2.2x the transactions per minute of a configuration with two NVMe drives alone

11.3x the transactions per minute of a configuration with 12 SATA SSDs alone

Watch your transactional database performance climb with Intel Optane DC persistent memory

Dell EMC PowerEdge R740xd servers with Intel Optane DC persistent memory handled more transactions per minute than configurations with NAND flash NVMe drives or SATA SSDs

While enterprises offer different goods and services, they're on the same quest to deliver speedy performance to end users and increase profits by making the most out of their resources. Organizations that need exceptional transactional database performance should take note of a new memory technology that could help them meet their goals: Intel® Optane™ DC persistent memory. This new technology looks like memory and offers quick reads and writes, but the 256GB capacity of each DCPMM lets it act like traditional storage and store entire databases on a DCPMM stick.

Through our tests in the Principled Technologies data center, we found that using Intel Optane DC persistent memory in a Dell EMC™ PowerEdge™ R740xd server delivered 2.2 times the Microsoft® SQL Server® 2019 performance of a two-NVMe™ drive configuration and improved performance even more significantly over SATA SSDs—delivering an impressive 11.3 times the transactions per minute. As your data center approaches its peak database performance capabilities, consider adding Intel Optane DC persistent memory—our tests suggest that it might help transactional database performance.

About 2nd Generation Intel Xeon Scalable processors

The latest from Intel, the 2nd Generation Intel Xeon® Scalable processor platform features a wide range of processors to support the workloads you run, including Bronze, Silver, Gold, and Platinum. According to Intel, the 2nd Generation Intel Xeon Scalable platform can handle a variety of workloads, including enterprise, cloud, HPC, storage, and communications. This new processor line also supports a new memory and storage technology to further accelerate workloads, Intel Optane DC persistent memory. To learn more about the 2nd Generation Intel Xeon Scalable processor family, visit **https://www.intel.com/content/www/us/en/products/docs/processors/xeon/2nd-gen-xeon-scalable-processors-brief.html**.

What is Intel Optane DC persistent memory?

Straddling the line between memory and traditional storage devices such as NAND flash NVMe SSDs, Intel Optane DC persistent memory DIMMs are a new memory technology that can accelerate some data-intensive applications. So, is it memory, or is it storage? The answer is both—or either, depending on the strategy that works best for your particular workload.

Intel Optane DC persistent memory has two modes:

- Memory Mode: Intel Optane acts as large-capacity, volatile DIMMs. Operations target DRAM first, but when DRAM is full, the Intel Optane DIMMs start handling operations themselves. Optane latency is higher than DRAM but has larger capacity for a larger overall memory footprint.
- App Direct Mode: The OS and applications see Intel Optane as a separate, persistent type of memory. Only applications that are persistent-memory aware, such as VMware® vSphere® or enlightened SQL Server 2019 on Linux, can use Intel Optane in App Direct Mode.

In this study, we used App Direct Mode.

To learn more about Intel Optane DC persistent memory, visit https://www.intel.com/content/www/us/en/architecture-and-technology/optane-dc-persistent-memory.html

How we tested Intel Optane DC persistent memory in our data center

To find out how SQL Server 2019 transactional database performance with Intel Optane DC persistent memory compared to using traditional storage, we tested multiple storage configurations in a Dell EMC PowerEdge R740xd server:

- Good: 12 Intel D3-S4510 SATA SSDs (capacity 1.92 TB each)
- Better:
  - 2 Intel P4610 NVMe SSDs (capacity 1.6 TB each)
  - 4 Intel P4610 NVMe SSDs (capacity1.6 TB each)
- Best: 12 Intel Optane DC persistent memory - Intel 8Rx4 PC4-2666V DCPMM (capacity 256GB each)

*Please note that adding more NVMe SSDs or choosing different models could improve performance of the NVMe configurations; in our tests, the processor reached full utilization at four NVMe SSDs. Your workloads and results will vary.

