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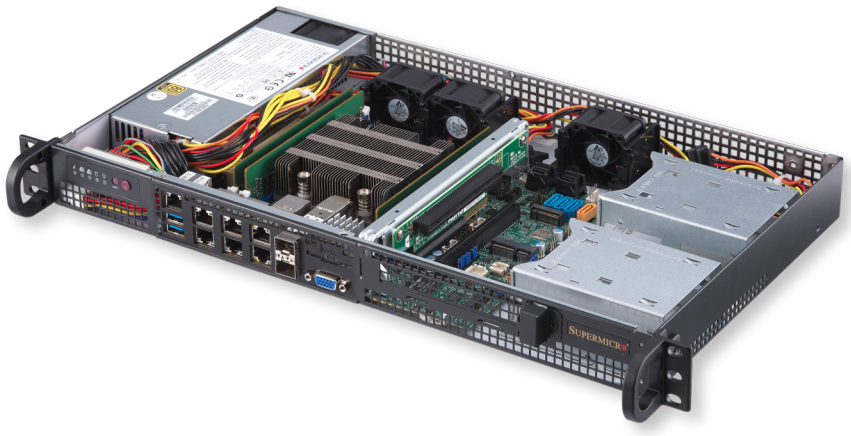
White Paper

Ready to Deploy SD-WAN and uCPE Solutions Based on Supermicro SuperServer 5019D Featuring Intel® Xeon® Processor D-2100 Product Family

Benchmarks and Proof of Concepts with Deep Packet Inspection (DPI) and Internet Protocol Security (IPsec) Use Cases

Supermicro introduces optimized solutions for SD-WAN, uCPE and Virtual Edge Networking applications featuring Intel® Xeon® processor D-2100 product family. Data



Plane Performance numbers are shown for compute intensive use cases such as DPI (Deep Packet Inspection) and IPsec (Internet Protocol Security).

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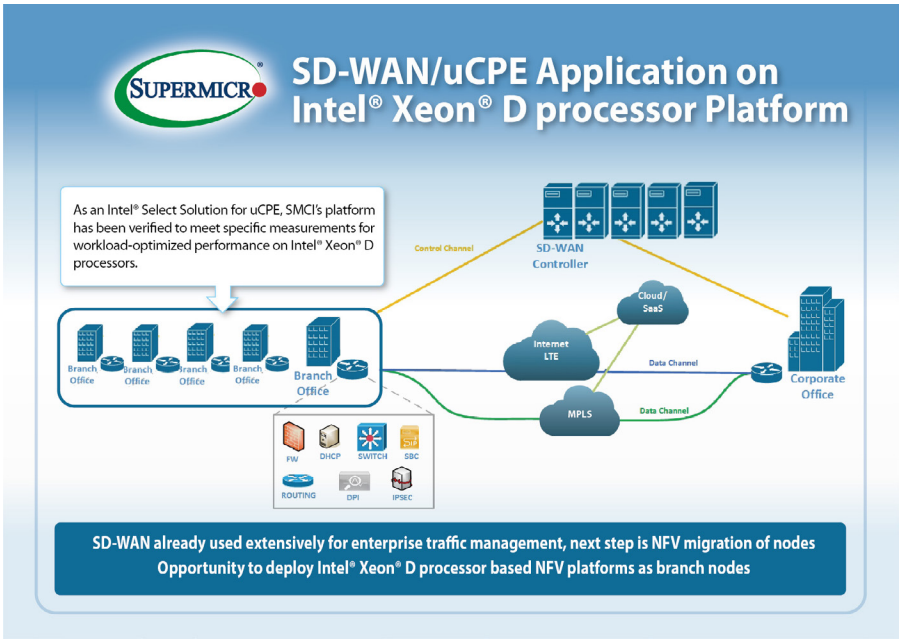
Executive Summary

Communications Services Providers (SPs) are increasingly investing in Software Defined Wide Area Network (SD-WAN) solutions with software-defined networking (SDN) technologies that are open and flexible, allowing software abstraction over industry standard Intel® architecture-based server hardware. Additionally, these solutions can enable network virtualization using virtual network functions (VNF). SDN innovations provide significant competitive advantages to SPs, especially when leveraging the broad portfolio of hardware solutions from Supermicro.

