



Increase System Memory and Enhance Security and Reliability for Mission-Critical In-Memory Database Workloads

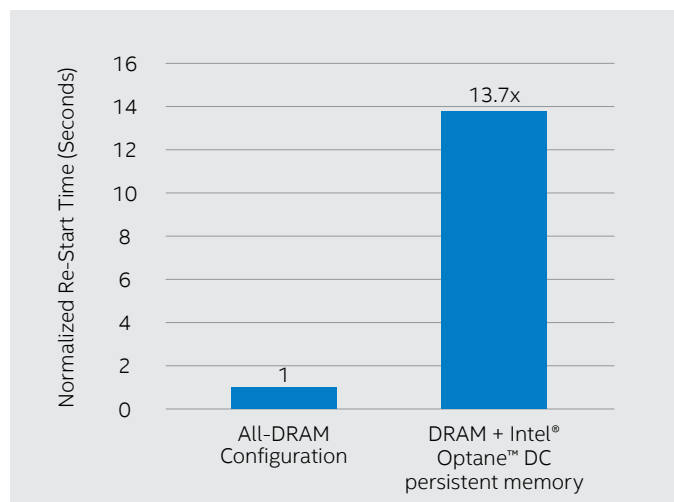
Help reduce database re-start times from hours to minutes with T-Systems* and an HPE Superdome Flex* server equipped with Intel® Optane™ DC persistent memory



Executive Summary

With enterprise resource planning (ERP), finance, healthcare and other mission-critical databases swelling quickly into the terabyte (TB) size range, finding a way to increase system memory is crucial. Without enough memory, database performance suffers. But continuously adding DRAM can cause budget overruns; eventually it may even be impossible to add more memory because there aren't any more memory slots. Another problem with limited system memory is that database reboot times can be hours long—leading to reluctance to apply critical operating system (OS) and application security patches or upgrades.

T-Systems*, collaborating with Intel and Hewlett Packard Enterprise* (HPE*), conducted a proof of concept (PoC) which shows that SAP S/4HANA* workloads can benefit from platforms equipped with Intel® Optane™ DC persistent memory installed in an HPE Superdome Flex* server. The system delivered re-start times of less than 15 minutes¹, is eminently scalable, and offers enhanced reliability, availability and serviceability (RAS) features.



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Figure 1. T-Systems* proof of concept (PoC) showed that a memory-centric solution from Intel and Hewlett Packard Enterprise* (HPE*) can improve SAP S/4HANA* re-start times by up to 13.7x².

Solution Benefits

- **Faster reboot times.** Intel® Optane™ DC persistent memory in App Direct Mode reduces re-start times for large in-memory databases from hours to mere minutes³.
- **Future-ready for growing amounts of data.** Larger memory capacity enables even databases that are multiple terabytes (TBs) in size to be kept as hot data and be used for real-time analytics.
- **Modular scalability and extreme reliability.** The modular design of the HPE Superdome Flex* server allows customers to scale from four sockets to 32 in a single system, and up to 48 TB of shared memory in a single node. HPE Superdome Flex's unique reliability, availability and serviceability (RAS) features deliver mission-critical availability.
- **Enhanced availability and security.** Mission-critical workloads can't afford downtime. Faster server reboots and database restarts help reduce downtime when security patches are required, removing some of the barriers to reducing vulnerabilities and increasing stability.

Business Challenge: Scaling Memory-Centric Workloads for Data Growth

As the world becomes increasingly digital and data processing requirements grow by leaps and bounds each year, businesses struggle to scale their mission-critical applications to keep up. In-memory databases, such as SAP S/4HANA, can help—but with database sizes growing into the TBs, adding enough DRAM to hold all the data can be prohibitively expensive—or impossible due to physical memory slot limitations.

What's more, although security has become paramount in today's complex cyberthreat environment, the thought of waiting hours for data to reload into memory after a server patch and reboot often discourages patching—meaning vulnerabilities may continue to exist. Mission-critical workloads require an end-to-end solution that combines flexibility, performance, security and reliability.

Memory-Centric Computing Spans Many Industries

In-memory computing brings business benefits across industries. The following examples are proof points of the power of scale-up memory-centric architectures that can address the current volume, variety and velocity of data—and support future growth.

- **ERP systems based on SAP S/4HANA.** These systems typically process multiple millions of transactions every day—in real time.
- **Financial services.** Digital natives expect banking services to be available 24/7 and from any device—and they don't like to wait. Banks must process thousands of transactions per second and securely store and process petabytes (PBs) of data.
- **Modern manufacturing.** Real-time supply-and-demand matching requires instant insight into supply chain elements spread around the world.
- **Energy.** Oil and gas companies consume huge amounts of data collected by sensors across reservoir exploration, drilling and production operations.

Essentially, any business with a large database that needs to scale up can benefit from a memory-centric architecture.

