

QUICK GUIDE

Three Ways Intel® Optane™ Technologies Can Help Drive Successful Hyperconverged Infrastructure Deployment

What is HCI?

Hyperconverged infrastructure (HCI) is an increasingly popular approach to cost effectively modernizing legacy infrastructure. It also helps simplify data management and smooth the path to hybrid cloud. With HCI, data is distributed across clusters of servers, while virtualizing and centralizing compute, storage and networking. Modular scalability can help optimize capital expenditure (CapEx), while ease of deployment and management can decrease operational expenditure (OpEx).

Although modern analytics and artificial intelligence (AI) often drive the deployment of HCI, it can be a good fit for a wide range of workloads. These include: real-time collaboration, databases, testing and development, enterprise resource planning (ERP), virtual desktop infrastructure (VDI) and multi-workload clusters.

Why is Choice of Storage Solution Important?

Typically, workloads running on HCI are highly data intensive. They are also often latency sensitive—like AI and analytics—needing fast, reliable and scalable access to complex datasets in order to derive insight. This means the right data must be held in the right place at the right time, with hot data as close to the CPU as possible—all while managing costs.

Organizations planning to run HCI workloads face three common challenges in achieving this delicate balancing act:



Scaling effectively as data volumes continue to grow



Meeting the demanding performance requirements of mission-critical workloads



Minimizing infrastructure complexity

Intel® Optane™ technologies help address these needs across the storage/memory continuum.

Intel® Optane™ Technology Helps Address Common HCI Challenges

1. Modular Scalability

Intel® Optane™ SSDs and Intel® 3D NAND SSDs help extend storage performance and capacity, consolidate storage resources and boost VM density. This lets you retain performance and enable more HCI workloads per server while helping to reduce costs. When you're upgrading your VMware vSAN cluster from the prior generation, be sure to add 2nd Gen Intel® Xeon® processors and Intel Optane SSDs in the caching tier. Meanwhile, Intel Optane persistent memory increases capacity¹ for memory-intensive workloads and offers native persistence to support greater resilience and productivity.

Moving the caching tier in your VMware vSAN cluster from 3D NAND to Intel® Optane™ SSDs can yield:

↓ **25%**

Up to 25% lower estimated cost²

Intel® Select Solution for VMware Horizon VDI on vSAN

On a cluster using 2nd Gen Intel Xeon Scalable processors with Intel Optane SSDs, scaling up the number of virtual desktop infrastructure (VDI) users by increasing the amount of memory from 384 GB to 1 TB Intel® Optane™ persistent memory helps achieve:³

+87%

Up to 87% increase in number of VDI users from 160 to 300 sessions

↓ **-16%**

16% reduction in costs \$/VDI

2. Consistently High Performance

Intel Optane SSDs increases performance and lower latency to support the most demanding HCI workloads, across multiple common platforms and environments. They deliver high endurance, low latency, and high quality of service (QoS) for the cache/metadata tier.

Using Intel Optane SSDs helps deliver significant performance and responsiveness advantages over 3D NAND SSD alone⁴:

Up to **6x** faster throughput⁵

Up to **60x** better quality of service (QoS)⁶

Up to **63x** faster response time⁷

Using Intel Optane SSDs to support multiple mixed workloads on a VMware VxRail cluster enables:

Up to **59%** lower latency than NAND SSDs alone⁸

Cisco HyperFlex All NVMe with Intel Optane SSDs running SQL Server online transaction processing (OLTP) workload

+57%

Delivers up to 57% increase in IOPs compared to HyperFlex All Flash without Intel Optane SSDs⁹

HPE ProLiant servers with Intel Optane SSDs running Oracle benchmark (SLOB) on a VMware vSAN cluster:

≡ **34%**

Provided up to 34% faster throughput than a solution with only NAND SSDs¹⁰

3. Simplified Solutions

Intel collaborates with leading HCI solution providers to deliver Intel® Select Solutions – proven solutions for HCI and hybrid cloud, available from a wide variety of server vendors. These pre-validated, workload-optimized solutions can help reduce the time required to evaluate, select, and purchase the necessary hardware and software components, and minimize the time required to deploy new infrastructure.

