

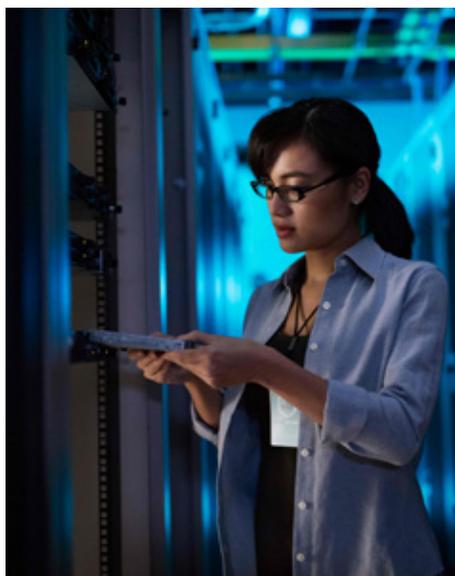
SOLUTION BRIEF

Hybrid Cloud
Intel® Optane™ SSDs
Intel® 3D NAND SSDs



Modern SSDs Set the Foundation for a Responsive Hybrid Cloud Data Center

Intel® Optane™ SSDs and Intel® 3D NAND SSDs increase agility and performance to modern data centers



Traditional Data Centers Struggle in the Digital Era

Is your data center keeping up in the age of digital transformation? All around the world, enterprise businesses and public sector agencies seek to revolutionize their data centers with infrastructure that supports agility, innovation, and rapid development times. Legacy technologies are insufficient. To keep pace with today's environment, you'll need to:

- Quickly roll out new services to provide new experiences and conveniences for your citizens
- Take better advantage of the wealth of data already available from external sources like social media, and internal sources for actionable, data-driven insights
- Increase utilization of resources with speed, efficiency, and agility, in order to reduce costs and increase productivity

Most IT managers recognize that the most effective way to accomplish these goals is by modernizing the data center infrastructure to enable hybrid clouds. Hybrid clouds offer the value and flexibility that forward-thinking businesses and governments need to accommodate diverse workloads. Hybrid clouds also help balance demands for rapid scale and agility with the need for control and protection of critical assets, intellectual property, and, sensitive data. That's why hybrid clouds are fast becoming the de facto compute model as businesses and governments transform to improve service time-to-market, drive innovation, and pursue new opportunities in a hyper-connected world of devices, services, and data.

Legacy Storage is the Bottleneck in Your Data Center

For enterprise businesses and many government agencies, modernizing legacy infrastructure has become an urgent must-do, not only for enabling hybrid clouds, but also for keeping up with the performance and security demands of a digital world. Compute is a good target for modernization efforts, but upgrading compute alone doesn't go far enough in optimizing the data center for increased efficiency and productivity. Specifically, upgrading compute alone doesn't address how data is moved into and out of processors. By upgrading only servers, you can quickly discover a new bottleneck in your overall cloud and data center performance: storage media.

Older, legacy storage technologies, like hard-disk drives (HDDs) or even Serial ATA (SATA)-based solid-state drives (SSDs), can't support the consolidation and performance required for modern applications and constantly evolving needs. Intel Optane SSDs and Intel® 3D NAND SSDs deliver enhanced levels of agility and performance to modern data centers, with a lower total cost of ownership solution brief needs. Part of the problem stems from the SATA interface, which becomes a bottleneck, throttling the higher speeds that SSDs are capable of providing.

In addition to performance issues, IT staffs struggle to manage and service the older, less robust drives, which do not have modern telemetry and support features. By spending inordinate time and resources on drive servicing and management, IT organizations are diverting limited funds away from new initiatives.

In contrast, modern Intel® SSDs are fundamentally changing the game for the data center by leading the industry in migrating from older SATA HDDs and SSDs to Peripheral Component Interconnect Express* (PCIe*) drives, built with Non-Volatile Memory Express (NVMe*) controllers. PCIe*/NVMe* controllers provide an optimized command set that makes full use of parallel input/output capabilities of PCIe 3.1 to accelerate performance by a factor of 6.6x compared to a SATA SSD and a factor of 3.2x compared to a SAS SSD.¹ Intel Optane SSDs with persistent memory and Intel® 3D NAND SSDs both use and extend NVMe benefits with performance, management, and other features designed specifically to support the needs of the modern hybrid cloud-based data center.

