Turn Storage into Memory Affordably

With Intel® Optane™ DC SSDs, cloud service providers can deliver more competitive pricing, while expanding capacity and maintaining performance

Lower Memory Cost

34% LOWER

$6,100 — DRAM

$4,000 — Intel® Optane™ SSD DC P4800X

Intel® Optane™ SSD DC P4800X provides an affordable alternative to DRAM.[4]
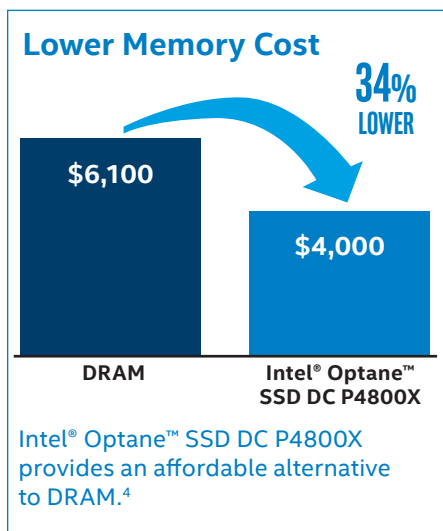
Industry Strategic Challenges

In an increasingly competitive space, today's cloud service providers (CSPs) need a compelling value proposition to win customers. More DRAM memory is an obvious answer. But DRAM has limited expansion capability, and for some use cases—like analytics, iterative statistical models, and high-performance batch processing for AI—it can be overkill.

What's more, DRAM comes with an increasingly high price tag, driven by rising demand. In fact, a Deloitte Technology report predicted that spending on IT as a Service for data centers, software, and services would reach $547 billion by the end of 2018 and at that pace, IT as a Service would be 50 percent of all IT spending in the 2020-2021 timeframe.[1]
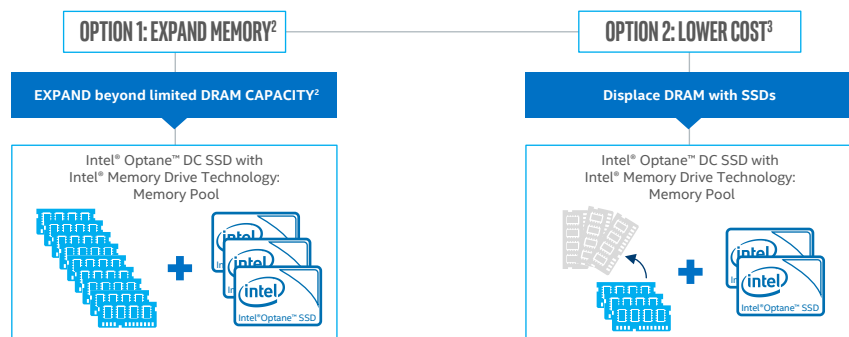
For data centers running Linux* and Kernel-based Virtual Machine (KVM), there is a solution offering two new strategies that allow CSPs to meet this growing customer demand:

- **Expanding memory.** Expand memory capacity beyond the DRAM limit to gain better insights into massive data pools.[2]
- **Lowering cost.** Displace expensive DRAM with much more affordable Intel® Optane™ DC SSDs.[3]

Using Intel Optane DC SSDs with Intel® Memory Drive Technology is an alternative to adding DRAM without prohibitive cost and without compromising performance. It's a seamless upgrade solution that manages memory with no change to application software or hardware resources,[5] and it can reduce future overall CAPEX expenditures by reallocating DRAM.[3]

Business Drivers and Desired Outcomes

- Deliver performance customers need for their most demanding workloads
- Keep up with memory expansion requirements, while containing costs
- Offer price-competitive cloud services
- Avoid over-provisioning

OPTION 1: EXPAND MEMORY[2] — EXPAND beyond limited DRAM CAPACITY[2] — Intel® Optane™ DC SSD with Intel® Memory Drive Technology: Memory Pool

OPTION 2: LOWER COST[3] — Displace DRAM with SSDs — Intel® Optane™ DC SSD with Intel® Memory Drive Technology: Memory Pool

Use Intel Optane DC SSDs with Intel Memory Drive Technology to expand beyond DRAM capacity or displace DRAM.

## Lower Cost Without Sacrificing Performance

In a cost and performance test conducted by Intel, KVM with Intel Optane DC SSDs with Intel Memory Drive Technology was compared to all-DRAM configurations:

- Available memory was consistent across both environments[6]
- Both environments delivered the same performance[7]
- The Intel Optane DC SSD environment delivered up to 34 percent cost savings[4]

Whether CSPs want to expand their memory capacity beyond available DRAM limits or replace expensive DRAM without sacrificing performance, Intel Optane DC SSDs are an innovative solution. On the customer side, this solution delivers high endurance, improved latency, and exceptional performance—keeping customers satisfied and CSPs competitive.