Intel® Select Solution for Azure Stack HCI

Using Intel Optane persistent memory to increase memory by 33 percent over DRAM alone, helps achieve:

35%↑

Up to 35% more VMs per node

↓ **26%**

up to 26% lower estimated hardware costs than DRAM alone¹¹

Intel® Select Solution for VMware vSAN

60%↑

Using Intel Optane persistent memory with Intel Optane SSDs delivers up to 60% higher VM density per server compared to the base configuration¹²

Learn More

Explore how storage and memory innovation can drive HCI and digital transformation for your organization:

- Webpage: [Intel Select Solutions for Hybrid Cloud](#)
- Business brief: [HCI: A critical component for the modern enterprise](#)
- HCI customer story: [Global Mobility Leader Hyper-Accelerates its ERP](#)
- Cloud customer story: [IONOS: Extending the cloud to SMBs](#)
- ESG report: [Mission-critical Hyperconverged Workload Performance Testing on Cisco HyperFlex All-NVMe with Intel Optane DC SSD](#)
- Solution brief: [Virtual Desktop Infrastructure: How to Scale and Optimize for Today's Realities](#)
- Infographic: [Get more VMware vSAN database performance with Intel Optane SSDs and HPE ProLiant DL380 servers](#)
- Partner case study: [Intel® Optane™ Technology Boosts Dell EMC VxRail HCI Performance](#)

