SOLUTION BRIEF

Communications Service Providers
Universal Customer Premises Equipment (uCPE)

Telco Systems NFVTime Enables Virtualized uCPE, MEC Services

Benchmark testing of next-generation firewall (NGFW) on Advantech FWA-3050 universal CPE (uCPE), powered by Intel® Xeon® D processor, meets real-world networking performance needs.[1]

Introduction

Universal customer premises equipment (uCPE) devices bring new flexibility and remote service deployment automation to communication service provider (CommSP) networks. To show that they also have the performance power to meet real-world needs, Telco Systems utilized its NFVTime uCPE virtualization platform in a test of virtualized next-generation firewalls (NGFW).

uCPEs Can Improve Agility but Performance Is a Question

uCPEs are virtualized servers that are an emerging service-deployment solution for CommSPs. With a virtualized uCPE platform, such as Telco Systems NFVTime, these servers can be placed in enterprise data centers, remote branch offices, and general multi-access edge computing (MEC) locations, and they can be remotely updated with new virtual network function (VNF)-based services.

The use of a uCPE as a replacement for fixed-function network appliances offers significant potential for improvement in network operations and service deployment agility.

The question then becomes, can the uCPE meet enterprise-class performance targets as well as deliver on the promise of next-generation edge computing use-cases required for high-throughput and low-latency 5G and IoT deployments? The closed nature of fixed-function appliances made it possible for the CommSP to know what performance to expect at the outset. Although uCPE performance benefits from the use of the latest processor technology from Intel and streamlined virtualization environments like NFVTime, it can vary depending upon which virtual network function (VNF) software is used.

To help evaluate the performance capability of a uCPE solution, Telco Systems tested the performance of a Fortinet FortiGate next-generation firewall (NGFW) VNF running on an Advantech FWA-3050 uCPE white box using NFVTime as the virtualization infrastructure.

NFVTime Integrated uCPE Virtualization

Virtualizing a uCPE requires multiple open source software components, including an operating system, hypervisor, virtual switch, management and orchestration (MANO), virtual machines, and other software that must be integrated onto the uCPE white box and then separately maintained and updated throughout the life of the device.

Telco Systems NFVTime replaces this collection of software with an open and neutral plug-and-play virtualization suite (see Figure 1), seamlessly turning any standard white box server into a fully functional uCPE or MEC platform that provides a complete service environment for quick service deployments. NFVTime comprises three components:

- **NVFTime-OS** offers all the software needed to turn any bare metal server into a fully virtualized, carrier-class uCPE or MEC platform, including a Linux operating system, KVM, OpenStack Compute and optional OpenStack Controller, and Open vSwitch enhanced with Data Plane Development Kit (DPDK). NFVTime-OS is feature-optimized for low-end uCPE devices, but it can also take full advantage of added performance in a high-end server or white box.
- **NFVTime Central** is a management and orchestration (MANO) platform that delivers service deployment automation, zero-touch provisioning, VNF life cycle management, and uCPE service monitoring and operation.
- **NFVTime Access** is a set of third-party VNFs such as vRouter, vFirewall, virtual software-defined WAN (vSD-WAN), and others that are pre-configured to provide out-of-the-box service bundles. Telco Systems selects the NFVTime Access VNFs from its partners.

