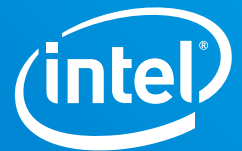


SOLUTION BRIEF

Intel® Select Solutions | Version 2
Enterprise Data Center Infrastructure
2nd Generation Intel® Xeon® Scalable Processor
April 2019



Intel® Select Solutions for Microsoft SQL Server* on Windows Server*

Scale out multi-tenant database-as-a-service (DBaaS) solutions for a wide variety of analytical and operational workloads.



Database-as-a-service (DBaaS) solutions play an increasingly important role in enterprise data center deployments, where scaling up and down quickly is a high priority. DBaaS offers the technical advantages of accommodating multiple tenants on a wide variety of concurrent workloads in databases ranging from hundreds of megabytes to terabytes in size. It also offers the financial advantages of tighter utilization of infrastructure, with IT paying only for resources actually used.

To capitalize on those advantages, IT organizations now seek new approaches to DBaaS that can meet the escalating demands of online transaction processing (OLTP), hybrid transactional/analytical processing (HTAP), and advanced analytics.

Intel® Select Solutions are verified hardware and software stacks optimized across compute, storage, and networking resources for specific workloads, such as DBaaS. Built on Intel® Xeon® Scalable processors, Intel Select Solutions help ensure enterprises get the performance, agility, and security they require.

Microsoft SQL Server as a DBaaS Offering

Many organizations extend their Microsoft SQL Server* deployments to use SQL Server as part of their DBaaS solutions. SQL Server provides the high performance, robust security, and flexibility in programming languages expected in a DBaaS environment. In addition to supporting in-memory database capabilities across all workloads, SQL Server offers in-database advanced analytics using SQL Server Machine Learning Services. SQL Server handles the workloads and user requirements in verticals as varied as IT services, manufacturing, retail and ecommerce, healthcare, education, energy, and infrastructure.

Under ordinary database workloads, the traditional way to scale up SQL Server is to add DRAM. But for workloads like machine learning (ML), predictive analytics, and HTAP, that practice has limitations. Those workloads require infrastructure that can smoothly handle sharp spikes and drops in transaction volume and can accommodate both business operations and enterprise data warehouse (EDW) operations. Simply adding more DRAM does not address all of the performance needs of multi-tenancy and enterprise private cloud deployments, nor does it offer a solution when a legacy version of SQL Server falls out of support.

Intel Select Solutions for SQL Server on Windows Server

In 2019, Intel and Microsoft created a second version of the Intel Select Solutions for SQL Server on Windows Server*. Intel Select Solutions for SQL Server on Windows Server are aligned with the building-block approach to scaling out a DBaaS hosting environment. They are designed to handle the concurrent, variable (for example, operational and analytical) workloads of business users running OLTP, EDW, or both.

Intel Select Solutions for SQL Server on Windows Server combine Microsoft* software with the Intel Xeon Scalable processor platform, Intel® Optane™ DC persistent memory, Intel® Solid State Drive (SSD) technology, Intel® Ethernet Connections, and Intel® Ethernet Converged Network Adapters. They offer:

- **Building blocks** for infrastructure that grows to meet the needs of DBaaS
- **Options for consolidating** older SQL Server environments
- **Benchmarked performance** that supports business operations and EDW workloads across a wide variety of verticals
- **Accelerated time to market** with a turnkey solution benchmarked to scale for a variety of workloads

A solid model for long-term compatibility, Intel Select Solutions for SQL Server on Windows Server can help simplify private and public cloud deployments. Intel's extensive benchmark testing validates the building-block model of adding and removing infrastructure for easy scaling.

Hardware Selections

Intel Select Solutions for SQL Server on Windows Server combine Intel Xeon Scalable processors, Intel Optane DC persistent memory, and Intel SSDs for high performance, easy scalability, and suitability to varied workloads.

