

Intel® Select Solutions for NFVI Ubuntu* Configurations

The Intel® Select Solutions for NFVI reference designs provide a roadmap to building optimized, next-generation network functions virtualization infrastructure (NFVI) servers powered by the Intel® Xeon® Scalable processors.



Introduction

Through Intel's engagement with the Intel® Network Builders ecosystem—and work with standards bodies and open source organizations—Intel® Xeon® processors have been successfully used by many ecosystem partners to power their network functions virtualization (NFV) solutions. In Intel Network Builders alone, there are more than 300 partners that utilize Intel Xeon processors to provide infrastructure or to power workloads. Intel has worked closely with many of these companies and has gained extensive experience that it has used to identify the optimal server hardware configurations and open source software stacks for NFV workloads.

Intel has developed Intel® Select Solutions for NFVI reference designs that combine this industry expertise with the performance of Intel Xeon Scalable processors. Intel Select Solutions for NFVI reference designs address the complexity that ecosystem partners face in choosing the right infrastructure, helping to accelerate NFV deployments.

With the Intel Select Solutions for NFVI, ecosystem partners can deliver workload-optimized server solutions to communication service provider (CommSP) customers that lessen the time, effort, and expense involved with evaluating hardware and software integrations for NFV-based service development and deployment.

What are Intel® Select Solutions?

Intel® Select Solutions are verified hardware and software stacks that are optimized for specific software workloads across compute, storage, and network. The solutions are developed from deep Intel experience with ISV and OEM/ODM industry partners, as well as extensive collaboration with the world's leading data center and service providers.

To qualify as an Intel Select Solution, solution providers must:

1. Follow the software and hardware stack requirements outlined by Intel
2. Replicate or exceed Intel's reference benchmark-performance threshold
3. Publish a detailed implementation guide to facilitate customer deployment

Solution providers can develop their own optimizations to add further value to the solutions.

Intel Select Solutions for NFVI Reference Designs

There are two Intel Select Solutions for NFVI platforms, each designed for specific use cases.

- Intel Select Solution for NFVI base configuration – This reference design is based on the Intel Xeon Gold 6138T processor, which is designed for high Tcase and extended reliability. It specifies network, storage, and add-in platform acceleration products from Intel for carrier-class use cases, which require longer life and higher reliability than standard server use cases.
- Intel Select Solution for NFVI plus configuration – This reference design is based on the high-performance Intel Xeon Gold 6152 processor. It is designed to maximize virtual machine density, supporting many simultaneous applications. The plus configuration provides one example of how system builders, system integrators, and solution and service providers can further optimize these reference designs to achieve higher performance and capability.

The high-performance CPUs, balanced I/O, and on-board acceleration with Intel® QuickAssist Technology, combined with optimizations through DPDK, allow for the achievement of exceptional throughput and latency performance. These technologies improve data and control plane throughput, latency, and jitter performance, and allow virtual network functions (VNFs) to meet their performance requirements. The specification offers a configuration that improves performance for three primary data flows:

- Packet-based network traffic
- Data storage
- Crypto/compression acceleration

Verified Performance Through Benchmark Testing

All Intel Select Solutions are verified by Intel to meet a specified minimum level of workload-optimized performance capability. Verified Intel Select Solutions for NFVI meet or exceed design and testing standards for data throughput and specialized security, encryption and compression performance that are essential in NFVI use cases. There are four key testing standards that are specified for Intel Select Solutions for NFVI:

Intel® QuickAssist Technology: Intel® QAT establishes stringent performance standards for bulk crypto performance across a range of NFVI use cases and applications running simultaneously. This benchmark tests both compression and encryption algorithms measured with typical packet sizes.

OpenSSL Performance: In addition to the bulk crypto performance, Intel® Select Solutions for NFVI compliant with the plus configuration must demonstrate a minimum OpenSSL throughput and sign operations performance requirements as measured by executing OpenSSL Speed Benchmark testing.

Packet Processing Performance: High data plane throughput is very important for all Intel® Select Solutions for NFVI, and achieving it requires implementing the open source Data Plane Development Kit (DPDK) to optimize performance. This performance is demonstrated using the DPDK L3 Forwarding sample application.

NGINX: NGINX provides valuable packet services, and Intel® NFVI Select Solutions for NFVI with Ubuntu* Host OS that are compliant with the plus configuration must demonstrate a minimum connections per second (CPS) performance.

Table 1 shows the minimum performance standards for both the base and plus configurations.