Intel's Data Center SSDs Are Key to Modernization

Intel Optane SSDs and Intel 3D NAND SSDs can help drive your data center modernization and hybrid-cloud initiatives. Because the drives are efficient, high-performing, robust, and security-enabled, they support greater consolidation, agility, and expanded capabilities in the data center. In addition, Intel SSDs are built on standards-based technologies, which provide flexibility to implement the virtualization and hyper-converged cloud models of your choice across multiple vendors or open-source solutions.

Intel® Optane™ SSDs

The Intel Optane SSD DC P4800X is the first product to combine the attributes of memory and storage media. Intel Optane SSDs accelerate applications for faster storage and improve performance for I/O- and latency sensitive workloads. Because of their unique design, Intel Optane SSDs provide performance close to that of volatile RAM, but with persistence and a cost structure closer to non-volatile NAND flash drives.

When combined with DRAM on servers powered by Intel® Xeon® processors, Intel Optane SSDs use Intel® Memory Drive Technology to emulate a single volatile memory pool, with no changes needed to the operating system or applications.

Intel Optane SSDs are ideal for performance-sensitive workloads that require consistent, predictable, and low latency with high performance, such as machine learning or complex analytics. With Intel Optane SSDs, there is no need for the system to erase data before writing and addressing each cell. That helps reduce latency and bring performance close to the performance of DRAM, but with a cost structure closer to NAND SSDs.

Because of the price and performance of Intel Optane SSDs, you can adopt them as DRAM replacements for high performance use cases that previously were out of reach or limited due to costs. For example, you might reduce 1TB of costly DRAM to 128GB, and then use Intel Optane SSDs as a more affordable way to cover the difference. Intel Optane SSDs can also be used as a caching tier to more quickly access “hot” data, whereas massive volumes of warm or cold data can be kept in a storage tier made up of PCIe Intel SSDs.

By using Intel Optane SSDs to augment system memory in your data center, you open the door to new possibilities. For example, you can:

- Accelerate analytics to gain new insights and broader context from larger working sets
- Work with massive data sets that were previously out of reach for machine learning, artificial intelligence (AI), or complex simulations
- Run more frequent analyses of large data sets for more accurate test results and improved quality assurance (QA)
- Restore complex analytics operations from a hosted cloud service to a hybrid cloud, consisting of a mix of on-premises, private cloud, and third-party public cloud services with orchestration between the platforms



Figure 1. Revolutionary new drive technologies from Intel are driving data center modernization through performance, consolidation, and agility, offering a better value when compared to traditional SSDs or HDDs

Intel SSDs Built on 3D NAND Technology

The PCIe-based Intel® SSD DC P4510 and Intel® SSD DC P4610, built on Intel® 3D NAND technology, offer multiple endurance levels, and deliver performance, Quality of Service (QoS), and capacity improvements to further optimize storage and cache efficiency. This enables data centers to significantly increase server agility and utilization, yet minimize service disruptions, and efficiently manage at scale.

Intel's 64-layer TLC 3D NAND technology enables higher capacity drives which are key to storage consolidation and server utilization. The robust design and advanced capabilities of the Intel SSD DC P4510 and P4610 help preserve data integrity and minimize disruption to your data center. For example, the Power Loss Imminent (PLI) feature provides protection from unplanned power loss through a proprietary combination of power-management chips, firmware algorithms, and a built-in self-test.

Intel SSDs supporting the PCIe and NVMe protocol also provide advanced telemetry to manage thermals, monitor endurance, and track drives' health statuses. And, by making use of the NVMe Management Interface (NVMe-MI) specification, these drives can even provide out-of-band management across a wide range of drive states.

This combination of affordability, durability, and management capabilities helps protect data and reduce time and effort for your IT staff, so they can more easily manage your hybrid cloud resources at scale, with greater simplicity and agility.

Intel® QLC Technology brings a new generation of large, affordable capacity, and reliable storage. As the industry's first PCIe* QLC 3D NAND SSD for the data center, the Intel® SSD D5-P4320 offers high density, operational cost benefits, and the ability to scale usable, massive capacities to meet large storage workload requirements. The Intel SSD D5-P4320 delivers high capacity and lower operational cost for the capacity or "warm" data storage layer traditionally served by hybrid or HDD arrays. Fewer drives to support, power, and cool, means lower storage expenses.

