BUSINESS BRIEF

Hybrid Cloud
Intel® Xeon® Scalable Processors

Future-Ready Cloud for Government

Hybrid Cloud Solutions for a Modern Public Sector

Intel® Xeon® Scalable Processors Empower Hybrid Cloud Solutions for Modern Government

- Reduce time to value with an agile and scalable hybrid cloud platform
- Boost security and reliability with fast encryption and a wide range of enhanced reliability, availability, and serviceability features
- Reduce TCO and data center footprint with better and more efficient virtualization capabilities compared to four- or five-year-old servers
- Deploy a future-ready platform built on Intel® architecture

Competitiveness Demands Innovation

With strict spending rules and lengthy purchasing processes, government IT typically has to navigate many more obstacles than their counterparts in enterprise IT. Finding a way to overcome these challenges is vital because being left behind is not really an option for governments today. With the hyper-digitalization of the business world, people now expect cutting edge technology to be the norm in every aspect of their lives. To meet the needs and expectations of a demanding population, governments need to innovate faster.

Data center technology is no longer only supporting internal processes—it has become the engine for innovation. This transformation starts with IT.

Government IT Faces Many Challenges

While IT is now integral to new innovations, its budget for infrastructure is flat to down. IT is challenged to **become simultaneously more versatile and more efficient**. Building agility and versatility into the infrastructure, combined with effectively utilizing resources, helps government agency IT departments meet the expectations of citizens while lowering total cost of ownership (TCO) for the data center.

Another challenge for government IT is the growing threat of cybercrime. As more agencies move their services to the web and look to enhance their offerings and experiences through digitization, malicious attackers are taking advantage. Cyber-attacks have become increasingly sophisticated and can disrupt even the most cautious or well-established agencies. For IT, this means significant focus and investment in enterprise-class security in order to defend against attacks, monitor the environment, and protect all data, its employees, and its citizens.

Hybrid Cloud Strategy

40% Enterprise IT with hybrid cloud environments in place already.[1]

60% Enterprise IT testing or planning to implement within two years.[1]

The Hybrid Cloud Solution

To meet these challenges, governments must continue to invest in data center computing; but they must do so differently to keep up with evolving demands and complexities. Intel believes that **investing in the hybrid cloud** allows governments to keep up with these challenges and continue to contend in the hyper-competitive and innovative technology landscape. Hybrid clouds offer a more comprehensive, flexible, and cost-effective solution for modernizing the data center with control, security, and manageability. With a hybrid cloud strategy, IT can deploy workloads and application environments that make the most sense for them—either on premises or in a public cloud—depending on the regulatory and technical requirements. IT specialists even have the versatility to mix and match cloud services when necessary, which can improve overall efficiencies and reliability.

Data Center Technology Matters in a Hybrid Cloud

To maximize your hybrid cloud investment, the **underlying architecture matters**. A common platform across both public and private infrastructures can help ease the transitions of workloads and help make migrations seamless. Additionally, hybrid cloud requires a powerful platform that can handle the widest range of workloads, that can efficiently scale to meet dynamic demands, and that supports increased security and reliability capabilities for the modern data center.

With the latest generation of Intel® Xeon® processors, Intel continues to improve and innovate with the needs of IT being top of mind, including supporting the hybrid cloud use case. The Intel® Xeon® processor Scalable family enables fast performance and scalability to support the diverse set of workloads, both on and off premises, running on your hybrid cloud. And that is the great thing about Intel® technology: it can support both cloud environments because the majority of the cloud runs on Intel. No matter what hybrid cloud vendor agencies choose to partner with, they can find solutions with Intel inside, and that compatibility of software and technology matters when bridging across clouds.