Intel® Xeon® Gold Processors

Intel Xeon Gold processors provide an excellent price/performance ratio for both business operations and EDW. Specifically, Intel selected the Intel Xeon Gold 5218 processor and the Intel Xeon Gold 6248 processor to power Intel Select Solutions for SQL Server on Windows Server. The processors optimize cost and performance for representative database workloads while taking into consideration speed and number of cores.

Intel® Optane™ DC Persistent Memory

Intel Optane DC persistent memory represents a new class of memory and storage technology that allows organizations to maintain larger amounts of data closer to the processor, with consistent, low latencies and near-DRAM performance. Organizations can use Intel Optane DC persistent memory to cost-effectively expand the capacity of memory available to support higher quantities of “hot” data available for processing with in-memory databases, analytics, and other demanding workloads.

Intel® SSD Data Center Family

For more-reliable database performance in the enterprise data center, Intel Select Solutions for SQL Server on Windows Server use Intel Optane SSD DC P4800X drives. They also use the Intel SSD DC S4510 and Intel SSD DC P4610, which provide a 3.2x lower annualized failure rate (AFR) than traditional hard-disk drives (HDDs).¹

What Are Intel® Select Solutions?

Intel Select Solutions are pre-defined, workload-optimized solutions designed to minimize the challenges of infrastructure evaluation and deployment. Solutions are validated by OEMs/ODMs, certified by ISVs, and verified by Intel. Intel develops these solutions in extensive collaboration with hardware, software, and operating system vendor partners and with the world's leading data center and service providers. Every Intel Select Solution is a tailored combination of Intel® data center compute, memory, storage, and network technologies that delivers predictable, trusted, and compelling performance.

To refer to a solution as an Intel Select Solution, a vendor must:

1. Meet the software and hardware stack requirements outlined by the solution's reference-design specifications
2. Replicate or exceed established reference-benchmark test results
3. Publish a solution brief and a detailed implementation guide to facilitate customer deployment

Solution providers can also develop their own optimizations in order to give end customers a simpler, more consistent deployment experience.

Intel® Ethernet Connections and Intel® Ethernet Adapters

Intel Select Solutions for SQL Server on Windows Server feature the Intel® C620 Series Chipset with Intel® Ethernet Connection X722 for 10GBASE-T.

The 25Gb Intel® Ethernet 700 Series Network Adapters accelerate the performance of Intel Select Solutions for SQL Server on Windows Server. The Intel Ethernet 700 Series delivers validated performance ready to meet high-quality thresholds for data resiliency and service reliability with broad interoperability.² All Intel Ethernet products are backed by worldwide pre- and post-sales support and offer a limited lifetime warranty.

Verified Performance through Benchmark Testing

All Intel Select Solutions are verified through benchmarking to meet a specified, minimum level of workload-optimized performance. In the case of Intel Select Solutions for SQL Server on Windows Server, the following benchmark tests were run using HammerDB*:

- Single-tenant, large OLTP³
- Single-tenant, large decision-support system (DSS)⁴

HammerDB workloads are designed to be reliable and scalable, and they are tested to produce accurate, repeatable, and consistent results, in addition to measuring relative, as opposed to absolute, database performance between systems.

Base and Plus Configurations

Intel Select Solutions for SQL Server on Windows Server include a “Base” and a “Plus” configuration. Both configurations are shown in [Appendix A](#), below.

The Base configuration specifies the minimum required performance capability for Intel Select Solutions for SQL Server on Windows Server. The Plus configuration is designed for the higher performance needed to handle large databases with memory-intensive workloads. The Plus configuration provides one example of how system builders, system integrators, and solution/service providers can use Intel Optane DC persistent memory as part of a DBaaS building block.

