SCTE·ISBE CABLE-TEC EXPO 2018 ATLANTA, GA OCTOBER 22-25

2018 Fall Technical Forum SCTE·ISBE • NCTA • CABLELABS

Enhancing Service Agility for the Enterprise Customers using an Integrated Orchestration and Test Automation Solution

A Technical Paper prepared for SCTE•ISBE by

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Introduction

The ability to rapidly launch and operationalize new services is a critical success factor for Multi-Service Operators (MSOs) competing in the enterprise and business space. Software Defined Networking (SDN) and Network Functions Virtualization (NFV) are key technology enablers for this. Deploying and managing the multi-vendor network cloud services is a very complex task due to the degree of change across virtualized service chains. Standards are still maturing, Virtual Network Function (VNF) vendors are releasing software and patches more frequently, and the components of the underlying NFV infrastructure are also subject to change. Managing these changes require a highly automated and integrated approach to network service orchestration and test automation. Ericsson has addressed these key challenges for our customers globally to accelerate the velocity of new service introduction.

Increasing the service velocity requires a holistic transformation for MSOs across many aspects of the MSO's operating context. MSOs need to transform from a network centric organization to a customer centric organization. In line with this, there are two key indicators:

- Service Agility – resulting in quicker time to revenue
- Operational Efficiency- Reducing the CapEx costs by utilizing the network equipment better and leveraging automation for OpEx improvements.

In this paper, to achieve these key indicators, Ericsson shall focus on the processes, automation approach, and best practices and risk mitigation an operator must undertake. Ericsson shall also examine the phases of the transformation journey for the MSOs, and key considerations for the MSOs, to make a successful transition. Specifically, we examine how an operator can leverage an integrated orchestration and test automation solution framework that can significantly accelerate the service velocity of launching new enterprise services in an operationally efficient manner.

Industry Context

Based on the global industry analysis, key drivers of Cloud (NFV/SDN) adoption that are improving Service Agility and Operational Efficiency [1] include the following:

- Introduce new services and gain revenue faster
- Improved customer experience using on-demand and self-service
- Scale services up or down quickly.

Some of the barriers for the Cloud adoption include

- Products available in the market or in open source communities are not carrier grade
- Multi -vendor VNF integration can be expensive, complex, and risky
- The changes to Operations Support System (OSS) and Business Support System (BSS) required for NFV.

In the NFV Adoption strategies, we are seeing three approaches for the deployment and delivering Cloud solutions. These are:

1. **Fully decoupled approach:** MSO takes the responsibility of building the cloud stack. This includes building the entire cloud stack in house or selecting specific vendors for Network Function Virtualization Infrastructure (NFVI), SDN provider, VIM layer, orchestration (resource

and service). This approach provides the maximum flexibility and has the highest inherent risks. 47% of the top 20 operators are embracing this approach.

2. **NFVI Integrated Stack Provider:** MSO selects a single vendor to provide the cloud stack. The vendor provides the NFVI/VIM and is responsible for providing the cloud and infrastructure for the application providers (VNF providers). Typically, orchestration is not included as part of the NFVI Integrated Stack. This approach provides reasonable flexibility and eliminates substantial risks. 51% of the top 20 operators are going down this approach.
3. **NFVI Full Stack:** MSO selects a single vendor to provide the cloud stack including the orchestration and the VNFs. This approach provides the least risk for the customer. Based on the marker survey, majority of the Tier 2/3 customers are considering this approach to meet their business goals.

Ericsson sees that the pendulum for the cloud adoption swinging towards more risk averse options (Option 2 and Option 3). One of the motivations for the shift is the increase in service velocity associated with Option 2 and Option 3.

Increasing the Service Velocity for Enterprise Services

MSOs are looking to increasing the service agility to serve their customers. However, we are seeing that many VNF vendors are moving from few VNF software releases to frequent releases, few products to many products. Unlike the physical world, the cloud infrastructure is also undergoing significant change. This results in the increase in certification cycles triggered by application upgrade, patch releases or OpenStack upgrades.

MSO needs to develop an automation solution that addresses the service onboarding, service validation and Life Cycle Management of the multi-vendor network services and NFVI.