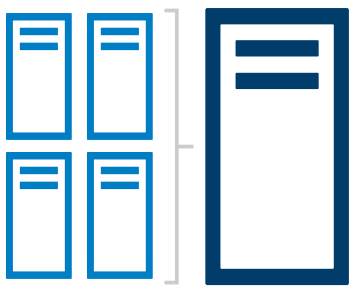
Intel® Xeon® Scalable Processors Deliver Agility and Scalability

Government agencies that make use of a hybrid cloud to deploy new capabilities with greater agility don't want their data center getting in the way. The new Intel Xeon Processor Scalable family represents the ideal hybrid cloud foundation, merging and extending the best enterprise-class attributes from the Intel Xeon processor E5 and E7 families. As the name suggests, the result is a highly versatile platform, scaling from two-socket up to eight-socket and beyond, all with the rich capabilities and software compatibility that is expected from an Intel Xeon processor.

Hybrid clouds are inherently multi-application and multi-tenant, demanding a high degree of agility from the underlying infrastructure. Intel® Xeon® Scalable processors, with new microarchitecture features, increased core count, and greater memory bandwidth, provide a high performing environment for a wide range of applications and workloads. In fact, this new processor has delivered up to 1.6 times average generational gains across a dozen of the most common enterprise workloads.[2]

Additionally, the Intel Xeon processor Scalable family delivers a strong performance boost in virtualization capabilities—also critical to hybrid cloud agility and efficiency. Servers based on Intel's latest processor allow more virtual machines (VMs) per server than ever before. As a result, Intel Xeon Scalable processors can support up to 4.2 times more VMs per server compared to a four- or five-year-old system, allowing government IT to run more workloads and applications to support their growing hybrid cloud strategies.[3]

Run More Efficient Data Centers



With new Intel® Xeon® Scalable processors, you can replace

4.2

four- or five-year-old systems with **one server**.[3]

Every IT department strives to do more with less. While the technology and business drivers will vary from agency to agency, at some point in the life cycle of all data center infrastructure, it is more efficient to modernize the equipment than continue to invest in maintenance and patching of outdated gear.

With the new Intel Xeon processor Scalable family, you can replace four four-to-five-year-old systems with one server, reducing data center footprint and allowing more of your limited IT budget to be allocated to driving innovation instead of maintaining the status quo.[3] Additionally, with reduced software and operating system licensing fees and lower maintenance and infrastructure costs, you can reduce your four-year TCO by up to 65 percent when upgrading from

a four-year-old server to one powered by the new Intel Xeon processor Scalable family.[4] This reduction is made possible by Intel's continued dedication to advancing its processor features and capabilities—for example, by including more cores with higher efficiency, improved cache hierarchy, and increased memory bandwidth.

Experience Enhanced Security and Reliability

When building out new infrastructures, such as hybrid clouds, governments want to build in highly responsive and multi-layered security, in addition to ensuring the underlying reliability of their new platforms. To protect data in flight and at rest, the Intel Xeon Scalable processor delivers enhanced processing of encryption algorithms, enabling you to broadly deploy more advanced security features and services into distributed environments without compromising performance. In addition, the Intel Xeon processor Scalable family integrates a new feature—Intel® Platform Trust Technology (Intel® PTT)—into the product, enabling an on-die trust module, further establishing the Intel Xeon processor product line as a hardware root-of-trust foundation for the cloud.

Lastly, in terms of platform reliability, availability, and serviceability (RAS) features, the new Intel Xeon Scalable processors inherit all the RAS features, including Intel® Run Sure technology, from the latest-generation, mission-critical Intel Xeon processor E7 family, but with their own additions. Offered with the Intel Xeon processor Scalable family are now two new Intel® Run Sure technologies; these, combined with 70+ proven RAS features, provide IT with additional peace of mind for the hybrid cloud infrastructure it relies upon.

Data and platform reliability and protection are mission-critical for government agencies dealing with increasing concerns and scrutiny regarding citizen's data security and privacy and even national security. As more data-rich workloads flow through the enterprise data center, the Intel Xeon processor Scalable family's comprehensive suite of hardware-enhanced features brings better data and platform-level protection mechanisms for trusted service assurance in hybrid cloud environments.