Supermicro (an Intel® Network Builders ecosystem member) introduces a range of compact server based virtual Customer Premises Equipment (vCPE) solutions supporting the latest 14nm Intel Xeon processors D-2100. Performance characteristics discussed here are based on the Supermicro SuperServer 5019D-FN8TP.

SPs employing Supermicro optimized solutions can most effectively provide flexible and cost effective solutions for edge appliances, while delivering line rate performance for DPI and IPsec packet processing and routing for variable packet sizes including encryption and decryption.



Intel Xeon Processor D-2100

The new Intel Xeon processor D-2100 delivers Intel's most transformative and ground-breaking data center processor architecture in a form factor optimized for flexible, scalable, high-density network, storage, and cloud edge solutions.

It brings the architectural innovations of the Intel Xeon Scalable processors to a system-on-a-chip (SoC) for lower-power, high-density solutions, integrating essential network, security, and acceleration capabilities.

A software-programmable platform featuring robust virtualization support, with low latency, high-bandwidth capabilities through a flexible design, for a variety of solution and service deployments in space and power constrained environments. Design innovation delivers seamless solution scalability from the data center to the network edge.

Introducing Supermicro SYS-5019D-FN8TP

The Supermicro SYS-5019D-FN8TP is a small 1U short-depth rackmount front I/O server solution featuring Intel® Xeon® processor D-2146NT (8-Core, 80W) supporting Intel® QuickAssist Technology (Intel® QAT) that enables 40Gbps crypto/compression rate in hardware. It supports 1x 3.5" or 4x 2.5" internal drive bays, up to 512GB DDR4 ECC memory, 1 PCI-E 3.0 x8 slot, 2 M.2 slots for SSDs, 1 Mini-PCI-E slot with mSATA support, 1 TPM 2.0 header, 2x 10GBase-T, 2x 10G SFP+, 4 GbE ports, and a dedicated IPMI LAN port.

For experimentation and proof of concept, Supermicro along with Intel Labs utilized the 8-core Intel Xeon D processor supporting Intel QAT as part of our testbench configuration to demonstrate that these platforms would meet and exceed the performance need for a small branch office SD-WAN application. The PoC was benchmarked for chained DPI and IPsec encryption/decrypting with variable packet sizes. Specifically, three tests were conducted that are discussed in detail in the following paragraphs:

SYS-E300-9D / SYS-E300-9D-4CN8TP / SYS-E300-9D-8CN8TP

- Network Appliance & Security, Embedded IoT Computing / NFV,
- SD-WAN and vCPE / uCPE, Hyper Converged Infrastructure
- Powerful in compact Box with high density design
- Plenty of M.2 selections for 4CN8TP/8CN8TP (M.2 M-Key for SSD in 2242/80, B-Key for SSD, WAN and 4G-TLE in 2242)
- 8CN8TP with embedded QAT support
- 1 PCIe3.0 x8 expansion for AOC
- Onboard TPM Header, IPMI with OOB support
- Up to 512GB DDR4 ECC LRDIMM
- Up to 256GB DDR4 ECC/non-ECC RDIMM

The first test shows Open vSwitch acceleration by a multi-core processor. Developers can reference these results and select the appropriate price/performance configuration according to their usage model.

The second test shows a comparison of Intel QuickAssist Technology (Intel QAT) and Intel® Advanced Encryption Standard New Instructions (Intel® AES-NI). Intel QAT improves performance across applications and platforms. Besides, Intel AES-NI is a new encryption instruction set that improves on the Advanced Encryption Standard (AES) algorithm and accelerates the encryption of data in the Intel Xeon processor family.

In summary, Intel QAT crypto accelerator engine almost doubles the performance when compared to Intel AES-NI in the same hardware configuration.

The last test compares the performance between assigning 1 core and 2 cores to Intel AES-NI. A developer can reference the performance results and optimize their configurations accordingly.

Test Configuration

To conduct the performance tests, two Supermicro SYS-5019D-FN8TP systems were used. Both devices under test (DUTs) utilized 8-core Intel Xeon processors D-2146NT that were configured per the configuration in following section.