Technology Selections for Intel Select Solutions for SQL Server on Windows Server

In addition to the Intel® hardware foundation used for Intel Select Solutions for SQL Server on Windows Server, Intel technologies integrated in Intel Xeon Scalable processors deliver further performance and reliability gains:

- **Intel® Platform Trust Technology (Intel® PTT) or a discrete Trusted Platform Module (TPM) 2.0:** Protects the system start-up process by ensuring the boot hardware is tamper-free before releasing system control to the operating system. TPM 2.0 also provides secured storage for sensitive data, such as security keys and passwords, and performs encryption and hash functions.⁵
- **Intel® Hyper-Threading Technology (Intel® HT Technology):** Enables multiple threads to run on each core, which ensures that systems use processor resources more efficiently. Intel HT Technology also increases processor throughput, improving overall performance on threaded software.
- **Intel® Turbo Boost Technology:** Accelerates processor and graphics performance for peak loads, automatically allowing processor cores to run faster than the rated operating frequency when operating below power, current, and temperature specification limits.
- **Intel® Speed Shift technology:** Allows the processor to quickly select its best operating frequency and voltage for optimal performance and power efficiency without intervention from the operating system.

Intel® Xeon® Scalable Processors

2nd Generation Intel Xeon Scalable processors:

- Offer high scalability that is cost-efficient and flexible, from the multi-cloud to the intelligent edge
- Establish a seamless performance foundation to help accelerate data's transformative impact
- Support breakthrough Intel® Optane™ DC persistent memory technology
- Accelerate artificial-intelligence (AI) performance and help deliver AI readiness across the data center
- Provide hardware-enhanced platform protection and threat monitoring⁵

Intel® Select Solutions for Microsoft SQL Server* on Windows Server* feature Intel Xeon Gold processors.



- **Power-management settings:** Operating system power-management settings are tuned for performance in Intel Select Solutions for SQL Server on Windows Server.
- **Intel® Rapid Storage Technology enterprise (Intel® RSTe) for Serial ATA (SATA) and Intel NVM Express* (NVMe*) drives (recommended):** Improve data reliability and deliver greater levels of performance, responsiveness, and expandability.

Scale Your DBaaS Infrastructure with the Building Blocks for Hosting Multi-Tenant SQL Server

Intel Select Solutions for SQL Server on Windows Server, optimized with Intel Optane DC persistent memory, are designed for IT organizations that need to offer DBaaS for a variety of concurrent workloads in a scalable, multi-tenant environment. Proven to scale with Intel Xeon Scalable processors, these pre-tuned and tested configurations are workload-optimized and allow organizations to deploy data center infrastructure quickly and efficiently with less tuning.

Visit intel.com/selectsolutions to learn more, and ask your infrastructure vendor for Intel Select Solutions.

Appendix A: The Base and Plus Configurations for Version 2 of the Intel Select Solutions for SQL Server on Windows Server

To refer to a solution as an Intel Select Solution, a server vendor or data center solution provider must meet or exceed the defined minimum configuration ingredients and reference minimum benchmark-performance thresholds listed below.