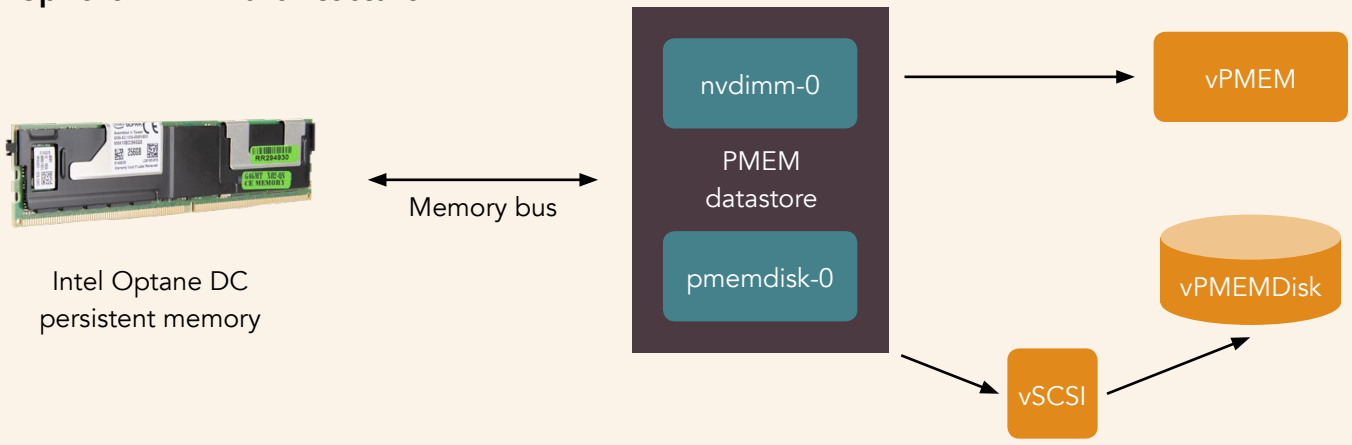
For these tests, we used a TPC-C-derived workload that Dell EMC provided, and ran all Intel Optane tests in App Direct Mode. The TPC-C-like workload simulates a database application used by a parts supplier. The data model and application mimic a company with warehouses, parts, orders, customers, and sales districts, and the benchmarks reports performance in transactions per minute. Dell EMC provided this workload utility, which is not an officially audited TPC-C test and therefore is not comparable to published TPC-C results. The configurations we tested are for performance gauging only; we tested the NVMe drives as single devices without redundancy, which real-world organizations would require.

To use Intel Optane memory in App Direct Mode, we used software that recognizes the new technology and allows it to act in this way—VMware vSphere ESXi™ sees Intel Optane as persistent memory datastore (storage), reporting it as a persistent memory (PMEM) datastore in vCenter™. VMware also offers a choice of two modes to utilize Intel Optane memory in App Direct Mode:

- vPMEMDisk, where users can create and store virtual disks directly on the Optane datastore. This can increase performance for legacy apps, because apps don't have to be PMEM aware.
- vPMEM, where users add NVDIMM devices to VMs and are presented as NVDIMM-specific block devices to the VM OS. This mode requires OS and apps that are PMEM aware to take advantage of the advanced performance this mode offers.

For this study we used the vPMEM mode, as Microsoft SQL Server 2019 on Linux is PMEM aware and Microsoft has introduced SQL enlightenment to allow database files to live on an NVDIMM device. The diagram below shows how vSphere PMEM architecture works.

vSphere PMEM architecture



About the Dell EMC PowerEdge R740xd

What does the xd stand for? Extra drives—with up to 24 NVMe drives and 32 2.5" or 18 3.5" drives in just 2U of rack space, the Dell EMC PowerEdge R740xd promotes flexibility through several drive options and high density. The two-socket Dell EMC PowerEdge R740xd rack server features 2nd Generation Intel Xeon Scalable processors and embedded Dell EMC iDRAC9 and Dell EMC OpenManage™ software for management.

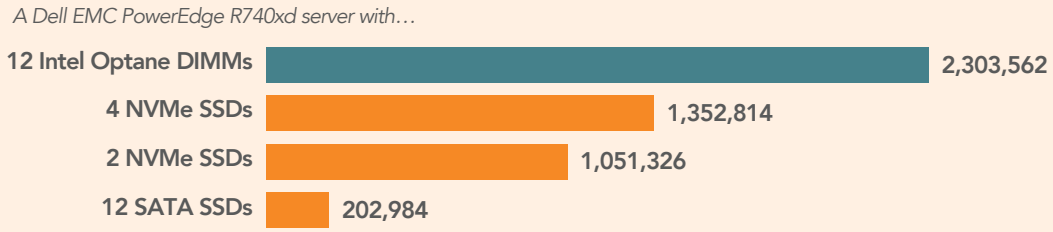
To learn more about the Dell EMC PowerEdge R740xd, visit **https://www.dell.com/en-us/work/shop/povw/poweredge-r740xd**.

