WHITE PAPER

Communications Service Providers
Virtual Customer Premises Equipment

Tests Show SD-WAN Potential of Lanner* vCPE Platform

Lanner's Intel Atom® Processor C3000-based NCA-2510 offers four-core and eight-core options that are effective for small branch offices; Intel tests show how compute-intensive deep packet inspection (DPI) and IPsec processes can be optimized for these use cases.

Executive Summary

As software-defined wide area network (SD-WAN) technology becomes more popular, communications service providers (CommSPs) want to expand their service offerings to include smaller remote offices. Low system costs for these locations are important, as is delivering line rate performance for deep packet inspection (DPI) and IPsec packet encryption/decryption and routing.

Intel® Network Builders ecosystem member Lanner Electronics Inc.* has built its NCA-2510 server products for these markets. The NCA-2510 product family is based on the Intel Atom® processor C3000 . The Intel Atom processor C3000 is designed to scale-out workloads in low-cost applications. The platform also features high I/O integration, making it a good choice for data networking applications.

To prove that these platforms can meet the performance needs of branch office SD-WAN applications, Intel conducted performance tests on four-core and six-core server configurations to characterize chained DPI and IPsec encryption/decryption performance. There were three tests conducted:

- The first test showed that the addition of additional cores to accelerated Open vSwitch* doubled overall switch throughput to between 3 Gbps and 4 Gbps depending on the number of flows.[1]
- The second test demonstrated the encryption/decryption benefits of Intel® QuickAssist Technology (Intel® QAT) compared to Intel® Advanced Encryption Standard New Instructions (Intel AES-NI). This test showed that the use of Intel QAT more than doubled switch throughput to between 3 Gbps and 4 Gbps depending on the number of flows.[2]
- The last test demonstrated the linear scalability of Intel AES-NI by comparing the performance of a single-core instantiation with performance from a two-core instantiation. The additional compute power increased performance to 2.5 Gbps from less than 1.5 Gbps across all flow sizes.[3]

These results show that branch office networks needing up to 1 Gbps of Internet bandwidth can utilize a four-core server, and they also demonstrated ways to optimize IPsec performance for larger branch offices that need network throughput of up to 4 Gbps

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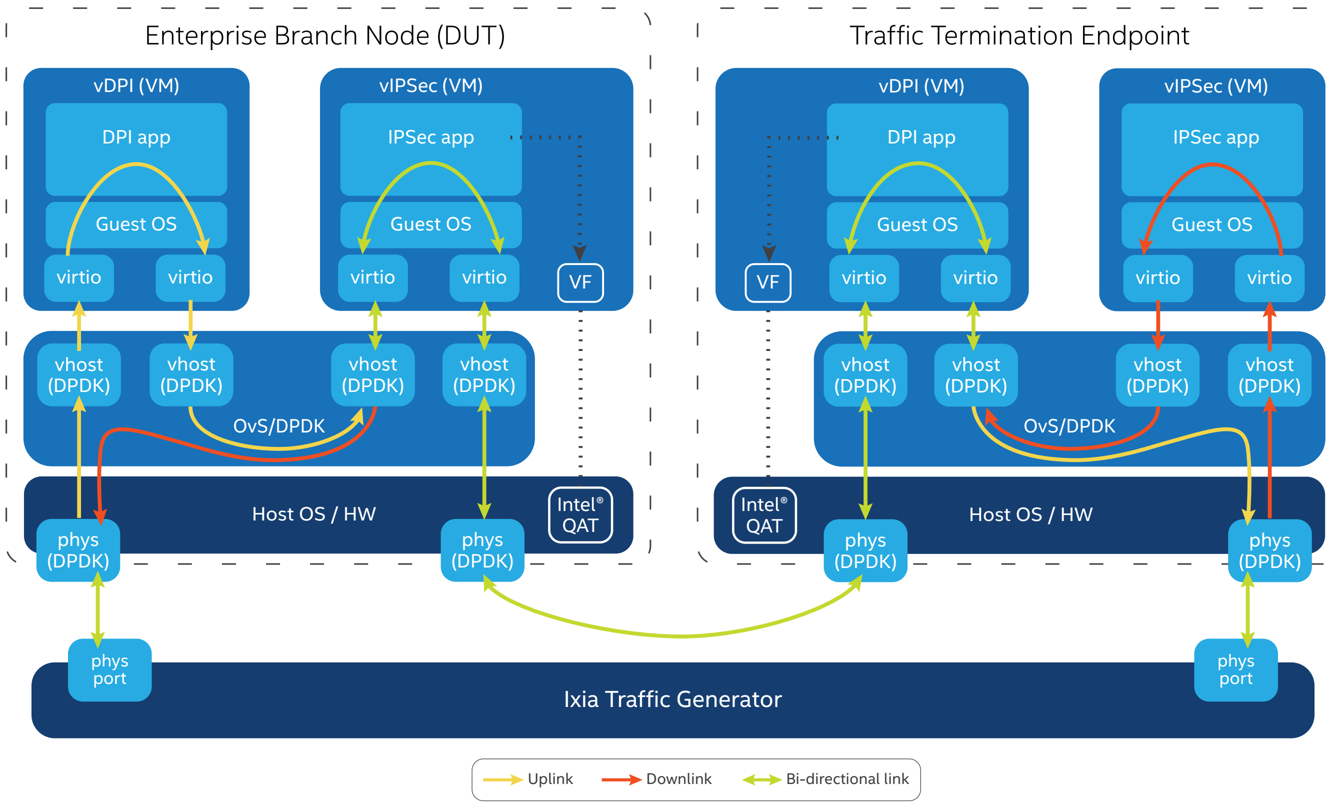

