WHITE PAPER

Communications Service Providers
Open Source NFV Scalability

Scalability of Enea NFV Core* Shown Using Intel® Processors

Enea NFV Core is designed to deliver virtualized services on between 2 and 100 servers; tests on Intel® Xeon® Scalable Gold processor-based servers show scalable performance as number of cores and flows are increased.[1]

The Challenge: Making Open Source NFV Suitable for CommSPs

Open source NFV such as OpenStack,* Open Platform for Network Functions Virtualization (OPNFV),* Open Networking Automation Platform (ONAP),* and others are an increasingly popular alternative for communications service providers (CommSPs) that are virtualizing their networks. Open source solutions are community developed, which brings innovation and a fast response to bugs or security breaches. This makes open source software well suited to CommSPs that are building out new networks optimized for service provisioning agility and service innovation.

But open source NFV software is designed to serve the needs of the entire community, which means that CommSPs must secure the software and integrate other open source software components to meet the needs of high-availability and high-performance CommSP networks.

Even with all of the benefits to be gained from open source NFV software, CommSPs are concerned about software stability, security, interoperability, and performance. Many CommSPs are embracing DevOps organizations to make open source NFV services operational, but they also are looking for hardened NFV software as a starting point.

To fill this need, Intel® Network Builders ecosystem partner Enea has developed Enea NFV Core, a virtualization platform built using OPNFV and OpenStack, with performance, availability, functionality, and scalability enhancements for CommSP networks. Enea NFV Core is designed for applications including multi-access edge computing (MEC), 5G and virtual customer premises equipment (vCPE), CommSP data centers, central office (CO), and edge points of presence (PoPs).

To be cost effective in all of these use cases, Enea NFV Core must offer scalable performance across a range of server configurations. This white paper describes Enea NFV Core and presents the results of testing by Enea to demonstrate performance scalability.

Enea NFV Core

Enea NFV Core is an NFV platform that combines virtualized compute, network, storage, and management and operations (MANO). The software builds on OpenStack and OPNFV with carrier network functionality added through the integration of open source software including Data Plane Development Kit (DPDK), Open vSwitch (OvS), Vitrage, Zabbix, Tacker, Aodh, Ceph, and others (see sidebar and Figure 1).* The company is an OPNFV leading contributor and has worked with the group to verify the interoperability of the software.

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In addition to this integration, Enea's engineering team has spent hundreds of hours tuning the parameters of the software to support CommSP use cases. These optimizations are designed to allow the software to serve as the NFV solution for virtualized services.

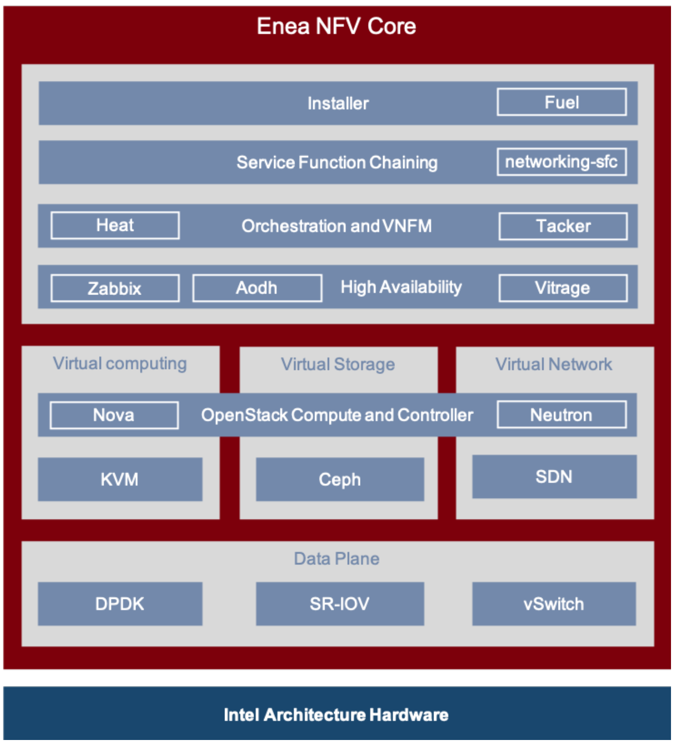

Figure 1. Block diagram of Enea NFV Core.[1]

Testing the Scalability of Enea NFV Core

Enea NFV Core is designed to be able to efficiently scale with the number of CPU resources and the number of data flows. Enea devised the following series of performance tests to demonstrate that performance scalability in an environment that represents a typical NFV use case featuring north-south data flows.