¹ Source – "The Challenge of Keeping Up with Data" <https://www.intel.com/content/www/us/en/products/memory-storage/optane-dc-persistent-memory.html>
² Source – The Evaluator Group. Estimated HW/SW/MEDIA/MAINT costs: Current General all Flash solution: \$303,739.13; Based on 6-node 3D NAND-based cluster needed to support the approximate same number of VMs vs. 4-Node Intel® Optane™ SSD Configuration. Intel Optane SSD based solution: \$218,133.39. Estimated pricing as of Feb 3,2020, see newegg.com for Intel all flash SSD and Optane SSD pricing.
³ In the Principled Technologies white paper (<https://www.principledtechnologies.com/VMware/VMware-HCI-Intel-Optane-VDI-0420.pdf>), the 200 user proof point was obtained by using 512GB Optane PMem + 96GB DRAM, using 8GB DIMMs. Principled Technologies also tested 16GB DIMMs and this data reference is located in the report supplement here: <https://www.principledtechnologies.com/VMware/VMware-HCI-Intel-Optane-VDI-science-0520-v2.pdf>. We chose to highlight the configuration using the 16GB DIMMs in this solution brief as 8GB DIMMs are becoming difficult to find and 16GB DIMMs are coming down in price. Three-year TCO estimates as of April 2020, include hardware, hardware support, software licensing and support. Software licensing and support includes VMware Horizon 7 Advanced production concurrent user licensing at <https://store-us.vmware.com/vmware-horizonadvanced-298798300.html> and VMware vSphere Enterprise Plus production concurrent user licensing at <https://store-us.vmware.com/vmware-vsphere-enterprise-plus-284281000.html>. Performance results may not reflect all publicly available security updates. TCO \$/VDI user calculated by dividing the 3-year TCO estimate by the average VDI users per given configuration. VDI users / TCO \$ calculated by dividing the average VDI users by the three-year TCO estimate per given configuration. For all tested configurations, each test was run three times and the average number of VDI users was used.
⁴ 160 User Configuration: Intel Xeon Gold 6258R Processor – 384GB RAM; 4 Node, 2x Intel Xeon Gold 6258R Processor, 1x Intel Server Board S2600WFT, Total memory: 384GB DDR4, 12 slots/32GB/2666 MT/s, Hyperthreading: Enabled, Turbo: Enabled, Intel VMD: Enabled, Storage (boot): 1x 960GB Intel SSD 3520 Series SATA, Storage (cache): 2x 375GB Intel Optane DC SSD P4800X Series, Storage (capacity): 6x 2TB Intel SSD DC P4510 Series PCIe NVMe, Network devices: 1x Intel Ethernet CNA XXV710-DA2 at 25GbE, Network speed: 25GbE, OS/Software: VMware 6.7.0 U1 and VMware Horizon 7. Testing by Principled Technologies. Tested between Feb 2-28, 2020 using VMware View Planner 4.3. 160 high memory users (2 vCPUs/16GB Memory, 50GB Disk space)
⁵ 300 User Configuration: Intel Xeon Gold 6258R Processor – 1024GB DCPMM; 4 Node, 2x Intel Xeon Gold 6258R Processor, 1x Intel Server Board S2600WFT, Total memory: 1,024GB Intel Optane DC persistent memory, 8 slots/128GB/2666 MT/s and 192GB DDR4, 12 slots/16GB/2666 MT/s, Hyperthreading: Enabled, Turbo: Enabled, Intel VMD: Enabled, Storage (boot): 1x 960GB Intel SSD 3520 Series SATA, Storage (cache): 2x 375GB Intel Optane DC SSD P4800X Series, Storage (capacity): 6x 2TB Intel SSD DC P4510 Series PCIe NVMe, Network devices: 1x Intel Ethernet CNA XXV710-DA2 at 25GbE, Network speed: 25GbE, OS/Software: VMware 6.7.0 U1 and VMware Horizon 7. Testing by Principled Technologies. Tested between Feb 2-28, 2020
⁶ Source: Breakthrough Performance Expands Datasets. Principled Technologies Bottlenecks <https://www.intel.com/content/dam/www/public/us/en/documents/product-briefs/optane-ssd-dc-p4800x-p4801x-brief.pdf>
⁷ Source: Intel-tested: 4K 7030 RW performance at low queue depth. Measured using FIO 3.1. Common configuration: Intel ZU Server System, OS: CentOS 7.5, Kernel 4.17.6-1.el7.x86_64, CPU 2 x Intel® Xeon® 6154 Gold @ 3.0Hz (18 cores), RAM 256 GB DDR4 @ 2666 MHz, Intel Microcode: 0x2000043, System BIOS: 00.01.0013, ME Firmware: 04.00.04.294, BMC Firmware: 1.43.917/B955, FRUSDR: 1.43, Configuration: Intel® Optane™ SSD DC P4800X 375 GB compared to Intel® SSD DC P4600 1.6 TB. Performance results based on testing as of November 30, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure.
⁸ Source: Intel-tested: Measured 99 percentile QoS under 4K 7030 workload at Qd1. See configuration in footnote (3) above. Performance results are based on testing as of July 24, 2018 and may not reflect all publicly available security updates.
⁹ Source: Intel-tested: Response time refers to average read latency measured at queue depth 1 during 4K random write workload. See configuration in footnote (3) above. Performance results are based on testing as of July 24, 2018 and may not reflect all publicly available security updates.
¹⁰ Source: ESG, "Dell EMC VxRail with Intel Xeon Scalable Processors and Intel Optane SSDs," Commissioned by Dell Technologies, August 2019. <https://www.dell.com/resources/en-us/asset/white-papers/products/converged-infrastructure/esg-technical-validation-dell-emc-vxrail-with-intel-optane.pdf>