Solution Value: Faster Re-Start Times Reduce Downtime and Enhance Security

In a PoC conducted by T-Systems in collaboration with Intel and HPE, tests show an HPE Superdome Flex server equipped with Intel Optane DC persistent memory enables large HANA instances to re-start in less than 15 minutes, compared to the typical HANA re-start time of several hours⁴—and the benefit increases with the size of the database. Specifically, as shown in Figure 1, the memory-centric solution enabled SAP S/4HANA to re-start 13.7x faster than the baseline configuration, which did not include Intel Optane DC persistent memory. This means that reboots for OS and application patches and failovers can occur very quickly, with minimal downtime. Regular OS and application maintenance can result in enhanced security and stability, especially in systems that do not have complex cluster configurations, which can then lead to improved productivity and cost efficiency.

A four-socket platform running on previous generation Intel® Xeon® Scalable processors can accommodate only 6 TB of memory, using 128 GB DRAM modules. But with 2nd generation Intel Xeon Scalable processors (the only processor that supports Intel Optane DC persistent memory), a four-socket platform can be equipped with up to 15 TB of memory (12 TB of 512 GB Intel Optane DC persistent memory modules plus 3 TB of 128 GB DRAM modules). With the increased memory, even huge SAP S/4HANA workloads can be operated against standard service-level agreements (SLAs). The solution is highly scalable and features excellent availability and reliability. What's more, the PoC results showed that the performance of the all-DRAM system and the Intel Optane DC persistent memory system was nearly identical—indicating that Intel Optane DC persistent memory is well-integrated with the PoC database application.

An additional benefit of the solution is that due to the structure of the HPE Superdome Flex server, you can have two to four times the memory of a standard server with a smaller physical footprint—improving data center density. With HPE Superdome Flex, customers can also choose to scale up compute, adding flexibility to the solution. The PoC also tested performing a typical lifecycle management activity, such as upgrading the database from SAP S/4HANA 2.0 Service Pack 3 to Service Pack 4. The upgrade completed successfully and benefited from the reduced offline time.

Solution Architecture: Persistent Memory from Intel and Modular High-Performance from HPE*

The solution tested by T-Systems in the PoC features two primary components that led to improved re-start times:

Intel Optane DC persistent memory: This is an additional level of memory to bridge the gap between DRAM and NAND SSD, in DIMM form factor. SAP S/4HANA has been optimized to take advantage of Intel Optane DC persistent memory's App Direct Mode, meaning a working data set can be maintained through power cycles.

Intel Optane DC persistent memory is comparable in speed to DRAM and modules can be configured at up to 3 TB per CPU socket (in addition to the DRAM in the system). That means fewer I/O trips and less latency for accelerated performance. In addition, the new media delivers a unique combination of affordable large capacity and support for data persistence. Intel Optane DC persistent memory modules are available in 128, 256, and 512 GB capacities.

HPE Superdome Flex Server: The unique modular design of HPE Superdome Flex (Figure 2) provides a cost-efficient four-socket entry point for mission-critical workloads, with the ability to scale up at your own pace to 32 sockets with the choice of either economical Gold or high-end 2nd generation Intel® Xeon® Platinum processors. HPE Superdome Flex starts at 768 GB of shared memory and can expand to 48 TB, offering plenty of room for growth.



Figure 2. HPE Superdome Flex* server.

Spotlight on T-Systems*

With a footprint in more than 20 countries, 37,500 employees, and external revenue of EUR 6.9 billion (2018), T-Systems* is one of the world's leading vendor-independent providers of digital services headquartered in Europe. In particular, according to T-Systems' website, the service provider is the world's largest cloud hosting platform for SAP* landscapes⁵.

T-Systems has been part of the worldwide SAP ecosystem for more than ten years and is one of the pioneers in providing state-of-the-art technologies such as SAP HANA* from the cloud. The company hosts more than 820 TB of SAP HANA databases, and works on over 1,000 SAP projects yearly. With 10,000 SAP instances, the company holds multiple SAP certifications, and is an end-to-end (E2E) certified SAP Partner globally.

T-Systems takes pride in offering its customers the latest technology available to help them scale their database workloads as needed, with high quality standards, transparency and efficiency, excellent IT security and the availability levels necessary for mission-critical workloads.

With its innovative scalable architecture that connects individual four-socket building blocks to one another in a point-to-point fashion, processors accessing data residing in memory in another block will always travel using a single "hop"—no matter if a processor at the top of the rack is accessing data from memory at the bottom. In addition, high-bandwidth technology across all the sub-systems—processors, memory, interconnectivity and I/O—means you can achieve the performance required to accelerate analytics and power-critical apps. The HPE Superdome Flex also features proven Superdome RAS capabilities not present in other standard servers.