Figure 1. SD-WAN characterization environment data flow.

Background

The servers in these tests were virtualized using network functions virtualization (NFV), a virtualization technology designed to replace networking appliances with software running on industry standard servers. NFV features a virtualization infrastructure that includes service orchestration and virtual machines (VMs) that can remotely install and instantiate virtual network functions (VNFs).

SD-WAN applies the centralized controller functionality of software defined network (SDN) to help make WAN routing decisions. SD-WAN grew in popularity as access to cloud computing required multiple broadband network links adding complexity to branch office networks that formerly just utilized carrier data services. With SD-WAN, enterprises can set policies to direct traffic over the right network.

Lanner NCA-2510

The SD-WAN market is a good market for the Lanner NCA-2510, which is a virtualization-optimized (1U 19" rackmount) design that utilizes Intel Atom processors C3000 and is available with up to 16 cores and up to 128 GB of memory. The NCA-2510 supports up to four 10 GbE small form-factor pluggable (SFP+) optical connections in addition to a four-port Intel® Ethernet Server Adapter I350 Gigabit Ethernet controller. The NCA-2510 leverages other Intel virtualization technologies including single root input/output virtualization (SR-IOV) and Intel® Virtualization Technology for Directed I/O (Intel® VT-d). For encryption performance, the system features Intel Advanced Encryption Standard New Instructions (Intel AES-NI), and Intel QuickAssist Technology (Intel QAT). Combined, these technologies give the device the features and throughput for virtual CPE, universal CPE, SD-WAN, and software-defined security applications.

Intel Atom processors C3000 deliver new options for cost and infrastructure optimization by bringing the efficient performance and intelligence of the Intel Atom processor into a dense, low-power system-on-a-chip (SoC) designed specifically for network and edge solutions. The Intel Atom processor C3000is Intel's third-generation SoC-based CPU manufactured on Intel's optimized 14nm process technology. It can be deployed for a variety of light scale-out workloads that require very low power, high density, and high I/O integration including network routers, switches, storage, security appliances, dynamic web serving, and more.

Test Set Up

To conduct the performance tests, two NCA-2510A systems were used. Both of these devices under test (DUT) utilized 16-core Intel Atom processors C3958 that were configured to utilize four, six, and seven cores. This was done to match the performance of the DUTs to the lower port-count systems that would be used in these applications, including the NCA-2510B, C, and D systems that are equipped with the four-core Intel Atom processor C3558 and eight-core Intel Atom processor C3758.

The data flow for the testing can be seen in Figure 1. IP packets generated by the Ixia* traffic generator, which emulate data traffic from the internet, come into one of the DUTs where the Open vSwitch (OvS*) switches them to a DPI VNF. The VNF processes the data stream and switches the packets to the IPsec VNF, which decrypts and routes the packets to the next DUT, which encrypts them before forwarding them back to the traffic generator to record the performance.

Using this set up, three test cases were developed, the first of which was devised to determine if the performance of the accelerated OvS could be improved with the addition of more processing power. OvS is an open source multilayer virtual switch that is accelerated by the Data Plane Development Kit (DPDK), which improves packet processing performance via a series of poll mode drivers. These drivers enable direct packet transfer between user space and the physical network interface, bypassing the kernel network stack. For these tests, the four-core DUT was configured with:

- 1 core for the DPI VNF
- 1 core for the IPsec VNF
- 1 core for the OvS
- 1 core for host OS and NFV infrastructure

The performance from this configuration was compared to the six-core DUT in which three cores were allocated to OvS. The results are shown in Figure 2, which shows bi-directional throughput nearly doubles for the six-core DUT at 100 streams and is significantly improved for all of the flow rates that were tested.