For the tests, Enea chose servers powered by the Intel® Xeon® Scalable Gold 6152 processor. The 22-core Intel Xeon Gold 6152 operates at a base frequency of 2.1 GHz and is part of the Intel Xeon Scalable platform, Intel's latest CPUs for virtualized, cloud-optimized network applications. In addition to the open source DPDK features, Enea also leveraged Intel® Advanced Vector Extensions 512 (Intel® AVX-512), which delivers workload-optimized performance and throughput increases for data compression workloads.

Using the PROX traffic generator and testpmd for packet forwarding, Enea set up a north-south the data flow between the PHY server on one side, and the VM, which runs on the Enea NFV Core server and is connected through OVS, on the other side. To show scalability, the number of cores dedicated to the OVS was increased and the resulting change in the packet throughput was logged. The results were measured with the constraint of almost zero packet loss for throughput per RFC2544. With these side-by-side configurations, Enea demonstrates how performance can be customized to meet the workloads involved in a variety of use cases, ranging from customer premises server to edge of the network applications, or even in the network core.

Enea NFV Core Key Components

- OpenStack core services include Horizon, Nova, Neutron, Cinder, Glance, Swift, Keystone, Congress, Heat, Tacker and Ceilometer.*
- Compute node software package that includes Linux* OS, KVM,* and DPDK packet throughput acceleration.
- Service function chaining (SFC) that is enabled through standardized networking APIs.
- Extended fault management baseline with an open source telco-grade high availability solution to meet CommSP availability requirements.
- Supports orchestration via OpenStack Heat Templates (HOT)* and features integrated OpenStack Tacker* as a lightweight orchestrator and TOSCA parser.
- OpenDaylight* Oxygen* is available as software defined networking (SDN) controller on request.

Five Test Scenarios

Servers featuring Intel Xeon Scalable Gold 6152 CPUs were used as the hardware platform for the tests. Each server configuration featured two 40 Gbps Ethernet NICs with both ports in use for the tests. Enea varied both the number of data flows per port and the number of CPU cores assigned to the OVS to show throughput at different resource levels. Specific flow and server configuration scenarios utilized in the tests included:

- Scenario 1: 1 flow per port with 1 core assigned to OVS
- Scenario 2: 1 flow per port with 2 cores assigned to OVS
- Scenario 3: 1 flow per port with 4 cores assigned to OVS
- Scenario 4: 2 flows per port with 4 cores assigned to OVS
- Scenario 5: 4 flows per port with 8 cores assigned to OVS

The results of the tests using Scenario 1 and Scenario 2 configurations are shown in Tables 1 and 2.[2] The tables show that throughput performance of Enea NFV Core is very consistent and scales linearly with additional processing resources assigned to OVS for small packet sizes (64 bytes up to 256 bytes). The results show nearly linear scalability for packets bigger than 512 bytes. Both the TX and RX measurements in the columns below were made on the PHY for each port on the PROX side. The TX and RX percentages represent the percentage of total available throughput (2 x 40 Gbps NICs) consumed by the data flows.

PHY-VM-PHY - 2 PORTS, 1 OVS CORE, 1 FLOW PER PORT						
	THROUGHPUT					
	RX (KPPS PER PORT)	TX (KPPS PER PORT)	RX (MBPS PER SERVER)	RX (% PER SERVER)	TX (MBPS PER SERVER)	TX (% PER SERVER)
64	1525	1530	2049.6	2.6	2056.3	2.6
	1525	1530				
128	1448	1451	3428.8	4.2	3435.9	4.2
	1448	1451				
256	1358	1360	5996.9	7.4	6005.7	7.5
	1358	1360				
512	1265	1271	10767.6	13.4	10818.7	13.5
	1265	1271				
1024	951	951	15885.5	19.8	15885.5	19.8
	951	951				

Table 1. Test results from Scenario 1.[2]

PHY-VM-PHY - 2 PORTS, 2 OVS CORES, 1 FLOW PER PORT						
	THROUGHPUT					
	RX (KPPS PER PORT)	TX (KPPS PER PORT)	RX (MBPS PER SERVER)	RX (% PER SERVER)	TX (MBPS PER SERVER)	TX (% PER SERVER)
64	3099	3099	4164.3	5.2	4165.1	5.2
	3098	3099				
128	2892	2900	6848.2	8.5	6867.2	8.5
	2892	2900				
256	2629	2630	11609.6	14.5	11614.1	14.5
	2629	2630				
512	2225	2230	18939.2	23.6	18981.7	23.7
	2225	2230				
1024	1503	1510	25106.1	31.3	25223.0	31.5
	1503	1510				

Table 2. Test results from Scenario 2.[2]

This scalability effect holds true when the number of cores is increased to four as in the scenarios shown in Tables 3 and 4. But Table 4 also shows the impact of increasing the number of flows to two per port. Throughput in Scenario 4 compared to Scenario 3 shows small-packet size performance improvement of approximately 14 percent, while the larger packet sizes demonstrate a larger performance increase of just under 26 percent.[2] As expected, larger-packet throughput should have a larger performance increase because of the reduced number of packets that need to be processed at larger packet sizes.

