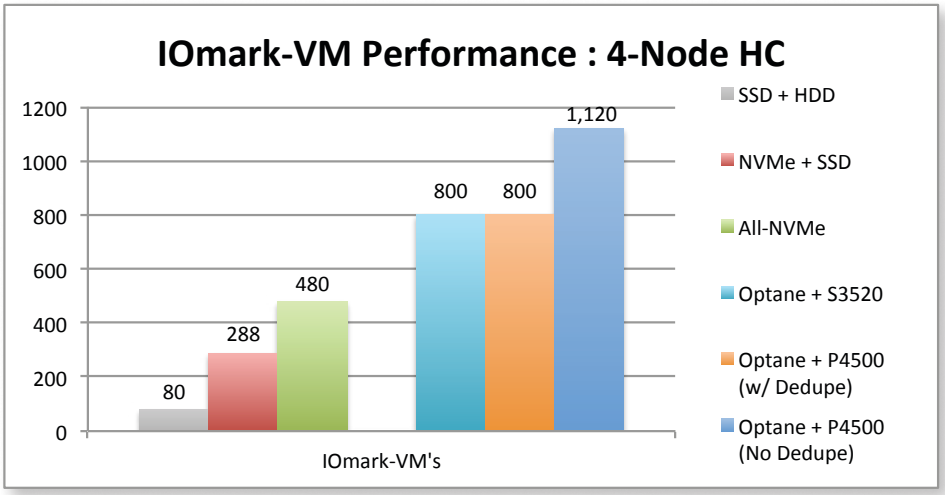

Figure 1: Performance Comparison of Intel Hyperconverged Systems

From these results it is clear that the results obtained with the new Xeon Scalable processor systems together with Intel Optane and 3D NAND storage media and vSAN 6.6 provide significant performance improvements compared to the prior generation systems.

Efficiency Comparison

While performance results are interesting, improving VM density and lowering the cost of infrastructure is often the most important considerations for IT environments. The price / performance results measured show compelling value obtained by moving to new Intel Xeon Scalable systems and VMware vSAN 6.6.

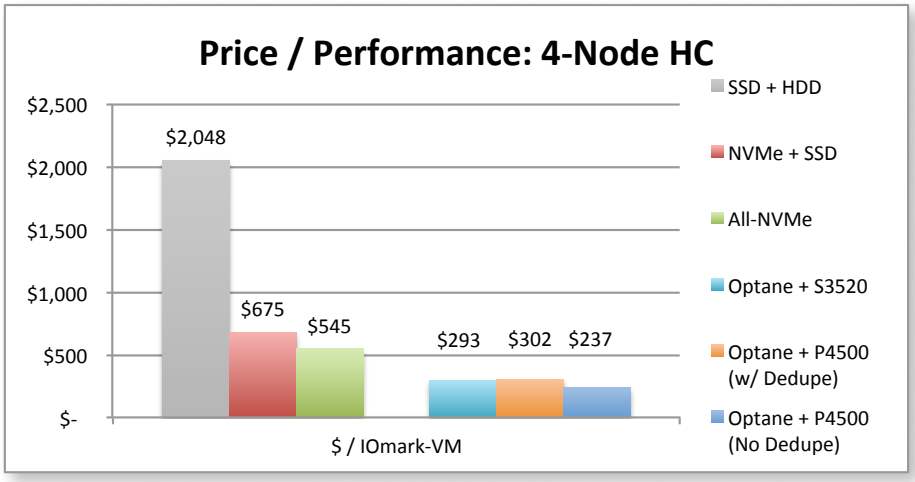

Figure 2: Price / Performance Comparison of Intel Hyperconverged Systems

As shown above, the cost per VM is significantly lower by using higher performing systems and storage. These results clearly show that the lowest cost on a per VM basis is obtained by using new Intel Optane and 3D NAND storage together with VMware vSAN 6.6.