Performance Benchmarks

Figure 1 below shows the topology of the first test configuration. This test simulates Internet activities using the PROX packet generator. PROX generates IP packets and sends/receives these packets via physical ports. When packets reach the system, the OvS (Open vSwitch) will forward them to a nDPI VNF (Virtual Network Function). The packets will then be forwarded to an IPsec VNF continually and then be encrypted and routed to the next DUT. Finally, the packets are transferred back to PROX after the decryption. Three testbenches were developed based on this architecture.

SYS-1019DFHN13TP

- Multi-Access Edge Computing (MEC), C-RAN (vRAN), uCPE
- AI on Edge, Deep Learning, Advance Network Security
- GPU supported
- DDR4 2667MHz up to 512GB ECC LRDIMM, or 256GB ECC/ non ECC RDIMM
- 2x 10GbE, 2x SFP+, 9x GbE (one for management), 1x dedicated IPMI LAN, 1x COM via RJ45
- 2x USB 3.0, 4x 2.5" SATA3 drive bays (2 hot swap, 2 internal)
- 2x PCIe3.0 x16 slots, 1x M.2 M-Key 2280/110, 1x M.2 B-Key 3042, 1x M.2 E-Key

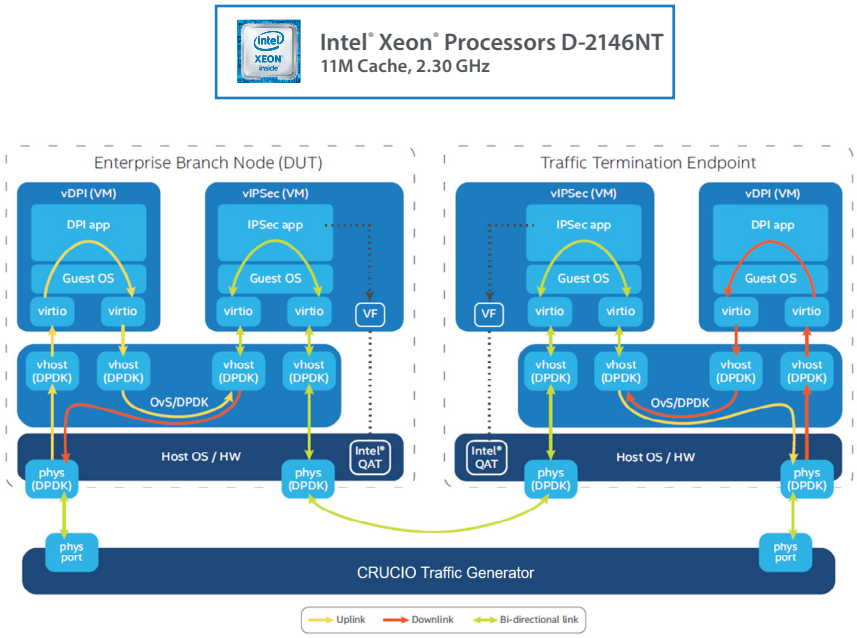


Figure 1. *SD-WAN Topology*

OvS is an open source multilayer virtual switch that is accelerated by DPDK (Data Plane Development Kit), which accelerates packet processing workloads running on a wide variety of CPU architectures. The DPDK implements a low overhead run-to-completion model for fast data plane performance and accesses devices via polling to eliminate the performance overhead of interrupt processing.

Test 1:CPU Core Assignment

Configuration	6-Core	4-Core
Host OS	Core 0	Core 0
Hypervisor (KVM/Qemu)	Core 0	Core 0
OVS Mgmt Threads	Core 0	Core 0
OVS DPDK PMD	Core 1 Core 2 Core 3	Core 1
DPI VNF (vCPU threads)	Core 0 (vCPU 0) Core 4 (vCPU 1)	Core 0 (vCPU 0) Core 2 (vCPU 1)
IPsec VNF (vCPU threads)	Core 0 (vCPU 0) Core 5 (vCPU 1)	Core 0 (vCPU 0) Core 3 (vCPU 1)