In Summary

The transition to a hybrid cloud infrastructure is by no means a simple task. However, by choosing the right underlying foundation—versatile, efficient, scalable, and more secure—government IT can reduce the headaches in building the cloud it needs to quickly roll out new services and apps. In this regard, the Intel Xeon processor Scalable family is the ideal platform for a hybrid cloud—increasing data center efficiency and security while simultaneously lowering TCO. With the Intel Xeon processor Scalable family, IT can be certain its data center is powered by Intel's high performance and exceptionally scalable platform, a platform that is truly future-ready and can handle the complex and unexpected requirements of today's data centers.

[1] Source: A commissioned study conducted by Forrester Consulting on behalf of Intel in May 2017.

[2] **Up to 1.6x geometric mean based on normalized generational performance across key industry benchmarks.** Estimated based on Intel internal testing of: online transaction processing (OLTP) brokerage, SAP SD 2-Tier*, HammerDB*, server-side Java*, SPEC*int_rate_base2006, SPEC*fp_rate_base2006, server virtualization, STREAM* triad, LAMMPS*, DPDK L3 Packet Forwarding, Black-Scholes*, and the Intel® Distribution for LINPACK*. See below for individual benchmark configurations:

1. **Up to 1.36x claim based on brokerage firm OLTP:** one-node with 2 x Intel® Xeon® processor E5-2699 v4 and 512 GB total memory on Windows Server 2012 R2 Standard* using Microsoft SQL Server 2014*. Data source: request number: 1,640, benchmark: brokerage firm OLTP, score: 4,373 transactions per second (tps) for OLTP vs. one-node with 2 x Intel Xeon Platinum 8180 Processor and 764 GB total memory on Windows Server 2016 RTM Standard using SQL Server 2016 data, score: 5,979 tps for OLTP. Higher is better.
2. **Up to 1.40x claim based on 2-Tier SAP SD*:** one-node with 2 x Intel Xeon processor E5-2699 v4 and 512 GB total memory on SUSE Linux Enterprise Server* 10 SP4 using SAP EHP5.0* for ERP 6.0 and Sybase ASE 16.0*. Data source: request number: 2,473, benchmark: SAP SD 2-Tier enhancement package 5 for SAP ERP 6.0, score: 19,721 vs. one-node with 2 x Intel Xeon

Platinum 8180 processor and 768 GB total memory on SUSE Linux Enterprise Server* 12 using SAP ERP6.0/EHP5. Data source: request number: 2,558, benchmark: SAP* SD 2-Tier enhancement package 5 for SAP ERP 6.0, score: 27,678. Higher is better.