PHY-VM-PHY - 2 PORTS, 4 OVS CORES, 1 FLOW PER PORT						
	THROUGHPUT					
	RX (KPPS PER PORT)	TX (KPPS PER PORT)	RX (MBPS PER SERVER)	RX (% PER SERVER)	TX (MBPS PER SERVER)	TX (% PER SERVER)
64	5279	5500	7094.3	8.8	7392.6	9.2
	5278	5501				

128	4850	4866	11485.9	14.3	11522.6	14.4
	4851	4866				
256	4460	4492	19693.1	24.6	19838.8	24.7
	4459	4493				
512	4042	4100	34575.7	43.2	34899.2	43.6
	4082	4100				
1024	2428	2450	40732.7	50.9	40924.8	51.1
	2449	2450				

Table 3. Test results from Scenario 3.[2]

PHY-VM-PHY - 2 PORTS, 4 OVS CORES, 2 FLOWS PER PORT						
THROUGHPUT						
	RX (KPPS PER PORT)	TX (KPPS PER PORT)	RX (MBPS PER SERVER)	RX (% PER SERVER)	TX (MBPS PER SERVER)	TX (% PER SERVER)
64	5968	5979	8006.2	10.0	8032.4	10.0
	5946	5974				
128	5531	5540	13040.5	16.3	13118.7	16.3
	5483	5540				
256	4898	4899	21569.9	26.9	21636.1	27.0
	4871	4900				
512	4140	4143	35175.8	43.9	35265.2	44.1
	4125	4143				
1024	3048	3049	50638.1	63.2	50930.4	63.6
	3015	3049				

Table 4. Test results from Scenario 4.[2]

Finally, Table 5 shows Enea NFV Core being able to process a large number of packets even with a single VNF. In this configuration, one VNF can process up to 90 percent of the 80 Gbps maximum throughput (for large packets) of the dual 40 Gbps NIC installed on the Intel Xeon Gold processor-based server.[2]

PHY-VM-PHY - 2 PORTS, 8 OVS CORES, 4 FLOWS/PORT						
THROUGHPUT						
	RX (KPPS PER PORT)	TX (KPPS PER PORT)	RX (MBPS PER SERVER)	RX (% PER SERVER)	TX (MBPS PER SERVER)	TX (% PER SERVER)
64	10458	10493	14075.0	17.5	14103.2	17.6
	10487	10494				
128	9572	9578	22590.7	28.2	22680.7	28.3
	9508	9578				
256	8551	8559	37639.7	47.0	37798.7	47.2
	8496	8560				
512	6426	6432	54544.8	68.1	54753.4	68.4
	6390	6433				
1024	4325	4328	72269.8	90.3	72294.9	90.3
	4328	4328				

Table 5. Test results from Scenario 5.[2]

Conclusion

The success of virtualization in CommSP networks starts with an NFV platform that is customized for the unique needs of those networks. This includes DPDK for high performance, orchestration, service function chaining, fault management, and other functionality. Enea NFV Core's software features this functionality along with scalable performance for use cases at the edge and at the core of the network. The company has shown this scalable performance in tests utilizing Intel Xeon Scalable Gold 6152 processor-based servers. Enea NFV Core brings the benefits of open source NFV to CommSP networks with the performance and features required to meet their specialized needs.

About Enea

Enea develops the software foundation for the connected society. We supply NFVI software platforms, embedded DPI, real-time operating systems, video traffic management, cloud data management, and professional services. Solution vendors, Systems Integrators, and Service Providers use Enea to create new networking products and services faster, better and at a lower cost. More than 3 billion people around the globe already rely on Enea technologies in their daily lives. Enea is listed on Nasdaq Stockholm. For more information: www.enea.com.

About Intel® Network Builders

Intel Network Builders is an ecosystem of infrastructure, software, and technology vendors coming together with communications service providers and end users to accelerate the adoption of solutions based on network functions virtualization (NFV) and software defined networking (SDN) in telecommunications and data center networks. The program offers technical support, matchmaking, and co-marketing opportunities to help facilitate joint collaboration through to the trial and deployment of NFV and SDN solutions. Learn more at http://networkbuilders.intel.com.

[1] Figure provided courtesy of Enea. Other names and brands may be claimed as the property of others.

[2] Tests conducted by Enea. Configurations: servers powered by 2.1 GHz, 22-core Intel® Xeon® Gold 6152 processors with 188 GB of RAM. The servers featured two 40 Gbps NICs. Software included Enea NFV Core 1.1 release with DPDK 17.11 (host) and DPDK 18.05 (VM). PROX was used to generate packets and testpmd was used for packet forwarding.