Driving Transformation

Intel has been pioneering technologies to enable data center modernization—a major goal for most enterprises today, and essential for cloud service providers. New storage solutions are a key component to building a data center that delivers performance to meet escalating demands. Turning storage into memory affordably and seamlessly is just one example of how Intel Optane DC SSDs optimize existing infrastructure like KVM.
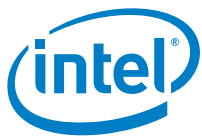
Intel® Optane™ DC SSDs deliver more benefits with fewer compromises:

- **More memory capacity:** Expands memory pools beyond DRAM capacity[2]
- **Affordability:** Lower cost per GB[8]
- **Seamless upgrade:** The solution manages memory with no change to application software or hardware resources[5]

Where to Get More Information:

- **Article:** The Age of Data Center Convergence Gives Storage a Boost

Find the solution that is right for your organization. Contact your Intel representative or visit intel.com/optane.

Discover more resources for CSPs, visit intel.com/csp.

[1] Deloitte Technology, Media & Telecommunications Predictions 2017, pg 40-41. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Technology-Media-Telecommunications/gx-deloitte-2017-tmt-predictions.pdf

[2] Detailed information on this option can be found in the Set Up and Configuration Guide, page 39, 9.7: Benchmarking Methodology. https://www.intel.com/content/dam/support/us/en/documents/memory-and-storage/intel-mdt-setup-guide.pdf

[3] System Memory at a Fraction of the DRAM Cost White Paper, page 4 , Economic Model for Memory Replacement: https://www.intel.com/content/dam/www/public/us/en/documents/brief/intel-ssd-software-defined-memory-with-vm.pdf

[4] Intel® Optane™ Technology: Turning Storage into Memory Affordably Solution Overview, March 2019, Slide 15: KVM+Redis* Memory Cost Comparison vs All-DRAM. See: '34% lower estimated memory cost'. https://digitallibrary.intel.com/content/solutions/us/en/assetdetail.html/content/dam/solutions/nsg-solution-kit-kvm-solution-overview-final-legal-approved.pptx

[5] Release Note: https://www.intel.com/content/dam/support/us/en/documents/memory-and-storage/ssd-software/ReleaseNotes_IMDT.pdf

[6] Intel® Optane™ Technology: Turning Storage into Memory Affordably Solution Overview, March 2019, Slide 15: KVM+Redis* Memory Cost Comparison vs All-DRAM. See: 'Similar size memory pool'. https://digitallibrary.intel.com/content/solutions/us/en/assetdetail.html/content/dam/solutions/nsg-solution-kit-kvm-solution-overview-final-legal-approved.pptx

[7] Intel® Optane™ Technology: Turning Storage into Memory Affordably Solution Overview, March 2019, Slide 15: KVM+Redis* Memory Cost Comparison vs All-DRAM. See: 'Same TPS Performance'. https://digitallibrary.intel.com/content/solutions/us/en/assetdetail.html/content/dam/solutions/nsg-solution-kit-kvm-solution-overview-final-legal-approved.pptx

[8] Intel: **Server base configuration:** 2x Intel® Xeon® Gold 6154 processor @ 3.00 GHz; Network topology: 10GigE dedicated back-to-back link; CentOS Linux* release 7.4 (Core); Kernel: 3.10.0-693.5.2 (el7.x86_64); BIOS: SE5C620.86B.00.01.0014.070920180847.
All-DRAM configuration: Server Base configuration +768 GB DRAM. **Intel Optane Configuration:** Server Base configuration + 96 GB DRAM and 2 – 375 GB Intel® Optane™ DC P4800 X SSDs. Intel: 2x Intel® Memory Drive Technology licenses @ $431/ea http://mark.intel.com/MM/958473?q=958473, + 2x Intel® Optane™ SSD DC P4800X SSD 375GB , MSRP $1031ea, http://mark.intel.com/products/97161/Intel-Optane-SSD-DC-P4800X-Series-375GB-2_5in-PCIe-x4-20nm-3D-XPoint; 640GB usable SSD created by combining two 375GB Intel® Optane™ DC P4800X and Intel® Memory Drive Technology with 96GB DRAM.

Performance results are based on testing as of August 14, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.