SOLUTION BRIEF

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

Intel® Select Solutions for Blockchain: Hyperledger Fabric*

Accelerate blockchain development and deployment on an optimized, verified infrastructure based on Hyperledger Fabric.

Enterprises face numerous challenges today, such as centralization, manual processes, and lack of trust, which can contribute to slower transactions and increased business expenses. Blockchain technology offers an option to resolve these challenges by adding transparency, privacy, anti-tampering protections, and traceability to transactions. These characteristics enable blockchain to help reduce costs and improve efficiency by streamlining processes and increasing transaction speeds. While organizations are enthusiastic about blockchain technology, there are concerns with deployment complexity, infrastructure overhaul, choosing the best platform for their business models, and scalability. To help address these concerns, Intel® Select Solutions for Blockchain: Hyperledger Fabric* provide a verified, tested solution, based on high-performance Intel® Xeon® Scalable processors and reliable Intel® Solid State Drives (SSDs), that simplifies blockchain deployment on Hyperledger Fabric and adds modularity and enterprise-grade privacy for organizations seeking to build blockchain solutions.

Intel Select Solutions for Blockchain: Hyperledger Fabric

Hyperledger Fabric provides a foundation for developing applications and solutions with a modular architecture, and it enables components, such as consensus and membership services, to be plug-and-play. Moreover, confidential transactions only appear on the ledgers of parties to those transactions, maintaining confidentiality. To implement modular architecture, Hyperledger Fabric uses container technology to host *chaincode*: smart contracts that compose the application logic of the system. While Hyperledger Fabric provides the building blocks for scalable blockchain for business use, it still requires high-performance, easy-to-deploy hardware to provide full benefits to businesses.

Hyperledger Fabric is one of several frameworks hosted by Hyperledger, the open source consortium advancing business blockchain technologies hosted by The Linux Foundation. Originally developed by IBM and Digital Asset, Hyperledger Fabric is widely supported by experienced providers with several proof-of-concept projects and is a foundation of the IBM Blockchain* and SAP Cloud Platform* offerings. Hyperledger Fabric is one of the most prominent enterprise blockchains in existence today due to its business-to-business (B2B) focus.

Intel Select Solutions for Blockchain: Hyperledger Fabric help optimize price and performance while significantly reducing infrastructure evaluation time. Specifically, Intel Select Solutions for Blockchain: Hyperledger Fabric combine the Intel Xeon Scalable processor platform, Intel SSDs, and Intel® Ethernet Network Adapters to empower enterprises to quickly harness reliable, comprehensive solutions that allow their organizations to:

- **Prepare** blockchain infrastructure investments for the future with scalable storage and compute
- **Generate excellent total cost of ownership (TCO)** with general-purpose hardware that IT organizations are used to managing
- **Accelerate time to market** by using a turnkey solution with a rich development toolset that is optimized for crucial software libraries

Solution Components

Intel Select Solutions for Blockchain: Hyperledger Fabric combine the Intel Xeon processor Scalable family, Intel 3D NAND SSDs, and the Intel® Ethernet 700 Series to enable businesses to quickly deploy reliable blockchain solutions on a performance-optimized infrastructure.

Intel® Xeon® Processor Scalable Family

Intel Xeon Scalable processors provide Intel Select Solutions for Blockchain: Hyperledger Fabric with an excellent performance-to-cost ratio because of their built-in technologies that can provide enhanced performance and efficiency for cryptographic hashing and blockchain security, such as:

- **Intel® AES New Instructions (Intel® AES-NI)**, a set of built-in encryption instructions that can greatly improve the compute efficiency of cryptographic algorithms, such as those used in blockchain transactions, while offering greater performance and improved security
- **Intel® Advanced Vector Extensions 512 (Intel® AVX-512)**, which provides 512-bit instructions that can accelerate performance for demanding workloads and usages like blockchain
- **Intel® Run Sure Technology**, which increases system resiliency, protects critical data, reduces unplanned server downtime, and increases data integrity
- **Intel® Trusted Execution Technology (Intel® TXT)**, software that helps protect critical confidential information, such as blockchain encryption keys, without compromising performance

Solutions incorporating the latest Intel Xeon Gold 5217 processors deliver the same performance or incremental performance gains as compared to similarly configured solutions based on previous-generation Intel Xeon Scalable processors.