1.1. Business Considerations for the Automation Solution

The automation solution needs to address three key aspects

- Reduce Operation Expenses (OpEx) associated with testing
- Increase Service Agility for Customers
- Enable Innovation for MSOs by enlarging the ecosystem of VNF vendor partners

1.2. Ericsson Solution Approach

Ericsson proposes an integrated service orchestration and test automation solution to address the MSO business needs. Integrated approach provides a solution-based approach to address service design, service onboarding, service validation and service LCM.

The automation solution will be realized on multiple phases as given below. One of the key solution components is the end to end service orchestration solution that is integrated with the test automation libraries for the validation of the NFVI and VNFs

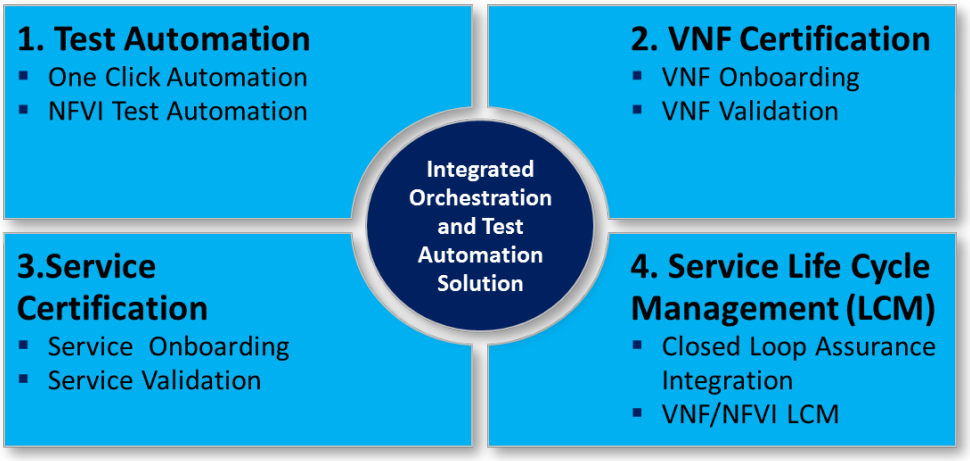

Figure 1: Integrated Service Orchestration and Solution Phases

Step 1: Test Automation

VNF Test Automation

MSO implements a test automation solution for testing the network functions. The goal is to create a **One Click Automation solution** wherein a test automation layer executes a series of automated test suites for testing the VNF, network services and NFVI. This step is applicable for the Physical Network Functions and/or Virtual Network Functions. This phase can happen today if the operator has PNFs or yet to deploy VNFs. Typically, this is done using licensed test platforms like IXIA.

NFVI Test Automation

Clear technical Service Level Agreements (SLAs) at Integration Points (red dots above) are required for VNFs to be able to commit to their performance SLAs. The red dots in the figure represent the interface points where the NFVI SLAs need to be verified.

