



Technical Brief

Intel® Optane™ DC Persistent Memory and SAP HANA® 2.0 SPS 03

How Intel and SAP are revolutionizing the next generation of in-memory computing

In today's business climate, IT organizations face increasing pressure to keep systems available 24 hours a day, 7 days a week for employees and customers. But administration mistakes or unforeseen events can happen—perhaps the wrong server gets unplugged during a maintenance window, or an uninterruptible power supply doesn't switch over fast enough during a storm.

As data volumes increase, starting a server after such an event and loading multi-terabyte databases into traditional memory can take hours or longer. Start times can be even more challenging for multi-terabyte in-memory database management systems, such as the SAP HANA® platform, due to the volatile nature of a server's main memory. In the event of power loss, all data stored in main memory, or DRAM, must be reloaded. Even in a high-availability configuration where a secondary system takes over the workload from a primary system, extended start times can increase risk because the primary system must still load all data back into main memory before redundancy can be restored.

Intel is changing the game for in-memory database start times with Intel® Optane™ DC persistent memory, which combines features of both DRAM and traditional persistent storage. With support for Intel Optane DC persistent memory in SAP HANA 2.0 SPS 03, Intel and SAP are ushering in a new generation of memory technologies.

The SAP HANA Business Data Platform: Ready for the Persistent Memory Revolution

Over the past six years, Intel and SAP have collaborated on bringing Intel Optane DC persistent memory support to the SAP HANA platform. Compared to traditional memory, this combination can help minimize system downtime.

The SAP HANA platform achieves its performance by storing data within a server's main memory, which consists of fast DRAM. But that speed comes with a cost: while DRAM is the fastest storage available, it is also volatile, meaning it does not retain its contents when the power is turned off, a server is rebooted, or the SAP HANA platform is restarted. All data stored in DRAM is lost and must be reloaded from slower storage that is based on solid-state drives (SSDs) or hard-disk drives (HDDs). This can mean extended downtimes for large, complex SAP HANA databases. Such downtimes can be expensive and distract database administrators (DBAs) and other IT operational

SAP HANA® 2

intel OPTANE™ DC
PERSISTENT MEMORY



personnel from other important tasks, and it could also mean critical data is not available for customers or company employees.

SAP HANA 2.0 SPS 03, running on servers that combine Intel Optane DC persistent memory with DRAM, changes the landscape for in-memory databases.¹ Intel Optane DC persistent memory provides nearly the same performance as DRAM, but it retains its contents when the power is shut off, a server is rebooted, or SAP HANA is restarted. For the SAP HANA platform, in-memory data no longer must be reloaded from other persistent storage, which can minimize downtimes and lower operational costs. When combined with other disaster-recovery mechanisms in SAP HANA 2.0 SPS 03, such as multi-site replication, organizations can better protect their data, keeping DBAs busy on critical projects and potentially reducing overall total cost of ownership (TCO).



Intel and SAP engineers demonstrated how servers equipped with Intel Optane DC persistent memory, traditional DRAM, and the SAP HANA 2.0 SPS 03 platform can dramatically reduce system downtime. On a server equipped with DRAM only, the SAP HANA 2.0 platform with 6 terabytes of data required 50 minutes to start. A server configured with a combination of DRAM and Intel Optane DC persistent memory reduced the start time of the SAP HANA 2.0 SPS 03 platform by 12.5x to only 4 minutes.²

Intel Optane DC Persistent Memory: A Game Changer for In-Memory Computing

IT organizations with large data requirements often use a tiered storage approach for in-memory database and analytics systems, such as the SAP HANA platform. These tiers include:

- **DRAM-based “hot” tier:** This is the fastest storage available, but it is also the costliest and most volatile. Data in this tier is frequently accessed, but it is not retained if the power is removed or the server reboots. DRAM capacities have not scaled as quickly as the technologies in other storage tiers, which has limited the size of in-memory databases and the amount of memory available per processor.
- **Flash-based “warm” tier:** Based on NAND memory, flash-based storage is less costly, but much slower than DRAM. Unlike DRAM, flash-based storage retains its data, even if the power is removed. Data in this tier is frequently accessed, but not as often as hot-tier data.
- **Disk-based “cold” tier:** This tier uses ubiquitous hard drives, which have large capacities but are slow compared to flash and DRAM. Data in this tier, which is often used for sensor and Internet of Things (IoT) data, is considered archival data and is not accessed frequently.