¹¹ <https://www.cisco.com/c/dam/en/us/products/collateral/hyperconverged-infrastructure/hyperflex-hx-series-dc-ssd-esg.pdf>
¹² Testing performed by Principled Technologies on June 4th 2019. Workload: SLob 2.4.2.1; Server platform: HPE ProLiant DL380 Gen10; BIOS: U30 v1.46; BIOS settings: Performance; OS: VMware ESXi 6.7 with vSAN 6.7; Date of last OS patch/update: January 4th 2019; Power management policy: Static high performance mode; Processor: 2x Intel Xeon Gold 6154; Core count: 18; Core frequency: 3.0 GHz; Stepping: H0; Hyperthreading: Yes; Turbo: Yes; Memory modules: Total memory in system: 384 GB; Number of memory modules: 24; Vendor and model: Samsung M93A4K40BB2-CTD6Q; Size: 32 GB; Type: PC4-2666V; Speed: 2,666 MHz; Speed running in the server: 2,666 MHz; NVMe memory present: No; Total memory: 384; Local storage: Number of drives: 1; Drive vendor and model: HP Boot 5D Card; Drive size: 32 GB; vSAN capacity tier storage (first configuration): Number of drives: 6; Drive model and vendor: Intel D5 SSD PC4500 (SSDPE2KX0207TP); Drive size: 2000 GB; Drive information: NAND NVMe; vSAN capacity tier storage (second configuration): Number of drives: 2; Drive vendor and model: Intel D5 SSD PC4500 (SSDPE2KX0207TP); Drive size: 2000 GB; Drive information: NAND NVMe; vSAN cache tier storage (first configuration): Number of drives: 2; Drive vendor and model: Intel D5 SSD PC4800 (SSDPE2KE75GAP); Drive size: 375 GB; Drive information: Intel Optane NVMe; Network adapter: 2x 25GbE Intel XXV710; Cooling fans: 6x Delta PFM0512XHE; Power supplies: 2x 800W HPE 865414-821.
¹³ Benchmark details: Benchmark Setup: VMfleet Test: Each VM with 1 Core, 8 GB Memory, 40 GB VHDX. Test setup: Threads=2, Buffer Size= 4KiB, Pattern: Random, Duration = 300 Seconds, Queue Depth=16, 30% write, OS: Windows Server 2019 Standard (Desktop) with updated patch. Performance results are based on testing by Intel as of 2/9/2019 and may not reflect all publicly available security updates. See configuration disclosures for details. No product or component can be absolutely secure. For more complete information visit <http://www.intel.com/benchmarks>. Intel system configuration: CPUs (4 systems): Baseline configuration: CPU: 2 - 6230 (CLX, Gold, 20 core) \$3,788; Memory Subsystem: Total Cap: 384GB (192GB/Socket) 24x16 GB 32.384; Storage: HDD/SSDs \$6,823; RBDOM: Chassis: PSUs; SW cost: \$969; SW cost (per/core or per system) \$15,415. Total system cost: \$30,195 x 4 systems = \$121,516. VMs per node: 41.5, \$732 per VM. ISO Cost \$12GB AEP: CPU: 2 - 6230 (CLX, Gold, 20 core) \$3,788; Memory Subsystem: Total Cap: 512GB (256GB/Socket) 12x16 GB \$1,692. 4x128 GB AEP \$1,508; Storage: HDD/SSDs \$6,823; RBDOM: Chassis: PSUs; SW cost: \$969; SW cost (per/core or per system) \$15,415. Total system cost: \$30,195 x 4 systems = \$121,516. VMs per node: 56, \$539 per VM. Estimated pricing as of Feb. 1, 2020. Boot device cost follows MICROSOFT LICENSING MODELS https://download.microsoft.com/download/77/C7/CEDE6910-C7B2-4196-8C55-208E0B427E2/Windows_Server_2019_Licensing_datasheet_EN_US.pdf
¹⁴ Plus System: CPU: 2x Intel® Xeon® Gold 6252 Processor MEMORY: 512 GB Intel® Optane™ DC Persistent Memory in Memory Mode and 128 GB 2666MHz DDR4 DRAM Memory NETWORK: 2x 25GbE Intel® X710 STORAGE: 2x Intel® Optane™ DC P4800X + 6x Intel® P4510 vS Base system: CPU: 2x Intel® Xeon® Gold 6230 Processor MEMORY: 384GB DDR4 2666MHz DRAM Memory NETWORK: 4x 10GbE Intel® X722 STORAGE: 2x Intel® Optane™ DC P4800X + 4x Intel® P4510. Intel® Optane™ DC persistent memory pricing & DRAM pricing referenced in TCO calculations is provided for guidance and planning purposes only and does not constitute a final offer. Pricing guidance is subject to change and may revise up or down based on market dynamics. Please contact your OEM/distributor for actual pricing. For more complete information about performance and benchmark results, visit www.intel.com/benchmarks. VMware vMMark is a product of VMware, Inc. 95 VMs on the base configuration and 152 VMs on the Plus configuration.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors.

Performance tests, such as SYSmark and MobileMark, are performed using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit www.intel.com/benchmarks.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Your costs and results may vary. Intel Optane persistent memory pricing and DRAM pricing referenced in TCO calculations is provided for guidance and planning purposes only and does not constitute a final offer. Pricing guidance is subject to change and may revise up or down based on market dynamics. Please contact your OEM/distributor for actual pricing.

Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.

Intel contributes to the development of benchmarks by participating in, sponsoring, and/or contributing technical support to various benchmarking groups, including the BenchmarkXPRT Development Community administered by Principled Technologies.

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