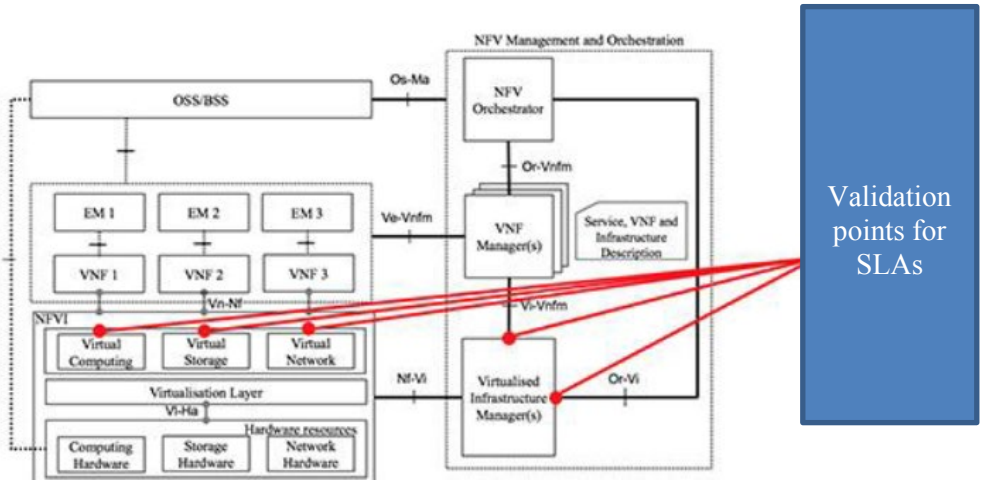

Figure 2 :Interface points for the SLA validation

Therefore, the NFVI's SLA compliance becomes the operator's commitment to the VNF vendors. Consequently, NFVI SLAs must be verified and guaranteed for Operators to be able to require VNFs' SLA compliance from the VNF vendors. Automated NFVI SLA compliance tests are needed in pre-operation validation as well as during the full Life Cycle.

Step 2: VNF Certification

In Step 2, MSOs develop a process automation methodology to onboard the VNFs to the MSO cloud environment. Typically, MSOs develop self-service portals which are integrated with the NFVO MANO functionality to instantiate the VNFs on the MSO cloud. Orchestrator will use the VNF artifacts to instantiate the VNF on the MSO cloud. Once they onboard, the next step is to automate the validation of the VNFs by triggering the test automation suites developed in Phase 1. VNF Vendors have varying levels of maturity. Hence, standardizing the entry criteria helps the MSOs to streamline the operations.

Step 3: Service Certification

In Step 3, MSOs extend the process to include the instantiation and the validation of Virtual network services. Virtual network services include multi-vendor VNFs. (e.g. VERSA SD-WAN with Palo Alto Firewall as a service to customers). Typically, this stage involves the integration of the end to end service orchestrator, the creation of service contexts for the orchestrator like Network Service Descriptors (NSDs)/TOSCA templates for the service instantiation and service configuration. Service Orchestration component of the solution creates the end to end service. Once the service is up and running, the service validation is automatically triggered by running end to end service tests

Step 4: Service Life Cycle Management (LCM)

MSOs implement a closed loop automation mechanism to monitor the functional and performance aspects of the multi-vendor service chains, VNFs and network infrastructure. Closed loop Assurance can be implemented at multiple levels"

- Infrastructure level: Monitoring is done for the data center and resources
- VNF& Network Services: Closed loop is implemented at the end-to-end service level with integration to Service Orchestrator. It can also be done at VNF level where the VNFs.
- Analytic recommendations for closed loop based on insights.

This is a highly evolved state where the service assurance engine is integrated with the end to end service orchestrator and performs highly complex functions like the auto-healing of network service (scaling up and down a network service etc.). The solution helps in managing the software versions of NFVi, VNF and network services

The business value and the technical complexity increases with each phase. Each of these phases is a logical extension of the previous phase and needs to be carefully designed and architected. Choosing the right strategic partner to assist the end to end transformation journey, is critical to the business success.

1.3. Integrated Orchestration and Test Automation Solution

Integrated Service Orchestration and Test Automation Solution should provide a vendor agnostic platform to facilitate the process automation to onboard, validate VNFs and virtual network services and do the LCM for VNF, NFVI and network services.

Figure 2 provides a functional architecture diagram of Integrated Service Orchestration and Test Automation Solution.