The Dell EMC PowerEdge R740xd with Intel Optane DC persistent memory outperformed traditional storage configurations

We found that using 12 Intel Optane DC persistent memory DCPMMs delivered greater transactional database performance than the traditional storage options we tested, delivering 1.7 times the SQL Server 2019 transactions per minute (TPM) of a four-drive NVMe configuration, 2.2 times the TPM of a two-drive NVMe configuration, and 11.3 times the TPM of the 12-drive SATA SSD configuration. This means that adding Intel Optane DC persistent memory to your data center could boost transactional database performance, allowing you to maximize your existing hardware without large investments in new server-and-storage solutions.

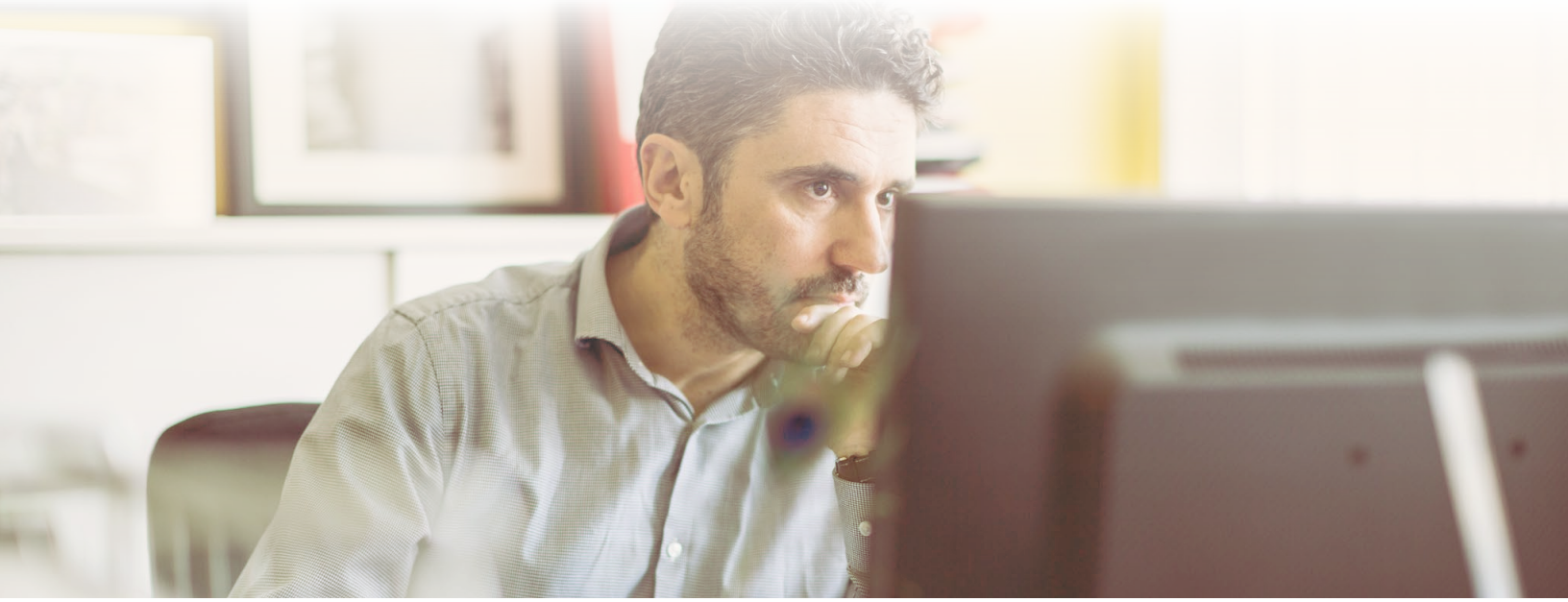
Database transactions per minute

Higher is better



Conclusion

For your quest for hardware that can quickly handle a large number of database transactions, Intel Optane DC persistent memory provides a new path. We found that using Intel Optane DC persistent memory in Dell EMC PowerEdge R740xd servers improved SQL Server 2019 transactional database performance compared to using NVMe SSDs or SATA SSDs, which means that it can help organizations improve data center efficiency. Don't let the newness scare you: Configuring the latest Dell EMC PowerEdge R740xd servers with new Intel Optane DC persistent memory could be just the solution that gives you the database performance you expect from your modern data center.



1 Intel, "2nd Gen Intel Xeon Scalable Processors Brief," accessed October 22, 2019, https://www.intel.com/content/www/us/en/products/docs/processors/xeon/2nd-gen-xeon-scalable-processors-brief.html.

Read the science behind this report at http://facts.pt/cazsej4 ►

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