Older systems without sufficient storage performance leads to VM's that are starved for I/O throughput, wasting the precious processor and memory resources of these systems. As a result, it was common for IT administrators to over-provision storage capacity, in order to achieve the required performance.

With new Intel Optane and 3D NAND media, IT architects are able to choose storage media for performance and capacity independently, enabling systems that exactly meet both the capacity and performance requirements.

Storage Capacity Comparison

Storage capacity requirements vary significantly between companies, workloads and for other reasons. In Hyperconverged environments excess storage capacity can be wasteful, since that capacity is not easily shared with other compute systems. Therefore, optimally configured Hyperconverged systems will have sufficient storage capacity for the workloads being run on them without excessive capacity.

The usable capacity includes RAID overhead reductions and capacity gains from deduplication and compression. For IOmark-VM, the data is approximately 2.5:1 reducible. The capacity factors used for each configuration are listed in the configuration details section of Appendix A.

SUMMARY

Evaluator Group analysis found that the new Intel Xeon Scalable system architecture, combined with next generation solid-state storage technologies are able to deliver up to 2.5 X better price / performance levels than previous generation systems and storage media as measured by IOmark-VM benchmark.

Virtual server workloads are the most common applications run as on-premise private and hybrid cloud, as well as by cloud service providers. These demanding workloads require balanced system performance in order to achieve high system utilization while still meeting application performance requirements.

A common perception is that new technologies are expensive; however, the reality is that using these technologies can provide significant price / performance advantages due to the high performance relative to their price. Testing using IOmark-VM clearly shows that the highest performing configurations also provide the greatest efficiency, delivering the lowest cost per VM. This is a new record for low cost as measured by IOmark-VM running virtual applications using Hyperconverged systems.

When compared to first generation Hyperconverged systems using hybrid storage, the price / performance benefits of the Intel Xeon Scalable processor systems together with Intel Optane and 3D NAND NVMe storage are nearly an order of magnitude better. The IOmark-VM performance for the four-node cluster surpasses most all-flash storage systems tested to date, making it possible to run even the most I/O intensive applications using the latest Intel processors and server-based storage technology.

Final Observations

Storage performance has traditionally been a significant limitation for Hyperconverged system performance, leading applications to waste system resources while simultaneously being starved for I/O. Intel's new system and storage technologies, combined with VMware vSAN's enhancements enable enterprises to meet their application I/O needs, resulting in better performance while lowering IT costs.

IT organizations looking to improve their VM density, improve performance or lower the cost of running virtual workloads should utilize Intel's next generation Optane and 3D NAND media in order to leverage the full benefits of new Intel processors and HCI software such as VMware vSAN.

Appendix A – Test Configurations

Provided in Table 1 is a summary of the three configurations tested, along with their respective costs, performance and the price / performance results. Data from this table is used in Figures previously listed.

Intel Storage / Node	Config "A"	Config "B"	Config "C"
	Optane + SSD	Optane + NVMe	Optane + NVMe
Intel DC S3520-1200	8		
Intel DC P4500-2000		4	
Intel DC P4500-4000			4
Intel DC P4800x-400	1	2	2
Raw Capacity / Node	9,600	8,000	16,000
IOmark-VM-HC Required Raw / Node	9,375	5,188	N/A
RAID Level Used	R-5 + R-10	R-5 + R-10	R-5 + R-10
Dedup - Compression	No	Yes	No
Storage Overhead Factor	1.5	0.8	1.5
Usable Capacity / Node (GB)	6,400	10,667	10,667
VMmark Tiles / Node	25	25	35
IOmark-VM's / Node	200	200	280