MINIMUM PERFORMANCE STANDARDS		BASE CONFIGURATION ¹	PLUS CONFIGURATION ²
	Compression (compress and verify) throughput ³	24 Gbps	50 Gb/s
Intel® QAT Performance	Encryption throughput ⁴	40 Gb/s	100 Gb/s
	RSA throughput ⁵	40 K Ops/s	100 K Ops/s
OpenSSL Performance	OpenSSL throughput ⁵	40 K signs/s	100 K signs/s
Packet Processing Performance using DPDK L3fwd RFC2544 zero packet loss test	2 x Dual Port 10 GbE	90% line rate with packet size 256B	Not applicable
	2 x Dual Port 25 GbE	90% line rate with packet size 256B	90% line rate with packet size 256B
	2 x Dual Port 40 GbE	Not applicable	60% line rate with packet size 256B ⁶

NGINX	NGINX Stack Utilizing Intel QAT Engine and OpenSSL 1.1.0 (HTTPS connections per second throughput)	Not applicable	80,000 connections per second
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Business Value of the Plus Configuration

2.5 times increase in Intel® QAT, OpenSSL, and DPDK throughput

Table 1. Minimum performance standards for Intel Select Solutions for NFVI with Ubuntu*. System builders, system integrators, and solution and service providers can further optimize the reference designs to achieve higher performance and capability.

Board Design Configurations

The two CPU socket, 1RU or 2RU Intel Select Solutions for NFVI server board designs build on a standard server design by adding a symmetric I/O design. The symmetric design provides balanced I/O partitioning that facilitates discovery and provisioning of networking, storage, and other peripherals, as well as improved performance and management of those peripherals.

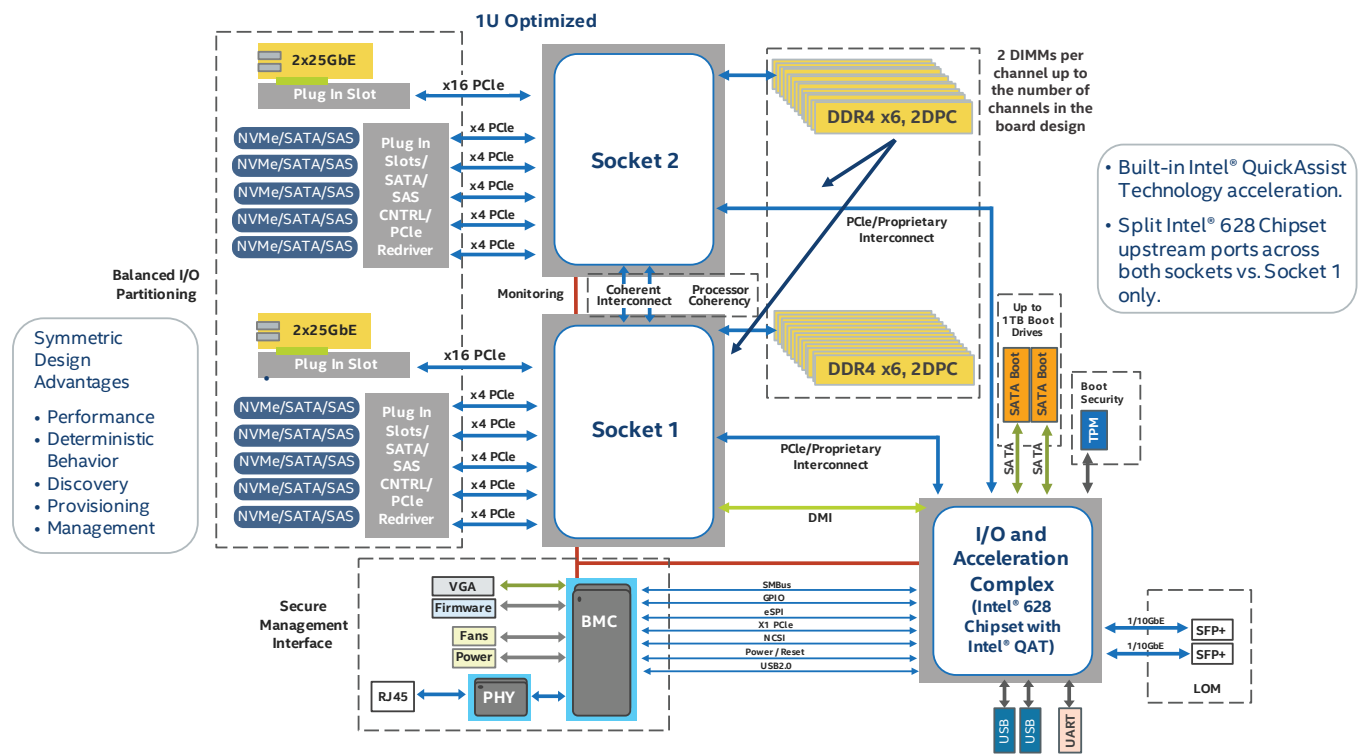


Figure 1. An example hardware design of an Intel Select Solution for NFVI shows symmetric design advantages and dual-CPU socket access to Intel QuickAssist Technology (Intel QAT) resources.

