

TOP 10 REASONS TO DEPLOY INTEL® OPTANE™ TECHNOLOGY IN THE DATA CENTER



FIRST, AN INTRODUCTION

As the first major memory and storage breakthrough in 25 years, Intel® Optane™ technology combines industry-leading low latency, high endurance, QoS, and high throughput that allows the creation of solutions to remove data bottlenecks, and unleash CPU utilization. With Intel® Optane™ technology, data centers can deploy bigger and more affordable datasets to gain new insights from large memory pools.

Here are just 10 ways Intel® Optane™ technology can make a difference for your business.

1 ACCESS DATA FASTER FOR GREATER INSIGHTS

Organizations are clamoring for faster, more efficient, and more affordable ways to consume, process, and extract useful insights from the mountains of data they deal with every day. And the amount of data out there is not only growing—it's constantly evolving. Intel® Optane™ technology brings access to much more data closer to the CPU. This means faster computing of real-time analytics, financial transactions, flight reservations, and other use cases that require predictably fast read-response times—when averaged response times are not good enough.



MOUNTAINS OF DATA

2 BOOST THE BOTTOM LINE

The Intel® Optane™ SSD DC P4800X does more work with the same servers when compared to alternative solutions. You can use the savings to reduce costs or expand capabilities and services.

✓	Bigger, more affordable memory
✓	Cost-optimized for storage consolidation
✓	More scale per server
✓	Faster insight and larger memory pools
✓	High endurance
=	Improve overall system with balanced cost, capacity, and performance

3 INNOVATE WITH A FLEXIBLE ARCHITECTURE

Intel delivers a wide range of products to provide data center architects with design flexibility and exceptional performance.



Intel® Xeon® Scalable Processors

Intel® Xeon® Scalable processors optimize interconnectivity with a focus on speed without compromising data security.



Intel® Optane™ DC Persistent Memory

Intel® Optane™ DC Persistent Memory sits directly on the memory bus, and represents a new class of memory and storage technology architected to extract further value from data. It can be used with the Intel® Optane™ DC SSD P4800X as a fast-cache storage tier.



Intel® Optane™ SSD DC P4800X

Intel® Optane™ DC SSDs help to eliminate data center storage bottlenecks and allows bigger, more affordable data sets. They can accelerate applications, reduce transaction costs for latency-sensitive workloads, and improve overall data center efficiency and performance.



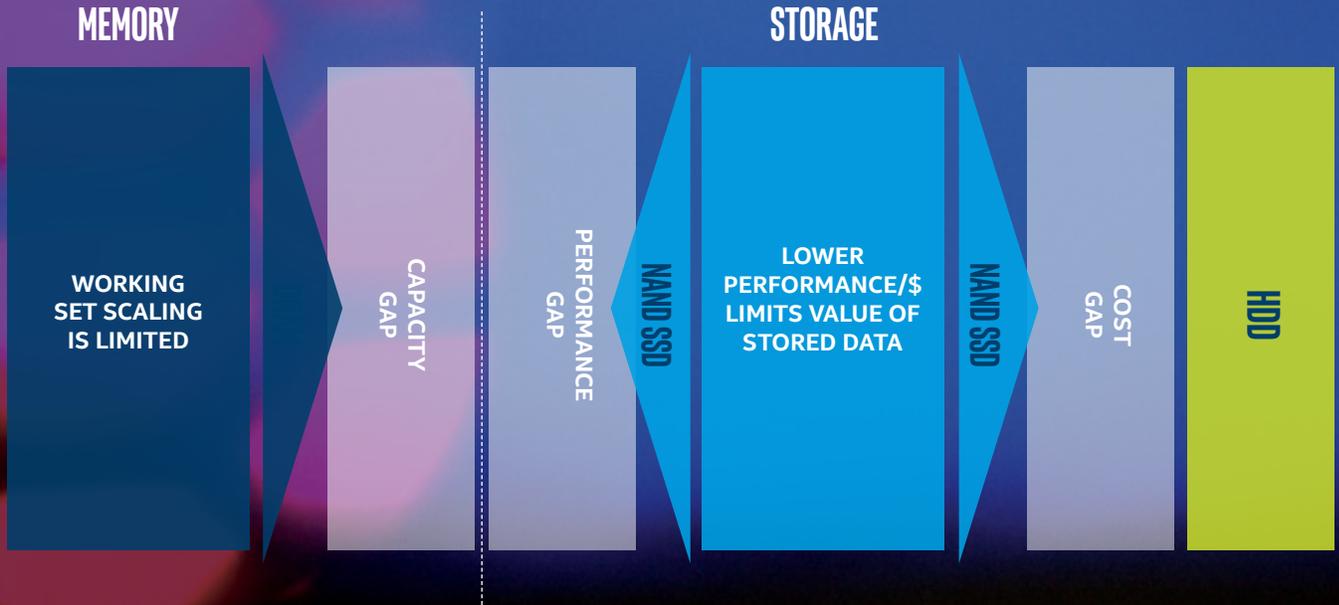
Intel® QLC 3D NAND SSD

Intel® QLC 3D NAND SSDs are reducing the cost gap between SSDs and traditional spinning hard drives, making all-flash storage an affordable option.