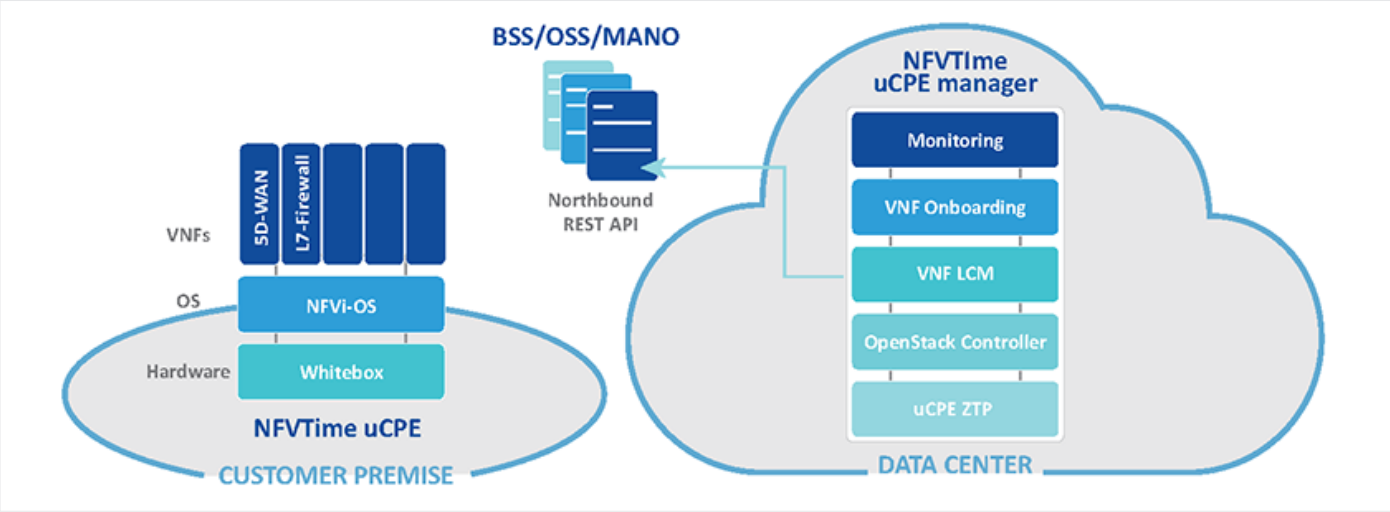

Figure 1. NFVTime virtualization platform architecture.[2]

NFVTime offers the required services for a complete virtualized uCPE solution without the complex integration needed for open source solutions. Service deployment can be fully automated with no manual intervention required. Built-in security features harden the uCPE by monitoring the NFV network topology, data flows, and service chains. Network managers will be immediately alerted of possible vulnerabilities and unauthorized changes.

NFVTime's modular approach means CommSPs can quickly create the uCPEs for a wide range of network locations—both in the enterprise and in their own network.

NFVTime Highlights

- **Pure play, open uCPE virtualization**
- **Automated, zero-touch deployment**
- **Carrier-class operation and maintenance**
- **Optimized for low-cost white box**
- **Quickly deploy solutions for short time to market**
- **uCPE MANO with full life cycle management**
- **Mix-and-match any VNF with any white box**

Advantech FWA-3050 Server

For this test, Telco Systems chose the Advantech FWA-3050, a managed network appliance for uCPE applications that is based on the Intel® Xeon® D-2100 processor. The FWA-3050 conforms to the Intel® Select Solution for uCPE reference design (see sidebar), which was an important factor for Telco Systems. The server can be used for all uCPE applications, but has optimized features and performance for next-generation firewall services.

Intel Xeon D processors are system on a chip processors that support high-density, single-socket network, storage and cloud edge computing solutions with a range of integrated security, network, and acceleration capabilities.

Platform Reference Test Setup

In Telco Systems platform reference testing, Fortinet's FortiGate NGFW was chosen to demonstrate the firewall performance of the NFVTime platform. Powered by Fortinet's Virtual SPU Technology, FortiGate VNFs deliver uncompromised performance in application and carrier security through innovative security processing optimizations and the latest packet processing acceleration technologies. The FortiGate NGFW VNFs provide comprehensive and advanced layer 7 network security capabilities including threat protection, intrusion prevention, web filtering and application control. The software has a small footprint, boots within seconds, and requires less storage, thereby helping service providers to cost-effectively help protect their virtual networks and cloud platforms.

To provide a point of comparison, performance was also measured on packets that were routed between two ports using DPDK-enabled OVS. These tests should not be compared directly with Fortinet or any VNF tests, but are useful in evaluating performance compared to other uCPE solutions performing the same basic OVS test.

Two FortiGate instances were tested, both of which were standalone VNFs running on four or eight virtual cores. One instance utilized four tunnels, or encrypted user connections, and the second test utilized eight tunnels.

Both the packet-per-second (PPS) and Mbps throughput results are the total accumulated performance for all directions and flows in that test. For example, there are two streams created for the two-port tests: LAN-to-WAN and WAN-to-LAN. The reported results are the summation of the two streams, which indicates the overall traffic processing capacity.

Test Results

Table 1 shows the performance as measured in packets-per-second (PPS) and throughput (Mbps) for each configuration using 66-byte packets, 1,500-byte packets, and an IMIX stream of different size packets[3] designed to mimic real-world packet traffic with 200 UDP flows each with a different combination of source and destination IP addresses. Average latency was also measured. The throughput results reflect the processing required for encrypting the packets and then transmitting them through the tunnel to their destination.