Because encryption/decryption and compression processes are more prevalent in NFV applications, the board design also provides expanded access to acceleration resources. As seen in Figure 1, there are two PCIe*/Proprietary connections between the CPUs and the I/O and Acceleration Complex, which is composed of one of several Intel QuickAssist Technology (Intel QAT)-enabled chipset options. The connections give both CPUs access to accelerated encryption/decryption and compression processes provided by Intel QAT.



Providing dual-CPU socket access to the Intel QAT-enabled chipsets allows workloads running on either CPU to have direct access to Intel QAT or network or storage resources. Thus, a workload can use memory local to its NUMA node, as well as have direct access to acceleration, storage, and network resources. If the workload is a VNF, this in turn simplifies the task of instantiating a VNF on an NFVI for optimal deterministic performance.

	INTEL® SELECT SOLUTION FOR NFVI BASE CONFIGURATION HARDWARE	INTEL® SELECT SOLUTION FOR NFVI PLUS CONFIGURATION HARDWARE
PROCESSOR	2 x Intel® Xeon® Gold 6138 processor @ 2.0 GHz 20C/40T, or higher number SKU	2 x Intel® Xeon® Gold 6152 processor @ 2.1 GHz 22C/44T, or higher number SKU
MEMORY	384 GB (12 x 32 GB 2666 MHz 288-pin DDR4 RDIMM)	384 GB (12 x 32 GB 2666 MHz 288-pin DDR4 RDIMM)
MEMORY CONFIGURATION	Balanced memory configuration to maximize performance	Balanced memory configuration to maximize performance
NICS	2 x Intel® Ethernet Network Adapter XXV710-DA2 @ 25 GbE, SFP28+, or 2 x Intel® Ethernet Converged Network Adapter X710-DA2 @10 GbE, or 2 x Intel® Ethernet Server Adapter X520-DA2 @ 10 GbE	2 x Intel® Ethernet Network Adapter XXV710-DA2 @ 25 GbE, SFP28+, or 2 x Intel® Ethernet Converged Network Adapter XL710-DA2 @ 40 GbE, QSFP+
INTEL® QAT	Intel® QuickAssist Adapter 8960 (PCIe) add in card (AIC) or higher SKU, or Intel® C627 Chipset or higher SKU with Intel® QAT enabled	Intel® C627 Chipset or higher SKU with Intel® QAT enabled with minimum PCIe x16 uplink
STORAGE	2 x Intel® SSD Data Center P4510 Series @ 2.0 TB or larger, symmetrically attached to both CPU sockets	4 x Intel® SSD Data Center P4510 Series @ 2.0 TB or larger, symmetrically attached to both CPU sockets
BOOT DRIVE	2 x Intel® SSD Data Center S3320 Series @ 480 GB or equivalent Intel® SSD	2 x Intel® SSD Data Center S3320 @ 480 GB or equivalent Intel® SSD

Table 2. Example hardware configuration for Intel Select Solution for NFVI with Ubuntu base configuration and Intel Select Solution for NFVI with Ubuntu plus configuration server boards.

Software and Firmware Stack

To ensure consistent performance, firmware, operating systems, drivers, hypervisors, and other software components for Intel Select Solutions are specified in the reference design and must be verified together to guarantee proper operation.

Operating systems are the foundation of the software stack and this solution integrates Ubuntu Linux* for its host operating system. CommSPs can integrate OpenStack* and Open vSwitch* on top of this stack if needed.

An example instantiation of the reference design software stack is described in Table 3. Intel drives this firmware and software through a continuous validation process to ensure that software updates will perform correctly when integrated into a deployed system. The components of the software stack are subject to change.