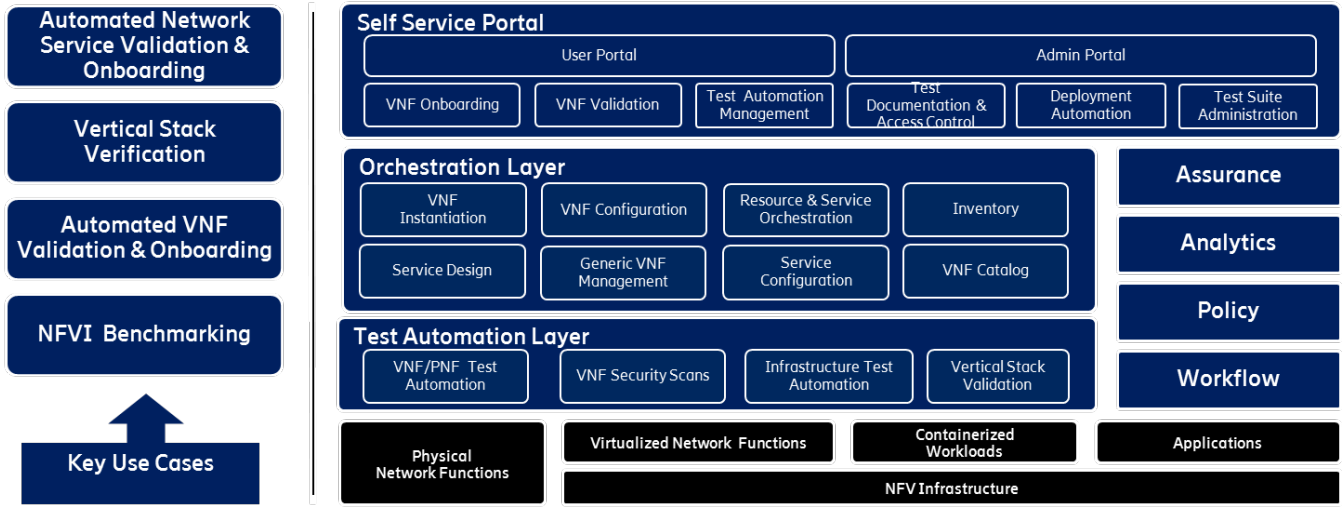

Figure 3: Integrated Service Orchestration and Test Automation Solution High-Level Functional Architecture Diagram

Some of the key components include:

Self Service Portals

The Integrated Service Orchestration and Test Automation Solution platform provides the self-service portals for vendors to onboard the VNFs into the MSO cloud environment. It also provides the administrator portal for the MSO to authorize vendor access and to define the validation criteria for the vendors and VNF types. The solution needs to have a dashboard that displays the results of the onboarding step and the validation tests.

Some of the key functions that are enabled by the self-service portal include

- VNF Onboarding – Uploading the VNF images and artifacts and then using the orchestrator to instantiate the VNF on the MSO cloud.
- VNF Validation – Functional validation of the VNFs
- Test Automation Management- Validating the VNF against multiple levels of tests like cloud compliancy tests, functional tests, smoke tests and others.

Some of the key functions that are enabled by the admin portal include

- Test Documentation and Access Control – Uploading the test documentation for the VNF types and managing the access to the self-service portal to the VNF vendors.
- Deployment Automation – Ability to push the golden image for the production deployment.
- Test Suite Administration- Ability to manage the test suites for the various test levels for the VNF type.

Orchestration Layer

Orchestration layer provides the following functions.

- VNF Instantiation – Using the VNF image and the templates, instantiate the VNF in the operator cloud.
- VNF Configuration – Automating the configuration of the VNF in the operator environment.
- NFV Orchestration- This provides the resource orchestration functionality as specified by the ETSI MANO specification.
- Inventory – Provides the inventory management of the VNFs. This layer provides the repository for the VNFs
- Service Design – Service Design Center provides the ability to design the network services. This is realized by the integration with the SDN Controller
- Generic VNF Management – Provides the G-VNFM functionality and talks to the specific VNFM to instantiate the VNFs.
- Service Configuration – Use the TOSCA templates to define the network service chain
- VNF Catalog- Provides the list of the VNFs which are part of the VNF Catalog.

Validation Layer

The Validation layer provides the ability to validate the multiple layers of the cloud stack, network service, network function, orchestration, and infrastructure layers.

Some of the key functions that are enabled by the validation layer integration include

- VNF/PNF Test Automation – Automating the PNF/VNFs for functionality verification
- VNF Security Scans- Doing vulnerability scans on the VNF to make sure that they are compliant to the security requirements
- Infrastructure test automation – Validating the infrastructure layer to make sure that the infrastructure layer meets the SLAs for the VNFs and network services.
- Vertical stack validation – Validating the entire network service with multiple layers of verification which includes infrastructure, orchestration, and network service level tests

Assurance

Integrated Service Orchestration and Test Automation Solution can be integrated with the service assurance engine to monitor the network service and closed loop automation.