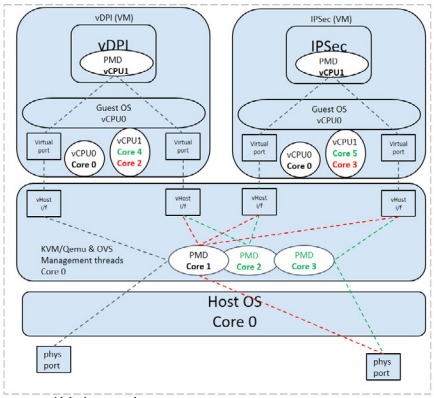


Figure 2. *CPU Core Assignment for the 1st Test*

SYS-1019DFRN5TP

- Application: Cloud Radio Access Network (cRAN), uCPE, SD-WAN
- Network Function Virtualization (NFV), Network Appliance
- Redundant 400W AC-DC power supply
- DDR4 2667MHz up to 512GB ECC LRDIMM, or 256GB ECC/ non ECC RDIMM
- 2x USB3.0, 1x USB2.0 (Type A), 2x console (via RJ45 and microUSB)
- 4x PCIe3.0 x8 SIOM slot2, 4x M.2 (two M key, one B key, and one E key), 2x SATA3 2.5" Drive Bays, 2 x EDSFF

Figure 3 shows the performance which was impacted from the number of OvS processors. Intel Xeon processors D-2146NT 4 cores vs 6 cores Intel QAT with 100/500/1000/2000 flows was tested, with the same configuration of VNF and NFV infrastructure: 1 core for the nDPI, 1 core for the IPsec VNF and 1 core for host OS, NFV infrastructure was configured. The different point is the arrangement for OvS (1 cores / 3 cores). Figures 2 & 3 show the CPU core assignment and the test results.

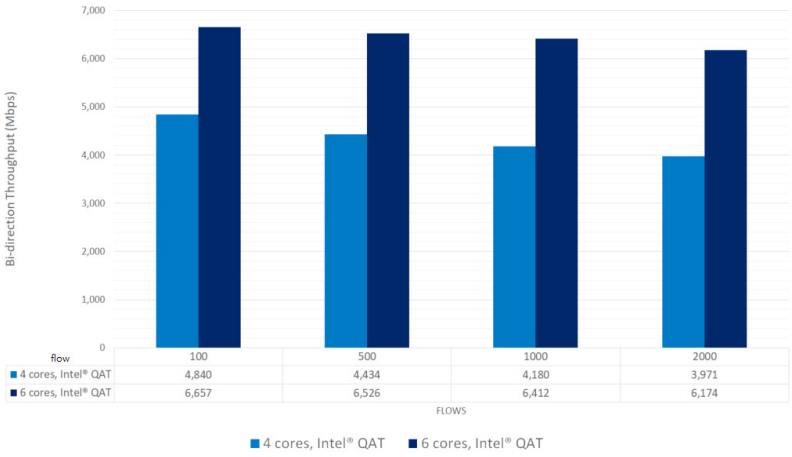


Figure 3. *SD-WAN performance of Intel® QAT*

The second test shows the encryption performance between Intel QAT and Intel AES-NI. Intel QAT is an encryption/decryption hardware engine built-in to the Intel Xeon D processor. Compared to Intel AES-NI, Intel QAT can accelerate most computational intensive cryptography tasks and frees up CPU resources for application workloads. These tests are based on the same hardware configuration with 6 core processors and shows the performance gap between Intel QAT and Intel AES-NI. Figure 4 shows the test result and CPU configuration is the same with Test 1 6-Core.

