Joint Solution Validation and Testing

Cisco Ultra Services Platform vPC on Dell EMC and VMware vCloud NFV Platform

In collaboration with Dell EMC and VMware

Introduction and objectives

The business needs for agility to define and deploy new services and reduce the operating cost of existing services are growing. Faced with relentless competition and rapid market changes, traditional network operators and new Communications Service Providers (CSPs) are being forced to investigate adopting new and modern technologies and architectures into their existing network services. Network Functions Virtualization (NFV) and Software-Defined Networking (SDN) are the two technologies that have the potential to address the above business needs.

Many operators select best-in-class solutions for Virtualized Network Functions (VNF), Management and Orchestration (MANO) layers, and hardware platforms independently. These operators conduct interoperability and optimization testing to assure correct functionality and to achieve the desired performance. These tests are usually time-consuming and resource-intensive, especially when complex VNFs with many components from various vendors are involved. Cisco, Dell EMC, and VMware conducted a set of joint interoperability and performance tuning activities between March and July 2017 at Dell EMC lab. The objective of this joint effort was to provide a virtual Evolved Packet Core (vEPC) solution using the Cisco Ultra Services Platform™ and Cisco Ultra Services Platform VNF over Dell EMC hardware platform with a VMware vCloud® NFVTM virtualization layer to speed carrier deployment and reduce operational cost.

The following is a high-level description of this joint solution and a summary of the tuning activities results. This document also states our joint support commitment to our customers for deploying this solution with a similar configuration or other configurations based on the results of this work.

Benefits to our customers

As described earlier in this document, the main objective of this joint effort was to provide additional benefits to our customers. Some of these benefits can be summarized as:

- The pre-validated and tested solution reduces time to market with and eliminated any perceived product, vendor, or integration risk
- Joint Dell EMC, VMware, and Cisco commitment to support this deployment model
- Reduced upfront investment for proof of concept testing at the customer site
- Pre-defined configuration and BOM
- Demonstrated commitment by the joint companies to validate and further support of this solution
- Repeatable, production-ready solution with predictable, class leading performance

Scope of the work

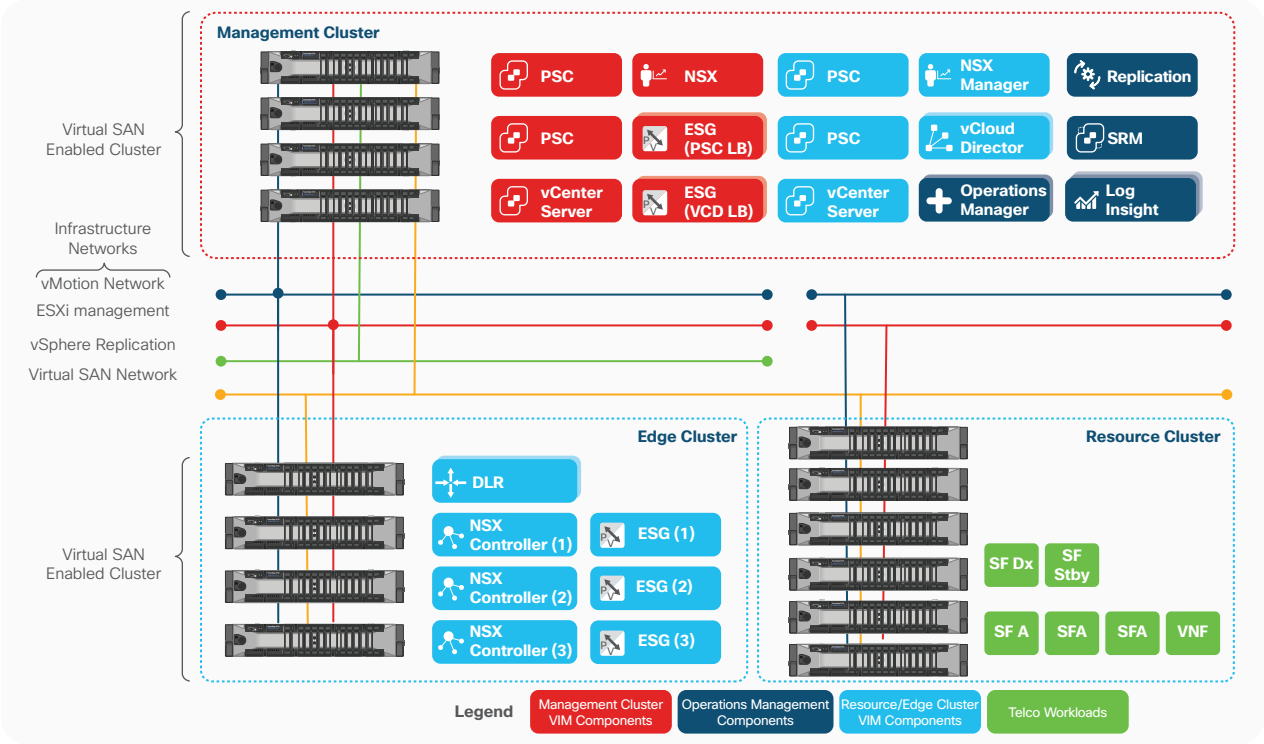
Major functional elements of the joint validation activities included Cisco Ultra Services Platform VNF version 5.0, Dell EMC, and VMware vCloud NFV infrastructure. Dell EMC and VMware components included VMware vCloud NFV 1.5 platform components at the virtualization layer and Dell EMC servers, storage, and networking components. Cisco® UPC is a complex VNF combined of many sub-functions (such as control function and service function) and many instantiations of these functions to achieve various mobile core functionalities. For more information about the Cisco Ultra Services Platform and its functions, refer to Cisco Ultra Services Platform documentation. The scope of this work included installation, configuration, performance tuning and testing, dimensioning, and creation of the associated Bill of Materials (BOM).