Analytics

Integrated Service Orchestration and Test Automation Solution should have an analytic engine that provides the dashboard views of the network service. This present a global view of the service validation in conjunction with the NFVI performance.

Policy

The native policy engine of Integrated Service Orchestration and Test Automation Solution can be integrated with the policy engine for specific operator policies

Workflow

Integrated Service Orchestration and Test Automation Solution can be integrated with the existing work flows associated with the onboarding and validation of specific workloads

Some of the key use cases enabled by the Integrated Service Orchestration and Test Automation Solution platform include.

- Automated VNF Onboarding and Validation: Ability to onboard the VNF using orchestrator on to the MSO cloud. Integrated Service Orchestration and Test Automation Solution also has internal traffic generators to validate the VNFs in a functional and performance context.
- Automated Network Service Validation and Onboarding: Ability to work with the end to end Service orchestrators to instantiate a network service on the operator cloud
- Vertical Stack Validation: The wholistic validation of network function or network service, in conjunction with the infrastructure and orchestration layers to verify the integrity of the cloud stack.
- NFVI Benchmarking: Ability to monitor the performance of the NFVI to support the VNF SLAs.

1.4. New Operational Context: NetOps – DevOps for the network

The integrated orchestration and test automation will be configured for continuous deployment and delivery to accelerate the service agility. The solution can be integrated with software release repository of any VNF vendor or it could be integrated to a central repository of the MSO where the software images are stored.

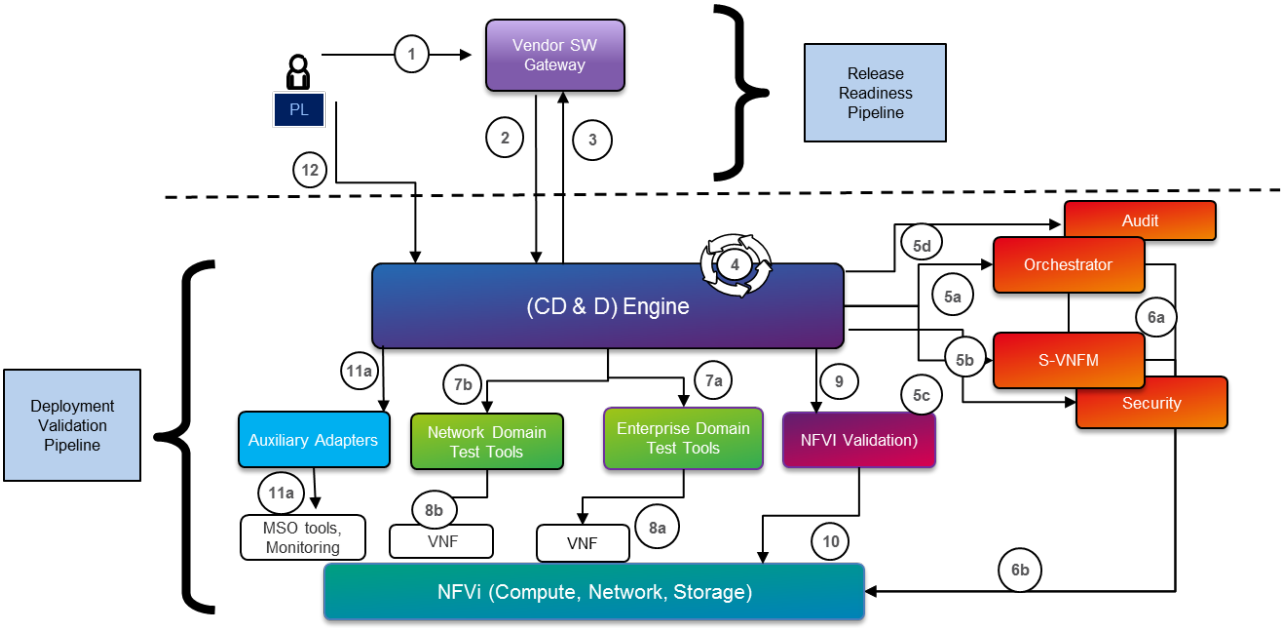

Figure 4 :Continuous Deployment and Delivery Facilitated by the Solution

The interactions in the figure above are as following:

Table 1: Interaction work flow for the Continuous Deployment and Delivery

Interface Number	Description of the interface
1	VNF Vendor development unit releases the software for verification to the Software Gateway
2, 3	SW Gateway notifies the Integrated Service Orchestration and Test Automation Solution platform and the Solution downloads the VNF package
4	Integrated Service Orchestration and Test Automation Solution uploads (manually) the VNF package using the web portal.
5a, 5b	Integrated Service Orchestration and Test Automation Solution selects the orchestrator for onboarding the VNFs.
5c, 5d	The solution can be integrated with the MSO audit engine or security policies if required. (Optional)
6a, 6b	Orchestrator acts as G-VNFM and works with S-VNFM to instantiate the VNFs on the NFVI. (This is an Optional Step)
7a, 7b	Integrated Service Orchestration and Test Automation Solution triggers the validation cycle by triggering the test engines to validate the VNFs
8a, 8b	Test Engines generate the traffic to test the VNFs under test. VNF validation reports are provided to Integrated Service Orchestration and Test Automation Solution from the test engines
9	Integrated Service Orchestration and Test Automation Solution platform can trigger the OpenStack level and infrastructure level tests using specific ONFV tests and some specific tests that are designed for the NFVI performance
10	Test Automation Solution triggers the NFVI tests for the OpenStack and infrastructure tests. Test Validation reports are provided to Integrated Service Orchestration and Test Automation Solution
11a, 11b	Develop adapters/work flow engine for MSO processes like ticket tracking systems, monitoring systems. Service assurance engines etc.
12	Vendor uploads a VNF patch to the Integrated Service Orchestration and Test Automation Solution. Integrated Service Orchestration and Test Automation Solution runs through the onboarding and validation cycle as mentioned above.

1.5. Key Benefits to the MSO from the approach

Ericsson has significant experience deploying orchestration solutions including Integrated Service Orchestration and Test Automation Solution in multi-vendor environment in the operators. Some of the key business benefits that the Integrated Service Orchestration and Test Automation Solution provide are the following

- The Solution has been able to accelerate the service velocity by 30 to 40% for enterprise service deployment for a Tier 1 customer in North America.
- Integrated Service Orchestration and Test Automation Solution provides end to end process automation which can reduce the total cost of ownership for the MSO.
- The solution also provides the ability for the MSO to enforce the MSO standards on the VNF vendors and ensure consistency across vendors.
- It provides scalable validation infrastructure with integration to test platforms for functional and performance validation of VNF and NFVI.

- It provides the ability to enlarge the ecosystem of the VNF partners for the MSOs. Integrated Service Orchestration and Test Automation Solution provides an alternative to the traditional RFQ process by enabling VNF vendors to onboard and validate the VNFs to see if they meet the desired Service Level Agreement (SLAs) prior to any commercial agreement.

Conclusion

Service velocity has emerged as the most critical benchmark of success for an MSO. To achieve this goal, it is necessary for much more advanced collaboration to occur between the MSOs and the vendor community. This paper explored the challenges in improving service velocity and developing advanced new services. Extending the automation domain to include service instantiation, validation and life cycle management is critical for improving the service velocity.

Choosing the right partner for this complex journey is critical for the success. The wholistic approach requires a cross functional solution which includes subject matter expertise and delivery experience in OSS (Orchestration and Assurance), Cloud and Infrastructure and VNF validation domains. Ericsson has successfully partnered with operators globally to enhance service agility and achieve operational efficiency using an Integrated Orchestration and Test Automation Solution

Abbreviations

VNF	Virtual Network Function
ETSI	European Telecommunication Standards Institute
E///	Ericsson
OPNFV	Open Platform for NFV
LCM	Life Cycle Management
NFV	Network Functions Virtualization
NFVI	NFV Infrastructure
SDN	Software Defined Network
MSO	Multiple System Operator
OSS	Operations Supports Systems
BSS	Business Support Systems

Bibliography & References

[1] Ericsson Elaboration on IHS Technology, “NFV Service Provider Strategies” 2017, 2018

[2] ETSI GS NFV-MAN 001, Network Function Virtualization (NFV) Management and Orchestration