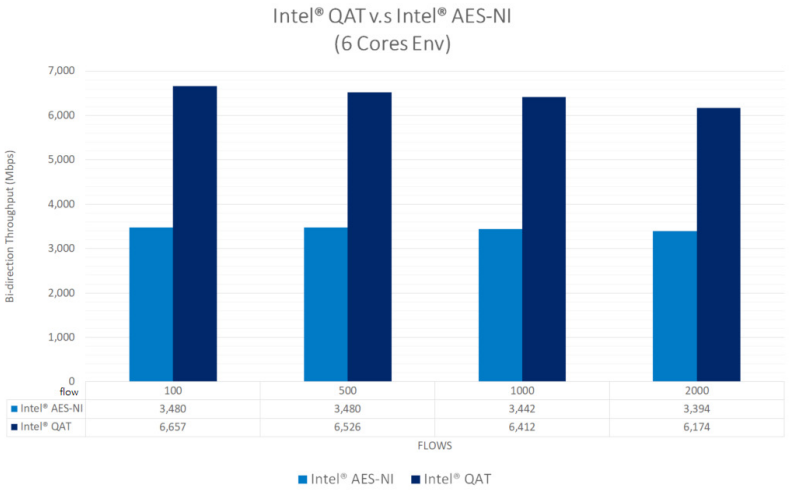


Figure 4. *Intel® QAT vs Intel® AES-NI*

Although Intel QAT improves performance significantly, users might still face some resource limitations of hardware. This section investigates if a system has surplus computing resources. To simulate this condition, we assigned one more core for IPsec VNF and Intel AES-NI, for a total 2 cores that were dedicated for IPsec VNF / Intel AES-NI. Figure 5 shows the CPU core assignment for Test 3.

SYS-1019D-FRN8TP

- Built in Intel QAT up to 40Gbps Crypto/Compression
- Network Security Appliance, FireWall Applications,
- Virtualization, SD-WAN and vCPE / uCPE
- 400W Platinum Redundant power supply
- DDR4-2666MHz, 512GB LRDIMM or 256GB Registered ECC RDIMM in 4 DIMM slots
- 1 M.2 M key for SSD, 2242/8; B Key for SSD/ WAN card

Test 3:CPU Core Assignment

Configuration	6-Core	7-Core
Host OS	Core 0	Core 0
Hypervisor (KVM/Qemu)	Core 0	Core 0
OVS Mgmt Threads	Core 0	Core 0
OVS DPDK PMD	Core 1 Core 2 Core 3	Core 1 Core 2 Core 3
DPI VNF (vCPU threads)	Core 0 (vCPU 0) Core 4 (vCPU 1)	Core 0 (vCPU 0) Core 4 (vCPU 1)
IPsec VNF (vCPU threads)	Core 0 (vCPU 0) Core 5 (vCPU 1)	Core 0 (vCPU 0) Core 5 (vCPU 1) Core 6 (vCPU 2)

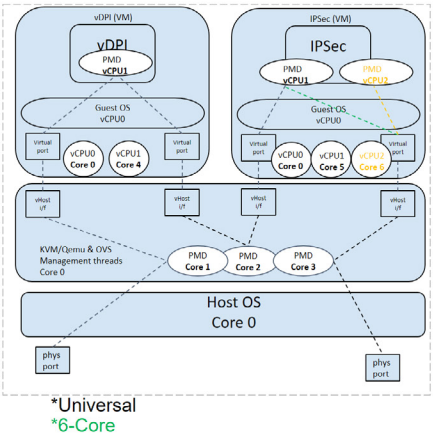


Figure 5. *CPU Core Assignment for the 3rd Test*

Figure 6 shows the performance improvements with 2 cores dedicated to Intel AES-NI, resulting in almost doubled the performance compared to the single core configuration.