3. **Up to 1.49x claim based on server-side Java:** one-node with 2 x Intel® Xeon® processor E5-2699 v4 and 128 GB total memory on Red Hat Enterprise Linux* 6.5 kernel 2.6.32-431 using Java 8 SE, JDK8U60, Java Hotspot V1.8.0_60* (if appropriate). Data source: request number: 1,633, benchmark: server-side Java workload—MultiJVM, score: 112,054 vs. one-node with 2 x Intel Xeon Platinum 8180 processor and 384 GB total memory on Red Hat Enterprise Linux* 7.3 using jdk1.8u121. Data source: request number: 2,513, benchmark: server-side Java workload—MultiJVM, score: 167,696. Higher is better.
4. **Up to 1.53x claim based on SPECint*_rate_base2006:** one-node with 2 x Intel Xeon processor E5-2699 v4 and 256 GB total memory on Red Hat Enterprise Linux* 7.2-kernel 3.10.0-327 using Compiler: C/C++: Version 16.0.0.101 of Intel C++ Studio XE* for Linux; Fortran: version 16.0.0.101 of Intel® Fortran Studio XE for Linux. Data source: request number: 2,342, benchmark: SPECint*_rate_base2006, score: 1,670 vs. one-node, 2 x Intel Xeon Platinum 8180 processor and 384 GB total memory on Red Hat Enterprise Linux* 7.2-kernel 3.10.0-327 using CPU2006_FOR-OEMs-cpu2006-1.2-ic17.0-lin-binaries-20160922. Data source: request number: 2,498, Benchmark: SPECint*_rate_base2006, score: 2,550. Higher is better.
5. **Up to 1.55x claim based on server virtualization workload:** one-node with 2 x Intel Xeon processor E5-2699 v4 and 512 GB total memory on VMware ESXi* 6.0 Update 1 using Guest VMs and RHEL 6 64-bit OS. Data source: request number: 1,637, benchmark: server virtualization workload, score: 1,034 at 58 vs. one-node with 2 x Intel Xeon Platinum 8180 processor and 768 GB total memory on VMware ESXi 6.0 U3 GA using Guest VMs and RHEL 6 64-bit OS. Data source: request number: 2,563, benchmark: server virtualization workload, score: 1,580 at 90 VMs. Higher is better.
6. **Up to 1.63x claim based on SPECfp*_rate_base2006:** one-node with 2 x Intel Xeon processor E5-2699 v4 and 256 GB total memory on Red Hat Enterprise Linux* 7.2-kernel 3.10.0-327 using Compiler: C/C++: Version 16.0.0.101 of Intel C++ Studio XE for Linux; Fortran: Version 16.0.0.101 of Intel Fortran Studio XE for Linux. Data source: request number: 2,340, benchmark: SPECfp*_rate_base2006, score: 1,050 vs. one-node with 2 x Intel Xeon Platinum 8180 processor and 384 GB total memory on Red Hat Enterprise Linux 7.2-kernel 3.10.0-327 using CPU2006_FOR-OEMs-cpu2006-1.2-ic17.0-lin-binaries-20160922. Data source: request number: 2,503, benchmark: SPECfp*_rate_base2006, score: 1,720. Higher is better.
7. **Up to 1.65x claim based on STREAM - triad:** one-node, 2 x Intel Xeon processor E5-2699 v4 and 256 GB total memory on Red Hat Enterprise Linux 6.5 kernel 2.6.32-431 using Stream NTW avx2 measurements. Data source: request number: 1,709, benchmark: STREAM - Triad, score: 127.7 vs. one-node with 2 x Intel Xeon Platinum 8180 processor and 384 GB total memory on Red Hat Enterprise Linux 7.2-kernel 3.10.0-327 using STREAM AVX 512 Binaries. Data source: request number: 2,500, benchmark: STREAM - Triad, score: 199. Higher is better.
8. **Up to 1.73x claim based on HammerDB:** one-node with 2 x Intel Xeon processor E5-2699 v4 and 384 GB total memory on Red Hat Enterprise Linux 7.1 kernel 3.10.0-229 using Oracle 12.1.0.2.0 (including database and grid) with 800 warehouses, HammerDB 2.18. Data source: request number: 1,645, benchmark: HammerDB, score: 4.13568e+006 vs. one-node with 2 x Intel Xeon Platinum 8180 processor and 768 GB total memory on Oracle Linux 7.2 using Oracle 12.1.0.2.0, HammerDB 2.18. Data source: request number: 2,510, benchmark: HammerDB, score: 7.18049e+006. Higher is better.
9. **Up to 1.73x claim based on LAMMPS:** LAMMPS is a classical molecular dynamics code, and an acronym for Large-scale Atomic/Molecular Massively Parallel Simulator. It is used to simulate the movement of atoms to develop better therapeutics, improve alternative energy devices, develop new materials, and more. 2-socket Intel Xeon processor E5-2697 v4, 2.3 GHz, 36 cores, Intel® Turbo Boost Technology, and Intel® Hyper-Threading Technology on, BIOS 86B0271.R00, 8 x 16 GB 2,400 MHz DDR4, Red Hat Enterprise Linux 7.2 kernel 3.10.0-327 vs. 2-socket Intel Xeon Gold 6148 processor, 2.4 GHz, 40 cores, Intel Turbo Boost Technology and Intel Hyper-Threading Technology on, BIOS 86B.01.00.0412.R00, 12 x 16 GB 2,666 MHz DDR4, Red Hat Enterprise Linux 7.2 kernel 3.10.0-327.
10. **Up to 1.77x claim based on DPDK L3 Packet Forwarding:** Intel Xeon processor E5-2658 v4: 5 x Intel® Ethernet Controller XL710-QDA2, DPDK 16.04. Benchmark: DPDK l3fwd sample application score: 158 Gbps packet forwarding at 256-B packet using cores. Intel Xeon Gold 6152 processor: Estimates based on Intel internal testing on Intel Xeon Gold 6152 processor, 2.1 GHz, 2 x dual-port Intel Ethernet Controller FM10420(RRC), 100 GbE (100 Gb/card), 2 x dual-port Intel® Ethernet Network Adapter XXV710 PCIe* gen, 25 GbE (2 x 25 Gb/card), DPDK 17.02. Score: 281 Gbps packet forwarding at 256-B packet using cores, I/O, and memory on a single socket.
11. **Up to 1.87x claim based on Black-Scholes:** A popular mathematical model used in finance for European option valuation. This is a double precision version. 2-socket Intel Xeon processor E5-2697 v4 , 2.3 GHz, 36 cores, Intel Turbo Boost Technology and Intel HT Technology on, BIOS 86B0271.R00, 128 GB total memory, 8 x 16 GB 2,400 MHz DDR4 RDIMM, 1 x 1 TB SATA, Red Hat Enterprise Linux 7.2 kernel 3.10.0-327 vs. Intel Xeon Gold 6148 processor at 2.4 GHz, H0QS, 40 cores 150 W. QMS1, Intel Turbo Boost Technology and Intel HT Technology on, BIOS SE5C 620.86B.01.00.0412.020920172159, 192 GB total memory, 12 x 16 GB 2,666 MHz DDR4 RDIMM, 1 x 800 GB Intel® SSD SC2BA80, Red Hat Enterprise Linux 7.2 kernel 3.10.0-327.
12. **Up to 2.27x claim based on LINPACK*:** One-node with 2 x Intel Xeon processor E5-2699 v4 and 64 GB total memory on Red Hat Enterprise Linux 7.0 kernel 3.10.0-123 using MP_LINPACK 11.3.1 (Composer XE 2016 U1). Data source: request number: 1,636, benchmark: Intel® Optimized MP LINPACK, score: 1,446.4 vs. one-node with 2 x Intel Xeon Platinum 8180 processor and 384 GB total memory on Red Hat Enterprise Linux 7.3 using mp_linpack_2017.1.013. Data source: request number: 3,753, benchmark: Intel Optimized MP LINPACK, score: 3,295.57. Higher is better.