4 BRIDGE THE MEMORY AND STORAGE GAP

Today's storage technologies leave a technology gap in data storage tiers. Memory is great from a performance standpoint, since it's close to the processor on the memory bus, but it's expensive and the ability to scale capacity for larger working sets is limited. NAND brings capacity and is inexpensive relative to DRAM, but it's not on the memory bus and therefore doesn't approach the performance of memory. This leaves data center architecture gaps when trying to balance capacity, performance, and cost considerations.

Intel® Optane™ technology and Intel QLC 3D NAND SSDs enable system architects to break through the bottlenecks in the working data caching tier while cost-effectively increasing the capacity for data storage. In tandem, these unique technologies bridge the gaps between localized hot data (near the CPU) and larger capacity data.



5 ACCELERATE RESPONSE AND PERFORMANCE

<p>BREAKTHROUGH PERFORMANCE</p>	<p>High throughput (fast movement of data) Reads and writes at bit level (not pages and blocks like NAND). This means no garbage collection for faster write times. Performance does not decay under stress.</p>	<p>UP TO 6X FASTER queue depth 1, 4K 70/30 RW IOPS¹</p>
<p>PREDICTABLY FAST SERVICE</p>	<p>High QoS (fast performing on mixed workload benchmarks) In an environment of fast growing data and demanding requirements, data centers must deploy solutions that enable predictably fast service.</p>	<p>UP TO 60X BETTER 99% QoS²</p>
<p>RESPONSIVE UNDER LOAD</p>	<p>Low latency, fast response time With NAND-based SSDs, random write operations can add significant delay to the read operations. Intel® Optane™ technology maintains consistent response times regardless of the write throughput applied to the drive. You can consistently experience fast service under any load even at low queue depth where most applications generate storage workloads.</p>	<p>UP TO 63X FASTER response times²</p>

6 CACHE DATA EFFICIENTLY

Fast storage or cache refers to the tiering and layering which enable a better memory-to-storage hierarchy. Intel® Optane™ technology's combination of extremely low and predictable latency and super high endurance allows it to function much more efficiently as a caching device vs. NAND-based solutions.

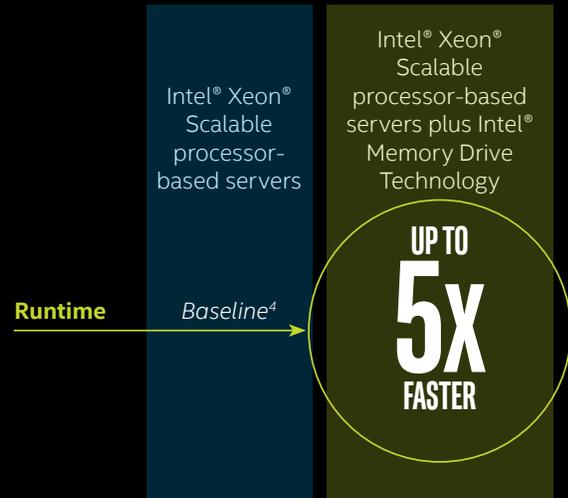
A system built on Intel® Xeon® Scalable processors, using Intel Optane SSD DC P4800X drives for the caching layer delivered up to 3x better price/performance levels than previous generation systems and storage media.³

3x

**BETTER
PRICE PER
PERFORMANCE³**

7 EXTEND MEMORY

Intel® Optane™ DC SSDs can be configured as extended memory by using Intel® Memory Drive Technology, which transparently integrates an SSD into the memory subsystem and makes it appear like DRAM. And no changes required to the operating system or applications. Intel Memory Drive Technology can be used to displace a portion of DRAM and reduce overall memory cost, or to grow the memory pool beyond DRAM capacities when large system memory capacities are required. Apache Spark* performance is 5x faster by adding Intel® Memory Drive Technology software with an Intel® Optane™ SSD DC P4800X.⁴



8 HANDLE THE BREADTH OF STORAGE WORKLOADS

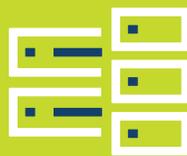
With Intel® Optane™ SSD DC P4800X, each server can do more, across applications. This data center SSD is ideal for working data and real-time data stored in large volumes; highly random storage bound applications; and random workloads at low queue depths, which is where the majority of activity occurs in real-world scenarios.