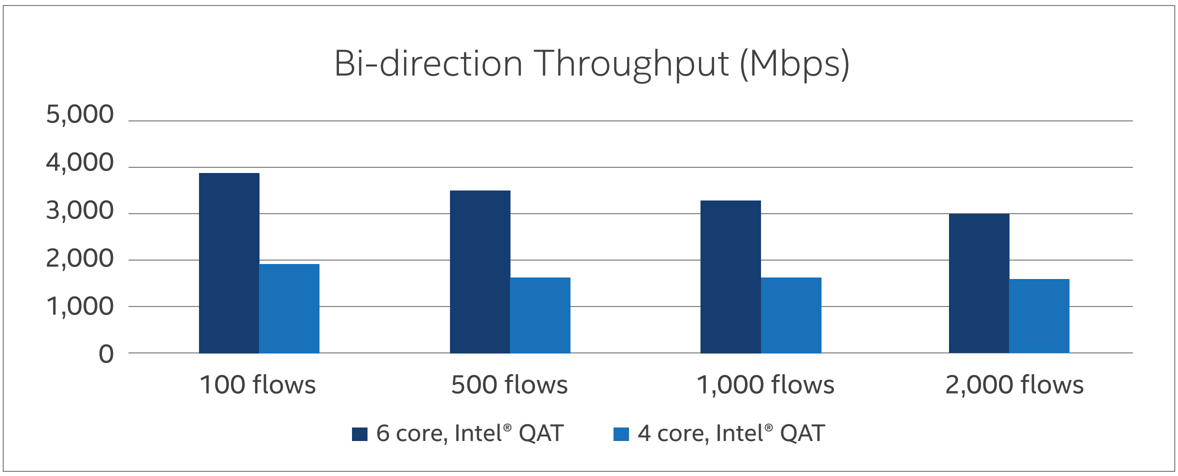

Figure 2. Results show adding two more cores to process Open vSwitch* improves throughput.[1]

In the next test case, the objective was to demonstrate the encryption performance difference between using Intel QAT and Intel AES-NI. Intel QAT is dedicated encryption/decryption hardware on the Intel Atom processor, whereas Intel AES-NI runs on a processor core. This test was conducted on the six-core DUT to accommodate the processor core needed for Intel AES-NI.

The results of this test are shown in Figure 3. Intel QAT performance is nearly double that of Intel AES-NI due primarily to the use of the dedicated Intel QAT hardware. A non-tested benefit of using Intel QAT is that the processor core used for Intel AES-NI processing can now be used for a VNF or other processing tasks.

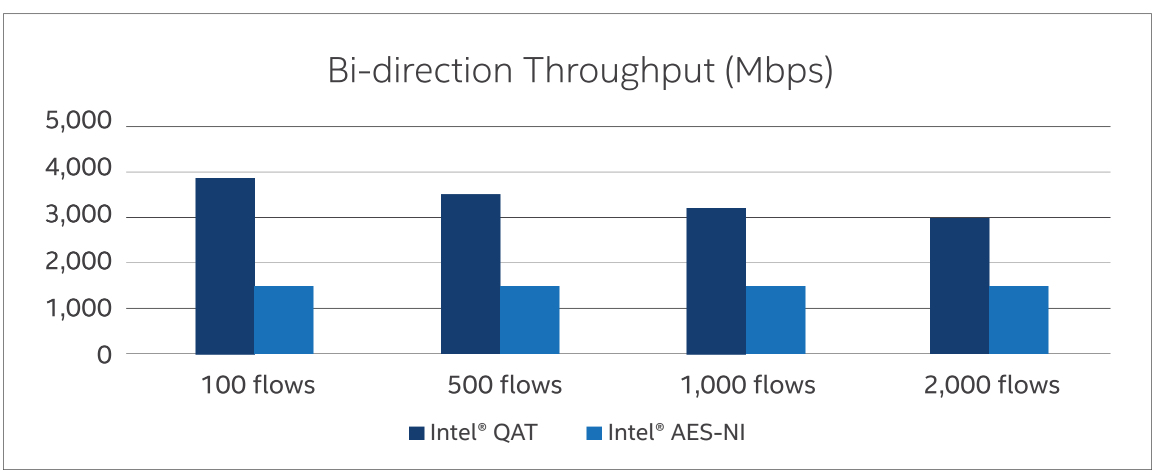

Figure 3. Intel® QAT delivers significantly better encryption throughput than Intel® AES-NI.[2]

While Intel QAT accelerates IPsec performance, it is a finite resource that can only provide acceleration up to a pre-specified maximum capacity. In the last test case, the objective was to determine whether Intel AES-NI performance would scale linearly with the addition of more compute power.