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® SSD Data Center Family

Storage latency can be a bottleneck for blockchain performance. For this reason, Intel Select Solutions for Blockchain: Hyperledger Fabric use the Intel SSD DC S4500 and Intel SSD DC P4610 Series. Based on Intel 3D NAND technology, these enterprise data center SSDs provide a 3.2x lower annualized failure rate (AFR) than hard-disk drives (HDDs).[1]

Intel® Ethernet Connections and Intel® Ethernet Adapters

The 25Gb Intel Ethernet 700 Series Network Adapters accelerate the performance of Intel Select Solutions for Blockchain: Hyperledger Fabric. 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 benchmark testing to meet a prespecified minimum capability level of workload-optimized performance. To do this for Intel Select Solutions for Blockchain: Hyperledger Fabric, Intel chose Hyperledger Caliper*, a blockchain benchmark tool and one of the Hyperledger* projects hosted by The Linux Foundation. Hyperledger Caliper enables users to measure the performance of a specific blockchain implementation for a set of predefined use cases. Specifically, Intel verified the performance of Intel Select Solutions for Blockchain: Hyperledger Fabric by testing the transactions per second (TPS), as measured by Hyperledger Caliper.

Base Configuration

Intel Select Solutions for Blockchain: Hyperledger Fabric are available in a "Base" configuration, as shown in Table 1. The Base configuration specifies the minimum required performance capability for Intel Select Solutions for Blockchain: Hyperledger Fabric.

To refer to solutions as Intel Select Solutions for Blockchain: Hyperledger Fabric, a server vendor or data center solution provider must meet or exceed the defined minimum configuration ingredients and reference the minimum benchmark-performance thresholds listed below.

Table 1. Base configuration for version 2 of Intel® Select Solutions for Blockchain: Hyperledger Fabric*

INGREDIENT	INTEL® SELECT SOLUTIONS FOR BLOCKCHAIN: HYPERLEDGER FABRIC* **BASE CONFIGURATION**
PROCESSOR	2 x Intel® Xeon® Gold 5217 processor (3.00 GHz, 8 cores, 16 threads), or a higher number Intel Xeon Scalable processor
MEMORY	96 GB (12 x 8 GB 2,933 MHz DDR4 RDIMMS) 1DC or higher
BOOT DRIVE**	1 x Intel® SSD DC S4510 (M.2 or 2.5-inch) (240 GB or higher)
DATA TIER**	2 x Intel SSD DC P4610 Series (1.6 TB or higher)
DATA NETWORK**	10Gb Intel® Ethernet Converged Network Adapter X710-DA2/DA4 (Intel® Ethernet CNA X710-DA2/DA4)
MANAGEMENT NETWORK PER NODE	Integrated 1 gigabit Ethernet (GbE) or better
NETWORK SWITCHES	
TOP-OF-RACK (ToR) SWITCH	10 gigabits per second (Gbps) 48x port switch**
MANAGEMENT SWITCH	1 Gbps 48x port switch**
SOFTWARE	
FABRIC SOFTWARE	Intel® Omni-Path Fabric (Intel® OP Fabric) software version 10.7.0.0.145 or later
LINUX* OS	Ubuntu* 16.04.5
HYPERLEDGER FABRIC SDK	1.4.0 or later
DOCKER*	18.x
DOCKER COMPOSE*	1.22.x
NODE.JS*	8.x or later
APPLIES TO ALL NODES	
TRUSTED PLATFORM MODULE (TPM)	TPM 1.2 discrete or firmware TPM (Intel® Platform Trust Technology [Intel® PTT])
FIRMWARE AND SOFTWARE OPTIMIZATIONS	Intel® Volume Management Device (Intel® VMD) enabled** Intel® Boot Guard enabled Intel® Trusted Execution Technology (Intel® TXT) enabled
MINIMUM PERFORMANCE STANDARDS Verified to meet or exceed the following minimum performance capabilities):[3]	
	Results of benchmark testing with Hyperledger Caliper* (using Simple* and Smallbank* workloads over one hour): throughput of 715 transactions per second (TPS), with an input of 1,400 TPS[3]

**Recommended, not required

Technology Selections for Intel Select Solutions for Blockchain: Hyperledger Fabric

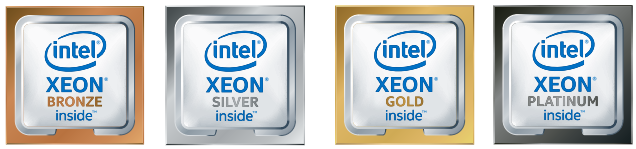
In addition to the Intel® hardware foundation used for Intel Select Solutions for Blockchain: Hyperledger Fabric, Intel technologies integrated in Intel Xeon Scalable processors deliver further performance and reliability gains:

- **Intel® Volume Management Device (Intel® VMD):** Enables hot-swap replacement of NVM Express* (NVMe*) SSDs from the PCIe* bus without shutting down the system, while standardized LED management helps provide much faster identification of SSD status. This standardization brings enterprise reliability, availability, and serviceability (RAS) features to NVMe SSDs, enabling you to deploy next-generation storage with confidence. IT professionals can now service these drives online without an outage, which minimizes interruptions and improves uptime and serviceability. The unique value of Intel VMD is that Intel is sharing this technology across the ecosystem for broad enablement.
- **Intel® Virtual RAID on CPU (Intel® VROC):** Delivers excellent performance and low power/TCO. Intel VROC supports full-featured RAID levels 0, 1, 5, and 10, and it is a host bus adapter (HBA)-less RAID solution.
- **Intel® QuickAssist Technology (Intel® QAT):** An offload engine to accelerate some critical workloads such as bulk cryptography, public key exchange, and data compression on Intel architecture–based platforms. Intel QAT on Intel Xeon Scalable processors offers outstanding capabilities: up to 100 gigabits per second (Gbps) encryption, 100 Gbps compression, and 100,000 decryption operations per second using a 2,084-bit RSA key.
- **Internet Wide Area Remote Protocol (iWARP) Remote Direct Memory Access (RDMA):** A host-offload, host-bypass technology that enables a security-enabled direct memory-to-memory data communication between two applications across a network. iWARP RDMA can make use of current Ethernet infrastructure without lossless network support. It also provides flow control and congestion management, and it is highly scalable.
- **Intel® Platform Trust Technology (Intel® PTT):** Root of trust with full Trusted Platform Module (TPM) 1.2 functionality integrated into platform firmware. The new Intel PTT feature is available as an option versus a discrete chip to simplify integration and activation.
- **Intel® Boot Guard:** Hardware-based boot-integrity protection that prevents unauthorized software and malware takeover of boot blocks critical to a system's function, thus providing an added level of platform security based on hardware.
- **Intel TXT:** Provides the foundation for highly scalable platform security in physical and virtual infrastructures. Intel TXT helps harden servers at the lowest level against threats of hypervisor, BIOS, or other firmware attacks, malicious rootkit installations, and other types of attacks or misconfiguration to firmware and operating systems.

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 monitoring



- **Intel® Hyper-Threading Technology (Intel® HT Technology):** Enables multiple threads to run on each core, which helps ensure that systems use processor resources more efficiently. Intel HT Technology also increases processor throughput, improving overall performance on threaded software.
- **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.

Deploy an Enterprise-Ready Blockchain Solution with Intel Select Solutions for Blockchain: Hyperledger Fabric

Intel Select Solutions provide a fast path to data center transformation with workload-optimized configurations verified for Intel Xeon Scalable processors. When organizations choose Intel Select Solutions for Blockchain: Hyperledger Fabric, they get pre-tuned and tested configurations that are workload-optimized and proven to scale so that IT can deploy blockchain solutions quickly and efficiently with less tuning.

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

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 Ethernet 700 Series: **intel.com/ethernet**

Intel Select Solutions are supported by Intel® Builders: **http://builders.intel.com**. Follow us on Twitter: **#IntelBuilders**

Intel and Blockchain: **intel.com/content/www/us/en/security/blockchain-overview.html**

Hyperledger: **hyperledger.org**

[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, XLPPI/CR4, 25G-CA/25G-SR/25G-LR), twisted-pair copper (1000BASE-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] Intel internal testing as of May 7, 2019. Configuration: 1 node with 2 x Intel® Xeon® Gold 5217 processor; DDR4 96 GB DRAM (12 x 8 GB at 2,666 MHz DDR4 RDIMMS) 1DC; 1 x boot drive: 240 GB Intel® SSD DC S4510; storage: 2 x 1.6 TB Intel SSD DC P4610 Series; 1 x onboard Intel® Ethernet Network Adapter; OS/software: Ubuntu* 16.04.5; Hyperledger Fabric* SDK v1.4.0; Docker* 18.09; Docker Compose* 1.22.0, Node.JS* v8.14.1.

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.

Optimization Notice: 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. Notice Revision #20110804

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