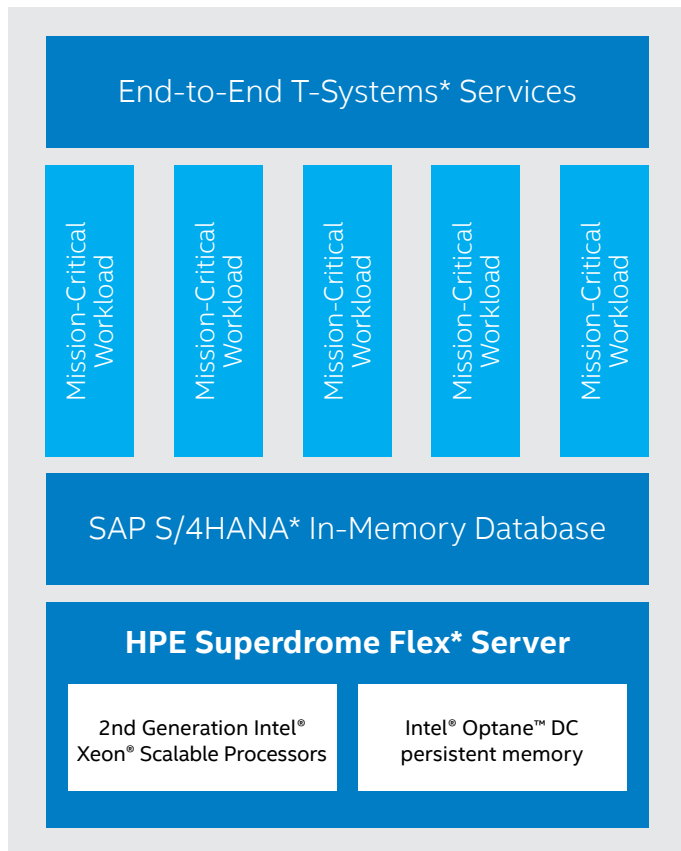


Figure 3. A memory-centric solution architecture from T-Systems*, Hewlett Packard Enterprise* (HPE*) and Intel powers mission-critical database workloads.

Conclusion

The results of T-System's PoC illustrate that the 2nd gen Intel Xeon Scalable processor's support for Intel Optane DC persistent memory, combined with the unique design of the modular, scalable and reliable HPE Superdome Flex server, is an excellent way to solve the in-memory database challenges facing T-Systems' customers today. With the ability to configure a four-socket system with up to 15 TB of memory, reboot times shrink to mere minutes (13.7x faster than a system without Intel Optane DC persistent memory⁶). With shorter downtime intervals, security patches can be applied without substantially affecting SLA compliance. Ongoing collaboration between T-Systems, Intel and HPE will further explore the significant potential of Intel Optane DC persistent memory and HPE Superdome Flex servers.

Learn More

You may find the following resources helpful:

- **T-Systems* home page**
<https://www.t-systems.com>
- **Intel® Optane™ DC persistent memory**
<https://software.intel.com/en-us/persistent-memory>
- **HPE Superdome* Flex Server**
<https://www.hpe.com/us/en/servers/superdome.html>
- **2nd generation Intel® Xeon® Scalable processors**
<https://www.intel.com/content/www/us/en/products/processors/xeon/scalable.html>
- **T-Systems: DSAG Annual Congress 2019**
<https://www.t-systems.com/de/en/about-t-systems/company/trade-shows-events/event-detail/dsag-annual-congress-2019-901390>

Find the solution that is right for your organization. Contact your Intel representative or visit <https://www.t-systems.com/de/en/solutions/sap/solutions/dynamic-services/sap-solutions-801844>.

Find more resources for cloud service providers at [intel.com/CSP](https://www.intel.com/CSP)

Solution Provided By:

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^{1,2,3,4,6} Testing by T-Systems as of March 18, 2019.

Baseline Configuration

Hardware: HPE Superdome Flex* server with 4x CPU sockets (Intel® Xeon® Platinum processor Beta 8276M 2.20 GHz GHz; Memory = 4x6 256 GB Intel® Optane™ DC persistent memory (6 TB) - DEACTIVATED and 4x6 64 GB DDR4 Memory (1.5 TB) for a total memory configuration of 1.5 TB

Software: Database: 4 TB SAP S/4HANA* database in App Direct Mode; OS: Standard SUSE Linux Enterprise Server* 12 Service Pack 4 microcode = 0xb00002e; kernel = Linux 4.12.14-95.16, standard NetApp cDot*-based storage used for persistence; SAP HANA 2.0 SPS4 rev. 40 installation with BW-Benchmark workload

Re-start time: 10, 248 seconds (approximately 2.85 hours)

Proof of Concept Configuration

Hardware: HPE Superdome Flex* server with 4x CPU sockets (Intel® Xeon® Platinum processor Beta 8276M 2.20 GHz GHz; Memory = 4x6 256 GB Intel® Optane™ DC persistent memory (6 TB) and 4x6 64 GB DDR4 Memory (1.5 TB) for a total memory configuration of 7.5 TB

Software: Database: 4 TB SAP S/4HANA* database in App Direct Mode; OS: Standard SUSE Linux Enterprise Server* 12 Service Pack 4 microcode = 0xb00002e; kernel = Linux 4.12.14-95.16, standard NetApp cDot*-based storage used for persistence; SAP HANA 2.0 SPS4 rev. 40 installation with BW-Benchmark workload

Re-start Time: 748 seconds (approximately 12.47 minutes)

⁵ <https://www.t-systems.com/de/en/about-t-systems/partner/sap/sap-225570>

Performance results are based on testing as of the date noted in the configuration details and may not reflect all publicly available security updates. See configuration disclosure for details. No product or component can be absolutely secure.

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