INGREDIENT	INTEL® SELECT SOLUTIONS FOR MICROSOFT SQL SERVER* ON WINDOWS SERVER* BASE CONFIGURATION	INTEL SELECT SOLUTIONS FOR SQL SERVER ON WINDOWS SERVER PLUS CONFIGURATION
PLATFORM	Intel® Server Board S2600WFT Qual	Intel Server Board S2600WFT Qual
PROCESSOR	2 x Intel® Xeon® Gold 5218 processor at 2.30 GHz (16 cores, 32 threads), or a higher number Intel Xeon Scalable processor	2 x Intel Xeon Gold 6248 processor at 2.60 GHz (20 cores, 40 threads), or a higher number Intel Xeon Scalable processor
MEMORY	384 GB or higher (12 x 32 GB 2,933 MHz 288-pin DDR4 RDIMM)	384 GB (12 x 32 GB 2,933 MHz 288-pin DDR4 RDIMM) and 1.0 TB Intel® Optane™ DC persistent memory (8 x 128 GB) or 768 GB (24 x 32 GB 2,933 MHz 288-pin DDR4 RDIMM)
PERSISTENT-MEMORY-TO-DRAM RATIO	N/A	2.67:1 (or lower) (1,024 GB:384 GB)
BOOT DRIVE**	1 x 240 GB Intel® Solid State Drive (SSD) D3-S4510 (2.5-in. SATA 6 gigabits per second [Gb/s], 3D2, TLC) or more	2 x 240 GB Intel SSD D3-S4510 Series (2.5-in. SATA 6 Gb/s, 3D2, TLC) or more (mirrored)
LOG DRIVE	2 x 1.6 TB Intel SSD DC P4610 (NVMe Express* [NVMe*])	2 x 750 GB Intel Optane SSD DC P4800X (NVMe)
DATA DRIVE	6 x 2 TB Intel SSD DC P4510 (NVMe)	6 x 4 TB Intel SSD DC P4510 (NVMe)
DATA NETWORK	10Gb Intel® C620 Series Chipset with integrated Intel® Ethernet Network Connection X722	10Gb Intel® C620 Series Chipset with integrated Intel® Ethernet Network Connection X722
MANAGEMENT NETWORK	Integrated 1 gigabit Ethernet (GbE)	Integrated 1 GbE
SOFTWARE	Windows Server 2016 Standard edition or higher SQL Server 2017 or higher	Windows Server 2019 Standard edition or higher SQL Server 2017 or higher
TPM	TPM 2.0 discrete or firmware TPM (Intel® Platform Trust Technology [Intel® PTT])	TPM 2.0 discrete or firmware TPM (Intel PTT)
FIRMWARE AND SOFTWARE OPTIMIZATIONS	Intel® Hyper-Threading Technology (Intel® HT Technology) enabled Intel® Turbo Boost Technology enabled Intel® Speed Shift technology, hardware P-states (HWP) native Intel® Rapid Storage Technology enterprise (Intel® RSTe) for SATA** Intel NVMe drivers** C-states disabled Operating system power management plan set for performance	Intel HT Technology enabled Intel Turbo Boost Technology enabled Intel Speed Shift technology, HWP native Intel RSTe for SATA** Intel NVMe drivers C-states disabled Operating system power management plan set for performance

MINIMUM PERFORMANCE STANDARDS

Verified to meet or exceed the following minimum performance capabilities⁶

	OLTP workload: 4.3 million transactions per minute; DSS workload: 840 seconds average query set response time per user at 1 TB database size and 7 users	OLTP workload: 5.7 million transactions per minute; DSS workload: 580 seconds average query set response time per user at 1 TB database size and 7 users
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BUSINESS VALUE OF CHOOSING A PLUS CONFIGURATION OVER A BASE CONFIGURATION

With the Plus configuration of Intel Select Solutions for SQL Server on Windows Server, businesses can achieve 32 percent higher performance on OLTP workloads and 31 percent shorter query response times (average) on DSS workloads than with the Base configuration.⁶

Learn More

Intel Select Solutions: intel.com/selectsolutions

Intel Xeon Scalable processors: intel.com/xeonscalable

Intel SSD Data Center Family: intel.com/content/www/us/en/products/memory-storage/solid-state-drives/data-center-ssds.html

Intel Optane DC persistent memory: intel.com/optanememory

Intel Select Solutions are supported by Intel® Builders: <http://builders.intel.com>. Follow us on Twitter: [#IntelBuilders](https://twitter.com/IntelBuilders)

SQL Server: microsoft.com/en-US/sql-server

Intel and Microsoft alliance: intel.com/content/www/us/en/big-data/intel-microsoft-partnership.html



¹ Based on initial product AFR of 0.66 percent vs. industry AFR average (2.11%). Source: Backblaze. "Hard Drive Stats for Q1 2017." May 2017. backblaze.com/blog/hard-drive-failure-rates-q1-2017/.