STORAGE



CLOUD & VMS



DATABASE



AI / ANALYTICS



HPC



COMMS

9 FULLY CONNECTED PLATFORM

Data defines the future, and Intel's unique position as a technology leader and breadth of capabilities can help customers deliver something new, or reimagine what they do, only better. This takes memory and platform innovation. Intel's end-to-end integrated architecture optimizes the Intel® Xeon™ processor, Intel Optane™ technology and Intel 3D NAND technology to create an efficient data center that can move data faster, store more of it, and process everything from cloud to the edge. Platform-connected capabilities link the compute and storage pools to efficiently manage storage at scale, accelerate applications, and simplify systems.

10 EXPERIENCE THE INTEL DIFFERENCE

Intel, building on 50 years of experience, is redesigning the fabric of how new systems are architected, building storage directly into the DNA of new system designs. The combination of Intel® Optane™ DC Persistent Memory with the performance-optimized Intel® Optane™ SSDs and next-generation cost-optimized Intel® 3D NAND SSDs with QLC technology is redefining the storage hierarchy and defining the future of storage--a future that is driven by Intel.



**BREAKTHROUGH PERFORMANCE
EXPANDS DATASETS,
ELIMINATES BOTTLENECKS**

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1. Intel-tested: 4K 70/30 RW Performance at Low Queue Depth. Test and System Configuration: CPU: Intel® Xeon® Gold 6140 FC-LGA14B 2.3GHz 24.75MB 140W 18 cores CD8067303405200, CPU Sockets: 2, RAM Capacity: 32G, RAM Model: DDR4, RAM Stuffing: NA, DIMM Slots Populated: 2 slots, PCIe* Attach: CPU (not PCH lane attach), Chipset: Intel C620 chipset BIOS: SE5C620.86B.00.01.0013.030920180427, Switch/ ReTimer Model/Vendor: Cable - Oculink 800mm straight SFF-8611 to right angle SFF-8611 Intel AXXCBL800CVCR, OS: CentOS 7.5, Kernel: 4.14.50(LTS), FIO version: 3.5; NVMe* Driver: Inbox, C-states: Disabled, Hyper Threading: Disabled, CPU Governor (through OS): Performance Mode, ELST (Speed Step), Intel Turbo Mode=Disabled, and P-states = Enabled. Performance results are based on testing as of August 7, 2018, and may not reflect all publicly available security updates. See configuration disclosure for details.
2. Source - Intel-tested: Common Configuration - Intel 2U Server System, OS CentOS 7.5, kernel 4.17.6-1.el7.x86_64, CPU 2 x Intel® Xeon® 6154 Gold @ 3.0GHz (18 cores), RAM 256GB DDR4 @ 2666MHz. Configuration - Intel® Optane™ SSD DC P4800X 375GB compared to the Intel® SSD DC P4600 1.6TB. Intel Microcode: 0x2000043; System BIOS: 00.01.0013; ME Firmware: 04.00.04.294; BMC Firmware: 1.43.91f76955; FRUSDR: 1.43. Latency and Response Time refers to average read latency measured at QD1 during 4k random write workload, using FIO 3.1. QoS: measures 99 percent QoS under 4K 70-30 workload at QD1 using FIO 3.1. SSDs tested were commercially available at time of test. Performance results are based on testing as of July 24, 2018, and may not reflect all publicly available security updates. See configuration disclosure for details.
3. Tests by The Evaluator Group. See config details at <https://www.evaluatorgroup.com/document/lab-insight-latest-intel-technologies-power-new-performance-levels-vmware-vsan-2018-update/>. Tested using IOmark-VM.
4. Source - Intel System Configuration for Management Node: S2600WFT Intel White Box, 2 sockets, Intel® Xeon® Gold 6140 CPU @ 2.30GHz, 18 cores per socket / 2 threads per core (total 72 vcores), 192GB DDR4, CentOS 7.4* distribution with 4.15.12 kernel, HortonWorks* Data Platform 2.6.4, Spark 2.2.0*. Performance results are based on testing as of July 31, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. Tests document performance of components on a particular test, in specific systems.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com/optane.

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 measured 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.

Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

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