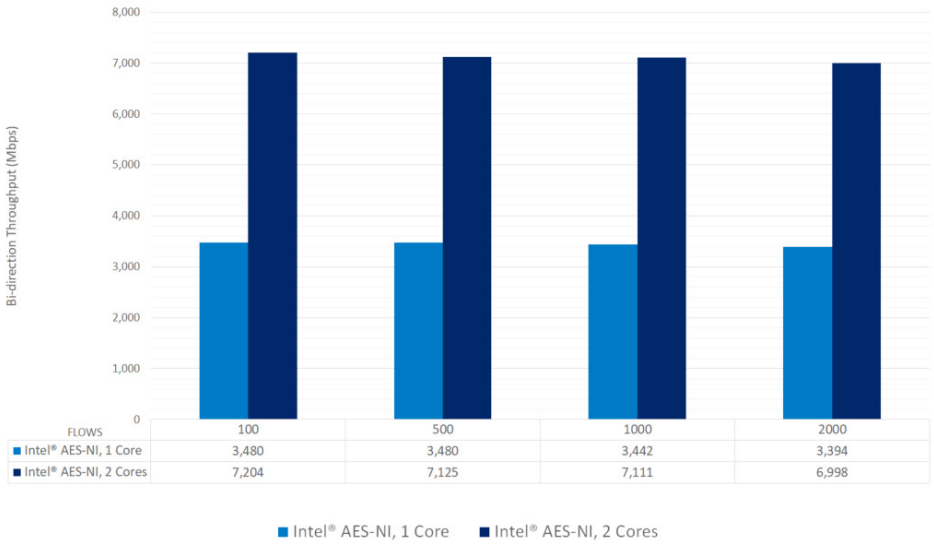


Figure 6. *Intel® AES-NI 1-core vs 2-core*

For More Information

- Supermicro® Embedded - Optimized SuperServer® Solutions www.supermicro.com/products/embedded/embedded_server.cfm

Conclusion

Supermicro provides a wide range of server platforms featuring Intel Xeon D processors (2-16 cores) hyper-threaded SoCs with optional Intel QAT and Intel AES-NI support. Supermicro SuperServers provide compact, flexible, expandable and low power, low decibel operation in 1U rackmount and mini tower form factors. These highly flexible platforms not only allow developers to choose Intel QAT support, and also have the option to configure CPU core affinity for Intel AES-NI to reach optimal application performance.

In this paper, we have demonstrated significant DPI and IPsec performance improvements on Supermicro SuperServer platforms optimized for uCPE and SD-WAN applications.

Server Model		SYS-5019D-FN8TP	SYS-1019D-FRN8TP	SYS-1019D-FRN5TP	SYS-1019D-FHN13TP	SYS-E300-9D-8CN8TP	SYS-E300-9D-4CN8TP	SYS-E300-9D
								
Processor	Cores	Intel® Xeon® SoC D-2146NT, 8C/16T	Intel® Xeon® SoC D-2146NT, 8C/16T	Intel® Xeon® SoC D-2146NT, 8C/16T	Intel® Xeon® SoC D-2146NT, 8C/16T	Intel® Xeon® SoC D-2146NT, 8C/16T	Intel® Xeon® SoC D-2123IT, 4C/8T	Intel® Xeon® SoC D-2123IT, 4C/8T
	Intel® QAT	40Gbps	40Gbps	40Gbps	40Gbps	40Gbps	N/A	N/A
	Intel® AES-NI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Onboard Networking	10G SFP+	2	2	2	2	2	2	N/A
	10G RJ45	2	2	1	2	2	2	2
	1G RJ45	4	4	1	9	4	4	N/A
	IPMI	1G RJ45 dedicated	1G RJ45 dedicated	10G RJ45 shared	1G RJ45 dedicated	1G RJ45 dedicated	1G RJ45 dedicated	1G RJ45 dedicated
Expansion Module		1x PCI-E 3.0 x8 w/ Full Height	1 x PCI-E 3.0 x8 w/ Full Height	4 Modules, up to 32x 1G RJ45 LAN ports	2 x PCI-E 3.0 x 16	1 x PCI-E 3.0 x8 w/Low profile	1 x PCI-E 3.0 x8 w/Low profile	1 x PCI-E 3.0 x8 w/Low profile
Storage Module	2.5" drive bays	4 internal	4 internal	4 internal	2 internal 2 hot-swap	2 internal	2 internal	2 internal
	M.2 M-Key slots	1	1	2 M.2 slots 2 EDSFF for NVMe	1	1	1	N/A
Wireless Networking	M.2 (B-key)	1	1	1	1	1	1	N/A
	Mini-PCI-E w/mSATA	1	1	1 M.2 E Key for WiFi	1 M.2 E Key for WiFi	1	1	N/A
Form Factor		1U RM	1U RM	1U RM	1U RM	1U Box	1U Box	1U Box

About Super Micro Computer, Inc.

Supermicro® (NASDAQ: SMCI), the leading innovator in high-performance, high-efficiency server technology is a premier provider of advanced server Building Block Solutions® for Data Center, Cloud Computing, Enterprise IT, Hadoop/Big Data, HPC and Embedded Systems worldwide. Supermicro is committed to protecting the environment through its "We Keep IT Green®" initiative and provides customers with the most energy-efficient, environmentally-friendly solutions available on the market.

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