Intel Test Configuration Pricing	Optane + SSD	Optane + NVMe	Optane + NVMe
Intel DC S3520-1200	$ 5,239.92	$ -	$ -
Intel DC P4500-2000	$ -	$ 5,432.00	$ -
Intel DC P4500-4000			$ 10,552.00
Intel DC P4800x-400	$ 1,520.00	$ 3,040.00	$ 3,040.00
1 Node Storage Media Total	$ 6,759.92	$ 8,472.00	$ 13,592.00
4 Node Storage Media Total	$ 27,039.68	$ 33,888.00	$ 54,368.00
4 Node System (Server Only)	$ 77,431.36	$ 76,615.36	$ 76,615.36
4 Node VMware (ESXi)	$ 27,960.00	$ 27,960.00	$ 27,960.00
4 Node VMware (vSAN)	$ 31,960.00	$ 31,960.00	$ 31,960.00
3 Year Ent Support (HW + SW)	$ 66,127.01	$ 66,127.01	$ 66,127.01
3 Year Media Maint. (5%)	$ 4,055.95	$ 5,083.20	$ 8,155.20
Total 4 Nodes (HW, SW, Media, Mnt.)	$ 234,574.00	$ 241,633.57	$ 265,185.57

Intel Price / Performance - Price / Cap.	Optane + SSD	Optane + NVMe	Optane + NVMe
$ / VM (All + Maintenance)	$ 293.22	$ 302.04	$ 236.77

Table 1 : Test Configuration and Pricing Details

Appendix B - Configuration Details

Server Configuration

The configuration consisted of a cluster of 4 physical server nodes running VMware ESXi 6.5.0d with vSAN 6.6. The Hyperconverged systems used for testing included the following CPU, memory and network configuration. The storage media utilized changed for each configuration as noted.

- Each Node in the 4 node cluster consisted of an Intel Xeon Scalable system platform
  - Intel Server System R2208WF, with 4 U.2 NVMe accessible slots
  - CPU: 2 x Intel Xeon 8168 CPU (24 cores @ 2.7 Ghz w/ hyper threading)
  - Memory: Tested with 256 GB DRAM, priced for comparison at 768 GB DRAM
  - NIC : Tested with 40 GbE XL710, price configured with onboard 10 GbE X-540 AT2

Software

- Hyperconverged Software
  - VMware ESXi 6.5.0d
  - VMware vSAN 6.6
  - VMware vCenter 6.5.0d
- Benchmark Software
  - IOmark-VM (I/O equivalent to VMmark 2.5)
  - IOmark-VM-HC requires Hyperconverged configurations are verified with reported VMware VMmark results

Previously Reported Results

As referenced in Footnote 1, several test configurations from a prior report were used for comparison purposes. The configuration details, along with the pricing information were taken from that paper. Prices can change and although they were accurate at the time of publication, the prices may not be accurate currently.

Theses tests consisted of a cluster of four physical server nodes running VMware ESXi 6.0 with vSAN 6.2.

- Configuration #1 (1 SSD + 4 HDD)
  - IOmark-VM-HC validated configuration
  - Storage: Media: 1 x DC S3700 + 4 x Seagate 1 TB 10K HDD
  - Performance: 80 IOmark-VM-HC ; Price / Performance: $2,048 / IOmark-VM-HC
- Configuration #5 (1 NVMe + 2 NVMe)
  - IOmark-VM-HC validated configuration
  - Storage: Media: 1 x DC P3700 + 2 DC P3700
  - Performance: 288 IOmark-VM-HC ; Price / Performance: $752 / IOmark-VM-HC
- Configuration #7 (2 NVMe+ 6 SSD + 1 NVMe)
  - IOmark-VM-HC validated configuration
  - Storage: Media: 3 Intel DC P3700 + 6 Intel DC S3700
  - Performance: 480 IOmark-VM-HC ; Price / Performance: $545 / IOmark-VM-HC

Pricing Data

Pricing was gathered for individual components and then combined in order to provide prices for each configuration as detailed in Appendix A of this report. Price data gathered included list prices for all Intel components including systems, CPU's and storage media as well as for VMware ESXi and vSAN. DRAM prices used were for Crucial 32 GB DDR4-2400 memory. All pricing data was verified as accurate on the date of publication. Additional details available upon request.

About Evaluator Group

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