The Intel® Xeon® Scalable Processors

Intel Xeon Scalable processors are the future-forward infrastructure platform for agile digital services. This processor family offers:

- High scalability for cloud-optimized and 5G-capable communications networks
- Exceptional processing of encryption algorithms and acceleration for compression and other key workloads
- Performance and efficiency to allow convergence of key communications workloads such as applications and services, control plane, packet, and signal processing



	INGREDIENT	SW NAME AND VERSION DETAILS		
FIRMWARE	BIOS		SE5C620.86B.0X.01.0117 or later	
	BMC		1.43.660a4315 or later ⁷	
	MCU		0x43	
	Firmware for Intel® Ethernet Controller XXV710		FVL25GFW: v6.02	
	Firmware for Intel® Ethernet Server Adapter X520-DA		FVL25G_DDP: GTPv1	
HOST	Development Kit	DPDK	18.02	
	OS	Ubuntu*	Ubuntu 16.04.3 (kernel 4.4.0-116-generic)	
	Hypervisor	KVM/QEMU*	2.5.0	
	Libvirt	Libvirt*	1.3.1	
	Drivers	Intel® QAT		Intel® QAT R4.1
		i40e		2.4.6
		ixgbe		5.3.6
GUEST	Development Kit	DPDK	18.02	
	OS	Ubuntu		14.04 LTS ⁷
		CentOS*		CentOS 7.2 (kernel 3.10.0-327.1.el7) ⁷
		Red Hat* Enterprise Linux*		RHEL 7.4 (kernel 3.10.0-693.11.6.el7.x86_64) ⁷
	Drivers	i40evf		3.4.2
ixgbev			4.3.4	

Table 3. An example software stack for the Intel Select Solutions for NFVI with Ubuntu. (With ongoing testing and optimization collaboration, version levels and components are subject to change over time.)

Conclusion

Intel has a significant legacy in the market for NFV solutions, and the company is building on that by offering the Intel Select Solutions for NFVI reference design for next-generation NFV services. The value of the Intel Select Solutions for NFVI is to provide NFV solution providers with a reference design to build on top of high-performance Intel Xeon Scalable processors and a customized software stack, which creates a roadmap to workload-optimized NFVI servers. With these reference designs, server manufacturers can get to market more quickly with a value-added solution for their CommSP customers. For more information on the Intel Select Solutions for NFVI, visit the Intel Select Solutions page on the Intel Network Builders website: <http://builders.intel.com/intelselectsolutions>.

Learn More

Intel Select Solutions web page: intel.com/selectsolutions

Intel Xeon Scalable processors: intel.com/xeonscalable

Intel Select Solutions are supported by the Intel Builders Program: <https://builders.intel.com>



¹ Testing conducted by Intel on Aug. 12, 2018, with the following hardware and software configurations: 1 Node, 2x Intel® Xeon® Gold 6138; 1x Intel® Server Board S2600WFT, Intel® C628 Series Chipset; Total Memory 384 GB, 24 slots/32 GB/2666 MT/s DDR4 RDIMM; HyperThreading: Enable; Turbo: Enable; Storage(boot): 2X 480 GB Intel® SSD SATA; Storage(capacity): 2x 2TB Intel® SSD DC P4500 PCIe NVME; Network devices: 2x Dual port Intel® Ethernet Converged Network Adapter XXV710 SFP28; Network speed: 25 GbE; ucode: 0x2000049; OS/Software: FusionSphere 6.3 (kernel 3.10.0-514.44.5.10_44.x86_64).

² Testing conducted by Intel on Aug. 12, 2018, with the following hardware and software configurations: 1 Node, 2x Intel® Xeon® Gold 6152; 1x Intel® Server Board S2600WFT, Intel® C628 Series Chipset; Total Memory 384 GB, 24 slots/32 GB/2666 MT/s DDR4 RDIMM; HyperThreading: Enable; Turbo: Enable; Storage(boot): 2X 480 GB Intel® SSD SATA; Storage(capacity): 4x 2TB Intel® SSD DC P4500 PCIe NVME; Network devices: 4x Dual port Intel® Ethernet Converged Network Adapter XXV710 SFP28; Network speed: 25 GbE; ucode: 0x2000049; OS/Software: FusionSphere 6.3 (kernel 3.10.0-514.44.5.10_44.x86_64).

³ Performance to be measured at 8 KB packet size

⁴ Performance to be measured at 4 KB packet size

⁵ Performance to be measured at 2 KB packet size.

⁶ The Intel® Ethernet Converged Network Adapter XL710 is a 40 GbE controller. The 2 x 40 GbE adapter using this controller is not intended to be a 2 x 40 GbE but a 1 x 40 GbE with an active back-up port. When attempting to use line-rate traffic involving both ports, the internal switch is saturated and the combined bandwidth between the two ports are limited to a total of 50 Gb/s.

⁷ Recommended, not required.

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 www.intel.com/benchmarks.

Performance results are based on testing as of Aug. 12, 2018, and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure.

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