VNF TYPE	INSTANCES/ SERVICE CHAIN @ THREADS	HOST SWITCHING @ THREADS	PORTS	PACKET SIZE	PACKETS-PER-SEC	THROUGHPUT	AVG. LATENCY (µS)
Port-to-port OVS-DPDK	None	OVS-DPDK @1T	2x10G	66	8,115,196	5,582	10
				1,500	1,614,596	19,632	15
	None	OVS-DPDK @4T	2x10G	66	28,779,068	19,748	11
				1,500	1,643,092	19,912	18
Fortinet FortiGate	1xVNF instance @4T	OVS-DPDK @4T	2x10G	66	4,360,464	2,999	108
				IMIX	1,969,274	5,961	110
				1,500	1,546,052	18,799	114
	1xVNF instance @8T	OVS-DPDK @8T	2x10G	66	6,686,046	4,599	94
				IMIX	2,133,380	6,457	98
				1,500	1,602,052	19,480	112
	2xVNF instances **(parallel)** @8T each	OVS-DPDK @15T	4x10G	66	7,583,332	5,189	50.5
				IMIX	5,926,924	17,944	22
				1,500	3,036,400	36,661	27.5
	2xVNF instances **(parallel)** @8T each	SR-IOV @0T (no OVS-DPDK)	4x10G	66	7,368,768	5,067	35
				IMIX	4,543,976	13,759	120
				1,500	2,772,520	33,711	48

Table 1. uCPE performance test results.[1,4]

The NGFW test results show that the device under test demonstrates increased performance with a higher number of tunnels, and that this performance is sufficient for uCPE and MEC deployments in large enterprises, large branch offices or in an MNO's point of presence (POP), or next-gen central office (NGCO).[1]

These network designs will be typically based on a hub and spoke topology, with connections from branch offices that are 1 Gbps or less. The headquarters will need to support 10 Gbps connections (one active and one back up) to aggregate these branch offices. The performance of the solution shows full line rate for 1 Gbps connections, even at the smallest packet sizes. Performance can be scaled up in the headquarters through use of additional processor cores. The tests also demonstrated latency that is consistent across both instances and is well below the round-trip latency of between 1 ms and 5 ms for latency-sensitive MEC services.

Intel® Select Solutions for uCPE

The Advantech FWA-3050 is designed to meet the requirements of the Intel Select Solutions for uCPE, which are uCPE solutions based on a workload-optimized reference design developed by Intel. Each Intel Select Solution for uCPE is verified to meet established reference benchmarks, which provide the benefit of predictable hardware performance.

Intel Select Solutions for uCPE are based on the performance of Intel Xeon D-2100 processors which uses the Intel Xeon Scalable processor architecture and is designed for low power consumption and high-density solutions. More information can be found at builders.intel.com/intelselectsolutions/intelselectsolutionsforucpe

Conclusion

In these tests, the Advantech uCPE white box with NFVTime successfully provided the necessary NGFW performance to meet real-world networking conditions for a wide range of remote locations.[1] With this level of performance, CommSPs can more safely deploy uCPE and general edge computing devices based on the tested HW and SW configuration throughout their network to improve the service flexibility and network agility without impacting network performance.

Learn More

Telco Systems, Advantech, and Fortinet are members of the Intel® Network Builders Ecosystem: networkbuilders.intel.com

Telco Systems NFVTime: www.telco.com/solutions/nfvtime-solution

Advantech FWA-3050: rebrand.ly/FWA-3050

Fortinet: www.fortinet.com/solutions/mobile-carrier.html

[1] Tests were performed by Telco Systems on Oct. 2, 2019. Configurations: Advantech FWA-3050 device with a sixteen-core (32 threads), 2.0 GHz Intel Xeon D-2187NT processor (microcode 0x200005e stepping 4). CPU also supports 100Gbps Intel QuickAssist Technology (Intel QAT). The Ethernet controller used in test was an Intel® Ethernet Network Adapter X722. Hyperthreading was turned on. BIOS was AMI 5.014 0.28 x64 3050000V018. The server featured 32GB DDR4, 2133MHz RAM. Software used included FortiGate (v6-build8248 DPDK) and NFVTime-OS (v4.5.1.1, Kernel v4.18). Traffic generator used was Ixia N2X with 10 GbE interfaces.

[2] Figure provided courtesy of Telco Systems.

[3] IMIX traffic is a sequence of 58 packets x 48B L3 (66B L2 frame); 33 packets x 570B L3 (588B L2), 8 packets x L3 1428B (L2 1446B); Also, all tests with small packets were actually done with 66B L2 frame size (payload + L2 hrd + FCS).

[4] The table is calculated based on the following formula:
Throughput (Mbps) = PPS / 1e6 * 8 * (Packet Size + 20)
Inter Frame Gap: 20 bytes