² The Intel® Ethernet 700 Series includes extensively tested network adapters, accessories (optics and cables), hardware, and software, in addition to broad operating system support. A full list of the product portfolio's solutions is available at intel.com/ethernet. Hardware and software is thoroughly validated across Intel® Xeon® Scalable processors and the networking ecosystem. The products are optimized for Intel® architecture and a broad operating system ecosystem: Windows®, Linux® kernel, FreeBSD®, Red Hat® Enterprise Linux (RHEL®), SUSE®, Ubuntu®, Oracle Solaris®, and VMware ESXi®. Supported connections and media types for the Intel Ethernet 700 Series are: direct-attach copper and fiber SR/LR (QSFP+, SFP+, SFP28, XLPP/CR4, 25G-CA/25G-SR/25G-LR), twisted-pair copper (100BASE-T/10GBASE-T), backplane (XLAUI/XAUI/SFI/KR/KR4/KX/SGMII). Note that Intel is the only vendor offering the QSFP+ media type. The Intel Ethernet 700 Series supported speeds include 10GbE, 25GbE, 40GbE.

³ The HammerDB® TPC-C* benchmark is based on the TPC-C specification for OLTP workloads. It simulates an online ordering system and is not optimized or biased towards any particular database implementation or system hardware. The HammerDB benchmark for OLTP testing was the benchmark test used to optimize the configurations. This benchmark's OLTP workload is derived from TPC-C, and as such is not comparable to published TPC-C results.

⁴ The HammerDB® TPC-H* benchmark is based on the TPC-H specification for DSS workloads. It consists of a suite of business oriented ad-hoc queries. The HammerDB benchmark for DSS testing was the benchmark test used to optimize the configurations. This benchmark's DSS workload is derived from TPC-H, and as such is not comparable to published TPC-H results.

⁵ No product or component can be absolutely secure.

⁶ Intel internal testing as of March 11, 2019. **Base configuration:** 2 x Intel® Xeon® Gold 5218 processors (2.30 GHz, 16 cores, 32 threads), 1 x Intel® Server Board S2600WFT, total memory: 384 GB 2,933 MHz DDR4 DIMM; 1 x 240 GB Intel® Solid State Drive (SSD) D3-S4510, 2 x 1.6 TB Intel SSD DC P4610 (NVM Express® [NVMe®]), 6 x 2 TB Intel SSD DC P4510; Intel® Ethernet Connection X722 for 10GBASE-T, integrated 1 GbE; running Windows Server 2016® Datacenter edition and Microsoft SQL Server 2017®; Intel® Hyper-Threading Technology (Intel® HT Technology) enabled, Intel® Turbo Boost Technology enabled, Intel® Speed Shift technology enabled, hardware P-states (HWP) native, C-states disabled, operating system power management plan set for performance. **Plus configuration:** 2 x Intel® Xeon® Gold 6248 processors (2.60 GHz, 20 cores, 40 threads), 1 x Intel® Server Board S2600WFT, total memory: 384 GB 2,933 MHz DDR4 DIMM, 1 TB Intel® Optane™ DC persistent memory; 2 x 240 GB Intel SSD D3-S4510, 2 x 750 GB Intel Optane SSD DC P4800X (NVM Express® [NVMe®]), 6 x 4 TB Intel SSD DC P4510; Intel® Ethernet Connection X722 for 10GBASE-T, integrated 1 GbE; running Windows Server 2019® Datacenter edition and Microsoft SQL Server 2017®; Intel HT Technology enabled, Intel Turbo Boost Technology enabled, Intel Speed Shift technology enabled, HWP native, C-states disabled, operating system power management plan set for performance.

Performance results are based on testing as of the date set forth in the configurations and may not reflect all publicly available security updates. See configuration disclosure for details.

No product or component can be absolutely secure.

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 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's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

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