The joint effort's stated goals have been:

- Provide confidence that the joint solution meets the stringent requirements of Mobile Network Operators (MNOs) demanded for mission-critical mobile applications
- Document the design and dimensioning guidelines
- Facilitate expedite order fulfillment and procurement process

Figure 1 depicts the high-level logical configuration that was used in this joint effort.

Figure 1. Validated Configuration



The Dell EMC and VMware NFV infrastructure contains three clusters: management cluster, resource cluster, and edge cluster. This architectural best practice, based on the vCloud NFV reference architecture, allows for efficient resource management, clear demarcation between resource providers and resource consumers, establishment of security boundaries, and ability to design different levels of availability based on cluster workloads.

Two vCenter servers and two NSX manager instances are deployed in the management cluster. The first instance is for the management components and provides networking services such as load balancer to the components in the management cluster. The second instance is used to manage the VNFs deployed in the resource cluster and provide networking services such as routing by deploying NSX edge devices in the edge cluster. Each vCenter server points to a load-balanced pair of external Platform Services Controller (PSC) instances.

Cisco Ultra Services Platform enhanced packet core VNF can scale up to take advantage of up to more than 30 servers. For the joint testing activity, we used 6 Dell EMC PowerEdge R630 servers to host the Cisco Ultra Services Platform. These 6 servers were configured as the resource cluster. This list shows the number of hosts in each of the three clusters that make up the solution:

- 4 Dell EMC PowerEdge R630 servers in the management cluster
- 4 Dell EMC PowerEdge R630 servers in the edge cluster
- 6 Dell EMC PowerEdge R630 servers in the resource cluster (4 active service function, 1 standby, 1 demux)

Dell EMC networking's S6010-ON and S4840-ON were used for connectivity as depicted in Figure 1. The Cisco VNF software was installed by using VMware vCloud Director for service providers, which is the virtualized infrastructure manager (VIM) used in this solution.

Table 1 describes the detailed software components used in this testing.

Category or function	Platform	Vendor	Software or firmware version
SAEGW	UPC-DI	Cisco	21.1. v0
Server lifecycle management	Dell EMC remote access controller	Dell EMC	2.40.40.40
NFVI: compute	Dell EMC PowerEdge	Dell EMC	PowerEdge R630
NFVI: networking	Dell EMC S-Series	Dell EMC	S6010-ON and S4840-ON
NIC adapters	Intel X520 DP 10Gb SR/SFP+	Intel: Dell EMC	17.5.10
NIC adapter	Intel 1350 DP 1GB Ethernet	Intel: Dell EMC	17.5.10
NFVI: virtual compute	VMware vSphere ESXi	VMware	6.0 update 2 (build 3620759)
MANO: NFVI management	VMware vCenter Server	VMware	6.0U2
MANO: VIM	VMware vCloud Director for service providers	VMware	8.10
NFVI: virtual networking	VMware NSX	VMware	6.2.2

Summary of joint activities and results

The joint engineering team conducted two separate sets of tests. Each set of tests included configuration and optimizations. The first test objective was to configure the test bed and measure and optimize the performance based on standard configuration of the Cisco Ultra Services Platform with one service function module per host. Cisco Ultra Services Platform was configured with two control function and four service function virtual machines in this setup. One of the control function virtual machines was configured in standby for high availability. Among the four service functions, one service function was configured as standby, while one of the active service functions was chosen as demux card. Table 2 depicts this configuration.

Table 2. Ultra function test configurations

Cisco USPM type	vCPU	Memory (GB)
Control function	2*4 =8	16
Service function	2*12=24	96

Multiple instances of the Ixia test tool were used to simulate network traffic from 200 eNodeB and 8 MMEs as well as subscriber voice and data sessions. Table 3 provides the test result details for the first test setup using 24 vCPUs per service function.

Table 3. First test results.

Metric	Unit	4-service functions/ 4 hosts (24 vCPUs)
Ixia target throughput	Gbps	16.75
Ixia HTTP throughput	Gbps	16.6
System throughput	Gbps	18.698
System throughput per service function	Gbps	4.6745
System throughput per host	Gbps	4.6745
System PPS (Tx)	b	2,620,000
System PPS/service function (Tx)	b	655,000
System PPS/host (Tx)	b	655,000

Note: Higher scalability beyond the presented results, but based on this configuration, is possible by adding additional Cisco Ultra Services Platform service functions and hosts.

The objective of the second set of tests was to explore means to improve the performance of the Cisco Ultra Services Platform VNF performance. One major focus was measuring the effects of running more than one service function module per host. The setup was reconfigured with two service function modules mapped to 18 vCores, each on two separate NUMA nodes as per VMware's performance-tuning best practice. Test results proved the performance to be almost linear in this configuration. Table 4 depicts the results. Running multiple service functions per host requires other system modifications for functions such as failover that were not part of this exercise.

Table 4. Performance improvement testing results

Metric	Unit	4 service functions on 2 hosts (18 vCPUs per host)
Ixia target throughput	Gbps	16.5
HTTP throughput	Gbps	13.6
System throughput	Gbps	16.386
System throughput/ service function	Gbps	4.0965
System throughput/host	Gbps	8.193
System PPS (Tx)	b	2,849,000
System PPS/service function (Tx)	b	712,2500
System PPS/host (Tx)	b	1,424,500