Improve Speed and Efficiency and Protect your Investment

Speed, efficiency, and agility are compelling reasons to upgrade. But any CIO or data center manager knows that they need to weigh benefits against cost before pulling the trigger on a major purchase. Intel Optane SSDs and Intel® 3D NAND SSDs can provide a better investment compared to older storage media technologies because they increase CPU utilization rates, which lets you perform more work without increasing the number of servers in your data center. The drives are also far more efficient than previous-generation SSDs and HDDs, which helps reduce power and cooling costs. And they offer a robust design with built-in management capabilities (such as NVMe-MI, PLI, and advanced telemetry) that can shrink IT support requirements.

Intel SSDs and Intel® Xeon® Processors: Better Together

Intel recently announced the Intel Xeon Scalable processor, which is a foundation for secure, agile, hybrid-cloud data centers. These processors are architected to drive storage modernization with exceptional performance and hardware-enhanced security. Designed for trusted data service delivery, the processors are fueled by significant leaps in I/O, memory, storage, and network technologies.

When combined with advanced Intel Optane SSDs and Intel® 3D NAND SSDs, these processors can help you pursue innovative initiatives by providing dramatic gains in:

- Efficiency and performance:
 - Increased I/O from additional PCIe lanes (an increase from 40 to 48 compared to the previous-generation Intel Xeon processor family) and faster data movement over each PCIe lane
 - Additional cores, with each core providing support for the higher throughput offered by Intel Optane SSDs
- Management and serviceability:
 - Remote, out-of-band management with Intel® Volume Management Device (Intel® VMD) on the processor and NVMe-MI on Intel SSDs
 - Improved efficiency for IT technicians with LED indicators on SSDs and enhanced hot-plug support
- Security and reliability:
 - End-to-end data protection/integrity and support for encryption of data at rest – Support for online firmware updates for Intel SSDs
 - Intel Xeon processors provide a root of trust and attestation to verify trusted environments for pooled servers



A Modern Data Center for the Digital Age

Modern infrastructure gives you the performance and capabilities you need to create a flexible and manageable hybrid cloud environment. The next evolutionary step for the data center is to fully disaggregate and pool the underlying hardware resources into a software-defined infrastructure (SDI). With SDI, compute, storage, and networking resources can each be assigned to support workloads as needed, with agility and scalability.

The latest generation of Intel® Xeon® processors, PCIe SSDs, and networking components are engineered to support the demands of SDI architectures. By modernizing your data center infrastructure, you can expand your data center and hybrid-cloud capabilities today, while exploring your transition to an orchestrated SDI solution tomorrow. In addition, standardizing on an Intel foundation gives you access to a broad ecosystem of solutions from industry-leading OEMs and ISVs who have optimized their offerings for Intel architecture. And because Intel supports open initiatives, you'll never be locked into a single-vendor solution.

Start Your Modernization Journey Today

Intel has a rich portfolio of technologies to accelerate your digital transformation with a cloud-ready data center. For example, Intel® Select Solutions offer workload-optimized configurations, including modern Intel SSDs, that are verified for Intel Xeon Scalable processor-based platforms and are designed to help accelerate your infrastructure transformation. Get started on the path to greater efficiency and capabilities today by upgrading your infrastructure with Intel Optane SSDs and Intel 3D NAND SSDs supported by powerful servers built on Intel Xeon Scalable processors.

Intel Innovation Helps Transform the Modern Data Center

Intel innovation is driving the modernization and hybrid-cloud transformation of the traditional enterprise data center. Migrating to the newest generation of high-performing and energy-efficient Intel® technology-based hardware tunes your data center for highly optimized performance across a broad set of workloads while helping maximize your investment and improve resource utilization. Over time, evolving to an SDI across all the critical domains of the data center (compute, storage, and network) will deliver critical automation, orchestration, and telemetry capabilities to help you unlock the full capabilities of hybrid-cloud computing. With modern, industry-standard Intel servers and technologies that run on SDI, you can seamlessly manage an environment that supports the development and delivery of cloud-native applications and mission-critical workloads on secure private clouds, while also integrating with public clouds, many of which already run on Intel architecture.



¹ Comparing max SSD speed of PCIe 3.1 x 4 (3700 MB/sec), SATA 3.0 (560 MB/sec) and SAS 3.0 (1150 MB/sec).

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.

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.

Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

© Intel Corporation. Intel, the Intel logo, Intel Optane, 3D NAND, and QLC technology are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others. Printed in USA 119/LD/JR/NSG Please Recycle 336373-002US