Intel Optane DC persistent memory dramatically changes the data-tiering landscape by merging the performance of DRAM with the persistence of flash- and disk-based storage. Unlike DRAM, Intel Optane DC persistent memory retains its data if power to the server is lost or the server reboots, but it still provides near-DRAM performance. By blurring the line between volatile DRAM and persistent storage, Intel Optane DC persistent memory drives new innovation as to how data is stored.

SAP HANA® 2.0 SPS 03 Features and Enhancements

In addition to supporting Intel® Optane™ DC persistent memory, SAP HANA 2.0 SPS 03 provides a mix of new innovations and enhancements across key areas:

- Artificial-intelligence (AI) enhancements help improve performance and productivity for data scientists to increase insights. SAP HANA spatial services enable developers to easily add additional advanced spatial capabilities to their applications.
- Database improvements provide greater data and privacy protection through the innovative addition of real-time data anonymization, better high-availability and disaster-recovery, and enhanced multi-tenancy capabilities, dynamic tiering, and workload/performance management.
- Data-management enhancements include new data integration, federation sources with additional data-type support, and simplified features that help improve data quality.
- Application development and tool enhancements help improve performance, simplify development, and enable a new class of security.

These improvements and support for Intel Optane DC persistent memory open up new possibilities for innovation and expand memory and storage configuration options.



DRAM is expensive and limited in size when compared to flash- and disk-based storage. When combined with DRAM, Intel Optane DC persistent memory allows for larger memory configurations than a DRAM-only configuration, but at a lower per-gigabyte cost. In addition, Intel Optane DC persistent memory is available as persistent memory modules (PMMs). These modules use the same dual in-line memory module (DIMM) form factor as DRAM, yet provide greater memory densities within the same physical server space as DRAM. As a result, in-memory database and analytics systems, such as SAP HANA 2.0 SPS 03, can benefit from a larger memory footprint and higher performance compared to using lower-tier storage, at a cost that is less than using only traditional DRAM.

Intel and SAP: Ushering In the Next Generation of In-Memory Computing

Intel Optane DC persistent memory, combined with SAP HANA 2.0 SPS 03, changes the data-tiering landscape by blurring the line between DRAM and persistent storage for in-memory computing. System downtime for the SAP HANA platform can be significantly reduced, resulting in lower operational costs and greater availability of data for both customers and employees. The SAP HANA platform can also benefit from combined DRAM and Intel Optane DC persistent memory configurations that exceed those provided by traditional DRAM.

To learn more about this game-changing technology, visit intel.com/sap or sap.com/hana.

¹ Intel® Optane™ DC persistent memory is available on servers equipped with Intel® Xeon® Gold processors and Intel Xeon Platinum processors.

² SAP HANA® simulated workload for SAP® BW edition for SAP HANA® Standard Application Benchmark Version 2 as of 30 May 2018. SAP and Intel engineers performed the testing. Baseline configuration with traditional DRAM: Lenovo ThinkSystem SR950* server with 8 x Intel® Xeon® Platinum 8176M processors (28 cores, 165 watt, 2.1 GHz). Total memory consists of 48 x 16 GB TruDDR4* 2,666 MHz RDIMMs, and 5 x ThinkSystem 2.5" PM1633a 3.84 TB capacity SAS 12 Gb hot swap SSDs for SAP HANA® storage. The operating system is SUSE* Linux* Enterprise Server 12 SP3 and uses SAP HANA® 2.0 SPS 03 with a 6 TB dataset. Start time: 50 minutes.

New configuration with a combination of DRAM and Intel® Optane™ DC persistent memory: Lenovo ThinkSystem SR950 server with 8 x Intel Xeon Platinum 8176M processors (28 cores, 165 watt, 2.1 GHz). Total memory consists of 48 x 16 GB TruDDR4 2,666 MHz RDIMMs and 48 x 128 GB Intel Optane DC persistent memory modules (PMMs), and 5 x ThinkSystem 2.5" PM1633a 3.84 TB capacity SAS 12 Gb hot swap SSDs for SAP HANA storage. The operating system is SUSE Linux Enterprise Server 12 SP3 and uses SAP HANA 2.0 SPS 03 with a 6 TB dataset. Start time: 4 minutes.

Results have been estimated or simulated using internal Intel analysis or architecture simulation or modeling, and provided to you for informational purposes. Any differences in your system hardware, software or configuration may affect your actual performance.

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