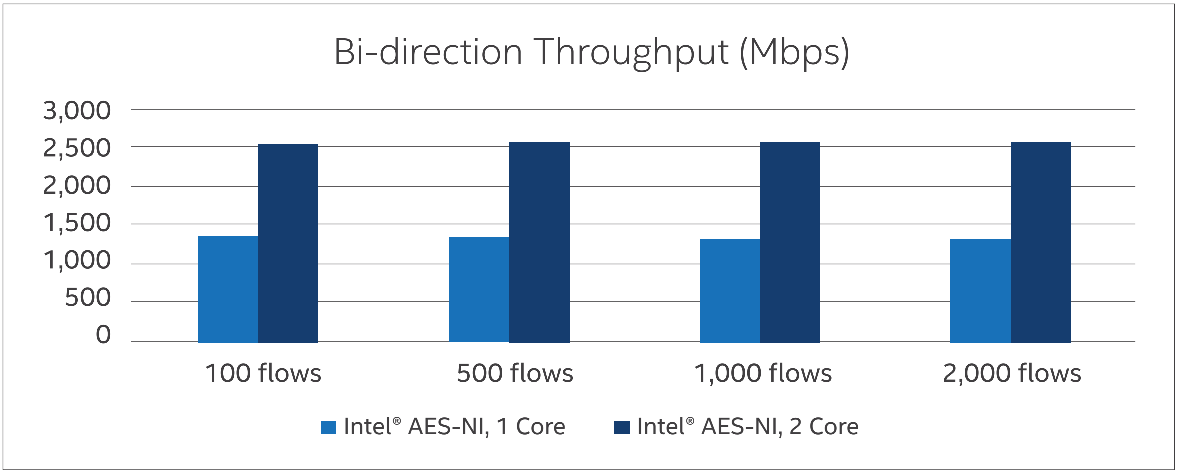

Figure 4. Intel® AES-NI performance increases significantly with the addition of more compute power.[3]

> "VNF performance tests help Lanner to accelerate the fine tuning of our Intel® QAT-based virtualization product performance, and surely is speeding up the deployment of our systems in virtual and universal CPE and other NFV markets."
>
> – Max Lee, Lanner CTO

To show this, the server was reconfigured with seven cores in order to dedicate two cores to the IPsec VNF. As seen in Figure 4, throughput for the seven-core DUT did scale linearly with the additional resources.

While not tested, one larger branch office use case could utilize Intel QAT as the primary encryption engine with a two-core Intel AES-NI implementation picking up overflow.

Conclusion

Lanner's NCA-2510 servers utilize the Intel Atom processors to serve as a right-sized SD-WAN devices for small branch offices. In the tests described in this paper, Intel has demonstrated significant DPI and IPsec performance from these servers. The availability of Intel QAT provides a high-performance hardware option that CommSPs can trust in small branch office applications.

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Intel® Network Builders: http://networkbuilders.intel.com

[1]Testing conducted by Intel®. Configurations: Lanner NCA-2501A system with Intel Atom® processor C3958 running at 2.0 GHz, with 8 GB of RAM, 150 GB Intel Solid State Drive, Intel® 82599 10 Gigabit Ethernet Controller, and Intel QAT. Software stack included Fedora22 (4.4 kernel) OS, Open vSwitch v2.5 with DPDK v2.2.0, Qemu v2.5.0 for virtualization, nDPI library v1.8 and Intel multi-buffer cryptography for IPsec Library (ipsec_v043) for Intel® AES-NI and DPDK-16.11 IPsec gateway sample app using Intel® QuickAssist PMD and Intel® Advanced Encryption Standard New Instructions (Intel AES-NI) Crypto PMD. Base: Intel Atom processors C3958 were configured with four cores. Performance was then compared to a six-core configuration.

[2]Testing conducted by Intel. Configurations: see footnote 1 for hardware and software configurations. Intel Atom processor C3958 was configured with six cores. Base: Test run with Intel AES-NI with Intel QAT functionality turned off, performance then compared to scenario with Intel® QAT running and no Intel AES-NI.

[3]Testing conducted by Intel. Configurations: see footnote 1 for hardware and software configurations. Base: Intel Atom processor C3958 was configured with six cores, one dedicated to Intel AES-NI. Performance was then compared to Intel Atom processor C3958 configured with seven cores, two dedicated to Intel AES-NI. Intel QAT turned off in each scenario.

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