[3] **Up to 4.28x more VMs based on a server virtualization consolidation workload:** Based on Intel® internal estimates with a one-node setup using 2 x Intel® Xeon® processor E5-2690 with 256 GB total memory on VMware ESXi* 6.0 GA using Guest OS Red Hat Enterprise Linux (RHEL) 6.4*, glassfish3.1.2.2*, postgresql9.2*. Data Source: Request Number: 1,718. Benchmark: Server virtualization consolidation, score: 377.6 @ 21 VMs vs. a one-node setup using 2 x Intel® Xeon® Platinum 8180 processor on Wolf Pass SKX with 768 GB total memory on VMware ESXi 6.0 U3 GA using Guest OS RHEL 6 64bit. Data Source: Request Number: 2,563. Benchmark: Server virtualization consolidation, score: 1,580 @ 90 VMs. Higher is better.

[4] **Up to 65 percent lower 4-year TCO estimate** example based on equivalent rack performance using a VMware ESXi* virtualized consolidation workload comparing 20 installed 2-socket servers with the Intel® Xeon® processor E5-2690, running VMware ESXi* 6.0 GA using Guest OS RHEL 6.4* compared at a total cost of $919,362 to five new Intel Xeon Platinum 8180 processors running VMware ESXi 6.0 U3 GA using Guest OS RHEL 6 64-bit at a total cost of $320,879 including basic acquisition. Server pricing assumptions are based on current OEM retail published pricing for a 2-socket server with the Intel Xeon processor E5-2690 v4 and two CPUs in 4-socket server using the Intel Xeon processor E7-8890 v4—subject to change based on actual pricing of systems offered.

Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.

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Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase. For more complete information about performance and benchmark results, 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 does not control or audit third-party benchmark data or the web sites referenced in this document. You should visit the referenced web site and confirm whether referenced data are accurate.

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